INFRA-DYNE

By E. M. Sargent

Der Remler "Infradyne-Empfänger von 1926

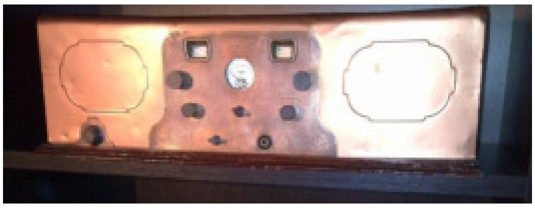
Originalartikel, Übersetzungen und Schaltungsanalysen
Juli 2025 von Edi

Inhalt

Der "Infradyne- Empfänger" von 1926

Vorgestellt von Edi





"Infradyne"- Radios, Exemplare von 1926, 1927 und 1928

Sehr geehrte Radiofreunde,

Nach meinen Recherchen und dem Nachbau- Projekt zu der besonderen "Octamonic"- Konstruktion komme ich nun nun zu einer weiteren, sehr besonderen Radio-Schaltungsvariante bzw. Konstruktion von 1926, also von vor 99 Jahren, ebenfalls wieder in den USA.

Der "Infradyne" wurde von E. M. Sargent, einem fleißigen und innovativen Entwickler, der für die Firma Remler, Oakland, Kalifornien, arbeitete, entwickelt, und in Radiozeitschriften jener Zeit beworben, es wurden Bausätze, Einbauchassis, Komplettgeräte und sogar Nachrüstgeräte für den Umbau von Geräten fremder Hersteller angeboten.

Wie auch der "Octamonic", verschwand nach kurzer Zeit der "Infradyne" sang- und klanglos.

Die Schaltung ist so außergewöhnlich, daß, wie beim "Octamonic", die Funktionsfähigkeit angezweifelt wurde.
Dabei ist es nicht nur funktionsfähig, sondern sogar ein sehr gutes Gerät.

Immerhin gibt es noch eine Anzahl Exemplare bei amerikanischen Radiofreunden, so das ich diese ebenfalls vorstellen kann.

Ich habe die relevanten Artikel und Bilder recherchiert, und möchte die besondere Schaltung hier vorstellen.
E. M. Sargent war ein besonderer Erfinder und Konstrukteur- ich hoffe, auch die Erinnerung an ihn zu bewahren.

Diesmal habe ich nur wenige Quellenauszüge übersetzt. Es ist einfach zu viel, und es interessiert zu wenige.

Dafür ist es eine sehr große Sammlung aller Artikel über den "Infradyne", die ich finden konnte.
Hilfe bekam ich auch von amerikanischen Radiofreunden, die mir schnell halfen, D. Bylung scannte mir sogar extra das im Internet nicht findbare erste Handbuch von 1926.

Die Texte entsprechen weitgehend dem damaligem Wissensstand, die meisten Grundlagen- Beschreibungen sind jedoch auch heute noch unverändert gültig.
Ich verwende hier meine Internet- Seiten in Deutsch, die einiges erklären.

Fehler können in diesem "Edi- Buch" enthalten sein, von den Autoren, und auch von mir.

Es geht mir auf meiner Internet- Seite und in den „Edi- Büchern“ um die Erhaltung alten Wissens.
Autoren, Erfinder und Bastler entwickelten einst diese Geräte, und brachten sie -oft in Fleißarbeit- zu guter, und manchmal sogar zu sehr guter Leistungsfähigkeit.

Erfreuen wir uns einfach an den Ergebnissen ihrer Arbeit !

Vielleicht bekommt der eine oder andere Radiofreund Lust, auch so ein Radio zu bauen- mit historischen, aber vielleicht auch moderneren Bauteilen- Röhren, Transistoren, oder sogar integrierte Schaltungen, die alten Konzept können auch mit allen diesen Bauteilen realisiert werden.

Ich wünsche "Viel Spaß !" beim Lesen, und Gutes Gelingen !" für's Bauen !

Olaf Freiberg
(Edi)

Special: Der Infradyne von 1926-27

Ich möchte Ihnen wieder ein vergessenes Gerät vorstellen- den "Infradyne" von E. M. Sargent, 1926/27.

Wie der "Octamonic", den ich vor kurzem hier vorstellte, ein Gerät, welches nur wenige Monate produziert wurde, die Stückzahl war also auch sehr gering.

Und wieder wird angezweifelt, daß der "Infradyne" überhaupt vernünftig funktionierte.

******Zitat*******
Der von EM Sargent entwickelte Infradyne war ein Superhet-Empfänger mit einer Zwischenfrequenz (ZF) von 3,2 MHz anstelle der damals üblichen 50 kHz.
...
"Natürlich gibt es bei einer Zwischenfrequenz von 3,2 MHz keine der oben beschriebenen Probleme mit dem Superhet, aber wie man mit Trioden bei einer so hohen Frequenz eine vernünftige Verstärkung erreicht? Der Autor glaubt nicht, dass dies möglich war!
...
Spätere Ausgaben der Zeitschrift „Radio“ beschrieben, wie der Infradyne-Verstärker in bestehende Radios integriert werden könnte. Viele enthielten einen Schalter zum Abschalten des Verstärkers, um das Radio in seinen ursprünglichen Zustand zurückzuversetzen. Warum genau das so ist, ist eine interessante Frage. Ich vermute, dass das Radio ohne den Infradyne-Verstärker wahrscheinlich besser funktionierte.
...

Der Infradyne schien 1927 von der Bildfläche zu verschwinden. Soweit mir bekannt ist, wurde der Entwurf nie kommerziell produziert. Es scheint eine „wilde Idee“ ohne wirklichen Nutzen zu sein.
*****Zitat Ende *****

Quelle http://www.antiqueradios.org/gazette/infradyn.htm

Letzteres ist totaler Quark- es wurden Geräte, Bausätze und Umrüstsätze produziert, vermutlich um 6000 Stück.
Duane Bylund von der Seite Duanesradio stellt etliche Varianten des Infradyne hier vor.

Der originale Verstärker wird heute (Juli 2025) sogar günstig bei Ebay (150$) angeboten, allerdings ohne Röhren, aber das ist kein besonderes Problem..
Auf jeden Fall eine interessante Sache.

Ich habe alles an Informationen aus alten Zeitschriften gesaugt, und stelle dies hier zur Verfügung.

Es fanden sich auch vorherige Entwicklungen des Mr. Sargent, die lasse ich mit einfließen, der "Infradyne" war dann wahrscheinlich der krönende Abschluß.

Infradyne- Der Hersteller

Leider habe ich nichts zu E. M. Sargent finden können- aber immerhin gibt es ein Foto der Fabrik Remler, für die Sargent die "Infradyne"- Modelle entwickelte, in San Francisco, welches ich per Street View mit dem heutigen Zustand vergleiche- es sieht so aus, als ob das Gebäude noch existiert, aber umgebaut wurde.

Figure 1. Remler Factory at 9th and Bryant Streets, San Francisco - circa 1940

dd

Infradyne- Die Funktion

Der "Infradyne" ist im Prinzip ein Superhet, obwohl E. M. Sargent den Begriff tunlichst vermied- um Patentansprüche von Armstrong nicht zu berühren.

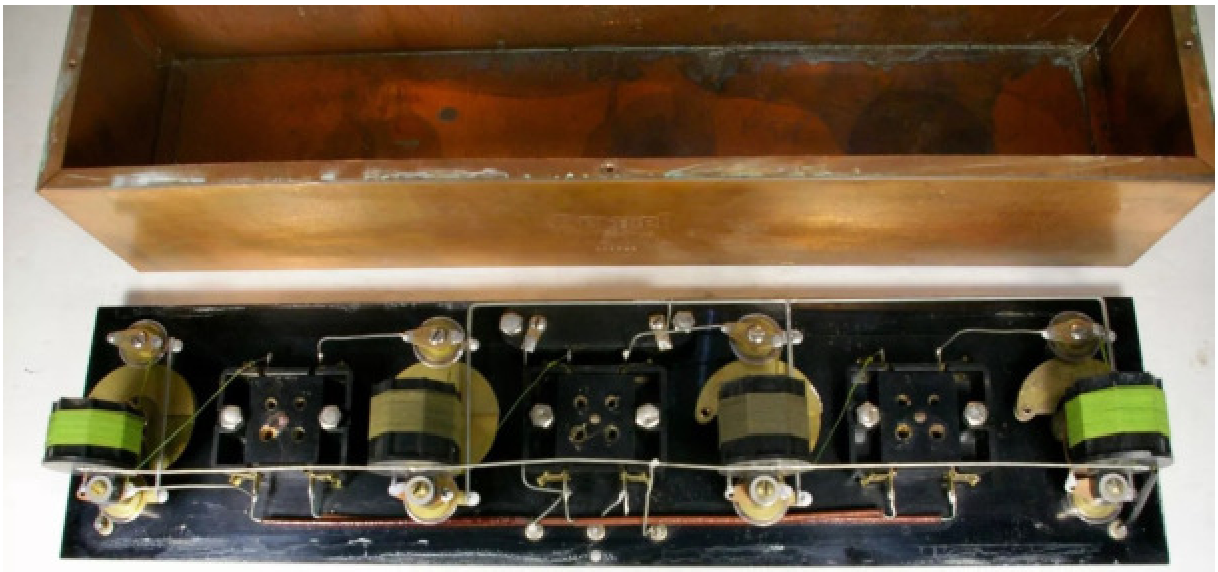
Der "Infradyne" arbeitete jedoch nicht auf den damals üblichen niedrigen ZF- Frequenzen von 150- 150 kHz, sondern mit sehr hohen 3,2, später 3,4 MHz !

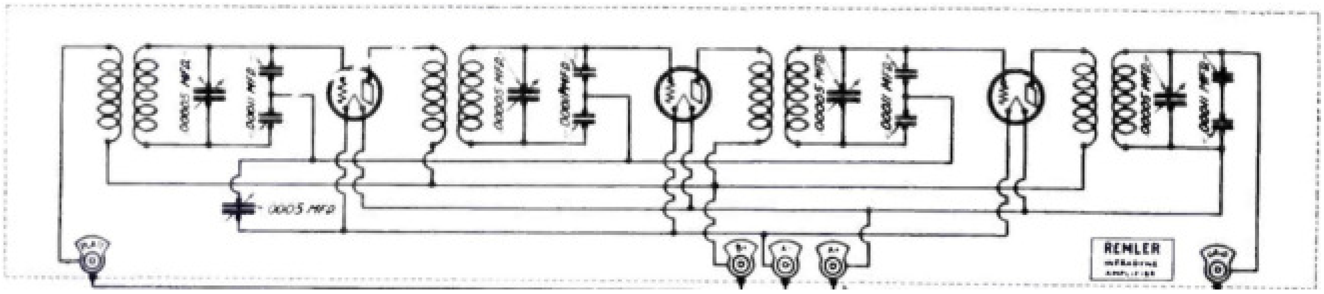
Das mag nahezu irrsinnig erscheinen- hatten die damaligen Trioden noch sehr hohe Anoden-/ Gitter- Kapazitäten, die Verstärkung ist also sehr gering zu erwarten.

Aber Sargent versprach sich, genau wie David Grimes mit seinem "Octamonic", eine hohe Trennschärfe und dabei der Beibehaltung einer sehr guten Bandbreite für beste Wiedergabequalität.

Dafür baute Sargent
1. einen 3- stufigen ZF- Verstärker "Infradyne Amplifier 700", eine abgeschlossene Baugruppe.
2. Später dann den "Infradyne- Adapter" für die Nachrüstung fremder Geräte.
3. Zum Schluß gab es die Vorstufen in einer Baugruppe: HF- Baugruppe "Infradyne RF- Amplifier 710" mit den Vorstufen.

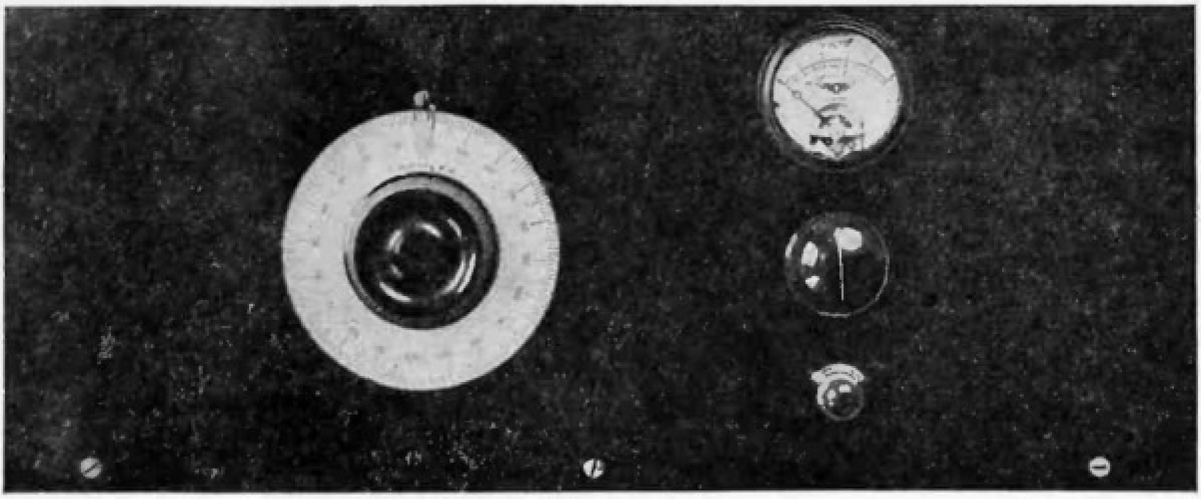
Die Grundbaugruppe aller "Infradyne", der "Amplifier 700"



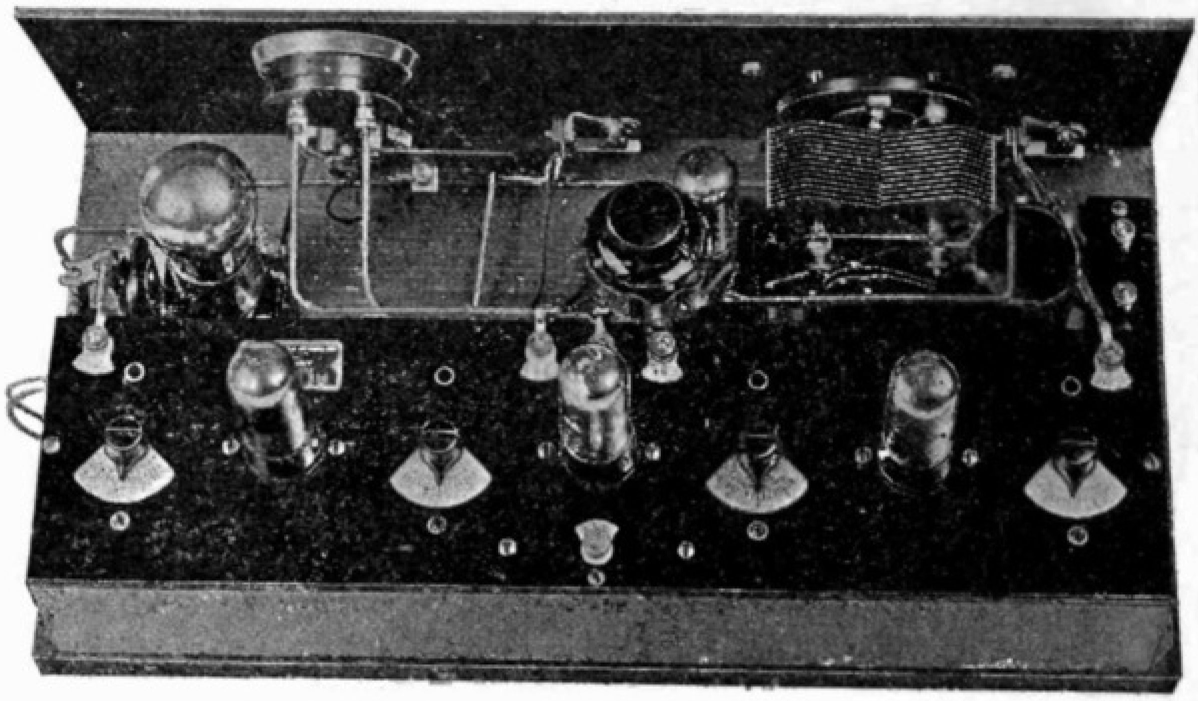


Die Grundbaugruppe aller "Infradyne", der "Amplifier 700"

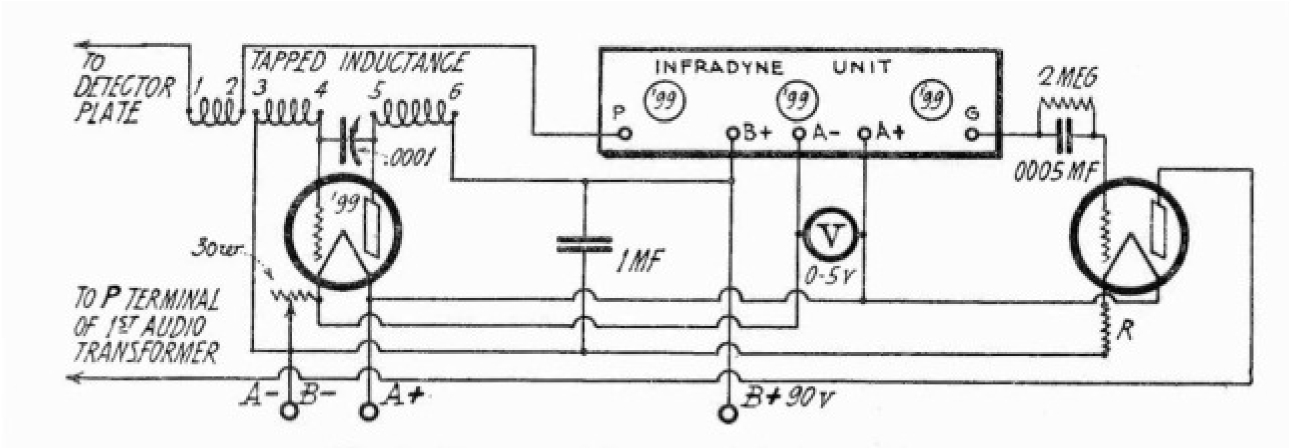
"Infradyne- Adapter" für die Nachrüstung fremder Geräte



Panel View of Infradyne Adapter.



Separate Infradyne Adapter With Switch Control.



Circuit Diagram of Separate Infradyne Adapter.

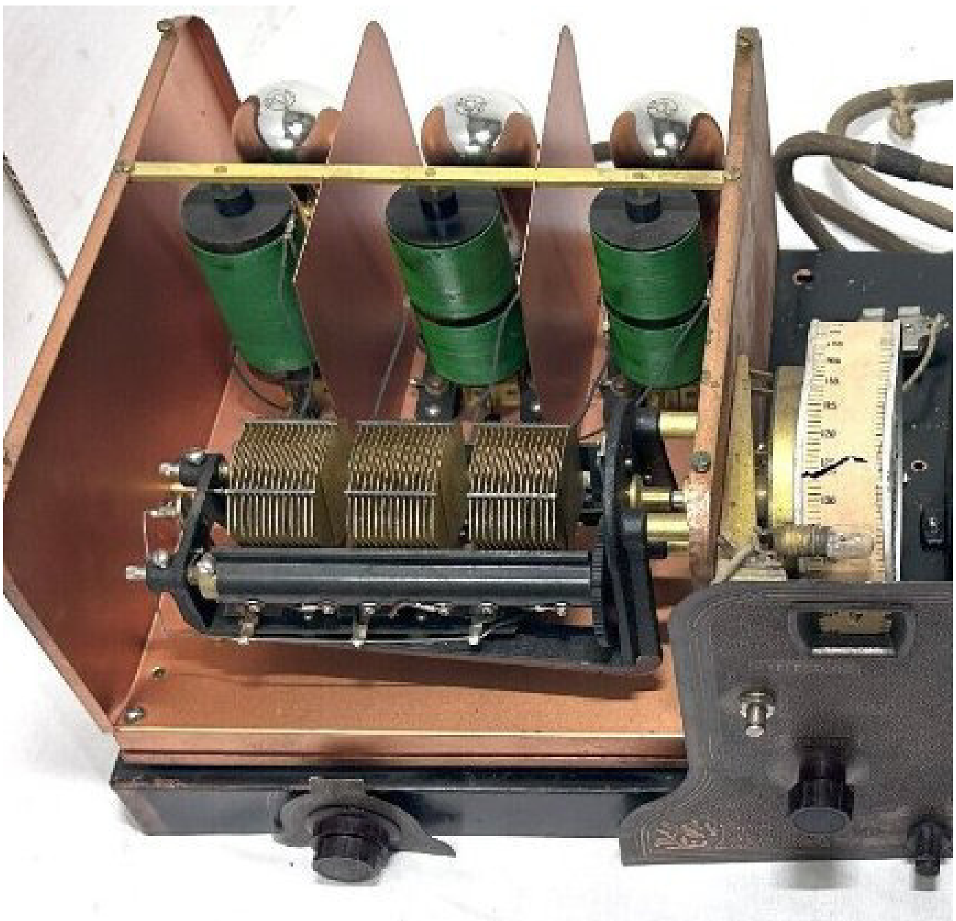
Für Nachrüstung fremder Geräte: Der "Infradyne Adapter" aus "Radio" 1926-10

Mit dieser Baugruppe konnten viele Superhets anderer Hersteller nachgerüstet = "infradynisiert" werden ("Infradyning"), es konnten sogar Geradeausempfänger zum Superhet aufgerüstet werden !

Das kann man durchaus eine sehr innovative Idee nennen.

Vorstufen- Baugruppe "Infradyne RF- Amplifier 710 von 1928

Die letzte Variante enthielt dann eine HF- Baugruppe "Infradyne RF- Amplifier 710" mit den Vorstufen.



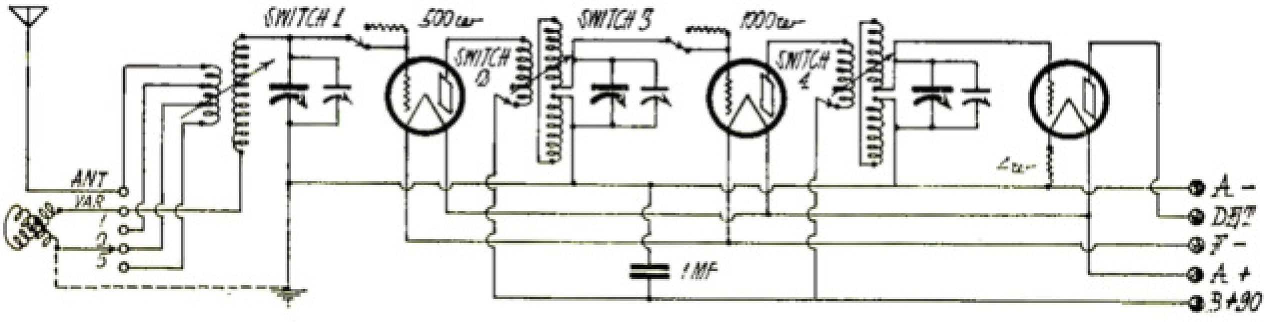
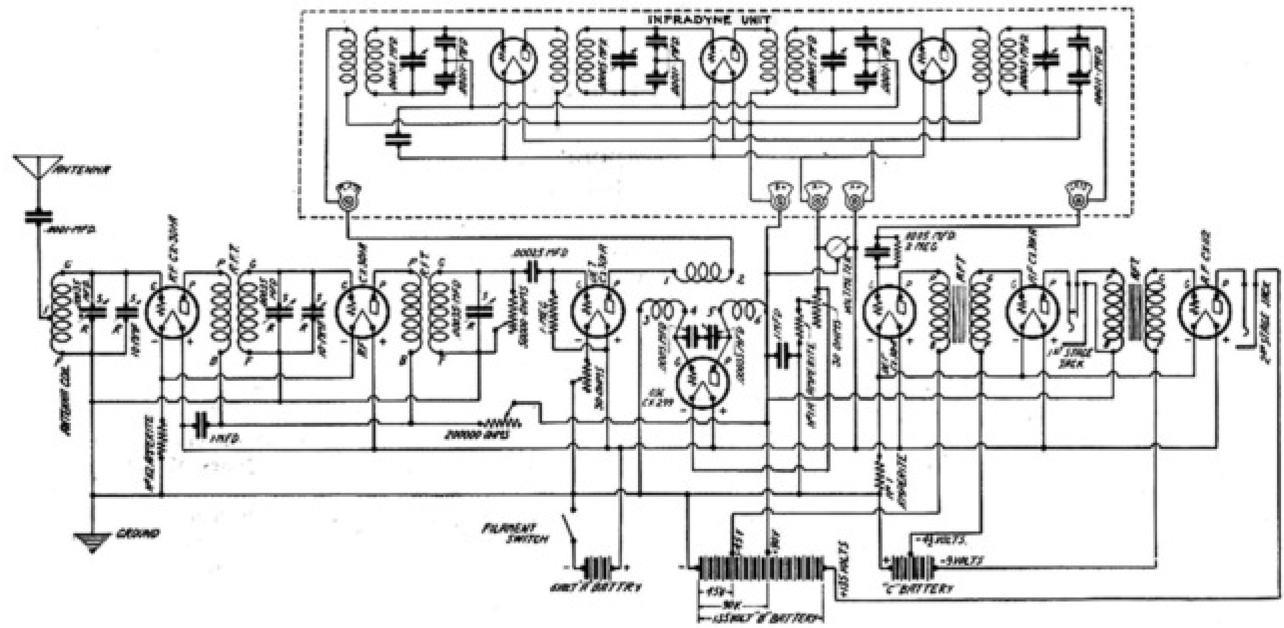


Fig. 1. Circuit Diagram of No. 710 Amplifier.

Für die letzte Version des "Infradyne" von 1928:
Die Vorstufen und Mischtufe in einer BAugruppe: Der "Infradyne RF- Amplifier""Baugruppe Infradyne RF- Amplifier 710",
Bild von D. Bylund

Infradyne- Die Schaltung

Die Erste Schaltung des "Infradyne"



Die Schaltung ist eigentlich nicht kompliziert, sie enthält jedoch einige bemerkenswerte Details.

In der Schaltung arbeiten 2 Vorstufen auf eine Mischstufe, in dieser wird die Oszillatorfrequenz induktiv an der Anode eingekoppelt, die entstehende ZF gleich an der Anode durch das erste ZF- Filter abgetrennt.

Der Empfangsbereich ist 550 - 1500 kHz, der Oszillator erzeugt passend dazu 3050 - 2100 kHz, die ZF ist 3600 kHz, die Oszillatorfrequenz ist absteigend, wenn die Empfangsfrequenz ansteigt.

In einer Verlautbarung stand zu lesen, daß eine 1. Harmonische des Oszillators benutzt wurde, also müßte dieser evtl. 1525 - 1050 kHz erzeugt haben, das müßte man ggf. anhand der Spulendaten nachrechnen.

3 Röhren verstärken die ZF, am 4. Filter wird die ZF dann zur Demodulatorröhre geleitet.

Wie damals üblich, kann man jedes ZF- Filter einzeln einstellen. Das macht man normalerweise nur einmal.
Wenn allerdings der kleine Sohn mal Papas Radio mal so richtig "verkurbelt" hat... :-(

Zwei weitere Röhren sind dann der Audio- Verstärker.

Alle Betriebsspannungen werden durch Batterien zur Verfügung gestellt.
Die ersten beiden HF- Röhren und die Ozillatorröhre bekommen keine Gittervorspannung, die Mischröhre besitzt eine R/C- Gitterkombination, sie benötigt einen Arbeitspunkt am unteren Teil der Kennlinie.

Die Demodulatorröhre hat wieder eine R/C- Gitterkombination, und die Audioverstärkerröhren bekommen Batterie- Gittervorpannungen von 4,5 und 9V.

Eine Besonderheit ist jedoch im ZF- Verstärker zu finden:
Die Gitter haben keinen Masse- Bezug und keine Vorspannung, gleichspannungsmäßig "hängen sie in der Luft" !
Dies hat wohl schon früh Fragen aufgeworfen, und Sargent soll in einer Beschreibung erklärt haben, daß genug "Rest- Vorspannung" in der Schaltung erzeugt würde, um die Funktion zu garantieren.
(ich fand diesen Text nicht).
Meiner Meinung nach entstehen entstehen im "Infradyne- Amplifier", bedingt durch den Elektronenstrom, mangels Ableitung höhere Gitter- Anlaufspannungen an den 3 Röhren des "Infradyne 700- Amplifiers", so daß die Röhren am untersten Ende der Kennlinie arbeiten, diese also nahezu voll gesperrt sind, und somit nur noch allergeringste Verstärkung möglich ist.
Ein solcher Betrieb ist für Vervielfacherstufen und Mischstufen in Ordnung, ZF- Verstärker sollten aber üblicherweise gut verstärkend im linearen Bereich der Röhren- Kennlinie arbeiten.

Ein Radiofreund hat in Radiomuseum.org einen Test des "Infradyne" beschrieben, und bestätigt die sehr geringe Verstärkung- und hielt sie für durch die damals verfügbaren Röhren begründet.

Ein weiterer Effekt konnte beobachtet werden, nämlich, daß sich die ZF sogar nach Ziehen der Röhren am Ausgang feststellen läßt, nur "mit geringerem Pegel"...
...bei ohnehin schon niedrigem Pegel.
Das verwundert nicht- die ZF- Stufen sind nicht durch Abschirmungen getrennt, und die Spulen können aufeinander koppeln, bei 3,6 MHz ist das denkbar.
Es gab verschiedene Varianten der Infradyne- Baugruppen, in einigen Geräten wurden die Spulen anders angeordnet, in einigen Geräten gab es Abschirmwände zwischen den Stufen.

Wenn auch noch eine Harmonische des Oszillators genutzt wurde, die im Pegel sicher gering war, ist dies vielleicht mit eine Ursache für sehr geringe Verstärkung.

Es ist eine sehr eigenartige Schaltung- und kaum nachzuvollziehen, was E. M. Sargent damit bezweckte.

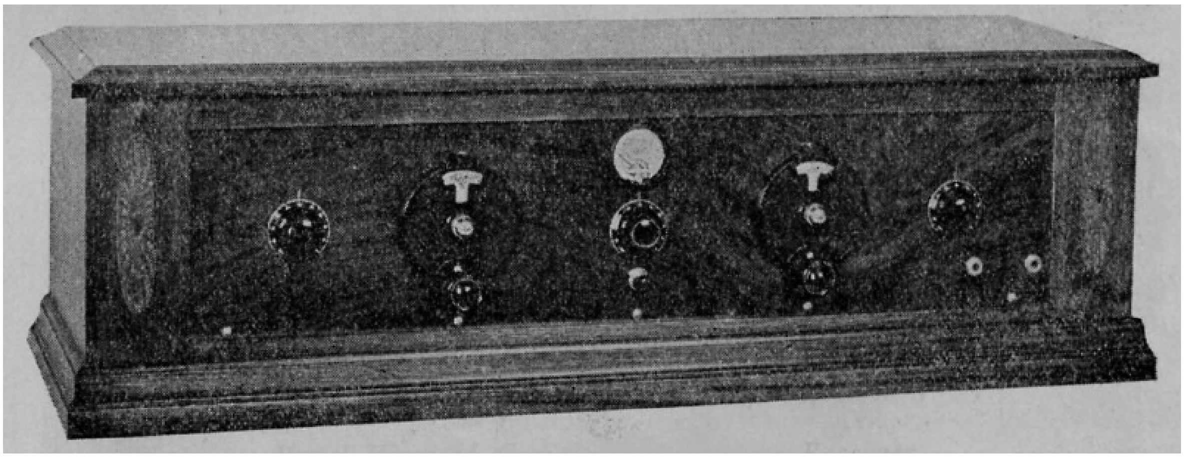
Andererseits gibt es etliche Videoaufnahmen, die den "Infradyne" hören lassen, und zwar mit recht guter Tonqualität.

Die Videos sind hier zu finden: Russ old Radios/ Infradyne
https://www.russoldradios.com/blog/remler-infradyne-and-tube-substitution
Leider quatscht der Ersteller in die Aufnahme rein, aber die Wiedergabequalität scheint gut zu sein, jedenfalls für ein fast 100 Jahre altes Gerät ist sie absolut in Ordnung.

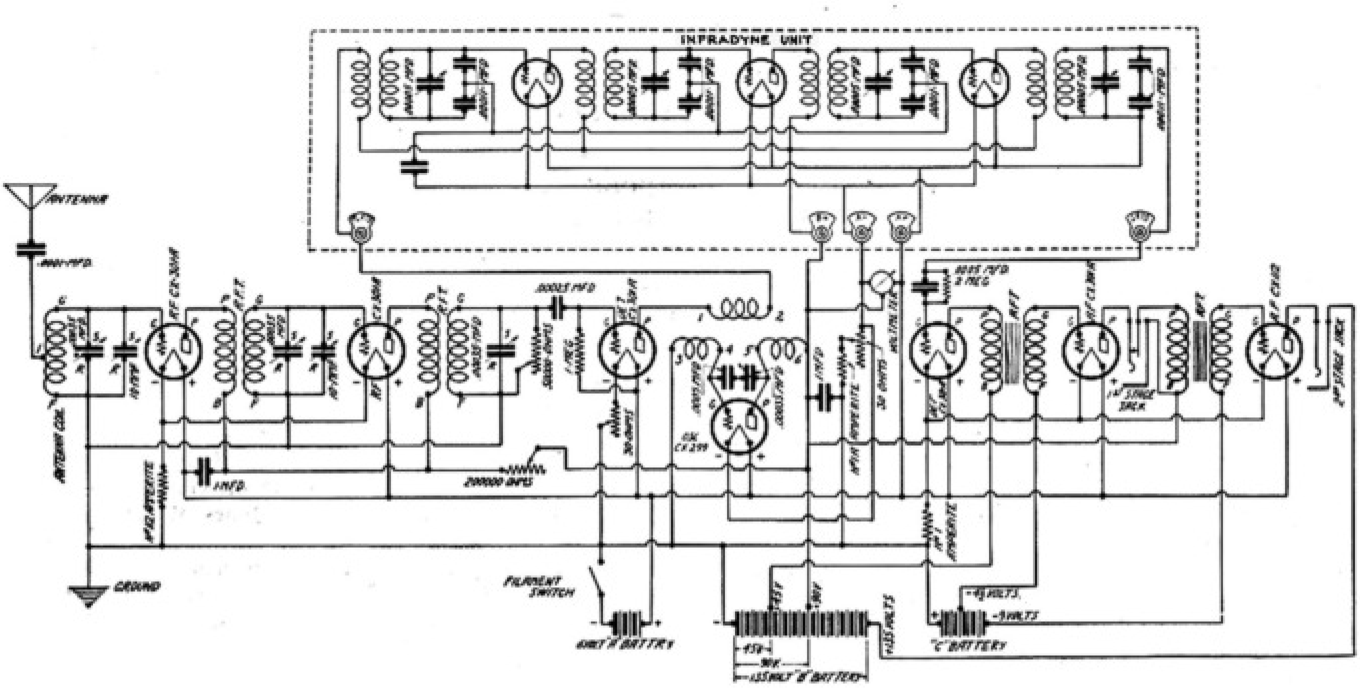
Und auch der Hersteller betonte, daß der "Infradyne" auch fernempfangsfähig wäre.

Leider kann ich keine Tests und Videos beitragen, ich besitze keinen "Infradyne", und meine Mittel sind doch recht begrenzt, ich habe bereits mehrere Nachbauten von Geräten der Jahre 1918- 1927 gebaut oder noch in Arbeit.

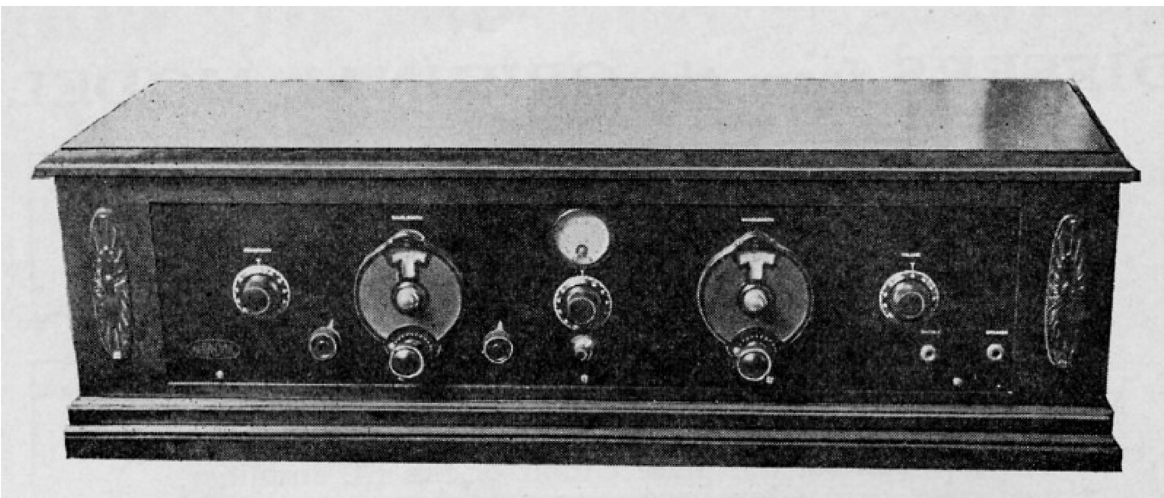
Infradyne- Varianten



Die erste Ausführung des "Infradyne", 1926, aus dem "Radio Magazoine 1926-08. es enthält Toroid- Spulen.

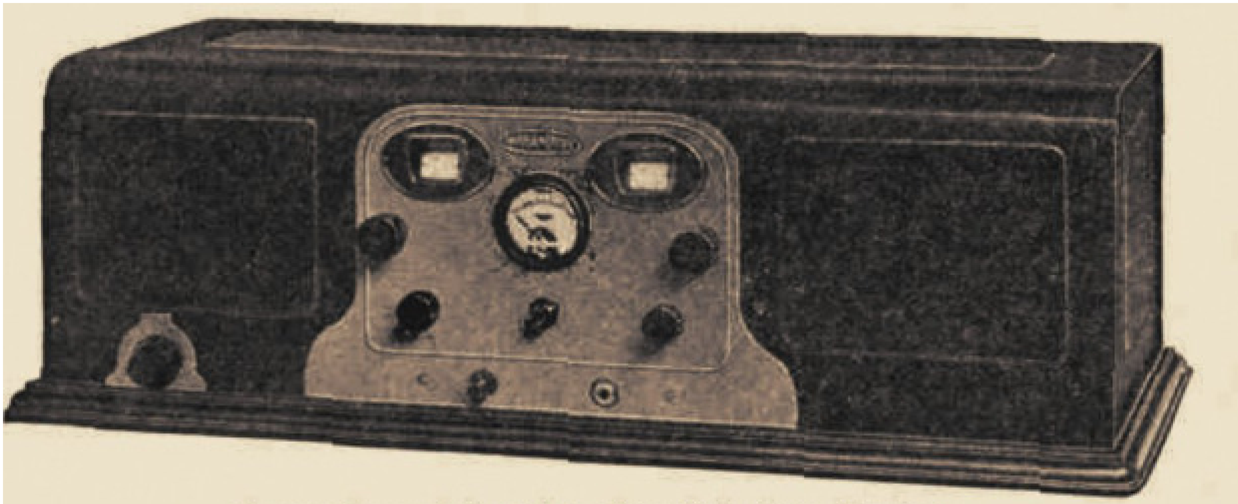


Die Schaltung des "Infradyne", 1926



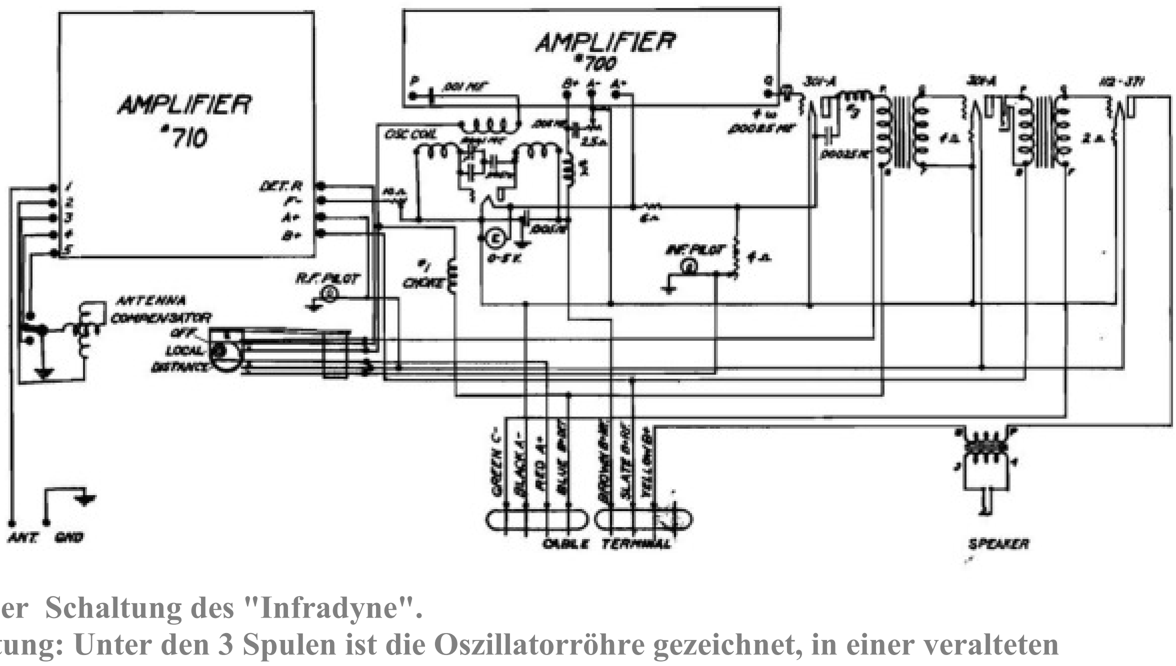
Die zweite Ausführung des "Infradyne", 1926, es enthält Toroid- Spulen

Die dritte Ausführung des "Infradyne", 1926, aus dem "Citizens Radio Callbook", 1926-09, es enthält Kammerspulen



Front View of Complete New Infradyne Receiver.

Die 1928er Ausführung des "Infradyne", aus dem 1928er Handbuch



1928er Schaltung des "Infradyne".
Achtung: Unter den 3 Spulen ist die Oszillatorröhre gezeichnet, in einer veralteten Darstellung, ohne Glaskolben !

Infradyne- Fotogalerie

Die Fotos habe ich -außer beim ersten Gerät- nach Seriennummern des Hauptbestandteils, des "Infradyne 700 Amplifiers", geordnet.
Es ist nicht immer klar, wie die Geräte entstanden sind, es gab von der Fa. Remler sowohl Bausätze, als auch fertige Geräte.

Es ist auch möglich, daß die Baugruppe später getauscht wurde, die Seriennummer sagt also nicht unbedingt etwas über das tatsächliche Baujahr aus.

Die Fotos stammen von der Infradyne- Internetseite des Radiofreunds Duane Bylund, der mir die Verwendung von Fotos und Textauszügen gestattete- vielen Dank an Duane !

Infradyne 1926

Infradyne 1926 Seriennummer 005720 von Robert, mit den Toroid- Spulen.
Es dürfte ein Exemplar von 1926 sein.
Die Seriennummer der "Infradyne 700 Amplifier"- Baugruppe ist viel zu hoch- die Toroid- Spulen wurden nur 1926/27 verwendet.
Möglicherweise wurde die Baugruppe später gegen eine neuere ausgetauscht.

Infradyne Seriennummer 000441 eines unbekannten Radiofreundes

Infradyne Seriennummer 000952 von Bill
Die Anordnung der Bauteile ist ganz anders, als in den veröffentlichten Versionen, Spulen und auch die Skalenantriebe sind anders.
Immerhin aber 10 Röhren (es sind nur 2 aufgesteckt), es wurde also die komplette Infradyne-Schaltung realisiert.
Ich vermute einen "freien Nachbau".

Infradyne 1927

Infradyne 1927 Seriennummer 000441von Luca

Infradyne 1927 Seriennummer 001553 von Jim

Infradyne 1927 Seriennummer 005700 von Duane

Infradyne 1928

1928 wurde der "Infradyne" überarbeitet, bekam eine eigene, in einer Kupferbox geschirmte Eingangsstufen- Baugruppe, und eine Mittel- Zierblende.
Das Gehäuse wurde aus Kupfer tiefgezogen, und braun/ Kristalleffekt- lackiert.

Infradyne 1928 Seriennummer 006493 von Luca

Ein komplettes Kupfer- Gehäuse, das stellte das Radio als etwas Besonderes heraus.

Meines Wissens waren die Kupfergehäuse braun/ Kristalleffekt- lackiert, möglicherweise hat ein Besitzer den Lack seines Exemplars entfernt.

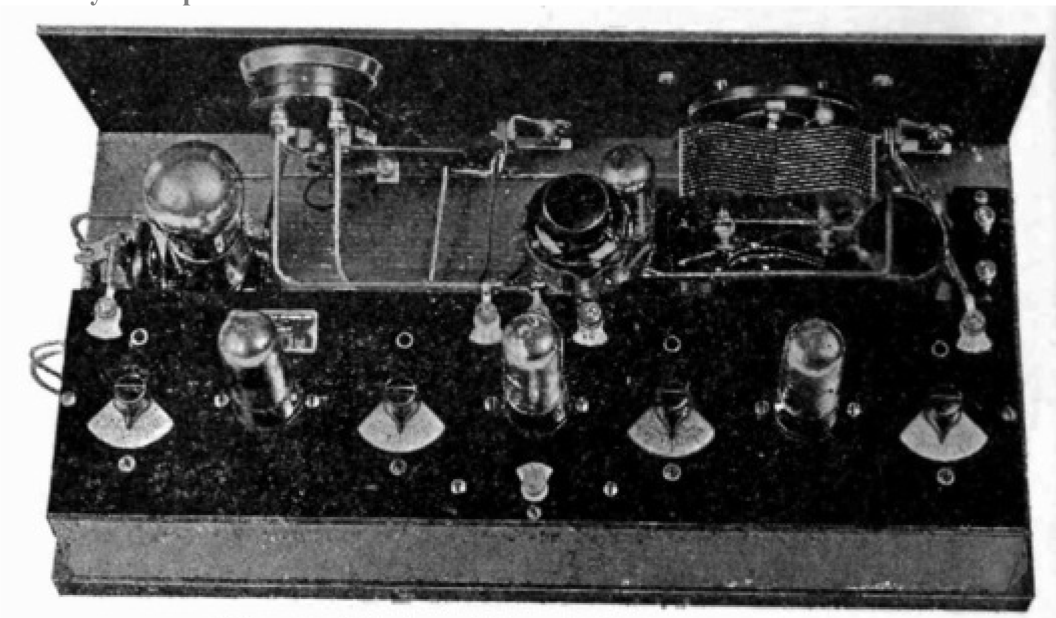
Infradyne- Umrüstgeräte

Für die Umrüstung von Geräten anderer Hersteller wurde der "Infradyne Adapter" entwickelt, dieser enthält eine Oszillatorstufe, die Einkopplung der Oszillatorfrequenz, die dreistufige ZF-Baugruppe "Infradyne Amplifier 700" und eine Demodulatorstufe.

Eine Zeitlang stellten sogar einige Hersteller in der Werbung für ihre Geräte die Umrüstbarkeit auf "Infradyne" heraus !

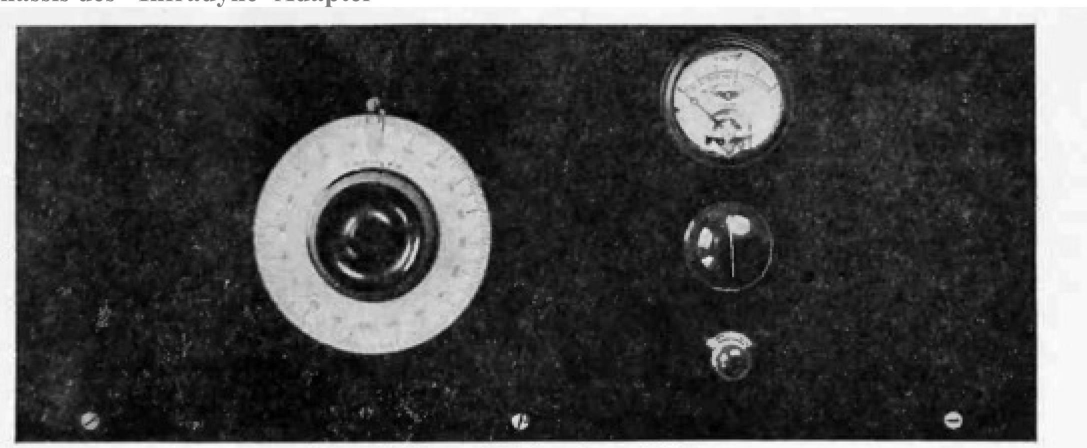
Umrüst- Baugruppe "Infradyne Adapter"

"Infradyne Amplifier 700" = ZF- Verstärker



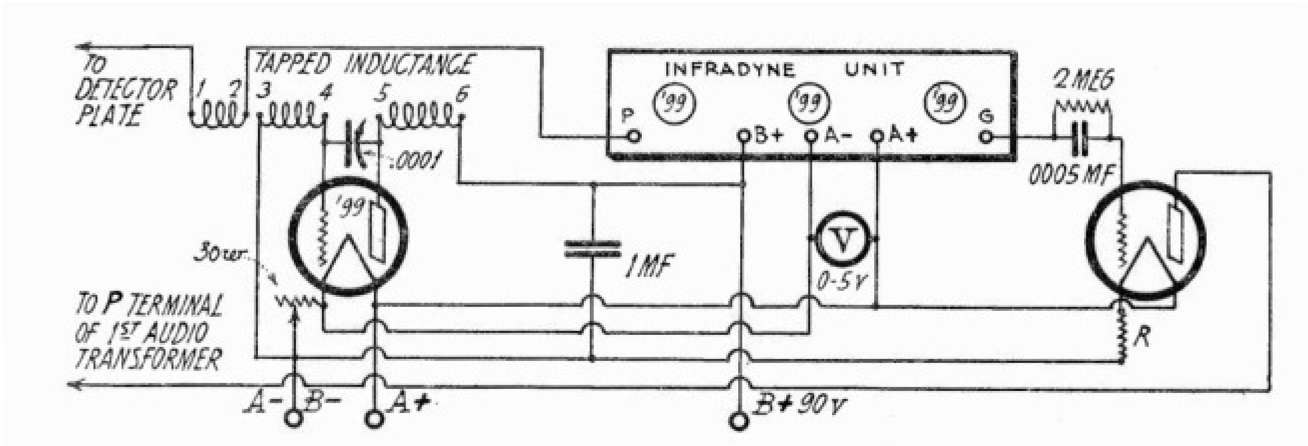
Separate Infradyne Adapter With Switch Control.

Chassis des "Infradyne- Adapter"



Panel View of Infradyne Adapter.

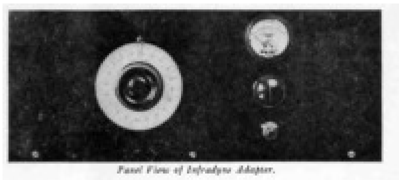
Kompletter "Infradyne- Adapter"



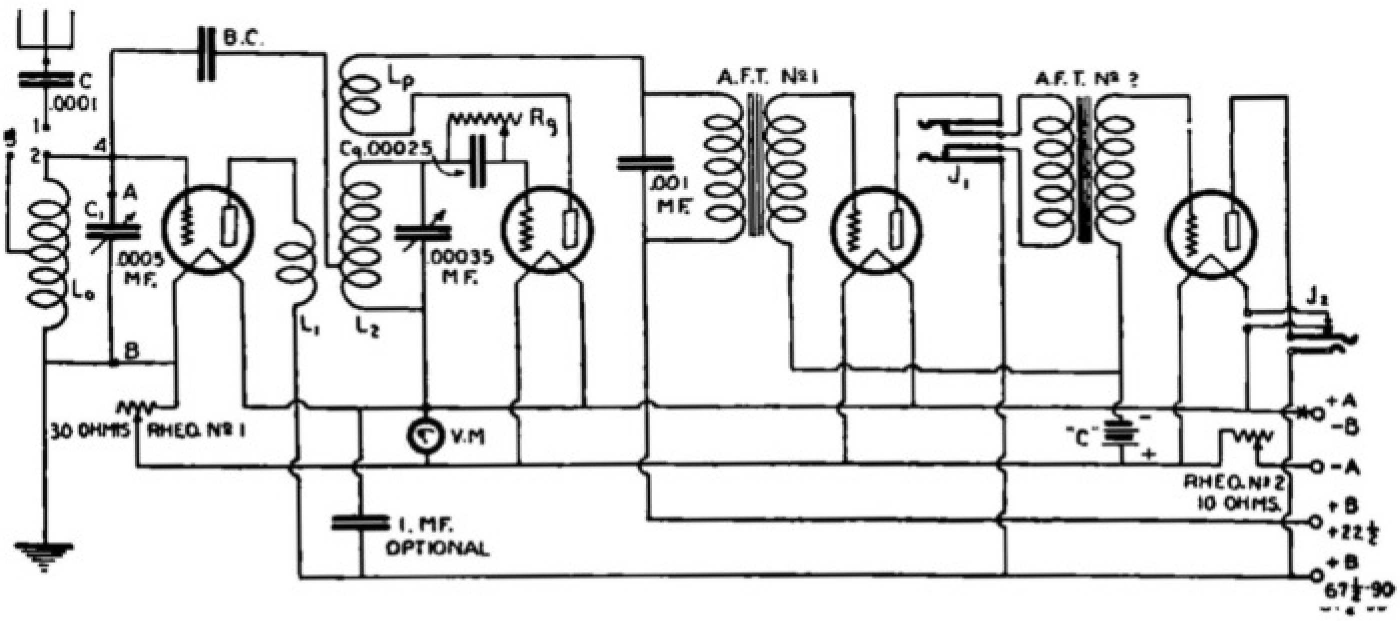
Circuit Diagram of Separate Infradyne Adapter.

Schaltplan "Infradyne- Adapter"

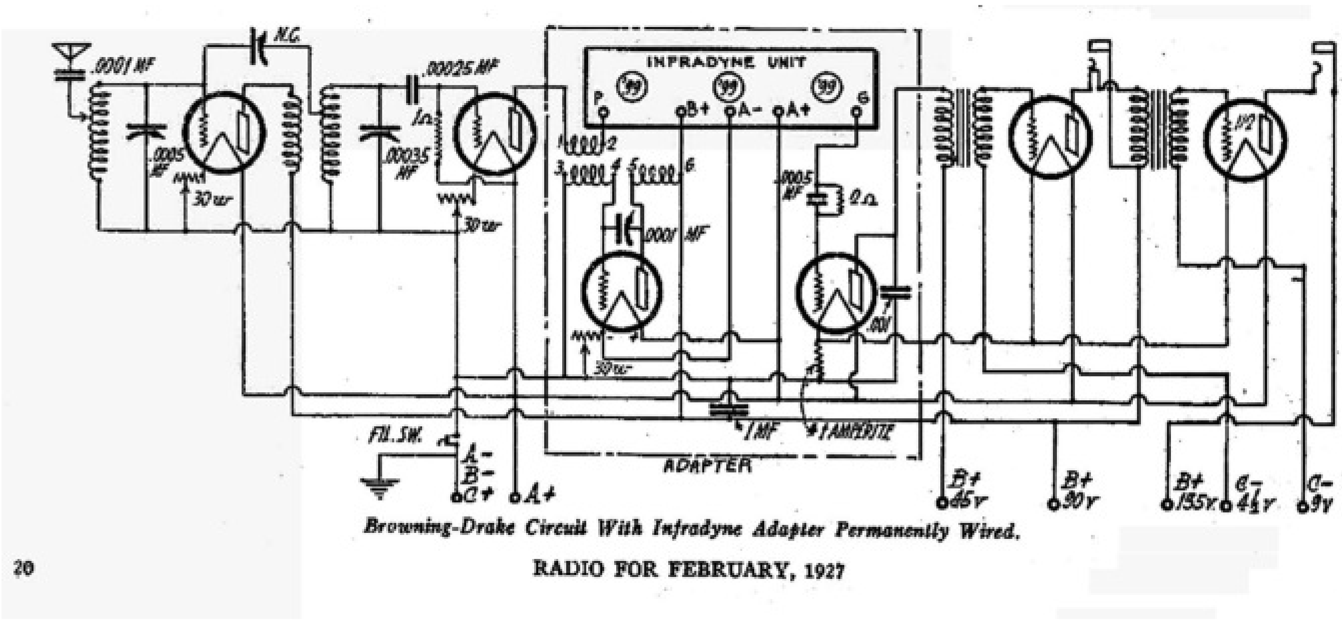
Umrüstgerät Browning- Drake

Links das Originalgerät, rechts der "Infradyne- Adaper",
so mußten die Geräte wohl nebeneinander angeordnet sein.
Das "Infradyne- Adapter" - Gerät ist ca 45 cm breit, der Browning- Drake "Regenaformer 4 tubes" 64 cm, da mußte schon über 1,10 m Platz bereitgestellt werden !



Browning- Drake 1927 Originalschaltung



Ein mittels "Adapter- Baugruppe" auf "Infradyne"umgerüsteter Browning- Drake

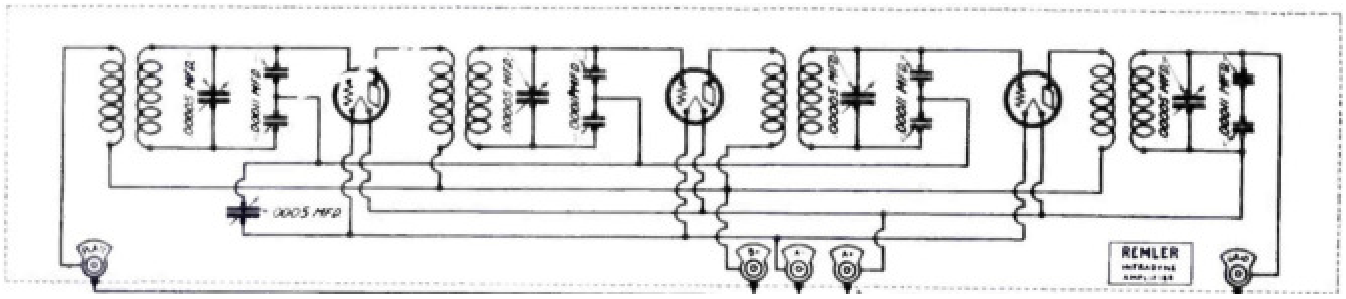
Hier wurde ein vorhandener Empfänger der Fa. Browning- Drake umgebaut, und zwar war das laut Beschreibung ein Geradeausempfänger, eine Vorstufe und ein Audion mit Neutralisation (Neutralisations- Kondensator "N.C."), sowie 2 Audio- Stufen.
Der "Infradyne- Adapter" wird hinter dem Audion eingeschleift.
Die Anode der Audionröhre wird vom Übertrager abgetrennt, und zum Adapter- Gerät geführt, der Übertrager kommt dann zum Ausgangs- Anschluß des Adapter- Geräts.
Heizungs. und Anodenspannungen ans Adapter- Gerät geführt- fertig.

Mit dieser Maßnahme wurde tatsächlich -und auf einfachste Art und Weise- ein Geradeaus- Empfänger zu einem Superhet "infradynisiert".

Der Browning- Drake ist original ein Zweikreis- Geradeausempfänger, und besitzt 2 einzeln abzustimmende Kreise für die Empfangfrequenz, und mit dem Umbau kommt nun der Oszillatorkreis dazu.
3 Kreise abzustimmen, ist schon eine Herausforderung.
Damals sah man das wohl recht locker.
Immerhin hatte man ohne riesigen Aufwand aus dem 4- Röhren-/ Zwei Kreis- Geradeausempfänger einen respektablen 9- Röhren- Superhet gemacht.

Ob der Umbau mittels der Adapter- Baugruppe, die den möglicherweise schwachbrüstigen Oszillator und definitiv schwachen ZF- Verstärker enthielt, sich wirklich lohnte ?

Infradyne- Warum funktioniert er ? "Schwebender Bezug"



**Der "schwebende Bezug ist eine spezielle Funktion des "Infradyne".
Den Begriff "schwebender Bezug" für den englischen Begriff "floating ground" ist von mir, "Erdung" ist es ja eher nicht.**

Dazu zitiere ich hier aus [Call Letters_2012](), Longhorne Infradyne Set S11, von mir übersetzt:

Der Infradyne-ZF-Verstärker von Remler wurde in der Augustausgabe 1926 des Magazins Radio vorgestellt. Der Infradyne war entweder als Drei- oder Vierröhrenmodell mit Bakelit-Panel und Kupfergehäuse erhältlich. Thomas J. Langhorne verwendete beide Modelle in seinen Empfängern von Ende 1926. Dort wurde er direkt vor dem Detektor in das Radio eingebaut und hatte eine ZF-Frequenz von 3,2 MHz. Diese hohe ZF-Frequenz wurde durch die Summe des Eingangssignals und Langhornes lokalem Oszillator von 48 kHz erzeugt, anstatt durch die Frequenzdifferenz zwischen beiden, wie bei anderen Superhets.

**Das Problem des von E. M. Sargent entwickelten Remler "Infradyne" war, dass der Verstärker UX-199-Trioden verwendete, die bei höheren Frequenzen nie wirklich gut funktionierten. Eine Dreielektrodenröhre oder Triode neigte aufgrund der Elektrodenkapazität zu Schwingungen bei Frequenzen über 1,5 MHz.
Sargent nutzte die "Restleckage" der UX-199 Röhren, um alle Gitterkreise über ein Kondensatornetzwerk ohne Rückleitung zur Erde oder zu anderen Spannungen, eine sogenannte „schwebende Masse“ ("floating ground") zu "erden".**

**Die Verwendung einer "Restleckage", also eines Verlustwiderstands, ist einmalig.
Es hat offensichtlich funktioniert.
Es nutzt jedoch einen nicht vom Röhrenhersteller definierte Eigenschaft bzw. Wert.**

**Meine Schlußfolgerung:
Mit den vorgesehenen Röhren wird es funktionieren, zahlreiche Berichte lassen darauf schließen.
Diese Verwendung dürfte problematisch für die Verwendung anderer Röhren sein- dann müßte wahrscheinlich ein definierter Masse- Bezug geschaffen werden.**

**Noch zum Begriff "Schwebende Erdung":
Wikipedia:
Eine schwebende Erdung ist ein Referenzpunkt für das elektrische Potential in einem Stromkreis, der galvanisch von der tatsächlichen Erdung isoliert ist .
Die meisten Stromkreise haben eine Erdung , die elektrisch mit der Erde verbunden ist, daher der Name „Erde“. Wenn diese Verbindung nicht besteht, spricht man von schwebender Erde.
Leiter werden auch als Leiter mit schwebender Spannung bezeichnet, wenn sie nicht elektrisch mit einem anderen nicht schwebenden (geerdeten) Leiter verbunden sind. Ohne eine solche**

Verbindung werden Spannungen und Ströme durch elektromagnetische Felder oder Ladungsansammlungen im Leiter induziert und nicht durch die übliche externe Potenzialdifferenz einer Stromquelle.

KI, von der Google- Seite eingebunden::
Eine „schwebende Erdung" bezeichnet den Referenzpunkt für das elektrische Potenzial eines Stromkreises, der von der Erde isoliert ist. Im Gegensatz zu einer herkömmlichen Erdung, die physisch mit der Erde verbunden ist, fehlt bei einer schwebenden Erdung diese direkte Verbindung. Diese Isolierung wird häufig in Anwendungen wie medizinischen Geräten, Audiogeräten und Prüf- und Messgeräten eingesetzt, um Erdschleifen zu vermeiden und das Rauschverhalten zu verbessern.

Infradyne- Warum funktioniert er ? Rückkopplung

Tatsächlich haben sich schon vor 66 Jahren Fachleute gefragt, warum der Infradyne eigentlich funktioniert.
Dabei... sollten die Grundlagen der Empfängertechnik schon eine einigermaßene Begründung liefern. Die lernte einst jeder Rundfunk-/ Fernsehmechaniker.
Aber auch mit guten Kenntnissen ist es nicht ganz einfach. eines der wichtigen Schaltungsdetails ist schwer zu erkennen.

Aber es gab zumindest EINEN Fachmann, der es erkannte !
Ich fand sogar die mit Messungen unterlegte Begründung !

Ich stelle hier die von mir übersetzte Seite ein.

Proceedings of the IRE 1959-07, S. 1275 Correspondence
https://www.worldradiohistory.com/Archive-IRE/50s/IRE-1959-07.pdf

Rückkopplung vor einem Dritteljahrhundert

GERÄTE
Ein recht ungewöhnlicher Radioempfänger namens "Infradyne" wurde von Sargent entwickelt und 1926 beschrieben. Die Zwischenfrequenz betrug etwa 3600 kHz, die Summe der Frequenzen des Eingangssignals und des lokalen Oszillators. Bei einem Eingangsfrequenzbereich von 550 bis 1500 kHz variierte die Oszillatorfrequenz zwischen 3050 und 2100 kHz. Die Spiegelfrequenz entspricht dem Doppelten der Zwischenfrequenz minus der Signalfrequenz. Folglich variiert sie zwischen 6650 und 5700 kHz. Ein einzelner Schwingkreis in der Mischstufe sorgt für eine ausreichende Aussiebung der Zwischenfrequenz und Unterdrückung der Spiegelfrequenz.

ZWISCHENFREQUENZVERSTÄRKER
Das Herzstück dieses Empfängers ist die dreistufige ZF-Stufe mit UX-199-Röhren.
Abb. I zeigt einen Schaltplan. Eine Neutralisierung ist nicht eingebaut. Der Verstärker wird durch eine vom Kondensator C gesteuerte Gesamtrückkopplung stabilisiert. Bei geringer Kapazität des Kondensators C ist eine maximale Rückkopplung gewährleistet.

TESTS
Kürzlich hatte ich das Glück, ein brandneues Exemplar dieser ZF-Stufe zu erhalten, das noch nie benutzt worden war.
Ein Aufbau mit einem 12.000-Ohm-Widerstand und einem 0,005 mfd-Kondensator (0,005 Mikrofarad = 5000 pF, Edi) in Reihe zwischen Signalgenerator und Anschluss P wurde erstellt. Dies simuliert den Anodenwiderstand einer UX-199-Röhre. Der Ausgang wurde mit einem Röhrenvoltmeter an den Anschlüssen G und - gemessen. Es wurde kein zusätzlicher Lastwiderstand verwendet.

Es wurden mehrere Tests mit unterschiedlichen Einstellungen von C durchgeführt.
Abb. 2 Die Frequenzgangkurve in wurde mit dem kleinsten Wert von C festgelegt.
Abb. 3 zeigt den Frequenzgang für einen etwas höheren Wert von C.
Abb. 4 zeigt den Frequenzgang für C, der knapp unter dem Wert liegt, der eine Schwingung erzeugt.

Die Verstärkungswerte beziehen sich auf Frequenzgangkurven mit 0 dB-Bandbreiten bei 3 und 20 dB sind dargestellt.

DISKUSSION
Es ist offensichtlich, dass dieser Verstärker eine einstellbare Gesamtrückkopplung besitzt, um ihn stabil zu machen. Wie zu erwarten, kann die Rückkopplung reduziert und die Verstärkung auf Kosten der Bandbreite erhöht werden.
Aus der Diskussion des Erfinders geht nicht hervor, dass er die Funktionsweise der Schaltung versteht, obwohl er Anweisungen zur Erstellung einer Frequenzgangkurve ähnlich wie in Abb. 4 gibt.
Ich nominiere Sargent jedenfalls als Erfinder der Rückkopplung.
Hat jemand ein Exemplar dieses Gerätes ?
Vielleicht besitzt ein Leser einen dieser Verstärker.
Falls ja, würde ich mich über eine Korrespondenz mit ihm freuen.

Eingegangen im IRE am 21. Februar 1959.
Quellen:
E. M. Sargent, „The Infradyne" in Radio“, Bd. 8, S. 11–14, 46; August 1926.
J. j. Simpson, 85–39 152nd St., Jamaica 32, N. V., private Mitteilung..

GROTE REBER

National Radio Astronomy Observatory Green Bank, W. Va
(W. Va = West Virginia, Edi)

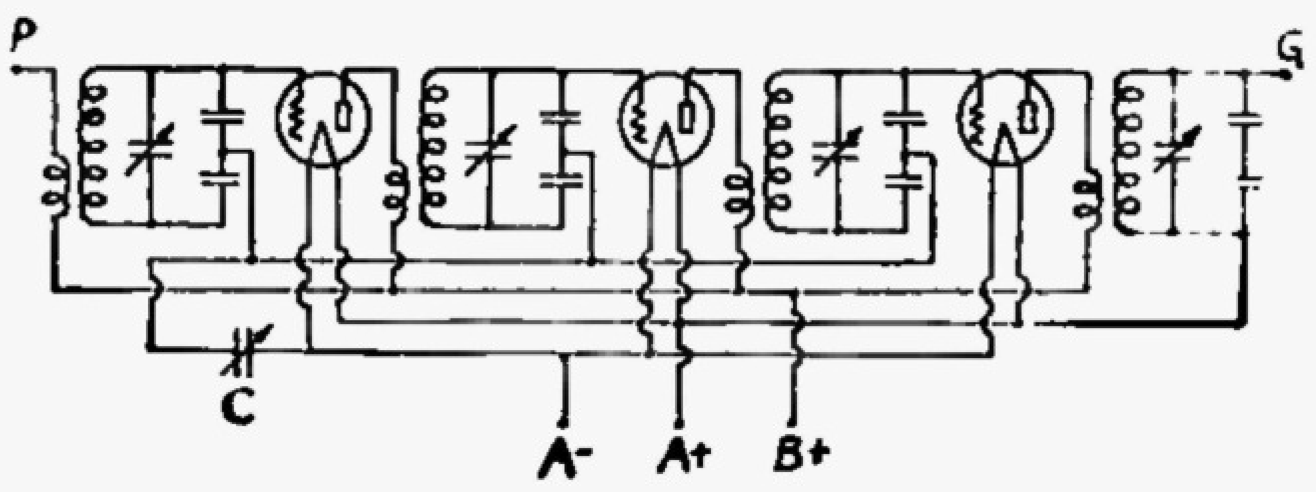


Fig. 1—Circuit diagram of 3600 kc amplifier.
Condenser *C* controls the feedback.

Die wichtigste Stelle: Kondensator C steuert die Rückkopplung !

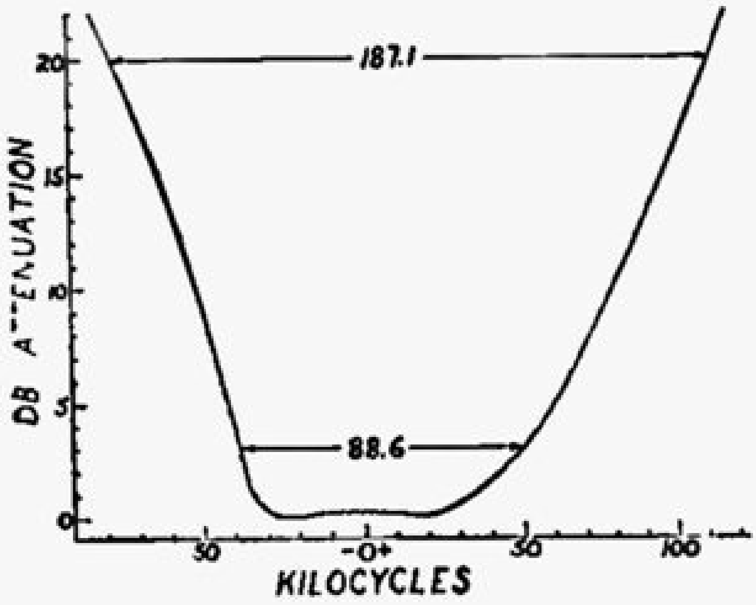


Fig. 2—Response curve with maximum feedback. Over-all gain, 11.1 db.

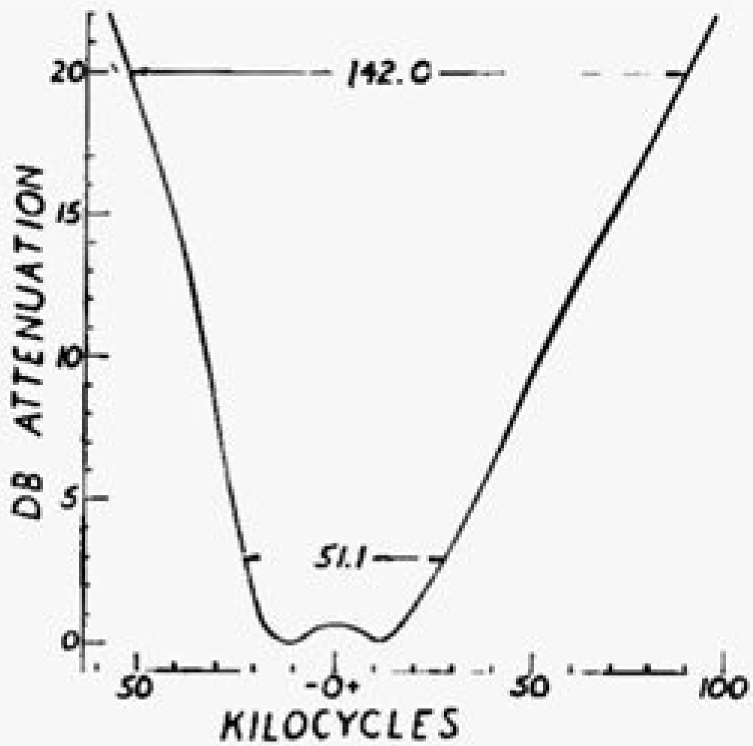


Fig. 3—Response curve with moderate feedback. Over-all gain, 18.1 db.

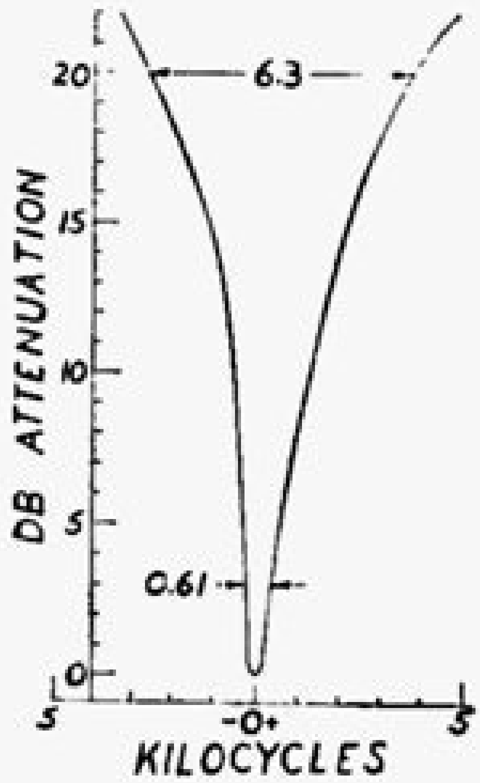


Fig. 4—Response curve with minimum feedback.
Over-all gain, 47.2 db.

Ich denke, die Messungen von G. Reber kann man als Beweis werten- hier ist es zwar nur der ZF- Teil ohne die Vorstufen, aber die hervorragenden Durchlaßkurven läßt darauf schließen, daß der komplette "Infradyne" noch besser war, und mit Sicherheit gute bis sehr gute Trennschärfe bei eingeschränkter Bandbreite, aber auch sehr guten Ton bei hoher Bandbreite erreichen konnte.

Bestätigt wird das von positiven Berichten von Besitzern dieser Geräte, wenngleich die Werbung gelegentlich übertreibt.

Die gemessenen Eigenschaften sind schon Eigenschaften von guten bis sehr guten Superhets späterer Jahrzehnte, erreicht aber... 1926, also vor 99 Jahren !

The Infradyne

A New and Efficient Ten-Tube Circuit Employing Three Stages of Intermediate Frequency Amplification at 3200 Kilocycles

By E. M. Sargent

LIST OF PARTS USED BY WRITER

1 Remler Infradyne Amplifier.
1 Continental triple vernier condenser.
1 Remler .00035 condenser.
1 Tapped inductance (see text for constructional details).
1 Gen. Radio No. 301 30 ohm rheostat.
1 Set No. 33 Thorola Doughnuts.
2 National Type B CCW Dials.
7 Benjamin UX Sockets.
1 112 Amperite.
2 1-A Amperites.
1 6V-199 Amperite.
1 30 ohm U. S. L. Rheostat.
1 10 ohm U. S. L. Rheostat.
1 Centralab 50,000 ohm Radiohm.
3 2-in. rheostat dials.
1 Yaxley Filament switch.
1 single closed Electrad jack.
1 single open jack.
1 Jewell No. 135 0-5 D. C. voltmeter.
1 Electrad grid leak mounting.
1 Electrad fixed Condenser mounting.
1 1-megohm Electrad Fused Metallic Leak or Arthur H. Lynch fixed Resistor.
1 2-megohm Electrad Fused Metallic Leak or Arthur H. Lynch fixed Resistor.
1 Electrad .0001 mfd. condenser.
2 Electrad 1 mfd. condensers.
2 Sangamo .0005 condensers, 1 with clips.
1 Electrad .00025 condenser.
9 Eby Binding posts.
1 Formica Walnut panel 3/16x7x30.
1 Redwood baseboard ½x10x34.
2 Amertran De Luxe Transformers.

WHEN an incoming radio frequency current is mixed in a circuit with a locally generated oscillating current two new frequencies are generated. One, the beat or *difference* frequency, is used in the superheterodyne. The other, the *sum* frequency, is employed in the infradyne so as to get greater distance, better selectivity, and quieter amplification than the writer has secured with any other circuit during his fifteen years' experience in radio construction.

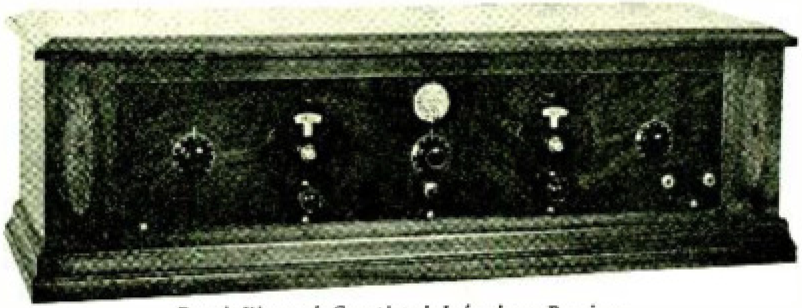
The use of the *sum* frequency has been neglected because of the general belief that this extremely high frequency of 3,200,000 cycles cannot be efficiently amplified. But after building and discarding nearly five hundred models Mr. L. C. Rayment and the writer finally found the means whereby practically the same degree of amplification can be produced at any frequency. The same principles as are used in the infradyne amplifier will eventually be applied to 80, 40, 20 and 5 meter reception.

A receiving set using this *sum* frequency amplifier has the advantages of eliminating arc "mush" or harmonics of double or treble a station's wavelength and in using but one oscillator setting for each station. As the intermediate amplifier is sharply peaked at one wavelength and is very inefficient at any other, noises from the radio frequency tubes are not amplified. Since iron core transformers are not needed to secure r.f. amplification the cost of construction is reduced and any "freaks" due to the peculiarities of the iron are eliminated. Finally the intermediate frequency employed may be used universally, being independent of the overlapping frequencies of local stations.

The infradyne set uses ten tubes, an oscillator, two stages of r.f. amplification, first detector or mixer, three stages of 95 meter amplification, second detector or de-modulator, and two stages of audio frequency amplification. It has two tuning controls, one dial operating a triple condenser to tune the two r.f. stages and another the oscillator tuning condenser. Since the *sum* frequency is used the capacity of one condenser increases while that of the other decreases, thus requiring condensers that turn in opposite directions so that the dials may read in the same direction.

Except for the infradyne amplifier, whose connections and constructional details are given at the close of this article, the circuit arrangement is simple, as shown in Fig. 1. But in order to insure a duplication of the good results secured by the writer it is essential to follow the placement of parts indicated in the baseboard layout of Fig. 2 and the panel layout of Fig. 3.

The importance of following exactly the layout cannot be over-emphasized. A common failing among both amateur and professional set builders is to pay too much attention to wiring diagrams and too little to the layout of the ap-



Panel View of Completed Infradyne Receiver.

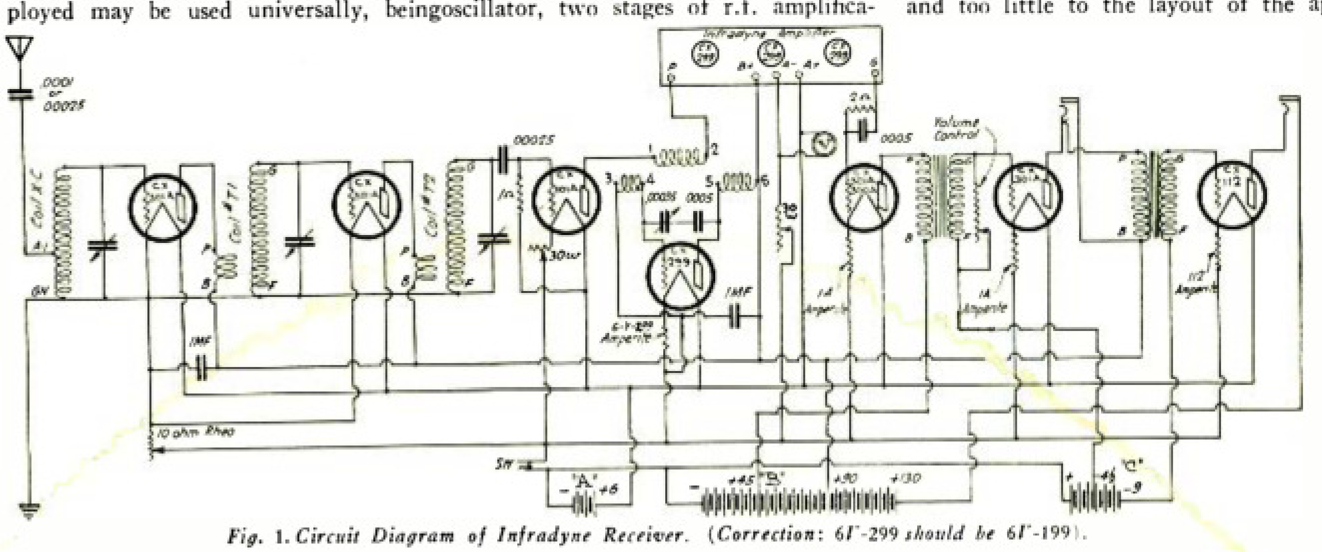


Fig. 1. Circuit Diagram of Infradyne Receiver. (Correction: 6V-299 should be 6V-199).

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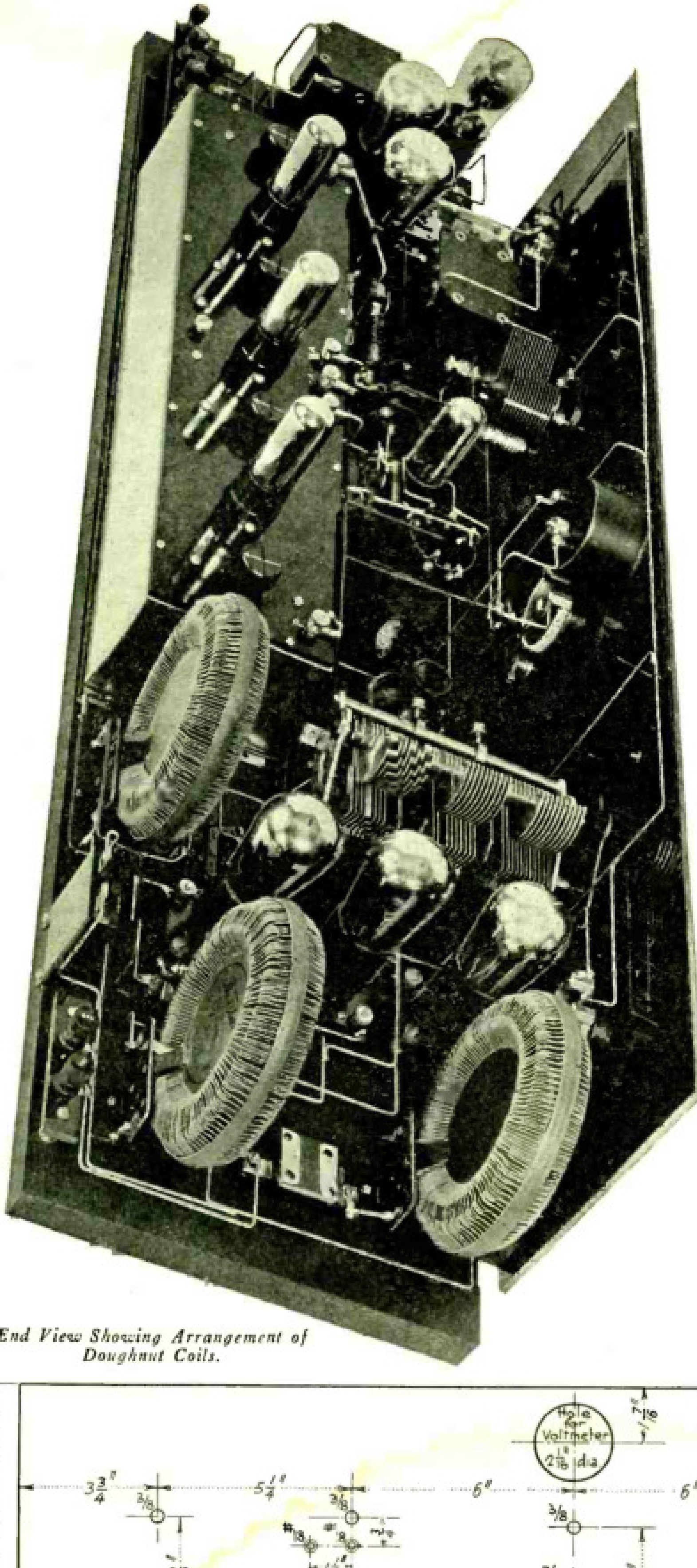

End View Showing Arrangement of Doughnut Coils.

paratus. A wiring diagram would be sufficient if the radio currents really travelled only in the paths in which we are accustomed to think of them as travelling, but we all know that they take short cuts via stray inductive and capacitive fields. The writer has made a detailed study of these fields insofar as they affect the set here described, and the layout is the result of this study. It would not be an exaggeration to say that with the same parts and hookup, but with a different arrangement, it would be a different set entirely and might exhibit several annoying freaks. This is true not only of the infradyne but of the super-heterodyne, the neutrodyne, or any other multi-tube set.

Another thing; do not try to put the infradyne in your phonograph or in a suitcase. Borrow a leaf from the book of Zenith, Kellogg, Stromberg-Carlson or any of the others who have found that a multi-tube radio set has to contain a certain number of cubic inches of space in order to give good results. Make your infradyne large enough to give it a chance to produce the results of which it is capable.

The two National dials included in the list of parts are specified because of instructions given later for setting this dial in relation to the condenser position. Any other dial that reads in the same direction can be used if the panel drilling is changed to suit. The Thorola toroid coils have been used throughout all our experiments and seem to line up perfectly with the Continental condenser. No doubt there are other toroids that will also work, but not having tested any others the writer is not in a position to name any alternates. It is important that toroid type coils be used, however, as neutrodyne type coils will not give the same selectivity.

The tapped inductance can be very easily constructed by the builder. It consists of three coils wound on a piece of bakelite tubing 1½ in. in diameter and 2 in. long, as shown in Fig. 4. These coils are of 14, 14, and 8 turns respectively and are all wound with the same direction with No. 24 d.s.c. wire. There should be a space of 1/16 in. between the two 14 turn coils and of 3/16 in. between the 14 and 8 turn coil. Commencing with the 8 turn coil the terminals should be num-

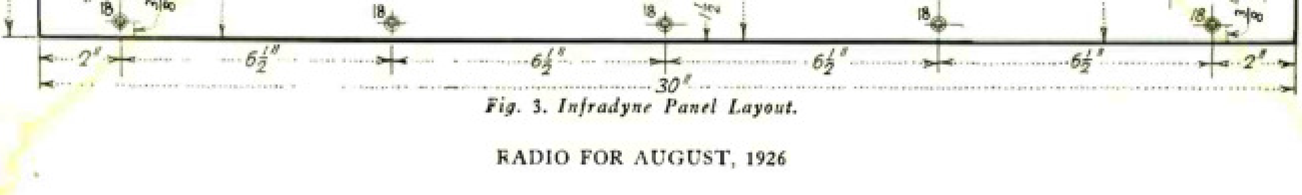

Fig. 3. Infradyne Panel Layout.

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bered from 1 to 6 as shown in the sketch of Fig. 4, *1* being the outside and *2* the inside terminal of the 8 turn coil, *3* the terminal of the 14 turn coil nearest the 8 turn coil and *4* the other end of this 14 turn coil, *5* the inside terminal of the second 14 turn coil and *6* the outside terminal of this coil.

These numbers correspond to those used in the wiring diagram. To insure operation of the set these directions for coil winding should be followed exactly,

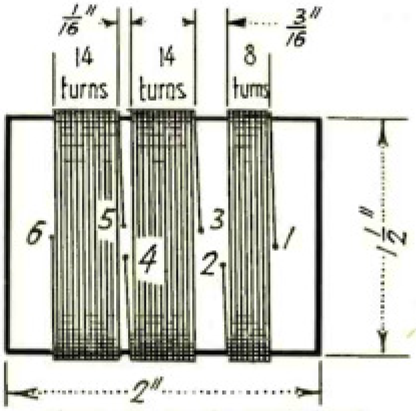


Fig. 4. Constructional Details of Tapped Inductance.

particularly as regards their all being wound in the same direction. This tapped inductance should be mounted in the position of the oscillator coupler as shown in the baseboard layout, Fig. 2.

Although the drawings are in the main self-explanatory, there are several minor details in regard to building up the set which should be mentioned. No shielding is desirable or necessary. The arrangement of the parts and wiring is such that there is no tendency toward body capacity.

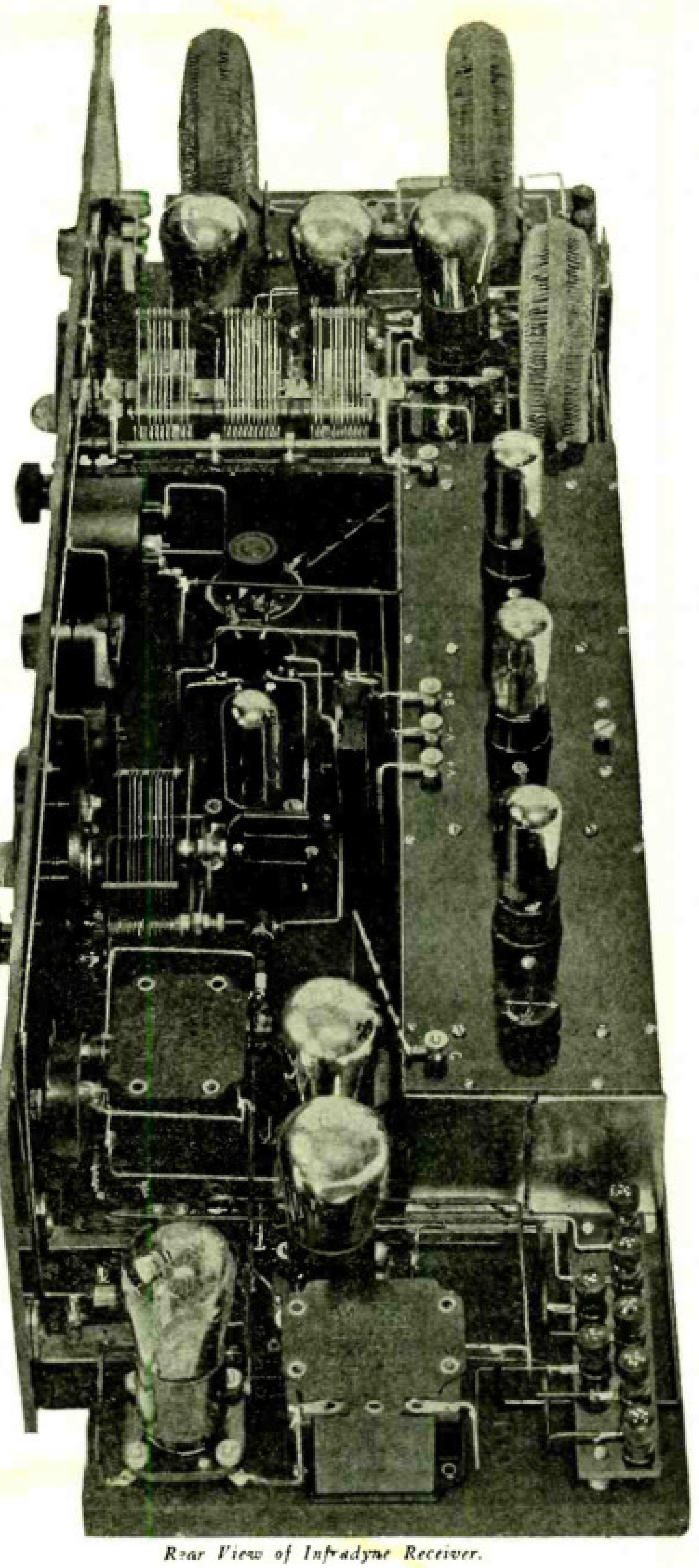
Do not use rosin core solder if you wish to avoid the possibility of making any "rosin joints." Run the plate lead of the first detector and the grid lead of the second detector as directly as possible. On the binding post strip there are no posts for *+C* or *—B*. These were left off to make more room for the others and to make possible the use of a Jones battery cable and plug instead of binding posts if desired. The *+C*, *—B*, and *—A* should all be connected to the *—A* post.

The bypass has purposely been left off the primary of the first audio transformer as the set operates a little smoother without it. If one is used it should not exceed .0001 mfd.

Operating Directions

AFTER the circuit has been checked over carefully, insert the tubes in their proper sockets and connect up the *A* battery. Turn on the filament switch and advance all rheostats enough to see that the tubes light. Examine the Amperites to see that they are all in their right places and that none are burned out. Everything being in good order so far, leave the set turned on and the *—A* connected, disconnect the *+A* wire and touch it in turn to the 45, 90, and 135 volt posts, meanwhile carefully watching to see whether any tubes light. This is a test to see whether any *A* and *B* wires have been unintentionally crossed.

Next, turn both the three-gang condenser and the oscillator condenser so that the plates are fully meshed. Set the triple condenser dial at 100, and the oscillator dial at 12°. Then turn both to about 60. Turn the four vernier knobs on the infradyne amplifier to the marks where they were "lined up" at the factory. Turn the adjusting screw on the amplifier so that it is almost all the way out.



Rear View of Infradyne Receiver.

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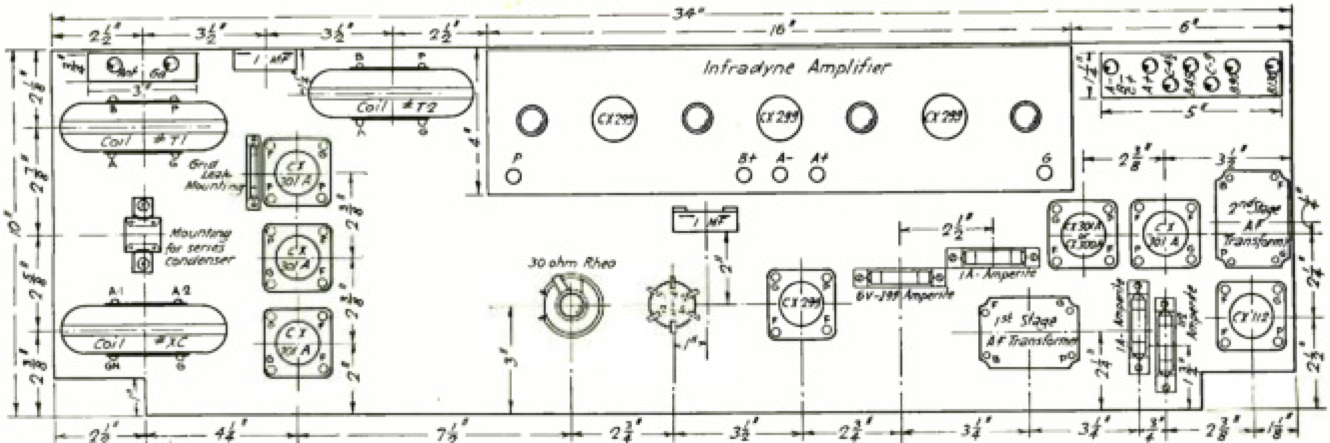


Fig. 2. Baseboard Layout for Infradyne.

The set is now ready to operate. Connect the antenna, about 50 ft. long, and a good ground and hook up the batteries. Turn the first detector rheostat (on baseboard) all the way on, turn rheostat on first two tubes (left hand one on panel) to about 30, turn intermediate tubes up to 3 volts, and leave the volume control at 0. Plug the loudspeaker in the second stage. The set is now tuned to about 315 meters and if there are any local stations near that wavelength they can easily be found by moving the dials slightly. Tune the set exactly like a super-heterodyne, that is, "cross" the dials continually using both hands to tune with. The dials will run almost together over the full scale. The rheostat on the first two tubes is best operated rather low and is used as a regenerative control, care being taken not to throw the tubes into oscillation.

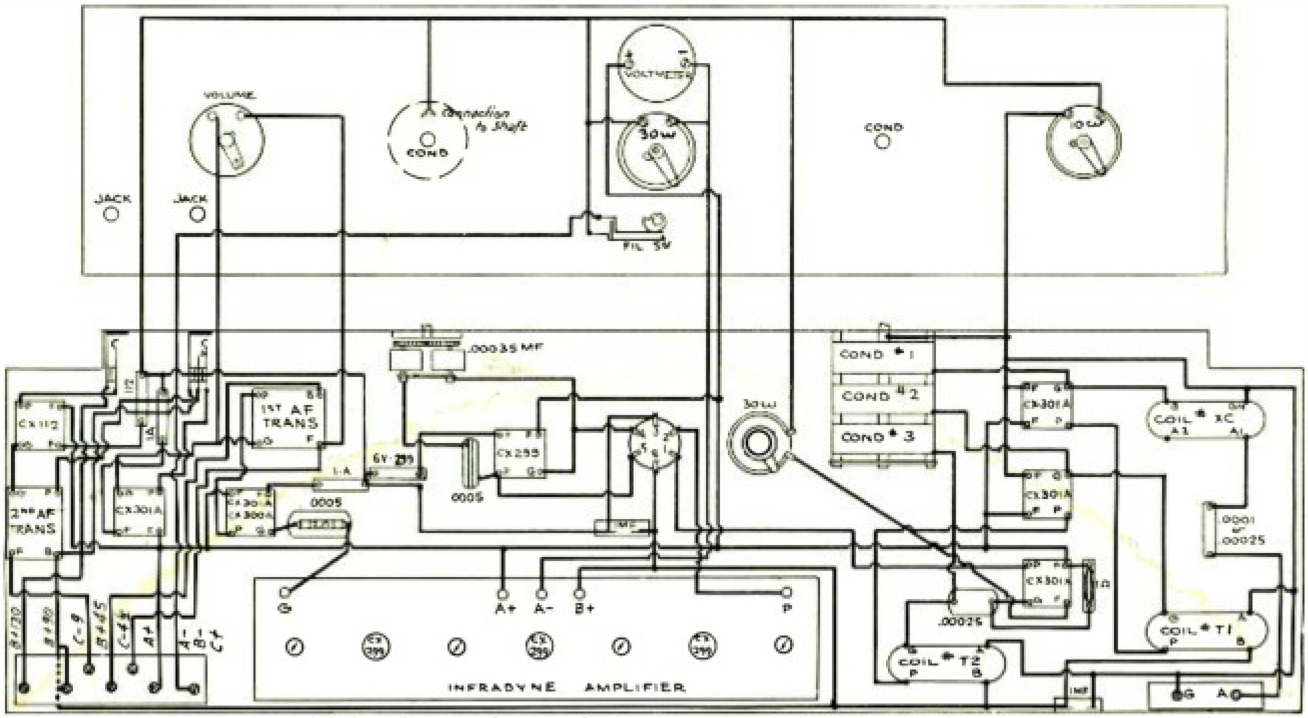
With the set adjusted as above, tune in and log a few locals, then try to find some station about 150 miles away, the idea being to get some moderately weak station for a test signal on which to further line up the set. When such a station has been found, set the two main tuning dials and leave them, and try a slight readjustment on the vernier knobs on the amplifier unit. The first three will probably be best at their original settings but the right hand one may differ some on account of different detector wiring. After the best setting on the verniers has been found, tighten up the adjusting screw on the amplifier with a screwdriver. Do this slowly, as this is the adjustment (with the filaments at 3 volts) that brings the amplifier up to the peak. Tighten this screw until the amplifier breaks into oscillation, then back it away again until the oscillation stops, and leave it there. That finishes the adjustment of the intermediate amplifier, and once adjusted it should not be disturbed again.

The rheostat on the baseboard should now be slowly backed down, the signal strength being carefully noted during the operation. As the rheostat is turned down the signal will decrease until a point is reached where it will rapidly increase again. Passing this point will sometimes throw the tube into oscillation, but will usually only result in another decrease in strength. The rheostat should be left in a non-critical adjustment near this amplification peak. If the peak cannot be found, turn the rheostat all the way on and leave it there.

Next is the lining up of the "front end." This is very important, and upon the care with which it is done will greatly depend the selectivity of the set. To start with, adjust both sliding vernier plates on the triple condenser so that they are in the half way position. Then turn up the panel rheostat to get good volume and tune in some moderately loud station, preferably not a local, and at about 60 or 70 degrees on the dials. Set the oscillator dial right on the station and leave it there.

Swing the triple condenser slowly

(*Continued on Page 46*)



Pictorial Diagram of Connections. (*Correction: 6V-299 should be 6V-199*).

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THE INFRADYNE

(*Continued from Page* 14)

across the station's setting three or four times, going five or ten degrees to each side of the center. Notice whether the station comes in sharply at one point and goes out completely on both sides, or whether it tends to come in at two points about 4 or 5 degrees apart. If the former, the front end is lined up and the vernier plates should be left as they are. If the latter, adjust the condenser to half way between the two points, and then try to tune in the station by sliding the vernier plates to new positions without turning the condenser. As the lining up becomes more perfect, the first two tubes may go into oscillation, in which case the rheostat should be retarded a little. One or two adjustments of this kind will line it up, and if the operation is performed at or near 60 degrees it will hold good for the entire swing of the condenser.

The choice of an antenna will be dictated entirely by surrounding conditions. The writer recommends 50 ft. until the operator gets accustomed to the "feel" of the set. Then put a .0001 mfd. condenser in series to prevent powerful locals from riding through on the carriers of other stations near the same wavelength. When the set is correctly operated an antenna of the picture molding variety provides plenty of pickup and will bring in coast to coast stations when conditions are at all favorable.

can be eliminated on 350 and 375 meters respectively, leaving CZE, Mexico City, and KTHS, Hot Springs, Ark. in the clear. KPO, 428 meters, 1000 watts, does not interfere with CFCN, Calgary, 435 meters, or WLW, 422 meters, on a good night.

Because of the selectivity and sensitivity of the set, distance follows as a matter of course. CNRM, Montreal, WMBF, Miami Beach, WGY, WJZ, KDKA, WSB, and PWX as well as 14 Chicago stations and 33 other "W" stations appear on our log sheet for the past few months.

For the benefit of those interested in the circuit of the infradyne amplifier unit, the circuit used is given in Fig. 5 and the coil and condenser data are given below. This is given as a matter of information only. It is impossible to give construction details because of the fact that a difference in placement of the fixed condensers of 1/4 in. or a difference of 1/32 in. in primary to secondary coupling between the coils may make the difference between a unit that will amplify and one that won't. The infradyne amplifier is a most outstanding example of the part played in a radio circuit by the relative positions of the different pieces of apparatus. If exactly the same hookup, capacities, and coils are used and the arrangement kept almost the same, but the connecting wires run differently, the unit will have en-

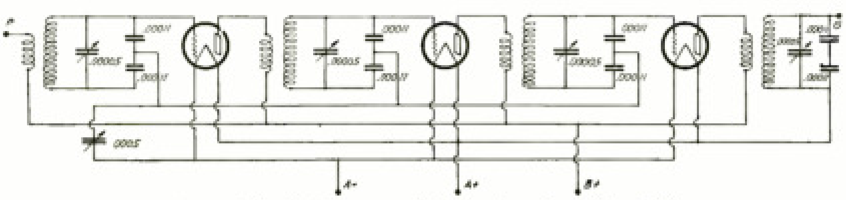


Fig. 5. Circuit Diagram of Infradyne Amplifier Unit.

Perhaps the best way to predict the results that may reasonably be expected will be to give specific instances regarding what has already been done. At Oakland, California, ten blocks from KTAB 240 meters, 1000 watts, KFSD in San Diego, 246 meters can be brought through on any night, using a 25 ft. antenna. KGO, 361 meters, 3000 watts,

tirely different characteristics. Such is radio at 90 meters. The 90 meter transformers are wound as follows: Secondaries on 1⅛ in. low-loss ribbed form, 35 turns No. 28 d.s.c. wire except coil next to second detector which has 28 turns. Primaries are wound inside secondaries, and consist of 20 turns of No. 28 d.s.c. wire.

VACUUM TUBE FREQUENCY METER

(*Continued from Page* 38)

ments are in series, being supplied from a 5 dry cell battery bank of 7½ volts.

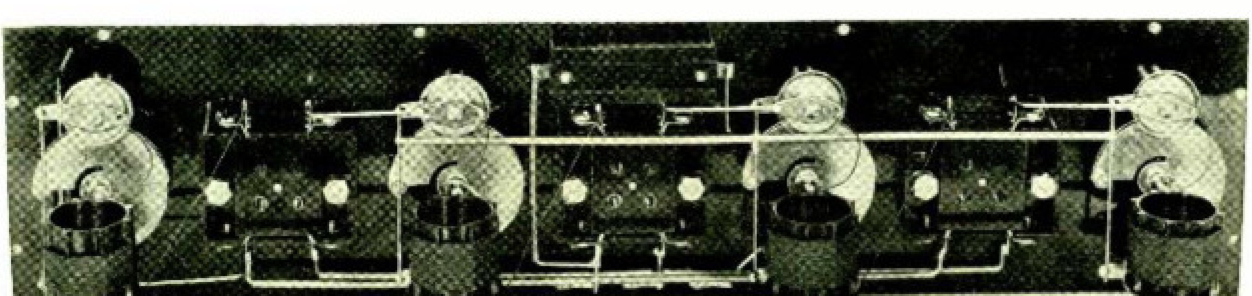
With only one tube, when a.c. is applied to the grid of the rectifier tube, current will flow in the plate circuit, and through the 0.1 megohm resistance to the filament. Another vacuum tube connected to the output of the rectifier tube can be made to amplify the output of the rectifier tube, but in the reverse direction, as will be explained.

In the plate circuit of the amplifier tube is connected a 45 volt *B* battery and a 1½ scale milliammeter. As the drop across the 200 ohm potentiometer is normally 6 volts, when 99 tubes are used, varying the slider of the potentiometer will vary the grid voltage of the amplifier tube from positive to 3 volts negative, according to the position of the slider. With 3 volts negative the plate current will be .5 milliampere, and when near the positive end of the filament it will rise above 1.5 milliamperes. Hence, if the slider is so adjusted that the plate current in the amplifier tube is 1.5 milliamperes, and plate current from the rectifier tube is made to flow through the .1 megohm resistance, the grid of the amplifier will be made more negative with respect to its filament by reason of the voltage drop through the .1 meg. resistance, and the plate current in the amplifier will fall.

The amount by which the plate current drops, in milliamperes, will be governed by the product of the amplification constant of the tube times the voltage drop across the.1 megohm resistance, so that the larger the plate current in the rectifier tube, the lower the plate current in the amplifier tube, and a point can be reached where the amplifier plate current is zero. Hence, with a 99 tube having a *mu* of 6, a rectifier plate current of only .1 milliampere will cause a change of .5 milliampere or more in the amplifier plate circuit, which means that the frequency meter to which the rectifier-amplifier is connected may be moved away from the transmitting set a considerable distance more than that possible with the rectifier alone.

The sensitivity of the outfit can be appreciated from the fact that in the writer's transmitting equipment installation this meter is mounted 20 ft. from the transmitter, on the table with the receiver, and gives almost a 1 milliampere downward deflection when the key of the transmitter is closed.

It should be borne in mind that the resonance indication is always downward. The slider of the 200 ohm potentiometer is first adjusted so that the plate current in the amplifier circuit is 1.5 milliamperes, with no signal being received in the frequency meter circuit. When a signal is received, the needle of the milliammeter will deflect downward, and cannot go below the zero setting, which is an excellent safeguard for the meter, preventing any possible burnout except a dead short between the plate and filament of the amplifier tube.



Infradyne Amplifier Unit.

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More About the Infradyne

Reasons for Selection of Intermediate Frequency, Necessary Precautions in Construction of Amplifier and Suggestions for Antenna Size

By E. M. Sargent

IN designing the infradyne, as described in August RADIO, a great many problems were encountered for which we had no precedent to help in determining the solution, one of the first being the selection of the best frequency on which to operate the intermediate amplifier. Theoretically, any frequency that is higher than the highest to be received can be used. The infradyne is designed to receive wavelengths from 200 to 550 meters, (frequencies 1500 to 545 kilocycles) and therefore any frequency above 1500 kc could be used were it not for other practical limitations.

Suppose a frequency of 1600 kc were selected. To receive a 200 meter signal (1500 kc) the oscillator would have to be adjusted to 100 kc, while to receive a 550 meter signal (545 kc), the oscillator would have to be set at 1055 kc. Thus the oscillator would not only travel through the broadcast wave band, but would have to cover a wave band of 280 to 3000 meters. It is not practicable to handle so large a wave band with an oscillating tube controlled by a single variable condenser.

In some earlier experiments, we used an intermediate frequency of 2000 kc (150 meters). This made it necessary for the oscillator to run from 200 to 600 meters, and we found that in the vicinity of 300 meters the oscillator was set on nearly the same wavelength as the incoming signal, and that the two actually crossed at exactly 300 meters. The result was that near this wavelength the oscillator fed so much energy directly into the antenna system that the radio frequency amplifier tubes were partially paralyzed and the set had a dead spot between 285 and 320 meters. The most perfect shielding of the oscillator would be necessary to overcome this trouble, and even then it is doubtful if a station exactly on 300 meters could be received.

To eliminate this type of trouble the intermediate wavelength had to be dropped to less than one-half of the lowest wavelength that was to be received. In this case it meant going well below 100 meters. As it is increasingly more difficult to amplify as the wavelength is shortened, the intermediate wave should not be dropped any further below 100 meters than is necessary. A wavelength of 95 meters was first adopted, and later this was changed to 86 meters. This is the wavelength which we are now using.

With the amplifier set at 86 meters, the oscillator has only to run from 100 to 151 meters. The advantages of confining it to this waveband are numerous. For one thing it will never radiate from the antenna so as to bother the neighbors, because it is far de-tuned from the antenna system and is not on a wavelength that anyone is normally trying to receive. Also, it is not constantly set at only 30 or 45 kilocycles from the incoming signal, as is the case with a superheterodyne, and thus it does not "wave trap" out the weak signals before they reach the first detector. In a 45,000 cycle superheterodyne half of the energy from a weak signal can be lost through the "wave trapping" effect of the oscillator, and in a 30,000 cycle super it is even worse. In the infradyne the oscillator wavelength is so far removed from that of the incoming signal that the wave trap effect is nil, and the net result is that weak signals have a better chance to be amplified and heard. Another advantage of confining the oscillator to this waveband is that strong local broadcasters will not modulate it and cause freak dial settings for strong stations.

It was stated in the previous article that the infradyne had only one setting of the dials per station. This is strictly true only when the dials are rotated together in the right direction. If both dials are set at 200 meters, and are turned together over the waveband up to 550 meters, no station will be encountered more than once. However, if the antenna tuning condenser is adjusted to a powerful local station and the oscillator dial turned alone throughout the scale, other freak settings can be found. These are all weaker than the sum frequency (infradyne) setting, but sometimes they are encountered when the set is first put into operation before the operator has had time to familiarize himself with it, and in that case they might cause a little confusion. That is the reason they are mentioned here. If the instructions given in August RADIO for putting the set into operation are carefully followed, these settings will not be encountered.

The writer has said a great deal from time to time about the arrangement of parts on a baseboard and the important role that it plays in the operation of any radio set employing radio frequency amplification. Fig 1 has been drawn with a view to explaining this more in detail.

A casual glance at the diagram will convince anyone that the circuit is anything but selective,—yet if the true circuits of a great many sets were drawn out they would look a good deal like this. A_1 is the intended antenna and is the pickup through which distant or weak signals enter the receiver. Powerful local signals enter the set through this antenna, and also through A_2, A_3, A_4, A_5, and A_6. These are shown as antennas on the diagram but in reality are merely long grid and plate leads which look innocent enough if you do not know too much about them. Distant signals, of course, are also picked up by these leads but not with sufficient strength to operate the tubes and be amplified.

Hence all distant signals enter through the real antenna and are amplified through the most selective path between the antenna and the detector tube, and as a result the selectivity of the set on distant signals will be "knife-edged." For a powerful local station, the net result of the several other pick-ups is to cause broad tuning over a band two or three times as wide as it should rightfully cover. There is only one cure for the evil,—eliminate these small energy collectors. This can best be done by so arranging the apparatus so that the grid and plate leads are as short as possible and run directly to their destinations, not around fancy square corners.

(*Continued on Page* 42)

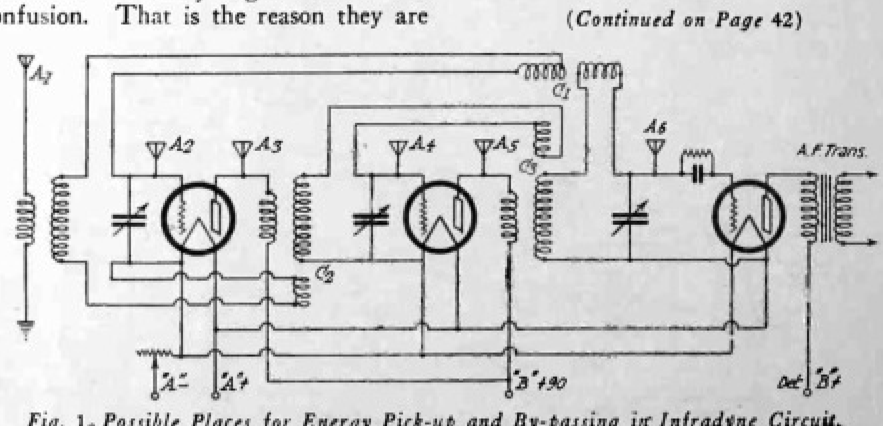

Fig. 1. Possible Places for Energy Pick-up and By-passing in Infradyne Circuit.

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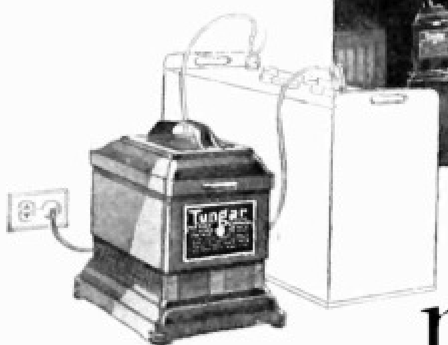

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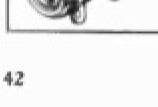

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MORE ABOUT THE INFRADYNE

(*Continued from Page 18*)

Even the energy that enters the antenna does not necessarily travel to the detector in its appointed path. Some of it is bypassed around both radio frequency tubes and fed right into the detector through inductive coupling between the first and third coils. This is represented by C_1 in Fig 1; C_2 and C_3 are other places where this coupling is likely to occur. The more compact a set is made, the greater the part played by these undesired inductive bypasses. Putting the coils at an angle or using toroids tends to cut down this effect but does not eliminate it. About the only practical solution is plenty of space between coils. In the infradyne the spacing and wiring are such that these undesirable features have been minimized.

The selectivity of the infradyne depends upon the size of the antenna used, the proper size to use being determined only after a study of local conditions. If a number of different sizes are tried, be sure and line up the three gang condenser for each one. The selection of the proper antenna brings up the old question of selectivity vs. sensitivity, and a suitable compromise must be made. Perhaps an illustration will help to make clear why the maximum selectivity and maximum sensitivity of any set cannot be had at the same time.

Suppose a man in Chicago about 5 miles from WEBH, 370 meters wants to receive WTAM in Cleveland, 389 meters. He starts out with a single circuit regenerative receiver and a 50 ft. antenna and finds that WEBH is "all over" the dial, covering from 285 to 500 meters and he cannot hear WTAM. He reduces the length of his antenna to 20 ft. and finds that WEBH now covers from 320 to 420 meters but is weaker and WTAM still cannot be found. The next step is to add a stage of tuned radio frequency amplification ahead of the regenerative receiver. With this in place and with the 50 ft. antenna, WEBH still covers from 285 to 500 meters but is nearly three times as strong as formerly. Cutting the antenna to 20 ft. reduces the interference band to 330 to 400 meters but WEBH is now as strong at resonance with a 20 ft. antenna and two tubes as formerly with a 50 ft. antenna and one tube. With the same signal strength on WEBH therefore the selectivity of the set has been doubled, but the selectivity has not been doubled with the original pickup which represents the maximum sensitivity. By oscillating the detector tube a carrier wave from WTAM can now be picked up, although nothing can be distinguished through the interference from WEBH. More stages of radio frequency are now added to amplify WTAM. WEBH again becomes too strong for the set, and a further

(*Continued on Page 44*)

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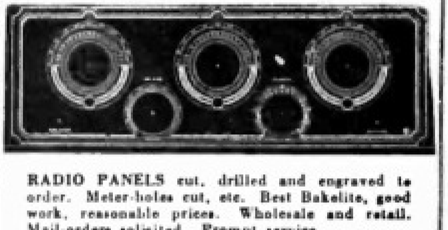

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AN ACCURATE DIRECTION FINDER

(*Continued from Page* 20)

loud, and when rotated 180 degrees the signal decreases greatly in intensity. While in this position carefully readjust uni-directional balance and the signal should be made to disappear entirely or nearly so.

Let us assume that the transmitter actually is known to lie in the direction indicated by our first bearing, viz:—90 degrees, and further that when the loop is rotated for uni-directional bearing one side of the loop will show a maximum signal when toward the station and the other side will give minimum signal when rotated so that it is toward the station. Having determined which side of the loop gives a minimum signal when toward the station, the direction of which is known, place a designating mark upon that side of the loop or upon the stem, as thereafter all uni-directional bearings will be determined by this means. This designating mark will correspond to the pointer in the photograph shown to the right of the azimuth circle.

Briefly then, the procedure is to tune in a signal for maximum, with switch in directional position. Tuning adjustments should be carefully made. Rotate the loop then and locate the "bearing" which at this juncture need not be accurately determined. Throwing the switch for uni-directional rotate loop approximately 90 degrees, so that its plane is in the line of bearing and adjust carefully for zero signal. If minimum cannot be achieved with loop in first setting rotate 180 degrees, and adjust. When minimum is achieved, an imaginary line drawn from the center of the loop through the side giving minimum signal will determine the direction of the transmitter. That narrows the actual bearing of the station to within very narrow limits. Throwing switch to first position, carefully adjust direction balance as loop is slowly swung, until a sharp minimum is obtained, and read the bearing from the dumb compass.

A reliable scale map of the city or locality upon which the bearings may be plotted as taken, completes the equipment.

MORE ABOUT THE INFRADYNE

(*Continued from Page* 44)

with the amplifier *B* battery lead that goes to the post marked *B*. The effect will be magical, as the volume will be increased threefold and the selectivity will be much greater. The choke coil does not have to be mounted on anything—simply suspend it in the air. If it has too many turns the oscillation will be uncontrollable, and turns must be stripped off until the right balance is found.

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MORE ABOUT THE INFRADYNE

(*Continued from Page 42*)

shortening of the antenna is necessary. Finally a point is reached where the proper balance between pickup and amplification and selectivity is effected and WTAM comes through without interference. Obviously the range of this receiver could be greatly increased if it could be connected up to the 50 ft. antenna but this could be done only at the sacrifice of some of the selectivity.

These rules also apply to a superheterodyne and govern the size of loop to be used. With the infradyne they determine the size of the antenna. A single circuit receiver on a 400 ft. antenna will receive the same distance that a super or an infradyne will, but it has no selectivity. To get both the distance and selectivity which we have learned to regard as necessary eight or ten tubes are essential, and a smaller number of tubes means less of each of these valuable qualities.

The recent development of power tubes and power amplifying transformers, while doing wonders for tone quality and volume, has also increased the microphonic tendencies of receiving sets, particularly when used with cone speakers. These "microphonics," which result in a continuous howling of the speaker, are built up by tremendous amount of audio amplification used. They are particularly noticeable when the UX-112 or UX-171 type power tubes are used because these tubes give a great deal more amplification than the older ones. Using spring sockets and putting pieces of sponge rubber under the corners of the cabinet will help some to eliminate microphonics, but sometimes the trouble is caused by a direct feedback through the air from the diaphram of the cone speaker to the glass shells of the tubes. Closing the cover on the radio cabinet will sometimes stop this, otherwise a 20 ft. extension loud speaker lead is recommended. Do not, under any conditions set the speaker on top of the radio cabinet if these microphonics are troublesome.

In the infradyne article in August RADIO the writer should have laid more stress on "lining up" the 2 stages of radio frequency controlled by the triple condenser. Although this triple condenser is equipped with sliding vernier plates, the capacities introduced by circuit wiring and antenna capacities are sometimes so large that these circuits are thrown too far out of resonance for the verniers to bring them back. When this happens, the set will not come up to oscillation above 400 meters, and the tuning on all wavelengths will be "broad."

This trouble may be remedied as follows: Slide the vernier plates as far as they will go towards one end of the condenser and notice where they hit the projecting brass supports of the stators. Then remove the two vernier plates from the condenser and cut away this interfering part with a pair of tin shears. The vernier plates can then be slid right up against the stator, and their balancing ability will be increased many times over. Be careful that the verniers do not come in actual contact with the stator plates, because if this should happen the incoming signal would be grounded and the set would be dead. If there is danger of such a short circuit, glue a thin piece of paper on one side of either plate so as to provide an insulating layer. This will not in any way impair the efficiency of the condenser.

The screw marked *increase* on the infradyne intermediate amplifier should bring the signals up to a peak and throw the amplifier into o s c i l l a t i o n when screwed down. If it does not do so, a small choke coil inserted in the *B* battery lead of the intermediate amplifier will rectify the trouble. This choke coil is very small, consisting of 8 or 10 turns of silk or cotton covered wire No. 20, 22, or 24 wound around the finger. Bunch the turns and tie them in two or three places with string so they won't spring apart. Solder this choke right in series

(*Continued on Page 46*)

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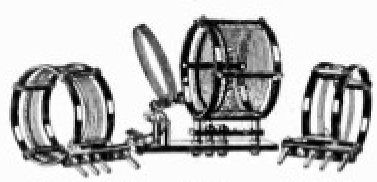

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Converting A Five-Tube Set to An Infradyne

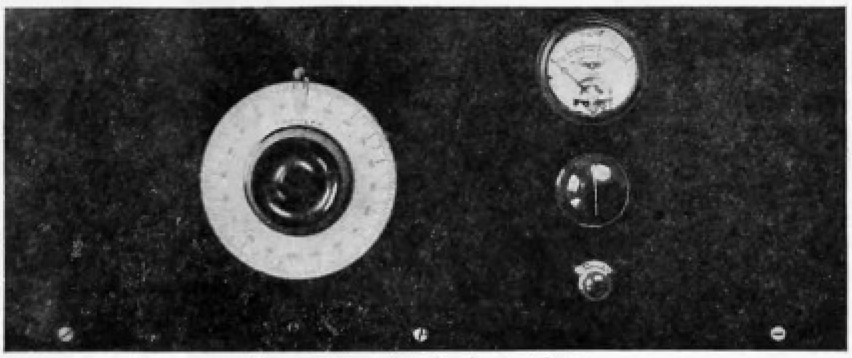
A Description of An Infradyne Adapter Applicable to Any Tuned R. F. Set. Also Some Suggestions for Selectivity.

By E. M. Sargent.

THOSE who have followed the series of articles on the infradyne circuit which have been appearing in these columns since August, 1926, have recognized the fact that a complete infradyne set consists of a five-tube tuned radio frequency set *plus* an oscillator-mixer and a three tube infradyne amplifier unit. In operation, the received signal is first amplified at radio frequency in the first two stages, then changed to a low wavelength of about 90 meters by the oscillator-mixer, then amplified to a still greater degree by the three stages in the infradyne amplifier, then detected or de-modulated by the detector tube, and finally amplified by two audio frequency transformers and tubes. In effect, an oscillator-mixer and infradyne amplifier have been merely added to a five-tube set.

That this addition can be easily made to almost any tuned r.f. set, including the neutrodyne, has been conclusively demonstrated during our laboratory tests. Consequently we have designed an infradyne adapter which will transform an existing five tube set into a complete ten tube infradyne set. This change can be readily made in a few minutes by simply adding the oscillator, infradyne unit and second detector whose constructional details were given in August RADIO.

As may be seen from the adapter circuit diagram in Fig. 1, the output from the plate of the original detector tube, now used as a mixer to give the *sum* frequency, is connected to the infradyne adapter. Then the output of the infradyne adapter is connected to the input of the first a.f. transformer. This, with the necessary battery connections, completes the job. The only changes made



Panel View of Infradyne Adapter.

in the original set is to disconnect the wire joining the plate terminal of the detector socket to the *P* terminal of the first audio frequency transformer, to remove the audio by-pass condenser in the tuned radio frequency set (if there is one), and to add a 30-ohm control rheostat for the first detector tube (if not already installed).

To add the infradyne adapter, connect its input terminal (point *1* of the tapped inductance) to the plate terminal of the detector socket and its output (the plate of the 2nd detector) to the *P* terminal of the first a.f. transformer. Then make the battery connections as indicated in Fig. 1, first disconnecting the *A* battery from the set.

The complete unit to be added can be mounted on a panel and baseboard, as

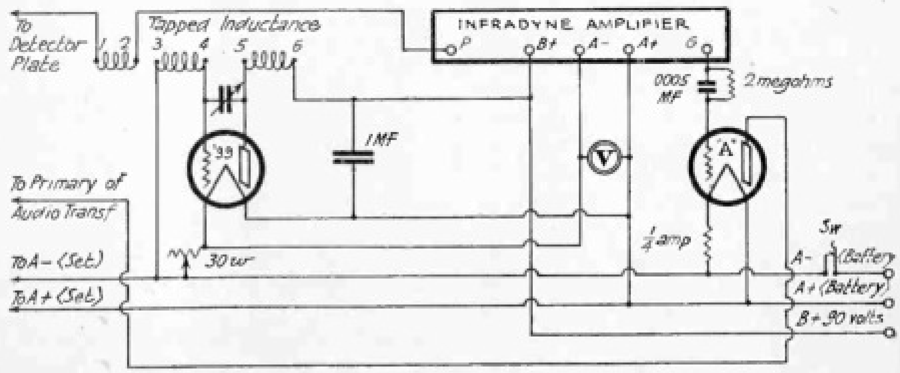


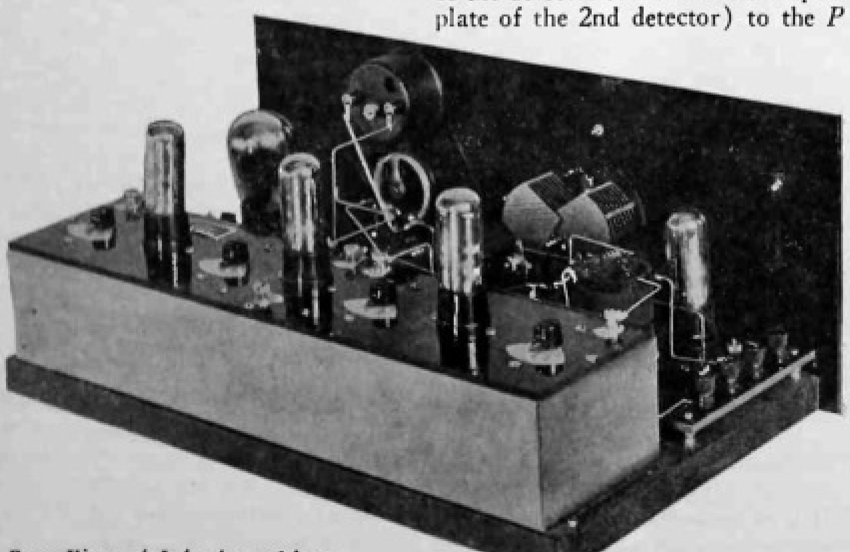
Fig. 1. Circuit Diagram for Infradyne Adapter.

shown in the pictures, and installed in a separate cabinet which may be placed near the main set so that the additional dial control of the oscillator can be conveniently operated.

The panel is 7x18x3/16 in. and the baseboard 9x17x3/4 in. The parts used in the pictured unit are 1 Remler No. 700 infradyne amplifier, 1 Remler .0001 mfd. variable condenser, 1 Sangamo .0005 mfd. fixed condenser and 2 meg. leak, 1 bypass condenser (1mfd.), 2 CX type tube sockets, 1 d. c. voltmeter (0-5 volts), 1 rheostat (30 ohms, Frost), 1 ballast resistance (¼ amp.), 1 filament switch, 7 binding posts, and 1 tapped inductance.

The tapped inductance consists of three coils, one 10 turn and two 30 turns of No. 24 d.s.c. wire, all wound in the same direction on a 1⅝ in. diameter formica tube 3 in. long, as shown in Fig. 2. The space between turns is ⅛ in.

All connections should be soldered. If solid solder is used, a non-acid soldering paste is the best flux, using the paste



Rear View of Infradyne Adapter.

very sparingly, especially in the vicinity of the tapped inductance. If rosin core solder is used no other flux is necessary. But take care to "sweat" the joint with the hot iron until the solder runs into place, giving the wire a tug to be sure that the solder and not the rosin is holding the wires together. As rosin is a non-conductor and does not ruin insulation rosin-core solder is particularly good if properly used.

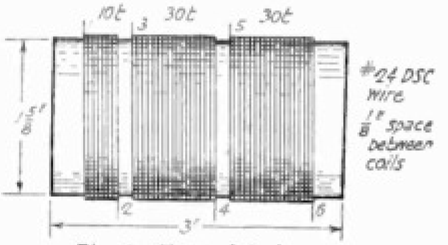


Fig. 2. Tapped Inductance.

Operation

USE "A" tubes in the first four sockets of the tuned radio frequency set and either an "A" tube or a power tube in the last audio stage. In the adapter, use three 99's in the infradyne amplifier, a 99 in the oscillator and an "A" tube in the detector. If the oscillator coil is built with care, and the Remler .0001 mfd. condenser used with the "high minimum" setting (see instructions regarding this in the condenser box), the Remler dial will set at about 48 degrees for 550 meters, and 142 degrees for 200 meters. This is a straight line frequency condenser and therefore the 96 channels used in broadcasting will be evenly distributed over the 94 degree swing of the condenser. This is practically one degree per wave band, which greatly simplifies tuning.

In the infradyne circuit, the oscillator condenser turns in the opposite direction from the tuning condensers. That is, the highest capacity setting is used to get 200 meters and the lowest to get 550 meters. This makes the tuning somewhat confusing if the regular Remler dial is used, and the writer recommends that this dial be replaced with a CCW dial. Also there is no reason why the dial should permanently read from 48 degrees to 142 degrees, and it is better after the limits of the broadcast band have been ascertained to reset the CCW dial so that it is on 0 for 200 meters.

To put the set in operation, the writer recommends making the adjustment on a moderately distant station,—some station that is out of daylight range but that comes in loud at night. The dial settings on the tuned radio frequency set will be in exactly the same places as when that set is used alone, and they can therefore be made in advance if a log sheet is at hand. Put the four indicators on the infradyne amplifier at 0, tune in the station with the dials on the tuned radio frequency set, and then slowly rotate the oscillator dial until the station is heard.

Sometimes the station can be picked up at more than one place on the oscillator if the other dials are not also moved. If this happens, locate all possible oscillator settings and select the loudest one. This will be the infradyne setting. These other oscillator settings are freaks which occur in any set using an oscillating tube, and the only time they appear is during a test of this kind. During normal operation of the set, no station ever appears more than once, unless the broadcast station itself emits a harmonic, in which case of course it will be heard on any set on one-half its fundamental wave length.

After the oscillator setting is determined, adjust the four indicators on the infradyne amplifier for maximum sensitivity, and also adjust the "increase" screw as per the instructions that come with the amplifier. If the set will stand it, a small by-pass condenser, usually not over .0001 mfd., may be used across the first audio transformer. This should not be put in, however, until the receiver and adapter have been tried without it first, as the insertion of this bypass sometimes causes troublesome oscillations.

This infradyne adapter makes a big improvement in a 5-tube set and true infradyne results can be expected. It is particularly good with sets of the single dial variety, as the resulting receiver is then only a two dial set and is easy to operate.

Increasing the Selectivity

AS WE have reports of a few cases of insufficient selectivity with sets that were built in accordance with the directions given in August RADIO, a few suggestions may be helpful in getting the fine results of which this set is capable. In every case the trouble is due to failure to properly line up the circuits tuned by the triple variable condenser.

This difficulty can be remedied very easily by mounting two vernier condensers on the panel, one on each side of the main antenna tuning dial at the level of the vernier tuning knob. We have found the extremely low minimum capacity of the General Radio No. 368A admirably adapts it for this purpose.

After these have been mounted, remove the tubes from the infradyne amplifier, the oscillator, and the second detector sockets. Then disconnect the wire from the plate terminal of the first detector socket and from it run a jumper to the plate terminal of the second detector socket. The set will now operate as a five tube tuned radio frequency, single dial control receiver, and this can be adjusted without having to bother with the infradyne amplifier at the same time.

With the set connected in this way and the shield plates of the condenser set half way between sections, tune in a local station between 400 and 500 meters if such a local station exists. If not, take the nearest powerful station in this band. The Continental condenser is so constructed that the rotor sections are held in place with set screws, and loosening these will permit each rotor separately to be swung to any desired angle with respect to the others. With the set turned on and the station tuned in, loosen the set screw on the rear rotor section, and with the main rotor shaft held stationary slowly rotate this rear section until the point is found where the signal comes in the loudest. Fasten it there. Do the same with the center section, and fasten that in its new position. The antenna section need not be changed, as that section determines the received wavelength anyway, and is therefore already in its right place. As the three sections are thus brought into alignment, the amplifier will be thrown into oscillation, and the rheostat will have to be backed down to control it.

Notice now the relative positions of the three rotor sections. Those two that are farthest enmeshed with the stators are the ones that need the two trimmers (variable verniers). If the three are practically in line with one another, then the rear and center sections are the ones that need the verniers. Now connect them across the two sections where they belong and set each trimmer at one-half its maximum capacity. Then tune the station in again, and when it is tuned on dead center, once more adjust the rotors by the set screw method. This is the final adjustment, and if the set is thus lined up between 400 and 500 meters the trimmers will handle it all over the dial. Log a few local stations on different parts of the dial as these settings will come in handy when getting the rest of the set lined up, and then cut back to the infradyne hookup.

The infradyne equipped with trimmers as above is a far more selective set than the one originally described, and a larger antenna can be used with it. In fact, 50 ft. or more with a .0001 mfd. series condenser will give the best all around results. The ability of the set to handle this enlarged pickup will result in more DX and in more powerful signals from the stations within 1000 miles radius. In fact, this arrangement comes mighty close to the ideal in a radio receiver because it can be used with a large antenna which will pound through the energy from even a very weak station, and the selectivity is still great enough to cut through the local stations.

Drilling dimensions for the General Radio No. 368 A verniers are as follows. Distance down from the top of the panel, 5-5/16 in., distance of first hole from left hand edge of panel 6-3/16 in., distance between the two trimmers 5-9/16 in., size of hole for mounting trimmer condenser, 3/8 in.

(Continued on Page 76)

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Two New, Wonderful Tube Developments

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TYPE "G"
Fil. V 5.0   Fil. Amp. 0.25
Plate Volts 90-180
Carries more power without overloading than any other available High Mu. Average Voltage Amplification 20. Average output Impedance 25,000.   Price $2.50

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FOR DETECTOR with absolutely no hiss or rushing sound, omit the Grid Leak and Condenser and use 90 Volt "B" with 4.5 Volt "C" Battery. Average Mutual Conductance 940.   Price $2.50

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RADIO FOR SOUTH SEA EXPEDITION

Zane Grey, the novelist, is taking his big schooner, the *Fisherman*, for a year's cruise to Australia, New Zealand and the South Seas (recently made famous by Gilda Grey). Wilford Deming, Jr., of Los Angeles, is installing aboard her the finest of long and short wave radio equipment. There will be a Navy-Marconi ½ kw. spark on 600, 700 and 800 meters, and a 1 kw. 500 cycle tube transmitter on the amateur bands of 20, 40 and 80 meters, to be normally operated on 40 meters. The receivers will be as follows: Grebe equipment throughout, a CR7 for long waves CR6 for commercial traffic and broadcast reception, and a CR18 for the short wave traffic. As the purpose of this extended trip to the South Seas is more or less of a scientific nature, the value of reliable radio communication is evident. Mr. Deming will accompany Mr. Gray as radio operator, leaving early in November. Schedules are now being formulated and it is expected that this ship will become a center for all radio traffic to and from ships in the South Pacific ocean.

U. C. RADIO CLUB

Things at the University of California Radio Club at Berkeley, Calif., are again in full swing. Lester D. Culley, '27, 6ACO, has been elected president; C. White, 6MP, hooked the chief Op's job and J. M. Barnett was elected secretary. New members were initiated into the organization at an informal dinner. Everything was conducted in an orderly, yet underhanded manner, and all the neophytes stood the test to perfection. The initiation committee consisted of J. Barnett, 6CTI, A. Binnewig, Jr., 6BX-6XAA, and L. H. Sortais, 6ANT. At a short business meeting held at the conclusion of the exercises it was decided to buy equipment for a powerful short-wave transmitter. 6BB is to be overhauled and will soon be on the air again with new equipment. The entire membership intends going down to the Hamfest to be held at San Jose in October.

INFRADYNE

(*Continued from Page* 36)

In the original infradyne circuit, the input radio frequency amplifier tubes were controlled with the filament rheostat. This means of control is rather abrupt when the set is lined up and operating from a small antenna, and if desired, a smoother control may be had by the method shown in Fig. 3. In that circuit, the tube filaments are supplied with current through a half ampere ballast resistor, and the control is accomplished with a 500,000 Centralab or Carter variable resistance inserted in the *B* battery lead. A 1 mfd. bypass condenser must be connected between the plate side of this resistance and the filament to provide a low resistance path for the high frequency current.

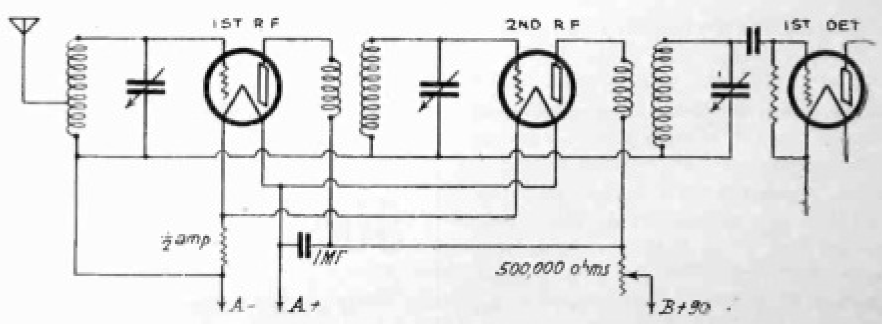


Fig. 3. New Plate and Filament Circuits for First Two Tubes.

A Power Amplifier for the Infradyne

A Socket Power Unit Providing Plate and Grid Voltages for the Set Together With a Power Stage of Audio Amplification

By E. M. Sargent

A SATISFACTORY method of plate voltage supply from socket power instead of batteries has been developed for the infradyne receiver after many unsuccessful efforts to use some of the *B* eliminators ordinarily available. The relatively heavy plate current drain by ten tubes causes the voltage delivered by some eliminators to drop below that required for the operation of the infradyne, and where the voltage is sufficient for ten tubes it may be too great for the five tubes when the 5-10 switch is thrown.

These difficulties have been overcome

Infradyne in Excello Console With Built-in Speaker and Power Unit

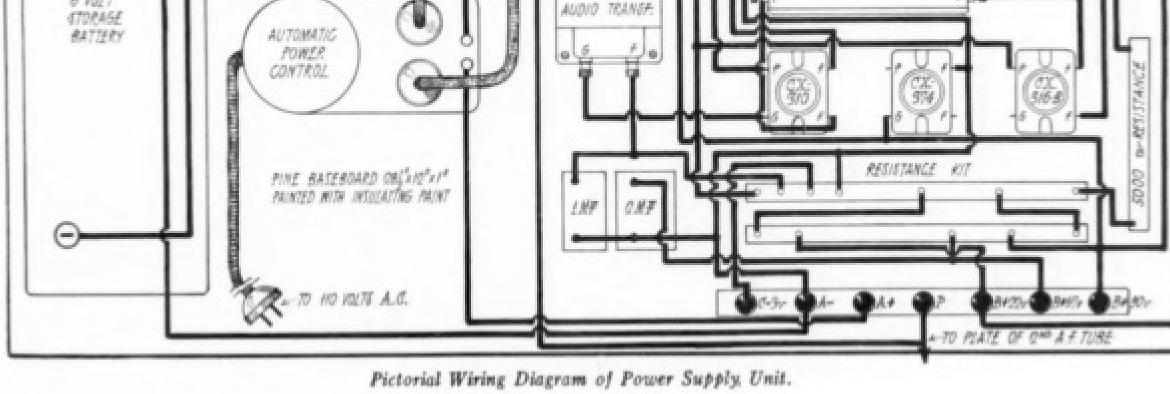
PARTS USED IN INFRADYNE POWER AMPLIFIER

1—Baseboard, pine, 12 by 28½ by 1 in.
1—Baffle Board for mounting loudspeaker, pine, 28 by 24 by ⅝ in.
1—Set Binding Posts, X-L, 22½ V., 67 V., 90 V., C—, C plus, 400 V., Plate, A— and A plus
1—Thordarson R200 Audio Transformer for power stage
1—Thordarson R76 Output Transformer
1—Thordarson R210 Power Compact
1—Tobe R210 B Block
1—Tobe 1 mfd. Bypass Condenser
1—Tobe 2 mfd. Bypass Condenser
1—Excello or Ehlert Console as illustrated
1—Yaxley Automatic Power Control Unit
1—½ ampere to 2 amp. trickle charger. Thordarson 2 amp. or Rectox ½ amp. (Depending on service required from set.)
1—6 volt Storage Battery, 100 ampere hour capacity
3—Remler Sockets
1—Bakelite strip, 1 in. by 12 in. for mounting binding posts
1—CX-310 Power Tube
1—CX-374 Glow Tube
1—CX-316B or 381 Rectifier Tube
1—No. 2313 Carter Resistance Kit
1—Ward Leonard S-5000 ohm Resistance
1—Loudspeaker (Electrodynamic speaker illustrated)
1—Jewell or Weston high resistance Voltmeter, 0 to 250 volts

by using a 400 volt rectifier and filter with a suitable resistance unit for cutting down to the required voltages, and by using a glow tube to control voltage variations. With this equipment available it is also possible to use a 310 power tube in the last stage of audio with 7½ volt a.c. filament supply, which is also used for the filament of the 316-B rectifier. Filament current for the other tubes may then be secured from a storage battery with trickle and booster charger, as indicated in the accompanying diagrams, or from an *A* battery eliminator. This gives a set operated from the 110 volt a.c. supply mains.

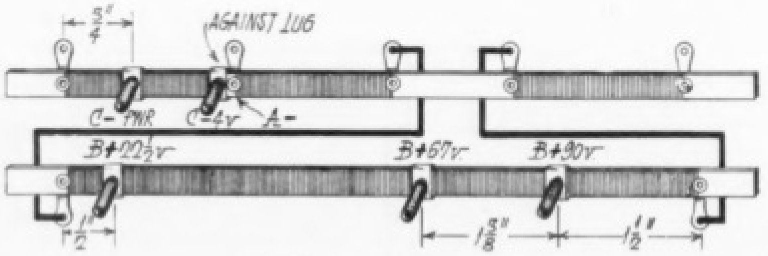
Plate voltages of 22½, 67 and 90 volts are secured through a Carter No. 2313 resistance unit equipped with sliders which can be initially set in the

Infradyne in Ehlert Console With Built-in Power Unit.



Pictorial Wiring Diagram of Power Supply Unit.

proper positions. This unit also gives the requisite *C* voltages. By using the settings marked on the diagram in inches, the required voltages may be closely approximated without measuring them with a high resistance voltmeter.



Resistance Unit Settings.

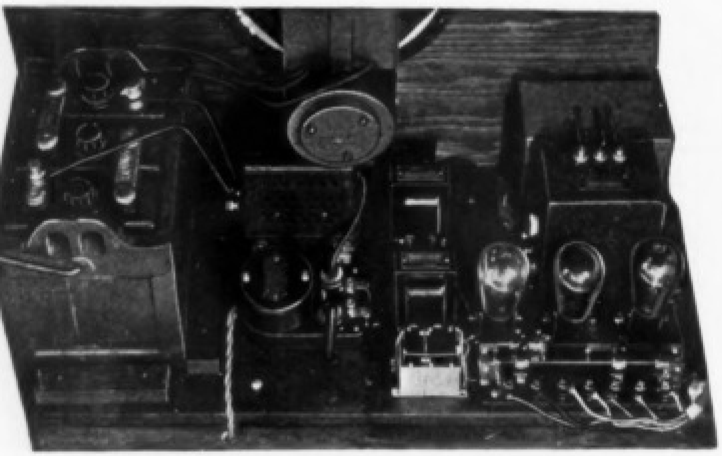
The constructional details are self-evident from the pictures and diagrams together with the list of parts used in the construction of the unit shown. The use of a 2 ampere booster charger in connection with a ½ ampere trickle charger is recommended where the set is used more than two hours a day.

The pictures show the power supply unit housed in a large Excello console and in a smaller Ehlert console with a walnut case for housing the receiver. The former has ample space for an electrodynamic speaker with baffleboard or for other types of loudspeakers.

The automatic power control unit or relay switch is not only a convenience but also a protection against dangerously high voltage if the power unit is turned on when the filament current is not in the tubes in the set. This precaution has prevented many a burn-out as it insures a load for the power supply unit.

This system is applicable to either the old or new models of the infradyne and the usual battery cable may be used without change by running a plate lead from the first audio transformer in the receiver to the *P* post of the power supply unit.

Where obtainable the UX-281 or CX-381 rectifier may well be substituted for the 316-B, as the former has a maximum possible output of 110 milliamperes as compared with the latter's 65 milliamperes.



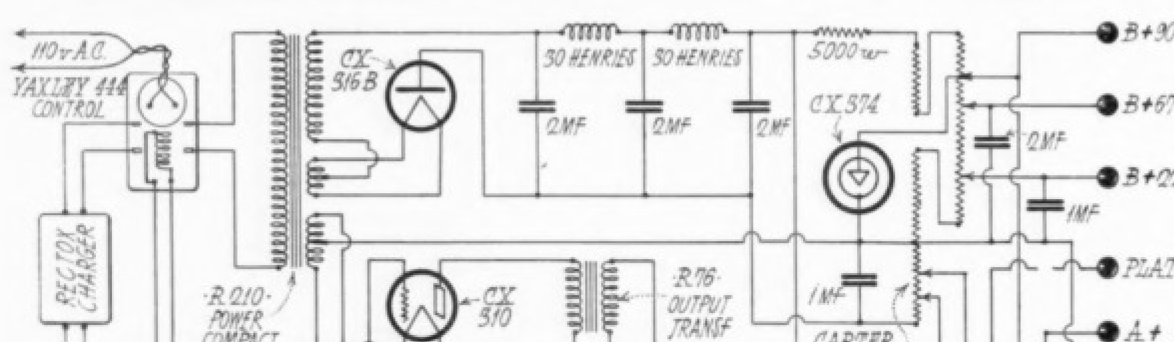
Rear View of Power Unit and Baffleboard Mounting.

LABORATORY NOTES ON THE TYRMAN TEN

Experiments with the Tyrman Ten, described in October RADIO, have shown that the push-pull transformers in the last audio stage are well adapted for use with UX-210 power tubes. Tremendous volume without distortion is this obtainable. Two UX-171 tubes in parallel deliver about the same energy as one UX-210. By using two of the latter tubes the energy is practically doubled.

This is accomplished without any change in the set excepting to supply the 210 filaments with ac. from the input transformer. A Thordarson 210 power pack and *B* eliminator proved satisfactory for the purpose.

The appearance of the receiver has excited much favorable comment because of its beauty which rivals that of much more expensive factory-built models. It is considered an outstanding example of what can be accomplished in home-built receivers.



Schematic Wiring Diagram of Power Supply Unit.

The Infradyne Amplifier

An Interesting Account of Its Evolution and of the Reasons for its Peculiar Design Features

By E. M. Sargent

THE heart of the infradyne circuit is the three stage tuned radio frequency amplifier that operates on 86 meters and which is known as the infradyne amplifier. The development of this amplifier involved many months of experimentation and a great deal of research work before success was achieved.

The infradyne circuit consists of two stages of radio frequency amplification at the incoming frequency, a mixer tube, three stage of radio frequency amplification in the infradyne amplifier, a detector and two stages of audio. The two stages of amplification at the incoming frequency are not particularly efficient, because of the fact that this part of the circuit must be varied over the whole waveband and it is almost impossible to make an amplifier which will work efficiently at all wavelengths between 200 and 550 meters. This input amplifier is in the infradyne to increase its selectivity. This throws the main burden of amplification on the infradyne amplifier, and it is therefore important that this be very efficient, being comparable in efficiency to the intermediate amplifier of a superheterodyne.

When we first started to develop this circuit we did not know at what wavelength it would be necessary to operate the infradyne amplifier. Our first experiment was performed using a neutrodyne adjusted to 200 meters for the intermediate frequency. This worked very well, except that the resulting receiver had a blank spot on the dials around 400 meters, the point at which the oscillator and the incoming wave crossed each other. From this experiment we readily saw that the wavelength of the intermediate amplifier would have to be less than half of the lowest wavelength that we desired to receive. As we wanted the receiving set to be efficient at 200 meters, it meant that the intermediate amplifier would have to operate at a wavelength of less than 100. We therefore next proceeded to reduce the wavelength of the neutrodyne.

The reduction of the neutrodyne's wavelength was accomplished a little at a time. A few turns would be removed from each of the secondary coils and an occasional turn from the primaries and the neutralizing tap changed to a new position before each test was made. In this way the wavelength of the neutrodyne circuit was gradually reduced to 150 meters.

Up to this point the Infradyne circuit as a whole had operated very well, exhibiting extreme selectivity combined with good sensitivity. In fact, the only drawbacks to the circuit in this form were, first the blank spot on the dials at twice the wavelength of the intermediate, and second the fact that the oscillator was traveling through the broadcast wave band. However, as soon as we dropped below 150 meters the selectivity of the circuit suddenly disappeared and the whole infradyne was no more selective than a good two stage radio frequency set operating on the main wavelength. At first it was thought that this decrease in selectivity might be a natural process which was fundamental in the set because of the fact that changing the broadcast frequency to a higher one, according to the selectivity formula, will naturally broaden it. Investigation proved that this was not the case, as our loss of selectivity was entirely too sudden and too great to be accounted for in this way.

teristics than the circuit through the grid to plate capacity of the tube and the primary of the next coil, the result was two circuits of slightly different wavelength reacting upon each other. The capacity of the tuning condenser was no longer high enough to eliminate the effect of these stray circuits and therefore the tuning of the neutrodyne became much broader as the wavelength was decreased. Continued experiments indicated that this circuit would not be suitable for the extremely short wavelengths at which we wanted to amplify.

Next the circuit shown in Fig. 2 was tried. This is known as the bridge circuit. As the stray tuning circuit through the grid to plate capacity is exactly counterbalanced by the neutralizing capacity it appeared that it would do everything that was desired. A split condenser is required with the bridge circuit in order to tap the center of capacity, but this split can be obtained by two small fixed con-

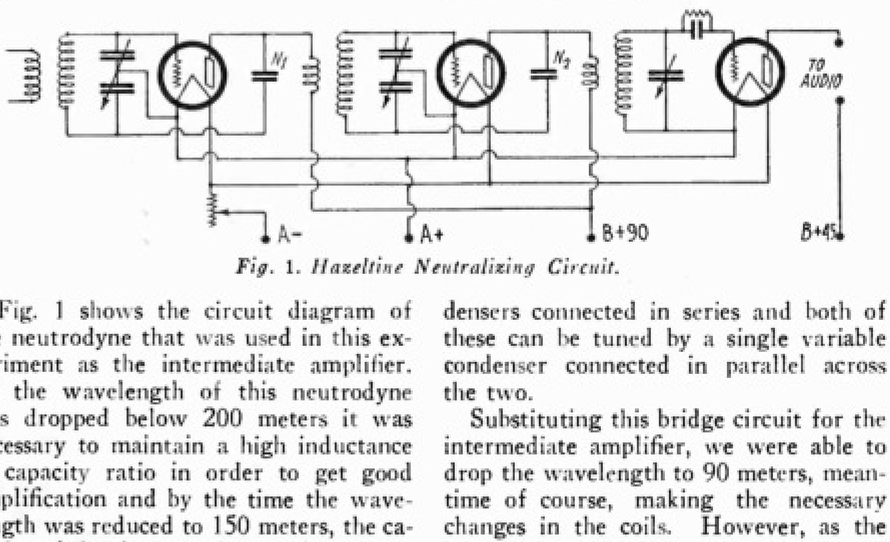


Fig. 1. Hazeltine Neutralizing Circuit.

Fig. 1 shows the circuit diagram of the neutrodyne that was used in this experiment as the intermediate amplifier. As the wavelength of this neutrodyne was dropped below 200 meters it was necessary to maintain a high inductance to capacity ratio in order to get good amplification and by the time the wavelength was reduced to 150 meters, the capacity of the shunt tuning condenser was less than .00008 mfd. The neutralizing circuit through N_1 to the point B_1 on the coil and thence through the bottom part of the coil to C_1 now began to have a very definite effect on the tuning of the neutrodyne. As this neutralizing circuit was of slightly different charac-

densers connected in series and both of these can be tuned by a single variable condenser connected in parallel across the two.

Substituting this bridge circuit for the intermediate amplifier, we were able to drop the wavelength to 90 meters, meantime of course, making the necessary changes in the coils. However, as the wavelength was dropped it became a more and more difficult process to adjust the circuit to neutralization. The tuning condensers had a maximum capacity of not over .00005 mfd. and the condensers used for neutralizing were one third of this capacity. The neutralizing condensers then had a very pro-

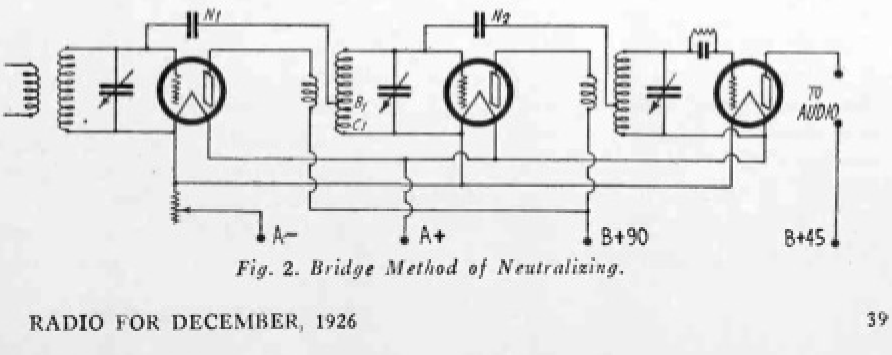


Fig. 2. Bridge Method of Neutralizing.

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nounced effect upon the tuning of the circuit and it took the services of a radio expert to tell when these condensers were adjusted at the neutralizing point. Any adjustment of the neutralizing condensers would stop oscillation because if they were not neutralized they would detune the circuit enough to stop it and consequently the resulting amplifier was a seven control affair, which was impractical.

4 in., the amplifier will lock up in uncontrollable oscillation. The fixed condensers must be mounted horizontally, because if they are turned up edgewise the capacity between them will be great enough to by-pass an appreciable part of the high frequency energy. The circuit as a whole must be laid out in such a way that the easiest path for the high frequency current to follow is along the

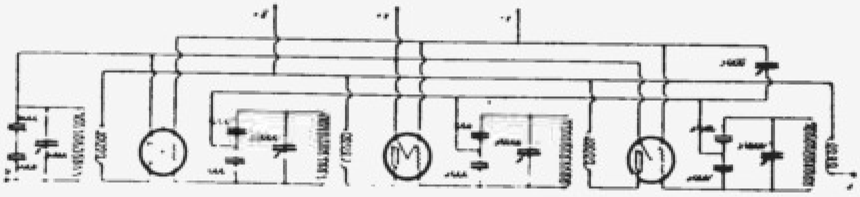

Fig. 3. Circuit Diagram of Infradyne Amplifier Unit

After a great deal of experimenting the circuit shown in Fig. 3. was developed. This is the circuit which is now used in the infradyne amplifier unit. In the strict sense of the word this is not a neutralizing circuit. Instead of neutralization the effect of the tube capacity is eliminated by a radio frequency choke in the plate circuit. This radio frequency choke is also the primary of the next radio frequency transformer. The coupling between the coil and condenser circuit and the input of the tubes is varied through a .0005 mfd. condenser. Decreasing this capacity decreases the coupling to the point at which oscillations cease. This method of stopping oscillations is so efficient that a very large primary to secondary coupling in the radio frequency transformers can be used with the result that a good transfer of the signal energy is obtained. The variation of this coupling capacity does not affect the signal strength but merely stops the self-oscillation of the circuit. It also has the effect of sharpening the tuning of the circuits as the damping effect of the tube on the tuned circuit is much less with this connection.

An examination of Fig. 3 would lead to the conclusion that the grids of the radio frequency tubes are "open." However such is not the case because due to unavoidable leakage through the condensers, the wiring to the tube sockets and the tube bases as well as inside the tube itself enough grid leak is present to keep the tubes at a constant grid bias. Measurement of the plate current drawn by the tubes while in operation indicates that the grid bias is about [illegible] volts which is the point on the characteristic curve at which the tubes amplify best.

As has been stated in previous articles the relative positions of the parts in this amplifier play an important part in its success. This is particularly true of the position of the coils in respect to that of the tubes. If the tubes are placed in the field of the coils even at a distance of 3 to

wires on which it is desired to have it travel.

During the development of the infradyne amplifier 301-A type tubes were used. The '99's were later substituted because it was found that the amplification with either type of tube was the same and the saving in filament current with the 99's made it worth while to use the small tubes. The difference in capacity between the 301-A and the 99 is not enough to make any difference in the amount of amplification that can be obtained.

When the infradyne amplifier is used in the regular ten tube Infradyne circuit the wire from the plate of the mixer tube to the terminal marked "plate" on the amplifier is an 80 meter lead and consequently should be run as short and direct as possible. This lead should be as far away as practicable from other metal objects as otherwise some of the high frequency energy will be by-passed before it enters the amplifier. The importance of running this lead in the right way will be readily understood when it is stated that a piece of shielding 1 in. long placed around this wire and grounded will by-pass the 80 meter input to the amplifier so effectively that even a closely coupled wavemeter cannot be heard through it.

In using electric lamps for voltage control for battery eliminators be sure to use the exact size lamps specified in the instructions and do not substitute other sizes, as such lamps are of such high resistance that even a change such as the substitution of a 40 watt lamp where the specifications call for a 50 watt one will throw your potentials hopelessly out of balance, and may destroy the efficient operation of your set.

Unaccountable noises may originate from high resistance ground connections. If you suspect such a thing, try a 50 ft. length of insulated wire as a counterpoise.

THE RADIO SEASONS

By C. Sterling Gleason

AND it cometh to pass that once more are gone the days of the summer, and winter draweth near. And our scribe sitteth himself down and pondereth long and deeply, and his musings follow this wise: The year of radio divideth itself into four seasons.

The first of these cometh with the passing of summer and the approach of autumn. The radio man sitteth before his receptor, and listeneth desultorily to what passeth upon the air, and lo! his heart is gladdened and his pulse quickens, for the static crasheth less loudly and gone is the constant frying which drowneth the far distant signal. And there remaineth but few of the violent noises which of late so paineth his ear, but instead is heard the live crackling which indicateth that somewhere is life separated not by the impenetrable dead wall of incessant static. And the fan of radiocast heareth a far-off carrier wave which pulsateth and straineth at the bonds of summer; he sitteth patiently in the hope of hearing pronounced the call letters thereof, and trieth connecting once more the long antenna, in the place of the short indoor wire of the summer months. And the ham in his shack taketh the old "one-step" from the shelf where it hath reposed during the long months of summer, and connecteth it to the detector, whereto he hath formerly attached the 'phones because of the loudness of the static. And he heareth as from afar the faint peepings of countless far-off cw's, and longeth mightily for the return of the golden season of great distance. Even at sea doth the commercial op sense the passing of the dog days and curseth less fervently the chance which hath given spark signals the consistency of mush and the semblance of static when received on an oscillating detector.

Now is begun an era of new life. Everywhere is heard the sound of the drilling of panels and the hiss of the soldering iron. Once more the gathering customers bring gladness to the heart of the radio dealer, and the cash register is heard singing its joyful song. The newspaper again printeth schedules of distant stations, and on the news stands appeareth the call-book and the log. The periodical of radio turneth from battery eliminator and static eliminator to circuit tricks and distance dope. The service man droppeth many a gentle hint as to rebuilding and remodeling, and mentioneth casually the wonderful results neighbor Jones across the highway enjoyeth from his rebuilt Dynaplex. The distance map is renewed, and the tube rejuvenated. Once more the president calleth together the radio club, and the clubhouse is full to overflowing, so that the davenport groaneth and the porch is filled with many soap boxes. The wise

(*Continued on Page 88*)

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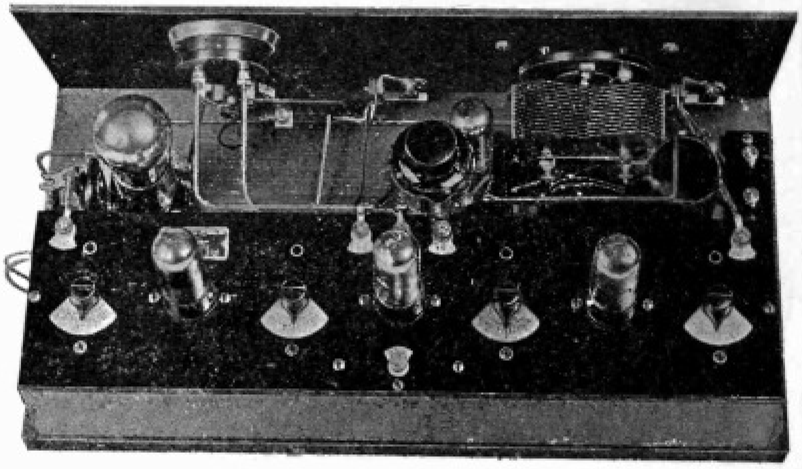
Infradyning R. F. Receivers

Directions for Adding An Infradyne Amplifier To Give Greater Range and Selectivity to Four Standard Circuits

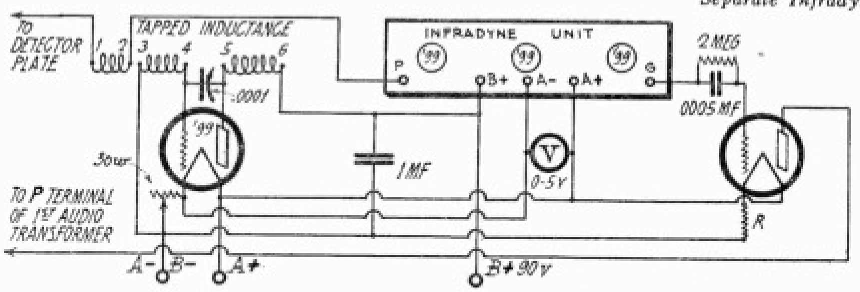
By E. M. Sargent

THE great sensitivity and selectivity now necessary in order to receive distant stations through local interference may easily be secured by adding an infradyne amplifier to almost any standard circuit. The general directions for doing this, as described by the writer in October, 1926, RADIO, brought many questions regarding its application to specific circuits. Consequently this text is written to give detailed directions for converting four popular kit sets, the Browning-Drake, Hi-Q, Counterphase, and Silver Six, into an infradyne.



Separate Infradyne Adapter With Switch Control.

The Sargent-Rayment infradyne is merely a well-designed tuned r. f. and audio amplifier *plus* a mixer tube, oscillator, and a three stage 86 meter amplifier, which are inserted between the last r. f. stage and the detector. Any similar tuned r. f. set can be likewise adapted, either incorporating the complete infradyne unit as an integral part of the set or using it as an external unit mounted in a separate cabinet.

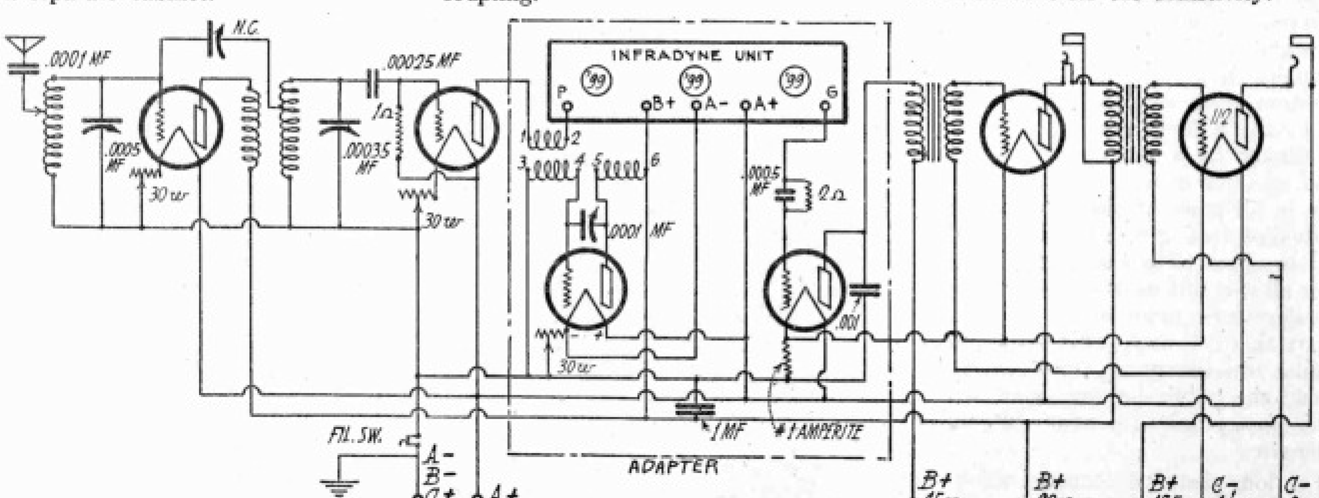


Circuit Diagram of Separate Infradyne Adapter.

Infradyning the Browning-Drake

THE former method is illustrated in the picture and diagram of the converted four-tube Browning-Drake receiver. This circuit uses one stage of neutralized tuned r.f., a regenerative detector, and two stages of audio frequency amplification, although three stages of audio are often used, in connection with impedance or resistance coupling.

In order to shorten the high frequency leads, the infradyne unit was turned around so that the grid, or input lead, was at the left end of the baseboard, looking at the set from the back, with the mixer tube placed directly back of the Browning-Drake regenaformer. The detector tube, connected to the output of the infradyne amplifier, has a long plate lead to the audio frequency amplifier, which is placed at the extreme left end of the baseboard near the input of the infradyne amplifier. But as a .001 mfd. by-pass condenser prevents r.f. from going through this lead, no harm is done. The r.f. tube is controlled by a 30 ohm filament rheostat, which is placed at the right of the panel, looking at it from the front. The 30 ohm rheostat in the mixer tube filament circuit is at the left of the panel, and controls the volume of the set, while the r.f. rheostat controls the sensitivity.



Browning-Drake Circuit With Infradyne Adapter Permanently Wired.

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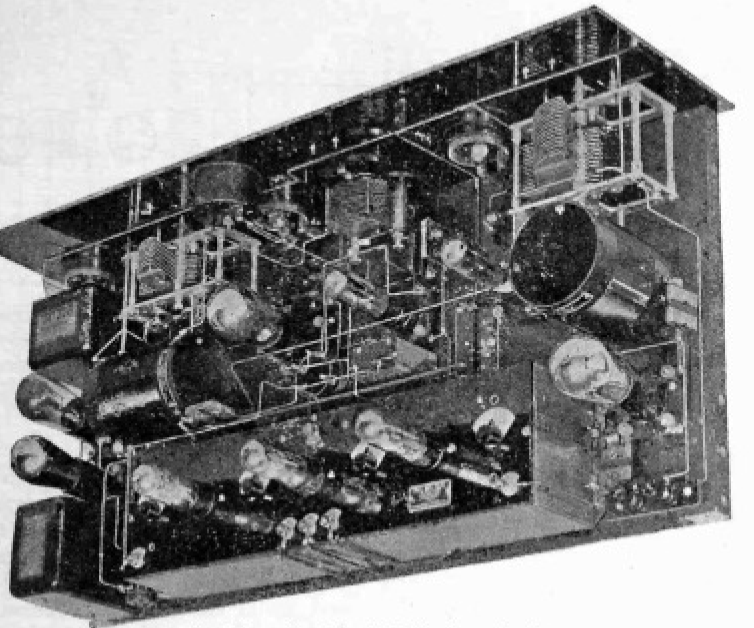
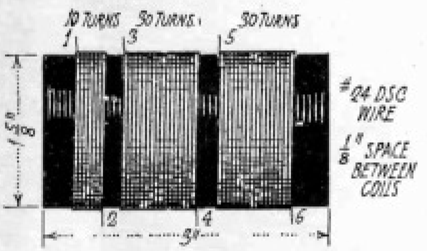


Complete Browning-Drake Infradyne Receiver.

As it was found that a type A tube could be used equally as well as the type 99 shown in the picture, the circuit diagram is drawn for an A tube. The connections to the tickler are not shown in the diagram, as it developed that sufficient regeneration was had in the r.f. tube as it approached the oscillating point. The tickler can be connected in the plate circuit of the mixer tube, next to the tube plate, if wanted.

The infradyne oscillator as shown in all diagrams herewith, is tuned by a .0001 mfd. Remler straight line frequency condenser, used in conjunction with a tapped inductance having the



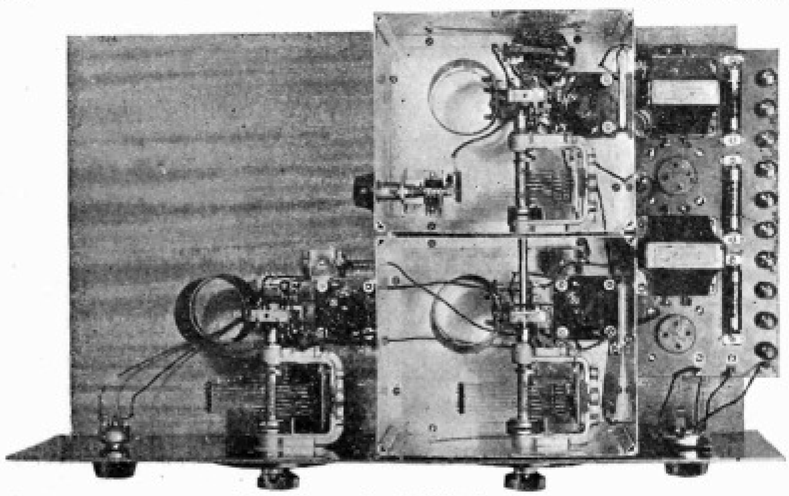
Tapped Inductance Specifications.

dimensions shown in sketch. Thus definite directions for setting the oscillator condenser for minimum and maximum wavelength settings can be given once for all. In the regular infradyne circuit a .00035 mfd. variable condenser is used in series with a .0005 mfd. fixed condenser with a tapped inductance having less turns. Using the .0001 mfd. variable condenser, the Remler dial will set at about 48 degrees for 550 meters, and 142 degrees for 200 meters. Since it is a straight line frequency condenser, there will be 96 ten kilocycle channels in the 94 degrees swing of the condensers, practically one degree per channel.

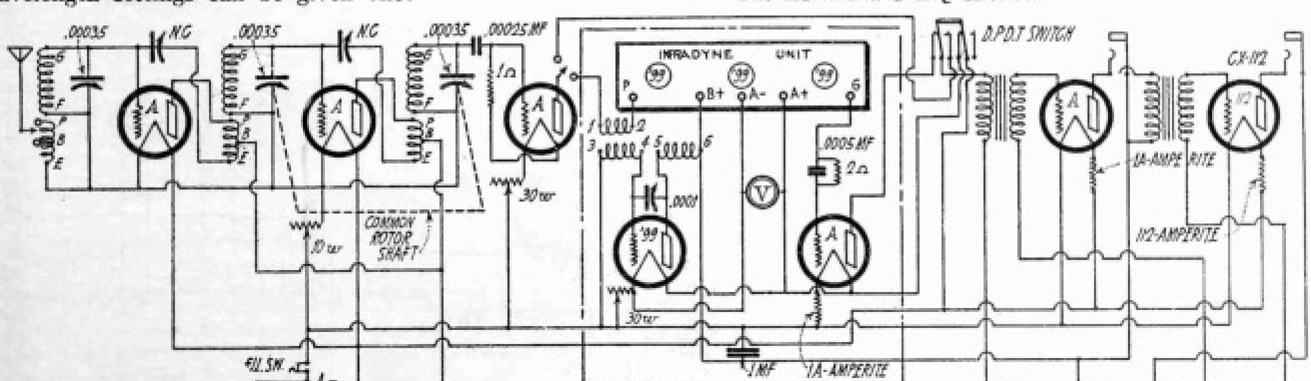
Adaptation of the HiQ

A TYPICAL five-tube circuit is the new Hammarlund HiQ shielded receiver. It consists of two stages of shielded tuned r.f., shielded detector and two stages of transformer coupled audio. As this set comes in kit form, it is easiest to build it in the usual manner, installing the adapter after the five-tube set is completed and working properly. The general arrangement of the HiQ can be seen in the picture, which shows the two shielded stages with twin condensers on one shaft, making an admirable front end combination for the infradyne amplifier.

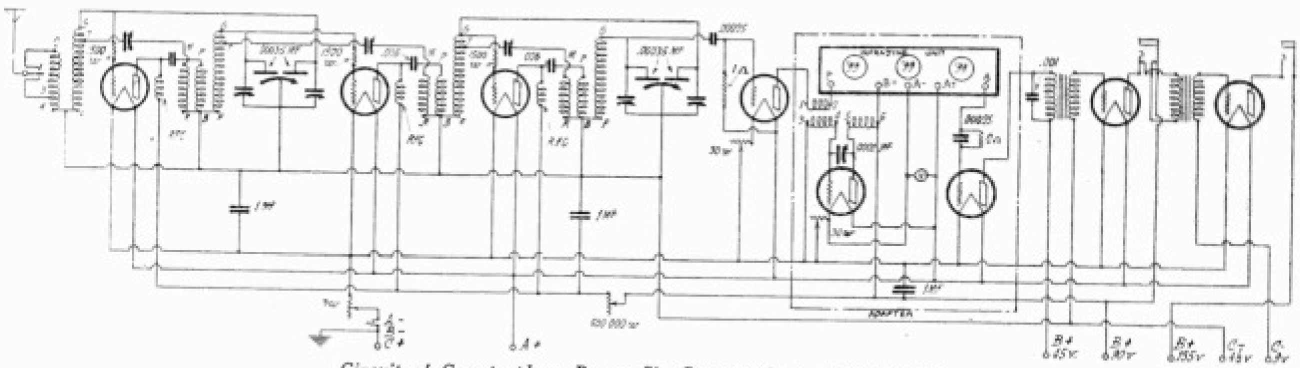
The diagram of the adapted HiQ shows a switching circuit whereby the adapter can be cut out, and the filaments of the adapter tubes turned off when the five tube set is to be used alone. This scheme requires two switches so as to avoid long 86 meter leads and capacity between switch blades which would occur if the two switches were combined in one. The switch in the detector plate should be a Federal No. 1424W anti-capacity key, it being a four-pole double-throw switch with little capacity between switch blades. The switch in the mixer tube plate circuit may be a Yaxley antenna switch having three contacts. One of the four switch groups of the Federal key should be used to turn off the filaments of the five tubes in the adapter when not in use, as is shown in the diagram. This switching device can be employed in any other



The Hammarlund HiQ Receiver.



Schematic Diagram of Hammarlund HiQ Receiver With Infradyne Adapter.



Circuit of Counterphase Power Six Converted to An Infradyne.

set, but is shown in the HiQ circuit only so as not to confuse the reader if the switches are not wanted.

The necessary changes in wiring the HiQ set are as follows: Disconnect the wire leading from terminal P of socket No. 3, as designated in the instruction manual accompanying the HiQ kit, and run flexible leads from terminal *P* of the socket, and terminal *P* of audio transformer No. 1, to the switches on the adapter. The detector tube in the HiQ set becomes the mixer, and the new detector tube in the adapter has its plate connected to terminal *P* of the first audio transformer, as is shown in the diagram. No other changes are necessary, and the adjustment of the two r.f. transformers, or of the audio end need not be changed in any way.

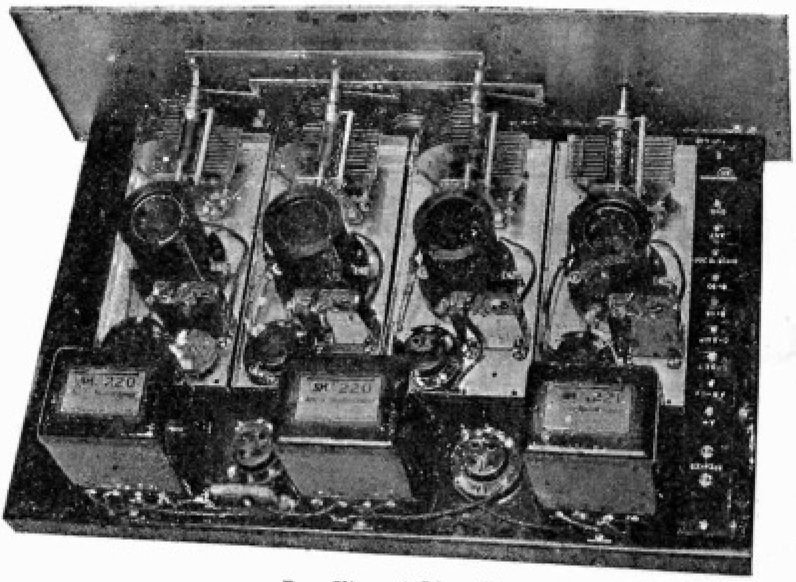
The circuit diagram shows the grid leaks connected from the grid to the filament. It may be left shunted across the grid condenser as in the regular HiQ circuit with equally good results.

If it is inconvenient to solder a wire to the *P* terminal of socket No. 3, the old wire coming out of the hole in the side of the shield can be extended by splicing the piece of flexible wire to it, with the joint carefully taped to prevent a short circuit with the shield. As the HiQ set has all important r.f. leads shielded, the adapter may be placed in a cabinet, and set on top of the HiQ cabinet, so that its tuning dial will be directly over the HiQ tuning dials so as to facilitate tuning.

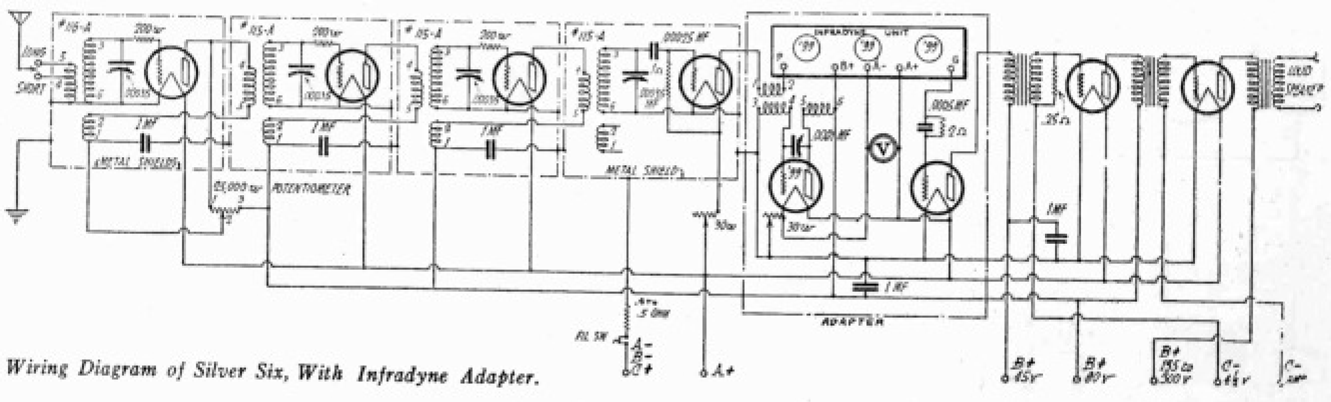
Conversion of the B. T. Counterphase

THE six-tube unshielded receiver employing toroid or other enclosed field coils, is represented by the Bremer-Tully Counterphase Power Six, described in December, 1926, RADIO. Here the three stages of tuned r.f. are controlled by two twin condensers. The changes in wiring are simple, since the detector plate lead is easily reached with the soldering iron. It is advisable to mount the infradyne adapter to the left of the Counterphase, so that there will be no interconnection between the wiring of the adapter, and the r.f. end of the Counterphase. The diagram is shown as a complete unit, as though the infradyne were built in the set, but to convert a Counterphase to an infradyne, it is only necessary to proceed as in the HiQ case and disconnect the plate lead from the detector to the *P* terminal of the first audio transformer, connecting the detector plate to No. 1 terminal of the tapped inductance in the infradyne adapter, and the plate of the detector in the adapter unit to the *P* terminal of the first audio transformer. If the switch combination is desired, use the same manner of connections as is shown in the HiQ diagram, making certain of the connections to the filament breaking contacts of the anti-capacity key, so that when the adapter is not in use, its filaments will not be lighted.

(*Continued on page* 54)



Rear View of Silver Six.



Wiring Diagram of Silver Six, With Infradyne Adapter.

Infradyne Tips

Simple Changes for Controlling Volume and Oscillation, Increasing Amplification, and Operating From Battery Eliminator

By E. M. Sargent

THOSE who have built the Sargent-Rayment infradyne as described in November, 1926, RADIO may be interested in a number of slight changes that make for smoother and simpler operation. Practical experience has shown that the 50,000 ohm resistance across the grid and filament of the mixer tube is not needed unless the set is located close to local stations whose volume is too great. Its place on the panel may be taken by the baseboard rheostat, which is used to cut down the filament current in the mixer tube, thereby reducing the plate current from the constant 90 volt supply. This change is shown in Fig. 1.

If the 50,000 ohm resistance is retained it should normally be left in the "off" position, cutting it in only when necessary to reduce the volume of locals. The usual 50,000 ohm resistance surrounded by a nickel-plated shell is not suitable for this circuit, as it reduces the sensitivity and broadens the tuning. The Frost 886 unit was especially designed for this circuit, being wound with fine resistance wire on an insulating strip placed around a bakelite core.

Two-thirds of the infradyne's selectivity is due to the two r.f. stages preceding the infradyne amplifier. The set is most selective when these three circuits are in resonance, when the tendency to oscillate is also the greatest. This resonance is controlled by the two trimmer condensers on the panel, which should first be set so as to give maximum oscillation. The oscillation can then be stopped by cutting in more plate resistance with the 200,000 ohm variable resistance marked "volume control" at the right of the panel. It may be necessary to slightly readjust the main tuning dial after tuning the trimmers. The trimmers require less attention when used with the Cardwell three gang condenser than with some others. A third trimmer inside the set is left fixed at one-third to one-half its maximum setting.

The three trimmers are necessary because of the single dial control of the three tuning condensers. Each of these condensers is associated with an inductance coil, all three of which have the same characteristics, so that the same condenser capacity will tune them to the same wavelength. But as the total capacity of the three circuits is seldom the same, any unbalancing must be equalized by the trimmers.

Thus the capacity of the first tuned r.f. circuit varies with different antennas. The capacity of the second is affected by the length of the grid lead. That of the third by the grid condenser and leak. With matched coils the three circuits should stay in line after the trimmers have once been adjusted.

Failure to stay in line, which is indicated by having to re-set the trimmers for different wavelengths, means that the three sections of the triple variable condenser do not change equally in capacity. A slight readjustment of a good type of condenser will often correct this unbalancing so that the trimmers need not be touched. Some condensers cannot be changed and reliance must be placed on the trimmers.

When a condenser is set for maximum capacity the rotor plates should be exactly half way between the stator plates when looked at through a piece of white paper. If they are closer to one side than the other an experienced radio builder can correct the trouble by loosening the nuts that hold the stator in place and sliding the stator around until its plates are in the right position. Never try to bend the plates.

Smoother operation and increased amplification may often be obtained by using 67½ instead of 90 volts on the plates of the small tubes while retaining 90 volts on the large tubes. This may be done by changing one connection in the set, as shown in Fig. 1. In the set described in November RADIO, the change is made by first removing the joiner wire between that leading to the 90 volt binding post and that tapped off the wire (below the 1 mfd. condenser), joining *No. 6* on the oscillator coil and the *B* post of the infradyne amplifier. Then run a wire from *No. 6* to terminal *B* on the first audio transformer. This puts the *B* supply for the 99 tubes on the 45 volt binding post, which should be connected to the 67½ volt + *B* battery clip. This also supplies 67½ volts to the two detectors which will operate as well on 67½ as on 45 volts.

The critical adjustment of the rheostat on the first detector tube may be eliminated by putting a .001 mfd condenser and choke coil in the plate circuit

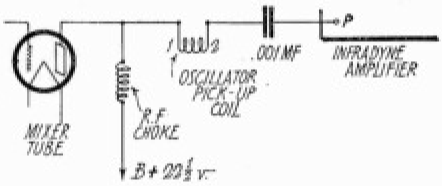


Fig. 2. Alternative Method of Plate Supply to First Detector.

of the tube, as is shown in Fig. 2. The choke may be either a Remler No. 35, Bremer-Tully, or Silver Marshall No. 275. This requires an extra *B* battery

(*Continued on page* 60)

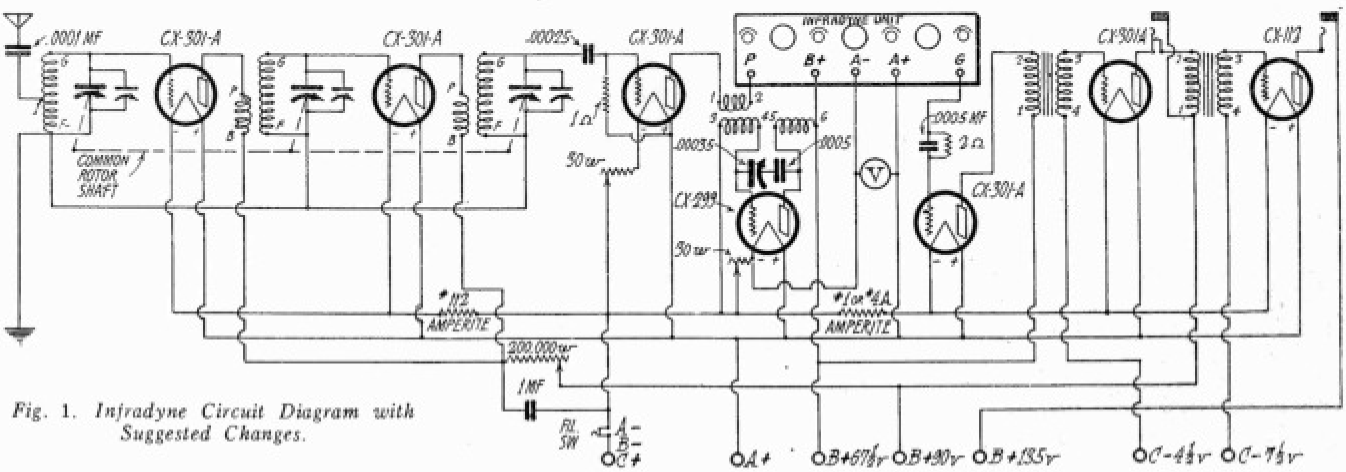


Fig. 1. Infradyne Circuit Diagram with Suggested Changes.

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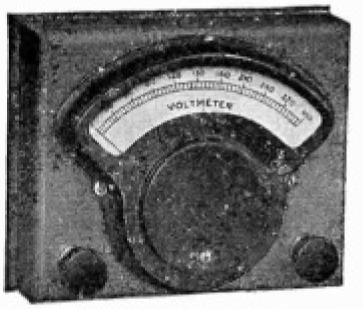

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INFRADYNE TIPS

(*Continued from page 12*)

lead to a 22½ volt supply. The filament current rheostat may be turned all the way on at all times if this scheme is used.

Each grid and plate lead in the set should be kept at least ½ in. from anything else. Do not cover them with spaghetti and run them along the baseboard among the filament leads in an attempt to improve the appearance of the wiring.

The infradyne can be logged definitely and conveniently, especially if National type B dials are used. Instead of writing call letters on the space available, write the wavelength, putting the figures vertically one below the other. The tuned r.f. dial spreads out those below 300 meters while the oscillator dial spreads out those above. The set should be properly adjusted before starting to log, marking the position of the four indicator ends on infradyne amplifier and putting a scratch on the plate of the fixed trimmer to show its setting.

If the plate supply for the 99 tubes is corrected to the 45 instead of the 90 volt post, as previously described, there should be little difficulty in satisfactorily operating the infradyne from a good *B* battery eliminator such as the Majestic Master B, the All-American Constant B, the General Radio, and probably others which the writer has not tested. The main requirement is that the eliminator delivers 67½ volts to the 45 volt post, supplying plate current for the 199 tubes, 90 volts for the A tubes and 135 volts or more for the power tube, as shown by a high resistance voltmeter.

Any eliminator can be combined with two 45 volt *B* batteries, the batteries being used to supply 90 volts to the two tuned r.f. tubes and the first audio, the eliminator supplying the balance. This elimination avoids any possible voltage reaction through the eliminator onto the rest of the set when the series plate resistance on the infradyne unit is changed.

When testing for trouble, always use *B* batteries throughout. The high d.c. resistance of an eliminator may indicate a fault that does not exist in the set and thus give misleading results.

EXPERIMENTAL SHOP

(*Continued from page 26*)

working glue can be made by mixing with an egg-beater 18 ounces of casein glue with 1 ounce of cold water. It will be ready to use after it has stood for half an hour when it will have the consistency of very ripe Camembert cheese. It may be applied with a spatula or brush, which should be well washed afterwards as the glue is almost waterproof when dry and dries quickly. Ammonia will soften it. The glued wood can be worked upon six hours after the joint is made.

Trouble-Shooting The Infradyne

Detailed Tests and Diagrams for Testing Possible Faults in Each Part of the Circuit

By E. M. Sargent

ALTHOUGH thousands of sets employing the Infradyne circuit have already been assembled and are giving eminent satisfaction, an occasional difficulty is encountered which may be understood and remedied by studying and applying various tests herein explained. Furthermore much of this information should be of interest and value to any person who operates this selective and sensitive set.

These various tests, with their special accompanying diagrams, may be identified by reference to the complete pictorial wiring diagram shown in Fig. 1. When several tests are indicated by one diagram they have been designated by the diagram number, followed by *a*, *b*, *c*, etc., it being assumed that the tests will be made in the alphabetic sequence suggested. Most of the tests may be made with a pair of phones by the click method, although in some cases a voltmeter is preferable.

It will be noticed that the circuit differs slightly from that originally shown. No change has been made in parts specified and the modifications shown can be very easily incorporated. Those modifications indicated have been made with a view to making the set more stable in operation and more easily handled. They are, it is felt, well worth while.

As originally designed, the first two radio frequency tubes, the mixer, the Infradyne Amplifier tubes, the oscillator and the first audio tube were operated at 90 volts plate. It has been found that the Infradyne Amplifier is more stable and more easily handled when operated at a plate voltage of 67½. Critical adjustment of the mixer tube filament temperature is necessary when that tube is operated at 90 volts. If a plate voltage of 22½ is applied to the mixer tube and a grid leak of 4 or 5 megohms is used, critical adjustment of the mixer tube filament temperature will be found no longer necessary. In order that a plate voltage, different from that applied to the Infradyne Amplifier, may be applied to the mixer tube it is necessary that a blocking condenser of .001 mfd. capacity be used as shown. Passage of the 3500 kc. intermediate frequency through the *B* battery is prevented by a Remler No. 35 Choke Coil. The mixer tube plate voltage is supplied from the 67½ volt battery terminal, the necessary voltage drop being obtained through the use of a fixed resistor of .05 megohms.

In order to obviate the necessity of adding an extra binding post, the detector is operated at a plate voltage of 67½ instead of 45 volts as in the original model; operation of the detector at this voltage will be found entirely satisfactory. In order to effect this change, it is necessary to disconnect from the Frost No. 954 Gem Jac (phone jack) the wire originally connected between that jack and terminal No. 6 of the tapped inductance and to connect this wire between terminal No. 6 of the tapped inductance and terminal No. 1 of the first Silver-Marshall Audio Transformer. The 67½ volt terminal of the *B* battery will then be connected to the binding post marked plus 45.

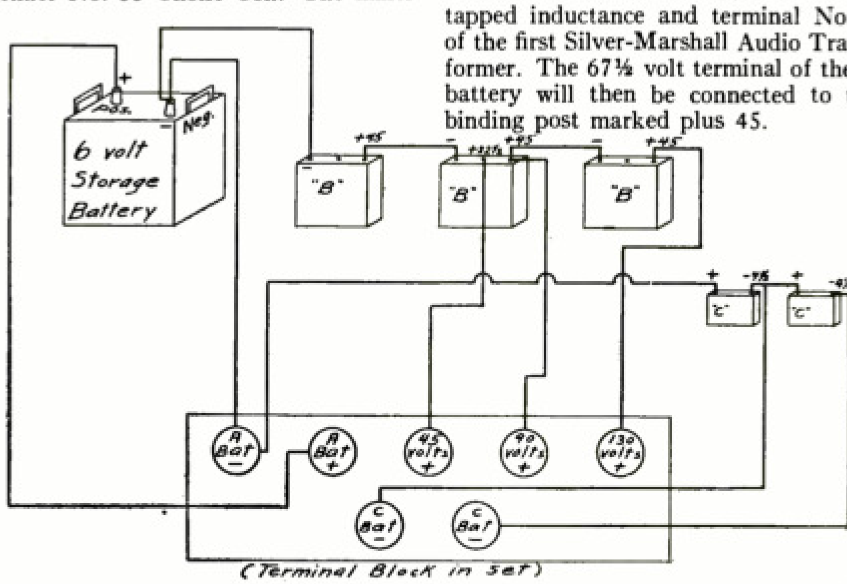


Fig. 2. Battery Connections.

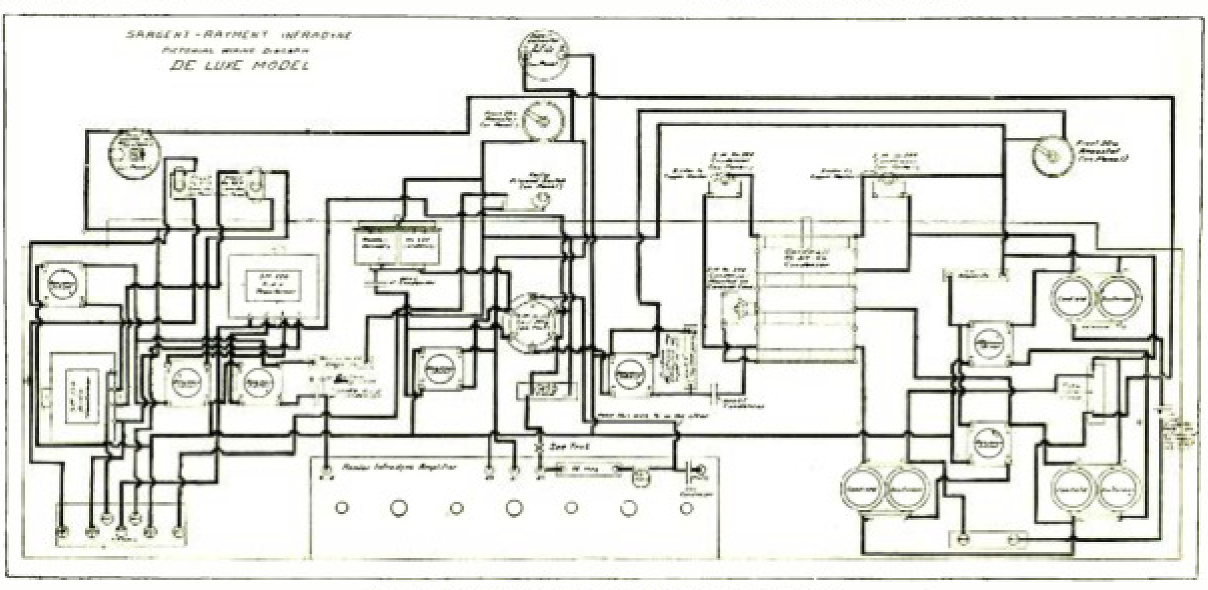
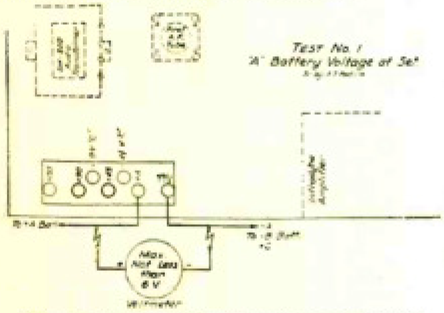


Fig. 1. Pictorial Wiring Diagram of the Infradyne.

TEST NO. 1—*A* BATTERY VOLTAGE

All tubes should be in their sockets and drawing normal current.

The filament switch should be in the *ON* position; the mixer tube and center panel rheostats should be turned on and the voltmeter should read 3 volts.



The test voltmeter should read 6 volts. If the voltmeter does not read 6 volts (1) The battery charge may be low or (2) The leads from the *A* battery to the set may be of too high resistance so that the voltage drop through them is excessive.

TESTS NOS. 2 A-B-C—*B* BATTERY VOLTAGE

The tubes can be left in their sockets or removed as desired.

The *B* batteries must be connected as in Fig. 2.

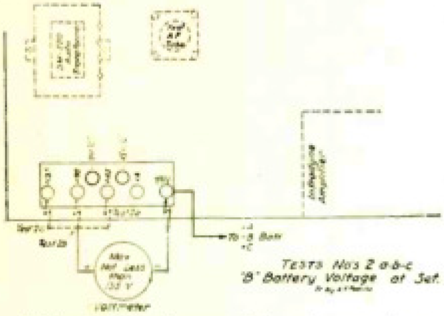
The filament switch should be in the *OFF* position.

Tests a, b and c should be made in natural sequence .

Test 2a.—The voltmeter should read 67½ volts.

Test 2b.—The voltmeter should read 90 volts.

Test 2c.—The voltmeter should read 135 volts.



If the voltmeter reads low in any case the trouble is probably due to deterioration or discharge of one or more of the *B* batteries.

If the voltmeter pointer is unsteady and all external connections are good there may be a poor connection inside of one of the *B* batteries. Such a poor connection would result in noisy operation of the set.

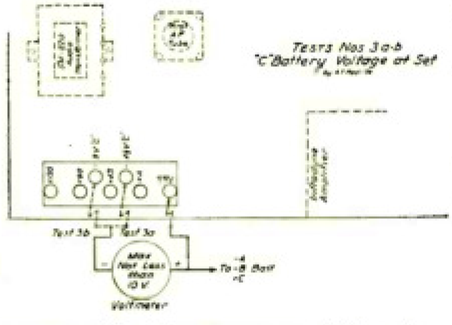
TESTS NOS. 3 A-B—*C* BATTERY VOLTAGE

The tubes can be left in their sockets or removed as desired.

The batteries should be connected as in Fig. 2.

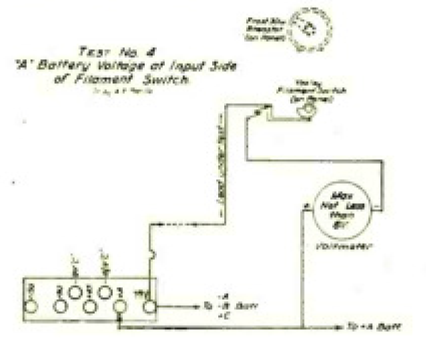
The filament switch should be in the *OFF* position.

Test 3a.—The voltmeter should read 4½ volts. It is assumed that a plate voltage of 90 is to be used on the first audio tube; if a different plate voltage is to be used on this tube, employ the



corresponding bias recommended by the manufacturer.

Test 3b.—The voltmeter should read 9 volts if a CX-112 or UX-112 is to be used at a plate voltage of 135. If a CX-371 or UX-171 is to be used in the last audio stage employ the grid bias recommended by the tube manufacturer.



TEST NO. 4—*A* BATTERY VOLTAGE

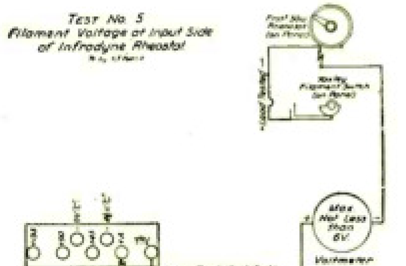
All tubes should be left out of their sockets as a protective measure.

The *A* battery must be connected as in Fig. 2.

The filament switch should be in the *OFF* position.

The voltmeter should read 6 volts.

If the voltmeter does not read 6 volts the lead from the —*A*—*B*+*C* binding post to the input side of the filament switch is incomplete. This lead is indicated in the diagram. The dotted portion of the lead is that part which could not be drawn due to space limitations.



TEST NO. 5—FILAMENT VOLTAGE

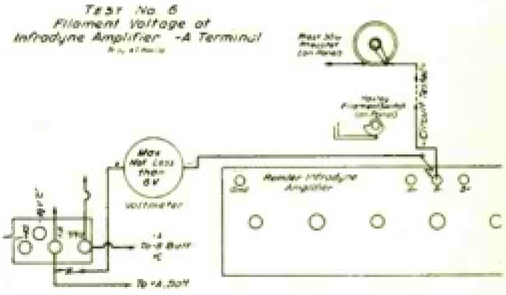
All tubes should be left out of their sockets as a precautionary measure.

The filament switch should be in the *ON* position.

The *A* battery should be connected as in Fig. 2.

The test voltmeter should read 6 volts.

If the voltmeter does not read 6 volts (1) The filament switch is defective or (2) The lead from the switch to the center panel rheostat is incomplete. This lead is indicated in the diagram.



TEST NO. 6—FILAMENT VOLTAGE

All tubes should be left out of their sockets as a protective measure.

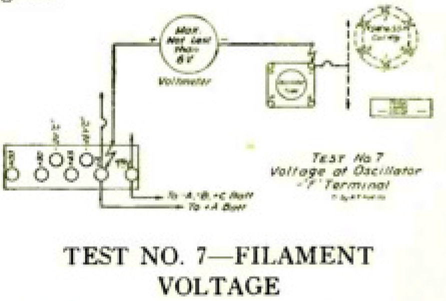
The *A* battery must be connected as in Fig. 2.

The filament switch should be in the *ON* position.

The center panel rheostat should be in the full *ON* position and the voltmeter should be temporarily disconnected.

The test voltmeter should read 6 volts.

If the test voltmeter does not read 6 volts (1) The center panel rheostat is defective or (2) The lead from the center panel rheostat to the Infradyne Amplifier minus *A* binding post is incomplete. This lead is indicated in the diagram.



TEST NO. 7—FILAMENT VOLTAGE

All tubes should be left out of their sockets as a protective measure.

The *A* battery must be connected as in Fig. 2.

The filament switch should be in the *ON* position.

The center panel rheostat should be in the full *ON* position and the panel voltmeter should be temporarily disconnected.

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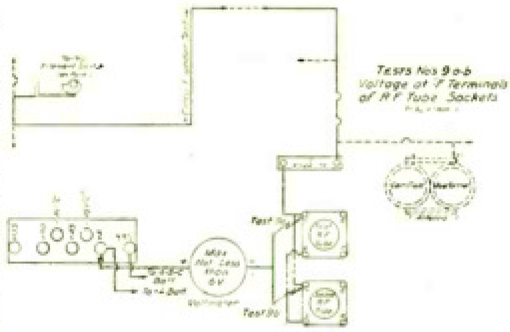
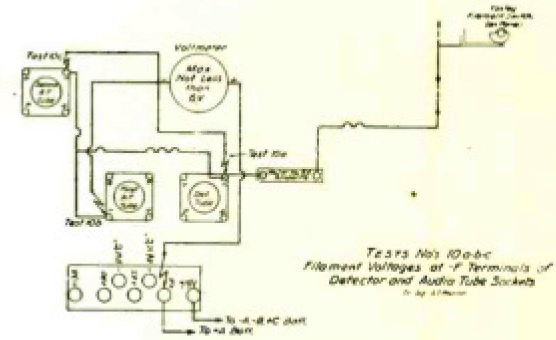
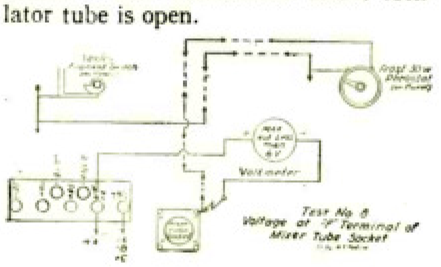
The test voltmeter should read 6 volts.

If the voltmeter does not read 6 volts (1) The center panel rheostat is defective or (2) The lead from the center panel rheostat to the minus *F* terminal of the oscillator tube socket is incomplete.

Note — In the original Infradyne the filament temperature of the oscillator tube was controlled by means of a 6V-199 Amperite. If this arrangement has been used, the test should be made with the oscillator tube in its socket. The test voltmeter should then read 3 volts. If the voltmeter does not read 3 volts it would indicate that the wiring from the filament switch to the Amperite is incomplete or that the Amperite is defective or that the filament of the oscillator tube is open.







TEST NO. 8—FILAMENT VOLTAGE

All tubes should be left out of their sockets as a protective measure.

The *A* battery must be connected as in Fig. 2.

The filament switch must be in the *ON* position.

The mixer tube rheostat (at the left hand end of the panel) should be in the full *ON* position.

The test voltmeter should read 6 volts.

If the voltmeter does not read 6 volts (1) The lead from the filament switch to the mixer tube rheostat is incomplete or (2) The mixer tube rheostat is defective or (3) The lead from the mixer tube rheostat to the minus *F* terminal of the mixer tube socket is incomplete. Both of the leads mentioned are indicated in the diagram.

TESTS NOS. 9 A-B—FILAMENT VOLTAGE

The first two radio frequency tubes should be inserted in their sockets.

The *A* battery must be connected as in Fig. 2.

The filament switch must be in the *ON* position.

Tests a and b should be made in natural sequence.

The voltmeter should read 5 volts in each test.

Test 9a.—If the voltmeter does not read 5 volts (1) The lead from the filament switch to the input side of the No. 112 Amperite is incomplete or (2) The No. 112 Amperite is defective or (3) The lead from the No. 112 Amperite to the minus *F* terminal of the first radio frequency tube socket is incomplete or (4) One or both of the radio frequency tube filaments is open.

Test 9b.—If the voltmeter does not read 5 volts (1) The lead from the No. 112 Amperite to the minus *F* terminal of the second radio frequency tube socket is incomplete or (2) One or both of the radio frequency tube filaments is open.

All leads mentioned are indicated in the diagrams.

Note—If rheostat control of the radio frequency tubes has been used, the tubes can be left out of their sockets during the test. The test will be made as above, the input side of the rheostat corresponding to the input side of the Amperite and the output side of the rheostat corresponding to the output side of the Amperite. The radio frequency tube rheostat should be turned all the way on during the test and the voltmeter should in each case read 6 volts.

TESTS NOS. 10 A-B-C—FILAMENT VOLTAGE

The detector and audio frequency tubes should be inserted in their sockets.

The *A* battery must be connected as in Fig. 2.

The filament switch must be in the *ON* position.

Tests a, b and c should be made in natural sequence.

The voltmeter should read 5 volts in each test.

Test 10a.—If the voltmeter does not read 5 volts (1) The lead from the filament switch to the input side of the No. 1 Amperite is incomplete or (2) The No. 1 Amperite is defective or (3) The lead from the No. 1 Amperite to the minus *F* terminal of the detector tube socket is incomplete or (4) The filament is open in one or more of the above listed tubes.

Test 10b.—If the voltmeter does not read 5 volts (1) The lead from the No. 1 Amperite to the minus *F* terminal of the first audio tube socket is incomplete or (2) The filament is open in one or more of the tubes listed above.

Test 10c.—If the voltmeter does not read 5 volts (1) The lead from the No. 1 Amperite to the minus *F* terminal of the second audio tube socket is incomplete or (2) The filament is open in one or more of the tubes listed above.

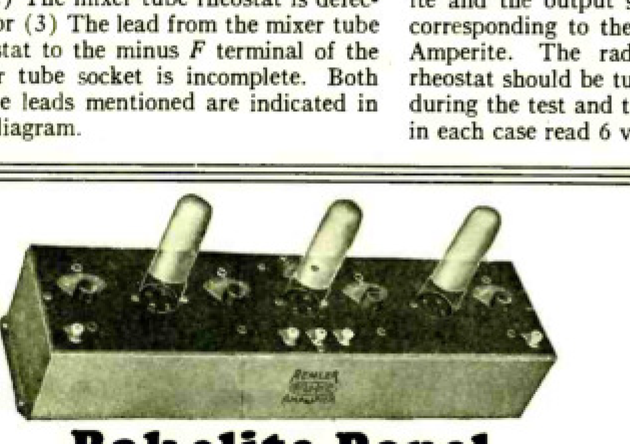
All leads mentioned have been indicated in the diagram.

TEST NO. 11—FILAMENT LEADS

All tubes may be left out of their sockets as a protective measure.

The *A* battery must be connected as in Fig. 2.

The filament switch should be in the *OFF* position.



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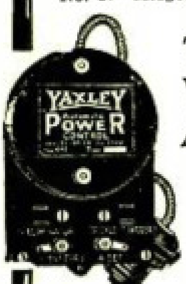

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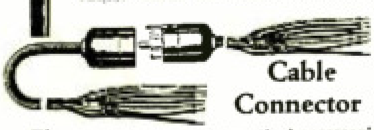

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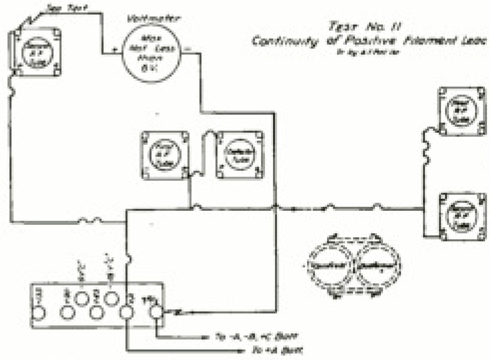
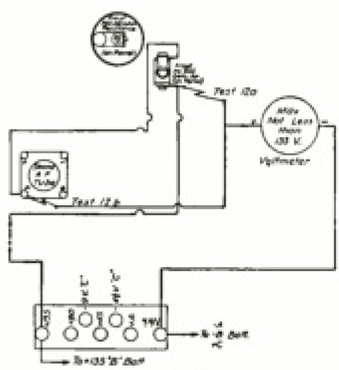


Test No. 11
Continuity of Positive Filament Lead

Connect the positive terminal of the test voltmeter to the positive terminal of each socket in turn and to the plus *A* binding post of the Infradyne Amplifier. The voltmeter should read 6 volts in each case.

If the voltmeter does not read 6 volts in any of the above tests, the lead from the plus *A* binding post on the binding post strip to the point to which the positive terminal of the test voltmeter is connected is incomplete.



Tests No's 12 a-b
Plate Voltage on Second Audio Frequency Tube

TESTS NOS. 12 A-B—PLATE VOLTAGE

All tubes should be left out of their sockets.

The *B* batteries must be connected as in Fig. 2.

The filament switch should be in the *OFF* position.

Tests a and b should be made in natural sequence .

Test 12a.—The voltmeter should read 135 volts. If the voltmeter does not read 135 volts the lead from the plus 135 volt binding post to the "Speaker" jack (Frost No. 953) is incomplete.

Test 12b.—The "Speaker" jack must be short-circuited (a phone plug whose circuit has been closed with a piece of wire can be used for this purpose). The voltmeter should read 135 volts. If the voltmeter does not read 135 volts (1) The "Speaker" jack is defective or (2) The lead from the "Speaker" jack to the plate terminal of the second audio tube socket is incomplete or (3) The "Speaker" jack has not been properly short-circuited.

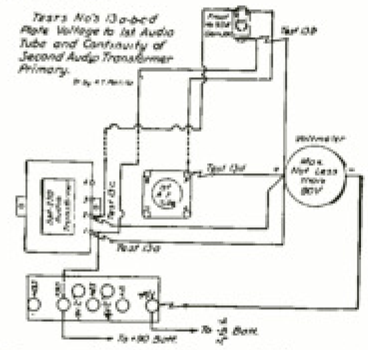
All leads mentioned have been indicated in the diagram.

TESTS NOS. 13 A-B-C-D—PLATE VOLTAGE

All tubes should be left out of their sockets as a protective measure.

The *B* batteries must be connected as in Fig. 2.

The filament switch may be in the *OFF* position.



Tests No's 13 a-b-c-d
Plate Voltage to 1st Audio Tube and Continuity of Second Audio Transformer Primary.

Tests a, b, c and d should be made in natural sequence.

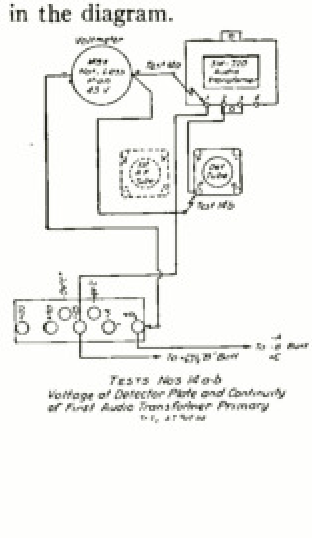
Test 13a.—The voltmeter should read 90 volts. If the voltmeter does not read 90 volts the lead from the plus 90 binding post to terminal No. 1 of the second audio transformer is incomplete.

Test 13b.—The voltmeter should read 90 volts. If the voltmeter does not read 90 volts, the lead from terminal No. 1 of the second audio transformer to the frame of the "Phone" jack is incomplete.

Test 13c.—The voltmeter should read 90 volts less the voltage drop due to the flow of the voltmeter current through the transformer primary. If the voltmeter does not read the correct voltage, the primary of the second audio transformer is open. The phones or phone plug should *NOT* be inserted in the "Phone" jack during test 13c.

Test 13d.—The voltmeter should read 90 volts less the voltage drop in the transformer primary due to the flow of the voltmeter current. If the voltmeter does not read the correct voltage (1) The lead from terminal No. 2 of the second audio transformer to the "Phone" jack is incomplete or (2) The "Phone" jack is defective or (3) The lead from the "Phone" jack to the plate terminal of the first audio tube socket is incomplete.

All leads mentioned have been indicated in the diagram.



Tests Nos 14 a-b
Voltage of Detector Plate and Continuity of First Audio Transformer Primary

TESTS NOS. 14 A-B—PLATE VOLTAGE

All tubes should be left out of their sockets as a protective measure.

The *B* batteries must be connected as in Fig. 2.

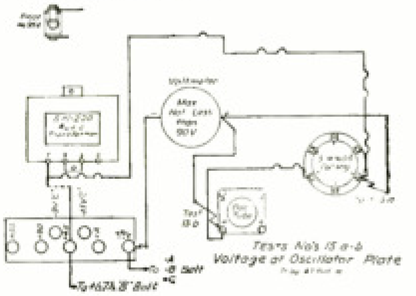
The filament switch may be in the *OFF* position.

Tests a and b should be made in natural sequence.

Test 14a.—The voltmeter should read 67½ volts. If the voltmeter does not read 67½ volts, the lead from the plus 45 binding post to terminal No. 1 of the first audio transformer is incomplete. (Remember that the plus 45 binding post is connected to the plus 67½ terminal of the *B* battery.)

Test 14b.—The voltmeter should read 67½ volts less the voltage drop due to the flow of the voltmeter current through the transformer primary. If the voltmeter does not read the correct voltage (1) The first audio transformer primary is open or (2) The lead from terminal No. 2 of the first audio transformer to the plate terminal of the detector tube socket is incomplete.

All leads mentioned have been indicated in the diagram.



TESTS NOS. 15 A-B—PLATE VOLTAGE

All tubes should be left out of their sockets as a protective measure.

The *B* batteries must be connected as in Fig. 2.

The filament switch may be in the *OFF* position.

Tests a and b should be made in natural sequence.

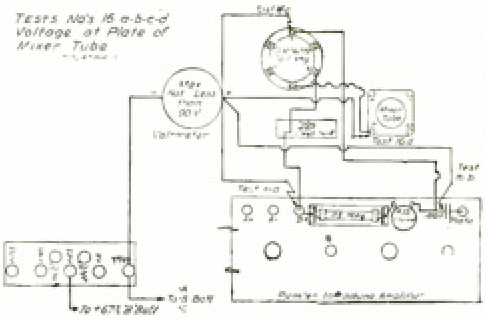
Test 15a.—The voltmeter should read 67½ volts. If the voltmeter does not read 67½ volts the lead from terminal No. 1 of the first audio transformer to terminal No. 6 of the tapped inductance is incomplete.

Test 15b.—The voltmeter should read 67½ volts. If the voltmeter does not read the correct voltage (1) Winding *5-6* of the tapped inductance is open or (2) The lead from terminal No. 5 of the tapped inductance to the plate terminal of the oscillator tube socket is incomplete.

All leads mentioned are indicated in the diagram.

TESTS NOS. 16 A-B-C-D—PLATE VOLTAGE

The mixer tube should be in its socket and the mixer tube rheostat should be adjusted so that 5 volts is applied to the mixer tube filament.



The *B* batteries must be connected as in Fig. 2.

The filament switch must be in the *ON* position.

Tests a, b, c and d should be made in natural sequence.

Test 16a.—The voltmeter should read 67½ volts. If the voltmeter does not read 67½ volts, the lead from terminal No. 6 of the tapped inductance to the plus *B* binding post of the Infradyne Amplifier is incomplete.

Test 16b.—The voltmeter should read 22½ volts. The exact reading of the voltmeter will depend upon the accuracy of the fixed resistor used; it should be in the neighborhood of the value given. If the voltmeter does not read the correct voltage (1) The Remler Choke Coil is open or (2) The fixed resistor is defective or (3) The circuit to the mixer tube plate is open and the plate current necessary to cause a voltage drop through the fixed resistor is not flowing. If the plate circuit to the mixer tube is open but the circuit through the choke coil and resistor is complete, the voltmeter in test 16b should read 67½ volts, less the voltage drop due to the flow of the voltmeter current.

Test 16c.—The voltmeter should read 22½ volts (subject, as before, to the accuracy of the fixed resistor). If a voltmeter having a low internal resistance per volt is used, the voltage drop due to the flow of the voltmeter current through the fixed resistor must be taken into account in tests b, c and d. If the voltmeter does not read the correct voltage, the lead from one side of the resistor to terminal No. 2 of the tapped inductance is incomplete.

Test 16d.—The voltmeter should read 22½ volts (making allowance as before for the accuracy of the fixed resistor and for the effect of the voltmeter current). If the voltmeter does not read the correct voltage (1) Winding *1-2* of the tapped inductance is open or (2) The lead from terminal No. 1 of the tapped inductance to the plate terminal of the mixer tube socket is incomplete.

All leads mentioned are indicated in the diagram.

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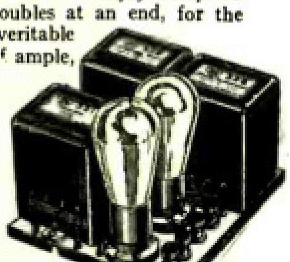

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TESTS NOS. 17 A-B-C-D—PLATE VOLTAGE

The first two radio frequency tubes must be in their sockets.

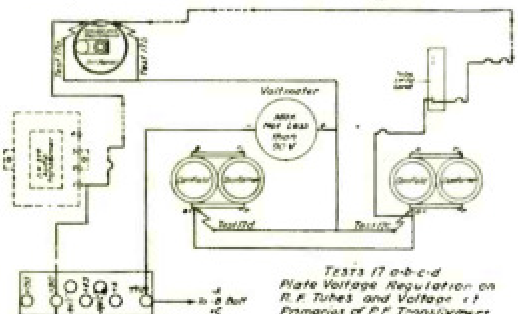
The *A* and *B* batteries must be connected as in Fig. 2.

The center panel rheostat should be in the *OFF* position.

The filament switch must be in the *ON* position.

Tests a, b, c and d should be made in natural sequence.

Test 17a.—The voltmeter should read 90 volts. If the voltmeter does not read 90 volts, the lead from the 90 volt binding post to the input side of the Frost 200,000 ohm resistance is incomplete.



Tests 17 a-b-c-d Plate Voltage Regulation on R.F. Tubes and Voltage at Primaries of R.F. Transformers

Test 17b.—The voltmeter reading should vary smoothly from approximately 90 volts to a minimum value as the 200,000 ohm resistance control knob is turned slowly over its whole range. If the voltage does not change smoothly and uniformly up to a maximum very close to 90 volts the resistance should be replaced with one having the desired characteristics.

Test 17c.—The 200,000 ohm resistance should be adjusted for the application of maximum plate voltage to the radio frequency tubes. The test voltmeter should read the maximum value obtained in test 17b. If the voltmeter does not read the correct value, the lead from the output side of the 200,000 ohm resistance to the plus *B* terminal of the second radio frequency transformer is incomplete.

Test 17d.—The 200,000 ohm resistance should be left as in test 17c and the voltmeter should again read the maximum value obtained in test 17b. If the voltmeter does not read the correct voltage, the lead from the plus *B* terminal of the second radio frequency transformer to the plus *B* terminal of the third radio frequency transformer is incomplete.

All leads mentioned are indicated in the diagram.

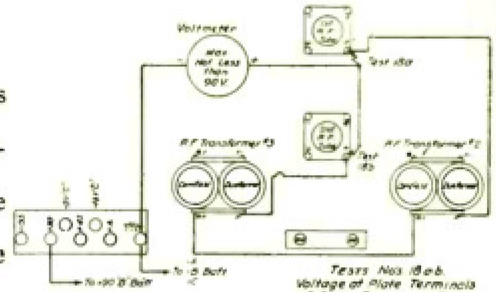
TESTS NOS. 18 A-B—PLATE VOLTAGE

All tubes should be left out of their sockets as a protective measure.

The *B* batteries must be connected as in Fig. 2.

The filament switch may be in the *OFF* position.

The 200,000 ohm resistance should be temporarily shorted out by means of a wire connected across its terminals.



Tests Nos 18 a-b Voltage of Plate Terminals of Radio Frequency Tubes

Tests a and b should be made in natural sequence.

Test 18a.—The voltmeter should read 90 volts. If the voltmeter does not read 90 volts (1) The primary of the second radio frequency transformer is open or (2) The lead from terminal *P* of the second radio frequency transformer to terminal *P* of the first radio frequency tube socket is incomplete.

Test 18b.—The voltmeter should read 90 volts. If the voltmeter does not read 90 volts (1) The primary of the third radio frequency transformer is open or (2) The lead from terminal *P* of the third radio frequency transformer to terminal *P* of the second radio frequency tube socket is incomplete.

All leads mentioned are indicated in the diagram.

TESTS NOS. 19 A-B-C-D—INFRADYNE AMPLIFIER

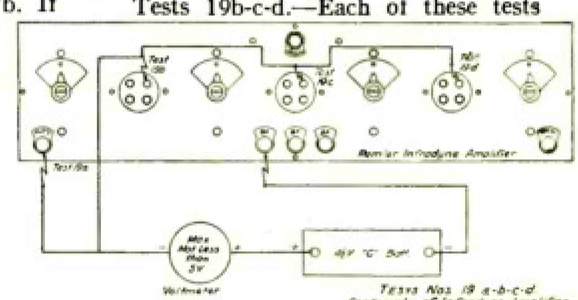
All batteries should be disconnected and the Infradyne Amplifier removed from the set.

The Infradyne Amplifier tubes should be left out of their sockets.

Tests a, b, c and d should be made in natural sequence.

Test 19a.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the Infradyne Amplifier input primary circuit is open.

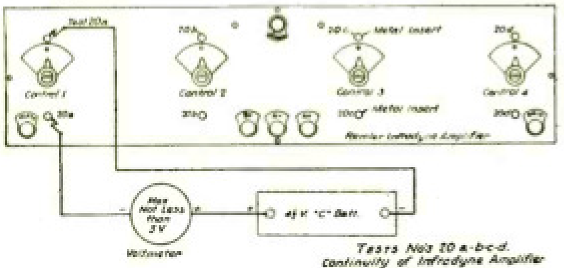
Tests 19b-c-d.—Each of these tests checks the continuity of a primary circuit. The voltmeter should read the *C* battery voltage in each case; if it does not, the primary circuit under test is open.



Tests Nos 19 a-b-c-d Continuity of Infradyne Amplifier Primary Circuits

During each of these tests the Amplifier should be jarred slightly so that any contact which may be made by one wire merely resting against the other will be broken. A loose contact of this kind will be indicated by fluctuation of the voltmeter pointer or by failure of the voltmeter to continue to register. Be sure that fluctuation of the voltmeter pointer is not due to poor contact outside of the Amplifier.

If in these tests the Amplifier proves to have an open circuit it should be returned to the manufacturer for adjustment through the channels through which purchase was made.



Tests Nos 20 a-b-c-d. Continuity of Infradyne Amplifier Secondary Circuits.

TESTS NOS. 20 A-B-C-D—INFRADYNE AMPLIFIER

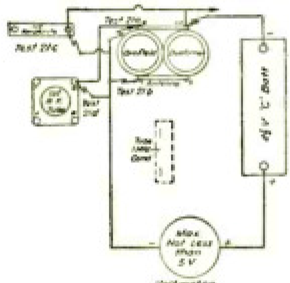
All batteries should be disconnected and the Infradyne Amplifier removed from the set.

The Infradyne Amplifier tubes should be left out of their sockets.

Tests a, b, c and d should be made in natural sequence, that is, the test terminals should be connected first across points 20a, then across points 20b, 20c and 20d in turn.

Each of these tests is a check on the continuity of a secondary circuit. The voltmeter should read the *C* battery voltage in each case. If in any of the four tests the voltmeter does not read the *C* battery voltage, it is an indication that the secondary circuit under test is open.

Should one of the secondaries prove to be open the Amplifier should be returned to the manufacturer for adjustment as described under Test 19.



Tests Nos 21a-b-c-d Continuity of Antenna Coil Windings.

TESTS NOS. 21 A-B-C-D—ANTENNA COIL

All tubes may be left out of their sockets.

All battery leads should be disconnected.

The filament switch may be in the *OFF* position.

Tests a, b, c and d should be made in natural sequence.

Test 21a.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage the antenna coil is open (possibly at a point where it is connected to a terminal lug).

Test 21b.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, that part of the antenna coil between the minus *F* terminal and terminal No. 1 is open.

Test 21c.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead between the minus *F* terminal of the antenna coil (radio frequency transformer No. 1) and the No. 112 Amperite is incomplete.

Test 21d.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage (1) The antenna coil is open or (2) The lead between terminal *G* of the antenna coil and terminal *G* of the first radio frequency tube socket is incomplete.

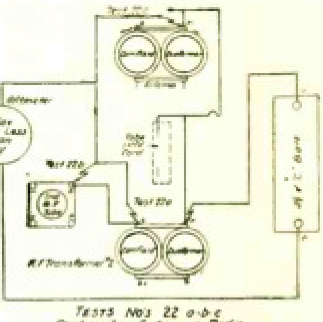
All leads mentioned are indicated in the diagram.

TESTS NOS. 22 A-B-C—R. F. TRANSFORMER

All tubes may be left out of their sockets.

All battery leads should be disconnected.

The filament switch may be in the *OFF* position.



Tests Nos 22 a-b-c Continuity of Second Radio Frequency Transformer Secondary

Tests a, b and c should be made in natural sequence.

Test 22a.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the secondary of the second radio frequency transformer is open.

Test 22b.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage (1) The secondary of r. f. transformer No. 2 is open or (2) The lead from terminal *G* of r. f. transformer No. 2 to terminal *G* of the second radio frequency tube socket is incomplete.

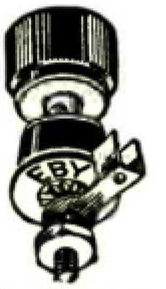
Test 22c.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from the minus *F* terminal of r. f. transformer No. 2 to the minus *F* terminal of the antenna coil is incomplete.

All leads mentioned have been indicated in the diagram.

TESTS NOS. 23 A-B-C—R. F. TRANSFORMER

All tubes may be left out of their sockets.

All battery leads should be disconnected.



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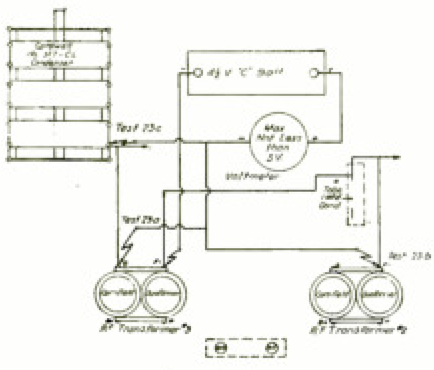


Tests No's 23 a-b-c Continuity of Third Radio Frequency Transformer Secondary

The filament switch may be left in the *OFF* position.

Tests a, b and c should be made in natural sequence.

Test 23a.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the secondary of r. f. transformer No. 3 is open (possibly at a point where contact should be made with a terminal lug).

Test 23b.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from the minus *F* terminal of r. f. transformer No. 3 to the minus *F* terminal of r. f. transformer No. 2 is incomplete.

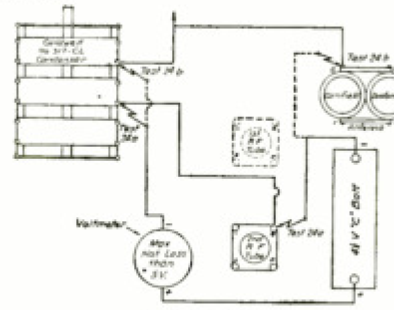
Test 23c.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage (1) The secondary of r. f. transformer No. 3 is open or (2) The lead from terminal *G* of r. f. transformer No. 3 to the rear stator section of the gang condenser is incomplete.

All leads mentioned are indicated in the diagram.

TESTS NOS. 24 A-B—GRID CIRCUIT

All tubes may be left out of their sockets.

All battery leads should be disconnected.



Tests No's 24 a-b Continuity Radio Frequency Grid Circuits.

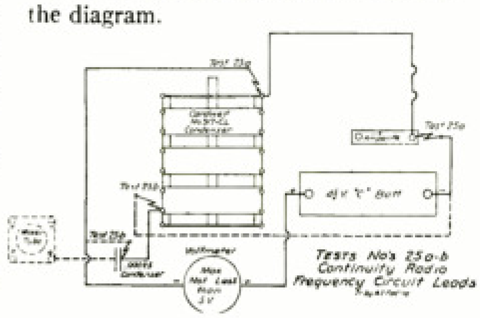
The filament switch may be in the *OFF* position.

Tests a and b should be made in natural sequence, that is, the test terminals should first be connected across points 24a and then across points 24b.

Test 24a.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from terminal *G* of the second radio frequency tube socket to the center stator section of the gang condenser is incomplete.

Test 24b.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from terminal *G* of the antenna coil to the front stator section of the gang condenser is incomplete.

All leads mentioned are indicated in the diagram.



Tests No's 25 a-b Continuity Radio Frequency Circuit Leads

TESTS NOS. 25 A-B—R. F. LEADS

All tubes may be left out of their sockets.

All battery leads should be disconnected.

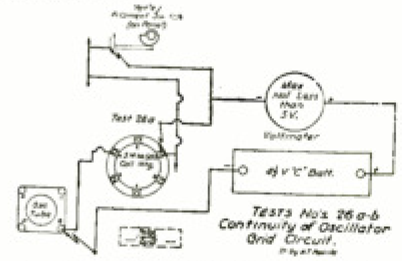
The filament switch may be in the *OFF* position.

Tests a and b should be made in natural sequence, that is, the test terminals should first be connected across points 25a and then across points 25b.

Test 25a.—The voltmeter should read the *C* battery voltage. If not, the lead from the No. 112 Amperite to the gang condenser rotor is incomplete.

Test 25b.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from the rear stator section of the gang condenser to the mixer tube grid condenser is incomplete.

All leads mentioned are indicated in the diagram.



Tests No's 26 a-b Continuity of Oscillator Grid Circuit.

TESTS NOS. 26 A-B—GRID CIRCUIT

All tubes may be left out of their sockets.

All battery leads should be disconnected.

The filament switch may be in the *OFF* position.

Tests a and b should be made in natural sequence.

Test 26a.—The voltmeter should read the *C* battery voltage. If not, (1) The lead from terminal *G* of the oscillator tube socket to terminal No. 4 of the tapped inductance is incomplete or (2)

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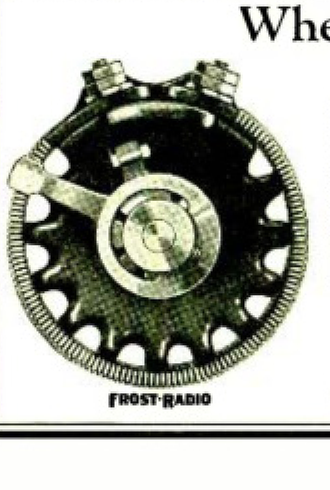

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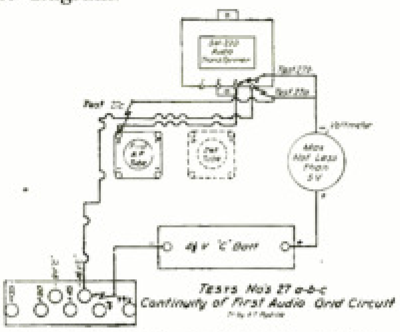
Winding 3-4 of the tapped inductance is open.

Test 26b.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from terminal No. 3 of the tapped inductance to the filament switch is incomplete.

All leads mentioned are indicated in the diagram.



Tests No's 27 a-b-c Continuity of First Audio Grid Circuit

TESTS NOS. 27 A-B-C—GRID CIRCUIT

All tubes may be left out of their sockets.

All battery leads should be disconnected.

The filament switch may be in the *OFF* position.

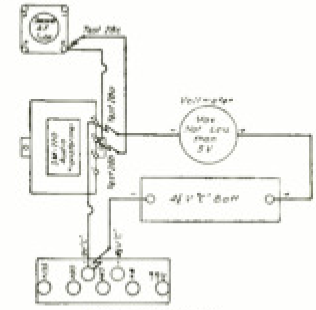
Tests a, b and c should be made in natural sequence.

Test 27a.—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from the minus 4½ volt *C* battery binding post to terminal No. 4 of the first audio transformer is incomplete.

Test 27b.—The voltmeter should read the *C* battery voltage less the voltage drop due to the flow of the voltmeter current through the first audio transformer secondary. If the voltmeter does not read the correct voltage, the secondary of the first audio transformer is open.

Test 27c.—The voltmeter should read the *C* battery voltage less the voltage drop due to the flow of the voltmeter current through the first audio transformer secondary. If the voltmeter does not read the correct voltage, the lead from terminal No. 3 of the first audio transformer to terminal *G* of the first audio tube socket is incomplete.

All leads mentioned are indicated in the diagram.



Tests No's 28 a-b-c Continuity of Second Audio Grid Circuit

TESTS NOS. 28 A-B-C—GRID CIRCUIT

All tubes may be left out of their sockets.

All battery leads should be disconnected.

The filament switch should be in the *OFF* position.

Tests a, b and c should be made in natural sequence.

Test 28a—The voltmeter should read the *C* battery voltage. If the voltmeter does not read the *C* battery voltage, the lead from the minus 9 volt *C* battery binding post to terminal No. 4 of the second audio transformer is incomplete.

Test 28b.—The voltmeter should read the *C* battery voltage less the voltage drop due to the flow of the voltmeter current through the second audio transformer secondary. If the voltmeter does not read the correct voltage, the second audio transformer secondary is open.

Test 28c.—The voltmeter should read the *C* battery voltage less the voltage drop due to the flow of the voltmeter current through the second audio transformer secondary. If the voltmeter does not read the correct voltage, the lead from terminal No. 3 of the second audio transformer to terminal *G* of the second audio tube socket is incomplete.

The foregoing tests do not offer a check on the continuity of several short leads. These are listed below and can be checked without the aid of any supplementary apparatus.

(a) The lead from terminal No. 4 of the tapped inductance to one side of the oscillator tuning condenser.

(b) The lead from the plate terminal of the oscillator tube socket to one side of the .0005 mfd. fixed condenser in series with the oscillator tuning condenser.

(c) The lead from the output side of the filament switch to the grounding lug on the oscillator condenser.

(e) Trimmer condenser leads. Note: The rotors of the trimmer condensers should be connected to the rotor of the gang condenser.

(f) Voltmeter connections.

(g) The lead from terminal No. 3 of the tapped inductance to one side of the 1 mfd. by-pass condenser which is located in front of the Infradyne Amplifier.

(h) The lead from the mixer tube grid condenser to the grid terminal of the mixer tube socket.

(i) Leads from the mixer tube grid leak mounting to the plus *F* and *G* terminals of the mixer tube socket.

(j) The lead from the "Grid" binding post of the Infradyne Amplifier to the detector grid condenser.

All condensers should be examined to make sure that they are not short-circuited or leaky, or that they are not seriously off rated capacity when they are used in positions such that their accuracy is of importance. The fixed condensers used in the Infradyne include (1) Two grid condensers of .00025 mfd. capacity each (2) One .0005 mfd. condenser in series with the oscillator tuning condenser; the accuracy of this condenser is of importance (3) One .001 mfd. condenser connected between the Infradyne Amplifier "Plate" binding post and terminal No. 2 of the tapped inductance. (4) One .0001 mfd. condenser connected in series with the antenna. (5) Two 1 mfd. by-pass condensers.

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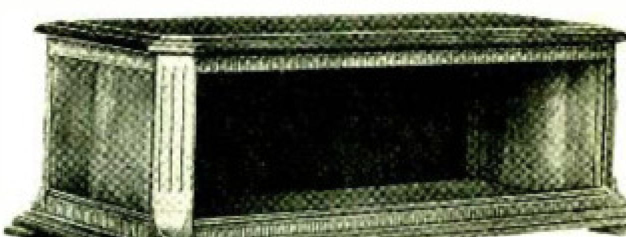

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If volume should be lacking in the receiver a check should also be made on the trimmer condensers to be sure that no leakage is occurring in them; such leakage would be particularly apt to occur if excessive amounts of soldering flux had been used.

Noisy operation is sometimes caused by defective grid leaks. If such trouble is experienced, therefore, this source should be investigated.

INFRADYNE OPERATION FROM SOCKET POWER

B eliminators can be most successfully used with the Infradyne. They are particularly desirable when a CX-371 or UX-171 tube is to be used in the last audio stage. As the Infradyne employs 10 tubes, the eliminator must be capable of supplying more current than one to be used with a smaller set of say 5 or 6 tubes. The average maximum plate current required by the Infradyne will be approximately 35 milliamperes; under certain unusual conditions this may momentarily rise to as much as 40 milliamperes. Under normal operating conditions the plate current drain will be approximately 25 milliamperes. Most eliminators will be capable of delivering this output easily but in order to insure freedom from hum or so-called "motor boating" it is necessary that the eliminator be capable of delivering several times the maximum required current. An eliminator capable of delivering from 60 to 80 milliamperes at the required voltages will be found most satisfactory.

We will assume that an eliminator having binding posts labeled 45, 90, 130 and "power" is to be used. Certain precautions must be taken in order to insure freedom from instability due to slight variations in terminal voltage. With such an eliminator the Infradyne Amplifier and oscillator tubes would be supplied from the 130 volt section, as well as the first two radio frequency tubes and the first audio frequency tube. As the stability of the radio frequency stages of the Infradyne is controlled by means of a 200,000 ohm resistance inserted in series with the common plus *B* lead to the first two tubes, and as variation of the 200,000 ohm resistance results in variation in the plate voltage applied to the first two radio frequency tubes, and consequently in the current they require, changes in the voltage applied to the Infradyne Amplifier and oscillator tubes will occur at such times as 200,000 ohm resistance is adjusted. This situation arises from the fact that any variation in the current drain from an eliminator results in variation in its terminal voltages. As the Infradyne Amplifier is adjusted for best results at a fixed plate voltage any such variation in the plate voltage applied to its terminals is undesirable. For this reason special precautions must be taken to maintain the voltage constant. A CX-374 tube connected across the eliminator section supplying the Infradyne Amplifier, oscillator and radio frequency tubes has been tried and found entirely satisfactory. The CX-374 tube will be found to draw in the neighborhood of 20 milliamperes. This additional current drain must be taken into account in considering the eliminator capacity.

The current drain on an eliminator 90 volt section may prove so large that the terminal voltage of this section is dropped to too low a value. Should this be the case it will probably be possible to use the eliminator section having the next highest voltage rating. As an example of this case may be mentioned the General Radio Eliminator which makes use of a Raytheon BH tube. This eliminator has binding posts labelled 45, 90, 130 and "power." The Infradyne 90 volt binding post was connected to the eliminator 130 volt binding post. A CX-374 tube was connected between the eliminator 130 volt binding post and the eliminator minus *B* binding post. In this particular instance, a 12,000 ohm fixed resistance was connected between the eliminator "power" binding post and the negative binding post in order to further drop the voltage. Any resistance used for this purpose should have a current carrying capacity of about 30 or 40 milliamperes.

With the General Radio *B* eliminator mentioned above, the first two radio frequency tubes, the Infradyne Amplifier and oscillator tubes, and the first audio tube were all supplied from the eliminator 130 volt section. The voltage to the Infradyne Amplifier and oscillator was dropped by means of a variable high resistance mounted inside of the receiver. A Bradleyohm can, for instance, be used for this purpose. It should have a resistance of approximately 5,000 ohms at the center of its operating range. To prevent undesirable coupling this resistance should be by-passed with a condenser of not less than 1 mfd. capacity. The mixer and detector tubes were supplied from the eliminator 45 volt section. This eliminator section is designed to supply 1 tube only. The additional drain placed on it drops the voltage to approximately 25 volts, which is very close to the voltage desired.

With those eliminators having separate binding posts labelled for all the various voltages desired in the Infradyne the procedure outlined above will of course be unnecessary. Should such an eliminator be used it is recommended that a separate *B* battery lead be taken out for the mixer and detector tubes as well as for the Infradyne Amplifier and oscillator tubes. The CX-374 glow tube mentioned previously can again be used to decided advantage.

In order to obtain maximum results from a *B* eliminator a voltmeter suitable for measuring *B* eliminator output voltages should be available. This voltmeter should have a high resistance per volt so that the current required by it will not cause a drop in the eliminator terminal voltage. A voltmeter particularly suited to this purpose is the Weston model 489 which has a resistance of 1000 ohms per volt and which requires a negligible current for its operation.

OPERATION AS A FIVE TUBE RECEIVER

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ing the tuned radio frequency stages and the audio frequency amplifier without the Infradyne and oscillator being in the circuit. After the five tube radio tuned frequency set thus obtained has been made to function properly and smoothly the Infradyne amplifier and oscillator can be returned to the circuit and the complete Infradyne put into operation.

The Infradyne can be considered as a five tube, single dial control, tuned radio frequency set to which the Infradyne amplifier and frequency changing circuit have been added. It is obvious that the five tube set must function properly before maximum results can be obtained from the complete Infradyne.

Remove from their sockets the four '99 tubes and the detector tube (the detector tube is the tube located between the first S-M audio transformer and the Infradyne Amplifier). Remove the .05 megohm resistor from its holder. Run a jumper wire from the mixer tube plate side of the Remler No. 35 Choke Coil to the plate terminal of the detector socket (the plate terminal is the one marked "P"). The jumper wire need not be soldered but may be temporarily connected. Any insulated wire will serve. Care must be exercised to see that an uninsulated part of it does not come into contact with the copper can in which the Infradyne Amplifier is enclosed, as damage would result.

The antenna and ground should now be connected and the loud speaker plugged in. If possible use an antenna 70 or 80 feet long for this test.

The set is now ready for operation as a five tube receiver. Turn off the rheostat under the voltmeter and turn the mixer tube rheostat (at left hand end of the panel) nearly all the way on, that is, nearly to the position at which the mixer tube filament becomes brightest. Set the Silver-Marshall trimmer inside of the set so that the plates are from ⅓ to ½ fully meshed. Turn the volume control (Frost 200,000 ohm resistance) about ¾ of the way on. Now rotate the left hand gang condenser dial slowly to tune in a local station.

If a series of tweets, or "birdies," is heard as the gang condenser dial is rotated it is an indication that the radio frequency stages are oscillating. This oscillation can be stopped by turning the volume control back; that is, by reducing the plate voltage applied to the radio frequency tubes. For maximum selectivity and sensitiveness, the volume control should, for any setting of the gang condenser dial, be turned to the point just below that at which oscillation occurs.

When a local station has been tuned in, set the volume control to the point just below that at which oscillation occurs. Note the settings of the panel trimmer condensers. Now vary the settings of the panel trimmers slightly and then turn the gang condenser dial backward and forward past the point at which it was set. Is there a "birdie" as the station setting is passed? If there is, the radio frequency circuits have been tuned more nearly to resonance by adjustment of the trimmers and have gone into oscillation. If this has occurred, turn the volume control back to the point just below that at which oscillation takes place. Remember that oscillation will be evidenced by "birdies" as the gang condenser dial is rotated.

Now note the new settings of the panel trimmer condensers. Repeat the above procedure until settings of the panel trimmer condensers are found such that their further adjustment does not throw the radio frequency stages into oscillation. When these settings of the panel trimmer condensers have been found readjust the gang condenser dial for maximum volume from the local station. If the gang condenser sections are uniform the panel trimmer condensers should need but little adjustment in tuning from the low to the high broadcast wavelengths.

All three radio frequency stages are now assumed to be in resonance, that is, to respond to the same frequency or wavelength. *This is the condition for maximum* selectivity and sensitiveness. As the gang condenser dial is rotated past the setting for a station the station should tune in and out sharply (remember that the volume control must be set at the point just below that at which oscillation occurs; the farther it is from this point the broader the tuning will be). If the approach to the station is rather broad, the trimmer condensers and volume control should be more accurately adjusted in accordance with the procedure outlined above.

If the radio frequency stages have been properly constructed and adjusted it should be possible to bring them into oscillation at any wavelength in the broadcast band. If construction has been poor or if the circuits have not been properly tuned to resonance it will not be possible to bring them into oscillation at the longer broadcast wavelengths; the result will be lack of selectivity and volume at these wavelengths.

Log stations over the entire wavelength band if possible. The dial settings for these stations will be useful when the complete Infradyne is to be put into operation.

It is well worth while to operate the five tube tuned radio frequency part of the set for a few days before connecting up the complete Infradyne. Be sure that this part of the set is functioning perfectly and that a certain amount of

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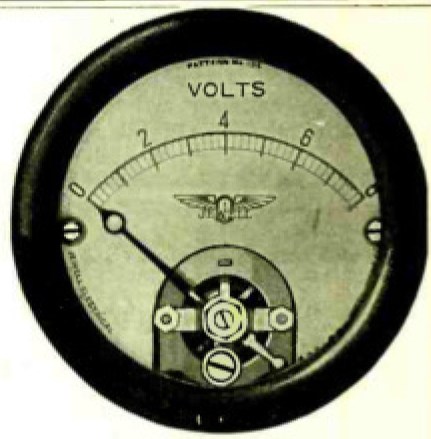

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familiarity with it has been gained before the change is made.

If trouble is experienced in getting the tuned radio frequency part of the Infradyne to operate as it should, make the tests previously outlined. If the tuned radio frequency receiver is functioning properly, return the Infradyne Amplifier and frequency changer to the circuit as follows:

Remove the temporary jumper connected between the Remler No. 35 Choke Coil and the plate terminal of the detector tube socket. Return the .05 megohm resistor to its holder. Put all of the tubes into their respective sockets. Turn the center panel rheostat on and adjust it until the voltmeter indicates 3 volts. The antenna, ground, and loud speaker are, of course, to be left connected as before.

Set the oscillator dial as follows: (Note: these directions apply only when a Remler .00035 mfd. Condenser and a National Type B, CCW Dial have been used with a Silver-Marshall No. 110-B Coil.)

Turn the oscillator condenser to the wide open position, that is, set it for minimum capacity. With the condenser in this position turn the dial to 150 and fasten it securely to the condenser shaft by means of the set screw.

Now turn the Cardwell gang condenser dial to about 30, being sure that the trimmers are correctly adjusted in accordance with the above instructions, and turn the volume control all the way on. This should throw the radio frequency stages into oscillation although nothing may be heard unless the Cardwell condenser happens to be adjusted for a local station which is transmitting. If this should be the case, shift the dial a little. Slowly turn the oscillator dial over the entire scale. At six or seven points on the oscillator dial squeals or "birdies" should be heard. These squeals are caused by heterodyning between the oscillator fundamentals and harmonics and the fundamental and harmonics of the oscillating radio frequency stages. If the squeals are not heard as described, two things are possible (1) the radio frequency stages are not oscillating or (2) the oscillator is not functioning. Momentarily make the change to the five tube hook-up to see if the radio frequency stages are oscillating. If they are, return the Infradyne Amplifier to the circuit again without changing the positions of the trimmers or volume control. If the difficulty is due to failure of the oscillator to function try another tube, or make sure that the one used is in good condition, and make circuit tests Nos. 7, 15, 16, and 26.

Having caused the oscillator to operate properly turn down the volume control until the radio frequency stages are no longer oscillating. We are now ready to adjust the Infradyne Amplifier tuning controls and "Increase" screw. Using the wooden wedge furnished with the Infradyne Amplifier, set the four Amplifier tuning controls to zero and turn the "Increase" screw about two-thirds of the way out. Set the oscillator condenser for minimum capacity and then slowly rotate the oscillator dial in the *decrease* direction (decreasing according to dial numbers but increasing according to capacity.) When the dial has been turned through about 50 degrees (so that it reads about 100) a point will be found at which a sound will come out of the speaker. It will sound as if the condenser might be short-circuiting or scraping or it may make the speaker howl. This sound will be spread over perhaps four or five degrees. This setting of the oscillator dial is that at which the oscillator frequency equals that of the Infradyne Amplifier. It may be used as a guide to the right oscillator settings for use in operating the receiver because the setting for 545 meters will fall about 20 or 25 degrees lower on the dial (say at 75 or 80).

The following is a typical log of the Infradyne oscillator condenser. In obtaining data for this table a Silver-Marshall No. 110-B Coil was used as an oscillator coupler. (The No. 110-B Coil wound with enameled wire must be used; the earlier model of this coil, which was wound with silk-covered wire, will not be satisfactory.) The fixed condenser in series with the .00035 mfd. Remler tuning condenser was of exactly .0005 mfd. capacity. The oscillator settings may vary 10 degrees or more, depending upon the accuracy of this fixed condenser.

Dial Setting	*Wavelength*
30	225
38	250
53	300
69	400
80	500
105	"Interference Point."

Using this table and the settings previously obtained for the gang condenser dial tune in a local station. Don't forget to turn up the volume control, not so that oscillations occur, but a little before that point. If everything is in good condition it should be possible to tune some one in easily. Adjust the trimmers and then turn down the volume control until the station is just comfortably audible. The Infradyne Amplifier tuning controls can now be adjusted more accurately. With the Infradyne Amplifier so placed that the "Increase" screw is away from you consider the tuning knobs, reading from the left, as numbers one, two, three and four.

Leaving knob number two set at zero adjust knob number three for maximum signal strength while slowly rotating the oscillator dial backward and forward over a few degrees. Next set knob number one for maximum signal strength while rotating the oscillator dial backward and forward slowly as before. Having adjusted knobs one, two and three, it remains only to find the correct setting for knob number four. While adjusting knob number four the oscillator dial should be slowly turned backward and forward as in the preceding cases. Knob number four will be found to tune quite broadly.

Now tune in a station at least 500 miles distant and check the settings of all four knobs. The circuit controlled by knob number two will determine the intermediate frequency to be used and the Amplifier circuits should be adjusted with knob number two set at zero. Use the wooden wedge furnished with the Amplifier in making all adjustments.

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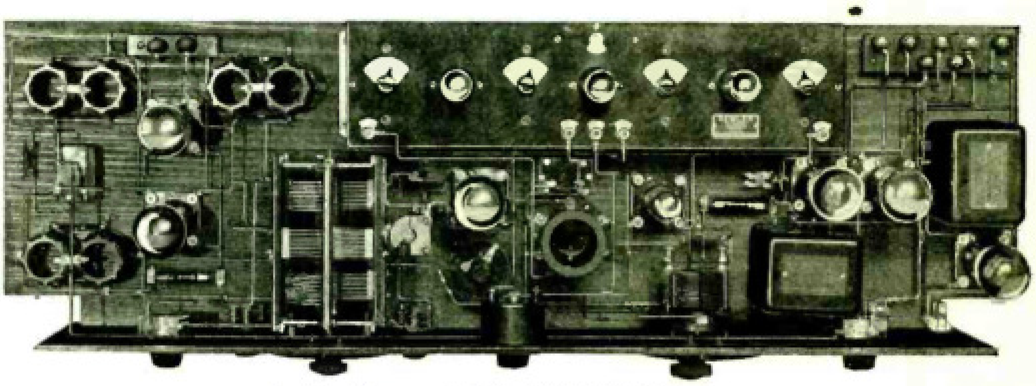
City and State..

If adjustment of the Infradyne Amplifier tuning controls throws the Amplifier into oscillation, this oscillation can be stopped by turning "Increase" screw outward. In order that the proper setting of the "Increase" screw may be found, the four Infradyne Amplifier tuning controls must first have been correctly set. It is assumed that final adjustment of the Amplifier tuning controls has been made on a station at least 500 miles distant. While this station is being received, with the right hand turn the oscillator dial several times back and forth across the station setting and note the volume. Continue to do this and with the left hand slowly turn down the "Increase" screw. The volume should become greater as the "Increase" screw is turned down and the character of the oscillator dial "crossing" should gradually change from a rather broad, weak cross to a louder, sharp "zip" as the amplification comes up to a peak. DO NOT USE PLIERS TO TURN THE "INCREASE" SCREW. USE THE FINGERS ONLY.

Front View of Infradyne in Decorative Cabinet.



Looking Down on the Completely Wired Receiver.

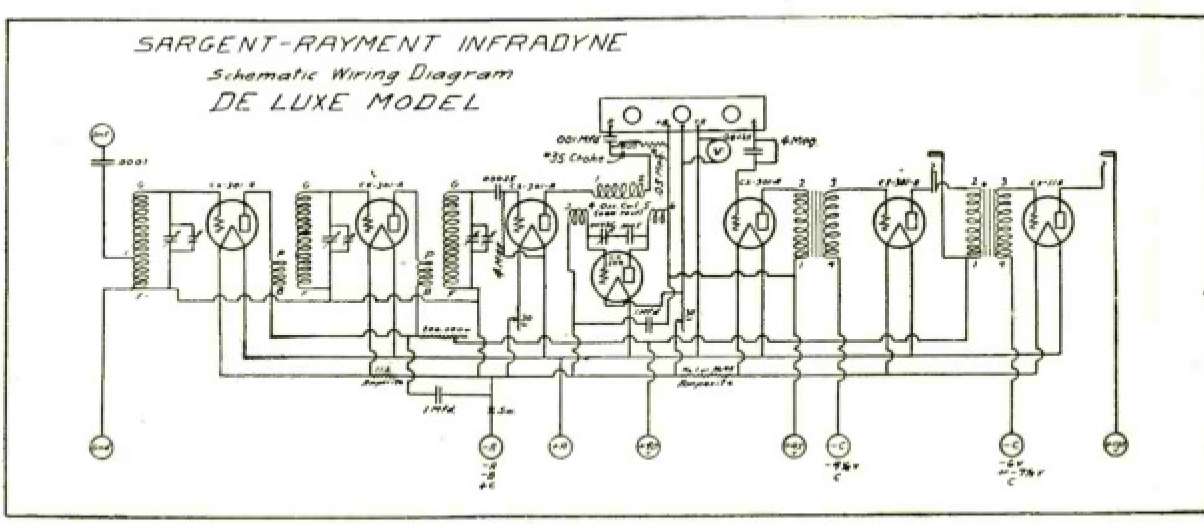
When the "Increase" screw has been turned down far enough the Amplifier should break into oscillation. When this happens, loosen the "Increase" screw until the oscillation ceases; it may then be left alone.

If turning the "Increase" screw down will not bring the Amplifier up to the point of oscillation, test your tubes. If they are not good the Amplifier will not oscillate. Also be sure that the right *B* battery voltage has been applied to the Amplifier. Everything else being in good shape, if the Amplifier will not come up to the point of oscillation the following procedure can be followed:

Disconnect from the Infradyne Amplifier plus *B* binding post the wire to terminal No. 6 of the tapped inductance. Connect a 10 ohm bakelite base rheostat in series with the wire that has been disconnected and the Amplifier plus *B* binding post. This rheostat must be mounted by means of a bracket directly on the Amplifier plus *B* binding post. The insertion of this rheostat is very desirable in many cases. With the filaments at three volts it will probably be found that the inclusion of only a few turns of the rheostat will bring the Amplifier up to the peak of amplification. The rheostat and "Increase" screw should be used in conjunction and adjusted for best results.

The more nearly the Infradyne Amplifier has been brought up to the peak of amplification through correct adjustment of the "Increase" screw (or of the "Increase" screw and the 10 ohm rheostat) the sharper the Amplifier circuits will tune.

The correct position for the 10 ohm rheostat in series with the Amplifier plus *B* lead is indicated by a small cross in the pictorial wiring diagram.



Schematic Wiring Diagram of the Improved Infradyne

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CLAROSTAT, the greatest variable resistor, again plays a leading role.

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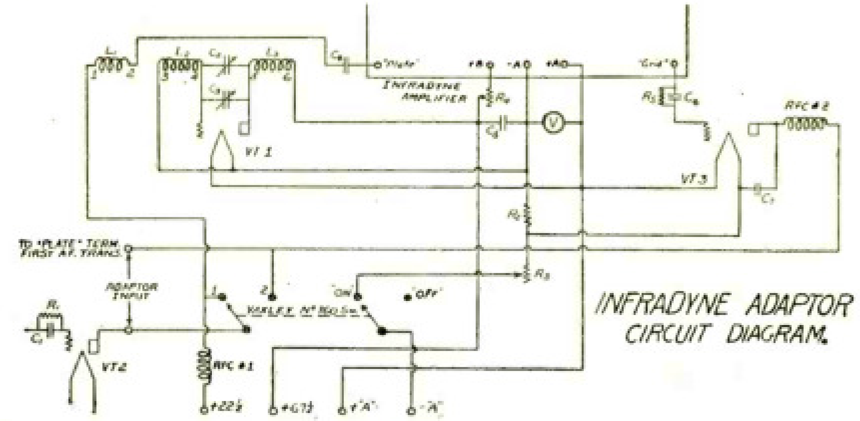
INFRADYNE ADAPTOR CIRCUIT DIAGRAM



VT 1	Oscillator Tube—CX 299 (UX 199).
VT 2	Mixer Tube—CX 300A (UX 200A) or CX 301A (UX 201A).
VT 3	Detector Tube—CX 301A (UX 201A).
R_1	Grid Leak—4 or 5 megohms.
R_2	Fixed Resistance—8 ohms (Yaxley No. 808).
R_3	Rheostat—10 ohm, panel mounting.
R_4	Rheostat—10 ohm, bakelite base.
R_5	Grid Leak—4 megohm.
C_1	Fixed Condenser—.00025 mfd.
C_2	Remler Twin Rotor Condenser—Type 659 of .0001 mfd. capacity (set for low minimum).
C_3	X-L Vario Denser Model G-1 (see special directions below for adjustment).
C_4	Fixed Condenser—.001 mfd.
C_5	By-Pass Condenser—1 mfd.
C_6	Fixed Condenser—.00025 mfd. (with grid leak clips).
C_7	Fixed Condenser—.00025 mfd.
RFC #1	Radio Frequency Choke—Remler No. 35.
RFC #2	Radio Frequency Choke—Remler No. 35.
L_1, L_2, L_3	Windings of tapped inductance wound with #24 dsc. wire on 1½-inch diameter. Spacing between pick-up and grid coils is 3/16 inch and spacing between grid and plate coils is 1/16 inch. See page 14 of Infradyne Manual, October 1, 1926 Edition, for order of terminals.
L_1	Pick-up Coil of Tapped Inductance (8 turns).
L_2	Grid Coil of Tapped Inductance (14 turns).
L_3	Plate Coil of Tapped Inductance (14 turns).
V	Voltmeter (0-5 volt range).

Directions for Adjusting the X-L Vario Denser.—The X-L Vario Denser should be adjusted so that the oscillator dial will read zero for the lowest wavelength station to be received (200 meters). The gang condenser should therefore be set for 200 meters, the oscillator condenser set at maximum capacity (plates fully meshed), and the oscillator dial set at zero. The X-L Vario Denser capacity should then be increased from minimum, by turning the adjusting screw downward, until the 200 meter signal is brought in best. It is assumed that the Infradyne Amplifier circuits have been adjusted as described in Infradyne Bulletin No. 1.

If there is no 200 meter station within receiving range, set the gang condenser dial for a station on a wavelength as near 200 meters as possible. Arbitrarily set the oscillator dial at about five degrees and by varying the capacity of the Vario Denser as above, tune the station in with maximum volume. Now set the gang condenser dial for the highest wavelength station to be received and adjust the oscillator dial. If it is found that the highest wavelength station cannot be tuned in on the oscillator dial it is an indication that the X-L Vario Denser has been set for too high capacity. In this case the Vario Denser adjusting screw should be turned out slightly.

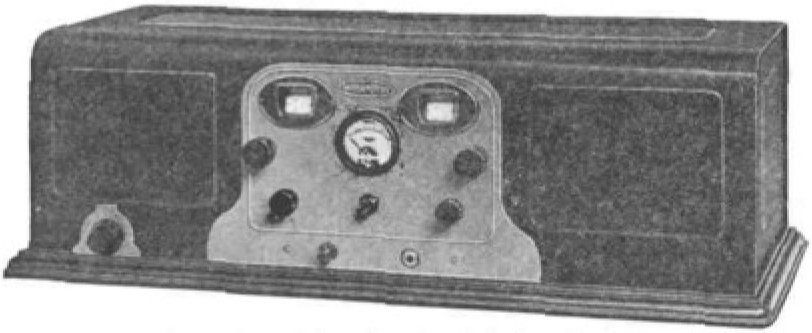
Parts Required But Not Indicated in Diagram

1 Remler Infradyne Amplifier.
2 "CX" Sockets—Remler No. 50.
1 Drum Dial—Remler No. 110.
1 Panel.
1 Yaxley Filament Switch No. 160.
6 Binding Posts (2 "Input," + A, — A, + 22½, + 67½).
1 Baseboard.

New Kits and Circuits for the Radio Builder

The 1928 Infradyne

THE new model of the infradyne is marked by the addition of a "front end" to the infradyne amplifier unit developed by Sargent and Rayment. This front end consists of a shielded two-stage tuned radio frequency amplifier, a control panel, metal chassis and a shield for the entire set. This equipment, together with the builder's choice of audio frequency amplifier can be quickly and easily assembled by a novice able to use a soldering iron, screw driver and pliers.



Front View of Complete New Infradyne Receiver.

This gives a ten-tube set which is unsurpassed in selectivity and sensitivity for long distance work, but which by the turn of a switch is available as a single-control five-tube set for local use. In fact the equipment is to be marketed separately for the latter use.

The r. f. circuit consists of a three-gang Remler variable condenser with fixed trimmers attached, the new Remler r. f. coils with coupling device geared to and operated by the condenser shaft (permitting of proper r. f. amplification over the entire broadcast wave band), sockets, condensers and resistors. This unit is housed in a completely shielded copper can, highly finished. Each r. f. stage compartment is individually shielded. The shield plates run between the three gangs of the variable condenser. The coupling of the r. f. coils is compensated for in the factory before the unit is shipped.

By this method it is now possible to accurately match the coils in the r. f. circuit with each gang of the variable condenser, eliminating the use of the trimmer condensers entirely. The coupling can also be varied for "loose" or "tight" by merely moving the r. f. coils up and down on a center shaft of brass, extending down through the coils. For extreme selectivity the coils are lifted upward—away from the coupling coil. For broader and less selective tuning the coils are brought closer together. The new Remler illuminated drum dial is attached directly to the condenser shaft.

The difficulty experienced with last year's infradyne in properly matching the r. f. coils with the gangs of the variable condenser is now eliminated. The secret of success of the infradyne is in a properly balanced and well designed front end. The vacuum tubes are enclosed in the shielded can of the r. f. unit. The top of the can can be easily removed for insertion of tubes or inspection of parts of the r. f. circuit.

Another improvement vital to the easy handling of the r. f. circuit is the addition of a variable antenna coupler. This coupler is attached to the metal chassis as can be seen at the extreme left hand corner in the illustration of the front view of the receiver. This antenna compensator brings the r. f. circuit into balance quickly and positively by a simple turn of the coupling knob. Three antenna tuning taps are also provided.

The entire new infradyne measures 26 in. in length and 11 in. deep. It is completely housed in a shielded copper cabinet, crystalline finished and beautifully embossed and decorated in various tones of bronze and black. This copper cabinet for the entire receiver is a part of the new set and is so designed as to make for maximum efficiency of the assembled receiver. The copper cabinet fits easily over the set and rests on a hardwood base, as the picture shows. By the use of this copper shielded cabinet it is obvious that a wood cabinet is no longer required. If a console cabinet is preferred by the builder, he merely slips the whole receiver with its shielded copper cabinet into the space provided in the console.

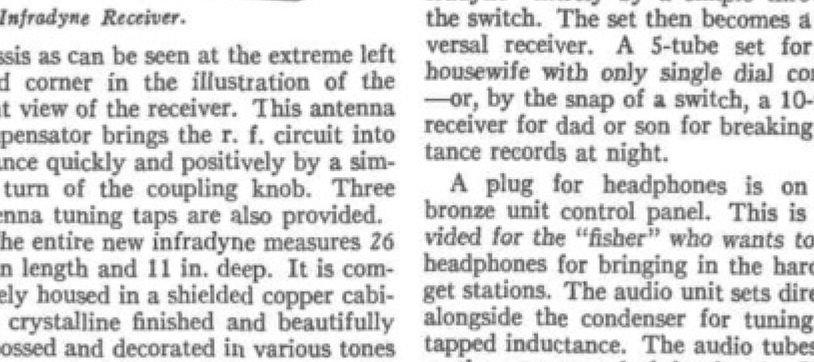
Another illustration shows the metal chassis of the new infradyne with the control units mounted in the center. This metal chassis is stamped and punched to accommodate the various units. All holes for the wiring are drilled in the proper places. The sockets for the detector and oscillator tube, audio and power tube, are built into the metal chassis. Loud speaker terminals are attached to the rear of the metal chassis, as are the connection posts for the antenna and ground. Holes are bored in proper place for slipping through the current supply cable.

The Remler variable condenser for tuning the tapped inductance is attached to the Remler illuminated drum dial. The two tuning dials are mounted directly on a "unit control panel." This unit control panel accommodates the voltmeter, rheostat and switch holes and a switch for converting the receiver from a five-tube r. f. switch to a 10-tube infradyne—merely by a simple throw of the switch. The set then becomes a universal receiver. A 5-tube set for the housewife with only single dial control —or, by the snap of a switch, a 10-tube receiver for dad or son for breaking distance records at night.

A plug for headphones is on the bronze unit control panel. This is provided for the "fisher" who wants to use headphones for bringing in the hard-to-get stations. The audio unit sets directly alongside the condenser for tuning the tapped inductance. The audio tubes are on the extreme end of the chassis. Silver Marshall audio transformers are used.

Directly behind the audio amplifier and the controls is the Infradyne amplifier. No change has been made in this unit. The wires from the various units are run through holes in the chassis to the bottom of the chassis and most of the wiring is therefore invisible. A colored wiring chart will be used in wiring.

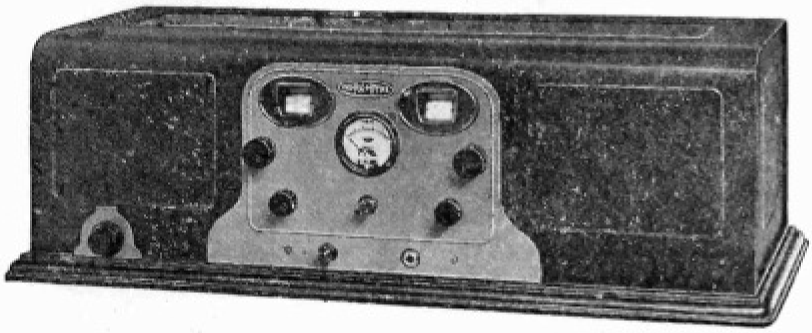
All the critical adjustments of the receiver have been eliminated.



Rear View of Infradyne Panel and Chassis.

the Precision of a Chronometer

Immediate Deliveries Now!



Copper Cabinet–

The cabinet problem solved. The 1928 Infradyne comes to you with a heavy copper cabinet, beautifully embossed and finished in baked crystalline of a neutral shade. The control panel is of bronze. A complete table model, with hand finished hardwood base. Can be easily inserted as a complete unit in a console table, highboy or writing desk. The entire receiver measures only 26 in. in length, a standard size adopted by radio cabinet and console manufacturers. On the control panel you see illustrated the two tuning controls, switch for 5 or 10 tube operation, "on-off" switch, sensitivity and volume control and plug for headphone operation when desired. Loud speaker plugs into the rear of the set. With its copper cabinet this receiver makes a beautiful table model. Here you save from $20.00 to $30.00 for a cabinet. The added shielding afforded by means of the copper cabinet is of vital importance in present-day broadcast congestion.

$179.50

WITH SHIELDED

CABINET

F. O. B. OAKLAND, CALIFORNIA

This price includes the completely assembled receiver with all current supply wiring in place. 90 per cent of the wiring is done for you in our laboratory. Two SM 220 Audios are included in the price. These transformers and the audio circuit are wired before the assembly is shipped to you. Deduct $7.00 if no wiring of any kind is wanted.

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Gentlemen—

I am interested in the "Model DX" Infradyne. Please send me further information about it.

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Address..

City and State..

NOTE—I am (not) a radio dealer.

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Now You Can Build the

INFRA-DYNE

Easily · Quickly
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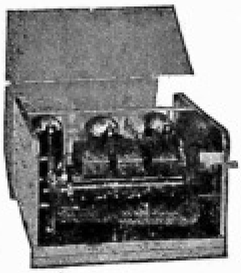
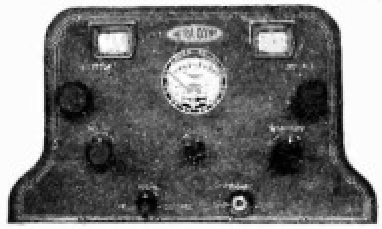




Remler R. F. Amplifier and Antenna Compensator

The No. 710 R. F. Amplifier incorporates two stages of R. F. Amplification and a detector. Entirely enclosed in a sheet copper case which gives complete electro-magnetic shielding. It is designed for single-dial control, either with Remler Drum Dial or the ordinary 360° vernier dial. An Antenna Compensator, supplied with the amplifier, nullifies the de-tuning effect of the antenna, which interferes with efficient operation in the usual single-control R. F. amplifier. A Switch is provided for selective or non-selective tuning.

Included in the Remler No. 710 Amplifier are special solenoid-type, small diameter coils, the Remler 3-in-Line Condenser, Remler No. 50 Sockets, and special resistances.

No. 710........Price $55.00

USE THE REMLER

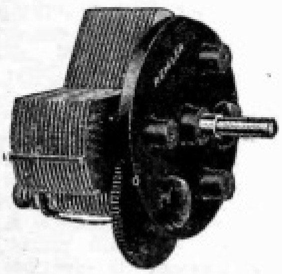
Radio Frequency
Amplifier
and Associated Parts

Control Panel of Infradyne Kit

The Remler Infradyne Kit, No. 750, includes the following apparatus: etched copper control panel (illustrated above); pressed steel instrument panel, two No. 110 Remler Drum Dials; one No. 659 Twin-Rotor Condenser; four No. 50 Remler Sockets, three No. 35 Remler Choke Coils; one special Coil; all necessary fixed condensers, rheostats, and fixed resistances; jacks; switches, binding posts; and wire and battery cable in colors to agree with wiring diagram.

The complete instructions include schematic wiring diagram; full-size cable harness template; schematic cable lay-out; diagram of parts and wiring under steel base; plan view of top of steel base.

No. 750—Infradyne Foundation Kit ....Price $52.00



Twin - Rotor Condenser

Rotation of the dial through a full 360° gives greater separation of stations at all wave lengths than is possible with the usual 180° dial. A special adjustment which permits variation of the condenser capacity at zero dial setting allows a still further spreading of the stations in the Straight Line Frequency type.

Both sets of plates rotate. They are driven by Bakelite gears operated by a cam and lever in the Straight Line Frequency type and by a brass pinion in the Straight Line Wave-Length type. This construction results in complete insulation of the dial shaft from the plates, allowing the dial to be grounded and completely eliminating body capacity effects.

Price $5.00

REMLER INFRADYNE CABINET

This copper cabinet, embossed in two-tone brown crystalline enamel, together with a decorated wood base, supplies the highest standards of convenience and appearance for the new Infradyne. Size: 11x26 inches.

No. 760 ....Price $15.00

Two Hours Work —Then Perfect Reception

The new Remler R. F. Amplifier and Infradyne Foundation Kit are designed to meet the growing demand for complete, tested and trouble-free construction units for the Infradyne Circuit.

Now, you can easily build the Infradyne in two hours with the simplest tools. Now, you can be sure of matched parts, scientifically correct design, and proper location of each piece of apparatus.

Remler leadership and reputation in the manufacture of quality parts is your guarantee of satisfaction.

Write for special Infradyne folder and also a two-color catalog of Remler parts.

Remler Division of
GRAY & DANIELSON MFG. CO.
260 First Street, San Francisco
Eastern Warehouse: Elkhart, Ind.
Chicago New York

Drum Dial

The Remler Drum Dial gives a full 15 inches of dial space, divided into 200 divisions—2 for each broadcast channel. Calibration strips are rigidly mounted, yet easily removable and renewable. Call letters are readily written in.

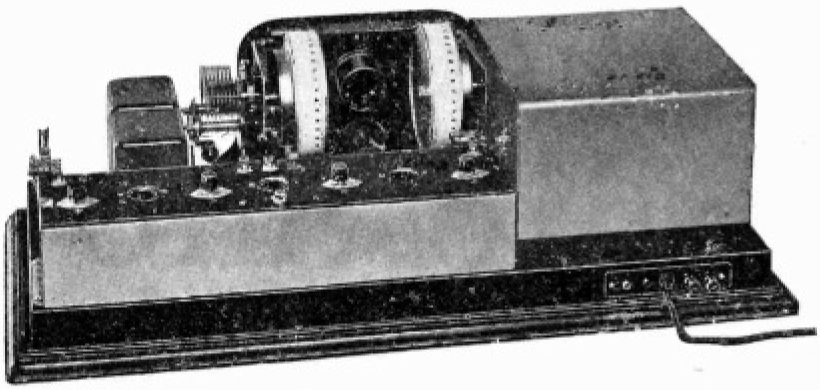
Spiral gear drive gives quiet operation and no back-lash.

Socket and 6-volt lamp furnished for illumination. Easily mounted, round drilled hole required for panel plate. The Remler Drum Dial will drive all standard makes of condensers either single or in gangs of two or three condensers.

Mounting template is included in each carton. Calibration strips supplied for either clock-wise or counter clock-wise rotation of dial.

No. 110—Remler Drum Dial ....Price $4.50

Built Like a Battleship, but with
The "Model DX" Infradyne



1930 Radio—

The times have changed. Home-built radio for the 1927-1928 season is three jumps ahead of a factory built set. All metal construction — illuminated drum controls—complete shielding—automatic coupling — concealed wiring — new unit construction system—hairsplitting selectivity and the finest tone quality obtainable are yours—NOW. Yet, the price for a real 1930 radio receiver is just about half what you would expect to pay for such construction and performance. The home set builder now buys his set completely assembled—with all of the essential current supply wiring and audio amplifier wiring in place. He takes a screw driver — hooks on about a dozen short wires and his set is ready for operation. He can change the circuit easily — quickly. He has his choice of a dozen circuits. The illustration shows the new vogue in radio for 1928. The completely assembled Infradyne—the acknowledged leader—the most selective circuit known. It has an enviable reputation for tone quality. Eight thousand Infradyne owners have already been convinced.

EIGHT REASONS WHY THE
MODEL "DX" INFRADYNE *Should Be Your Choice*

1. Acknowledged to be the best DX getter.
2. Razor-edged selectivity.
3. Easy to operate — No critical adjustments.
4. The five and ten tube switch is an exclusive Infradyne feature. Economical operation.
5. Tone quality unsurpassed.
6. Built with the strength of a battleship and the precision of a chronometer.
7. Beautiful in appearance. Will be in style for years.
8. A set that you will be proud to own.

The 1928 Infradyne Receiver

Assembly Details for The New Model of This Popular Ten-Tube Circuit

By E. M. Sargent

ASSEMBLY of the 1928 infradyne whose salient features were described in July RADIO, has been so greatly simplified by the kit manufacturers, that a comparative novice can put it together ready for operation in a few hours.

Examination of the picture in Fig. 1 and the diagram in Fig. 2 shows it to consist essentially of a shielded two-stage tuned r. f. amplifier unit at the left, a three-stage high frequency Infradyne amplifier unit in the rear, two drum dials operated by tuning knobs on the front panel, an oscillator tube, a detector tube, and two a. f. tubes with their associated transformers.

Most of these units are mounted on a pressed steel base with the wiring concealed beneath. The control knobs and voltmeter are mounted on a small steel panel in the front and center of set and the complete equipment is housed in an enamelled sheet copper cabinet supported on a decorative wooden base. By means of the filament switch the set is instantly converted from a 10-tube infradyne for long distance work to a five tube tuned r. f. receiver for local reception.

The two stage tuned r. f. amplifier unit covered by the copper shield at the left in these pictures contains a Remler type 633 three-in line condenser, three coils and three tube sockets, these constituting two stages of r. f. amplification and a first detector. The triple condenser is operated by the left hand drum dial being associated with

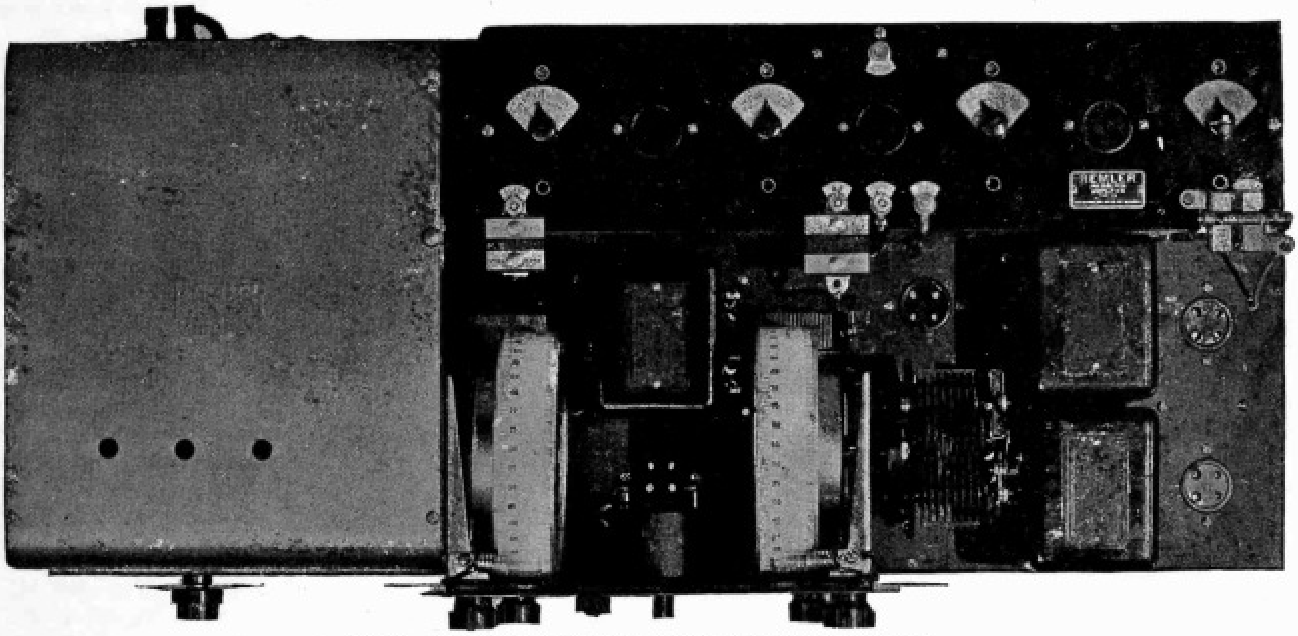


Fig. 1. Complete Infradyne Receiver with Cabinet Removed.

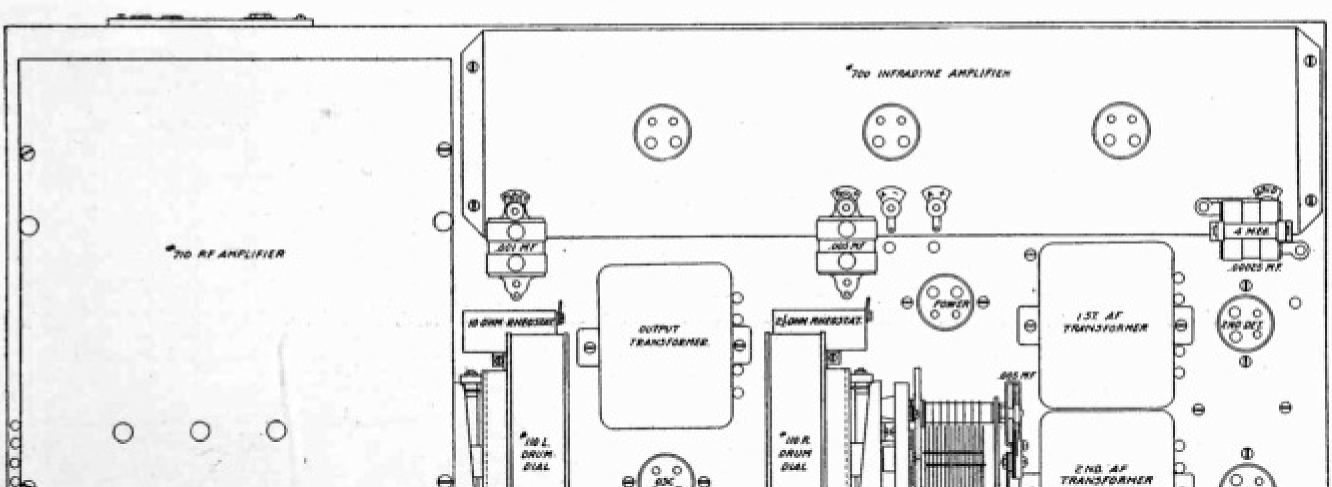


Fig. 2. General Arrangement of Parts

three small compensating condensers with which the set is balanced when first put into service.

The solenoid coils are wound so as to have a small external field, the secondaries being in two halves connected so as to help maintain stability throughout the entire wavelength range. The primaries are automatically rotated inside the secondaries by means of the condenser shaft.

The circuit diagram of Fig. 3 shows the remaining connections and circuit constants. These may also be identified in the accompanying list of parts.

Actual assembly is started by mounting the various small parts on the bottom of the steel base as shown in Fig. 4 and 5. The base is drilled to receive all mounting screws and wires which are to project through it.

The four Remler No. 50 sockets are first mounted with their terminals placed as shown in Fig. 4. The two special bakelite terminal blocks are next put in place and then the two Remler No. 35 choke coils (Nos. 1 and 2.)

Choke No. 3, at the upper right of Fig. 3 together with its associated .00025 mfd. condenser is mounted by putting the machine screw through its base from the top side, placing one condenser lug over the screw, putting on the spacers, then the choke coil, and fastening the assembly down with the nut.

The Electrad Type P .005 mfd. condenser with bent lugs is fastened in place with screw and nut in a position about halfway between the front and back of the base and directly opposite the hole in the front edge of the base for the switch. Now solder the three fixed resistors to the proper socket terminals. The next step is to fasten the 4 in. x 3/4 in x 1/8 in bakelite terminal strip in place using two 1/4 in. x 6-32 screws, one at each end. On this strip mount the *"Antenna"* and *"Ground"* binding posts and the Frost No. 953 jack. The jack is mounted so that the 1 1/4 inch fibre insulating washer is held between the steel base and the body of the jack.

Before preparing the cable harness, make ready and connect up the battery cable. Cut 4 in. of the outside covering from one end of the cable and 15 in. from the other end; wrap binding cord around the ends of the covering to keep it from fraying. Pass that end of the cable having the 4 in. leads through the bakelite terminal strip from the outside. Cut the individual cable wires the correct length for connection to the terminal blocks in accordance with the color code indicated in Fig. 4. The general method of connecting up the battery cable is shown clearly in Fig. 5. Wrap tape around the battery cable where it passes through the clip holding it to the base and fasten the clip to the base. Scrape about 1/2 in. of the insulation from the terminal block end of each of the cable wires and solder the wires to the terminal blocks.

The cable harness is built up by means of a template which is supplied with the kit and placed on a flat board into which nails are driven at designated points. When finished in accordance with the directions there given it is laid out on another template so as to indicate the position of the various leads. As these aids are necessary only for the extreme novice, their details are omitted here. The soldered connection for the units on the underside of the steel base are well shown in the pictures herewith including the picture of the cable layout in Fig. 6.

The base is then turned over with the control panel side to the front so that the 10 and 2½ ohm rheostats constituting the *"Volume"* and *"Sensitivity"* controls can be mounted on brackets as shown in Fig. 7.

The 10 ohm rheostat is at the left and the 2 1/2 ohm rheostat at the right. The leads to be connected to the 10 ohm rheostat extend up through the steel base; of these, the double lead should be connected to that side of the rheostat which is common electrically with the steel base, or in other words, to that side of the rheostat which is grounded. Soldered connections should be made to lugs fastened securely under the rheostat terminal nuts.

The two Silver-Marshall audio transformers, the Silver-Marshall ouput transformer and the No. 700 Infradyne amplifier are now fastened in place with screws and nuts. Fasten to the Silver-Marshall transformer terminals the leads projecting up through the steel base. The colors of these leads and the terminals to which they are to be connected are clearly indicated in the diagrams.

The Electrad Type P .001 mfd. condenser is placed on the Infradyne Amplifier *"Plate"* binding post and the .00025 mfd. condenser on the Infradyne Amplifier *"Grid"* binding post, using for the latter condenser the special bracket supplied. Put soldering lugs

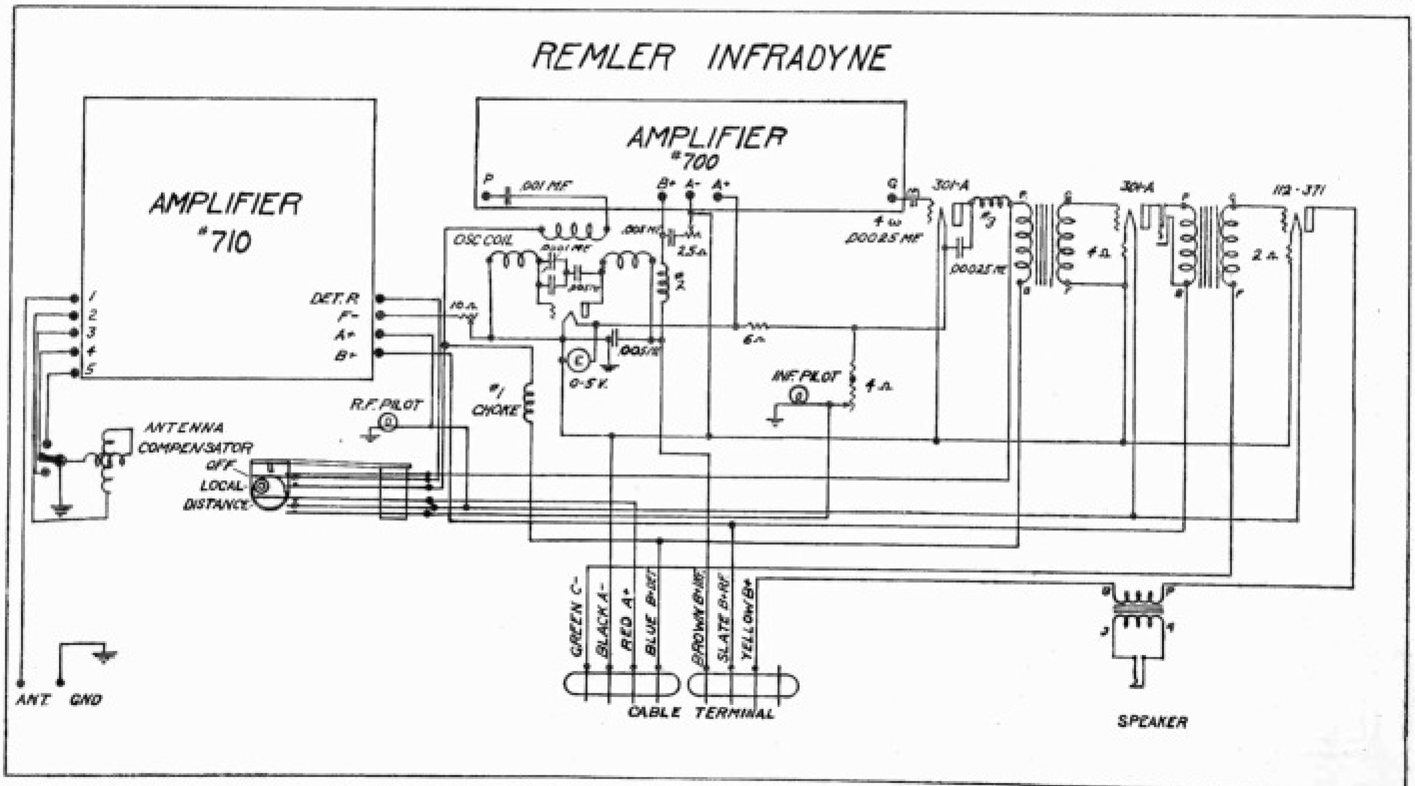


Fig. 3. Infradyne Schematic Circuit Diagram

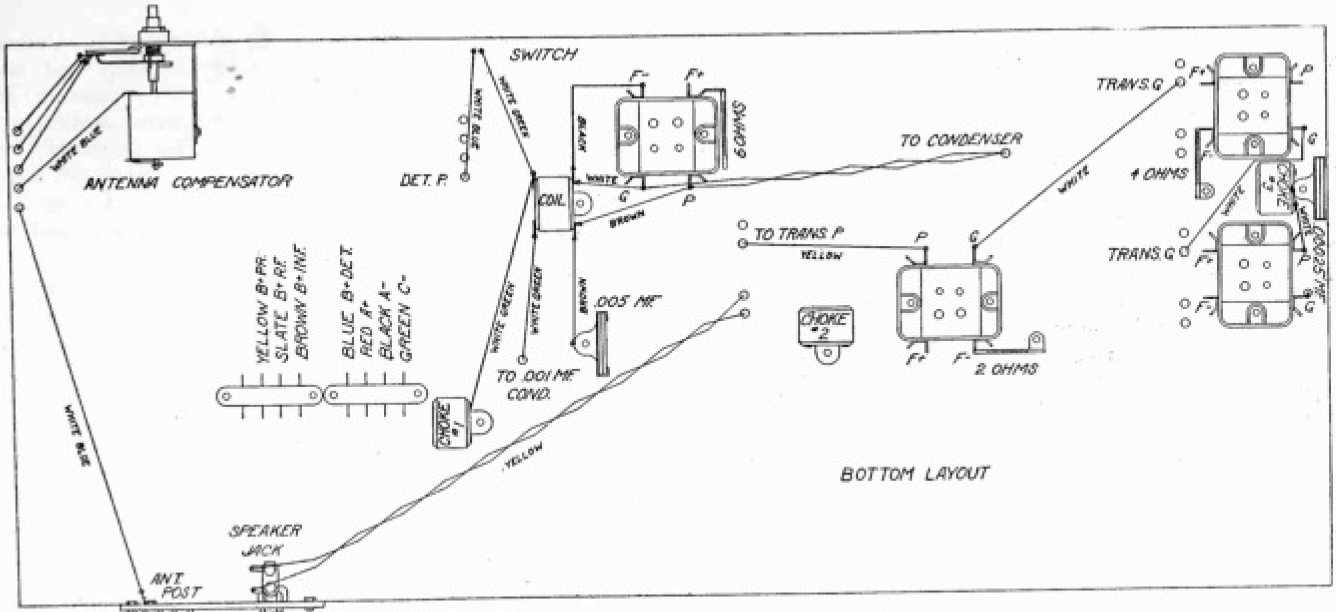


Fig. 4. Arrangement of Parts on Bottom of Steel Base

on the Infradyne Amplifier *B*+, *A*—, and *A*+ binding posts; solder to these lugs the leads projecting up through the steel base.

Mount the .005 mfd. condenser on the Infradyne Amplifier *B*+ binding post. Tighten the nuts on all of the Infradyne Amplifier binding posts. Connect the free side of the .005 mfd. condenser mounted on the Infradyne Amplifier *B*+ binding post to that side of the 2½ ohm rheostat which is not common with the steel base. The free side of the .001 mfd. condenser mounted on the Infradyne Amplifier *"Plate"* terminal will be connected to terminal No. 2 of the special coil on the under side of the steel base; a hole is provided in the base to allow passage of this connecting wire. The free end of the .00025 mfd. grid condenser will be connected to the grid terminal of the detector socket; a hole is likewise provided in the base for the passage of this lead. The detector socket is the one at the extreme right-hand end of the base and nearest to the Infradyne Amplifier.

We are now ready to use the No. 710 Radio Frequency Amplifier. Fasten the left-hand drum dial plate to the shaft side of the Amplifier case, using the 1¼ in. machine screws holding the Type 633 gang condenser in place. Fasten the No. 710 Amplifier to the steel base using the screws and nuts supplied for the purpose. Solder the leads projecting up through the steel base to the terminal blocks on the Amplifier.

Next in order will be connections to the switch. Turn the base up so that it stands on edge or leans back against a convenient object. Examine the Yaxley No. 69 Switch; it will be found that the terminals have been colored to correspond to the colors of the wires which are to be soldered to them. With the switch loosely fastened in place or entirely unmounted solder to its terminals the proper leads as indicated by the color code. There are two yellow leads close together near the switch; one of them is single and the other is double. Connect the single yellow lead to the switch.

The pressed steel instrument panel is then screwed to the base, and the switch mounted on the panel, reversing the nut so that it will fit tightly against the panel. Next, fasten the left-hand drum dial plate (No. 110 L) to the steel instrument panel with ¼ in. screws.

The 4 ohm rheostat controlling the Infradyne Amplifier tubes is mounted on the steel instrument panel below the opening for the voltmeter. Place the 2 in. insulating washer on the back of the rheostat and attach the rheostat to the panel with the 1-¼ in. fibre washer under the threaded bushing. Put the ½ in. insulating washer over the shaft. Solder the leads to the rheostat. Of

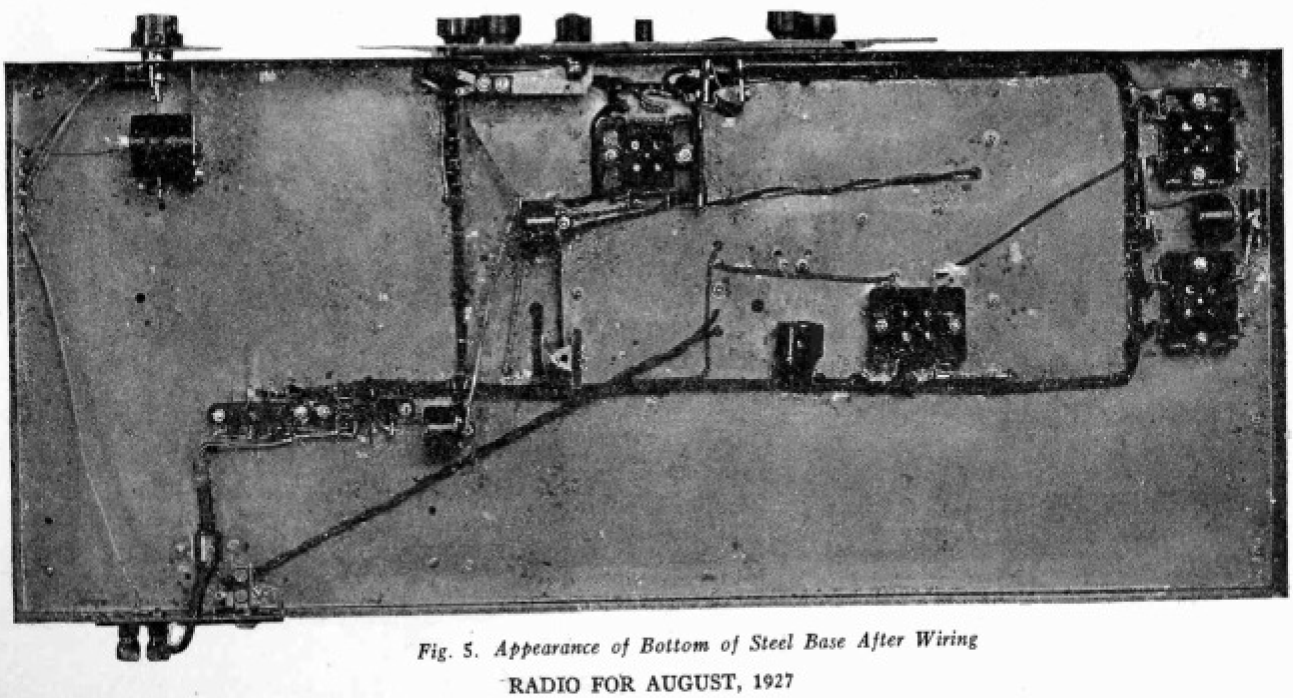


Fig. 5. Appearance of Bottom of Steel Base After Wiring

the single and double yellow leads above mentioned the double yellow lead will be connected to the rheostat.

The right-hand drum dial and oscillator condenser assembly will now be put in place. Fasten the special brace to the right-hand drum dial plate and mount the dial plate on the steel instrument panel with ¼ in. screws. Fasten the special brace to the pressed steel base. Fasten the special condenser and the .005 mfd. fixed condenser to the Remler Type 659 condenser and mount the assembly on the drum dial plate. One terminal of the Type 659 tuning condenser is connected to one terminal of the special condenser and to one terminal of the .005 mfd. condenser. The other terminal of the special condenser is connected to the remaining terminal of the tuning condenser and the free terminal of the .005 mfd. fixed condenser is connected to the brown wire of the twisted pair of wires extending up through the base. The remaining wire of the twisted pair will be connected to the terminal of the Type 659 Condenser to which we have previously connected only one terminal of the special condenser. The twisted pair referred to is shown in Fig. 4.

Next mount the voltmeter on the steel instrument panel and connect to its terminals the leads extending up through the base. Now mount the lamp brackets on the drum dial plates and connect them into the circuit. The leads to the pilot lamps project up through the steel base. Make connections to the lugs next to the lamp socket shells.

The bronze control panel can now be placed in position. It will be held in place by the threaded bushings which are screwed into the drum dial plates and through which the dial shafts extend. Insert the rheostat extension shafts with the lock-nuts over them between the panel and the rheostats and attach the threaded bushings to the control panel by means of the lock-nuts. Washers are furnished for use next to the panel. Fasten the extension shafts to the rheostats.

The Frost No. 954 Jack, insulating bushing, threaded bushing and washer are then connected. We can now turn the pressed steel base up on end and fasten the antenna compensator in place as shown in Figs. 4 and 5.

Comparatively little remains to be done. Those wires indicated in Fig. 4 and not yet installed must be soldered in position, thus completing the wiring. The bakelite control knobs are now mounted on the control panels. Two of the knobs are small in size; they are for the switch and voltage controls. The last step before testing will be to put the 4 megohm grid leak in place in the clips on the .00025 mfd. condenser supported on the Infradyne Amplifier *"Grid"* binding post.

TESTING

Remove about 1½ in. of the insulation from each of the wires at the outside end of the battery cable. Connect a lamp and battery in series and, with the switch in the "OFF" position, test between the various wires of the cable for short-circuits. The *"Ground"* and *A—* are connected to the steel frame. Connect *C+* and *B—* to *A—* or *A+*. The color code for the cable and terminal wires follows:

A—	Black
A+	Red
B+Detector	Blue
B+Intermediate	Brown
B+R.F. and 1st A.F.	Slate
B+Power	Yellow
C—	Green

We are now ready to install the tubes and to put the set into operation. Remove the top from the No. 710 Radio Frequency Amplifier and insert three CX 301A or UX 201A tubes. Now install CX 299 or UX 199 tubes in the Infradyne Amplifier sockets and in the socket located in the steel base immediately below and back of the voltmeter. Put CX 301A or UX 201A tubes in the sockets at the extreme right-hand end of the base. Put a CX 112 or UX 112 tube (CX 371 or UX 171 can be used) into the socket located between the oscillator tuning condenser and the Infradyne Amplifier.

Connect the red and black wires in the battery cable to the positive and negative terminals respectively of a 6-volt storage battery. Turn the switch to the *"LOCAL"* position. All tubes except the CX 299's and the CX 301A

(*Continued on page* 40)

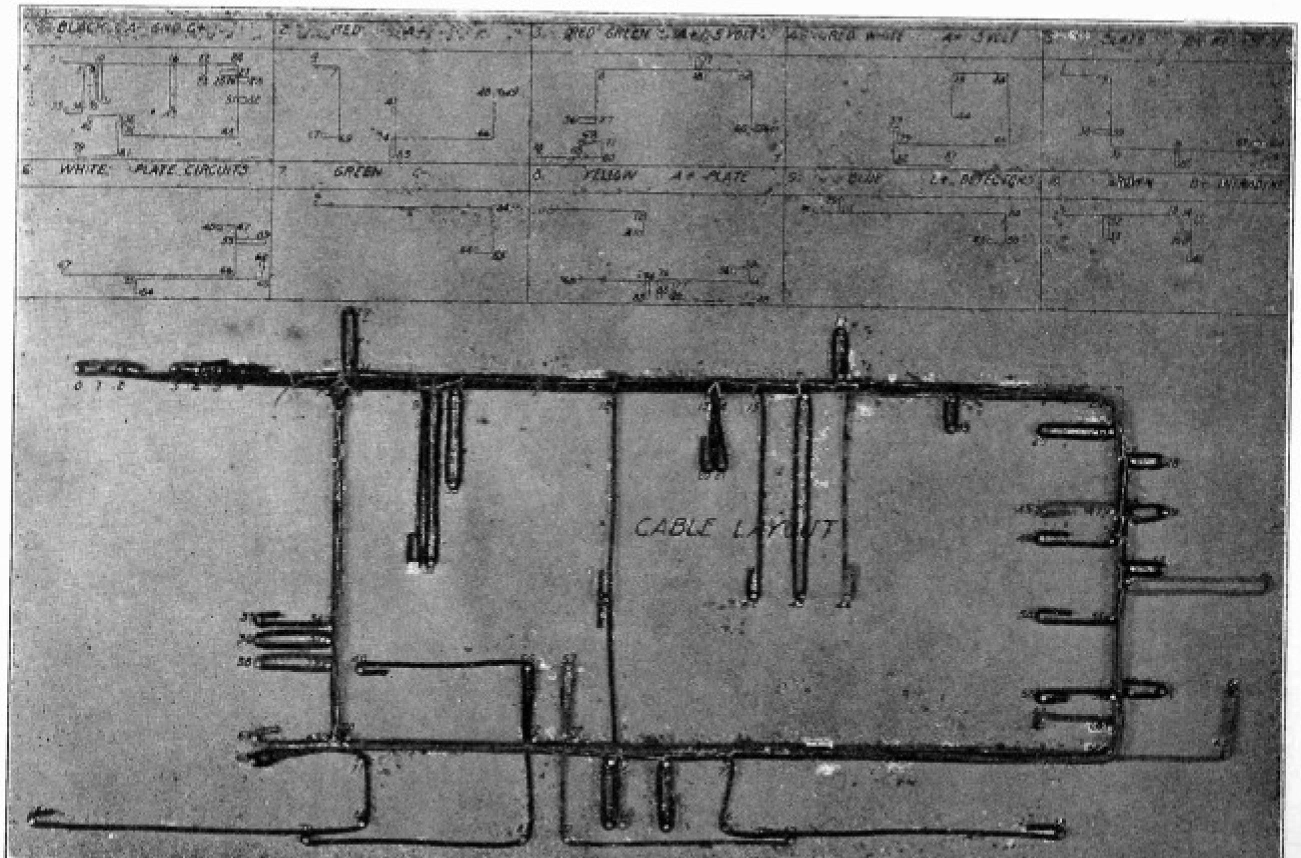


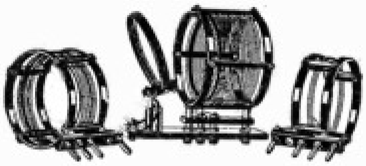
Fig. 6. Cable Layout

Aero Coils

Recommended Again

for use in the

SHORT WAVE CONVERTER



Low Wave Tuner Kit
Price $12.50

In his article printed in "RADIO" for May, Mr. Perry Graffam describes the construction of an unusually efficient short wave converter. Of course he specifies AERO Low Wave Tuner Kit as the inductances to use in this converter. This kit is completely interchangeable and has a gapless range of 15 to 130 meters. Kit includes 3 coils and base mounting. Range can be reduced to 13 meters by use of AERO Coil INT. O (Price $4.00) or increased to cover broadcast band by use of AERO Coil INT. 4 (Price $4.00) and INT. 5, described below.

Aero Interchangeable Coil No. 5

Normal range 235 to 550 meters. Range can be increased to 725 meters by use of .0001 Sangamo fixed condenser across rotor and stator of .00014 variable condenser. This gives coverage of Airplane to Airplane, Land to Airplane, and Ship to Shore (Great Lakes and Atlantic and Pacific Oceans) bands. Price of INT. 5, $4.00.

You can get these AERO coils from your nearest dealer. If he should be out of stock, order direct from the factory.

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MODEL "N"—Slight turn obtains correct tube oscillation on all tuned radio frequency circuits. Neutrodyne, Roberts two tube, Browning - Drake, McMurdo Silver's Knockout, etc. Capacity range 1.8 to 20 micro-microfarads.
Price $1.00

Model "G"

MODEL "G"— With grid clips obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in heterodyne and positive grid bias in all sets.

Capacity range:

Model G-1	.00002	to .0001	M. F. D.
Model G-5	.0001	to .0005	M. F. D.
Model G-10	.0003	to .001	M. F. D.

Price $1.50

X-L PUSH POST — Push it down with your thumb, insert wire, remove pressure and wire is firmly held. Vibrations will not loosen. Releases instantly.
Price 15c

X-L PUSH POST PANEL— Permanently marked in white on black insulating panel. In box including soldering lugs, raising bushings and screws for mounting, etc.
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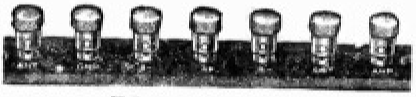
X-L Push Post



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Built the new LOFTIN - WHITE constant coupled radio frequency circuit. FREE wiring diagrams showing use of this and other popular circuits sent on request.

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INFRADYNE MANUAL SHOWING LAST SEASON'S MODEL, & HOW TO TEST IT. "RADIO" SAN FRANCISCO **25c**

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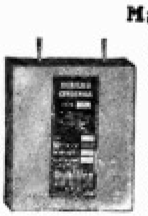

1¾ mfd. 1000 volts rated D.C. Working Voltage. **Extra Special at $1.35 each**
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Manufactured by Stromberg-Carlson Tel. & Mfg. Co.

3½ mfd. 600 volts rated D.C. Working Voltage. **Extra Special $1.75 each**

All of these High Quality Filter Condensers are brand new, and guaranteed as rated. They are excellent for use in your Eliminator, Transmitter, or Experimental Work.

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1928 INFRADYNE

(*Continued from page* 14)

tube at the far right-hand end of the base and nearest to the Infradyne Amlifier should light. The pilot light over the left-hand dial should also light. Now turn the switch to the *"DISTANCE"* position. Adjust the panel rheostat so that the voltmeter registers three volts. All tubes in the set and the pilot lamps above both the right and left-hand dials should light. Momentarily remove each of the CX 299's in turn and watch the voltmeter. If the tube removed was lighted the voltmeter should register a higher voltage while the tube is out of the socket.

If all the tubes are found to light properly turn the switch off and connect up the *B* and *C* batteries using the color scheme given above. Connect the blue battery cable wire to the 22½ volt *B* battery terminal, the brown battery cable wire to the 67½ volt *B* battery terminal, the slate wire to the 90 volt *B* battery terminal and the yellow wire to either the 135 or 180 volt *B* battery terminal. If a CX 112 tube is used in the second audio stage a plate voltage not higher than 135 should be used; if a CX 371 tube is used a plate voltage of either 135 or 180 can be employed. The *C* battery voltage used will depend upon the type of second audio tube and upon the plate voltage employed. Connect up the antenna and ground and plug a pair of phones into the jack on the control panel.

Turn the switch to the *"LOCAL"* position. Set the inner part of the antenna compensator control knob at 3. Adjust the outer part of the antenna compensator control knob so that the moving coil in the compensator makes an angle of about 45 degrees with the stationary coil. The left-hand tuning dial should read zero with the plates of the condenser in the radio frequency amplifier wide open or, in other words when the capacity of this condenser is a minimum. Turn the *"VOLUME"* control about four-fifths of the way on. Now rotate the left-hand dial slowly, beginning at zero, until a station operating on a wavelength in the neighborhood of 200 meters is picked up.

The balancing condenser which is connected across the antenna section of the gang condenser in the radio frequency amplifier must next be adjusted in conjunction with the antenna compensator. The antenna section of the gang condenser is that at the rear or, in this case, left-hand end. The balancing condenser which is to be adjusted is located at the end of the gang condenser farthest from the dial shaft; it is mounted, together with two other balancing condensers, on a bakelite sheet supported below the plates on the die-cast aluminum condenser frame.

A Power Amplifier for the Infradyne

A Socket Power Unit Providing Plate and Grid Voltages for the Set Together With a Power Stage of Audio Amplification

By E. M. Sargent

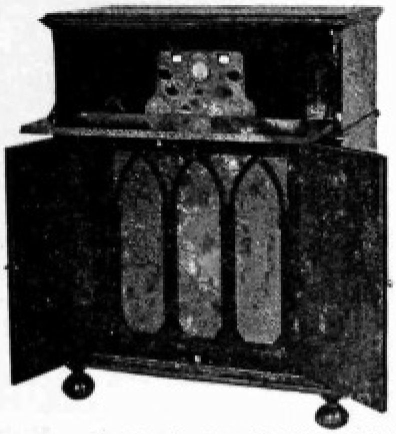
A SATISFACTORY method of plate voltage supply from socket power instead of batteries has been developed for the infradyne receiver after many unsuccessful efforts to use some of the *B* eliminators ordinarily available. The relatively heavy plate current drain by ten tubes causes the voltage delivered by some eliminators to drop below that required for the operation of the infradyne, and where the voltage is sufficient for ten tubes it may be too great for the five tubes when the 5-10 switch is thrown.

These difficulties have been overcome by using a 400 volt rectifier and filter with a suitable resistance unit for cutting down to the required voltages, and by using a glow tube to control voltage variations. With this equipment available it is also possible to use a 310 power tube in the last stage of audio with 7½ volt a.c. filament supply, which is also used for the filament of the 316-B rectifier. Filament current for the other tubes may then be secured from a storage battery with trickle and booster charger, as indicated in the accompanying diagrams, or from an *A* battery eliminator. This gives a set operated from the 110 volt a.c. supply mains.

Plate voltages of 22½, 67 and 90 volts are secured through a Carter No. 2313 resistance unit equipped with sliders which can be initially set in the

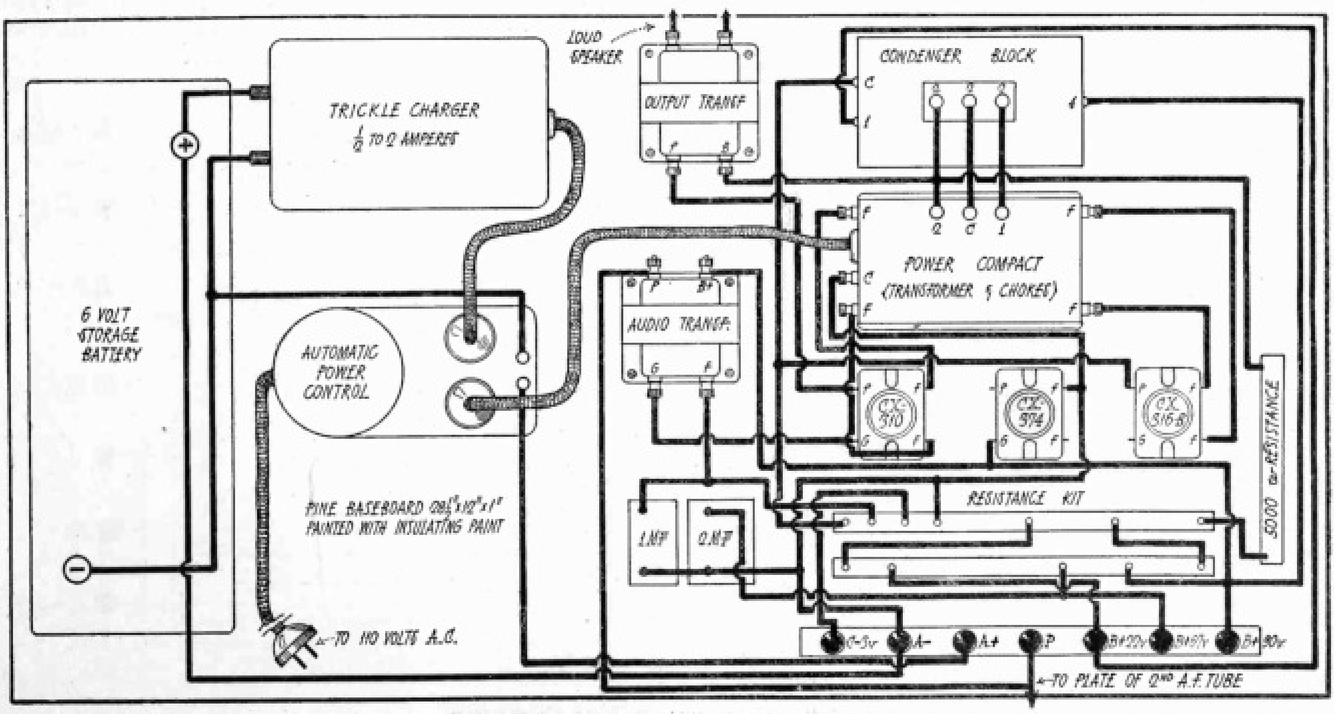
PARTS USED IN INFRADYNE POWER AMPLIFIER

- 1—Baseboard, pine, 12 by 28½ by 1 in.
- 1—Baffle Board for mounting loudspeaker, pine, 28 by 24 by ⅝ in.
- 1—Set Binding Posts, X-L, 22½ V., 67 V., 90 V., C—, C plus, 400 V., Plate, A— and A plus
- 1—Thordarson R200 Audio Transformer for power stage
- 1—Thordarson R76 Output Transformer
- 1—Thordarson R210 Power Compact
- 1—Tobe R210 B Block
- 1—Tobe 1 mfd. Bypass Condenser
- 1—Tobe 2 mfd. Bypass Condenser
- 1—Excello or Ehlert Console as illustrated
- 1—Yaxley Automatic Power Control Unit
- 1—½ ampere to 2 amp. trickle charger. Thordarson 2 amp. or Rectox ½ amp. (Depending on service required from set.)
- 1—6 volt Storage Battery, 100 ampere hour capacity
- 3—Remler Sockets
- 1—Bakelite strip, 1 in. by 12 in. for mounting binding posts
- 1—CX-310 Power Tube
- 1—CX-374 Glow Tube
- 1—CX-316B or 381 Rectifier Tube
- 1—No. 2313 Carter Resistance Kit
- 1—Ward Leonard S-5000 ohm Resistance
- 1—Loudspeaker (Electrodynamic speaker illustrated)
- 1—Jewell or Weston high resistance Voltmeter, 0 to 250 volts



Infradyne in Excello Console With Built-in Speaker and Power Unit

Infradyne in Ehlert Console With Built-in Power Unit.

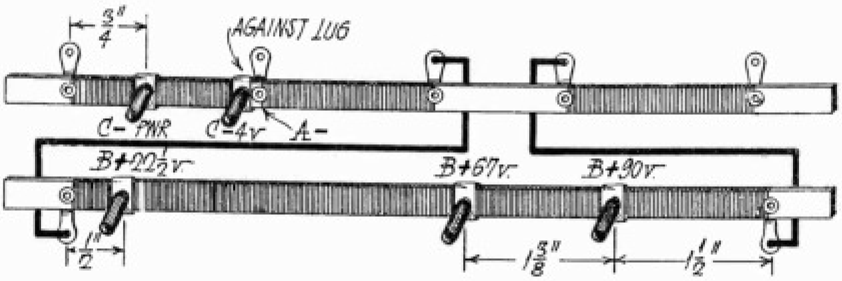


Pictorial Wiring Diagram of Power Supply Unit.

proper positions. This unit also gives the requisite C voltages. By using the settings marked on the diagram in inches, the required voltages may be closely approximated without measuring them with a high resistance voltmeter.

charger is recommended where the set is used more than two hours a day.

The pictures show the power supply unit housed in a large Excello console and in a smaller Ehlert console with a walnut case for housing the receiver.



Resistance Unit Settings.

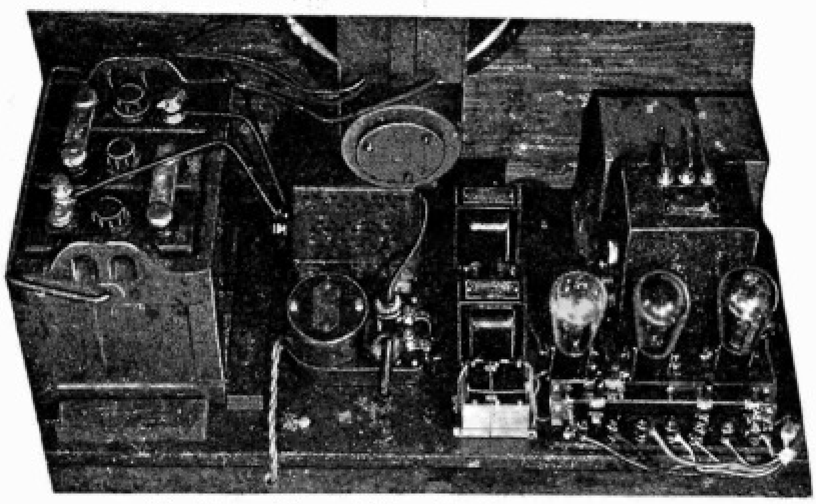
The constructional details are self-evident from the pictures and diagrams together with the list of parts used in the construction of the unit shown. The use of a 2 ampere booster charger in connection with a ½ ampere trickle

The former has ample space for an electrodynamic speaker with baffleboard or for other types of loudspeakers.

The automatic power control unit or relay switch is not only a convenience but also a protection against dangerously high voltage if the power unit is turned on when the filament current is not in the tubes in the set. This precaution has prevented many a burn-out as it insures a load for the power supply unit.

This system is applicable to either the old or new models of the infradyne and the usual battery cable may be used without change by running a plate lead from the first audio transformer in the receiver to the P post of the power supply unit.

Where obtainable the UX-281 or CX-381 rectifier may well be substituted for the 316-B, as the former has a maximum possible output of 110 milliamperes as compared with the latter's 65 milliamperes.

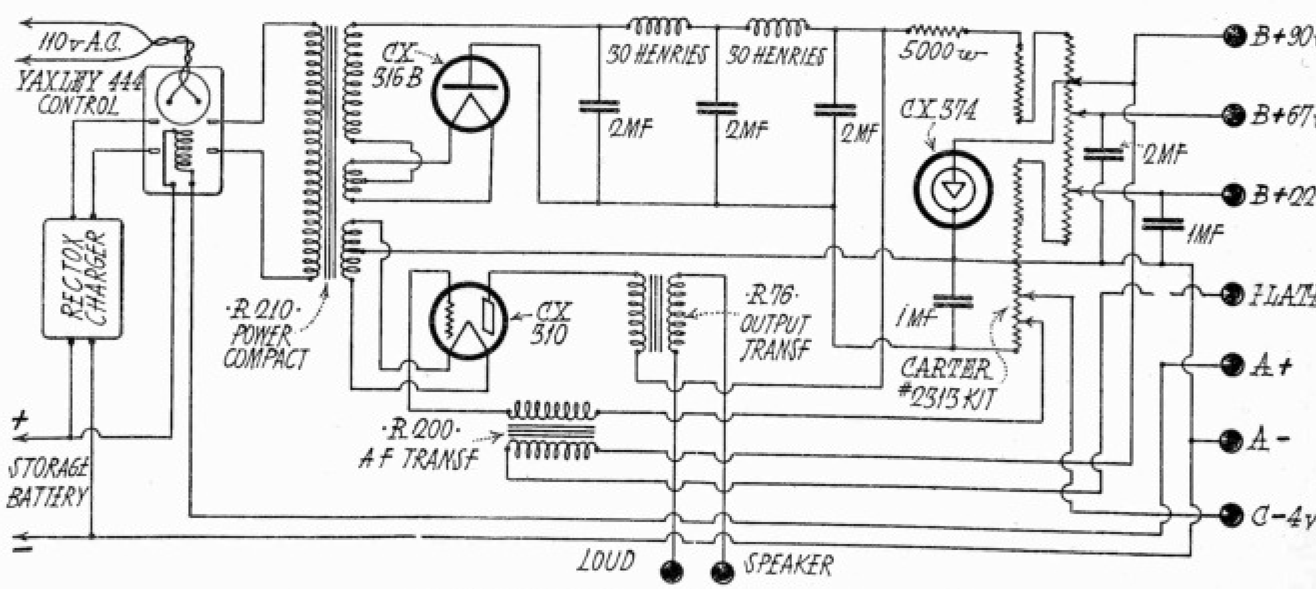

Rear View of Power Unit and Baffleboard Mounting.

LABORATORY NOTES ON THE TYRMAN TEN

Experiments with the Tyrman Ten, described in October RADIO, have shown that the push-pull transformers in the last audio stage are well adapted for use with UX-210 power tubes. Tremendous volume without distortion is this obtainable. Two UX-171 tubes in parallel deliver about the same energy as one UX-210. By using two of the latter tubes the energy is practically doubled.

This is accomplished without any change in the set excepting to supply the 210 filaments with ac. from the input transformer. A Thordarson 210 power pack and B eliminator proved satisfactory for the purpose.

The appearance of the receiver has excited much favorable comment because of its beauty which rivals that of much more expensive factory-built models. It is considered an outstanding example of what can be accomplished in home-built receivers.



Schematic Wiring Diagram of Power Supply Unit.

Revamping An Old Infradyne

By E. M. Sargent

THE original 1926 model and the subsequent 1927 model of the Infradyne can be changed to conform to the 1928 model, as described in August RADIO, with but slight trouble and expense. This gives an up-to-date instrument equipped with illuminated drum dials, switch for 5 or 10 tube operation, and a radio frequency amplifier unit especially designed to operate in conjunction with the infradyne amplifier unit.

The r.f. amplifier unit is intended to obviate any trouble from oscillation that may be introduced by a self-constructed "front end" as well as to give maximum amplification and selectivity. It consists of a Remler 710 amplifier and antenna compensator. The former consists of a three-in-line condenser equipped with semi-fixed balancing condensers together with three r.f. transformers and sockets, all housed in a shielded cabinet. The primary coils of the transformers are mounted inside of the solenoid secondaries so that the coupling can be varied by means of a common shaft which is driven by a lever and cam from the main condenser shaft. Inter-coil coupling is minimized by winding the second and third secondaries in two halves so that the grid and filament terminals are brought out from the center.

The antenna compensator includes a three-point switch which varies the number of turns in the antenna primary, and consequently the selectivity. It also includes a miniature variometer which is connected to the grid return from the secondary of the antenna coupler and is used as a final vernier adjustment to bring up a weak signal. When a proper balance has been obtained between the adjustment of the variometer and that of the antenna section balancing condenser the first tuned circuit will stay in line with the others without adjustment.

By means of these various refinements the amplifier can be adjusted to give maximum selectivity in congested areas or greater sensitivity in remote districts.

The principal substitution and replacement of parts is found first in the removal of the original coils, three-gang condenser and trimmer condensers making up the radio frequency unit, and its replacement with the 710 amplifier. As it is desirable that the original cabinet be retained, the baseboard remains the same, but in order to provide for the drum dial arrangement, which the location of the amplifier unit renders necessary, a new panel, drilled as shown in Fig. 2, is called for.

Two No. 110 drum dials are specified. These dials with their 360 degree rotation, removable logging charts and illumination secured through small pilot lamps mounted directly on their supporting brackets, afford smooth and certain adjustment for both the three gang condenser of the No. 710 Amplifier, and the twin rotor .00035 mfd. condenser, which is retained from the previous models. The dials are so constructed as to provide automatically for the reverse action of the oscillator condenser as compared with the gang condenser in the infradyne.

The 50,000 ohm variable resistance of the 1926 model and the 200,000 ohm variable resistance of the 1926-27 models are done away with. Volume is controlled solely through the 10 ohm rheostat which controls the filaments of the first two tubes of the r.f. amplifier, and through the interstage audio jacks, which are retained as in past models. The inherent stability of the new r.f. unit makes other forms of adjustment unnecessary. The 1 mfd. fixed condenser used as a by-pass for the radio frequency amplifier is no longer needed as a condenser performing the function is built into the 710 amplifier.

The two 30 ohm rheostats, one of which controlled the mixer tube and the other of which controlled the 99 type tubes in the oscillator and infradyne amplifier sockets, are replaced with the 10 ohm rheostat mentioned above and another 10 ohm rheostat, which in conjunction with a fixed resistance of 6

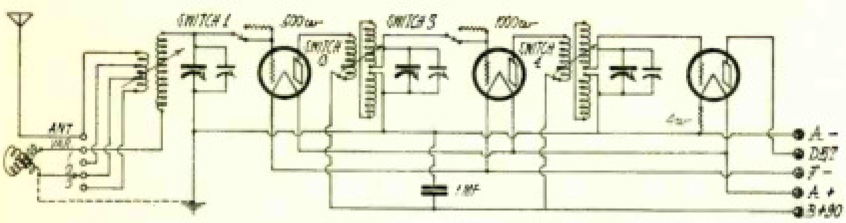


Fig. 1. Circuit Diagram of No. 710 Amplifier.

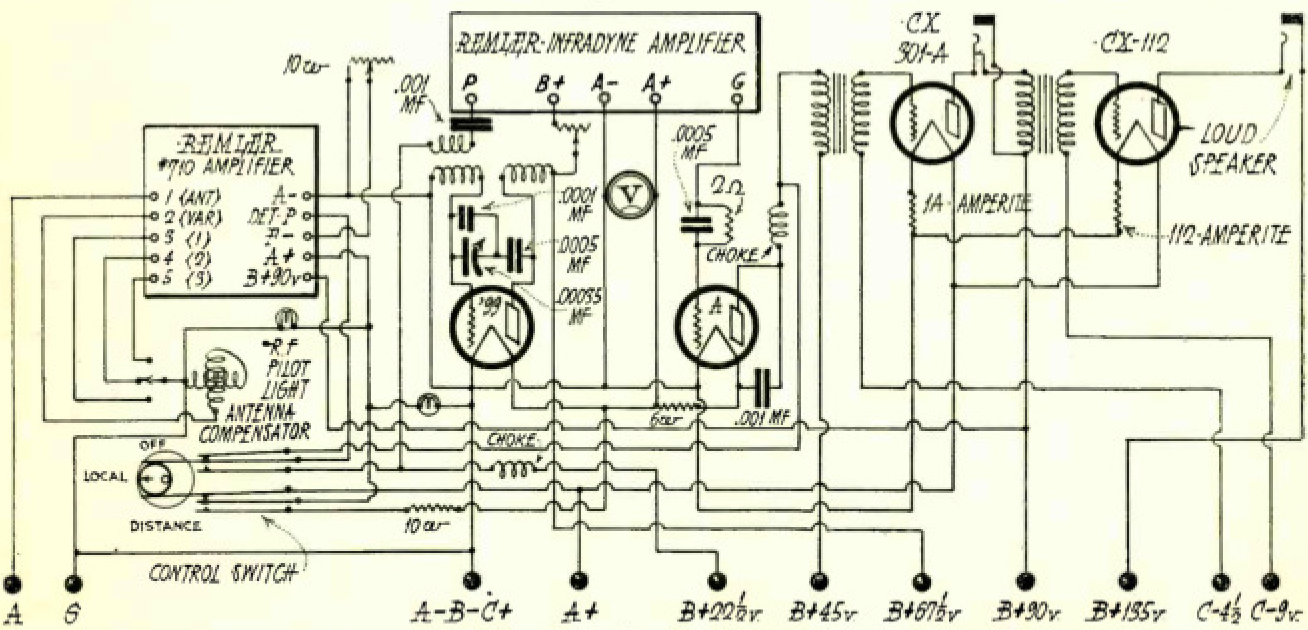


Fig. 4. Infradyne Circuit Diagram.

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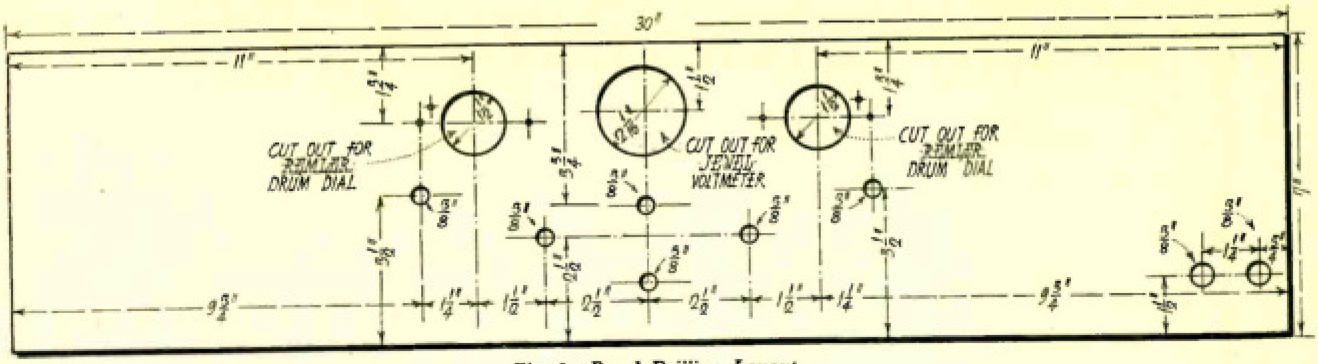

Fig. 2. Panel Drilling Layout.

ohms, gives control of the oscillator and infradyne amplifier tubes, and the second detector tube, as shown in the circuit diagram. The grid condenser and leak used in the mixer tube grid circuit are removed, as bias detection is employed, the mixer tube being biased by a 1 volt drop obtained through a 4 ohm filament resistance which is a part of the r.f. amplifier. As the mixer tube socket is now a part of the r.f. amplifier, the mixer tube socket of the two previous models is dispensed with. The Yaxley No. 10 filament switch is replaced by the Yaxley No. 69 switch, which provides an off position and positions for the five and ten tube operation.

In some cases the more experienced wireman will be able to leave the audio side much as it was before reconstruction of the layout. However, as in most cases it will be necessary to move the first audio transformer toward the right, in order to make room for the remounted oscillator condenser with its drum dial, and to move the first audio jack toward the right also, some wires, depending on the method of arrangement, will have to be cut and resoldered. In some cases it will be advisable to make a clean sweep of the old wiring and rewire. As to the form of wiring used, the constructor may wire as called for in previous models, or may adopt the switchboard or cable harness wiring as is used in the 1928 model infradyne assembly described in August RADIO.

If cable wiring is used filament and negative *B* leads can be included in the cable as can the audio plate leads. All

NEW PARTS REQUIRED FOR REVAMPED INFRADYNE

1—Engraved panel, 3/16x7x30
1—Remler No. 710 amplifier and antenna compensator
2—10 ohm Frost rheostats
1—2 to 10 ohm Frost rheostat (used as sensitivity control)
2—Remler No. 110 drum dials
1—Yaxley No. 69 switch
1—Sangamo .0001 mfd. fixed condenser

grid leads and the radio frequency plate leads must be kept free from the cable. The grid leads should be kept as short and direct as possible.

While exact dimensions are necessary in laying out the panel preparatory to drilling, an exact mounting layout for the baseboard is not required, and therefore in the baseboard layout arrangement here given, exact dimensions to scale are not given. Working from this pictorial layout, the constructor will have no difficulty in placing the r.f. amplifier and the audio transformer so as to work in with the arrangement of the other units.

In the remodelled instrument, the original oscillator coupler is retained. This may be either the 14, 14 and 8 turn coupler for which dimensions were given in previous issues of RADIO dealing with the infradyne, or it may be the Silver Marshall No. 110 B coupler wound with enameled wire.

It will be noted that in the circuit diagram presented herewith, a .0001 mfd. condenser is shown shunted around the variable .00035 mfd. twin rotor condenser. In the previous models of the Infradyne, in order to utilize the sum frequency principle involved in the infradyne circuit, the dial of this condenser was so set as to read at 100 with the plates out of mesh, thereby utilizing but one-half the dial surface. The purpose of the .0001 mfd. fixed condenser in shunt around the oscillator condenser is to make it possible to use the entire 360 degree surface of the drum dial instead of but one-half. In order to use the original coil with this arrangement, two turns must be removed from the filament end of the grid coil. The oscillator coupler will then consist of a pick up coil of 8 turns, a grid coil of 12 turns and a plate coil of 14 turns.

Testing the Finished Job

After completion of wiring and setting up of the completed job, the usual methods of testing out connections, tubes and batteries, familiar to the average radio constructor and to those who have already built previous models of the infradyne, should be resorted to. Especial care should be used, in wiring up the Yaxley change-over switch, to see that no soldering flux gets in between the leaves of same, and into the insulation, as leakage across the various connections involved will result in a very marked decrease in the performance of the set. The switch is set on the five tube arrangement first. Properly wired, the three tubes of the 710 r.f. amplifier and the two audio tubes will light. After checking performance on five tubes, the switch is moved to the ten tube position, which will light the oscillator and three infradyne tubes of the 99 type, and the A tube in the second detector socket.

Full directions for adjusting the 710 amplifier are supplied with it.

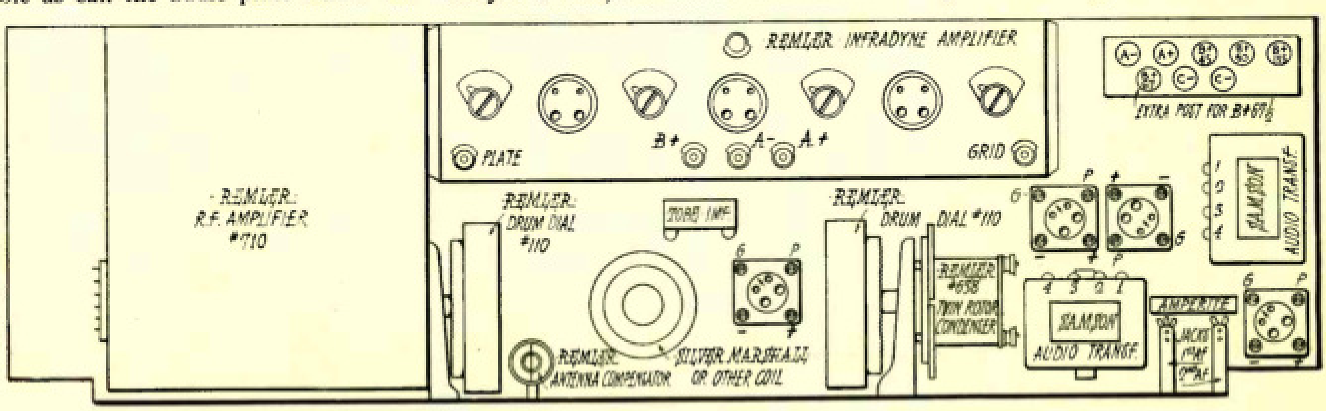

Fig. 3. Baseboard Layout.

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"1928 Infradyne" Presents Attractive New Features

AMONG the new radio receivers and equipment for the 1928 radio season we find the "1928 Infradyne" one of the most distinctive. Here is a radio set embodying really new features; interesting alike to the man who builds his own set and to the professional set builder. All the difficulties a man encounters in building, such as the tedious alignment of the tuned radio frequency stages, stabilizing, preventing inter-stage coupling, etc., have been removed before the parts for the set reach him, and he has a much better chance of immediately getting perfect and gratifying results; still there is the satisfaction which every radio fan knows, derived from having constructed one's own set. The assembly of parts and wiring is a matter of two or three hours of interesting work and the result is a receiver which not only has the appearance of the finest factory built set, costing considerably more money, but also performs like the best of them. The creation of this set is certainly a progressive step in the industry.

Ten tubes are used throughout the set, two CX301As in the first two stages of tuned radio, one in the first detector socket, one as the second detector, and also one in the first stage of audio; three CX399 tubes are used in the Infradyne Amplifier unit and one more in the oscillator socket. Either a CX112 or CX371 is recommended for the last stage of audio.

The photo, Figure 1, shows the set as it looks completely assembled and housed in an all-metal cabinet, which provides an effective shield against picking up radio frequency and other electrical disturbances by the coils and associated wiring in the set, permitting only energy which is picked up on the antenna and going through the tuned channels to be amplified. Through the efficient shielding and very selective circuits all but the desired signals are rejected. The tuning controls or selectors are the two upper knobs on either side of the voltmeter, connecting with the two drum indicators which are mounted, one on the three-in-line Remler gang condenser to the left, and the other on the single

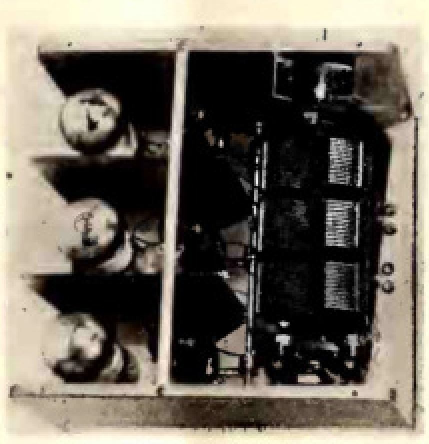


Figure 3—Radio frequency amplifier with the metal case removed

Remler condenser to the right. A filament control is directly beneath the voltmeter, the voltage applied to the tubes being indicated on the meter. A volume control is on one side and "sensitivity" control on the other, both of these are rheostats mounted behind the condensers; extension shafts connect the rheostats with the knobs on the front panel.

A switch at the bottom of the front panel controls all the filaments. When the switch is at the "OFF" position all the filaments are out; when it is turned to "LOCAL" position the Infradyne amplifier is out of the circuit and only the radio frequency tube and audio frequency tubes are lighted, and when the switch is turned to "Distance" all the tubes are lighted and the Infradyne Amplifier is automatically put into operation.

Just above the base and to the left of the central control panel is a supplementary bronze shield carrying the antenna compensator control. The antenna compensator control knob is double, the larger part operating a three-point switch permitting variable antenna coupling and the smaller part controlling a small variometer connected in series with the secondary of the input radio frequency transformer or antenna coupler. Adjustment of the antenna compensator is made when the set is first put into operation after which the antenna circuit will stay in line with the remaining circuits over the entire wavelength band. A very slight adjustment of the antenna compensator might be desirable as a last step in obtaining the best possible reception of a distant station but under ordinary conditions it can be forgotten when it has once been correctly set. In the rear of the cabinet, at the end nearest the antenna compensator controls, are the "Antenna" and "Ground" binding posts, the battery cable and the jack for the loud speaker.

The whole receiver is made up of several units which are easily assembled. One of the most interesting features is the all metal base, with holes already drilled, and the completely assembled radio frequency amplifier which constitutes the front part of the set. The photo, Fig. 2, shows the complete layout of parts and the photo, Fig. 3, the radio frequency amplifier with the metal case removed. The r.f. amplifier is unique in many respects, and shows real engineering on the part of the designers. The three transformers are tuned with the single Remler three-in-line condenser to which is mechanically connected a shaft having the primaries of the transformers mounted thereto; as the capacity of the condenser is increased the coupling between primary and secondary of the transformers is increased, in a relation which tends to keep the greatest sensitivity without oscillation over the whole wavelength range; also, provision is made for two degrees of primary to secondary coupling so that the amplifier is readily adaptable to various broadcast conditions.

The coupling can also be changed by moving the secondary coils which are mounted on brass rods extending up through the center of the coils, up or down, thus changing the relation of the secondary to the primary coils. The coils are matched with the gang condenser at the factory, this eliminating trimmer condensers to compensate for deviations in the coils as the wavelength range is covered. For greater selectivity the coils are moved upward and for less selective tuning the coils are moved down.

Shields between stages minimize interstage coupling; together with the automatic coupling scheme, the amplifier is very stable over the whole wavelength range, and also at maximum sensitivity over the whole range. The front part, or radio frequency amplifier, of last year's infradyne was in some cases rather difficult to handle. In the new Infradyne this complication is eliminated.

At the rear of the set is mounted the Infradyne Amplifier. This is the same amplifier which has become so well known during the past year for its ability to sharpen tuning and to build up volume of signal without an annoying increase in background noise. In construction and per-

Figure 1—The receiver as it looks completely assembled and housed in an all-metal cabinet

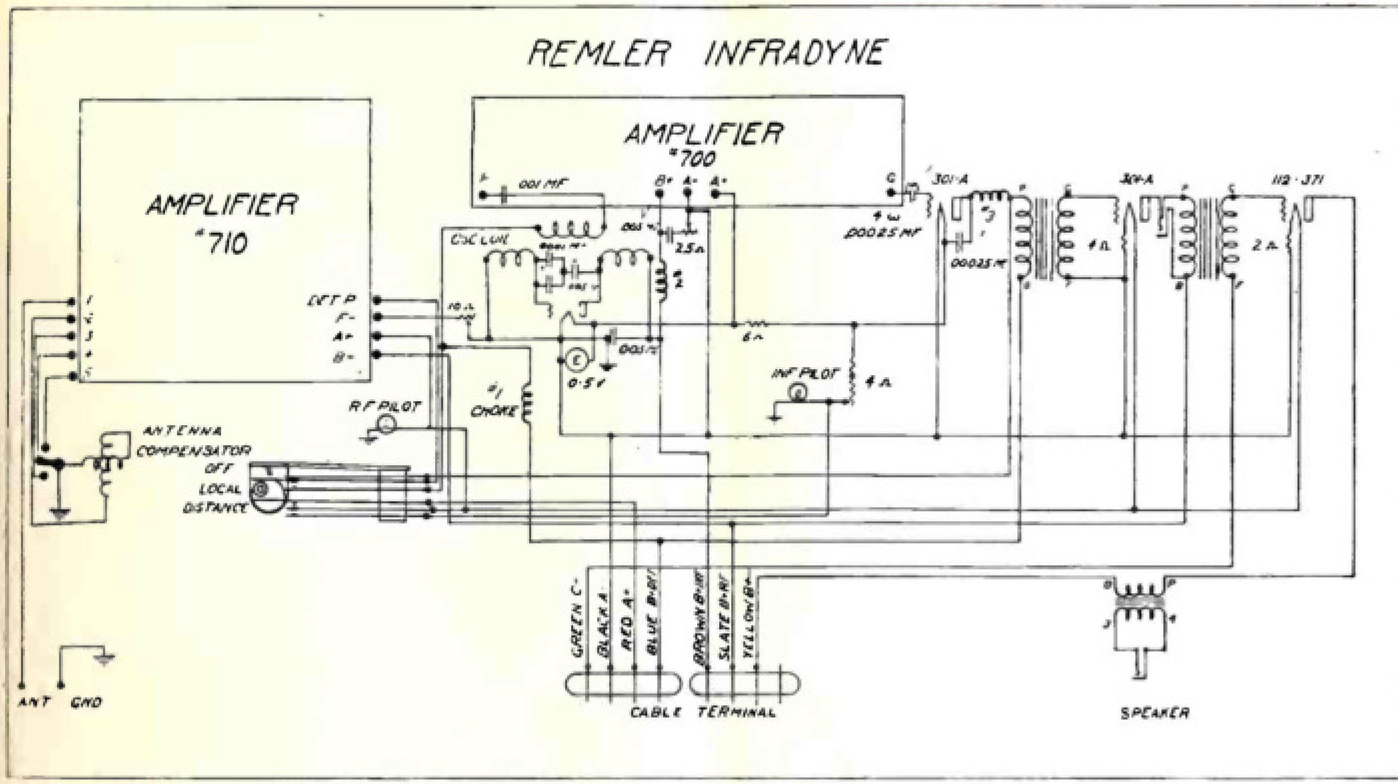


Figure 5—Wiring diagram of the "1928 Infradyne," showing also the color scheme for the battery cables

formance this amplifier has not been changed in any respect from that of last year.

Back of the bronze panel carrying the instrument controls is a pressed steel panel upon which are mounted the voltmeter, Infradyne Amplifier rheostat, two drum dials, and the oscillator tuning condenser. Located directly in back of the drums are the two rheostats for volume and sensitivity control. From the layout it is obvious that the assembly of this receiver is far from complicated, and perfectly symmetrical.

The bottom of the pressed steel base is illustrated in the photograph, Figure 4. Since the holes are already drilled for mounting the instruments and running the wires the job of building the set is greatly simplified.

All the small parts used in the Infradyne receiver, including nuts and screws, wire, etc., comprise the Infradyne Foundation Kit, saving a lot of troublesome shopping for these odds and ends. The parts are as follows:

Infradyne Foundation Kit—Parts List.

1 Pressed Steel base
1 Pressed steel instrument panel
2 Bronze control panels
1 Remler No. 110 Drum Dial (Right-hand) with brace and lamp
1 Remler No. 110 Drum Dial (Left-hand) with lamp
1 Remler Type 659 Condenser
4 Remler No. 50 Sockets
3 Remler No. 35 Choke Coils with special spacers
1 Special coil and spacer
1 10 ohm rheostat, extension shaft and bushing (Frost)
1 2½ ohm rheostat, extension shaft and bushing (Frost)
1 4 ohm rheostat (Frost)
1 2 ohm fixed resistor
1 4 ohm fixed resistor
1 6 ohm fixed resistor
1 Electrad Type GS .00025 mfd. condenser
1 Electrad Type P .00025 mfd. condenser
1 Electrad Type P .001 mfd. condenser
3 Electrad Type P .005 mfd. condensers
1 Special adjustable condenser

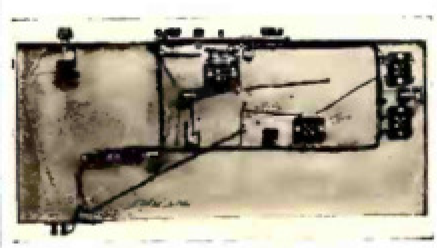


Figure 4—Bottom of the pressed steel base of the "1928 Infradyne"

1 4 megohm grid leak
1 Frost No. 953 Jack
1 Frost No. 954 Jack
1 Yaxley No. 69 Switch
1 "Antenna" binding post
1 "Ground" binding post
1 Bakelite terminal strip 4" x ¾" x⅛"
2 Special bakelite terminal blocks
1 Battery cable
12 Lengths wire (colored as per code)

Necessary screws, nuts, washers, soldering lugs, spacers and brackets. The rest of the units are the Remler No. 710 Radio Frequency amplifier and Antenna Compensator, two Silver-Marshall Type 220 Audio Transformers, one Silver-Marshall Type 221 Output Transformer, and a Western Model 506 or Jewell Pattern 135 O-5 volt voltmeter.

A simple plan has been devised by the manufacturers for making up a cable harness. A full sized template is furnished showing the positions for the various nails on which the wires are wound to make up the panel. The plan is so simple that even a man who has had almost no experience whatever can easily complete the job.

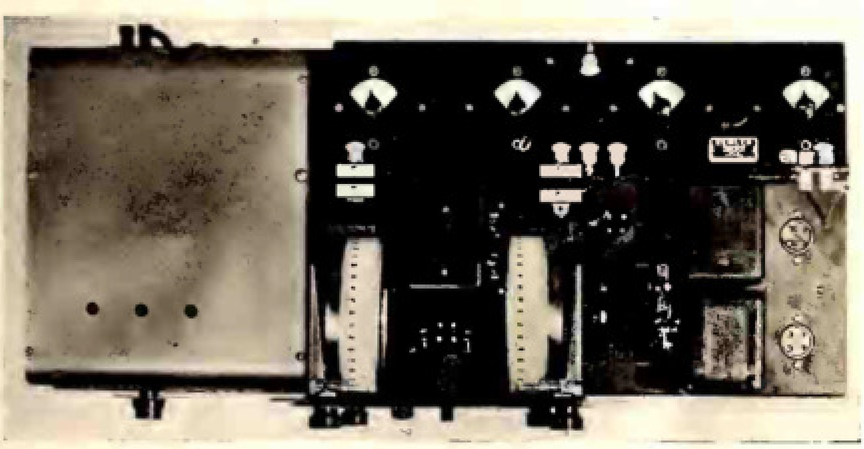
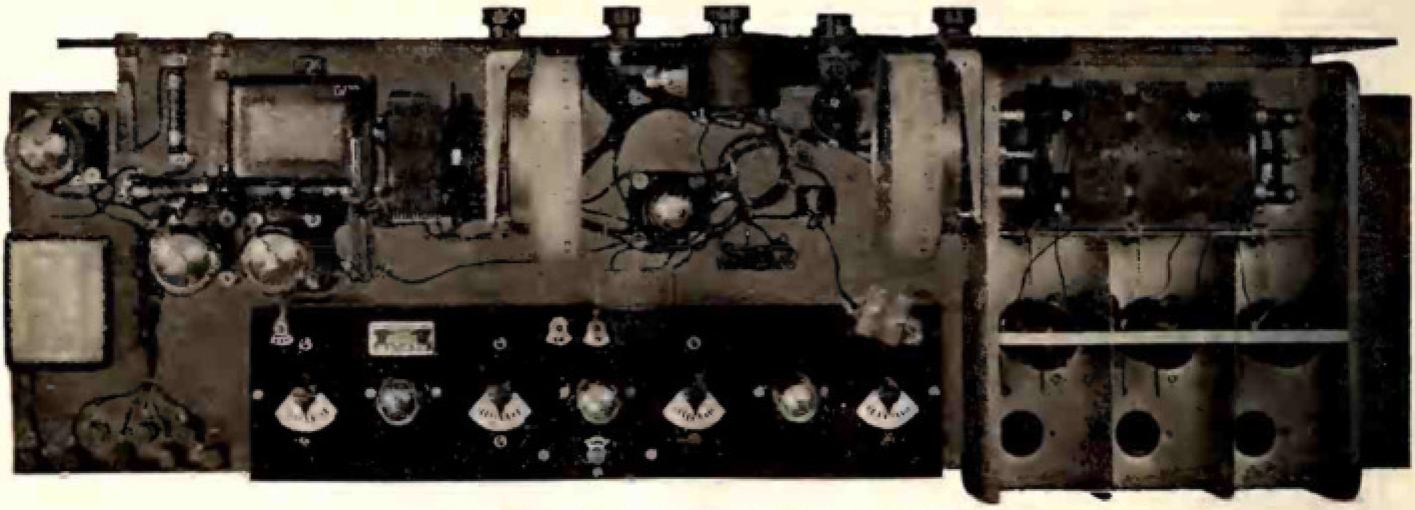


Figure 2—Layout of parts in the "1928 Infradyne"

New Infradyne With Amplifier

By ALEXANDER MAXWELL



Top view of the 1928 Infradyne with new amplifier

IT HAS been nearly three years since the Remler Infradyne first made its bow, and because it is steadily increasing in favor the manufacturers are bending every effort to develop further refinements.

Minor improvements have been made from time to time, but now a major improvement has been released, an enclosed New Style 710 Radio Frequency Amplifier. This unit is similar to the one furnished with the Infradyne Kit, the only difference being it employs a bias on the mixer tube instead of a leak and condenser, and therefore requires an additional terminal.

We will go more into detail concerning the amplifier itself presently, but right now we desire to state that this article is written primarily for the man who already has an Infradyne of his own construction and desires to bring it up to date. If the reader is contemplating building the entire outfit from the ground up we advise constructing the Infradyne Kit, as described in these pages of the October number. If you do not have the October RADIO AGE it will be supplied upon receipt of thirty cents, post paid.

We take it for granted that the prospective remodeler has his set already mounted on panel and baseboard, and the parts wired at least somewhere near the specifications given at the time his particular model was released.

If so, the baseboard may be used as it is. If not, then all the parts must be removed and regrouped. If time is no object it will be advantageous to remove the subpanel entirely and replace it with one of bakelite, putting all the wiring on the under side. There are so many wires in the Infradyne, especially after the change-over switch has been added, the finished set is likely to look like the wrong side of a telephone exchange unless care is used in placing the wires.

Remler recommends using the bunched cable system, which we heartily second. The smaller wires are every bit as satisfactory as the heavy, unwieldy bus, and if a different colored casing is used for each circuit it will make wiring and tracing very simple.

All of the present radio frequency amplifier must be dispensed with. Other instruments are left as they were, and those in the enclosed box must be purchased in addition.

Each wire in a receiver acts as a tiny aerial, and not only that, but each and every coil is a miniature substation, redistributing the energy received from the aerial. There are several methods of preventing this intercoupling, as it is called, the two in most common practice being shielding and the use of coils with a restricted field. To be on the safe side the 710 Amplifier is provided with both methods. Copper partitions are placed between all coils, and a continuous shell surrounds the entire instrument. This shell and the partitions are grounded. Any stray oscillation that can penetrate this defense deserves a lot of credit. The coils deserve special mention for they are of unique construction. The secondary is split into two sections with their fields opposing, the grid and filament leads coming from the middle instead of the ends. The magnetic field extends just far enough to produce a coupling effect with the primary and right there it stops.

By consulting the wiring diagram of the 710 one will observe that the primary coil is tapped in four places and these leads go to the terminals as indicated. Tap number two is the grounded end of the secondary coil. The antenna compensator is furnished with the amplifier and is mounted on the panel between the drum and the meter. It consists of a tiny variometer and a three point switch, its purpose being to adapt the receiver to the particular aerial used, as well as providing additional selectivity in cutting out unwanted signals. It is a very important instrument, and it is rather delicate, so great care must be used, both in handling and in soldering the connections. Too much heat will melt other connections farther down the line, spoiling the entire effect and making a source of difficulty that is hard to locate. Use a bright iron and the minimum amount of solder, and do not apply the iron for more than five seconds at a time.

The Remler type 633 condenser is used in the amplifier. It is an elaboration of the original twin rotor condenser, maintaining all the desirable features and simplifying matters by the fact that all three condenser units are controlled in unison by a single knob.

It is practically impossible to make three variable condensers work in absolute harmony without a trimming device. In the case of the 633 these consist of small,

Back-Panel view of the New Infradyne

mica insulated compression condensers which are a part of the complete assembly and are not detachable. The three gangs are adjusted to resonance before leaving the factory, but if at any time one desires to change the adjustment it may be readily accomplished by means of a wooden screw driver furnished with the amplifier. Each of the three trimimng condensers is regulated by means of a screw with a slotted head. The wooden wedge is inserted in this slot and turned slightly. It is not advisable to make any adjustments on trimmers till the receiver is in working order, and then only when convinced beyond a shadow of a doubt the condensers do not aline properly.

In order to obtain the greatest coupling effect at a specified frequency the primary of the radio frequency transformer must be varied. This is in direct relation with the rotation of the condenser. By means of a system of levers and an ascending cam, the primaries of the three transformers are rotated as the condenser is advanced. This insures a maximum energy transfer at a given point, or to put it a bit more positively, the maximum energy transfer on all points within the range of the condenser.

The primary inductance may be varied by means of a three point switch on the first one, which is incorporated in the antenna compensator, and a two point switch on the other two. The adjustments of the latter are made permanently when the Infradyne is put in operation and need not be touched again. The first is varied whenever the occasion demands.

It is well known that a resistance inserted in the grid lead of a radio frequency receiver has a tendency to prevent oscillation. Therefore 500 ohms is provided for the first stage and 1000 ohms for the second, with short circuiting switches when not desired.

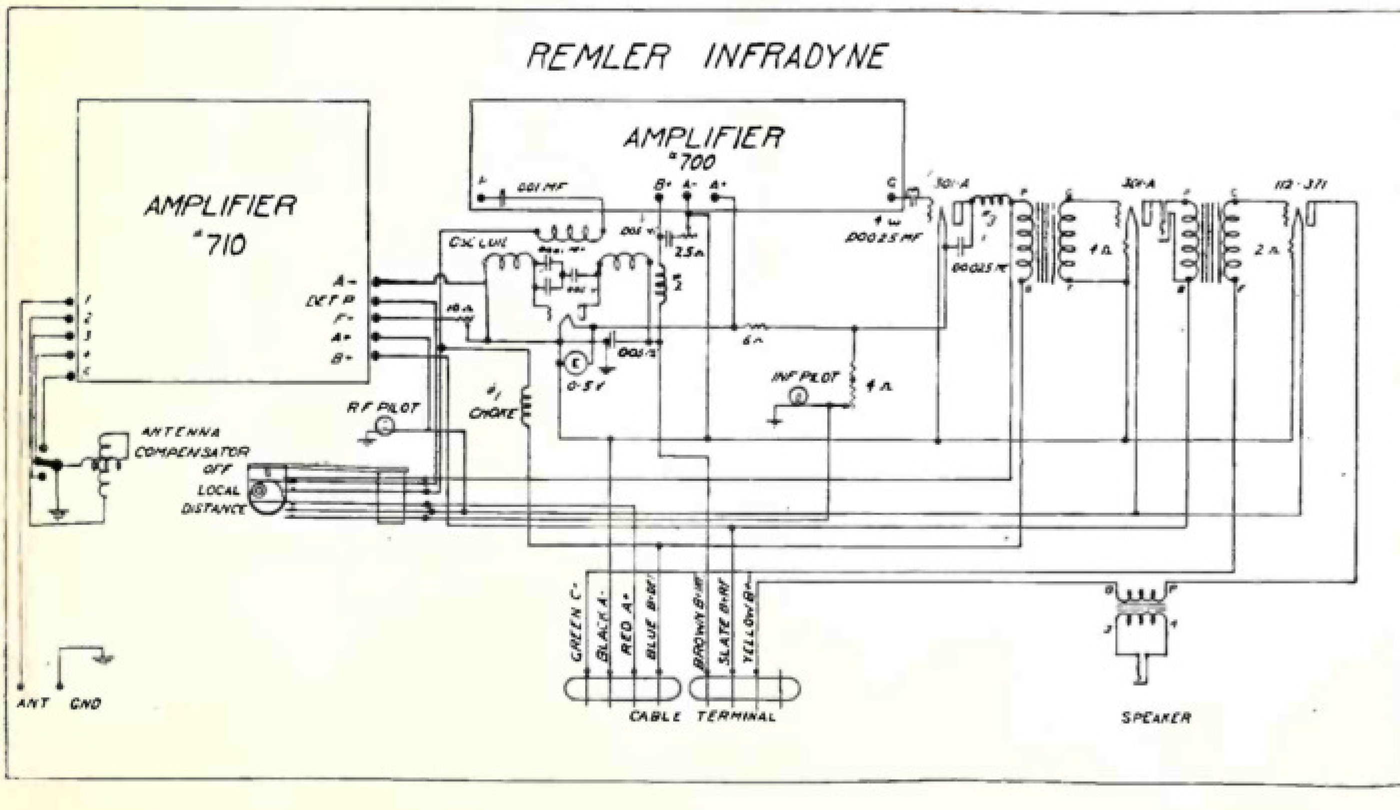
Panel view of the New 1928 Infradyne Receiver

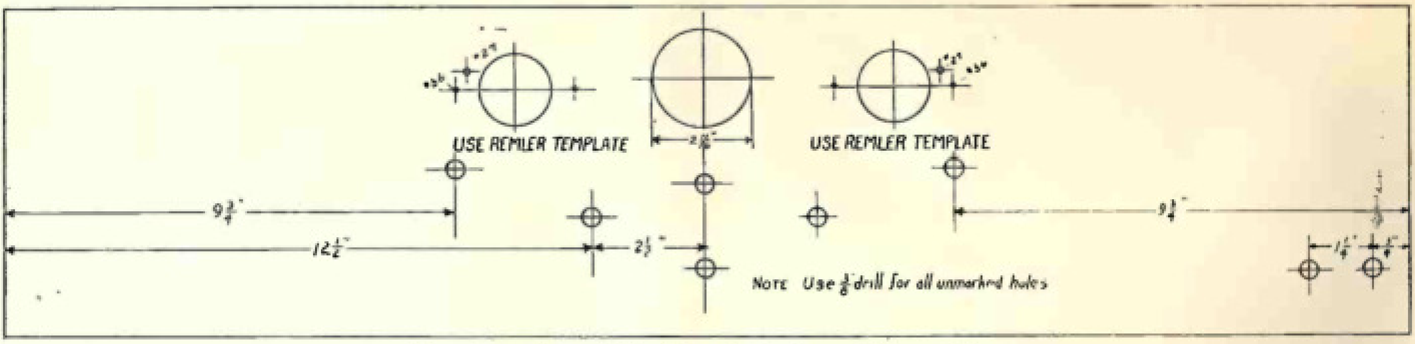
It is difficult without vernier controls to build an amplifier which will function equally well in both metropolitan areas and the more rural districts. Remler has taken this into serious consideration and believes the 710 to be a solution to the difficulty. By adjusting the four switches and the antenna compensator the receiver may be made to tune sharp enough to cut through the superpower station in the next block, or it may be broadened till the out of town user will have no trouble in picking up stations. Using the compensator as a vernier one should be able to bring in very weak signals with sufficient audibility to be readily distinguished.

Now that we know just what the instrument is with which we are dealing we will go ahead and install it. Perhaps you noticed that in the panel layout no vertical dimensions were given. It is a bit difficult to do this in remodeling because all baseboards and subpanels are not the same thickness. To determine the correct height for mounting the condensers fasten the 710 amplifier to the baseboard and fasten the mounting for the drum dial, using the holes provided. Leave the control shaft off for the time being. Now screw the new panel onto the baseboard and with a soft pencil or a scratch awl carefully trace around inside the hole through which the control shaft would protrude. This gives a point around which to work and all other measurements are made in direct relation. Now unscrew the panel and with a small drill make a hole in the center of the scribed circle, from the back side coming forward.

Take the left hand Rembler Template and paste it to the panel, making sure it is aligned correctly and the drilled hole is exactly under the center lines of the corresponding marking. Take the center punch and make an indentation for each hole. To locate the oscillator condenser it is only necessary to carry the guide lines over, and paste the right hand template in the correct place. The others are purely a matter of personal taste. We furnish a suggested panel layout which one will do well to follow.

Beginning from the left hand end the first knob controls the R. F. condenser, the second the antenna compensator, the third the R. F. rheostat, the one under it the Yaxley switch, the fourth the Infradyne rheostat, and the last the oscillator condenser. Certain parts have been done away with, namely the 50,000 ohm variable resistance. Volume is controlled solely by the ten ohm rheostat which controls the filaments of the first two tubes. The one mfd. fixed condenser is no longer used as one which performs its function is built into the R. F. amplifier.





Panel template of the New Infradyne with amplifier

The two thirty ohm rheostats, one of which controlled the mixer tube and the other the 299 tubes have been replaced by a ten ohm rheostat, the one mentioned above, and another ten ohm rheostat used in conjunction with a six ohm fixed resistance. The Yaxley 10 switch has been replaced by a Yaxley 69 switch which provides an off position as well as changing from five to ten tube reception.

Wiring, as stated previously, may be left as it was, with suitable changes, or all replaced. If using the cable harness style keep the plate and grid leads free or trouble will develop. The old oscillator coupler may be used, or a Silver Marshall 110B substituted. It is not material as long as it contains the correct amount of wire.

It is most important that directions are followed in regard to connecting the three condensers in the oscillator circuit. The .0001 mfd. is shunted across the .00035 mfd. and a .0005 Sangamo hooked in series with the lead which goes to the plate. The purpose of the .0001 condenser is to alter the range so that the entire 360 degrees of the dial will be used instead of just half as in former models. In order to use the original coil in this manner two turns must be removed from the filament end of the grid coil. The coupler will then consist of an eight turn pickup coil, a twelve turn grid coil and a plate coil of fourteen turns.

New Parts Needed

One panel 7x30x3/16 inches.

One Remler 710 Amplifier complete with compensator.

Two 10 ohm Frost Bakelite Deluxe Rheostats.

One 2 to 10 ohm Frost Bakelite Deluxe Rheosate (used as sensitivity control)

Two Remler 110 Drum Dials.

One Yaxley 69 Switch.

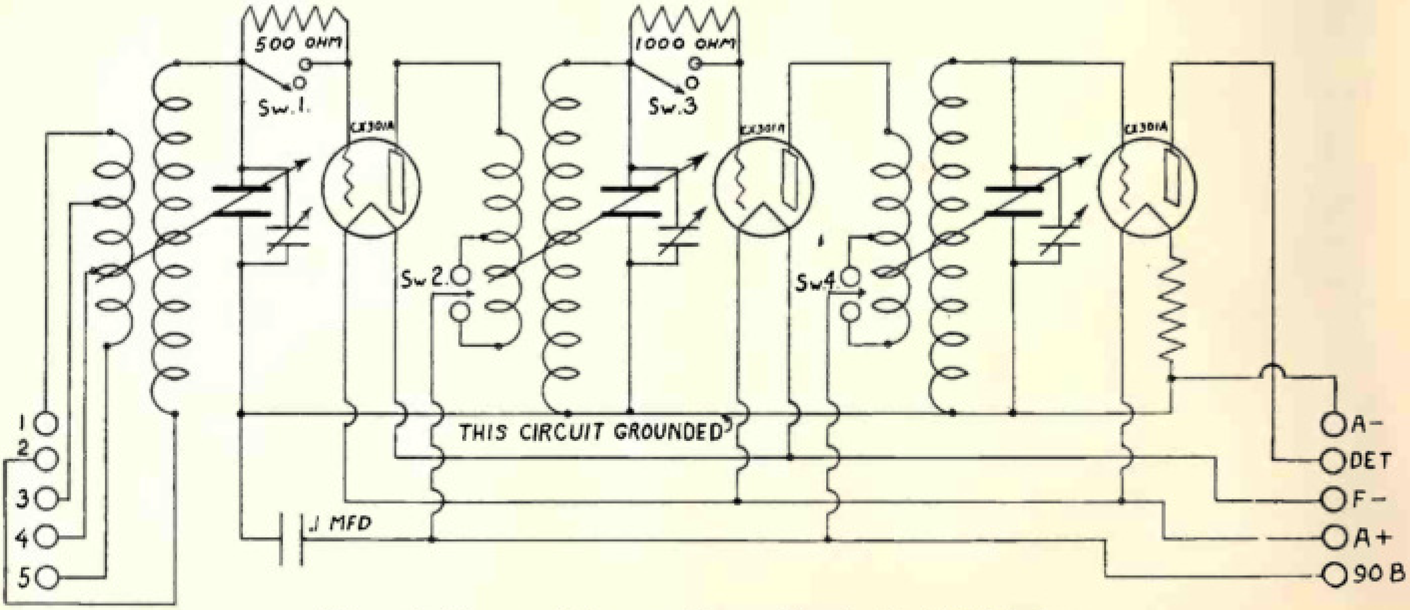
One Sangamo .0001 mfd. Fixed Condenser.

One Thordarson output choke.

As soon as the new receiver is finished it must be carefully tested to make sure that all connections are correct and the B battery is not turned through the filament circuit. This may be determined by placing the tubes in the sockets and after connecting the A battery and proving that all tubes light correctly remove one wire and touch it to each of the B binding posts. If nothing happens then it is safe to connect the B batteries. Use plenty of patience and don't turn anything without making sure it needs turning. The Amplifier is already adjusted for best results with an aerial of from 50 to 150 feet, when received. These adjustments are for localities where conditions may be termed average, in regard to interference and electrical noises.

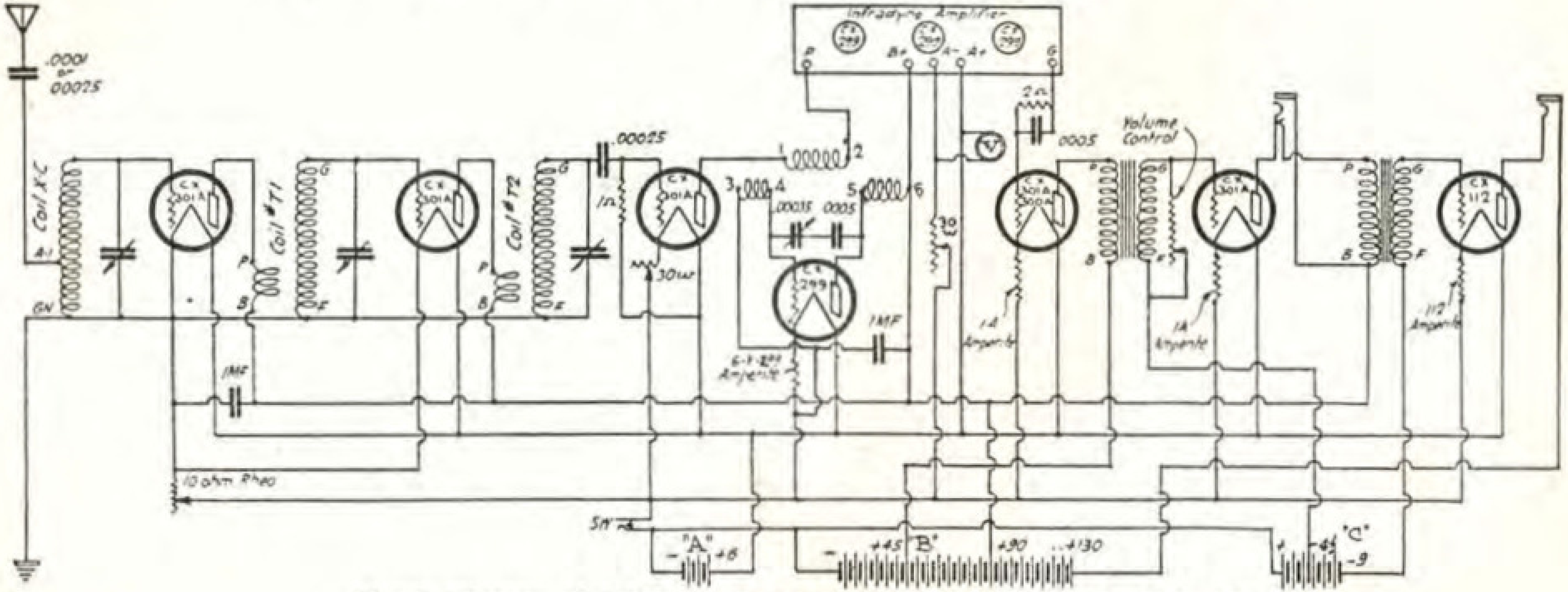
Switches One, Two, and Three are set on "non selective," switch Four on "selective." In localities where conditions are excellent switch number one is set on "selective," number two on "non selective," and numbers three and four on "selective." In locations where interference is bad different combinations may be tried, but be sure to make notations of the original settings so one may return to them at any time. Remember that this amplifier is designed to function in all localities, and for that reason is a bit more complicated than the average. Once it is out of resonance and the combination lost it is about as difficult to get back in working order as it is to pick the combination on the First National. It has been said that no matter how badly it is jammed up, turning something else will make it a little worse. This just as a word of precaution. It will work when received, and the best plan is to stay as close to the orginal scheme of adjustments as is possible.

When once in working order it should be left strictly alone, for nothing needs turning but the two tuning condensers and possibly the antenna compensator. The builder is probably so familiar with the adjustments of the Infradyne amplifier by this time no additional explanation is needed.

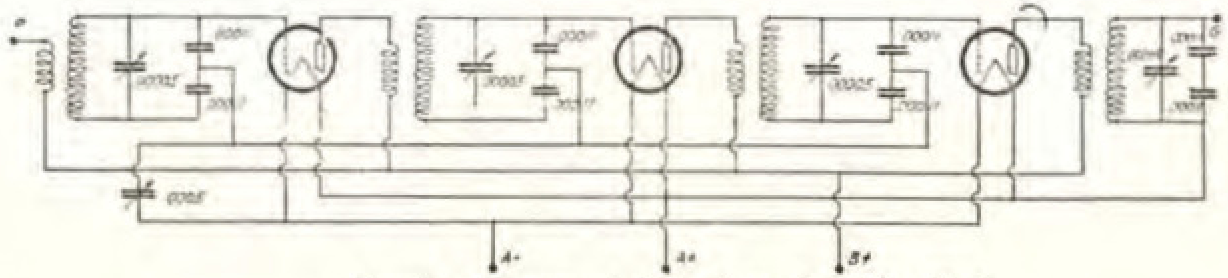


Schematic diagram of the new style amplifier for the 1928 Infradyne

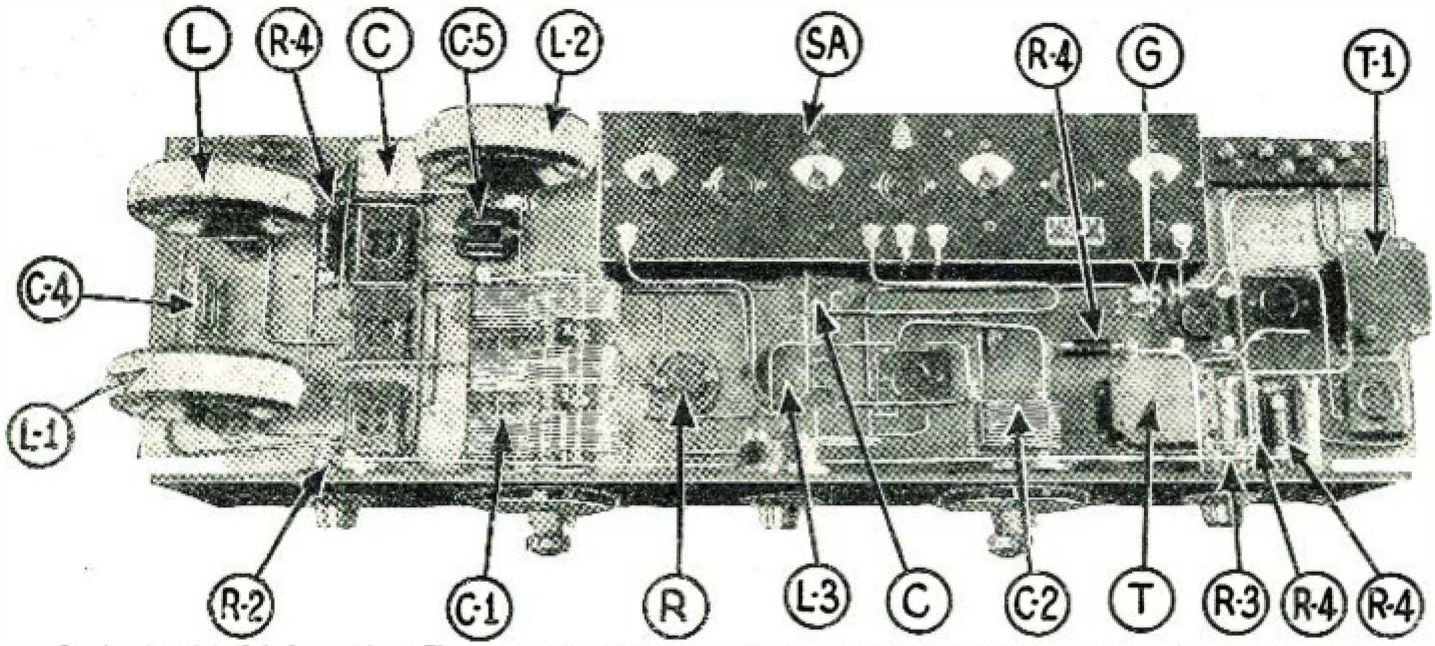
Infradyne Receiver and Amplifier Unit



Circuit Diagram of Infradyne Receiver. (Correction: 6V-299 should be 6V-199).



Circuit Diagram of Infradyne Amplifier Unit.



Interior view of the Infradyne receiver. The parts are: L-1 first R.F. transformer; C-4, series antenna fixed condenser; L, antenna coil; R-4, self adjusting rheostat; C, by-pass condensers; C-5. first detector grid condenser; L-2, Second R.F. transformer; SA, Infradyne amplifier; G, grid leak; T-1, second A.F. transformer; R-3, 50,000-ohm variable resistance; T. first A.F. transformer; C-2, oscillator variable condenser; L-3, oscillator coupler; R, 30-ohm rheostat; C-1, R.F. tuning condenser unit; and R-2, 10-ohm rheostat.

The Infradyne

By HERNDON GREEN

RADIO NEWS takes pleasure in presenting to its readers a new circuit which, though similar to the super-heterodyne, has incorporated in it some striking features that immediately justify the use of the word "original."

The salient point of the Infradyne is that, instead of making use of the "difference" in frequency between the local oscillator and the incoming signal and amplifying this beat, the "sum-frequency" is utilized and amplification carried out on the very short wave of 95 meters, instead of between 3,000 and 10,000 meters as in the super-heterodyne. The result is total absence of interference from long-wave transmitting stations, arc "mush," stray heterodyning, and what is far more gratifying, the complete elimination of "harmonics," which are so prevalent in super-heterodyne receivers. A broadcast station is never picked up at more than one setting on the dials.

Combined with this circuit are two stages of tuned-radio-frequency amplification. This advantageous tie-up offers a receiver as sensitive and selective as one could wish for.

RADIO NEWS recommends this circuit to experimenters and constructors and feels sure that they will find it of extreme interest.

—EDITOR.

MANY really excellent receivers, in the last year or two, have been developed. In some of these extreme selectivity has been the aim; while in others quality of reproduction has been emphasized. All of these receivers have, however, left something to be desired; clearness and purity of tone have been perfected at the expense of selectivity, or extreme selectivity has been gained with a sacrifice of quality. We must grant that a receiver offering extreme selectivity together with superior reproduction would have a most decided appeal to all of us. The writer believes that in the Infradyne such a receiver has been found.

ACCOMPLISHMENTS

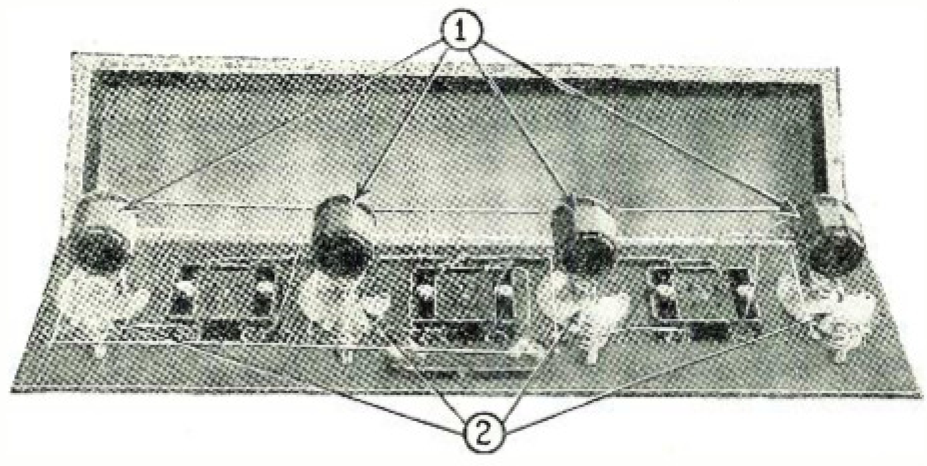
The Infradyne is, first of all, remarkably selective. It has been easily possible to receive with this set at Oakland, California, through KGO (a 3,000-watt station transmitting on 361 meters from that city) CZE, Mexico City, on 350 meters, and KTHS, Hot Springs, Ark., on 375 meters. Likewise, WLW, transmitting on 422 meters from Cincinnati, and CFCN, a 435-meter station at Calgary, Alberta (Canada), can be received while KPO, a 1,000-watt station, is in operation on 428 meters at San Francisco.

Of equal, if not greater importance is quality of reproduction. In this connection it can only be said that this receiver is capable of well-nigh perfect reproduction, the only limitations being those which may be imposed by the loud-speaker or audio-frequency amplifier used. As large strides have recently been made toward perfection of these very important parts of every receiver any such limitations must necessarily be slight.

A further very desirable feature of the Infradyne is quietness of operation. More will be said later of the elimination of "background noise," which has made this possible.

SHORT-WAVE AMPLIFICATION

It is natural to wonder what revolutionary departure could have been made from present practice to produce a receiver of such merit. The secret of success has been the employment of amplification at a *constant, very short wavelength.* The idea is not entirely a new one; but such amplification has heretofore been deemed impracticable, because of the difficulty of controlling energy transfer through parasitic tube capacities. While a certain amount of such energy transfer is not undesirable, lack of control has made the practical use of the method impossible. It has remained for E. M. Sargent to develop a simple and effective method to overcome obstacles which have until the present, been insurmountable.



Interior view of the Infradyne amplifier, the schematic diagram of which is shown on page 380. 1 are short-wave transformers, and 2 low-capacity adjusting condensers.

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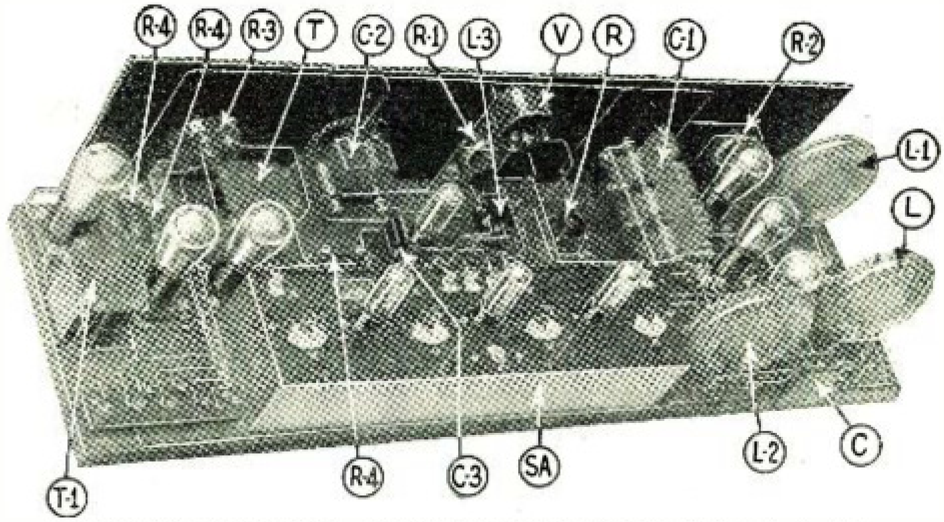
The super-heterodyne and the tuned-radio-frequency receiver (in the latter of which provision is usually made for the neutralization of tube capacities) have recently enjoyed the greatest popularity. Of these, the super-heterodyne has, in the writer's opinion, offered the greatest degree of sensitivity and selectivity obtainable. A brief comparison of these circuits with the Infradyne will follow.



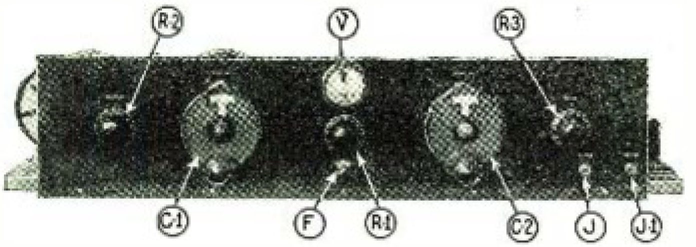
Rear view of the Infradyne set. The indicating letters correspond with those in the illustration on the opposite page, and the diagram below. Note that 199-type tubes are used in the short-wave amplifier and the oscillator.

COMPARISON OF CIRCUITS

Let us first consider the fundamental differences in operation between the Infradyne and the super-heterodyne. As the result of the mixture of a locally-generated frequency with a received frequency, two new frequencies are generated. One of these is the *difference* or "beat" between the received and locally-generated frequencies; and the other is the *sum* of the locally-generated and received frequencies. It might be well at this point to call the reader's attention to the fact that both the "sum" and "difference" frequencies will be modulated *exactly as the incoming signal is modulated* and their amplification will therefore result in no distortion of the received music or speech.

The *beat-frequency* is that which is amplified in the super-heterodyne. It is relatively low and has been employed because it is comparatively easy to handle. The effect of parasitic capacities decreases as the frequency decreases and, therefore, fewer difficulties are met in the design of circuits to operate at the longer wavelengths. The beat-frequency, which has been chosen for amplification in the super-heterodyne, has usually been in the neighborhood of 50 kilocycles. Its use has been responsible for several undesirable features common to receivers of this type.

It will be apparent that a difference of frequency equal to the intermediate frequency will be obtained for *two values* of locally-generated frequency. This condition will hold when the locally-generated frequency is 50 kilocycles *above* the received frequency and when it is 50 kilocycles *below* the received frequency. There are thus, normally, two settings of the oscillator dial for each station. Because of the value of the intermediate frequency chosen for use in the super-heterodyne, it is possible in these receivers, due to harmonics generated in the oscillator circuit, to receive certain stations in as many as six places on the dial. Additional interference and confusion have resulted through production of this relatively low intermediate frequency, as a result of heterodyning between powerful stations on adjacent wavelength bands.



Front view of the Infradyne. V is the filament voltmeter; R-1, 30-ohm rheostat; F the filament switch; and J and J-1 the first and second stage audio stage jacks. The other letters correspond with those in the illustration above.

INTERFERENCE WITH I.F. CIRCUITS

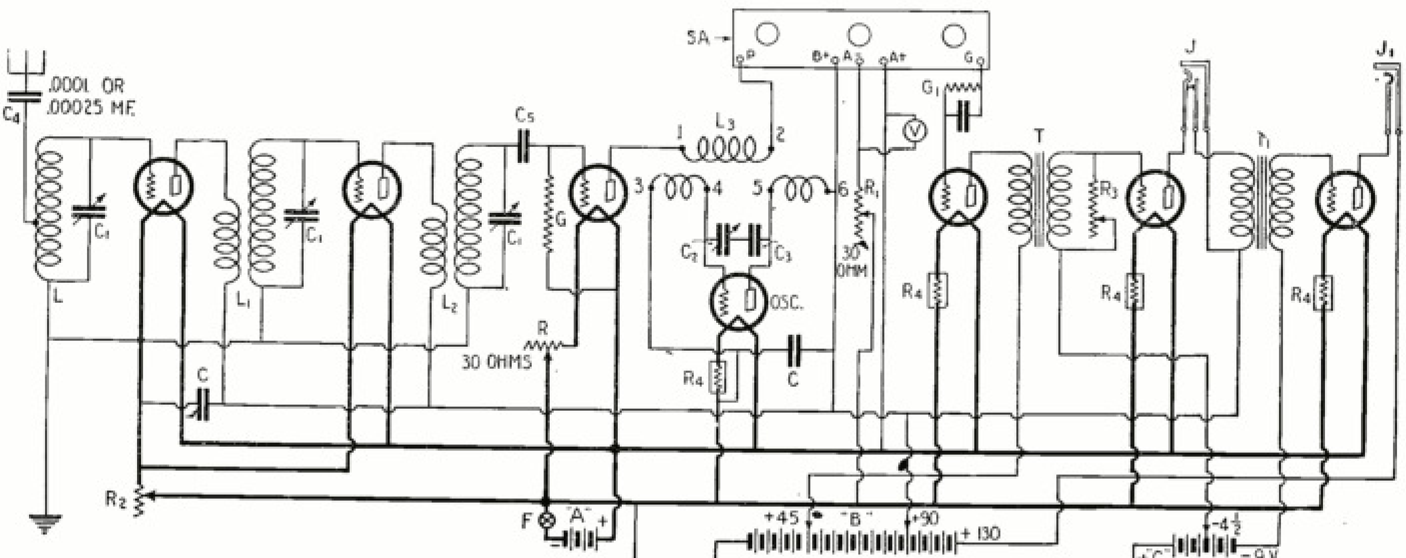
Reception in these receivers, particularly in localities adjacent to long-wave commercial or government stations, has been further marred by direct pick-up by the intermediate amplifier circuit of long-wave signals or arc "mush." In this connection it will be remembered that many of these stations are transmitting on wavelengths very close to those to which these intermediate amplifiers have been tuned.

THE INFRADYNE PRINCIPLE

The *"sum-frequency,"* resulting from the mixture of a locally-generated frequency with the received frequency, is amplified in the Infradyne. The sum-frequency employed is in the neighborhood of 3,200 kilocycles, which is equivalent to about 95 meters. The special circuit used permits maximum amplification at this frequency and perfect stability at all times. There is no tendency for circuits tuned to this very high frequency to pick up directly signals from local commercial or government long-wave stations. Because of the very high frequency of any harmonics, which might be generated in the oscillator circuit, they will not cause confusion, as in the case of the super-heterodyne.

A numerical example may serve to make this clear. The oscillator will be tuned to its highest frequency, when it is adjusted for reception of the station having the highest wavelength; and it will be tuned to its lowest frequency, when it is adjusted for reception of the station having the shortest wavelength. We will assume that the highest and lowest wavelengths to be received are, respectively, 526 meters and 200 meters. 526 meters is equivalent to a frequency of 570 kilocycles. Since the intermediate frequency to be employed is 3,200 kilocycles, the oscillator frequency will be 2,630 kc., whose second harmonic is 5,260 kc. This will obviously not *add* to any received frequency to

(*Continued on page 380*)



Complete circuit diagram of the Infradyne, employing a special short-wave amplifier S.A. (diagramed on page 380) and oscillator together with two stages of regular radio-frequency amplification. The indicating letters correspond to those in the illustrations.

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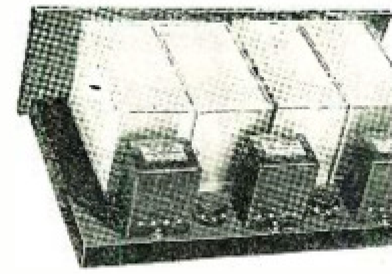
SM

630



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Behind the Shielded Six is competent engineering. It is sensitive. Day in and day out it will get distance—on the speaker. It is selective. Local stations in the most crowded area separate completely—yet there are but two dials to tune.

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The SM-630 Shielded Six Kit—including all specified matched and measured parts to build this remarkable receiver — price $95.00.

The 633 Essential Kit—contains 4 condensers, 4 R.F. transformers, 4 coil sockets, 4 stage shields and the link motion—all laboratory matched—price $45.00.

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S-M 220—the big, husky audio transformer you hear in the finest sets—the only transformer with the *rising* low note characteristic that means real quality—not only on paper—but when you *hear* it—$6.00.

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SILVER-MARSHALL, Inc.

848 W. Jackson Blvd., Chicago, U. S. A.

The Infradyne

(*Continued from page 357*)

produce the intermediate frequency; it will *beat* with a received frequency equal to 8,460 kc. (or 5,260 kc. plus 3,200 kc.), to produce the intermediate frequency. However, a frequency of 8,460 kc. is equivalent to a wavelength between 35 and 36 meters, which is, of course, far below the broadcast band.

Let us next consider the shortest wavelength to be received. 200 meters is equivalent to 1,500 kc. In this case the oscillator frequency will be 1,700 kc., the second harmonic of which is 3,400 kc. This will likewise not add to any received frequency to produce the intermediate frequency. It will beat with 6,600 kc. to produce the intermediate, or sum-frequency; but 6,600 kc. is equivalent to about 45.5 meters which is also far below the broadcast band. Any given station is therefore received at *only one place on the oscillator dial.*

It will also be readily apparent that there is no opportunity for confusion to result from the production of the intermediate frequency by heterodyning between powerful stations on adjacent wavelength bands, as there is in the case of the super-heterodyne.

SELECTIVITY AND SENSITIVITY PROBLEMS

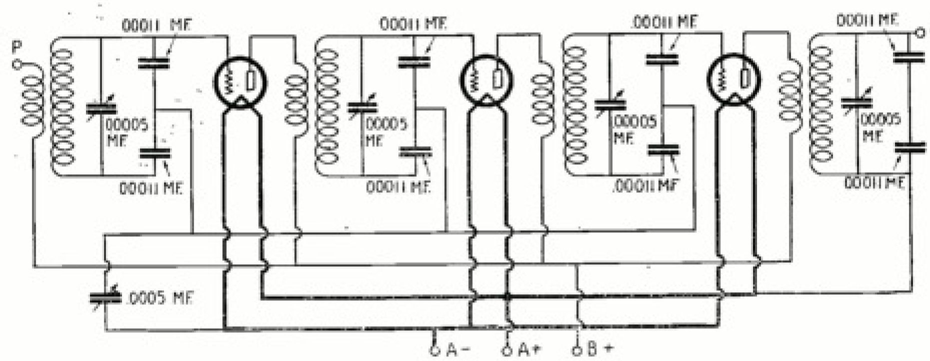
Having discussed the fundamental differences between the Infradyne and the super-heterodyne, let us consider the matter of selectivity, or sharpness of tuning. The super-heterodyne is generally dependent for its selectivity upon one transformer stage, tuned to respond to a narrow band of frequencies, and upon the natural selective qualities of the loop antenna with which it is used. Here it might be mentioned that the amount of energy picked up by a loop is exceedingly small; if it were possible to obtain with this type of receiver, when using an antenna, selectivity equal to that obtained with a loop, it would be desirable to use the antenna, because of the greater energy pickup. Occasionally two, or even four sharply tuned stages are used in a super-heterodyne. This practice often results in poor reproduction of speech and music, due to cutting off of the extreme voice and music frequencies, and in instability, so that the set is difficult to handle.

Tuned-radio-frequency sets usually depend for their selectivity upon not more than two stages of radio-frequency amplification, functioning at the frequency of the received signal. Were it possible to employ successfully more than two stages of such amplification the sensitivity and selectivity of these receivers would undoubtedly be considerably increased. In the usual type of set such an attempt may result in uncontrollable instability, because of stray coupling between stages.

This is not to convey the impression that more than two stages of such amplification are never used. There are on the market two or three commercially-made receivers employing up to as many as four stages of tuned-radio-frequency amplification. Such sets are very carefully laid out and contain elaborate shielding, which the average set builder is by no means equipped to make. Their cost, which is high, also places them well beyond the reach of most of us.

R.F. AMPLIFICATION

In the Infradyne, two stages of tuned-radio-frequency amplification, operating at the received signal frequency, are employed ahead of three stages of amplification at the very high sum-frequency heretofore described. All of these stages can be operated at maximum efficiency and there is no tendency toward undesirable reaction between the lower-frequency and highest-frequency amplifiers. The receiver can therefore be kept perfectly stable at all times without the use of any of the "losser" methods of control now used in radio-frequency sets. The high-frequency stages can be quite broadly tuned, as any very slight loss in selectivity, which might result from this practice, is more than compensated by the additional sharpness of tuning obtained in the two low frequency stages.



The circuit diagram of the Infradyne short-wave amplifier. There are four coupling transformers and their attendant fixed and variable condensers, the latter employed for peaking the transformers and stabilizing the circuits.

Incidentally, it will be recalled that a circuit can, at high frequencies, respond to a fairly broad band of frequencies and still be tuned quite sharply with respect to *wavelength*. For instance, 90 meters equals 3,331 kc.; but 3,321 kc. and 3.341 kc. equal respectively 90.35 and 89.8 meters. A circuit tuned sharply between 89.8 and 90.35 meters will therefore still pass freely a band 20 kc. wide. This permissible slight broadness of tuning of these circuits results in complete response to the full range of music and voice frequencies. Music and speech are, therefore, not distorted in the radio-frequency amplifiers, but reproduced just as they are received.

For the benefit of those who are interested in this receiver and desire some details of

CORRECTION

The kit of parts manufactured by the Bremer-Tully Mfg. Co., of Chicago, and especially designed for their patented Counterphase circuit was illustrated in the article "Kits of Parts for the Set Constructor" on page 224 of the September issue of RADIO NEWS and described as "parts for a 6-tube Neutrodyne set." We wish to correct this erroneous statement. The Bremer-Tully Counterphase is original and is not to be confused with the Neutrodyne circuit.

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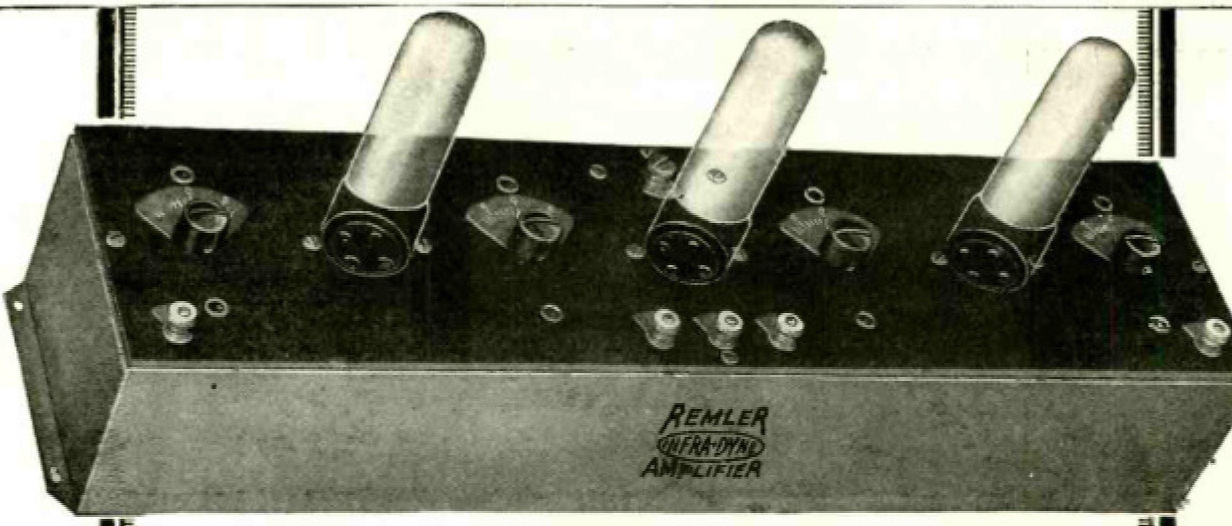

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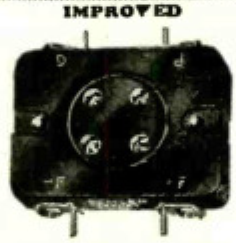

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An Infradyne Combination Set

Adapting the Infradyne Unit to a Standard 5-Tube Set

By CLYDE J. FITCH

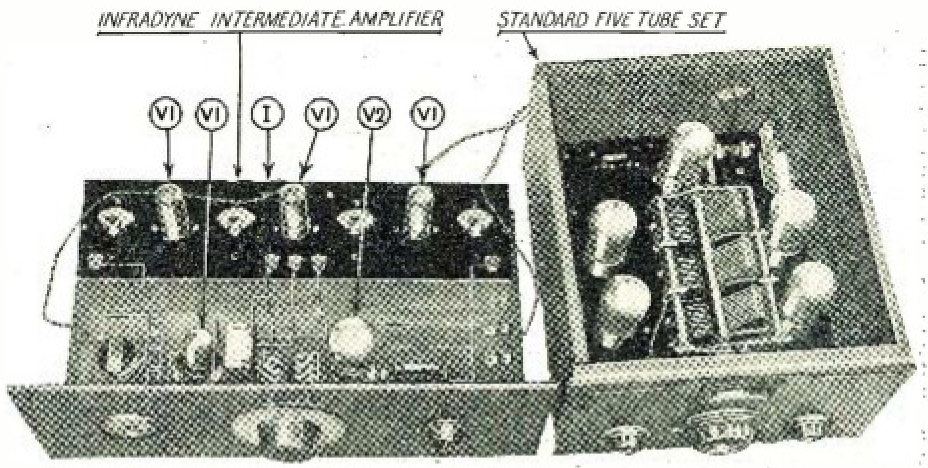
IN the October, 1926, issue of RADIO NEWS, we presented to our readers a complete description of an entirely new type of radio receiving set—the Infradyne. Now we are showing a new version of the same set, an amplifying unit that may be attached to any good five- or six-tube set and thereby convert it into the now popular Infradyne. The original Infradyne receiver employs ten tubes.

Obviously, to build such an elaborate set requires quite an outlay of both time and money; but Mr. E. M. Sargent, designer of the Infradyne, shows us how to build a simple five-tube unit that can be attached to our present five-tube set to convert it into the Infradyne. Simply connect the unit between the detector and audio amplifier of your present set and you have an Infradyne. The unit shown in the various illustrations was built in the RADIO NEWS LABORATORIES, and when connected to a standard five-tube set, gave excellent results.

While the theory of the Infradyne was told in the previous article referred to above, a brief outline of its action will be given here for the benefit of the possible few, who had the misfortune to overlook or miss the original copy.

THE THEORY

The Infradyne is simply another form of superheterodyne. And if you are familiar with superheterodyne action, you will at once recognize the similarity. In the superheterodyne, the incoming radio frequency current is combined with a radio frequency current of a different frequency generated at the receiver by the oscillator tube. And as always has been explained in superheterodyne articles, the two currents of different frequencies set up two beat frequencies, one equal to the difference, and the other equal to the sum, of the two frequencies of the applied currents. In the standard super-



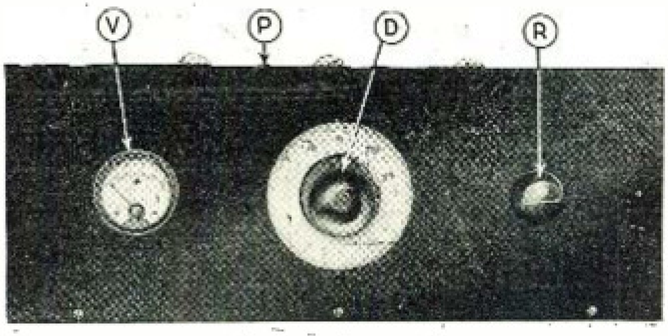
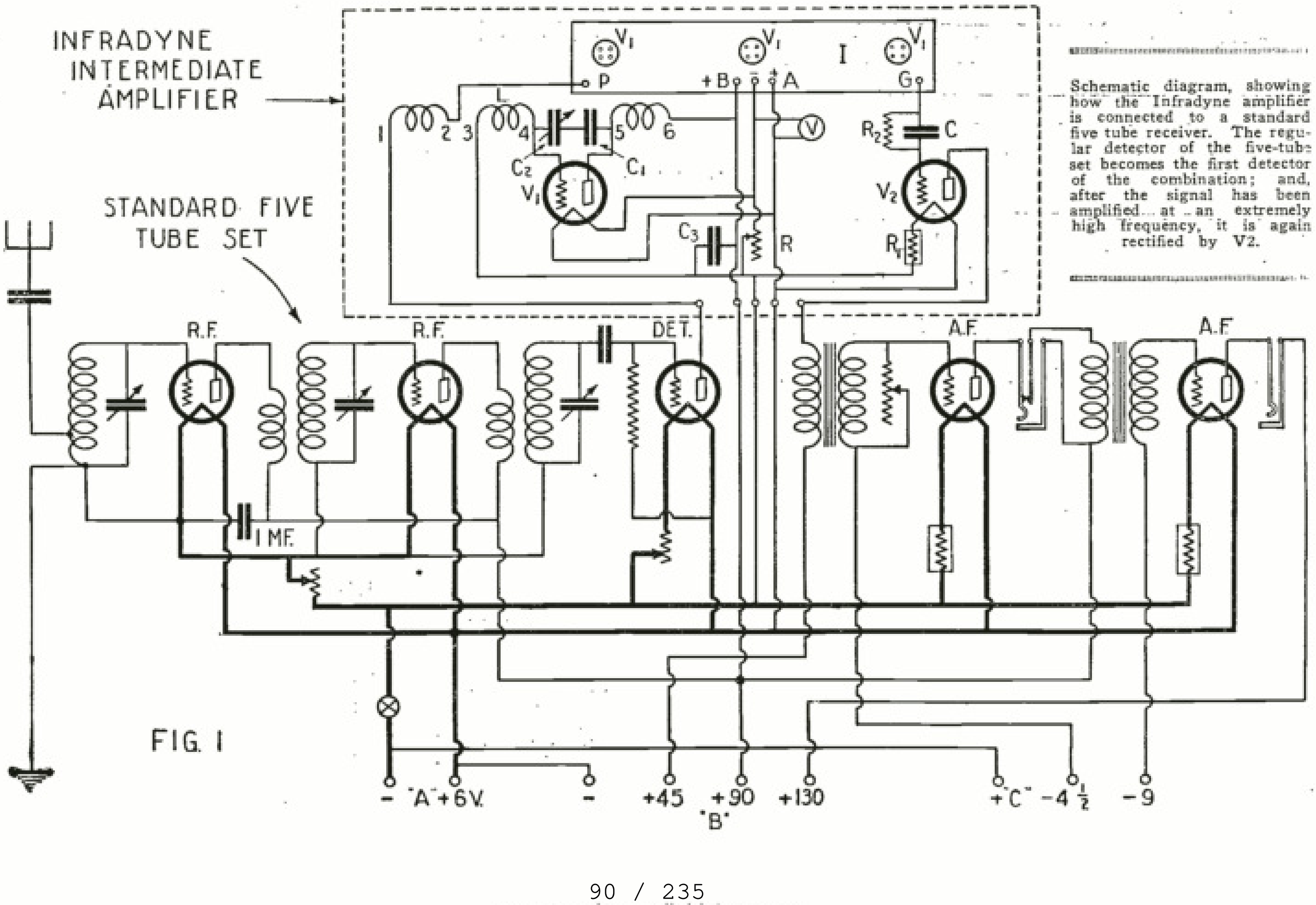


Fig. 4 (above). Tubes marked VI are 199-type, three in the high-frequency amplifier I, and an oscillator on the sub-panel. Fig. 2 (right) shows the oscillator-condenser control D of the Infradyne unit. V indicates the voltage in the filament circuit of the tubes VI, regulated by rheostat R.

Photos courtesy of Gray and Danielson (Remler Div.) Mfg. Co. and The Magnavox Company.



Schematic diagram, showing how the Infradyne amplifier is connected to a standard five tube receiver. The regular detector of the five-tube set becomes the first detector of the combination; and, after the signal has been amplified at an extremely high frequency, it is again rectified by V2.

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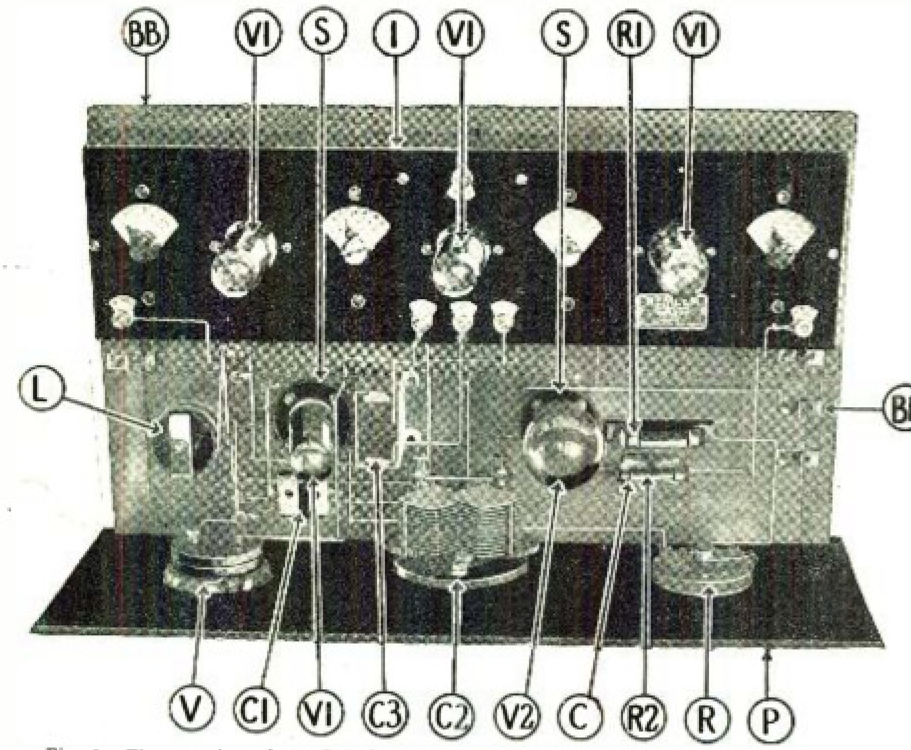

Fig. 3 The top view of the Infradyne amplifier, assembled for connection to a standard five-tube set The symbols are the same as those in the list of parts at the bottom of this page.

heterodyne, the *difference* between the two frequencies is made use of, giving a beat which in practice is in the vicinity of 40,000 cycles per second. In the Infradyne, however, the *sum* of the two frequencies is made use of, and in this particular set the beat produced has a frequency of 3,200,000 *cycles* per second (94 meters wavelength).

In the superheterodyne, the intermediate amplifier is designed to operate on a frequency of about 40,000 cycles. The intermediate amplifier of the Infradyne is designed to operate on a frequency of 3,200,000 cycles.

In the superheterodyne, where the *difference* between the two frequencies is made use of, the frequency of the oscillator must be *increased* while tuning the set to receive waves of higher frequency, so that the *difference* remains constant. In other words, the oscillator condenser dial reading is increased when the tuning condenser dial reading is increased, and vice versa. In the Infradyne, where the *sum* of the two frequencies is made use of, the frequency of the oscillator must be *decreased* while tuning the set to receive waves of higher frequency, so that the *sum* remains constant. In other words, the oscillator dial on the Infradyne is decreased when the tuning dials are increased, and vice versa. The oscillator dial on the Infradyne should have its scale reading backwards, which will aid in tuning and logging stations.

While it has always been known that the sum-frequency as well as the difference-frequency existed in the superheterodyne, the practical utilization of the sum-frequency has been considered such a complicated engineering problem on account of the high frequencies involved, that, until Mr. Sargent developed the Infradyne, apparently no one had the courage to tackle it. Just think of it. An amplifier working at a frequency of 3,200 kc. This is the type of amplifier used in the Infradyne. And to assist experimenters in building their own Infradyne, the amplifier is made available completely wired in one part. It is employed in the apparatus illustrated, and was fully described in the October issue.

BUILDING THE UNIT

The assembly of the complete unit is a very simple task. First procure the parts specified in the list, and proceed to assemble them according to the layout shown in the various illustrations. The sizes of the panel and the baseboard are given in the list of parts, and the drilling, of course, depends upon the parts you select; consequently it is not given. There is only one part which you are to make yourself—the oscillator coil.

THE OSCILLATOR COUPLER

The oscillator coupler consists of three coils wound on a single piece of bakelite tubing 1½ in. in diameter and 2 in. long, as shown in Fig. 5. These coils are of 14, 14, and 8 turns respectively and are all wound in the same direction with No. 24 dsc wire. There should be a space of 1/16 in. between the two 14-turn coils and of 3/16 in. between the 14- and 18-turn coils. Commencing with the 8-turn coil the terminals should be numbered from 1 to 6 as shown in the sketch of Fig. 5, *1* being the outside and *2* the inside terminal of the 8-turn coil, *3* the terminal of the 14-turn coil nearest the 8-turn coil and *4* the other end of this 14-turn coil, *5* the inside terminal of the second 14-turn coil and *6* the outside terminal of this coil.

These numbers correspond with those used in the wiring diagram. To insure operation of the set these directions for coil winding should be followed exactly, particularly as regards their all being wound in the same direction. This oscillator coupler should be mounted in the position shown at L in the illustration, Fig. 3.

The oscillator coil complete, we are now ready to assemble all the parts and start wiring.

WIRING THE UNIT

Fig. 1 shows not only the diagram of connections of the unit but also that of a standard five-tube radio set, employing the conventional two-stage tuned R.F. amplifier, detector and two-stage audio amplifier. The wiring of the Infradyne amplifier unit is shown within the dotted border lines. All the parts employed are marked with symbols corresponding to those in the other illustrations. None of the parts in the diagram of the five-tube set is labeled because any good set may be used and we are not primarily interested in the parts or connections of the set. Therefore, wire the amplifier unit according to that part of the diagram within the dotted lines of Fig. 1, and bring the connections to the unit out of five binding posts, as indicated in the diagram. Only four posts are in view in the photographic illustrations.

The front view of the finished amplifier will look like Fig. 2. On the panel are shown the oscillator condenser dial D, filament rheostat R for the four dry cell tubes, and voltmeter V. The meter is essential, because the 3-volt dry cell tubes are connected

(*Continued on page 726*)

SYMBOL	Quantity	NAME OF PART	VALUE OF PART	REMARKS	MANUFACTURER ★	
C	1	Grid Condenser	.0005 MFD.	With grid leak mounting	1	2, 3, 4, 5
C1	1	Fixed condenser	.0005 MFD.	For oscillator	1	2, 3, 4 5
C2	1	Variable cond.	.00035 MF.	For oscillator	6	7, 8, 9, 10
C3	1	Fixed condenser	1 MFD.	By-pass	11	40, 14, 2
I	1	Amplifier		Remler (special)	6	
V	1	Voltmeter	0-5 D.C.	For 3-volt tubes	12	13, 15
R	1	Rheostat	30 ohms	For 3-volt tubes	16	17, 8, 18, 19, 9
R1	1	Auto. Fil. Cont.	¼ amp.		22	21, 20
R2	1	Grid leak	2 meg.		21	2, 23, 9, 24
S	2	Socket		UX type	25	26, 8, 17, 9, 6
D	1	Dial	4"	For variable condenser	6	27, 8, 28, 29, 9
P	1	Panel	7"x18"x3/16"		30	31, 32, 33
BB	1	Baseboard	9½"x17"x5/8"	Hard wood		
L	1	Oscillator coil		Special (see instructions)		
BP	5	Binding posts			34	35, 36, 31, 9
V1	4	Vacuum tubes		3V. dry cell type	37	38, 39
V2	1	Vacuum tube		5V. storage battery type	37	38, 39

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 Sangamo Elec. Co.	17 H.H. Frost, Inc.	33 Dupoint Viscoloid Co., Inc.
2 Electrad, Inc.	18 General Radio Co.	34 Fahnestock Electric Co.
3 Miconold Radio Corporation	19 Yaxley Mfg. Company	35 X-L Radio Labs.
4 Aerovox Wireless Corporation	20 Langbein-Kaufman Radio Co.	36 H. H. Eby Mfg. Company
5 The Wizard Company	21 Daven Radio Corporation	37 E. T. Cunningham, Inc.
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★ THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.

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Infradyne Tuning

MANY fans have fixed frequency amplifiers of the Infradyne type which they wish to use with modern Superheterodynes. The question that arises is how to construct the oscillator so that it will cover the broadcast band. There is no particular difficulty in determining the constants of the coil and the tuning condenser.

It must be clearly understood that the Infradyne is not a Superheterodyne. A Superheterodyne is characterized by the fact that the locally generated oscillation beats with the signal frequency to form a beat frequency which is tuned in by the intermediate frequency filter. The term "intermediate" is not used because the amplifier is located in the circuit between the radio frequency and the audio frequency parts of the circuit but because the frequency at which the amplifier operates is actually intermediate between the carrier and the audio frequencies.

The Infradyne does not utilize a beat at all but an addition or a summation frequency. Hence the circuit is not a Superheterodyne and the fixed-frequency amplifier is not an intermediate frequency amplifier. The fixed frequency is the highest frequency involved, or supermediate frequency.

When two frequencies interact in a distorting circuit like a detector or modulator there are two principal products of the interaction, the difference, or heterodyne, frequency and the summation frequency. We can tune the fixed-frequency amplifier to either. If we tune it to the difference frequency we have a Superheterodyne and the fixed-frequency amplifier is an intermediate frequency amplifier, but if we tune it to the summation frequency we have an Infradyne.

Fixing the Frequency

If we decide to use the summation frequency of the products of the interaction we may choose almost any value we desire, but for practical reasons we should choose a frequency which is higher than any of the signal frequencies we desire to receive. In the Infradyne the fixed frequency selected was 3,500 kc. This is satisfactory because it is much higher than 1,500 kc, the highest broadcast frequency. It is satisfactory also because it is not so high that an effective fixed-frequency amplifier cannot be designed.

When we have selected the fixed frequency we can proceed to determine the range of the oscillator that will cover the broadcast band. The broadcast range is from 550 to 1,500 kc and the fixed frequency is 3,500 kc. What should the frequency of the local oscillator be when the circuit is to tune in 550 kc? Let F be the frequency. We then have 550+F=3,500 kc. Solving for F we get F=2,950 kc. And what should the frequency of the oscillator be when the 1,500 kc broadcast frequency is to be tuned in? Let f be the frequency. Then we have 1,500+f=3,500 kc. Solving for the unknown we get f=2,000 kc. Thus we get the range of the oscillator as 2,000 to 2,950 kc. It will be noted that the oscillator range is inverted with respect to the broadcast range, that is, the higher broadcast frequency requires the lower oscillator frequency. That this should be so is obvious from the fact that the sum of the two must always be equal to the constant frequency 3,500 kc.

Small Relative Range

Relatively the range 2,000-2,950 is very small, since it is only 1.475. The relative range of the broadcast tuner must be 2.73, since this is the ratio of 1,500 to 550 kc.

This small relative range has an important bearing on the design of the oscillator. If the inductance coil is reduced so that the lower frequency comes in at 100 on the dial the higher extreme frequency will come in well above the middle of the dial. This means that the whole broadcast band would be crowded into a small portion of the tuning dial. The circuit would seem to be very selective, although its selectivity might be considerably less than that of a Superheterodyne. Most of the oscillator tuning condenser would be useless. The situation would not be any better if the inductance were adjusted so that the higher frequency came in at zero on the dial. In this case the upper half or more of the condenser would be useless.

The thing to do is to use both a relatively small variable condenser and a large fixed condenser across the tuning inductance. If Co is the fixed capacity in the circuit when the variable condenser is set at minimum, the variable capacity should be .863 as large as the fixed capacity. These are so nearly the same that one fixed and one variable condenser of the same rating might be used. The broadcast band will then nearly cover the entire dial of the variable condenser. If the ratio of the fixed to the variable capacities were exactly as given above the broadcast stations would be spread out from zero to 100 on the dial.

Determination of Inductance

So far we have said nothing about the required inductance. The reason is that we have not yet specified the capacity. Since the frequencies involved are rather high we need a small capacity and a small inductance. Suppose we make the fixed portion of the condenser .0001 mfd. Then the variable portion should be .863×.0001, or .0000863. The nearest commercial condenser is a .0001 mfd. midget.

Then we have a total capacity in the circuit, when the condenser is set at maximum, of .0002 mfd. The inductance must be determined so that the circuit will tune to 2,000 kc when this capacity is used. We get 31.7 microhenries as the required inductance. This is, indeed, a very small coil. It can be obtained by winding 49 turns of No. 24 DCC wire on a one-inch diameter. The tickler winding may be put on the same form, using the same wire, and it need not have more than 20 turns.

It should not be supposed that a Superheterodyne cannot be built with an intermediate frequency as high as 3,500 kc., even for receiving broadcast frequencies. It is obvious that the locally generated frequency can be increased to such a value that when a broadcast frequency is subtracted from it the difference is equal to the fixed frequency. If we wish to receive the 550 kc broadcast frequency we can set the oscillator at 3,850 kc and if we want to receive the 1,500 kc broadcast frequency we can set the oscillator at 5,000 kc. Thus by making the range of the local oscillator from 3,850 to 5,000 kc we can cover the entire broadcast band.

In this case we note that the higher oscillator frequency will bring in the higher broadcast frequency, and vice versa. Thus a good way to distinguish whether we are using the difference or the summation frequency is to note whether or not the oscillator seems inverted. If the stations come in in the same order as the broadcast frequencies we have a Superheterodyne, but if they come in in the reverse order we have a summation, or Infradyne, receiver.

Smaller Coil for Super

If the circuit is made into a Superheterodyne with a 3,500 kc beat frequency the inductance in the oscillator must be less than when the circuit is used as an Infradyne, because the oscillator frequency is higher. Instead of being adjustable from 2,000 to 2,950 kc it should be adjustable from 3,850 to 5,000 kc. If we use the same tuning capacity the inductance should be 8.52 microhenries. This is so small that it is probable that the circuit will not oscillate with the specified capacities. In that case it will be necessary to use smaller tuning capacity and a larger coil.

If there is a radio frequency tuner in the circuit for selecting broadcast frequencies, this is not changed in any way whether the fixed frequency amplifier is to be used as a heterodyne amplifier or an Infradyne. It is only the oscillator that need be changed, but that may have to be changed either by varying the inductance or the capacity, or by varying both.

Use Low Fixed Frequency

A fixed frequency of 3,500 kc is not recommended for a Superheterodyne for several reasons. First, the receiver will not be so selective as a receiver using an amplifier of much lower fixed frequency. The high selectivity of the Superheterodyne of low intermediate frequency is due to the fact that the ratio of interfering frequency of given value to the fixed frequency differs much from unity. As the fixed frequency increases, the ratio becomes closer and closer to unity, and the closer to unity the ratio is, the harder it is to separate the stations.

We give an example to emphasize this fact. Suppose the intermediate frequency is 50 kc. A station of 600 kc is desired and there is a station operating on 610 kc. The oscillator is set so that the beat with the 600 kc frequency is 50 kc, that is, it is set at 650 kc. When so set the oscillator also beats with the 610 carrier and generates a frequency of 40 kc. The ratio of the interfering frequency to the fixed frequency is 4/5, or 0.8. The original ratio of the two frequencies was 60/61, or .984. Hence, the frequency changing has made a decided improvement.

Now suppose the fixed frequency is 3,500 kc. The oscillator is set at 4,100 kc. The interfering frequency will beat at 3,490 kc. The ratio of the interference to the carrier is 349/350, or .9975. This is much closer to unity than .984. It would be better from the point of view of selectivity not to use the fixed frequency for the original ratio was only .984.

Advantages of High Frequency

Those who have 3,500 kc fixed-frequency amplifiers can use them by making the oscillator as previously described, that is, using a condenser of 100 mfd. fixed capacity, a variable condenser of the same capacity, and a coil having 49 turns of No. 24 DCC wire on a one-inch diameter. But they should realize that the selectivity will not be so good as if the fixed frequency were lower, or as it would be if a straight radio frequency amplifier were used.

The high fixed-frequency amplifiers have some advantages as well as disadvantages. First, the coils needed in the fixed-frequency amplifiers are very small and occupy little room. Second, the tuning condensers may be small, inexpensive trimmer condensers, which also take little room. Third, the oscillator coil and the oscillator condenser are also small and comparatively inexpensive.

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A KEY TO RECENT RADIO ARTICLES

By E. G. SHALKHAUSER

THIS is the sixteenth installment of references to articles which have appeared recently in various radio periodicals. Each separate reference should be cut out and pasted on cards for filing, or pasted in a scrap book either alphabetically or numerically. An outline of the Dewey Decimal System (employed here) appeared last in the January, RADIO BROADCAST, *and will be reprinted in an early number.*

R343. ELECTRON-TUBE RECEIVING SETS. RECEIVER, *Infradyne.*
Radio News. Oct., 1926. Pp. 356-ff.
"The Infradyne," H. Green.

The principles upon which this receiver is built are not unlike those of the common and well-known super-heterodyne, differing only in the method in which the intermediate stages deliver the energy to the detector tube. This intermediate stage does not tune to the difference of frequencies of the local oscillator and the incoming signal but to the sum frequency, thus utilizing the very short wavelengths for amplification. This eliminates interference from long-wave stations, stray heterodyning, and all harmonics, so that stations are tuned-in on only one point of the dial setting. A description of this receiver is given in detail.

R347.7 PATENT PRACTICE. PATENTS.
Popular Radio. Nov., 1926. Pp. 651ff.
"How to Patent Your Radio Invention," E. H. Felix.

The writer gives pertinent advice to radio experimenters on the subject of patents and patent practice. Every inventor should ask himself the following questions before applying for a patent:

(1). Does the device perform a service so useful that a sufficient number of people will pay enough for it to yield you a substantial profit?

(2). Is the service performed by the device a new one, or is it accomplished by your device much more economically, efficiently, and satisfactorily than by other existing devices?

(3). Is it sufficiently simple of manufacture to permit it to be made in quantity at a profit?

(4). Does it fill a need sufficiently obvious to its prospective users that it can be sold to them without excessive advertising and promotion cost?

What to patent and what not to patent, how to proceed with a patent application, and the rules of patent practice in general, are discussed.

R553. METEOROLOGICAL SIGNALS. METEOROLOGICAL SIGNALS.
Popular Radio. Nov., 1926. Pp. 656ff.
"Radio Transmits Weather Maps to Ships," S. C. Hooper.

The Jenkins system of picture transmission is described as being used for broadcasting the daily weather maps to ships. A photograph of a transmitted map is shown.

R343. ELECTRON-TUBE RECEIVING SETS. RECEIVERS, *Crosley, Murad, Freshman.*
Popular Radio. Nov., 1926. Pp. 656ff.
"Inside Information on New Radio Receivers."

In this third series of articles on new receiving sets, the following receivers are discussed in detail. The New Model Crosley 5–50 receiver: The Murad Super-Six receiver; The New Model Freshman Console.

R281.71. QUARTZ. QUARTZ CRYSTALS.
Radio. Nov. 1926. Pp. 27ff.
"The Operation and Construction of Quartz Crystals," J. B. Dow.

A theoretical discussion on the properties of quartz crystals is presented. A quartz crystal has three axes spoken of as the optical, the electrical, and the third axis. The laws pertaining to such a crystal are determined by applying pressures or stretching forces along these three axes. These laws are explained. The operation of such a crystal, when placed in the grid of a vacuum tube, is to set up continuous oscillations when the plate circuit has the same resonant frequency as the mechanical vibrations of the crystal. Details are given on the relation of a good crystal, the cutting, grinding, and polishing.

R343.7. ALTERNATING-CURRENT SUPPLY. POWER-PACK, *the LC.*
Popular Radio. Nov., 1926, Pp. 638–642.
"How to Build the LC Senior Power Pack," L. M. Cockaday.

A "power pack" unit which supplies the A, B, and C voltages for a 210 tube, B voltage for all the tubes in a receiver, and C voltage, is described. Diagrams on construction and assembly, as well as operating instructions, are given.

R110. RADIO WAVES. WAVES, RADIO.
Popular Radio. Nov., 1926. Pp. 643ff.
"Waves and Wavelengths," Sir. Oliver Lodge.

A simple explanation of sound and light vibrations, and their effects upon our senses, is given. Sound waves are said to be compressions and rarefactions in the air, whereas light waves are thought of as waves in a subtle medium called the ether. The properties of light waves and their characteristics are presented.

R582. TRANSMISSION OF PHOTOGRAPHS. TELEVISOR.
Popular Radio. Nov., 1926. Pp. 649ff.
"The 'Televisor'," O. E. Dunlap.

The transmission of moving pictures by the Baird system has been perfected to such an extent that licenses have been granted in Great Britain for purposes of transmitting and receiving by this system. The details of the method are clearly outlined, only one photo-electric cell being necessary at the transmitting end.

(Continued on page 426)

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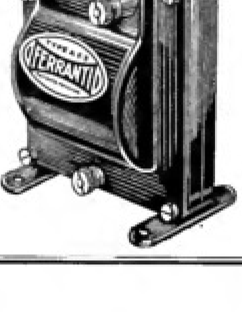

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A New Ten Tube Receiver Using the Remler Infradyne Amplifier

PERHAPS the most striking recent example of a radical departure in radio design is the development of the Infradyne Intermediate Amplifier, having a peak frequency of 3,200 kilocycles or 95 meters. This design of interdiate frequency amplifier employs a hitherto neglected prinle of heterodyning.

If a locally generated oscillat- current is mixed in a circuit th an incoming frequency, two w frequencies are generated. ne of them, the beat or differce frequency, is utilized in per heterodyne receivers. The ner, known as the sum freency, is used in the Infradyne nplifier incorporated in the reiver described herewith.

Research endeavoring to delop a sum frequency amplifier s been neglected due to the nerent difficulty of efficiently nplifying the extremely high equencies. However, extensive perimentation has disclosed a ans by which any frequency y be amplified to the same dece.

Actual tests under ordinary reption conditions have proven at only one oscillator dial setg is used for each station, as e method employed in the amfier, when properly balanced, s the ability of eliminating harnics of double or treble the tion's wave length. Since the ermediate amplifier is very arply peaked at 95 meters, it llows that maximum efficiency ll be found only at that freency. Therefore, tube noises d other interference, being at higher wave length, will only slightly amplified, making a uch quieter receiver than herefore possible.

When the condenser of the ned radio frequency amplifier adjusted to the peak of the coming signal the tuning of e oscillator condenser will be ghtly broader. This can be ercome by readjusting the ng condenser so that it is not ned directly to the peak of e incoming signal. If too long antenna is used it may be cessary to insert a .00025 mfd. fixed condenser in series th it.

The receiver described herewith consists of two stages of ned radio frequency with a detector, an oscillator circuit, three ges of 95 meter amplification, a second detector and two stages audio frequency amplification.

Figure 4 shows a schematic wiring diagram of the complete ceiver. A standard tuned radio frequency circuit tuned by a triple gang condenser, each of .00035 mfd. capacity, is used before the detector. To enable the constructor to insert a pair of phones in the circuit to properly test and balance the tuned radio frequency end of the receiver, a single closed circuit jack is inserted in the output of the first detector.

To receive distant stations when using the first three tubes only, it may be necessary to temporarily shunt a .001 or .002 mfd. fixed condenser across the terminals of the head phones.

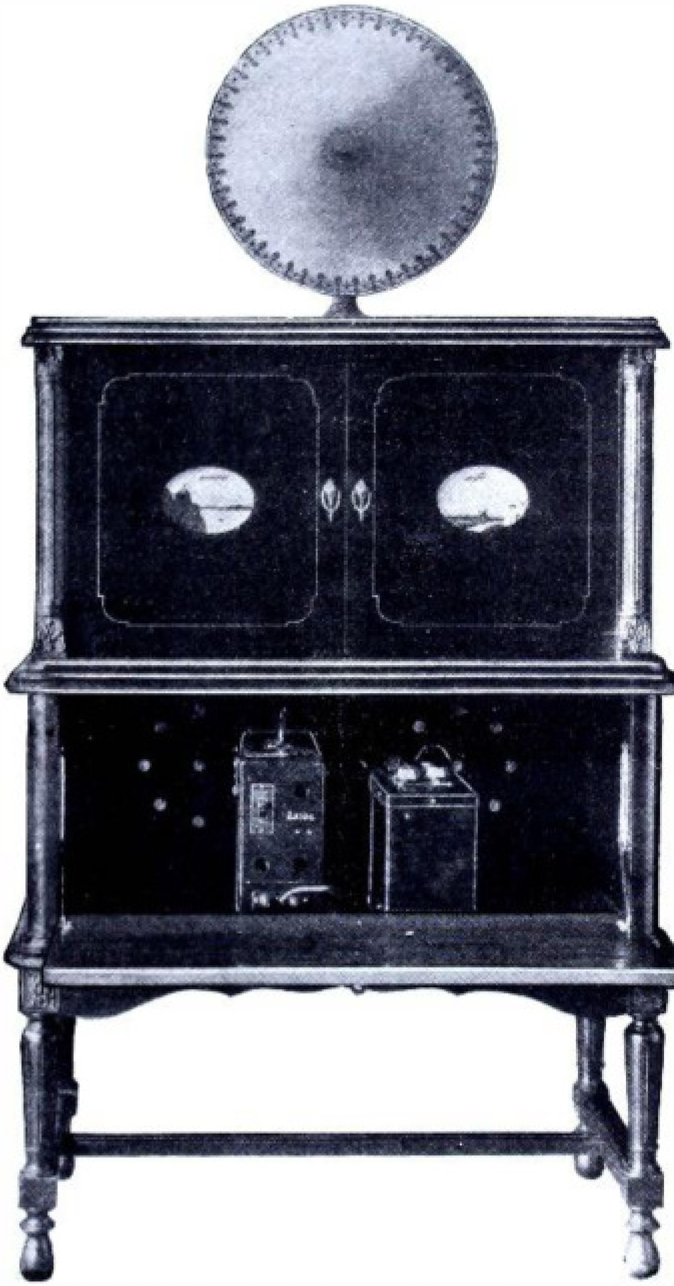

Photo A. Front view showing how receiver can be mounted in a console with suggested accessories

The oscillator coupler is wound on a tube 1½ inches in diameter and 2 inches long in the following manner, using a No. 24 D. S. C. wire throughout. The detector plate coil, the oscillator plate coil and the oscillator grid coil consisting of 8, 14 and 14 turns respectively are wound in that order upon the tube. A space of 3/16 inch separates the detector plate and oscillator plate coils, while only 1/16 inch separates the oscillator and grid coils. The ends of each coil are securely anchored and a short length of wire allowed to project to facilitate connections. The tube is mounted in a vertical position with the 8 turn coil at the top. The ends of the coils are numbered as follows: Starting at the top, the beginning of the detector plate coil is number 1, and the end is number 2; the beginning of the oscillator plate coil is number 3, and so forth up to 6. This numbering is important, since all diagrams show the various terminals marked. Care should be taken that all three coils are wound in the same direction and the proper numbering applied to their respective terminals. If the constructor does not have the facilities to properly wind a coupler and desires a manufactured product, he may obtain a standard coupler, designed especially for this circuit.

A .0005 mfd. fixed condenser is in series with the plate lead of the .00035 mfd. oscillator condenser. This decreases the capacity of the variable condenser to approximately .000212 mfd., which is the correct capacity for maximum efficiency. This will prevent the burning out of any of the tubes in case the plates of the variable condenser happen to be "shorted."

Figure 1 is the front panel layout, plainly showing all mounting holes and the necessary engraving. The pair of countersunk holes in the lower corner at each end of the panel are for mounting the brackets supporting the sub-panel.

The baseboard layout shown in Figure 2 shows the location of

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all apparatus in the completed receiver. Particular attention should be paid to the proper position of each part so that its terminals bear a correct relation to the terminals on other pieces of apparatus. This is very important and makes short leads possible. All terminals are plainly marked for this purpose.

purposes. This jack is also mounted under the sub-panel.

The assembling and wiring of the receiver is no difficult ta Just mount the sub-panel on the two supporting brackets. Th turn the amplifier unit over on its face and place a piece of s wood, 4 inches long, 2 inches high and ¾ inch thick against t

Photo B—Front view of receiver installed in cabinet

Figure 3, the sub-panel layout, shows the correct location of all holes. Those holes which are shown solid black are 3/32 inch drill. These holes are provided for the wires which pass through the sub-panel. The holes with the extra circle around them are 5/32 inch drill and countersunk for No. 6 flat head brass machine screws. These holes are provided for the mounting, under the sub-panel, of the Jones Multiplug, the supporting brackets, the two 1 mfd. by-pass condensers and the two blocks of wood supporting the Intradyne Amplifier. The sub-panel is cut out so that the unit may be easily inserted into position and fastened into place.

case under each projecting flange. Carefully transfer the loc tion of the mounting holes in the flange to the wood, using small punch or pencil. Then drill a shallow hole at each ma and liberally countersink it. Replacing the blocks, insert a N 5x1 inch flat head wood screw into each hole and slowly tu it until the soft copper is drawn down into the depression arou the hole and the screw is flush or under-flush with the botto Turning the unit right side up, it may be easily inserted into t slot and securely fastened into place using four flat head wo screws through the sub-panel.

Next remove the two angle brackets on each Duoformer whi

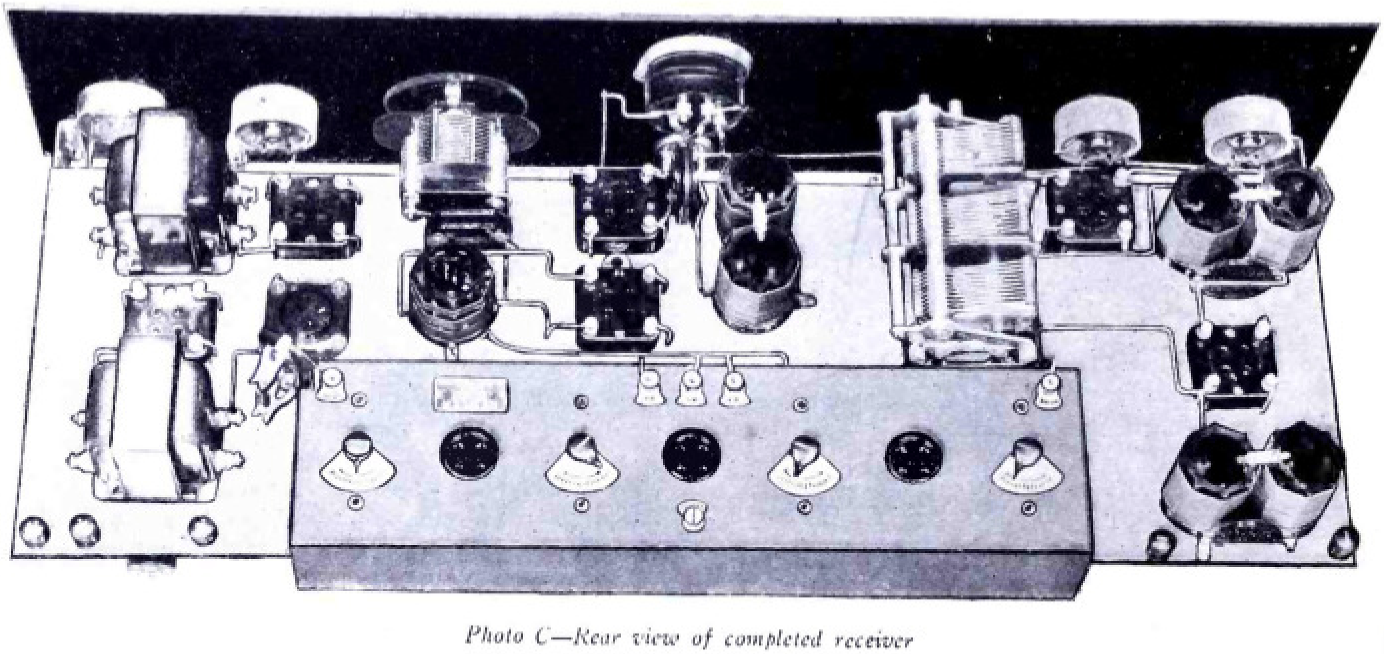

Photo C—Rear view of completed receiver

Nine holes are shown with a dotted circle around them. They are all ⅛ inch drill and tapped for a No. 6-32 machine screw. These holes are provided for mounting the four Carter fixed resistances and the Lynch grid leak mounting under the sub-panel.

The 5/16 inch hole near the center of the sub-panel is provided for the Frost No. 954 Three Spring Gem Jac used for testing

are normally used for mounting purposes. Replace the outsi lugs on the terminals marked 1 and F negative on the anten coil and the outside lugs on the terminals marked B positive a F negative on the two radio frequency transformers with t brackets. This arrangement allows soldering lugs to be plac under the nuts below the sub-panel in such a manner that lirect connection is made to the coils through the mounting crews, thereby obviating the necessity of drilling extra holes through the panel for the passage of wires. Great care must be exercised in the replacement of the terminals so that the ends f the windings are not broken from the inside lugs.

harmless to the 199 tubes when less than four tubes are in the circuit.

Both the second detector and first audio tubes are each controlled by a Carter four ohm fixed resistance, while the last audio tube is controlled by a two ohm fixed resistance. Since the

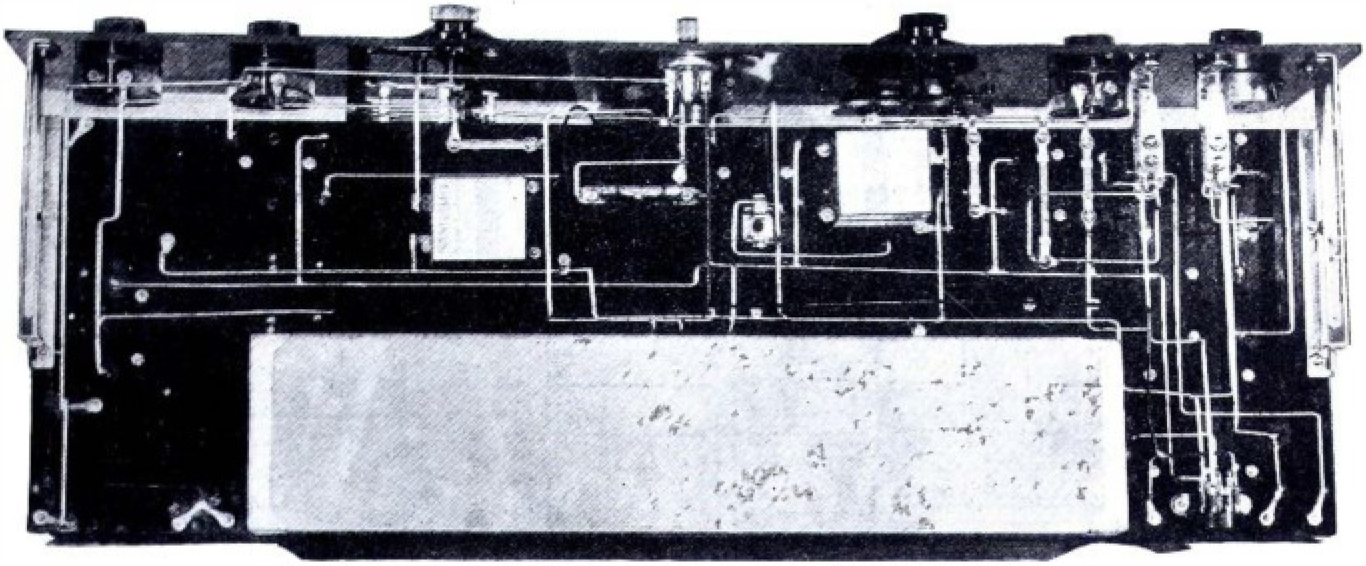

Photo D—Bottom view of receiver

Complete the assembling under the sub-panel by mounting the ur Carter fixed resistances, the two 1 mfd. by-pass condensers, e Jones plug, the grid leak mounting and the test jack.

Turning the sub-panel right side up, fasten all remaining appatus upon it, referring to Figure 2 for proper locations and so rth.

Next mount the rheostats, filament switch, the two jacks, the riable condensers, the variable resistance and the voltmeter on e front panel.

It is best not to mount the front panel on the brackets until l possible wiring is completed on the sub-panel. A careful udy of the various photographs accompanying this article will iow the best manner in which to arrange the wires. Either sulated or bare wires may be employed to wire up the set.

Three rheostats are used in this receiver. A ten ohm rheostat ontrols the two radio frequency tubes, a thirty ohm rheostat ontrols the first detector, and a four ohm fixed resistance in ries with a thirty ohm rheostat regulates the intermediate fre-

adjustment of these three tubes is not critical, this method is quite efficient.

A Frost 50,000 ohm variable resistance is shunted across the secondary of the first audio transformer. It functions admirably as a volume control and helps considerably in obtaining good volume.

A separate jack is used for the first stage of audio. The second stage uses a filament control jack which automatically completes the filament circuit of the last tube when the speaker plug is inserted.

A Weston Model 506 Type 217 double scale voltmeter is used in this receiver. When properly connected into the circuit as shown in the diagrams, the lower scale will show the filament voltage applied to the 199 tubes. The upper scale reading is obtained by pushing the button on the meter frame and shows the "B" battery voltage on the Infradyne Amplifier.

All connections on the Jones plug are as shown on the color

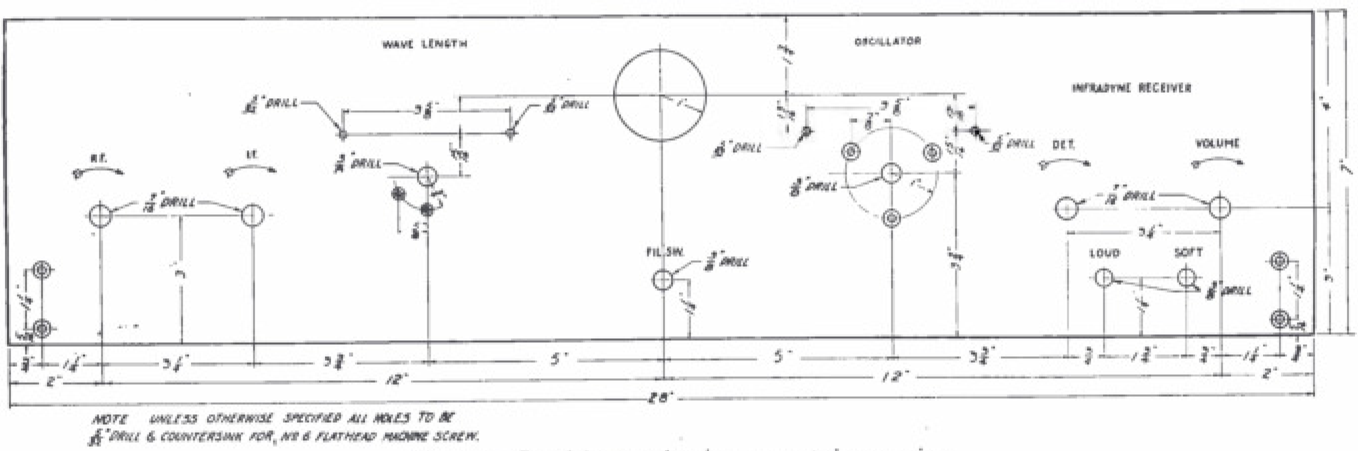

Figure 1—Panel layout showing suggested engraving

quency and oscillator tubes. The four ohm fixed resistance is nserted in the circuit as a safety device to protect the 199 tubes. It effectually prevents more than the normal operating voltage o be applied to the tubes, regardless of the amount of resistance "cut out" in the rheostat. *Under no circumstances remove any of the 199 tubes from a socket without first turning off the filament switch.* The fixed resistance will be insufficient to properly reduce the "A" battery current to such an extent that it will be

chart supplied with the cable. The terminal normally used for the antenna connection has the 135 volt "B" lead connected to it while the ground terminal is not used. The proper "C" battery bias, 4½ volts for the first stage and 7½ volts for the second stage, is connected to separate binding posts located at the rear edge of the sub-panel.

All plate and grid leads are made on the upper side of the sub-panel except the plate lead of the second radio frequency

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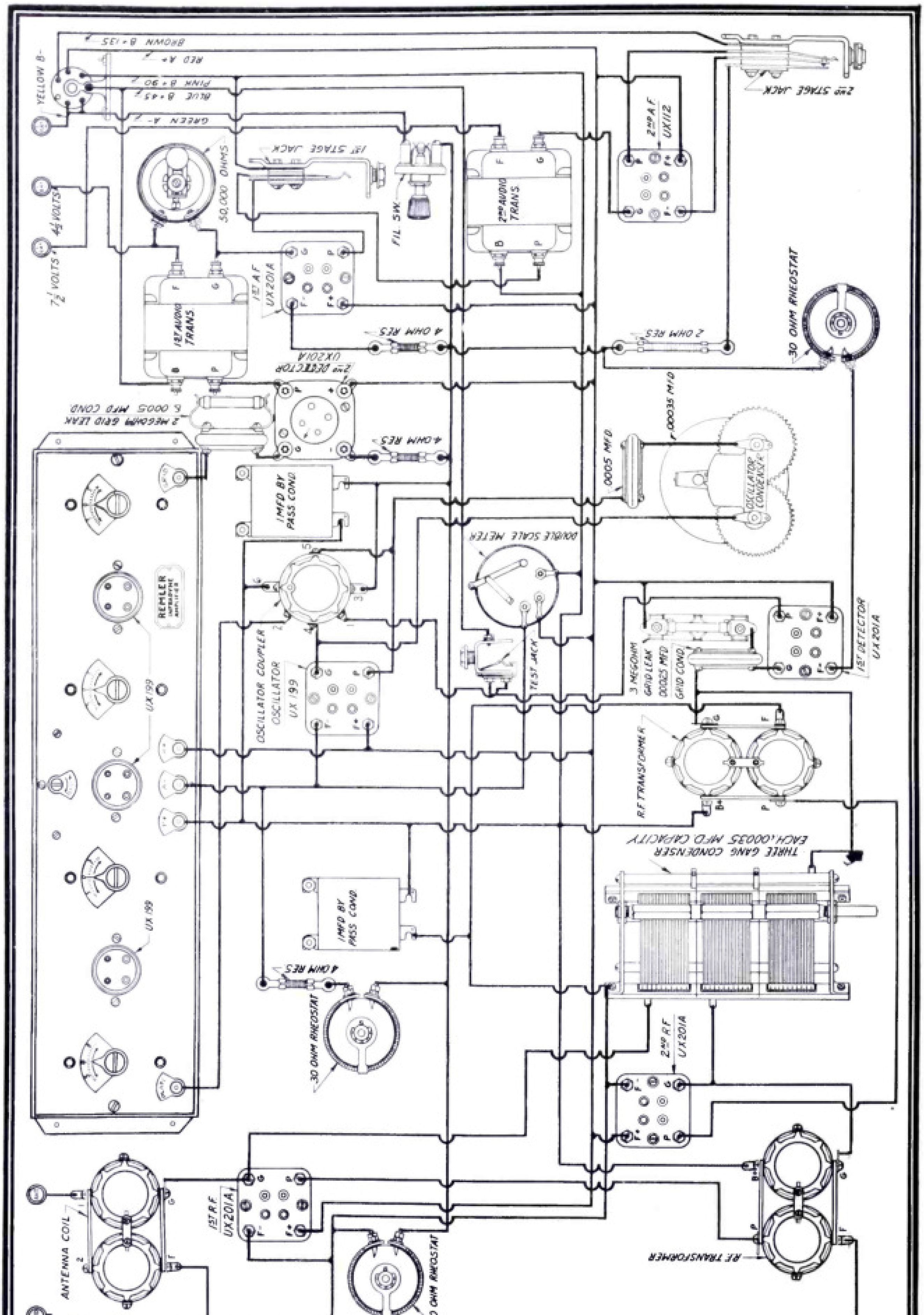

Figure 5—Graphic illustration showing all connections

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be. This lead runs under the panel to the plate terminal of the cond radio frequency transformer.

After the receiver has been completely wired, carefully check l connections against the large graphic illustration shown in gure 5. Then connect the "A" battery leads only to the set. Insert ree UX 199 tubes in the Infradyne unit and one in the oscilla-

it will go to the right. Then set the pointer on each of the four Vernier condenser knobs at zero. Slowly change the settings of the four knobs, using the wooden wedge furnished with the unit, until the combination is found which gives the greatest volume. As the settings of the knobs approach more nearly the values for the most satisfactory operation, the amplifier will be

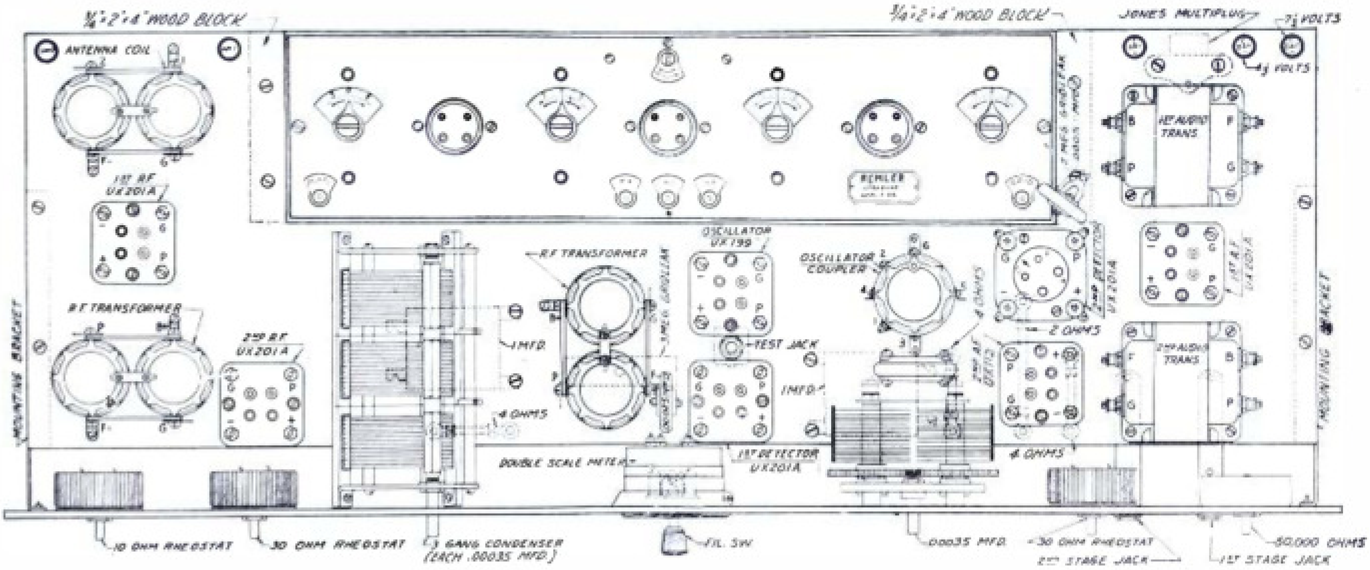

Figure 2—Baseboard layout

socket. The last stage of audio uses a UX 112 power tube and remaining sockets UX 201A tubes. Turn on the filament itch and turn up each rheostat, observing whether all tubes ht up and are controlled by the proper resistance. When all lications show that the tubes are properly connected, disnect the "A" positive lead and touch it in turn to the other ttery terminals on the receiver, noting each time whether any bes light. If there is no indication of tubes lighting except en the "A" battery is properly connected, it is safe to connect up the rest of the batteries, attach aerial and ground and ug in the speaker.

After removing all tubes except the first three, plug in with ad phones at the test jack and begin tuning with the three ng condenser until some station of fairly good volume, located

found to go into oscillation. This oscillation can be prevented by carefully loosening the adjusting screw marked "Increase." The vernier condenser settings should again be slightly changed until the point of best operation is obtained. Should the latter adjustment again throw the amplifier into oscillation it will be necessary to further slightly loosen the adjusting screw. If difficulty is experienced in obtaining maximum amplification in the unit, and all other instructions for placing the receiver in proper working order have been followed, the trouble may probably be remedied by inserting a coil of about 8 to 10 turns of No. 20 D. S. C. wire, wound around a finger, in the plus "B" lead just before it enters the Infradyne Amplifier. Once the above adjustments have been made and the settings for the most satisfactory operation found, the amplifier will function without fur-

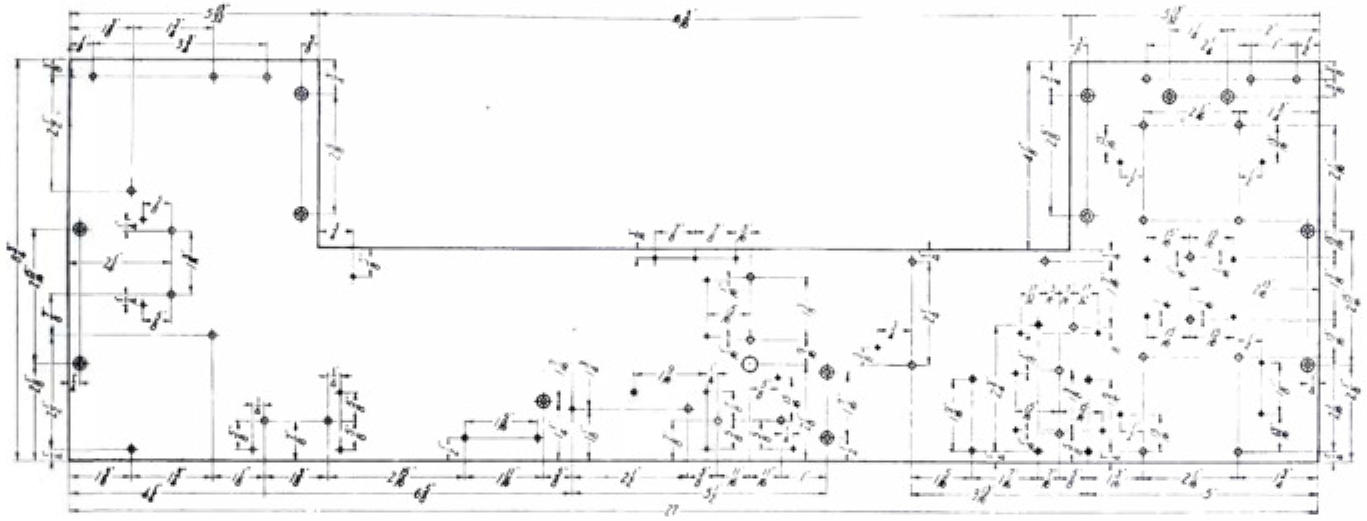

Figure 3—Sub-panel layout

a moderate distance, is found. Then carefully adjust the comnsating plates on the condenser until the station heard comes in ry sharply only at one place on the dial.

Next insert all tubes and with the speaker plugged in its proper ck, tune in a station with a moderately weak signal. The staon should be at least 150 miles distant. The next procedure the balancing of the Infradyne unit, which is accomplished as llows: Turn the adjusting screw marked "Increase" as far as

ther attention other than the adjustment of the filament temperature.

An antenna no longer than 50 feet, including lead in, will serve very nicely. A good ground is absolutely necessary.

If no great volume is obtained from the audio amplifier, remove all the leads connected to the terminals of the voltmeter and connect separate flexible leads to them. Then test the filament voltage of the different tubes controlled by the fixed resistances.

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This is a helpful hint for any type of receiver using various types of fixed resistances, as often various tubes do not consume the same amount of current.

If 4.8 to 5.2 volts are not indicated for the 201 A tubes and 2.75 to 3 volts for the 199 tubes, change either the resistor or the tube until the correct voltage is obtained. Amperites or any other resistor of the correct value may be used. 135 volts "B" battery is used on the plate of the last tube as specified in the illustration. The only necessary change to be made if other types of power tubes are used in the last stage is to change the 2 ohm fixed resistance to the proper size for the tube used and increase the "C" battery and "B" battery voltage as specified on the circular supplied with the tube.

This receiver has been very neatly arranged both for construction and wiring, and we advise that you do not change the location of any parts and use only those specified, although any of the minor controls may be substituted, providing they are of the same value as given. While Thordarson R-200 Audio Transformers and the Continental 3 gang condenser have been selected for this receiver, Silver-Marshall Audio Transformers and the Hammarlund 3 gang condenser, designed especially for this circuit, may be successfully substituted.

1—Frost No. 880 50,000 ohm Variable Resistance
6—Frost No. 530 UX Sockets
1 Set Camfield Type 22K Duoformers
1—Special Oscillator Coupler
2—Thordarson Type R200 Audio Transformers
2—Kurz-Kasch Aristocrat Vernier Dials
1—Jones Type BM Multiplug
1—Carter 2 ohm Fixed Resistance
3—Carter 4 ohm Fixed Resistances
2—Sangamo 1 mfd. By-Pass Condensers
1—Sangamo .0005 mfd. Fixed Condenser
1 Pair Sangamo Grid Leak Clips
1—Lynch Grid Leak Mounting
1—Lynch 2 megohm Grid Leak
1—Lynch 3 megohm Grid Leak
5—Eby Engraved Binding Posts
2 Dozen No. 6x1-inch R. H. Br. Mach. Screws
2 Dozen No. 6x½-inch R. H. Br. Mach. Screws
1 Dozen No. 6x½-inch Flat Head Br. Mach. Screws
½ Dozen No. 5x1-inch Flat Head Br. Mach. Screws
1 Dozen No. 6x¼-inch R. H. Br. Mach. Screws
100 Kellogg Tinned Soldering Lugs

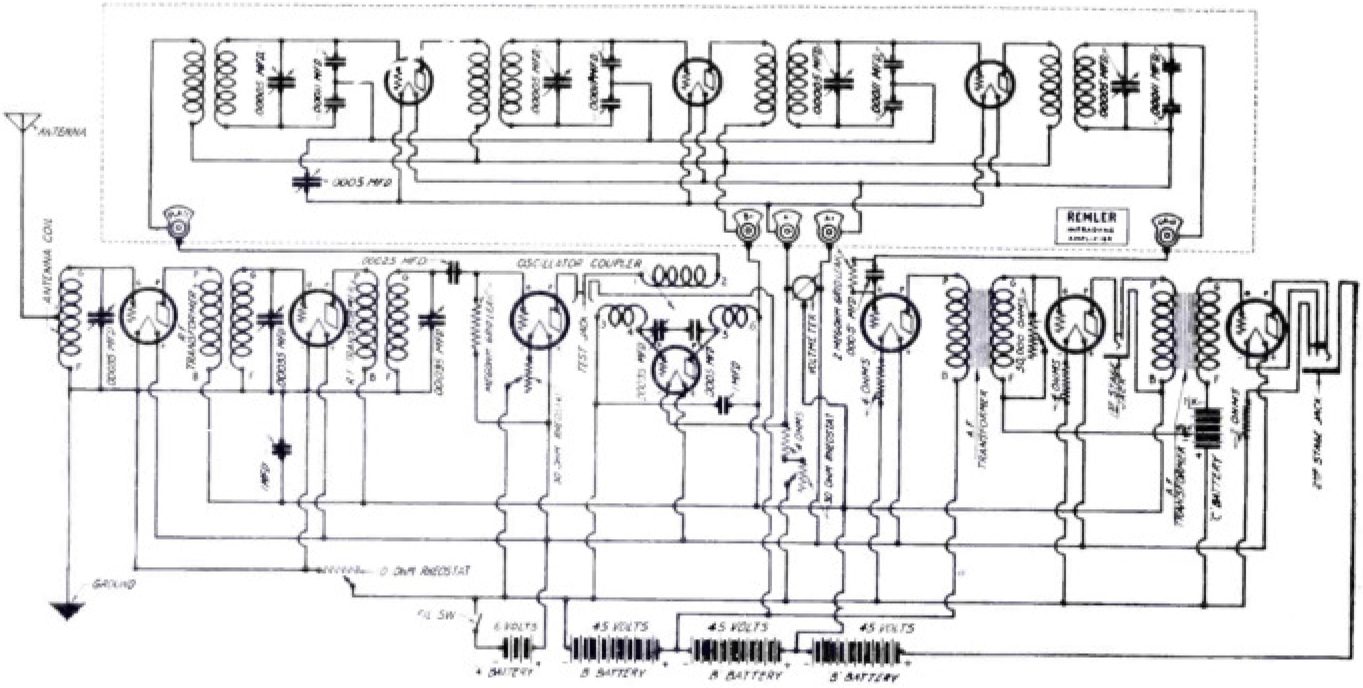

Figure 4—Schematic wiring diagram

It is unfair to expect the receiver to give phenomenal results the first time it is placed on the air. Being an extremely sensitive and selective instrument, it has certain peculiarities of tuning which must be experienced and thoroughly understood. When the little intricacies of tuning are mastered, a properly balanced receiver will perform in such a manner so as to give the utmost satisfaction in reception.

List of Parts

These parts or their equivalent will give satisfactory results:

1—7x28x3/16-inch Formica Panel
1—8¾x27x3/16-inch Formica Sub-Panel
1—Remler Type 700 Infradyne Amplifier
1—Remler Type 630 .00035 mfd. Variable Condenser
1—Continental .00035 mfd. 3-gang Vernier Condenser
1—Weston Model 506, Type 217 0-7-140 Voltmeter
1 Pair Benjamin Type 8629 Shelf Brackets
1—Benjamin Type 9040 UX Cushion Socket
1—Frost No. 710 10 ohm Rheostat
2—Frost No. 730 30 ohm Rheostats
1—Frost No. 608 Filament Switch
1—Frost No. 954 Gem-Jac
1—Frost No. 234 Pan-Tab Jack
1—Frost No. 235 Pan-Tab Jack
50 Feet Belden Tinned Copper Hookup Wire (12 gauge)
1 Package Kester Solder

The accessories shown in the Infradyne article consist of the following:

The "A" battery supply is furnished by an Exide "A Plant," which is connected into any convenient house lighting plug furnishing 110-volt A.C. This unit furnishes a 6 volt supply kept at full charge by a trickle charger, and is made by the Electric Storage Battery Co., Philadelphia, Pa.

The "B" supply is furnished by the New Raytheon "B" Eliminator made by the Kokomo Electric Co., Kokomo, Ind. It will supply all necessary voltages to operate both detector and amplifier circuits.

The new Trimm Cone Type Speaker is shown, made by Trimm Radio Products Co., Chicago.

The Console is a piece of furniture of rare beauty. It has a sliding door arrangement so that when the doors are opened they may be pushed back out of the way. It is also beautifully decorated with genuine inlay work, and would be an ornament of the highest quality in any home. It is made by Detroit Woodcraft Co., Detroit, Mich.

(If any further information is desired about these accessories—kindly write manufacturer direct.)

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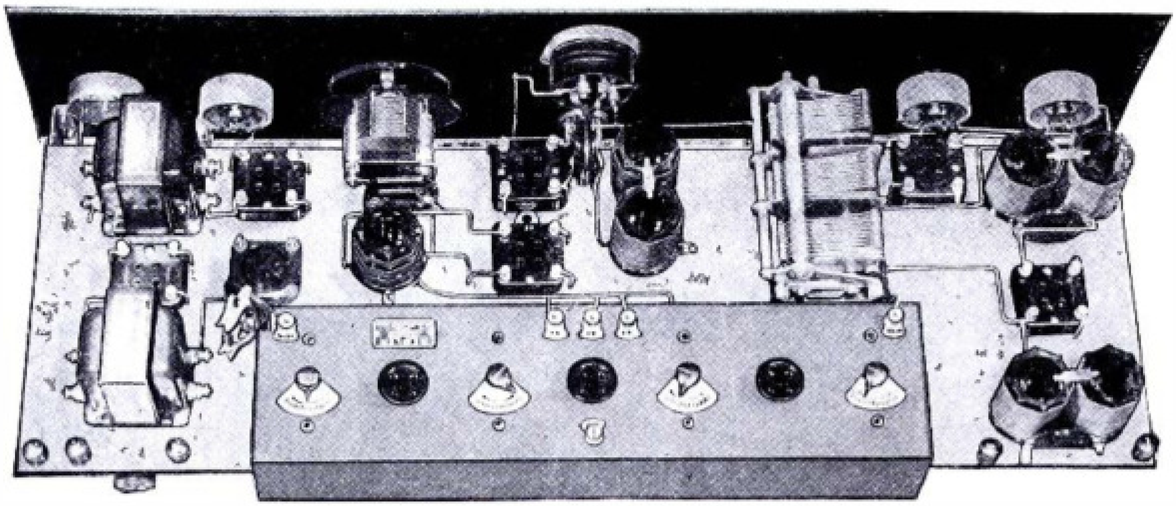

Infradyne—the Ultimate in Radio—

From all indications, the Infradyne Circuit promises to be the outstanding development in Radio receivers for the season of 1926-27. Best results, however, cannot be obtained when using inferior parts. We recommend and offer the list as shown in this issue of the Call Book. The complete kit includes drilled and engraved panel and sub-base, also miscellaneous screws, wire, lugs, etc. Write for complete catalog and prices.

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The Improved Infradyne Receiver

Here Is a Revised Infradyne Incorporating Extensive Developments, Greatly Adding to the Efficiency of This Receiver

This Receiver Was Constructed and All Illustrations Made in the Citizens Radio Laboratory

THERE appeared in the last issue of the CITIZENS RADIO CALL BOOK complete construction details of the Infradyne Receiver. Considerable time was spent before publication in developing a set which was easy to build, balance and operate. However, certain difficulties have been experienced by constructors in assembling the receiver and placing it in operation. These difficulties have been carefully examined, and the means of overcoming them found by careful experimentation in our laboratory. We now offer an Improved Infradyne Receiver which incorporates the following changes:

For tuning the two stages of radio frequency and the first detector, a Cardwell, balanced rotor, triple gang, condenser of the straight frequency line type is used. In conjunction with this gang condenser, there are two trimming or compensating condensers used on the two stages of tuned radio frequency. By the use of these trimming condensers, it is possible to compensate for any discrepancy in the three gang condensers, at any dial setting. Also on a very sharp signal absolute resonance may be obtained by the use of these condensers. These trimming condensers are of precise make, three plate, .00001 mfd. capacity, and mounted directly on the front panel on either side of the wavelength dial. Electrad rheostats are now used throughout, and are of the Bakelite shell type and have a very high heat-dissipating factor. Electrad and Sangamo by-pass and blocking condensers are also used throughout the Receiver.

The test jack in the plate circuit of the first detector has been discontinued. This jack was formerly used in the balancing of the gang condenser, but due to the advent of the two trimming condensers, it has been found unnecessary. Amertran De Luxe Audio Frequency transformers are used. The Yaxley pup jacks are used on the first and second stages of the Audio Frequency. A slight change has also been made in the sub-panel layout. The oscillator coil has been moved directly in back of the first detector socket, and the oscillator socket has been placed in back of the oscillator tuning condensers. In other words, the oscillator socket and the oscillator coil have been reversed in their respective positions. The resonate frequency of the Infradyne amplifier has been changed from that of 95 meters or 3,200,000 cycles to 86 meters or 3,490,000 cycles. A Jones Multiple Plug has been placed on top of the sub-panel.

When an incoming signal, or frequency, is combined with a locally generated frequency, there are two resultant frequencies generated in the circuit. The two frequencies are, namely, "the difference of the frequencies" and "the sum of the frequencies."

Heretofore, "the difference of the frequencies" has been the only one that has been put into practical use, which has been due largely to the supposition that a low frequency could be much more easily controlled than a high frequency. For this reason the exact value of "the sum of the frequencies" method had never been realized or exploited to any great extent.

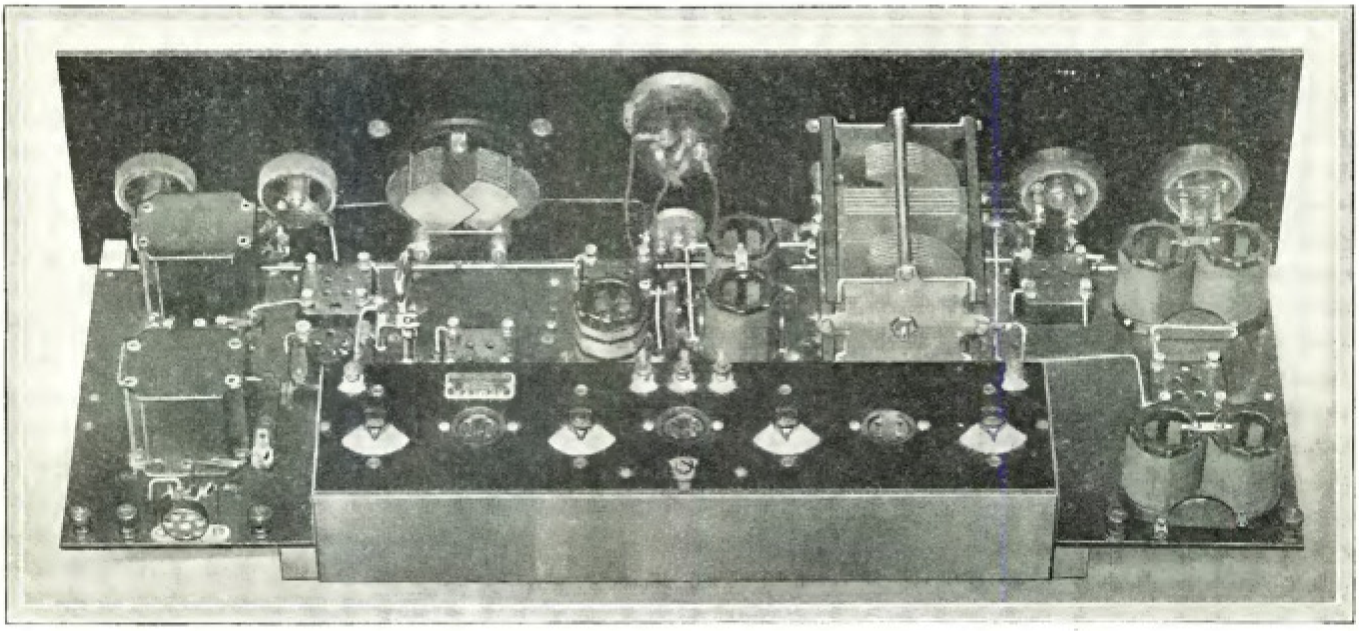

Photo A. Rear view of receiver removed from cabinet. Note simplicity of arrangement of parts and absence of unsightly wiring

The greatest objection to "the difference of the frequencies" method is very probably due to the characteristic action of the method which causes the oscillator to be subjected to harmonics, which causes the reception of long wave code stations on the harmonics of their fundamental wavelengths, "arc mush," and the commonly called repeater action, or the reception of one station on more than one setting of the oscillator dial.

In the Infradyne circuit "the sum of the frequencies" method is used to many advantages over "the difference of the frequencies" method. Actual tests in our laboratory have shown that only one dial setting of the oscillator is used for each station of the same wavelength, which avoids the usual undesirable repeater actions so common to receivers of this type. When properly balanced the method employed in the Infradyne amplifier has the faculty of eliminating harmonics of double or treble the wavelength of the station being received. The Infradyne amplifier

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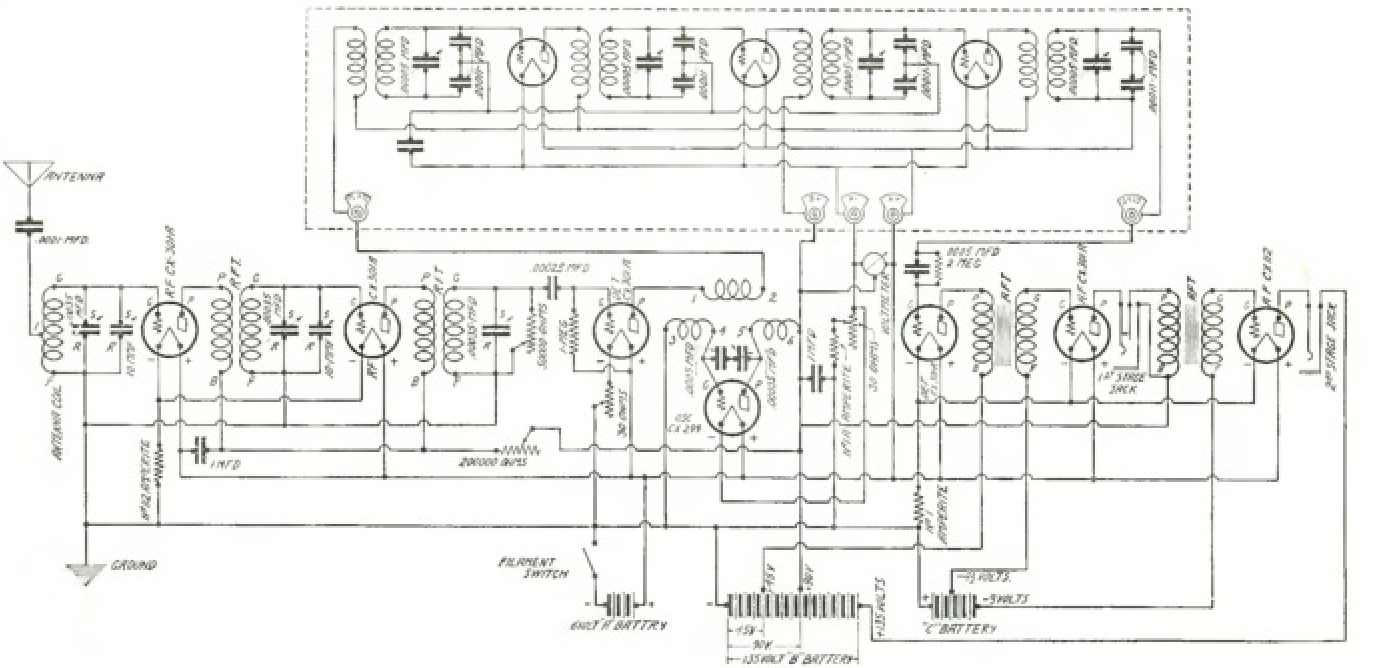

Fig. 1. Schematic wiring diagram of completed receiver

is very sharply resonated at 86 meters. From this fact it is obvious that the amplification of any other frequency is very low, which means that tube noises, etc., being of much lower frequency, or higher wavelength, will be amplified very little, if any at all.

There are ten tubes used in the, herewith described, Infradyne Receiver, two stages of Tuned Radio Frequency, first detector, oscillator, three stages of Infradyne intermediate amplification, second detector, and two stages of Audio Frequency amplification. It is self-evident that with the incoming signal passing through two sharply tuned stages of radio frequency, that it is in a high state of amplification before reaching the Infradyne intermediate amplifier and the audio frequency ampli-

(Continued on Page 184)

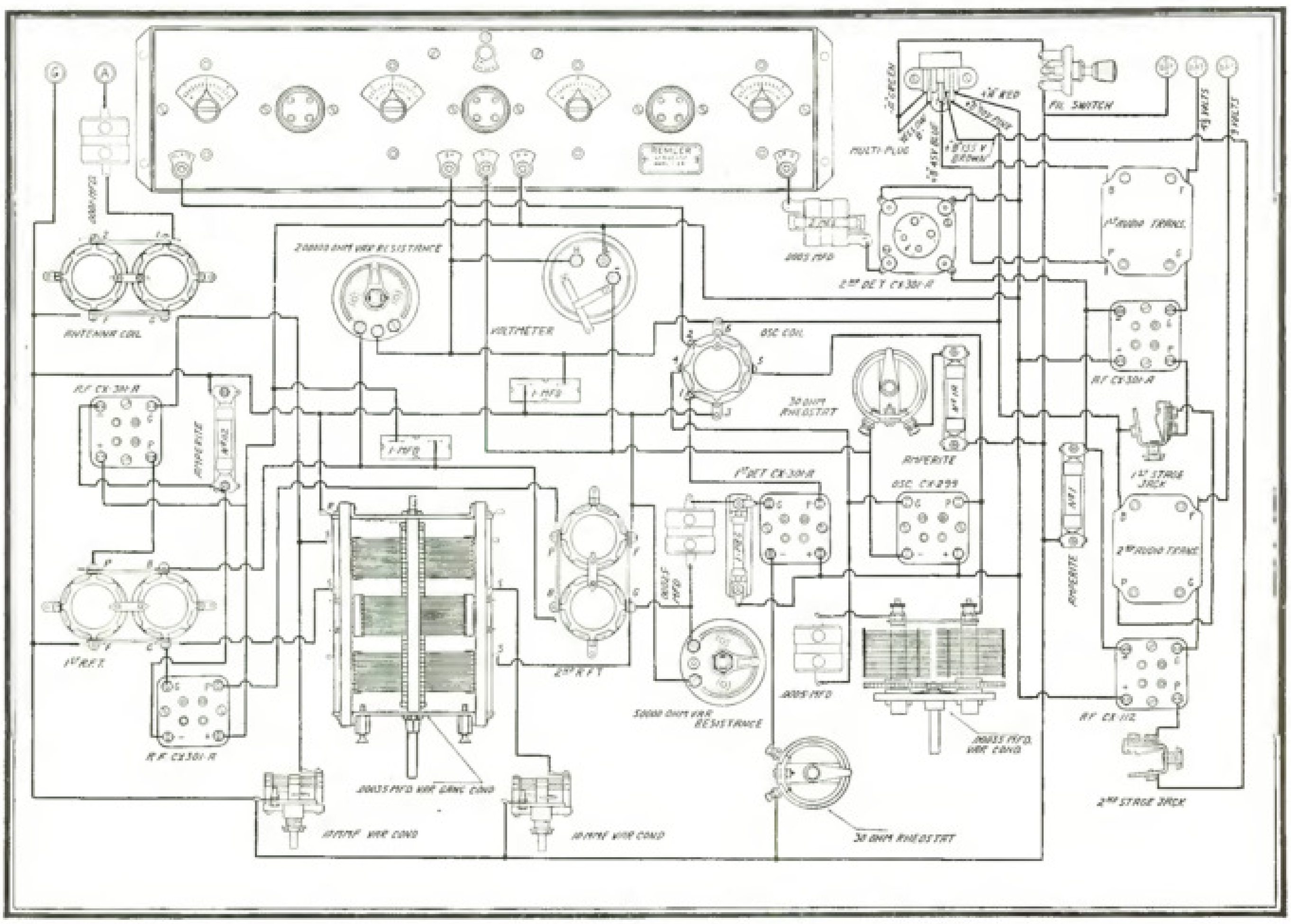

Fig. 2. Graphic illustration showing in a pictorial manner all the necessary connections for properly wiring receiver

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SM

Build YOUR Infradyne Right.

The S-M parts illustrated on this page have been selected by the inventors of the "Infradyne" as the only ones ideally suited to the "Infradyne." In building *your* Infradyne take advantage of the months of experimenting and research work of the inventors and insure success by using the parts they have endorsed above all others.

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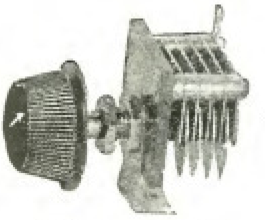
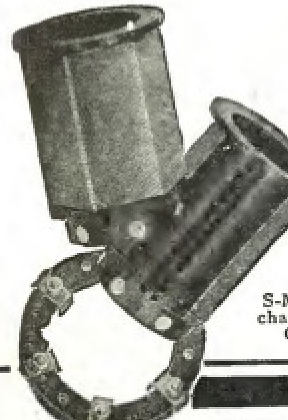


S-M Compensating Condenser, $1.50

S-M 220 Audio and 221 Output Transformers, $6.00 Each



S-M Uniformly Interchangeable Coils, $2.50
Coil Socket, $1.00

A STATEMENT FROM THE INVENTORS

THE Infradyne circuit, as originated by us, was first described in August, 1926, "RADIO." While we have no connection with this magazine, Mr. Sargent has agreed to write exclusively for it under his own name concerning the circuit. Otherwise our co-operation is freely given to anyone interested in its development and sale. We alone are responsible for the selection of the parts recommended for use in building sets which incorporate the Infradyne principle. This recommendation is based upon our personal experience and will be adhered to without change for at least six months. Consequently the parts specified herewith may be safely used in building the set. As the art progresses there may be new recommendations of parts perhaps better adapted to the peculiar needs of this circuit.

(Signed) E. M. SARGENT,
L. C. RAYMENT.

HERE IS THE LIST OF SPECIFIED PARTS

INFRA-DYNE

E. M. SARGENT and L. C. RAYMENT, 721 McKINLEY AVE., Oakland, Calif.

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fore leaving the factory, so only a slight turn will be needed. The object in balancing is to narrow the tuning range on the dial to an absolute minimum. When the station comes in with the greatest volume on the sharpest dial adjustment, with only one peak, the condenser is perfectly balanced. Now as a matter of checking, tune in a station at the high end of the dial. Adjust the antenna compensator till signals are loudest, then vary the balancing condenser and observe if the reception has improved. If the volume of the signals is much greater when the condenser screw is turned, an error has been made in the original adjustment and the whole thing should be readjusted, this time on the high wave station. It takes patience and plenty of time, but the results are well worth the effort, for when once adjusted no more attention need be given it and signals will come in loud and clear over the entire scale with no mushy overtones to spoil the reception.

After one is satisfied that the radio frequency amplifier is working properly, throw the switch over the "Distance." The Infradyne is then connected in the circuit. Set the right hand tuning condenser at zero and then turn the four controls on the Infradyne amplifier to minimum. Next turn the "Increase" screw about two-thirds of the way to the right. Use the fingers for this, not pliers. Set the sensitivity control until a series of whistles are heard, then adjust the increase screw till the whistles disappear. Now rotate the right hand tuning control till a station is brought in. It is best to check on the same stations used in tuning the radio frequency amplifier earlier in the balancing.

Now while swinging the right hand control back and forth across the wave of the station being received, adjust the four controls on the Infradyne until the signal clears up and the various circuits in the amplifier are in resonance. If the set breaks into oscillation, turn the sensitivity control back a bit. This final adjustment should be made on a distant station, preferably when one is wearing headphones. Above all else, don't get impatient and don't try to rush. The time spent in delicate adjustment is well worth the effort.

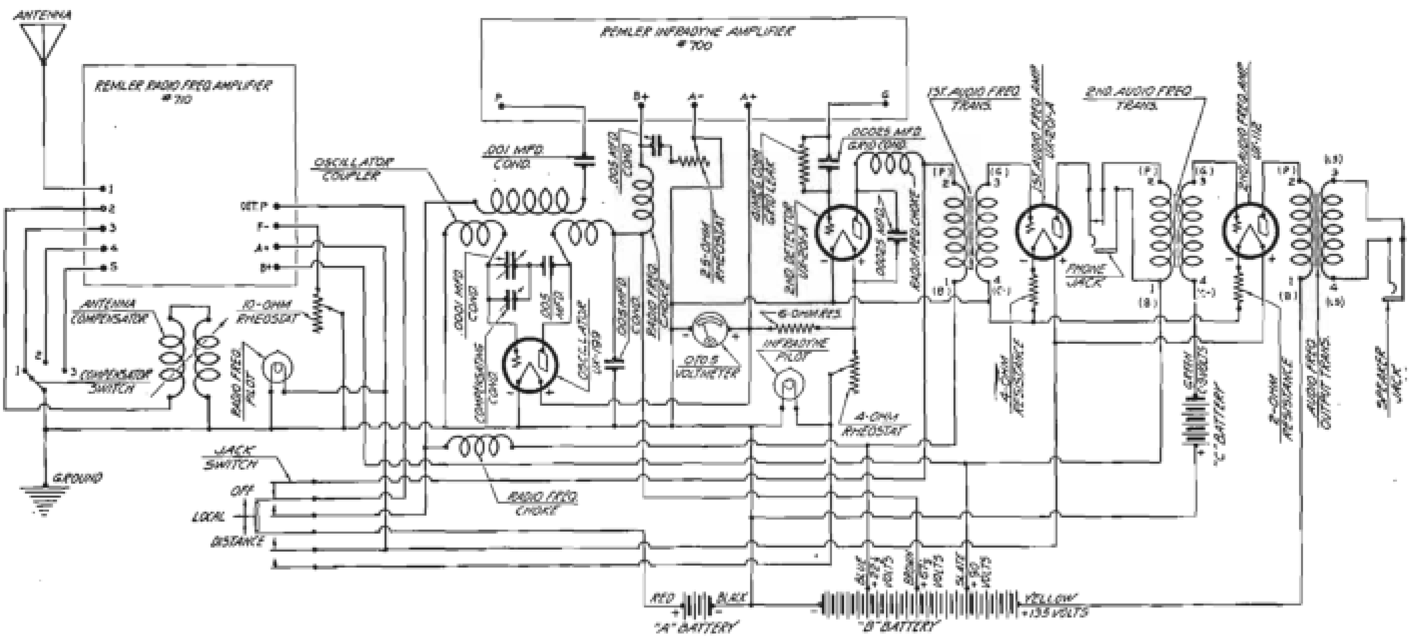

Fig. 3. Schematic wiring diagram

LIST OF ACCESSORIES FOR USE WITH THE INFRADYNE RECEIVER

The following is a list of accessories that have actually demonstrated their ability to properly operate the 1928 Model Infradyne Receiver. While these particular accessories are suggested, it is possible to make any reasonable substitution without decreasing the all-around efficiency of the receiver:

1—Ehlert Super Excellent Speaker Console
1—Sterling Type R-96 "A" Power Supply
1—Fansteel Type B-180 "B" Power Supply
1—Utah Cone Junior Speaker

The Ehlert Super Excellent Speaker Console is finished in walnut of the correct height to make operation of the receiver easy. There is an unusually large battery compartment, the door of which swings outward. A screen opening is provided in the door, behind which the speaker may be placed. A shelf is built in the door for the speaker to rest upon. The table has an attractive top with beveled edges. The four supporting legs are short and fluted, making a firm foundation. Holes in the back of the cabinet are provided for the battery connections which go to the receiver.

A Sterling R-96 "A" Power Supply is a highly efficient device using the Raytheon Cartridge units. It is of unusually large capacity and will furnish ample current for a receiver the size of the Infradyne. Because of the special design, the owner will not find his power supply antiquated when high capacity Raytheon Cartridge units are developed. They are mounted on clips on the under side, and may be replaced with others at any time convenient. There is a Sterling meter adjustment which gives voltage control to the actual amount required by the tubes. The instrument is contained in a metal cabinet finished in a dark green enamel with nickel trimmings. It operates from 110 volts 60 cycles A.C. and is made by the Sterling Manufacturing Company of Cleveland, Ohio.

The Fansteel "B" Supply Model 180 employs the tantalum and electrolyte rectifier, which has proven itself so successfully in years of actual operation. It is silent and requires very little attention. This model is of ample capacity to supply any set now on the market using a voltage of 180 at 55 milliamperes, maximum output. Taps are provided for the lesser "B" voltages required. The unit is contained in an attractive metal case with a carrying handle at the top. It is supplied also with a flexible rubber covered cord and attachment plug, which is screwed in the nearest light socket. This unit is made by the Fansteel Products Corporation, North Chicago, Illinois.

The Utah Cone Junior is an attractive speaker employing the principle used in the original Nathaniel Baldwin, Mica diaphragm. The unit has been enlarged in proportion to deliver correct volume and tone quality without distortion at power tube operation. The cone is floating, being supported by the driving armature passing through its center. It is of attractive design and is ornamented with a single band of decoration around the outside edge. The base is of ample spread and weight to make tipping and possible damage quite unlikely. This speaker is made by the Utah Radio Products Company of Salt Lake City, Utah.

(If further information on any of the above described accessories is desired, it may be secured by writing direct to the manufacturer.)

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The 1928 Model Infradyne

Complete Details on the Assembly of the New Model of This Popular Ten-Tube Receiver

This Receiver Was Constructed and All Illustrations Made in the Laboratory of the Citizens Radio Call Book

THE 1928 Model Infradyne not only oversteps all of the cut and dried conventionalities of radio set construction, but it also represents a new type of home constructed receiver that is unique in performance, pleasing to the eye, and above all, most satisfactory in operation. The New Infradyne has gone so far as to eliminate cabinet, panel, bus bar wiring and all external capacity effects. Absolutely no wood and only a minimum of bakelite enter into its construction. Like the auto, it can boast of an all metal chassis, body and wheels. Aluminum and pressed copper are the metals employed.

The cabinet is an artistically designed cowl of copper fitting over the entire set like the hood of a sewing machine. The outside is finished in a seal brown crystalline lacquer with embossed panels of a burnt sienna tone. The inside of it is lacquered with a transparent varnish so that the natural copper finish is present. One very important fact is that the back of the hood is just as pleasing to the eye as the front, which certainly obviates the need of pushing the set up against the wall as is usually the case with the home constructed receiver. This will be especially appreciated when one stops to consider that very often one will want the set on the porch, or other place where it is visible on all sides. The hood is not affected by heat or moisture, making it perfectly secure under both the hot rays of the sun or the extremely damp atmosphere along the sea coast or lakes.

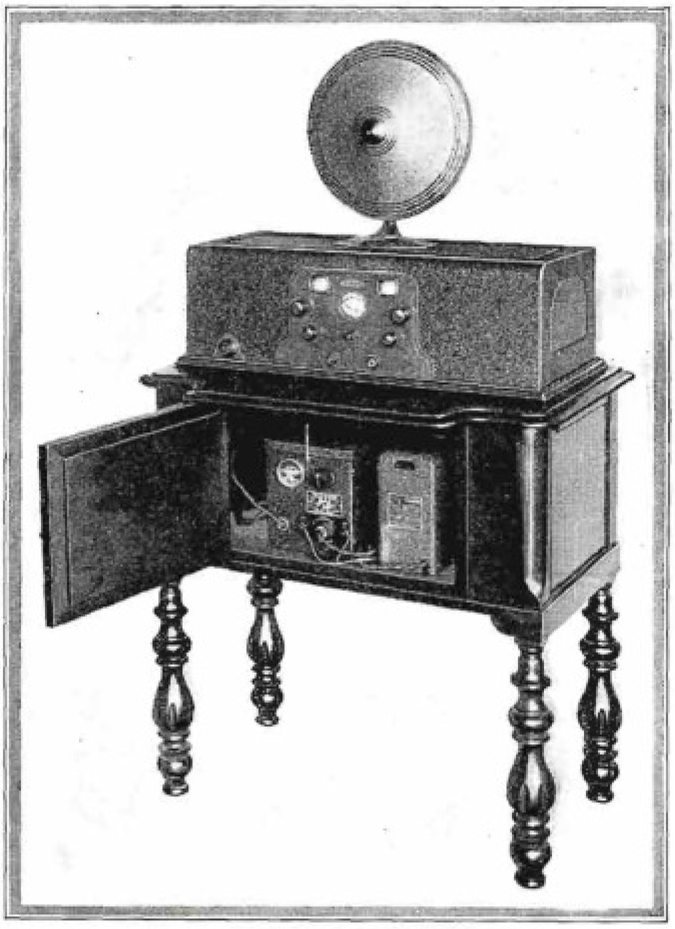

Photo "A." The Infradyne Receiver Installed on a Table with Appropriate Accessories

The tuning controls are brought out to a dashboard which is located in the center of the front side. This panel is made of copper, etched with acid in a pleasing design of Grecian simplicity. This dashboard is "floating," being secured only by the bushings holding the various instruments. Unsightly screw heads do not mar the front of this receiver. A voltmeter with a full scale deflection of five volts is located in the center of the control panel. This is to indicate the filament voltage of the 199 type tubes in the Infradyne amplifier and in the oscillator.

Two major controls are used to regulate the tuning. The radio frequency control is located on the left side of the voltmeter, while the Infradyne control is located on the right side. A bezel is set in the panel for each control to enable the operator to see the graduations on the illuminated dial. Both controls are of the drum type and are so placed that they are just flush with the panel.

Directly below the tuning controls are three rheostats labeled "Volume," "Voltage" and "Sensitivity." They control the filament voltage for the different sets of tubes. At the bottom of the panel is a jack for head phones and a three-way switch for shifting from local to DX. reception. For local use, the Infradyne amplifier is cut out of the circuit and the set becomes a single dial two stage tuned radio frequency receiver. This gives ample volume in an average room. In changing from local to distance reception, the switch is turned to the right as far as it will go, which automatically inserts the Infraydne unit into the circuit, lights the tubes and places the set in operation so that the operator may tune in on the other side of the continent.

At the left hand end of the receiver is the two stage tuned radio frequency amplifier. This is entirely enclosed in a pressed copper cabinet with a removable top. The unit includes a three gang variable condenser, three radio frequency transformers, three flush mounted sockets and other miscellaneous parts. There is an additional shielding partition between each of the three transformers. Tuning with a maximum of efficiency is accomplished in an ingenious manner. As the condenser rotates, an eccentric cam brings pressure upon a spring bar which in turn rotates a shaft. The primaries of the three transformers are fastened to this shaft by means of compound levers. They are pushed up and down inside of the secondary coils, the coupling varying with the frequency tuned. A method of correcting the coupling and bringing all three transformers into resonance is provided in a sliding collar and lock nut fastened to the top end of the secondary. The entire secondary is supported on a rod and if it appears to be a bit out of resonance, it may be moved up or down a fraction of an inch until the difficulty is remedied. The three stage amplifier comes as a unit and is fastened to the main baseboard by means of screws. All wiring is done on the under side, between the two bases.

The Infradyne amplifier is the standard unit with which we are all familiar. It includes the four balancing controls, three flush mounted sockets and all the necessary binding posts. The entire unit is enclosed in a copper cabinet with a bakelite top. It is mounted

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on the rear side of the baseboard, reaching from the radio frequency amplifier to the right hand end of the receiver.

In the center of the baseboard directly between the two tuning condensers is the oscillator system. It is flush mounted, all the apparatus being slung on the under side of the panel. To the right and forward are the detector and two stage audio amplifier. An output transformer is included.

For the convenience of the home constructor, the manufacturer has put the set into convenient kits. One distinct advantage of this method is that a set may be built which is not a complete Infradyne receiver and yet will give satisfactory reception. At first one may buy the baseboard, the radio frequency amplifier and detector and enjoy a five-tube receiver until such a day as it is convenient to add the Infradyne amplifier. The wiring is such that none of it need be ripped out when an addition is made. Only one tuning condenser, the three gang, is needed for this simple set.

The baseboard is made of pressed steel and much resembles an inverted baking pan. It is deep enough to allow plenty of room for wiring and instruments. It is supplied by the manufacturer already drilled for all wires and instrument mounting. It is lacquered black on the outside, while the under side is finished in the natural copper.

Near the extreme left end of the receiver, directly under the radio frequency amplifier, is the antenna compensator. It consists of a tiny variometer hooked in series with the antenna, with a three pole rotary switch tapping off different turns on the primary coil. This compensation is used to tune the antenna circuit and for bringing it to resonance.

The wiring of this receiver utilizes a type of harness seldom seen in radio, but one which is quite common in telephone systems and electrical circuits. It uses the bunched cable method, that is, insulated wire, a different color for each circuit, all tied together into a bundle. This method of wiring looks extremely neat and gives the receiver more of the appearance of a delicate instrument than a high tension power plant.

The rheostats are mounted directly on the baseboard with angle brackets and are controlled from the panel by means of extension shafts. Fixed resistances regulate the voltage of the audio amplifier tubes.

The phone jack is inserted in the plate lead of the first audio transformer. The current passing through a two step amplifier is of tremendous volume and is not desirable for headset reception. A jack on the rear of the baseboard is available for the loud speaker. In addition to the speaker jack, a cable for the battery connections and two binding posts for the antenna and ground are provided.

LIST OF PARTS NEEDED FOR THE CONSTRUCTION OF THE 1928 MODEL INFRADYNE

The list of parts given below were used in the laboratory model of the receiver. While it is possible for the experinced experimenter to substitute other good apparatus for that actually specified, it is advisable that the novice strictly adhere to the list given below:

1—Pressed Steel Base
2—Bronze Control Panels
2—Remler Universal Drum Dials No. 110
1—Remler Condenser No. 659
4—Remler Sockets 50
3—Remler Choke Coils No. 35
1—Remler Special Coil and Spacer
1—Frost 10-ohm Rheostat, Extension Shaft and Bushing
1—Frost 2½-ohm Rheostat, Extension Shaft and Bushing
1—Frost 4-ohm Rheostat
1—Frost 2-ohm Fixed Resistance
1—Frost 4-ohm Fixed Resistance
1—Frost 6-ohm Fixed Resistance
1—Frost Jack No. 953
1—Frost Jack No. 954
1—Electrad .00025 mfd. Fixed Condenser No. GS
1—Electrad .00025 mdf. Fixed Condenser P
1—Electrad .001 mfd. Fixed Condenser
3—Electrad .005 mfd. Fixed Condenser
1—Electrad 4-megohm Grid Leak
1—Yaxley Switch 69
2—Eby Engraving Binding Posts
1—Celeron 4x¾x⅛-inch Strip
1—Special Adjustable Condenser
2—Special Bakelite Terminal Blocks
1—Acme Battery Cable
All of the above parts are included in the Infradyne Foundation Kit No. 750
1—Remler Infradyne Unit No. 700
1—Remler Radio Frequency Ampifier Unit complete assembled and wired No. 710
1—Remler Infradyne Cabinet No. 760
1—Ekko Ground Clamp
1—Pkg. Kester Radio Solder
4—Ceco Type "BX" Tubes
1—Ceco Type "F" Tubes
5—Ceco Type "A" Tubes
2—Silver-Marshall Audio Transformers No. 220
1—Silver-Marshall Output Transformer No. 221

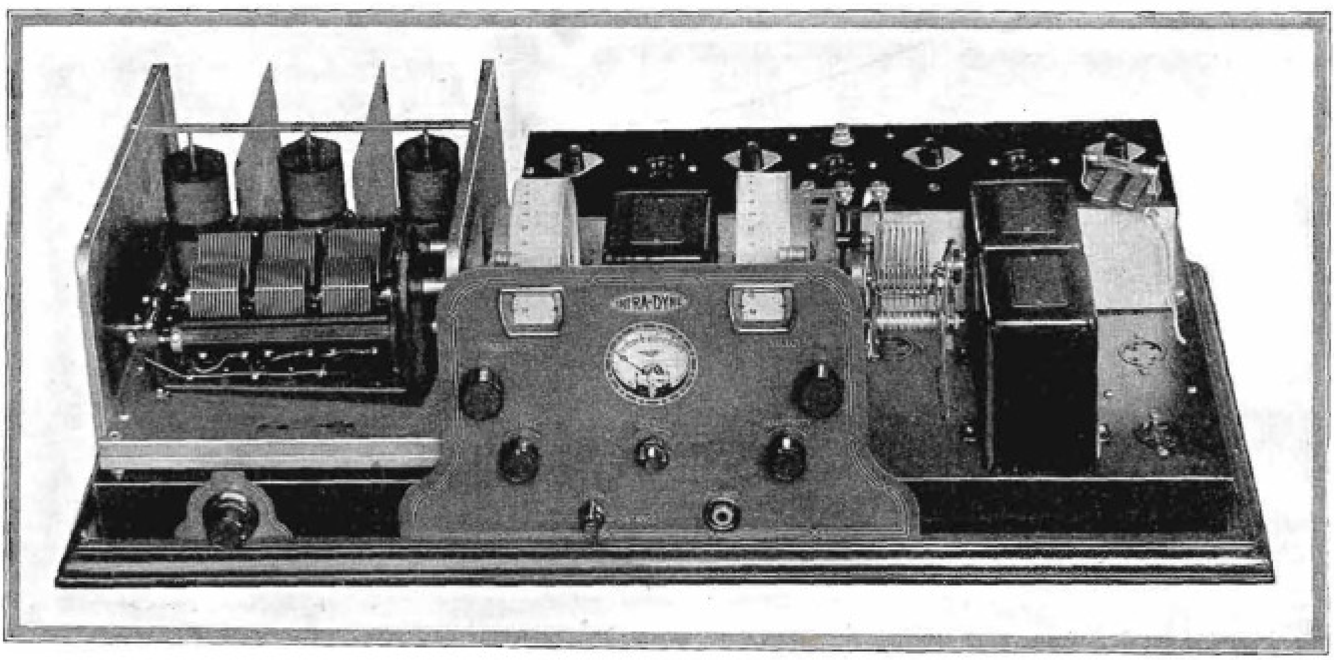

Photo B. View showing arrangement of parts with covers removed

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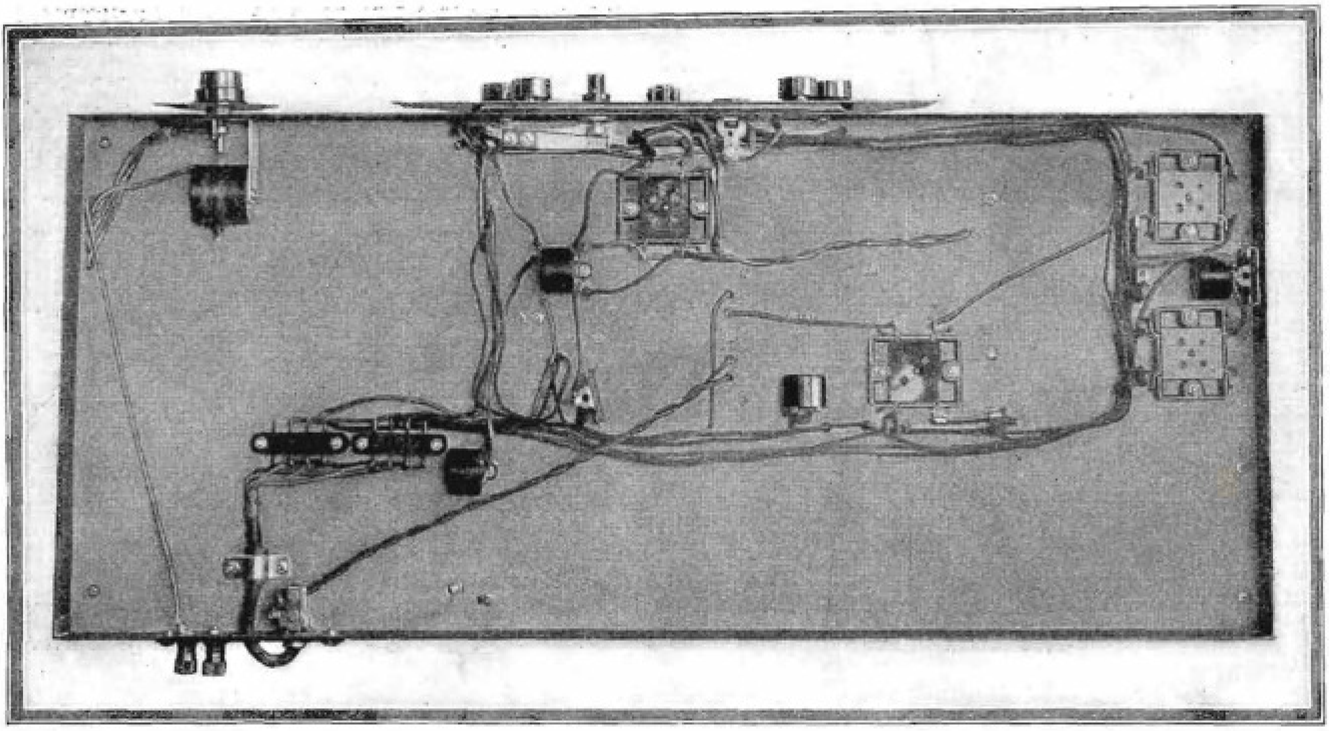

Photo C. Bottom view showing cable harness

1—Jewell 0.5 Voltmeter
Miscellaneous lugs, screws, etc.

The 201-A tubes are used in the radio frequency amplifier, 199 tubes in the Infradyne amplifier and oscillator. Either a 200-A or 201-A tube makes a good detector, a 201-A for the first stage audio amplifier and a 171 power tube for the second stage. Next turn the panel switch from "off" to "local." All the tubes but the oscillator and those in the Infradyne amplifier and second detector should burn. The light on the left tuning dial should also light up. Now turn the switch to "Distance" and all of the tubes will light. The voltmeter reads only on the 199 tubes and it should be kept at exactly three volts.

Now turn the switch back to "Local" position and begin tuning. Set the larger knob of the antenna compensator control knob at No. 3, then adjust the inner knob at approximately 45 degrees. The left hand dial is the only one used for "local" tuning, and at first it should be set at zero. Turn the volume control until a roar is heard in the speaker. Turn back a bit on the volume control and rotate the dial slowly until a signal is picked up.

With a good steady signal proceed to balance the radio frequency amplifier. On a bakelite strip incorporated in the base of the three gang tuning condenser are three midget condensers, regulated by set screws. They have been carefully regulated be-

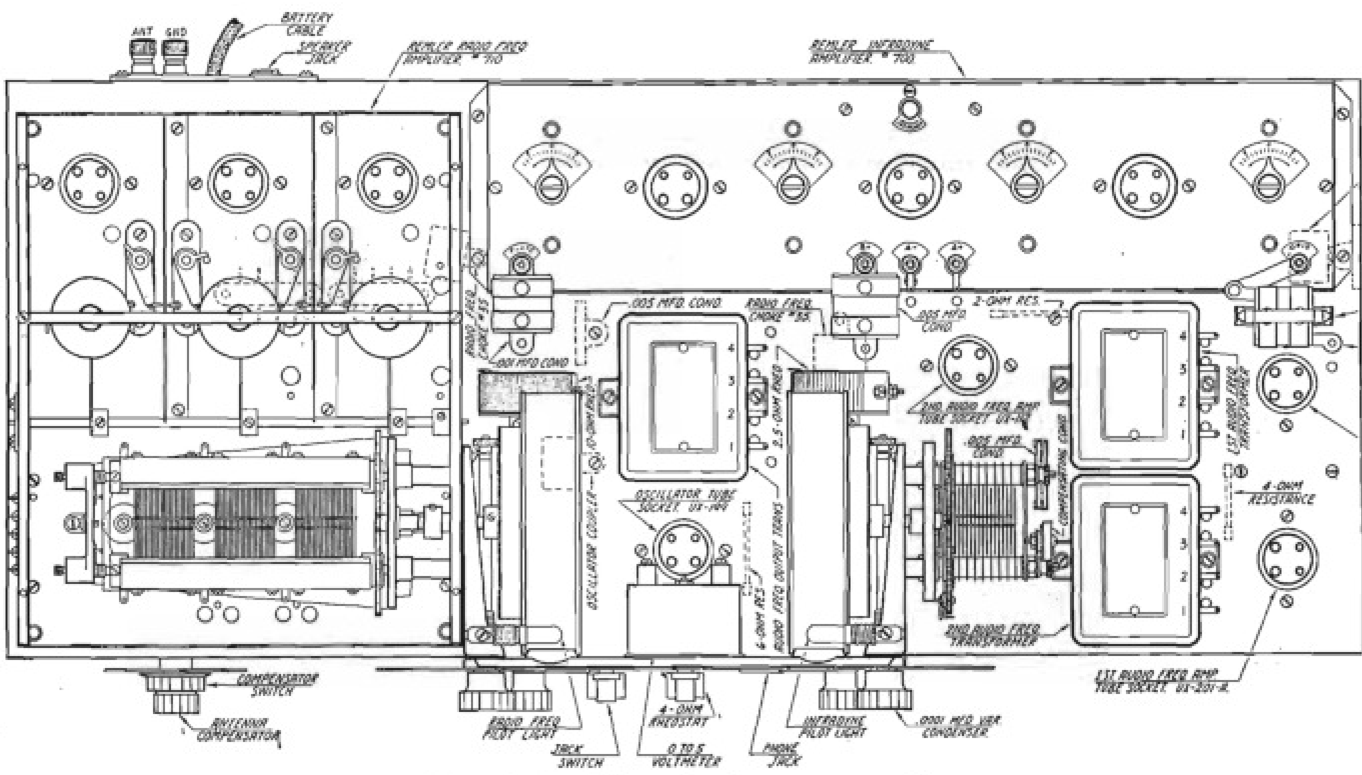

Fig. 1. Baseboard layout showing arrangement of parts

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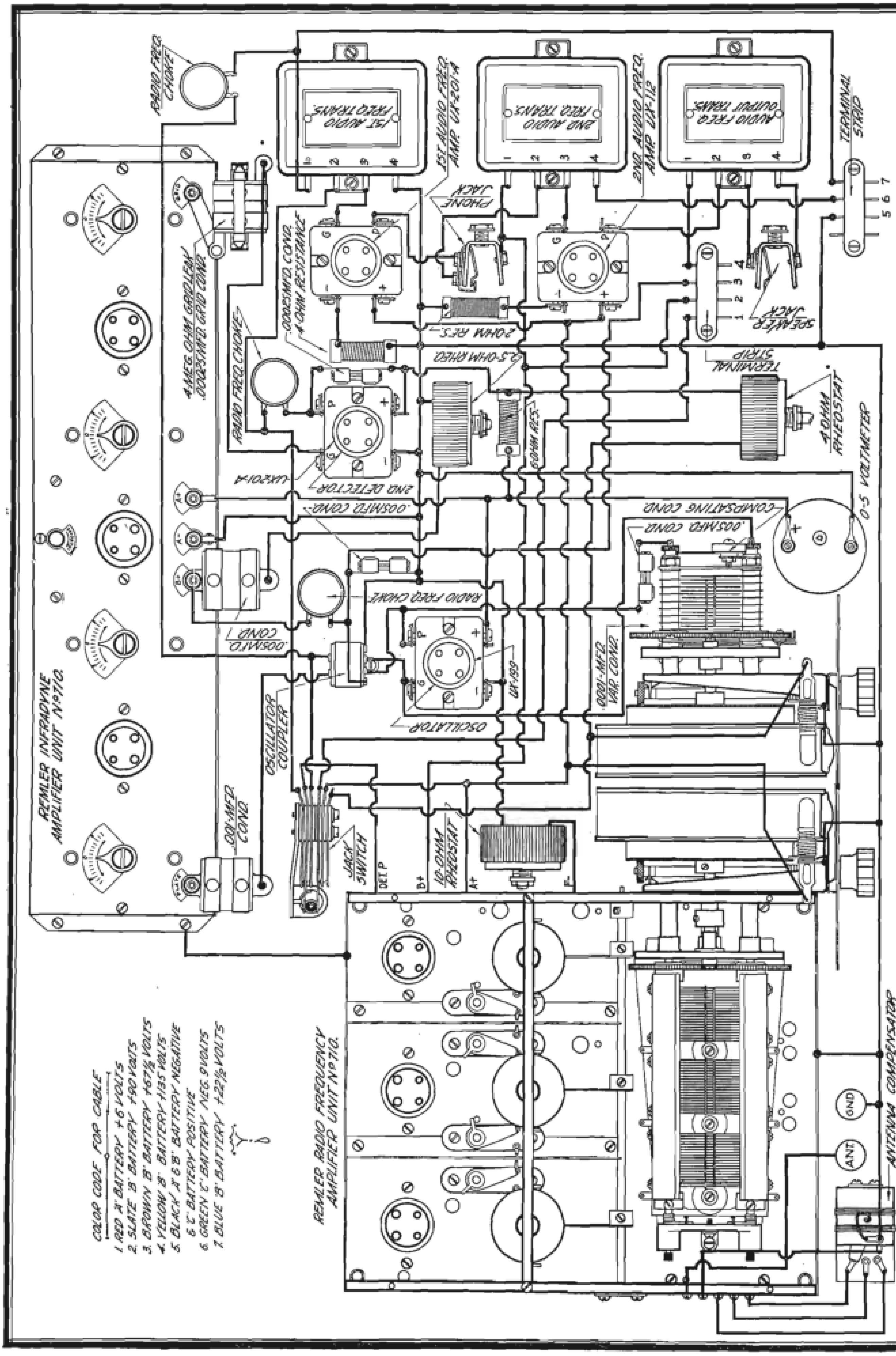
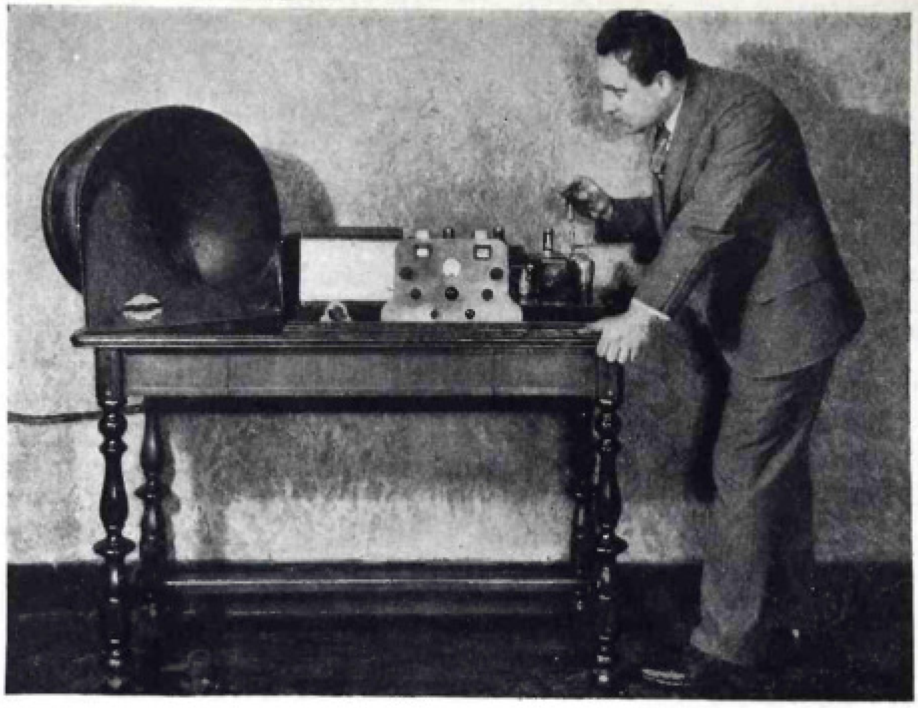


Fig. 2. Graphic illustrations shown all connections



ADJUSTING THE INFRADYNE AMPLIFIER

Since the Infradyne amplifier works on one frequency, it needs no attention after its initial tuning when the set is built. For local reception it may be switched out of the receiver circuit, with a consequent saving in operating voltages.

Plenty of New Ideas *in* the Remler Infradyne

By LAURENCE M. COCKADAY

By inverting the principles of the superhetrodyne, the Remler 10-valve Infradyne receiver, whose construction is described here, gives the set builder a brand-new circuit to play with—a circuit that brings in distant stations like locals, and gives the locals a volume and quality that few other receivers can match.

THERE are few radically new circuits for radio reception offered to the experimenter or the radio enthusiast who builds his own set. The infradyne system, however, *is* different and offers some advantages that are not found in any other type of receiver circuit.

In the first place, the new infradyne receiver is a ten-valve set and is arranged so that instantaneous conversion may be made for local reception so that only five valves, with single dial control, are used. In this condition the infradyne comprises two stages of tuned-high-frequency amplification, a detector and two stages of low-frequency amplification. Operated on this circuit the receiver is sufficiently selective and will produce excellent tone quality on local reception. By a mere turn of the switch the set is changed so that two stages of high-frequency amplification are used, after which the signals are rectified by a detector valve, and a beat frequency produced by means of a local oscillator of approximately 3,500 kilocycles, at which frequency three extra stages of high-frequency amplification are used, working into a second detector and two final stages of low-frequency amplification.

The receiver is not a superheterodyne; in fact, it works in exactly the opposite manner from the superheterodyne. Instead of the beat frequency being the difference between the initial frequency and that of the local oscillator frequency, it is the sum of these two frequencies, so that the signal will appear on but one setting of the dial. Of course, the beat frequency is on a very short wavelength and the three-stage short-wave amplifier operates with the utmost selectivity without cutting sidebands or impairing quality of reproduction. This new form of amplification, beside amplifying the received signal to a remarkable extent, helps also to suppress a large amount of the noises that are amplified through the standard wavelength amplifiers ordinarily used.

An inspection of the new infradyne, as shown in the accompanying illustrations, will show that the new receiver presents a neat and pleasing appearance, that it is sturdy in design and compact in construction, and that in it have been incorporated all the latest improvements and electrical features in keeping with the latest developments in the field of radio. The schematic wiring diagram in Figure 4 gives the theoretical circuit in its entirety.

In construction this new set can be built by any one whether he is familiar with radio or not. When it is completed the constructor will have a re-

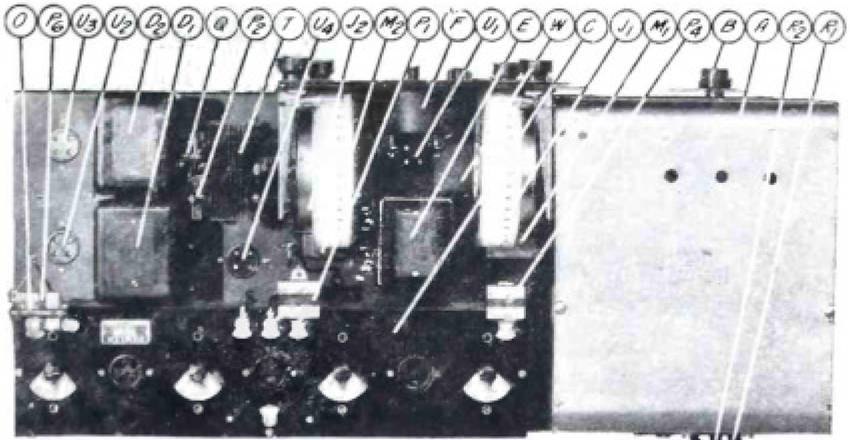
POPULAR RADIO WORK SHEET

The Remler Infradyne Receiver

List of Parts for Building This Receiver

Cost of Parts—*Not over $180.00*

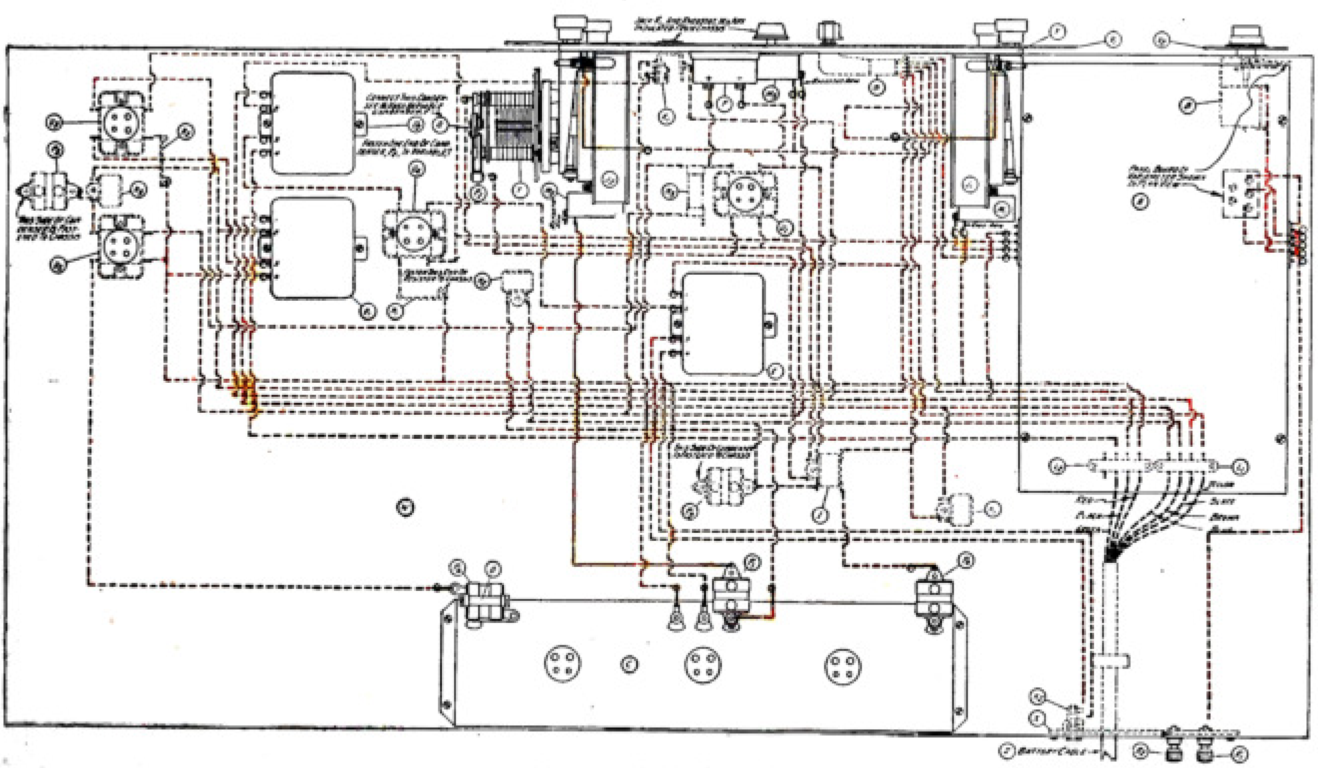
A—Remler high-frequency amplifier, No. 710;
B—Remler antenna compensator;
C—Remler Infradyne amplifier, No. 700;
D1 and D2—Silver-Marshall low-frequency transformers, type 220;
E—Silver-Marshall output transformer, type 221;
F—Weston voltmeter, Model 506, 0 to 5 volts;
G1 and G2—Remler cabinet and wooden base, No. 760;
Remler Infradyne foundation kit, No. 750, consisting of:
- H1 to H3—Remler high-frequency chokes, type No. 35;
- I—Remler special oscillator coil;
- J1—Remler drum dial, No. 110-L;
- J2—Remler drum dial, No. 110-R;
- K1—Frost Gem Jac, No. 954, equipped with oxidized metal bushing;
- K2—Frost Gem Jac, No. 953;
- L1 and L2—Remler special bakelite terminal blocks;
- M1—Frost 10-ohm rheostat with extension shaft;
- M2—Frost 2½-ohm rheostat with extension shaft;
- M3—Frost 4-ohm rheostat;
- N1 to N3—Frost fixed resistances, 2 ohms, 4 ohms and 6 ohms, respectively;



THE RECEIVER VIEWED FROM ABOVE

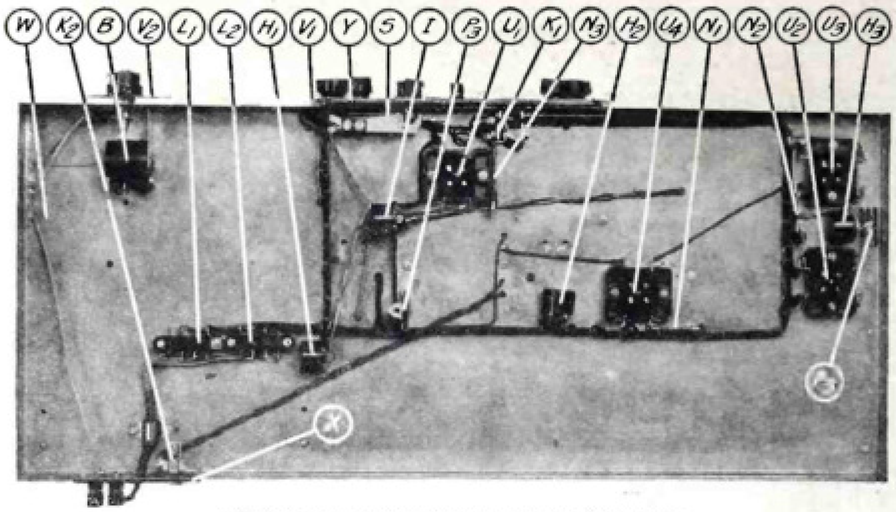
Figure 1: *The high-frequency amplifier, encased in its shield, appears at the right, the infradyne amplifier may be seen at the bottom of the picture, at the left.*

O—Durham metalized resistor, 4 megohms;
P1 to P3—Electrad fixed condensers, .005 mfd., type P;
P4—Electrad fixed condenser, .001 mfd., type P;
P5—Electrad fixed condenser, .00025 mfd., type P;
P6—Electrad fixed condenser, .00025 mfd., type GS, equipped with grid-leak bracket;
Q—Special adjustable condenser with bracket attached;
R1 and R2—Eby binding posts, marked *antenna* and *ground;*
S—Yaxley switch, No. 69;
T—Remler variable condenser, type 659;
U1 to U4—Remler sockets, No. 50;
V1—Remler bronze control panel;
V2—Remler bronze antenna panel;
W—Remler steel chassis;
X—Bakelite binding-post strip, 4 by ¾ by ⅛ inch;
Y—Pressed steel instrument panel;
Z—Battery cable;
Connecting wires, screws, nuts, etc.;
Instruction book and blue prints.



HOW TO WIRE THE RECEIVER

Figure 2: *The wiring of the receiver is simplified by the fact that the high-frequency amplifier and the infradyne amplifier may be obtained completely wired.*



THE UNDER SIDE OF THE SUB-PANEL

FIGURE 3: *The method of cabling the wiring and the connections to the instruments mounted under the sub-panel are clearly shown in this view of the set.*

ceiver that is absolutely up-to-date in design and performance, producing such excellent results for selectivity, sensitiveness and reproduction qualities that he will be very proud to own it.

How to Construct the Receiver

The first job will be to mount the various instruments, parts and amplifiers on the metal chassis, W. It is preferable to start with the bottom side and to mount the antenna compensator, B, the terminal blocks, L1 and L2, the choke coils, H1, H2 and H3, the four sockets, U1, U2, U3 and U4, the condensers, P3 and P5, the resistances, N1, N2 and N3, the jack, K2, and the binding post strip, X, on the underneath side of the chassis, W. The correct positions for these instruments are shown in Figure 1. They are to be mounted on the chassis, in the screw holes provided for them, by means of the screws, washers and nuts that are provided in the envelopes in which the instruments come packed.

After this is done the various instruments on the top side of the chassis should be mounted, including the high-frequency amplifier, A, the infradyne amplifier, C, the transformers, D1, D2 and E, the condensers, P1, P4 and P6, and the grid-leak, O.

Next mount the pressed steel instrument panel, Y, on the chassis, W. An envelope will be found containing screws for this purpose. When the instrument panel has been attached to the base mount on it the switch, S, the jack, K1, the right and left-hand drum dials, J1 and J2, the voltmeter, F, and the rheostats, M1, M2 and M3. These should be mounted without attaching the dials. Next put in place the bronze escutcheon plate, B1, and attach all the dials to the shafts of the instruments, as well as the front of the jack, K1. The rheostat, M3, should be insulated with an insulating washer that is packed in one of the envelopes. Next attach the variable condenser, T, and on it mount the condenser, P2, and the adjustable condenser, Q.

The next work to be done is to prepare the cable harness and the battery cable. Cut about four inches of the outside covering from one end of the battery cable, Z, and fifteen inches from the other end; wrap binding cords around the ends to keep them from fraying. Pass the ends of the cable having the four-inch leads through the terminal strip, X, from the outside and cut the individual wires the correct lengths for connection to the terminal blocks in accordance with the picture wiring diagram in Figure 2.

Now we are ready to build up the cable harness. With the foundation kit is supplied a full size sheet which is reproduced in Figure 7. On the lower part of this diagram are small numbered circles. Procure a flat, soft-wood board about ten inches wide and two feet long. The full size template should be placed on top of this board and nails driven in part of the way through each of the numbered circles.

At the top of the template are ten detailed drawings, each for a wire of different color. These detailed drawings are numbered from one to ten, inclusive. Cut the separate wires of the correct length, following the detailed drawings in natural sequence, laying out, in each case, the wire of the color called for. When all of the wires have been placed in position and twisted around the nails, as shown in Figure 7, they may be tied together with cord, using the form of knot known as the "half

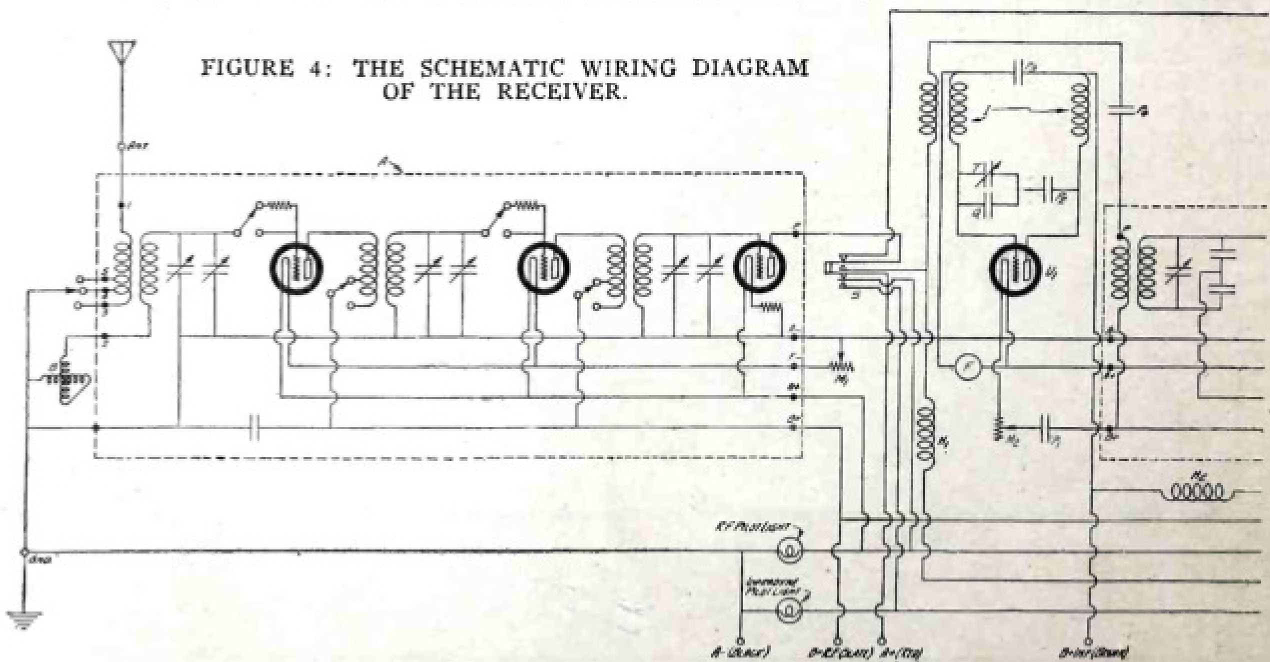
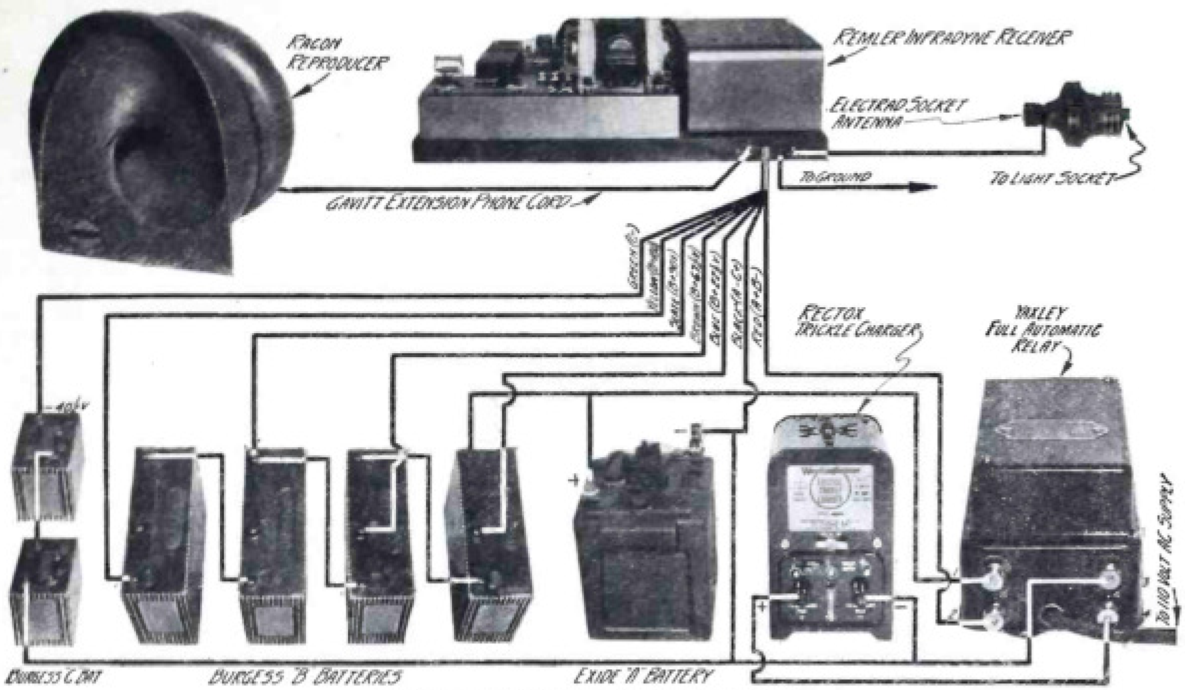


FIGURE 4: THE SCHEMATIC WIRING DIAGRAM OF THE RECEIVER.



HOW TO HOOK UP THE RECEIVER

FIGURE 5: *All the connections between the receiver and the "A," "B" and "C" supplies, as well as the reproducer, ground and antenna, are shown in* BLACK *lines. For ordinary local reception, without the use of the infradyne amplifier, it will be found that the current drain is very low.*

hitch." In tying the cable be particularly careful to make the hitches at all branches, starting at the upper left-hand corner.

The cable harness can now be put into the bottom of the pressed steel base and the various leads soldered to the terminals of the units mounted under the chassis. In making these connections refer to the picture wiring diagram in Figure 2. Figure 3 also shows these connections and the holes through which a number of them are to be passed up to the top side of the set.

The connections to the various instruments and terminals on the top side of the receiver should be made in accordance with the picture diagram shown in Figure 2.

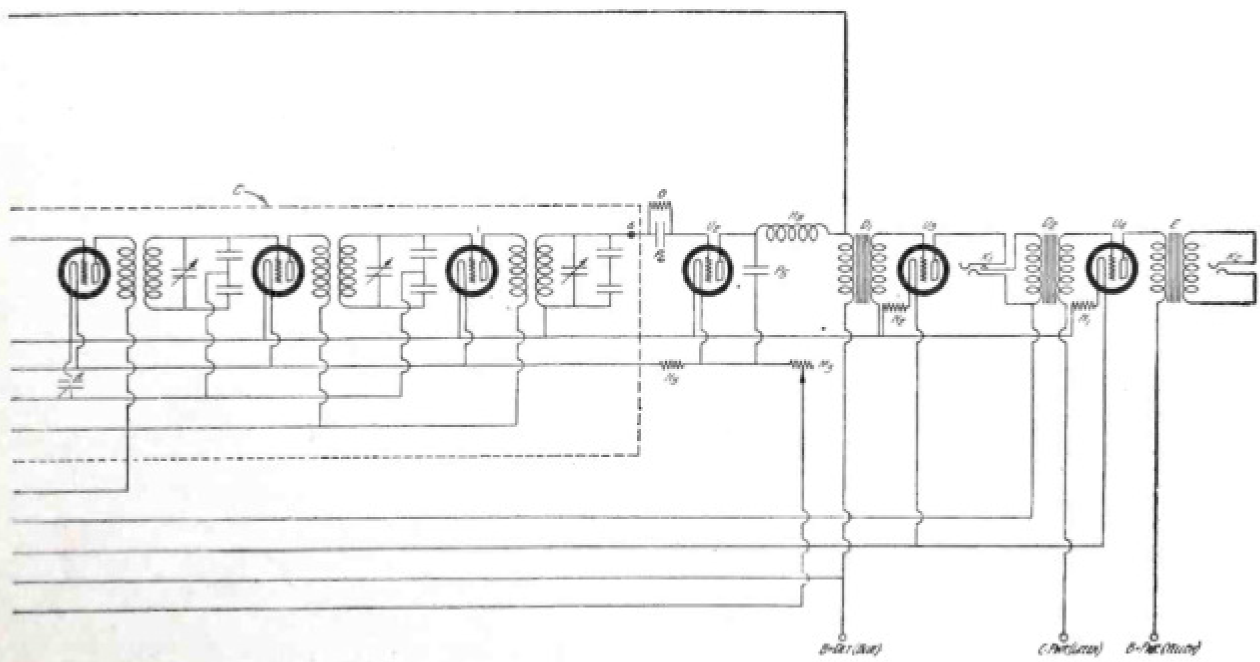
Packed with the foundation kit is an instruction booklet and full size blue prints showing the exact connection for each colored wire. These should be followed explicitly and checked with the picture wiring diagram shown in Figure 2.

When the wiring has been completed the set is ready for installation and may be fastened to the wooden base, G2, and the set is ready for operation.

How to Install and Operate the Set

We are now ready to install the vacuum valves and to put the set into operation. Remove the top from the amplifier, A, and insert three CX-301-a type valves and replace the metal top. Next place three CX-299 type valves in the socket of the infradyne amplifier, C, and in the socket located in the steel chassis immediately below and back of the voltmeter. This is designated in Figure 1 as socket U1. Place two CX-301-a type valves in

(*Continued on page 340*)



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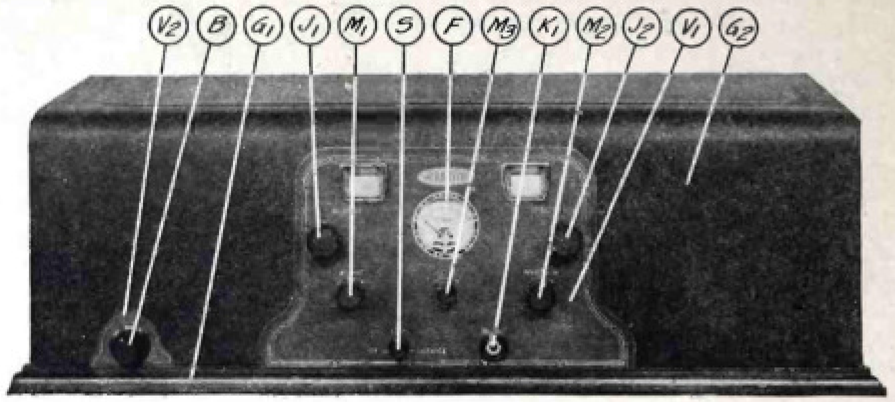
Plenty of New Ideas in the Remler Infradyne

(*Continued from page 289*)



THE PANEL CONTROLS

FIGURE 6: *Although the panel controls seem rather complicated for these days of simplified operation, it will be found that tuning in most stations requires only two controls. The other controls are for use in bringing in extreme distances.*

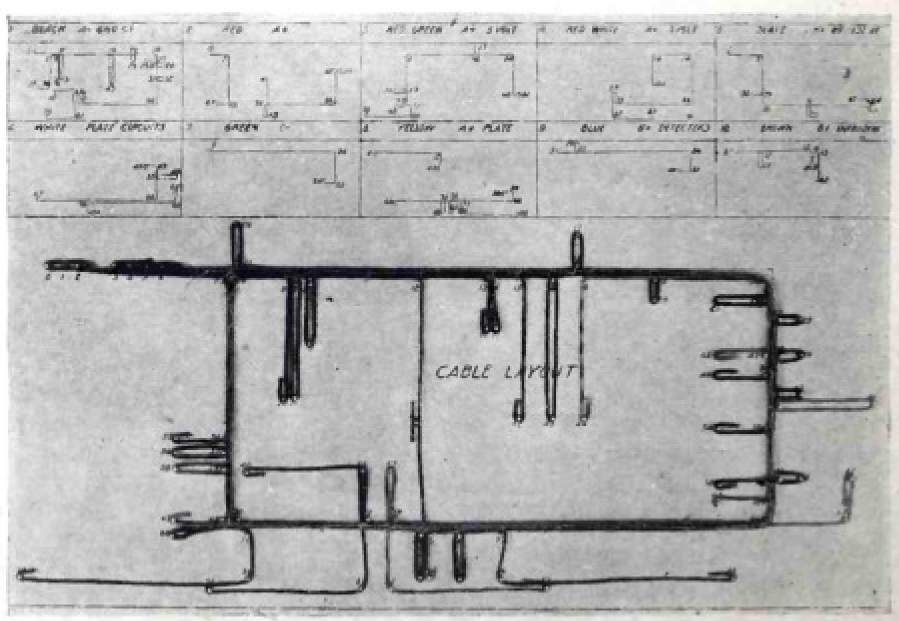
sockets U2 and U3, at the extreme right-hand end of the base. Place a CX-371 type valve in socket U4.

In connecting the batteries the red and black wires in the battery cable should be connected to the positive (+) and negative (—) terminals, respectively, of a 6-volt storage battery. Turn the switch, S, to the "local" position. All of the valves except those of the CX-299 type and the CX-301-a type valve at the extreme right-hand end of the base in socket U2 should light. The pilot light over the left-hand dial should also light. Now turn the switch to the "distance" position, and adjust the panel rheostat, M1, so that the voltmeter registers 3 volts; all of the valves in the set and both pilot lamps should now light.

Next connect up the "B" and "C" batteries, as shown in photo-diagram in Figure 5. Connect up the antenna and ground and plug in a pair of phones into the jack on the control panel. Set the inner part of the antenna compensator knob at "3" and adjust the outer part of the antenna compensator so that the moving coil makes an angle of about 45 degrees with the stationary coil. The left-hand tuning dial should read "zero" with the plates of the condenser in the high-frequency amplifier "wide open." Turn the volume control about 4/5 of the way "on" and rotate the left-hand dial slowly until a station on about 200 meters is picked up.

The balancing condenser connected across the antenna section of the gang condenser in the amplifier, A, should then be adjusted for the loudest signals. Fasten down the cover of this amplifier and the adjustment of the infradyne amplifier can be begun.

First see that the right-hand dial reads "100" when the plates of the con-



THE CABLE LAYOUT

FIGURE 7: *This picture is a reproduction of the paper template that comes with the foundation unit, with the cable properly laid out upon it by means of nails.*

denser are "wide open." Using the wooden wedge furnished with the amplifier turn the four infradyne amplifier tuning controls to "zero" and turn the infradyne amplifier "increase" screw abut 2/3 of the way "down," using the fingers instead of pliers. Then turn the switch on the front panel to the "distance" position and set the panel rheostat to exactly 3 volts. Set the left-hand dial for a station in about the middle range and set the "sensitivity" control to a point just beyond which a series of whistles is heard as the right-hand tuning dial is turned. The "increase" screw should be adjusted so that the whistles appear when the "sensitivity" control has been advanced about 1/3 of its range. Next rotate the right-hand dial until the station for which the left-hand dial is adjusted is brought in.

Consider the infradyne amplifier tuning controls reading from left to right as numbers 1, 2, 3 and 4. Leave No. 2 set at "zero." Adjust No. 3 for maximum signal strength, while rotating the right-hand tuning dial slowly back and forth past the station setting. Next rotate knob No. 1 for maximum signal strength and then adjust knob No. 4, coming back to knob No. 2 for a final adjustment. As the proper settings are found the amplifier will probably go into oscillation and a whistle will be heard as the station setting is passed. If this happens, turn the "sensitivity" control back until it ceases.

In operating the infradyne several pointers should be kept in mind. When the switch is in the "local" position only the left-hand tuning dial and "volume" control should be used. With the switch in the "distance" position the "sensitivity" control and both tuning dials will be used, in addition to the "volume" control. The voltmeter should always indicate 3 volts.

The two tuning dials should read nearly alike over the entire range.

When all of the adjustments have been made we are ready to put in place the metal cabinet, G1.

We now have a receiver which needs no further adjustment and is amply selective to cope with any local broadcast conditions.

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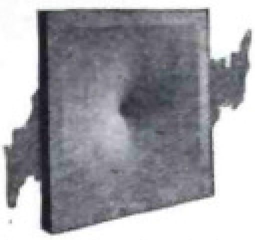

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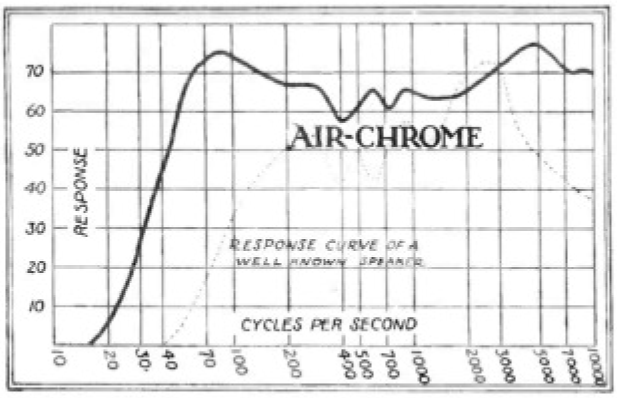

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REVISED AND CORRECTED AS OF OCTOBER 1, 1926

REPRINTED FROM "RADIO" PUBLISHED IN SAN FRANCISCO

INFRA+DYNE

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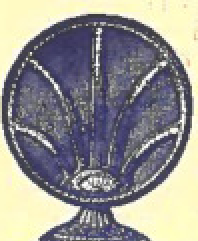

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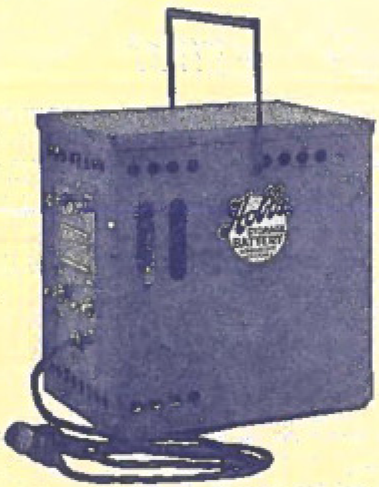

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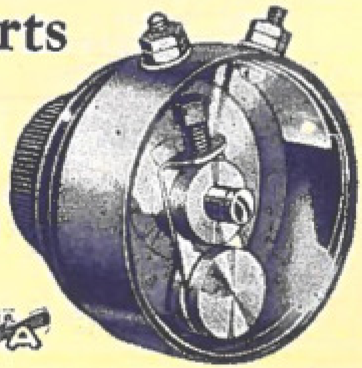

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FOREWORD

E. M. Sargent announced his revolutionary Infradyne in the August issue of "RADIO," published in San Francisco. The announcement met with instant response. Radio enthusiasts everywhere welcomed the news that the ultimate in radio had been attained. Thousands of Infradyne receivers are already in use—and the circuit is only two months old. Gratifying reports from enthusiastic owners tell of almost unbelievable results. Australia, Chicago, Kansas City and Pittsburgh have all been heard on the Pacific Coast. The purpose of this Manual is to simplify the problem of constructing and operating the Infradyne. If the instructions contained herein are carefully followed the builder should have no difficulty in receiving stations 2000 miles distant with loud speaker volume. Those who have already built the Infradyne are advised to make the last-minute improvements to the circuit as announced by E. M. Sargent in this manual. The Infradyne is more selective, is quieter in operation and brings in the extreme long distance stations better than any other circuit used by the inventor during his 15 years' experience in radio construction. Truly, it is a revelation. The receiver you have long waited for is here.

INFRA·DYNE

Radio's Greatest Development

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HOW THE IMPROVED INFRADYNE

1- It uses a new method for controlling the filament voltage of the oscillator tube. The Amperite control for this tube is eliminated.

2- A single ballast resistor controls the filaments of the detector and two audio amplifier tubes, eliminating the three individual Amperites.

3- A single ballast resistor controls the filaments of both r.f. tubes, eliminating the 10 ohm rheostat.

THE NEW SARGENT

By E. M.

ACTUAL experience in constructing the infradyne circuit, garnered from questions asked by thousands who have built the set in accordance with the directions first published in August, 1926 RADIO, is the basis for the revised circuit here presented. To distinguish it from the original and to give due credit to Mr. L. C. Rayment for his part in developing the circuit during the two years of research of which it is the product, the new model is called the Sargent-Rayment infradyne.

The infradyne is a distinctly new development and is in no sense a superheterodyne. Both use an oscillator in combination with the incoming wave, as also some other types of sets. But otherwise it is fundamentally different in operation and in characteristics.

The complete set is essentially a standard five-tube tuned radio frequency unit to which is added an oscillator tube, a mixer tube and a three stage infradyne amplifier unit. This last unit is tuned to give maximum amplification at a constant frequency of 3,490,000 cycles, or 86 meters. This frequency is equal to the sum of the incoming signal's frequency and the oscillator frequency, this summation being made in the mixer tube. For instance if the incoming frequency is 1,000,000 cycles, roughly corresponding to 300 meters, the oscillator is set to generate 2,490,000 cycles so as to give a sum of 3,490,000 cycles. Or if the incoming frequency is 750,000 cycles, corresponding to 400 meters, the oscillator is set to generate 2,740,000 cycles, so as to give the require constant sum. The sum frequency is detected and then amplified through two stages as in any other standard circuit.

The advantages in the use of the sum frequency include the fact that each station can be heard at but one setting of the wavelength condenser and of the os-

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DIFFERS *from the* ORIGINAL MODEL

4- "Trimmer" or vernier condensers are shunted across the banks of the three gang condenser, resulting in extreme selectivity.

5- The 500,000 ohm variable resistance is replaced by a 200,000 ohm resistance and this is now used to control the plate circuit of the r.f. amplifier.

6- A 50,000 ohm Frost No. 886 volume control is shunted across the mixer tube. This is used to regulate volume.

RAYMENT INFRADYNE

Sargent

cillator condenser. Furthermore reception is quieter because circuits tuned to 86 meters will not pick up interference from long wave commercial transmitters nor can microphonic tube noises and other audio frequency currents generated in the tuned r. f. stages or in the mixer tube pass through the infradyne amplifier unit.

The infradyne does not radiate energy into the antenna and thus does not annoy your neighbor with squeals and howls. Due to its design it is extremely selective, more so than any other type of commercial receiver. With what virtually amounts to six stages of tuned radio frequency amplification it is very sensitive, picking up the most distant stations. Although the infradyne amplifier unit is so sharply tuned that its peak or resonance point is less than one meter wide, that represents a 20 kilocyle band at the high frequency employed, so that no distortion is introduced in the r. f. amplification and with good audio transformers perfect tone quality is attained.

The detailed method of constructing the Sargent-Rayment infradyne is obvious from the pictures and diagrams. The changes shown in the pictures of the front and rear views, in the schematic and pictorial wiring diagrams, and in the panel and baseboard layouts are summarized in the following paragraphs:

1—The 6V199 Amperite which controls the oscillator tube is removed from the baseboard. The filament control for the oscillator tube is now made by the same rheostat which controls the filaments on the infradyne amplifier unit. In other words, all four "99" tubes are controlled from the rheostat directly below the voltmeter. This assures better control of the oscillator tube voltage.

2—A Cardwell or Hammarlund three-gang variable condenser is used in the radio frequency circuit and "trimmer," or small vernier condensers are shunted across the gangs for finer tuning.

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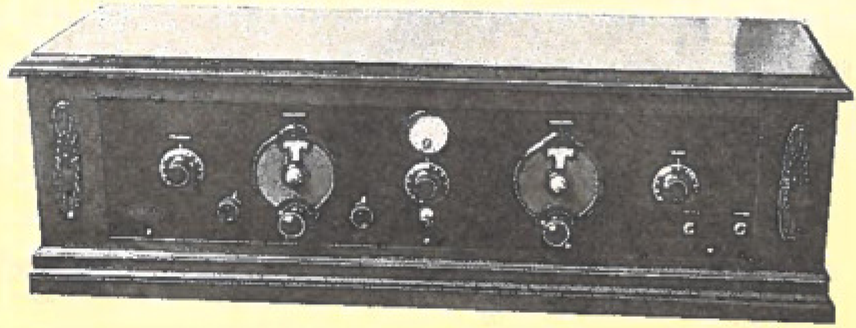

Front View of Sargent-Rayment Infradyne

3—**The 500,000 ohm variable resistance is removed from the panel of the original model. In its place a 200,000 ohm variable resistance is installed. This 200,000 ohm variable resistance controls the plate circuit of the tuned r. f. amplifier.**

4—**The 10-ohm rheostat on the left hand end of the panel is removed from the original model. A 112 Amperite is used in place of this rheostat to control the r. f. tubes. Diagrams shows how to wire this in its proper place.**

5—**In place of the 10-ohm rheostat mentioned in the preceding paragraph, install a 50,000-ohm variable resistance. This is shunted across the mixer tube. See diagram.**

6—**Take out the following Amperites, mounted on the baseboard of the original model—**

Amperite—1-A, controlling the detector tube.

Amperite—1-A, controlling first audio tube.

Amperite—112, controlling the power tube.

In place of these three separate Amperites, install one No. 1 Amperite, which now controls all three of these tubes. The diagram shows how to connect the No. 1 Amperite in the circuit.

It will also be noted that the baseboard layout is somewhat different. The mixer tube has been moved over next to the infradyne amplifier so as to make the shortest possible wiring between the plate terminal of this tube and the plate connector on the infradyne amplifier. This being an 86 meter lead, it is essential that it be as short and direct as possible. For this reason the new layout is more efficient than the first one.

The variable plate resistance of (3) gives a much smoother method of control than the filament rheostat and reduces the drain on the *B* battery by nearly eight milliamperes. Any good 200,000 ohm variable resistance may be used here.

The volume control is a 50,000 ohm variable resistance having an "off" position. It is very important to have this "off" position and the builder should examine his 50,000 ohm resistance carefully to see that the contact in this position is fully broken. If it is not, a decrease of 50 to 75% on weak signals will be experienced. At the present time, the writer knows of only one such variable resistance, the Frost No. 886. This method of cutting down volume on a powerful local station has the advantage of reducing it near the input end of the receiver. When the volume control is placed in the audio frequency amplifier it

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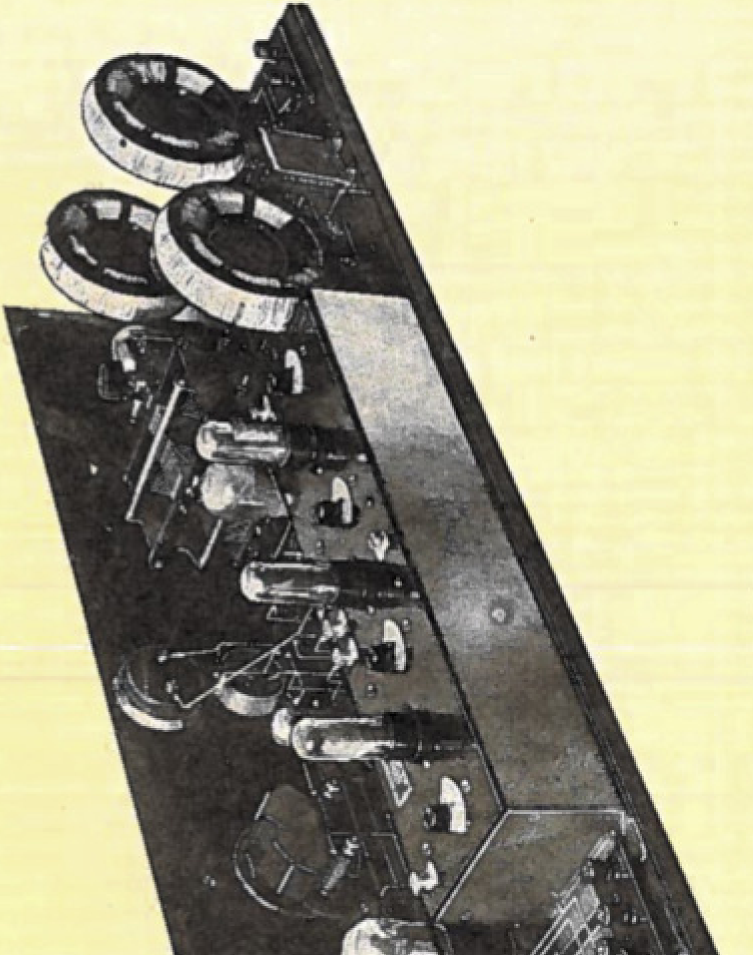

Rear View

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is frequently too near the output end of the circuit to control it without spoiling the tone quality. A powerful local station coming in through six stages of radio frequency amplification is sometimes so strong that the detector tube is flooded with more energy than it can handle. Distortion results and no amount of cutting down after this point will save the tone quality. By cutting down at the source obviously this trouble is eliminated and where the variable resistance has a full "off" position, the radio frequency losses caused by its introduction into the circuit are almost negligible.

The pictures show a binding post terminal block for battery connections. If desired this can be replaced by a seven-wire cable and plug. If the plug-in arrangement is used the seven wires should be run to the batteries as follows. Red to positive *A*, green to negative *A*, blue to 45 volt *B*, yellow to 90 volt *B*, pink to 135 volt *B*. Of the two other wires which are not wrapped inside the cable, one is black and the other brown. These may be used as *C* battery connections, running the black to negative 3 volts and the brown to negative 6 or negative 7½ volts. In order to complete the battery circuit, the positive *C*, negative *B* and negative *A* are then joined together externally. The antenna and ground wires are connected to a small binding post block at the left hand end of the set.

The filament circuit is quite different and is more efficient and less expensive to build than that originally given. The two incoming wave radio frequency amplifier tubes are lighted through a half ampere ballast resistor and the detector and two audio tubes are controlled by a one ampere ballast. The oscillator filament is connected directly in parallel with the three infradyne amplifier tubes and all four are controlled by the 30 ohm rheostat in the center of the panel. This filament circuit eliminates several ballast resistors that were used in the first circuit and is therefore cheaper and easier to build.

The Cardwell and Hammarlund factories have designed a special three-gang condenser. An accuracy of 1 mmf. over the entire scale is secured by this new design. This makes the three midget vernier condensers of value only in balancing up the external wiring to the condenser. Two of the midgets are mounted on the panel and the third one can be supported on its bus-bar connections inside the set. *The midget that is inside the set may be left set at one-quarter or one-half its maximum capacity. The two midgets on the panel will then be used to balance the other two sections to the one across which this fixed midget is connected. This new triple condenser is responsible for the increased selectivity of the Sargent-Rayment infradyne, and if it is used, the midgets can be practically neglected in tuning as all three condenser sections will increase equally. Hammarlund has also announced a new 3-gang condenser for the infradyne. It has been approved for this circuit.

When the set is first put into operation, be sure that the 99 tubes are turned up to a full 3 volts as otherwise the oscillator tube will not oscillate. If this tube does not oscillate, the oscillator dial can be turned over the entire scale and it will make no difference whatever in the tuning.

Sometimes it is less confusing when the set is first put into operation to adjust the input amplifier separately from Infradyne amplifier. This may be done as follows: Take the four 99 tubes and the detector tube out of the set. Lift the wire from the plate terminal of the infradyne amplifier and connect this wire through an extension directly to the plate terminal of the detector tube socket. The set will now operate as a straight five-tube tuned radio frequency receiver and while in this condition may be adjusted for full efficiency for these five tubes. After this adjusting has been done, it will be an interesting experiment to tune in a station just barely audible on the five tubes and then connect in the Infradyne amplifier and see the tremendous increase in volume that results.

The original infradyne receiver was

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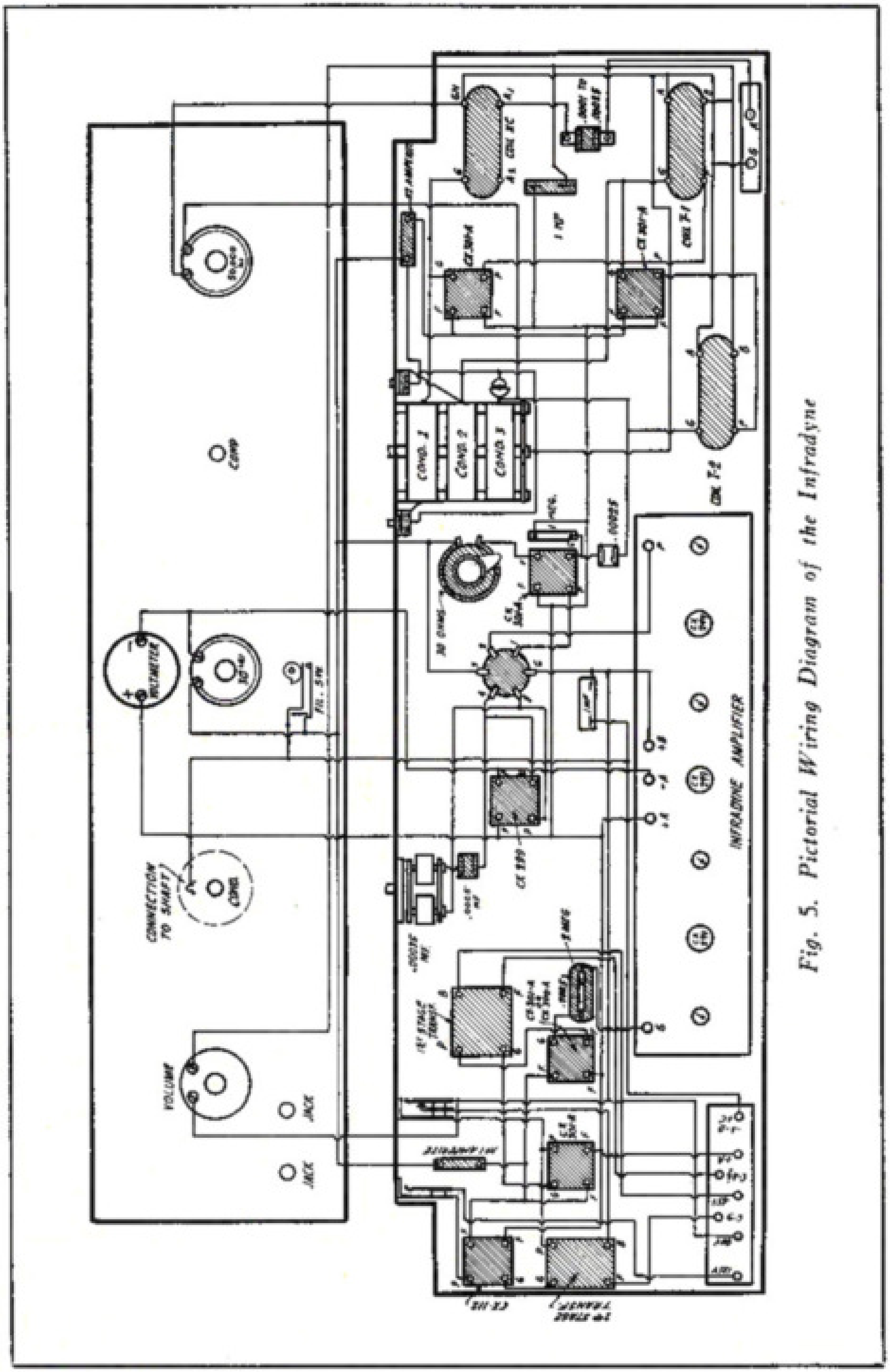

Fig. 5. Pictorial Wiring Diagram of the Infradyne

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designed to work on a short inside antenna. This revised model, because of its much greater selectivity, works best with a 75 or 100 ft. antenna with a .0001 mfd. condenser in series. The pictures of the revised infradyne show a few parts different from those specified in the original article. This must not be taken to mean that these new parts are to be preferred as, in most cases either will work equally well. In the list of parts, the only ones that are specified by name are those that cannot be substituted for. All those parts that are not specified by manufacturers name are left to the option of the builder and any high quality parts will work in those places.

Regarding the choice of the midget balancing condensers, low minimum capacity is essential. The General Radio No. 368-A five plate vernier is ideal for this purpose.

The tapped inductance can be very easily constructed by the builder. It consists of three coils wound on a piece of ba
and 2
coils are of 14, 14, and 8 turns respectively and are all wound with the same direction with No. 24 d.s.c. wire. There should be a space of 1/16 in. between the two 14 turn coils and of 3/16 in. between the 14 and 8 turn coil. Commencing with the 8 turn coil the terminals should be numbered from 1 to 6 as shown in the sketch of Fig. 8, *1* being the outside and *2* the inside terminal of the 8 turn coil, *3* the terminal of the 14 turn coil nearest the 8 turn coil and *4* the other end of this 14 turn coil, *5* the inside terminal of the second 14 turn coil and *6* the outside terminal of this coil.

These numbers correspond to those used in the wiring diagram. To insure operation of the set these directions for coil winding should be followed exactly, particularly as regards their all being wound in the same direction. This tapped inductance should be mounted in the position of the oscillator coupler as shown in the baseboard layout.

To Put the Set in Operation

AFTER the set has been carefully constructed according to the diagrams and the wiring checked, the set is put in operation as follows:

Connect the 6 volt *A* battery to the terminals of the filament circuit. Turn the filament switch to the "off" position. Insert 201A or 301A type tubes in the two incoming wave radio frequency amplifier sockets, in the mixer tube sockets, and in the detector and first audio. Put a 112 tube in the second audio and 99 type tubes in the infradyne amplifier and in the oscillator. Turn the 30 ohm rheostat that controls the 99 tubes so that nearly all the resistance is cut in. Turn up the rheostat on the baseboard so that it is in the half way position. Then turn on the filament switch and see if all the tubes light. Do not turn the 99 tubes up any higher than 3 volts.

After the filament circuit has been checked in this way, connect up the rest of the batteries and the antenna and ground. Set the four indicator knobs
turn
so
that it is about half as far as it will go and turn the rheostat on the baseboard all the way on. Turn the Remler oscillator condenser to the minimum capacity position and then tighten up the set screw on the dial with the dial set at 170 degrees. This dial should read in a counter clock-wise direction. After the dial has been fastened to the condenser in this way, turn it to the zero-to-100 degree range.

Next tune in a station, preferably a local. To do this, both dials must be moved. When the station is tuned in, leave the antenna tuning condenser set on that wavelength and turn the oscillator dial over the whole scale. Two or three or even four oscillator settings will probably be found and the loudest of these will be infradyne setting.

Leaving the oscillator dial at this loudest setting, turn down the plate resistance which controls the first two tubes until the signal is just comfortably audible. Then using the wooden adjustor

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PANEL AND BASEBOARD LAYOUTS

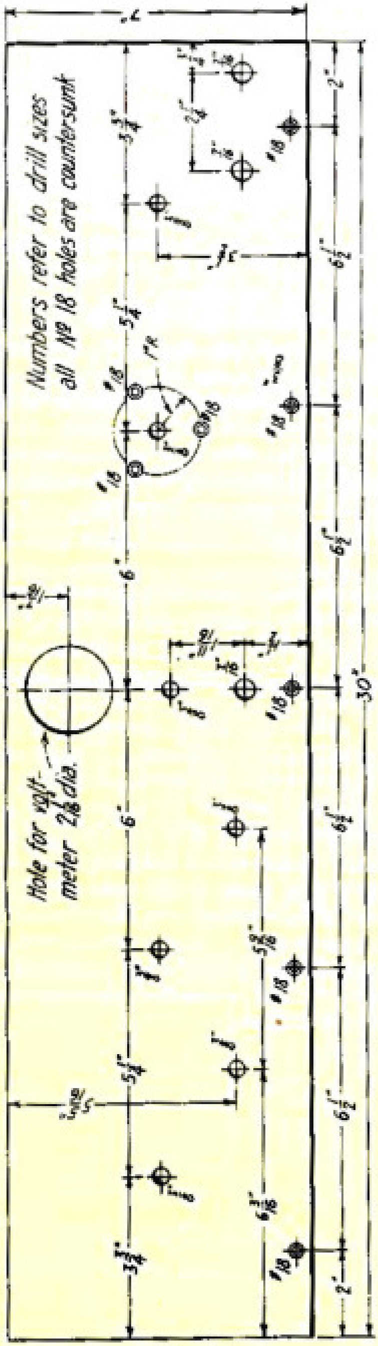

Fig. 7

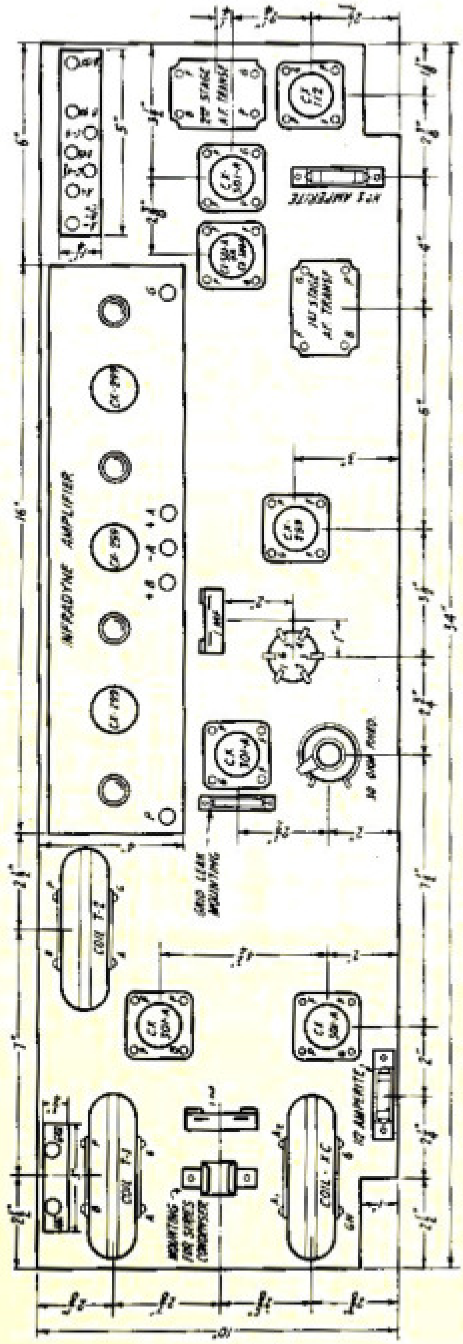

Fig. 6

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that is furnished with the infradyne amplifier reset all four indicator knobs on the amplifier for maximum signal strength. If this throws the amplifier into oscillation, loosen up the increase screw until the oscillation stops. If it does not throw it into oscillation, tighten up the screw until it does, and then loosen it to just before this point. If it does not oscillate with the screw tightened all the way down, lift the wire from the plus *B* terminal on the infradyne amplifier and connect a little coil of about eight turns wound around the finger in series between the wire and the *B* terminal of the amplifier. In most cases this choke is not necessary but when it is used it should suffice to throw the amplifier into oscillation. No more than eight turns should be used in this place.

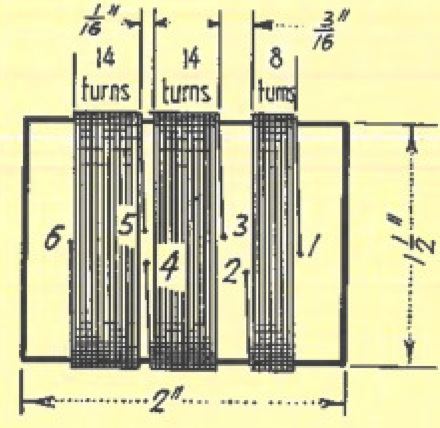

Fig. 8. Tapped Inductance

The 30 ohm rheostat mounted on the baseboard should next be turned until the most sensitive filament temperature for the mixer tube is found. This will probably be at about the half way position and will be indicated by a sharp rise in signal strength as the point of efficiency is reached. The signal strength should fall away rapidly on each side of this peak. If moving this rheostat throws the set into oscillation loosen up on the increase screw on the Remler amplifier and try again.

Because of the fact that the sum frequency is used, the oscillator condenser works in an opposite direction from the antenna condenser when the set is tuned. In order to make the dials read in the same direction, the oscillator condenser is equipped with a dial which reads opposite to its capacity increase.

It was mentioned above that with the antenna condenser set on a given station, two or three oscillator dial settings could be found. It should be pointed out, however, that this is the only condition under which more than one oscillator setting can be found. These other settings are freaks which are likely to appear in any set using an oscillator tube. Under normal operation of the set when both dials are turned together no more than one setting per station will be found. The oscillator condenser is connected between the grid and plate of the tube and both sides of the condenser are therefore alive to hand capacity. This limits the choice of an oscillator condenser to one in which the shaft is not connected electrically to either set of plates.

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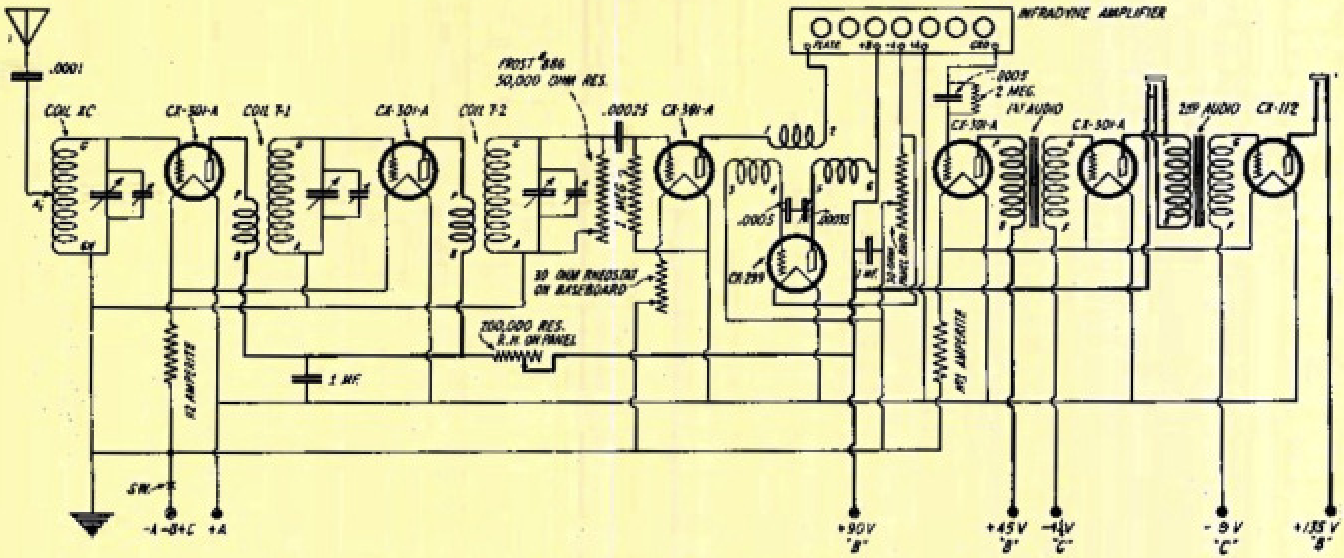

Fig. 4. Schematic Wiring Diagram of the Infradyne

NOTE: Connect Voltmeter as shown in Pictorial Diagram on Page 11.

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HOW TO BALANCE THE CON DENSER IN THE ORIGINAL

1. Remove the tubes from the Infradyne Amplifier, the oscillator and the second detector.

2. Mount a vernier condenser (General Radio No. 368) on the panel at each side of the wavelength or left-hand dial at about the level of the vernier tuning knob. Leave these vernier condensers disconnected for the time being.

3. Disconnect the wire from the plate terminal of the first detector socket.

3-(a) Turn off the Infradyne Amplifier Rheostat (the one below the voltmeter). The voltmeter will then read zero.

4. Run a jumper wire from the plate terminal of the first detector socket to the plate terminal of the second detector socket. The set will now operate as a five-tube single-dial control tuned radio frequency receiver.

5. Tune in a local station on a wavelength between 400 and 500 meters.

6. Loosen the set screw holding the rear rotor section of the Continental condenser and shift the rotor section backward and forward until the signal comes in loudest. Tighten the set screw. If the radio frequency stages go into oscillation as the position of the rotor is shifted the oscillation can be stopped by cutting down the filaments on these two tubes.

7. Loosen the set screw holding the middle rotor section of the Continental condenser and move this section backward and forward until the station is received with the greatest volume. Tighten the set screw. Any oscillation of the radio stages can be stopped as before by cutting down the filament temperatures.

7-(a) Loosen the set screw holding the rotor plates of the front section of the Continental condenser and line-up this section in the same manner as in the preceding paragraph.

8. Note the sections in which the plates are farthest enmeshed.

9. Connect the two vernier or trimmer condensers across the sections in which the plates are farthest enmeshed. The rotor plates of the vernier condensers will be connected to the rotor sides of these two sections and their stator plates will be connected to the stator sides of the gang condenser sections.

10. Turn the vernier condensers to about half their maximum capacity.

11. Rebalance the circuits by again shifting the rotor sections as above described. The set will now be lined-up at one wavelength between 400 and 500 meters, and can be lined-up at any wavelength by using the trimmer condensers.

12. Log a few dial settings.

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13. Remove the jumper wire and reconnect the wire to the plate terminal of the first detector socket.

14. Insert the tubes in the oscillator and second detector sockets and in the Infradyne Amplifier.

15. Set the panel voltmeter to three volts.

16. Turn the first detector rheostat, which is mounted on the baseboard, about three-quarters full on.

17. Turn the "Increase" screw on the Infradyne Amplifier panel almost all the way in.

18. Set the tuning knobs on the Infradyne Amplifier at zero. If the Amplifier goes into oscillation back up the "Increase" screw until the osciallation stops.

19. Set the volume control to maximum.

20. Tune in a moderately weak station. The settings previously obtained for the left-hand or wavelength dial can be used and it will be only necessary to obtain a setting for the oscillator dial.

21. Adjust the first detector rheostat on the baseboard for maximum volume.

22. Using the wooden wedge furnished with the Infradyne Amplifier vary the positions of the knobs on the Amplifier panel. Since the amplifier contains four tuned circuits any one of these can be tuned to any wavelength within its tuning range and the rest can be tuned to resonance with it. Therefore the first tuning knob can be set to any desired position over a certain range and the other three circuits tuned to resonance. There will, however, be a setting of the first knob and a resultant setting of each of the other three knobs a which operation will be best. Suppose then that as a first trial the left-hand knob is set at zero. The settings of the other three will then be varied slightly progressively and in turn until the points of best operation are found. As the setting of each knob is changed slightly rotate the oscillator dial slowly backward and forward over a few degrees. As each of the knobs on the Amplifier is adjusted and the circuit being tuned is brought into resonance with the circuit, the wavelength of which was determined by arbitrary setting, the amplifier will tend to go into oscillation. When this occurs unscrew the screw marked "Increase" until the oscillation stops. Set the four knobs successively for best reception. Now try another slightly different setting of the first knob and follow the above procedure through again. In this way the Infradyne Amplifier can be adjusted for best results.

23. Check the setting of the first detector rheostat, which is mounted on the baseboard.

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LIST OF PARTS USED

By SARGENT IN HIS NEW MODEL

The Parts Specified by

MANUFACTURER'S NAME

Should Not Be Substituted

1 Remler Infradyne Amplifier.
1 Three Gang Condenser, Cardwell 317CL or Hammarlund.
3 General Radio type 318-A midget vernier condensers.
1 Remler .00035 mfd. condenser.
1 Frost No. 886 50,000 ohm resistance.
1 Tapped Inductance. See text.
1 30 ohm rheostat, baseboard type.
1 Set (3) Thorola or Camfield coils for .00035 condenser.
2 National type B, CCW dials.
7 UX base sockets. Cushion type (Benjamin).
1 No. 112 Amperite.
1 No. 1 Amperite.
1 30 ohm panel mounting rheostat.
1 200,000 ohm variable high resistance, Centralab.
3 2-inch Dials.
1 Filament switch.
1 Single closed jack.
1 Single open jack.
1 Jewell 0-5 DC voltmeter. Pat. 135.
1 Electrad grid leak mounting.
1 1 meg. grid leak, Durham, Lynch, Electrad or other good leak.
1 2 meg. grid leak, Durham, Lynch, Electrad or other good leak.
1 .0001 fixed condenser.
2 .0005 fixed condensers.
1 .00025 fixed condenser.
2 Audio transformers.
2 1 mfd. Condensers.
1 Panel, 3/16x7x30 in.
1 Baseboard, ¾x10x34 in.
9 Eby binding posts or 2 Eby posts and a Jones battery plug and cable.

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Converting a Five-Tube Set to An Infradyne

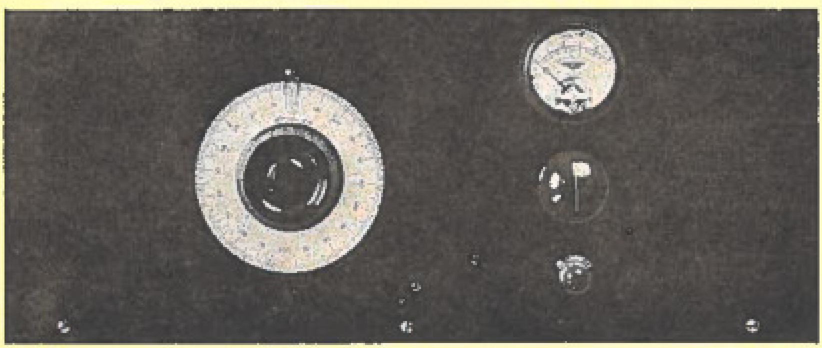
A Description of An Infradyne Adapter Applicable to Any Tuned R. F. Set. Also Some Suggestions for Selectivity.

By E. M. Sargent

THOSE who have followed the series of articles on the infradyne circuit which have been appearing in "RADIO" since August, 1926, have recognized the fact that a complete infradyne set consists of a five-tube tuned radio frequency set *plus* an oscillator-mixer and a three tube infradyne amplifier unit. In operation, the received signal is first amplified at radio frequency in the first two stages, then changed to a low wavelength of about 90 meters by the oscillator-mixer, then amplified to a still greater degree by the three stages in the infradyne amplifier, then detected or de-modulated by the detector tube, and finally amplified by two audio frequency transformers and tubes. In effect, an oscillator-mixer and infradyne amplifier have been merely added to a five tube set.

That this addition can be easily made to almost any tuned r.f. set, including the neutrodyne, has been conclusively demonstrated during our laboratory tests. Consequently we have designed an infradyne adapter which will transform an existing five tube set into a complete ten tube infradyne set. This change can be readily made in a few minutes by simply adding the oscillator, infradyne unit and second detector whose constructional details are given elsewhere in this booklet.

As may be seen from the adapter circuit diagram in Fig. 1, the output from the plate of the original detector tube, now used as a mixer to give the *sum* frequency, is connected to the infradyne adapter. Then the output of the infradyne adapter is connected to the input of the first a.f. transformer. This, with the necessary battery connections, completes the job. The only changes made in the original set is to disconnect the wire joining the plate terminal of the detector socket to the *P* terminal of the first audio frequency transformer, to remove the audio by-pass condenser in the tuned radio frequency set (if there



Panel View of Infradyne Adapter.

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is one), and to add a 30-ohm control rheostat for the first detector tube (if not already installed).

To add the infradyne adapter, connect its input terminal (point *1* of the tapped inductance) to the plate terminal of the detector socket and its output (the plate of the 2nd detector) to the *P* terminal of the first a.f. transformer. Then make the battery connections as indicated in Fig. 1, first disconnecting the *A* battery from the set.

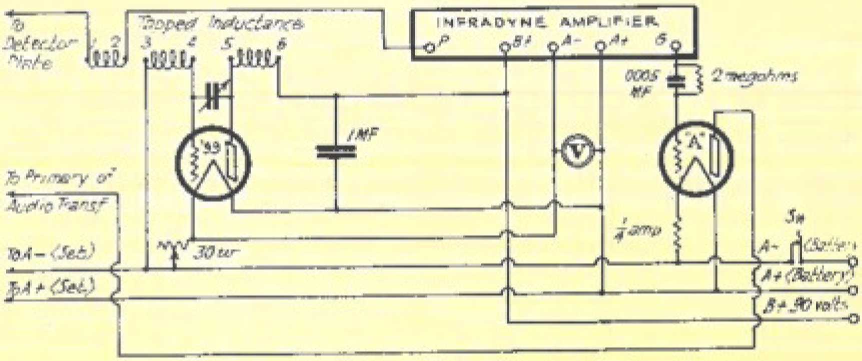

Fig. 1. Circuit Diagram for Infradyne Adapter.

The complete unit to be added can be mounted on a panel and baseboard, as shown in the pictures, and installed in a separate cabinet which may be placed near the main set so that the additional dial control of the oscillator can be conveniently operated.

The panel is 7x18x3/16 in. and the baseboard 9x17x3/4 in. The parts used in the pictured unit are 1 Remler No. 700 infradyne amplifier, 1 Remler .0001 mfd. variable condenser, 1 Sangamo .0005 mfd. fixed condenser and 2 meg. leak, 1 bypass condenser (1mfd.), 2 CX type tube sockets, 1 d. c. voltmeter (0-5 volts), 1 rheostat (30 ohms, Frost), 1 ballast resistance (¼ amp.), 1 filament switch, 7 binding posts, and 1 tapped inductance.

The tapped inductance consists of three coils, one 10 turn and two 30 turns of No. 24 d.s.c. wire, all wound in the same direction on a 1⅝ in. diameter formica tube 3 in. long, as shown in Fig. 2. The space between turns is ⅛ in.

All connections should be soldered. If solid solder is used, a non-acid soldering paste is the best flux, using the paste very sparingly, especially in the vicinity of the tapped inductance. If rosin core solder is used no other flux is necessary. But take care to "sweat" the joint with the hot iron until the solder runs into place, giving the wire a tug to be sure that the solder and not the rosin is holding the wires together. As rosin is a non-conductor and does not ruin insulation rosin-core solder is particularly good if properly used.

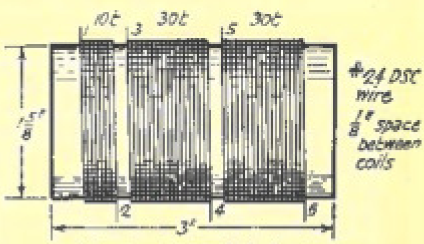

Fig. 2. Tapped Inductance.

Operation

USE "A" tubes in the first four sockets of the tuned radio frequency set and either an "A" tube or a power

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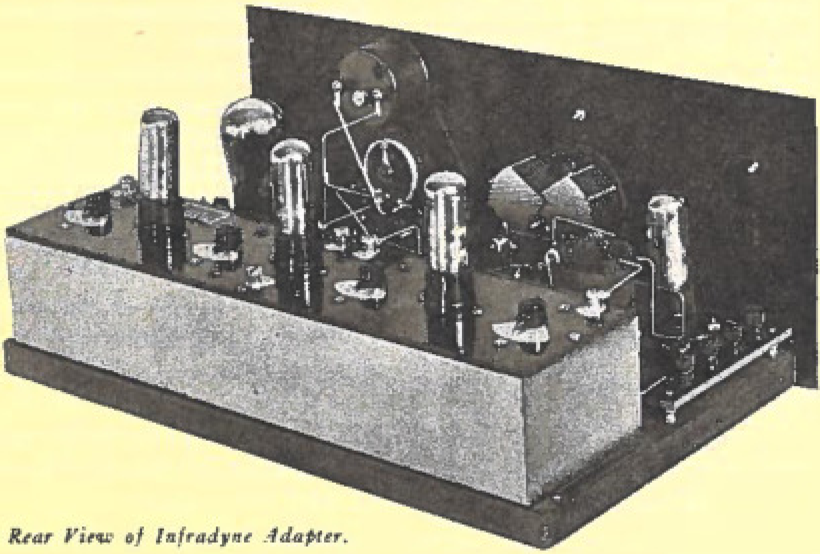
tube in the last audio stage. In the adapter, use three 99's in the infradyne amplifier, a 99 in the oscillator and an "A" tube in the detector. If the oscillator coil is built with care, and the Remler .0001 mfd. condenser used with the "high minimum" setting (see instructions regarding this in the condenser box), the Remler dial will set at about 48 degrees for 550 meters, and 142 degrees for 200 meters. This is a straight line frequency condenser and therefore the 96 channels used in broadcasting will be evenly distributed over the 94 degree swing of the condenser. This is practically one degree per wave band, which greatly simplifies tuning.

In the infradyne circuit, the oscillator condenser turns in the opposite direction from the tuning condensers. That is, the highest capacity setting is used to get 200 meters and the lowest to get 550 meters. This makes the tuning somewhat confusing if the regular Remler dial is used, and the writer recommends that this dial be replaced with a CCW dial. Also there is no reason why the dial should permanently read from 48 degrees to 142 degrees, and it is better after the limits of the broadcast band have been ascertained to reset the CCW dial so that it is on 0 for 200 meters.

To put the set in operation, the writer recommends making the adjustment on a moderately distant station,—some station that is out of daylight range but that comes in loud at night. The dial settings on the tuned radio frequency set will be in exactly the same places as when that set is used alone, and they can therefore be made in advance if a log sheet is at hand. Put the four indicators on the infradyne amplifier at 0, tune in the station with the dials on the tuned radio frequency set, and then slowly rotate the oscillator dial until the station is heard.

Sometimes the station can be picked up at more than one place on the oscillator if the other dials are not also moved. If this happens, locate all possible oscillator settings and select the loudest one. This will be the infradyne setting. These other oscillator settings are freaks which occur in any set using an oscillating tube, and the only time



Rear View of Infradyne Adapter.

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they appear is during a test of this kind. During normal operation of the set, no station ever appears more than once, unless the broadcast station itself emits a harmonic, in which case of course it will be heard on any set on one-half its fundamental wave length.

After the oscillator setting is determined, adjust the four indicators on the infradyne amplifier for maximum sensitivity, and also adjust the "increase" screw as per the instructions that come with the amplifier. If the set will stand it, a small by-pass condenser, usually not over .0001 mfd., may be used across the first audio transformer. This should not be put in, however, until the receiver and adapter have been tried without it first, as the insertion of this bypass sometimes causes troublesome oscillations.

This infradyne adapter makes a big improvement in a 5-tube set and true infradyne results can be expected. It is particularly good with sets of the single dial variety, as the resulting receiver is then only a two dial set and is easy to operate.

How to Use the Na-Ald Connectorald for adapting the Infradyne to an ordinary 5-tube tuned radio frequency receiver

TO SIMPLIFY connections in converting your five-tube radio frequency receiver to an Infradyne, you can use the Na-Ald Connectorald. This device has a little shell with a base that fits on a tube socket. Put the Connectorald on the detector tube base. The Connectorald has four leads. Then insert the detector tube in the socket on which the Connectorald has been attached.

There are 4 leads on the Connectorald, labeled as follows:

Plus B
Minus B
Plus C
Minus C

The Plus *B* lead goes to terminal 1 of the pick-up coil.

The Minus *B* lead goes to the plate of the second detector.

If your tuned radio frequency receiver has a grid condenser and grid leak in it, connect the plus *C* and minus *C* together. If the set has no grid leak and grid condenser in it, connect the grid condenser in series with the plus *C* and minus *C* leads coming from the Connectorald. Shunt this grid condenser with a grid leak of one or two megohms.

If your receiver has a by-pass condenser across the first audio transformer, be sure to take this out. If you care to use a condenser, do not use one of more than .0001 mfds. capacity.

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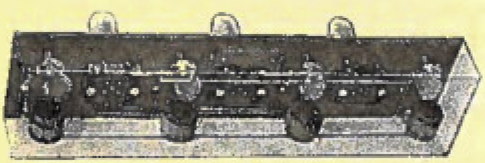
The Amplifier Unit

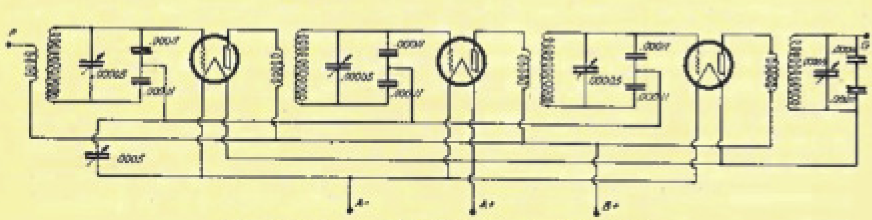
THE heart of the Sargent-Rayment Infradyne circuit is the Infradyne amplifier. The illustrations show the interior and exterior views of this device. The circuit diagram shows how the unit is wired. The circuit will be of interest to those who have been experimenting with amplification at the extreme high frequencies. The circuit is published as a matter of information only. It is impossible to give construction details because of the fact that a difference in placement of the fixed condensers of ¼ inch or a difference of 1/32 inch in primary to secondary coupling between the coils may make the difference between a unit that will amplify and one that won't. The Infradyne amplifier is a most outstanding example of the part played in a radio circuit by the relative positions of the different pieces of apparatus.

If exactly the same hook-up, capacities, and coils are used and the arrangement kept almost the same, but the connecting wires run differently, the unit will have entirely different characteristics. Such is radio at 90 meters.

Unless you have at your disposal a complete radio calibration laboratory it will be practically impossible for you to build an amplifier unit that will give results. Each unit is calibrated by laboratorians in the factory. Each circuit is tested. All parts are inspected and all inductances and capacities are carefully checked and matched before the amplifier unit is assembled. It is housed in a copper container, effectively grounded. This provides an ideal shield for the entire unit. The 90-meter transformers are wound on low-loss ribbed forms. 35 turns of No. 28 d.s.c. wire on 1⅛ inch forms are used on the secondaries with the exception of the coil next to the second detector. This coil has 28 turns. Primaries are wound inside of the secondaries, and consist of 20 turns of No. 28 d.s.c. wire. The bakelite top of the unit has three "X" base sockets, four vernier condensers and the necessary connecting posts. The vernier condensers are adjusted for maximum signal strength. Once this adjustment has been made there is no further attention necessary.

The Unit in Its Container.


Interior View of Amplifier.


Circuit Diagram of Infradyne Amplifier Unit.

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Where to Get Information

A "trouble shooting" service for Infradyne receivers is being maintained by many radio parts dealers in various sections of the U. S. Those wishing to secure expert advice on the circuit and others desiring information should correspond with any of the following:

E. M. SARGENT,
1200 Franklin Street, Oakland, California.

L. C. RAYMENT,
1200 Franklin Street, Oakland, California.

GERALD M. BEST,
Technical Editor of "RADIO,"
Pacific Building, San Francisco, California.

Questions are answered by Gerald M. Best when accompanied by twenty-five cents in coin or stamps for each question asked.

E. M. Sargent writes exclusively for "RADIO." Every month for the next six months his down-to-the-minute developments on the Infradyne will be published in "RADIO."

Hammerlund & Cardwell

Announce

Infradyne Condensers

As this Manual goes to press, word reaches us from Mr. E. M. Sargent that two new three-gang condensers for the Infradyne have been announced. One is made by Cardwell—the other by Hammarlund. Both have been endorsed by Mr. E. M. Sargent. The Hammarlund and Cardwell factories are making a special condenser for the Infradyne. Specifications for these condensers were carefully checked by Sargent. They will give 100% satisfaction. Lack of time prevents us from showing a pictorial drilling template for mounting these new condensers on the Infradyne panel. The panel lay-out, as shown on Page 13, gives the center shaft hole drilling dimensions only. This same shaft hole can be used for either the Cardwell or the Hammarlund Infradyne condenser, but it will be necessary for the builder to drill three additional holes for mounting the condenser to the panel. These holes should be countersunk and flat head screws used for mounting the condenser. Before drilling these holes, make a paper template by placing a sheet of paper over the front end of the condenser and carefully marking the location for drilling the holes for the mounting screws. Use a stiff grade of paper.

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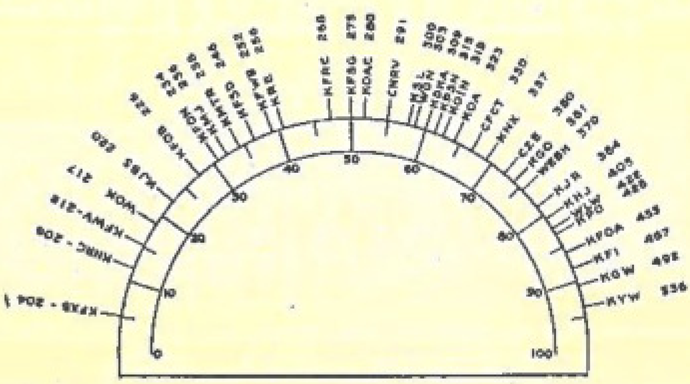

The Dial

of an

INFRA·DYNE

This illustration shows the actual results obtained from the Sargent-Rayment Infradyne Circuit.

You will get results equally good when you use it. Only via the Infradyne route can you secure broadcast reception which will be far superior to that from the ordinary run of receivers. The readings shown are taken from the antenna dial. The oscillator dial readings will be within 10° of the wavelength dial readings.

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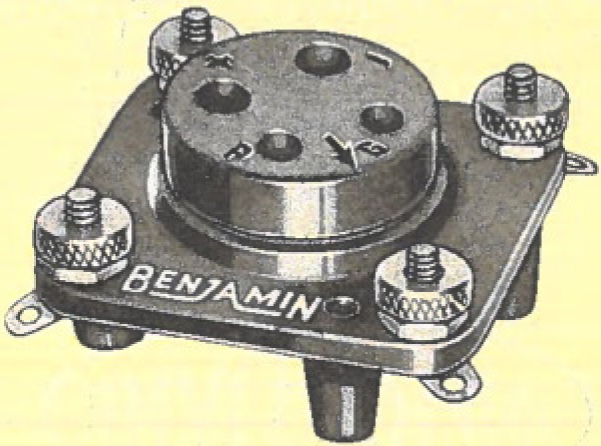
BENJAMIN
TRADE MARK

Cle-Ra-Tone Radio Sockets

Spring Supported, Shock Absorbing



used in the New

INFRADYNE Reciver

The new INFRA+DYNE Receiver is a marvel for long distance reception, simplicity and ease of tuning because of Mr. E. M. Sargent's insistance on radio parts of proven merit. Benjamin Cle-Ra-Tone Sockets were chosen because they are shock-absorbing, non-microphonic—they give longer life and protect the tubes from sudden impacts which would otherwise cause "tube noises." Four perfectly balanced springs "float" the tube-holding elements independently of the base, with positive tube-to-terminal connection. Shock-absorbing feature not affected by stiff bus wiring. Made of molded Bakelite —highly polished. Nickel plated screws and nuts, tinned soldering terminals. Side wiping contacts assure perfect connections.

Cle-Ra-Tone Sockets for UX Type Tubes, 75 Cents

Your dealer has them in stock

BENJAMIN ELECTRIC MFG. CO.

Pacific Sales Dept.: 448 Bryant St., San Francisco

Eastern Sales Dept.: 247 W. 17th St., New York

General Offices: 120-128 S. Sangamon St., Chicago

Manufactured in Canada by the Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto, Ontario

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ALL PARTS

INFRA-DYNE

TRADE MARK

$118.00

Prompt Mail Order Service To Any Part of U. S. or Canada

WE MAKE PROMPT DELIVERY

Parts Also Sold Separately

We specialize in shipments of complete parts for the new improved Infradyne. Everything specified by Sargent in this Manual will be shipped to you for $118.00. This price includes the new type Cardwell 3-gang condenser; three new General Radio vernier condensers; the new Frost 50,000 ohm variable resistance, the new 200,000 ohm variable resistance and the new set of Amperite filament controls which are explained by Sargent in his latest article. In other words, the list of parts to the right is exactly what is needed for building the new Infradyne. We guarantee the merchandise to be exactly as represented and we will ship c.o.d. if half cash is sent with order. Money orders or certified checks accepted. We have been supplying the Infradyne builder's wants for the past three months and we have a host of satisfied customers.

Here are the Official Parts Which We Sell

1 Remler Infradyne Amplifier.
1 Cardwell three-gang condenser.
3 General Radio 318-a Midgets.
1 Remler .00035 condenser.
1 Frost No. 886 Resistance, 50,000 ohms.
1 Tapped inductance.
1 30 ohm baseboard rheostat.
1 Set, 3, Thorola Doughnuts.
2 National Dials, Type B. CCW.
7 Benjamin UX base sockets.
1 112 amperite.
1 No. 1 amperite.
1 30 ohm panel rheostat.
1 Centralab 200,000 ohm resistance.
3 2-inch dials.
1 Filament switch, Electrad.
1 Single closed jack, Electrad.
1 Single open jack, Electrad.
1 Jewell Pat. 135 voltmeter.
1 Electrad grid leak mount.
1 1 meg. Electrad grid leak.
1 2 meg. Electrad grid leak.
1 .0001 Fixed condenser, Electrad.
1 .00025 Fixed condenser, Sangamo.
2 .0005 Fixed condensers, Electrad.
2 Amertran audio transformers.
2 1 mfd. Electrad condensers.
2 Binding post strips with Eby Posts.
1 Bakelite Panel, drilled and engraved, 3/16" thick.
1 Baseboard, Poplar, Egyptian lacquered.

All of Above........................$118.00

WIRES $6.00

All of the wires, bent to shape. Saves you the trouble and saves hours of time. Neatly packed and labelled, with instruction sheet.

CABINETS $19.50

Beautiful mahogany cabinets built especially for the Infradyne. They do justice to this famous set.

C.O.D. shipments made if half cash accompanies order.

International Radio Sales Co.

Address Orders to Dept. M.

5441 CALIFORNIA STREET. SAN FRANCISCO, CALIF.

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Full Line of Parts

FOR E. M. SARGENT'S

INFRADYNE

Now in Stock

Doughtnut Coils, Panels, Inductances, Meters, and All Other Parts.

RADIO SUPPLY COMPANY
WHOLESALERS
920 So. Broadway, Los Angeles

SEND FOR NEW RADIO CATALOGUE

INFRA-DYNE
PANELS

Drilled and Engraved Panels	$6.85
Inductances, Green Silk Wound	1.25
Baseboards, Varnished	2.85
Binding Post Strips, Complete	1.75

POSTPAID—IMMEDIATE SHIPMENT

Complete Set $11.40, Prepaid

DISTRIBUTORS FOR
C E L O R O N
DIAMOND FIBRE

Diamond-F

TWINING-SCOTT
1125 WALL STREET
WE 4277
LOS ANGELES, CALIF.

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How to Tune In Stations More Than 2000 Miles Distant

Hair-breadth selectivity is required for tuning-in stations several thousand miles away. The secret of bringing in these stations is in the proper control of the tuned r.f. amplifier, assuming that the oscillator and Infradyne amplifier are performing correctly. Infradyne users report that stations three meters apart are easily separated from powerful local stations on the antenna dial. Carefully follow the instructions contained elsewhere in this manual for lining-up the three gang condenser. Unless the gangs of this condenser are properly lined up, it will be impossible to get selectivity. Set the antenna tuning dial at, say, about 30 degrees for tuning in stations on low wavelengths. Leave it in that position. Then "cross" this wavelength with the oscillator dial by moving it slowly back and forth over a range of about five degrees on either side of the same dial reading as on the antenna dial. When you "cross" a station in this manner, set the oscillator dial at the point where the station comes in clearest and loudest. Then vary the voltage of the "99" tube filaments until you get clear, undistorted reproduction of signals. Do not use more than three volts on the small tubes. Keep your eye on the voltmeter. Distortion will result if too much voltage is used. You will also force the oscillator and Infradyne Amplifier tubes and long distance stations will not come through satisfactorily. The two tuning dials will not always read alike. They should not vary more than five or ten degrees. For this reason it is essential that the oscillator dial be swung back and forth over a ten degree sector of the scale until you "cross the station." Regulate your variable high resistances until you get undistorted signals. The control of the 50,000 ohm resistance plays an important part in getting good reception from long distance stations. A slight re-adjustment of the rheostat on the baseboard may give you a better "peak" point for DX stations.

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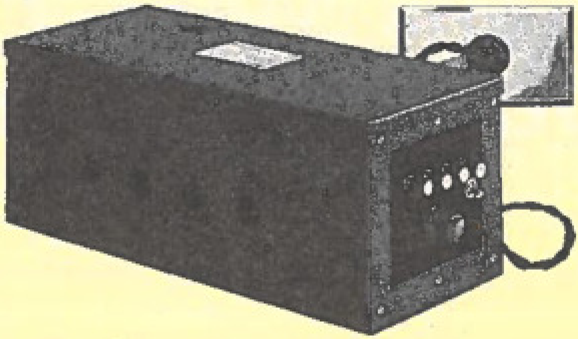
Operate your INFRA-DYNE with 100% Efficiency



Precision

"B" Power Unit
135 Volts $42.50

Infradyne's 10 tubes require considerable B voltage—this sensitive circuit requires an exceptionally even flow of B current as well as an ample supply. This is so in a greater or lesser degree in all circuits, but in Infradyne it is even more important. Precision will deliver an even flow of "B" current that will operate the Infradyne with 100% efficiency—a reserve of Power that is not taxed at any time. An absolute quiet flow of "B" voltage.

Infradyne draws a maximum of 26 milliamperes at 135 volts, using a CX112 power tube in the last audio stage.

Precision has an output of 40 milliamperes at 135 volts—a condensing capacity of 100 microfarads—assuring you an uninterrupted flow of current indifferent to temporary power line interferences.

This advertisement is placed in this publication because Precision has proven its efficiency in operating the Infradyne. If your dealer can't supply you, write us for full information.

Precision Electric Mfg. Corp.

1020 Santa Fe Avenue
Los Angeles

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How to Bend Wires and Solder Connections

Great care should be taken in bending wires and soldering connections. Use a good grade of copper wire, insulated where insulation is required. It is not advisable to bend and re-bend bus-bar wiring. Try to find the exact place for making the bend in the first place. Hardware stores sell a handy pair of wire-bending pliers which have a combination round and smooth flat nose. Do not use pliers with "teeth" or "ribs" because you will mar the insulation on the wires and a poor job will be the result.

Use lugs. Use them liberally. But do not use too much solder. "Sweat" the joints by using solder sparingly and see that the soldering iron is heated to a sufficient temperature to allow the joints to "sweat" together. If you use rosin core solder take great care that the rosin is thoroughly melted and allow the solder to run smoothly over the joints. Do not use too much rosin or soldering flux. A little of this goes a long way toward making a good joint. Carefully wipe the rosin or paste from the wires and instruments. High resistance leaks will result if paste is not thoroughly removed. The secret of good soldering is in the proper temperature of the iron, the correct amount of solder and flux and the manner in which this is applied. Do your experimenting on some scraps of wire before attempting to wire your Infradyne. Run leads as short and direct as possible—especially in the grid circuit. Keep the grid leads well separated from other wires.

After a connection has been soldered it is always advisable to test its strength by gently pressing it. A poor joint will give 'way under slight pressure.

INFRADYNE SERVICE

Specializing in building, adjusting and repairing.

We make 'em play or no charge. Correspondence invited.

PALMER RADIO LABORATORY

Established 1923

4529 S. Vermont Ave., Los Angeles — Phone VErmont 7883

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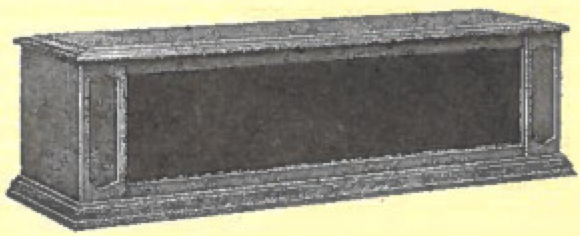
TYPE OF ANTENNA
To Use for the Infradyne

That "No Chain Is Stronger Than Its Weakest Link" can be safely applied to the antenna for use with the Infradyne. The Infradyne gives best results when used with an antenna not more than 100 feet long. A 75-foot antenna will give excellent results although 100 feet can be used in connection with the Improved Infradyne. Greater flexibility of antenna tuning control is accomplished in the new model by the use of the trimmer condensers and other minor improvements as made by the inventor. The original Infradyne operates best with a 50-foot antenna. If you bring your set up to date as shown in this Manual you can safely use an antenna up to 100 feet in length. An indoor antenna can be used for reception from stations up to 1000 miles distant. In San Francisco an Infradyne receiver using a fifteen foot wire stretched along the floor succeeded in picking up KOA at Denver with enough volume to fill the room. The selectivity of the Infradyne will be impaired if more than 100 feet of antenna is used. Use copper wire for the antenna. Do not use smaller wire than the equivalent of No. 14. Thoroughly insulate the wires at both ends. Use a good lead-in wire. Make sure that your ground connection is perfect. Use a good ground clamp. Make the distance between the set and ground connection as short as possible. The ground connection is as important as the antenna itself.

CABINETS for the INFRADYNE



Rigid in construction, beautiful in design and workmanship.

$18.50

Genuine hand rubbed, durable laquer finish.
Choice of Walnut or Mahogany.

Send for complete bulletin of radio furniture

A-1 WOODWORKING COMPANY
1338-1342 San Julian St., Los Angeles

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A
TRIBUTE

Mr. E. M. Sargent and Mr. L. C. Rayment have this to say in regard to the nation-wide overnight popularity of the Infradyne:

"The magazine 'RADIO' of San Francisco, with its ultra-conservative and unbiased editorial policy and its reader confidence gained through nine years of fair play—with its national reputation as a magazine entirely free from sensationalism, is greatly responsible for the success of popularizing the Infradyne circuit."

The publishers of "RADIO" announced that the Infradyne was new—revolutionary—ultra-selective and a remarkable circuit for bringing in the extreme long distance stations. The radio public believed this statement because it came from "RADIO." Reader confidence is our greatest asset. We published this latest radio scoop months in advance of others. If you care to join the ranks of subscribers to this pioneer radio magazine, kindly send us a check or money order for $2.50. That brings you "RADIO" for a full year.

PACIFIC RADIO PUBLISHING CO.

Established 1917

A. H. HALLORAN
Editor

GERALD M. BEST
Tech. Editor

PACIFIC BUILDING SAN FRANCISCO-CAL.

20 East 42nd Street
New York, N. Y.

52 Irving Street
Boston, Mass.

307 N. Michigan Avenue
Chicago, Ill.

1411½ Alta Vista Boulevard
Hollywood, California

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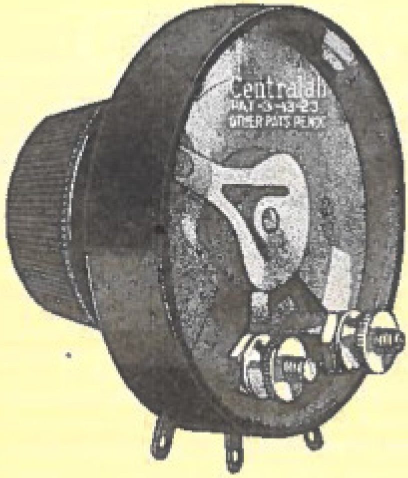
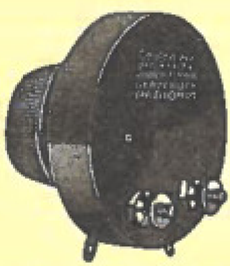


Centralab RadiohM



HEAVY DUTY Centralab RadiohM

Non-Inductive Variable High Resistances

CENTRALAB Radiohms with two terminals, and Modulators or Potentiometers with three terminals, provide gradual, noiseless control of oscillation or volume in any circuit. Specified for the Infradyne, S-C, Samson T-C, Henry Lyford, Universal, and many other circuits. Used as standard equipment on a large number of commercial receivers, and by both the U. S. Navy and Signal Corps.

There is a resistance and correct taper for every circuit. The No. 25 M or No. 51 M are ideal oscillation controls when shunted across the tickler coil of short wave receivers.

Bakelite base and knob. Single hole mounting. Resistance of Potentiometers. 400 or 2000 ohms, modulators 500,000 ohms, Radiohms 2000, 25,000, 50,000, 100,000, 200,000, 500,000 ohms, $2.00.

Gives Full Efficiency from "B" Eliminators

Centralab Heavy Duty Radiohms *fully approved by the Raytheon Laboratories*, will control the output voltage of "B" Battery Eliminators, resistance remaining permanent as adjusted and the same for any knob setting. Full resistance variation with a single turn of knob. Insulated for 1500 volts. Smooth and noiseless to outlast the eliminator, $2.00.

At your dealer's or mailed direct.

CENTRAL RADIO LABORATORIES

14 Keefe Avenue — Milwaukee, Wis.

Australian Representative
United Distributors, Ltd., Sydney

Canadian Representative
Irving W. Levine, Montreal

Great Britain Representative
R. A. Rothermel, Ltd., London

Makers of variable resistance for 69 makers of leading standard sets.

Mr. L. S. Hillegas-Baird, 9HO, will cheerfully answer inquiries and supply circuits and descriptive literature.

Centralab CRL

 "THE HOUSE THAT PARTS BUILT"

IMMEDIATE DELIVERY (Wholesale Only)

INFRA-DYNE

IMMEDIATE DELIVERY (Wholesale Only)

All Parts for the Improved Infradyne

The New SARGENT-RAYMENT Circuit specifies CARDWELL NO. 317-C TRIPLE CONDENSER and GENERAL RADIO 368-A MIDGET CONDENSERS. You need these parts. Your customers will demand them.

Order Your Infradyne Parts from Us

Our stock of DRILLED and ENGRAVED PANELS, BASEBOARDS, in fact ALL PARTS required for the circuit is COMPLETE.

We are exclusive Northern California distributors for this OFFICIAL INFRADYNE MANUAL.

APEX SETS
Amsco
Acme Speakers
All-American "B" Bty. Eliminators
Aero Coils
Aero Loops
AmerTran
Amperites
"A1" Crystals
BALKITE
BREMER-TULLY
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Kester
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Mueller Clips
Microdensers
Morrison
Musselman Tubes
Philco
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Radiall
Reel Aerial
SILVER-MARSHALL
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Signal
TELETONE SPEAKERS
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United Radio Supplies Company

Northern California Distributors for the "BREMER-TULLY COUNTERPHASE SETS" and the "APEX SIX"

"Radio Exclusively"
(Wholesale Only)

693 MISSION STREET
SAN FRANCISCO

Phones: Douglas 8357
Douglas 8358

 "THE HOUSE THAT PARTS BUILT"

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TESTIMONIALS
from INFRADYNE OWNERS

HEARS AUSTRALIA

EDW. M. CORCORAN
RADIO
Sets and Parts
Artesia, Calif.

Sept. 22, 1926

RADIO,
San Francisco, Calif.,

Gentlemen:

It will probably be of interest to your subscribers to know that at four a. m. this morning I picked up Australia on the Infradyne described in your magazine.

I have built several sets described in your magazine since 1920 and have always found them to do all things that you claim and I cannot say this about any other.

Will say that Mr. Best and Mr. Sargent's articles are worth the price of the magazine.

Your well wisher since 1920,
(Signed) EDW. M. CORCORAN,

SEPARATES STATIONS 3 METERS APART

ELLIOT M. EPSTEEN
Attorney-at-Law
DeYoung Building, 690 Market St.,
San Francisco, Calif.

Sept. 27, 1926

Mr. H. W. Dickow,
Care Pacific Radio Pub. Co.
Pacific Bldg..
San Francisco, Calif.
Dear Mr. Dickow:

I know you will be interested in learning some of the results had on my Infradyne last evening.

Station KPO, 428 meters, and Station CFCN at Calgary, 435 meters, both came in with great volume and though they are but 7 meters apart, I was able to completely blank out KPO although I am only one and a half miles from it in an air line.

At the same time, I was able to separate KSL at Salt Lake City, 300 meters, from KTAB, 303 meters. In the latter case, the military band playing there last night came in like a local station as did KFI and KGW.

Later in the evening I brought in KFWC from San Bernardino with loud speaker volume, and this is but a 100 watt station.

The set is doing all that was claimed for it.

Cordially yours,
EME:AS (Signed) ELLIOT M. EPSTEEN,

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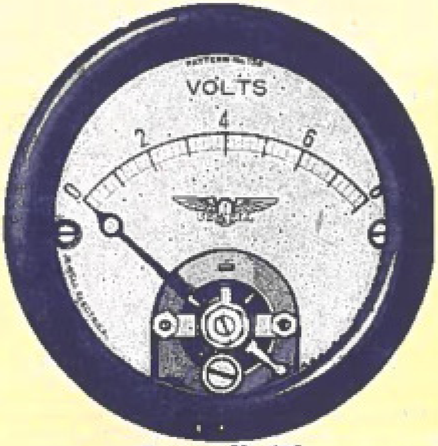
JEWELL

A Quality Instrument



PATTERN No. 135

Actual Size

Infradyne Builders

—here is the radio instrument recommended for use with the new Infradyne receiver It is obtainable in any of the following ranges of which the **0-5 volt** has been particularly specified for the Infradyne.

0-5, 0-8 or 0-10 Volts	$7.00
0-10, 15, 25, 50 or 100 Milliamperes	7.00

Send for New Radio Instrument Catalog No. 15-C

Jewell Electrical Instrument Co.

1650 Walnut Street, Chicago

"26 Years Making Good Instruments"

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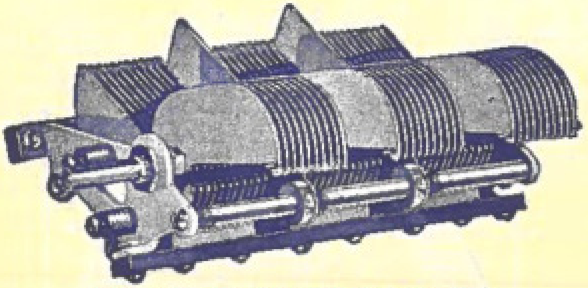

CONTINENTAL

LO LOSS

TRIPLE CONDENSER

Recommended for the INFRA-DYNE Circuit

This Continental special triple condenser was designed for the INFRA-DYNE Circuit.

The low dielectric losses, exact capacities and mechanical perfection of these straight line wave length and frequency condensers make them the logical choice wherever fine reception is desired.

Licensed under Hogan Pat. No. 1014002
Capacity .00035---List Price
$9.50

GARDINER & HEPBURN, Inc.
611 Widener Building, Philadelphia

The Continental Single Condenser is also made in the following capacities: .00035, $2.50 list price; .00025, $2.50 list price; .0005, $2.50 list price, and Continental Junior Vernier Condenser listing at $1.25.

INFRA-DYNE

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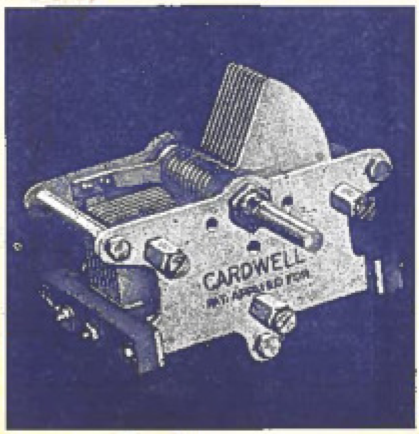
Cardwell Condensers



The Type "C" has a tuning characteristic which approaches straight frequency at minimum and straight wavelength at maximum. Priced from $4.00 up. The Type 317-CL, specified for the "Infradyne" is $12.

The Type "C" Cardwell Condenser is almost the universal selection of Radio Engineers and Editors who want the best. Mr. John B. Brennan used them in the New Radio Broadcast "Lab" circuit. . . . Mr. E. M. Sargent recommends the 317-C as the only condenser for the "Infradyne." . . . The "A. C. Varion," which you can build to work direct from the lighting fixtures, uses the 217-C. . . . For Short Wave Reception, Cardwell Condensers have always been accepted as the only practical instrument.

Allen D. Cardwell Mfg., Corporation
81 Prospect Street, Brooklyn, N. Y.

ENDORSED FOR USE IN SARGENT-RAYMENT INFRA-DYNE CIRCUIT

"THE STANDARD OF COMPARISON"

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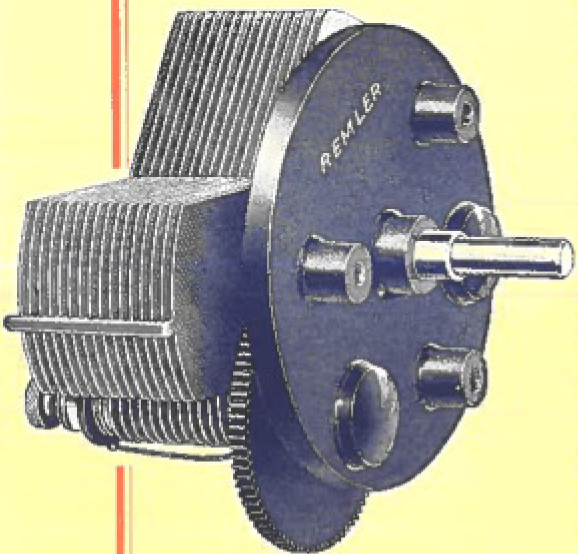
REMLER

Remler TWIN ROTOR Condenser



Made in both Straight Line Frequency and Straight Line Wave Length types. Condenser rotates through a full 360°, giving a greater separation of stations at all wave lengths than is possible with the usual 180° type.

A special adjustment which permits variation of the condenser capacity at zero dial setting allows a still further spreading of the stations in the Straight Line Frequency type. In consequence the condenser can be adapted to the particular coil used. Perfected insulation completely eliminates body capacity effects and electrical losses are reduced to a minimum.

Straight Line Frequency

This type gives the greatest possible separation of stations over the entire broadcast band. Equal divisions on the dial represent equal frequency bands. Longer wave length stations are crowded somewhat and the lower wave length stations are proportionately spread out. Capacity is variable at the zero dial setting.

No. 648—.00035 max. less dial....$4.50
No. 649—.0005 max. less dial.... 4.50
No. 659—.0001 max. less dial.... 4.50

Straight Line Wave-Length

This type should be used to separate to the greatest extent the long-wave class "B" stations which usually offer the better programs. Equal dial divisions represent equal wave-length bands. The smaller low-wave length stations are slightly crowded to give maximum spacing for the higher powered class "B" stations.

No. 630—.00035, with dial............$5.00
No. 638—.00035, less dial............ 4.50
No. 631—.0005, with dial............ 5.00
No. 639—.0005, less dial............ 4.50
Dial Complete.................................... .75

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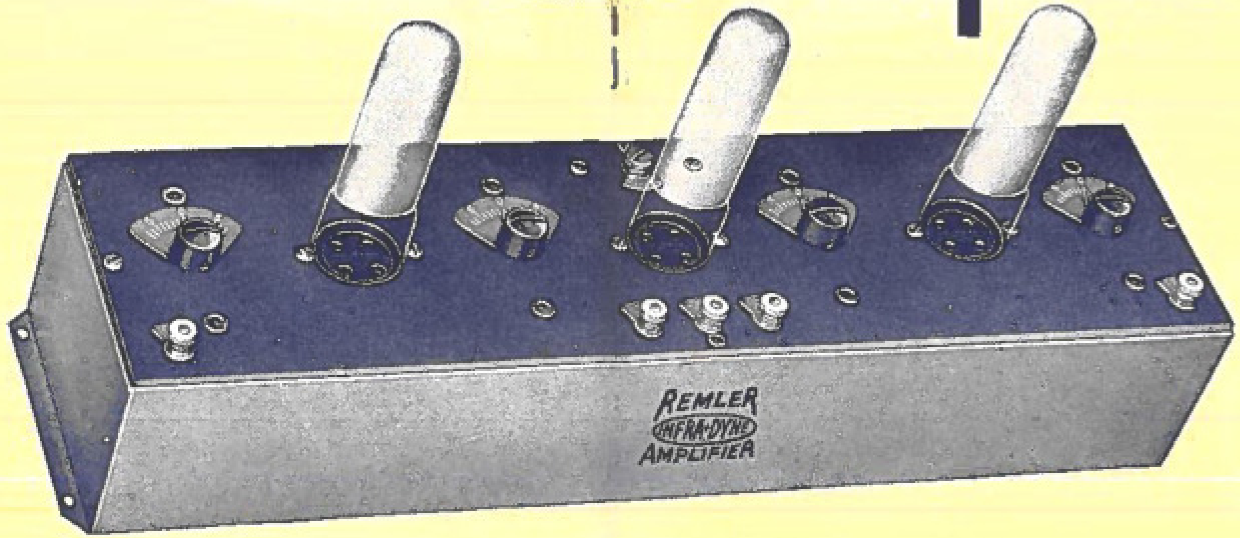
Remler INFRA·DYNE Amplifier



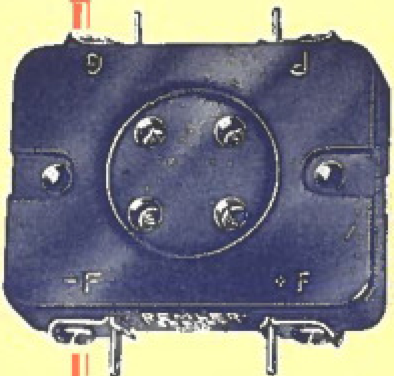
The Key to Successful Amplification

The name Remler is indicative of the best in radio equipment, representing many years' accomplishment of pioneers in scientific engineering. This, the No. 700 Remler Infradyne Amplifier, exhibits the highest achievement of those years of experience and skilful engineering design. Use it with your tuned radio frequency or neutrodyne circuit—you will get reception far ahead of any that, through past experience, you have ever been lead to expect.

List Price $25.00

REMLER

Remler *Improved* Socket



Contact—close, positive, gripping contact—is the secret of success in all radio connections. It is not enough that contact should be made at a given point or even along a given line. Too often is insufficient contact the source of long unsuspected trouble. The fact that the best practice demands the soldering of all permanent electrical connections is additional proof of this point.

Made to Meet the Quality Demand

Made of moulded Bakelite and easily installed, this new Remler socket will at once make a real appeal to the man who realizes the necessity of perfect contact for the tubes. The contacts are self aligning, and the full floating springs allow a smooth in-and-out pull. Both soldering lug terminals and screw terminals are provided for each connection, and each contact spring is an integral part of the terminal lug.

List Price 50 Cents

REMLER

DIVISION OF GRAY and DANIELSON Manufacturing Company

CHICAGO

260 FIRST STREET
SAN FRANCISCO

NEW YORK

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For the INFRADYNE

AMSCO

AMSCO FLOATING SOCKETS

...gged and substantial, ...se sockets are space-...ing and—"they float!" ...e tubes fit with the click ...t accompanies positive ...e contact yet they al-...st literally float on air, ...ctically isolated from ... base or panel. Micro-...nic noises, mechanical ...d back and audio vibra-...n are effectively elimi-...ed.

...u'll need seven AMSCO ...ating Sockets for the ...ra-dyne. Insist upon the ...uine, approved by Sar-...t.

...CO METALOID GRID GATES ...uniquely silent, due to a per-...d colloidal Metaloid resistance ...ent. Get two for the Infra-dyne ... megohm and 2 megohms, re-...ively. Approved by Sargent for ...Infra-dyne.

AMSCO 3-GANG ALLOCATING CONDENSERS

Build your Infra-dyne of the best, for the best results. Quality parts are an investment that pays in Perfection.

This is especially true of the heart of the Infra-dyne—the three-gang AMSCO Allocating Condenser. Each unit of the AMSCO triple is .00035 micro-farads capacity, matched within less than 1%.

They allocate or "spread" the stations with engineering precision—their uniformity making practical the hitherto theoretical ideal of Simplified Control. Construction guaranteed mechanically and electrically perfect.

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Broome & Lafayette Sts., N. Y. C.

All AMSCO Parts are manufactured in accordance with Standards of the Radio Mfrs. Association, Inc.

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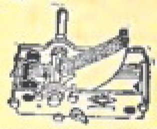
A true midget for saving valuable space front and back of the Infra-dyne panel. No less effective because of its compactness—it has the normal amount of resistance, the normal electrical contacts. It is simply that needless bulk is eliminated by AMSCO design. Air cooled construction—Bakelite base and knob with indicator arrow. You'll need one 10 ohm and two 30 ohm Tom Thumb Rheostats. Approved by Sargent.



AMSCO SINGLE ALLOCATING CONDENSER. You'll need this single AMSCO Allocator for your Infra-dyne. Capacity .00035 mfd. Look for the name AMSCO—for Excellence.

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Radio "A" Power for the Infradyne

Keeps Batteries for 10-Tube Set Fully Charged

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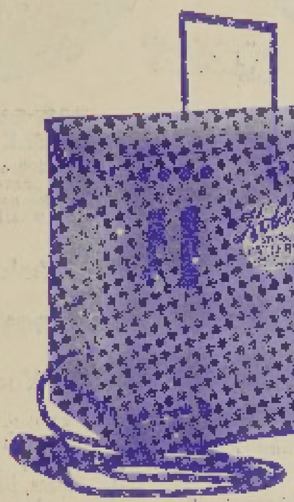

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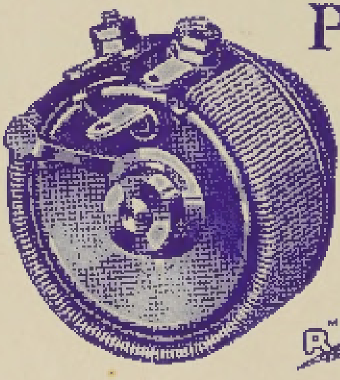

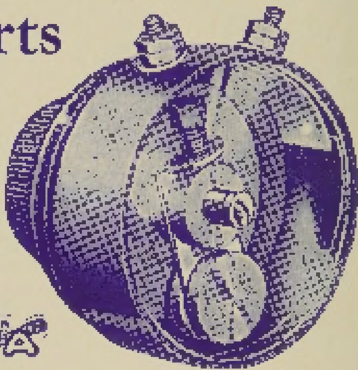

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No. 830 **FROST-RADIO** Bakelite Rheostat, 30 ohm	.75
No. 710 **FROST-RADIO** Metal Frame Rheostat, 10 ohm	.50
or, if preferred,	
No. 810 **FROST-RADIO** Bakelite Rheostat, 10 ohm	.75
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Protect the efficiency of your Infradyne receiver at these vital points: Rheostats, high resistance units, sockets, jacks and switches. If these parts bear the name **FROST-RADIO** you may be certain that you are using the best parts obtainable. **FROST-RADIO** parts and accessories are precision-built and because of their practical design and fine finish they are a pleasure to work with.

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FOREWORD

E. M. Sargent announced his revolutionary Infradyne in the August issue of "RADIO," published in San Francisco. The announcement met with instant response. Radio enthusiasts everywhere welcomed the news that the ultimate in radio had been attained. Thousands of Infradyne receivers are already in use—and the circuit is only two months old. Gratifying reports from enthusiastic owners tell of almost unbelievable results. Australia, Chicago, Kansas City and Pittsburgh have all been heard on the Pacific Coast. The purpose of this Manual is to simplify the problem of constructing and operating the Infradyne. If the instructions contained herein are carefully followed the builder should have no difficulty in receiving stations 2000 miles distant with loud speaker volume. Those who have already built the Infradyne are advised to make the last-minute improvements to the circuit as announced by E. M. Sargent in this manual. The Infradyne is more selective, is quieter in operation and brings in the extreme long distance stations better than any other circuit used by the inventor during his 15 years' experience in radio construction. Truly, it is a revelation. The receiver you have long waited for is here.

INFRA·DYNE

Radio's Greatest Development

HOW THE IMPROVED INFRADYNE

1- It uses a new method for controlling the filament voltage of the oscillator tube. The Amperite control for this tube is eliminated.

2- A single ballast resistor controls the filaments of the detector and two audio amplifier tubes, eliminating the three individual Amperites.

3- A single ballast resistor controls the filaments of both r.f. tubes, eliminating the 10 ohm rheostat.

THE NEW SARGENT

By E. M.

ACTUAL experience in constructing the infradyne circuit, garnered from questions asked by thousands who have built the set in accordance with the directions first published in August, 1926 RADIO, is the basis for the revised circuit here presented. To distinguish it from the original and to give due credit to Mr. L. C. Rayment for his part in developing the circuit during the two years of research of which it is the product, the new model is called the Sargent-Rayment infradyne.

The infradyne is a distinctly new development and is in no sense a superheterodyne. Both use an oscillator in combination with the incoming wave, as also some other types of sets. But otherwise it is fundamentally different in operation and in characteristics.

The complete set is essentially a standard five-tube tuned radio frequency unit to which is added an oscillator tube, a mixer tube and a three stage infradyne amplifier unit. This last unit is tuned to give maximum amplification at a constant frequency of 3,490,000 cycles, or 86 meters. This frequency is equal to the sum of the incoming signal's frequency and the oscillator frequency, this summation being made in the mixer tube. For instance if the incoming frequency is 1,000,000 cycles, roughly corresponding to 300 meters, the oscillator is set to generate 2,490,000 cycles so as to give a sum of 3,490,000 cycles. Or if the incoming frequency is 750,000 cycles, corresponding to 400 meters, the oscillator is set to generate 2,740,000 cycles, so as to give the require constant sum. The sum frequency is detected and then amplified through two stages as in any other standard circuit.

The advantages in the use of the sum frequency include the fact that each station can be heard at but one setting of the wavelength condenser and of the os-

DIFFERS *from the* ORIGINAL MODEL

4- "Trimmer" or vernier condensers are shunted across the banks of the three gang condenser, resulting in extreme selectivity.

5- The 500,000 ohm variable resistance is replaced by a 200,000 ohm resistance and this is now used to control the plate circuit of the r.f. amplifier.

6- A 50,000 ohm Frost No. 886 volume control is shunted across the mixer tube. This is used to regulate volume.

RAYMENT INFRADYNE

Sargent

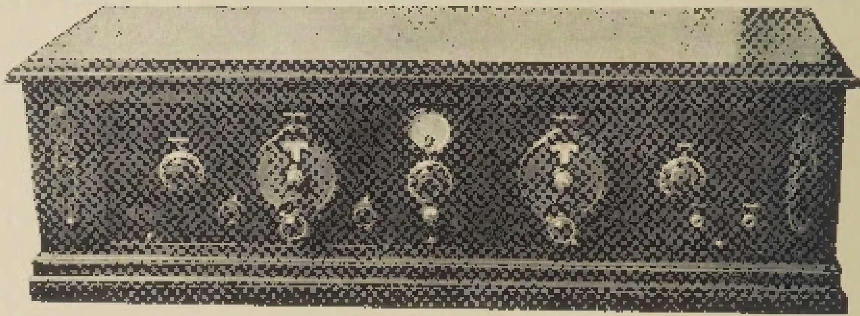
cillator condenser. Furthermore reception is quieter because circuits tuned to 86 meters will not pick up interference from long wave commercial transmitters nor can microphonic tube noises and other audio frequency currents generated in the tuned r. f. stages or in the mixer tube pass through the infradyne amplifier unit.

The infradyne does not radiate energy into the antenna and thus does not annoy your neighbor with squeals and howls. Due to its design it is extremely selective, more so than any other type of commercial receiver. With what virtually amounts to six stages of tuned radio frequency amplification it is very sensitive, picking up the most distant stations. Although the infradyne amplifier unit is so sharply tuned that its peak or resonance point is less than one meter wide, that represents a 20 kilocyle band at the high frequency employed, so that no distortion is introduced in the r. f. amplification and with good audio transformers perfect tone quality is attained.

The detailed method of constructing the Sargent-Rayment infradyne is obvious from the pictures and diagrams. The changes shown in the pictures of the front and rear views, in the schematic and pictorial wiring diagrams, and in the panel and baseboard layouts are summarized in the following paragraphs:

1—The 6V199 Amperite which controls the oscillator tube is removed from the baseboard. The filament control for the oscillator tube is now made by the same rheostat which controls the filaments on the infradyne amplifier unit. In other words, all four "99" tubes are controlled from the rheostat directly below the voltmeter. This assures better control of the oscillator tube voltage.

2—A Cardwell or Hammarlund three-gang variable condenser is used in the radio frequency circuit and "trimmer," or small vernier condensers are shunted across the gangs for finer tuning.



Front View of Sargent-Rayment Infradyne

3—The 500,000 ohm variable resistance is removed from the panel of the original model. In its place a 200,000 ohm variable resistance is installed. This 200,000 ohm variable resistance controls the plate circuit of the tuned r. f. amplifier.

4—The 10-ohm rheostat on the left hand end of the panel is removed from the original model. A 112 Amperite is used in place of this rheostat to control the r. f. tubes. Diagrams shows how to wire this in its proper place.

5—In place of the 10-ohm rheostat mentioned in the preceding paragraph, install a 50,000-ohm variable resistance. This is shunted across the mixer tube. See diagram.

6—Take out the following Amperites, mounted on the baseboard of the original model—

Amperite—1-A, controlling the detector tube.

Amperite—1-A, controlling first audio tube.

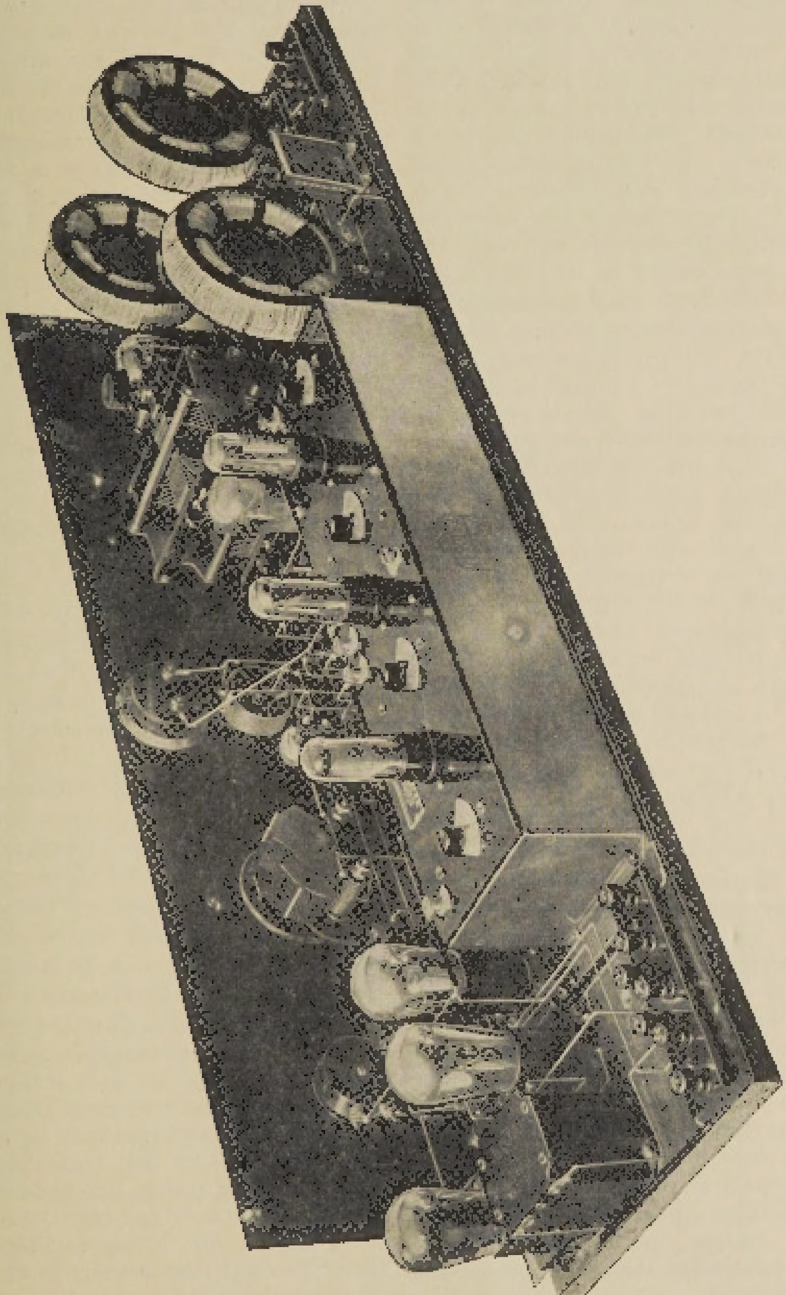
Amperite—112, controlling the power tube.

In place of these three separate Amperites, install one No. 1 Amperite, which now controls all three of these tubes. The diagram shows how to connect the No. 1 Amperite in the circuit.

It will also be noted that the baseboard layout is somewhat different. The mixer tube has been moved over next to the infradyne amplifier so as to make the shortest possible wiring between the plate terminal of this tube and the plate connector on the infradyne amplifier. This being an 86 meter lead, it is essential that it be as short and direct as possible. For this reason the new layout is more efficient than the first one.

The variable plate resistance of (3) gives a much smoother method of control than the filament rheostat and reduces the drain on the *B* battery by nearly eight milliamperes. Any good 200,000 ohm variable resistance may be used here.

The volume control is a 50,000 ohm variable resistance having an "off" position. It is very important to have this "off" position and the builder should examine his 50,000 ohm resistance carefully to see that the contact in this position is fully broken. If it is not, a decrease of 50 to 75% on weak signals will be experienced. At the present time, the writer knows of only one such variable resistance, the Frost No. 886. This method of cutting down volume on a powerful local station has the advantage of reducing it near the input end of the receiver. When the volume control is placed in the audio frequency amplifier it



Rear View

is frequently too near the output end of the circuit to control it without spoiling the tone quality. A powerful local station coming in through six stages of radio frequency amplification is sometimes so strong that the detector tube is flooded with more energy than it can handle. Distortion results and no amount of cutting down after this point will save the tone quality. By cutting down at the source obviously this trouble is eliminated and where the variable resistance has a full "off" position, the radio frequency losses caused by its introduction into the circuit are almost negligible.

The pictures show a binding post terminal block for battery connections. If desired this can be replaced by a seven-wire cable and plug. If the plug-in arrangement is used the seven wires should be run to the batteries as follows. Red to positive *A*, green to negative *A*, blue to 45 volt *B*, yellow to 90 volt *B*, pink to 135 volt *B*. Of the two other wires which are not wrapped inside the cable, one is black and the other brown. These may be used as *C* battery connections, running the black to negative 3 volts and the brown to negative 6 or negative 7½ volts. In order to complete the battery circuit, the positive *C*, negative *B* and negative *A* are then joined together externally. The antenna and ground wires are connected to a small binding post block at the left hand end of the set.

The filament circuit is quite different and is more efficient and less expensive to build than that originally given. The two incoming wave radio frequency amplifier tubes are lighted through a half ampere ballast resistor and the detector and two audio tubes are controlled by a one ampere ballast. The oscillator filament is connected directly in parallel with the three infradyne amplifier tubes and all four are controlled by the 30 ohm rheostat in the center of the panel. This filament circuit eliminates several ballast resistors that were used in the first circuit and is therefore cheaper and easier to build.

The Cardwell and Hammarlund factories have designed a special three-gang condenser. An accuracy of 1 mmf. over the entire scale is secured by this new design. This makes the three midget vernier condensers of value only in balancing up the external wiring to the condenser. Two of the midgets are mounted on the panel and the third one can be supported on its bus-bar connections inside the set. The midget that is inside the set may be left set at one-quarter or one-half its maximum capacity. The two midgets on the panel will then be used to balance the other two sections to the one across which this fixed midget is connected. This new triple condenser is responsible for the increased selectivity of the Sargent-Rayment infradyne, and if it is used, the midgets can be practically neglected in tuning as all three condenser sections will increase equally. Hammarlund has also announced a new 3-gang condenser for the infradyne. It has been approved for this circuit.

When the set is first put into operation, be sure that the 99 tubes are turned up to a full 3 volts as otherwise the oscillator tube will not oscillate. If this tube does not oscillate, the oscillator dial can be turned over the entire scale and it will make no difference whatever in the tuning.

Sometimes it is less confusing when the set is first put into operation to adjust the input amplifier separately from Infradyne amplifier. This may be done as follows: Take the four 99 tubes and the detector tube out of the set. Lift the wire from the plate terminal of the infradyne amplifier and connect this wire through an extension directly to the plate terminal of the detector tube socket. The set will now operate as a straight five-tube tuned radio frequency receiver and while in this condition may be adjusted for full efficiency for these five tubes. After this adjusting has been done, it will be an interesting experiment to tune in a station just barely audible on the five tubes and then connect in the Infradyne amplifier and see the tremendous increase in volume that results.

The original infradyne receiver was

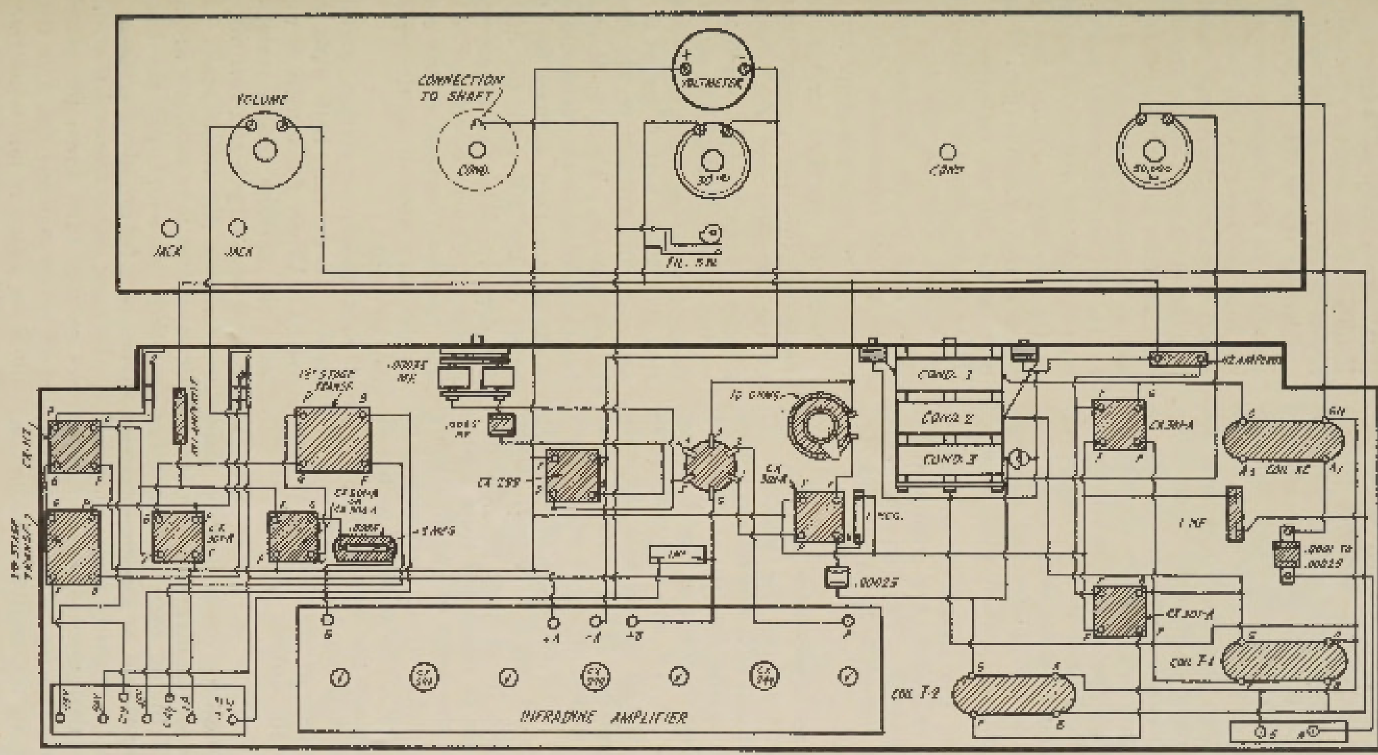


Fig. 5. Pictorial Wiring Diagram of the Infradyne

designed to work on a short inside antenna. This revised model, because of its much greater selectivity, works best with a 75 or 100 ft. antenna with a .0001 mfd. condenser in series. The pictures of the revised infradyne show a few parts different from those specified in the original article. This must not be taken to mean that these new parts are to be preferred as, in most cases either will work equally well. In the list of parts, the only ones that are specified by name are those that cannot be substituted for. All those parts that are not specified by manufacturers name are left to the option of the builder and any high quality parts will work in those places.

Regarding the choice of the midget balancing condensers, low minimum capacity is essential. The General Radio No. 368-A five plate vernier is ideal for this purpose.

The tapped inductance can be very easily constructed by the builder. It consists of three coils wound on a piece of bakelite tubing 1½ in. in diameter and 2 in. long, as shown in Fig. 4. These coils are of 14, 14, and 8 turns respectively and are all wound with the same direction with No. 24 d.s.c. wire. There should be a space of 1/16 in. between the two 14 turn coils and of 3/16 in. between the 14 and 8 turn coil. Commencing with the 8 turn coil the terminals should be numbered from 1 to 6 as shown in the sketch of Fig. 8, *1* being the outside and *2* the inside terminal of the 8 turn coil, *3* the terminal of the 14 turn coil nearest the 8 turn coil and *4* the other end of this 14 turn coil, *5* the inside terminal of the second 14 turn coil and *6* the outside terminal of this coil.

These numbers correspond to those used in the wiring diagram. To insure operation of the set these directions for coil winding should be followed exactly, particularly as regards their all being wound in the same direction. This tapped inductance should be mounted in the position of the oscillator coupler as shown in the baseboard layout.

To Put the Set in Operation

AFTER the set has been carefully constructed according to the diagrams and the wiring checked, the set is put in operation as follows:

Connect the 6 volt *A* battery to the terminals of the filament circuit. Turn the filament switch to the "off" position. Insert 201A or 301A type tubes in the two incoming wave radio frequency amplifier sockets, in the mixer tube sockets, and in the detector and first audio. Put a 112 tube in the second audio and 99 type tubes in the infradyne amplifier and in the oscillator. Turn the 30 ohm rheostat that controls the 99 tubes so that nearly all the resistance is cut in. Turn up the rheostat on the baseboard so that it is in the half way position. Then turn on the filament switch and see if all the tubes light. Do not turn the 99 tubes up any higher than 3 volts.

After the filament circuit has been checked in this way, connect up the rest of the batteries and the antenna and ground. Set the four indicator knobs on the infradyne amplifier at zero, turn down the screw marked "increase" so that it is about half as far as it will go and turn the rheostat on the baseboard all the way on. Turn the Remler oscillator condenser to the minimum capacity position and then tighten up the set screw on the dial with the dial set at 170 degrees. This dial should read in a counter clock-wise direction. After the dial has been fastened to the condenser in this way, turn it to the zero-to-100 degree range.

Next tune in a station, preferably a local. To do this, both dials must be moved. When the station is tuned in, leave the antenna tuning condenser set on that wavelength and turn the oscillator dial over the whole scale. Two or three or even four oscillator settings will probably be found and the loudest of these will be infradyne setting.

Leaving the oscillator dial at this loudest setting, turn down the plate resistance which controls the first two tubes until the signal is just comfortably audible. Then using the wooden adjustor

PANEL AND BASEBOARD LAYOUTS

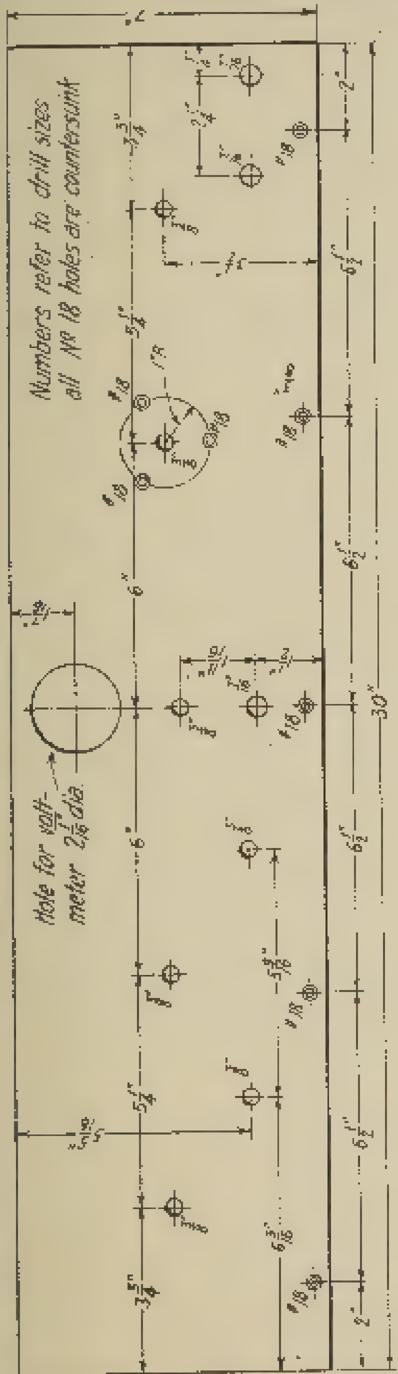


Fig. 7

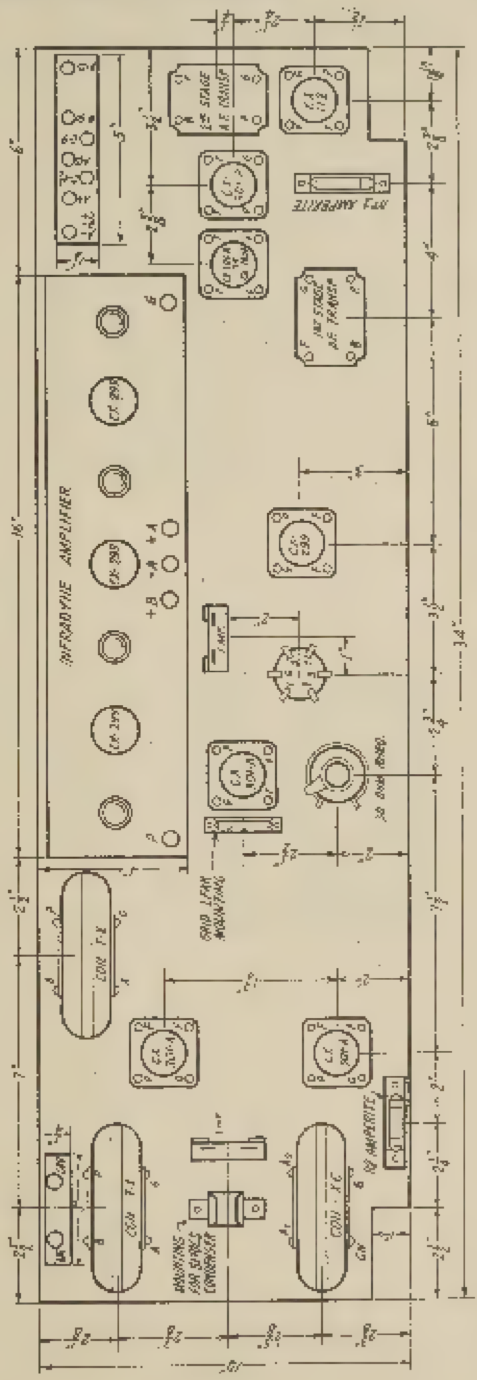


Fig. 6

that is furnished with the infradyne amplifier reset all four indicator knobs on the amplifier for maximum signal strength. If this throws the amplifier into oscillation, loosen up the increase screw until the oscillation stops. If it does not throw it into oscillation, tighten up the screw until it does, and then loosen it to just before this point. If it does not oscillate with the screw tightened all the way down, lift the wire from the plus *B* terminal on the infradyne amplifier and connect a little coil of about eight turns wound around the finger in series between the wire and the *B* terminal of the amplifier. In most cases this choke is not necessary but when it is used it should suffice to throw the amplifier into oscillation. No more than eight turns should be used in this place.

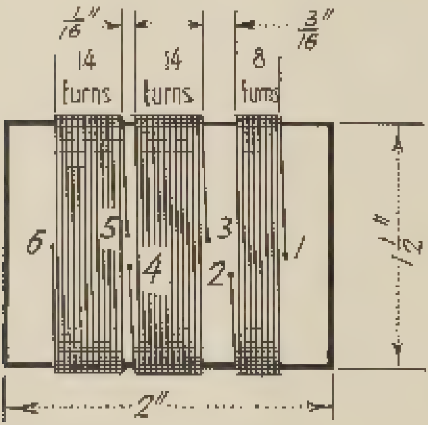


Fig. 8. Tapped Inductance

The 30 ohm rheostat mounted on the baseboard should next be turned until the most sensitive filament temperature for the mixer tube is found. This will probably be at about the half way position and will be indicated by a sharp rise in signal strength as the point of efficiency is reached. The signal strength should fall away rapidly on each side of this peak. If moving this rheostat throws the set into oscillation loosen up on the increase screw on the Remler amplifier and try again.

Because of the fact that the sum frequency is used, the oscillator condenser works in an opposite direction from the antenna condenser when the set is tuned. In order to make the dials read in the same direction, the oscillator condenser is equipped with a dial which reads opposite to its capacity increase.

It was mentioned above that with the antenna condenser set on a given station, two or three oscillator dial settings could be found. It should be pointed out, however, that this is the only condition under which more than one oscillator setting can be found. These other settings are freaks which are likely to appear in any set using an oscillator tube. Under normal operation of the set when both dials are turned together no more than one setting per station will be found. The oscillator condenser is connected between the grid and plate of the tube and both sides of the condenser are therefore alive to hand capacity. This limits the choice of an oscillator condenser to one in which the shaft is not connected electrically to either set of plates.

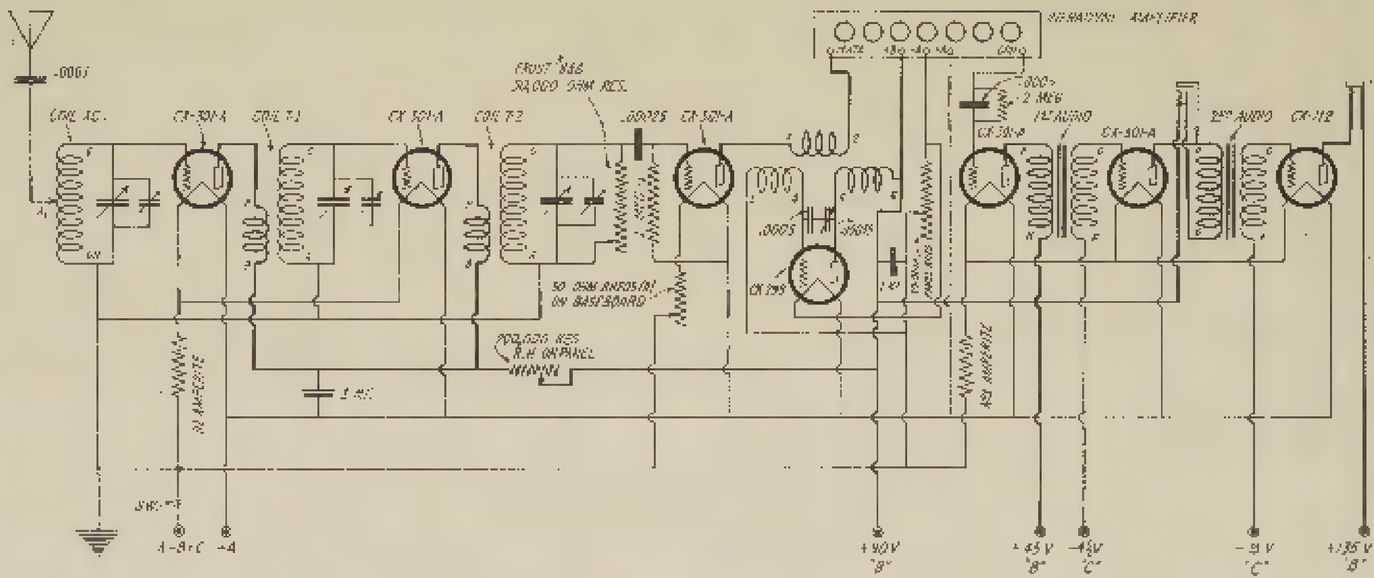


Fig. 4. Schematic Wiring Diagram of the Infradyne

NOTE: Connect Voltmeter as shown in Pictorial Diagram on Page 11.

HOW TO BALANCE THE CONDENSER IN THE ORIGINAL

1. Remove the tubes from the Infradyne Amplifier, the oscillator and the second detector.

2. Mount a vernier condenser (General Radio No. 368) on the panel at each side of the wavelength or left-hand dial at about the level of the vernier tuning knob. Leave these vernier condensers disconnected for the time being.

3. Disconnect the wire from the plate terminal of the first detector socket.

3-(a) Turn off the Infradyne Amplifier Rheostat (the one below the voltmeter). The voltmeter will then read zero.

4. Run a jumper wire from the plate terminal of the first detector socket to the plate terminal of the second detector socket. The set will now operate as a five-tube single-dial control tuned radio frequency receiver.

5. Tune in a local station on a wavelength between 400 and 500 meters.

6. Loosen the set screw holding the rear rotor section of the Continental condenser and shift the rotor section backward and forward until the signal comes in loudest. Tighten the set screw. If the radio frequency stages go into oscillation as the position of the rotor is shifted the oscillation can be stopped by cutting down the filaments on these two tubes.

7. Loosen the set screw holding the middle rotor section of the Continental condenser and move this section backward and forward until the station is received with the greatest volume. Tighten the set screw. Any oscillation of the radio stages can be stopped as before by cutting down the filament temperatures.

7-(a) Loosen the set screw holding the rotor plates of the front section of the Continental condenser and line-up this section in the same manner as in the preceding paragraph.

8. Note the sections in which the plates are farthest enmeshed.

9. Connect the two vernier or trimmer condensers across the sections in which the plates are farthest enmeshed. The rotor plates of the vernier condensers will be connected to the rotor sides of these two sections and their stator plates will be connected to the stator sides of the gang condenser sections.

10. Turn the vernier condensers to about half their maximum capacity.

11. Rebalance the circuits by again shifting the rotor sections as above described. The set will now be lined-up at one wavelength between 400 and 500 meters, and can be lined-up at any wavelength by using the trimmer condensers.

12. Log a few dial settings.

13. Remove the jumper wire and reconnect the wire to the plate terminal of the first detector socket.

14. Insert the tubes in the oscillator and second detector sockets and in the Infradyne Amplifier.

15. Set the panel voltmeter to three volts.

16. Turn the first detector rheostat, which is mounted on the baseboard, about three-quarters full on.

17. Turn the "Increase" screw on the Infradyne Amplifier panel almost all the way in.

18. Set the tuning knobs on the Infradyne Amplifier at zero. If the Amplifier goes into oscillation back up the "Increase" screw until the oscillation stops.

19. Set the volume control to maximum.

20. Tune in a moderately weak station. The settings previously obtained for the left-hand or wavelength dial can be used and it will be only necessary to obtain a setting for the oscillator dial.

21. Adjust the first detector rheostat on the baseboard for maximum volume.

22. Using the wooden wedge furnished with the Infradyne Amplifier vary the positions of the knobs on the Amplifier panel. Since the amplifier contains four tuned circuits any one of these can be tuned to any wavelength within its tuning range and the rest can be tuned to resonance with it. Therefore the first tuning knob can be set to any desired position over a certain range and the other three circuits tuned to resonance. There will, however, be a setting of the first knob and a resultant setting of each of the other three knobs a which operation will be best. Suppose then that as a first trial the left-hand knob is set at zero. The settings of the other three will then be varied slightly progressively and in turn until the points of best operation are found. As the setting of each knob is changed slightly rotate the oscillator dial slowly backward and forward over a few degrees. As each of the knobs on the Amplifier is adjusted and the circuit being tuned is brought into resonance with the circuit, the wavelength of which was determined by arbitrary setting, the amplifier will tend to go into oscillation. When this occurs unscrew the screw marked "Increase" until the oscillation stops. Set the four knobs successively for best reception. Now try another slightly different setting of the first knob and follow the above procedure through again. In this way the Infradyne Amplifier can be adjusted for best results.

23. Check the setting of the first detector rheostat, which is mounted on the baseboard.

LIST OF PARTS USED

By SARGENT IN HIS NEW MODEL

The Parts Specified by

MANUFACTURER'S NAME

Should Not Be Substituted

1 Remler Infradyne Amplifier.
1 Three Gang Condenser, Cardwell 317CL or Hammarlund.
3 General Radio type 318-A midget vernier condensers.
1 Remler .00035 mfd. condenser.
1 Frost No. 886 50,000 ohm resistance.
1 Tapped Inductance. See text.
1 30 ohm rheostat, baseboard type.
1 Set (3) Thorola or Camfield coils for .00035 condenser.
2 National type B, CCW dials.
7 UX base sockets. Cushion type (Benjamin).
1 No. 112 Amperite.
1 No. 1 Amperite.
1 30 ohm panel mounting rheostat.
1 200,000 ohm variable high resistance, Centralab.
3 2-inch Dials.
1 Filament switch.
1 Single closed jack.
1 Single open jack.
1 Jewell 0-5 DC voltmeter. Pat. 135.
1 Electrad grid leak mounting.
1 1 meg. grid leak, Durham, Lynch, Electrad or other good leak.
1 2 meg. grid leak, Durham, Lynch, Electrad or other good leak.
1 .0001 fixed condenser.
2 .0005 fixed condensers.
1 .00025 fixed condenser.
2 Audio transformers.
2 1 mfd. Condensers.
1 Panel, 3/16x7x30 in.
1 Baseboard, ¾x10x34 in.
9 Eby binding posts or 2 Eby posts and a Jones battery plug and cable.

Converting a Five-Tube Set to An Infradyne

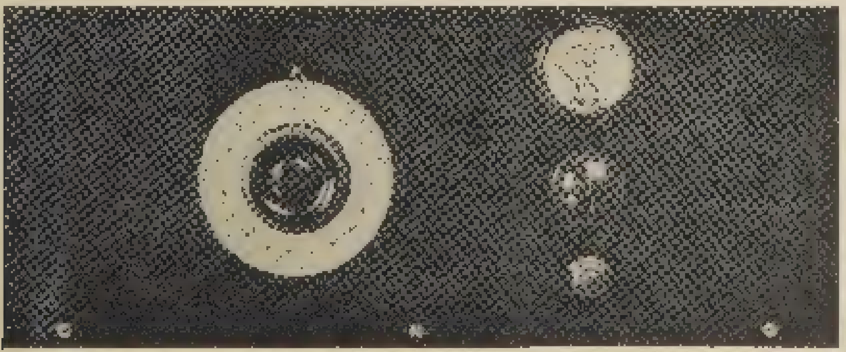
A Description of An Infradyne Adapter Applicable to Any Tuned R. F. Set. Also Some Suggestions for Selectivity.

By E. M. Sargent

THOSE who have followed the series of articles on the infradyne circuit which have been appearing in "RADIO" since August, 1926, have recognized the fact that a complete infradyne set consists of a five-tube tuned radio frequency set *plus* an oscillator-mixer and a three tube infradyne amplifier unit. In operation, the received signal is first amplified at radio frequency in the first two stages, then changed to a low wavelength of about 90 meters by the oscillator-mixer, then amplified to a still greater degree by the three stages in the infradyne amplifier, then detected or de-modulated by the detector tube, and finally amplified by two audio frequency transformers and tubes. In effect, an oscillator-mixer and infradyne amplifier have been merely added to a five tube set.

That this addition can be easily made to almost any tuned r.f. set, including the neutrodyne, has been conclusively demonstrated during our laboratory tests. Consequently we have designed an infradyne adapter which will transform an existing five tube set into a complete ten tube infradyne set. This change can be readily made in a few minutes by simply adding the oscillator, infradyne unit and second detector whose constructional details are given elsewhere in this booklet.

As may be seen from the adapter circuit diagram in Fig. 1, the output from the plate of the original detector tube, now used as a mixer to give the *sum* frequency, is connected to the infradyne adapter. Then the output of the infradyne adapter is connected to the input of the first a.f. transformer. This, with the necessary battery connections, completes the job. The only changes made in the original set is to disconnect the wire joining the plate terminal of the detector socket to the *P* terminal of the first audio frequency transformer, to remove the audio by-pass condenser in the tuned radio frequency set (if there



Panel View of Infradyne Adapter.

is one), and to add a 30-ohm control rheostat for the first detector tube (if not already installed).

To add the infradyne adapter, connect its input terminal (point *1* of the tapped inductance) to the plate terminal of the detector socket and its output (the plate of the 2nd detector) to the *P* terminal of the first a.f. transformer. Then make the battery connections as indicated in Fig. 1, first disconnecting the *A* battery from the set.

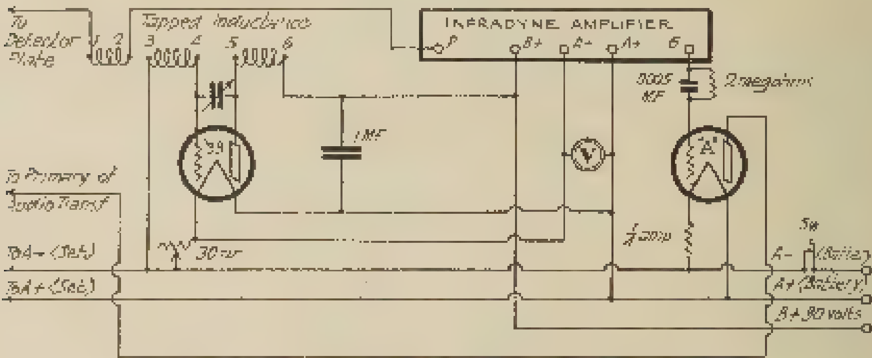


Fig. 1. Circuit Diagram for Infradyne Adapter.

The complete unit to be added can be mounted on a panel and baseboard, as shown in the pictures, and installed in a separate cabinet which may be placed near the main set so that the additional dial control of the oscillator can be conveniently operated.

The panel is 7x18x3/16 in. and the baseboard 9x17x3/4 in. The parts used in the pictured unit are 1 Remler No. 700 infradyne amplifier, 1 Remler .0001 mfd. variable condenser, 1 Sangamo .0005 mfd. fixed condenser and 2 meg. leak, 1 bypass condenser (1mfd.), 2 CX type tube sockets, 1 d. c. voltmeter (0-5 volts), 1 rheostat (30 ohms, Frost), 1 ballast resistance (¼ amp.), 1 filament switch, 7 binding posts, and 1 tapped inductance.

The tapped inductance consists of three coils, one 10 turn and two 30 turns of No. 24 d.s.c. wire, all wound in the same direction on a 1⅝ in. diameter formica tube 3 in. long, as shown in Fig. 2. The space between turns is ⅛ in.

All connections should be soldered. If solid solder is used, a non-acid soldering paste is the best flux, using the paste very sparingly, especially in the vicinity of the tapped inductance. If rosin core solder is used no other flux is necessary. But take care to "sweat" the joint with the hot iron until the solder runs into place, giving the wire a tug to be sure that the solder and not the rosin is holding the wires together. As rosin is a non-conductor and does not ruin insulation rosin-core solder is particularly good if properly used.

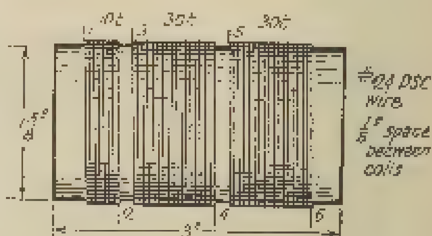


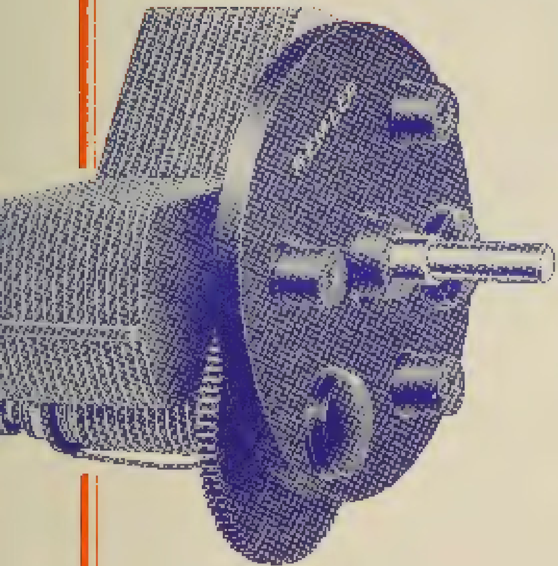
Fig. 2. Tapped Inductance.

Operation

USE "A" tubes in the first four sockets of the tuned radio frequency set and either an "A" tube or a power

REMLER

Remler TWIN ROTOR Condenser



Made in both Straight Line Frequency and Straight Line Wave Length types. Condenser rotates through a full 360°, giving a greater separation of stations at all wave lengths than is possible with the usual 180° type.

A special adjustment which permits variation of the condenser capacity at zero dial setting allows a still further spreading of the stations in the Straight Line Frequency type. In consequence the condenser can be adapted to the particular coil used. Perfected insulation completely eliminates body capacity effects and electrical losses are reduced to a minimum.

Straight Line Frequency

This type gives the greatest possible separation of stations over the entire broadcast band. Equal divisions on the dial represent equal frequency bands. Longer wave length stations are crowded somewhat and the lower wave length stations are proportionately spread out. Capacity is variable at the zero dial setting.

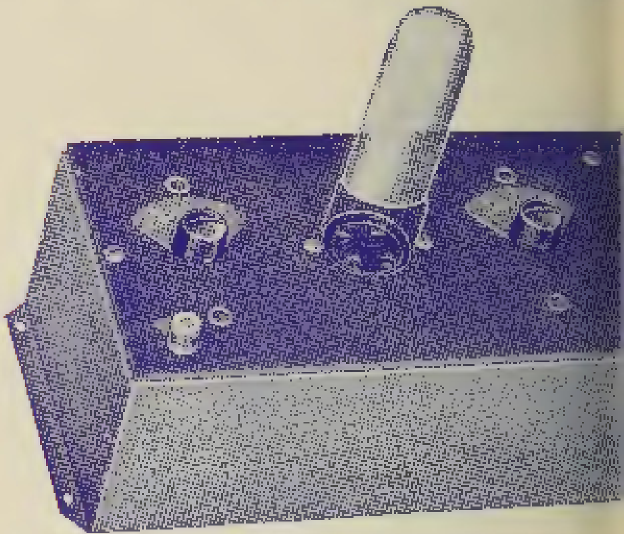
No. 648 -.00035 max. less dial....$4.50
No. 649 .0005 max. less dial.... 4.50
No. 659- .0001 max. less dial.... 4.50

Straight Line Wave-Length

This type should be used to separate to the greatest extent the long-wave class "B" stations which usually offer the better programs. Equal dial divisions represent equal wave-length bands. The smaller low-wave length stations are slightly crowded to give maximum spacing for the higher powered class "B" stations.

No. 630—.00035, with dial $5.00
No. 638—.00035, less dial........... 4.50
No. 631—.0005, with dial........... 5.00
No. 639—.0005, less dial........... 4.50
Dial Complete.......................... .75

Remler INFRA-

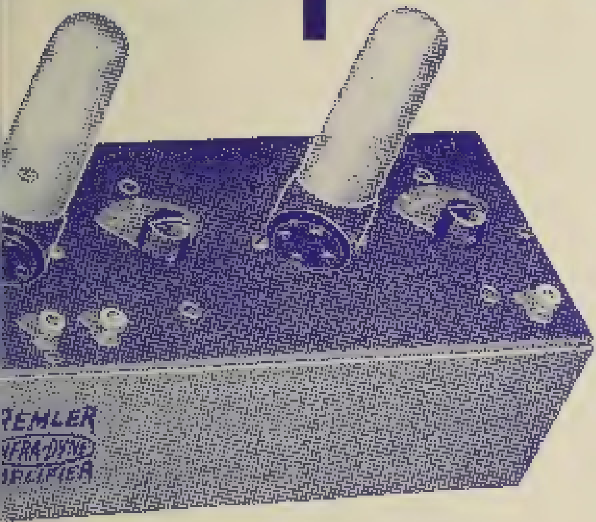


The Key to Succes

The name Remler is indicative o
resenting many years' accomplis
neering. This, the No. 700 Reml
highest achievement of those ye
neering design. Use it with you
dyne circuit—you will get recep
past experience, you have ever b

List Pr

NE Amplifier



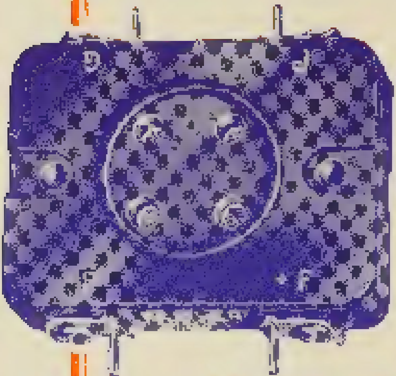
sful Amplification

ne best in radio equipment, rep-
ent of pioneers in scientific engi-
nfradyne Amplifier, exhibits the
of experience and skilful engi-
ned radio frequency or neutro-
far ahead of any that, through
lead to expect.

$25.00

REMLER

Remler *Improved* Socket



Contact—close, positive, gripping contact—is the secret of success in all radio connections. It is not enough that contact should be made at a given point or even along a given line. Too often is insufficient contact the source of long unsuspected trouble. The fact that the best practice demands the soldering of all permanent electrical connections is additional proof of this point.

Made to Meet the Quality Demand

Made of moulded Bakelite and easily installed, this new Remler socket will at once make a real appeal to the man who realizes the necessity of perfect contact for the tubes. The contacts are self aligning, and the full floating springs allow a smooth in-and-out pull. Both soldering lug terminals and screw terminals are provided for each connection, and each contact spring is an integral part of the terminal lug.

List Price 50 Cents

REMLER

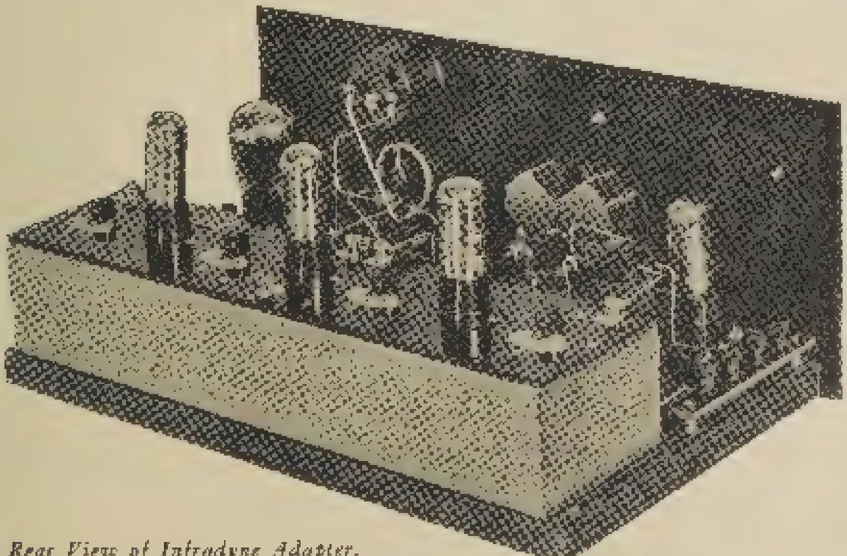
GRAY and DIVISION OF R DANIELSON
Manufacturing Company

CHICAGO — 260 FIRST STREET, SAN FRANCISCO — NEW YORK tube in the last audio stage. In the adapter, use three 99's in the infradyne amplifier, a 99 in the oscillator and an "A" tube in the detector. If the oscillator coil is built with care, and the Remler .0001 mfd. condenser used with the "high minimum" setting (see instructions regarding this in the condenser box), the Remler dial will set at about 48 degrees for 550 meters, and 142 degrees for 200 meters. This is a straight line frequency condenser and therefore the 96 channels used in broadcasting will be evenly distributed over the 94 degree swing of the condenser. This is practically one degree per wave band, which greatly simplifies tuning.

In the infradyne circuit, the oscillator condenser turns in the opposite direction from the tuning condensers. That is, the highest capacity setting is used to get 200 meters and the lowest to get 550 meters. This makes the tuning somewhat confusing if the regular Remler dial is used, and the writer recommends that this dial be replaced with a CCW dial. Also there is no reason why the dial should permanently read from 48 degrees to 142 degrees, and it is better after the limits of the broadcast band have been ascertained to reset the CCW dial so that it is on 0 for 200 meters.

To put the set in operation, the writer recommends making the adjustment on a moderately distant station,—some station that is out of daylight range but that comes in loud at night. The dial settings on the tuned radio frequency set will be in exactly the same places as when that set is used alone, and they can therefore be made in advance if a log sheet is at hand. Put the four indicators on the infradyne amplifier at 0, tune in the station with the dials on the tuned radio frequency set, and then slowly rotate the oscillator dial until the station is heard.

Sometimes the station can be picked up at more than one place on the oscillator if the other dials are not also moved. If this happens, locate all possible oscillator settings and select the loudest one. This will be the infradyne setting. These other oscillator settings are freaks which occur in any set using an oscillating tube, and the only time



Rear View of Infradyne Adapter.

they appear is during a test of this kind. During normal operation of the set, no station ever appears more than once, unless the broadcast station itself emits a harmonic, in which case of course it will be heard on any set on one-half its fundamental wave length.

After the oscillator setting is determined, adjust the four indicators on the infradyne amplifier for maximum sensitivity, and also adjust the "increase" screw as per the instructions that come with the amplifier. If the set will stand it, a small by-pass condenser, usually not over .0001 mfd., may be used across the first audio transformer. This should not be put in, however, until the receiver and adapter have been tried without it first, as the insertion of this bypass sometimes causes troublesome oscillations.

This infradyne adapter makes a big improvement in a 5-tube set and true infradyne results can be expected. It is particularly good with sets of the single dial variety, as the resulting receiver is then only a two dial set and is easy to operate.

How to Use the Na-Ald Connectorald for adapting the Infradyne to an ordinary 5-tube tuned radio frequency receiver

TO SIMPLIFY connections in converting your five-tube radio frequency receiver to an Infradyne, you can use the Na-Ald Connectorald. This device has a little shell with a base that fits on a tube socket. Put the Connectorald on the detector tube base. The Connectorald has four leads. Then insert the detector tube in the socket on which the Connectorald has been attached.

There are 4 leads on the Connectorald, labeled as follows:

Plus B
Minus B
Plus C
Minus C

The Plus *B* lead goes to terminal 1 of the pick-up coil.

The Minus *B* lead goes to the plate of the second detector.

If your tuned radio frequency receiver has a grid condenser and grid leak in it, connect the plus *C* and minus *C* together. If the set has no grid leak and grid condenser in it, connect the grid condenser in series with the plus *C* and minus *C* leads coming from the Connectorald. Shunt this grid condenser with a grid leak of one or two megohms.

If your receiver has a by-pass condenser across the first audio transformer, be sure to take this out. If you care to use a condenser, do not use one of more than .0001 mfds. capacity.

The Amplifier Unit

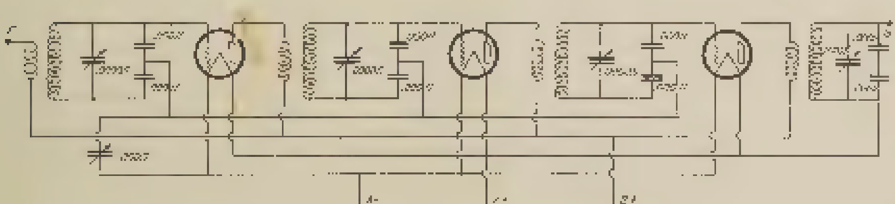
THE heart of the Sargent-Rayment Infradyne circuit is the Infradyne amplifier. The illustrations show the interior and exterior views of this device. The circuit diagram shows how the unit is wired. The circuit will be of interest to those who have been experimenting with amplification at the extreme high frequencies. The circuit is published as a matter of information only. It is impossible to give construction details because of the fact that a difference in placement of the fixed condensers of ¼ inch or a difference of 1/32 inch in primary to secondary coupling between the coils may make the difference between a unit that will amplify and one that won't. The Infradyne amplifier is a most outstanding example of the part played in a radio circuit by the relative positions of the different pieces of apparatus.

If exactly the same hook-up, capacities, and coils are used and the arrangement kept almost the same, but the connecting wires run differently, the unit will have entirely different characteristics. Such is radio at 90 meters.

Unless you have at your disposal a complete radio calibration laboratory it will be practically impossible for you to build an amplifier unit that will give results. Each unit is calibrated by laboratorians in the factory. Each circuit is tested. All parts are inspected and all inductances and capacities are carefully checked and matched before the amplifier unit is assembled. It is housed in a copper container, effectively grounded. This provides an ideal shield for the entire unit. The 90-meter transformers are wound on low-loss ribbed forms. 35 turns of No. 28 d.s.c. wire on 1½ inch forms are used on the secondaries with the exception of the coil next to the second detector. This coil has 28 turns. Primaries are wound inside of the secondaries, and consist of 20 turns of No. 28 d.s.c. wire. The bakelite top of the unit has three "X" base sockets, four vernier condensers and the necessary connecting posts. The vernier condensers are adjusted for maximum signal strength. Once this adjustment has been made there is no further attention necessary.

The Unit in Its Container.

Interior View of Amplifier.



Circuit Diagram of Infradyne Amplifier Unit.

Where to Get Information

A "trouble shooting" service for Infradyne receivers is being maintained by many radio parts dealers in various sections of the U. S. Those wishing to secure expert advice on the circuit and others desiring information should correspond with any of the following:

E. M. SARGENT,
1200 Franklin Street, Oakland, California.

L. C. RAYMENT,
1200 Franklin Street, Oakland, California.

GERALD M. BEST,
Technical Editor of "RADIO,"
Pacific Building, San Francisco, California.

Questions are answered by Gerald M. Best when accompanied by twenty-five cents in coin or stamps for each question asked.

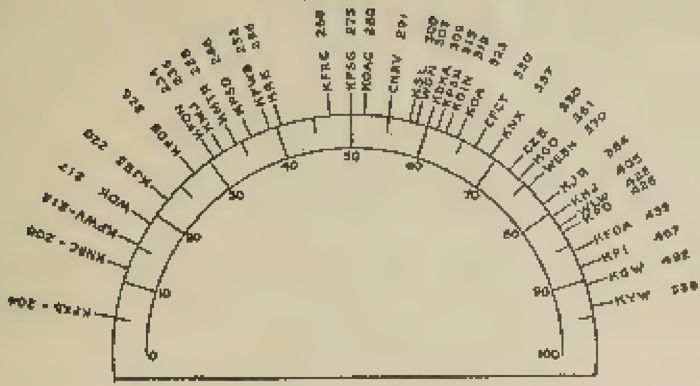
E. M. Sargent writes exclusively for "RADIO." Every month for the next six months his down-to-the-minute developments on the Infradyne will be published in "RADIO."

Hammerlund & Cardwell

Announce

Infradyne Condensers

As this Manual goes to press, word reaches us from Mr. E. M. Sargent that two new three-gang condensers for the Infradyne have been announced. One is made by Cardwell—the other by Hammarlund. Both have been endorsed by Mr. E. M. Sargent. The Hammarlund and Cardwell factories are making a special condenser for the Infradyne. Specifications for these condensers were carefully checked by Sargent. They will give 100% satisfaction. Lack of time prevents us from showing a pictorial drilling template for mounting these new condensers on the Infradyne panel. The panel lay-out, as shown on Page 13, gives the center shaft hole drilling dimensions only. This same shaft hole can be used for either the Cardwell or the Hammarlund Infradyne condenser, but it will be necessary for the builder to drill three additional holes for mounting the condenser to the panel. These holes should be countersunk and flat head screws used for mounting the condenser. Before drilling these holes, make a paper template by placing a sheet of paper over the front end of the condenser and carefully marking the location for drilling the holes for the mounting screws. Use a stiff grade of paper.



The Dial

of an

INFRA-DYNE

This illustration shows the actual results obtained from the Sargent-Rayment Infradyne Circuit.

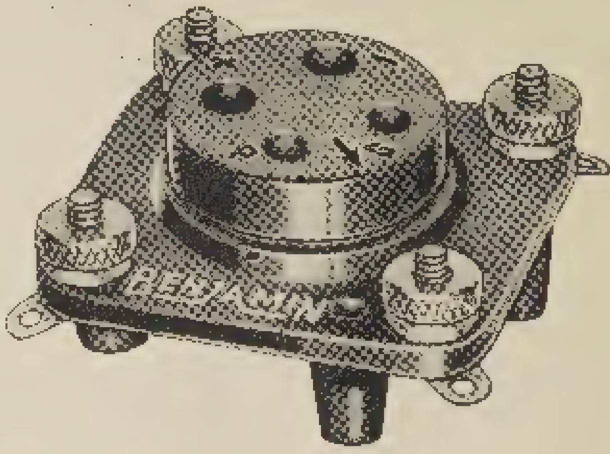
You will get results equally good when you use it. Only via the Infradyne route can you secure broadcast reception which will be far superior to that from the ordinary run of receivers. The readings shown are taken from the antenna dial. The oscillator dial readings will be within 10% of the wavelength dial readings.

BENJAMIN

TRADE MARK

Cle-Ra-Tone Radio Sockets

Spring Supported, Shock Absorbing



used in the New

INFRADYNE Reciver

The new INFRA÷DYNE Receiver is a marvel for long distance reception, simplicity and ease of tuning because of Mr. E. M. Sargent's insistance on radio parts of proven merit. Benjamin Cle-Ra-Tone Sockets were chosen because they are shock-absorbing, non-microphonic they give longer life and protect the tubes from sudden impacts which would otherwise cause "tube noises." Four perfectly balanced springs "float" the tube-holding elements independently of the base, with positive tube-to-terminal connection. Shock-absorbing feature not affected by stiff bus wiring. Made of molded Bakelite —highly polished. Nickel plated screws and nuts, tinned soldering terminals. Side wiping contacts assure perfect connections.

Cle-Ra-Tone Sockets for UX Type Tubes, 75 Cents

Your dealer has them in stock

BENJAMIN ELECTRIC MFG. CO.

Pacific Sales Dept.: 448 Bryant St., San Francisco

Eastern Sales Dept.: 247 W. 17th St., New York

General Offices: 120-128 S. Sangamon St., Chicago

Manufactured in Canada by the Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto, Ontario

ALL PARTS $118.00

INFRA-DYNE

TRADE MARK

Prompt Mail Order Service To Any Part of U. S. or Canada

WE MAKE PROMPT DELIVERY

Parts Also Sold Separately

We specialize in shipments of complete parts for the new improved Infradyne. Everything specified by Sargent in this Manual will be shipped to you for $118.00. This price includes the new type Cardwell 3-gang condenser; three new General Radio vernier condensers; the new Frost 50,000 ohm variable resistance, the new 200,000 ohm variable resistance and the new set of Amperite filament controls which are explained by Sargent in his latest article. In other words, the list of parts to the right is exactly what is needed for building the new Infradyne. We guarantee the merchandise to be exactly as represented and we will ship c.o.d. if half cash is sent with order. Money orders or certified checks accepted. We have been supplying the Infradyne builder's wants for the past three months and we have a host of satisfied customers.

Here are the Official Parts Which We Sell

1 Remler Infradyne Amplifier.
1 Cardwell three-gang condenser.
3 General Radio 318-a Midgets.
1 Remler .00035 condenser.
1 Frost No. 886 Resistance, 50,000 ohms.
1 Tapped Inductance.
1 30 ohm baseboard rheostat.
1 Set, 3, Thorola Doughnuts.
2 National Dials, Type B. CCW.
7 Benjamin UX base sockets.
1 112 amperite.
1 No. 1 amperite.
1 30 ohm panel rheostat.
1 Centralab 200,000 ohm resistance.
3 2-inch dials.
1 Filament switch, Electrad.
1 Single closed jack, Electrad.
1 Single open jack, Electrad.
1 Jewell Pat. 135 voltmeter.
1 Electrad grid leak mount.
1 1 meg. Electrad grid leak.
1 2 meg. Electrad grid leak.
1 .0001 Fixed condenser, Electrad.
1 .00025 Fixed condenser, Sangamo.
2 .0005 Fixed condensers, Electrad.
2 American audio transformers.
2 1 mfd. Electrad condensers.
2 Binding post strips with Eby Posts.
1 Bakelite Panel, drilled and engraved, 3/16" thick.
1 Baseboard, Poplar, Egyptian lacquered.

All of Above $118.00

WIRES $6.00

All of the wires, bent to shape. Saves you the trouble and saves hours of time. Neatly packed and labelled, with instruction sheet.

CABINETS $19.50

Beautiful mahogany cabinets built especially for the Infradyne. They do justice to this famous set.

C.O.D. shipments made if half cash accompanies order.

International Radio Sales Co.

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Doughtnut Coils, Panels, Inductances, Meters, and All Other Parts.

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SEND FOR NEW RADIO CATALOGUE

INFRA-DYNE

PANELS

Drilled and Engraved Panels	$6.85
Inductances, Green Silk Wound	1.25
Baseboards, Varnished	2.85
Binding Post Strips, Complete	1.75

POSTPAID—IMMEDIATE SHIPMENT

Complete Set $11.40, Prepaid

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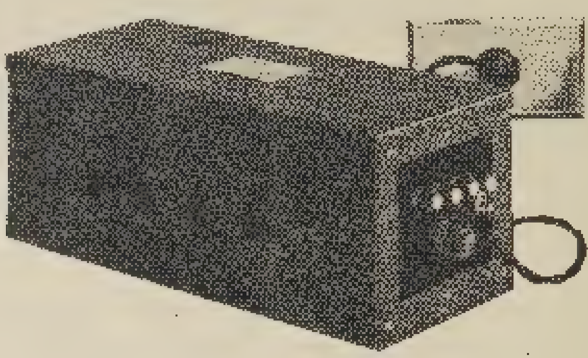
LOS ANGELES, CALIF.

How to Tune In Stations More Than 2000 Miles Distant

Hair-breadth selectivity is required for tuning-in stations several thousand miles away. The secret of bringing in these stations is in the proper control of the tuned r.f. amplifier, assuming that the oscillator and Infradyne amplifier are performing correctly. Infradyne users report that stations three meters apart are easily separated from powerful local stations on the antenna dial. Carefully follow the instructions contained elsewhere in this manual for lining-up the three gang condenser. Unless the gangs of this condenser are properly lined up, it will be impossible to get selectivity. Set the antenna tuning dial at, say, about 30 degrees for tuning in stations on low wavelengths. Leave it in that position. Then "cross" this wavelength with the oscillator dial by moving it slowly back and forth over a range of about five degrees on either side of the same dial reading as on the antenna dial. When you "cross" a station in this manner, set the oscillator dial at the point where the station comes in clearest and loudest. Then vary the voltage of the "99" tube filaments until you get clear, undistorted reproduction of signals. Do not use more than three volts on the small tubes. Keep your eye on the voltmeter. Distortion will result if too much voltage is used. You will also force the oscillator and Infradyne Amplifier tubes and long distance stations will not come through satisfactorily. The two tuning dials will not always read alike. They should not vary more than five or ten degrees. For this reason it is essential that the oscillator dial be swung back and forth over a ten degree sector of the scale until you "cross the station." Regulate your variable high resistances until you get undistorted signals. The control of the 50,000 ohm resistance plays an important part in getting good reception from long distance stations. A slight re-adjustment of the rheostat on the baseboard may give you a better "peak" point for DX stations.

Operate your INFRA-DYNE with 100% Efficiency



Precision

"B" Power Unit

135 Volts $42.50

Infradyne's 10 tubes require considerable B voltage—this sensitive circuit requires an exceptionally even flow of B current as well as an ample supply. This is so in a greater or lesser degree in all circuits, but in Infradyne it is even more important. Precision will deliver an even flow of "B" current that will operate the Infradyne with 100% efficiency—a reserve of Power that is not taxed at any time. An absolute quiet flow of "B" voltage.

Infradyne draws a maximum of 26 milliamperes at 135 volts, using a CX112 power tube in the last audio stage.

Precision has an output of 40 milliamperes at 135 volts—a condensing capacity of 100 microfarads—assuring you an uninterrupted flow of current indifferent to temporary power line interferences.

This advertisement is placed in this publication because Precision has proven its efficiency in operating the Infradyne. If your dealer can't supply you, write us for full information.

Precision Electric Mfg. Corp.

1020 Santa Fe Avenue
Los Angeles

How to Bend Wires and Solder Connections

Great care should be taken in bending wires and soldering connections. Use a good grade of copper wire, insulated where insulation is required. It is not advisable to bend and re-bend bus-bar wiring. Try to find the exact place for making the bend in the first place. Hardware stores sell a handy pair of wire-bending pliers which have a combination round and smooth flat nose. Do not use pliers with "teeth" or "ribs" because you will mar the insulation on the wires and a poor job will be the result.

Use lugs. Use them liberally. But do not use too much solder. "Sweat" the joints by using solder sparingly and see that the soldering iron is heated to a sufficient temperature to allow the joints to "sweat" together. If you use rosin core solder take great care that the rosin is thoroughly melted and allow the solder to run smoothly over the joints. Do not use too much rosin or soldering flux. A little of this goes a long way toward making a good joint. Carefully wipe the rosin or paste from the wires and instruments. High resistance leaks will result if paste is not thoroughly removed. The secret of good soldering is in the proper temperature of the iron, the correct amount of solder and flux and the manner in which this is applied. Do your experimenting on some scraps of wire before attempting to wire your Infradyne. Run leads as short and direct as possible—especially in the grid circuit. Keep the grid leads well separated from other wires.

After a connection has been soldered it is always advisable to test its strength by gently pressing it. A poor joint will give 'way under slight pressure.

INFRADYNE SERVICE

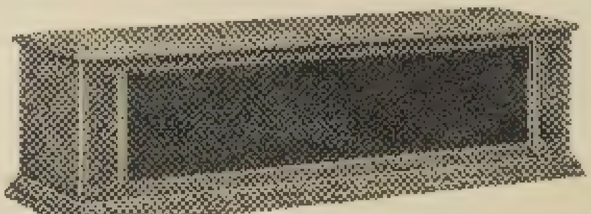
Specializing in building, adjusting and repairing.
We make 'em play or no charge. Correspondence invited.

PALMER RADIO LABORATORY
Established 1923
4520 S. Vermont Ave., Los Angeles — Phone VErmont 5883

TYPE OF ANTENNA
To Use for the Infradyne

That "No Chain Is Stronger Than Its Weakest Link" can be safely applied to the antenna for use with the Infradyne. The Infradyne gives best results when used with an antenna not more than 100 feet long. A 75-foot antenna will give excellent results although 100 feet can be used in connection with the Improved Infradyne. Greater flexibility of antenna tuning control is accomplished in the new model by the use of the trimmer condensers and other minor improvements as made by the inventor. The original Infradyne operates best with a 50-foot antenna. If you bring your set up to date as shown in this Manual you can safely use an antenna up to 100 feet in length. An indoor antenna can be used for reception from stations up to 1000 miles distant. In San Francisco an Infradyne receiver using a fifteen foot wire stretched along the floor succeeded in picking up KOA at Denver with enough volume to fill the room. The selectivity of the Infradyne will be impaired if more than 100 feet of antenna is used. Use copper wire for the antenna. Do not use smaller wire than the equivalent of No. 14. Thoroughly insulate the wires at both ends. Use a good lead-in wire. Make sure that your ground connection is perfect. Use a good ground clamp. Make the distance between the set and ground connection as short as possible. The ground connection is as important as the antenna itself.

CABINETS for the INFRADYNE



Rigid in construction, beautiful in design and workmanship.

$18.50

Genuine hand rubbed, durable laquer finish.
Choice of Walnut or Mahogany.

Send for complete bulletin of radio furniture

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A TRIBUTE

Mr. E. M. Sargent and Mr. L. C. Rayment have this to say in regard to the nation-wide overnight popularity of the Infradyne:

"The magazine 'RADIO' of San Francisco, with its ultra-conservative and unbiased editorial policy and its reader confidence gained through nine years of fair play—with its national reputation as a magazine entirely free from sensationalism, is greatly responsible for the success of popularizing the Infradyne circuit."

The publishers of "RADIO" announced that the Infradyne was new—revolutionary—ultra-selective and a remarkable circuit for bringing in the extreme long distance stations. The radio public believed this statement because it came from "RADIO." Reader confidence is our greatest asset. We published this latest radio scoop months in advance of others. If you care to join the ranks of subscribers to this pioneer radio magazine, kindly send us a check or money order for $2.50. That brings you "RADIO" for a full year.

PACIFIC RADIO PUBLISHING CO.

Established 1917

A. H. HALLORAN
Editor

GERALD M. BEST
Tech. Editor

PACIFIC BUILDING — SAN FRANCISCO-CAL.

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New York, N. Y.

52 Irving Street
Boston, Mass.

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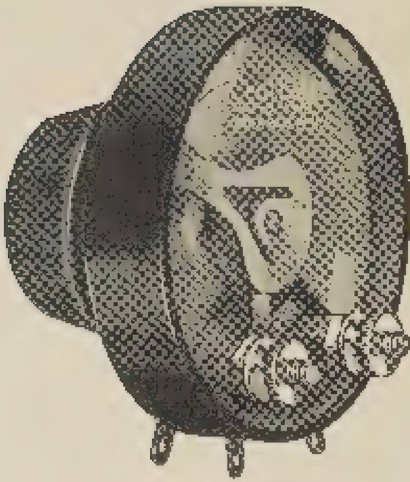
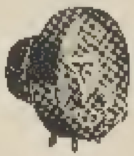
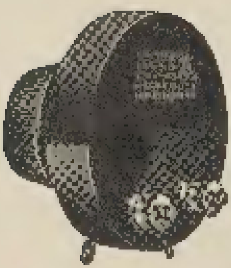
Hollywood, California



Centralab RadiohM





HEAVY DUTY Centralab RadiohM

Non-Inductive Variable High Resistances

CENTRALAB Radiohms with two terminals, and Modulators or Potentiometers with three terminals, provide gradual, noiseless control of oscillation or volume in any circuit. Specified for the Infradyne, S-C, Samson T-C, Henry Lyford, Universal, and many other circuits. Used as standard equipment on a large number of commercial receivers, and by both the U. S. Navy and Signal Corps.

There is a resistance and correct taper for every circuit. The No. 25 M or No. 51 M are ideal oscillation controls when shunted across the tickler coil of short wave receivers.

Bakelite base and knob. Single hole mounting. Resistance of Potentiometers, 400 or 2000 ohms, modulators 500,000 ohms, Radiohms 2000, 25,-000, 50,000, 100,000, 200,000, 500,000 ohms, $2.00.

Gives Full Efficiency from "B" Eliminators

Centralab Heavy Duty Radiohms *fully approved by the Raytheon Laboratories,* will control the output voltage of "B" Battery Eliminators, resistance remaining permanent as adjusted and the same for any knob setting. Full resistance variation with a single turn of knob. Insulated for 1500 volts. Smooth and noiseless to outlast the eliminator, $2.00.

At your dealer's or mailed direct.

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United Distributors, Ltd., Sydney

Canadian Representative
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Makers of variable resistance for 60 makers of leading standard sets.

Mr. L. S. Hillegas-Baird, 9HO, will cheerfully answer inquiries and supply circuits and descriptive literature.

Centralab CRL

IMMEDIATE DELIVERY
(Wholesale Only)

INFRA-DYNE

IMMEDIATE DELIVERY
(Wholesale Only)

All Parts for the Improved Infradyne

The New SARGENT-RAYMENT Circuit specifies CARDWELL NO. 317-C TRIPLE CONDENSER and GENERAL RADIO 368-A MIDGET CONDENSERS. You need these parts. Your customers will demand them.

Order Your Infradyne Parts from Us

Our stock of DRILLED and ENGRAVED PANELS, BASEBOARDS, in fact ALL PARTS required for the circuit is COMPLETE.

We are exclusive Northern California distributors for this OFFICIAL INFRADYNE MANUAL.

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United Radio Supplies Company

Northern California Distributors for the
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SAN FRANCISCO

"Radio Exclusively"
(Wholesale Only)

Phones: Douglas 8157
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TESTIMONIALS
from INFRADYNE OWNERS

HEARS AUSTRALIA

EDW. M. CORCORAN
RADIO
Sets and Parts
Artesia, Calif.

Sept. 22, 1926

RADIO,
San Francisco, Calif.,

Gentlemen:

It will probably be of interest to your subscribers to know that at four a. m. this morning I picked up Australia on the Infradyne described in your magazine.

I have built several sets described in your magazine since 1920 and have always found them to do all things that you claim and I cannot say this about any other.

Will say that Mr. Best and Mr. Sargent's articles are worth the price of the magazine.

Your well wisher since 1920,
(Signed) EDW. M. CORCORAN.

SEPARATES STATIONS 3 METERS APART

ELLIOT M. EPSTEEN
Attorney-at-Law
DeYoung Building, 690 Market St.,
San Francisco, Calif.

Sept. 27, 1926

Mr. H. W. Dickow,
Care Pacific Radio Pub. Co.
Pacific Bldg.,
San Francisco, Calif.

Dear Mr. Dickow:

I know you will be interested in learning some of the results had on my Infradyne last evening.

Station KPO, 428 meters, and Station CFCN at Calgary, 435 meters, both came in with great volume and though they are but 7 meters apart, I was able to completely blank out KPO although I am only one and a half miles from it in an air line.

At the same time, I was able to separate KSL at Salt Lake City, 300 meters, from KTAB, 303 meters. In the latter case, the military band playing there last night came in like a local station as did KFI and KGW.

Later in the evening I brought in KFWC from San Bernardino with loud speaker volume, and this is but a 100 watt station.

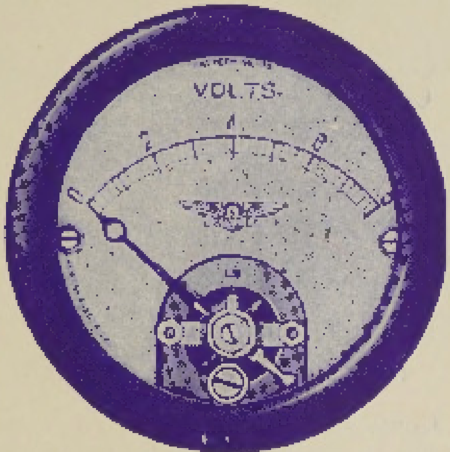
The set is doing all that was claimed for it.

Cordially yours,
EME:AS (Signed) ELLIOT M. EPSTEEN.

JEWELL

Actual Size

A Quality Instrument



PATTERN NO. 135

Infradyne Builders

—here is the radio instrument recommended for use with the new Infradyne receiver It is obtainable in any of the following ranges of which the **0-5 volt** has been particularly specified for the Infradyne.

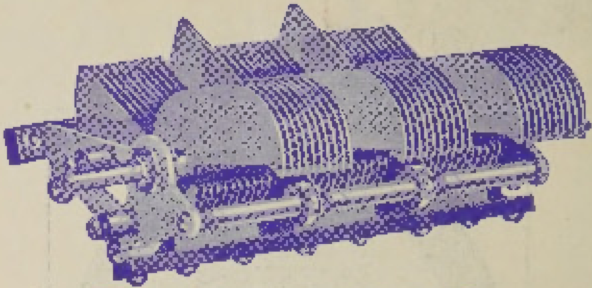
0-5, 0-8 or 0-10 Volts........................$7.00
0-10, 15, 25, 50 or 100 Milliamperes........ 7.00

Send for New Radio Instrument Catalog No. 15-C

Jewell Electrical Instrument Co.

1650 Walnut Street, Chicago

"26 Years Making Good Instruments"



CONTINENTAL

LO LOSS

TRIPLE CONDENSER

Recommended for the INFRA-DYNE Circuit

This Continental special triple condenser was designed for the INFRA-DYNE Circuit.

The low dielectric losses, exact capacities and mechanical perfection of these straight line wave length and frequency condensers make them the logical choice wherever fine reception is desired.

Licensed under Hogan Pat. No. 1014002
Capacity .00035—List Price
$9.50

GARDINER & HEPBURN, Inc.
611 Widener Building, Philadelphia

The Continental Single Condenser is also made in the following capacities: .00035, $2.50 list price; .00025, $2.50 list price; .0005, $2.50 list price, and Continental Junior Vernier Condenser listing at $1.25.

INFRA-DYNE

JOSEPH J. SIMPSON
85-39 152 STREET
JAMAICA 32, L. I., NEW YORK

1/7/60

Dear OM

Found these in my junk box: any Value?
This for IRE Copy. FB.
Enclosed is my "Want List" for 1960
Please write again

73
Joe

REMLER INFRA-DYNE AMPLIFIER

No. 700

INSTRUCTION SHEET

The Remler No. 700 Amplifier employs three CX299 or UX199 tubes. These should be operated from a separate rheostat and are rated at 3.3 volts filament. They should be operated at the lowest filament temperature which will give satisfactory results; the correct voltage will probably be found to lie between 3 and 3.3 volts. The Amplifier will be found to give best results when a plate voltage of 90 is employed.

The following procedure should be employed in getting the Infradyne Amplifier into operation.

1. Install the Amplifier in the receiver, making connections as indicated on the binding posts.
2. With the fingers turn the adjusting screw, marked "Increase," all the way in.
3. Set the pointer of each of the four vernier condenser knobs to zero.
4. Tune in a moderately weak station.
5. Change the settings of the four vernier condenser knobs slightly, using the wooden wedge furnished with the unit. While these condensers are adjusted at the factory for best operation when the pointers are set at zero, the settings will, in practice, be found to vary somewhat from this position due to a slight difference in tubes.
6. As the settings of the vernier condenser knobs approach more nearly the values for most satisfactory operation the amplifier will be found to go into oscillation. This oscillation can be prevented by carefully loosening the adjusting screw, marked "Increase." The vernier condenser settings should again be slightly changed until the point of best operation is obtained. Should the latter adjustment again throw the amplifier into oscillation it will be necessary to further slightly loosen the adjusting screw.

Once the above adjustments have been made and the settings for most satisfactory operation have been obtained the Infradyne Amplifier will function without further attention other than adjustment of the filament temperature.

If difficulty is experienced in obtaining maximum amplification after all instructions given for placing your receiver into operation have been carefully followed, the trouble can probably be remedied by lengthening somewhat the wire connected to the plus "B" binding post of the amplifier. The best length for this lead will be found by experiment.

The Infradyne Amplifier meets exactly the requirements of the Sargent Infradyne described in "Radio" for August, 1926, and is also adapted to use with many standard receivers of the tuned radio frequency type. When used with standard tuned radio frequency receivers it offers a decided increase in selectivity and a marked reduction in background noise.

Additional information regarding the special application of the Infradyne Amplifier to your individual requirements will be furnished upon request.

REMLER

GRAY and DANIELSON Manufacturing Company

CHICAGO — 260 FIRST STREET SAN FRANCISCO — NEW YORK

REMLER

SERVICE FOR SET BUILDERS

GRAY & DANIELSON MANUFACTURING CO., 260 FIRST STREET, SAN FRANCISCO, CALIF.

REMLER 1928 INFRADYNE

BY H. W. SCRIBNER

The 1928 Infradyne is a ten-tube receiver in which radio frequency amplification at broadcast frequencies is combined with amplification at the relatively high intermediate frequency of 3500 kc. which is approximately equivalent to a wavelength of 86 meters. In the intermediate stages the "sum frequency" is amplified. The "sum frequency" is, as its name indicates, the sum of the received frequency and a locally generated frequency. Through the use of the sum frequency selectivity, quiet amplification and freedom from repeat settings on the oscillator tuning dial are obtained.

The 1928 Infradyne is particularly distinguished for the fidelity of its reproduction. For mellowness of tone, for volume without distortion, it can not be surpassed. Selectivity, which has not been made so great that side-bands are cut and reproduction is spoiled, is ample for present day conditions. In locations immediately adjacent to high-power broadcasting stations fewer distant stations will necessarily be received during the operation of the local stations than would be received were the receiver situated in a slightly less congested locality although no trouble will at any time be experienced in completely separating local stations. The 1928 Infradyne combines excellent selectivity and really enjoyable, life-like reproduction with ease of operation, compactness and attractiveness of appearance. The Infradyne is truly a universal set which appeals alike to the man who requires the utmost [illegible] of operation and the man who [illegible] reception of distant stations. It is finished in a beautiful, sheet-copper cabinet finished in two-tone brown crystalline enamel which will harmonize perfectly with the finest of surroundings.

The 1928 Infradyne is provided with a switch having three positions, "Off," "Local" and "Distance." A turn of this switch to "Local" brings into operation a single-dial control, five-tube tuned radio frequency receiver. When the switch is in the "Distance" position the complete Infradyne is available. There are but two major tuning dials, one of which operates the condenser tuning the radio frequency amplifier circuits and the other of which operates the condenser tuning the local oscillator circuit. When the panel switch is in the "Local" position and five tubes only are in use only the tuning dial controlling the radio frequency amplifier circuits is employed. Each of the two tuning dials rotates through a full 360 degrees in covering the broadcast band and ample dial separation of stations is had at all parts of the scale. An adjustment is provided so that the dials can easily be made to read quite closely together, with a maximum deviation at the far ends of the scale of perhaps five or ten degrees. Illumination of the dials is provided and during the time that five tubes only are in use only the tuning dial employed will be illuminated.

In addition to the tuning dial controls, volume and sensitivity controls and a filament rheostat are located on the panel. These controls are all of the semi-fixed type. The volume control is a rheostat in the filament circuit for the first two radio frequency tubes and its adjustment determines the gain in the radio frequency amplifier. The sensitivity rheostat controls the gain in the intermediate amplifier. The panel rheostat is adjusted so that the panel voltmeter reads "3" and is not further used. An "Antenna Compensator" control is provided. The antenna compensator is a device which nullifies the detuning effect of the antenna system, making the use of variable trimmer controls for the radio frequency amplifier unnecessary and hence simplifying tuning. It permits the immediate adaptation of the receiver to the particular antenna system used and does not need to be used for ordinary tuning, once it has been correctly adjusted.

Variable coupling between the primary and secondary circuits of the transformers used in the radio frequency amplifier is employed and the degree of coupling is automatically controlled through a cam located on the shaft of the tuning condenser. The result is that maximum and uniform gain is obtained at all wavelengths in the broadcast band. The radio frequency amplifier is a completely shielded, wired and balanced unit ready for installation in the receiver without special attention. Switches are provided which can be adjusted at the time of installation for the degree of selectivity and stability of operation best suiting the operator and local conditions.

Five CX 301A tubes, four CX 299's and one power tube, which may be either a CX 112 or a CX 371, are used. These comprise two radio frequency amplifiers functioning at the frequency of transmission, a first detector or mixer tube, an oscillator, three intermediate amplifiers functioning at the fixed frequency of 3500 kc., a second detector and two audio amplifiers. A six-volt filament supply is required and this should perferably be a storage battery of 100 ampere-hour or more capacity. Plate voltages of 22½, 67½, 90 and either 135 or 180 are necessary. The plate supply may consist of "B" batteries of the heavy duty dry-cell type or the storage type or a suitable "B" eliminator may be used. The Infradyne is critical as regards filament and plate voltages and the peculiar requirements of the set must be kept in mind in choosing power supply devices. The receiver draws a total filament current of two amperes when the ten tubes are in use and a total current of 1½ amperes when five tubes only are being used. The maximum drain on the plate current supply device, assuming the use in the second audio stage of a CX 371 tube operated at a plate voltage of 180, will be in the neighborhood of 40 milliamperes. Detailed information regarding the use of "A" and "B" eliminators with the Infradyne will be supplied upon application.

The Infradyne is, as has been implied in the above discussion, intended for use with an antenna. One about 40 feet in length will generally be found about right. In localities far from broadcasting stations longer antennas can successfully be used and in localities which are congested as regards broadcast conditions short antennas of the inside variety can be used with surprisingly good results.

Parts for the 1928 Infradyne are available in kit form. Six blue prints and a complete and detailed instruction book are supplied with the No. 750 Foundation Kit. Construction of the set is simple and virtually resolves itself into the assembly of the component parts and the installation of a wiring cable laid out by the builder in accordance with full instructions furnished.

THIS SERVICE WILL BE BROADENED

WATCH FOLLOWING BULLETINS

REMLER

BULLETIN NO. 5

SERVICE FOR SET BUILDERS

GRAY & DANIELSON MANUFACTURING CO., 260 FIRST STREET, SAN FRANCISCO, CALIF.

REMLER 1928 INFRADYNE

BLUE PRINTS AND INSTRUCTIONS

$1.00 SET

FURNISHED BY JOBBERS

INCLUDED WITH No. 750 FOUNDATION KIT

FOR THE **CUSTOM** SET-BUILDER

OPERATES ON **FIVE OR TEN TUBES**

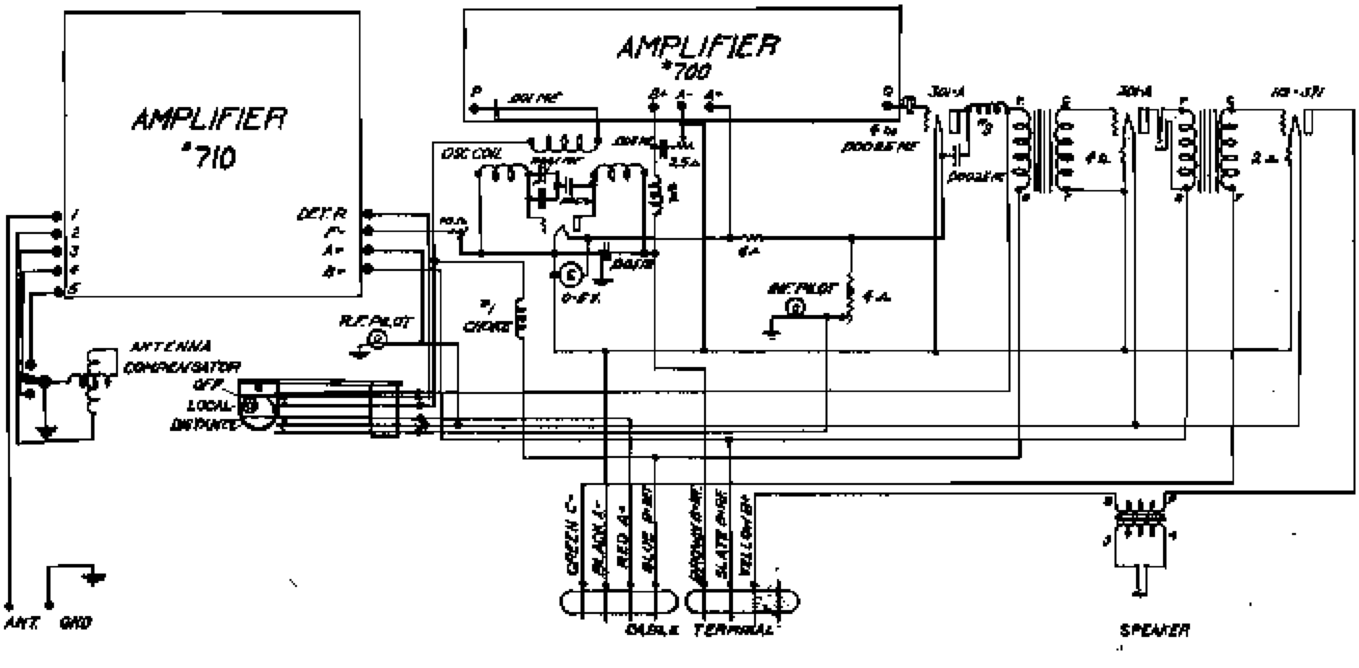
LIST OF PARTS

1	REMLER No. 750 Infradyne Foundation Kit. Includes Steel Base, Bronze Control Panels, Dials, Condensers, Rheostats, Switches, Chokes, Coupling Coil, Resistances, Sockets, Cable, Wires, Bolts, Nuts, Screws, Washers, Brackets, Knobs and a Complete Set Blue Prints with Instructions	$ 52.00
1	REMLER No. 710 Radio Frequency Amplifier and Antenna Compensator	55.00
1	REMLER No. 700 Infradyne Amplifier	27.50
1	REMLER No. 760 Copper Cabinet Two-Tone Brown Crystalline Enamel and Wood Base	15.00
2	Silver-Marshall No. 220 Audio Transformers $8.00	16.00
1	Silver-Marshall No. 221 Output Transformer	7.50
1	Jewell No. 135 or Weston No. 506 Voltmeter	7.00
	Complete Set of Parts, List	$180.00

SOLD THROUGH JOBBERS

FOR DESCRIPTION SEE OTHER SIDE

RMA



SERVICE FOR SET BUILDE

GRAY & DANIELSON MANUFACTURING CO., 260 FIRST STREET, SAN FRANCISCO, C

PARTS FOR THE 1928 INFRADYNE RECEIVER

REMLER *Infradyne* AMPLIFIER

The Remler Infradyne Amplifier is a three-stage radio frequency amplifier designed to function at a fixed frequency of 3500 kc. It is adapted to use with virtually any receiver of the neutrodyne or tuned radio frequency type; it fully meets, as well, the requirements of the Sargent Infradyne circuit.

The Infradyne Amplifier not only decidedly improves the selectivity of a receiver and greatly amplifies the received signal but it suppresses, to a large degree, audio frequency disturbances originating both within and external to the receiver. It makes possible the reception of stations which would otherwise be entirely inaudible or blanketed out by locals and permits quieter and more enjoyable reception of distant stations.

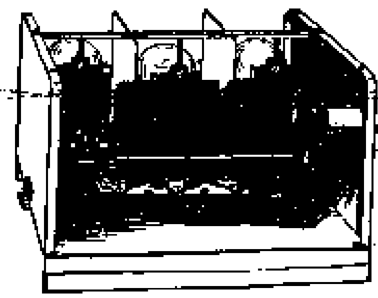
Controls are of moulded bakelite and nickel-plated brass and the Amplifier is enclosed in a bright-dipped and lacquered copper case which effectively prevents it from influencing or being influenced by adjacent apparatus.

Construction is in accordance with the best engineering practice. Low-loss design has been employed and parts and wiring are arranged so that undesirable capacitive and inductive coupling is eliminated.

The success of the Infradyne Amplifier has been made possible by the development of a simple and effective method of controlling amplification at very high frequencies. Amplification at 3500 kc. permits the attainment of extreme selectivity without impairment of quality of reproduction due to cutting of side bands.

The Infradyne Amplifier employs three CX 299 (UX 199) tubes. These tubes are operated at a filament voltage of 3 and a plate voltage of 67½.

No. 700. Infradyne Amplifier..List Price $27.50



REMLER *Radio Frequency* AMPLIFIER

The Remler No. 710 Radio Frequency Amplifier is a completely shielded, single-dial control unit incorporating two stages of radio frequency amplification and a detector. It is designed to employ tubes of the CX 301A (UX 201A) type. A resistor automatically controlling the detector filament temperature is included in the Amplifier and leads are brought out so that an external rheostat can be used on the radio frequency tubes.

So-called plate or "bias" detection is used in the Amplifier. Plate detection introduces less distortion than grid detection. For detection the third tube is operated at a plate voltage of 22½; to convert the unit to a three-stage radio frequency amplifier it is only necessary to raise the plate voltage applied to the third tube to 67½ or 90.

The No. 710 Amplifier is completely enclosed in a sheet copper case which is "grounded" to the negative filament circuit. It is therefore electromagnetically shielded and broadness of tuning which would result from direct pick-up of energy by the coils is eliminated. Electrostatic shielding is employed between stages.

Tuning is accomplished by means of the Remler Type 633 Three-in-Line Condenser which is included in the Amplifier. Three special balancing condensers are an integral part of the Type 633 Condenser and these balancing condensers are carefully adjusted before the Amplifier leaves the factory to compensate for differences in capacity introduced by coils, tubes and wiring.

The coils are wound with double-silk covered wire, are small in diameter and are of the solenoid type. The secondaries are specially wound to limit the external fields and to further the stability of the Amplifier. The primaries are arranged to rotate within the secondaries and their motion is automatically controlled through the condenser shaft. Constant coupling and uniform gain at all wavelengths are thus obtained. Switches are provided whereby two degrees of primary to secondary coupling can be obtained in the second two r.f. transformers while the antenna compensator permits three degrees of antenna coupling. Switches are also provided by which stabilizing resistances can be connected into the grid circuits of the first and second tubes when necessary. The entire unit is extremely flexible and can be adjusted for maximum efficiency under widely varying conditions. Amplifier Dimensions: Width 8½, depth 10¼, height 5¾.

The Antenna Compensator is supplied with the No. 710 Radio Frequency Amplifier. It consists of a three-point switch and a small variometer. The antenna coupling is varied by means of the switch. The variometer is connected in series with the secondary of the input transformer or antenna coil and is included in the tuned circuit controlled by the antenna section of the tuning condenser. The compensator variometer is adjusted in conjunction with the antenna section balancing condenser so that the antenna tuned circuit will stay in resonance with the remaining tuned circuits at all wavelengths without the further adjustment of the compensator controls. The compensator switch and variometer are controlled by the two halves of a single knob. The compensator can be used as a final adjustment in order to obtain the greatest possible volume from a distant station.

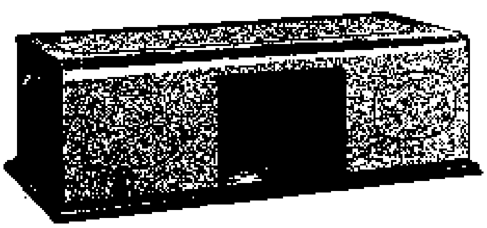
No. 710. Radio Frequency Amplifier..List Price $55.00

REMLER

SERVICE FOR SET BUILDERS

GRAY & DANIELSON MANUFACTURING CO., 260 FIRST STREET, SAN FRANCISCO, CALIF.

REMLER CABINET AND BASE

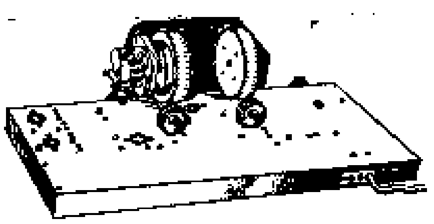


The Remler Infradyne Cabinet and Base add the necessary finishing touch to the 1928 Infradyne Receiver. They make of the Infradyne a receiver which will harmonize perfectly with the richest of furnishings and which is beautiful in its simplicity.

The cabinet is of formed sheet copper finished in two-tone brown crystalline enamel. It fits over and closely around the pressed steel base on which the set is built. The receiver and cabinet are set on top of the decorative wooden base which is finished in satin walnut.

List Price
No. 760, Cabinet and Base $15.00

REMLER *Infradyne* FOUNDATION KIT



The Infradyne Foundation Kit is the basis of the 1928 Infradyne Receiver. With it are included a drilled, pressed steel base, instrument panel, bronze control panels, and all of the small parts which would otherwise have to be gathered together from various sources. When the Foundation Kit is employed the builder of the Infradyne is assured of materials of the highest class and of a receiver that will function perfectly and that is the equal in constructional details of the highest priced factory-built sets. The bronze control panels and special bakelite fittings insure a standard of appearance second to none. With the Foundation Kit are included blueprints and complete and detailed instructions covering building and operation of the set.

The following items are included in the Infradyne Foundation Kit. A survey of this list will give to the reader an idea of the thoroughness and care with which all details have been taken care of and will convey a partial realization of the saving of time, energy and expense which the Kit offers.

- 1 Pressed Steel Base (11x26x1½).
- 1 Pressed Steel Instrument Panel.
- 2 Bronze Control Panels.
- 1 Remler No. 110L Dial Complete.
- 1 Remler No. 110R Dial Complete with Special Bracket.
- 1 Remler Type 639 Condenser.
- 4 Remler No. 50 Sockets.
- 1 Frost 2½ Ohm Rheostat.
- 1 Frost 4 Ohm Rheostat.
- 1 Frost 10 Ohm Rheostat.
- 1 Frost No. 953 Jack.
- 1 Frost No. 954 Jack with Oxidized Metal Bushing.
- 1 Yaxley No. 69 Switch.
- ~~3 Remler No. 35 Choke Coils.~~
- 1 Electrad Type P .00025 Mfd. Condenser.
- 1 Electrad Type P .001 Mfd. Condenser.
- 3 Electrad Type P .005 Mfd. Condensers.
- 1 Electrad Type GS .00025 Mfd. Condenser with Special Bracket Attached.
- 1 Coupling Coil.
- 1 2-Ohm Resistor.
- 1 4-Ohm Resistor.
- 1 6-Ohm Resistor.
- 1 6-Megohm Durham Grid Leak.
- 1 Eby "Antenna" Binding Post.
- 1 Eby "Ground" Binding Post.
- 8 ft. Battery Cable.
- 12 Pieces Colored Wire.
- 1 Coil Binding Cord.
- 1 Special Adjustable Condenser with Bracket Attached.
- 2 Special Bakelite Terminal Blocks.
- 6 Special Molded Bakelite Knobs.
- 1 Special Bakelite Bushing.
- 2 Rheostat Extension Shafts.
- 2 Rheostat Levers.
- 2 Special Spring Washers.
- 2 Special Nickel-Plated Brackets.
- 5 Special Brass Spacers.
- 2 Nickel-Plated Brass Threaded Bushings.
- 1 4" x ¾" x ⅛" Bakelite Strip.
- 1 Battery Cable Clamp.
- 1 ½" Fibre Washer.
- 3 1⅛" Fibre Washers.
- 1 2" Fibre Washer.
- 2 Nickel-Plated Washers.
- 2 oz. Brads.
- 21 6-32 x ¼" n.p. Machine Screws.
- 6 6-32 x ⅜" n.p. Machine Screws.
- 7 6-32 x ½" n.p. Machine Screws.
- 1 6-32 x ⅝" n.p. Machine Screws.
- 8 6-32 x ¾" n.p. Machine Screws.
- 42 6-32 x ¼" n.p. Hex. Nuts
- 2 21/64" x 36 Brass Hex. Nuts.
- 4 Soldering Lugs.
- 6 Prints.
- 1 Instruction Book.

No. 750 Foundation Kit Unassembled .... List Price $52.00

The following accessories will be needed: 1 6-Volt Storage Battery (80 ampere-hour capacity or larger), 3 45-Volt "B" Batteries (Eveready No. 770 or Layerbilt or Burgess No. 10308), 1 "C" Battery (See Tube Mfrs. Specifications), 5 CX 301A (UX 201A) Tubes, 1 CX 112 (UX 112) or CX 371 (UX 171) Tube, 4 CX 299 (UX 199) Tubes. Suitable Loud Speaker, preferably of the cone type.

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EQUIPMENT NEEDED

Crystal wheel for TURNEY CRYSTALOI DETECTOR
600 T Deforest Honeycomb Coil
½" E I CO or similar SPARK COIL
~~½ or 1" E I CO HELIXES~~
Several fixed condensers by E I CO

Joe Simpson
Jamaica L.I.

Informationen

Die folgenden Seiten sind zusätzliche Informationen, andere Schaltungen des Entwicklers E. M. Sargent, sowie Artikel über den "Infradyne" späterer Jahrzehnte.

An Ultra-Selective Crystal Set

The First Unit in a Series of Circuits Involving a Minimum of Discarded Parts As More Elaborate Sets Are Built

By E. M. Sargent

MANY new or so-called new circuits have come on the market, held sway for a short time, and then died a sudden death. Some had been discarded years ago, because of inherent faults, only to be resurrected by some well meaning experimenters who had accidentally stumbled upon them. Others, such as the Cockaday, Harkness, Browning-Drake, and the Roberts, were real contributions to the radio receiving game. However, after playing around with all of these circuits for the past three years, the leading radio fans who like to build their own have about come to the conclusion that, tube for tube, one good circuit is about the equal of any other good circuit, all of which brings us to the newest development, namely,—the series of circuits.

This series of circuits, the writer believes, will fill a long-felt want on the part of the radio set builder. Roughly, the idea is as follows: Let us assume that our set builder has not much ready cash available and is rather doubtful about just how deep he wants to go into the radio game. After looking the field over, he decides to start in with a crystal set. At the same time, he is a believer in quality and therefore wants a crystal set on which he will not have to listen to the nearest and most powerful station all the time but on which he can take his choice of programs as between local stations. A set of this type requires a few dollars more for material than the average, but is well worth it in results gained.

Proceeding along these lines, our radio fan builds his crystal set, puts it on the air and, as is the case nine times out of ten, is immediately inoculated with the radio bug. He wants a larger set and finds that in order to get it he will have to throw away practically everything that he has in his present one. This is where the series of circuits steps in to help out the pocketbook of the newly-made radio fan. Instead of having to discard entirely his crystal set, and buy an entire set of new parts, he finds that Circuit No. 1, which is a very efficient one-tube set, can be easily made in about two hours by slightly redesigning his present set, and finds to his further surprise that this same circuit No. 1 can later be expanded into a two, three, or four tube set, using the same panel and baseboard layout and the same cabinet in which the crystal set was originally built. Not only that, but by redesigning the panel and cabinet when the five tube stage is reached, and using the same parts with a few additions, this same set can be built right up to an efficient eight tube superheterodyne.

LIST OF MATERIAL USED

1 Sargent Input Coil.
1 Battery Clip and Lead.
1 620 Remler Coupler.
2 631 Remler Condensers, .0005 mfd.
1 .001 Micadon.
1 Lincoln Crystal Detector.
1 B. M. S. Open Jack.
1 2-in. Dial.
2 Eby Binding Posts.
1 Bakelite Panel, 3/16 x 7 x 16 in.
1 Baseboard, 3/4 x 7 3/4 x 15 in.
1 Bakelite Strap, 3/16 x 3/4 x 9 in.
5 No. 6 Wood Screws, F.H., 3/4 long.
2 6/32 Machine Screws, 1/2 in. long, with nuts.
2 1/2 in. Angle Brackets.

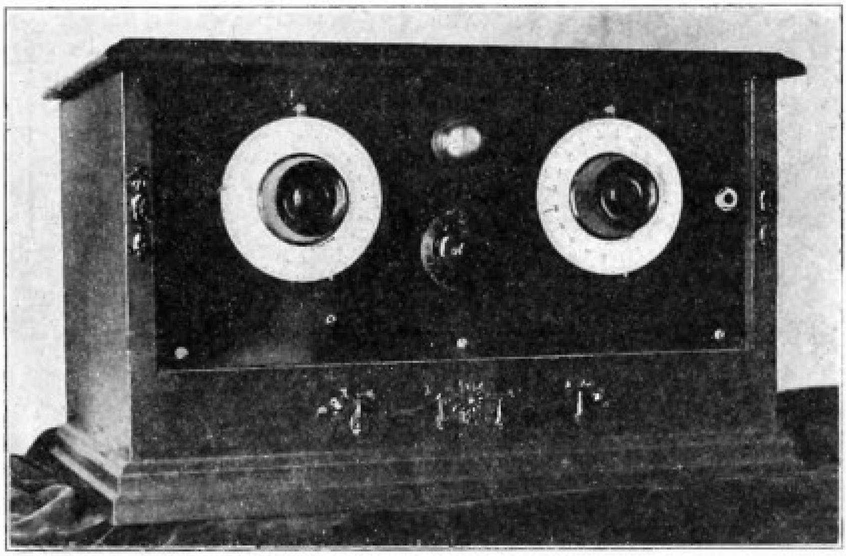

Fig. 1. Panel View of Completed Set.

Obviously it is necessary that these circuits be at least the equal of any others using the same number of tubes. This, the writer believes, has been accomplished. Incidentally, it should be stated that all of these circuits are not new and that the writer is not laying claim to any originality in a great many of them. They will not put the Browning-Drake, or the Cockaday, or the Haynes, or any other fundamentally good circuits out of date. On the other hand, several excellent ideas have been borrowed from the above named circuits, as well as from a great many other circuits that have appeared in print during the last few years. The one object has been to develop ten highly efficient radio receiving circuits from a crystal up to an eight tube set, having as the most important considerations maximum selectivity, good tone quality, and ability to receive distance. No reflex or trick circuits are included in the series. All of the sets, including the crystal, are selective enough to separate all local stations, one from the other.

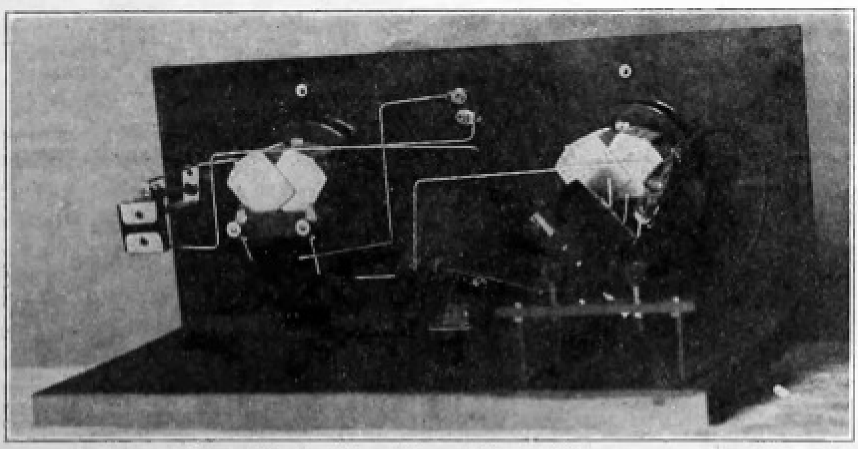

Fig. 2. Rear View of Crystal Set.

Circuit No. 0—A Selective Crystal Set

THE circuit numbers in this series, with the exception of Nos. 9 and 10, correspond to the number of tubes used. It has been unkindly suggested that the numbers are also an indication of the results that may be expected, but this is unfair to the crystal set. The crystal set is selective, sensitive, has good tone, and is not in any way critical to operate. In fact, it will be a distinct surprise to those who have never before operated a good one. There is no reason why a good crystal set is not a perfectly practical proposition, and the writer attributes the poor quality of the present ones to the fact that the engineers who are capable of designing good crystal sets have been concentrating their attention on the multi-tube receivers.

Bearing in mind the fundamental idea that the same parts are going to be used over and over again in the later sets, the radio set builder finds himself in a distinctly new position regarding the cost of his crystal set. He can now afford to immediately buy enough high-grade parts to get the results that he wants. Figs. 1 and 2 show the panel and the back of the crystal set, while Fig. 3 is a wiring diagram, an inspection of which will show why the set is selective. There are three tuned circuits between the incoming signal and the crystal detector, and these three circuits are plenty to filter out any but the most powerful interference. The perspective sketch in Fig. 4 will help those who have difficulty in following a circuit diagram.

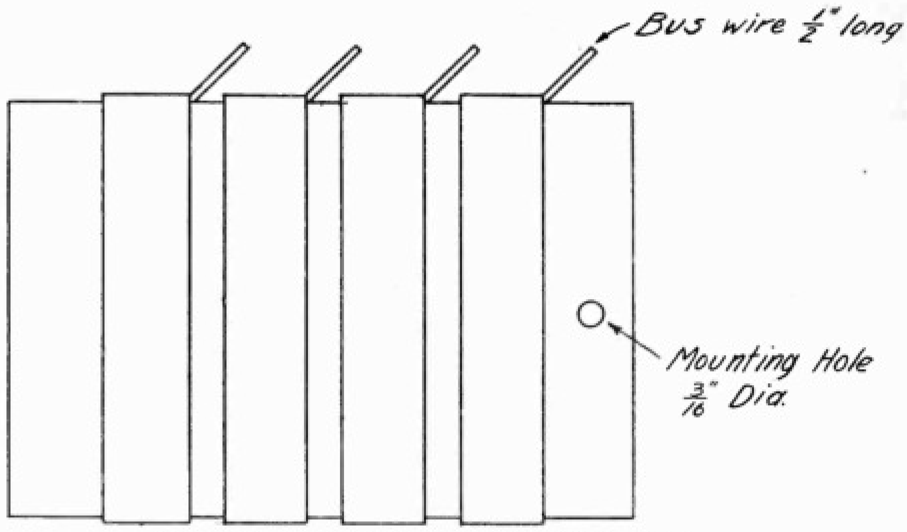

Fig. 5. Constructional Details of Sargent Input Coil.

The Sargent input coil, Fig. 5, consists of 60 turns of No. 24 double silk-covered wire wound on a piece of 2-in. Formica tubing 2¾ in. long. This coil is tapped every 15 turns and each tapped section is separated from the next by a spacing of about ⅛ in. The best way to take off these taps is to slip a small square of heavy paper or empire cloth under every 15th turn when winding the coil. Then cut four pieces of bus bar wire about ¾ in. long and bend them L shape. Scrape the insulation off each of the four wires where they cross the paper squares and solder one of these bus bar taps at each square, so that the bus bar stands up at an angle with the coil, as shown in Fig. 2. The small square of paper will protect the windings of the coil from any injury while soldering. The paper squares may be removed if desired after the taps have been attached.

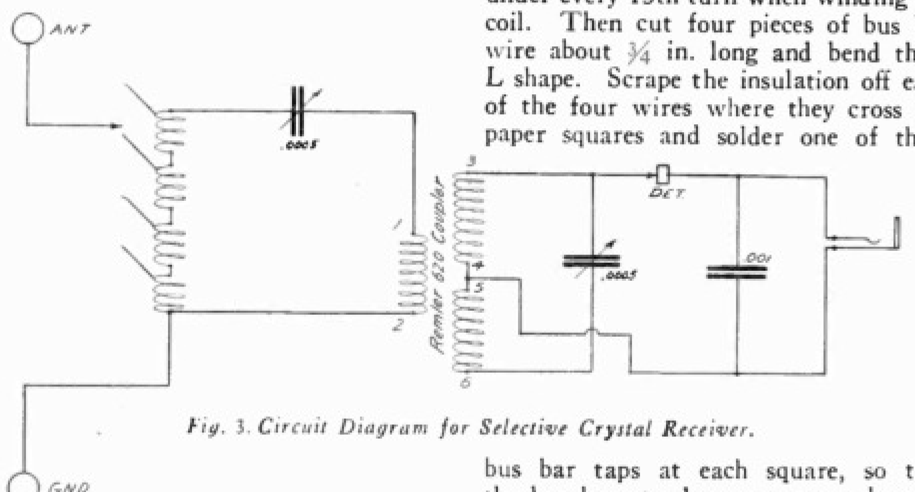

Fig. 3. Circuit Diagram for Selective Crystal Receiver.

It will be noticed that no provision has been made for a tap switch on the panel. This is done purposely, because the taps are not intended to tune with but are merely to adjust the coupling between the set and the antenna and ground in use. Once this coupling has been set for the antenna and ground in question, it need not be changed. Adjustment is made with a small No. 48 *B* battery clip and a flexible lead wire about 6 or 8 in. long.

The radio frequency transformer used in the set must have an adjustable coupling coil, and can be bought almost as cheaply as it can be made. The writer has selected the Remler No. 620 Coupler as being the best for this use. However, for those who wish to make their own, the specifications are as follows: The primary is wound on a piece of formica tubing 2 in. in diameter and 2½ in. long and consists of 70 turns of No. 28 D.S.C. wire. The secondary is wound on a piece of 1½-in. tubing, ¾ in. long and consists of 25 turns of No. 28 D. S. C. wire. The secondary must rotate inside of the primary and be adjustable by a dial from the panel. The panel layout and drilling instructions are shown in Fig. 6, the numbers on the panel template referring to the drill sizes to be used. All No. 18 holes are to be countersunk. Plenty of clearance has been allowed in every place where a condenser shaft comes through the panel so that if a slight mistake is made in drilling the holes for the screws, the shaft will not bind. The panel is laid out for two .0005 Remler Condensers. If any other condenser is used, the condenser drilling will have to be changed correspondingly. This same panel layout is used, with a few additions, up to and including the four tube set.

A word about variable condensers. There are so many good ones available on the market that it is not possible to select any one make and say that is the best. The standard of variable condensers has been raised so much in the last eighteen months that most of the better known makes are almost perfect, both electrically and mechanically. However, in certain of this series of circuits it is absolutely necessary to have a condenser with a neutral shaft; that is, a shaft that

(Continued on Page 80)

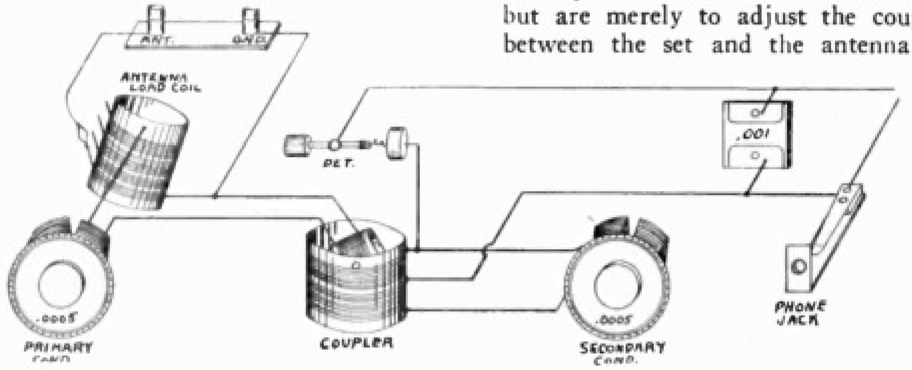

Fig. 4. Perspective Sketch of Completed Receiver.

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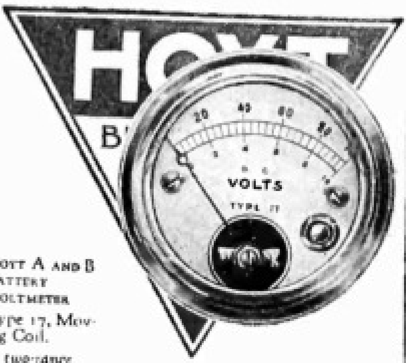
Don't Blame the Set



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Type 17, Moving Coil.
A two-range voltmeter with pushbutton in cover glass.

WHEN your radio set begins to act queerly and symptoms of hoarseness appear in your loud speaker, when distance dies and locals lose their accustomed appeal, don't blame the set — first. The best car in the world won't run on flat tires. You probably have a tire gauge to tell you the air pressure in your tires. Hoyt meters in your radio set will prevent the flat tires of radio — discharged batteries, loose connections, and poor tubes. Without meters, a radio set in trouble is anyone's guess. With meters, you can diagnose the trouble. Usually you can prevent it. Don't blame the set — use Hoyt meters and place the blame where it belongs.

Send for catalogue describing the entire line of Hoyt Radio Meters — an instrument for every use.

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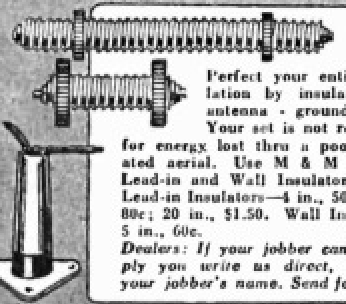

Perfect your entire installation by insulating your antenna - ground system. Your set is not responsible for energy lost thru a poorly insulated aerial. Use M & M Low-Loss Lead-in and Wall Insulators.
Lead-in Insulators—4 in., 50c; 10 in., 80c; 20 in., $1.50. Wall Insulators—5 in., 60c.
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The M&M Co.
CLEVELAND, OHIO.

ULTRA-SELECTIVE CRYSTAL SET

(*Continued from Page 14*)

has no electrical connection with either set of plates, and the Remler condenser fills this requirement very nicely. That is the reason that it has been chosen.

A baseboard is not needed if the set builder never intends to make more than a crystal set out of it. However, for one tube and more, a baseboard is needed and later trouble will be avoided if the binding post strip is mounted as shown.

jack, it will ruin it as well as make the set very noisy. It is best to tin the extreme ends of the jack terminals, whether or not they are already tinned, using as little flux as possible, then tin the wire and use no flux whatever when joining the two.

The operation of the crystal set is simple. To begin with put the antenna clip on about the second tap from the bottom, and turn the coupling coil so that the coupling is a maximum. Adjust the crystal until static or some noise is heard that indicates that a sensitive point has been found. Then turn both dials until a station is tuned in. If there is interference with any other station, loosen the coupling, and, if necessary, drop the antenna clip to a lower tap. The position of the antenna tap is in no way an indication of the amount of energy being used in the set or of the strength of the signal that will be heard, and very frequently the strongest signals will be received with the loosest antenna coupling. This crystal set is selective enough so that a large antenna can be used to get good signal strength.

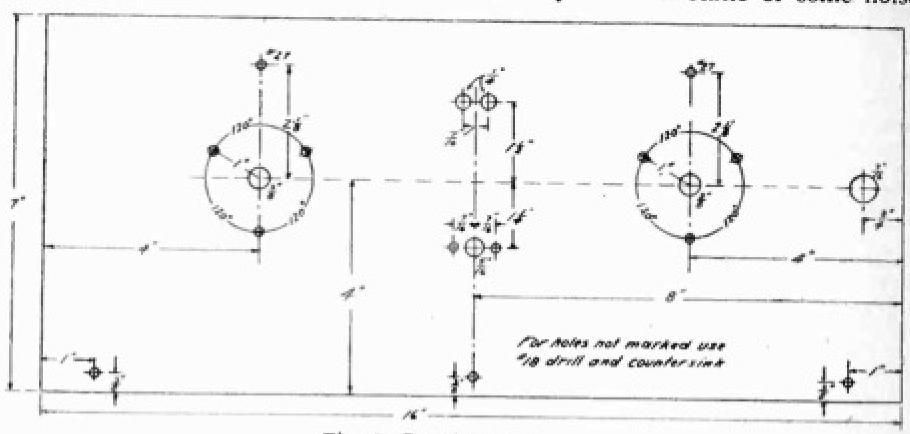


Fig. 6. Panel Layout.

A great deal of the efficiency of Circuit No. "O" depends upon the choice of a good crystal detector. The detector shown in the picture is a Lincoln but as this detector may not be available everywhere, the builder may substitute any similar type. It is best to have a detector with a semi-permanent adjustment, which is at the same time easily accessible to change when needed. A "fixed" detector is not recommended. For the crystal, use a good piece of galena, either mounted or unmounted, or an A-1 Crystal.

The parts are wired up as per the diagram in Fig. 3. Use No. 14, round, bus bar and solder all joints. Spaghetti may be used where there is danger of two wires crossing and forming a short circuit in the set. Aside from insulating against short circuits, spaghetti neither adds to nor detracts from the efficiency of the set and can be very conveniently left out. The writer does not recommend rosin core solder unless the set builder is an expert mechanic. Quite frequently the rosin will stick two wires together and at the same time form a thin insulating film between them which will hinder the passage of the current and many hours can easily be wasted in looking for one of these rosin joints. It is best to use the solid wire solder and a good grade of non-acid soldering paste. Use a great deal of care in soldering to the jack terminals, because if the soldering paste runs into the insulation on the

The results that may be expected will, of course, vary greatly with the locality, with the individual operator, and also with the care with which the set has been built. The writer is going to risk a laugh from the old timers by stating in plain print that this set will operate a sensitive loud speaker on nearby powerful stations under good conditions. The loud speaker operation, of course, will not compare with that of the tube sets, but it will be loud enough to be heard distinctly all over a medium-sized room when everyone in the room keeps quiet. The set will not receive further than the local stations except under extraordinary conditions, under which it might be possible to get 300 or 400 miles on earphones. Earphones are recommended as standard equipment for this set, regardless of its capabilities of operating a loud speaker.

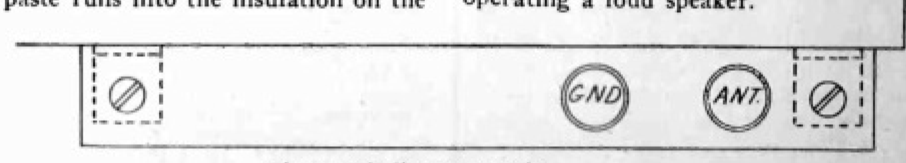


Fig. 7. Binding Post Strip.

An Efficient One-Tube Set

The Second in the Series Started in December Radio

By. E. M. Sargent

HAVING built the ultra-selective crystal set described in December, 1925, RADIO, you are now probably ready to substitute a vacuum tube for the crystal detector. This can easily be done with the former set as the basis by removing the crystal and adding a few parts, or the one-tube set can be made as the initial unit by those who have not made the crystal set.

A comparison of the materials required for the one-tube set with those required for the crystal shows that the only discarded apparatus is the crystal detector, which may be used in a future reflex set. Aside from the storage battery the new parts are inexpensive. The writer recommends the use of the storage battery tube.

The crystal detector is removed from the panel and a three plate variable condenser put in its place. A small copper shield should be put on the panel under this condenser, this shield being grounded. Care should be taken that none of the screws in the condenser are allowed to touch this shield, and it will probably be best to use two or three washers as bushings between the panel and the condenser to make sure that no undesired contact is made.

A rheostat is mounted in the lower right hand corner of the panel and the battery switch on the left hand side at about the center, as per the template, which is drawn for the apparatus specified. Slight changes may be necessary if other equipment is used. The baseboard layout looks to the future and the parts are so placed that they will not have to be moved when the parts are added later for the larger sets. The writer therefore, recommends that this layout be very carefully followed. It is advisable to use a good quality, non-microphonic socket, like the Benjamin, in order to minimize tube noises.

LIST OF PARTS

New

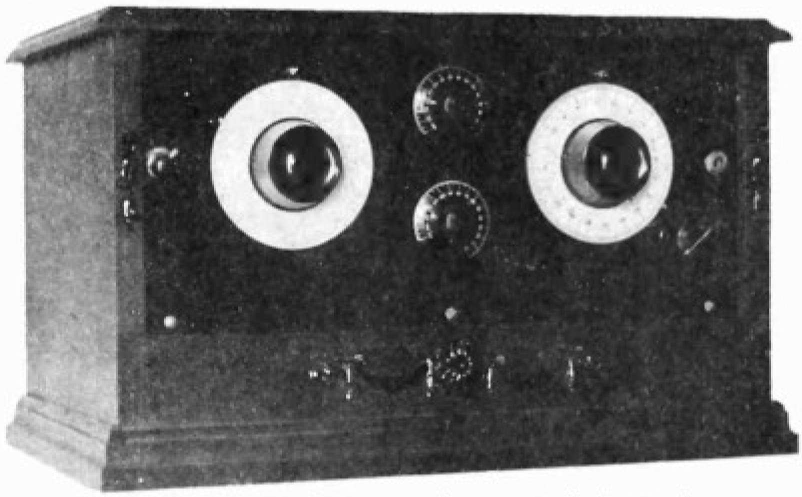
1 3-plate condenser (B. T.)
1 2-in. dial.
1 20 ohm rheostat (U. S. L.)
2 .0001 mfd. condenser (N. Y.).
1 .006 Micadon.
1 5 meg. grid leak (Daven).
1 vacuum tube socket (Remler).
3 Binding Posts (Eby).
1 filament switch (C. H.).
15 ft round bus wire.
2 lengths spaghetti.

From Crystal Set

1 input coil (des. in Dec. RADIO).
1 coupler (ditto).
2 variable condensers. (ditto).
1 battery clip and lead.
1 open crt. jack.
2 binding posts.
Panel 7x10x3/16 in.
Baseboard ¾x7¾x15 in.
Bakelite strip 3/16x¾x9 in.
3 No. 6. wood screws F. H. ¾ in. long.
4 ditto R. H.
2 ½ in. angle brackets.
2 6/32x½ in. machine screws.
2 6/32 hex. nuts.

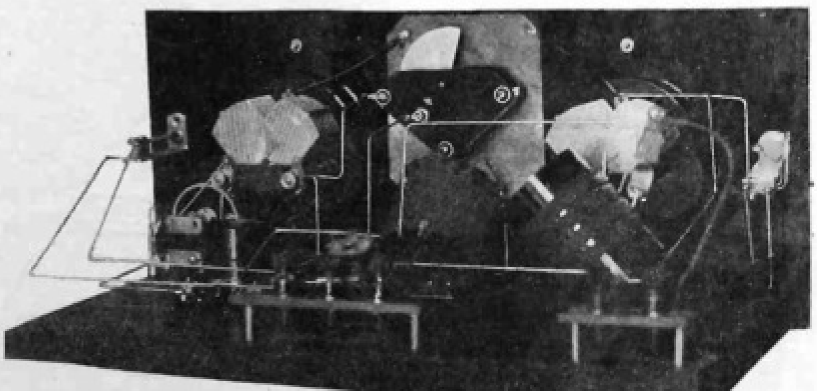
The grid condenser represents somewhat of a departure from the accepted size. In fact, the writer has never been able to discover why .00025 mfd. should have been decided on as the proper size for a short wave grid condenser. The early experimenters used variable grid condensers for which the most efficient dial setting was about 15 degrees which corresponded to about .00005 mfd. capacity. Some of the earlier receivers held to this variable grid condenser idea, but it was discarded in favor of the fixed condenser, probably because inexperienced operators persisted in trying to tune in stations with this dial.

A variable grid condenser is not a necessity but it is a great advantage to use one of approximately the right capacity. Tests show that the best results are secured with .00005 mfd. and a 5 meg grid leak. Incidentally this grid leak should be of high quality and should not only have a 5 meg label pasted on it but should be tested and guaranteed to be somewhere in the neighborhood of 5 megohms. Grid condensers of the size mentioned are not obtainable in single units and can best be made by putting two .0001 condensers in series. The pictures of the complete set, the wiring diagram, list of material, and the template give all of the necessary information for constructing the set.



Panel View of One-Tube Regenerative Non-Radiating Receiver.

Although this set is regenerative, it is not one that will radiate and bother the neighbors. The three circuit arrangement between the antenna and the tube practically eliminates this radiation. The regeneration is accomplished by means of the three plate variable condenser, which is used exactly as if it were a tickler coil. The operator of this set will be pleasantly surprised by its selectivity, as



Rear View of Receiver Showing Placement of Parts.

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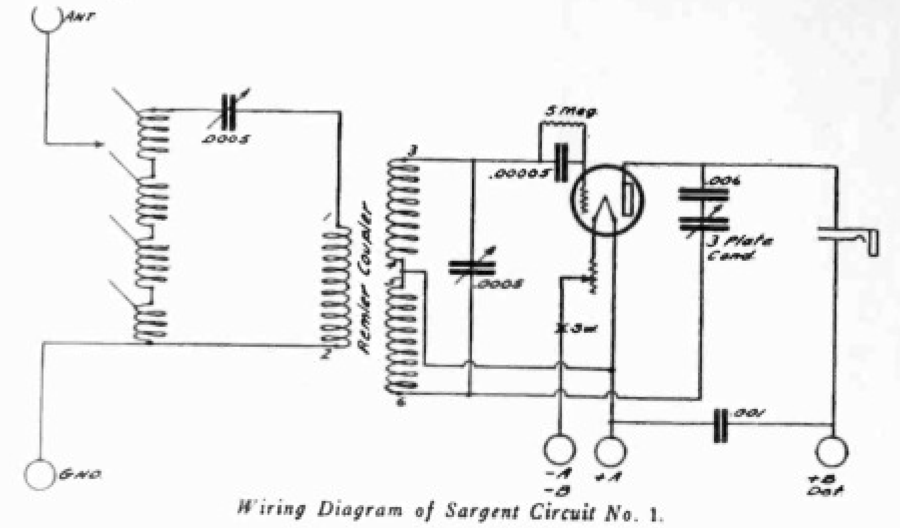
it is almost as selective as the average five tube tuned radio frequency receiver.

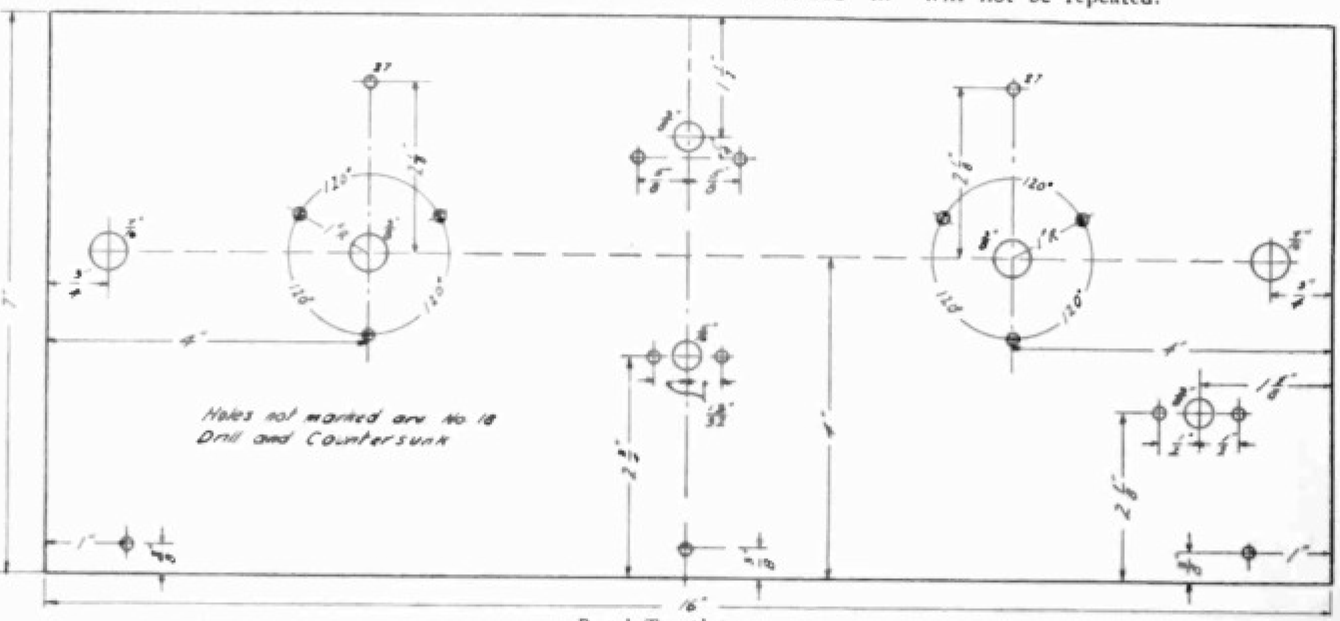
The operation of the set is rather difficult unless the operator bears in mind the general layout of the set and what he is actually accomplishing by adjusting each dial. The coupling dial and the antenna taps are purely selectivity controls and should not, under any conditions, be used to adjust the wavelength. This does not mean that they will not affect the wavelength of the receiver. On the contrary, they sometimes have a very marked effect on the wavelength, but it is not the right way to tune the set and a much more efficient setting can be found by changing the wave with the two large condenser dials. Turn both of these dials at once, keeping them as near as possible on the resonant points.



Wiring Diagram of Sargent Circuit No. 1.

For local reception, the three plate condenser can be set at zero but for the distant stations it should be brought up to the point of regeneration. The distance that can be received depends almost entirely upon local conditions and upon the weather. Suffice to say that the set has the required selectivity to eliminate the locals and has the sensitivity to pick up weak signals. This is as far as the set designer can go towards assuring himself of distant reception and the balance is a matter of chance.

In the next issue of RADIO, the two tube set will be described in detail. The writer would suggest, in order to avoid repetition, that the reader lay aside this and the preceding issue, because several of the parts, such as the input coil, are used in a great many of the later sets, and the instructions for building, as outlined in the first article, will not be repeated.



Panel Template.

SHORT WAVE STATIONS

L.C.—LIMITED COMMERCIAL   L.P.—LIMITED PUBLIC   P.G.—GENERAL PUBLIC

Class	Frequency Kilocycles	Wavelength Meters	STATION	Owner	Power (Watts)	Call
L.P.	13630	22	New Brunswick, N.J.	R.C.A.	40 KW	WIK
L.P.	8560	35.05	Rocky Point, N.Y.	R.C.A.	20 KW	QO
L.P.	6970	43.02	New Brunswick, N.J.	R.C.A.	20 KW	WIZ
L.C.	6814	44	Los Angeles, Calif.	Jay Peters	50	KZA
L.C.	6814	44	Portable, Calif.	Jay Peters	250	KZB
L.C.	5996	50	Springfield, Mass.	Westinghouse E. & M. Co.	20 KW	WBZ
*L.P.	5820	51.5	Rocky Point, N.Y.	R.C.A.	20 KW	WQN
L.C.	5100	58.79	E. Pittsburgh, Pa.	Westinghouse E. & M. Co.	20 KW	KDKA
L.C.	5082	59	Casper, Wyo.	Illinois Pipe Line Co.	500	KDC
L.C.	4400	68.4	Miami, Fla.	Florida Radio Tele. Co.	100	WRB
**L.C.	4400	68.4	Pinecrest, Fla.	Florida Radio Tele. Co.	5	WRP
L.P.	4052	74	New Brunswick, N.J.	R.C.A.	20 KW	WIR
L.P.	3331	90	Kahuku, Oahu	R.C.A.	20 KW	KIO
L.P.	3156	95	Bolinas, Calif.	R.C.A.	20 KW	KEL
L.P.	2910	103	Tuckerton, N.J.	R.C.A.	20 KW	WGH
L.C.	2188	137	Springvale, Pa.	West Penn. Power Co.	100	WOY
L.C.	2188	137	Pottsville, Pa.	Pa. Power & Light Co.	500	WDS
L.C.	2188	137	Wilsonville, Pa.	Pa. Power & Light Co.	200	WLF
L.C.	2188	137	Frackville, Pa.	Pa. Power & Light Co.	200	WBI
L.C.	2188	137	Williamsport, Pa.	Pa. Power & Light Co.	200	WPH
L.C.	2188	137	Hazelton, Pa.	Pa. Power & Light Co.	100	WCJ
L.C.	2188	137	Allentown, Pa.	Pa. Power & Light Co.	200	WHC
†L.C.	2142	140	Dearborn, Mich.	Ford Motor Co.	500	WAV

Class	Frequency Kilocycles	Wavelength Meters	STATION	Owner	Power (Watts)	Call
L.C.	2142	140	Iron M'tain, Mich.	Ford Motor Co.	500	WDY
L.C.	2142	140	Flint, Mich.	F. D. Fallain	500	WGF
L.C.	2142	140	Quanah, Tex.	Quanah Light & Ice Co.	250	KPC
L.C.	2142	140	Lawton, Okla.	Southwestern Light & Power Co.	250	KPP
L.C.	2142	140	Portable-Okla., Tex.	Southwestern Light & Power Co.	100	KPK
L.C.	2142	140	Oklahoma City, Okla.	Southwestern Light & Power Co.	250	KPR
L.C.	2142	140	Brownsville, Tex.	Rio Grande Radio Supply	10	KFWS
L.C.	2142	140	San Benito, Tex.	Rio Grande Radio Supply	10	KFWR
L.C.	2142	140	Detroit, Mich.	Detroit Yacht Club	500	WDYC
L.C.	2110	142	Charleroi, Pa.	West Penn. Power Co.	100	WJBF
L.C.	2100	143	Baltimore, Md.	Board of Fire Cmssrs.	250	WEQ
L.C.	2100	143	Washington, D.C.	Potomac Electric Power	50	WJX
L.C.	2100	143	Washington, D.C.	Potomac Electric Power	50	WJH
L.C.	2050	146	Boston, Mass.	Boston Fire Dept.	5	WEY
L.C.	2050	146	Dallas, Texas	Dallas Fire Dept.	100	KVP
L.C.	2050	146	Pysht, Wash.	Merrill & Ring Lumber Co.	5	KJA
L.C.	2050	146	Portable—Calif.	Russell Reed	50	KFZ
L.C.	2050	146	Portable—Calif.	Russell Reed	50	KGZ
L.C.	2050	146	Portable—Calif.	Pratt & Dutro	500	KYX
L.C.	2050	146	Portable—Calif.	Pratt & Dutro	500	KZI
L.C.	2050	146	Culver City, Calif.	Cecil B. DeMille	50	KJU
L.C.	2050	146	Los Angeles, Calif.	L.A.Co. Forestry Dept.	500	KYY
L.C.	2050	146	Portable—Calif.	L.A.Co. Forestry Dept.	500	KFV

*Also on 54.5 and 57 meters.   †Also on 143 meters, 1713 meters, 1875 meters.   **Also on 1600 meters, 1875 meters.

NOTE—42.8 to 52.6 meter band used for the development of apparatus for picture transmissions.

66.25 to 70.1 meter band reserved for Mutual Telephone Company, Hawaii, for inter-island telephone service, 133 to 150 meter band now being used experimentally by this company for the same service.

109 to 120 meter band used by voluntarily equipped tug boats and small pleasure craft.

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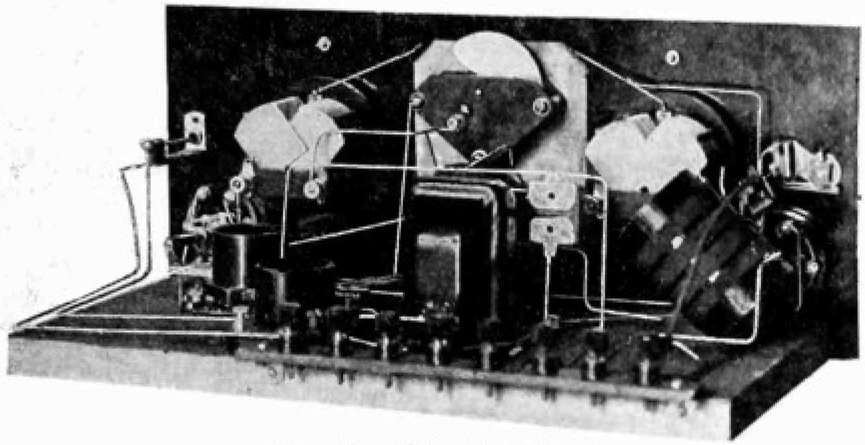
An Efficient Two-Tube Set

The Third in the Series Started in December RADIO

By E. M. Sargent

AS previously stated, all of the sets in this series have been designed with selectivity as the first consideration, tone quality next, and ability to get distance a third but still an important factor. It is the belief of the writer that these three items should be considered in this order in any radio set, it being obvious that the first thing to do is to be able to get the station that you want, that after getting the station it is next important to have it sound well, and third, the ability to get distance gives a greater choice of stations from which to pick a good program. Following out this order, Circuit No. 2 is merely Circuit No. 1 with one good stage of audio frequency added. This is a set that will bring in all locals, clear and loud on the speaker, without any interference. The real long distance fans will have to wait until next month when Circuit No. 3 comes out before they will be able to log a great number of DX stations.



Rear View of Completed Receiver.

We are now fortunate in having at our disposal a large number of extremely fine audio transformers. These transformers not only have from two to three times the power of the transformers formerly available but they also have flat frequency characteristics, which means that they amplify equally well over practically the entire musical scale. It is, therefore, not an easy matter to select the best. The writer has chosen the General Radio No. 285, 6 to 1 transformer as being well suited for the requirements of the series of circuits. This transformer delivers about the same power in a one stage amplifier that former transformers delivered with two stages. Other transformers that may be substituted are the Rautand Lyric, the Thordarson 2 to 1, the Karas Harmonic or the Amertran De Luxe. Any one of these five, when used with the circuit diagram shown in Fig. 1 will successfully operate a cone type loudspeaker.

The parts neeeded, in addition to those used in Circuit No. 1 as described in January 1926 RADIO, are one high grade audio transformer, one vacuum tube socket, one rheostat and two Eby *C* binding posts. The panel layout is the same as for Circuit No. 1 except the holes for the rheostat to be placed in the lower left hand corner, corresponding to those in the lower right hand corner. This makes a well-balanced panel which remains practically the same for the subsequent three and four tube sets.

The placement of parts is shown in the rear view of the completed set, which leaves room for the addition of a third and fourth tube. To facilitate wiring, the transformer should be placed with the primary toward the panel. The set should be wired up with No. 14 round tinned wire, spaghetti being used in any places where the wires are likely to short-circuit. Otherwise, insulation is unnecessary.

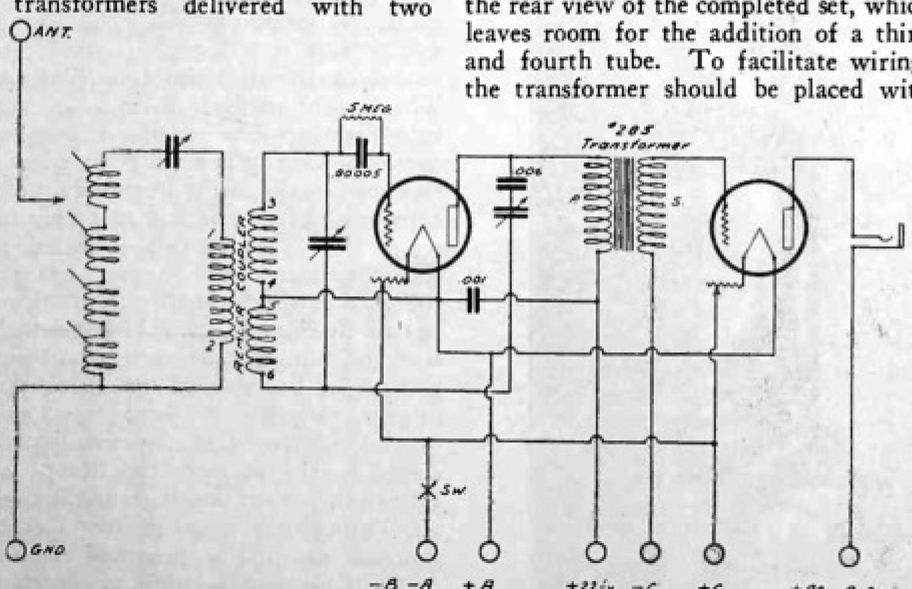


Fig. 1. Diagram of Circuit No. 2 for the Efficient Two-Tube Set.

The operation of Circuit No. 2 is exactly the same as that of Circuit No. 1. The first adjustment is the battery clip on the input coil. This clip should be set on the tap which gives the best selectivity and all-around results. The coupler at the bottom of the panel in the center should be set in a position so that the coils are about ¾ of the way uncoupled. These two are selectivity controls and in no case should be used as tuning controls to vary the wavelength. Although the variocoupler may look like a tickler coil, it is not one, regeneration being accomplished with the three plate condenser at the top of the panel. This condenser should be brought into the regenerative position, which will be about half way in, and then the two large dials turned in unison to locate the stations that are on the air. The best voltage to use on the detector is 22½, and the transformer should be provided with a *C* battery of 4½ volts.

Circuit No. 2 will operate fairly well with dry cell tubes if the builder has not had storage battery tube experience. The recommendation of the writer in a previous article,—to hock everything including the family silverware in order to get a storage battery—still stands if the builder expects to get the very best that is in the set.

The selectivity of Circuit No. 2 is something to be marvelled at and compares very favorably with the best neutrodynes. A recent test made at a distance of one mile from KTAB, 1,000 watts, 240 meters, proved that with a

(Continued on Page 52)

An Efficient Two-Tube Set

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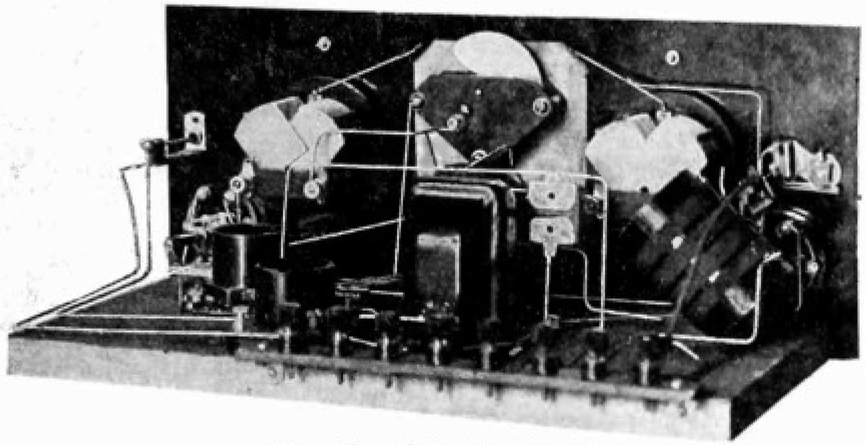

Rear View of Completed Receiver.

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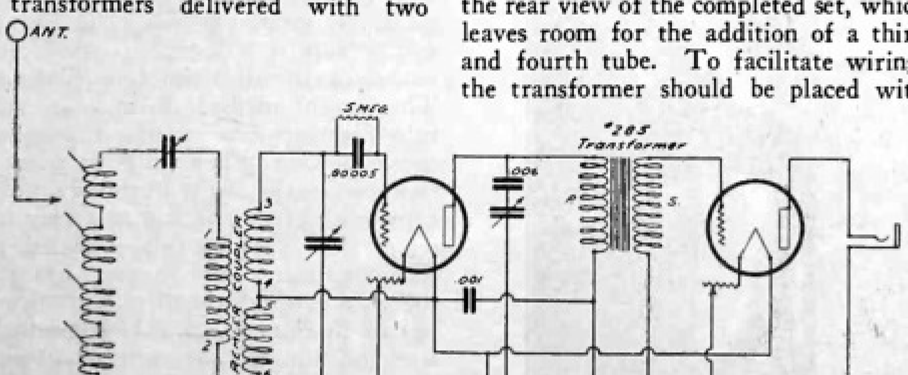

Fig. 1. Diagram of Circuit No. 2 for the Efficient Two-Tube Set.

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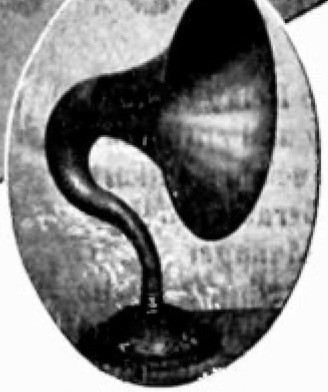

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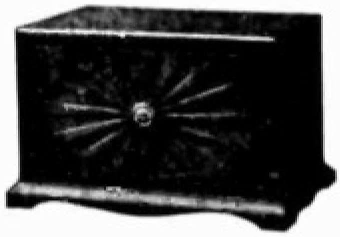

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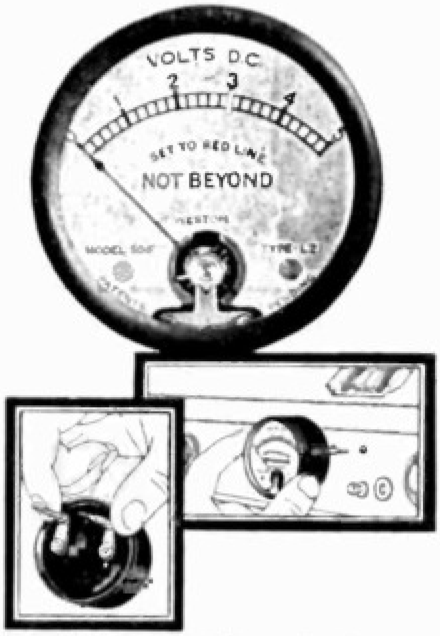

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(Continued from Page 50)

plaint amongst the listeners who like their American cousins have come to regard dancing as part of their everyday life. Dance music at present is restricted to three periods a week, when the band of the Savoy Hotel, that resort which is so much favored by the American tourist, plays selections from its repertoire.

Announcing in the B. B. C. is not carried on to such an extent as it is in the States, and long intervals frequently elapse before the new listener can ascertain to which station he is listening.

This article would not be complete without a few words as to the possibility of Anglo-American broadcasting. The erection of the high power station at Daventry in England and the projected high power station at Bound Brook, New Jersey are undoubtedly the precursors to this form of broadcasting, and America may expect to hear some of the English programs during the winter months which will be rebroadcast through the American stations. This will aid in cementing the friendship between the two great English speaking nations.

AN EFFICIENT TWO-TUBE SET

(Continued from Page 13)

small antenna it was possible to tune in on the loud speaker, without interference, station KFRC, a 50 watt station on 268 meters, fourteen miles away. It was further possible to tune in between these two stations and locate the wandering wavelength of KRE, which has a peak on about 256 meters. KRE was three miles away and using 50 watts.

This extreme selectivity cuts down the distance to some extent, but in localities which are not so congested, a large antenna can be used and this will bring in the distant stations with more power. To the writer's knowledge, there is nothing except a single circuit regenerative receiver that will do any better on distance using two tubes than circuit No. 2. A radio fan located at Modesto, California, recently reported that using Circuit No. 2 in combination with a Western Electric power amplifier he has logged 82 stations, among them being KDKA and several Chicago, Cincinnati, and Kansas City stations. This, however, is to be regarded as exceptional performance and can only be duplicated in the best of locations.

As stated before, the DX fans will have to wait another month for the set that really "brings 'em in with a roar," but it will be out in the March issue and the writer believes it will be a treat when the details are given.

National tests of radio reception to study the causes of fading are to be conducted by the Stewart-Warner Company in co-operation with Northwestern University on February 9, 10 and 11 from 8 to 11 p. m., central standard time.

An Efficient Three-Tube Set

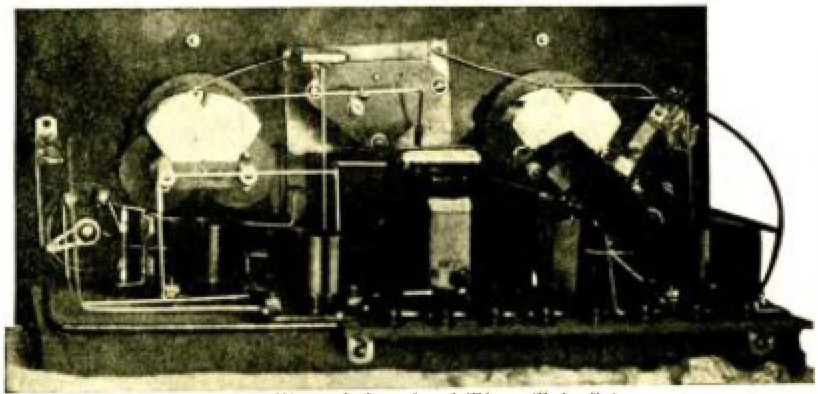
Consisting of One R. F. Stage Detector and One A. F. and Based Upon Circuits Previously Described

By E. M. Sargent

BEFORE starting with the details of Circuit No. 3, the writer would like to answer one or two questions which have come up several times since this series was started. One question which has been asked repeatedly is regarding the use of a crystal detector. It seems that many radio fans are under the impression that in order to get good tone from a set it is essential to use a crystal detector and conversely, when a crystal detector is used, perfection of tone is bound to follow. This, the writer believes, is an erroneous idea.

It is true that, as a general thing, a crystal detector has a better tone than a tube detector, but this is not because of any inherent fault in the tube; rather, the trouble is usually with the operator of the set. It is natural with a tube set to try to work it at its maximum capacity so as to get all the distance and volume possible. If a local station is coming in clearly on the headphones, the owner of the set usually proceeds to see how loud he can get it and the resulting overload on the tube causes distortion. Overloading a crystal detector in a crystal set is impossible and hence the tone delivered is always good.

A simple experiment will convince any crystal set owner that his crystal set is not delivering to the earphones an exact replica of the music that is being radiocast. Tune the set to some station that is coming in fairly loud and then, without changing the tuning dials, lift up the cat whisker and set it down in several different places. Notice that the tone of the music has slightly different characteristics every time the cat whisker is moved to a new place. It is therefore clear that all of these different tones cannot be correct and it is more than likely that not one of them are, which is another way of saying that even a crystal distorts.



Rear View of Completed Three-Tube Set.

When used in a reflex set, a crystal is much more likely to distort because of the heavy overload put on it by the radio frequency amplifiers ahead of it, and as a general rule better tone quality can be obtained with a tube detector. The tone can be still further improved by eliminating the reflex and using each tube for but one purpose. That is one reason why this series of circuits contains no reflex sets.

Another question that has come up several times is regarding the substitution of parts which may already be in the work-shop of the set builder. The circuits of this series as described are made to operate most efficiently with a given set of parts which are specified with each circuit. This does not mean that in certain places other parts will not work just as well but it does mean that if the circuit is to be given a fair trial it should be made up exactly as described.

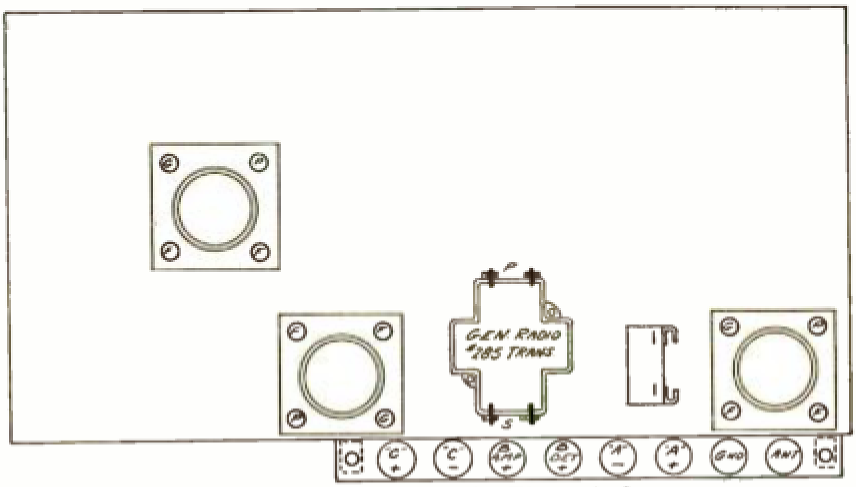


Fig. 2. Baseboard Layout for Three-tube Set.

Now to Circuit No. 3. Fig. 1 shows the wiring diagram. The panel layout is exactly the same as in Circuit No. 2, which was described in February RADIO. The added parts for the three tube set are: one socket, one 1 mfd. condenser, and a tube. The input coil is used between the antenna and ground

(Continued on Page 50)

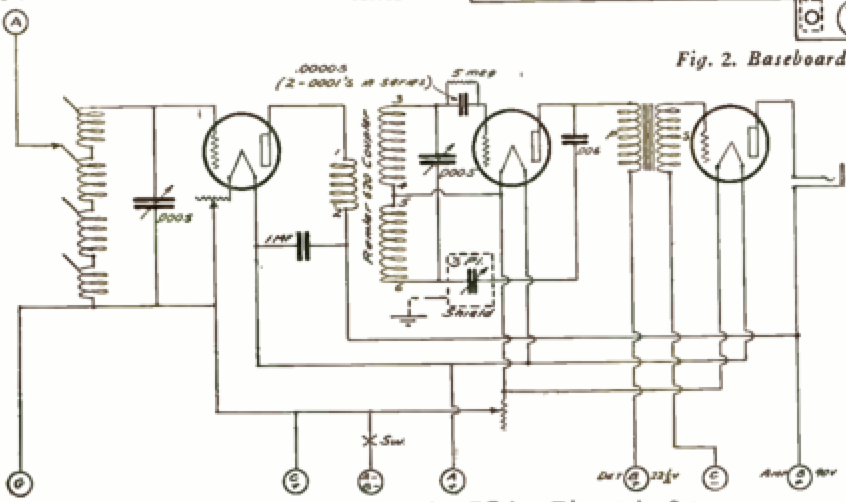


Fig. 1. Circuit Diagram for Efficient Three-tube Set.

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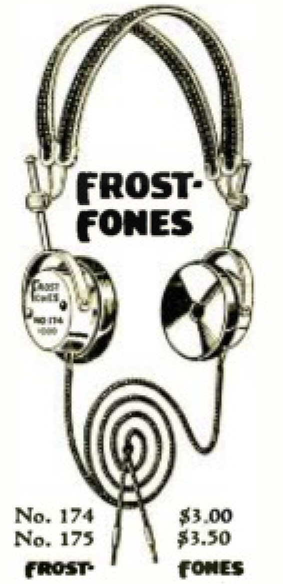

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AN EFFICIENT THREE-TUBE SET

(Continued from Page 14)

and the first radio frequency tube and the Remler oscillator coupler becomes the radio frequency transformer between the r. f. tube and the detector. The socket is added at the back of the baseboard and at the extreme left. The rheostat on the left hand side of the panel is shifted to control the r. f. tube only, the detector and audio tubes being handled by the right hand rheostat. A spring detector socket should be used to avoid howling and microphonic noises from the detector tube. Either a Benjamin or the new Eby spring socket is recommended in this place. The wiring is very simple and may be followed out from Fig. 1.

The results obtained from the three tube set will depend largely upon the patience used to master the tuning. There are many controls on the panel and it is necessary to operate each one intelligently to get the most sensitive results from the set. The operator should understand what each control is for. Any set that uses one stage of tuned radio frequency and a regenerative detector is very tricky and will do many strange and unusual things if not handled right. On the other hand, it is a very efficient combination when operated properly.

Tuned radio frequency amplifiers always have a strong tendency to oscillate and some means of oscillation control must be introduced to hold the set down. In a circuit like this where a few turns in series with the plate are closely coupled to the grid coil of the following tube, which is tuned by a condenser, the effect is the same as if the plate circuit itself were tuned. Loosening the coupling between the few plate turns and the following tuned grid coil lessens the reacting effect of the grid coil and hence lessens the tendency for oscillation in the first tube. This coupling can be loosened to such a degree that regeneration will take place but no oscillations will occur. This is the most efficient point at which to operate the radio frequency coupling.

Referring to Fig. 1, the rotor of the Remler coupler is in the plate circuit and the turns on the stationary coil are in the following grid circuit which is tuned to the same wavelength as the antenna. With the rotor tightly coupled to the stator, the tendency to oscillate is so strong with the rheostat turned up that the whole set will be locked tight. As this coupling is gradually loosened and the two tuning dials slightly readjusted to keep both circuits on the same wavelength, a point will be found where the oscillation will cease. This is the right setting for the coupler and once it is found it can be left practically unchanged. This setting should be determined when the radio frequency rheostat is turned at least three quarters of the way on, and the 3 plate condenser set at zero. Although this coupling will vary slightly with the wavelength, the difference can easily be made up by changing the setting of the radio frequency rheostat.

This method of avoiding oscillation takes the place of neutralizing. It is a little better because a point can always be found where the oscillations will stop, while with a neutralizing system, the services of an expert are sometimes required to find the neutralizing point. The same thing is accomplished by both methods.

The three plate condenser supplies the regeneration for the detector tube and the operation of this condenser will be very much as previously described in connection with the two tube set.

Operation: Use two hands to operate the set. Remember that trying to get nine tube results on three tubes requires plenty of work on the part of the operator, and act accordingly. "Cross" the two dials slowly up and down the scale. This means to rotate one slowly from zero to maximum and keep continually but slowly crossing back and forth over the point of resonance (where they are on the same wave) with the other. The tuning will be very sharp on the right hand control and any except local stations will probably tune out in less than two degrees. The set is very selective—even more so than Circuit No. 2.

Under the most favorable conditions, the set has done two thousand miles on the loud speaker. To be exact, the set located in Oakland, Cal., has received WEBH, KYW, WHB and KDKA. How near these results can be duplicated depends on location, atmospheric conditions and the operator. Probably forty per cent depends on location and conditions and sixty per cent on the operator. And it is well to bear in mind that the above results are under the most favorable conditions—not average conditions.

From time to time a great deal has been said about the effect of location on radio reception. Do not take this lightly, as location means everything. The writer had this forcibly impressed upon him several months ago while carrying a self-contained portable receiving set around town in the back seat of an automobile. A start was made from KGO and the machine driven directly away from the station for about three miles along a street which had no street cars but which was crossed in several places by high power lines. There were points along the street where it was impossible to pick up the program and other points where it came in very strong. These dead spots would suddenly appear for no apparent reason and they were undoubtedly caused by reflection from power wires or other metallic objects in the vicinity. A lack of signals in one

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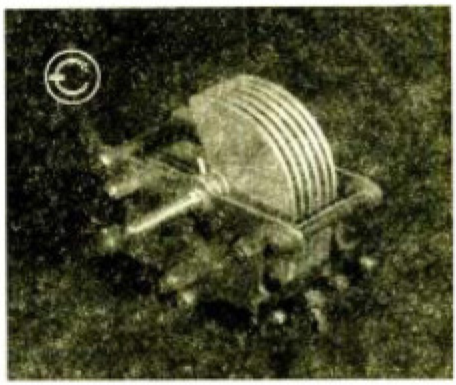

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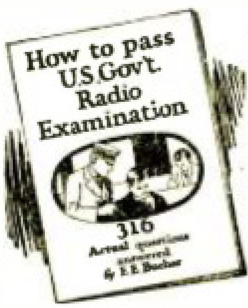

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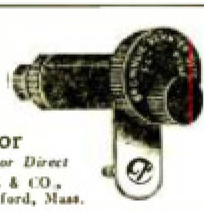

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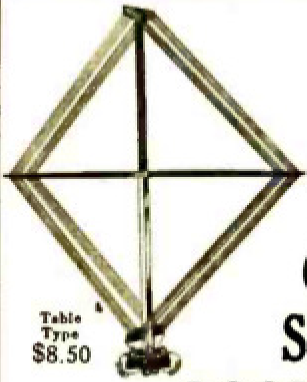

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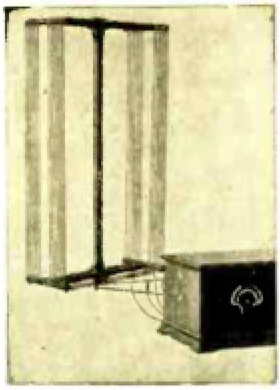

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Bracket Type, $8.50

A bracket type that attaches right onto the end of your radio cabinet or a table type—you can't miss it on either one. When you buy a Signal Loop you're buying more than just good looks. You're buying an aerial backed by thirty years of experience in the manufacturing of electrical equipment.

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Both aerials are beautifully constructed. The bracket type is of solid walnut. The table type is mahogany finished. All metal parts are heavily nickel plated. A third tap is provided for sets requiring it. Ask your favorite dealer to show you the Signal Loops—either type $8.50. You will surely want one.

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It distributes the wave lengths evenly over the 360° of the dial. Stations come in clearly without interference. Just step in at your dealer's and ask him to show you the Signal Spiral Cam Condenser—the condenser with the patented cam control. Then you will appreciate why thousands of fans have selected this condenser for their sets above hundreds of other condensers on the market today.

The Signal Spiral Cam Condenser is built for perfect control of high frequency as well as low frequency wave lengths. Results are uniform at all points on the dial—the scientifically designed cam takes care of that. There is absolutely no back lash and a balanced condition of the plate assemblies permits a smooth, velvety action that makes tuning a pleasure. Design permits single or three-hole mounting and the attaching of air core transformer directly onto the condenser.

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place seemed to be made up by more somewhere else.

An electrical map of a city block would show your receiving set surrounded first by a maze of water, drain, vent and gas pipes, standing up like a forest around it. Electric and doorbell wiring would appear to be hanging like vines around these pipes. In the center of it all would be the furnace with large pipes almost a foot in diameter, radiating in several directions. If the house happened to be finished in stucco, a complete iron wire shield would surround this entire forest of pipes and wire, all of which act like antennae and absorb radio waves. Does this sound like an ideal place for a radio set? It is no wonder that loop sets work better on the top story of a house than in the basement. There are about twenty such electrical forests to the city block, besides the street power wires and phone wires. These wires, being visible, usually come in for all of the blame when a dead spot is encountered, although actually they form a very small portion of the total interference to the passage of radio waves. It is no wonder that extreme distance is not done very often in city locations and it is easily seen why moving from a steel frame apartment house to a ranch in the country is like putting five stages of radio frequency into your set.

However, that is getting away from the story. In the average city location, Circuit No. 3 should do from 500 to 1000 miles at this time of the year. If the set fails to get distance don't tear it apart and change the hookup without first taking it to the house of a friend who has been getting distance, and trying it there. Remember that the circuit has worked and done good distance and is not a trick circuit. If instructions are carefully followed the set and the results can be duplicated.

A. R. R. L. BANQUET

(*Continued from Page* 36)

"guaranteed not to oscillate." Don Brockway, 6PL, won the "booby" prize, a boob medal, after a determined effort to do so. We are sorry that 6PL will be silent for an indefinite period owing to college, as it was an excellent station. Possibly Don may find time at a future date, if he can ease up on the Y. L.'s. If he can Charleston half as well as his brother, W. W. Brockway, 6MG, he is all right. The latter concluded the entertainment with another Charleston, demonstrating the fact that he surely "knows his stuff." The boys liked it.

T. A. Graul, ex-8SF, was introduced to the gang. He was welcomed by the California representatives to the National Convention, who remembered him as an excellent code artist on a door key. He is a real "ham" and will soon become a "six." More power to him. He can get it from the Edison Co.

Dr. J. E. Waters, 6EC, of Santa Ana, made a good suggestion for handling local traffic. He suggested 80 meters for this work with a simple loading device to QSY. We are tired of hearing the old story about Australia being easier to QSO than a point twenty miles distant. Some of the old "ham spirit" is being lost this way too.

transferred from the antenna circuit to the secondary circuit is reached when $M=\sqrt{R_a R_b}$ where R_a and R_b are the respective circuit resistances of the antenna and secondary circuits.

The induced voltage into the secondary is given by $E_s=6.28\, f\, M\, I_a$ where I_a is the antenna circuit.

The wavelength of the secondary circuit $L_2\ C_2$ may be found from an LC table or, if desired, may be computed from the formula: $\lambda=1884\sqrt{L\,C}$.

The current flowing in secondary circuit may be computed from Ohm's Law when the secondary circuit is tuned to the same wavelength as the antenna and both in turn are tuned to resonance with the incoming signal. This is the case with which we are usually concerned and under these conditions the computation is very easy, $I=E/R$ where E is the voltage induced into the secondary and R is the resistance of the circuit $L_2\ C_2$. When not in resonance with the incoming wave, the formula

$$I=\frac{E}{\sqrt{R^2+(2\,\pi\, f\, L-1/2\,\pi\, f\, C)^2}}$$

must be used. This is of value in computing the current that is received from an interfering station that is on a different wavelength than that which it is desired to receive.

The voltage built up across the secondary should not be confused with the voltage which is induced into the secondary coil L_2, as the voltage that is built up across the coil is many times greater than that which is induced. This is found by $E=6.28\, f\, L\, i$, where i is the current flowing thru the coil. Inasmuch as there is no appreciable voltage drop thru the grid condenser C_3 and grid leak R_3 this may be considered as the voltage that is applied between the grid and filament of the detector tube.

The Filament Circuit is computed by Ohms Law. We will assume that the tube is a CX-301A. From the manufacturer's specifications we find that this tube requires a filament current of ¼ ampere and that there will be a drop of 5 volts across the filament. A 6 volt storage battery will be used. Suppose it is desired to find out what size rheostat will be required to cut down battery voltage to the 5 volts that the tube requires. As 5 volts will be the drop across the tube filament, the drop thru the rheostat must be 1 volt. Therefore,

$$R=E/I=1/.25=4 \text{ ohms.}$$

If a CX-299 tube, which has a filament current of .06 amperes and a 3-volt filament is used and it is to be supplied from a 6-volt storage battery, the rheostat will have to be of 50 ohms capacity, as shown by the same formula.

In Fig. 1, the grid return is shown as going to the positive filament. This puts the grid at the potential of that point less a small drop thru the leak. If the grid return is brought to the negative filament, there is no drop thru the leak and the potential is exactly the same as the point to which the wire is attached. If the grid return is brought to the negative A battery, the grid is one volt negative with respect to the filament on account of the drop thru the rheostat.

In the plate circuit the size of the tickler coil L_3 depends upon the closeness of coupling. It should usually have from ⅓ to ½ the inductance value of the secondary L_2. Most audio transformers have a primary resistance of about 2000 ohms and a distributed capacity of about .00005 mfd. Suppose that the incoming signal is on 600 meters. The inductance of the audio transformer is so high as to make passage of this frequency impossible. The only radio frequency path, therefore, is thru the capacity of the primary windings. The reactance of this path may be found by $Z=\dfrac{159154}{f\,c}$

which shows a capacity of .00005 to have a reactance of 6366 ohms to a 600 meter signal. This is usually too high to permit the tube to oscillate and, therefore, a by-pass condenser C_4 is connected from the end of the tickler coil to the filament. If this by-pass condenser is .001 mfd., the reactance is reduced to 318.3 ohms for the same signal.

The impedance of the transformer primary at one thousand cycles, which is the average voice frequency, is about 30,000 ohms. The reactance of the by-pass condenser C_4 to a frequency of 1,000 cycles, is 159,154 ohms. Thus the reactance of the by-pass condenser to the audio frequency is more than five times the impedance of the primary of the transformer and the by-pass condenser will not materially cut down the volume of the signal. If, however, a large by-pass, such as .006 mfd., is used, the reactance to 1000 cycles will be only 24,858 ohms, or less than that of the primary. Over half the signal will, therefore, be shunted back to the filament and lost with such

(*Continued on Page* 61)

SARGENT CIRCUIT NO. 4

By E. M. SARGENT

Circuit No. 4 is exactly the same as Circuit No. 3, as described in March RADIO, except for an added stage of audio frequency amplification. Fig. 1 shows the wiring diagram. On the panel an extra jack is added 1 in. above the jack on the No. 3 panel (1 in. between centers); otherwise the panel is exactly as before. This added stage of audio frequency is controlled by the same rheostat that controls the first stage. The parts necessary to convert a No. 3 set into a No. 4 are: A Daven No. 42 resisto-coupler, a .05 megohm Daven resistor for the plate leak, a Daven 1 meg grid leak, a VT socket, a single closed circuit jack and a tube.

The circuit is now equipped with two jacks, one after the first stage of audio and one in the output circuit of the second stage. In order to make the proper connections, it will be necessary to take out the single open jack that was used in the No. 3 set and connect in its place the closed circuit jack specified in the above list. Fig. 1 shows the wiring for this jack. The open circuit jack is thus transferred to the output of the second stage.

The addition of another stage of audio frequency amplification to Circuit No. 3 adds quite a bit to the volume and makes loud speaker operation possible on several distant stations that come in weak on the No. 3 set. The addition of the fourth tube will not in any way affect the selectivity and will have very little effect in increasing distance. Its main purpose is to bring in louder and clearer that which is already received on the three tube set. Resistance coupled amplification has been chosen for this second stage because of its remarkable clarity of reproduction. A plate voltage of 90 on both stages is plenty.

Either the regular CX 301A tube or the CX 112 power tube may be used in this second stage. The set will operate the Western Electric Cone speaker if the power tube is used in the last stage.

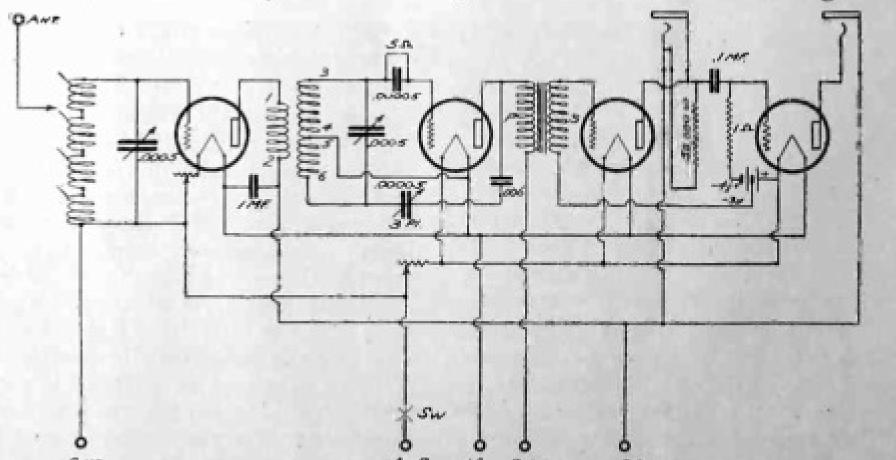


Fig. 1. Diagram for Sargent No. 4 Circuit.

The Sargent-Rayment

By Edwin

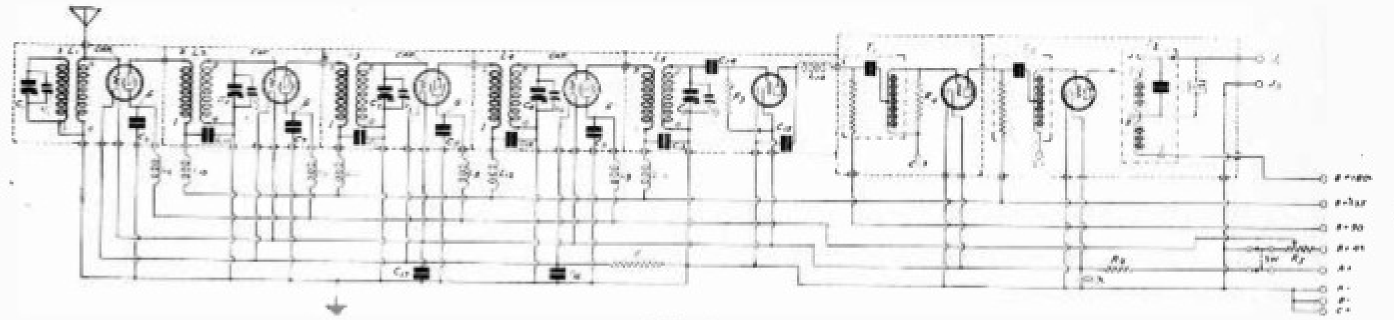


FIG. 1

THE CIRCUIT DIAGRAM OF THE SARGENT-RAYMENT SEVEN RECEIVER IN WHICH FOUR SCREEN GRID TUBES ARE USED FOR ULTRA-SENSITIVITY AND THE CLOUGH SYSTEM OF AUDIO AMPLIFICATION FOR TONE QUALITY.

PART I

"I HAVE tried all DX receivers which have come to my notice," writes O. D. Brown, a Connecticut man, "but the Sargent-Rayment Seven is the only receiver which I have found that will pull in KFI, Los Angeles, with ample loudspeaker volume at any time, night or day, Summer or Winter."

This man lives on the Atlantic coast and the station is situated on the Pacific coast. The distance between the receiver and the transmitter is almost the longest line that could be drawn across the United States. And the receiver covers the distance with ample volume. That means that no distance can be found in the United States over which the signals cannot be pulled in with the receiver.

Indeed, few places can be found in the inhabited North American continent which have a greater air line distance to Los Angeles. If a few such places can be found, the "ample" qualification of the loudspeaker reception in Connecticut amply takes care of the difference in the requirements. Therefore one is justified in assuming that the Sargent-Rayment Seven placed anywhere in the North American continent will pull in any broadcasting station in that huge territory, if that station has approximately the same power as KFI. All the more desirable stations have as much power as, or more, than KFI had at the time the tests were made in Connecticut.

Birthplace of Great Circuits

The Sargent-Rayment circuit was designed by two gifted radio engineers in the laboratories of Silver-Marshall in Chicago, the birthplace of many of the greatest receivers and parts that have been presented to American radio fans. These engineers received the co-operation of the research staff of the S-M laboratory, and consequently the outstanding developments originating there have been incorporated in the circuit. The result is a circuit of phenomenal sensitivity, unique selectivity and unsurpassed fidelity of tone.

Fans often ask whether it is possible to use the Sargent-Raymond circuit for phonograph record playing, and if so, the quality is as good as the quality when used for radio reception. It can be used. Whether or not the quality is as good depends entirely on the record and on the pick-up used. The audio amplifier, which alone is used for phonograph work, is the same as when it is used for radio reception. The quality remains the same.

When the amplifier is used for phonograph work there is no volume control in the circuit. But one must be used if the pick-up is at all efficient, for the amplification of the audio amplifier is enormous. The volume control usually supplied with the pick-up unit will serve the purpose very nicely.

There are two places at which the phonograph pick-up may be connected to the audio amplifier. One is across the grid leak of the detector. The other is across the input of the first audio transformer. The volume will be greater when the pick-up is connected across the grid leak, but the probability is that it will be loud enough when it is connected across the input of the first audio transformer. In fact it may be so loud as to require considerable cutting down by the volume control.

Magneto pick-up units are usually supplied with a plug which is to be inserted into the detector socket of the set. In most cases, these connect the pick-up output across the first audio transformer and the plate voltage for the detector. This causes a steady current to flow through the pick-up. This is not desirable, and the connection across the first transformer alone is preferable.

In some cases, the plug-in adapter is arranged so that the pick-up is connected between the grid and the filament of the detector. This is a good arrangement and should be used provided that the volume does not become so great that it cannot be controlled satisfactorily by the volume control provided with the pick-up. It only takes a few moments to test this.

Should the volume prove to be too great, the pick-up terminals should be connected across the input of the first transformer, as was explained above. For convenience two binding posts or tip jacks might be provided at the back of the set, that is tip jacks just like those used for the loudspeaker terminals. Leads are run from these jacks to terminals (1) and (2) on the first transformer T1. In the event there is considerable needle scratch noise in the output of the speaker, some of this can be eliminated by making a slight change in the connection one of the tip jacks. Instead of running one of them to (2), it should be run to the plate of the detector tube. This puts the low pass filter L14C15 in series with the output of the pick-up, and this suppresses much of the high frequency noise which may be present. A temporary connection should be made while deciding which of the two places gives better results.

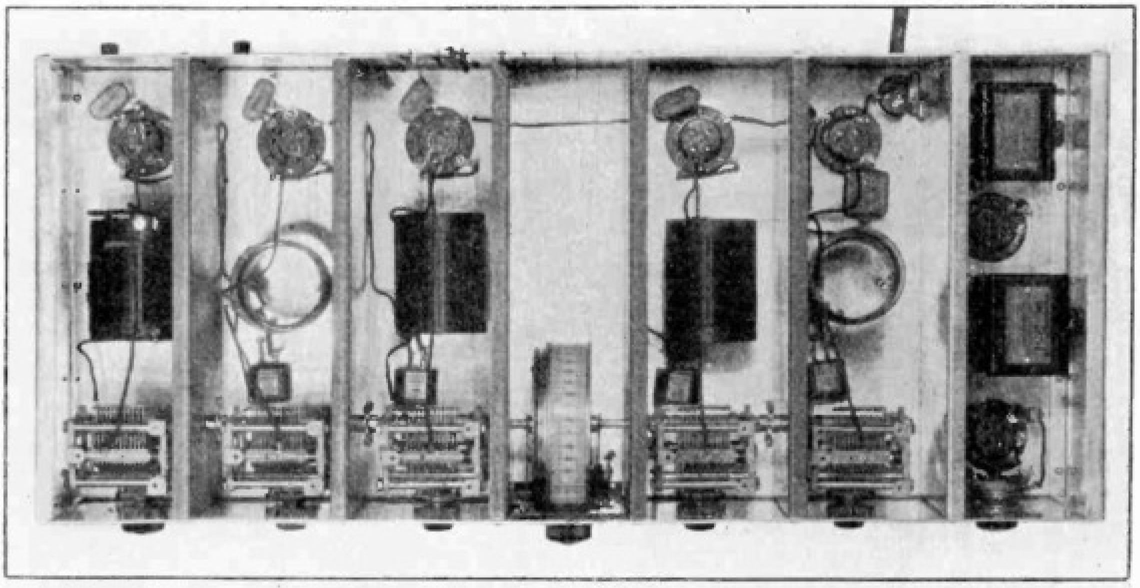
The sensitivity of the circuit is obtained from the use of four screen grid radio frequency amplifiers, precise tuning of the four tuned circuits and the use of RF coupling transformers designed for the screen grid tubes. The radio frequency amplification is enormous. This RF amplification, with perfect stability of the circuit, has been achieved by very thorough shielding of the individual stages and of the set as a whole, as well as by thorough filtering of the individual supply leads. Thus there is a radio frequency choke coil in each of the four screen grid

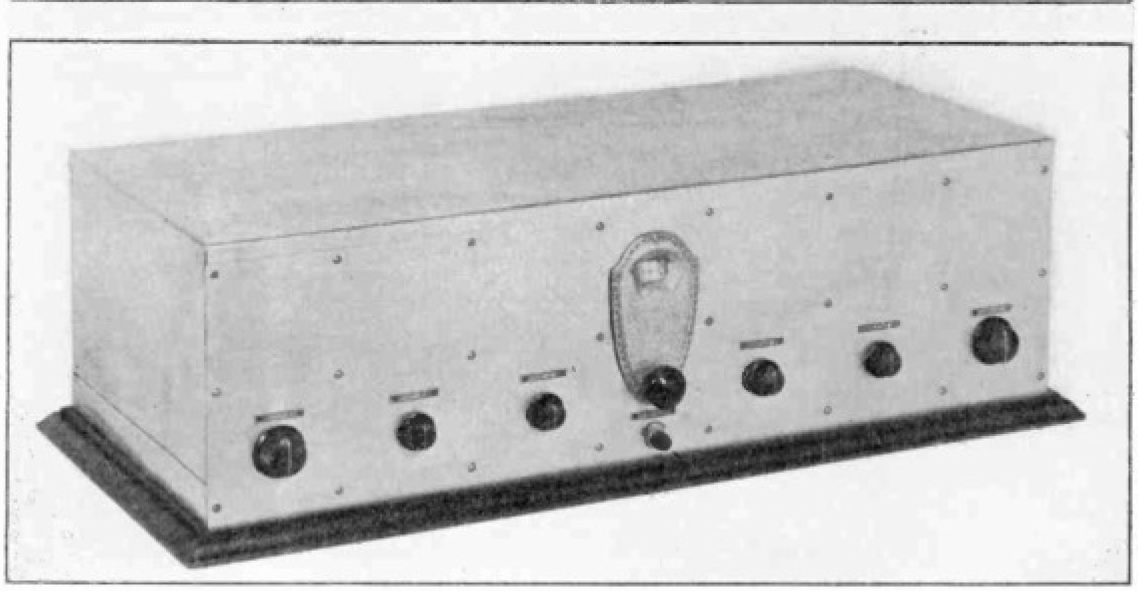
LIST OF PARTS

L1—One S-M 141 antenna coil
L2, L3, L4, L5—Five S-M 142 RF transformers
C1, C2, C3, C4, C5—Five S-M 32OR variable condensers
V1, V2, V3, V4, V5—Five S-M 340 midget condensers
L6, L7, L8, L9, L10, L11, L12, L13, L14—Nine S-M 275 RF chokes
T1—One S-M 225 first stage transformer
T2—One S-M 256 second stage transformer
T3—One S-M 251 output transformer
C6, C7, C8, C9, C10, C11, C12, C13—Eight Polymet ¼ mfd. condensers
14—One Polymet .00015 mfd. condenser
C15—One Polymet .002 mfd. condenser
C16, C17—Two Polymet 2 mfd. by-pass condensers
R1—One Carter H3 three ohm resistor
R2—One Carter H1 1 ohm resistor
R3—One Polymet 2 megohm grid leak
R4—One Durham 150,000 ohm resistor (optional)
R5—One Yaxley 53,000 P (3,000 ohms) potentiometer
SW—One Yaxley 740 Junior switch, double pole single throw
J1, J2—Two Yaxley 420 insulated tip jacks
One S-M 705 aluminum shielding cabinet
Seven S-M 511 tube sockets
One S-M 708 lead cable
One National type "F" velvet vernier dial with illuminator
Two insulated binding posts
One knob for V1 to match knob of R5
Twenty-five feet of S-M hook-up wire
One S-M 706 walnut base moulding
One set of assembly hardware

for Extreme Distance

F. Schmitt





FIGS. 2 AND 3 The arrangement of the parts in the Sargent-Rayment Seven receiver. A completely shielded compartment is used for each of the five tuned circuits and one for the audio frequency amplifier. The supposedly missing audio transformer is hidden by the output transformer. The other view is the front.

leads and one in each of the four plate leads for the screen grid tubes. For each choke coil there is a by-pass condenser of adequate capacity to provide a short path for the radio frequency currents.

Uniform Volume Level

One might suppose that the enormously high amplification in this circuit would result in terrific volume on local stations, since the receiver will bring in transcontinental stations with loudspeaker volume. But this is not so. There is relatively little difference between the volumes from a local and a distant station. The reason for this near equality under such widely divergent conditions is that the screen grid tubes act as automatic volume controls. That is, the amplification is not so great on local stations as it is on the distant ones. This, of course, is a result of the limited volume handling capacity of the tubes.

In addition to the automatic volume equalizer there is a very effective explicit volume control incorporated in the circuit. This is the high resistance voltage divider R5, Fig. 1, connected between ground and plus 45 volts, to the slider of which the screen grids of the four RF amplifiers are connected. By adjusting the position of the slider any screen grid voltage from zero to 45 volts may be obtained. The amplification of a screen grid tube depends on the screen grid voltage as well as on the other voltages applied to the tube. Hence by moving the slider on R5 the volume of the receiver can be adjusted from zero to maximum. This variation is entirely independent of the tuning.

The selectivity necessary for unique transcontinental reception is obtained by the use of four tuned circuits and aided by the use of a rejector or wave trap circuit. The four tuned circuits select the signal desired and the wave trap circuit rejects any one interfering signal which may be so close to the desired signal that it is impossible to tune it out by the four acceptor circuits. This adds a very powerful device to the circuit for sharpening the tuning.

We have spoken of unique selectivity and unique reception. Perhaps a definition of the meaning of this term is in order, especially in view of the fact that it has not been used often in connection with radio receivers. Of course, by unique reception is meant the reception of one station at a time, without any interference from any station. And by unique selectivity is meant the capability of the circuit to receive one station, and only one, at a time. When the noise from a jazz orchestra from a local station is heard in the background while listening to a program of a station two or three thousand miles away the reception is dual and the selectivity is far from being unique. Uniqueness of reception is an outstanding characteristic of the Sargent-Rayment receiver.

And it is the proper manipulation of the trimmers which makes the selectivity unique no matter what the interference conditions may be.

[*Part II, the concluding instalment of Mr. Schmitt's presentation of the Sargent-Rayment receiver, will appear next week on page 15 in the December 15th issue*—Editor]

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The Sargent-Rayment

By F. Edwin Schmitt

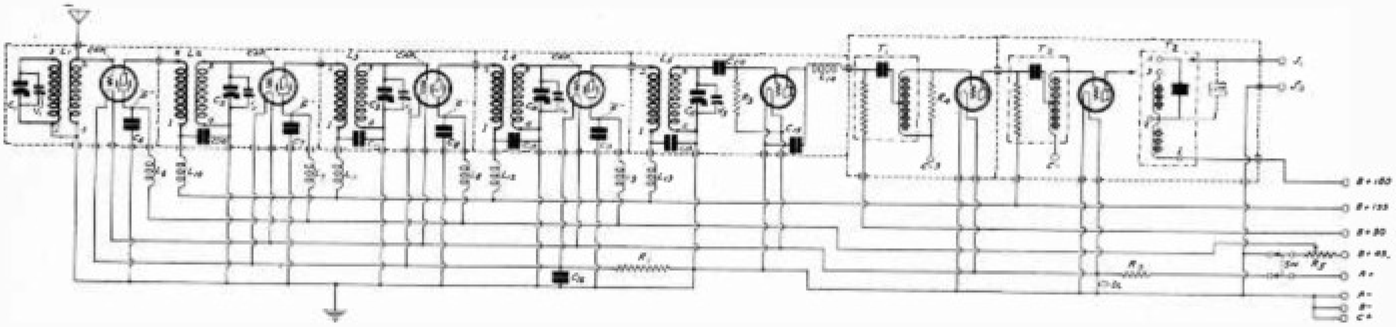

FIG. 4

THE CIRCUIT DIAGRAM OF THE SARGENT-RAYMENT SEVEN RECEIVER, WHICH INCORPORATES FOUR SCREEN GRID TUBES AND UNIFIED TUNING CONTROL.

[*Readers of* RADIO WORLD *are enjoyably familiar with F. Edwin Schmitt's articles on Silver-Marshall circuits. Here is Part II of his discussion of a real DX-getter. Part I was published last week, December 8th issue.*]

IN the Sargent-Rayment the trimmers are vernier condensers connected across the main tuning condensers. There is a knob for each of these on the panel. The verniers do not complicate tuning nor make it difficult to find distant stations, for the main tuning control alone can be used for bringing them in and the small controls are merely used to strengthen the weak signals. On local stations it is not necessary to adjust the verniers, for these stations will come in with sufficient intensity even when the tuning is not exact, and there will be no interference from stations not desired.

Where Quality Resides

Sensitivity and selectivity are functions of the circuit ahead of the detector. Quality of tone resides mainly in the audio frequency amplifier. In the Sargent-Rayment Seven the famous Clough system of amplification is used. This system has an exceptionally high voltage gain, which increases the sensitivity of the circuit. It also has a remarkably uniform frequency characteristic from about 30 cycles per second to well above 5,000 cycles. Above 5,000 cycles the amplification drops off rapidly, a fact which accounts for the absence of the disagreeable background noise and hissing strays heard in many receivers. It also accounts in part for the effective 10 kilocycle selectivity of which the receiver is capable.

The volume which may be obtained from the receiver depends largely on the type of tube that is used in the last stage, for the amplification is ample to load up any power tube now available for reception purposes. If the last tube is a —71A there will be ample volume for the average home. If a —10 is used there will be still more. And if a —50 type tube is used with suitable voltages there will be enough for a small auditorium. Where the finest possible quality is desired in the home the —50 tube should be used, as that tube will not even approach the overloading point on any volume that can be used in a home.

Provision has been made in the output circuit for any one of these tubes. On the circuit diagram, Fig. 1, it will be observed that the plate lead and the lead J1 from the loudspeaker terminate in arrows, which means that they should be connected according to the requirements of the output tube used. If a —12A or —10 type is used, connect the plate lead to terminal No. 3 on the output unit T3. If a —71A or a —50 type tube is used, connect this lead to No. 2 on T3.

If 180 volts or less is used with the —12A or —71A tube, connect the lead from J1 to terminal No. 4 as shown by the solid lines. If more than 180 volts is used, the lead from J1 should be connected through a 600 volt, 1 mfd. condenser as shown by the dotted lines.

Special attention is called to the arrangement of the filament circuit. There is no rheostat and only two filament ballast resistors. One of these, R1, is put in the negative side of the line, and the other, R2, is put in the positive. Both carry the current of all the tubes and of the pilot light. The object of the splitting up the ballast resistor is to provide a suitable grid bias for the screen grid tubes without using a battery for them.

Note also that a double pole single-throw switch Sw is used. One side of this switch opens and closes the filament circuit and the other side opens and closes the potentiometer circuit R5. Thus when the circuit is not in operation no current flows through the potentiometer resistance, even when a battery is used to supply the plate voltage.

The layout of the receiver is one of utmost simplicity, as shown last week, Fig. 2. In this photograph are shown seven metal compartments. In the first to the left is the trap circuit and one tube. In the next two are the first two tuned circuits. In the middle compartment is the drum dial which controls the tuning condensers. In the fifth and sixth compartments are the two second tuned circuits. The audio amplifier is located in the seventh compartment. Transformer T2 is not shown, for it is placed directly under T3, the output transformer.

In each of the tuner compartments is a main tuning condenser next to the panel, a midget vernier directly under this condenser, a tuning coil, a tube socket and one or two by-pass condensers. The first has only one by-pass condenser. The next four have two each. The detector compartment also contains the grid condenser, the grid leak, and the choke coil L14. The contents of each compartment are shown clearly in the circuit diagram as well as in the layout photograph.

Eight RF Filter Chokes

The radio frequency filter chokes are shown outside the shields on the circuit diagram. The actual location of these on the layout is shown in the photograph of the bottom on the subpanel, Fig. 3. There are eight of these chokes. This photograph also shows the two by-pass condensers C16 and C17 as well as the double pole single-throw switch.

At the rear on the left are shown the two jacks J1 and J2 and at the opposite corner are shown the ground and the antenna binding posts. Also at the left is shown the cable containing the battery leads.

Both Figs. 2 and 3 showed the extreme simplicity of the wiring. There are only a few connections in each compartment, and only a few more under the sub-panel. Part of this simplicity is due to the use of the shield frame work as the return circuit. When a lead is supposed to be run to ground or to minus A it is not run to a binding post, but is connected to the frame at the most convenient point. The entire metal frame work is grounded and is at A— potential.

[*The author has consented to answer questions concerning this circuit. Address him as follows*: *F. Edwin Schmitt, 136 Liberty Street, New York City.*]

LIST OF PARTS

L1—One S-M 141 antenna coil
L2, L3, L4, L5—Four S-M 142 RF transformers
C1, C2, C3, C4, C5—Five S-M 320R variable condensers
V1, V2, V3, V4, V5—Five S-M 340 midget condensers
L6, L7, L8, L9, L10, L11, L12, L13, L14—Nine S-M 275 RF chokes
T1—One S-M 255 first stage transformer
T2—One S-M 256 second stage transformer
T3—One S-M 251 output transformer
C6, C7, C8, C9, C10, C11, C12, C13—Eight Polymet ¼ mfd. condensers
C14—One Polymet .00015 mfd. condenser
C15—One Polymet .002 mfd. condenser
C16, C17—Two Polymet 2 mfd. by-pass condensers
R1—One Carter H3 three ohm resistor
R2—One Carter H1 1 ohm resistor
R3—One Polymet 2 megohm grid leak
R4—One Durham 150,000 ohm resistor (optional)
R5—One Yaxley 53,000 P (3,000 ohms) potentiometer
SW—One Yaxley 740 Junior switch, double pole single throw
J1, J2—Two Yaxley 420 insulated tip jacks
One S-M 705 aluminum shielding cabinet.
Seven S-M 511 tube sockets.
One S-M 708 ten lead cable.
One National type "F" velvet vernier dial with illuminator.
Two insulated binding posts.
One knob for V1 to match knob of R5
Twenty-five feet of S-M hook-up wire.
One S-M 706 walnut base moulding.
One set of assembly hardware.

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1959 Correspondence

Rückkopplung vor einem Dritteljahrhundert

GERÄTE
Ein recht ungewöhnlicher Radioempfänger namens "Infradyne" wurde von Sargent entwickelt und 1926 beschrieben. Die Zwischenfrequenz betrug etwa 3600 kHz, die Summe der Frequenzen des Eingangssignals und des lokalen Oszillators. Bei einer Signalschwankung von 550 bis 1500 kHz variierte die Oszillatorfrequenz zwischen 3050 und 2100 kHz. Die Spiegelfrequenz entspricht dem Doppelten der Zwischenfrequenz minus der Signalfrequenz. Folglich variiert sie zwischen 6650 und 5700 kHz. Ein einzelner Schwingkreis im Mischgitter sorgt für eine ausreichende Unterdrückung der Spiegelfrequenz und der Zwischenfrequenz.

ZWISCHENVERSTÄRKER Das Herzstück dieses Empfängers ist die dreistufige ZF-Stufe mit 11x199-Röhren. Abb. I zeigt einen Schaltplan. Eine Neutralisierung ist nicht eingebaut. Der Verstärker wird durch eine vom Kondensator C gesteuerte Gesamtrückkopplung stabilisiert. Bei geringer Kapazität des Kondensators C ist eine maximale Rückkopplung gewährleistet. Kürzlich hatte ich das Glück, ein brandneues Exemplar dieser ZF-Stufe zu erhalten, das noch nie benutzt worden war.

TESTS
Ein Aufbau mit einem 12.000-Ohm-Widerstand und einem 0,005-Ohm-Kondensator in Reihe zwischen Signalgenerator und Anschluss P wurde erstellt. Dies simuliert den Plattenwiderstand einer UX199-Röhre. Der Ausgang wurde mit einem Röhrenvoltmeter an den Anschlüssen G und - gemessen. Es wurde kein zusätzlicher Lastwiderstand verwendet. Es wurden mehrere Tests mit unterschiedlichen Einstellungen von C durchgeführt. Die Frequenzgangkurve in Abb. 2 wurde mit dem kleinsten Wert von C festgelegt. Abb. 3 zeigt den Frequenzgang für einen etwas höheren Wert von C. Abb. 4 zeigt den Frequenzgang für C, der knapp unter dem Wert liegt, der eine Schwingung erzeugt. Die Verstärkungswerte beziehen sich auf Frequenzgangkurven mit 0 dB. Bandbreiten bei 3 und 20 dB sind dargestellt.

DISKUSSION
Es ist offensichtlich, dass dieser Verstärker eine einstellbare Gesamtrückkopplung besitzt, um ihn stabil zu machen. Wie zu erwarten, kann die Rücjkkopplung reduziert und die Verstärkung auf Kosten der Bandbreite erhöht werden. Aus der Diskussion des Erfinders geht nicht hervor, dass er die Funktionsweise der Schaltung versteht, obwohl er Anweisungen zur Erstellung einer Frequenzgangkurve ähnlich wie in Abb. 4 gibt. Ich nominiere Sargent jedenfalls als Erfinder der Rückkopplung.
Hat jemand ein Exemplar ? Vielleicht besitzt ein Leser einen dieser Verstärker. Falls ja, würde ich mich über eine Korrespondenz mit ihm freuen

Wo * Empfangen vom IRE am 21. Februar 1959. I. E. M. Sargent, „The infradyne,n Radio“, Bd. 8, S. 11–14, 46; August 1926. 2. J. j. Simpson, 85–39 152nd St., Jamaica 32, N. V., private Mitteilung..

GROTE REBER
National Radio Astronomy Observatory Green Bank, W. Va

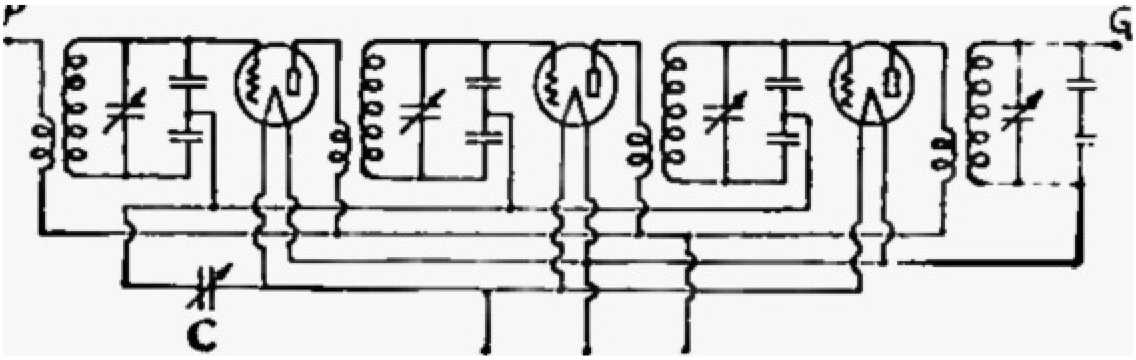


Abb. I: Schaltplan eines 3600-kHz-Verstärkers. Kondensator C steuert die Rückkopplung.

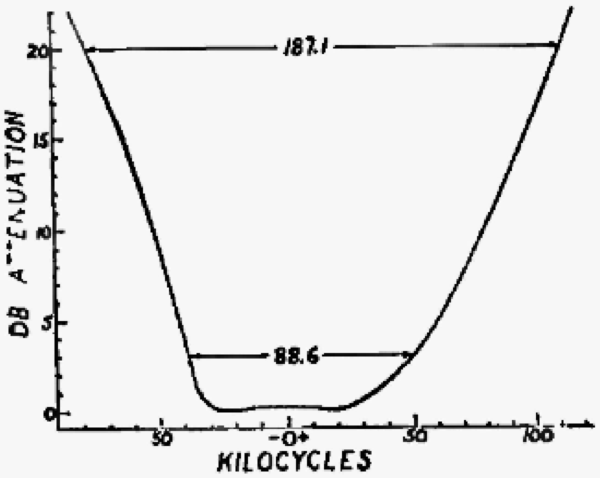


Fig. 2—Response curve with maximum feedback. Over-all gain, 11.1 db.

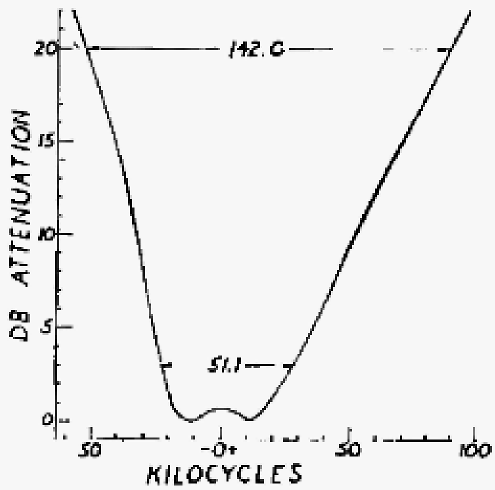


Fig. 3—Response curve with moderate feedback. Over-all gain, 18.1 db.

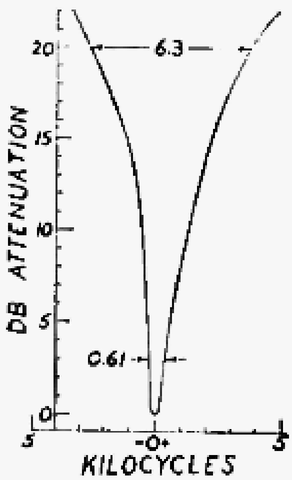


Fig. 4—Response curve with minimum feedback. Over-all gain, 47.2 db.

the relation (1) must be written as the dyadic inner product

$$\boldsymbol{J} = \boldsymbol{\sigma}\cdot\boldsymbol{E}. \qquad (8)$$

It no longer appears possible to determine any simple differential equation such as (4) for the charge density ρ.

The case when the electron density N_e and collision frequency ν of the ionized medium vary harmonically with time:

$$\omega_e^2 \propto N_e \propto e^{i\Omega t}; \qquad \nu \propto PT^{-1/2} \propto e^{i\Omega t}, \qquad (9)$$

as in a pressure oscillation of the medium, is essentially different from the situation considered above. Suppose further that $\omega \ll \nu$, where ω is the angular frequency, and that the constitutive parameters ϵ and σ vary only with time. We shall then have

$$\epsilon(r, t) = \bar{\epsilon} e^{-i\Omega t} \sim 1 - \frac{\omega_e^2}{\nu^2} \qquad (10)$$

$$\sigma(r, t) = \bar{\sigma} \sim \omega_e^2/(\omega\nu). \qquad (11)$$

The Faraday and Ampere equations then yield the following wave equation for the magnetic field vector $\boldsymbol{H}$:

$$\nabla^2 H + i\Omega\mu_0\epsilon\left(1 + i\frac{\sigma}{\Omega\epsilon}\right)\frac{\partial H}{\partial t} - \mu_0\epsilon\frac{\partial^2 H}{\partial t^2} = 0. \qquad (12)$$

Note that the second term contains a dissipative factor involving the modulating frequency Ω. If the magnetic vector $\boldsymbol{H}$ is also assumed to vary harmonically:

$$H(r, t) = H(r)e^{i\omega t},$$

then the wave equation (12) takes the form

$$\nabla^2 H(r) + k^2\left\{1 - \frac{\Omega}{\omega}\left(1 + i\frac{\sigma}{\Omega\epsilon}\right)\right\}H(r) = 0, \qquad (13)$$

where

$$k^2 = \omega^2\mu_0\bar{\epsilon}e^{-i\Omega t}. \qquad (14)$$

The corresponding equations for the electric vector are

$$\nabla^2 E + \Omega^2\mu_0\epsilon E + 2i\Omega\mu_0\epsilon\left(1 + i\frac{1}{2}\frac{\sigma}{\Omega\epsilon}\right)\frac{\partial E}{\partial t} - \mu_0\epsilon\frac{\partial^2 E}{\partial t^2} = 0, \qquad (15)$$

and, assuming harmonic time dependence,

$$\nabla^2 E(r) + k^2\left\{1 - \frac{2\omega\Omega}{\omega^2 + \Omega^2}\cdot\left(1 + i\frac{1}{2}\frac{\sigma}{\Omega\epsilon}\right)\right\}E(r) = 0, \qquad (16)$$

where

$$k^2 = (\omega^2 + \Omega^2)\mu_0\bar{\epsilon}e^{-i\Omega t}.$$

The modulating and dissipative ffeects of the pressure oscillation at the frequency Ω are again in evidence.

W. C. Hoffman
Hughes Res. Labs.
Culver City, Calif.

Negative Feedback a Third of a Century Ago*

Apparatus

A rather curious radio receiver called an Infradyne[1] was designed by Sargent and described in 1926. The intermediate frequency was about 3600 kc which is the sum of the incoming signal and local oscillator frequencies. Thus as the signal varies from 550 to 1500 kc the oscillator varied from 3050 to 2100 kc. The image frequency is twice the IF less the signal frequency. Consequently it varies from 6650 to 5700 kc. A single tuned circuit in the mixer grid gives ample image and IF rejection.

Intermediate Amplifier

The heart of this receiver is the three-stage IF strip using UX199 tubes. A circuit diagram is shown in Fig. 1. No neutralization is incorporated. The amplifier is made stable by over-all feedback controlled by condenser C. When C has small capacity a maximum of feedback is secured. Recently I have been fortunate in securing[2] a brand new sample of this IF strip which never had been used.

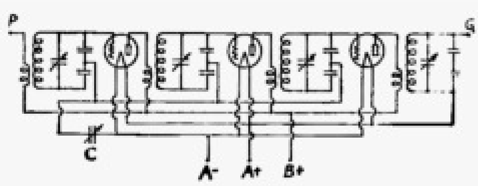


Fig. 1—Circuit diagram of 3600 kc amplifier. Condenser C controls the feedback.

Tests

A setup was made using a 12,000-ohm resistor and a 0.005 mfd condenser in series between signal generator and terminal P. This simulates the plate resistance of a UX199 tube. The output was measured by a vacuum tube voltmeter across terminals G and $A-$. No additional load resistance was used. Several tests were made using different adjustments of C. The response curve of Fig. 2 was secured with C at its smallest value. Fig. 3 shows the response for a bit larger value of C. Fig. 4 shows the response for C set to a value just less than that which will produce oscillation. The gain values are for 0 db of response curves. Bandwidths at 3 and 20 db are shown.

* Received by the IRE, February 21, 1959.
[1] E. M. Sargent, "The infradyne," *Radio*, vol. 8, pp. 11–14, 46; August, 1926.
[2] J. J. Simpson, 85-39 152nd St., Jamaica 32, N. Y., private communication.

Discussion

It is clear that this amplifier incorporates adjustable over-all degeneration to make it stable. As may be expected, the degeneration may be reduced and the gain increased at the expense of bandwidth. It is not clear from the inventor's discussion that he appreciates how the circuit works although he gives instructions on how to produce a response curve similar to Fig. 4. In any case, I nominate Sargent as the inventor of negative feedback. Does anyone else have an earlier

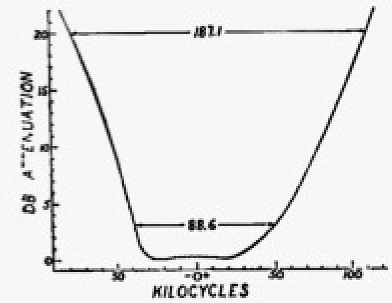


Fig. 2—Response curve with maximum feedback. Over-all gain, 11.1 db.

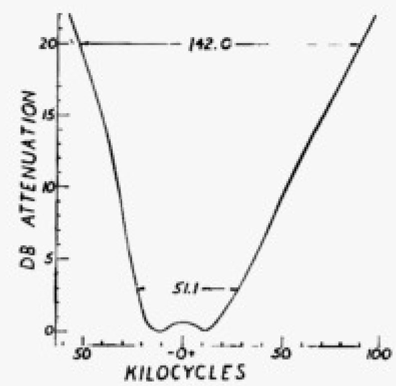


Fig. 3—Response curve with moderate feedback. Over-all gain, 18.1 db.

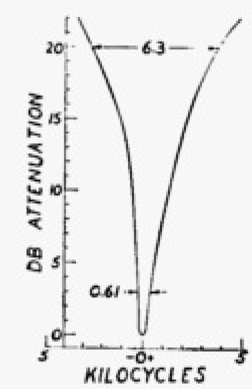


Fig. 4—Response curve with minimum feedback. Over-all gain, 47.2 db.

example? Perchance a reader may have one of these amplifiers. If so, I'd appreciate entering into a correspondence with him.

Grote Reber
National Radio
Astronomy Observatory
Green Bank, W. Va.

The Langhorne Infradyne Set

by Art Redman

The Langhorne Radio Company of Portland located in the Commonwealth Building on SW Sixth Avenue and SW Stark began manufacturing Super-Heterodyne parts, and long wave transformers for oscillators, which sold for $5.50 each in early 1924. Their motto as advertised in the Oregon Journal on March 9, 1924 was “Reception With a Smile”. They invited the radio kit builder to bring in or mail their unworkable transformer and coil and “we will balance them for you”

Langhorne never labeled the front panel or had model numbers. Instead, they labeled their IF transformers and coils, which are the only way to identify their fifteen radios that went by circuits and types. It appears Langhorne just went on trying to improve one basic radio circuit. By November, 1924 they marketed in the Portland Telegram their new Super long distance receiver by the list of DX stations received: WJAR, WGR, WGY, WJAS, WEAY, KFKB, KFDX, KYDM, CJCA, CKCK, CRY and Mexico.

The Infradyne IF amplifier made by Remler was introduced in the August 1926 issue of Radio magazine. The Infradyne came in either a three or four tube model with Bakelite panel and copper case. Thomas J. Langhorne used both models in his late 1926 receivers where it was inserted into the radio just ahead of the detector with an IF frequency of 3.2 MHz. This high frequency IF was created by using the sum of the incoming signal and Langhorne’s local oscillator of 48 kHz instead of the frequency difference between the two as in other superhets.

The problem in the Remler Infradyne as designed by E.M. Sargent, was the amplifier used UX-199 triodes, which never really worked well at higher frequencies. A three-element tube or triode tended to oscillate at frequencies above 1.5 MHz due to inter-electrode capacity. Sargent used the residual leakage of the 199 tubes to an advantage to ground all the grid circuits through a capacitor network with no return to ground or other voltage known as a “floating ground”.

As a company, Remler actively sent representatives in the field to recruit radio manufacturers to work around the RCA superhetrodyne patents and did not just rely on magazine ads and mail order. LC. Rayment of the Remler Company of San Francisco branch visited Portland and the Langhorne laboratory in September 1926 to appoint Langhorne the official service station for the Pacific Northwest territory of the Infradyne receiver when it was announced in the November 13th newspapers. He also visited the Stubbs Electric Company to successfully pitch the Infradyne Amplifier and manuals, which Stubbs sold as improvement to any trf or neutradyne set or as an item to build into the new Infradyne circuit for $28.00.

It is not known whether Rayment ever visited the Long Brothers in Cornelius to help develop the Long Superhet Model S-8 in 1925. The Long set is a Remler assembled eight tube kit similar to the set made and sold by Doctor Orrin Heathcock of LaGrande, Oregon.

One other West Coast radio connection is that Langhorne recruited Ralph Love from the Gilfillan Company of Los Angles to build their cabinets. Other Portland radio companies like the Sonometer Speaker Company relied the local Lents Cabinet Shop and the Universal Wood Working Company for cabinet construction and finishing.

Langhorne Sets

Zum "Langhorne Infradyne Set" gibt es keine Bilder, aber zur Firma Langhorne doch einige Informationen:

Ricks Langhorn, eines der Juwelen seiner Sammlung! Rick hatte ein kleines Foto dieses Radios auf seiner Website, und es sah aus, als wäre es restauriert und aufgemöbelt worden. Nachdem ich es persönlich gesehen habe, kann ich bestätigen, dass es hundertprozentig original ist. Ein wunderschönes Superheterodyn aus den 1920er Jahren! Hier ist Ricks Kommentar zum Langhorne, kopiert aus seiner Datenbank:

Drei-Skalen-Super. Wunderschönes Gerät! Es scheint werkseitig montiert zu sein, da die Verarbeitung erstklassig ist.

Informationen von Art H. Redman aus Portland (8/05): „Ich hätte mich früher bei Ihnen gemeldet, aber zuerst musste ich die Mulnomah County Library besuchen, um Informationen zu finden. 1923 arbeitete Thomas J. Langhorne für die C.L. Boss Auto Company. In den Stadtverzeichnissen von 1924 bis 1926 ist die Firma Thomas J. Langhorne and Company Radio Parts and Manufacturers im Commonwealth Building 316 aufgeführt. 1927 und 1928 wird die Firma als Langhorne Radio Company geführt. Im Eintrag von 1928 ist C.S. Finley als Gesellschafter aufgeführt. Langhorne wird nicht erwähnt. Im Stadtverzeichnis von 1929 findet sich kein Eintrag. Die Firma war daher nur von 1924 bis 1928 im Geschäft. In den Indizes der beiden in Portland, Oregon, erscheinenden Zeitungen, dem Oregonian und dem Oregon Journal, finden sich keine Artikel.“ (Danke, Art! Herausgeber) Die erste HF-Stufe ist mit dem ersten von drei Reglern einstellbar. Kein Hybrid. Sehr langes Gerät mit graviertem Bedienfeld, aber ohne Markennamen. Basierend auf den Röhrenfassungen eines der beiden bekannten Geräte wurden sie Anfang 1925 hergestellt. Auf jeder Zwischenfrequenz steht jedoch „Langhorne Radio Company“, was auf 1927 oder 28 hindeutet.

Thanks to D. Bylund !
http://duanesradios.info/html/langhorne.html


SELECTOR
OSCILLATOR
HETERODYNE

Remler Reminiscences

by RICK FERRANTI, WA6NCX
254 Florence Avenue
Arlington, MA 02174-7248
(617) 646-6343

Background on Remler Company:

Remler Company, Limited, was founded in 1918 and was in business until 1988, a remarkable span of 70 years in the San Francisco Bay Area. Some of its logos over this period are reproduced nearby. It was founded by Elmer Cunningham of vacuum tube fame (the name Remler is supposed to be Elmer spelled backwards with an extra "R" for Radio!). Cunningham was still General Manager in September of 1921. By 1922 the company was owned solely by co-founders Thomas B. Gray and Ernest G. Danielson. In the early 20's the company made radio components such as tube sockets, variometers, and switches. A little later they came out with detector panels and amplifiers. By 1924 they were marketing components for the first of a long succession of Gerald Best's 45 kHz low intermeduate frequency (i-f) superhets (one is in my collection.) In 1926 E.M. Sargent invented the first up-conversion superhet (i-f of about 3 MHz), and it was Remler who sold the kits for this "Infradyne" circuit.

In the spring of 1930, a fire destroyed the Remler factory at 260 First Street, but Gray and Danielson rebuilt the company headquarters at 2101 Bryant Street, where it remained for four decades. A photo of the facility appears in Figure 1. Tom Gray died in December 1931, and his son Robert Gray took his place.

In the late 20's, Remler started building complete receivers, first TRF sets and later superhet midgets and mantel radios. Almost everyone has seen one of their famous "Scotty" receivers, which were marketed from this period up to the time Remler got out of the consumer radio market in the early 1950's. During the 30's, Remler also marketed a low-cost line of consumer sets under the "Norco" label. Remler built ship-board radio and public address systems, and had brought out a line of microphones, when my father Guido started working there in 1937.

(The foregoing section on early Remler history includes material abstracted from an article appearing in the CHRS Journal, December 1981, written by Alan Douglas.)

Background on Guido Ferranti:

My father Guido Ferranti, is a native San Franciscan who grew up in what was known as the "Butchertown" district of The City. He graduated from Heald Engineering College (now Heald Institute of Technology) with a BS in mechanical engineering in 1933. He worked as a machinist for the Marchant Calculating Company in Emeryville (near Oakland) for a few years, then landed a job at Remler Company in 1937. His specialty was the set-up and operation of Brown and Sharpe automatic screw machines, a kind of automatic turret lathe, mechanically programmed to make precision production parts at high speed. Almost

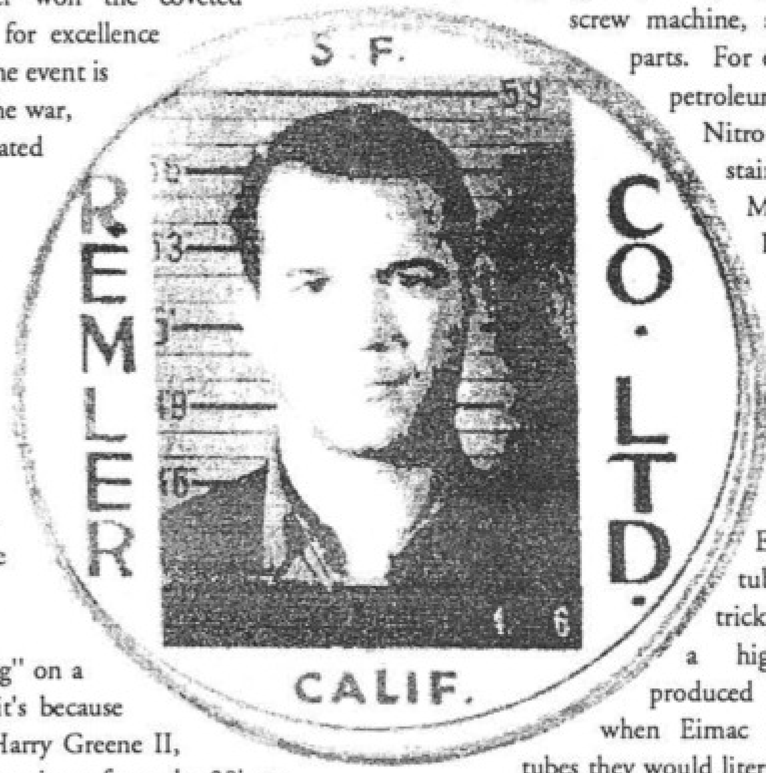
Figure 1. Remler Factory at 9th and Bryant Streets, San Francisco - circa 1940

any small machined part in a early radio set like a binding post, phone plug, etc. was made on an "automatic."

During his nearly 20 years at Remler, Mr. Ferranti rose from his original position to become the firm's assistant general production foreman. He left the company in 1954 to found his own machine shop, and retired from a highly successful business some ten years ago. He can still set up a "Brownie" in his sleep. A copy of his Remler identification badge appears nearby.

Remler Reminiscences, 1937 — 1954:

In the late thirties, Remler had about 70 employees. During World War Two, the number grew to about 400, with many of the production workers being women. A photo of some of the W.W. II personnel appears nearby. During the war, Remler won the coveted Army—Navy "E" award for excellence in war work. A photo of the event is shown in figure 2. After the war, the company consolidated down to its pre-war size.



President Bob Gray's son, Robert Gray II, was nicknamed "Scooter," though nobody remembers how or why. He used to practice the saxophone in his father's office, the tones resonating throughout the factory.

If you ever see the letter "g" on a Remler radio schematic, it's because the set was designed by Harry Greene II, Remler's chief electronics engineer from the 30's to the early 70's. One of his sons, Harry III, was my father's apprentice machinist, and went on to found his own successful machine business in Carson City. Harry's two other sons, Clay and Dick, also worked at Remler during W.W. II.

Dad still remembers finding gravel, of all things, inside some of the older screw machines he would service. The gravel was from the roof of the old First Street Remler factory; it fell into the machines salvaged from 1930 fire.

The powered raw stock advance mechanism for an automatic screw machine is a formidable device. Once, a piece of stock got sheared off by a misaligned feed and shot up into the factory ceiling, where it probably still remains.

The Remler ceiling also held other surprises. As in many older factories, much of the equipment was run by a large central motor driving pulleys and belts to the individual machines. This arrangement shook the ceiling so much that the vibration was clearly felt on the upper floors. After a few years it became obvious that individual motors in each machine would work a lot better, so my father slowly began converting each one. When he finished the last conversion and took down the overhead power driveshaft, he apparently missed removing one of the spacers. Not to worry -- it fell on his head several weeks later!

Remler did a good deal of outside contract work, jobshopping for punchpress, molding, tool and die, screw machine, sheet metal, and radio parts. For example, Remler made petroleum metering parts (out of Nitroloy, a fancy kind of stainless steel) for Brodie Meter of Oakland. Brodie insisted on a credit for every part not meeting their standards.

During W.W. II, Remler made tube caps and internal parts for Eimac transmitting tubes. There was a very tricky internal part requiring a highly polished finish produced by rolling. However, when Eimac built and tested these tubes they would literally explode! Apparently the rolling trapped solvents (required during the machining) in the part. After this, Remler supplied just the unrolled pieces, and Eimac finished them. No more blown tubes.

Also during the war, the Federal Communications Commission (FCC) heard reports of strange buzzing noises propagating worldwide on the shortwave bands. After an intensive search using their direction-finding equipment, the FCC found the source at Remler Company. Big Eimac tubes in Remler's unshielded induction heating equipment were pouring out the shortwave juice until the FCC forced them to shield their three machines!

Navy equipment made by Remler Company during the war had a "CRLnnnn" identifier; for example, the prized telegraph key in my collection is a Navy model CRL26012. Longtime family friend Elmer Talbert, W6PFC (now a silent key), was the tool and die machinist who did the key tooling; my father remembers making the knurled adjustment nuts by the thousands on his Brown and Sharpes.

Among the military radio sets produced by Remler after W.W. II was the R-122A/ARN-12, an airborne navigation receiver, crystal controlled for the 75 MHz beacon band (one's in my collection). According to Alfred Price's HISTORY OF U.S. ELECTRONIC WARFARE, Vol. II, Remler also made 30 airborne radar/communications intercept receivers called the S-120. These 1952 vintage sets covered a frequency range of 500 to 4,000 MHz and used some of the earliest production traveling wave tubes. Remler also produced an elaborate electronic training aid (sort of the ultimate "200-in-1 Electronic Build-It Kit") for the military; fellow Remler employee and family friend Pete Sanfilippo is pictured in the instruction book assembling one of the dozens of electronics panels included with the training aid.

After the war, Remler actually marketed a television receiver. It was not very successful, only about 1,000 being built. Even my father opted for another brand, a Hoffman manufactured in Los Angeles.

The post-war Scotties were rather handsome sets; one of the nicest is the Model 5100, with an ivory plastic cabinet and retractable handle. Despite this, the competition was fierce. Some 25,000 sets were sold on consignment by a fast-talking salesman Back East, but it turned out that less than 3,000 were actually paid for. Thousands of receivers were returned to the factory, most with broken cabinets, and that was the end of Remler's manufacture of consumer radio products. A little while later, Remler had an internal sale to let employees buy the consumer radio parts inventory at surplus prices.

Remler once produced a bakelite gearshift knob as a sales promotion gimmick -- in its top was molded a Scotty dog just like the ones on their radios. (I have one in my collection).

Some Remler Personalities:

Several persons famous in engineering and ham radio circles worked at Remler Company; these included:

Gerald M. Best, designer of the 50 kHz i-f Remler-Best Superhet kit in 1926. It's not clear whether this same person (with identical name, of about the right age, and living in the San Francisco Bay Area) later became a

Figure 2. Belt driven machinery at Remler factory with employees Buzz Sinclair (l) and Guido Oppici (R).

famous Western railroad photographer.

E.M. Sargent, who designed the first commercial upconverting superheterodyne broadcast receiver. As mentioned above, the Remler "Infradyne" had an intermediate frequency of 3 MHz and several versions were marketed as kits from about 1927 to 1929. Sargent also designed and marketed regenerative and superhet ham communications receivers in the mid to late 30's out of Oakland, California.

Frank Jones, W6AJF, who wrote innumerable articles for the San Francisco-based magazine Radio, and later authored several editions of the RADIO HANDBOOK (the "West Coast Handbook"). Frank was a consulting engineer to Remler in the 1930's, and continued to be active through the 1980's, building UHF ham gear.

Byron Goodman, W1DX, longtime staffer at the American Radio Relay League and author of such early publications as the ARRL ANTENNA HANDBOOK in 1939. Frank Jones recommended Byron as chief engineer Harry Greene's lab assistant. Byron recalls his work at Remler during the 1934 - 1935 period:

"One thing I do recall was a huge "exponential" loud speaker that was being developed...This speaker was on the ground alongside the building. The opening was square, and maybe six or eight feet high/wide. I have no recollection of the power involved or the length of the horn or the size of the neck, but I think it could be heard at quite a distance! It was for some park (Yosemite?). There might be an interesting story there.

"Another thing I recall was that occasionally some competitive table model set would be brought into the lab and Harry trusted me with tracing out the circuit, to make sure that no company was beating us by devising a circuit with one less resistor or condenser."

Finally, Byron recalled to me how Remler president Danielson insisted that the engineering staff develop and demonstrate a high fidelity shortwave set. The demo room was full of acoustic resonances, so that the sound quality depended on where the set was placed. Needless to say, Remler never marketed a hi-fi shortwave set.

Dave Atkins, W6VX, who worked at Remler in 1930 and later marketed a line of his own variable capacitors in QST. Dave writes that he was in quality control and final alignment of superhet receivers, particularly the early Scotty.

John Kaar, founder of KAAR Radio, in Palo Alto, California (still a CHRS member).

Former CHRS member Ed Merrick, who worked at Remler from 1964-65 as an electronics technician. Ed remembers several Remler products, including an intercom system for Cape Canaveral, and a pair of handsets for Air Force One, the presidential aircraft. He also remembers Remler president Robert Gray's fancy cars!

Remler officials receiving Army/Navy "E" award for excellence during WWII. Founder Danielson second from left. Military man far right can't keep his finger out of the cake (or his mouth!)

The Remler Company's Final Years:

After my father left Remler in 1954, the company stayed at its Bryant Street location for another 20 years. In 1975 the majority of the fabricating equipment was sold, and Remler moved to Brisbane, just south of San Francisco. Most fabrication work was subcontracted, though engineering, testing, and light assembly were still done in their new location. Robert Gray Sr. died in April 1983, and left the company to his son, Robert Gray, Jr. (Scooter).
Remler branched out beyond the older line of marine communications and public address gear that was their mainstay for decades. In the mid-seventies they designed, patented, and marketed an ambulatory blood pressure recorder, originally built for the Cardiology Department of the UCSF Hospital.

Quoting from a 1987 letter from Paul Karp, then Remler Vice President and a Remler employee since 1941:

"The major portion of our work is still in the communication field. We designed and manufactured the ground communication system for the NASA Apollo Program and various types of systems for the Lockheed Satellite Program, Boeing's hydrofoil ships, U.S. Navy vessels, etc. The Remler Transluctance Handset is also still supplied to the major airlines. "

Sadly, President Robert Gray, Jr., the grandson of Remler's founder and a man still in his 40's, died suddenly in late 1987. Vice President Paul Karp, who then took over for Scooter, only lived a few more months. Without a President or Vice-President, Remler's telephone was disconnected and the building vacated in mid-1988, after 70 years of business. One of the oldest and longest-surviving pioneer companies in Bay Area electronics had closed its doors forever. ##

General Manager

Eastern and Central Representative
Herbert H. Frost
154 West Lake St.
Chicago, Ill.

REMLER RADIO MFG CO.

163 SUTTER STREET, SAN FRANCISCO, CALIF.

MANUFACTURERS OF

"APPARATUS THAT RADIATES QUALITY"

FOR RADIO EXPERIMENTERS

BULLETIN 1001 SEPTEMBER, 1921

REMLER

BULLETIN

SERVICE

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