Fall Edition BROADCAST WRNY STATION **Fifty Cents**

Radio Listeners' Guide and Call Book

Edited by S. Gernsback

A Quarterly Magazine

C. M. Cahill

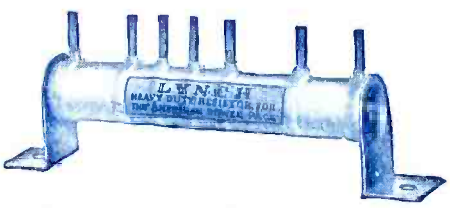
The Complete Resistance Line

LYNCH RESISTORS

Filament Equalizers

are used in the filament circuits to keep the filaments at their best operating points. The Lynch Equalizer consists of a special alloy encased in a glass cartridge having metal end-pieces. The cartridge can be inserted or removed from its mounting so that the proper resistance may be employed for different types or combinations up to six "A" type tubes. Equalizer cartridges are furnished complete with mountings.

Filament Equalizers, all sizes, $1.00 complete with mountings.



Special, Tapped Wire-Wound Heavy Duty Resistors

There is a special Lynch Heavy Duty, Wire-Wound Resistor for every popular "B" eliminator and Power Pack. The Lynch AmerTran Resistor, illustrated, is a sample of this type of resistor. Units for use in the AmerTran, Mayolian, Thordarson and Silver Power Packs are but a few of the types available, as well as resistors for use with new Mayolian R-71 AC Driver unit.

Tapped resistors may be had in any resistance value with any number of taps on special order!

Lynch AmerTran Tapped Heavy Duty, Wire-Wound Resistor, $8.50.

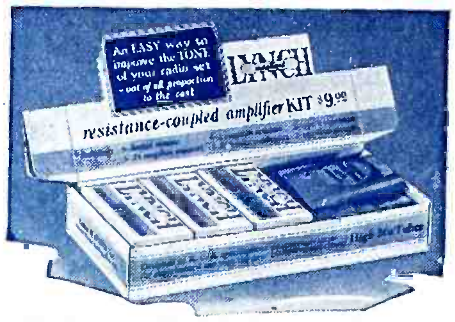
Type "P", Heavy Duty Resistors, Wire-Wound in Porcelain

Lynch Type "P" Heavy Duty Resistors are conservatively rated at 20 watts carrying capacity and are designed for power circuits where the use of high voltages make ordinary resistors impractical.

They are made in a variety of sizes, carefully selected to meet the requirements of the average eliminator and other power circuits. The stock sizes range from 2,000 to 100,000 ohms.

Any other size or form to suit special requirements can be made to order.

Lynch Type "P", Heavy Duty Wire-Wound Resistors, $1.25 to $4.00 according to resistance value.



Resistance-Coupled Amplifier Kit

The Lynch kit is a complete unit containing the essential parts for building a high quality resistance-coupled amplifier unit.

Price of complete kit $9.00

Which do you need?

SOMETIME, somewhere, you will need some one resistor whether it be in constructing a new set or to replace those in your present receiver.

There are but two points to remember when that time comes.

One is that any one resistor will not meet all resistance requirements in radio.

The other is that when you know, or want to know, what your resistance requirements are, go to your nearest dealer and ask for LYNCH Resistors.

There you will find the most complete Resistance Line from which to choose, and our free booklet which fully explains the proper use of Resistance in Radio.

If your dealer can't supply you, write direct.

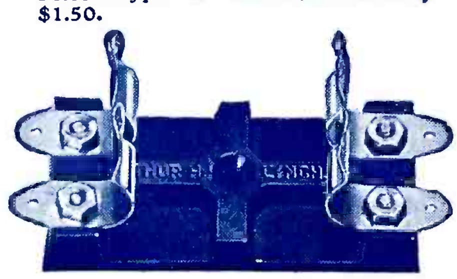
Arthur H. Lynch, Inc.
1775 Broadway at 57th Street
General Motors Bldg, New York, N.Y.

Metallized Resistors

give continuous, non-arcing and noiseless resistance. Available in sizes from .25 to 10 megohms at 75 cents each; .012 to .2 megohms at 75 cents each and .0005 to .01 megohms at $1.00 each.

For heavier duty use Type "C" Metallized resistor, made in sizes from .0005 to .1 megohm. These units are capable of dissipating 2.5 watts.

Also suited for use in battery eliminator circuits and resistance-coupled power amplifier plate circuits where the output voltage is less than 180 volts. Price of type "C" Metallized resistors, $1.50.



Leak-proof Double Mountings

have all the good features of the single mountings, rugged construction, single-hole mounting feature, low surface leakage and mechanical strength.

Double mounting $0.50

Grid Suppressors

are special resistance units designed for use in tuned radio frequency circuits to stop oscillation and improve reception without broadening tuning. The Grid Suppression method of tuned radio frequency amplification is rapidly increasing in popularity, especially in connection with power operated receivers. Suppressors are furnished complete with mountings in resistance values of from 100 to 1800 ohms varying in even hundred units.

Price, all sizes, $1.50 complete with mounting.

Leak-Proof Single Mountings

are made of highly polished genuine Bakelite. This fact, coupled with the skillful design, gives the mountings their extremely low surface leakage. The springs are made of heavy phosphor bronze, nickel plated. They are held rigidly in grooves by a screw and nut to prevent turning. The head of the screw is sunk well into the base so as to permit mounting the base on metal surfaces. Spring and soldering lug are one piece, thus eliminating poor and noisy contacts.

Single mounting $0.35

Type "C", Heavy Duty Resistors, Wire-Wound on Glass

The Type "G" Heavy Duty Resistors are designed for use in circuits where the ability to withstand high voltages and heavy currents is not of primary importance. They are also adapted for use as grid biasing resistors.

This type of resistor is available in the same resistance values as the Type "P" resistors but is conservatively rated at 7 watts carrying capacity. Special sizes may be had to order.

Lynch Type "G" Heavy Duty Wire-Wound Resistors, $1.00 to $3.75 according to resistance value.

Radio Listeners' Guide and Call Book

A Quarterly Magazine

Volume II **Number 2**

SEPTEMBER, 1927

Contents *of* This Issue

RADIO LISTENERS' GUIDE AND CALL BOOK

VOL. II, No. 2 SEPTEMBER, 1927

Published quarterly by The Consrad Co., Inc., 230 Fifth Ave., New York, N. Y., telephone number Ashland 9344; H. Gernsback, President; S. Gernsback, Vice-President and Treasurer; R. W. De Mott, Secretary. Price 50c a copy; subscriptions $1.75 a year in the United States of America, Canada and all countries within the domestic postal zone; elsewhere $2.00 a year, payable in advance. Subscriptions only acceptable in U. S. currency or stamps. No foreign currency or stamps. Checks and money orders should be drawn to the order of THE CONSRAD CO., Inc.

When subscribing to RADIO LISTENERS' GUIDE AND CALL BOOK send your name and remittance to The Consrad Company, Inc., 230 Fifth Ave., New York, N. Y. Mention that you desire to subscribe to RADIO LISTENERS' GUIDE AND CALL BOOK. We also publish and distribute CONSRAD PATTERNS, E. I. COMPANY BOOKS, etc. Write clearly.

Entered as second class matter, March 10, 1925, at the Post Office at New York, N. Y. under the Act of March 3, 1879.

Published by the Same Management:

RADIO NEWS — SCIENCE AND INVENTION — AMAZING STORIES

FRENCH HUMOR — SPARE-TIME MONEY MAKING

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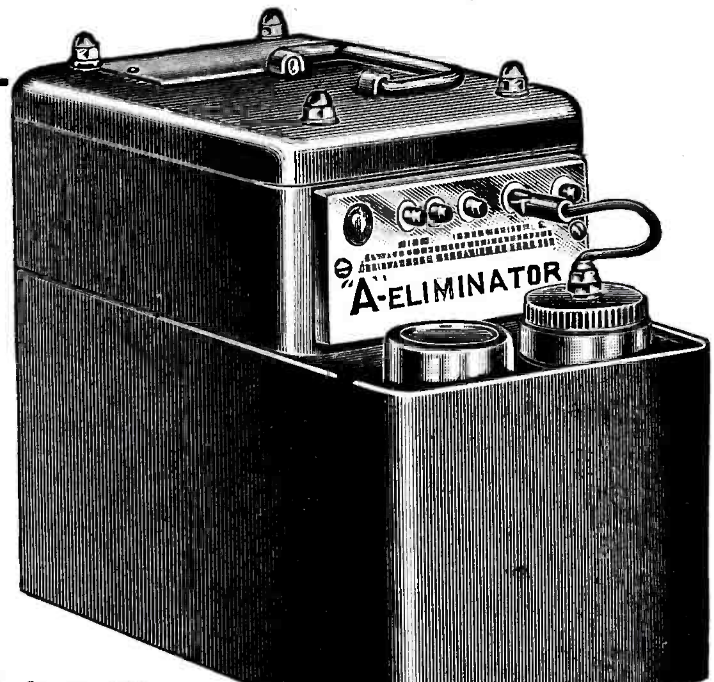
INDEX TO ADVERTISERS

$1.00 DOWN Brings You Either OF THESE SUPER "A" or "B" Eliminators

ELECTRIFY ANY SET
No battery
No charger
No tubes
No noise
No hum



$31.50

NOTHING TO WEAR OUT OR REPLACE—
NO MOVING PARTS

SUPER "A" ELIMINATOR

No More Storage Battery or Chargers —Takes the Place of Both—A Real "A" Eliminator

Not a so-called power unit small capacity battery trickle charger and relay. Has large capacity rectifier, changing alternating lighting current to direct current. High average, heavy duty filter system with extremely high capacity condenser. Smooths out pulsating, direct current into constant, humless current. Brings better results than obtained from even a fully-charged storage battery. Can be used in connection with any good "B" eliminator for complete electrification.

DEPENDABLE POWER

Always ready at touch of switch. No complicated parts—just plug in to electric socket. Requires no adjustment. Delivers constant current at 6 volts regardless of line variations. Can be connected up in a few minutes—requires no changes in set or circuit. Simply attach filament to post and plug cord into light socket. Uses current only when set is in use. Does not deteriorate—needs no charging. Specially priced at $31.50 to be paid in easy installments.

SUPER "B" ELIMINATOR

Eliminate the Expense of Repurchasing "B" Batteries and Always Obtain Maximum Results From Your Set by a Steady Full-Voltage "B" Current Supply

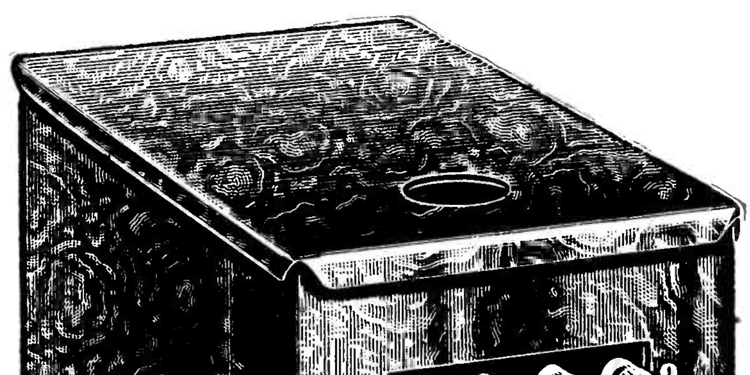
Complete with Raytheon tube, doing away with the "B" batteries and their troubles. Easily and instantly attached to any light socket. Delivers steady flow without hum, pulse or distortion. Built with heavy chokes, transformer and finest condenser in the filter circuits. Written guarantee for one year against mechanical and electric difficulties goes with each unit. The case is beautifully finished in olive green Duco-panel black etched in gold. Equipped with rubber covered cord and socket plug. High voltage taps and variable adjustments so that any new power tubes may be used. Variable adjustment delivers any desired detector voltage. Raytheon tube makes possible delivery of great current at high voltage. Will deliver up to 180 volts. Indefinite life because it has no filament to burn out. Complete instructions with each unit.

UNBELIEVABLY LOW PRICE

The "B" eliminator operates from the light socket 110 to 120 volts—50-60 cycle A. C.—output 6 volts direct current for all sets up to 12 tubes—NOW offered at the lowest price ever made. Only $29.50 that can be paid for in easy installments. Simply sign the coupon today while this remarkable offer lasts.

ELLIOTT RADIO CORPORATION
709 West Lake Street Chicago, Ill.

NO MORE "B" BATTERIES OR RUN DOWN SETS



$29.50

QUICKLY AND EASILY INSTALLED

Mail This Coupon Now!

ELLIOTT RADIO CORP.
709 West Lake Street, Dept. 63,
Chicago, Illinois.

Attached find $1.00 for which you agree to send me
( ) "A" Eliminator @ $31.50
( ) "B" Eliminator @ $29.50
{Check here whether "A" or "B" is desired. Send $2.00 if both are desired.
as described in your ad. Full particulars will be sent me by return mail and my money refunded if I do not accept your offer.

Name ....

Address ....

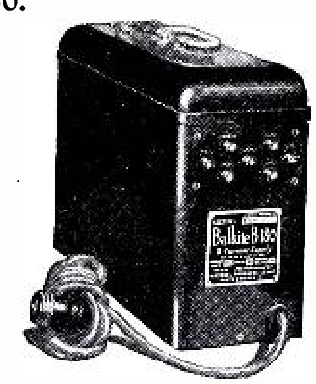
City ....State ....

Pioneering is important

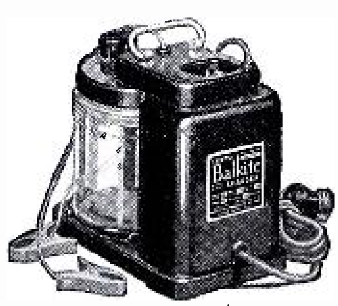
but performance is more so

BALKITE "AB" A complete unit, replacing both "A" and "B" batteries and supplying both "A" and "B" current from the light socket. Contains no battery in any form. Operates only while the set is in use. Turns on and off at the light switch. Two models. 135 volts "B" current, $59.50. 180 volts, $67.50.

BALKITE "A" Like Balkite "AB" above, but for the "A" circuit only. One of the most remarkable developments in radio. Price $32.50.



BALKITE "B" Like Balkite "AB" above, but for the "B" circuit only. The accepted "B" power supply. Has probably the longest life of any device in radio. Three models at remarkably low prices. 90 volts, $22.50. 135 volts, $32.50. 180 volts, $39.50.



BALKITE CHARGER The standard battery charger for radio "A" batteries. Noiseless. Can be used during reception. Three models, all trickle chargers. Prices, $17.50, $9.50, $7.50.

Prices are slightly higher West of the Rockies and in Canada.

Most of the great improvements in radio power have been made by Balkite. First noiseless battery charging. Then successful light socket "B" power. Then trickle charging. And today, most important of all, Balkite "AB," a complete unit containing no battery in any form, supplying both "A" and "B" power directly from the light socket, and operating only while the set is in use.

Important as this pioneering has been, yet it has not been the most important factor in making Balkite the leader. The real factor has been Balkite performance in the hands of its owners. With 2,000,000 units in the field Balkite has a record of long life and freedom from trouble seldom equalled in any industry. The first Balkite "B," purchased 5 years ago is still in use and will be for years to come. To your radio dealer Balkite is a synonym for quality. The electrolytic rectification developed and used by Balkite is so reliable that today it is standard on the signal systems of most of the railroads of the country. These facts have made Balkite one of the best-known names in radio.

Today, whatever type of set you own, whatever type of power equipment you want, Balkite has it. And production is so enormous that prices are astonishingly low. Balkite today costs no more than ordinary equipment. Your dealer will recommend the particular equipment you need for your set.

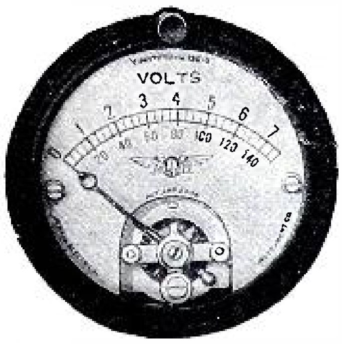
FANSTEEL PRODUCTS COMPANY, Inc.
North Chicago, Illinois

FANSTEEL
Balkite
Radio Power Units

APPROVED RADIO NEWS LABORATORIES

JEWELL INSTRUMENTS

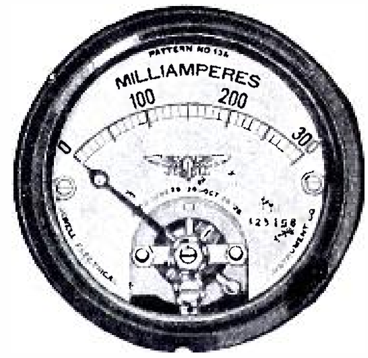
Good Instruments—
—Better Radio



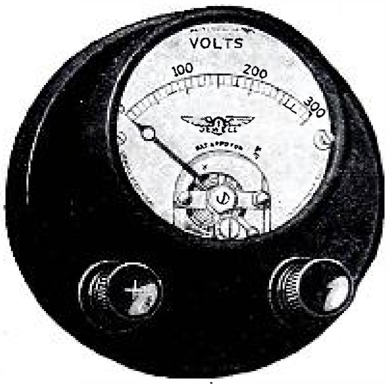
Pattern No. 135-B—Double scale, panel mounting voltmeter

The use of good instruments in connection with your radio testing and checking is certain to improve reception.

Jewell instruments are good instruments. Their widespread use among amateurs and set builders, and by broadcast stations, testify to their quality. Panel mounting and portable instruments are available in such styles and ranges as to practically give the set owner his own choice of scale readings.



Pattern No. 135—Milliammeter. Matches Pattern No. 135-B in size and appearance



Pattern No. 139—High resistance voltmeter for the set owner

Pattern No. 135-B.—The perfect radio voltmeter for panel mounting, 0-7.5-150 volts, covers all ordinary requirements for A and B battery checking. A handy switch allows an instant change from one range to the other.

Pattern No. 135.—Milliammeter matches Pattern No. 135-B in size and appearance. Used with Pattern 135-B gives the most complete indication of set conditions. To be used in the grid or plate circuit to show current flowing.

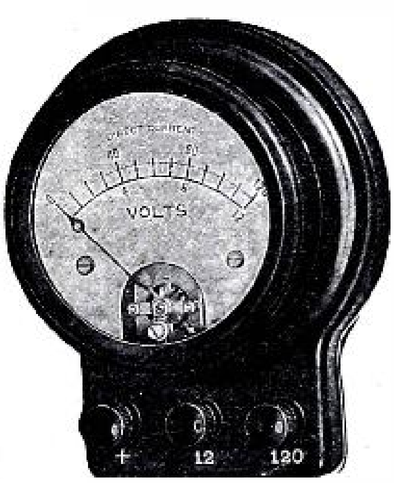
Pattern No. 139.—A high resistance voltmeter for the set owner for use in checking and adjusting B-eliminator voltages. Highly accurate but priced low.

Pattern No. 57.—A portable voltmeter suitable for testing battery and filament voltages and for testing currents. This instrument is a great favorite among set owners.

Pattern No. 107.—Junior Tube Checker for testing tubes at home. It helps the set owner to keep only the best radio tubes in his set. It gives tube characteristics under actual operating conditions.

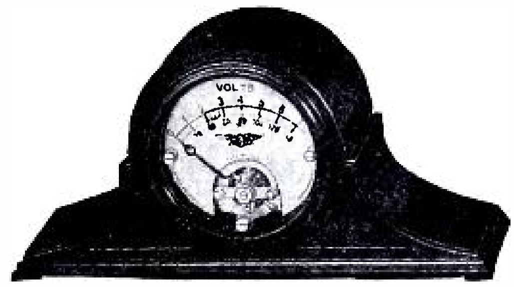
Pattern No. 135-C O-7.5-150 volts. This is the most beautiful portable voltmeter on the market. It tests batteries, circuits and filament voltages. It is a most desirable instrument for radio use.

Pattern No. 107—Jr. tube checker for testing tubes at home



Pattern No. 57—Double scale voltmeter for set testing or battery checking

Write for a copy of our Radio Instrument Catalog No. 15-C which describes all Jewell Radio Instruments in detail.



Pattern No. 135-C—A beautiful portable double scale voltmeter for filament adjustment.

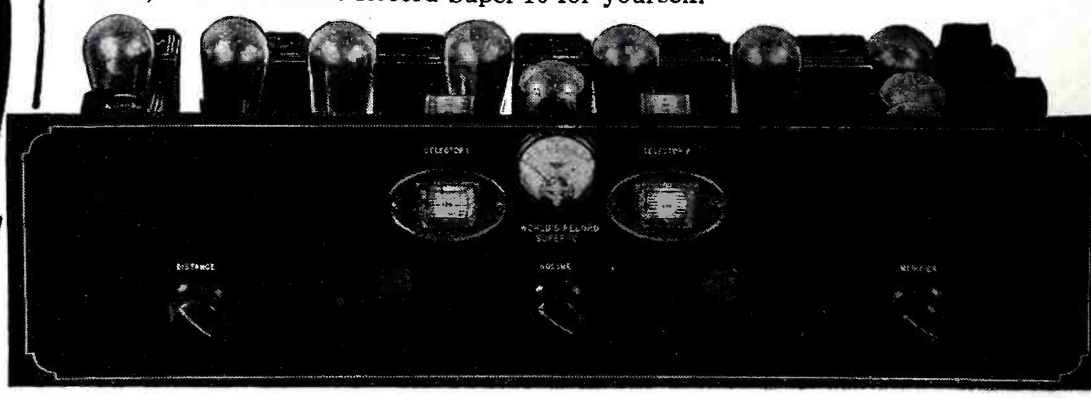
Jewell Electrical Instrument Co.

1650 Walnut St. - Chicago

"27 Years Making Good Instruments"

Build Radio's New

Mr. E. H. Scott, himself, will tell you how he designed the original DX receiver, with which he made the four World's Records described on the opposite page—how that set has been duplicated hundreds of times, each one performing as well as the original—how later developments and refinements have enabled him to improve on the original in the New World's Record Super 10—and how you can, even without any previous experience, build a World's Record Super 10 for yourself.



DISTANCE—Here is the receiver for the man who wants the most powerful and sensitive set it is possible to build. Many claim to have received far distant stations once or twice, but Mr. Scott with his World's Record Super proved his claims to record honors by bringing in consistently, night after night, stations distant six thousand miles or more. The new World's Record Super 10, in actual comparative tests with the original receiver on which the records were made, has proved that it is even more powerful and brings in the far distant stations with almost unbelievable volume.

No other receiver has approached the marvelous DX records that the World's Record Super has established, and it is safe to say none will for years to come.

REMARKABLE SELECTIVITY—Here is a receiver for today's conditions. In Chicago, where there are about forty broadcasting stations, the New World's Record Super 10 cuts through with the greatest of ease. It brings in distant stations only a few meters apart with such volume that you think you have a local station until you hear the call letters and find you are listening to a station hundreds of miles away.

NATURAL TONE QUALITY—A receiver may have great DX ability and wonderful selectivity, but what good is it if the tone is raspy or distorted? When you hear the New World's Record Super 10, you will realize that here at last is a receiver that it is a pleasure to listen to.

EASY TO BUILD—With the parts here listed, any one can build an exact duplicate of the New World's Record Super 10. The only tools required are a screw driver, pliers, and soldering iron. The building instructions and full size blue prints show exactly where to place each part and how to run every connection, and are so simple and easy to follow that any one, even without previous experience in building a radio receiver, can duplicate this marvelous receiver and own the finest radio set available today.

— LIST OF PARTS —

1 Formica panel drilled and engraved 26x7x3/16	$ 6.70
1 Formica sub panel drilled 25x10x3/16	7.00
1 Remler 3-in-line condenser No. 633 00035	15.00
1 Remler condenser No. 638 00035	5.00
2 Remler drum dials No. 110	9.00
2 Remler R. F. choke coils No. 35	1.80
2 Thordarson audio transformers R200	16.00
1 Thordarson output transformer No. 76	6.00
2 Selectone L. W. transformers No. B500	12.00
2 Selectone L. W. transformers No. B510	12.00
2 Selectone R. F. transformers No. 520	10.00
1 Selectone Antenna coupler No. 530	5.00
1 Selectone Oscillator coupler No. 540	5.00
10 Benjamin sockets No. 9044	5.00
1 pr. Benjamin brackets No. 8629	.75
1 Carter Imp. rheostat 1R-15S ohms	1.50
1 S. M. balancing condenser No. 340	1.50
1 Carter power rheostat MW-1 ohm	.75
1 Carter Imp. pot. 1R-400 ohms	1.25
1 Carter fixed condenser 00025 with grid clips	.50
1 Carter fixed condenser 002	.50
1 pr. No. 10 Carter pin jacks	.20
1 Jewel Voltmeter 0.8v Pat. 135	7.00
4 Tobe Bypass condensers 1 Mfd	3.60
1 Tobe grid leak	.50
1 Jones 10 contact multi-plug and 4 ft. cable type BM	3.50
40 Kellog soldering lugs	.25
30 ft. rubber covered hook-up wire	.50

Here's your chance to build a radio set that will give you all that radio has to give—distance, selectivity, clear and natural tone. Experience is not required, for full instructions will be sent you by Mr. Scott himself. Don't hesitate—don't delay. Send *now* for full details. Then you can't forget it, and you'll never regret it.

Radio Dealers!

Get This Valuable 1928 Catalog FREE

The new 136-Page Colored and Illustrated 1928 Hamilton-Carr **Wholesale Radio Catalog** is ready. It has been carefully compiled after an exhaustive study of all radio sets and radio accessories on the market or to be introduced. We have examined these sets, accessories and parts and tested them in our own laboratories and know their value. You can be sure that you will find in this complete new catalog an accurate and reliable illustration and listing of everything pertaining to radio.

ALL THE CALL BOOK KITS

We show the latest Radio Listeners' Guide Kits, including complete Parts for the following at the best dealers' prices:

Tyrman Ten, Karas 2-Dial Equamatic, Improved Infradyne, Best's 45 K. C. Super, Citizen's Super, Camfield Duoformer 7, Scott's World Record Ten, Camfield Super 9, Bodine Electric, Aero Seven, Aerodyne, Improved 9-in-Line, Hot Spot 14, Magnaformer-9-8, Best Lincoln 8, Silver Shielded Super, S.M. Unipac.

All Electric Radio Sets

This year electric (socket-power) radio receivers are very popular. The demand for them is constantly on the increase. In the Hamilton-Carr catalog you will find a complete showing of six, seven and eight-tube electric and non-electric sets. And you can be sure that both are of the finest quality—sure to deliver satisfaction. Easy to sell on demonstration. Styles of receivers in both table models and console models have been made to meet all requirements.

Nationally Advertised Accessories

All the fast-selling, nationally advertised accessories, parts and kits are shown in the new Hamilton-Carr Catalog. Many of these are advertised in this magazine now or have been in the past. All the recognized successful methods of converting old sets into electric sets are explained.

"A" and "B" Eliminators

The success and sale of **"A"** and **"B" Eliminators** is unquestioned. There is always a call for them. This new catalog shows all the latest improved models at **astonishingly big discounts.** You will want to stock them at once for immediate sales. You can win hundreds of customers with these great values.

Thousands of Other Amazing Values

Get this new catalog today and keep it handy. You will find in it everything you want in radio, including all new types of loud speakers and chargers. During the last few months cabinet and console designers have created many beautiful new models. All of these are shown.

Hamilton-Carr Service to Dealers

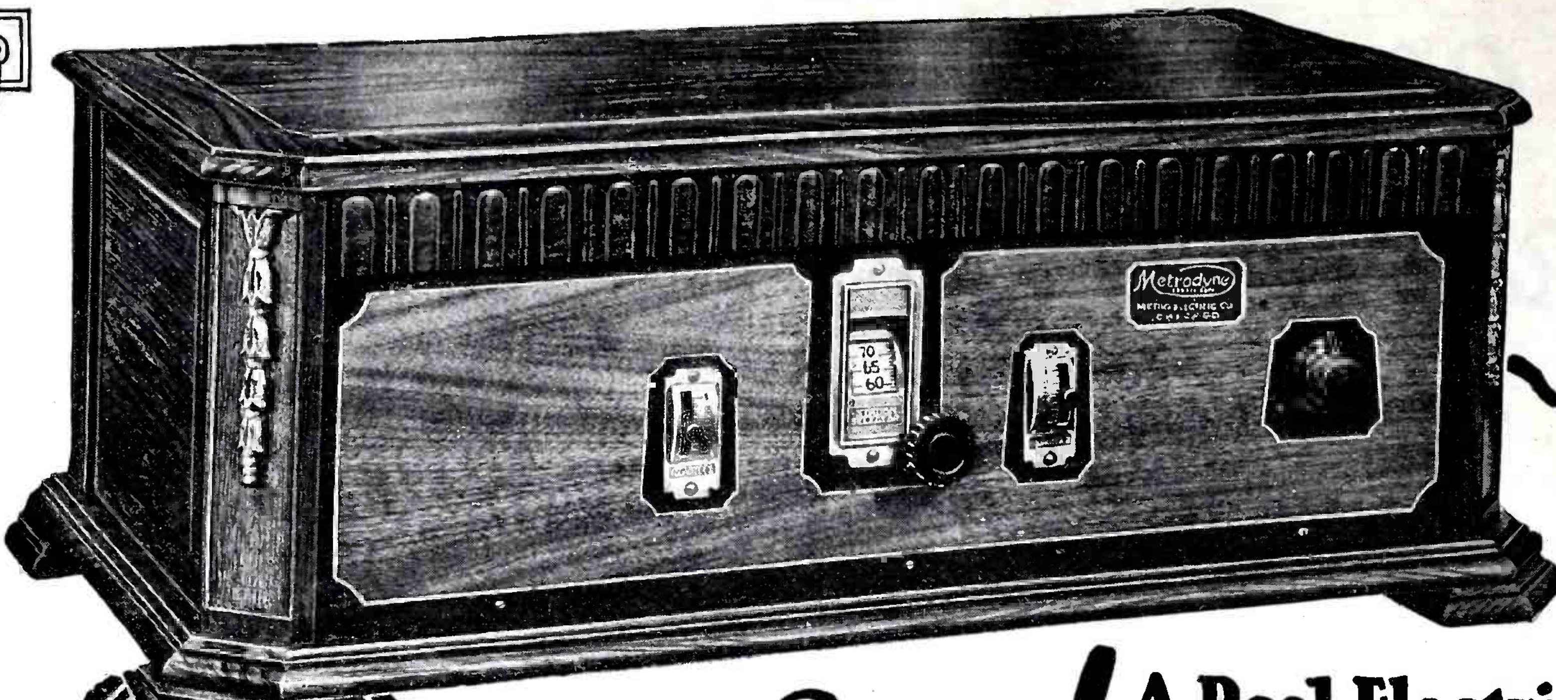
The Hamilton-Carr Radio Corporation is not new. They pioneered in the radio business and have devoted all their efforts exclusively to radio and bettering their service to dealers. The thousands and thousands of dealers now doing business with Hamilton-Carr show how successful we have been. We have perfected our organization in every department. Orders received are shipped when they are wanted without fail. We unconditionally stand back of all merchandise bought from us whether of our manufacture or not.

Write for the New Catalog Today

Of course, you want this new Hamilton-Carr Catalog. Write for it today on your letterhead. Silver-Marshall Kits and Parts in stock. It is new from start to finish—and packed full of the greatest values ever offered. **Write now while it is fresh in your mind.**

HAMILTON-CARR RADIO CORP.

711 West Lake Street Dept. 64 Chicago, Illinois



30 Days Free Trial

Now! A Real Electric Radio Set

Three Year Guarantee

Shipped direct from our factory at rock bottom prices—cost less than most battery sets

No Batteries, Chargers or Eliminators

No Acids; No Liquids—Plug In—Press Button—"Tune In"

Metrodyne

ALL ELECTRIC RADIO

AGENTS! DEALERS! BIG PROFITS!

Make big money taking orders for Metrodynes. All or part time. Metrodyne All Electric Radios are in a class by themselves. Unequalled for quality, performance and price. Demonstrate at home and take orders. Lowest wholesale prices. Your demonstrating set on 30 days' free trial. Mail coupon below for details.

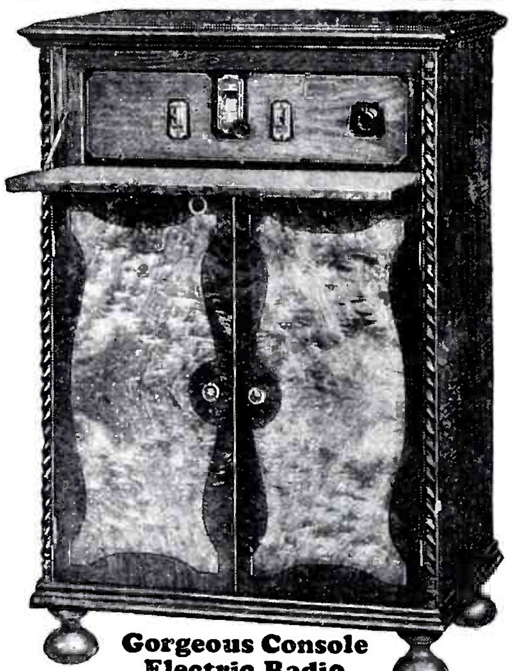
7 Tubes—Single Dial Set

100% Electric Radio

At last! The radio you've dreamed about! If you have electricity in your home you can now really enjoy coast to coast radio reception without the care, bother and muss of batteries, chargers, eliminators, etc. The Metrodyne **All Electric** is a real, genuine **batteryless** radio set. Simply insert the plug in the socket, press the switch button and "tune in." You could not possibly buy a better radio set than the Metrodyne **All Electric**, no matter what price you paid.

BEAUTY—EFFICIENCY DEPENDABILITY

The Metrodyne All Electric Radio is a 7 tube, single dial set. Only the highest quality low loss parts are used throughout. Solid walnut cabinet, beautiful two-tone effect, with handsome gilt metal trimmings. Size of cabinet, 28 inches long, 13 inches deep, 10 inches high. Has electrically lighted dial so that you can log stations in the dark. Only one dial to tune in all stations. Excellent tone qualities — wonderful volume — very selective.



Gorgeous Console Electric Radio

Here is the Metrodyne All Electric Console Radio — a gorgeous, genuine walnut cabinet, in a beautiful two-tone finish. Has a built-in genuine Metro-Cone large size speaker. Brings in programs with great volume, reproducing the entire range from the lowest to the highest notes with remarkable clearness and distinction. All metal parts are finished in old gold. Wonderful electric radio, in a cabinet that will beautify the appearance of any home.

Costs Less Than Most Battery Sets

Do not confuse the Metrodyne electric radio with ordinary light socket sets, because the Metrodyne is truly an **all electric** radio — consumes less than 2c worth of power a day. Comes to you **direct from the factory.** Its low cost brings it down to the price of an ordinary battery set. We are so confident that you will be delighted with this wonderful, easy-to-operate **batteryless radio** that we offer to ship it to your home for **thirty days' free trial** — you to be the judge.

Mail This Coupon

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer**, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis — **WRITE TODAY!**

METRO ELECTRIC COMPANY

2165 N. California Ave. *Dept.* 636 Chicago, Illinois

METRO ELECTRIC COMPANY
2165 N. California Ave., Dept. 636
Chicago, Illinois

Gentlemen:
Send me full particulars about Metrodyne All Electric Radio and your **thirty days' free trial offer.**

Name ____________________

Address ____________________

If you are interested in AGENT'S proposition place an "X" in the square → ☐

MAIL COUPON NOW!

RADIO LISTENERS' GUIDE and CALL BOOK

A Quarterly Magazine

Sidney Gernsback, Editor *W. G. Many, Managing Editor*

RADIO BROADCAST STATIONS OF THE UNITED STATES

Indexed Alphabetically by Call Letters

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KD	**KDKA—East Pittsburgh, Pa.**—Westinghouse Elec. & Mfg. Co.	30000	315.6	950	Eastern
	KDLR—Devils Lake, N. D.—Radio Elec. Co.	15	230.6	1300	Central
	KDYL—Salt Lake City, Utah—Intermountain Broadcasting Corp., 1009 Ezra Thompson Bldg.	100	258.5	1160	Pacific
KE	**KELW—Burbank, Calif.**—E. L. White, 3702 Magnolia Ave. (Divides time with KPPC)	250	228.9	1310	Pacific
	KEX—Portland, Ore.—Western Broadcasting Co.	2500	239.9	1250	Pacific
KF	**KFAB—Lincoln, Nebr.**—Nebraska Buick Auto Co. (5000 watts before 7 P. M.)	2000	309.1	970	Central
	KFAD—Phoenix, Ariz.—Electrical Equipment Co.	500	272.6	1100	Mountain
	KFAU—Boise, Idaho—Independent School, District of Boise (4000 watts Daytime)	2000	285.5	1050	Mountain
	KFBB—Havre, Mont.—F. A. Buttrey Co.	50	275.1	1090	Mountain
	KFBC—San Diego, Calif.—W. K. Azbill and Dr. A. W. Yale, 5038 Cliff Place	100	247.8	1210	Pacific
	KFBK—Sacramento, Calif.—Kimball Upson Co., 610 California St.	100	535.4	560	Pacific
	KFBL—Everett, Wash.—Leese Bros., 2814 Rucker Ave.	100	223.7	1340	Pacific
	KFBS—Trinidad, Colo.—Trinidad High School	15	238	1260	Mountain
	KFBU—Laramie, Wyo.—St. Mathews Cathedral, Bishop N. S. Thomas	500	428.3	700	Mountain
	KFCB—Phoenix, Ariz.—Nielsen Radio Supply Co., 311 N. Central Ave.	125	243.8	1230	Mountain
	KFCR—Santa Barbara, Calif.—Santa Barbara Broadcasting Co.	50	211.1	1420	Pacific
	KFDM—Beaumont, Tex.—Magnolia Petroleum Co.	500	374.8	800	Central
	KFDX—Shreveport, La.—First Baptist Church	250	236.1	1270	Central
	KFDY—Brookings, S. D.—South Dakota State College	500	394.5	760	Central
	KFDZ—Minneapolis, Minn.—H. O. Iverson, 2510 Thomas Ave., So.	10	215.7	1390	Central
	KFEC—Portland, Ore.—Meier & Frank Co. (Divides time with KFIF)	50	214.2	1400	Pacific
	KFEL—Denver, Colo.—Eugene P. O'Fallon, Argonaut Hotel	250	247.8	1210	Mountain
	KFEQ—St. Joseph, Mo.—Scroggin & Co. Bank	1000	230.6	1300	Central
	KFEY—Kellogg, Idaho—Bunker Hill & Sullivan Mining & Concentrating Co., 834 McKinley Ave.	10	232.4	1290	Pacific

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KF	**KFGQ—Boone, Iowa**—Boone Biblical College, 924 W. Second St.	10	209.7	1430	Central
	KFH—Wichita, Kans.—Rigby-Gray Hotel Co., Hotel Lassen	500	245.8	1220	Central
	KFHA—Gunnison, Colo.—Western State College of Colorado	50	254.1	1180	Mountain
	KFHL—Oskaloosa, Iowa—Penn College	10	212.6	1410	Central
	KFI—Los Angeles, Calif.—Earle C. Anthony, Inc., 1000 So. Hope St.	5000	468.5	640	Pacific
	KFIF—Portland, Ore.—Benson Polytechnic School (Divides time with KFEC)	50	214.2	1400	Pacific
	KFIO—Spokane, Wash.—North Central High School (Divides time with KFPY)	100	245.8	1220	Pacific
	KFIQ—Yakima, Wash.—Dr. I. M. Miller	100	208.2	1440	Pacific
	KFIZ—Fond du Lac, Wis.—Fond du Lac Commonwealth Reporter, 22 Forest Avenue	100	267.7	1120	Central
	KFJB—Marshalltown, Iowa—Marshalltown Elec. Co.	15	247.8	1210	Central
	KFJF—Oklahoma City, Okla.—National Radio Mfg. Co. (1000 watts Daytime)	750	272.6	1100	Central
	KFJI—Astoria, Ore.—Liberty Theatre (E. E. Marsh), (Divides time with KMED)	15	249.9	1200	Pacific
	KFJM—Grand Forks, N. Dak.—University of N. D.	100	333.1	900	Central
	KFJR—Portland, Ore.—Ashley C. Dixon & Son, 1350 E. 36 St. (Divides time with KTBR)	100	282.8	1060	Pacific
	KFJY—Fort Dodge, Iowa—Tunwall Radio Co., 1004 Central	100	239.9	1250	Central
	KFJZ—Fort Worth, Tex.—W. E. Branch, 3rd and Main Sts.	50	249.9	1200	Central
	KFKA—Greeley, Colo.—Colorado State Teachers College	200	399.8	750	Mountain
	KFKB—Milford, Kans.—J. R. Brinkley, M. D. (2500 watts Daytime)	1500	241.8	1240	Central
	KFKU—Lawrence, Kans.—University of Kansas (Divides time with WREN)	500	254.1	1180	Central
	KFKZ—Kirksville, Mo.—State Teachers College	15	225.4	1330	Central
	KFLU—San Benito, Tex.—San Benito Radio Club	15	236.1	1270	Central
	KFLV—Rockford, Ill.—Swedish Evangelical Mission Church	100	267.7	1120	Central
	KFLX—Galveston, Tex.—Geo. R. Clough, 3327 Ave. P.	100	270.1	1110	Central
	KFMR—Sioux City, Iowa—Morningside College	100	440.9	680	Central
	KFMX—Northfield, Minn.—Carleton College (Divides time with WCAL)	500	236.1	1270	Central
	KFNF—Shenandoah, Iowa.—Henry Field Seed & Nursery Co. (Divides time with KMA)	1000	270.1	1110	Central
	KFOA—Seattle, Wash.—Rhodes Dept. Store, 6144 Arcade Bldg.	1000	447.5	670	Pacific
	KFON—Long Beach, Calif.—Nichols & Warriner, Inc., Jergins Trust Bldg.	500	241.8	1240	Pacific
	KFOR—Lincoln, Nebr.—Lincoln Hatchery	100	217.3	1380	Central
	KFOX—Omaha, Nebr.—Technical High School (Divides time with KOCH, WNAL)	100	258.5	1160	Central
	KFOY—St. Paul, Minn.—Beacon Radio Service, 376 Robert St.	250	285.5	1050	Central
	KFPL—Dublin, Tex.—C. C. Baxter, 205 Grafton St.	15	275.1	1090	Central
	KFPM—Greenville, Tex.—The New Furniture Co.	15	230.6	1300	Central

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KF	**KFPR—Los Angeles, Calif.**—Los Angeles County Forestry Dept. (Divides time with KFQZ)	250	232.4	1290	Pacific
	KFPW—Carterville, Mo.—St. Johns M. E. Church	50	263	1140	Central
	KFPY—Spokane, Wash.—Symons Investment Co. (Divides time with KFIO)	250	245.8	1220	Pacific
	KFQA—St. Louis, Mo. (Transmitter in Kirkwood)—The Principia, 5539 Page Ave	50	322.4	930	Central
	KFQB—Fort Worth, Tex.—Lone Star Broadcast Co., 205 Worth Bldg	1000	260.7	1150	Central
	KFQU—Alma (Holy City), Cal.—W. E. Riker	100	249.9	1200	Pacific
	KFQW—Seattle, Wash. (Transmitter in Wenatchee)—Carl F. Knierim	100	217.3	1380	Pacific
	KFQZ—Hollywood, Calif.—Taft Radio & Broadcasting Co., Inc., 1641 N. Argyle (Divides time with KFPR)	100	232.4	1290	Pacific
	KFRC—San Francisco, Calif.—Don Lee, Inc. (1000 watts Daytime)	500	454.3	660	Pacific
	KFRU—Columbia, Mo.—Stephens College, Administration Bldg	500	249.9	1200	Central
	KFSD—San Diego, Calif.—Airfan Radio Corp., 402 "B" St	1000	440.9	680	Pacific
	KFSG—Los Angeles, Calif.—Echo Park Evangelistic Association, Angelus Temple	500	275.1	1090	Pacific
	KFUL—Galveston Tex.—Thos. Groggan and Bros. Music Co., 2126 Market St	500	258.5	1160	Central
	KFUM—Colorado Springs, Colo.—W. D. Corley, Ford Vollmer Bldg	100	236.1	1270	Mountain
	KFUO—St. Louis, Mo.—Lutheran Church of the Missouri Synod, Concordia Theological Seminary (Divides time with KSD)	500	545.1	550	Central
	KFUP—Denver, Colo.—Fitzsimons General Hospital, Red Cross Bldg	100	227.1	1320	Mountain
	KFUR—Ogden, Utah—Peery Building Co., 420—25 St.	50	225.4	1330	Pacific
	KFUS—Oakland, Calif.—Louis L. Sherman, 529—28 St. (Divides time with KRE)	50	256.3	1170	Pacific
	KFUT—Salt Lake City, Utah—University of Utah	50	499.7	600	Pacific
	KFVD—Venice, Calif.—McWhinnie Elec. Co., 1825 So. Pacific Ave. (Divides time with KGFJ)	250	208.2	1440	Pacific
	KFVE—St. Louis, Mo.—Benson Broadcasting Corp., Hotel Chase (2000 watts Daytime)	1000	234.2	1280	Central
	KFVG—Independence, Kans.—First Methodist Episcopal Church	50	225.4	1330	Central
	KFVI—Houston, Tex.—Headquarters Troop 56th Cavalry	50	238	1260	Central
	KFVN—Fairmont, Minn.—Carl E. Bagley	100	228.9	1310	Central
	KFVS—Cape Girardeau, Mo.—Hirsch Battery & Radio Co., 312 S. Fred St	50	223.7	1340	Central
	KFWB—Los Angeles, Calif.—Warner Bros. Pictures, Inc., 5842 Sunset Blvd	500	361.2	830	Pacific
	KFWC—San Bernardino, Calif.—L. E. Wall	100	222.1	1350	Pacific
	KFWF—St. Louis, Mo.—St. Louis Truth Center, 4030 Lindell Blvd	250	214.2	1400	Central
	KFWH—Eureka, Calif.—F. Wellington Morse, Jr., Hotel Vance	100	254.1	1180	Pacific
	KFWI—San Francisco, Calif. (Transmitter in So. San Francisco)—Radio Entertainments, Inc., 1400 Van Ness Ave	500	267.7	1120	Pacific
	KFWM—Oakland, Calif.—Oakland Educational Society, 1520—8 Ave., (1000 watts Daytime)	500	236.1	1270	Pacific
	KFWO—Avalon, Catalina Island, Calif.—Major Lawrence Mott, Signal Corps, U. S. Army	250	218.8	1370	Pacific
	KFXD—Jerome, Utah—The Service Radio Co	15	204	1470	Mountain

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KF	**KFXF—Denver, Colo.**—Pikes Peak Broadcasting Co., Brown Palace Hotel	500	282.8	1060	Mountain
	KFXH—El Paso, Tex.—Bledsoe Radio Co., 115 S. El Paso St.	100	241.8	1240	Central
	KFXJ—Edgewater, Colo.—R. G. Howell	15	215.7	1390	Mountain
	KFXR—Oklahoma City, Okla.—Classen Film Finishing Co., 132½ W. Main St.	50	223.7	1340	Central
	KFXY—Flagstaff, Ariz.—Mary M. Costigan, Orpheum Theatre	25	205.4	1460	Mountain
	KFYF—Oxnard, Calif.—Carl's Radio Den, 207—5th St.	25	238	1260	Pacific
	KFYR—Bismarck, N. D.—Hoskins Meyer, Inc., 200 4th St. (500 watts Daytime)	250	239.9	1250	Central
KG	**KGA—Spokane, Wash.**—Northwest Radio Co., 325 Rowan Ave.	2000	260.7	1150	Pacific
	KGAR—Tucson, Ariz.—Tucson Citizen, 80 So. Stone St.	100	234.2	1280	Mountain
	KGBS—Seattle, Wash.—A. C. Dailey, 844 E. 58 St.	100	202.6	1480	Pacific
	KGBX—St. Joseph, Mo.—Foster-Hall Tire Co., 1221 Fred Ave.	100	277.6	1080	Central
	KGBY—Shelby, Nebr.—Dunning & Taddiken	50	202.6	1480	Central
	KGBZ—York, Nebr.—Federal Live Stock Remedy Co., 303 West 5th St.	100	212.6	1410	Central
	KGCA—Decorah, Iowa—Chas. W. Greenley	10	247.8	1210	Central
	KGCB—Oklahoma City, Okla.—Wallace Radio Inst., 105 W. 13 St. (Divides time with KGFG)	50	215.7	1390	Central
	KGCG—Newark, Ark.—Moore Motor Co.	100	223.7	1340	Central
	KGCH—Wayne, Nebr.—Wayne Hospital	250	293.9	1020	Central
	KGCI—San Antonio, Tex.—Liberto Radio Sales, 409 So. Flores St. (Divides time with KGRC)	15	220.4	1360	Central
	KGCL—Seattle, Wash.—Louis Wasmer and Archie Taft, 609 Washington Blvd. (Divides time with KPCB)	50	230.6	1300	Pacific
	KGCN—Concordia, Kans.—Concordia Broadcasting Co., 1117 So. Hill St.	50	208.2	1440	Central
	KGCR—Brookings, S. D.—Cutler's Radio Broadcasting Service, Inc., 415 Main St.	15	208.2	1440	Central
	KGCU—Mandan, N. D.—Mandan Radio Assoc.	100	208.2	1440	Central
	KGCX—Vida, Mont.—First State Bank of Vida	10	243.8	1230	Mountain
	KGDA—Dell Rapids, S. D.—Home Auto Co. (Daytime only)	15	234.2	1280	Central
	KGDE—Barrett, Minn.—Jaren Drug Co	50	205.4	1460	Central
	KGDJ—Cresco, Iowa—R. Rathert, 316—5th Ave.	10	202.6	1480	Central
	KGDM—Stockton, Calif.—Victor G. Koping and E. F. Peffer, 42 S. California St.	10	217.3	1380	Pacific
	KGDP—Pueblo, Colo.—Pueblo Council, Boy Scouts of America	15	223.7	1340	Mountain
	KGDR—San Antonio, Tex.—Radio Engineers Assoc.	15	202.6	1480	Central
	KGDW—Humboldt, Nebr.—Frank J. Rist	100	206.8	1450	Central
	KGDX—Shreveport, La.—Wm. Erwin Anthony	250	212.6	1410	Central
	KGDY—Oldham, S. D.—J. Albert Loesch	15	206.8	1450	Central
	KGEF—Los Angeles, Calif.—Trinity Methodist Church	500	263	1140	Pacific
	KGEH—Eugene, Ore.—Eugene Broadcasting Station	50	201.2	1490	Pacific
	KGEK—Yuma, Colo.—Beehler Elec. Equipment Co., 109 W. Second Ave.	10	263	1140	Mountain
	KGEN—El Centro, Calif.—E. R. Irey and F. M. Bowels	15	225.4	1330	Pacific
	KGEO—Grand Island, Nebr.—Raymond D. Chamberlain, 116 N. Locust St.	100	205.4	1460	Central
	KGEQ—Minneapolis, Minn.—Fred W. Herrmann, 920 Fifth Ave, N.	50	202.6	1480	Central

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KG	KGER—Long Beach, Calif.—C. Merwin Dobyns, 435 Pine Ave. (Divides time with KRLO)	100	215.7	1390	Pacific
	KGES—Central City, Nebr.—Central Radio Elec. Co.	10	204	1470	Central
	KGEU—Lower Lake, Calif.—I. W. Clement	50	227.1	1320	Pacific
	KGEW—Fort Morgan, Colo.—City of Fort Morgan	10	218.8	1370	Mountain
	KGEY—Denver, Colo.—J. W. Dietz, 1631 California St.	15	201.2	1490	Mountain
	KGEZ—Kalispell, Mont.—Flathead Broadcasting Assoc.	100	205.4	1460	Mountain
	KGFB—Iowa City, Iowa—A. C. Dunckle	10	223.7	1340	Central
	KGFF—Alva, Okla.—Earl E. Hampshire	25	205.4	1460	Central
	KGFG—Oklahoma City, Okla.—Full Gospel Church (Divides time with KGCB)	50	215.7	1390	Central
	KGFH—La Crescenta, Calif.—Frederick Robinson, Box 163 (Divides time with KMIC)	250	223.7	1340	Pacific
	KGFI—San Angelo, Tex—M. L. Eaves	15	220.4	1360	Central
	KGFJ—Los Angeles, Calif.—Ben S. McGlashan, 2333 W. 21st St. (Divides time with KFVD)	100	208.2	1440	Pacific
	KGFK—Hallock, Minn.—Kittson County Enterprise	50	223.7	1340	Central
	KGFL—Trinidad, Colo. (Transmitter in Paton, N. M.)—Trinidad Broadcasting Co., 219 W. Main St.	50	222.1	1350	Mountain
	KGFM—Yuba City, Calif.—Geo. W. Johnson, 336 Plumas St.	15	211.1	1420	Pacific
	KGFN—Aneta, N. D.—Haraldson & Thingstad	15	199.9	1500	Central
	KGFO—Terre Haute, Ind.—Brandt Radio Power Co.	100	204	1470	Central
	KGFP—Mitchell, S. D.—Mitchell Broadcast Co., 113 W. 4th Ave.	10	212.6	1410	Central
	KGFW—Ravenna, Nebr.—Otto F. Sothman, 318 Grand Ave.	10	299.8	1000	Mountain
	KGO—Oakland, Calif.—General Elec. Co.	5000	384.4	780	Pacific
	KGRC—San Antonio, Tex.—G. Roth & Co., 103 San Pedro Ave. (Divides time with KGCI)	50	220.4	1360	Central
	KGRS—Amarillo, Tex.—Gish Radio Service, 108 E. 8 St.	150	243.8	1230	Central
	KGTT—San Francisco, Calif.—Glad Tidings Temple and Bible Inst.	50	206.8	1450	Pacific
	KGW—Portland, Ore.—The Oregonian Pub. Co.	1000	491.5	610	Pacific
	KGY—Lacey, Wash.—St. Martins College	50	243.8	1230	Pacific
KH	KHJ—Los Angeles, Calif.—The Times Mirror Co.	500	405.2	740	Pacific
	KHQ—Spokane, Wash.—Louis Wasmer, Davenport Hotel	1000	370.2	810	Pacific
KI	KICK—Anita, Iowa—Atlantic Automobile Co.	100	461.3	650	Central
KJ	KJBS—San Francisco, Calif.—Julius Brunton & Sons Co., 1380 Bush St.	50	220.4	1360	Pacific
	KJR—Seattle, Wash.—Northwest Radio Service Co., 614 Terminal Sales Bldg.	2500	348.6	860	Pacific
KK	KKP—Seattle, Wash.—City of Seattle, Harbor Dept.	15	265.3	1130	Pacific
KL	KLDS—Independence, Mo.—Reorganized Church of Jesus Christ of Latter Day Saints	1500	238	1260	Central
	KLIT—Portland, Ore.—Lewis I. Thompson, 475—21 St.	10	206.8	1450	Pacific
	KLS—Oakland, Calif.—Warner Bros. Radio Supplies Co., 2201 Telegraph Ave. (Divides time with KZM)	250	245.8	1220	Pacific
	KLX—Oakland, Calif.—The Oakland Tribune	500	508.2	590	Pacific
	KLZ—Denver, Colo.—Reynolds Radio Co., 1534 Glenarm St.	250	267.7	1120	Mountain
KM	KMA—Shenandoah, Iowa—May Seed & Nursery Co. (Divides time with KFNF)	500	270.1	1110	Central
	KMED—Medford, Ore.—W. J. Virgin (Divides time with KFJI)	50	249.9	1200	Pacific

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KM	KMIC	**Inglewood, Calif.**—J. R. Fouch, 217 Market St. (Divides time with KGFH)	250	223.7	1340	Pacific
	KMJ	**Fresno, Calif.**—Fresno Bee	50	365.6	820	Pacific
	KMMJ	**Clay Center, Nebr.**—M. M. Johnson Co. (Divides time with WCAJ)	500	379.5	790	Central
	KMO	**Tacoma, Wash.**—KMO, Inc., Hotel Winthrop	250	254.1	1180	Pacific
	KMOX	**St. Louis, Mo.** (Transmitter in Kirkwood)—The Voice of St. Louis, Inc., Mayfair Hotel	5000	299.8	1000	Central
	KMTR	**Los Angeles, Calif.**—KMTR Radio Corp., 1025 N. Highland Ave.	500	526	570	Pacific
KN	KNRC	**Santa Monica, Calif.**—C. B. Juneau	500	374.8	800	Pacific
	KNX	**Los Angeles, Calif.**—Los Angeles Evening Express, 6116 Hollywood Blvd.	500	336.9	890	Pacific
KO	KOA	**Denver, Colo.**—General Elec. Co. (10000 watts until 7 P. M.)	5000	325.9	920	Mountain
	KOAC	**Corvallis, Ore.**—Oregon Agricultural College	500	270.1	1110	Pacific
	KOB	**State College, N. Mex.**—New Mexico College of Agriculture and Mechanic Arts (Divides time with KWSC and KTW)	5000	394.5	760	Mountain
	KOCH	**Omaha, Nebr.**—Omaha Central High School, 22nd and Dodge (Divides time with WNAL and KFOX)	250	258.5	1160	Central
	KOCW	**Chickasha, Okla.**—Oklahoma College for Women	250	252	1190	Central
	KOIL	**Council Bluffs, Iowa**—Mona Motor Oil Co. (4000 watts Daytime)	2000	277.6	1080	Central
	KOIN	**Portland, Ore.**—KOIN, Inc.	1000	319	940	Pacific
	KOLO	**Durango, Colo.**—Gerald K. Hunter	5	199.9	1500	Mountain
	KOMO	**Seattle, Wash.**—Bert F. Fisher, 604 Home Savings Bldg.	1000	305.9	980	Pacific
	KOW	**Denver, Colo.**—The Olinger Corp.	250	475.9	630	Mountain
	KOWN	**Walla Walla, Wash.**—Blue Mountain Radios Assoc	500	299.8	1000	Pacific
KP	KPCB	**Seattle, Wash.**—Pacific Coast Biscuit Co., 505 Central Bldg. (Divides time with KGCL)	50	230.6	1300	Pacific
	KPJM	**Prescott, Ariz.**—Wilburn Radio Service, Journal Mines Bldg.	15	214.2	1400	Mountain
	KPLA	**Los Angeles, Calif.**—Pacific Development Radio Co.	500	252	1190	Pacific
	KPNP	**Muscatine, Iowa**—Central Radio Co., East Second St.	100	211.1	1420	Central
	KPO	**San Francisco, Calif.**—Hale Bros. and the San Francisco Chronicle	1000	422.3	710	Pacific
	KPPC	**Pasadena, Calif.**—Pasadena Presbyterian Church (Divides time with KELW)	50	228.9	1310	Pacific
	KPRC	**Houston, Tex.**—Houston Post Dispatch	500	293.9	1020	Central
	KPSN	**Pasadena, Calif.**—The Star-News	1000	315.6	950	Pacific
KQ	KQV	**Pittsburgh, Pa.**—Doubleday-Hill Elec. Co., 719 Liberty Ave. (Divides time with WJAS)	500	270.1	1110	Eastern
	KQW	**San Jose, Calif.**—First Bapist Church of San Jose, Montevina Ave.	500	296.9	1010	Pacific
KR	KRAC	**Shreveport, La.**—Caddo Radio Club, Fair Grounds	50	220.4	1360	Central
	KRE	**Berkeley, Calif.**—First Congregational Church of Berkeley (Divides time with KFUS)	100	256.3	1170	Pacific
	KRLD	**Dallas, Tex.**—Dallas Radio Labs., 208 N. St. Paul St.	500	461.3	650	Central
	KRLO	**Los Angeles, Calif.**—Freeman Lang and A. B. Scott, 218 N. Larchmont Blvd. (Divides time with KGER)	250	215.7	1390	Pacific

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KR	**KRSC—Seattle, Wash.**—Radio Sales Corp., 1202 Fifth Ave.	50	211 1	1420	Pacific
KS	**KSAC—Manhattan, Kans.**—Kansas State Agricultural College	500	333 1	900	Central
	KSBA—Shreveport, La.—Shreveport Broadcasting Co.	1000	267 7	1120	Central
	KSCJ—Sioux City, Iowa—Perkins Bros. Co. (Divides time with KWUC)	500	243 8	1230	Central
	KSD—St. Louis, Mo.—Pulitzer Pub. Co. (Divides time with KFUO)	500	545 1	550	Central
	KSEI—Pocatello, Idaho—KSEI Broadcasting Assoc	250	333 1	900	Mountain
	KSL—Salt Lake City, Utah—Radio Service Corp. of Utah, 505 Templeton Bldg.	1000	302 8	990	Mountain
	KSMR—Santa Maria, Calif.—Santa Maria Valley R. R. Co.	100	272.6	1100	Pacific
	KSO—Clarinda, Iowa—A. A. Berry Seed Co.	500	227 1	1320	Central
	KSOO—Sioux Falls, S. D.—Sioux Falls Broadcast Assoc., 609 Minnehaha Bldg.	250	209 7	1430	Mountain
KT	**KTAB—Oakland, Calif.**—The Associated Broadcasters, Inc., 1410 Tenth Ave.	500	280 2	1070	Pacific
	KTAP—San Antonio, Tex.—Robert B. Bridge, Radio Service Shop, 2412 Main Ave	20	228 9	1310	Central
	KTBI—Los Angeles, Calif.—Bible Institute of Los Angeles	500	288 3	1040	Pacific
	KTBR—Portland, Ore.—Brown's Radio Shop, 172 Tenth St. (Divides time with KFJR)	50	282 8	1060	Pacific
	KTCL—Seattle, Wash.—American Radio Tel. Co.	500	277 6	1080	Pacific
	KTHS—Hot Springs Nat'l. Park, Ark.—New Arlington Hotel Co.	1000	384.4	780	Central
	KTNT—Muscatine, Iowa—Norman Baker (5000 watts Daytime)	3500	256.3	1170	Central
	KTSA—San Antonio, Tex.—Alamo Broadcasting Co.	2000	265.3	1130	Central
	KTUE—Houston, Tex.—Uhalt Electric Co., 614 Fannin St.	5	212.6	1410	Central
	KTW—Seattle, Wash.—The First Presbyterian Church of Seattle (Divides time with KWSC and KOB)	1000	394.5	760	Pacific
KU	**KUJ—Seattle, Wash.**—The Puget Sound Radio Broadcasting Co., Inc., 5811—5 Ave., N. E.	10	199.9	1500	Pacific
	KUOA—Fayetteville, Ark.—University of Arkansas	500	296.9	1010	Central
	KUOM—Missoula, Mont.—State University of Montana	500	374.8	800	Mountain
	KUSD—Vermillion, S. D.—University of S. Dak	250	483.6	620	Central
	KUT—Austin, Tex.—University of Texas	500	232.4	1290	Central
KV	**KVI—Tacoma, Wash.**—Puget Sound Radio Broadcasting Co., Inc., Ninth and A Sts.	50	234.2	1280	Pacific
	KVOO—Bristow, Okla.—Southwestern Sales Corp	1000	348.6	860	Central
	KVOS—Seattle, Wash.—L. L. Jackson and L. Kessler, 1208 Tenth Ave.	50	209.7	1430	Pacific
KW	**KWBS—Portland, Ore.**—Schaeffer Mfg. Co., 226 E. 41 St.	15	199.9	1500	Pacific
	KWCR—Cedar Rapids, Ia.—H. F. Paar, Cedar Rapids Broadcasting Corp., 1444—2nd Ave., E. (Divides time with WJAM)	250	384.4	780	Central
	KWG—Stockton, Calif.—Portable Wireless Telephone Co., 530 E. Market St.	50	344.6	870	Pacific
	KWJJ—Portland, Ore.—Wilbur Jernian, 385 E. 58 St., So.	50	228.9	1310	Pacific
	KWKC—Kansas City, Mo.—Wilson Duncan Broadcasting Studios, Werby Bldg.	100	222.1	1350	Central
	KWKH—Shreveport, La.—W. K. Henderson	1000	394.5	760	Central
	KWLC—Decorah, Iowa—Norwegian Lutheran College.	50	247.8	1210	Central

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
KW KWSC	**Pullman, Wash.**—State College of Washington, Mechanic Arts Bldg. (Divides time with KTW and KOB)	500	394.5	760	Pacific
KWTC	**Santa Ana, Calif.**—Dr. John W. Hancock, 1101 North Ross St.	5	352.7	850	Pacific
KWUC	**Le Mars, Iowa**—Western Union College (Daytime only. Divides time with KSCJ)	1500	243.8	1230	Central
KWWG	**Brownsville, Tex.**—Chamber of Commerce	500	277.6	1080	Central
KX KXL	**Portland, Ore.**—KXL Broadcasters, 501 Pantage Bldg.	50	220.4	1360	Pacific
KY KYA	**San Francisco, Calif.**—Pacific Broadcasting Co.	500	309.1	970	Pacific
KYW	**Chicago, Ill.**—Westinghouse Elec. & Mfg. Co., 508 S. Michigan Ave. (Divides time with KFKX)	2500	526	570	Central
KZ KZM	**Oakland, Calif.**—Preston D. Allen, 13th and Harrison Sts. (Divides time with KLS)	100	245.8	1220	Pacific
WA WAAD	**Cincinnati, Ohio**—Ohio Mechanics Inst.	25	267.7	1120	Central
WAAF	**Chicago, Ill.**—Chicago Daily Drovers Journal (Divides time with WBBM and WJBT)	500	389.4	770	Central
WAAM	**Newark, N. J.**—I. R. Nelson, 1 Bond St. (Divides time with WGBS)	500	348.6	860	Eastern
WAAT	**Jersey City, N. J.**—Bremer Broadcasting Corp., 210 Jackson Ave. (Divides time with WGBB and WSOM)	500	245.8	1220	Eastern
WAAW	**Omaha, Nebr.**—Omaha Grain Exchange (Before 7 P. M. only)	300	348.6	860	Central
WABC	**New York, N. Y.**—Atlantic Broadcasting Corp., 113 W. 57 St. (Divides time with WBOQ)	2500	325.9	920	Eastern
WABF	**Pringleboro, Pa.**—Markle Broadcasting Corp., 294 Wyoming Ave.	250	205.4	1460	Eastern
WABI	**Bangor, Me.**—First Universalist Church, Park St.	100	389.4	770	Eastern
WABO	**Rochester, N. Y.**—Hickson Elec. Co. (Divides time with WHEC)	100	232.4	1290	Eastern
WABQ	**Philadelphia, Pa.**—Keystone Broadcasting Co.	500	260.7	1150	Eastern
WABR	**Toledo, Ohio**—Scott High School (Divides time with WTAL)	50	280.2	1070	Eastern
WABW	**Wooster, Ohio**—College of Wooster	50	247.8	1210	Eastern
WABY	**Philadelphia, Pa.**—John Magaldi, Jr.	50	247.8	1210	Eastern
WABZ	**New Orleans, La.**—Colis Place Baptist Church	50	247.8	1210	Central
WADC	**Akron, Ohio**—Allen T. Simmons	500	296.9	1010	Eastern
WAFD	**Detroit, Mich.**—Albert B. Parfet Co., Charlotte St. and Woodward Ave. (Divides time with WRAV)	100	340.7	880	Eastern
WAGM	**Royal Oak, Mich.**—Robert L. Miller, 309 So. Main St.	50	225.4	1330	Eastern
WAGS	**Somerville, Mass.**—Transmitter in Lexington—Willow Garages, Inc., 131 Willow Ave.	5	215.7	1390	Eastern
WAIT	**Taunton, Mass.**—A. H. Waite & Co., 32 Weir St.	10	214.2	1400	Eastern
WAIU	**Columbus, Ohio**—American Insurance Union (Divides time with WEAO)	5000	282.8	1060	Eastern
WALK	**Willow Grove, Pa.**—Albert A. Walker	50	201.2	1490	Eastern
WAMD	**Minneapolis, Minn.**—Radisson Radio Corp.	500	225.4	1330	Central
WAPI	**Auburn, Ala.**—Alabama Polytechnic Inst. (Daytime only)	1000	325.9	920	Central
WARS	**Brooklyn, N. Y.**—Amateur Radio Specialty Co., 77 Cortlandt St., N. Y. (Divides time with WSDA and WBBC)	500	227.1	1320	Eastern
WASH	**Grand Rapids, Mich.**—The Baxter Launderers and Cleaners	250	256.3	1170	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WA	**WATT—Boston, Mass. (Portable)**—Edison Elec. Illuminating Co.	100	201.2	1490	
WB	**WBAA—West Lafayette, Ind.**—Purdue University (Divides time with WRN)	500	272.6	1100	Central
	WBAK—Harrisburg, Pa.—Pennsylvania State Police (Divides time with WPSC)	500	299.8	1000	Eastern
	WBAL—Baltimore, Md.—Transmitter in Glen Morris—Consolidated Gas, Elec. Light & Power Co.	3000	285.5	1050	Eastern
	WBAO—Decatur, Ill.—James Millikin University	100	267.7	1120	Central
	WBAP—Fort Worth, Tex.—Carter Publishing Co. (Divides time with WFAA)	1500	499.7	600	Central
	WBAW—Nashville, Tenn.—Waldrum Drug Co.	100	247.8	1210	Central
	WBAX—Wilkes-Barre, Pa.—John H. Stenger, Jr., 66 Gildersleeve St. (Divides time with WBRE)	100	249.9	1200	Eastern
	WBBC—Brooklyn, N. Y.—Brooklyn Broadcasting Corp., 2123 Troy Ave. (Divides time with WARS and WSDA)	500	227.1	1320	Eastern
	WBBL—Richmond, Va.—Grace-Covenant Presbyterian Church, 1627 Monument Ave.	100	247.8	1210	Eastern
	WBBM—Chicago, Ill.—Atlass Investment Co., 1554 Howard St. (Divides time with WJBT and WAAF)	1000	389.4	770	Central
	WBBP—Petoskey, Mich.—Petoskey High School	100	239.9	1250	Central
	WBBR—Rossville, N. Y.—People's Pulpit Assoc., 124 Columbia Heights, Brooklyn (Divides time one-half with WJBI—WEBJ)	1000	256.3	1170	Eastern
	WBBW—Norfolk, Va.—Ruffner Junior High School	50	236.1	1270	Eastern
	WBBY—Charleston, S. C.—Washington Light Infantry	75	499.7	600	Eastern
	WBBZ—Chicago, Ill. (Portable)—C. L. Carrell, 1506 No. American Bldg.	100	204	1470	
	WBCN—Chicago, Ill.—Great Lakes Broadcasting Co., 728 W. 65th St. (Divides time with WENR)	250	288.3	1040	Central
	WBES—Tacoma Park, Md.—Bliss Electrical School	100	296.9	1010	Eastern
	WBET—Boston, Mass.—Boston Transcript	500	265.3	1130	Eastern
	WBIS—Boston, Mass.—The Shepard Stores (Divides time with WSSH)	100	302.8	990	Eastern
	WBKN—Brooklyn, N. Y.—Arthur Faske, 1515 Eastern Parkway (Divides time with WWRL, WIBI and WBMS)	100	267.7	1120	Eastern
	WBMH—Detroit, Mich.—Braun's Music House, 13214 E. Jefferson Ave.	100	211.1	1420	Central
	WBMS—Union City, N. J.—George J. Schowerer, 837—34 St. (Divides time with WBKN, WWRO and WIBI)	100	267.7	1120	Eastern
	WBNY—New York, N. Y.—Baruchrome Corp., 400 E. 139 St. (Divides time with WHAP—WMSG)	250	236.1	1270	Eastern
	WBOQ—New York, N. Y.—Atlantic Broadcasting Corp., 113 W. 57 St. (Divides time with WABC)	500	325.9	920	Eastern
	WBRC—Birmingham, Ala.—Birmingham Broadcasting Corp., Age-Herald Bldg.	250	243.8	1230	Central
	WBRE—Wilkes-Barre, Pa.—Baltimore Radio Exchange, 17 W. Northampton St. (Divides time with WBAX)	100	249.9	1200	Eastern
	WBRL—Tilton, N. H.—Booth Radio Labs., 23 Summer St.	500	232.4	1290	Eastern
	WBRS—Brooklyn, N. Y.—North American Broadcasting Corp. (Divides time with WCDA, WCGU and WRST)	100	211.1	1420	Eastern
	WBSO—Wellesley Hills, Mass.—Babson's Statistical Organization (Divides time with WDWF)	100	384.4	780	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WB WBT	**Charlotte, N. C.**—Charlotte Chamber of Commerce, 500 West Trade St. (Uses 1000 watts Daytime)	500	258.5	1160	Eastern
WBZ	**Springfield, Mass.**—Transmitter is in East Springfield—Westinghouse Elec. & Mfg. Co., Hotel Kimball	15000	333.1	900	Eastern
WBZA	**Boston, Mass.**—Westinghouse Elec. & Mfg. Co., Hotel Brunswick	500	333.1	900	Eastern
WC WCAC	**Mansfield, Conn.**—Connecticut Agricultural College (Divides time with WDRC)	500	275.1	1090	Eastern
WCAD	**Canton, N. Y.**—St. Lawrence University (1000 watts Daytime)	500	365.6	820	Eastern
WCAE	**Pittsburgh, Pa.**—Kaufmann Bros. and Baer Co., Sixth and Smithfield Sts.	500	516.9	580	Eastern
WCAH	**Columbus, Ohio**—Entrekin Elec. Co., 321 W. 10th Ave.	250	535.4	560	Eastern
WCAJ	**Lincoln, Nebr.**—Nebraska Wesleyan University (Divides time with KMMJ)	500	379.5	790	Central
WCAL	**Northfield, Minn.**—St. Olaf College (Divides time with KFMX)	500	236.1	1270	Central
WCAM	**Camden, N. J.**—City of Camden, Civic Centre	500	223.7	1340	Eastern
WCAO	**Baltimore, Md.**—Monumental Radio, Inc., 848 N. Howard St. (Divides time with WCBM)	250	384.4	780	Eastern
WCAT	**Rapid City, S. D.**—South Dakota State School of Mines	100	247.8	1210	Mountain
WCAU	**Philadelphia, Pa.**—Universal Broadcasting Co.	500	260.7	1150	Eastern
WCAX	**Burlington, Vt.**—University of Vermont	100	254.1	1180	Eastern
WCAZ	**Carthage, Ill.**—Carthage College	50	340.7	880	Central
WCBA	**Allentown, Pa.**—Chas. W. Heimbach, 1015 Allen St. (Divides time with WSAN)	100	222.1	1350	Eastern
WCBD	**Zion, Ill.**—Wilbur G. Voliva (Divides time with WLS)	5000	344.6	870	Central
WCBE	**New Orleans, La.**—Uhalt Bros., 1219 N. Rampart St.	5	227.1	1320	Central
WCBH	**Oxford, Miss. (near)**—University of Mississippi	100	241.8	1240	Central
WCBM	**Baltimore, Md.**—Hotel Chateau, Charles St. and North Ave. (Divides time with WCAO)	100	384.4	780	Eastern
WCBR	**Providence, R. I. (Portable)**—Chas. H. Messter, 42 Doyle Ave.	100	201.2	1490	
WCBS	**Springfield, Ill.**—Harold L. Dewing and Chas. H. Messter	250	209.7	1430	Central
WCCO	**Minneapolis, Minn.**—Washburn-Crosby Co., (7500 watts Daytime)	5000	405.2	740	Central
WCDA	**Cliffside, N. J.**—Italian Educational Foundation Corp. (Divides time with WRST, WBRS and WCGU)	250	211.1	1420	Eastern
WCFL	**Chicago, Ill.**—Chicago Federation of Labor, 166 West Washington St. (Divides time with WLTS)	1500	483.6	620	Central
WCGU	**New York, N. Y.**—Chas. G. Unger, 1587 Broadway. (Divides time with WCDA, WBRS and WRST)	500	211.1	1420	Eastern
WCLO	**Camp Lake, Wis.**—C. E. Whitmore	100	227.1	1320	Central
WCLS	**Joliet, Ill.**—WCLS, Inc., 301 E. Jefferson St. (Divides time with WKBB)	150	215.7	1390	Central
WCMA	**Culver, Ind.**—Culver Military Academy	250	258.5	1160	Central
WCOA	**Pensacola, Fla.**—City of Pensacola	500	249.9	1200	Central
WCOC	**Columbus, Miss.**—Crystal Oil Co.	100	230.6	1300	Central
WCOM	**Manchester, N. H.**—172nd Field Artillery, N. H. N. G.	100	238	1260	Eastern
WCOT	**Olneyville, R. I.**—Jacob Conn, 1849 Westminster St. (Divides time with WFCI)	50	225.4	1330	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WC	**WCRW—Chicago, Ill.**—Clinton R. White, 650 Waveland Ave. (Divides time with WFKB, WPPC)	500	223.7	1340	Central
	WCSH—Portland, Me.—Henry P. Rines, Congress Square Hotel Co.	500	361.2	830	Eastern
	WCSO—Springfield, Ohio—Wittenberg College	500	256.3	1170	Central
	WCWK—Fort Wayne, Ind.—Chester W. Keen, 1729 Lafayette St. (Divides time with WOWO)	500	228.9	1310	Central
	WCWS—Danbury, Conn.—Connecticut Portable Broadcasting Corp.	100	214.2	1400	Eastern
	WCX—Pontiac, Mich.—Detroit Free Press	5000	440.9	680	Eastern
WD	**WDAD—Nashville, Tenn.**—Dad's Auto Accessory and Radio Store, 171 Eighth Ave., North (1000 watts Daytime)	500	225.4	1330	Central
	WDAE—Tampa, Fla.—Tampa Daily Times	500	267.7	1120	Eastern
	WDAF—Kansas City, Mo.—The Kansas City Star	1000	370.2	810	Central
	WDAG—Amarillo, Tex.—J. Laurance Martin, 655 E. 4th St.	250	263	1140	Central
	WDAH—El Paso, Tex.—Trinity Methodist Church, Cor. Blod and Misa Ave.	100	234.2	1280	Mountain
	WDAY—Fargo, N. D.—Radio Equipment Corp., 119 Broadway	250	361.2	830	Central
	WDBJ—Roanoke, Va.—Richardson-Wayland Electric Corp., 106 Church Ave., S. W.	250	230.6	1300	Eastern
	WDBK—Cleveland, Ohio, Transmitter in Akron, W. F. Jones (Divides time with WJAY)	250	227.1	1320	Eastern
	WDBO—Orlando, Fla.—Central Florida Broadcast Station, Inc. (1000 watts Daytime)	500	288.3	1040	Eastern
	WDBZ—Kingston, N. Y.—Under Management of Kingston Chamber of Commerce Boy Scouts of America (Divides time with WOKO)	50	215.7	1390	Eastern
	WDEL—Wilmington, Del.—Wilmington Elec. Specialty Co., 405 Delaware Ave.	100	265.3	1130	Eastern
	WDGY—Minneapolis, Minn.—Geo. W. Young, 909 W. Broadway	500	260.7	1150	Central
	WDOD—Chattanooga, Tenn.—Chattanooga Radio Co., 615 Market St.	500	245.8	1220	Central
	WDRC—New Haven, Conn.—Doolittle Radio Corp., 115 Crown St. (Divides time with WCAC)	250	275.1	1090	Eastern
	WDWF—Cranston, R. I.—Dutee W. Flint and Lincoln Studios, Inc. (Divides time with WBSO)	500	374.8	800	Eastern
	WDWM—Asbury Park, N. J.—Radio Industries Broadcast Co., 20 Central Ave.	500	361.2	830	Eastern
	WDZ—Tuscola, Ill.—Jas. L. Bush (Daytime only)	100	277.6	1080	Central
WE	**WEAF—New York, N. Y.**—(Transmitter at 463 West St.)—National Broadcasting Co., Inc., 195 Broadway	5000	491.5	610	Eastern
	WEAI—Ithaca, N. Y.—Cornell University	250	483.6	620	Eastern
	WEAM—North Plainfield, N. J.—Borough of North Plainfield (Divides time with WOAX)	250	239.9	1250	Eastern
	WEAN—Providence, R. I.—The Shepard Co., 122 Mathewson St. (Divides time with WNAC)	500	319	940	Eastern
	WEAO—Columbus, Ohio—The Ohio State University (Divides time with WAIU)	750	282.8	1060	Eastern
	WEAR—Cleveland, Ohio—Willard Storage Battery Co. (Divides time with WTAM)	1000	399.8	750	Eastern
	WEBC—Superior, Wis.—W. C. Bridges	250	241.8	1240	Central
	WEBE—Cambridge, Ohio—R. W. Waller, 319 Wall Ave.	10	247.8	1210	Eastern
	WEBH—Chicago, Ill.—Edgewater Beach Hotel Co., 5300 Sheridan Rd. (Divides time with WJJD)	2000	365.6	820	Central
	WEBJ—New York, N. Y.—Third Ave. Railway Co., 2396 Third Ave. (Divides time [one quarter] with WJBI—WBBR)	500	256.3	1170	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WE	WEBQ—**Harrisburg, Ill.**—Tate Radio Co., 700 W. Robinson St.	15	223.7	1340	Central
	WEBR—**Buffalo, N. Y.**—Howell Broadcasting Co., 54 Niagara St.	200	241.8	1240	Eastern
	WEBW—**Beloit, Wis.**—Beloit College	500	258.5	1160	Central
	WEDC—**Chicago, Ill.**—Emil Denemark Broadcasting Station, 3860 Ogden Ave. (Divides time with WGES)	500	241.8	1240	Central
	WEEI—**Boston, Mass.**—The Edison Elec. Illuminating Co.	500	447.5	670	Eastern
	WEHS—**Evanston, Ill.**—A. T. Becker, 1318 Elmwood Ave.	100	215.7	1390	Central
	WEMC—**Berrien Springs, Mich.**—Emmanuel Missionary College, (Divides time with WCFL and WLTS)	1000	483.6	620	Central
	WENR—**Chicago, Ill.**—Commonwealth Edison Co. (Divides time with WBCN)	500	288.3	1040	Central
	WEPS—**Gloucester, Mass.**—Matheson Radio Co., 209 Main St.	100	296.9	1010	Eastern
	WEW—**St. Louis, Mo.**—St. Louis University	1000	352.7	850	Central
WF	WFAA—**Dallas, Tex.**—Dallas News and Dallas Journal, Baker Hotel (Divides time with WBAP)	500	499.7	600	Central
	WFAM—**St. Cloud, Minn.**—Times Publishing Co	10	252	1190	Central
	WFBC—**Knoxville, Tenn.**—First Baptist Church	50	234.2	1280	Central
	WFBE—**Cincinnati, Ohio**—Garfield Place Hotel Co.	250	245.8	1220	Central
	WFBG—**Altoona, Pa.**—The William F. Gable Co	100	280.2	1070	Eastern
	WFBJ—**Collegeville, Minn.**—St. John's University	100	272.6	1100	Central
	WFBL—**Syracuse, N. Y.**—The Onondaga Co.	750	258.5	1160	Eastern
	WFBM—**Indianapolis, Ind.**—Merchants Heat & Light Co.	250	225.4	1330	Central
	WFBR—**Baltimore, Md.**—Fifth Infantry National Guard	100	225.4	1330	Eastern
	WFBZ—**Galesburg, Ill.**—Knox College (Divides time with WRAM)	50	247.8	1210	Central
	WFCI—**Pawtucket, R. I.**—Frank Crook (Inc.), 103 Exchange St. (Divides time with WCOT)	50	225.4	1330	Eastern
	WFDF—**Flint, Mich.**—Frank D. Fallain, Police Bldg.	100	348.6	860	Eastern
	WFHH—**Clearwater, Fla.**—(Transmitter in Dunedin)—Fort Harrison Hotel	500	365.6	820	Eastern
	WFI—**Philadelphia, Pa.**—Strawbridge & Clothier (Divides time with WLIT)	500	405.2	740	Eastern
	WFIW—**Hopkinsville, Ky.**—Acme Mills, Inc. (1000 watts Daytime)	500	280.2	1070	Central
	WFKB—**Chicago, Ill.**—Francis K. Bridgman, 4536 Woodlawn Ave. (Divides time with WCRW)	500	223.7	1340	Central
	WFKD—**Philadelphia, Pa.**—Foulkrod Radio Engineering Co.	10	205.4	1460	Eastern
	WFLA—**Boca Raton, Fla.**—Boca Raton Radio Club	1000	212.6	1410	Eastern
WG	WGAL—**Lancaster, Pa.**—Lancaster Elec. Supply and Construction Co., 23 E. Orange St.	15	252	1190	Eastern
	WGBB—**Freeport, N. Y.**—Harry H. Carman, 217 Bedell St. (Divides time with WAAT and WSOM)	400	245.8	1220	Eastern
	WGBC—**Memphis, Tenn.**—First Baptist Church	15	277.6	1080	Central
	WGBF—**Evansville, Ind.**—Finke Furniture Co., 307 So. Seventh St.	250	236.1	1270	Central
	WGBI—**Scranton, Pa.**—Scranton Broadcasters, Inc., 608 Linden St. (Divides time with WQAN)	250	230.6	1300	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WG	**WGBS—New York, N. Y.**—(Transmitter in Astoria, L. I.)—Gimbel Bros., 33rd and Broadway) (Divides time with WAAM)	500	348.6	860	Eastern
	WGCP—Newark, N. J.—Lauter Piano Co., Broad & Washington Sts. (Divides time with WNJ)	500	280.2	1070	Eastern
	WGES—Chicago, Ill.—(Transmitter in Oak Park)—Oakleaves Broadcasting Corp., Coyne Electric School, 128 N. Crawford Ave. (Divides time with WEDC	500	241.8	1240	Central
	WGHP—Mount Clemens, Mich.—Geo. H. Phelps, 110 Rowena St	750	319	940	Central
	WGL—New York, N. Y.—(Transmitter in Secaucus, N. J.)—International Broadcast Corp., Hotel Majestic	500	293.9	1020	Eastern
	WGM—Jeanette, Pa.—Verne & Elton Spencer, 501 Cowan Ave	50	208.2	1440	Eastern
	WGMS—Minneapolis, Minn.—University of Minnesota	500	245.8	1220	Central
	WGMU—New York, N. Y. (Portable)—Atlantic Broadcasting Corp. (Divides time with WRMU)	100	201.2	1490	
	WGN—Chicago, Ill.—The Chicago Tribune, Drake Hotel (Divides time with WLIB)	15000	305.9	980	Central
	WGR—Buffalo, N. Y.—Federal Radio Corp., Hotel Statler	750	302.8	990	Eastern
	WGST—Atlanta, Ga.—Georgia School of Technology (Divides time with WMAZ)	500	270.1	1110	Central
	WGWB—Milwaukee, Wis.—Radiocast Corp. of Wisconsin, 144 Broadway	500	218.8	1370	Central
	WGY—Schenectady, N. Y.—General Electric Co. (Divides time with WHAZ)	30000	379.5	790	Eastern
WH	**WHA—Madison, Wis.**—University of Wisconsin (Divides time with WLBL)	750	319	940	Central
	WHAD—Milwaukee, Wis.—Marquette and Milwaukee Journal (Divides time with WTMJ)	500	293.9	1020	Central
	WHAM—Rochester, N. Y.—Stromberg-Carlson Telephone Mfg. Co. (Will use 5000 watts from Aug. 15)	500	277.6	1080	Eastern
	WHAP—New York, N. Y. (Transmitter in Carlstadt, N. J.)—Defenders of Truth Society, Inc., 9 W. 96th St. (Divides time with WBNY and WMSG)	1000	236.1	1270	Eastern
	WHAR—Atlantic City, N. J.—F. B. Cook's Sons, Inc., Seaside Hotel (Divides time with WPG)	750	272.6	1100	Eastern
	WHAS—Louisville, Ky.—Courier-Journal and Louisville Times	500	461.3	650	Central
	WHAZ—Troy, N. Y.—Rensselaer Polytechnic Inst. (Divides time with WGY)	500	379.5	790	Eastern
	WHB—Kansas City, Mo.—Sweeney Automotive and Elec. School. Sweeney Bldg. (Divides time with WOQ)	500	336.9	890	Central
	WHBA—Oil City, Pa.—Shaffer Music House	10	260.7	1150	Eastern
	WHBC—Canton, Ohio—St. John's Catholic Church, 627 McKinley Ave., N. W.	10	236.1	1270	Eastern
	WHBD—Bellefontaine, Ohio—Chamber of Commerce	100	222.1	1350	Central
	WHBF—Rock Island, Ill.—Beardsley Specialty Co., 217 Eighteenth St	100	222.1	1350	Central
	WHBL—Chicago, Ill. (Portable)—C. L. Carrell	100	204	1470	
	WHBM—Chicago, Ill. (Portable)—C. L. Carrell, 1536 So. State St	100	201.2	1490	
	WHBN—St. Petersburg, Fla.—First Ave. Methodist Church	10	296.9	1010	Eastern
	WHBP—Johnstown, Pa.—Johnstown Automobile Co., 101 Main St. (500 watts Daytime)	250	228.9	1310	Eastern
	WHBQ—Memphis, Tenn.—WHBQ, Inc., Dermon Bldg	100	232.4	1290	Central
	WHBU—Anderson, Ind.—Citizens Bank, 1002 Meridian St	15	220.4	1360	Central

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WH	**WHBW—Philadelphia, Pa.**—D. R. Kienzle, 4916 Chestnut St. (Divides time with WIAD)	50	220.4	1360	Eastern
	WHBY—West De Pere, Wis.—St. Norbert's College	50	249.9	1200	Central
	WHDI—Minneapolis, Minn.—Wm. Hood Dunwoody Industrial Inst., 818 Superior Blvd. (Divides time with WLB)	500	245.8	1220	Central
	WHEC—Rochester, N. Y.—Hickson Elec. Co., 36 South Ave. (Divides time with WABO)	100	232.4	1290	Eastern
	WHFC—Chicago, Ill.—Triangle Broadcasters, Hotel Flanders, 4145 Broadway	200	215.7	1390	Central
	WHK—Cleveland, Ohio—Radio Air Service Corp., 116 Carnegie Hall (Divides time with WJAY) (1000 watts Daytime)	500	265.3	1130	Eastern
	WHN—New York, N. Y.—George Schubel, 1540 Broadway (Divides time with WQAO and WPAP)	500	394.5	760	Eastern
	WHO—Des Moines, Ia.—Bankers Life Co., 1110 Liberty Bldg.	5000	535.4	560	Central
	WHPP—New York, N. Y.—Bronx Broadcasting Corp., 953 Southern Blvd.	10	206.8	1450	Eastern
	WHT—Chicago, Ill. (Transmitter in Deerfield)—Radiophone Broadcasting Corp., 410 N. Michigan Blvd. (Divides time with WIBO)	5000	416.4	720	Central
WI	**WIAD—Philadelphia, Pa.**—Howard R. Miller, 6318 North Park Ave. (Divides time with WHBW)	100	220.4	1360	Eastern
	WIAS—Burlington, Iowa—Home Elec. Co., 315 N. 3 St.	100	475.9	630	Central
	WIBA—Madison, Wis.—Capital Times Studio, and Strand Theatre Corp., 14 E. Mifflin St.	100	239.9	1250	Central
	WIBG—Elkins Park, Pa.—St. Paul's Protestant Episcopal Church (Sunday's Daytime only)	50	440.9	680	Eastern
	WIBI—Flushing, N. Y.—Frederick B. Zittell, Jr., 369 Amity St. (Divides time with WBKN, WWRL and WBMS)	100	267.7	1120	Eastern
	WIBJ—Chicago, Ill. (Portable)—C. L. Carrell, 1506 No. American Bldg.	100	201.2	1490	
	WIBM—Chicago, Ill. (Portable)—C. L. Carrell, 1506 No. American Bldg.	100	201.2	1490	
	WIBO—Chicago, Ill.—WIBO Broadcasters, Inc., 6312 Broadway (Divides time with WHT)	500	416.4	720	Central
	WIBR—Steubenville, Ohio—Thurman A. Owings	50	249.9	1200	Eastern
	WIBS—Elizabeth, N. J.—Lieut. Thos. F. Hunter (Divides time with WTRC and WLBX)	150	204	1470	Eastern
	WIBU—Poynette, Wis.—Wisconsin State Journal	20	217.3	1380	Central
	WIBW—Chicago, Ill. (Portable)—C. L. Carrell, 1506 No. American Bldg.	100	204	1470	
	WIBX—Utica, N. Y.—WIBX, Inc., Hotel Utica	150	238	1260	Eastern
	WIBZ—Montgomery, Ala.—A. D. Trum, 217 Catonia St.	15	230.6	1300	Central
	WICC—Bridgeport, Conn.—Bridgeport Broadcasting Co., Inc.	250	214.2	1400	Eastern
	WIL—St. Louis, Mo.—Benson Radio Co.	250	258.5	1160	Central
	WIOD—Miami Beach, Fla.—Carl G. Fisher Co.	1000	247.8	1210	Eastern
	WIP—Philadelphia, Pa.—Gimbel Bros., Market St. Bldg., (Divides time with WOO)	500	508.2	590	Eastern
WJ	**WJAD—Waco, Tex.**—Frank P. Jackson	500	447.5	670	Central
	WJAG—Norfolk, Nebr.—Norfolk Daily News	250	285.5	1050	Central
	WJAK—Kokomo, Ind.—J. A. Kautz, 1531 Washington St.	50	234.2	1280	Central
	WJAM—Cedar Rapids, Ia.—D. M. Perham, 322 Third Ave., W. (Divides time with KWCR)	100	384.4	780	Central
	WJAR—Providence, R. I.—The Outlet Co.	500	483.6	620	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WJ	**WJAS—Pittsburgh, Pa.**—Pittsburgh Radio Supply House, 10th and Pennsylvania Ave. (Divides time with KQV)	500	270.1	1110	Eastern
	WJAX—Jacksonville, Fla.—City of Jacksonville	1000	336.9	890	Eastern
	WJAY—Cleveland, Ohio—Cleveland Radio Broadcasting Corp., Hotel Hollenden (Divides time with WHK)	500	227.1	1320	Eastern
	WJAZ—Chicago, Ill. (Transmitter in Mount Prospect)—Zenith Radio Corp., 3620 Iron St. (Divides time with WMBI)	5000	263	1140	Central
	WJBA—Joliet, Ill.—D. H. Lentz, Jr., 301 Whitley Ave.	50	322.4	930	Central
	WJBB—St. Petersburg, Fla.—Financial Journal, 126—13th St., N.	250	344.6	870	Eastern
	WJBC—LaSalle, Ill.—Hummer Furniture Co., 2nd & Joliet Sts	100	227.1	1320	Central
	WJBI—Red Bank, N. J.—Robt. S. Johnson, 63 Broad St. (Divides time [one quarter] with WBBR—WEBJ)	250	256.3	1170	Eastern
	WJBK—Ypsilanti, Mich.—Ernest F. Goodwin, 803 Congress St.	15	220.4	1360	Central
	WJBL—Decatur, Ill.—Wm. Gushard Dry Goods Co., 301 N. Water St.	250	212.6	1410	Central
	WJBO—New Orleans, La.—Valdemar Jensen, 119 S. St. Patrick St.	100	263	1140	Central
	WJBR—Omro, Wis.—Gensch & Stearns	100	227.1	1320	Central
	WJBT—Chicago, Ill.—John S. Boyd, 1554 Howard St. (Divides time with WBBM and WAAF)	500	389.4	770	Central
	WJBU—Lewisburg, Pa.—Bucknell University, Engineering Bldg.	100	214.2	1400	Eastern
	WJBW—New Orleans, La.—C. Carlson, Jr., 2743 Dumaine St.	30	238	1260	Central
	WJBY—Gadsden, Ala.—Electric Const. Co., 517 Broad St.	50	234.2	1280	Central
	WJBZ—Chicago Heights, Ill.—Roland G. Palmer and A. Coppotelli, 144 E. 16 St.	100	208.2	1440	Central
	WJJD—Mooseheart, Ill.—Supreme Lodge, Loyal Order of Moose (Divides time with WEBH)	1000	365.6	820	Central
	WJPW—Ashtabula, Ohio—J. P. Wilson, 192 Prospect St.	50	208.2	1440	Eastern
	WJR—Detroit, Mich. (Transmitter in Pontiac)—WJR, Inc. & Detroit Free Press, Cadillac Hotel	5000	440.9	680	Central
	WJZ—New York, N. Y.—(Transmitter in Bound Brook, N. J.)—National Broadcasting Co., 195 B'way	30000	454.3	660	Eastern
WK	**WKAR—East Lansing, Mich.**—Michigan State College (Divides time with WREO) (Uses 1000 watts Daytime)	500	285.5	1050	Central
	WKAV—Laconia, N. H.—Laconia Radio Club, 533 Main St.	50	223.7	1340	Eastern
	WKBB—Joliet, Ill.—Sanders Bros., 607 Jefferson St. (Divides time with WCLS)	150	215.7	1390	Central
	WKBC—Birmingham, Ala.—H. L. Ansley, 1428 N. 12th Ave.	10	218.8	1370	Central
	WKBE—Webster, Mass.—K. & B. Elec. Co., 59 Emerald Ave.	100	228.9	1310	Eastern
	WKBF—Indianapolis, Ind.—Noble B. Watson, 233 Iowa St.	250	252	1190	Central
	WKBG—Chicago, Ill. (Portable)—C. L. Carrell, 36 S. State St.	100	201.2	1490	
	WKBH—La Crosse, Wis.—Callaway Music Co., 221 Main St.	500	220.4	1360	Central
	WKBI—Chicago, Ill.—Fred L. Schoenwolf, 1917 Warner Ave.	50	322.4	930	Central
	WKBL—Monroe, Mich.—Monrona Radio Mfg. Co., 16 S. Monroe St.	15	205.4	1460	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WK WKBM	**Newburgh, N. Y.**—WKBM Radio Broadcasting Co., 130 Broadway	100	208.2	1440	Eastern
WKBN	**Youngstown, Ohio**—Young Men's Christian Ass'n (Divides time with WMBW)	50	214.2	1400	Eastern
WKBO	**Jersey City, N. J.**—Camith Corporation, 2866 Boulevard (Divides time with WKBQ and WLTH)	500	218.8	1370	Eastern
WKBP	**Battle Creek, Mich.**—Battle Creek Enquirer and News	50	212.6	1410	Eastern
WKBQ	**New York, N. Y.**—Starlight Amusement Park, Inc., 1100 E. 177 St. (Divides time with WKBO and WLTH)	500	218.8	1370	Eastern
WKBS	**Galesburg, Ill.**—P. N. Nelson 227 Duffield, Ave. (Divides time with WLBO)	100	217.3	1380	Central
WKBT	**New Orleans, La.**—First Baptist Church	50	252	1190	Central
WKBU	**New Castle, Pa. (Portable)**—Harry K. Armstrong	50	204	1470	
WKBV	**Brookville, Ind.**—Knox Battery & Elec. Co., 1058 Main St.	100	217.3	1380	Central
WKBW	**Buffalo, N. Y.**—Churchill Evangelistic Assoc.	500	217.3	1380	Eastern
WKBZ	**Ludington, Mich.**—Karl L. Ashbacker, First National Bank Bldg.	15	199.9	1500	Eastern
WKDR	**Kenosha, Wis.**—Edward A. Dato, 936 N. Michigan Ave., Chicago, Ill.	15	322.4	930	Central
WKEN	**Buffalo, N. Y.**—H. L. Turner, 121 Norwood Ave. (Divides time with WSVS)	250	204	1470	Eastern
WKJC	**Lancaster, Pa.**—Kirk Johnson Co., 16 W. King St. (Divides time with WGAL)	50	258.5	1160	Eastern
WKRC	**Cincinnati, Ohio**—Kodel Radio Corp., 507 E. Pearl St.	500	333.1	900	Central
WKY	**Oklahoma City, Okla.**—WKY Radiophone Co., Huckins Hotel	150	288.3	1040	Central
WL WLAC	**Nashville, Tenn.**—Dad's Auto Accessory & Radio Store (1000 watts Daytime)	500	225.4	1330	Central
WLAP	**Louisville, Ky.**—Virginia Ave. Baptist Church, 2600 Virginia Ave. (1000 watts Daytime)	50	267.7	1120	Central
WLB	**Minneapolis, Minn.**—University of Minnesota (Divides time with WHDI)	500	245.8	1220	Central
WLBC	**Muncie, Ind.**—D. A. Burton, 2224 So. Jefferson St.	50	209.7	1430	Central
WLBF	**Kansas City, Mo.**—Everett L. Dillard, 300a E. 33 St.	50	209.7	1430	Central
WLBG	**Petersburg, Va.**—R. A. Gamble	100	214.2	1400	Eastern
WLBH	**Farmingdale, N. Y. (Portable)**—Joseph J. Lombardi	30	232.4	1290	
WLBI	**East Wenona, Ill.**—Wenona Legion Broadcasters, Inc.	250	238	1260	Central
WLBL	**Stevens Point, Wis.**—Wisconsin Dept. of Markets (Divides time with WHA)	1000	319	940	Central
WLBM	**Boston, Mass.**—Browning-Drake Corp., 353 Washington St.	50	230.6	1300	Eastern
WLBN	**Chicago, Ill. (Portable)**—Wm. E. Hiler, 339 S. Homan Ave.	50	204	1470	
WLBO	**Galesburg, Ill.**—Frederick Trebbe, Jr. (Divides time with WKBS)	100	217.3	1380	Central
WLBP	**Ashland, Ohio**—Robert A. Fox	15	202.6	1480	Eastern
WLBQ	**Atwood, Ill.**—E. Dale Trout	25	202.6	1480	Central
WLBR	**Belvedere, Ill.**—Alford Radio Co	15	322.4	930	Central
WLBT	**Crown Point, Ind.**—Harold Wendell	50	322.4	930	Central
WLBV	**Mansfield, Ohio**—Mansfield Broadcasting Assoc.	50	206.8	1450	Central

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WL	**WLBW—Oil City, Pa.**—Petroleum Telephone Co	500	293.9	1020	Eastern
	WLBX—Long Island City, N. Y.—John N. Brahy, 283 Crescent St. (Divides time with WIBS, WMBQ and WTRC)	250	204	1470	Eastern
	WLBY—Iron Mountain, Mich.—Aimone Electric	50	209.7	1430	Central
	WLBZ—Dover-Foxcroft, Me.—Thompson L. Guernsey	250	208.2	1440	Eastern
	WLCI—Ithaca, N. Y.—Lutheran Assoc. of Ithaca	50	247.8	1210	Eastern
	WLIB—Chicago, Ill.—Liberty Weekly (Divides time with WGN)	500	305.9	980	Central
	WLIT—Philadelphia, Pa.—Lit Bros. (Divides time with WFI)	500	405.2	740	Eastern
	WLS—Chicago, Ill.—(Transmitter in Crete, Ill.)—Sears Roebuck & Co. (Divides time with WCBD)	5000	344.6	870	Central
	WLSI—Cranston, R. I.—Dutee W. Flint and Lincoln Studios, Inc., 335 Westminster St. (Divides time with WBSO)	500	384.4	780	Eastern
	WLTH—Brooklyn, N. Y.—Flatbush Radio Labs., 1421 E. 10 St. (Divides time with WKDQ and WKBO)	250	218.8	1370	Eastern
	WLTS—Chicago, Ill.—Lane Technical High School (Divides time with WCFL)	100	483.6	620	Central
	WLW—Cincinnati, Ohio—(Transmitter in Harrison)—Crosley Radio Corp	5000	428.3	700	Central
	WLWL—New York, N. Y.—Paulist Fathers, 415 W. 59 St. (Divides time with WMCA)	1000	370.2	810	Eastern
WM	**WMAC—Cazenovia, N. Y.**—Clive B. Meredith (Divides time with WSYR)	500	225.4	1330	Eastern
	WMAF—South Dartmouth, Mass.—Round Hills Radio Corp	500	428.3	700	Eastern
	WMAK—Lockport, N. Y.—Norton Labs	750	545.1	550	Eastern
	WMAL—Washington, D. C.—M. A. Leese Radio Co., 720 Eleventh St., N. W.	120	302.8	990	Eastern
	WMAN—Columbus, Ohio—Heskett Radio Station, 507 N. High St.	50	234.2	1280	Eastern
	WMAQ—Chicago, Ill.—Chicago Daily News, 15 N. Wells St. (Divides time with WQJ)	1000	447.5	670	Central
	WMAY—St. Louis, Mo.—Kings Highway Presbyterian Church	100	247.8	1210	Central
	WMAZ—Macon, Ga.—Mercer University (Divides time with WGST)	500	270.1	1110	Eastern
	WMBA—Newport, R. I. (Portable)—LeRoy Joseph Beebe	100	204	1470	
	WMBB—Chicago, Ill.—American Bond & Mortgage Co., 6201 Cottage Grove Ave. (Divides time with WOK)	500	252	1190	Central
	WMBC—Detroit, Mich.—Michigan Broadcasting Co.	100	243.8	1230	Eastern
	WMBD—Peoria Heights, Ill.—Peoria Heights Radio Laboratory, 107 E. Glen Ave.	250	205.4	1460	Central
	WMBE—St. Paul, Minn.—Dr. C. S. Stevens, 2018 Grand Ave	10	208.2	1440	Central
	WMBF—Miami Beach, Fla.—Fleetwood Hotel Corp.	500	384.4	780	Eastern
	WMBG—Richmond, Va.—Havens & Martin, 914 West Broad St.	15	206.8	1450	Eastern
	WMBH—Chicago, Ill. (Portable)—Edwin Dudley Aber, 1526 E. 53 St.	100	204	1470	
	WMBI—Chicago, Ill.—Moody Bible Inst. of Chicago, 153 Institute Place (Divides time with WJAZ)	500	263	1140	Central
	WMBJ—Monessen, Pa.—Wm. Roy McShaffrey	50	232.4	1290	Eastern
	WMBL—Lakeland, Fla.—Benford Radio Studios, 14 Marble Arcade Bldg	50	228.9	1310	Eastern
	WMBM—Memphis, Tenn.—Seventh Day Adventist Church	10	209.7	1430	Central
	WMBO—Auburn, N. Y.—Radio Service Labs., 17 South St.	100	220.4	1360	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WM WMBQ	**Brooklyn, N. Y.**—Paul J. Gollhofer, 95 Leonard St. (Divides time with WTRC, WIBS and WLBX)	100	204	1470	Eastern
WMBR	**Tampa, Fla.**—F. J. Reynolds	100	252	1190	Eastern
WMBS	**Harrisburg, Pa.** (Transmitter in Lemoyne)—Mack Battery Co.	250	234.2	1280	Eastern
WMBU	**Pittsburgh, Pa.**—Paul J. Miller, 1133 Creedmoor Ave.	50	217.3	1380	Eastern
WMBW	**Youngstown, Ohio**—Youngstown Broadcasting Co., 647 Market St. (Divides time with WKBN)	50	214.2	1400	Eastern
WMBY	**Bloomington, Ill.**—R. A. Isaacs, 108 E. Front St. (Divides time with WNBL)	15	199.9	1500	Central
WMC	**Memphis, Tenn.**—The Commercial Pub. Co., Commercial Appeal Bldg.	500	516.9	580	Central
WMCA	**New York, N. Y.**—(Transmitter in Hoboken, N. J.)—Associated Broadcasters, Inc., Hotel McAlpin (Divides time with WLWL)	500	370.2	810	Eastern
WMCO	**Detroit, Mich.**—Transmitter in Saginaw, W. T. Thomas Radio Co., Whittier Hotel (Divides time with WAFD)	250	218.8	1370	Eastern
WMES	**Boston, Mass.**—Educational Society, Barristers Hall	100	211.1	1420	Eastern
WMPC	**Lapeer, Mich.**—First Methodist Protestant Church	30	234.2	1280	Eastern
WMRJ	**Jamaica, N. Y.**—Peter J. Prinz, 10 New York Blvd. (Divides time with WTRL and WHPP)	10	206.8	1450	Eastern
WMSG	**New York, N. Y.**—Madison Square Garden Broadcasting Corp., 319 W. 49 St. (Divides time with WBNY and WHAP)	500	236.1	1270	Eastern
WN WNAC	**Boston, Mass.**—The Shepard Stores	500	352.7	850	Eastern
WNAD	**Norman, Okla.**—University of Oklahoma	500	239.9	1250	Central
WNAL	**Omaha, Nebr.**—R. J. Rockwell, 5019 Capital Ave. (Divides time with KOCH and KFOX)	250	258.5	1160	Central
WNAT	**Philadelphia, Pa.**—Lennig Bros. Co., Spring Garden and 9 Sts. (Divides time with WRAX)	100	288.3	1040	Eastern
WNAX	**Yankton, S. D.**—Gurney Seed & Nursery Co.	250	302.8	990	Central
WNBA	**Forest Park, Ill.**—M. T. Rafferty, 810 Desplaines Ave.	200	208.2	1440	Central
WNBF	**Endicott, N. Y.**—Howitt-Wood Radio Co., 117 W. Main St.	50	206.8	1450	Eastern
WNBH	**New Bedford, Mass.**—New Bedford Broadcasting Co.	250	260.7	1150	Eastern
WNBJ	**Knoxville, Tenn.**—Lonsdale Baptist Church	50	206.8	1450	Central
WNBL	**Bloomington, Ill.**—Harvey R. Storm, 107 E. Front St. (Divides time with WMBY)	15	199.9	1500	Central
WNBO	**Washington, Pa.**—John B. Spriggs, 319 E. Bean St.	15	211.1	1420	Eastern
WNBQ	**Rochester, N. Y.**—Gordon P. Brown, 192 S. Goodman St.	15	202.6	1480	Eastern
WNBR	**Memphis, Tenn.**—Popular Radio Shop, 883 Poplar Ave.	20	228.9	1310	Central
WNBW	**Carbondale, Pa.**—Home Cut Glass & China Co., 21 Salem Ave.	5	258.5	1160	Eastern
WNBX	**Springfield, Vt.**—First Congregational Church	10	241.8	1240	Eastern
WNJ	**Newark, N. J.**—Herman Lubinsky, 89 Lehigh Ave. (Divides time with WGCP)	500	280.2	1070	Eastern
WNOX	**Knoxville, Tenn.**—People's Telephone and Telegraph Co., 313 Commerce Ave.	1000	265.3	1130	Central
WNRC	**Greensboro, N. C.**—Wayne M. Nelson	500	223.7	1340	Eastern
WNYC	**New York, N. Y.**—Dept. of Plants and Structures, Municipal Bldg.	500	535.4	560	Eastern
WO WOAI	**San Antonio, Tex.**—Southern Equipment Co.	5000	302.8	990	Central
WOAN	**Lawrenceburg, Tenn.**—Jas. D. Vaughn	250	285.5	1050	Central
WOAX	**Trenton, N. J.**—Franklyn J. Wolff, The Monument Pottery Co. (Divides time with WEAM)	500	239.9	1250	Eastern
WOBR	**Shelby, Ohio (Portable)**—Earl Smith	10	204	1470	

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WO	**WOC—Davenport, Iowa**—The Palmer School of Chiropractic, 1002 Brady St.	5000	352.7	850	Central
	WOCL—Jamestown, N. Y.—A. E. Newton	25	223.7	1340	Eastern
	WODA—Paterson, N. J.—James K. O'Dea, Inc., 115 Ellison St. (Divides time with WGL)	1000	293.9	1020	Eastern
	WOI—Ames, Iowa—Iowa State College (5000 watts daytime 6 to 6) (Divides time with WSUI)	2500	265.3	1130	Central
	WOK—Chicago, Ill.—(Transmitter in Homewood)—Trianon, Inc. (Divides time with WMBB)	5000	252	1190	Central
	WOKO—Peekskill, N. Y.—Harold E. Smith	250	215.7	1390	Eastern
	WOKT—Rochester, N. Y.—Titus-Ets. Corp.	500	209.7	1430	Eastern
	WOMT—Manitowoc, Wis.—Mikadow Theatre	50	222.1	1350	Central
	WOO—Philadelphia, Pa.—John Wanamaker (Divides time with WIP)	500	508.2	590	Eastern
	WOOD—Furnwood, Mich.—Walter B. Stiles	500	260.7	1150	Central
	WOQ—Kansas City, Mo.—Unity School of Christianity, (500 watts Daytime) (Divides time with WHB)	250	336.9	890	Central
	WOR—Newark, N. J.—(Transmitter in Kearney)—L. Bamberger & Co.	5000	422.3	710	Eastern
	WORD—Batavia, Ill.—People's Pulpit Assoc., 124 Columbia Heights, Brooklyn, N. Y. (Divides time with WTAS)	5000	275.1	1090	Central
	WOS—Jefferson City, Mo.—Missouri State Marketing Bureau	500	468.5	640	Central
	WOW—Omaha, Nebr.—Woodmen of the World Life Insurance Assoc.	1000	508.2	590	Central
	WOWO—Fort Wayne, Ind.—The Main Auto Supply Co., 213 W. Main St. (Divides time with WCWK)	1000	228.9	1310	Central
WP	**WPAP—Cliffside, N. J.**—Palisades Amusement Park (Divides time with WHN)	500	394.5	760	Eastern
	WPCC—Chicago, Ill.—North Shore Congregational Church	500	223.7	1340	Central
	WPCH—New York, N. Y.—Concourse Radio Corp., Park Central Hotel (Divides time with WRNY)	500	309.1	970	Eastern
	WPEP—Waukegan, Ill.—Maurice Mayer	250	215.7	1390	Central
	WPG—Atlantic City, N. J.—Municipality of Atlantic City (Divides time with WHAR)	5000	272.6	1100	Eastern
	WPRC—Harrisburg, Pa.—Wilson Printing & Radio Co., Fifth and Kelker Sts	100	209.7	1430	Eastern
	WPSC—State College, Pa.—Pennsylvania State College (Divides time with WBAK)	500	299.8	1000	Eastern
	WPSW—Philadelphia, Pa.—Philadelphia School of Wireless Telegraphy	50	202.6	1480	Eastern
WQ	**WQAA—Parkersburg, Pa.**—Horace A. Beale, Jr	500	215.7	1390	Eastern
	WQAE—Springfield, Vt.—Moore Radio News Station	50	249.9	1200	Eastern
	WQAM—Miami, Fla.—Electrical Equipment Co., 42 Northwest Fourth St.	750	322.4	930	Eastern
	WQAN—Scranton, Pa.—Scranton Times (Divides time with WGBI)	250	230.6	1300	Eastern
	WQAO—Cliffside, N. J.—Calvary Baptist Church (Divides time with WHN)	500	394.5	760	Eastern
	WQJ—Chicago, Ill.—Calumet Rainbo Broadcasting Co. (Divides time with WMAQ)	500	447.5	670	Central
WR	**WRAF—Laport, Ind.**—The Radio Club, Inc., 719 Michigan Ave.	100	208.2	1440	Central
	WRAH—Providence, R. I.—Stanley N. Read, 191 Alabama Ave.	250	199.9	1500	Eastern

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WR	**WRAK—Escanaba, Mich.**—Economy Light Co., 1105 Ludington St.	50	282.8	1060	Central
	WRAM—Galesburg, Ill.—Lombard College (Divides time with WFBZ)	50	247.8	1210	Central
	WRAV—Yellow Springs, Ohio—Antioch College	100	340.7	880	Central
	WRAW—Reading, Pa.—Avenue Radio & Elec. Shop, 460 Schuylkill Ave.	100	238	1260	Eastern
	WRAX—Philadelphia, Pa.—Berachach Church, Inc., 1608 Allegheny Ave. (Divides time with WNAT)	250	288.3	1040	Eastern
	WRBC—Valparaiso, Ind.—Immanuel Lutheran Church	250	238	1260	Central
	WRC—Washington, D. C.—Radio Corp. of America	500	468.5	640	Eastern
	WRCO—Raleigh, N. C.—Wynne Radio Co., 226½ Fayetteville St.	250	217.3	1380	Eastern
	WRCV—Norfolk, Va.—Radio Corp. of Virginia	100	209.7	1430	Eastern
	WREC—Memphis, Tenn.—WREC, Inc	50	254.1	1180	Central
	WREN—Lawrence, Kans.—Jenny Wren, Inc. (Divides time with KFKU)	750	254.1	1180	Central
	WREO—Lansing, Mich.—Reo Motor Car Co.	500	230.6	1300	Eastern
	WRES—Quincy, Mass.—Harry L. Sawyer, 335A Newport Ave.	50	217.3	1380	Eastern
	WRHF—Washington, D. C.—Washington Radio Hospital Fund, 525 11 St., N. W. (Daytime only)	150	319	940	Eastern
	WRHM—Minneapolis, Minn.—Rosedale Hospital Co., Andrews Hotel (Divides time with WDGY)	1000	260.7	1150	Central
	WRK—Hamilton, Ohio—Doron Bros. Elec. Co., 3 Railroad St.	100	205.4	1460	Central
	WRM—Urbana, Ill.—University of Illinois (1000 watts before 6 P. M.) (Divides time with WBAA)	500	272.6	1100	Central
	WRMU—New York, N. Y. (Portable)—Atlantic Broadcasting Corp., 113 W. 57th St.	100	201.2	1490	
	WRNY—New York, N. Y.—(Transmitter in Coytesville, N. J.)—Experimenter Pub. Co., 230—5th Ave. (Divides time with WPCH)	500	309.1	970	Eastern
	WRPI—Terre Haute, Ind.—Rose Polytechnic Inst.	100	208.2	1440	Central
	WRR—Dallas, Tex.—City of Dallas, Police and Fire Signal Dept.	500	352.7	850	Central
	WRRS—Racine, Wis.—Racine Radio Co.	50	322.4	930	Central
	WRSC—Chelsea, Mass.—Wm. S. Pote	15	205.4	1460	Eastern
	WRST—Bay Shore, N. Y.—Radiotel Mfg. Co., Carleton Theatre (Divides time with WCDA, WBRS and WCGU)	250	211.1	1420	Eastern
	WRVA—Richmond, Va.—Larus & Brother Co., 22nd and Cory Sts.	1000	254.1	1180	Eastern
WS	**WSAI—Cincinnati, Ohio** (Transmitter in Mason)—United States Playing Card Co.	5000	361.2	830	Central
	WSAJ—Grove City, Pa.—Grove City College	250	223.7	1340	Eastern
	WSAN—Allentown, Pa.—Allentown Call Pub. Co. (Divides time with WCBA)	100	222.1	1350	Eastern
	WSAR—Portsmouth, R. I.—Doughty & Welch Elec. Co., 46 N. Main St.	100	252	1190	Eastern
	WSAX—Chicago, Ill. (Portable)—Zenith Radio Corp., 332 So. Michigan Ave.	100	204	1470	
	WSAZ—Huntington, W. Va.—McKeller Elec. Co	100	241.8	1240	Eastern
	WSB—Atlanta, Ga.—The Atlanta Journal	1000	475.9	630	Central
	WSBC—Chicago, Ill.—World Battery Co., 1219 South Wabash Ave. (Divides time with WWAE)	500	232.4	1290	Central
	WSBF—St. Louis, Mo.—Mississippi Valley Broadcasting Co., 6th and Washington Sts.	250	440.9	680	Central
	WSBT—South Bend, Ind.—South Bend Tribune (Divides time with WEMC)	500	238	1260	Central

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
WS	**WSDA—New York, N. Y.**—Seventh Day Adventist Church, 120 St. and Lenox Ave. (Divides time with WARS and WBBC)	250	227.1	1320	Eastern
	WSEA—Virginia Beach, Va.—Virginia Beach Broadcasting Co., 17th St. and Atlantic Ave.	500	218.8	1370	Eastern
	WSIX—Springfield, Tenn.—Tire & Vulc. Co.	150	212.6	1410	Central
	WSKC—Bay City, Mich.—World's Star Knitting Co.	250	491.5	610	Eastern
	WSM—Nashville, Tenn.—The National Life & Accident Ins. Co.	5000	340.7	880	Central
	WSMB—New Orleans, La.—Saenger Amusement Co.	500	322.4	930	Central
	WSMK—Dayton, Ohio—S. M. K. Radio Corp., 39 E. 3rd St.	200	296.9	1010	Eastern
	WSOE—Milwaukee, Wis.—School of Engineering, 415 Marshall St.	500	270.1	1110	Central
	WSOM—New York, N. Y.—Union Course Labs. (Divides time with WGBB and WAAT)	500	245.8	1220	Eastern
	WSRO—Hamilton, Ohio—H. W. Fahrlander, 421 High St.	100	384.4	780	Central
	WSSH—Boston, Mass.—Tremont Temple Baptist Church	1000	249.9	1200	Eastern
	WSUI—Iowa City, Iowa—State University of Iowa (Divides time with WOI)	500	422.3	710	Central
	WSVS—Buffalo, N. Y.—Seneca Vocational School. 666 E. Delavan Ave. (Divides time with WKEN)	50	205.4	1460	Eastern
	WSYR—Syracuse, N. Y.—Clive B. Meredith, Hotel Syracuse (Divides time with WMAC)	500	225.4	1330	Eastern
WT	**WTAD—Quincy, Ill.**—Illinois Stock Medicine Broadcasting Corp.	250	236.1	1270	Central
	WTAG—Worcester, Mass.—Worcester Telegram Pub. Co., 18 Franklin St.	500	516.9	580	Eastern
	WTAL—Toledo, Ohio—Toledo Broadcasting Co., Hotel Waldorf (Divides time with WABR)	100	280.2	1070	Eastern
	WTAM—Cleveland, Ohio—Willard Storage Battery Co. (Divides time with WEAR) (5000 watts Daytime)	3500	399.8	750	Eastern
	WTAQ—Eau Claire, Wis.—C. S. Van Gorden	500	254.1	1180	Central
	WTAR—Norfolk, Va.—Reliance Elec. Co., 519 W. 21 St.	500	275.1	1090	Eastern
	WTAS—Batavia, Ill.—Richmond, Harris & Co.	3500	275.1	1090	Central
	WTAW—College Station, Tex.—Agricultural & Mechanical College of Texas	500	309.1	970	Central
	WTAX—Streater, Ill.—Williams Hardware Co., 115 So. Vermillion St.	50	322.4	930	Central
	WTAZ—Lambertville, N. J.—Thos. J. McGuire	15	220.4	1360	Eastern
	WTFF—Mount Vernon Hills, Va.—Independent Publishing Co.	50	204	1470	Pacific
	WTIC—Hartford, Conn.—Travelers Ins. Co	500	475.9	630	Eastern
	WTMJ—Milwaukee, Wis.—Radio Service Corp. (Divides time with WHAD)	1000	293.9	1020	Central
	WTRL—Midland Park, N. J.—Technical Radio Labs. (Divides time with WMRJ and WHPP)	15	206.8	1450	Eastern
WW	**WWAE—Chicago, Ill.**—Lawrence J. Crowley (Divides time with WSBC)	500	232.4	1290	Central
	WWJ—Detroit, Mich.—Evening News Assoc.	1000	374.8	800	Eastern
	WWL—New Orleans, La.—Loyola University	100	275.1	1090	Central
	WWNC—Asheville, N. C.—Asheville Chamber of Commerce, 101 Patton Ave.	1000	296.9	1010	Central
	WWRL—New York, N. Y.—W. H. Reuman 1587 Broadway (Divides time with WBKN, WJBI, WIBI and WBMS)	100	267.7	1120	Eastern
	WWVA—Wheeling, W. Va.—John C. Stroebel, Jr.	100	389.4	770	Eastern

This list has been corrected up to and including August 15, 1927

RADIO BROADCAST STATIONS OF THE UNITED STATES

By Wavelengths and Frequencies

Meters	Kilocycles	Power	Call Letters	Location
199.9	1500	15	KGFN	Aneta, N. Dak.
199.9	1500	5	KOLO	Durango, Colo.
199.9	1500	10	KUJ	Seattle, Wash.
199.9	1500	15	KWBS	Portland, Ore.
199.9	1500	15	WKBZ	Ludington, Mich.
199.9	1500	15	WMBY	Bloomington, Ill.
199.9	1500	15	WNBL	Bloomington, Ill.
199.9	1500	250	WRAH	Providence, R. I.
201.2	1490	50	KGEH	Eugene, Ore.
201.2	1490	15	KGEY	Denver, Colo.
201.2	1490	50	WALK	Willow Grove, Pa.
201.2	1490	100	WATT	Boston, Mass.
201.2	1490	100	WCBR	Providence, R. I.
201.2	1490	100	WGMU	New York, N. Y.
201.2	1490	100	WHBM	Chicago, Ill.
201.2	1490	100	WIBJ	Chicago, Ill.
201.2	1490	100	WIBM	Chicago, Ill.
201.2	1490	100	WKBG	Chicago, Ill.
201.2	1490	100	WRMU	New York, N. Y.
202.6	1480	100	KGBS	Seattle, Wash.
202.6	1480	50	KGBY	Shelby, Nebr.
202.6	1480	10	KGDJ	Cresco, Iowa
202.6	1480	15	KGDR	San Antonio, Tex.
202.6	1480	50	KGEQ	Minneapolis, Minn.
202.6	1480	15	WLBP	Ashland, Ohio
202.6	1480	25	WLBQ	Atwood, Ill.
202.6	1480	15	WNBQ	Rochester, N. Y.
202.6	1480	50	WPSW	Philadelphia, Pa.
204	1470	15	KFXD	Jerome, Utah
204	1470	10	KGES	Central City, Nebr.
204	1470	100	KGFO	Terre Haute, Ind.
204	1470	100	WBBZ	Chicago, Ill.
204	1470	100	WHBL	Chicago, Ill.
204	1470	150	WIBS	Elizabeth, N. J.
204	1470	100	WIBW	Chicago, Ill.
204	1470	50	WKBU	New Castle, Pa.
204	1470	250	WKEN	Buffalo, N. Y.
204	1470	50	WLBN	Chicago, Ill.
204	1470	250	WLBX	Long Island City, N. Y.
204	1470	100	WMBA	Newport, R. I.
204	1470	100	WMBH	Chicago, Ill.
204	1470	100	WMBQ	Brooklyn, N. Y.
204	1470	10	WOBR	Shelby, Ohio
204	1470	100	WSAX	Chicago, Ill.
204	1470	50	WTFF	Mt. Vernon Hills, Va.
205.4	1460	25	KFXY	Flagstaff, Ariz.
205.4	1460	50	KGDE	Barrett, Minn.
205.4	1460	100	KGEO	Grand Island, Nebr.
205.4	1460	100	KGEZ	Kalispell, Mont.
205.4	1460	25	KGFF	Alva, Okla.
205.4	1460	250	WABF	Pringleboro, Pa.
205.4	1460	10	WFKD	Philadelphia, Pa.
205.4	1460	15	WKBL	Monroe, Mich.
205.4	1460	250	WMBD	Peoria Heights, Ill.
205.4	1460	100	WRK	Hamilton, O.
205.4	1460	15	WRSC	Chelsea, Mass.
205.4	1460	50	WSVS	Buffalo, N. Y.
206.8	1450	100	KGDW	Humboldt, Nebr.
206.8	1450	15	KGDY	Oldham, S. Dak.
206.8	1450	50	KGTT	San Francisco, Cal.
206.8	1450	10	KLIT	Portland, Ore.
206.8	1450	10	WHPP	New York, N. Y.
206.8	1450	50	WLBV	Mansfield, Ohio
206.8	1450	15	WMBG	Richmond, Va.
206.8	1450	10	WMRJ	Jamaica, N. Y.
206.8	1450	50	WNBF	Endicott, N. Y.
206.8	1450	50	WNBJ	Knoxville, Tenn.
206.8	1450	15	WTRL	Midland Park, N. J.
208.2	1440	100	KFIQ	Yakima, Wash.
208.2	1440	250	KFVD	Venice, Calif.
208.2	1440	50	KGCN	Concordia, Kans.
208.2	1440	15	KGCR	Brookings, S. Dak.
208.2	1440	100	KGCU	Mandan, N. Dak.
208.2	1440	100	KGFJ	Los Angeles, Calif.
208.2	1440	50	WGM	Jeanette, Pa.
208.2	1440	100	WJBZ	Chicago Heights, Ill.
208.2	1440	50	WJPW	Ashtabula, Ohio
208.2	1440	100	WKBM	Newburgh, N. Y.
208.2	1440	250	WLBZ	Dover-Foxcroft, Me.
208.2	1440	10	WMBE	St. Paul, Minn.
208.2	1440	200	WNBA	Forest Park, Ill.
208.2	1440	100	WRAF	Laport, Ind.
208.2	1440	100	WRPI	Terre Haute, Ind.
209.7	1430	10	KFGQ	Boone, Iowa
209.7	1430	250	KSOO	Sioux Falls, S. D.
209.7	1430	50	KVOS	Seattle, Wash.
209.7	1430	250	WCBS	Springfield, Ill.
209.7	1430	50	WLBC	Muncie, Ind.
209.7	1430	50	WLBF	Kansas City, Mo.
209.7	1430	50	WLBY	Iron Mountain, Mich.
209.7	1430	10	WMBM	Memphis, Tenn.
209.7	1430	500	WOKT	Rochester, N. Y.
209.7	1430	100	WPRC	Harrisburg, Pa.
209.7	1430	100	WRCV	Norfolk, Va.
211.1	1420	50	KFCR	Santa Barbara, Cal.
211.1	1420	15	KGFM	Yuba City, Calif.
211.1	1420	100	KPNP	Muscatine, Iowa
211.1	1420	50	KRSC	Seattle, Wash.
211.1	1420	100	WBMH	Detroit, Mich.
211.1	1420	100	WBRS	Brooklyn, N. Y.
211.1	1420	250	WCDA	Cliffside, N. J.
211.1	1420	500	WCGU	NEW YORK, N. Y.
211.1	1420	100	WMES	Boston, Mass.
211.1	1420	15	WNBO	Washington, Pa.

Meters	Kilocycles	Power	Call Letters	Location
211.1	1420	250	WRST	Bay Shore, N. Y.
212.6	1410	10	KFHL	Oskaloosa, Iowa
212.6	1410	100	KGBZ	York, Nebr.
212.6	1410	250	KGDX	Shreveport, La.
212.6	1410	10	KGFP	Mitchell, S. Dak.
212.6	1410	5	KTUE	Houston, Tex.
212.6	1410	1000	WFLA	Boca Raton, Fla.
212.6	1410	250	WJBL	Decatur, Ill.
212.6	1410	50	WKBP	Battle Creek, Mich.
212.6	1410	150	WSIX	Springfield, Tenn.
214.2	1400	50	KFEC	Portland, Ore.
214.2	1400	50	KFIF	Portland, Ore.
214.2	1400	250	KFWF	St. Louis, Mo.
214.2	1400	15	KPJM	Prescott, Ariz.
214.2	1400	10	WAIT	Taunton, Mass.
214.2	1400	100	WCWS	Danbury, Conn.
214.2	1400	250	WICC	Bridgeport, Conn.
214.2	1400	100	WJBU	Lewisburg, Pa.
214.2	1400	50	WKBN	Youngstown, Ohio
214.2	1400	100	WLBG	Petersburg, Va.
214.2	1400	50	WMBW	Youngstown, Ohio
215.7	1390	10	KFDZ	Minneapolis, Minn.
215.7	1390	15	KFXJ	Edgewater, Colo.
215.7	1390	50	KGCB	Oklahoma City, Okla.
215.7	1390	100	KGER	Long Beach, Calif.
215.7	1390	50	KGFG	Oklahoma City, Okla.
215.7	1390	250	KRLO	Los Angeles, Calif.
215.7	1390	5	WAGS	Somerville, Mass.
215.7	1390	150	WCLS	Joliet, Ill.
215.7	1390	50	WDBZ	Kingston, N. Y.
215.7	1390	100	WEHS	Evanston, Ill.
215.7	1390	200	WHFC	Chicago, Ill.
215.7	1390	150	WKBB	Joliet, Ill.
215.7	1390	250	WOKO	Peekskill, N. Y.
215.7	1390	250	WPEP	Waukegan, Ill.
215.7	1390	500	WQAA	Parkersburg, Pa.
217.3	1380	100	KFOR	Lincoln, Nebr.
217.3	1380	100	KFQW	Seattle, Wash.
217.3	1380	10	KGDM	Stockton, Calif.
217.3	1380	20	WIBU	Poynette, Wis.
217.3	1380	100	WKBS	Galesburg, Ill.
217.3	1380	100	WKBV	Brookville, Ind.
217.3	1380	500	WKBW	Buffalo, N. Y.
217.3	1380	100	WLBO	Galesburg, Ill.
217.3	1380	50	WMBU	Pittsburgh, Pa.
217.3	1380	250	WRCO	Raleigh, N. C.
217.3	1380	50	WRES	Quincy, Mass.
218.8	1370	250	KFWO	Avalon, Catalina Is., Cal.
218.8	1370	10	KGEW	Fort Morgan, Colo.
218.8	1370	500	WGWB	Milwaukee, Wis.
218.8	1370	10	WKBC	Birmingham, Ala.
218.8	1370	500	WKBO	Jersey City, N. J.
218.8	1370	500	WKBQ	New York, N. Y.
218.8	1370	250	WLTH	Brooklyn, N. Y.
218.8	1370	250	WMCO	Detroit, Mich.
218.8	1370	500	WSEA	Virginia Beach, Va.
220.4	1360	15	KGCI	San Antonio, Tex.
220.4	1360	15	KGFI	San Angelo, Tex.
220.4	1360	50	KGRC	San Antonio, Tex.
220.4	1360	50	KJBS	San Francisco, Cal.
220.4	1360	50	KRAC	Shreveport, La.
220.4	1360	50	KXL	Portland, Ore.
220.4	1360	15	WHBU	Anderson, Ind.
220.4	1360	50	WHBW	Philadelphia, Pa.
220.4	1360	100	WIAD	Philadelphia, Pa.
220.4	1360	15	WJBK	Ypsilanti, Mich.
220.4	1360	500	WKBH	LaCrosse, Wis.
220.4	1360	100	WMBO	Auburn, N. Y.
220.4	1360	15	WTAZ	Lambertville, N. J.
222.1	1350	100	KFWC	San Bernardino, Cal.
222.1	1350	50	KGFL	Trinidad, Colo.
222.1	1350	100	KWKC	Kansas City, Mo.
222.1	1350	100	WCBA	Allentown, Pa.
222.1	1350	100	WHBD	Bellefontaine, O.
222.1	1350	100	WHBF	Rock Island, Ill.
222.1	1350	50	WOMT	Manitowoc, Wis.
222.1	1350	100	WSAN	Allentown, Pa.
223.7	1340	100	KFBL	Everett, Wash.
223.7	1340	50	KFVS	Cape Girardeau, Mo.
223.7	1340	50	KFXR	Oklahoma City, Okla.
223.7	1340	100	KGCG	Newark, Ark.
223.7	1340	15	KGDP	Pueblo, Colo.
223.7	1340	10	KGFB	Iowa City, Iowa
223.7	1340	250	KGFH	La Crescenta, Calif.
223.7	1340	50	KGFK	Hallock, Minn.
223.7	1340	250	KMIC	Inglewood, Calif.
223.7	1340	500	WCAM	Camden, N. J.
223.7	1340	500	WCRW	Chicago, Ill.
223.7	1340	15	WEBQ	Harrisburg, Ill.
223.7	1340	500	WFKB	Chicago, Ill.
223.7	1340	50	WKAV	Laconia, N. H.
223.7	1340	500	WNRC	Greensboro, N. C.
223.7	1340	25	WOCL	Jamestown, N. Y.
223.7	1340	500	WPCC	Chicago, Ill.
223.7	1340	250	WSAJ	Grove City, Pa.
225.4	1330	15	KFKZ	Kirksville, Mo.
225.4	1330	50	KFUR	Ogden, Utah
225.4	1330	50	KFVG	Independence, Kans.
225.4	1330	15	KGEN	El Centro, Calif.
225.4	1330	50	WAGM	Royal Oak, Mich.
225.4	1330	500	WAMD	Minneapolis, Minn.
225.4	1330	50	WCOT	Olneyville, R. I.
225.4	1330	500	WDAD	Nashville, Tenn.
225.4	1330	250	WFBM	Indianapolis, Ind.
225.4	1330	100	WFBR	Baltimore, Md.
225.4	1330	50	WFCI	Pawtucket, R. I.
225.4	1330	500	WLAC	Nashville, Tenn.
225.4	1330	500	WMAC	Cazenovia, N. Y.
225.4	1330	500	WSYR	Syracuse, N. Y.
227.1	1320	100	KFUP	Denver, Colo.
227.1	1320	50	KGEU	Lower Lake, Calif.
227.1	1320	500	KSO	Clarinda, Iowa
227.1	1320	500	WARS	Brooklyn, N. Y.
227.1	1320	500	WBBC	Brooklyn, N. Y.
227.1	1320	5	WCBE	New Orleans, La.
227.1	1320	100	WCLO	Camp Lake, Wis.
227.1	1320	250	WDBK	Cleveland, O.
227.1	1320	500	WJAY	Cleveland, Ohio

Meters	Kilocycles	Power	Call Letters	Location
227.1	1320	100	WJBC	LaSalle, Ill.
227.1	1320	100	WJBR	Omro, Wis.
227.1	1320	250	WSDA	New York, N. Y.
228.9	1310	250	KELW	Burbank, Calif.
228.9	1310	100	KFVN	Fairmont, Minn.
228.9	1310	50	KPPC	Pasadena, Calif.
228.9	1310	20	KTAP	San Antonio, Tex.
228.9	1310	50	KWJJ	Portland, Ore.
228.9	1310	500	WCWK	Fort Wayne, Ind.
228.9	1310	250	WHBP	Johnstown, Pa.
228.9	1310	100	WKBE	Webster, Mass.
228.9	1310	50	WMBL	Lakeland, Fla.
228.9	1310	20	WNBR	Memphis, Tenn.
228.9	1310	1000	WOWO	Ft. Wayne, Ind.
230.6	1300	1000	KFEQ	St. Joseph, Mo.
230.6	1300	15	KFPM	Greenville, Tex.
230.6	1300	50	KGCL	Seattle, Wash.
230.6	1300	50	KPCB	Seattle, Wash.
230.6	1300	100	WCOC	Columbus, Miss.
230.6	1300	250	WDBJ	Roanoke, Va.
230.6	1300	250	WGBI	Scranton, Pa.
230.6	1300	15	WIBZ	Montgomery, Ala.
230.6	1300	50	WLBM	Boston, Mass.
230.6	1300	250	WQAN	Scranton, Pa.
230.6	1300	500	WREO	Lansing, Mich.
232.4	1290	10	KFEY	Kellogg, Idaho
232.4	1290	250	KFPR	Los Angeles, Cal.
232.4	1290	100	KFQZ	Hollywood, Cal.
232.4	1290	500	KUT	Austin, Tex.
232.4	1290	100	WABO	Rochester, N. Y.
232.4	1290	500	WBRL	Tilton, N. H.
232.4	1290	100	WHBQ	Memphis, Tenn.
232.4	1290	100	WHEC	Rochester, N. Y.
232.4	1290	30	WLBH	Farmingdale, N. Y.
232.4	1290	50	WMBJ	Monessen, Pa.
232.4	1290	500	WSBC	Chicago, Ill.
232.4	1290	500	WWAE	Chicago, Ill.
234.2	1280	1000	KFVE	St. Louis, Mo.
234.2	1280	100	KGAR	Tucson, Ariz.
234.2	1280	15	KGDA	Dell Rapids, S. Dak.
234.2	1280	50	KVI	Tacoma, Wash.
234.2	1280	100	WDAH	El Paso, Tex.
234.2	1280	50	WFBC	Knoxville, Tenn.
234.2	1280	50	WJAK	Kokomo, Ind.
234.2	1280	50	WJBY	Gadsden, Ala.
234.2	1280	50	WMAN	Columbus, O.
234.2	1280	250	WMBS	Harrisburg, Pa.
234.2	1280	30	WMPC	Lapeer, Mich.
236.1	1270	250	KFDX	Shreveport, La.
236.1	1270	15	KFLU	San Benito, Tex.
236.1	1270	500	KFMX	Northfield, Minn.
236.1	1270	100	KFUM	Colorado Springs, Colo.
236.1	1270	500	KFWM	Oakland, Calif.
236.1	1270	50	WBBW	Norfolk, Va.
236.1	1270	250	WBNY	New York, N. Y.
236.1	1270	500	WCAL	Northfield, Minn.
236.1	1270	250	WGBF	Evansville, Ind.
236.1	1270	1000	WHAP	New York, N. Y.
236.1	1270	10	WHBC	Canton, Ohio

Meters	Kilocycles	Power	Call Letters	Location
236.1	1270	500	WMSG	New York, N. Y.
236.1	1270	250	WTAD	Quincy, Ill.
238	1260	15	KFBS	Trinidad, Colo.
238	1260	50	KFVI	Houston, Tex.
238	1260	25	KFYF	Oxnard, Cal.
238	1260	1500	KLDS	Independence, Mo.
238	1260	100	WCOM	Manchester, N. H.
238	1260	150	WIBX	Utica, N. Y.
238	1260	30	WJBW	New Orleans, La.
238	1260	250	WLBI	East Wenona, Ill.
238	1260	100	WRAW	Reading, Pa.
238	1260	250	WRBC	Valparaiso, Ind.
238	1260	500	WSBT	South Bend, Ind.
239.9	1250	2500	KEX	Portland, Ore.
239.9	1250	100	KFJY	Fort Dodge, Ia.
239.9	1250	250	KFYR	Bismarck, N. D.
239.9	1250	100	WBBP	Petoskey, Mich.
239.9	1250	250	WEAM	No. Plainfield, N. J.
239.9	1250	100	WIBA	Madison, Wis.
239.9	1250	500	WNAD	Norman, Okla.
239.9	1250	500	WOAX	Trenton, N. J.
241.8	1240	1500	KFKB	Milford, Kans.
241.8	1240	500	KFON	Long Beach, Calif.
241.8	1240	100	KFXH	El Paso, Tex.
241.8	1240	100	WCBH	Oxford, Miss.
241.8	1240	250	WEBC	Superior, Wis.
241.8	1240	200	WEBR	Buffalo, N. Y.
241.8	1240	500	WEDC	Chicago, Ill.
241.8	1240	500	WGES	Chicago, Ill.
241.8	1240	10	WNBX	Springfield, Vt.
241.8	1240	100	WSAZ	Huntington, W. Va.
243.8	1230	125	KFCB	Phoenix, Ariz.
243.8	1230	10	KGCX	Vida, Mont.
243.8	1230	150	KGRS	Amarillo, Tex.
243.8	1230	50	KGY	Lacey, Wash.
243.8	1230	500	KSCJ	Sioux City, Iowa
243.8	1230	1500	KWUC	Le Mars, Iowa
243.8	1230	250	WBRC	Birmingham, Ala.
243.8	1230	100	WMBC	Detroit, Mich.
245.8	1220	500	KFH	Wichita, Kans.
245.8	1220	100	KFIO	Spokane, Wash.
245.8	1220	250	KFPY	Spokane, Wash.
245.8	1220	250	KLS	Oakland, Calif.
245.8	1220	100	KZM	Oakland, Calif.
245.8	1220	500	WAAT	Jersey City, N. J.
245.8	1220	500	WDOD	Chattanooga, Tenn.
245.8	1220	250	WFBE	Cincinnati, Ohio
245.8	1220	400	WGBB	Freeport, N. Y.
245.8	1220	500	WGMS	Minneapolis, Minn.
245.8	1220	500	WHDI	Minneapolis, Minn.
245.8	1220	500	WLB	Minneapolis, Minn.
245.8	1220	500	WSOM	New York, N. Y.
247.8	1210	100	KFBC	San Diego, Cal.
247.8	1210	250	KFEL	Denver, Colo.
247.8	1210	15	KFJB	Marshalltown, Ia.
247.8	1210	10	KGCA	Decorah, Iowa
247.8	1210	50	KWLC	Decorah, Iowa
247.8	1210	50	WABW	Wooster, Ohio
247.8	1210	50	WABY	Philadelphia, Pa.

Meters	Kilocycles	Power	Call Letters	Location
247.8	1210	50	WABZ	New Orleans, La.
247.8	1210	100	WBAW	Nashville, Tenn.
247.8	1210	100	WBBL	Richmond, Va.
247.8	1210	100	WCAT	Rapid City, S. D.
247.8	1210	10	WEBE	Cambridge, Ohio
247.8	1210	50	WFBZ	Galesburg, Ill.
247.8	1210	1000	WIOD	Miami Beach, Fla.
247.8	1210	50	WLCI	Ithaca, N. Y.
247.8	1210	100	WMAY	St. Louis, Mo.
247.8	1210	50	WRAM	Galesburg, Ill.
249.9	1200	15	KFJI	Astoria, Ore.
249.9	1200	50	KFJZ	Fort Worth, Tex.
249.9	1200	100	KFQU	Alma (Holy City), Calif.
249.9	1200	500	KFRU	Columbia, Mo.
249.9	1200	50	KMED	Medford, Ore.
249.9	1200	100	WBAX	Wilkes-Barre, Pa.
249.9	1200	100	WBRE	Wilkes-Barre, Pa.
249.9	1200	500	WCOA	Pensacola, Fla.
249.9	1200	50	WHBY	West De Pere, Wis.
249.9	1200	50	WIBR	Steubenville, Ohio
249.9	1200	50	WQAE	Springfield, Vt.
249.9	1200	1000	WSSH	Boston, Mass.
252	1190	250	KOCW	Chickasha, Okla.
252	1190	500	KPLA	Los Angeles, Calif.
252	1190	10	WFAM	St. Cloud, Minn.
252	1190	15	WGAL	Lancaster, Pa.
252	1190	250	WKBF	Indianapolis, Ind.
252	1190	50	WKBT	New Orleans, La.
252	1190	500	WMBB	Chicago, Ill.
252	1190	100	WMBR	Tampa, Fla.
252	1190	5000	WOK	Chicago, Ill.
252	1190	100	WSAR	Portsmouth, R. I.
254.1	1180	50	KFHA	Gunnison, Colo.
254.1	1180	500	KFKU	Lawrence, Kans.
254.1	1180	100	KFWH	Eureka, Calif.
254.1	1180	250	KMO	Tacoma, Wash.
254.1	1180	100	WCAX	Burlington, Vt.
254.1	1180	50	WREC	Memphis, Tenn.
254.1	1180	750	WREN	Lawrence, Kans.
254.1	1180	1000	WRVA	Richmond, Va.
254.1	1180	500	WTAQ	Eau Claire, Wis.
256.3	1170	50	KFUS	Oakland, Cal.
256.3	1170	100	KRE	Berkeley, Cal.
256.3	1170	3500	KTNT	Muscatine, Iowa
256.3	1170	250	WASH	Grand Rapids, Mich.
256.3	1170	1000	WBBR	Rossville, N. Y.
256.3	1170	500	WCSO	Springfield, Ohio
256.3	1170	500	WEBJ	New York, N. Y.
256.3	1170	250	WJBI	Red Bank, N. J.
258.5	1160	100	KDYL	Salt Lake City, Utah
258.5	1160	100	KFOX	Omaha, Neb.
258.5	1160	500	KFUL	Galveston, Tex.
258.5	1160	250	KOCH	Omaha, Neb.
258.5	1160	500	WBT	Charlotte, N. C.
258.5	1160	250	WCMA	Culver, Ind.
258.5	1160	500	WEBW	Beloit, Wis.
258.5	1160	750	WFBL	Syracuse, N. Y.
258.5	1160	250	WIL	St. Louis, Mo.
258.5	1160	50	WKJC	Lancaster, Pa.

Meters	Kilocycles	Power	Call Letters	Location
258.5	1160	250	WNAL	Omaha, Neb.
258.5	1160	5	WNBW	Carbondale, Pa.
260.7	1150	1000	KFQB	Fort Worth, Tex.
260.7	1150	2000	KGA	Spokane, Wash.
260.7	1150	500	WABQ	Philadelphia, Pa.
260.7	1150	500	WCAU	Philadelphia, Pa.
260.7	1150	500	WDGY	Minneapolis, Minn.
260.7	1150	10	WHBA	Oil City, Pa.
260.7	1150	250	WNBH	New Bedford, Mass.
260.7	1150	500	WOOD	Furnwood, Mich.
260.7	1150	1000	WRHM	Minneapolis, Minn.
263	1140	50	KFPW	Carterville, Mo.
263	1140	500	KGEF	Los Angeles, Calif.
263	1140	10	KGEK	Yuma, Colo.
263	1140	250	WDAG	Amarillo, Tex.
263	1140	5000	WJAZ	Chicago, Ill.
263	1140	100	WJBO	New Orleans, La.
263	1140	500	WMBI	Chicago, Ill.
265.3	1130	15	KKP	Seattle, Wash.
265.3	1130	2000	KTSA	San Antonio, Tex.
265.3	1130	500	WBET	Boston, Mass.
265.3	1130	100	WDEL	Wilmington, Del.
265.3	1130	500	WHK	Cleveland, Ohio
265.3	1130	1000	WNOX	Knoxville, Tenn.
265.3	1130	2500	WOI	Ames, Iowa
267.7	1120	100	KFIZ	Fond du Lac, Wis.
267.7	1120	100	KFLV	Rockford, Ill.
267.7	1120	500	KFWI	San Francisco, Calif.
267.7	1120	250	KLZ	Denver, Colo.
267.7	1120	1000	KSBA	Shreveport, La.
267.7	1120	25	WAAD	Cincinnati, Ohio
267.7	1120	100	WBAO	Decatur, Ill.
267.7	1120	100	WBKN	Brooklyn, N. Y.
267.7	1120	100	WBMS	Union City, N. J.
267.7	1120	500	WDAE	Tampa, Fla.
267.7	1120	100	WIBI	Flushing, N. Y.
267.7	1120	50	WLAP	Louisville, Ky.
267.7	1120	100	WWRL	NEW YORK, N. Y.
270.1	1110	100	KFLX	Galveston, Tex.
270.1	1110	1000	KFNF	Shenandoah, Iowa
270.1	1110	500	KMA	Shenandoah, Iowa
270.1	1110	500	KOAC	Corvallis, Ore.
270.1	1110	500	KQV	Pittsburgh, Pa.
270.1	1110	500	WGST	Atlanta, Ga.
270.1	1110	500	WJAS	Pittsburgh, Pa.
270.1	1110	500	WMAZ	Macon, Ga.
270.1	1110	500	WSOE	Milwaukee, Wis.
272.6	1100	750	KFJF	Oklahoma City, Okla.
272.6	1100	100	KSMR	Santa Maria, Cal.
272.6	1100	500	WBAA	West Lafayette, Ind.
272.6	1100	100	WFBJ	Collegeville, Minn.
272.6	1100	750	WHAR	Atlantic City, N. J.
272.6	1100	5000	WPG	Atlantic City, N. J.
272.6	1100	500	WRM	Urbana, Ill.
275.1	1090	50	KFBB	Havre, Mont.
275.1	1090	15	KFPL	Dublin, Tex.
275.1	1090	500	KFSG	Los Angeles, Calif.
275.1	1090	500	WCAC	Mansfield, Conn.
275.1	1090	250	WDRC	New Haven, Conn.

Meters	Kilocycles	Power	Call Letters	Location	Meters	Kilocycles	Power	Call Letters	Location
275.1	1090	5000	WORD	Batavia, Ill.	302.8	990	750	WGR	Buffalo, N. Y.
275.1	1090	500	WTAR	Norfolk, Va.	302.8	990	120	WMAL	Washington, D. C.
275.1	1090	3500	WTAS	Batavia, Ill.	302.8	990	250	WNAX	Yankton, S. D.
275.1	1090	100	WWL	New Orleans, La.	302.8	990	5000	WOAI	San Antonio, Tex.
277.6	1080	100	KGBX	St. Joseph, Mo.	305.9	980	1000	KOMO	Seattle, Wash.
277.6	1080	2000	KOIL	Council Bluffs, Iowa	305.9	980	15000	WGN	Chicago, Ill.
277.6	1080	500	KTCL	Seattle, Wash.	305.9	980	500	WLIB	Chicago, Ill.
277.6	1080	500	KWWG	Brownsville, Tex.	309.1	970	2000	KFAB	Lincoln, Nebr.
277.6	1080	100	WDZ	Tuscola, Ill.	309.1	970	500	KYA	San Francisco, Cal.
277.6	1080	15	WGBC	Memphis, Tenn.	309.1	970	500	WPCH	New York, N. Y.
277.6	1080	500	WHAM	Rochester, N. Y.	309.1	970	500	WRNY	New York, N. Y.
280.2	1070	500	KTAB	Oakland, Calif.	309.1	970	500	WTAW	College Station, Tex.
280.2	1070	50	WABR	Toledo, Ohio	315.6	950	30000	KDKA	Pittsburgh, Pa.
280.2	1070	100	WFBG	Altoona, Pa.	315.6	950	1000	KPSN	Pasadena, Cal.
280.2	1070	500	WFIW	Hopkinsville, Ky.	319	940	1000	KOIN	Portland, Ore.
280.2	1070	500	WGCP	Newark, N. J.	319	940	500	WEAN	Providence, R. I.
280.2	1070	500	WNJ	Newark, N. J.	319	940	750	WGHP	Mt. Clemens, Mich.
280.2	1070	100	WTAL	Toledo, Ohio	319	940	750	WHA	Madison, Wis.
282.8	1060	100	KFJR	Portland, Ore.	319	940	1000	WLBL	Madison, Wis.
282.8	1060	500	KFXF	Denver, Colo.	319	940	150	WRHF	Washington, D. C.
282.8	1060	50	KTBR	Portland, Ore.	322.4	930	50	KFQA	St. Louis, Mo.
282.8	1060	5000	WAIU	Columbus, Ohio	322.4	930	50	WJBA	Joliet, Ill.
282.8	1060	750	WEAO	Columbus, Ohio	322.4	930	50	WKBI	Chicago, Ill.
282.8	1060	50	WRAK	Escanaba, Mich.	322.4	930	15	WKDR	Kenosha, Wis.
285.5	1050	2000	KFAU	Boise, Idaho	322.4	930	15	WLBR	Belvedere, Ill.
285.5	1050	250	KFOY	St. Paul, Minn.	322.4	930	50	WLBT	Crown Point, Ind.
285.5	1050	3000	WBAL	Baltimore, Md.	322.4	930	750	WQAM	Miami, Fla.
285.5	1050	250	WJAG	Norfolk, Nebr.	322.4	930	50	WRRS	Racine, Wis.
285.5	1050	500	WKAR	East Lansing, Mich.	322.4	930	500	WSMB	New Orleans, La.
285.5	1050	250	WOAN	Lawrenceburg, Tenn.	322.4	930	50	WTAX	Streator, Ill.
288.3	1040	500	KTBI	Los Angeles, Cal.	325.9	920	5000	KOA	Denver, Colo.
288.3	1040	250	WBCN	Chicago, Ill.	325.9	920	2500	WABC	NEW YORK, N. Y.
288.3	1040	500	WDBO	Orlando, Fla.	325.9	920	1000	WAPI	Auburn, Ala.
288.3	1040	500	WENR	Chicago, Ill.	325.9	920	500	WBOQ	NEW YORK, N. Y.
288.3	1040	150	WKY	Oklahoma City, Okla.	333.1	900	100	KFJM	Grand Forks, N. D.
288.3	1040	100	WNAT	Philadelphia, Pa.	333.1	900	500	KSAC	Manhattan, Kans.
288.3	1040	250	WRAX	Philadelphia, Pa.	333.1	900	250	KSEI	Pocatello, Idaho
293.9	1020	250	KGCH	Wayne, Nebr.	333.1	900	15000	WBZ	Springfield, Mass.
293.9	1020	500	KPRC	Houston, Tex.	333.1	900	500	WBZA	Boston, Mass.
293.9	1020	500	WGL	NEW YORK, N. Y.	333.1	900	500	WKRC	Cincinnati, Ohio
293.9	1020	500	WHAD	Milwaukee, Wis.	336.9	890	500	KNX	Los Angeles, Calif.
293.9	1020	500	WLBW	Oil City, Pa.	336.9	890	500	WHB	Kansas City, Mo.
293.9	1020	1000	WODA	Paterson, N. J.	336.9	890	1000	WJAX	Jacksonville, Fla.
293.9	1020	1000	WTMJ	Milwaukee, Wisc.	336.9	890	250	WOQ	Kansas City, Mo.
296.9	1010	500	KQW	San Jose, Cal.	340.7	880	100	WAFD	Detroit, Mich.
296.9	1010	500	KUOA	Fayetteville, Ark.	340.7	880	50	WCAZ	Carthage, Ill.
296.9	1010	500	WADC	Akron, Ohio	340.7	880	100	WRAV	Yellow Springs, Ohio
296.9	1010	100	WBES	Takoma Park, Md.	340.7	880	5000	WSM	Nashville, Tenn.
296.9	1010	100	WEPS	Gloucester, Mass.	344.6	870	50	KWG	Stockton, Calif.
296.9	1010	10	WHBN	St. Petersburg, Fla.	344.6	870	5000	WCBD	Zion, Ill.
296.9	1010	200	WSMK	Dayton, Ohio	344.6	870	250	WJBB	St. Petersburg, Fla.
296.9	1010	1000	WWNC	Asheville, N. C.	344.6	870	5000	WLS	Chicago, Ill.
299.8	1000	10	KGFW	Ravenna, Nebr.	348.6	860	2500	KJR	Seattle, Wash.
299.8	1000	5000	KMOX	St. Louis, Mo.	348.6	860	1000	KVOO	Bristow, Okla.
299.8	1000	500	KOWW	Walla Walla, Wash.	348.6	860	500	WAAM	Newark, N. J.
299.8	1000	500	WBAK	Harrisburg, Pa.	348.6	860	300	WAAW	Omaha, Neb.
299.8	1000	500	WPSC	State College, Pa.	348.6	860	100	WFDF	Flint, Mich.
302.8	990	1000	KSL	Salt Lake City, Utah	348.6	860	500	WGBS	New York, N. Y.
302.8	990	100	WBIS	Boston, Mass.	352.7	850	5	KWTC	Santa Ana, Calif.

Meters	Kilocycles	Power	Call Letters	Location
352.7	850	1000	WEW	St. Louis, Mo.
352.7	850	500	WNAC	Boston, Mass.
352.7	850	5000	WOC	Davenport, Iowa
352.7	850	500	WRR	Dallas, Tex.
361.2	830	500	KFWB	Los Angeles, Calif.
361.2	830	500	WCSH	Portland, Me.
361.2	830	250	WDAY	Fargo, N. D.
361.2	830	500	WDWM	Asbury Park, N. J.
361.2	830	5000	WSAI	Cincinnati, Ohio
365.6	820	50	KMJ	Fresno, Calif.
365.6	820	500	WCAD	Canton, N. Y.
365.6	820	2000	WEBH	Chicago, Ill.
365.6	820	500	WFHH	Clearwater, Fla.
365.6	820	1000	WJJD	Mooseheart, Ill.
370.2	810	1000	KHQ	Spokane, Wash.
370.2	810	1000	WDAF	Kansas City, Mo.
370.2	810	1000	WLWL	New York, N. Y.
370.2	810	500	WMCA	New York, N. Y.
374.8	800	500	KFDM	Beaumont, Tex.
374.8	800	500	KNRC	Santa Monica, Calif.
374.8	800	500	KUOM	Missoula, Mont.
374.8	800	500	WDWF	Cranston, R. I.
374.8	800	1000	WWJ	Detroit, Mich.
379.5	790	500	KMMJ	Clay Center, Nebr.
379.5	790	500	WCAJ	Lincoln, Nebr.
379.5	790	30000	WGY	Schenectady, N. Y.
379.5	790	500	WHAZ	Troy, N. Y.
384.4	780	5000	KGO	Oakland, Calif.
384.4	780	1000	KTHS	Hot Spgs. Natl. Pk., Ark.
384.4	780	250	KWCR	Cedar Rapids, Iowa
384.4	780	100	WBSO	Wellesley Hills, Mass.
384.4	780	250	WCAO	Baltimore, Md.
384.4	780	100	WCBM	Baltimore, Md.
384.4	780	100	WJAM	Cedar Rapids, Iowa
384.4	780	500	WLSI	Cranston, R. I.
384.4	780	500	WMBF	Miami Beach, Fla.
384.4	780	100	WSRO	Hamilton, Ohio
389.4	770	500	WAAF	Chicago, Ill.
389.4	770	100	WABI	Bangor, Me.
389.4	770	1000	WBBM	Chicago, Ill.
389.4	770	500	WJBT	Chicago, Ill.
389.4	770	100	WWVA	Wheeling, W. Va.
394.5	760	500	KFDY	Brookings, S. D.
394.5	760	5000	KOB	State College, N. Mex.
394.5	760	1000	KTW	Seattle, Wash.
394.5	760	1000	KWKH	Shreveport, La.
394.5	760	500	KWSC	Pullman, Wash.
394.5	760	500	WHN	New York, N. Y.
394.5	760	500	WPAP	Cliffside, N. J.
394.5	760	500	WQAO	Cliffside, N. J.
399.8	750	200	KFKA	Greeley, Colo.
399.8	750	1000	WEAR	Cleveland, Ohio
399.8	750	3500	WTAM	Cleveland, Ohio
405.2	740	500	KHJ	Los Angeles, Calif.
405.2	740	5000	WCCO	St.Paul-Minneap., Minn.
405.2	740	500	WFI	Philadelphia, Pa.
405.2	740	500	WLIT	Philadelphia, Pa.
416.4	720	5000	WHT	Chicago, Ill.
416.4	720	500	WIBO	Chicago, Ill.
422.3	710	1000	KPO	San Francisco, Calif.
422.3	710	5000	WOR	Newark, N. J.
422.3	710	500	WSUI	Iowa City, Iowa
428.3	700	500	KFBU	Laramie, Wyo.
428.3	700	5000	WLW	Cincinnati, Ohio
428.3	700	500	WMAF	South Dartmouth, Mass.
440.9	680	100	KFMR	Sioux City, Iowa
440.9	680	1000	KFSD	San Diego, Calif.
440.9	680	5000	WCX	Pontiac, Mich.
440.9	680	50	WIBG	Elkins Park, Pa.
440.9	680	5000	WJR	Detroit, Mich.
440.9	680	250	WSBF	St. Louis, Mo.
447.5	670	1000	KFOA	Seattle, Wash.
447.5	670	500	WEEI	Boston, Mass.
447.5	670	500	WJAD	Waco, Tex.
447.5	670	1000	WMAQ	Chicago, Ill.
447.5	670	500	WQJ	Chicago, Ill.
454.3	660	500	KFRC	San Francisco, Calif.
454.3	660	30000	WJZ	New York, N. Y.
461.3	650	100	KICK	Anita, Iowa
461.3	650	500	KRLD	Dallas, Tex.
461.3	650	500	WHAS	Louisville, Ky.
468.5	640	5000	KFI	Los Angeles, Calif.
468.5	640	500	WOS	Jefferson City, Mo.
468.5	640	500	WRC	Washington, D. C.
475.9	630	250	KOW	Denver, Colo.
475.9	630	100	WIAS	Burlington, Iowa
475.9	630	1000	WSB	Atlanta, Ga.
475.9	630	500	WTIC	Hartford, Conn.
483.6	620	250	KUSD	Vermillion, S. D.
483.6	620	1500	WCFL	Chicago, Ill.
483.6	620	250	WEAI	Ithaca, N. Y.
483.6	620	1000	WEMC	Berrien Springs, Mich.
483.6	620	500	WJAR	Providence, R. I.
483.6	620	100	WLTS	Chicago, Ill.
491.5	610	1000	KGW	Portland, Ore.
491.5	610	5000	WEAF	New York, N. Y.
491.5	610	250	WSKC	Bay City, Mich.
499.7	600	50	KFUT	Salt Lake City, Utah
499.7	600	1500	WBAP	Fort Worth, Tex.
499.7	600	75	WBBY	Charleston, S. C.
499.7	600	500	WFAA	Dallas, Tex.
508.2	590	500	KLX	Oakland, Calif.
508.2	590	500	WIP	Philadelphia, Pa.
508.2	590	500	WOO	Philadelphia, Pa.
508.2	590	1000	WOW	Omaha, Nebr.
516.9	580	500	WCAE	Pittsburgh, Pa.
516.9	580	500	WMC	Memphis, Tenn.
516.9	580	500	WTAG	Worcester, Mass.
526	570	500	KMTR	Los Angeles, Calif.
526	570	2500	KYW	Chicago, Ill.
535.4	560	100	KFBK	Sacramento, Calif.
535.4	560	250	WCAH	Columbus, Ohio
535.4	560	5000	WHO	Des Moines, Iowa
535.4	560	500	WNYC	New York, N. Y.
545.1	550	500	KFUO	St. Louis, Mo.
545.1	550	500	KSD	St. Louis, Mo.
545.1	550	750	WMAK	Lockport, N. Y.

This list has been corrected up to and including August 15th, 1927

RADIO BROADCAST STATIONS OF THE UNITED STATES

By States and Cities

State and City	Call Letters	Wave Length	Power
ALABAMA			
Auburn	WAPI	325.9	1000
Birmingham	WBRC	243.8	250
Birmingham	WKBC	218.8	10
Gadsden	WJBY	234.2	50
Montgomery	WIBZ	230.6	15
ARIZONA			
Flagstaff	KFXY	205.4	25
Phoenix	KFAD	272.6	500
Phoenix	KFCB	243.8	125
Prescott	KPJM	214.2	15
Tucson	KGAR	234.2	100
ARKANSAS			
Fayetteville	KUOA	296.9	500
Hot Spring National Park	KTHS	384.4	1000
Newark	KGCG	223.7	100
CALIFORNIA			
Alma (Holy City)	KFQU	249.9	100
Avalon, Catalina Island	KFWO	218.8	250
Berkeley	KRE	256.3	100
Burbank	KELW	228.9	250
El Centro	KGEN	225.4	15
Eureka	KFWH	254.1	100
Fresno	KMJ	365.6	50
Hollywood	KFQZ	232.4	100
Inglewood	KMIC	223.7	250
La Crescenta	KGFH	223.7	250
Long Beach	KFON	241.8	500
Long Beach	KGER	215.7	100
Los Angeles	KFI	468.5	5000
Los Angeles	KFPR	232.4	250
Los Angeles	KFSG	275.1	500
Los Angeles	KFWB	361.2	500
Los Angeles	KGEF	263	500
Los Angeles	KGFJ	208.2	100
Los Angeles	KHJ	405.2	500
Los Angeles	KMTR	526	500
Los Angeles	KNX	336.9	500
Los Angeles	KPLA	252	500
Los Angeles	KRLO	215.7	250
Los Angeles	KTBI	288.3	500
Lower Lake	KFEU	227.1	50
Oakland	KFUS	256.3	50
Oakland	KFWM	236.1	500
Oakland	KGO	384.4	5000
Oakland	KLS	245.8	250
Oakland	KLX	508.2	500
Oakland	KTAB	280.2	500
Oakland	KZM	245.8	100
Oxnard	KFYF	238	25
Pasadena	KPPC	228.9	50
Pasadena	KPSN	315.6	1000
Sacramento	KFBK	535.4	100
San Bernardino	KFWC	222.1	100
San Diego	KFBC	247.8	1210
San Diego	KFSD	440.9	1000
San Francisco	KFRC	454.3	500
San Francisco	KFWI	267.7	500
San Francisco	KGTT	206.8	50
San Francisco	KJBS	220.4	50
San Francisco	KPO	422.3	1000
San Francisco	KYA	309.1	5000
San Jose	KQW	296.9	500
Santa Ana	KWTC	352.7	5
Santa Barbara	KFCR	211.1	50
Santa Maria	KSMR	272.6	100
Santa Monica	KNRC	374.8	500
Stockton	KGDM	217.3	10
Stockton	KWG	344.6	50
Venice	KFVD	208.2	250
Yuba City	KGFM	211.1	15
COLORADO			
Colorado Springs	KFUM	236.1	100
Denver	KFEL	247.8	250
Denver	KFUP	227.1	100
Denver	KFXF	282.8	500
Denver	KGEY	201.2	15
Denver	KLZ	267.7	250
Denver	KOA	325.9	5000
Denver	KOW	475.9	250
Durango	KOLO	199.9	5
Edgewater	KFXJ	215.7	15
Fort Morgan	KGEW	218.8	10
Greeley	KFKA	399.8	200
Gunnison	KFHA	254.1	50
Pueblo	KGDP	223.7	15
Trinidad	KFBS	238	15
Trinidad	KGFL	222.1	50
Yuma	KGEK	263	10
CONNECTICUT			
Bridgeport	WICC	214.2	250
Danbury	WCWS	214.2	100
Hartford	WTIC	475.9	500
Mansfield	WCAC	275.1	500
New Haven	WDRC	275.1	250
DELAWARE			
Wilmington	WDEL	265.3	100
DISTRICT OF COLUMBIA			
Washington	WMAL	302.8	120
Washington	WRC	468.5	500
Washington	WRHF	319	150

State and City	Call Letters	Wave Length	Power
FLORIDA			
Boca Raton	WFLA	212.6	1000
Clearwater	WFHH	365.6	500
Jacksonville	WJAX	336.9	1000
Lakeland	WMBL	228.9	50
Miami Beach	WIOD	247.8	1000
Miami Beach	WMBF	384.4	500
Miami	WQAM	322.4	750
Orlando	WDBO	288.3	500
Pensacola	WCOA	249.9	500
St. Petersburg	WHBN	296.9	10
St. Petersburg	WJBB	344.6	250
Tampa	WDAE	267.7	500
Tampa	WMBR	252	100
GEORGIA			
Atlanta	WGST	270.1	500
Atlanta	WSB	475.9	1000
Macon	WMAZ	270.1	500
IDAHO			
Boise	KFAU	285.5	2000
Kellogg	KFEY	232.4	10
Pocatello	KSEI	333.1	250
ILLINOIS			
Atwood	WLBQ	202.6	25
Batavia	WORD	275.1	5000
Batavia	WTAS	275.1	3500
Belvedere	WLBR	322.4	15
Bloomington	WMBY	199.9	15
Bloomington	WNBL	199.9	15
Carthage	WCAZ	340.7	50
Chicago	KYW	526	2500
Chicago	WWAE	232.4	500
Chicago	WAAF	389.4	500
Chicago	WBBM	389.4	770
Chicago	WBBZ	204	100
Chicago	WBCN	288.3	250
Chicago	WCFL	483.6	1500
Chicago	WCRW	223.7	500
Chicago	WEBH	365.6	2000
Chicago	WEDC	241.8	500
Chicago	WENR	288.3	500
Chicago	WFKB	223.7	500
Chicago	WGES	241.8	500
Chicago	WGN	305.9	15000
Chicago	WHBL	204	100
Chicago	WHBM	201.2	100
Chicago	WHFC	215.7	200
Chicago	WHT	416.4	5000
Chicago	WIBJ	201.2	100
Chicago	WIBM	201.2	100
Chicago	WIBO	416.4	500
Chicago	WIBW	204	100
Chicago	WJAZ	263	5000
Chicago	WJBT	389.4	500
Chicago	WKBG	201.2	100
Chicago	WKBI	322.4	50
Chicago	WLBN	204	50
Chicago	WLIB	305.9	500
Chicago	WLS	344.6	5000
Chicago	WLTS	483.6	100
Chicago	WMAQ	447.5	1000
Chicago	WMBB	252	500
Chicago	WMBH	204	100
Chicago	WMBI	266	500
Chicago	WOK	252	5000
Chicago	WPCC	223.7	500
Chicago	WQJ	447.5	500
Chicago	WSAX	204	100
Chicago	WSBC	232.4	500
Chicago Heights	WJBZ	208.2	100
Decatur	WBAO	267.7	100
Decatur	WJBL	212.6	250
East Wenona	WLBI	238	250
Evanston	WEHS	215.7	100
Forest Park	WNBA	208.2	200
Galesburg	WFBZ	247.8	50
Galesburg	WKBS	217.3	100
Galesburg	WLBO	217.3	100
Galesburg	WRAM	247.8	50
Harrisburg	WEBQ	223.7	15
Joliet	WCLS	215.7	150
Joliet	WJBA	322.4	50
Joliet	WKBB	215.7	150
LaSalle	WJBC	227.1	100
Mooseheart	WJJD	365.6	1000
Peoria Heights	WMBD	205.4	250
Quincy	WTAD	236.1	250
Rockford	KFLV	267.7	100
Rock Island	WHBF	222.1	100
Springfield, Ill.	WCBS	209.7	250
Streator	WTAX	322.4	50
Tuscola	WDZ	277.6	100
Urbana	WRM	272.6	500
Waukegan	WPEP	215.7	250
Zion	WCBD	344.6	5000
INDIANA			
Anderson	WHBU	220.4	15
Brookville	WKBV	217.3	100
Culver	WCMA	258.5	250
Crown Point	WLBT	322.4	50
Evansville	WGBF	236.1	250
Fort Wayne	WCWK	228.9	500
Fort Wayne	WOWO	228.9	1000
Indianapolis	WFBM	225.4	250
Indianapolis	WKBF	252	250
Kokomo	WJAK	234.2	50
Lafayette	WBAA	272.6	500
Laport	WRAF	208.2	100
Muncie	WLBC	209.7	50
South Bend	WSBT	238	500
Terre Haute	KGFO	204	100
Terre Haute	WRPI	208.2	100
Valparaiso	WRBC	238	250
IOWA			
Ames	WOI	265.3	2500
Anita	KICK	461.3	100
Boone	KFGQ	209.7	10

State and City	Call Letters	Wave Length	Power
IOWA—Con.			
Burlington	WIAS	475.9	100
Cedar Rapids	KWCR	384.4	250
Cedar Rapids	WJAM	384.4	100
Clarinda	KSO	227.1	500
Council Bluffs	KOIL	277.6	2000
Cresco	KGDJ	202.6	10
Davenport	WOC	352.7	5000
Decorah	KGCA	247.8	10
Decorah	KWLC	247.8	50
Des Moines	WHO	535.4	5000
Fort Dodge	KFJY	239.9	100
Iowa City	KGFB	223.7	10
Iowa City	WSUI	422.3	500
Le Mars	KWUC	243.8	1500
Marshalltown	KFJB	247.8	15
Muscatine	KPNP	211.1	100
Muscatine	KTNT	256.5	3500
Oskaloosa	KFHL	212.6	10
Shenandoah	KFNF	270.1	1000
Shenandoah	KMA	270.1	500
Sioux City	KFMR	440.9	100
Sioux City	KSCJ	243.8	500
KANSAS			
Concordia	KGCN	208.2	50
Independence	KFVG	225.4	50
Lawrence	KFKU	254.1	500
Lawrence	WREN	254.1	750
Manhattan	KSAC	333.1	500
Milford	KFKB	241.8	1500
Wichita	KFH	245.8	500
KENTUCKY			
Hopkinsville	WFIW	280.2	500
Louisville	WHAS	461.3	500
Louisville	WLAP	267.7	50
LOUISIANA			
New Orleans	WABZ	247.8	50
New Orleans	WCBE	227.1	5
New Orleans	WJBO	263	100
New Orleans	WJBW	238	30
New Orleans	WKBT	252	50
New Orleans	WSMB	322.4	500
New Orleans	WWL	275.1	100
Shreveport	KFDX	236.1	250
Shreveport	KGDX	212.6	250
Shreveport	KWKH	394.5	1000
Shreveport	KRAC	220.4	50
Shreveport	KSBA	267.7	1000
MAINE			
Bangor	WABI	389.4	100
Dover-Foxcroft	WLBZ	208.2	250
Portland	WCSH	361.2	500
MARYLAND			
Baltimore	WBAL	285.5	3000
Baltimore	WCAO	384.4	250
Baltimore	WCBM	384.4	100
Baltimore	WFBR	225.4	100
Tokoma Park	WBES	296.9	100

State and City	Call Letters	Wave Length	Power
MASSACHUSETTS			
Boston	WATT	201.2	100
Boston	WBET	265.3	500
Boston	WBIS	302.8	100
Boston	WBZA	333.1	500
Boston	WEEI	447.5	500
Boston	WLBM	230.6	50
Boston	WMES	211.1	100
Boston	WNAC	352.7	500
Boston	WSSH	249.9	1000
Chelsea	WRSC	205.4	15
Gloucester	WEPS	296.9	100
New Bedford	WNBH	260.7	250
Somerville	WAGS	215.7	5
South Dartmouth	WMAF	428.3	500
Springfield	WBZ	333.1	15000
Taunton	WAIT	214.2	10
Webster	WKBE	228.9	100
Wellesley Hills	WBSO	384.4	100
Wollaston	WRES	217.3	50
Worcester	WTAG	516.9	500
MICHIGAN			
Battle Creek	WKBP	212.6	50
Bay City	WSKC	491.5	250
Berrien Springs	WEMC	483.6	1000
Detroit	WAFD	340.7	100
Detroit	WBMH	211.1	100
Detroit	WJR	440.9	5000
Detroit	WMBC	243.8	100
Detroit	WMCO	218.8	250
Detroit	WWJ	374.8	1000
Escanaba	WRAK	282.8	50
Flint	WFDF	348.6	100
Furnwood	WOOD	260.7	500
Grand Rapids	WASH	256.3	250
Iron Mountain	WLBY	209.7	50
East Lansing	WKAR	285.5	500
Lansing	WREO	230.6	500
Lapeer	WMPC	234.2	30
Ludington	WKBZ	199.9	15
Monroe	WKBL	205.4	15
Mt. Clemens	WGHP	319	750
Petoskey	WBBP	239.9	100
Pontiac	WCX	440.9	5000
Royal Oak	WAGM	225.4	50
Ypsilanti	WJBK	220.4	15
MINNESOTA			
Barrett	KGDE	205.4	50
Collegeville	WFBJ	272.6	100
Fairmont	KFVN	228.9	100
Hallock	KGFK	223.7	50
Minneapolis	KFDZ	215.7	10
Minneapolis	KGEQ	202.6	50
Minneapolis	WAMD	225.4	500
Minneapolis	WDGY	260.7	500
Minneapolis	WGMS	245.8	500
Minneapolis	WHDI	245.8	500
Minneapolis	WLB	245.8	500

State and City	Call Letters	Wave Length	Power
MINNESOTA—Con.			
Minneapolis	WRHM	260.7	1000
Northfield	KFMX	236.1	500
Northfield	WCAL	236.1	500
St. Cloud	WFAM	252	10
St. Paul	KFOY	285.5	250
St. Paul	WMBE	208.2	10
St. Paul-Minneapolis	WCCO	405.2	5000
MISSISSIPPI			
Columbus	WCOC	230.6	100
Oxford (near)	WCBH	241.8	100
MISSOURI			
Cape Girardeau	KFVS	223.7	50
Carterville	KFPW	263	50
Columbia	KFRU	249.9	500
Independence	KLDS	238	1500
Jefferson City	WOS	468.5	500
Kansas City	KWKC	222.1	100
Kansas City	WDAF	370.2	1000
Kansas City	WHB	336.9	500
Kansas City	WLBF	209.7	50
Kansas City	WOQ	336.9	250
Kirksville	KFKZ	225.4	15
St. Joseph	KFEQ	230.6	1000
St. Joseph	KGBX	277.6	100
St. Louis	KFQA	322.4	50
St. Louis	KFUO	545.1	500
St. Louis	KFVE	234.2	1000
St. Louis	KFWF	214.2	250
St. Louis	KMOX	299.8	5000
St. Louis	KSD	545.1	500
St. Louis	WEW	352.7	1000
St. Louis	WIL	258.5	250
St. Louis	WMAY	247.8	100
St. Louis	WSBF	440.9	250
MONTANA			
Havre	KFBB	275.1	50
Kalispell	KGEZ	205.4	100
Missoula	KUOM	374.8	500
Vida	KGCX	243.8	10
NEBRASKA			
Central City	KGES	204	10
Clay Center	KMMJ	379.5	500
Grand Island	KGEO	205.4	160
Humboldt	KGDW	206.8	100
Lincoln	KFAB	309.1	2000
Lincoln	KFOR	217.3	100
Norfolk	WJAG	285.5	250
Omaha	KFOX	258.5	100
Omaha	KOCH	258.5	250
Omaha	WAAW	348.6	300
Omaha	WNAL	258.5	250
Omaha	WOW	508.2	1000
Ravenna	KGFW	299.8	10
Shelby	KGBY	202.6	50
University Place	WCAJ	379.5	500
Wayne	KGCH	293.9	250
York	KGBZ	212.6	100

State and City	Call Letters	Wave Length	Power
NEW HAMPSHIRE			
Laconia	WKAV	223.7	50
Manchester	WCOM	238	100
Tilton	WBRL	232.4	500
NEW JERSEY			
Asbury Park	WDWM	361.2	500
Atlantic City	WHAR	272.6	750
Atlantic City	WPG	272.6	5000
Camden	WCAM	223.7	500
Cliffside	WCDA	211.1	250
Cliffside	WPAP	394.5	500
Cliffside	WQAO	394.5	500
Elizabeth	WIBS	204	150
Jersey City	WAAT	245.8	500
Jersey City	WKBO	218.8	500
Lambertville	WTAZ	220.4	15
Midland Park	WTRL	206.8	15
Newark	WAAM	348.6	500
Newark	WGCP	280.2	500
Newark	WNJ	280.2	500
Newark	WOR	422.3	5000
North Plainfield	WEAM	239.9	250
Paterson	WODA	293.9	1000
Red Bank	WJBI	256.3	250
Trenton	WOAX	239.9	500
Union City	WBMS	267.7	100
NEW MEXICO			
State College	KOB	394.5	5000
NEW YORK			
Auburn	WMBO	220.4	100
Bay Shore	WRST	211.1	250
Brooklyn	WARS	227.1	500
Brooklyn	WBBC	227.1	500
Brooklyn	WBKN	267.7	100
Brooklyn	WBRS	211.1	100
Brooklyn	WLTH	218.8	250
Brooklyn	WMBQ	204	100
Buffalo	WEBR	241.8	200
Buffalo	WGR	302.8	750
Buffalo	WKBW	217.3	500
Buffalo	WKEN	204	250
Buffalo	WSVS	205.4	50
Canton	WCAD	365.6	500
Cazenovia	WMAC	225.4	500
Endicott	WNBF	206.8	50
Farmingdale	WLBH	232.4	30
Flushing	WIBI	267.7	100
Freeport	WGBB	245.8	400
Ithaca	WEAI	483.6	250
Ithaca	WLCI	247.8	50
Jamaica	WMRJ	206.8	10
Jamestown	WOCL	223.7	25
Kingston	WDBZ	215.7	50
Lockport	WMAK	545.1	750
Long Island City	WLBX	204	250
Newburgh	WKBM	208.2	100
New York	WABC	325.9	2500
New York	WBNY	236.1	250

State and City	Call Letters	Wave Length	Power
NEW YORK—Con.			
New York	WBOQ	325.9	500
New York	WCGU	211.1	500
New York	WEAF	491.5	5000
New York	WEBJ	256.3	500
New York	WGBS	348.6	500
New York	WGL	293.9	500
New York	WGMU	201.2	100
New York	WHAP	236.1	1000
New York	WHN	394.5	500
New York	WHPP	206.8	10
New York	WJZ	454.3	30000
New York	WKBQ	218.8	500
New York	WLWL	370.2	1000
New York	WMCA	370.2	500
New York	WMSG	236.1	500
New York	WNYC	535.4	500
New York	WPCH	309.1	500
New York	WRMU	201.2	100
New York	WRNY	309.1	500
New York	WSDA	227.1	250
New York	WSOM	245.8	500
New York	WWRL	267.7	100
Peekskill	WOKO	215.7	250
Rochester	WABO	232.4	100
Rochester	WHAM	277.6	500
Rochester	WHEC	232.4	100
Rochester	WNBQ	202.6	15
Rochester	WOKT	209.7	500
Rossville	WBBR	256.3	1000
Schenectady	WGY	379.5	30000
Syracuse	WFBL	258.5	750
Syracuse	WSYR	225.4	500
Troy	WHAZ	379.5	500
Utica	WIBX	238	150
NORTH CAROLINA			
Asheville	WWNC	296.9	1000
Charlotte	WBT	258.5	500
Greensboro	WNRC	223.7	500
Raleigh	WRCO	217.3	250
NORTH DAKOTA			
Aneta	KGFN	199.9	15
Bismarck	KFYR	239.9	250
Devils Lake	KDLR	230.6	15
Fargo	WDAY	361.2	250
Grand Forks	KFJM	333.1	100
Mandan	KGCU	208.2	100
OHIO			
Akron	WADC	296.9	500
Ashland	WLBP	202.6	15
Ashtabula	WJPW	208.2	50
Bellefontaine	WHBD	222.1	100
Cambridge	WEBE	247.8	10
Canton	WHBC	236.1	10
Cincinnati	WAAD	267.7	25
Cincinnati	WFBE	245.8	250
Cincinnati	WKRC	333.1	500
Cincinnati	WLW	428.3	5000
Cincinnati	WSAI	361.2	5000
Cleveland	WDBK	227.1	250
Cleveland	WEAR	399.8	1000
Cleveland	WHK	265.3	500
Cleveland	WJAY	227.1	500
Columbus	WAIU	282.8	5000
Columbus	WCAH	535.4	250
Columbus	WEAO	282.8	750
Columbus	WMAN	234.2	50
Dayton	WSMK	296.9	200
Hamilton	WRK	205.4	100
Hamilton	WSRO	384.4	100
Mansfield	WLBV	206.8	50
Shelby	WOBR	204	10
Springfield	WCSO	256.3	500
Steubenville	WIBR	249.9	50
Toledo	WABR	280.2	50
Toledo	WTAL	280.2	100
Wooster	WABW	247.8	50
Yellow Springs	WRAV	340.7	100
Youngstown	WKBN	214.2	50
Youngstown	WMBW	214.2	50
OKLAHOMA			
Alva	KGFF	205.4	25
Bristow	KVOO	348.6	1000
Chickasha	KOCW	252	250
Norman	WNAD	239.9	500
Oklahoma City	KFJF	272.6	750
Oklahoma City	KFXR	223.7	50
Oklahoma City	KGCB	215.7	50
Oklahoma City	KGFG	215.7	50
Oklahoma City	WKY	288.3	150
OREGON			
Astoria	KFJI	249.9	15
Corvallis	KOAC	270.1	500
Eugene	KGEH	201.2	50
Medford	KMED	249.9	50
Portland	KEX	239.9	2500
Portland	KFEC	214.2	50
Portland	KFIF	214.2	50
Portland	KFJR	282.8	100
Portland	KGW	491.5	1000
Portland	KLIT	206.8	10
Portland	KOIN	319	1000
Portland	KTBR	282.8	50
Portland	KWBS	199.9	15
Portland	KWJJ	228.9	50
Portland	KXL	220.4	50
PENNSYLVANIA			
Allentown	WCBA	222.1	100
Allentown	WSAN	222.1	100
Altoona	WFBG	280.2	100
Bethayres	WALK	201.2	50
Carbondale	WNBW	258.5	5
E. Pittsburgh	KDKA	315.6	30000
Elkins Park	WIBG	440.9	50
Grove City	WSAJ	223.7	250
Harrisburg	WBAK	299.8	500

State and City	Call Letters	Wave Length	Power
PENNSYLVANIA—Con.			
Harrisburg	WMBS	234.2	250
Harrisburg	WPRC	209.7	100
Jeanette	WGM	208.2	50
Johnstown	WHBP	228.9	250
Lancaster	WGAL	252	15
Lancaster	WKJC	258.5	50
Lewisburg	WJBU	214.2	100
Monessen	WMBJ	232.4	50
New Castle	WKBU	204	50
Oil City	WHBA	260.7	10
Oil City	WLBW	293.9	500
Parkersburg	WQAA	215.7	500
Philadelphia	WABQ	260.7	500
Philadelphia	WABY	247.8	50
Philadelphia	WCAU	260.7	500
Philadelphia	WFI	405.2	500
Philadelphia	WFKD	205.4	10
Philadelphia	WHBW	220.4	50
Philadelphia	WIAD	220.4	100
Philadelphia	WIP	508.2	500
Philadelphia	WLIT	405.2	500
Philadelphia	WNAT	288.3	100
Philadelphia	WOO	508.2	500
Philadelphia	WPSW	202.6	50
Philadelphia	WRAX	288.3	250
Pittsburgh	KQV	270.1	500
Pittsburgh	WCAE	516.9	500
Pittsburgh	WJAS	270.1	500
Pittsburgh	WMBU	217.3	50
Pringleboro	WABF	205.4	250
Reading	WRAW	238	100
Scranton	WGBI	230.6	250
Scranton	WQAN	230.6	250
State College	WPSC	299.8	500
Washington	WNBO	211.1	15
Wilkes-Barre	WBAX	249.9	100
Wilkes-Barre	WBRE	249.9	100
RHODE ISLAND			
Cranston	WDWF	374.8	500
Cranston	WLSI	384.4	500
Newport	WMBA	204	100
Olneyville	WCOT	225.4	50
Pawtucket	WFCI	225.4	50
Portsmouth	WSAR	252	100
Providence	WCBR	201.2	100
Providence	WEAN	319	500
Providence	WJAR	483.6	500
Providence	WRAH	199.9	250
SOUTH CAROLINA			
Charleston	WBBY	499.7	75
SOUTH DAKOTA			
Brookings	KFDY	394.5	500
Brookings	KGCR	208.2	15
Dell Rapids	KGDA	234.2	15
Mitchell	KGFP	212.6	10
Oldham	KGDY	206.8	15
Rapid City	WCAT	247.8	100
Sioux Falls	KSOO	209.7	250
Vermillion	KUSD	483.6	250
Yankton	WNAX	302.8	250
TENNESSEE			
Chattanooga	WDOD	245.8	500
Knoxville	WFBC	234.2	50
Knoxville	WNBJ	206.8	50
Knoxville	WNOX	265.3	1000
Lawrenceburg	WOAN	285.5	250
Memphis	WGBC	277.6	15
Memphis	WHBQ	232.4	100
Memphis	WMBM	209.7	10
Memphis	WMC	516.9	500
Memphis	WNBR	228.9	20
Memphis	WREC	254.1	50
Nashville	WBAW	247.8	100
Nashville	WDAD	225.4	500
Nashville	WLAC	225.4	500
Nashville	WSM	340.7	5000
Springfield	WSIX	212.6	150
TEXAS			
Amarillo	KGRS	243.8	150
Amarillo	WDAG	263	250
Austin	KUT	232.4	500
Beaumont	KFDM	374.8	500
Brownsville	KWWG	277.6	500
College Station	WTAW	309.1	500
Dallas	KRLD	461.3	500
Dallas	WFAA	499.7	500
Dallas	WRR	352.7	500
Dublin	KFPL	275.1	15
El Paso	KFXH	241.8	100
El Paso	WDAH	234.2	100
Fort Worth	KFJZ	249.9	50
Fort Worth	KFQB	260.7	1000
Fort Worth	WBAP	499.7	1500
Galveston	KFLX	270.1	100
Galveston	KFUL	258.5	500
Greenville	KFPM	230.6	15
Houston	KFVI	238	50
Houston	KPRC	293.9	500
Houston	KTUE	212.6	5
San Angelo	KGFI	220.4	15
San Benito	KFLU	236.1	15
San Antonio	KGCI	220.4	15
San Antonio	KGDR	202.6	15
San Antonio	KGRC	220.4	50
San Antonio	KTAP	228.9	20
San Antonio	KTSA	265.3	2000
San Antonio	WOAI	302.8	5000
Waco	WJAD	447.5	500
UTAH			
Jerome	KFXD	204	15
Ogden	KFUR	225.4	50
Salt Lake City	KDYL	258.5	100
Salt Lake City	KFUT	499.7	50
Salt Lake City	KSL	302.8	1000

e and City	Call Letters	Wave Length	Power
n	WCAX	254.1	100
	WNBX	241.8	10
	WQAE	249.9	50
n Hills	WTFF	204	50
	WBBW	236.1	50
	WRCV	209.7	100
	WTAR	275.1	500
	WLBG	214.2	100
	WBBL	247.8	100
	WMBG	206.8	15
	WRVA	254.1	1000
	WDBJ	230.6	250
ach	WSEA	218.8	250
NIA			
n	WSAZ	241.8	100
	WWVA	389.4	100
N			
	KFBL	223.7	100
	KGY	243.8	50
	KWSC	394.5	500
	KFOA	447.5	1000
	KFQW	217.3	100
	KGBS	202.6	100
	KGCL	230.6	50
	KJR	348.6	2500
	KKP	265.3	15
	KOMO	305.9	1000
	KPCB	230.6	50
	KRSC	211.1	50
	KTCL	277.6	500

State and City	Call Letters	Wave Length	Power
Seattle	KTW	394.5	1000
Seattle	KUJ	199.9	10
Seattle	KVOS	209.7	50
Spokane	KFIO	245.8	100
Spokane	KFPY	245.8	250
Spokane	KGA	260.7	2000
Spokane	KHQ	370.2	1000
Tacoma	KMO	254.1	250
Tacoma	KVI	234.2	50
Walla Walla	KOWW	299.8	500
Yakima	KFIQ	208.2	100
WISCONSIN			
Beloit	WEBW	258.5	500
Camp Lake	WCLO	227.1	100
Eau Claire	WTAQ	254.1	500
Fond du Lac	KFIZ	267.7	100
Kenosha	WKDR	322.4	15
La Crosse	WKBH	220.4	500
Madison	WHA	319	750
Madison	WIBA	239.9	100
Manitowoc	WOMT	222.1	50
Milwaukee	WGWB	218.8	500
Milwaukee	WHAD	293.9	500
Milwaukee	WSOE	270.1	500
Milwaukee	WTMJ	293.9	1000
Omro	WJBR	227.1	100
Poynette	WIBU	217.3	20
Racine	WRRS	322.4	50
Stevens Point	WLBL	319	1000
Superior	WEBC	241.8	250
West De Pere	WHBY	249.9	50
WYOMING			
Laramie	KFBU	428.3	500

This list has been corrected up to and including August 15th, 1927

Canadian Radio Broadcast Stations

Indexed Alphabetically by Call Letters

Radio Call Letters	BROADCAST STATIONS Location and Owner	Power Watts	Wave Length (Meters)	Frequency (Kilocycles)	Time at Station
CF					
CFAC	**Calgary, Alberta**—The Calgary Herald, Herald Bldg	500	434.5	690	Mountain
CFCA	**Toronto, Ont.**—Star Publishing & Printing Co., S. W. Cor. Yonge St. and St. Clair Ave	500	356.9	840	Eastern
CFCF	**Montreal, Que.**—Canadian Marconi Co., Mount Royal Hotel	1650	410.7	730	Eastern
CFCH	**Iroquois Falls, Ont.**—Abitibi Power & Paper Co., Ltd	250	499.7	600	Eastern
CFCN	**Calgary, Alberta**—W. W. Grant (Ltd.), 708 Crescent Rd., N. W	1800	434.5	690	Mountain
CFCQ	**Vancouver, B. C.**—Sprott-Shaw Radio Co., 153 Pender St., W	10	410.7	730	Pacific
CFCT	**Victoria, B. C.**—G. W. Deaville, 1405 Douglas St	500	329.5	910	Pacific
CFCY	**Charlottetown, P. E. Island**—Island Radio Co., 176 Kent St	100	312.3	960	Atlantic
CFGC	**Brantford, Ont.**—The Brant Radio Supply Co., 90 Colborne St	50	296.9	1010	Eastern
CFJC	**Kamloops, B. C.**—N. S. Dalgleish & Sons, and Weller & Weller, 186 Victoria St	15	267.7	1120	Pacific
CFLC	**Prescott, Ont.**—Radio Assoc. of Prescott, Victoria Hall	50	296.9	1010	Eastern
CFMC	**Kingston, Ont.**—Monarch Battery Co., Montreal St	20	267.7	1120	Eastern
CFNB	**Fredericton, N. B.**—James S. Neill & Sons, Ltd., 212 Waterloo Row	25	247.8	1210	Atlantic
CFQC	**Saskatoon, Sask.**—The Electric Shop, Ltd., 1322 Osler St	500	329.5	910	Mountain
CFRB	**York Co., Ont.**—Standard Radio Mfg. Corp., Ltd., Township of King	1000	291.1	1030	Eastern
CFRC	**Kingston, Ont.**—Queen's University, Dept. of Electrical Engineering, Fleming Hall, Queen's University	500	267.7	1120	Eastern
CFYC	**Burnaby, B. C.**—International Bible Students Assoc., 2243 Royal Oak Ave	500	410.7	730	Pacific
CH					
CHCS	**Hamilton, Ont.**—The Hamilton Spectator, Spectator Bldg	10	340.7	880	Eastern
CHCY	**Edmonton, Alberta**—Int'l Bible Students Assoc., King Edward Park	250	516.9	580	Mountain
CHGS	**Summerside, P. E. I.**—R. T. Holman, Ltd., Holman Bldg	25	267.7	1120	Atlantic
CHIC	**Toronto, Ontario**—Northern Electric Co., Ltd., Hillcrest Park. (Uses Station CKNC, Canadian Nat'l Carbon Co., Toronto, Ontario)	500	356.9	840	Eastern
CHMA	**Edmonton, Alberta**—Christian & Missionary Alliance, 9618—106A Ave	250	516.9	580	Mountain
CHNC	**Toronto, Ont.**—Toronto Radio Research Soc., Hillcrest Park. (Uses Station CKNC, Canadian Nat'l Carbon Co., Toronto, Ont)	500	356.9	840	Eastern
CHNS	**Halifax, N. S.**—Northern Elec. Co., Carleton Hotel, Cor. Prince and Argyle Sts	100	322.4	930	Atlantic

Canadian Radio Broadcast Stations

By Provinces and Cities

Provinces	Cities	Call Letters	Wave Length (Meters)	Power (Watts)
ALBERTA	Calgary	CFAC	434.5	500
"	Calgary	CFCN	434.5	1800
"	Calgary	CJCJ	434.5	250
"	Calgary	CNRC	434.5	500
"	Edmonton	CHMA	516.9	250
"	Edmonton	CJCA	516.9	500
"	Edmonton	CKUA	516.9	500
"	Edmonton	CNRE	516.9	500
"	Red Deer	CKLC	356.9	1000
BRITISH COLUMBIA	Burnaby	CFYC	410.7	500
"	Kamloops	CFJC	267.7	15
"	Mission City	CJCU	247.8	5
"	Sea Island	CJOR	291.1	50
"	Vancouver	CFCQ	410.7	10
"	Vancouver	CHPC	410.7	1000
"	Vancouver	CKCD	410.7	1000
"	Vancouver	CKFC	410.7	50
"	Vancouver	CKWX	410.7	10
"	Vancouver	CNRV	291.1	500
"	Victoria	CFCT	329.5	500
MANITOBA	Winnipeg	CKY	384.4	500
"	Winnipeg	CNRW	384.4	500
NEW BRUNSWICK	Fredericton	CFNB	247.8	25
"	Moncton	CNRA	322.4	500
NOVA SCOTIA	Halifax	CHNS	322.4	100
ONTARIO	Bowmanville	CKCW	312.3	5000
"	Brantford	CFGC	296.9	50
"	Cobalt	CKMC	247.8	5
"	Hamilton	CHCS	340.7	10
"	Hamilton	CKOC	340.7	50
"	Iroquois Falls	CFCH	499.7	250
"	Kingston	CFMC	267.7	20
"	Kingston	CFRC	267.7	500
"	London	CJGC	329.5	500
"	Midland	CKPR	267.7	50
"	Ottawa	CKCO	434.5	100
"	Ottawa	CNRO	434.5	500
"	Prescott	CFLC	296.9	50
"	Preston	CKPC	247.8	7½
"	Scarboro Station	CJYC	291.1	500
"	Scarboro Station	CKCX	291.1	500
"	Toronto	CFCA	356.9	500
"	Toronto	CHIC	356.9	500
"	Toronto	CHNC	356.9	500
"	Toronto	CJBC	291.1-356.9	500
"	Toronto	CJSC	356.9	500
"	Toronto	CKCL	356.9	500
"	Toronto	CKNC	356.9	500
"	Toronto	CKSM	291.1	1000
"	Toronto	CNRT	356.9	500
"	York Co.	CFRB	291.1	1000

Provinces	Cities	Call Letters	Wave Length (Meters)	Power (Watts)
P. E. ISLAND	Charlottetown	CFCY	312.3	100
"	Summerside	CHGS	267.7	25
QUEBEC	Montreal	CFCF	410.7	1650
"	Montreal	CHYC	410.7	750
"	Montreal	CKAC	410.7	1200
"	Montreal	CNRM	410.7	1000-1650
"	Quebec	CHRC	340.7	5
"	Quebec	CKCI	340.7	22½
"	Quebec	CKCV	340.7	50
"	Quebec	CNRQ	340.7	50
"	St. Hyacinthe	CKSH	312.3	50
SASKATCHEWAN	Moose Jaw	CJRM	296.9	50
"	Regina	CHWC	312.3	15
"	Regina	CJBR	312.3	500
"	Regina	CKCK	312.3	500
"	Regina	CNRR	312.3	500
"	Saskatoon	CFQC	329.5	500
"	Saskatoon	CHUC	329.5	500
"	Saskatoon	CJWC	329.5	250
"	Saskatoon	CNRS	329.5	500
"	Unity	CHSC	267.7	50
"	Yorkton	CJGX	475.9	500

Licenses Required for Both Transmitters and Receivers in Canada

All radio stations, whether used for transmitting or receiving purposes are required to be licensed in Canada. The penalty on summary conviction for operating an unlicensed radio station is a fine not exceeding $50.00, and on conviction or indictment a fine not exceeding $500.00, with imprisonment for a term not exceeding 12 months. in addition to forfeiture of all unlicensed apparatus. The different classes of stations for which licenses are issued and their license fees vary from $1.00 for a private receiving set to $50.00 for a public commercial station.

The issue of licenses for transmitting stations is limited to British subjects or to companies incorporated under the laws of the Dominion of Canada or its provinces. Licenses for private receiving sets are issued to any person irrespective of nationality. Licenses for receiving sets are obtained from the Postmaster of the larger towns and cities in the Dominion, radio dealers, Royal Canadian Mounted Police, Department of Radio Inspectors, Departmental Agencies or from the Department of Marine and Fisheries. Licenses for all other classes of stations are obtained from the Department of Marine and Fisheries at Ottawa.

Foreign Radio Broadcast Stations

Including U. S. Possessions

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
ALASKA				
Anchorage	Anchorage Radio Club		227.1	100
Juneau	Alaska Elec. Light & Power Co.	**KFIU**	226	10
Ketchikan	Alaska Radio & Service Co.	**KGBU**	229	500
ALGERIA				
Algiers	Colin & Fils	**8DB**	310	100
ARGENTINE				
Buenos Aires	Enrique Caride	**LOK**	280.5	500
" "	Radio America	**LOL**	236	500
" "	Telegrafo de la Provincia	**LOM**	450	1000
" "	Radio Fenix	**LON**	210	2000
" "	Radio Prieto	**LOO**	252	1000
" "	Radio Buenos Aires	**LOQ**	261	500
" "	Sociedad Radio Argentine	**LOR**	330	1000
" "	Municipality of Buenos Aires	**LOS**	291.2	5000
" "	Francisco J. Brusa	**LOV**	361.5	2000
" "	Grand Splendid	**LOW**	303	2000
" "	Radio Cultura	**LOX**	380	500
" "	Sociedad Radio Nacional	**LOY**	315.8	1000
" "	"La Nacion"	**LOZ**	330	1000
" "	Gino Bocci y Hno.	**B2**	215	100
" "	Gino Bocci Hnos.	**A11**		
" "	Radio Club Argentine	**A1**		
" "	Francisco J. Brusa	**B1**		1000
" "	Facultad de Ciencias Medicas	**C1**	229.2	100
" "	Departmento Nacional de Higiene	**C2**		
Cordoba	Antonio Vanelli	**H4**	275	20
"	Sociedad Radio Comercial de Cordoba		381	100
"	Jorge Coen	**HA8**	255	50
"	Diario "Los Principios"	**H6**	250	20
Hurlingham, FCP.	Felix Gunther	**DA-1**		
La Plata, FCS.	Universidad Nacional	**LOP**	425	1000
Mendoza	Ministerio de Obras Publicas	**LOU**	380	500
"	Pedro B. Baldasarre	**M6**	348	100
Monte Grande, FCS.	Argentine Broadcasting Assn.			
Olivos, FCCA.	Radio Broadcasting	**LOT**	400	1000
Rio Cuarto	Arturo Rodriguez	**H5**	275	100
Rosario	Manuel Fugardo	**F4**	260	100
San Fernando, FCCA.	Americo Liberti	**D3**	235.3	100
San Luis	Santoalla	**Q4**	205.1	60
Santa Fe	Jose Roca Soler	**F1**	285.8	100
" "	Sociedad Rural de Cerealistas	**F2**	275	100
Tucunian	Radio Club	**K4**	311.8	250
AUSTRALIA				
Adelaide	Central Broadcasters Ltd.	**5CL**	395	5000
"	F. J. Hume	**5DN**	313	500
"	Millswood Auto & Radio Co.	**5MA**		
"	Marshall & Co.	**5MC**	273	500
Bathurst	Mockler Bros.	**2MK**	250	50
Brighton		**3PB**		
Brisbane	Dr. V. McDowell	**4CM**	278	250
"	Radio Manufacturers Ltd.	**3MB**	337	250

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
AUSTRALIA				
Brisbane	Queensland Radio Service	4QG	385	5000
Hobart	Tasmanian Broadcasting Pty.	7ZL	535	1500
Melbourne	Associated Radio Co.	3AR	484	1600
"	Broadcasting Co. of Australia	3LO	371	5000
"	O. J. Nilson & Co.	3UZ	319	100
"	L. J. Hellier	3WR	303	100
Mildura	R. J. Egge	3EO	286	100
Newcastle	H. A. Douglas	2HD	288	100
Northbridge	Otto Sandel	2UW	263	500
Perth	Westralian Farmers, Ltd.	6WF	1250	5000
Rockhampton	Queensland Government	4RN	323	500
Sydney	The Electrical Utilities Supply Co.	2UE	297	250
"	Burgin Electric Co.	2BE	316	100
"	Theosophical Broadcasting Service	2GB	316	1000
"	Trades Hall Broadcasting Station	2KY	280	300
"	Farmer & Co., Ltd.	2FC	442	5000
"		2WA	462	100
"	Broadcasters Sydney, Ltd.	2BL	353	5000
Toowoomba	Gold Radio Elec. Service	4GR	294	100
AUSTRIA				
Graz	Oesterreichische Radio-verkehrs Gesellschaft		404	500
Vienna	Oesterreichische Radio-verkehrs Gesellschaft	ORV	577	1500
BELGIUM				
Brussels	Radio Belgique Co.	BAV	508 5	1500
"	Radio Belgique Co	SBR	481	1500
BOLIVIA				
La Paz			175—300	50
Oruro	Radio Club Boliviano	CPM	50—200	50
BRAZIL				
Bahia	Radio Sociedade de Bahia	SQID	425	50
Bello Horizonte	Radio Sociedade de Mina Geraes		400	500
Ceare	Radio Club Cearense			50
Curytiba	Livio Moreira			
Fortaleza	Radio Club			300
Goyanna	Benedicto Ravello			
Matto Grosso	Radio Club de Campo Grande			
Minas Geraes	Juiz de Fora			100
Para	Radio Club de Para			100
Parana			370	300
Parahyba	Radio Sociedade de Parahyba			
Pelotas	Radio Sociedade Pelotense			
Penedo	A. G. Oliveira			
Pernambuco	Radio Club de Pernambuco		310	1000
"	Cia Radiotelegrafica Brasileira		250—380	500
"	Radio Sociedade de Jader de Andrada			
"	Radio Sociedade de Garanhuns			
Petropolis	Radio Club de Petropolis			
Porto Alegre	Radio Sociedade Riograndense	RSR	381	80
Praia Vermelha	Radio Club do Brasil	SQIB	320	500
Rio de Janeiro	Radio Sociedade de Rio de Janeiro	SQIA	400	2000
" " "	Radio Club do Brasil	SPE	312	500
" " "	National Telegraph Service		450	500
Sao Paulo	Sociedade Radio Educadora		310	1000
" "	Sociedade Radio Educadora Paulista	SQIG	360	1000
" "	Radio Club de Sao Paulo		350	100
" "	Radio Bandeirantes		370	50
" "	Dias Carneiro & Cia.		380—420	100

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
CANARY ISLANDS				
La Laguna	Servando Ortoll Delmotte	EAJ5	280	50
Las Palmas	Canary Islands Radio Club		300	6
Teneriffe	Cervanado Ortoll Delmotte	EAR5	280	50
CEYLON				
Colombo			800	1500
CHILE				
Antofagasta	Sr. J. Pedreny	CHAO		40
"	Oficina Jose Santos Ossa	CLAC		50
"	Oficina Jose Francisco Vergara	CLAD		50
Iquique	Gildemeister & Cia.	CLAE		100
"	Oficina San Pedro	CLAF		100
"	Oficina Pena Chica	CLAG		100
San Eugenio	Rene Doneaud		230	25
Santiago	Radio Corporation of Chile	CBC	400—600	250
"	Chilean Radiophone Club	CMAH	300	100
"	Ferrocarril Transandino Chileno	CLAA		200
"	Carlos Buin Walsen	CMAA	240	20
"	International Machinery Co.	CMAB	480	1500
"	Castagneto Felli	CMAD	320	100
"	Ministerio de Higiene	CMAF	400	1350
"	Sociedad Broadcasting de Chile	CRC	385	350
"	"El Mercurio"	CMAC	360	1000
"	Radio Commercial	CMAE	280	100
"	Pedro Arroyo	CMAG	250	250
"	Cia Radio Transandino	CMAI	260	100
"	Universidad de Chile	CMAU	440	100
"		ORC	430	
"		RC	350	50
"	Harvey Diamond	CNAA		
"	Jose Bellalta	CNAC		
"	Fratelli Castagneto		320	100
"	Commercial Radio Co.		350	50
Tacna	Ministerio de Relaciones Exteriores	CMAT	365	1000
"	Chilean Government	CRCT	550	200
Valparaiso	Cia Radio Transandina	CNAD	265	500
"	Cia de Salitres de Antofagasta	CLAB		50
Vilna del Mar	Antonio Cornish Besa	ACB	400	50
" " "	Antonio Cornish Besa	CNAB		
CHINA				
Shanghai	Kellogg Switchboard & Supply Co.	KRC	335	150
"	Radio Supply Co. of Nanking Road	RSC	235	10
Tientsin	Gisho Electrc Co.	GEC	288	50
Victoria (Hongkong)	Hongkong Radio Society	5HK	475	150
COSTA RICA				
San Jose	Government			
CUBA				
Caibarien	Maria J. Alvarez	6EV	250	50
Camaguey	Pedro Nogueras	7AZ	225	10
Camajuani	Diego Ibarra	6YR	200	20
Central Elia	Salvador Rionda	7SR	350	500
Central Tuinicu	Frank H. Jones	6KW	340	100
" "	Frank H. Jones	6JK	272	100
Ciego de Avila	Eduardo V. Figueroa	7BY	235	20
Cienfuegos	Jose Ganduxe	6VY	260	200
"	Antonio T. Figueroa	6CX	170	20
"	Eduardo Terrv	6DW	225	10
"	Luis Del Castillo	6GR	253	10

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
CUBA				
Cienfuegos	Juan Pablo Ros	6GF	190	50
"	Eligio Cobelo Ramirez	6JQ	275	10
"	Valentin Ullivarri	16AZ	200	20
Havana	Credito y Construcciones Cia.	2HP	295	100
"	Julio Power	2JP	185	20
"	Frederick W. Borton	2CX	320	10
"	Alberto S. Bustamante	2AB	220	10
"	Cuban Telephone Co.	PWX	400	500
"	Jose Leiro	2JL	275	5
"	Alvara Daza	2K	200	20
"	E. Sanchez de Fuentes	2KD	350	50
"	"El Pais"	2EP	355	400
"	F. W. Borton	2CG	350	15
"	Bernardo Barrie	2BB	250	15
"	Frederick W. Borton	2BY	260	100
"	Julio Power	2HS	180	50
"	Jose Lara	2LR	32	50
"	Manuel y Guillermo Salas	2MG	284	20
"	R. B. Waters	2MK	85	20
"	Maria Garcia Velez	2OK	360	100
"	Oscar Collado	2OL	225	100
"	Roberto E. Ramirez	2TW	270	20
"	Benito Veita Ferro	2UF	265	10
"	Raul Karman	2RK	315	20
"	Raul Karman	2RY	170	5
"	Homero Sanchez	2SZ	418	10
"	Amadeo Saenz	2WW	210	20
"	Antonio A. Ginard	2XX	150	5
"	Raul Perez Falcon	2JD	105	20
"	Heraldo de Cuba	2HC	275	500
Matanzas	Leopoldo T. Figueroa	5EV	360	5
Nueva Gerona	Isle of Pines Telephone Co.	8JQ	130	20
Puerto del Rio	Antonio Zarazola	1AZ	275	5
Sagua la Grande	Guillermo Polanco	6HS	200	10
Santiago	Alfredo Vinnet	8FU	225	15
"	Pedro C. Anduz	8DW	275	50
"	Alfredo Brooks	8AZ	240	20
"	Ceferino Ramos	8IR	190	20
"	Alberto Ravelo	8BY	250	100
"	Guillermo Polanco	8HS	200	20
Tuinicu	Frank H. Jones	6KW	340	100
"	Short Wave Experimental Station	6XJ	30½	100
CZECHOSLOVAKIA				
Bratislava		OKR	300	500
Brunn	Radio Journal	OKB	441.2	2500
Koszice (Kassa)			1870	
Prague	Radio Journal	OKP	1110	1000
DANZIG				
Danzig			272.7	
DENMARK				
Copenhagen	Copenhagen Radio Broadcasting Station		337	2000
Ryvang			1150	1500
Soro	Ministry of War		1153.8	1500
EGYPT				
Cairo		SRE	255	
EQUADOR				
Guayaquil	J. Puig Verdaguer			

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
ESTONIA				
Tallinn			285.7	2250
FINLAND				
Bjorneborg	Nuoren Voiman Liiton Radiohydistys		311	200
Hango	Nuoren Voiman Liiton Radiohydistys		260	250
Helsingfors	Civil Guards of Finland		375	2000
Jacobstad			275.2	
Jyvaskyla	Nuoren Voiman Liiton Radiohydistys		297	250
Lahtis			318	
Mikkeli	Nuoren Voiman Liiton Radiohydistys		566	250
Pori	Nuoren Voiman Liiton Radiohydistys		255.3	100
Skatudden	Military Station Radio Div.		318	750
St. Michel	Nuoren Voiman Liiton Radioyhdistys		566	250
Tammerfors	Nuoren Voiman Liiton Radiohydistys	3NB	393	250
Tampere			373	250
Uleaborg			250	250
Viborg			214.3	750
FRANCE				
Agen	Dept. of Lot et Garonne	2BD	297	250
Angers	Radio Anjou		275.2	500
Bordeuax			419.5	2000
Dijon			207.5	1000
Grenoble	Ministry of P. T. T.		588.2	1500
Issy-les-Moulineaux	Ministry of War	QGA	1800	500
Juan-les-Pins			230	500
Lille			287	500
Lyon	Ministry of P. T. T.	YN	478.1	1000
"	Radio Lyon		291.3	1500
Marseilles	Ministry of P. T. T.		309	500
Mont-de-Marsen	Radio Club Landrais		400	500
Montpelier	Societe Languedocienne de T. S. F.		252.1	1000
Paris	Ecole Superieure de P. T. T.	FPTT	464	500
"	Eiffel Tower, Army	FL	2650	5000
"	Societe Francaise Radioelectrique	8AJ	1780	100
"	Lucien Levy		350	250
"	Petit Parisien	5NG	340.9	500
"	Cie. Francaise de Radiophone		1750	6000
"	Radio Paris	CFR	1750	3000
"	Radio Vitus		308	1000
Pic du Midi			350	
Reims			204.1	500
Reziers			178	500
St. Etienne	Radio Club Forezien		220	50
Strasbourg	Military Station Radio Club	8GF	222.2	250
Toulouse	Aerodrome	MRD	315	2000
"	La Radio		389.6	3000
GERMANY				
Berlin	Koenigswusterhausen Deutsche Welle A. G.	AFP	4000–2900	18000
"	Koenigswusterhausen Station	AFT	1250	8000
"	Vox Haus Funkstunde	AB	566–483.9	2000–4000
"	Witzleben Funkstunde A. G.		483.9	4000
"	Wolff's Bureau		2525	5000
Bremen	Nordischer Rundfunk	BMN	400	1500
Breslau	Schlessische Funkstunde		315.8	5000
Dortmund	Westdeutsche Funkstunde		283	750
Dresden	Mitteldeutscher Rundfunk		294.1	750

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
GERMANY				
Elberfeld	Westdeutsche Funkstunde		259	
Frankfort-on-the-Main	Sudwestdeutscher Rundfunkdienst	LP	428.6	4000
Freiburg im Breisgau	Suddeutscher Rundfunk		577	9500
Gleiwitz	Schlesische Funkstunde		250	750
Hamburg	Nordischer Rundfunk	EG	394.7	10000
"		HA	394.7	4000
Hanover	Nordischer Rundfunk		297	750
Kassel	Sudwestdeutscher Rundfunk		272	750
Kiel	Nordicher Rundfunk		254.2	750
Koenigsberg	Ostmarken Rundfunk		329.7	4000
Langenberg		LA	468.8	25000
Leipzig	Mitteldeutscher Rundfunk	MR	365.8	4000
Munich	Deutsche Stunde in Bayern	WM	535.7	1500
Munster	Westdeutsche Funkstunde	MS	241.9	1500
Norddeich		KAV	1800	
Nuremberg	Deutsche Stunde in Bayern		303	750
Stettin	Funkstunde A. G.		252.1	500
Stuttgart	Suddeutscher Rundfunk	OKP	379.7	4000
HAITI				
Port-au-Prince	Haitien Government	HHK	361.2	1000
HAWAII				
Honolulu	Honolulu Advertiser	KGU	270	500
HUNGARY				
Budapest	Hungarian States' Post and Telegraph	MTI	546	1000
"	Magyar Tavirati Iroda		1050	2000
"	Hungarian Telephone & Radio Co.		555.6	3000
ICELAND				
Reykjavik			333.3	500
INDIA				
Bangalore	Indian Broadcasting Co.			
Bombay	Walter Rogers & Co.	2AX	226	
"	Bombay Residency Radio Club	2FV	375	220
Calcutta	Radio Club of Bengal	2BZ	800	500
"	Indian States & Eastern Agency	5AF	425	1500
Karachi	Karachi Radio Club		425	40
Madras	Crampton Elec. Co.		220	120
Rangoon	Radio Club of Burmah	2HZ	350	40
IRISH FREE STATE				
Cork		6CK	400	1500
Dublin	Government	2RN	319.1	1500
ITALY				
Milan	Unione Radiofonica Italiana	IMI	322.6	1500
Naples	Unione Radiofonica Italiana	INA	333.3	1500
Nice			362	1000
Rome	Unione Radiofonica Italiana	IRO	449	3000
JAPAN				
Nagoya	Nagoya Radio Broadcasting Co.	JOCK	360	1000
Osaka	Osaka Central Broadcasting Co.	JOBK	385	1000
Tokyo	Tokyo Central Broadcasting Co.	JOAK	375	1000
JAVA				
Batavia	Bataviasche Radio Vereeninging	JFC	220	40
JUGOSLAVIA				
Agram (Zagreb)			310	500
KWANTUNG				
Dairen	Government Bureau of Communications		390	200
LATVIA				
Riga			526.5	2000

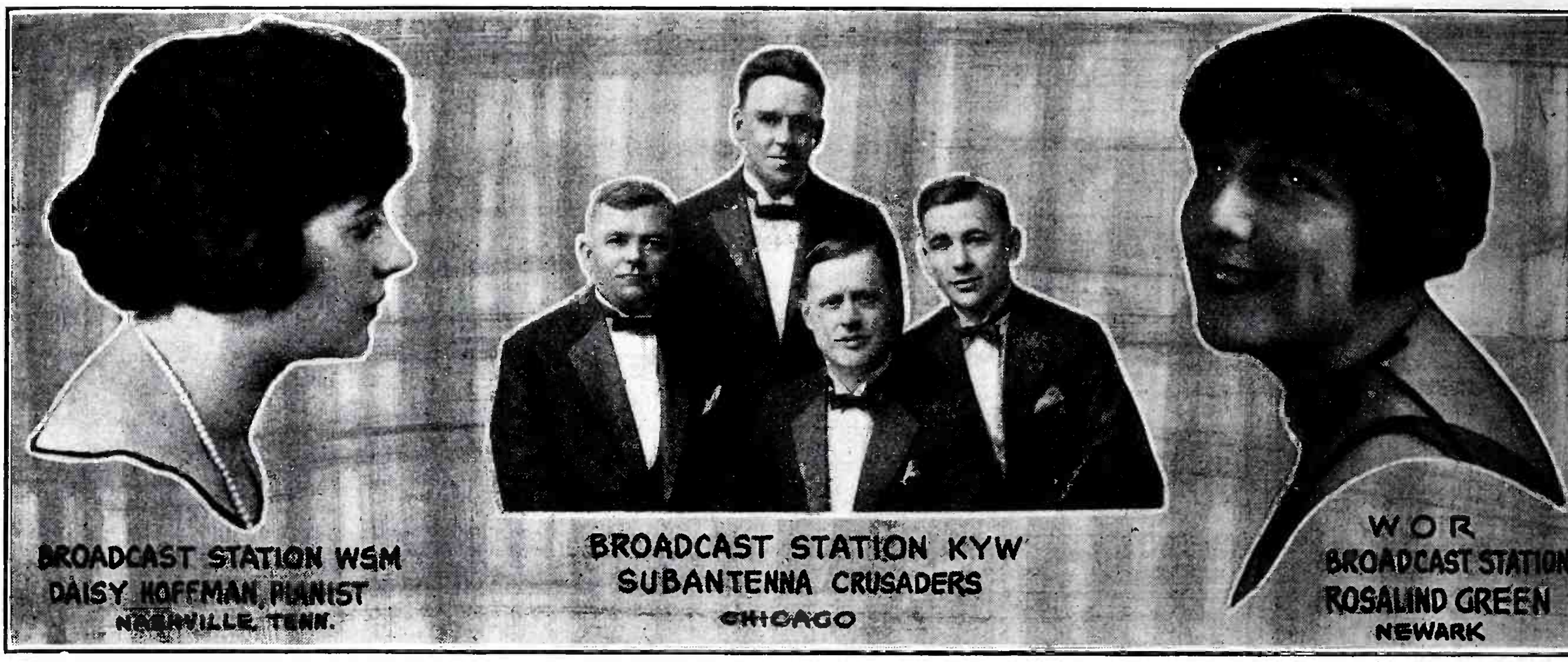
Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
LITHUANIA				
Kovno			2000	2000
LUXEMBURG				
Luxemburg		LOAA	217.4	250
MEXICO				
Chihuahua	Federal Government	CZF	310	250
"	Telefonos Del Gobierno del Estado de Chihuahua	ZCF	310	250
"	Compania Telefonica	XICE	500	500
Guadelajara	Radio Club—Degollado Theatre		280	10
"	Federal Military Command	FAM	490	1000
Mazatlan	Castulo Llamas	CYR	475	250
Merida	Partido Socialista del Surestan	CYY	549	100
Mexico City	Efran R. Gomez	CYA	300	500
" "	Jose J. Reynosa (El Buen Tono)	CYB	275	500
" "	Miguel S. Castro (La High Life)	CYH	375	100
" "	General Electric Co.	CYJ	410	1000
" "	"El Universal"	CYL	400	500
" "	Martinez y Zetina	CYO	425	100
" "	Excelsior Compania Editorial	CYX	260	750
" "	La Liga del Radio	CYZ	400	100
" "	Departmento de Educacion	CZE	357	1000
" "	Secretaria de Industria, Comercio y Trabajo	CZI	450–505	750
" "	Fabrica Nacional de Vestuario	IJ		500
" "	F. C. Stephenex	IR	250	100
Monterrey	Roberto Reyes	CYM	275	100
"	D. Constantino de Tarnava, Jr.	CYH		
"	Constantino de Tarnava	CYS	311	250
Oaxaca	Federico Zonılla	CYF	265	100
Puebla	Augustin del P. Saenz	CYU	312	100
Saltillo	Colegio Ateneo Fuente		450	135
Tampico		CYE	360	100
Vera Cruz	Ministerio de Communicaciones	CYC	300	500
" "		CYD	250	500
MOROCCO				
Casablanca	Radio Club de Moroc	CNO	250	500
NETHERLANDS				
Amsterdam		PCFF	2125	
Bloemendaal			566	
De Bilt		PCFF	1100	1250
Eindhoven	Phillips Lamp Works	PCJJ	30.2	
Scheveningen			1950	2500
Hilversum	Nederlandische Seintoellen Fabriek	PFBI	1000	10,000
"		HDO	1060	5000
NETHERLANDS EAST INDIES				
Soerabaya	Radiotelegraph Club		90	
NEW ZEALAND				
Auckland	Newcomb (Ltd.)	1YL	260	500
"	The Radio Broadcasting Co. of New Zealand	1YA	420	200
"	La Gloria Gramophone Co.	1YB	275	50
"	L. R. Keith	IZO	330	50
Christchurch	Radio Broadcasting Co., of New Zealand	3AC	240	10
"	Radio Broadcasting Co. of New Zealand	3YA	400	
Dunedin	Otago University	4XO	140	
"	British Electrical & Engineering Co.	4YA	310	500
"	Radio Supply Co.	4YO	370	500
"	Radio Broadcasting Co.	VLDN	380	750
Gisborne	Gisborne Radio Co.	2YM	260	500

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
NEW ZEALAND				
Napier	B. C. Spackman	2YL	190	100
Wellington	Broadcastings Ltd.	2YB	275	15
"	Radio Broadcasting Co.	2YK	295	120
Whangarei	N. C. Shepherd	1YC	250	15
NORWAY				
Bergen	Bergen Broadcasters		370.4	1500
Fredrikstad	Broadcasting Co. A. S.		384.8	750
Hamar	Broadcasting Co. A. S.		566	750
Natodden	Broadcasting Co. A. S.		447.8	
Oslo	Broadcasting Co. A. S.	OSLO	461.5	1500
Porsgrund	Broadcasting Co. A. S.		504	750
Rjuken	Broadcasting Co. A. S.		443	250
Stavanger			277.8	250
Tromso	Tromso Broadcasters		500	
Trondhjem			243.9	
PERU				
Arequipa	Augusto Gilardi	3OA	240	10
Lima	Peruvian Broadcasting Co.	OAX	380	1500
"	German Gallo	5OA	250	20
"	Enrique Perez	4OA	250	20
PHILIPPINE ISLANDS				
Baguio		KZUY	359.9	500
Iloilo		KPM	400	500
Manila	I. Beck Inc.	KZIB	260	10
"	Radio Corp. of the Philippines	KZKZ	270	500
"	Radio Corp. of the Philippines	KZRM	413	1000
"	Radio Corp. of the Philippines	KZRQ	400	500
POLAND				
Cracow			422	1500
Posen			270	1500
Warsaw	Government	PTR	380	700
"		AXO	1111	10000
PORTO RICO				
San Juan	Radio Corp. of Porto Rico	WKAQ	340.7	500
PORTUGAL				
Lisbon	Grandes Armazens do Chiado	PIAA	310	150
Montesanto	Government Wireless Station	CTV	2450	1500
SAN SALVADOR				
San Salvador	Government of el Salvador	AQM	452	500
SENEGAL				
St. Louis	Senegal Radio Club		300	100
SPAIN				
Barcelona	Radio Barcelona (Hotel Colon)	EAJ1	344.8	1500
"	Radio Catalana	EAJ13	462	1000
Bilbao	Radio Club Vizcaina	EAJ9	436	1000
"	Radio Vizcaya	EAJ11	418	2000
"	Armando de Otera		383	200
Cadiz	Radio Cadiz	EAJ3	400	500
"	Radio Lehera	EAJ10	297	1000
Cartagena	Enrique de Orbe	EAJ16	279	1000
"		EBX	1200	1000
Madrid	Radio Espana	EAJ2	393	3000
"	Escuela Superior	PTT	458	1000
"	Antonio Castilla	EAJ4	375	6000
"	Radio Iberica	EAJ6	392	1000
"	Union Radio	EAJ7	373	3000
"		EAJ12	306	2000

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
SPAIN				
Madrid	Radio Espanola	**EAJ15**	490	1000
"		**EGC**	1650–2200	2000
Malaga	Spanish Telecommunication Co.	**EAJ25**	325	1000
"	Alfonso Villota		325	200
Oviedo (Cima)	Arturo Cima Fernandez	**EAJ19**	340	1000
Salamanca		**EAJ22**	402.5	500
San Sebastian	Sabino Ucelayeta	**EAJ8**	346	2000
Sevilla	Manuel Garcia Ballesta	**EAJ17**	400	1000
"	Jorge la Riva	**EAJ21**	300	1000
"	Radio Club Sevillano	**EAJ5**	344.8	1000
Valencia		**EAJ24**	360	1000
"	Jose Lopes Azcar	**EAJ14**	500	500
Zaragoza		**EAJ23**	325	1500
STRAIGHTS SETTLEMENTS				
Singapore	Malaya Amateur Wireless Society		330	150
SWEDEN				
Boden	Radiotjanst	**SASE**	1200	1500
Boras		**SMBY**	230.8	250
Eskilstume	Radio Club	**SMUC**	250	250
Falun	Radiotjanst	**SMZK**	400	1500
Gaevle	Radio Club	**SMXF**	204.1	250
Goteborg	Radiotjanst	**SASB**	416.7	1000
Halmstad		**SMSB**	215.8	250
Helsingborg		**SMYE**	229	250
Jonkopings	Jonkopings Rundradiostation	**SMZD**	201.3	500
Kalmar		**SMSN**	252.1	250
Karlsborg	Radiotjanst	**SASF**	1350	50
"		**SAJ**	1365	5000
Karlskrona		**SMSM**	196	2000
Karlstadt	Radio Club of Karlstad	**SMXG**	221	150
Karlstadt		**SMXZ**	221	250
Kristinehamm		**SMTY**	202.7	250
Linkoeping	Radio Club	**SMUV**	467	25
"		**SMUW**	497.5	250
Malmo	Radiotjanst	**SASC**	260.9	500
Motola			1305	30000
Norrkoeping	Radio Club	**SMVV**	275.2	250
Orebro		**SMTI**	218	250
Ostersund			720	1000
Saffle		**SMTS**	252.1	500
Stockholm	The Swedish Broadcasting Co.	**SASA**	454.5	1500
Sundsvall	Radiotjanst	**SASD**	545.6	500
Trodhattan	Trodhattans Rundradiostation	**SMXQ**	277.8	250
Uddevalla		**SMZP**	294.1	250
Umea		**SMSN**	229	250
Varborg		**SMSO**	297	250
SWITZERLAND				
Basle		**HB3**	1100	250
Berne	Radio—Genossenschaft	**HBA**	411	5000
Geneva	Radio Broadcasting Soc. of Geneva	**HBI**	760	1500
Lausanne	Lausanne Radio Society	**HB-2**	318	500
Zurich	Zurich University	**RGZ**	515–650	500
"	Zurich Radio Genossenschaft	**HBZ**	496	1000
TUNISIA				
Tunis	French Army	**OCTU—TUA**	1450—45	500
UNION OF SO. AFRICA				
Cape Town	African Broadcasting Assn.		375	1500

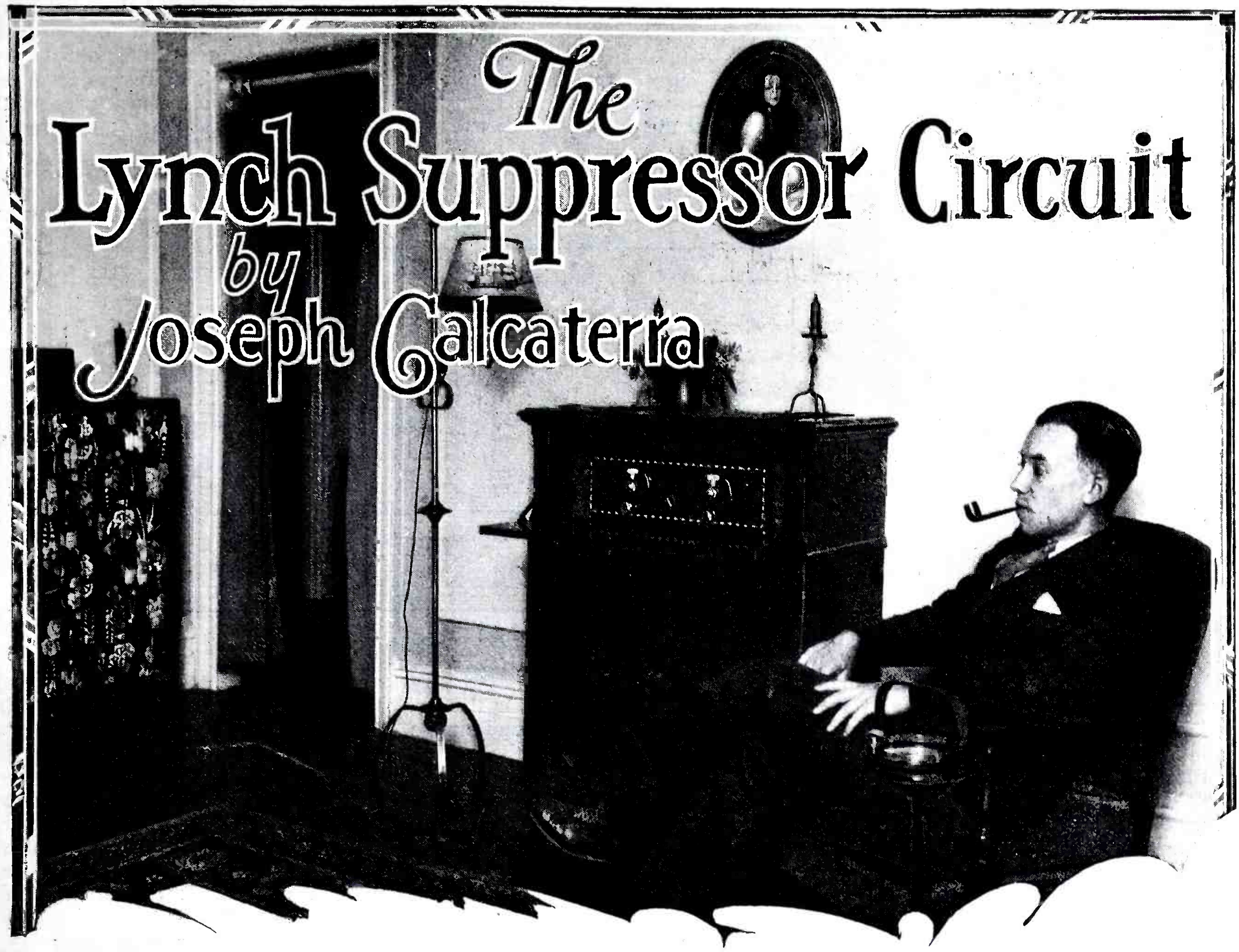
Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power (Watts)
UNION OF SO. AFRICA				
Durban	Town Council		400	1500
Johannesburg	African Broadcasting Co.	**JB**	450	500
UNION OF SOVIET SOCIALIST	**REPUBLICS (formerly Russia)**			
Astrakhan		**RA26**	700	1000
Baku		**RA45**	760	1250
Bogorodsk		**RA8**	750	
Ekaterinburg		**RA15**	750	250
Homel		**RA39**	925	1250
Irkutsk			1300	
Ivanovo Voznesensk		**RA7**	800	1000
Kharkov		**RA43**	640	4000
"		**RA24**	475	4000
Kiev		**RA5**	775	1000
Kniepropetrovsk			560	1000
Krasnodar		**RA38**	513	1000
Leningrad		**RA6**	940	2000
"		**RA42**	1000	10000
Minsk		**RA18**	950	1250
Moscow	Sokolniki		1010	2000
"	Trade Union	KAZ	450	2000
"	Lubovitch		365	
"		MSK	650	2000
"	Union of Soviet Workers	RA4	675	500
"	Kominern	RDW—RAI	1450	40000
"	Radio-Peredatcha		420	2000
Niji-Novgorod		**RA13**	1400	1500
Novosibirsk		**RA33**	700	4000
Odessa		**RA40**	1000	1250
Rostov-on-Don		**RA14**	820	1250
Saratoff			700	1000
Sevastopol		**RA9**	800	1000
Stavropol		**RA20**	655	1250
Tashkent		**RA27**	800	4000
Tiflis			870	4000
Tver		RA44	965	1250
Ust-Syssolsk		REG	1000	1250
Veliky Ustjuk		**RA16**	1010	1250
Vladivostok		**RA17**	456	1250
Voronesh		**RA12**	950	1250
UNITED KINGDOM				
Aberdeen	British Broadcasting Co.	**2BD**	500	1500
Belfast	British Broadcasting Co.	2BE	306.1	1500
Birmingham	British Broadcasting Co.	**5IT**	326.1	1500
Bournemouth	British Broadcasting Co.	**6BM**	491.8	1500
Cardiff	British Broadcasting Co.	**5WA**	353	1500
Chelmsford	British Broadcasting Co.	**2BR**		
Daventry	British Broadcasting Co.	**5XX**	1604.3	5000-10000
Dundee	British Broadcasting Co.	**2DE**	288.5	200
Edinburgh	British Broadcasting Co.	**2EH**	294.1	200
Glasgow	British Broadcasting Co.	**5SC**	405.4	1500
Hull	British Broadcasting Co.	**6KH**	288.5	200
Leeds-Bradford	British Broadcasting Co.	**2LS**	277.8—254.2	200
Liverpool	British Broadcasting Co.	**6LV**	297	2000
London	British Broadcasting Co.	**2LO**	361.4	3000
Manchester	British Broadcasting Co.	**2ZY**	384.6	1500
Newcastle	British Broadcasting Co.	**5NO**	312.5	1500
Nottingham	British Broadcasting Co.	**5NG**	275.2	200

Countries and Cities	Owner	Call Letters	Wave Length (Meters)	Power Watts)
UNITED KINGDOM				
Plymouth	British Broadcasting Co.	**5PY**	400	200
Poldhu	British Broadcasting Co.	**2YT**		
Sheffield	British Broadcasting Co.	**6FL**	272.7	200
Stoke-on-Trent	British Broadcasting Co.	**6ST**	288.5	200
Swansea	British Broadcasting Co.	**5SX**	288.5	200
URUGUAY				
Montevideo	Radio Sudamericano	**CWOZ**	320	500
"		**CWOA**		1000
"	Diario "El Dia"	**CWOR**	350	500
"	Danree & Cia	**CWOF**	300	100
"	Templo Metodista	**CWOG**	280	10
"	Instituto Metereologico	**CWOB**	250	50
"	General Electric Co. of Uruguay	**CWOS**	380	500
VENEZUELA				
Caracas	Empresa Venezolana de Radiotelefonia	**AYRE**	375	1000
YUGOSLAVIA				2000
Belgrade	Cie. Generalle De T. S. F.	**HFF**	225.6	1000
Zagreb			310	1000



The Lynch Suppressor Circuit

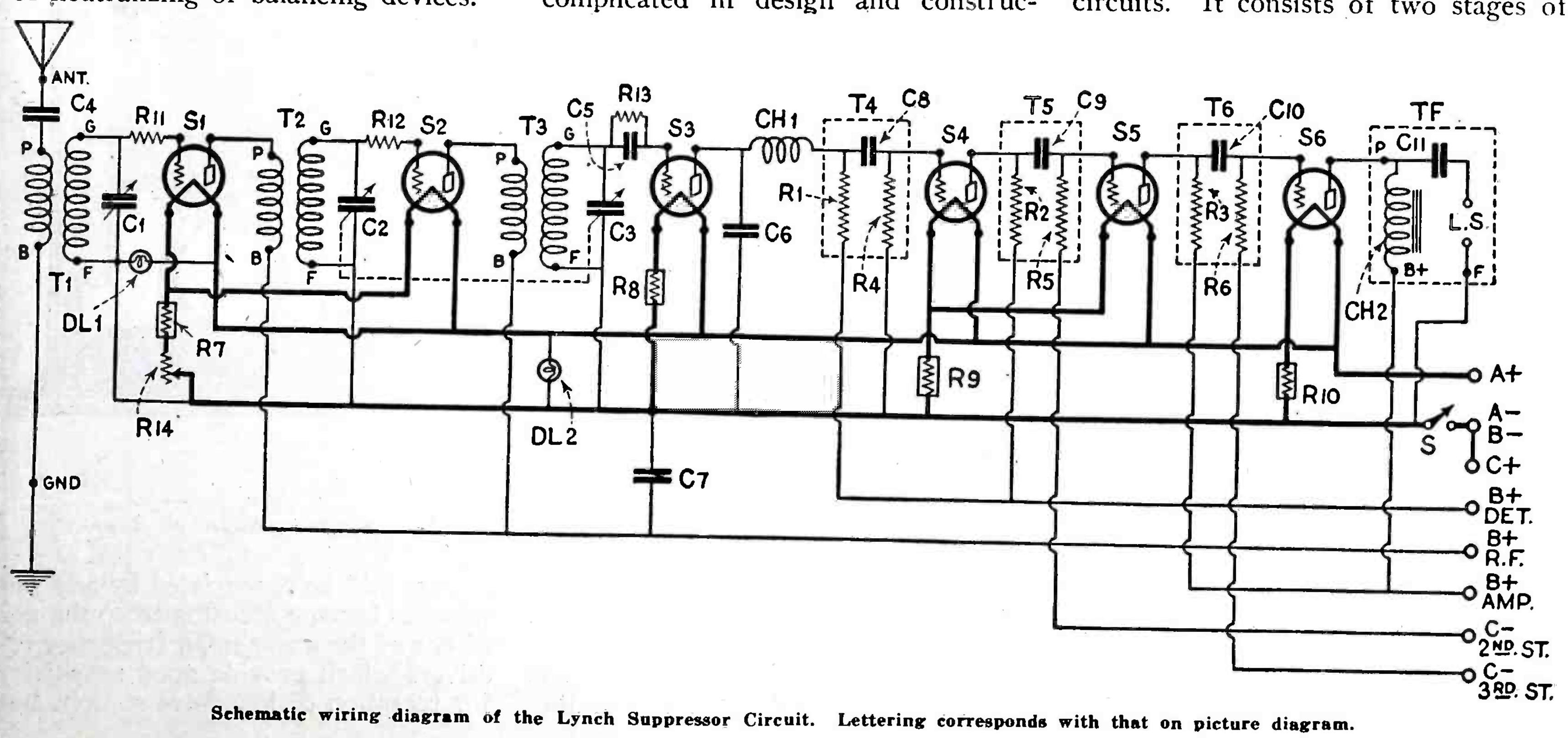
by Joseph Calcaterra



FOLLOWING the vogu of neutrodynes and other "dynes" which has prevailed for the past two years it is a decided relief to find that engineers have discovered other and far more simple means for providing efficient radio frequency amplification that is free from oscillation but at the same time involves no critical adjustments of neutralizing or balancing devices.

This should not be taken as a general denunciation of all neutralized or balanced circuits, because there can be no question about the high degree of efficiency of some of the receivers of these types that have been developed during the past year or so. It will be found, however, that practically without exception these good receivers are complicated in design and construction; involve the use of elaborate shielding and filtering systems; employ special bridge circuits; and on the whole present a difficult construction problem even for engineers and commercial manufacturers.

The Lynch suppressor circuit provides a welcome contrast to the complexities of these other radio frequency circuits. It consists of two stages of

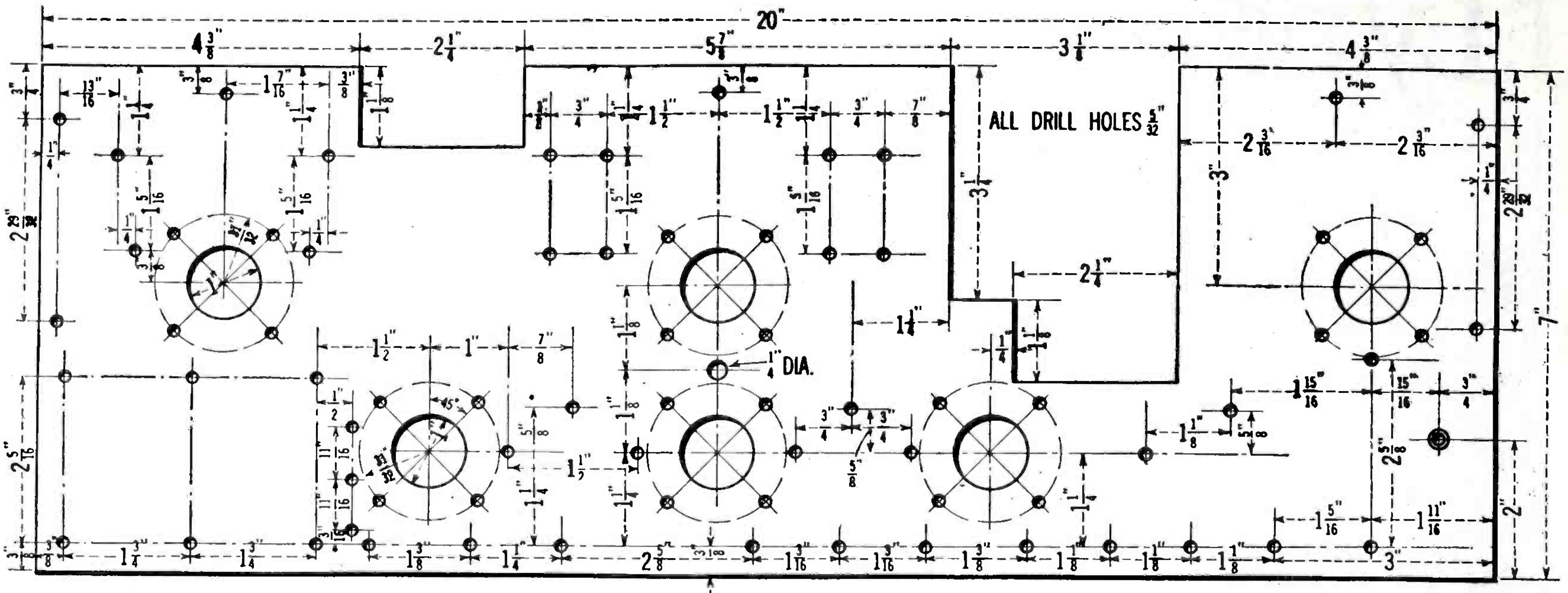


Schematic wiring diagram of the Lynch Suppressor Circuit. Lettering corresponds with that on picture diagram.

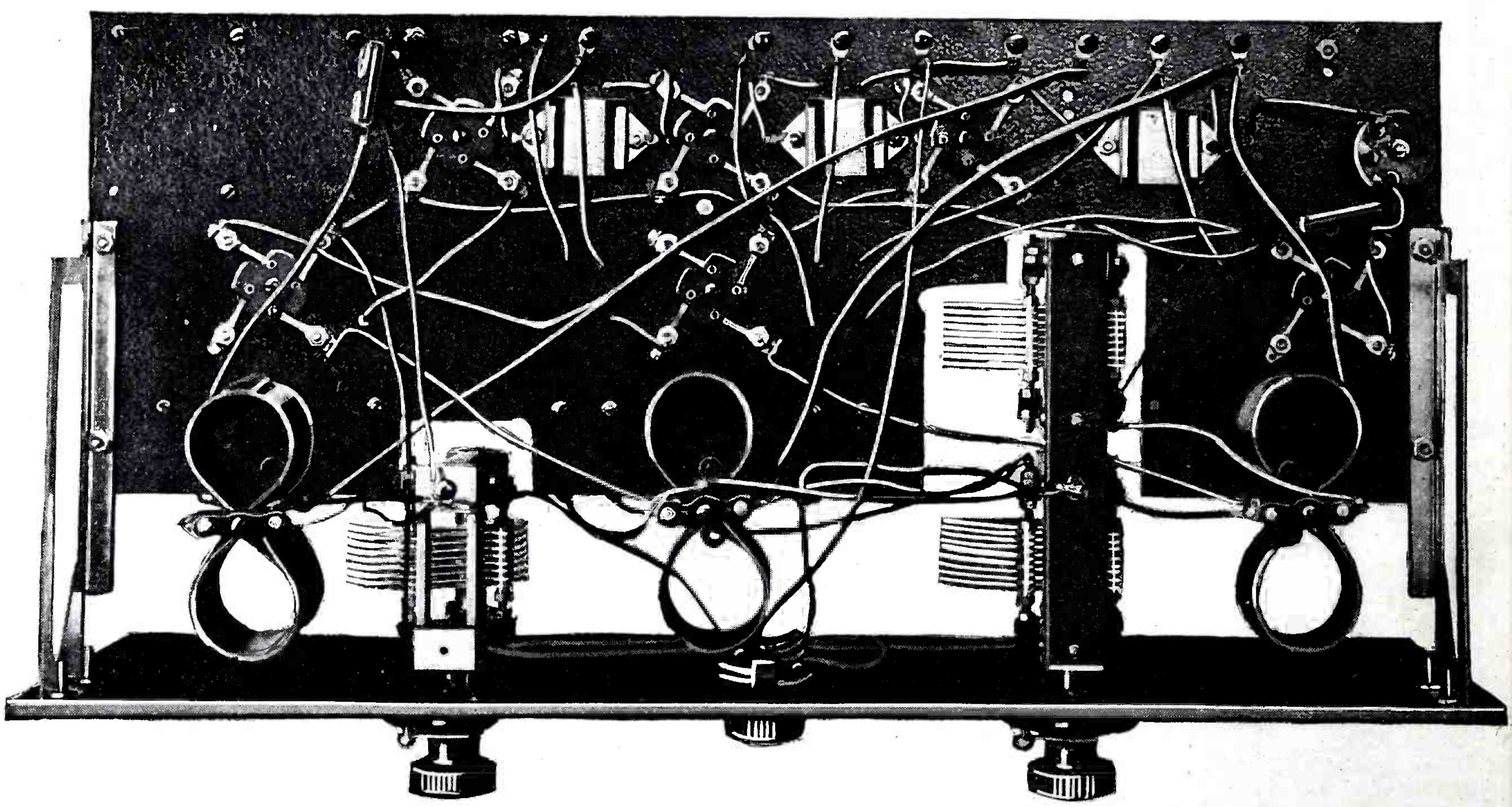
highly efficient, tuned radio frequency amplification, a detector and three stages of resistance-coupled audio frequency amplification. Every precaution has been taken in its design to obtain an extremely high degree of efficiency, combined with good volume and excellent tone quality; and all this with the minimum number of parts and the maximum simplicity of construction.

The required stability in the radio frequency amplifier is obtained through the use of a 700 ohm Lynch suppressor, R11 and R12, in the grid circuit of each of the two radio frequency amplifier tubes. At first glance this would seem to include this circuit in the "losser" class; that is, as a circuit which controls oscillation by reducing the efficiency to a point where oscillation cannot take place. Actually this is not the case. The function performed by these resistors is to prevent a flow of current in the grid circuits. If the resistances used for this purpose are of the correct values and are so constructed as to have an extremely low capacity there is no loss in the circuit except the loss of the undesirable current flow which causes the oscillation. By the more technical fan this will be understood when it is realized that when the flow of current is stopped by the use of a sufficiently high resistance there can be no voltage drop across the resistance itself, and in that case the full signal voltage is applied to the tube grid just as though the resistance were not in the circuit.

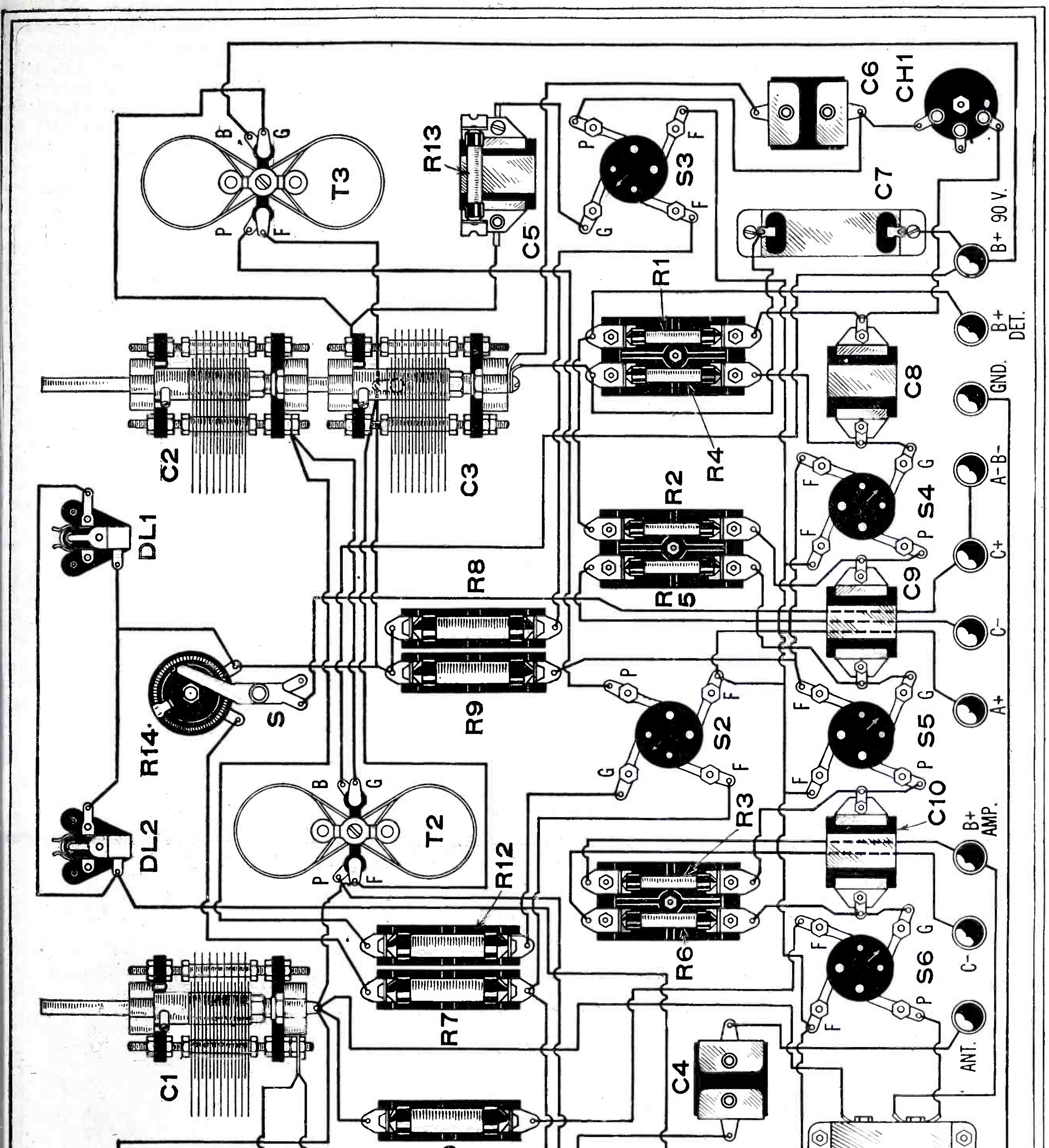
Another feature which marks the use of suppressors as an outstanding development is the fact that the radio-frequency amplification obtained is practically uniform throughout the entire waveband. This results from the fact that the radio frequency resistance of the suppressors (or of any resistance unit) automatically increases with the frequency. Therefore, on the lower wavelengths where there is a greater tendency toward oscillation the attendant increase in the radio frequency resistance of the suppressors still is adequate to prevent the current flow in the grid circuits. Thus at all frequencies the resistance is just enough to prevent oscillation. This feature will be appreciated by any fan who has become accustomed to the use of one of the many radio frequency receivers which provide good sensitivity for reception of low wave stations but



Dimensions for cutting out and drilling the sub-panel.



How the set appears from the underside of the sub-panel. All wiring is made with Celatsite flexible hook-up wire in the fashion shown.


T3
R13
C5
S3
C6
CH1
C7
B+ 90 V.
R1
R4
B+ DET.
GND.
C8
A-B-
S4
R2
R5
C+
C9
C-
C2
C3
DL1
R8
R9
S
R14
S2
S5
A+
T2
DL2
R12
R3
R6
C10
B+ AMP.
S6
C-
ANT.
C1
R7
R10
C4
T1
S1
TF
R11

will scarcely bring in any stations up around five hundred meters.

The coils used in the radio frequency stages, T1, T2 and T3, are the Bodine "Twin Eight" matched radio frequency transformers. These coils, which are of the double-barrel type, have the advantage that they reduce the undesirable interstage coupling and are less inclined to direct pick-up than are coils of the solenoid type. The latter feature increases the selectivity of the receiver, particularly in cutting out powerful, nearby stations.

These coils are tuned by means of the three variable condensers, C1, C2 and C3. In order to reduce the number of tuning controls to two in number, condensers C2 and C3 are mounted on a single shaft. The vernier tuning controls are provided with pilot lights DL1 and DL2 which serve the double purpose of showing when the receiver is turned "on," and also of illuminating the tuning scales so that tuning may be readily accomplished, even in a darkened room.

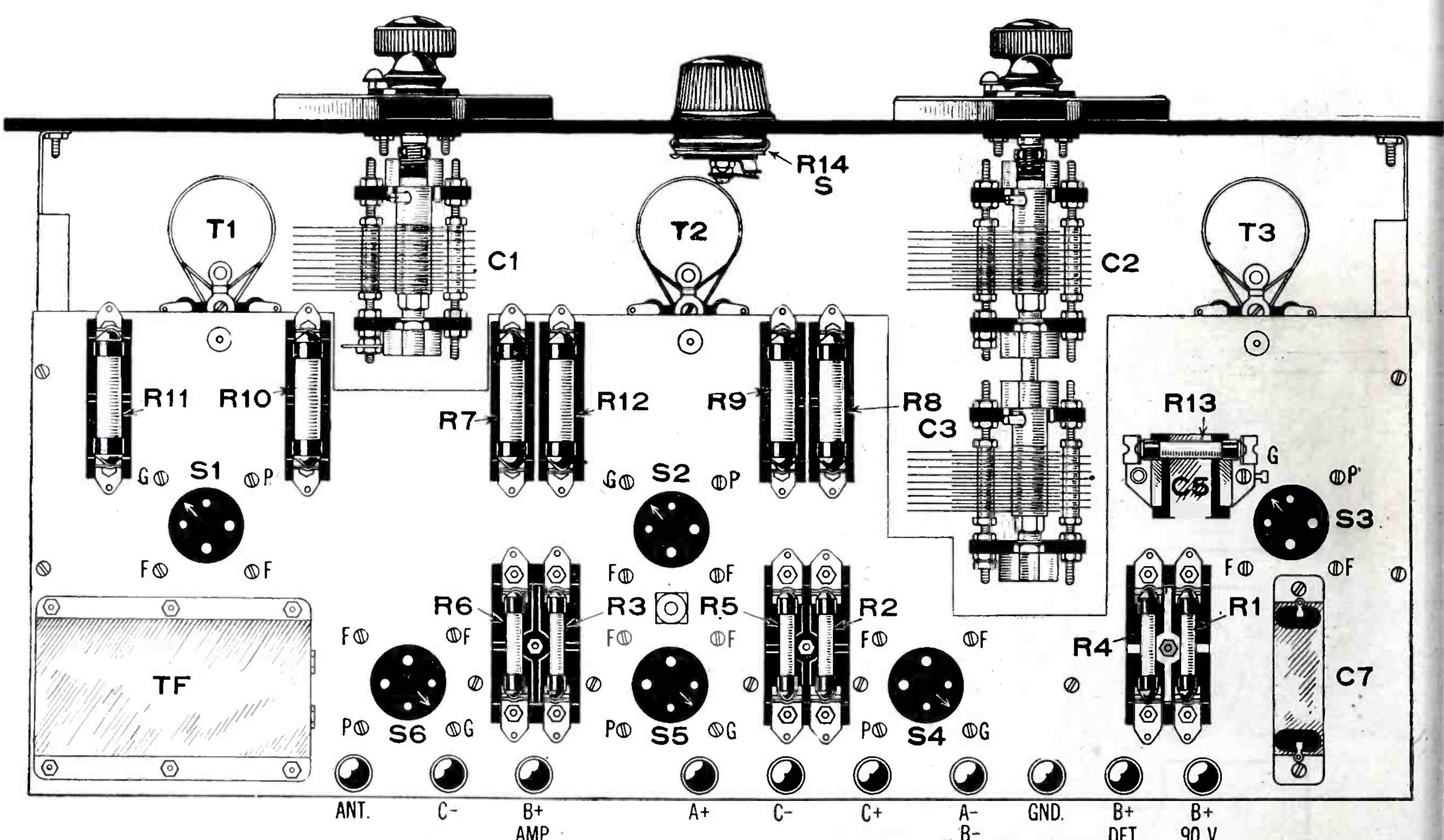
The detector circuit makes use of a standard grid leak and condenser, and employs a 300 A type tube. With this arrangement the maximum sensitivity is obtained and at the same time the fine quality is maintained. This latter is partially accounted for by the use of a radio frequency filter, consisting of the radio frequency choke CH1 and the fixed condenser C6. This choke serves to block the passage of the radio frequency current in the detector output and the condenser by-passes this current back to the filament circuit. Thus the radio frequency currents are kept out of the audio frequency circuits where they would be highly undesirable. The large by-pass condenser C7 is used to by-pass the radio frequency currents around the "B" batteries.

The three stages of resistance-coupled audio frequency amplification provide reproduction of highest quality and more than ample volume for ordinary home use. The new type 340 high mu tubes are used in the first and second stages. It is the use of these tubes, with coupling condensers and resistances of the highest quality that accounts for the superior results obtained from this amplifier. The high voltage amplification obtained with the high mu tubes provides a degree of amplification per stage that compares favorably with the volume of amplification obtained with any other coupling means, and the quality obtained is exceptional.

Experiment has shown that best results are obtained with this amplifier if the plate resistances R1, R2 and R3

LIST OF PARTS REQUIRED FOR LYNCH SUPPRESSOR SET

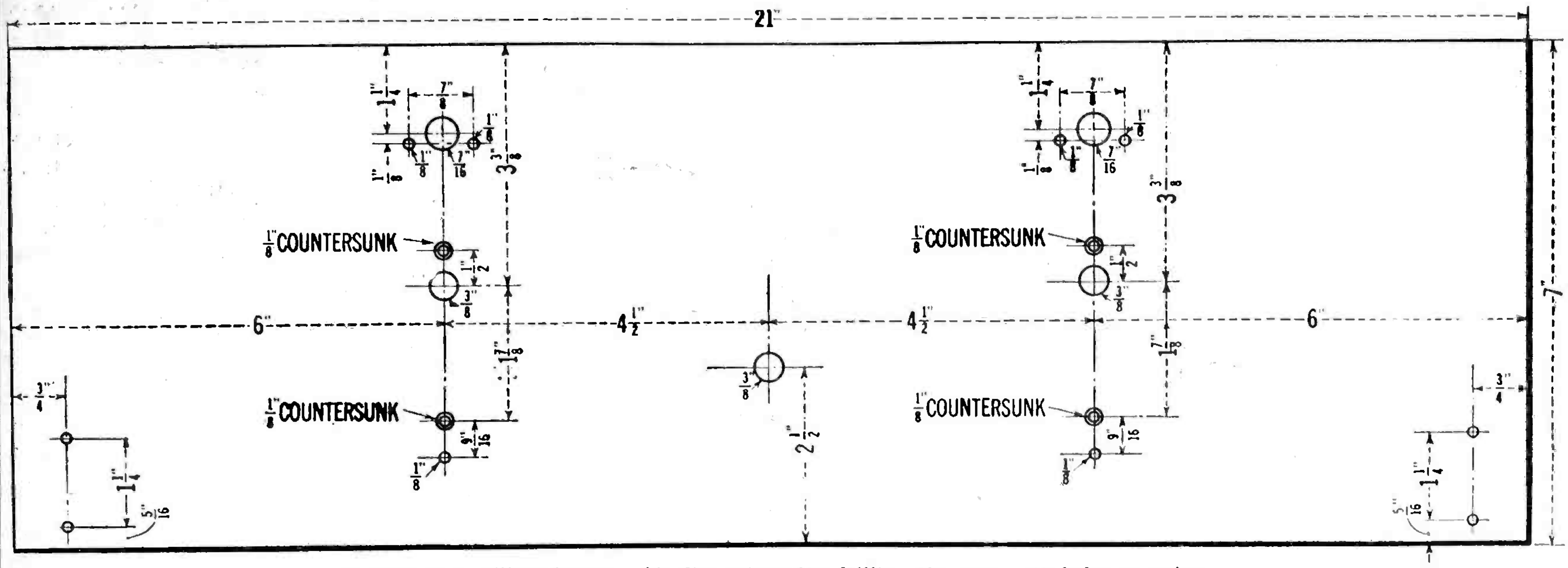
- One 7" x 21" x 3/16" Formica panel
- One 7" x 20" x 3/16" Formica sub-panel
- Two Benjamin No. 8629 subpanel brackets
- One set Bodine matched "Twin Eight" R. F. transformers; T1, T2 and T3
- One National .00035 mfd. Equitune variable condenser, C1; with illuminated dial, DL1.
- Two National .00035 mfd. Equitune variable condensers, C2 and C3; with illuminated dial DL2, gauged together with a strip of Formica fastened to their bases and a brass rod through both shafts.
- Six Benjamin No. 9044 sockets; S1, S2, S3, S4, S5, and S6
- Three Lynch double resistor mountings; T4, T5 and T6
- Three Lynch .25 megohm metallized resistors; R1, R2 and R3
- Three Lynch 2 megohm metallized resistors; R4. R5 and R6
- Three Lynch type 2 equalizors; R7, R9 and R10
- One Lynch type 4 equalizor; R8
- Two Lynch 700-ohm Grid Suppressors; R11 and R12
- One Lynch 2-megohm Metallized resistor; R13
- One Carter M-S-6, combination 6-ohm midget rheostat and battery switch; R14, S
- One National tone filter; TF (includes CH2 and C11)
- Two Dubilier, type 601, .0005 mfd. fixed condensers; C4, C6
- One Dubilier, type 640-G, .00025 mfd. grid condenser; C5
- One Dubilier, type 907, 1 mfd.. fixed condenser; C7
- Three Dubilier, type 640, .006 mfd. fixed condensers; C8, C9 and C10
- One Silver-Marshall R. F. choke coil; CH1
- Ten X-L Radio Labs. aluminum binding posts with suitable markers.
- One package Kester radio solder.
- 25 feet Acme Celatsite hook-up wire
- Two 301-A type tubes
- One 300-A type detector tube
- Two 340 type high Mu tubes
- One 371 or 112 type power tube



Layout of parts on the front and sub-panel. This layout can be easily followed by comparing the component parts with those as indicated in the picture diagram.

are of .25 megohm each; and the grid resistances R4, R5 and R6 are each of 2 megohm resistance. The coupling condensers C8, C9 and C10 are Dubilier mica condensers of .006 microfarad capacity. The use of such comparatively low capacity is made permissible by the use of the high mu tubes and represents a decided adantage in the matter of cost.

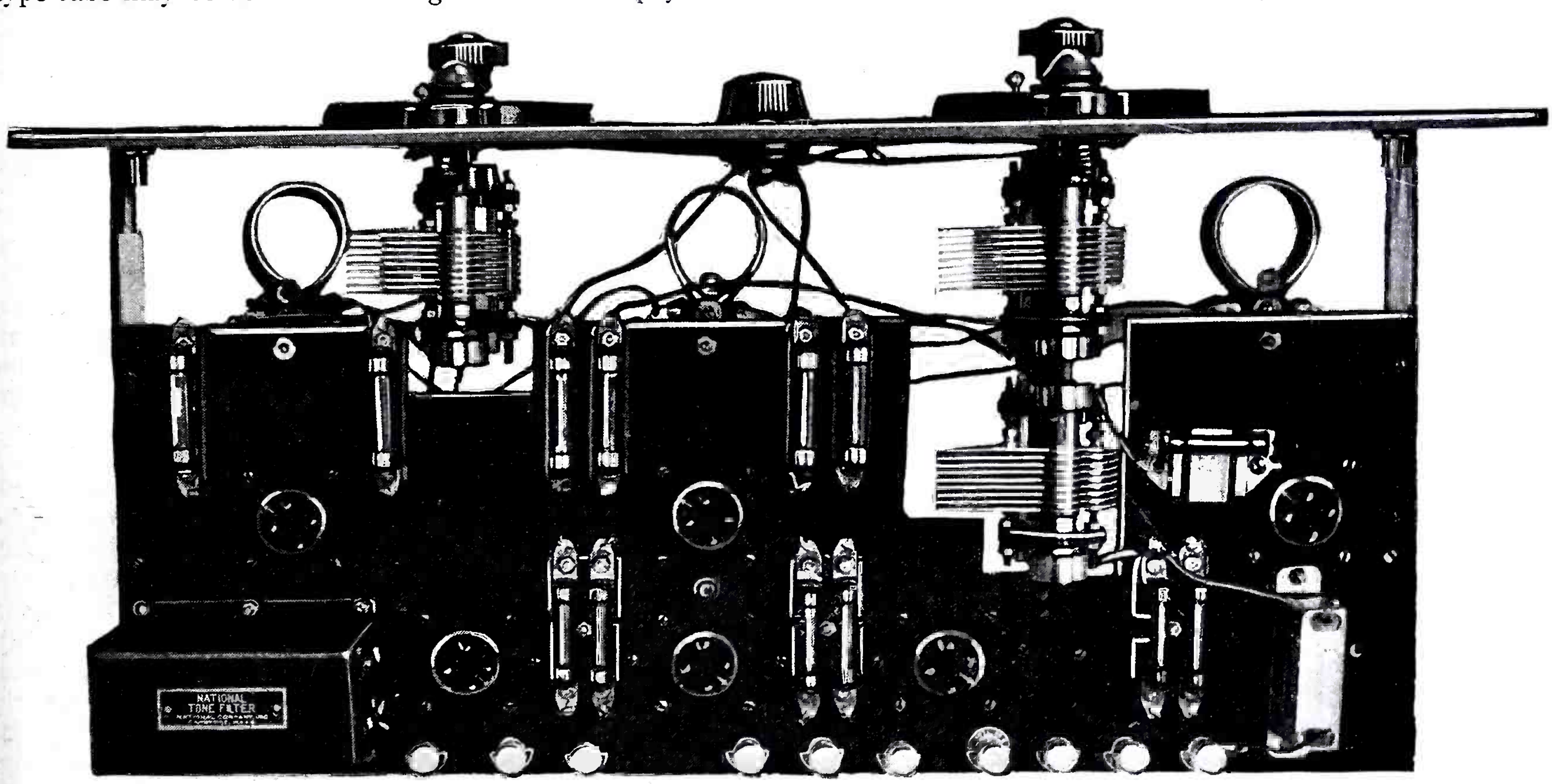
The last audio stage should be a power stage, using a 371 type tube in socket S6. If it is desired to use lower "B" voltages, however, a 112 type tube may be used to advantage in this stage. When more than 135 volts of "B" battery is to be used an output filter device should be used in the plate circuit of the last audio tube. In this receiver the National Tone filter is used and is shown as TF in the diagram. This filter consists of the choke coil, CH2, and the filter condenser, C11. The purpose of this device is to prevent the heavy direct current from the batteries from passing through the windings of the loudspeaker. Thus the speaker is protected from magnet depolarization, distortion and burnout.



Front panel drilling layout. All dimensions for drilling the necessary holes are given.

The output circuit should be arranged as shown in the diagram. To connect it in this way it is necessary to break the wire connection between the "B" and "F" terminals of the tone filter. No jacks or binding posts are provided in the receiver for the loudspeaker. Instead, its tips are inserted in the tip jacks which are included in the tone filter and are designated as "LS" and "F" on the outside of the filter case.

The "C" bias on the second and third audio stages must be determined by the amount of "B" battery voltage used and the type of tube used in the last audio stage. The bias on the 2nd stage will lie between 0 and 3 volts. This voltage is to be used where the "B" voltage is around 135. Where the "B" voltage is around 180 then the "C" voltage should be from 1½ to 3 volts. The "C" voltage on the last tube can best be determined by the tone quality of reproduction, and from the instructions which come with the power tube. It might be added that the "C" voltage on the last tube is not particularly critical but the higher the "C" voltage, the lower the current drain on the "B" batteries. The "C" voltage on the 2nd audio tube is critical. So much so that 1½ to 3 volts more than the voltages specified above will render the receiver inoperative.



A photographic view of the set looking down on the sub-panel.

The receiver is intended for use with a six volt storage battery or its equivalent, as the supply source for the filament lighting voltage. This voltage is reduced to the individual requirements of the tubes through the use of suitable

(*Continued on page* 154)

The AERO-SEVEN BROADCAST RECEIVER

by *Zeh Bouck*

A GENERAL consensus sums up the characteristics of the ideal broadcast receiver, with logic and justice, as follows: First of all the number of tuning dials should be limited to unity. A single dial receiver is certainly most easily tuned, a simplicity that reflects the fact that radio has been graduated from the laboratory stage and has now become an instrument of pleasure, to be operated by the casual pass of the hand from an easy chair. Selectivity should be perfect. That is, it should tune neither too sharply nor too broadly. Either variation from the optimum is most undesirable. If a station tunes too broadly, interference will be experienced. One local station will often interfere with another, not to mention the impossibility of tuning through locals for distance when the lure of many miles impels. If a receiver tunes too sharply, side bands, frequencies which constitute the higher audio notes, will be cut off, with resulting distortion. The receiver is then said to have a high cut off. The effect is similar to certain types of poor audio amplifying transformers. The tone is drummy—muffled. It should be possible to control the selectivity of the receiver, from a comparatively insensitive state to the point where it readily detects relatively small impulses. In other words the volume control should be confined to the radio frequency circuit. If a receiver operates at all times at maximum sensitivity, the noise level will always be at its highest point, regardless of whether distant or local stations are being received. The extreme sensitivity required for the reception of DX necessarily sensitizes the receiver to extraneous and stray waves. Such sensitivity is quite unnecessary on local stations, where, aside from introducing disturbing noises, it generally results in overloading various tubes with resulting loss in quality.

LIST OF PARTS FOR THE AERO-SEVEN

- 1 Aero-Seven Foundation Unit
- 1 Aero Choke Coil No. 60
- 1 Aero Kit of Coils U-12
- 1 Silver-Marshall Drum Dial
- 1 Carter "Imp" Battery Switch
- 1 Carter "Imp" 200-Ohm Potentiometer
- 1 Carter "Imp" 6-Ohm Rheostat
- 1 Carter H-1000 Resistor
- 1 Carter H-1 Resistor
- 1 Carter .00025 Mfd. Condenser
- 1 Carter .001 Mfd. Condenser
- 2 Carter one-half mfd. by-pass condensers
- 10 X-L Binding Posts, lettered—aerial ground, "A" battery plus, "A" battery minus, 2 "C" batteries minus, "B"+ 90 volts, speaker positive, speaker minus, amplifier B +.
- 1 Amsco Floating Socket
- 6 Amsco Plain sockets
- 1 Amsco .0005 Mfd. Triplet Condenser, No. 1526
- 1 Amsco Grid-Gate Mounting
- 1 Amsco 5 Meg. Grid-Gate
- 1 Amsco Resistance coupled audio kit
- Excello Console, Style R-31

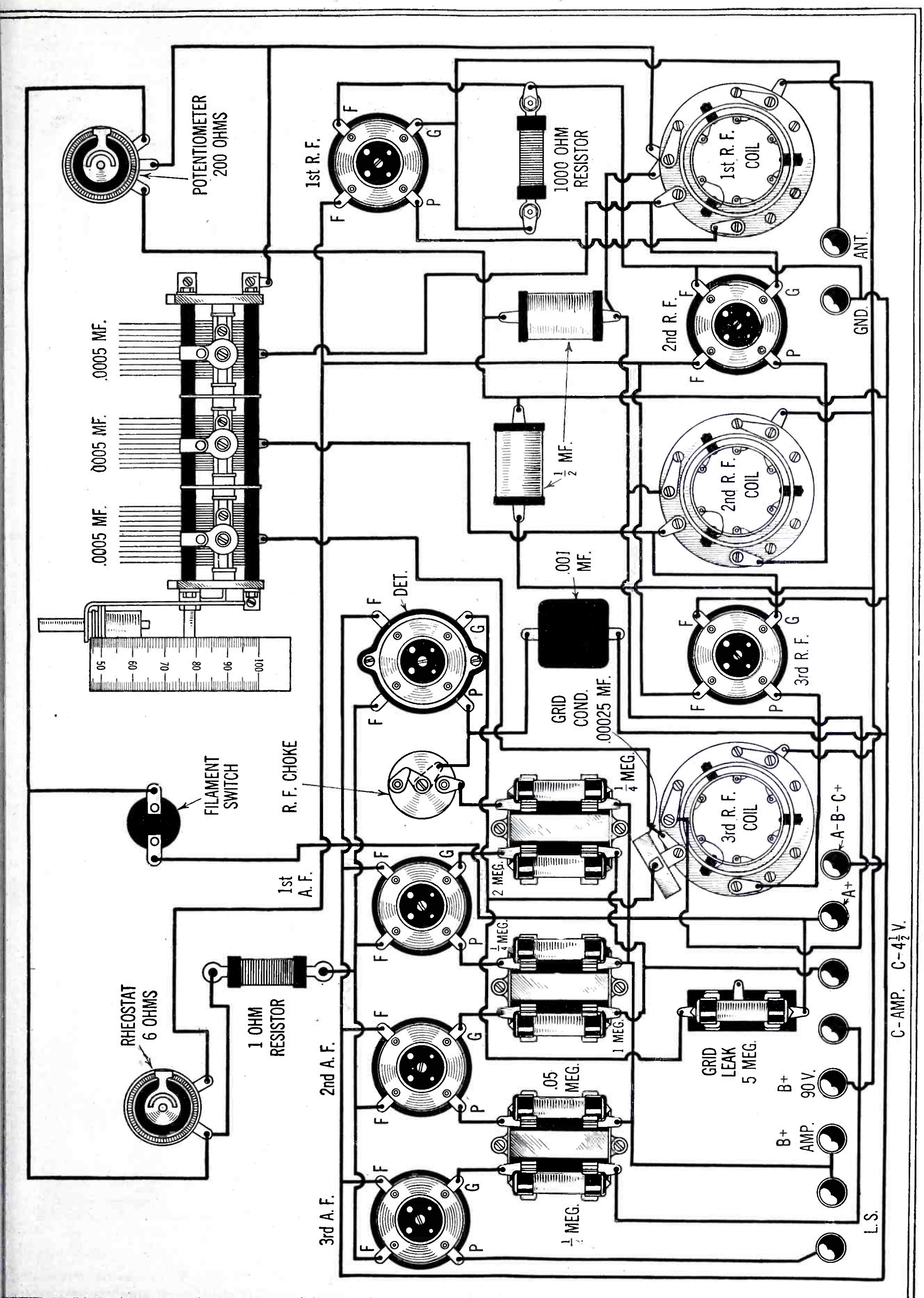
The volume or sensitivity control also should effect the desired control without broadening tuning to more than a negligible degree.

Assuming these various approaches to perfection in the radio frequency section of the receiver, an audio amplifier of comparable worth is essential to justify the electrical efficiency achieved.

The Aero-Seven

To call the Aero-Seven "just another circuit" would do this receiver a gross injustice. As a matter of fact it is not another circuit. It is a combination of well known circuits so modified that its action conforms very closely to the requirements for the ideal receiver outlined above.

Single dial control, of several r.f. circuits, is achieved by well designed tandem tuning. The problem of simultaneous tuning has always been the alignment of the various circuits. For successful tandem tuning the inductive values and the capacitative values in each circuit must be accurately matched at all frequencies. It has been very difficult to do this for two reasons. It is a painstaking and highly scientific task to match all coils and condenser sections. Even with these elements carefully checked the capacitative and inductive effects of the proximity of parts and wiring introduce perplexing discrepancies. Also, the antenna coupling to the first r.f. tube often renders the tuning line of the first circuit inconsistent with that of succeeding circuits—an inconsistency which varies with the electrical characteristics of antennas.


POTENTIOMETER 200 OHMS
1st R. F.
F
G
P
F
1000 OHM RESISTOR
1st R. F. COIL
ANT.
2nd R. F.
GND.
.0005 MF.
.0005 MF.
.0005 MF.
1 MF.
½ MF.
2nd R. F. COIL
.001 MF.
3rd R. F.
DET.
GRID COND. .00025 MF.
FILAMENT SWITCH
R. F. CHOKE
¼ MEG.
3rd R. F. COIL
A-B-C+
1st A. F.
2 MEG.
A+
¼ MEG.
C-AMP. C-4½ V.
RHEOSTAT 6 OHMS
1 OHM RESISTOR
1 MEG.
GRID LEAK 5 MEG.
2nd A. F.
.05 MEG.
B+ 90 V.
B+ AMP.
3rd A. F.
½ MEG.
L.S.

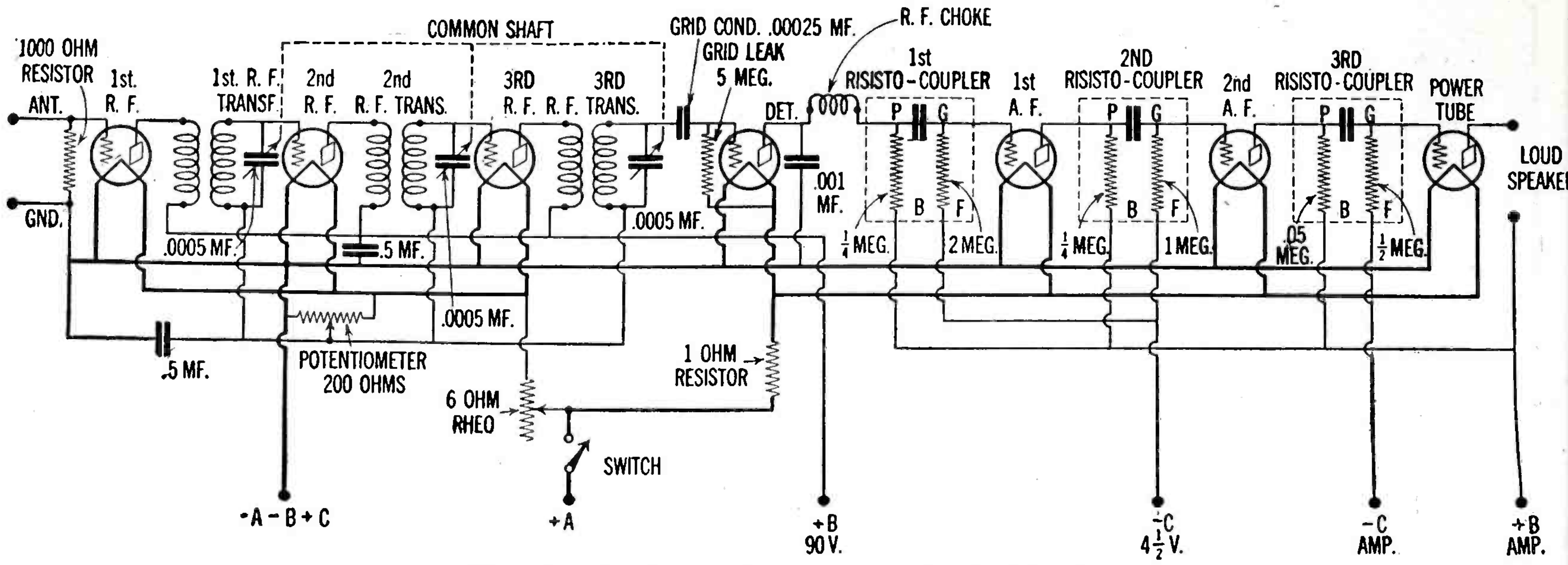
Matching of Coils and Condensers

The Aero coils are matched with a satisfactory degree of precision, im-

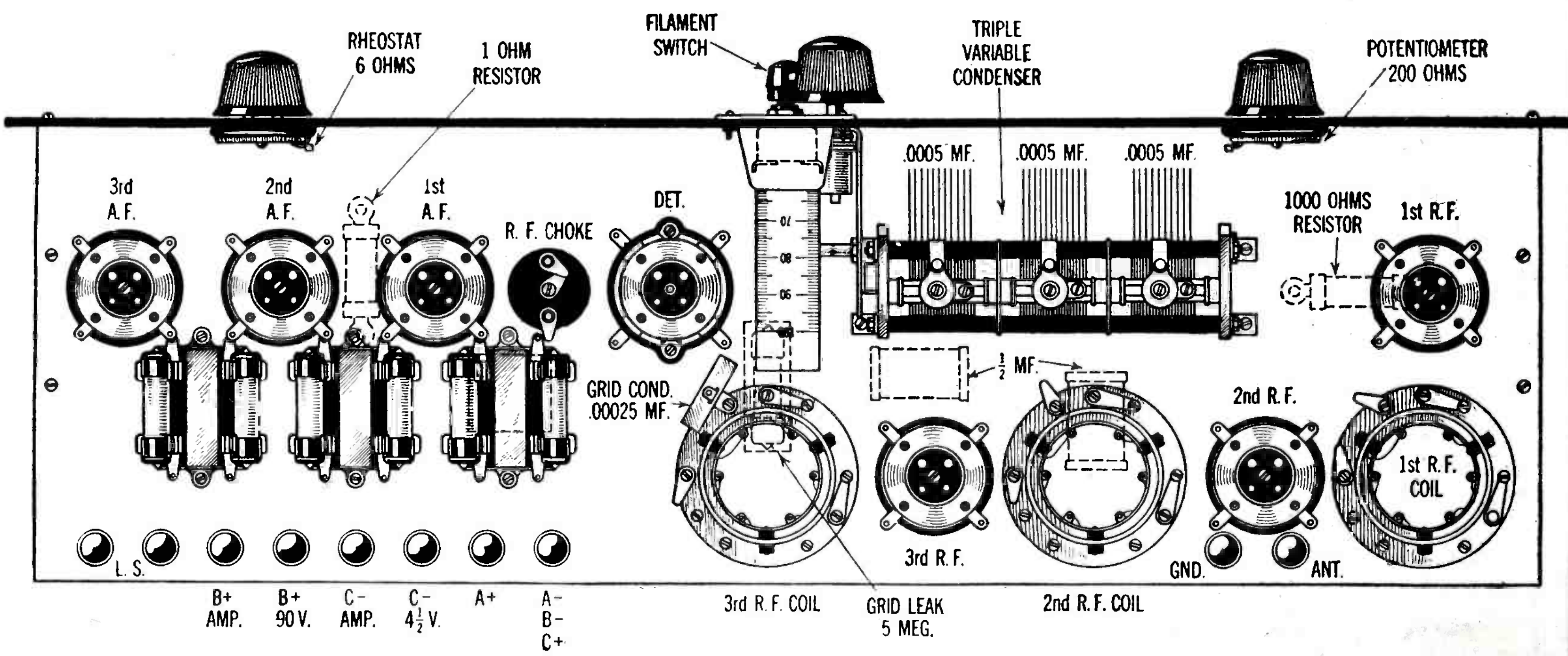
section of this condenser is equipped with a small equalizing or compensating capacity which can be varied to compensate stray circuit capacities. Stray inductive effects are matched by

the picture layout followed in every detail.)

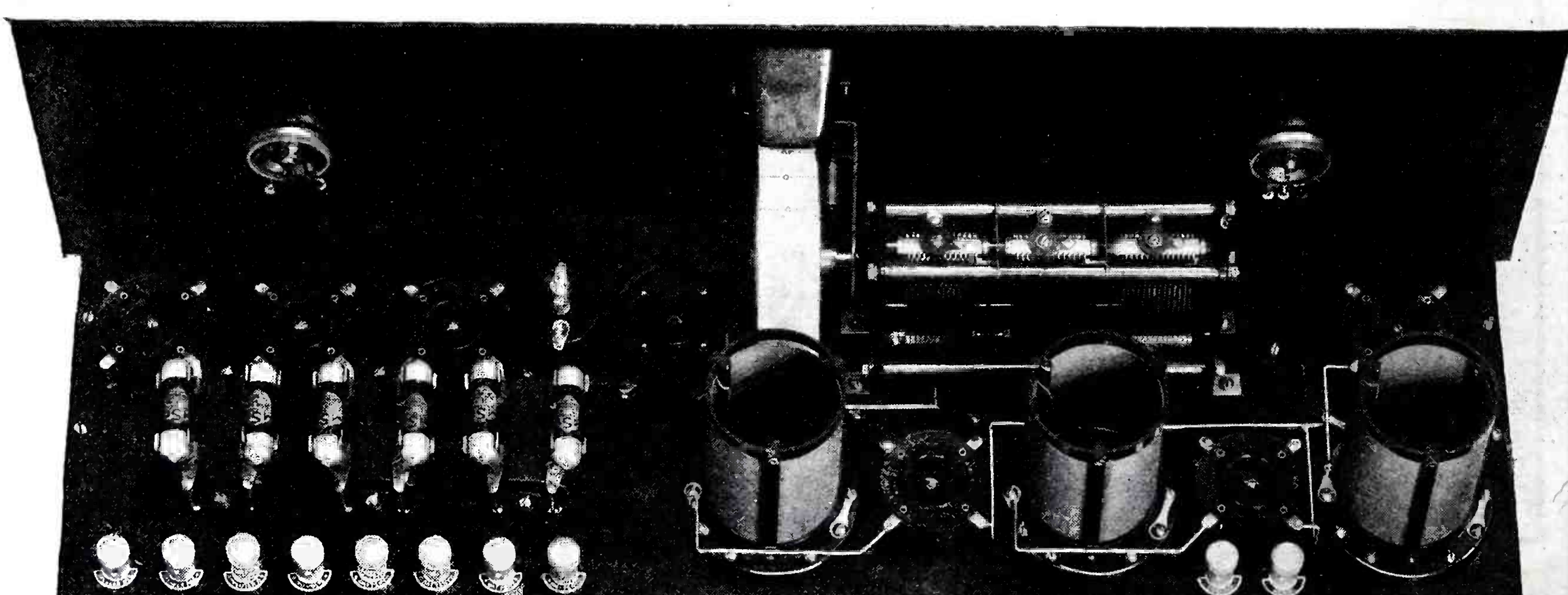
The effect of the antenna circuit on the first tuned circuit is eliminated in the Aero-7, by coupling the antenna to



Schematic wiring diagram of the Aero-Seven Broadcast Receiver.



Layout of parts as they are mounted on the sub-panel.



A photographic view of the Aero-Seven Broadcast Receiver seen from the rear of the set.

mediately eliminating a possible factor for failure. The same may be said of the Amsco Triplet condenser. Each

careful layout and design of wiring. (It is therefore important that drilled panels be secured for this receiver, and

the first tube by means of a resistance connected between antenna and ground as shown in the schematic diagram.

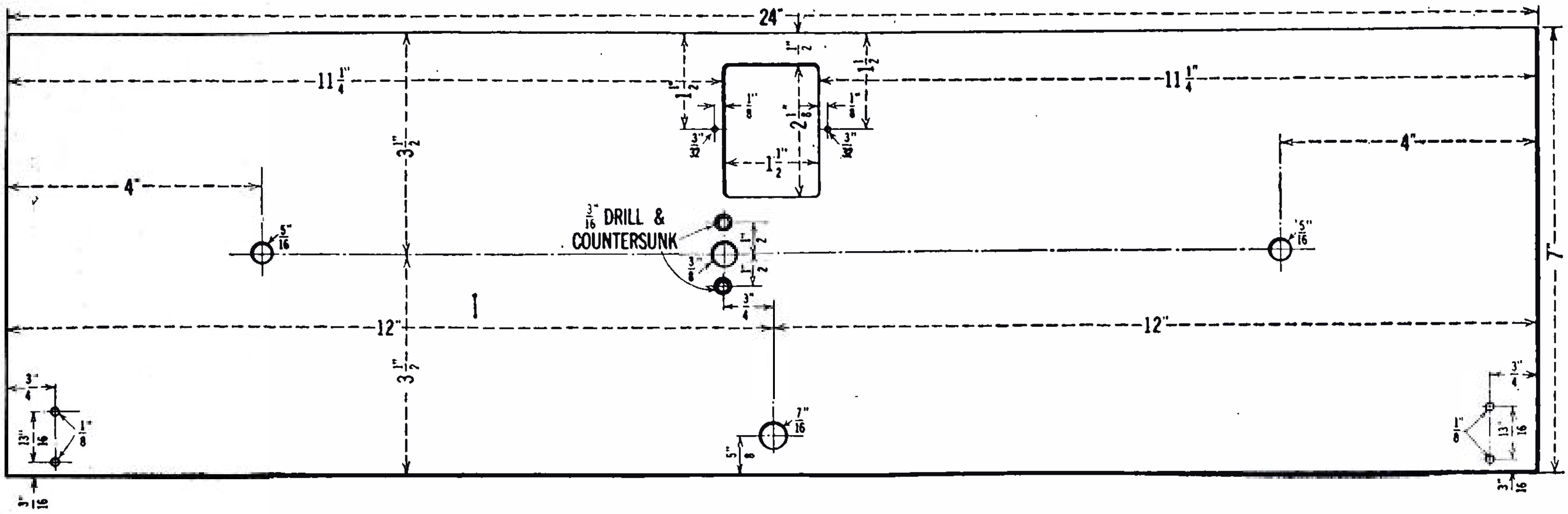
The first r.f. tube therefore acts as an untuned radio frequency amplifier.

The optimum value of selectivity has been attained in this receiver. The circuits cover, over a wide range of wavelengths, a frequency band closely approximating ten kilocycles—five kilocycles on each side of the fundamental frequency. This condition is achieved through careful coil design in combination with an efficient gain or sensitivity control.

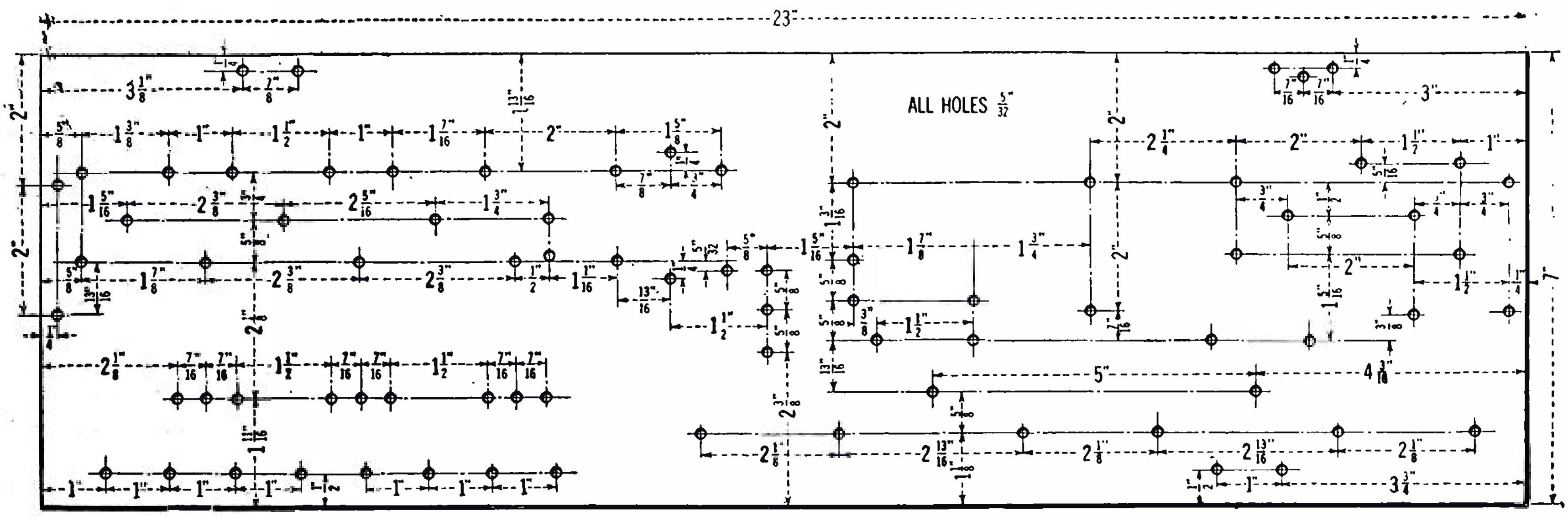
Extreme sensitivity can be obtained with this receiver. The coils are characterized by low radio frequency resistances (genuinely scientific low loss construction) which results in a high amplification factor. Also, the design of the coils is such that there exists little inter-stage coupling. Amplification therefore approaches a true cascade effect, with high amplification and a thoroughly satisfactory degree of selectivity.

The potentiometer volume control is not included in the tuned oscillatory circuits. It therefore has no effect on the damping of these circuits with resulting broadening of tuning. Whatever broadening exists is due to reduced regeneration, but never exceeds a highly satisfactory tuning characteristic.

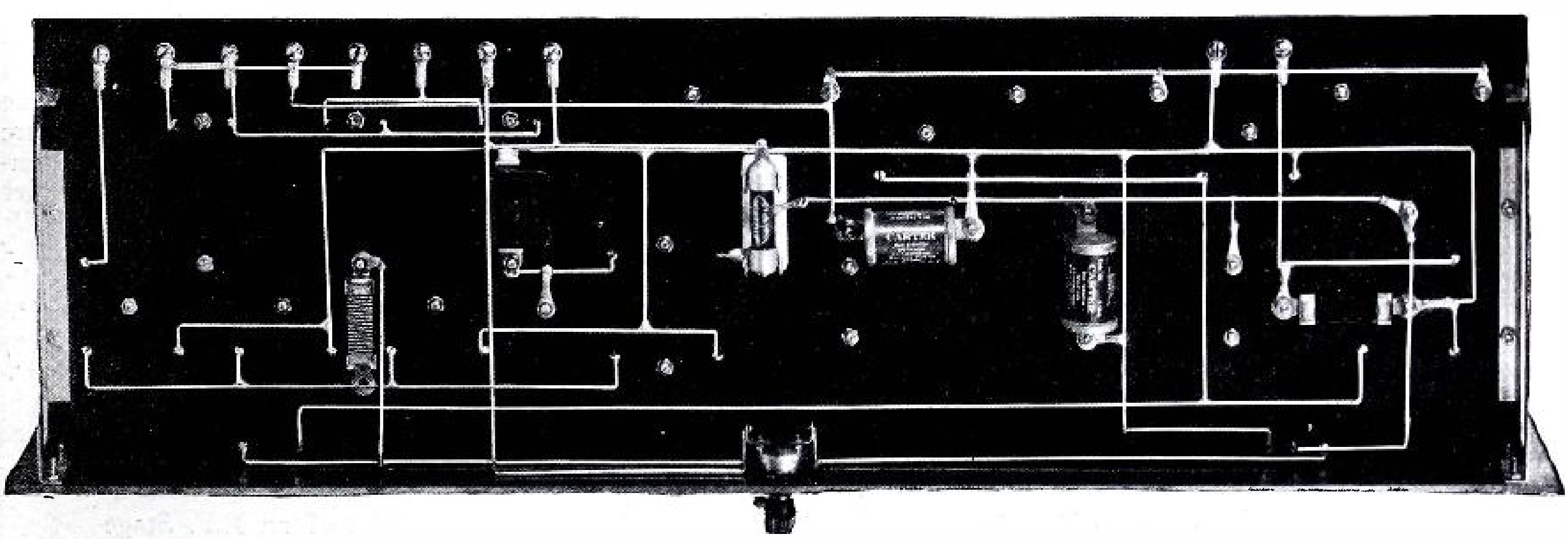
(*Continued on page* 140)



Dimensions for drilling the front panel.



All dimensions for drilling holes in the sub-panel are given in the layout directly above.



A view of the set beneath the sub-panel showing parts and wiring.

How to Build The STROBODYNE

By Lucien Chrétien

The Strobodyne receiver described in the following article has been built with standard American parts in order that the American radio public can take advantage of this remarkably efficient receiver which has been proclaimed as one of the season's greatest sets. The circuit embodied in the Strobodyne is borrowed from the principle of optical illusion created by means of the Stroboscope.

Mr. R. E. Lacault, widely known Super-Heterodyne expert and deisgner of the Ultradyne receiver, has undertaken the work of adapting this novel and interesting circuit to American standards under the auspices of Radio News *Magazine, by whose permission the following article is republished.*—Editor.

When I designed the Strobodyne circuit, I might have announced it as a revolution in radio. I am aware of the fact, however, that this has been done so many times before that I might better desist.

I would much rather leave any extravagant claims to my American radio confrères, who no doubt will find enough adjectives themselves after they have built the Strobodyne for their own use.

There is only one point on which I admit that I am puzzled. What claims can be made for the Strobodyne? How can I make myself understood and prove to you that this new circuit is not merely a new adaptation of an old system? This, as we are all aware, has been done many times, too, and the radio builder has become pretty much discouraged for that reason.

I should, therefore, much rather say that the Strobodyne is not a revolution, but, to be more exact, an evolution. Perhaps I may be pardoned for saying that the Strobodyne will prove to be a *revelation.*

However, better to permit the readers to judge for themselves. The constructional data of the Strobodyne are given in the following article, and radio enthusiasts will be able to form their own opinions; even though I do not call it "The King of the Ether," or the "Emperor of the Waves."

Distance with Selectivity

It may be well to mention the results obtained with this receiver, which any reader should be able to duplicate. Thus, for instance, the short-wave transmission of WGY at Schenectady was picked up (in Paris) on the loud speaker in the middle of the evening, and I mean by this that the reception was such that we heard it over a room of average size. Other stations in all parts of Europe were received with much better volume. (With the American-built set described in this article, stations over a radius of fifteen hundred miles were picked up *in the heart of New York City* with excellent volume and no trouble at all from interference.) Stations come in at but one point of the dials, if the dials are turned together. However, if the tuner dial is left fixed and the oscillator condenser varied, then the other beat note will be heard. Also, if the stations produce harmonics, these can not be eliminated.

We have tried, and succeeded, in incorporating in this Strobodyne the following characteristics:

An Ambitious Program

(1) The set has been designed to use the smallest possible energy-collecting device, *i. e.,* the loop antenna; and with the set used in Paris a loop one foot square was employed. (However, the set described in this issue has been designed for use with an outdoor antenna, and the results mentioned above were obtained while using this type of collector.)

(2) I have tried to obtain the greatest possible selectivity in order to receive, in districts where there are a number of broadcast stations, the maximum number of distant broadcasters with a minimum of interference.

(3) I have endeavored to obtain the best quality of reproduction which is possible with the available apparatus on the market.

(4) The receiver has been designed to have as much "reserve power" as possible, in order to overcome partially the fading of distant stations. This, of course, is of great advantage.

It is easy to describe these conditions, but it is an entirely different matter to obtain them. It should be noted that some of these conditions are antagonistic. For instance, a very sensitive receiver is generally not selective and a very selective receiver generally causes distortion. Since we are not limited in the number of tubes to be used, we can overcome these apparent contradictions in the results. It is entirely possible to obtain sensitivity together with selectivity, if enough stages of radio-frequency amplification are used.

Use of an R.F. Stage

When designing the set the question arose, whether radio-frequency amplification should be used ahead of the frequency-changer. In previous experiments with a standard super-heterodyne receiver it had been found that amplification of this type aided reception to a very great extent. For example, while I was listening to Berne (Switzerland) on a small loop, the fading was very pronounced and the local (Paris) station PTT was heard in the background. When a stage of radio-frequency amplification was placed ahead of the super-heterodyne, the fading was not so noticeable and the interfering station was entirely cut out, which seems to indicate a gain in both amplification and selectivity. Of course, this requires one more tube and another control to adjust. However, since the input circuit and radio-frequency unit are tuned to the same wavelength, they can be controlled by a tandem variable condenser, as in the set here described.

It is of advantage to use three stages of intermediate-frequency (long-wave) amplification. Although the third stage does not produce much amplification, it provides the reserve of power mentioned before. In practice a third stage may be eliminated if one wishes to eliminate a tube; but it will be found very advantageous to use three stages in order to secure the best results. If it is desirable to reduce the number of tubes, it is better to cut out one of the stages of the intermediate-frequency amplifier, rather than the R.F. before the frequency-changer.

Grid-Bias Control

The intermediate-frequency stages are controlled by a potentiometer, the value of the latter being in the neighborhood of four or five hundred ohms. This value is not critical and affects only the amount of "A" battery current flowing through the potentiometer winding. This instrument is used to vary the grid potential of the tubes and to bring them near the point of oscillation, where they are most sensitive.

Before adopting transformer-coupling in the A.F. system, I hesitated between resistance and transformer coupling. The former has the advantage that, if all the proper precautions are taken, an approximately straight-line amplification curve can be obtained. However, in resistance coupling three tubes are required to give the same volume that can be obtained with two tubes when transformers are used. Transformer coupling was therefore decided upon, as excellent quality may be had with a good make of transformer; besides we can eliminate a tube.

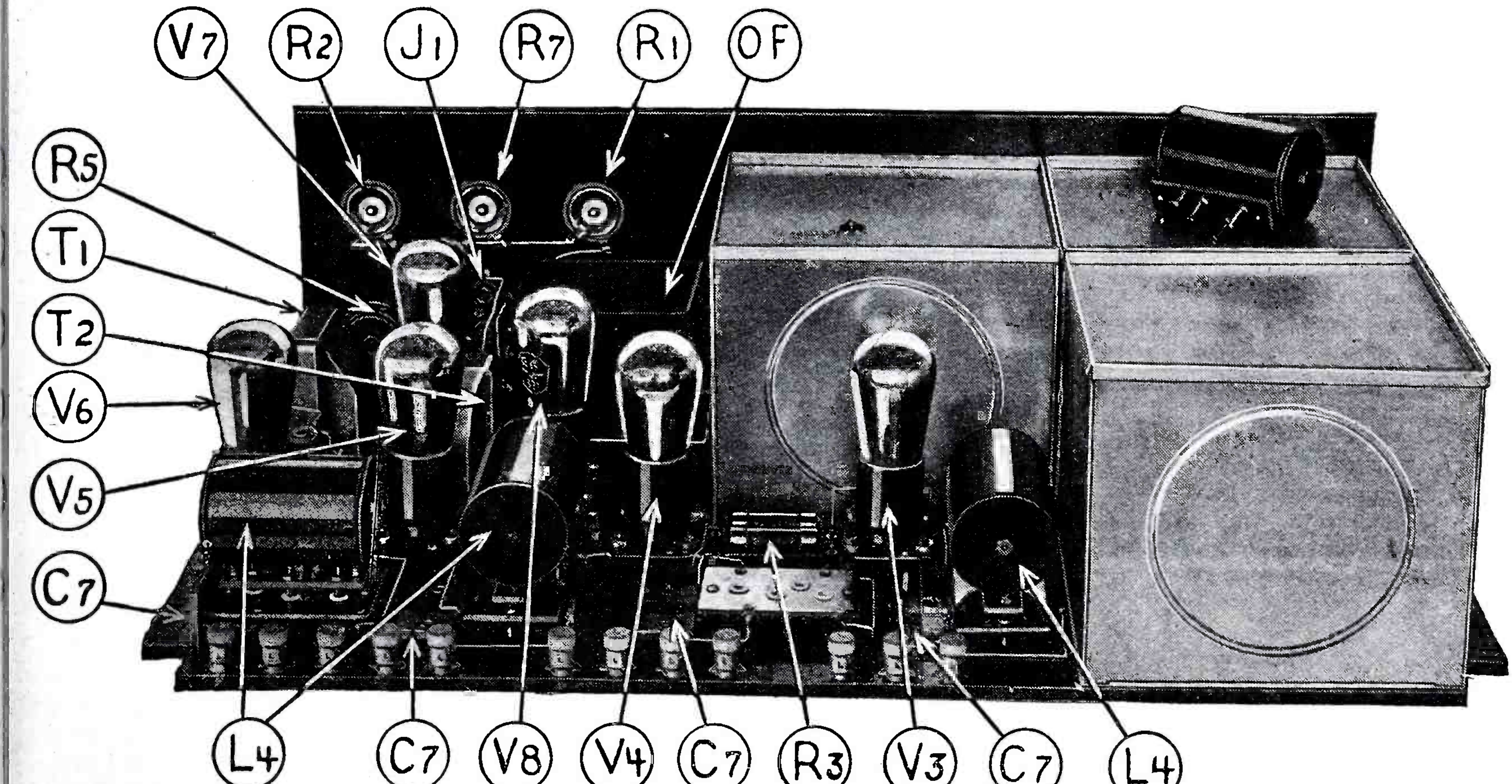
The Fundamental Circuit

Fig. 1 shows the circuit of the frequency changer. The coil L1 is used to apply the signal through the tube; coils L2 and L3 form the oscillating circuit to which is coupled the feed-back coil L4, which is inserted in the plate circuit of the tube. Also, in the plate circuit, there is inserted the primary of the first intermediate-frequency transformer; this primary being shunted by a by-pass condenser, C1.

The frequency-changing system as

LIST OF PARTS FOR THE STROBODYNE

- 3 Hammarlund .00035 mfd. Variable Condensers (C1, C2, C5)
- 1 Hammarlund special tapped auto couple (L1)
- 1 Hammarlund special auto couple coil (L2)
- 1 Hammarlund regular auto couple coil (L3)
- 4 Radio Elec. Labs. plug-in type tuned R.F. Units (L4)
- 5 Radio Elec. Labs. matched fixed condensers (C7)
- 3 Hammarlund shields
- 2 Samson A.F. transformers (T1, T2)
- 1 Interstate Output filter (OF)
- 1 Samson R.F. Choke (RFC)
- 1 Cardwell Compensator Condenser, 2 stators—1 rotor (C6)
- 3 Carter Rheostats, 20 ohms (R1, R2, R7)
- 1 Carter 400 ohm potentiometer (R6)
- 4 Dubilier .5 mfd. by-pass condensers (C4)
- 1 Dubilier .002 mfd. fixed condenser (C8)
- 8 Benjamin UX type sockets
- 1 Carter filament switch (SW)
- 2 Carter short jacks, 1-2 circuit and 1-1 circuit (J1, J2)
- 12 X-L Binding Posts
- 2 National Dials
- 4 Radiall Filament Ballasts, 5 volts, ¼ ampere (R3)
- 1 Radiall Filament Ballast, 5 volts, ½ ampere (R4)
- 2 Hammarlund Balancing Condensers (C3)
- 1 Electrad 100,000 ohm Variable Resistor (R5)
- 1 Micarta Panel, 8" x 24" x $\frac{3}{16}$"
- 1 Micarta sub-panel, 12" x 25¼" x 1¼"
- 6 doz. machine screws, 6/32-1" long with nuts
- 1½ ft. Angle Brass, ½" x ½"
- 2 Belden Rolls of Wire, rubber covered
- 1 Fritts Cabinet for panel 8" x 24" x 12⅛"
- 1 Hammarlund Brass Shaft, ¼" diameter—10¼" long
- 7 CeCo 201-A type Vacuum Tubes
- 1 CeCo 112 type Vacuum Tube
- 1 package of Kester radio solder



Rear view of the 8-Tube Strobodyne receiver, with one of the long-wave R.F. units on top of one of the shields (right) to show the base into which it is plugged. C7, fixed condensers. which tune the coils, L4; V3, V4, and V5, long-wave amplifier tubes; V6, detector; V7 and V8, A.F. amplifiers; T1 and T2, A.F. transformers; R1, R.F. rheostat; R2, frequency-changer rheostat; R7, detector rheostat.

employed in the Strobodyne circuit should be so adjusted that the oscillations produced are of the proper amplitude. This amplitude may be adjusted in several ways, viz.:

(a) By varying the size of the feed-back coil, L4.

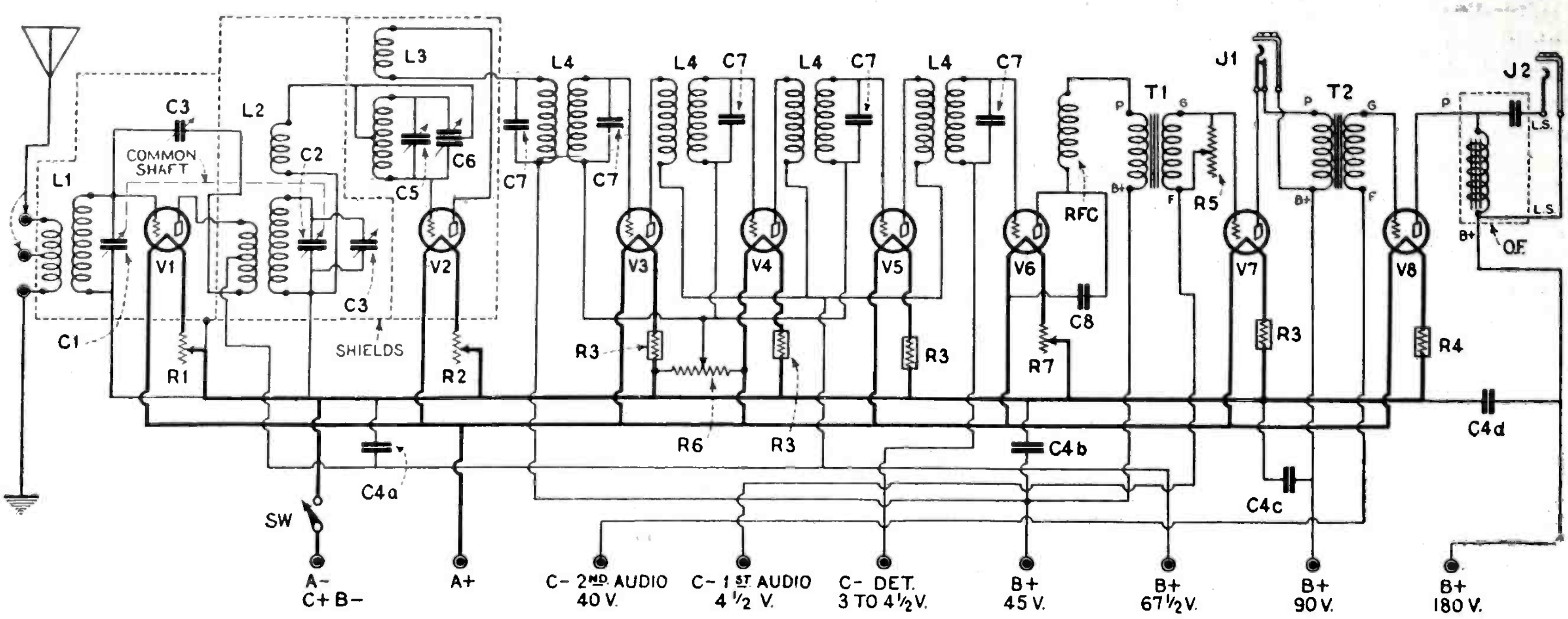
(b) By varying the coupling between L2, L3 and L4.

(c) By adjusting the voltage on the plate of the tube.

It should be noticed, however, that if any of these methods are employed, the adjustment is good for only one wavelength and has to be varied for every signal that is tuned in. However, the necessity of readjusting the controls has been eliminated by using a large inductance in L2 and L3 and a small tuning condenser, together with a low plate voltage. The compensating condenser, Cp, should have as small a capacity as possible, as it is in parallel with the variable condenser, CV1 which has a capacity of .00035-mf. The capacity of the compensating condenser should be small and the instrument should have one rotor and two stators, as indicated in Fig. 1.

This receiver is designed to amplify the received signals after their frequency has been lowered through the Strobodyne oscillator. Therefore, the usual precautions taken in circuits using a frequency-changer must be observed in this case also. In the American adaptation, shielding has been used to prevent interaction or feed-back between the various radio-frequency units; and provisions have been made in the binding-post arrangement for the use of a power tube in the second audio stage, and to insure a suitable choice in the voltages, depending upon the tube used, etc.

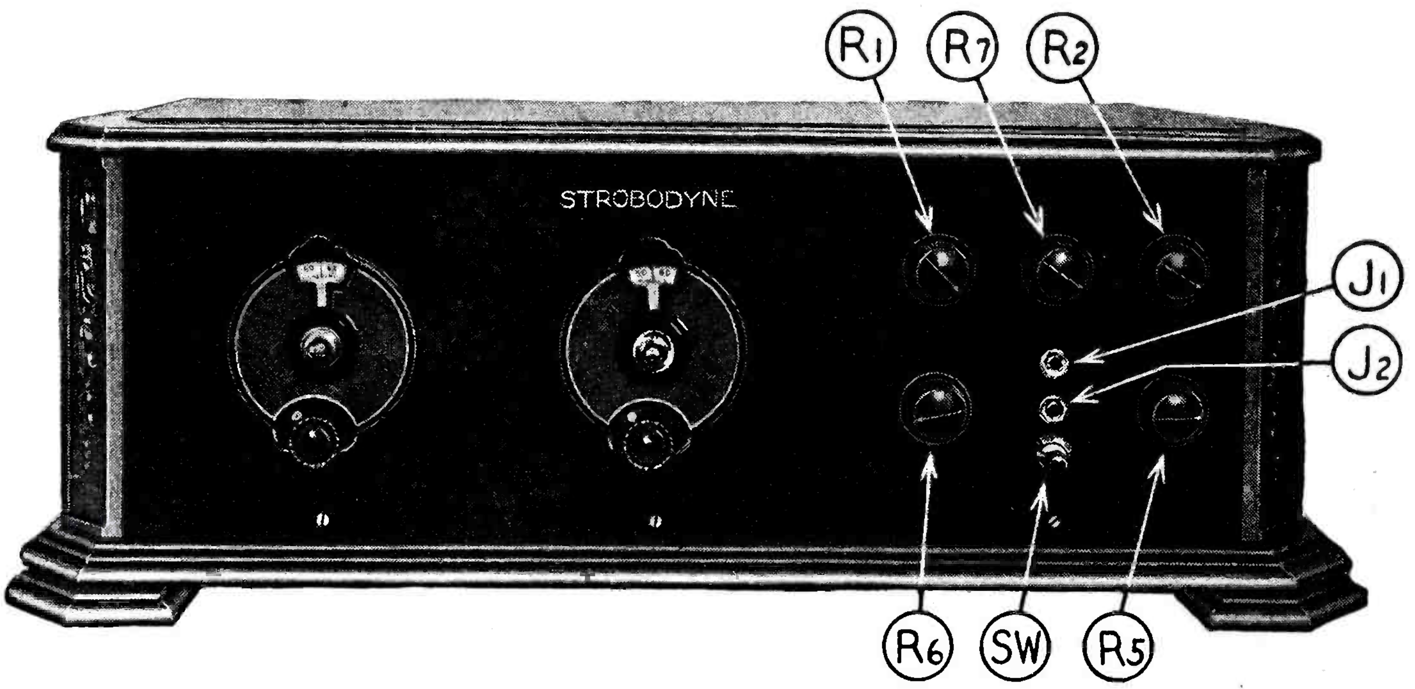
The Strobodyne may be equipped with either batteries or any good socket-power unit supplying enough current. If desired 199-type tubes may be used with dry cells; but the ¼-ampere tubes are to be preferred. The present model is designed for operation with an aerial, either outdoor or indoor; and any length up to about 120 feet is suitable. In the following we shall explain how the receiver is built.



The circuit diagram of the 8-Tube Strobodyne Receiver is shown above. The symbols indicating the different pieces of apparatus are the same as those which appear on the other illustrations in this article and in the list of parts.

Constructing the Set

The first thing to do, after all the parts required are on hand, is to drill the panel and sub-panel, as shown in Figs. 2 and 2A. The panel should then be fastened to the sub-panel by means of pieces of angle-brass, cut and drilled as shown in Fig. 3. Machine screws, No. 6/32 about 1 inch long, are used for this and the mounting of the parts on the sub-base. The same screws used for fastening the sub-base to the angle brass also hold the shield in place, and these may be mounted at the same time. The No. 1 shield is the left forward one. The back and right shields are No. 2 and are different, in that the back partition is not drilled. The back of the sub-base is raised, by means of either a piece of brass strip bent to form a letter "U," or pieces of wood of the proper thickness. The



The front view of the Strobodyne Eight-Tube receiver, R1, R2, R5, R6, and R7 are rheostat controls; J1 and J2, jacks; and SW is the filament switch.

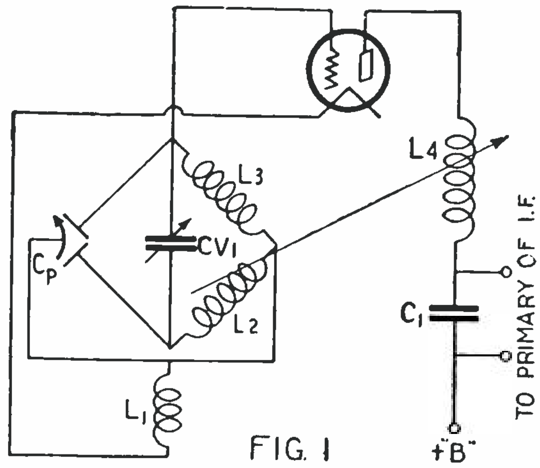
space under the sub-base is used to wire the set with soft rubber-covered, or other flexible insulated wire, and to provide space for the by-pass condensers used across the "B" circuit. These condensers are fastened on pieces of angle brass if their legs are at the ends of the condenser; but, if the legs are in the plane of the back of the condenser, no angle brass is required.

Mounting the Condensers

After the bottoms of the shields have been placed on the sub-base, the forward left condenser should be mounted on the panel. This holds the front of the forward shield in place.

Next mount the R.F.-stage variable condenser on the front of the back shield and the back of the front shield, placed back to back. The mounting screws hold these in place.

loosening the two set screws on each rotor, and replaced by the 10¼-inch shaft, which is pushed through both condensers to line them up. The rotor set-screws are then tightened when the



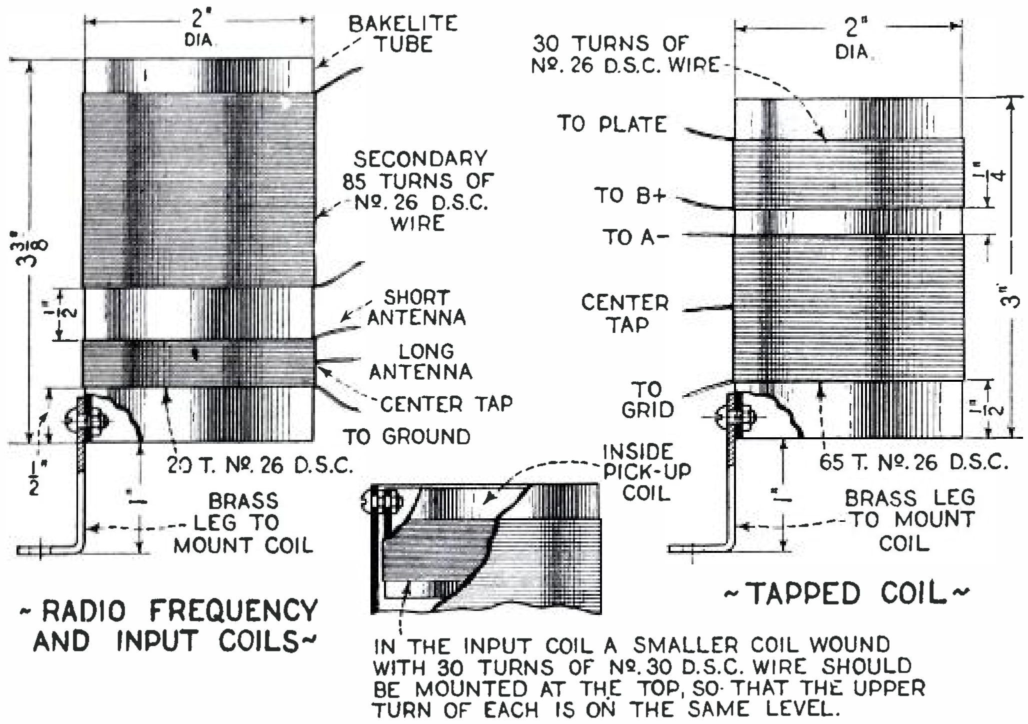
The "bridge circuit" of the frequency-changer, which is the heart of the Strobodyne circuit. The letters in this circuit do not correspond with those in the other diagrams and illustrations.

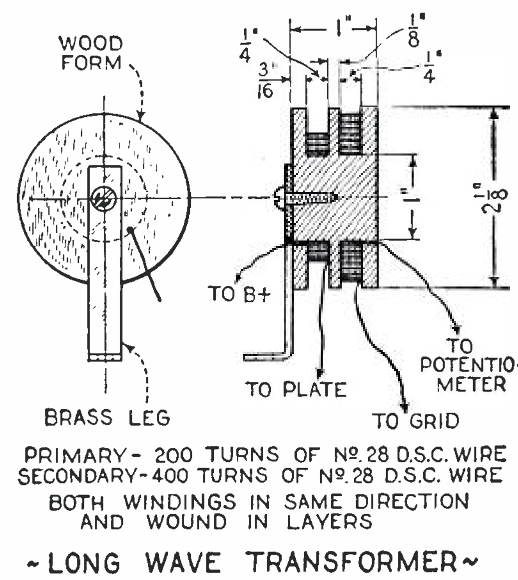
means of the bracket and screws furnished with the coil, and remove the long machine screw which limits the motion of the primary on the coil. This is not used: because the primary is made to move up and down inside of the secondary by means of the cam which must be fastened on the end of the shaft.

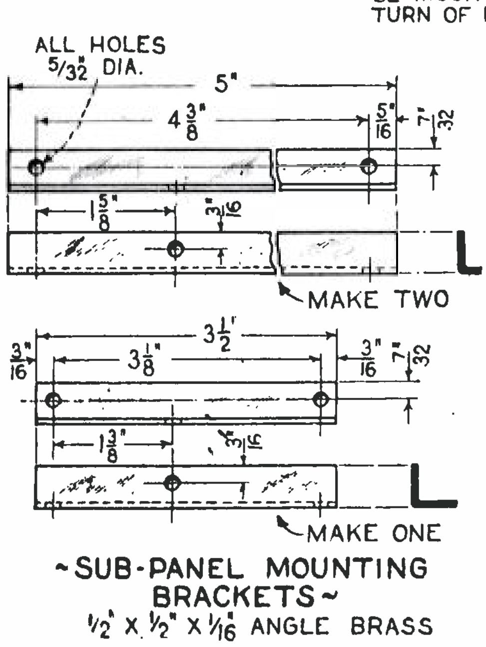
The three-circuit auto-couple coil is mounted in the same way on the frame of the forward variable condenser and the cam slipped over the shaft so as to move the primary out of the secondary when the plates are all unmeshed. Note that these two coils are mounted with the movable coil at the bottom.

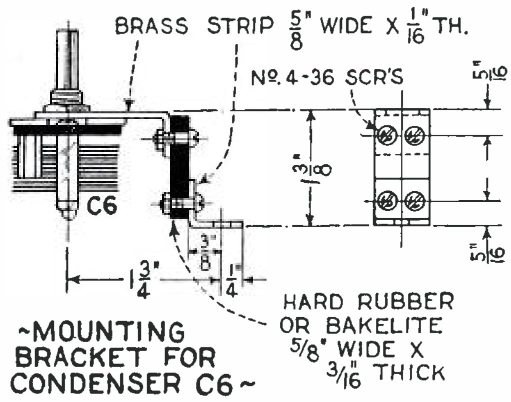
The Strobodyne Unit

As the oscillator uses a bridge circuit, it is necessary to insulate the variable condenser from the shield.









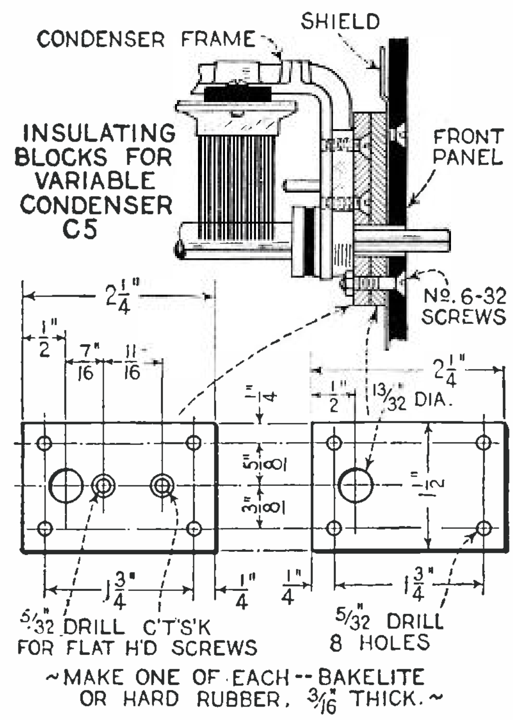


Fig. 3. Above are given the specifications for constructing some of the apparatus for the Strobodyne receiver. Directions should be carefully followed, in order that the apparatus may fit perfectly in the allotted space.

Note that the small shields furnished with each condenser are not used; the large threaded bushing provided on each condenser for single-hole mounting is not required, either, and should be taken out. The short shafts of each condenser should be taken out by

two rotors are completely meshed in the stators, and the two shield partitions are screwed down on the sub-base so that the rotors turn freely without binding at any point.

Next mount the auto-couple coil on the back variable-condenser frame, by

This is done by mounting the condenser on a piece of bakelite, which is covered with another in order to insulate the heads of the mounting screws; both of these strips being fastened on the panel as shown in Fig. 3. When mounting this condenser be sure that the shaft is not touching the shield. With some types of dials, some hand-capacity may be noticed and it may be necessary to replace the con- tapped auto-couple coil is mounted on the frame of the condenser with the movable coil *on top*. In this case the long machine-screw is used to adjust mounted as shown in Fig. 3, to insulate it from the bottom of the shield upon which it is mounted.

The wiring diagram shows clearly

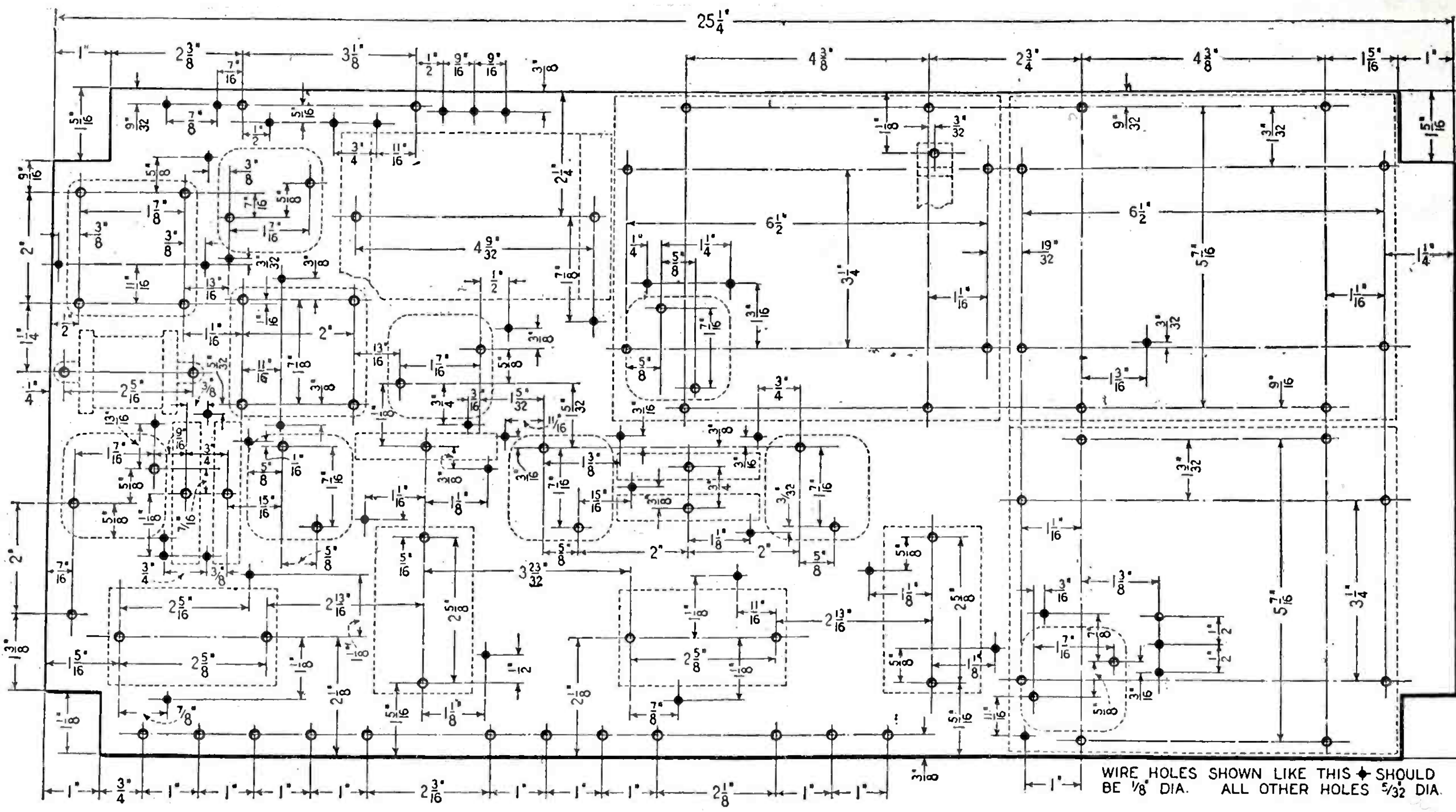
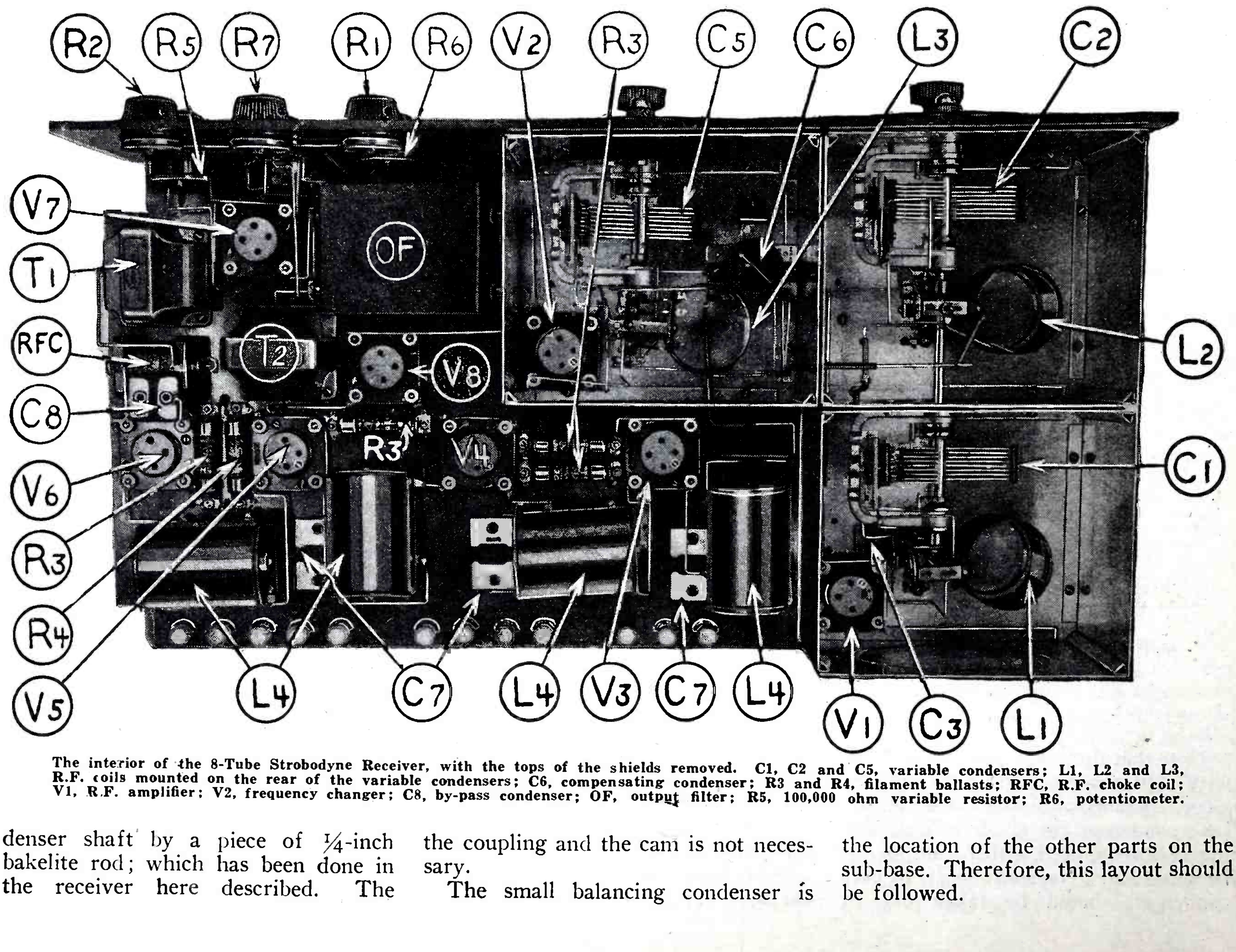


Fig. 2A. The drilling specifications for the sub-panel of the 8-Tube Strobodyne Receiver. To make it easier for the constructor the outlines of the different apparatus are drawn in dotted lines about the holes for mounting them on the sub-panel. The solid black holes are those through which the connections are run, from the upper to the lower side of the sub-panel, as shown in the wiring diagrams.



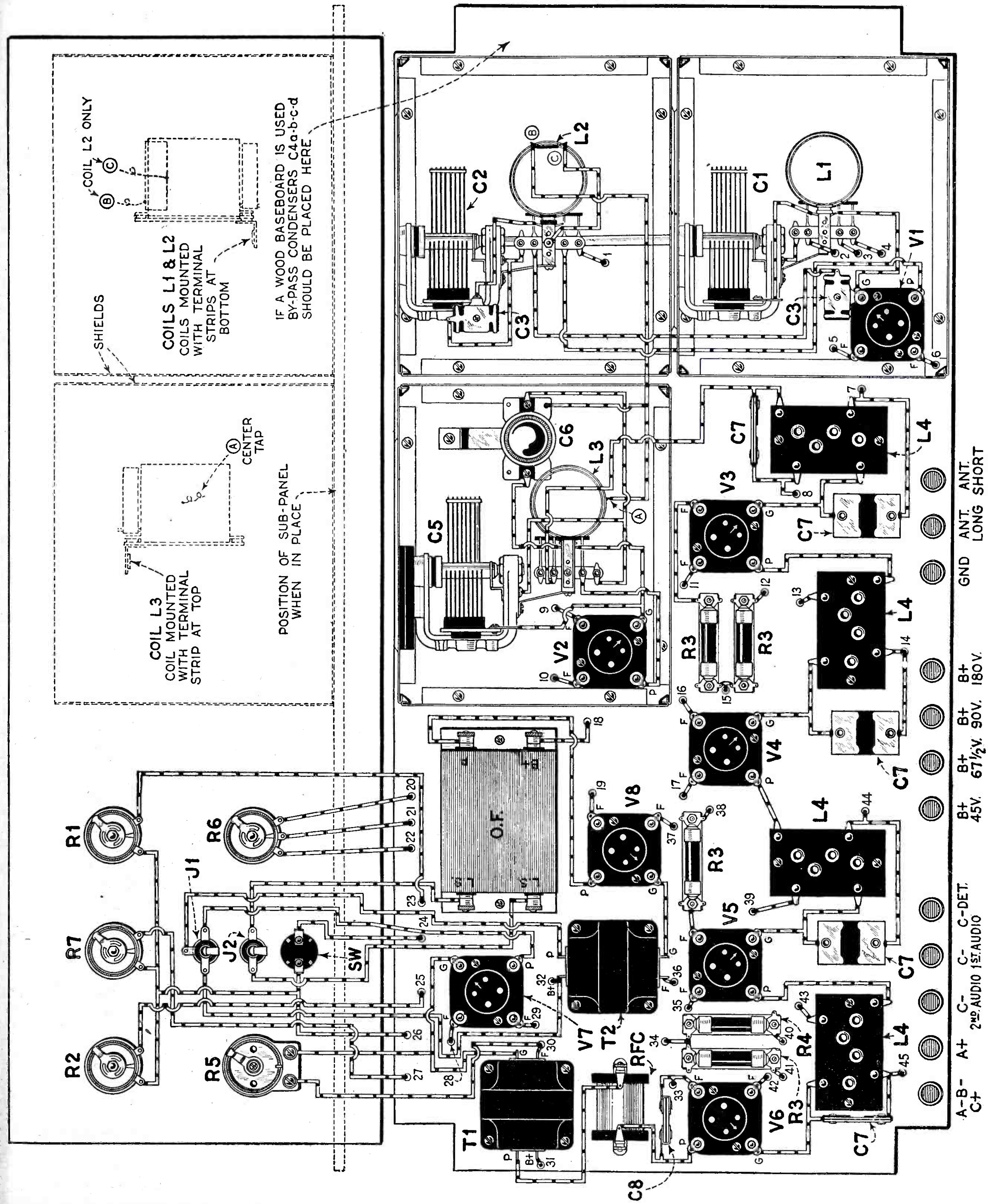
The interior of the 8-Tube Strobodyne Receiver, with the tops of the shields removed. C1, C2 and C5, variable condensers; L1, L2 and L3, R.F. coils mounted on the rear of the variable condensers; C6, compensating condenser; R3 and R4, filament ballasts; RFC, R.F. choke coil; V1, R.F. amplifier; V2, frequency changer; C8, by-pass condenser; OF, output filter; R5, 100,000 ohm variable resistor; R6, potentiometer.

denser shaft by a piece of ¼-inch bakelite rod; which has been done in the receiver here described. The the coupling and the cam is not necessary.

The small balancing condenser is the location of the other parts on the sub-base. Therefore, this layout should be followed.

Ever since the advent of the power tubes of the 112 and 171 type for use in the last stage of audio-frequency amplifiers, there is an attendant danger that some damage may be done to the windings of the loud speaker, unless some protective device be inserted in the output circuit of the power tube. The plate voltage required by these tubes is anywhere from 135 to 180 and, in the majority of cases, such a voltage flowing through the loud-speaker windings will burn them out or cause some other damage.

The protective device mentioned above generally takes the form of either a 1:1-ratio transformer or an audio-frequency choke coil with a large



The wiring diagram of the panel and the upper side of the sub-panel of the 8-Tube Strobodyne Receiver. On another page will be found that for the under side of the sub-panel. The holes which are numbered correspond with identical holes shown in the other drawing, and the connecting wires are run through these holes. Notice the change in layout if a wooden baseboard is used.

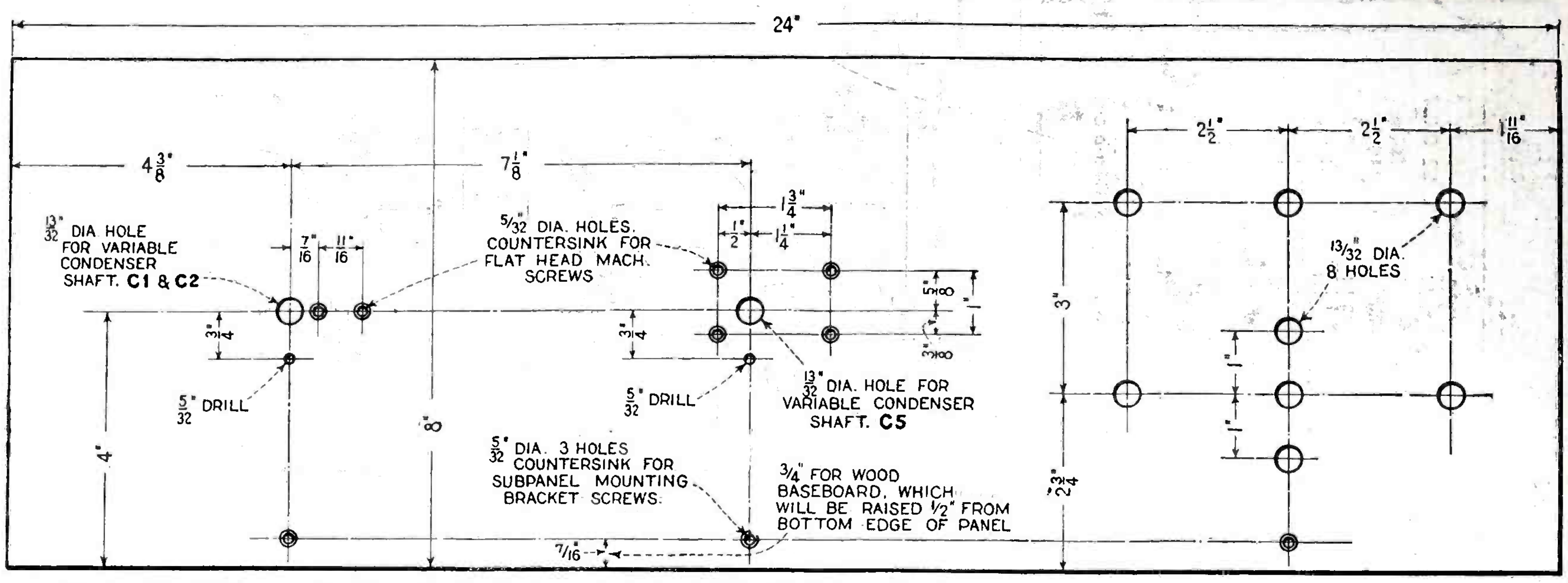
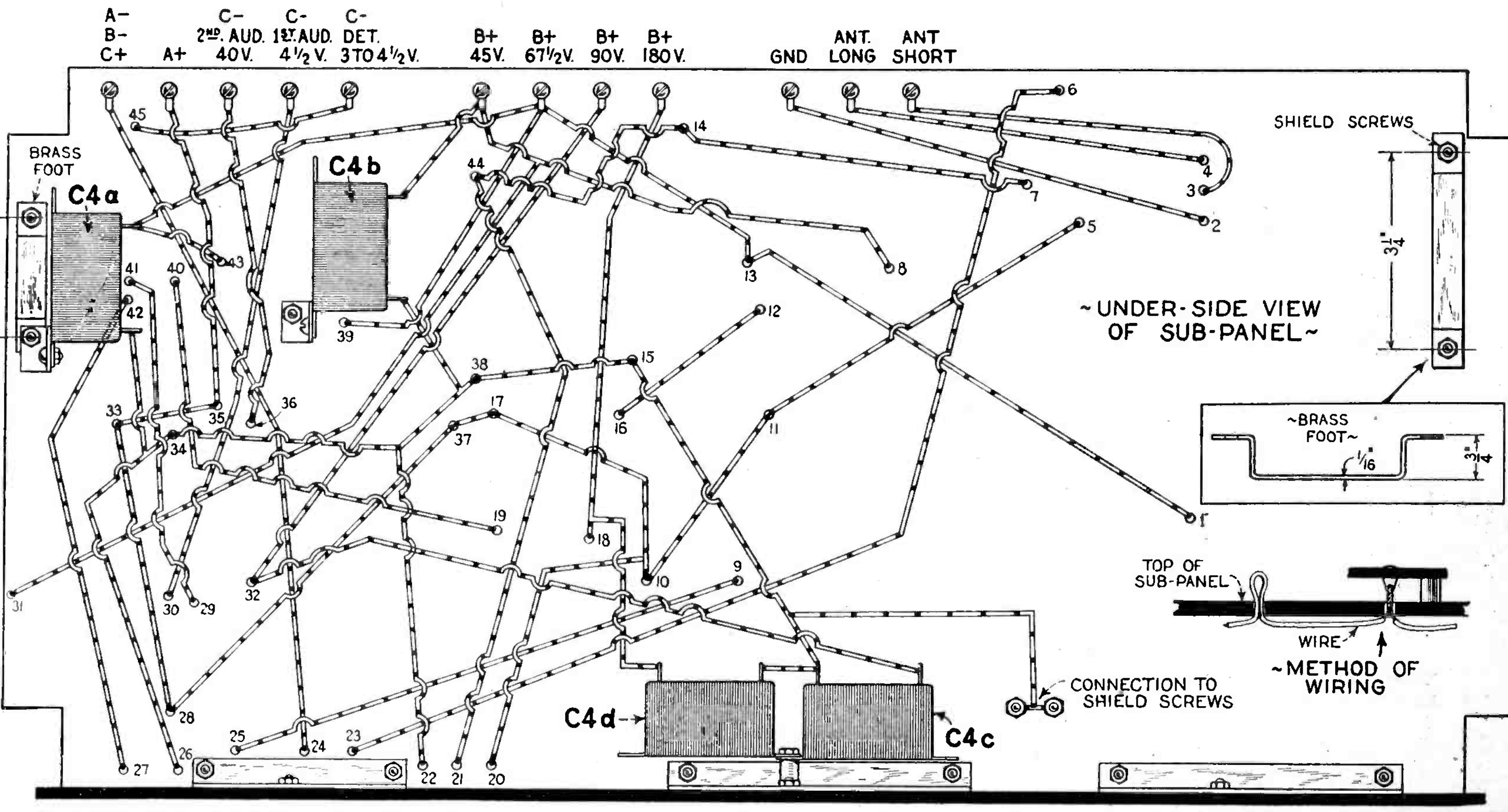


Fig. 2. The drilling specifications for the front panel of the 8-Tube Strobodyne Receiver. Notice that, if a wooden baseboard is used, the dimensions of the mounting screws are changed.



The wiring diagram for the under side of the sub-panel of the 8-Tube Strobodyne. The four condensers C4a, C4b, C4c and C4d are by-pass condensers. Notice, in the lower right-hand corner, the method which is used for running the connections between the different instruments.

fixed condenser placed in the plate lead of the power tube. By either of these means the high voltage is supplied to the plate of the tube without passing through the loud-speaker coils. In the Strobodyne receiver the choke coil and condenser combination is used, as is indicated in the illustrations at O.F. In this system of protection the condenser prevents any of the high voltage from passing to the loud speaker, without impeding its progress to the plate; and the choke successfully stops any of the audio-frequency currents from getting into the "B" circuit, at the same time allowing free passage for the "B" voltage.

Wiring the Set

The wiring on this set should be done by starting from each binding post and running the wire to the various instruments in the circuit. The wire is looped, passed through the hole in the sub-base and after being cut, connected to the terminals of the various apparatus. (See diagram below).

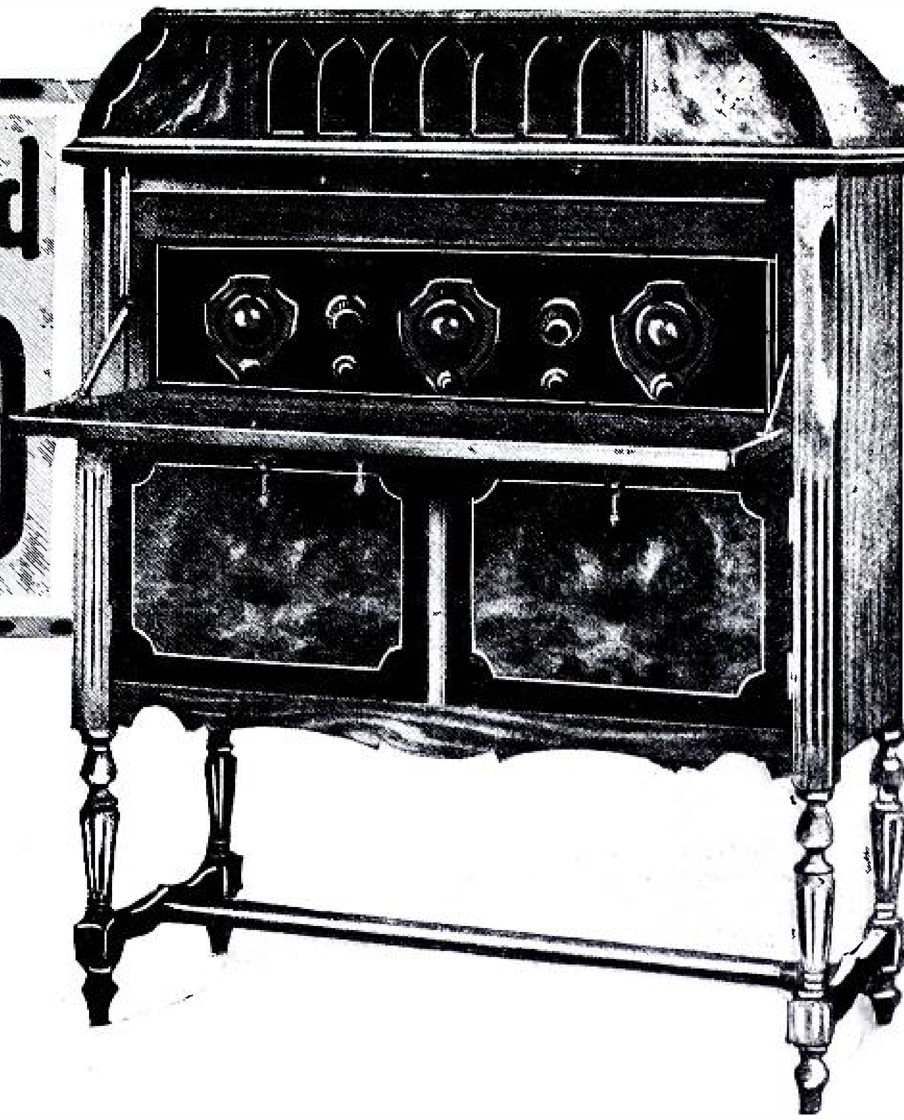
The wiring above the sub-base, which includes the grid, plate and other high-frequency leads, is made with bus bar covered with spaghetti where it passes through the shields. The rigid wiring is preferable because, once it is in place, the receiver may be balanced and the extra capacities caused by the proximity of the wiring to the shield may be compensated.

After the wiring is completed, check it carefully to make sure no lead has been left out or connected wrong. Then connect the "A" battery only and plug all the tubes into the sockets. Turn the rheostats up and the switch on, and see if all the tubes light. If they do, leave the "A—" lead connected, touch the "A+" lead to the various "B+" terminals, and notice if any of the tubes light. If some of them do there is a wrong connection or a short circuit, which would burn out the tubes if the "B" voltage were applied. If none of the tubes lights during this test, everything is O. K., and the set may be completely hooked up for operation.

Before attempting to tune in signals one should adjust the equalizer mounted on the grid terminal of the R.F.-tube socket. This may be set so that there is a gap of about 1/16 to ⅛ of an inch between the copper plate and the mica sheet. It may have to be

(*Continued on page* 138)

The Camfield Super-Selective 9



THE circuit used in the Camfield Super-Selective 9 has been developed to fill the requirements for a super-sensitive and super-selective receiver that could be satisfactorily operated in congested broadcasting districts such as the Metropolitan areas of New York and Chicago as well as being sensitive and powerful for the reception of distant stations from any location in the United States or Canada.

For several years the Super-Heterodyne circuit has been very popular whenever extreme sensitivity combined with selectivity has been desired. About three years ago the Super-Heterodyne was considered to be the most satisfactory circuit for use under any conditions, but with the large number of broadcasting stations now on the air in the metropolitan areas a serious drawback of this type of circuit has developed. This difficulty is the presence of so-called oscillator harmonics.

Many Supers that were popular several years ago can be operated in congested broadcasting districts today with the oscillator tube entirely removed from the circuit. A Super that is designed to operate on an Intermediate Frequency of 50 Kilocycles will receive any local broadcasting station regardless of the oscillator dial setting if there happens to be another local station on the air having a frequency of 50 Kilocycles above or below the first station. This condition spoils the selectivity of the Super, which was one of the chief advantages, and has resulted in decreased popularity of this type of circuit for use in Metropolitan areas.

In the Camfield Super 9 this condition of oscillatory harmonics has been entirely eliminated. This is accomplished by the use of two stages of tuned radio frequency amplification ahead of the first detector tube and also by the choice of an Intermediate Frequency of 95 Kilocycles. There are no stations in the United States that are exactly 95 Kilocycles apart. Furthermore when the two radio frequency stages are tuned to resonance with the station that it is desired to receive they will not pass signals from stations broadcasting at a frequency 90 or 100 Kilocycles above or below the station being received. Hence, no energy from such stations can get to the first detector tube to heterodyne with the incoming signal and thereby spoil selectivity and cause squeals and howls or heterodyne beat notes in the loud speaker, as would be the case with the previous type loop-operated Super.

PARTS REQUIRED

1 Camfield No. 251 .00025 Equaltune Variable Condenser
1 Camfield No. 351 .00035 Equaltune Variable Condenser
1 Camfield No. 352 .00035 Equaltune Variable Condensers (2-gang)
1 Camfield No. 22K Kit of 3 Camfield Duoformers
1 Camfield No. 620 Coupling Unit
1 Rusco No. 10KC Band Pass Filter
2 Rusco No. 95KC I. F. Transformers
1 Dubilier No. 601 .002 Fixed Condenser
2 Dubilier No. 601G .00025 Grid Condensers
2 Dubilier 2 Megohm Grid Leaks
2 Tobe ½ mfd. Condensers
2 Silver-Marshall No. 220 Audio Transformers
1 Frost No. 806 6 ohm Rheostat
2 Frost No. 824 400 ohm Potentiometers
3 National Vernier Dials
9 Benjamin No. 9040 Sockets
3 Karas Brackets
1 Carter Midget Battery Switch
1 Carter No. 6 Jack Switch
5 X-L Laboratories Binding Posts
1 Jones Type BM Multi-Plug (Sub-Panel)
2 Amperites, No. 4-A
1 Formica 7 x 30" x 3/16" Panel
1 Formica 10 x 29 x 3/16" Sub-Panel
Miscellaneous lugs, wire, screws, etc.

Radio Frequency Amplifier Adds Sensitivity

In any Super-Heterodyne there must be a definite minimum of input energy to the first detector tube before the circuit will function. This factor forms one of the most important limits to the sensitivity of the circuit.

Signals so weak that they will not actuate the first detector tube in an ordinary Super are picked up and amplified through two stages of tuned radio frequency amplification before reaching the first detector tube in the Camfield Super-Selective 9. This makes it possible to get satisfactory reception of distant stations with this new circuit that could not be received at all with the previous type of Super.

The Camfield Super-Selective 9 is the first circuit made available to radio fans using a Band Pass Filter in the Intermediate Frequency Amplifier.

A Band Pass Filter is a network of inductance and capacity designed to pass a particular band of frequencies with uniform amplification and to reject all other frequencies.

The filter used in the Camfield Super-Selective 9 has been designed to pass a band of frequencies 10 Kilocycles wide between 90 and 100 Kilocycles. All Frequencies lying within this band are amplified equally by the intermediate stages of the Camfield Super-Selective 9. The filter is designed to cut off very sharply on both sides of this band and the circuit, therefore, has excellent selectivity.

It must be remembered that the frequency of a broadcasting station on any given wavelength is not absolutely constant. It is modulated by the frequency of the voice or music being transmitted and, therefore, varies about 5 kilocycles above and below the rated frequency. If a circuit is not designed to give practically uniform amplification over a band of frequencies 5 kilocycles above and below that of the incoming wave some of the voice or music frequencies will not be properly amplified and distortion results. This action and consequent distortion has been very noticeable in Super-Heterodyne circuits where extreme selectivity was obtained by the use of the so-called peak Intermediate Frequency Transformers.

In the Camfield Super-Selective 9 the use of the 10 Kilocycle Band Pass Filter absolutely eliminates this cause of distortion.

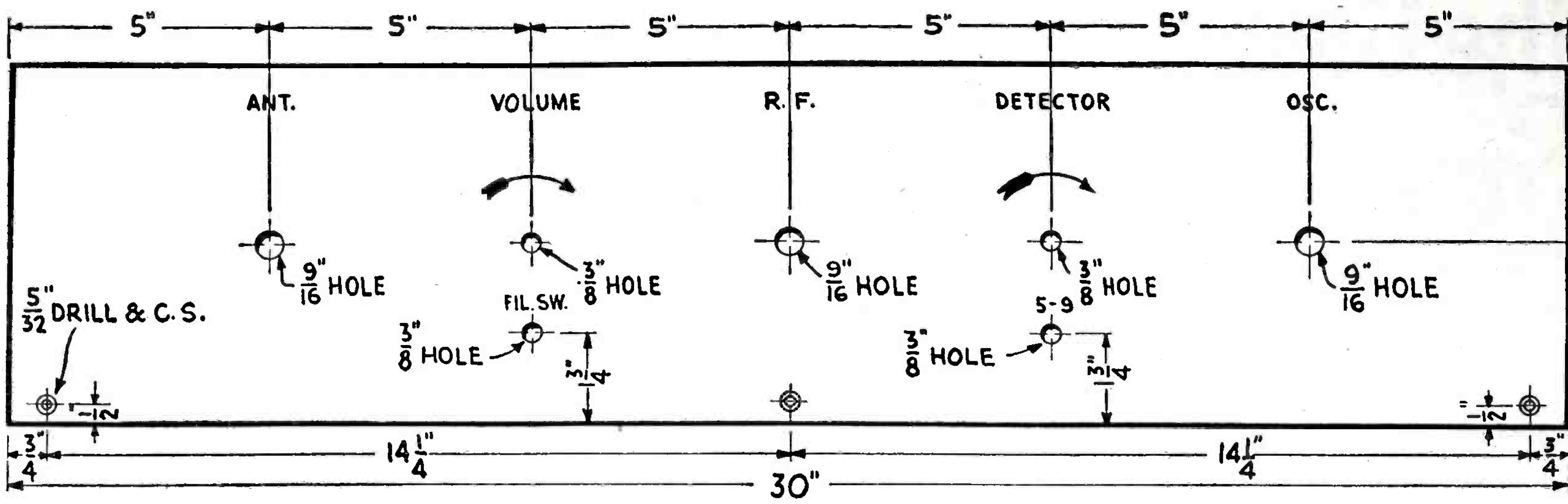


Fig. 1. Dimensions for drilling the front panel of the set.

All former Super-Heterodyne circuits have been designed to operate on a loop. It is well known that the loop does not pick up as much energy as even a short Antenna and for this reason many experimenters have attempted to couple an Antenna to a Super-Heterodyne. The result has always been to utterly spoil the selectivity.

In the case of the Camfield Super 9 the use of the band pass filter gives such perfect selectivity that it is possible not only to use an Antenna, but also to use two stages of radio frequency amplification. This naturally results in greater sensitivity than can be obtained with any other type of circuit.

Combination 5 and 9 Tube Receiver

The Camfield Super 9 may be operated either as a 5 tube two control tuned radio frequency set or as a 9 tube Super-Heterodyne. This transfer from 5 to 9 tubes is accomplished by a jack switch mounted on the front panel as shown in Fig. 2. The manner of connecting this switch in the circuit is illustrated in the schematic wiring diagram of Fig. 3. The circuit is so arranged that when the switch is thrown to the left only the two radio frequency tubes, the first detector and the audio amplifier tubes are lighted. When operated this way the output of the first detector tube is connected direct to the audio frequency amplifier. When the switch is thrown to the right the other 4 tubes are automatically lighted and the proper circuit connections are made for the operation of the set as a 9 tube Super.

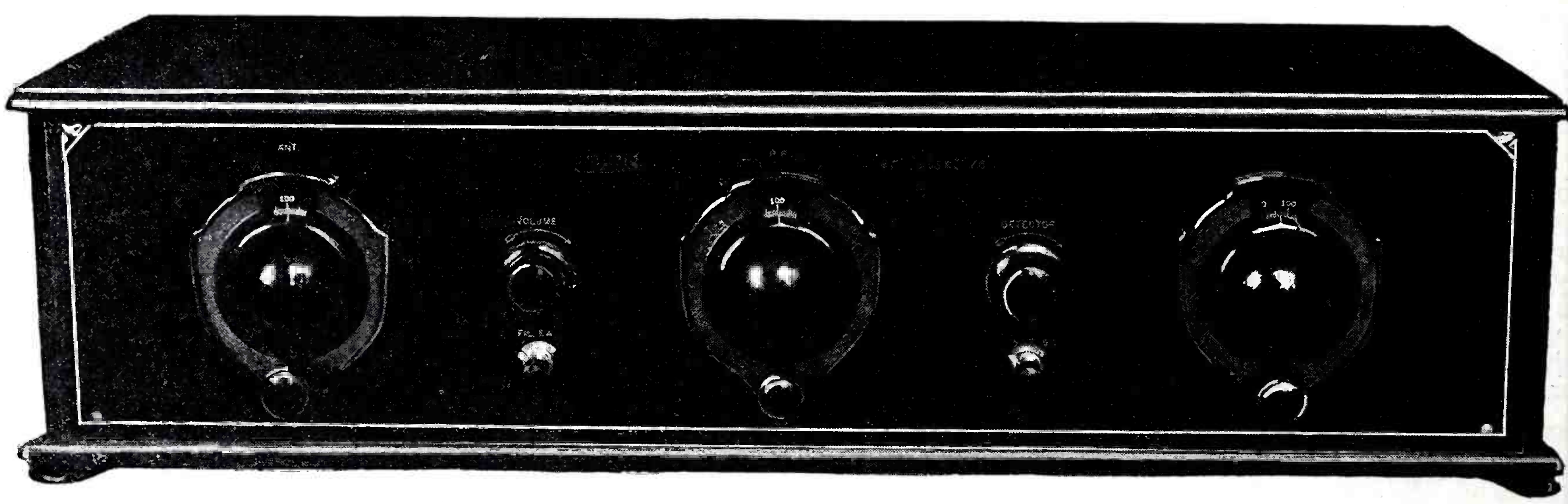
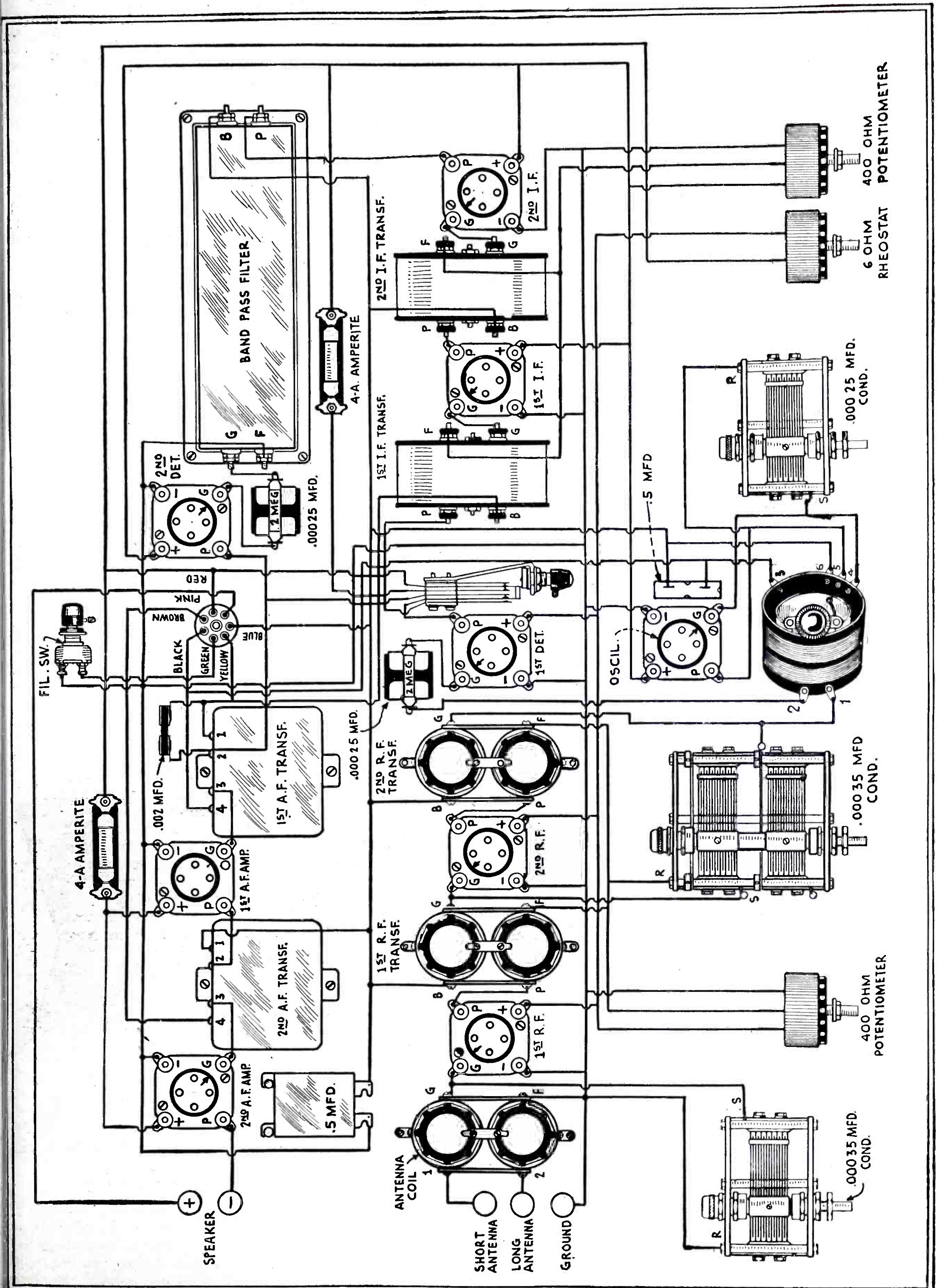


Fig. 2. The Camfield Super-Selective 9 installed in a table type cabinet. The switch beneath the detector rheostat, between the second and third dials, is used to turn on either five or nine tubes.

This feature provides for the economical operation of the receiver when the reception of local stations only is desired. This is an exclusive feature of the Camfield Super 9 and is not found in any other circuit. Furthermore this arrangement of the wiring makes it possible to construct the receiver in two units. It fills the requirements of those who at present can only afford a 5 tube set but who will want a 9 tube Super at some later date. The 5 tube end of the circuit may be constructed first and the other 4 tubes added at any later date without changing any of the original wiring.

In the Camfield Super-Selective 9 squeals and whistles due to oscillator harmonics have been eliminated in the manner described above. Further stability is obtained by designing the circuit and the parts used so as to prevent oscillation of the radio frequency amplifier tubes.

Special construction of the Camfield Duoformers used as the Radio Frequency Transformers in the Camfield Super 9 prevents disturbing oscillations



BAND PASS FILTER
4-A. AMPERITE
2ND I.F. TRANSF.
2ND I.F.
400 OHM POTENTIOMETER
6 OHM RHEOSTAT
1ST I.F.
1ST I.F. TRANSF.
.00025 MFD. COND.
2ND DET.
.00025 MFD.
2 MEG
.5 MFD
RED
PINK
BROWN
BLUE
BLACK
GREEN
YELLOW
FIL. SW.
1ST DET.
OSCIL.
2 MEG
.00025 MFD.
2ND R.F. TRANSF.
.00035 MFD COND.
1ST A.F. TRANSF.
.002 MFD.
4-A AMPERITE
1ST A.F. AMP.
2ND R.F.
1ST R.F. TRANSF.
2ND A.F. TRANSF.
400 OHM POTENTIOMETER
1ST R.F.
2ND A.F. AMP.
.5 MFD.
ANTENNA COIL
.00035 MFD. COND.
SPEAKER
SHORT ANTENNA
LONG ANTENNA
GROUND

in the radio frequency end of the circuit.

Oscillation in a tuned radio frequency amplifier is caused by coupling between the plate or output circuit of the tube and the grid or input circuit. One or more of the following forms of coupling are always inherent to some degree in tuned radio frequency amplifier circuits:

First—Inductive coupling between the windings of interstage radio frequency transformers.

Second—Capacity and inductive coupling in the wiring of the set.

Third—Capacity coupling between the two circuits due to the capacity between the grid and plate of the vacuum tube.

The first and second causes of oscillation are comparatively easy to eliminate. The Camfield Duoformer has been designed to minimize its effective external magnetic field. Thus, when three of these transformers are used in a set, magnetic coupling between them is negligible.

The second cause of oscillation may be eliminated by the proper arrangement of parts and wires in the set and the proper use of by-pass condensers. This has been done in the set layout recommended for the Camfield Super-Selective 9, and for this reason it is advocated that the builder of the set follow our detailed instructions as closely as possible.

The third cause of oscillation, that is, the grid-plate capacity of the vacuum tube, cannot be eliminated without entirely changing the design of the tube itself.

In the past few years, several methods of compensating for the energy fed back from the plate circuit to the grid circuit through the tube capacity have been developed. The most noteworthy of these is the use of some means to feed back additional energy from the plate circuit to the grid circuit in such a manner that it is out of phase with the energy fed back through the tube, thus preventing oscillation. Several different ways of doing this are in use today, and some of them unquestionably have a great deal of merit. However, this system has several disadvantages, principal among them being that the means of feeding back compensating energy is often very critical in its adjustment, and that circuits using it are not equally efficient over the full range of wave lengths.

Another means of preventing oscillation in general use today is to place a resistance, or in some other manner to

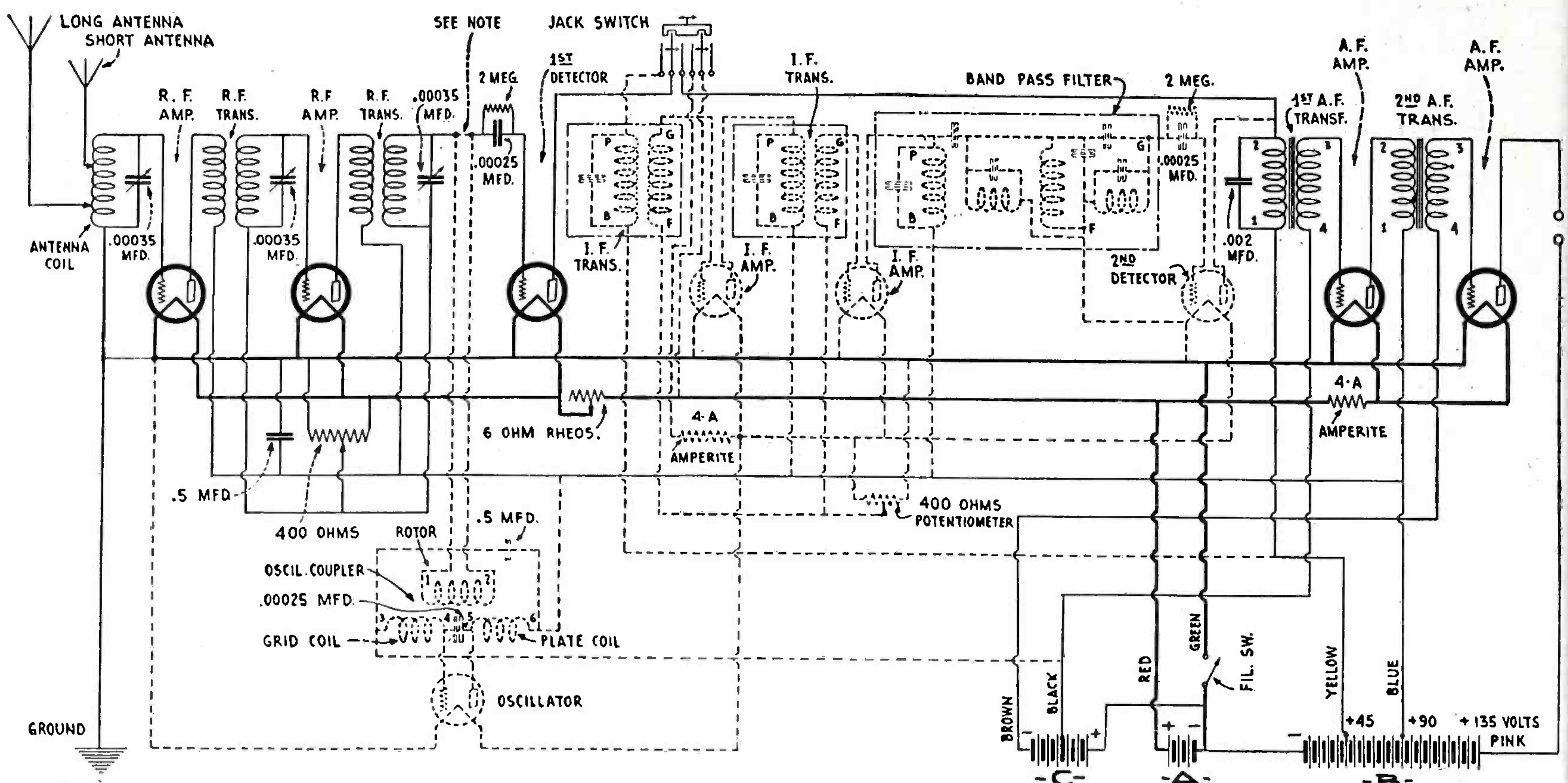


Fig. 3. Schematic wiring diagram of the Camfield Super-Selective 9. Connections indicated in dotted lines are made when nine tube set is built. Solid lines are the connections for the five tube set. The jack switch is employed in the combination receiver to turn on either five or all nine tubes.

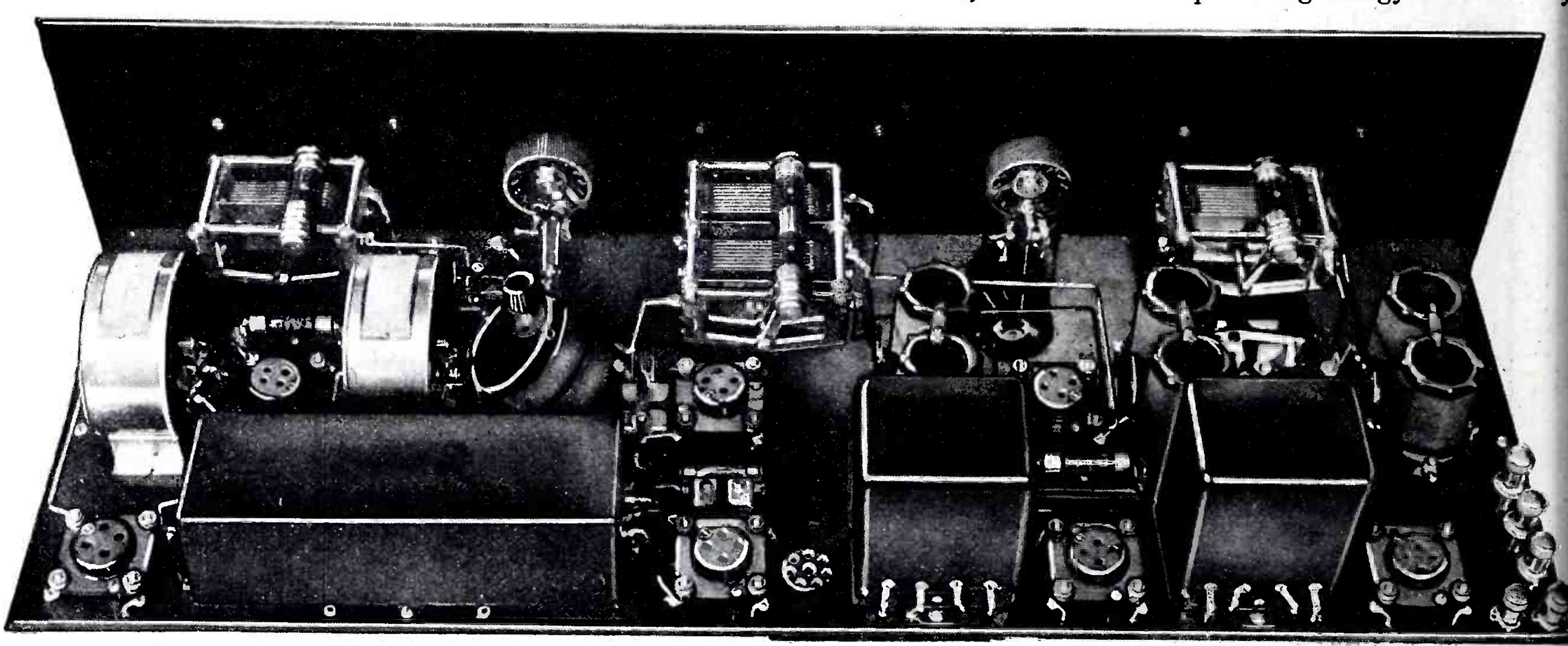


Fig. 4. A back panel view of the completed receiver. The encased unit in the foreground at the left is the band pass filter.

introduce a loss, in the grid circuit of the tube. It is very easy to prevent oscillations in this manner, but at the expense of decreasing the sensitivity of the circuit and broadening its tuning.

Some set and part manufacturers prevent oscillation by using tuned radio frequency transformers of very low efficiency, so that the over-all gain in each stage of the radio frequency amplifier is so low that oscillations are not produced. This is generally accomplished by making the primary inductance so small that the proper degree of coupling between the primary and secondary is not obtained. Practically all transformers that do not necessitate the use of some form of compensating feed-back or resistance in the grid circuit are made in this manner. They usually have the characteristics of being fairly efficient on the low wavelengths and efficient on the upper range of the broadcasting scale.

In support of this comparatively inefficient type of transformer, some manufacturers and technical writers have made the radical statement that the minute capacity between the grid and plate of a tube does not cause a sufficient transfer of energy to produce oscillation. They claim that oscillations are caused entirely by coupling between transformers and coupling in the wiring, and that it can be overcome by the use of the close-field transformers. This, however, is not the case. Feed-back due to tube capacity does exist in all well designed radio frequency amplifiers and must be compensated for if the circuit is to be prevented from oscillating. To substantiate this the following statement is quoted from "Principles of Radio Communications," by Professor J. H. Morecroft, Chapter Six, page 432:

"It would seem as though the capacity (electrostatic) of a vacuum tube is so small as to be negligible, but such is far from the truth. The internal capacity of a tube may have very great effect on its operations, especially at high frequency."

In designing the Duoformer, the engineers of the Camfield Radio Manufacturing Company fully recognized the existence of feedback through the tube capacity and the necessity of compensating for it in order to prevent oscillations when all stages of the radio frequency amplifiers are tuned to resonance. Not satisfied with the means previously employed, which resulted either in inefficient operation or in the necessity of making critical internal adjustments, their engineers worked along an entirely new line.

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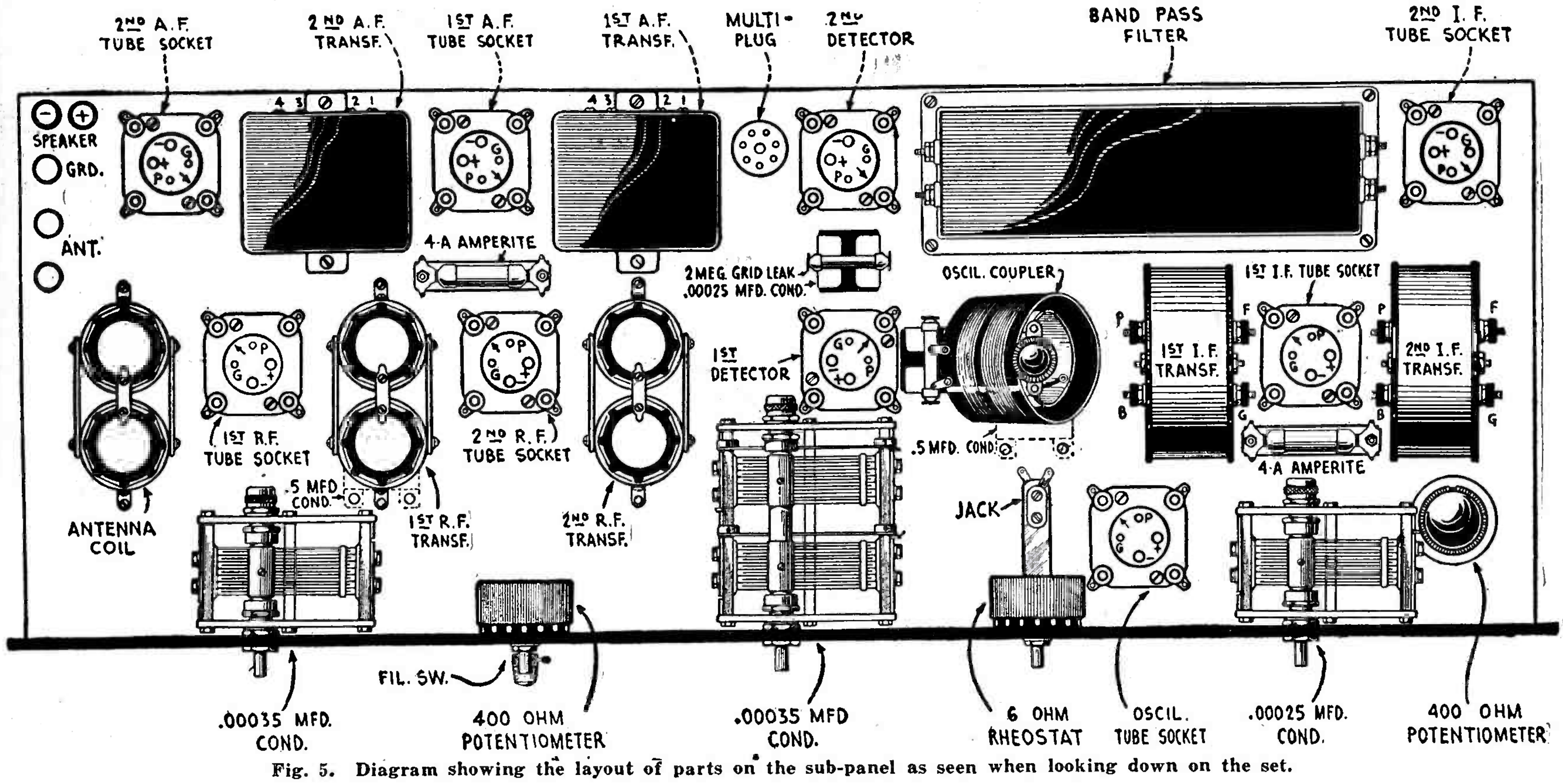


Fig. 5. Diagram showing the layout of parts on the sub-panel as seen when looking down on the set.

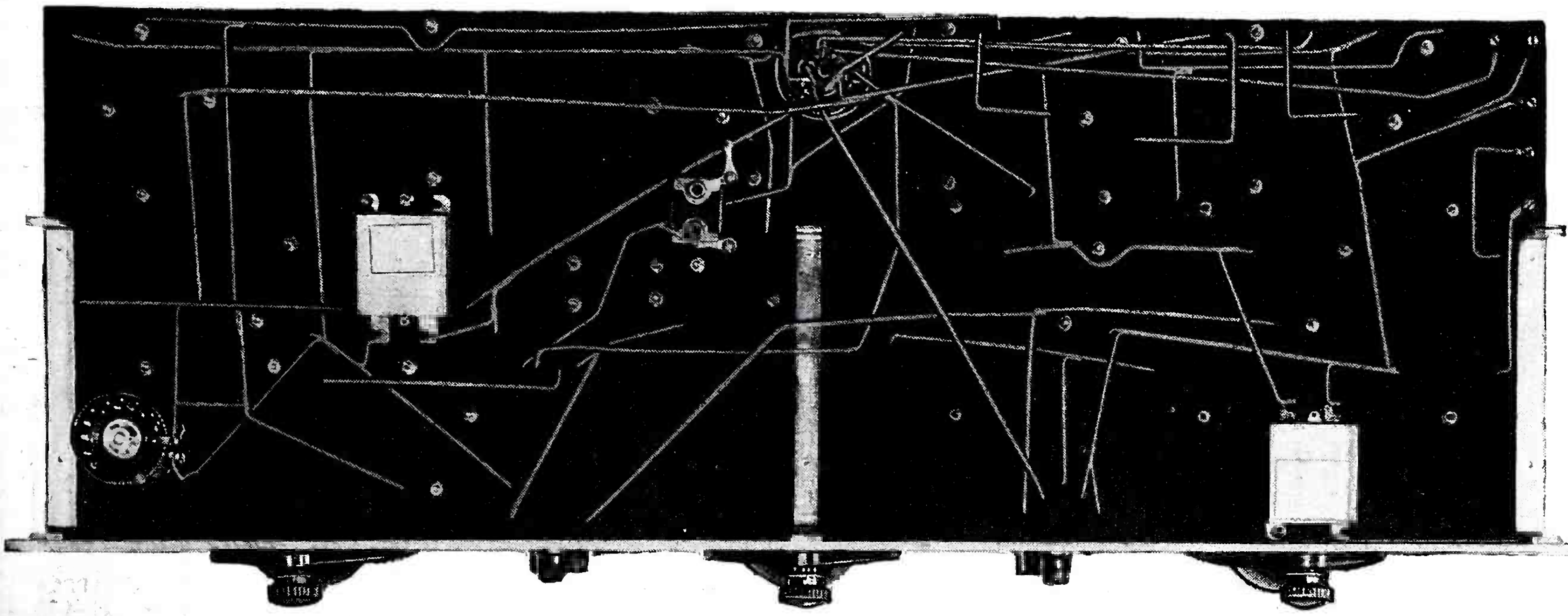


Fig. 6. A photographic view of the wiring beneath the sub-panel of the Camfield Super-Selective 9.

The Improved "Nine-in-Line"

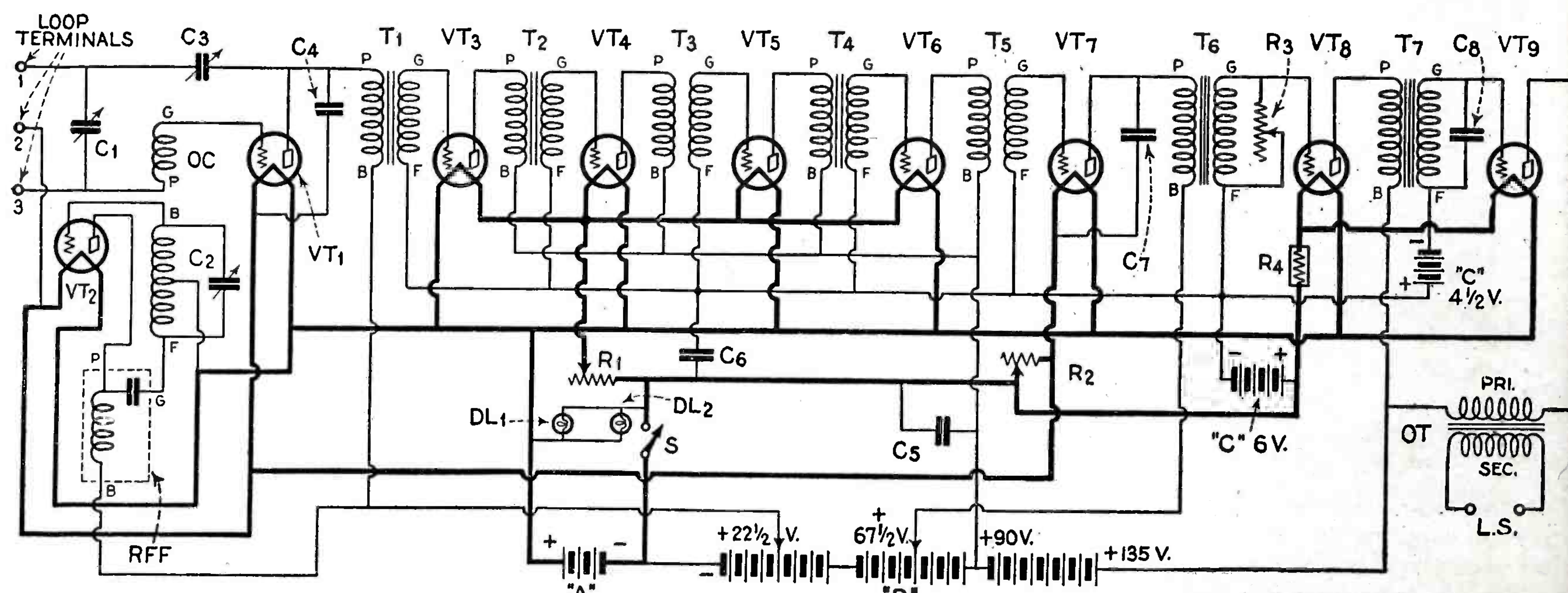
By A. M. Powers

RECEIVERS may come and receivers may go but the super-heterodyne receiver does seem to go on forever. From the date of Armstrong's origination of this circuit principle in France during the war, the super-heterodyne receiver has opened up intriguing vistas to the dyed-in-the-wool radio fan. The builder and owner of a good super-heterodyne receiver is in a class apart from the ordinary run of radio devotees.

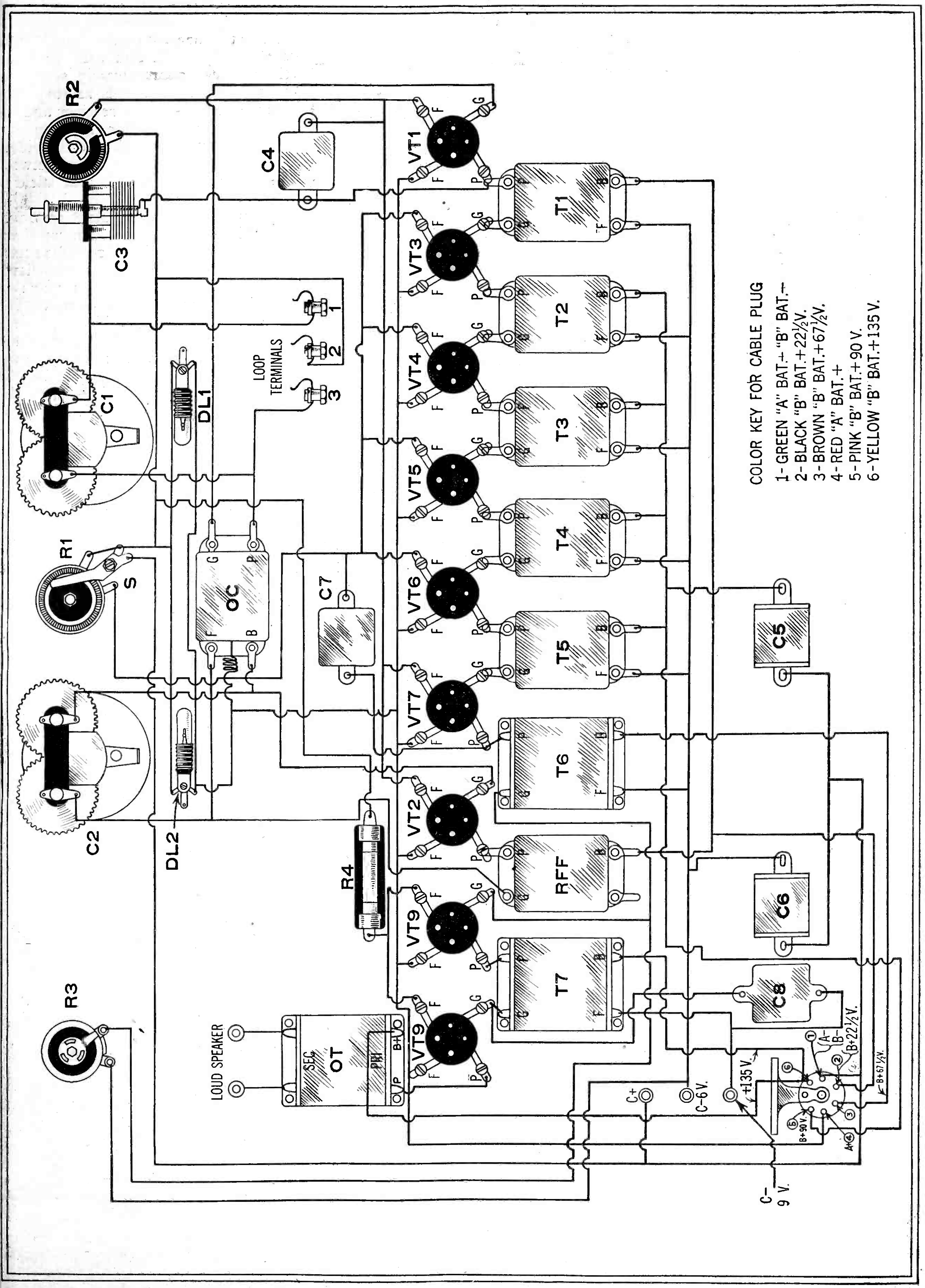
It stands to reason that a single type of circuit could not hold its intense popularity through the entire period of radio broadcasting to date unless it had some features to recommend it above all others. In every stage of the development and popularization of radio reception the receivers which incorporate the super-heterodyne principle have managed to keep just a step ahead of others. In fact there is no other receiver or type of circuit that has been able to hold the popular favor of the radio public for anything like the length of time that the "super" has remained in favor.

Most of the outstanding records of distance reception on the broadcasting or higher wavelengths have been made with super-heterodyne receivers. In the great trans-oceanic radio stations the super-heterodyne receiver is used for reception. Practically all of our broadcasting stations use super-heterodyne receivers for listening in on their own and other broadcasters, and for the constant watch that is kept for S O S calls.

The reason for all of this is that the super-heterodyne will do everything that any other receiver will do—and in most cases do it better. In sensitivity it is incomparable. Its volume is tremendous and its quality is governed only by the quality of the audio amplifier included in its make-up.



Schematic wiring diagram of the Improved Nine-in-Line.



R2
C4
VT1
T1
C3
VT3
T2
LOOP TERMINALS
1
2
3
C1
DL1
VT4
T3
VT5
T4
R1
S
OC
C7
VT6
C5
T5
VT7
C2
DL2
T6
VT2
R4
RFF
C6
VT9
T7
R3
LOUD SPEAKER
OT
SEC
PRI
B+
VT9
C8
C+
C−6 V.
+135 V.
C−9 V.
A−
B−
B+22½ V.
B+67½ V.
B+90 V.
A+
COLOR KEY FOR CABLE PLUG
1-GREEN "A" BAT.− "B" BAT.−
2-BLACK "B" BAT.+22½V.
3-BROWN "B" BAT.+67½V.
4-RED "A" BAT.+
5-PINK "B" BAT.+90 V.
6-YELLOW "B" BAT.+135 V.

Aside from all its other advantages, this type of receiver may be used without an outdoor antenna of any kind and without a ground connection. Connected with an ordinary receiver a small loop antenna resting on the receiver cabinet, and with no other external wires, provides so little "pick-up" that, except in the case of reception from local stations, the average receiver would not be able to reproduce broadcast signals at all. But connect the same loop to a super-heterodyne receiver and stations all over the country may be tuned in. The tremendous amplification obtained with a super-heterodyne receiver is capable of overcoming this obstacle of extremely minute "pick-up" and reproducing the signals with strong loud-speaker volume.

Of course the whole trick lies in the fact that the amplification is obtained at a high wavelength where radio-frequency amplification is vastly more efficient than it is at the ordinary broadcast wavelengths. A long wave amplifier is also far more stable than one which amplifies at broadcast wavelengths and this fact permits the use of more R. F. amplifier stages in the "super." Where two stages of R. F. are the practical limit in an ordinary, unshielded type of broadcast receiver, it is quite possible and practicable to use three and even four stages in a super-heterodyne. Also, the amplification per stage in the latter is considerably higher than that of the average broadcast receiver.

But with all this sensitivity and volume there is still another feature to recommend this type of receiver—its selectivity. In spite of the good already accomplished by the radio commission in Washington, there is still an overcrowded condition on the air as every radio listener knows. The old days when any number of out of town stations could be tuned in during the early evening when the locals were going full force, and with an ordinary receiver, seem to be gone for good. If one desires to listen to out of town stations now he must, except in rare instances, burn the midnight oil to do it. But not so with a good super-heterodyne receiver. With such equipment the local stations are confined to one or two degrees on the dials. With such confinement, and with local stations spaced approximately seven degrees apart on the dials as they now are with an up-to-date receiver and the 50 kilocycle separation between stations that now prevails, it is evident that there is plenty of room between the local stations for going far afield in the world of DX.

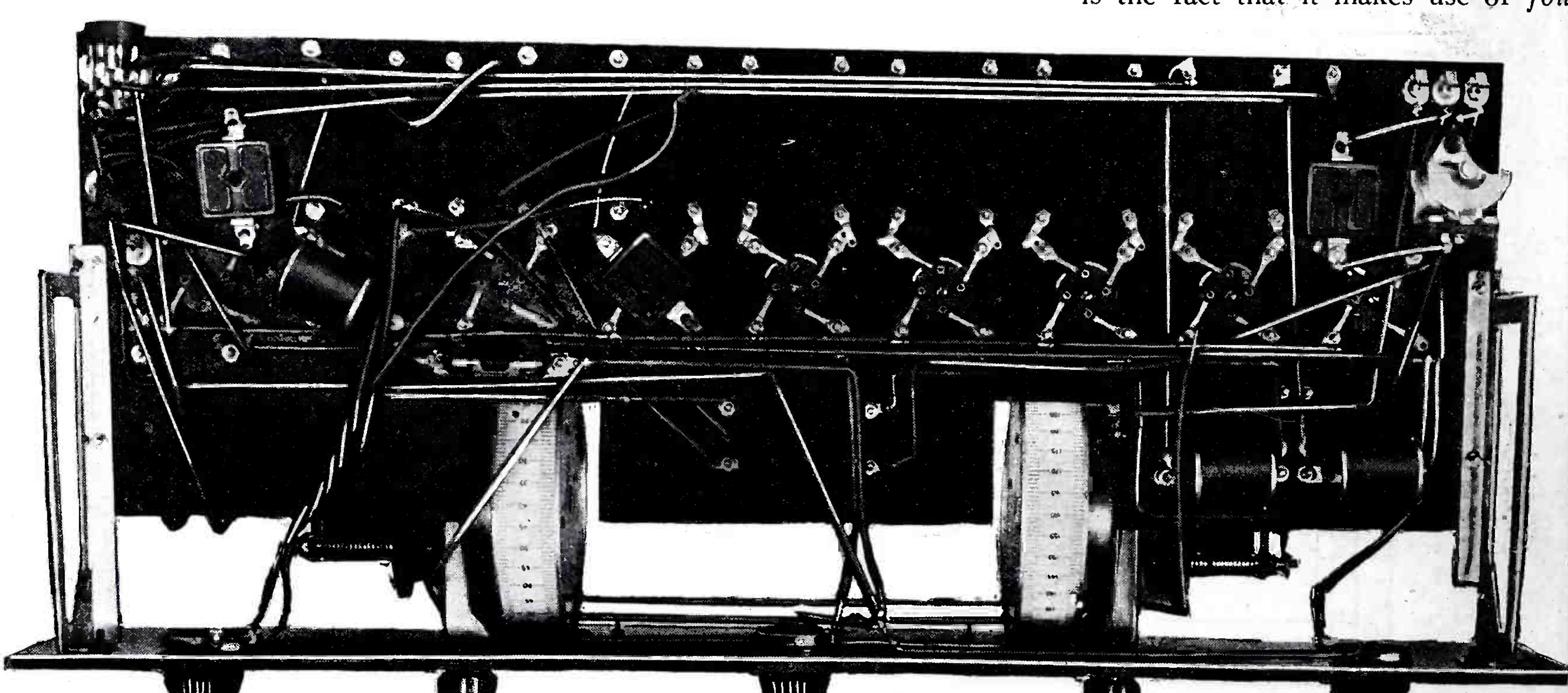
There have been constant improvements in the super-heterodyne receiver. The fundamental circuit remains pretty much the same but almost unbelieveable refinements have been made in the parts used in the circuit. The original receivers of this type were extremely complicated in operation and in the construction. If memory serves correctly there were something like 34 adjustments to be made in some of the earlier models in order to bring them up to full efficiency.

Perhaps nowhere are the numerous refinements in this circuit exemplified as in the H. F. L. "Nine in Line" super-heterodyne receiver. The physical simplicity is evident from the top and bottom views of the receiver, shown below. The circuit itself is rather complex; although not more so than that of other super-heterodyne receivers; but the design of the individual parts and the carefully designed layout result in the most simple kind of assembly and wiring. The entire receiver, in spite of its nine tubes, requires less connecting wire than many three tube receivers. The grid and plate leads are all short and direct and there is no possibility for the constructor to go wrong.

An unusual feature of this receiver is the fact that it makes use of *four stages of intermediate frequency amplification* to provide unprecedented sensitivity, and *two of these are sharply*

LIST OF PARTS REQUIRED FOR THE NINE-IN-LINE

3 H. F. L. No. H210, iron core intermediate frequency transformers; T1, T2, T4
2 H. F. L. No. H215, air core intermediate frequency transformers; T3, T5
2 H. F. L. No. C.16, audio frequency transformers; T6, T7
1 H. F. L. No. L.425, R. F. Choke coil unit; RFF
1 H. F. L. No. L.430, Oscillator coupler unit; OC
1 H. F. L. No. C.25, output transformer; OT
9 Benjamin Sub-panel mounting sockets No. 9044
2 Remler .0005 mfd. variable condensers with drum controls; C1, C2
1 pair Benjamin No. 8629 Sub-panel brackets
1 Hammarlund, .000045 mfd. midget variable condenser; C3
2 Carter 1 mfd. by-pass condensers; C5, C6
1 Carter .0005 mfd. fixed mica condenser; C4
2 Carter .002 mfd. fixed mica condensers; C7, C8
1 Carter No. M-S6 combined 6 ohm rheostat and battery switch; R1-S.
1 Carter No. M-6, 6 ohm rheostat; R2
1 Amperite No. 3-A or Carter, ¾ ampere filament resistance unit; R4
1 Jones, Type B M, Multi-Plug, connection cable
5 Carter No. 10 tip jacks
1 Formica panel, 7" x 26"
1 Formica sub-panel, 7" x 24"
1 Carter 200,000 ohm variable resistance; R3
1 Excello console cabinet
1 Bodine, De Luxe loop
1 package Kester radio solder
Flexible, insulated hook-up wire.

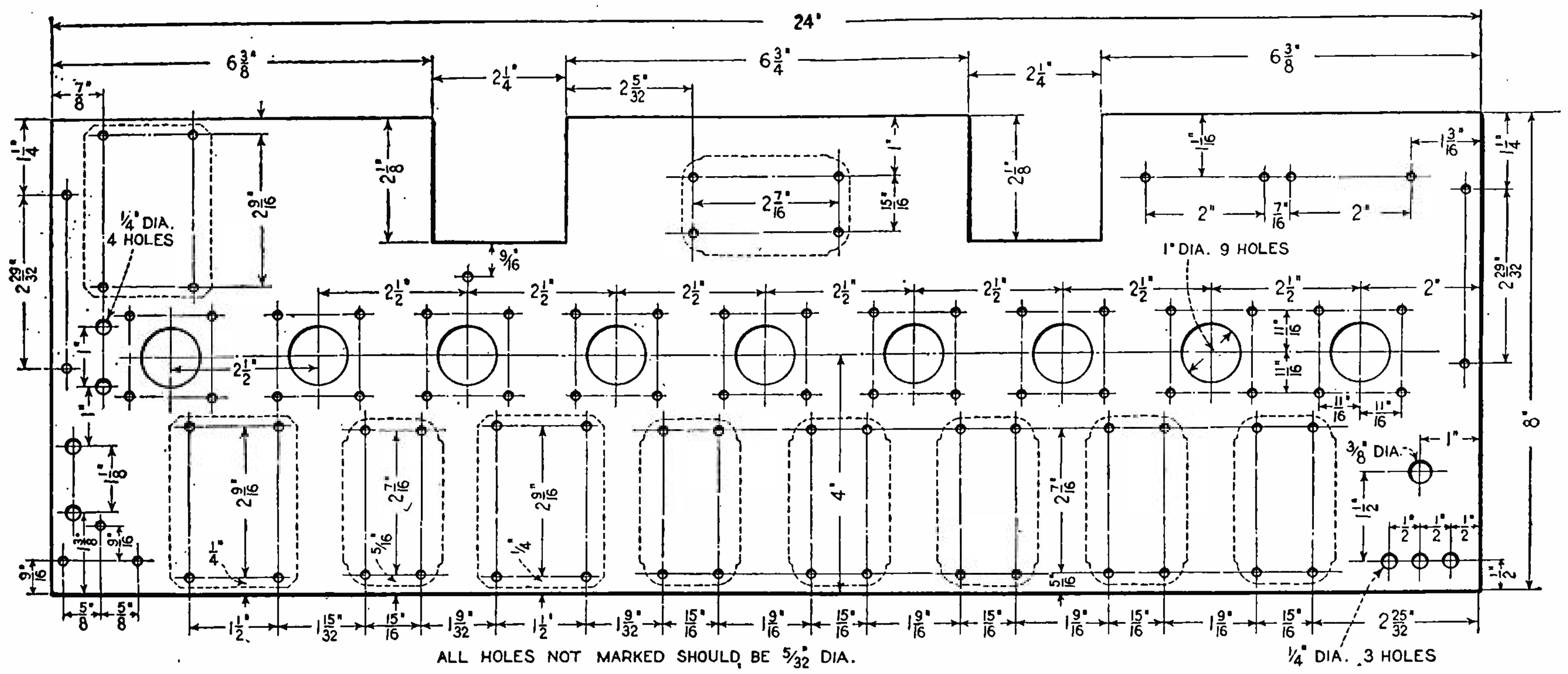


A view of the set from beneath the sub-panel showing the placement of parts and wiring.

tuned to provide a degree of selectivity even in excess of the average good super-heterodyne receiver.

The intermediate-frequency amplifier consists of an untuned input transformer followed by another untuned transformer in the first stage. Next tuned transformer, the output of this stage is in the form of a narrow frequency band. But wishing to go even further than this the designers of this receiver added another untuned, intermediate stage for the sake of additional amplification, and followed this with a plifier stage is obtained, without adding another tuning control.

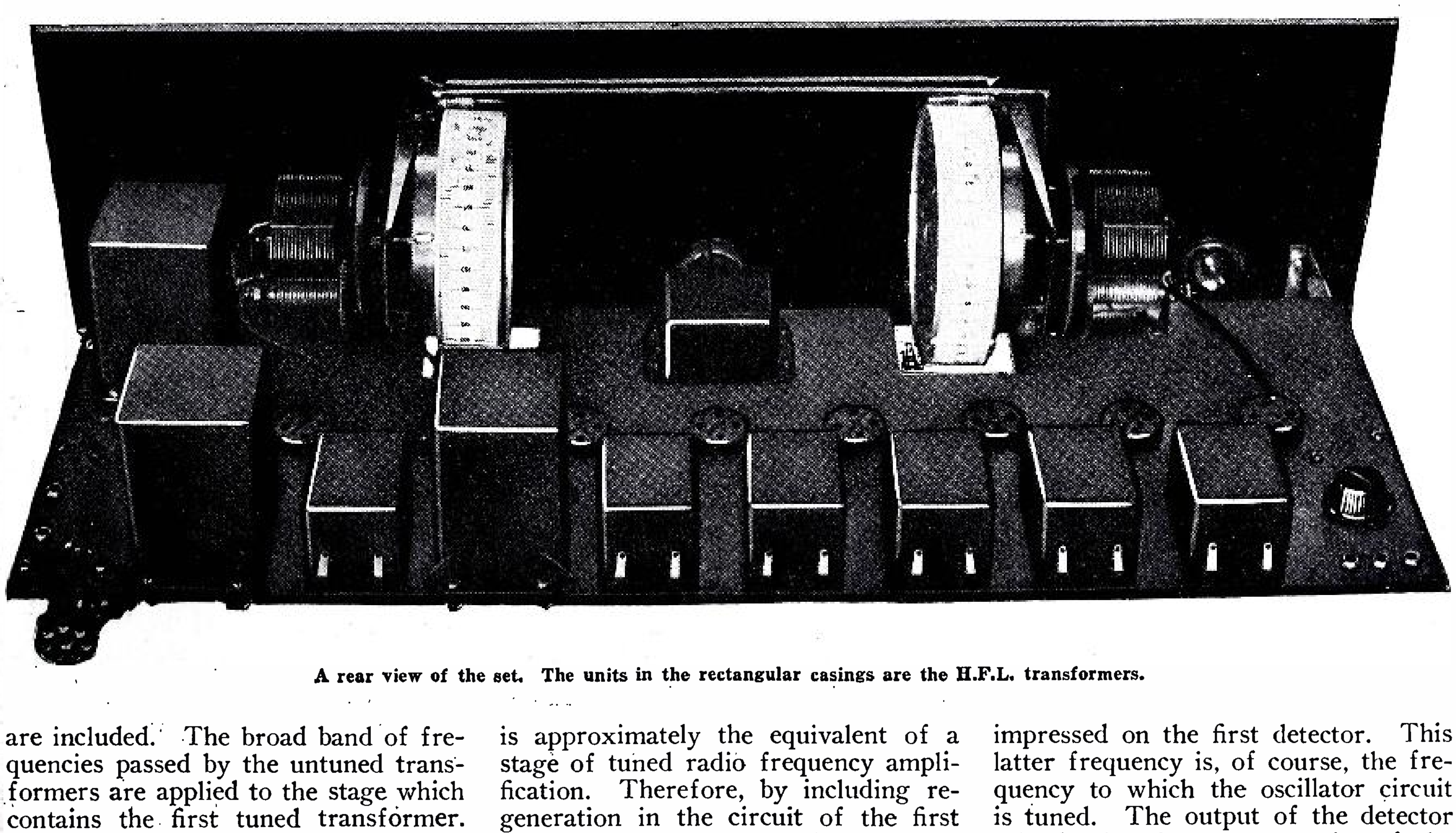
The input and frequency changer circuits are not unusual and employ a tried and true circuit. The broadcast signal energy picked up by the loop antenna is applied to the grid of



The drilling specifications for the sub-panel of the Nine-in-Line.

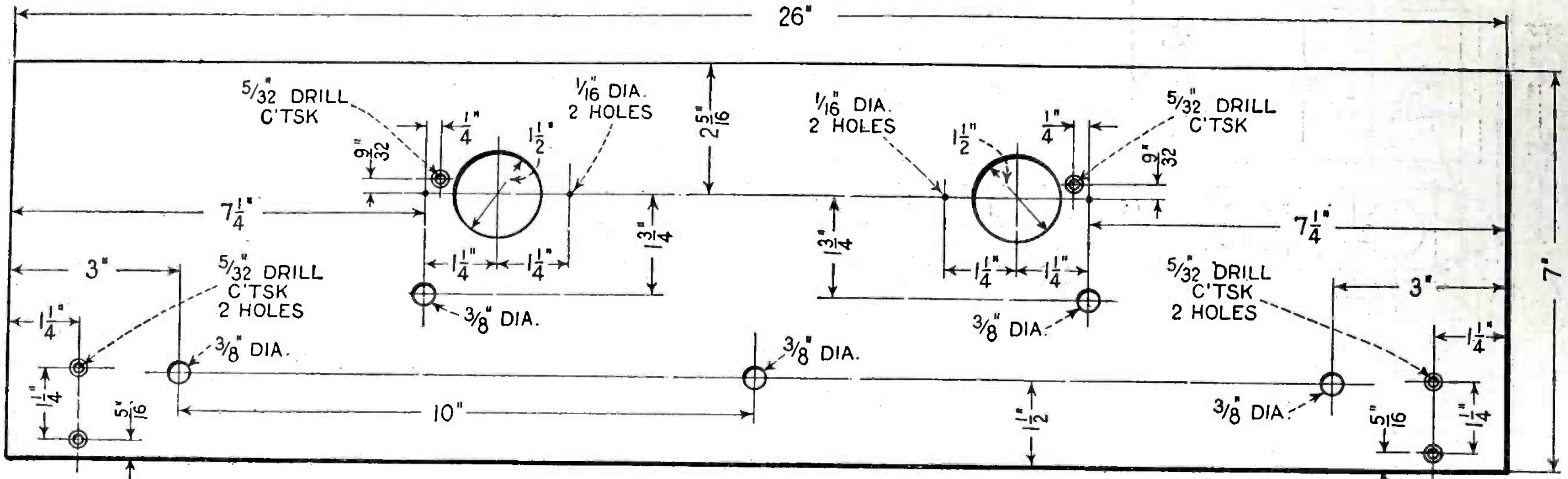
comes a tuned transformer, then an untuned transformer in the third stage and this is followed by another tuned transformer. Each of the untuned transformers will pass a wide band of frequencies. Their function is to provide coupling which will result in a high degree of amplification. But selectivity cannot be neglected and it is for this purpose that the tuned transformers second tuned stage, for greater selectivity. This arrangement will surely appeal to the radio fan as being a most logical method of obtaining the maximum sensitivity and selecitivity.

Another feature which tends to increase sensitivity is the inclusion of regeneration in the circuit of the first detector. It is a known fact that regeneration, at broadcasting frequencies, the first detector tube, VT1. The regeneration in this circuit is provided by the center tapped loop and is controlled by the midget variable condenser C3. In the lead from the loop to the grid of the first detector a small coil is inserted and this coil is coupled to the tuned circuit of the oscillator, VT2. Through this coupling medium a locally generated frequency is also



A rear view of the set. The units in the rectangular casings are the H.F.L. transformers.

are included. The broad band of frequencies passed by the untuned transformers are applied to the stage which contains the first tuned transformer. Because of the effect of this sharply is approximately the equivalent of a stage of tuned radio frequency amplification. Therefore, by including regeneration in the circuit of the first detector the effect of an additional am- impressed on the first detector. This latter frequency is, of course, the frequency to which the oscillator circuit is tuned. The output of the detector tube is therefore a composite of the two impressed frequencies. An incoming signal of any frequency can be changed to any other pre-determined frequency by simply varying the frequency of the local oscillator. In this particular case it is desired to have the detector output correspond in frequency to that to which the intermediate amplifier is tuned. This is accomplished by tuning the detector input circuit by means of the condenser C1 to the wavelength of the broadcasting station to which it is desired to listen, and then adjusting the oscillator tuning condenser to a frequency which will combine with the incoming signal frequency to form a third frequency equal to that to which the intermediate amplifier is tuned.



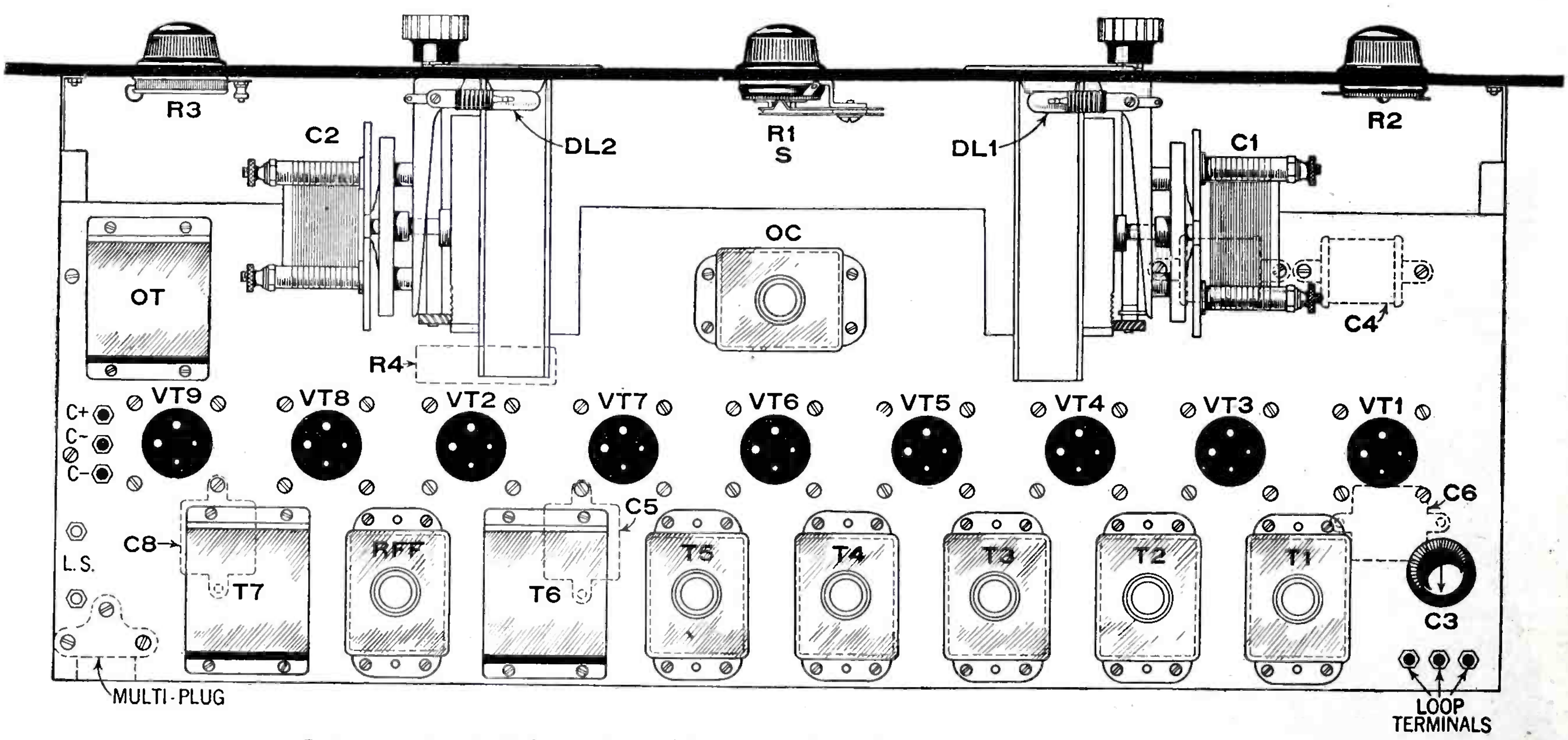
Dimensions for drilling the front panel. The two large holes are for the drum dial windows.

The two variable condensers C1 and C2 are therefore the only tuning controls for the entire receiver. The principle of frequency changing as described may sound complicated but in tuning this principle may be forgotten and tuning accomplished in just the same manner as with any two control receiver. For all ordinary reception the regeneration control condenser C3 may be set at zero and left that way. The only time it is used is when it is desired to tune in some very distant station, in which case it can be moved up until the detector circuit is just below the oscillating point.

After the signal passes through the intermediate amplifier it is impressed on the grid of the second detector, VT7. Here the "plate detection" method is used, which eliminates the grid leak and grid condenser. The signal then passes on through the two stage audio frequency amplifier. Normally the output of the second audio stage would be too great in volume, even on distant stations. To permit the operator to control volume to suit his taste a variable resistance, R3, is included across the secondary of the first audio transformer. This resistance is mounted on the panel and is controlled by means of the knob shown at the right hand end of the front panel.

In order to protect the loudspeaker winding from the high direct current flowing in the plate circuit of the power tube used in the last stage, an output transformer, OT, is included in this circuit. The direct current can flow only through the primary of this transformer, while the useful, alternating current which comprises the signal energy is transferred to the secondary by induction and flows on through the speaker winding.

The construction of the receiver can be accomplished through the diagrams and illustrations which accompany this article. The panel and sub-panel templates are given, and show the location of all instruments. All of the parts except the condensers and resistances are identical in form. Each of these bears a type number, and these type numbers are shown in the layout diagrams so there is no possibility of the constructor misplacing any of the units.



Instrument layout of the receiver. All parts are lettered to correspond with wiring diagrams.

The "Nine in Line" receiver employs eight tubes of the 301-A type and either a 312 or a 371 type in the last audio stage, which is the last socket at the right. If a "B" supply of over

(*Continued on page* 136)

The New World's Record Super 10

by Felix Anderson

HEADING a long line of highly efficient superheterodynes, the new World's Record Super 10 is the latest development of E. H. Scott, well-known designer of the original World's Record Super with which so many distance records have been made.

Those who have followed the history of the various models of superheterodynes which Mr. Scott has designed, each one developed for maximum distance, highest selectivity and truest tone quality, will now find in the new World's Record Super 10 as described herewith a culmination of all the virtues of its predecessors, with generous use of all the latest refinements of proven merit.

In sharp contrast to the previous models the new Super 10 is designed for antenna operation in answer to the requests of thousands of superhet experimenters who wanted to secure the highest amount of original radio frequency pickup possible and who felt that their loop was not able to furnish it, usually because of absorption conditions in their own location.

With antenna operation it then became possible to use two stages of tuned r.f. ahead of the detector and thus provide that tube with a signal the strength of which would never be possible with the loop pickup arrangement. Under ordinary conditions this would have been a matter of added controls and a possibility of an unbalanced set. However, with the Remler three gang condenser the two added stages of r.f. as well as the tuned detector stage may be operated effectively and with the same major control used in other loop operated superheterodynes. The oscillator, of course, is operated on a single condenser.

As others have found when using tuned r.f. ahead of a super the question of designing radio frequency coils that would match and permit peak efficiency over the entire scale, became an important one. Therefore, the especially designed radio frequency couplers as employed in this set assure perfect operation. These couplers, as the photos show, are housed in the same type of containers that enclose the intermediate frequency transformers, so all units present a similar and compact appearance.

PARTS REQUIRED FOR NEW WORLD'S RECORD SUPER 10

- 1 Formica Panel, drilled and engraved, 26x7x3/16
- 1 Formica sub-panel, drilled 25x10x 3/16
- 1 Remler 3 in line condenser No. 633 .00035
- 1 Remler condenser No. 638 .00035
- 2 Remler Drum dials No. 110 (1 each 110 & 110-R)
- 2 Remler R.F. Choke Coils No. 35
- 2 Thordarson Audio transformers R200
- 1 Thordarson output transformer No. 76
- 2 Selectone L.W. transformers No. B 500
- 2 Selectone L. W. transformers No. B 510
- 2 Selectone R. F. transformers No. 520
- 1 Selectone Antenna Coupler No. 530
- 1 Selectone Oscillator Coupler No. 540
- 10 Benjamin Sockets (without bases)
- 1 Pair Benjamin brackets No. 8629
- 1 Carter Imp Rheostat IR-15 Ohms
- 1 Carter Imp Rheostat IR-30-S Ohms (with filament Switch)
- 1 Carter Power Rheostat MW-1 Ohm
- 1 Carter Imp Pot. IR-400 Ohms
- 1 Carter fixed condenser .00025 with grid clips
- 1 Carter fixed condenser .002
- 1 Pair No. 10 Carter pin jacks
- 1 Jewell Voltmeter 0-8 Volts, type No. 135
- 4 Tobe By-Pass condensers 1 Mfd.
- 1 Tobe grid leak
- 1 Jones 10 contact Multi-Plug and 4 ft. cable
- 40 soldering lugs and Kester radio solder
- 30 Feet Belden rubber covered hook-up wire

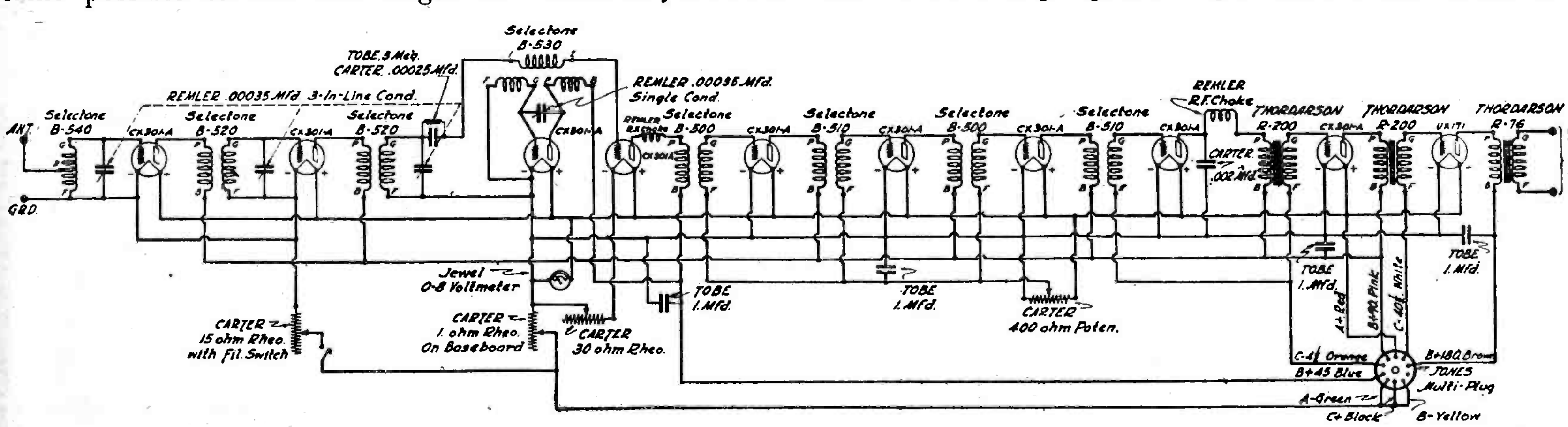


Fig. 1. Wiring diagram of the new World's Record Super 10. All connections are clearly indicated to correspond with markings on the component parts of the set so the constructor will have little difficulty in following this diagram.

The frequency values of the transformers used in this set are very closely matched and the same applies to the r.f. couplers, with the result the entire r.f. and i.f. train funct ns with a great receiver, with its controls cut to a minimum consistent with ample flexibility. In Figure 5 may be seen the scaled drawing of the front panel, while Figure 6 gives the builder a correct and of the .00035 mfd. sections of the Remler three gang condenser, the full scope of the broadcast band is covered; that is, from 1500 kc at the lowest wavelength to 550 kc at the highest.

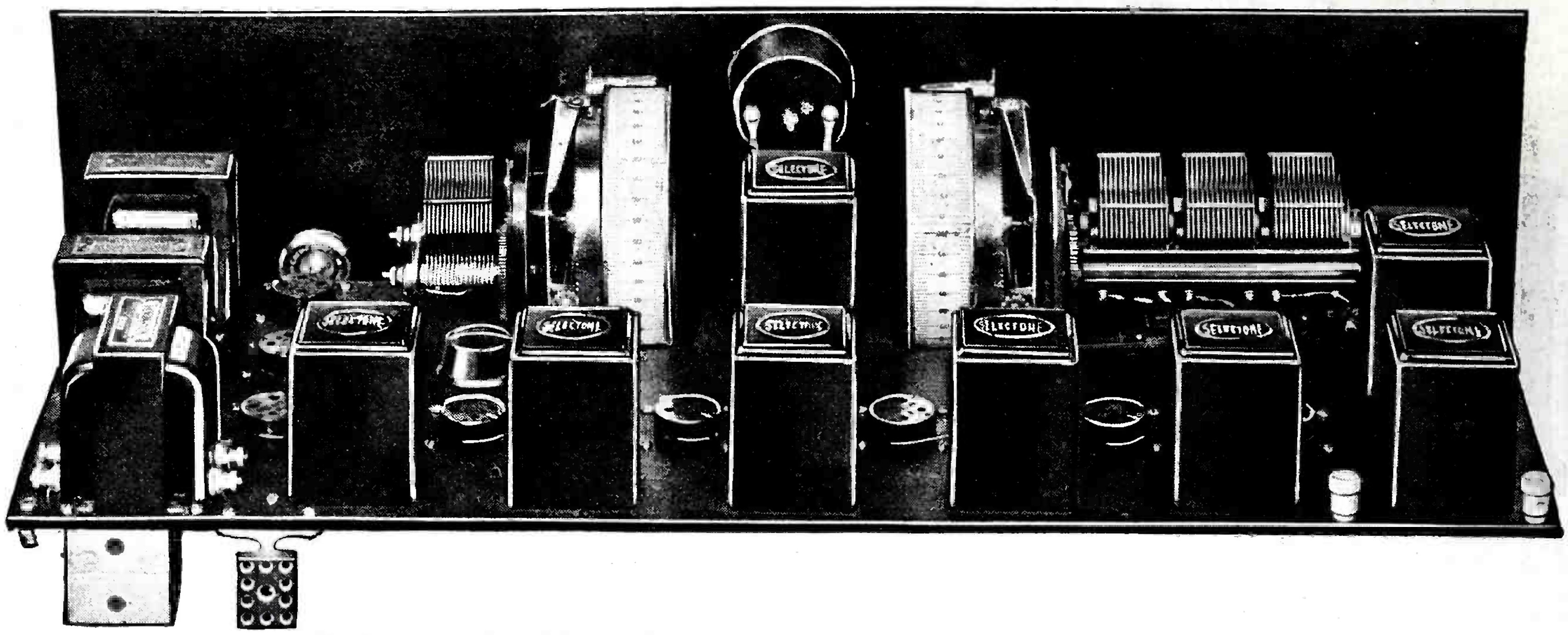


Fig. 2. A rear view of the set showing the arrangement of parts mounted on the sub-panel.

degree of efficiency. In the case of the audio transformers, the two Thordarson type R-200 will give exceptionally good audio quality.

Before going into the constructional description of this circuit the reader might secure a keener understanding of the receiver by examining the photographs and diagrams which accompany this article.

Schematically the receiver is illustrated in Figure 1. A rear view of the completed set is found in Figure 2. exact method of duplicating this latest model superheterodyne, showing the exact position of each part.

Because of its subpanel construction the assembly of the set is even easier than in previous models. All leads may be carried below the subpanel and as a result lengthy leads are eliminated. Either flexible wire, or solid busbar may be used in hooking up the set, depending upon the desires of the home constructor.

Examining the schematic diagram, Succeeding the first r.f. stage is the type B-520 of which there are two, one in the second r.f. and one in the detector stage. The inductance value of these two units is identical with that of the first one, and the range is covered with the three section condenser. Each condenser section on the Remler gang is isolated from the next, and a small trimmer capacity is provided to balance the main capacity and to correct any slight inequality that may exist due to differences in wiring. Once these

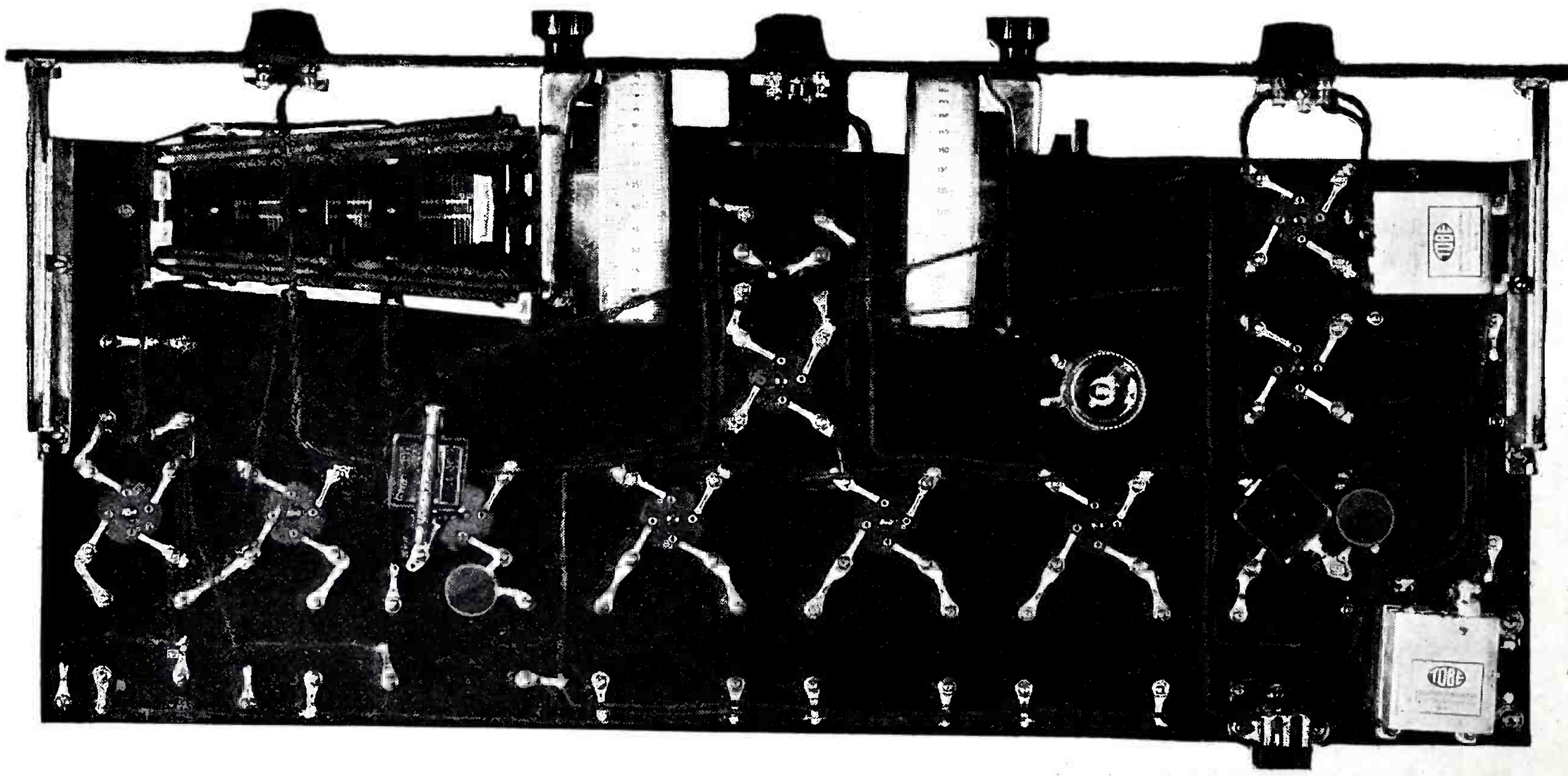


Fig. 3. The layout of parts and wiring beneath the sub-panel.

Extremely short plate and grid leads are to be seen in the photograph showing the bottom sub-panel view of the Super 10, Figure 3. Figure 4 gives the builder an idea of the beauty of the from which of course all wiring should be done, we see the first r.f. coupler, designated as Selectone B-540. It consists of an inductance tapped for antenna connection. When tuned by one trimmer capacities are set, if that is required, they are left alone and the r.f. train will remain in balance.

No regeneration is used in the detector stage, this being another departure from previous models made necessary when two added stages of r.f. are used. It also results in leaving off one minor control, adding to the simplicity of the set's operation. Sensitivity control in the first and second r.f. is accomplished with a 15 ohm rheostat. This rheostat is placed in the negative filament where it is common with the negative B battery, the positive of the C battery, and with the ground, and the control is quite smooth and effective. It also has combined with it the filament switch.

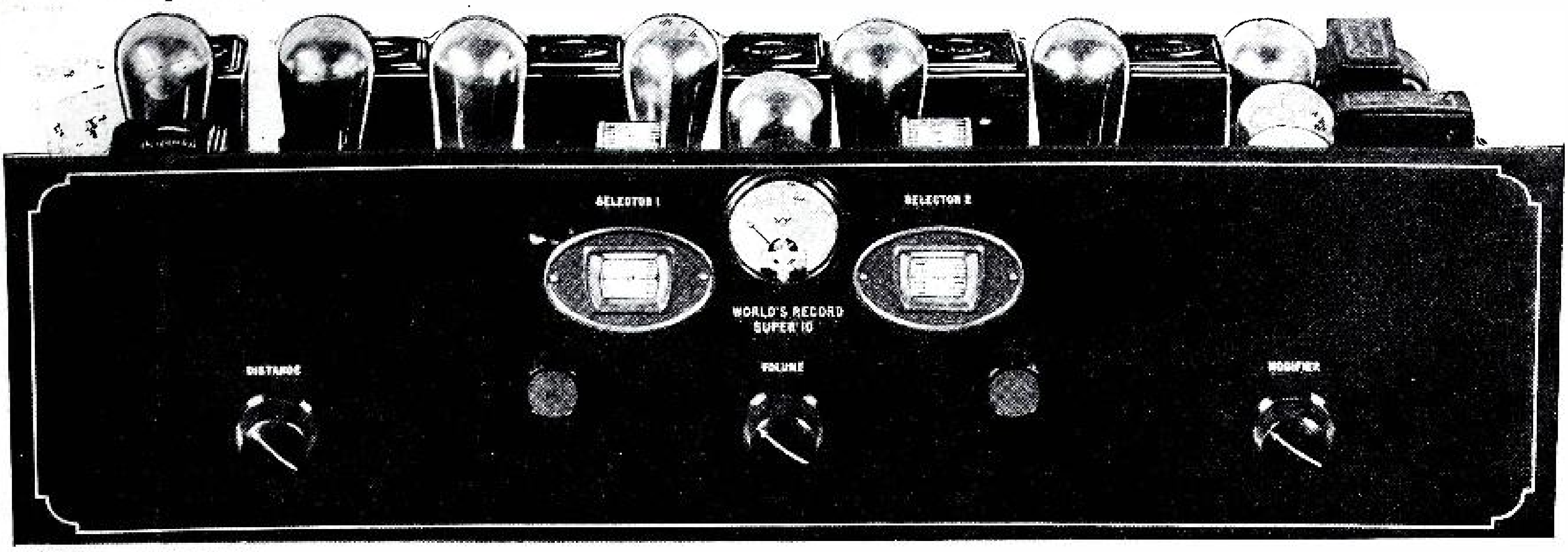


Fig. 4. A close-up of the front panel. Balance in panel design is another feature of this new set. The number of controls have been reduced to minimum consistent with ample flexibility.

On the first detector another refining control is used in the form of a 30 ohm rheostat in series with the 1 ohm rheostat supplying the oscillator, first, second, and third intermediates, second detector, and first and second audio. With the detector rheostat the input to that stage may be altered at will, being reduced on locals and increased on distant signals.

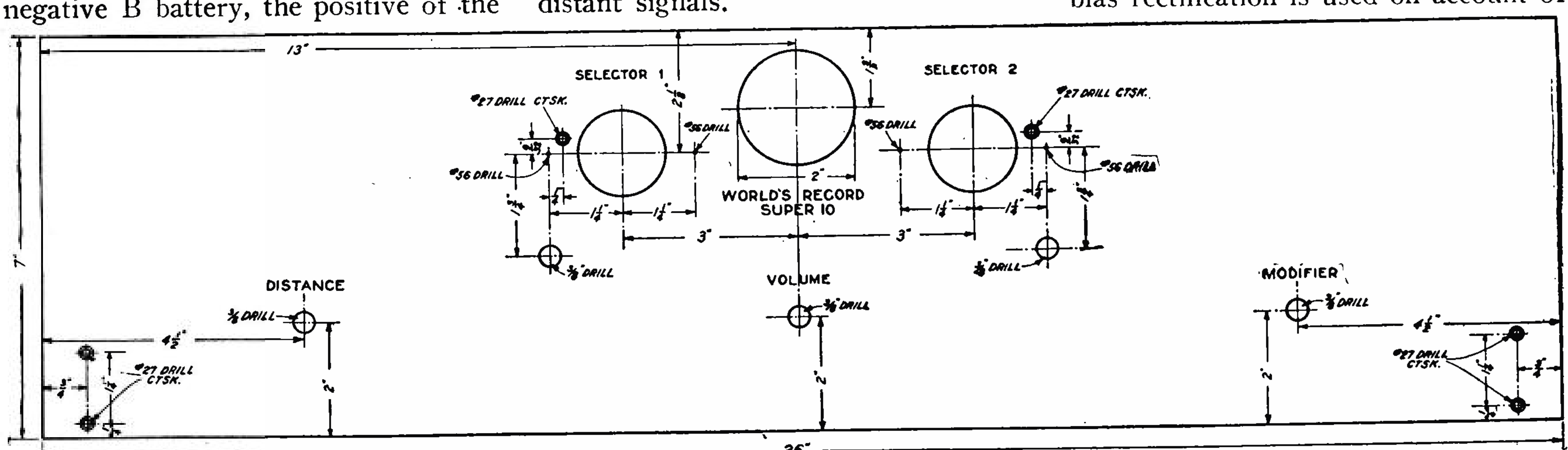


Fig. 5. The panel drilling layout of the set with dimensions.

The Selectone transformers, accurately peaked and matched, are located ahead of the second detector, there being two type B-500 transformers, and two type B-510. The oscillator, for plate to grid tuning with a .00035 mfd. Remler variable condenser (single) is shown as Selectone type B-530. Its pickup winding is placed in series with the grid of the first detector where grid leak and condenser rectification is used.

In the second detector circuit grid bias rectification is used on account of greater stability, less possibility of detector overload and freedom from noise. The bias for detection is fur-

(*Continued on page* 152)

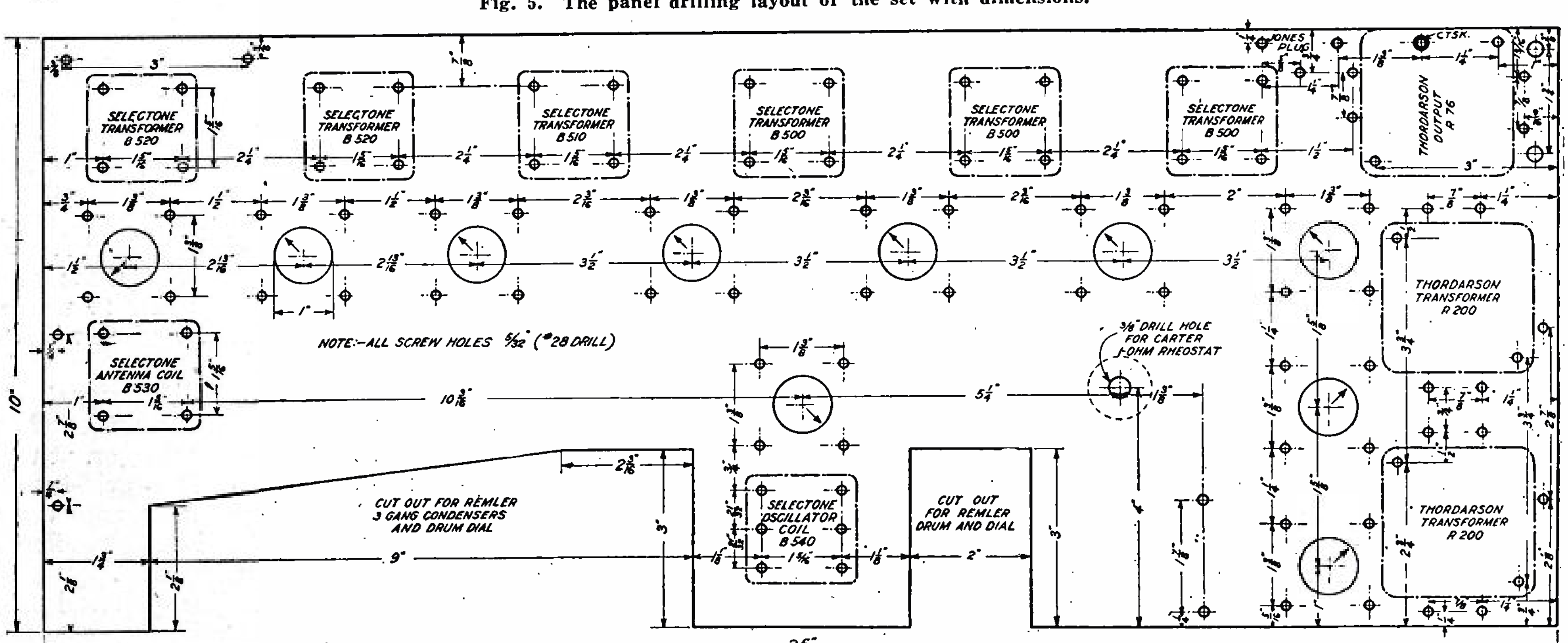
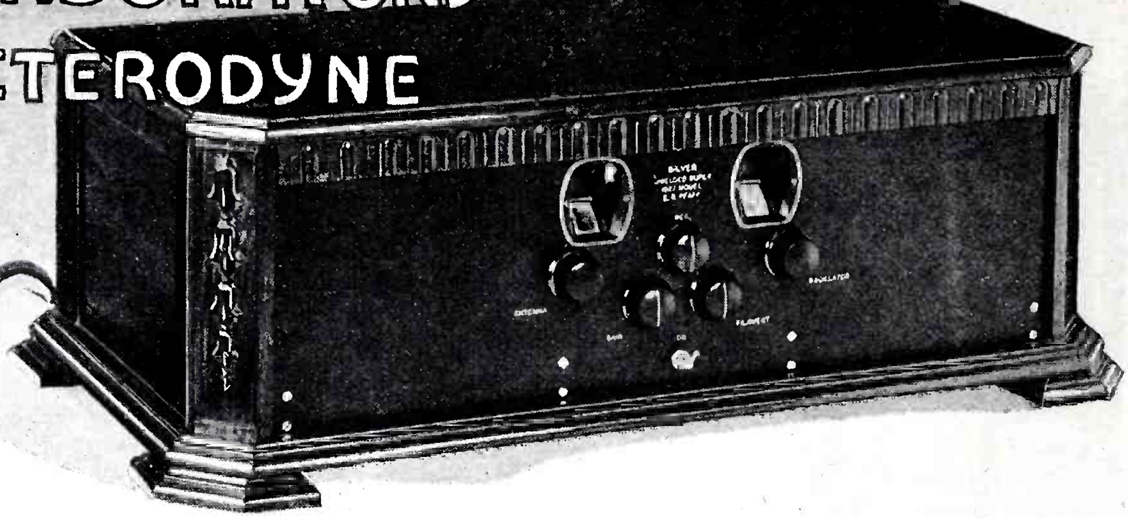


Fig. 6. Sub-panel drilling layout giving placement of parts.

The Improved Laboratory Super-Heterodyne

By E. R. Pfaff



IN the Improved Laboratory Super-Heterodyne is at last found a receiver free of the almost age-old bugaboo of individually matched long wave transformers, for the long wave amplifier is a sealed, laboratory-calibrated unit that will not vary one kilocycle in operation with standard tubes. Almost every builder of a super-heterodyne has either been disappointed in his set's not possessing the expected knife-like selectivity, or, if he has employed really sharp, efficient transformers, they only too frequently do not function properly. This condition is not always due to the individual transformers not having been properly matched to begin with, but because individual assembly conditions result in altered circuit capacities and operating conditions which do not duplicate the laboratory conditions under which the transformers were first matched. Then, again, any of the popular iron-core 30, 40, 50 or 60 kilocycle transformers have very low winding capacities, for operation with low circuit, and low tube capacities. Since the operating frequency of the transformers is largely determined by the total circuit capacity, and since winding capacity is low, it follows that any small variations in wiring, assembly, or tube capacity will represent a large proportionate change of the total capacity, with the result that individual receiver stages built with accurately matched transformers may often be as far as 15 to 20 kilocycles apart. This, of course, means little or no selectivity, even if there still remains fair amplification.

The logical way to build an intermediate amplifier is to use, not iron-core—air-core transformer combinations, but to follow along the lines of best R.F. amplifier design practice, and use low resistance air-core transformers thruout, tuned with large fixed capacities, so that variations in tube capacities represent such a small percentage change of the whole as to be ineffectual. Exactly this course has been followed in the Laboratory Super, but it has been carried a step farther, and the whole amplifier built into a single, carefully tested unit, so that two causes of variation have been eliminated, and the remaining third—tube capacity—rendered so small a percentage change as not to affect operation. On top of this, the whole amplifier is completely shielded, each of the RF stages and detector being housed in individual compartments of a copper-brass catacomb. The amplifier without shielding is remarkably efficient, but when the shielding is added, the amplification jumps tremendously. Actually, shielding adds at least 50 to 100 per cent in volume on weak stations—exactly as it would intelligently applied to any multi-stage RF amplifier. This is because of the elimination of detrimental feedbacks, always and invariably present with unshielded amplifier stages.

PARTS REQUIRED

1 Van Doorn panel and chassis unit, pierced, with hardware
1 Carter .00015 condenser with leak clips
1 Carter M-200 potentiometer
2 Carter ½ mf. condensers
1 Carter 3 ohm rheostat
1 Carter battery switch
4 Carter No. 10 tipjacks
1 Polymet 2 megohm leak
2 S-M 220 audio transformers
4 S-M 511 tube sockets
2 S-M 805 vernier drum dials
1 S-M 275 RF choke
1 S-M 342 .000075 mf. condenser
1 S-M 440 time signal amplifier
2 S-M 515 coil sockets
2 S-M 111A coils
2 S-M 320 .00035 condensers
9 X-L binding posts

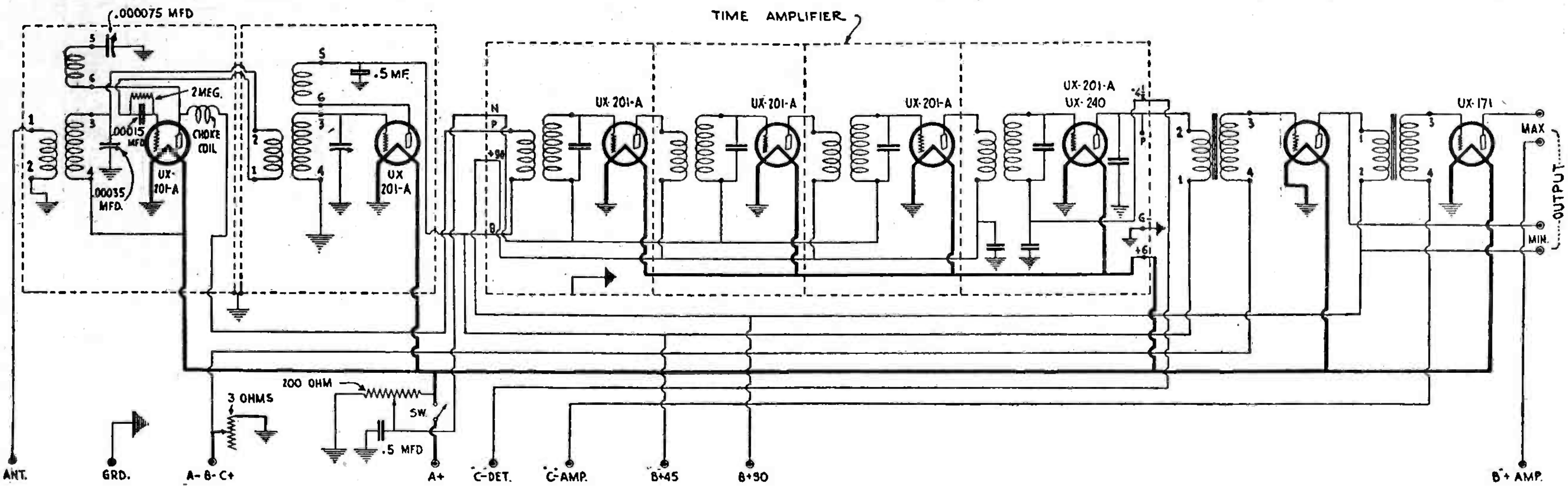
With each chassis should come the following items of hardware, contained in a small envelope:

9 sets binding post insulating washers (1 plain, 1 extruded to a set)
4 sets tipjack insulating washers (1 plain, 1 extruded to a set)
3 sets instrument insulating washers (1 plain, 1 extruded to a set)
27 3/4" 6/32 RHNP brass screws
1 1¼" 6/32 RHNP brass screws
29 6/32 N.P. brass nuts

Eight tubes are employed in the Improved Laboratory Model Super-Heterodyne—a first detector, an oscillater, three long wave amplifiers, a second detector, and two audio stages. The first detector circuit is very similar to the conventional short wave regenerative circuits so popular, and, in fact, on short waves the first detector system alone of the new set will bring in European amateur stations on headphones! The circuit is regenerative, a small 75 mmf. midget condenser controlling regeneration; while a .00035 modified SLW-SLF condenser does the tuning. The coil system is a conventional S-M plug-in coil, so connected that both regeneration and tuning condenser are at ground potential, with consequent total absence of hand-capacity effect. No provision is made to use a loop, as it has been found that for extreme selectivity the use of an antenna—the coupling to which is variable—provides for greater flexibility than a loop.

The oscillator circuit is designed to keep harmonics at a minimum so that stations are heard at but one, or, at the most, two dial points. It is grid-tuned with a 350 mmf. condenser with consequent absence of hand capacity effect. Its output at different wavelengths is sufficiently constant for practical requirements, as is its calibration; while the coupling to first detector is variable.

A copper can 15 inches long, 5 inches wide, and 3 inches deep holds the I.F. amplifier and second detector. It contains four individual stage compartments, each holding an RF transformer and its tuning capacity, a tube socket, and the necessary wiring and bypass condensers. Three RF stages and a detector are employed, with the whole unit tuned to exactly 112 kilocycles. The reason for the selection of this immediate frequency is that very very satisfactory low resistance air-core tuned RF transformers may be built for operation there. If a lower frequency were used, serious cutting of side-bands would result, or poor selectivity as pointed out. The 112-kilocycle amplifier frequency results in decreased interference possibilities. Normally, in a super employing, say, a 50 kilocycle intermediate frequency, two stations 50 kilocycles away will heterodyne each other and be received without the use of the local oscillator at all, selectivity being dependent upon the selectivity of the antenna tuner and the local coil pick-up. As the intermediate frequency is increased, this possibility decreases, since it is far easier for an antenna tuner to discriminate between stations 112 kilocycles apart, than between powerful locals 30, 50, or even 60 kilocycles apart. Further, powerful stations are generally spaced on even 10 kilocycle separations, so that the odd 112 kilocycle frequency is a greater aid to selectivity. Coil pick-up is, of course, absent in the shielded amplifier, and wiring pick-up is almost negligible since all wiring is very close to the grounded metal panel or chassis. Complete shielding of first detector and oscillator sections prevents pick-up of strong local stations on the coil systems themselves, though for receivers to be operated in the country, or in non-congested broadcasting centers, these two shields might be omitted.

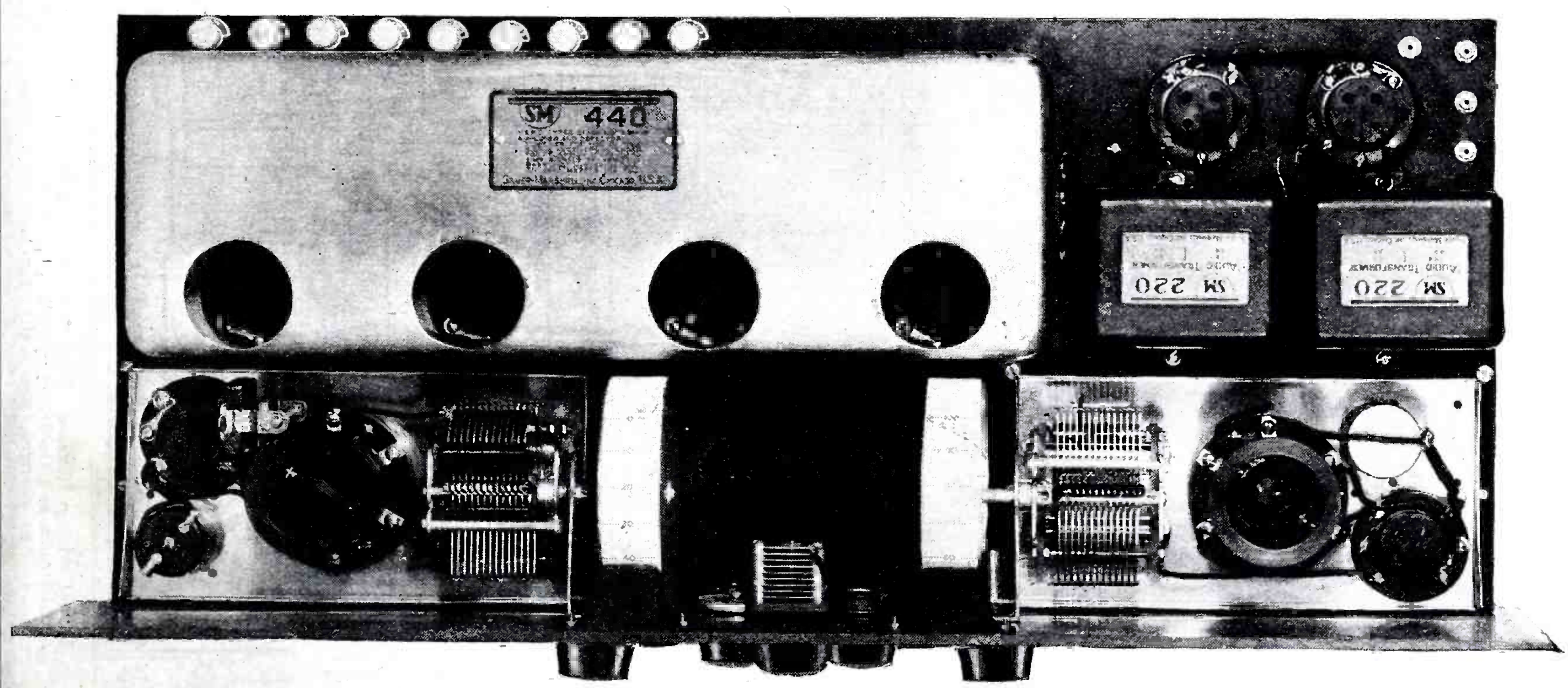


Schematic wiring diagram of the set. The dotted lines around portions of the circuit indicate the parts in shielded casings.

Amplification of the Set

The audio amplifier offers a very unusual point of very great value in an ultra-selective receiver. This is the 5,000 cycle cut-off, or decrease in amplification, which aids receiver selectivity. Frequencies above 5,000 cycles do not contribute to realism of reproduction, according to no less an authority than the Bell Telephone Laboratories, while in the range above 5,000 cycles lie practically all parasitic amplifier noises, atmospheric disturbances and the prevalent heterodyne squeals.

The amplification of the set is tremendous, due to careful design of every individual circuit. The very sensitive first detector gives an amplification of 200 times or more on a very weak signal when carefully operated. The computed, and actual measured gain of each RF stage is about 20, while the gain of the audio stages is also about 20. Regarding the over-all amplification in the most conservative light, a gain of 25 is assumed for the first detector—one eighth that experienced on a weak signal. The gain of the RF amplifier is split in half for the sake of conservatism—to 10 per stage. The audio gain may be considered as 20 per stage. Thus the over-all amplification may be conservatively taken as $25 \times 10 \times 10 \times 10 \times 10 \times 20 \times 20 =$ 100,000,000 times. Considering an average eight tube super employing iron-core transformers, and without as careful first detector design, the computed, and measured gain of a typical popular set works out about as follows: first detector 5, RF averages 5 per stage including second detector, and audio 20 per stage. Thus, $5 \times 5 \times 5$



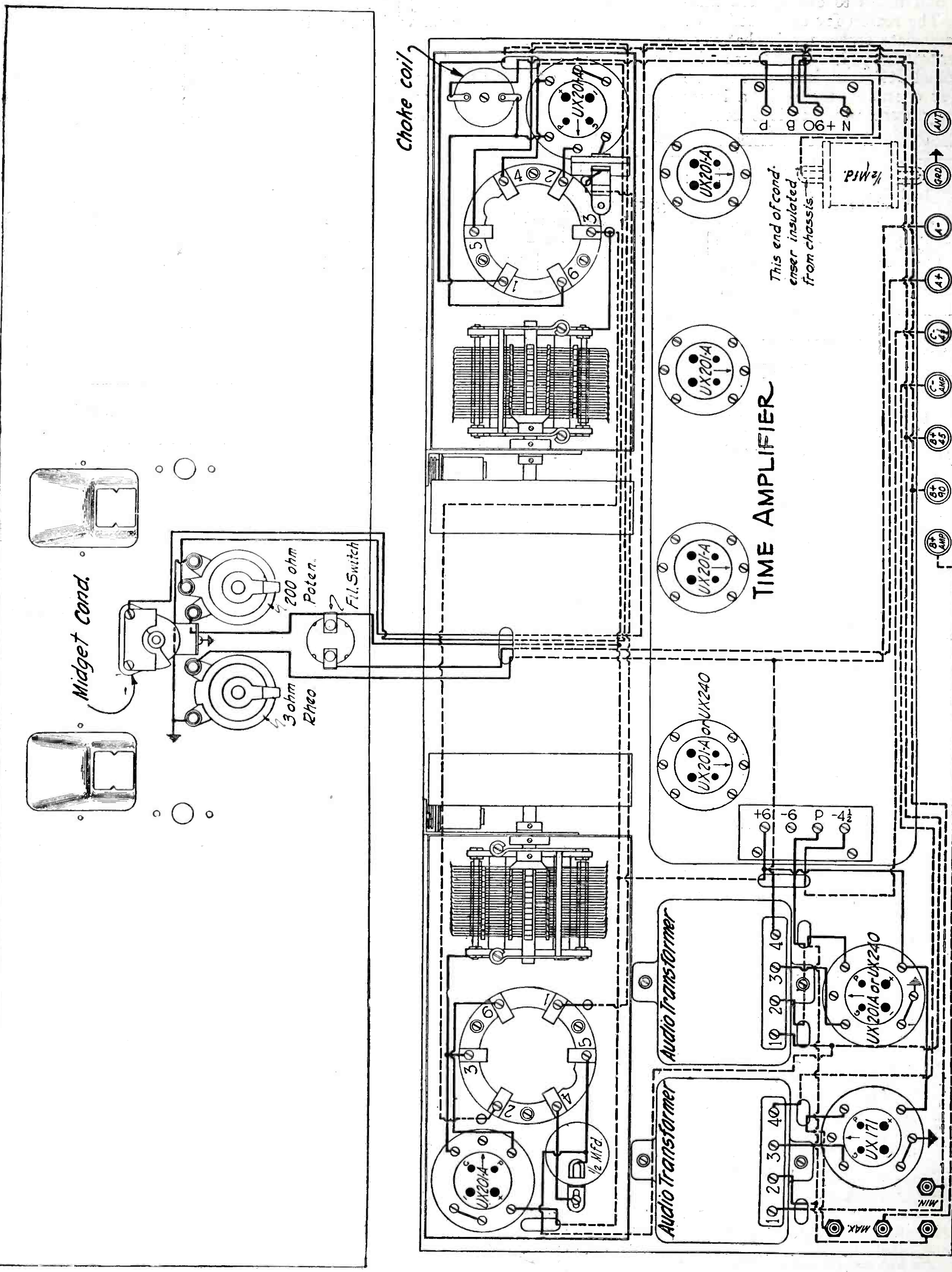
A top view of the Improved Laboratory Super-Heterodyne. The first detector is shielded in the casing in the lower left hand corner of the above photo. The first and second audio stages are seen in the upper right hand corner. The oscillator with the shielded casing is in the lower right hand corner.

$\times 5 \times 5 \times 20 \times 20 = 1{,}250{,}000$ times, or only one eightieth of that of the Laboratory Model!

which it has been tried, either tuned RF or super-heterodyne. Generally, it will bring in on the loud speaker sta-

—simply because every tube is worked to the absolute limit of performance.

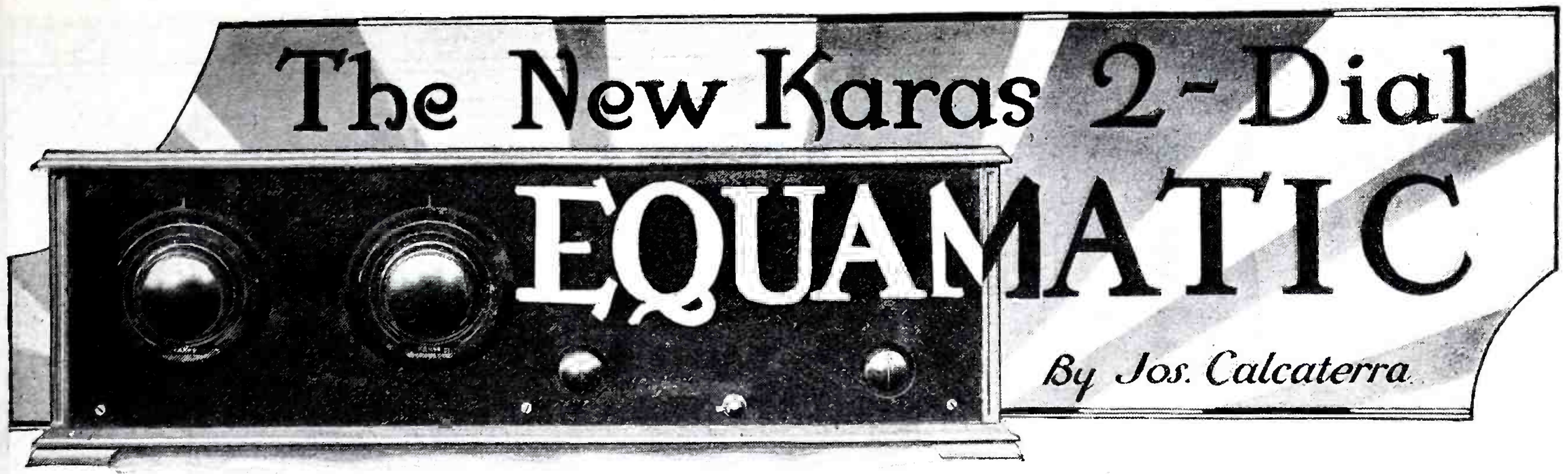
Located in Chicago, the set is selec-



Layout wiring diagram of the Improved Laboratory Super-Heterodyne. All A—, Filament, and Circuit connections made through Metal Chassis, Long Wave Amplifier Shield, and Detector and Oscillator Shields, if latter are used. Oscillator and Detector Stage Shields need not be used, except in congested broadcasting centers. The Circuit may not be changed, practically, for for Loop Operation. Small 20 to 60 feet single wire Indoor Antenna will give greater sensitivity and selectivity.

These figures are borne out in practice, for the Laboratory Set will outperform all other eight tube sets against tions only rarely heard, or not at all on other sets. Compared against two ten tube supers, it out-performed them tive enough to cut thru to out-of-town stations within 10, and sometimes 5 or

(*Continued on page* 122)



The New Karas 2-Dial EQUAMATIC

By Jos. Calcaterra

JUST the other day, in going over some laboratory records of years gone by the writer was brought up with a start to find a number of records of distance reception, accomplished with one tube regenerative receivers. For instance, during the evening of election day, 1920 (or 1921—the records were not clear as to which of these two years) the log of a single tube, three coil honey-comb receiver, operated in New York City, shows reception of radio broadcast programs from St. Louis, Kansas City, Chicago and a number of other mid-western cities. This was not a remarkable record for those days—not by any means. But it is rather startling to realize that practically the same DX ability was demonstrated in those days with from one to three tubes and with no radio-frequency amplifiers, as is accomplished today with the average five and six tube receiver.

Greater distances can be covered today, of course, but on the other hand many of the broadcasting stations are using up to 40 times the power used in the old days. Given the same power at the broadcasting station, it is doubtful that the average present day receiver with its two stages of radio frequency amplification would bring in more distant stations than some of the old one tube receivers. But of course this is not all the story.

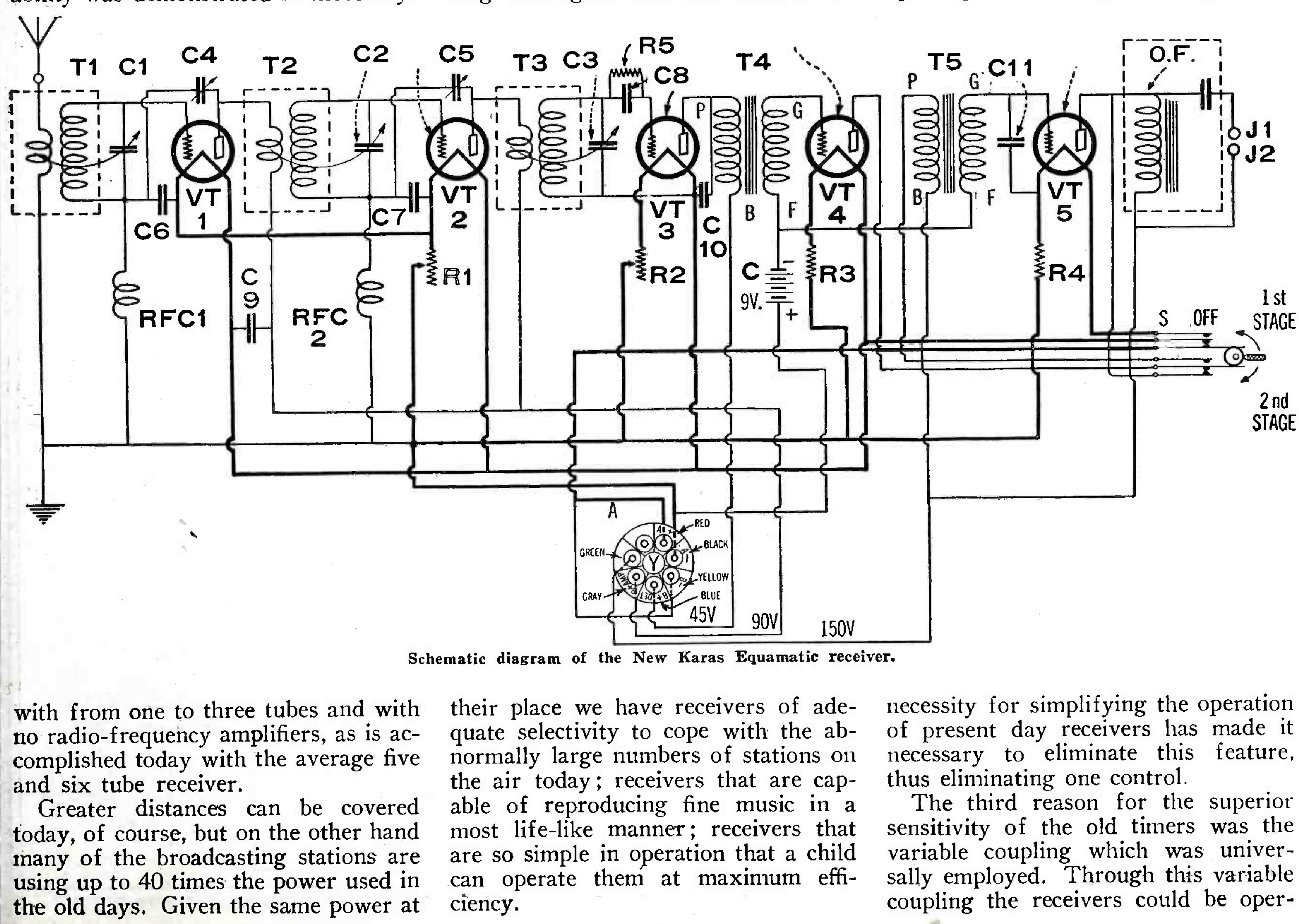
The one claim for the old one, two and three tube sets was sensitivity. They were quite lacking in selectivity—as we know selectivity today. They were likewise innocent of any semblance of good tone quality. They were an experimenter's plaything — and something to strike wonderment to the minds of the uninitiated. But had they continued in existence, radio would not be where it is today.

Fortunately these receivers have long since gone into the discard. In their place we have receivers of adequate selectivity to cope with the abnormally large numbers of stations on the air today; receivers that are capable of reproducing fine music in a most life-like manner; receivers that are so simple in operation that a child can operate them at maximum efficiency.

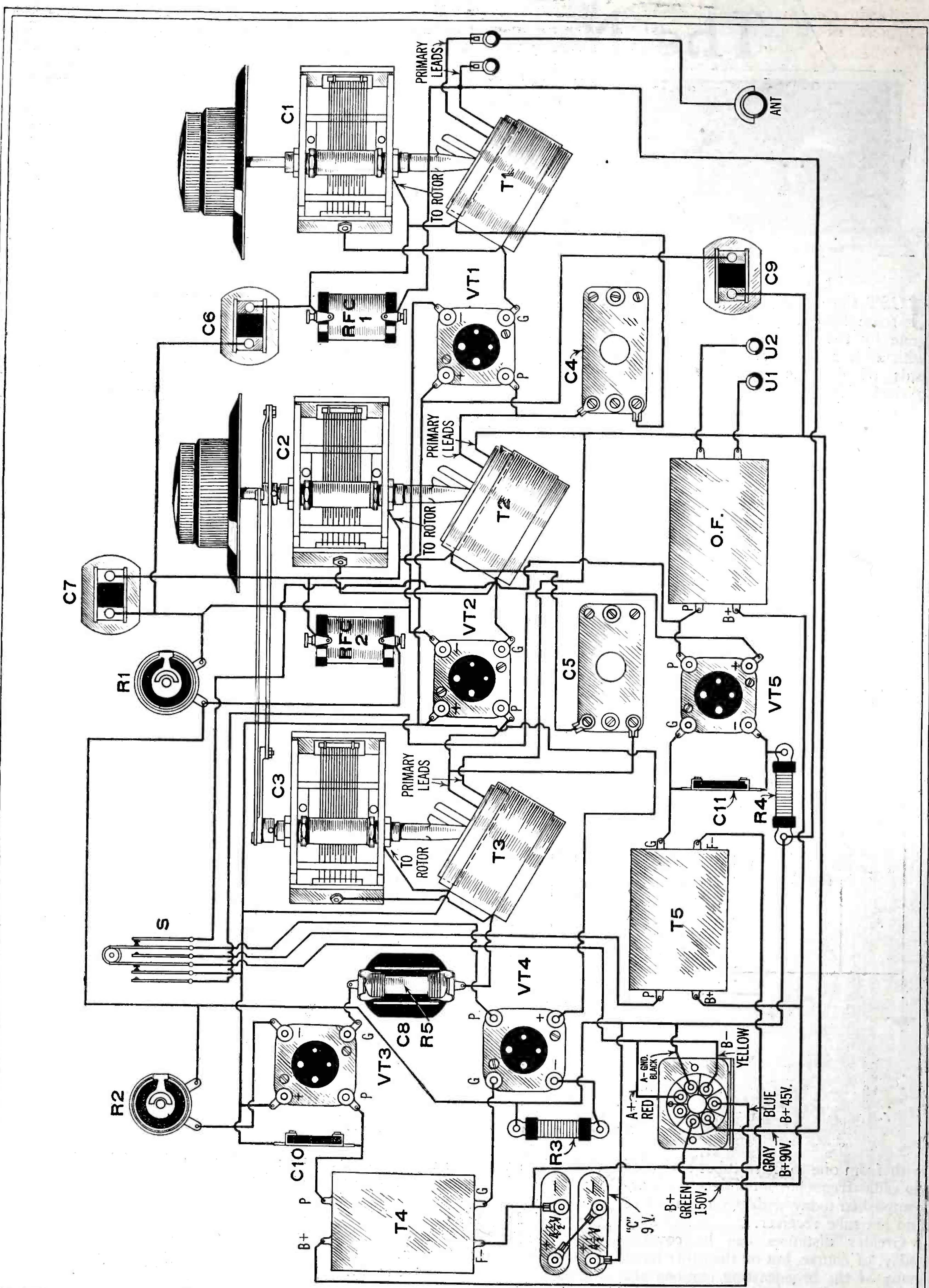
But the comparatively greater sensitivity of the old time receivers provides considerable room for thought. An analysis of their differences from the present day receivers shows three outstanding differences, besides the difference in the number of tubes. The first is that they all employed regeneration and that this regeneration was always under the exact control of the operator. While many of the present day receivers employ regeneration in one form or another, it is either out of control or is so suppressed as to be useless.

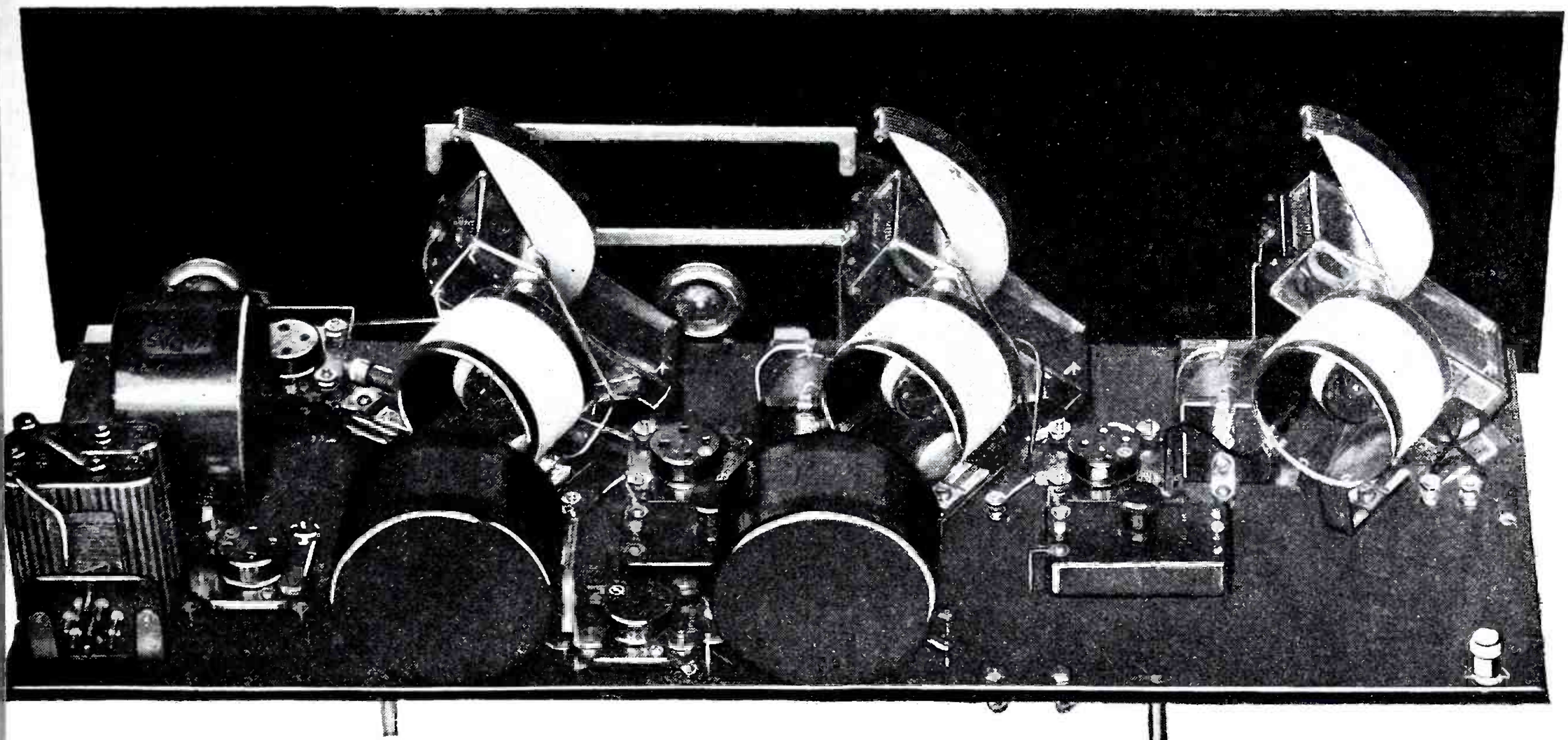
Secondly, the old time receivers usually employed a tuned antenna circuit. This provided the maximum amount of "pick-up" of the signal energy. The necessity for simplifying the operation of present day receivers has made it necessary to eliminate this feature, thus eliminating one control.

The third reason for the superior sensitivity of the old timers was the variable coupling which was universally employed. Through this variable coupling the receivers could be oper-

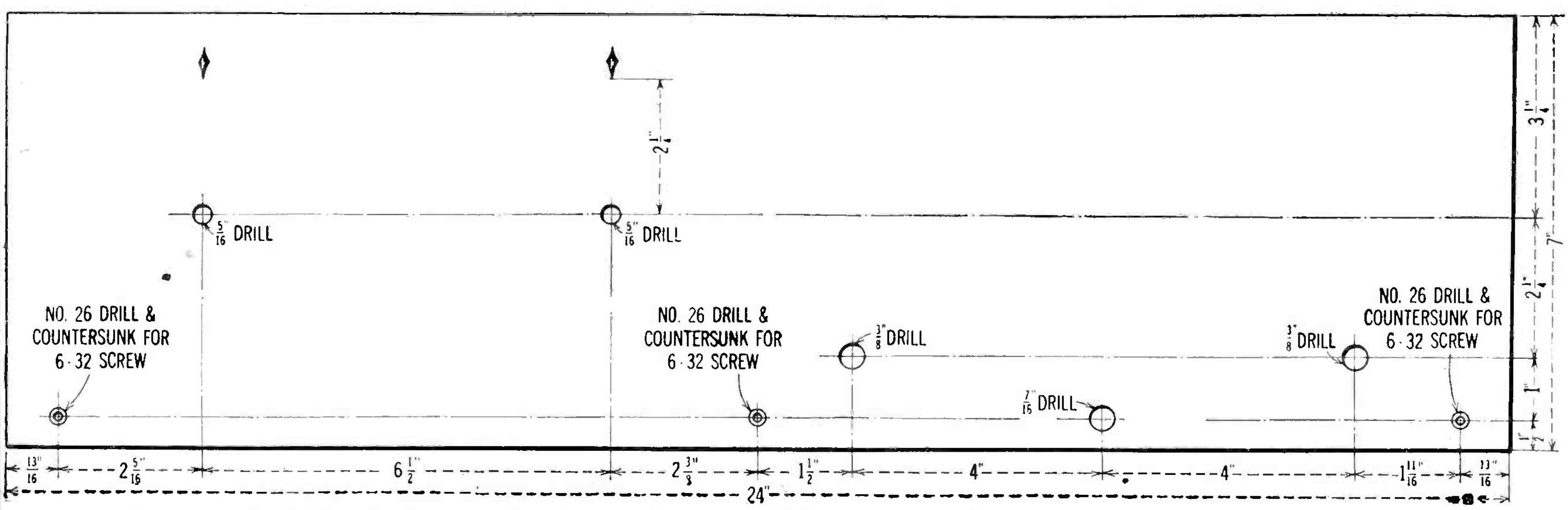


Schematic diagram of the New Karas Equamatic receiver.

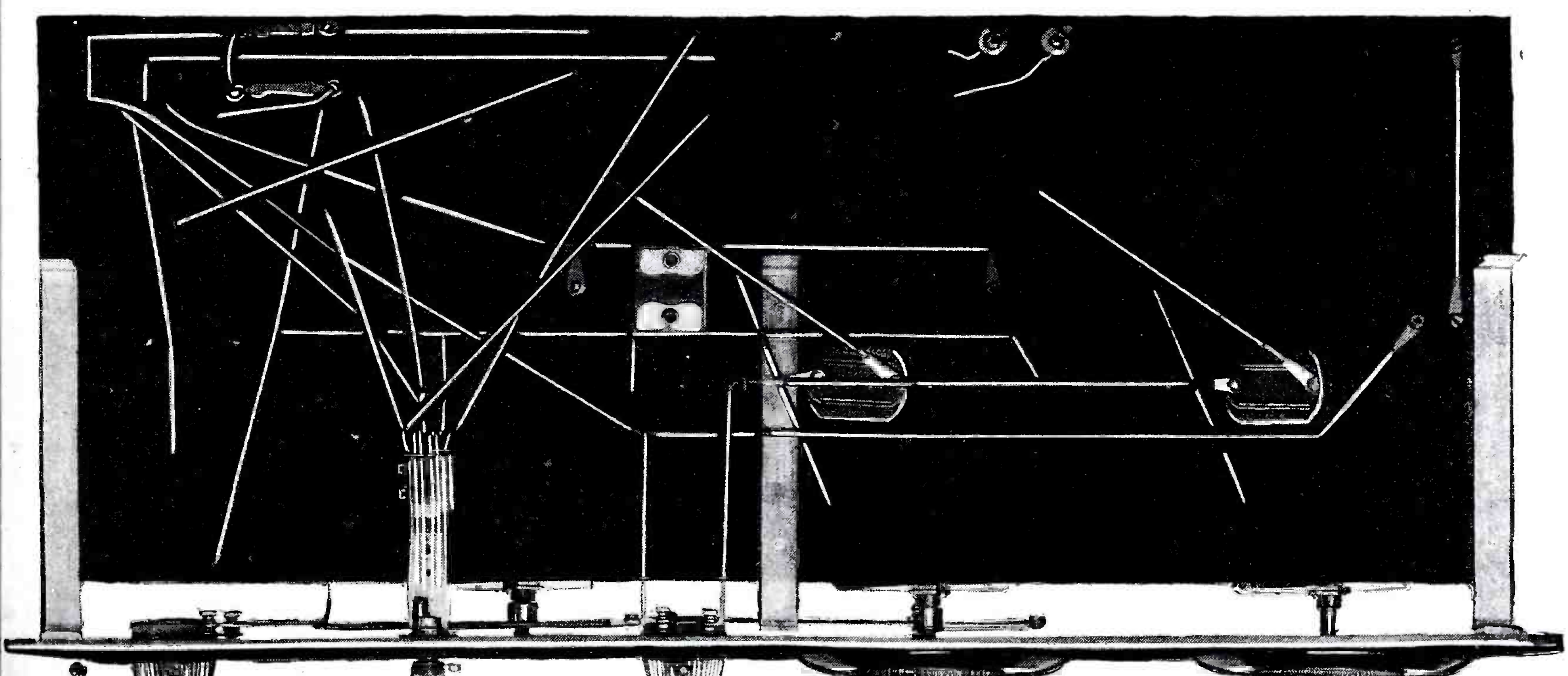

C1
PRIMARY LEADS
ANT
TO ROTOR
T1
C6
RFC 1
VT1
C9
C4
U1
U2
C2
T2
O.F.
C7
RFC 2
VT2
R1
C5
VT5
C3
C11
R4
T3
T5
S
VT4
C8
R5
VT3
R2
R3
C10
T4
A+ RED
A– GND. BLACK
B– YELLOW
BLUE B+45V.
GRAY B+90V.
B+ GREEN 150V.
"C" 9 V.
4½ V.



A rear view of the set showing how the parts are mounted on the sub-panel. The two round units in the foreground are the second audio frequency transformer and output filter choke (right) while that at the left behind the two "C" batteries is the first A.F. transformer.



Dimensions for drilling the front panel. The shaft holes for the Equamatic radio frequency units are indicated at the left side.



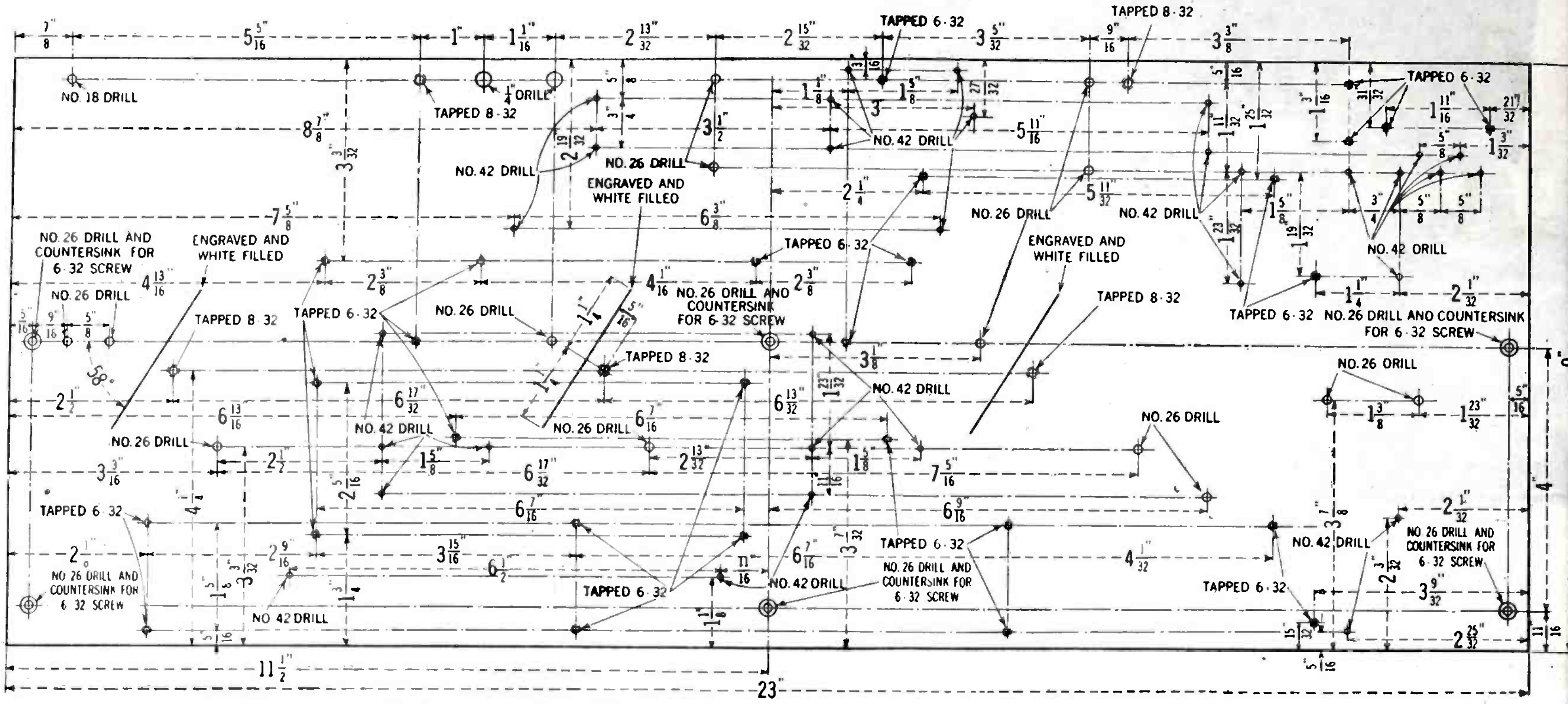
All wiring beneath the sub-panel is made directly from one terminal to another as seen in the photo immediately above.

ated at maximum efficiency at any wavelength within the broadcast band. Today variable coupling has been eliminated almost entirely and one of the results of this elimination is the uneven amplification obtained at different

to be provided to make the tube approach the oscillating point.

Of even greater significance today is the fact that there is far greater tendency for a multi-tube receiver to oscillate at some wavelengths than at others.

tion is greatest. That is, a certain amount of regeneration is usually obtainable but no actual oscillation. This provides good sensitivity and good selectivity at these wavelengths. But at the higher wavelengths the case is dif-

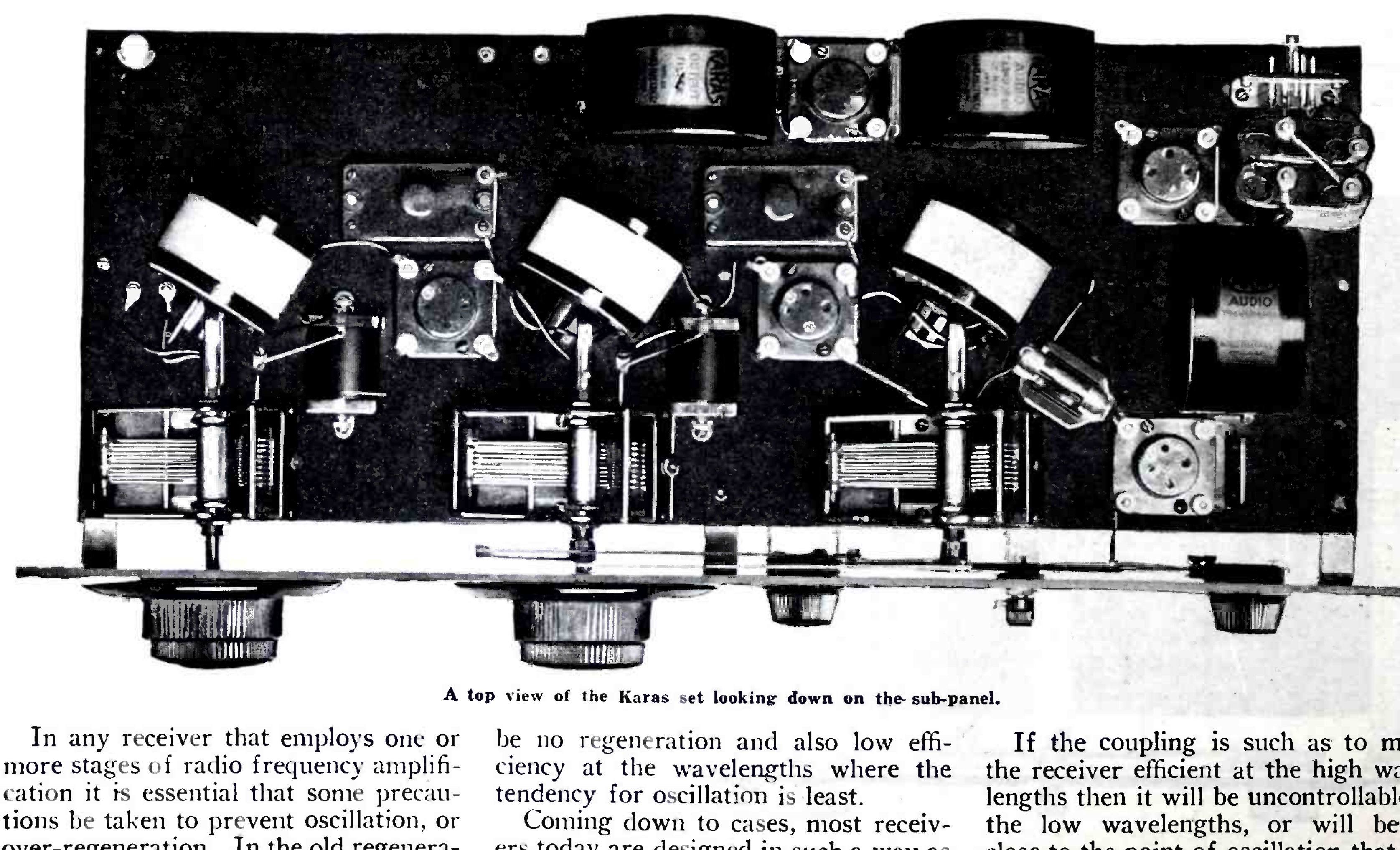


All dimensions for drilling holes in the sub-panel are given in the above layout.

wavelengths. With few exceptions the receivers of today provide an amplification of from three to ten times greater on some wavelengths than on others. One of the exceptions to this statement is the Karas Equamatic receiver, which is to provide the subject for this article.

Therefore a device to limit oscillation at one wave-length is not adequate for this purpose at some other wavelengths where the tendency to oscillate is greater. Or, if a device is included which will suppress oscillation at the wavelengths where the tendency for oscillation is greatest, then there will

ferent. Here there is no regeneration at all and the low interstage coupling necessary to prevent oscillation at the lower wavelengths is not adequate for sufficient energy transfer at the higher wavelengths. The total result is that when tuned to the high wavelengths the receiver is much less efficient than at the lower waves.



A top view of the Karas set looking down on the sub-panel.

In any receiver that employs one or more stages of radio frequency amplification it is essential that some precautions be taken to prevent oscillation, or over-regeneration. In the old regenerative detector circuit this was not necessary. As a matter of fact, means had

be no regeneration and also low efficiency at the wavelengths where the tendency for oscillation is least.

Coming down to cases, most receivers today are designed in such a way as to prevent oscillation at the lower wavelengths, where the tendency for oscilla-

If the coupling is such as to make the receiver efficient at the high wavelengths then it will be uncontrollable at the low wavelengths, or will be so close to the point of oscillation that the received signals will be distorted and

(*Continued on page* 151)

Power Supply *from the* House Lighting Current

THERE is probably no element of radio receiver operation that has caused more trouble, exasperation, faulty reception and annoyance than the sources of power to supply the electric current required to operate the receiver.

As a result, most of the effort expended in perfecting radio receivers has rightfully been devoted to developing some means of supplying power for radio receivers, that would eliminate charging and replacing of batteries with their consequent annoyances.

Most radio engineers realized that before the radio receiver could take its rightful place in the line of home necessities, it would have to be stripped of the technical phases that required the members of the family to know all about "A," "B" and "C" batteries; how to test the batteries; how to order the proper number and size of batteries; how to charge storage batteries and how to disconnect and reconnect the batteries without running the danger of blowing out a perfectly good and expensive set of tubes or worse still causing a short circuit that might easily result in a fire.

The aim of radio engineers has been to reduce the power supply of the radio receiver to a matter as simple as plugging a vacuum cleaner plug into the electric light socket.

Various means for eliminating "B" batteries have been tried with very fine results, but simply eliminating the "B" battery is not enough. The only real solution of the problem lies in the use of a power unit which will supply all the power, "A," "B" and "C" for the receiver and will do so month after month and year after year without constant servicing or replacements.

The only obstacle to the building of such a unit has been the lack of a rectifier and filter circuit capable of handling the current required for filament operation. The recent production of a rectifier tube capable of handling 400 milliamperes of full-wave rectified current has solved this last obstacle in the way of full light socket operation of radio receivers.

The Q. R. S. 400 milliampere rectifier tube used for this purpose is a gaseous rectifier tube very similar to the usual lower current capacity rectifier tubes used for "B" eliminators.

The power unit itself is very easy to build. In fact, two hours is ample time to lay out the apparatus on a panel or baseboard and wire it up ready for operation.

To avoid any possibility of this unit being used directly with an unsuitable receiver, it is well to mention that to

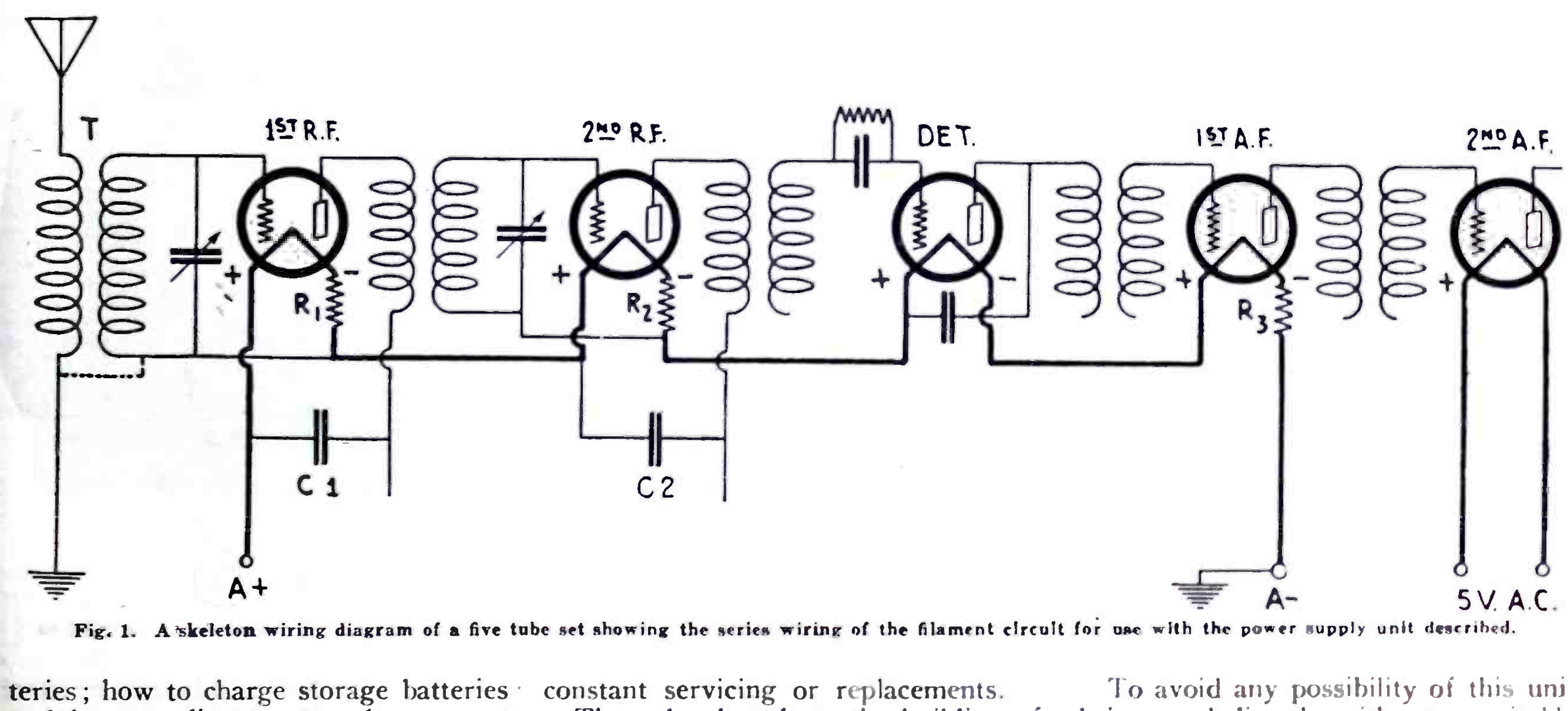


Fig. 1. A skeleton wiring diagram of a five tube set showing the series wiring of the filament circuit for use with the power supply unit described.

use this type of power unit, the filaments of the receiver must be connected in series instead of in parallel as is common practice when using a storage battery as the source of supply for "A" current.

Changing the connections of a receiver which has already been built is a rather simple procedure. The wiring diagram shown in Fig. 1 shows a skeleton wiring diagram of the essential connections affected by a series connection of the filaments. It is important to bear in mind that the antenna circuit can be connected in the manner shown only when there is no connection between the primary and secondary circuits of transformer "T" of Fig. 1 which couples the antenna and grid circuit together. If there is a connection between the primary and secondary winding of this transformer as shown by the dotted line, no ground connection is necessary to the antenna coil. The ground connection to the "A—" binding post as shown will provide all the ground connection required. Connecting two grounds to the set in that case would result in a short circuit of the power unit.

The placing of the proper fixed bypass condensers and the grid returns of the radio frequency tubes are shown. The grid return in the detector stage will depend on the type of detector tube used, being on the positive side for the 201A type tube and to the negative side for the 200A type tubes.

No matter what type of set you are using or plan to build, the filaments can be wired in series. A few changes made in the grid returns as shown in the diagram and a check up of the antenna coupling transformer is all that is necessary to change over from a battery to a light socket operated set.

The series wired set possesses more tone and stability than the battery operated set due both to the series connection of the filaments which gives a steady voltage across the tube filaments and the fact that the grids of the tubes are properly biased.

A four ohm fixed resistance is placed in the filament lead to each of the two radio frequency tubes. This furnishes a one-volt drop that is used to give the radio frequency tubes a negative grid bias of one volt each. A similar resistance of 20 to 24 ohms is inserted in the filament circuit of the first audio frequency tube to give the first audio tube a negative C bias of approximately four and a half volts.

In the wiring diagram, the last audio tube is shown operated from five volts alternating current with the proper C bias coming from resistances in the power unit. This is optional, for the regular 201A type tube may be used in this stage wired in series with the other tubes and with a 24 ohm fixed resistance in series with the filament wiring to give a C bias voltage for the grid. In the diagram the filament terminals are marked positive and negative according to the marking on the sockets

(*Continued on page* 164)

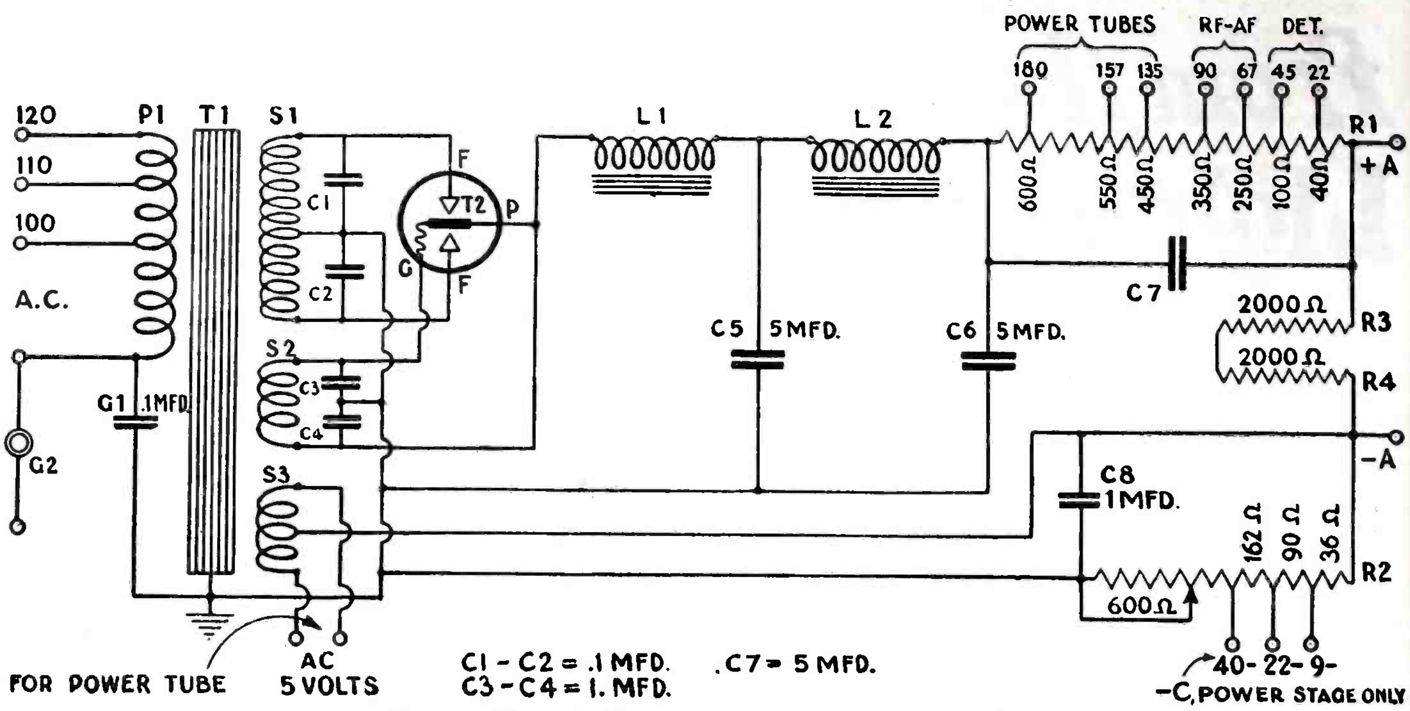


Fig. 2. Schematic diagram of the Q. R. S. power unit.

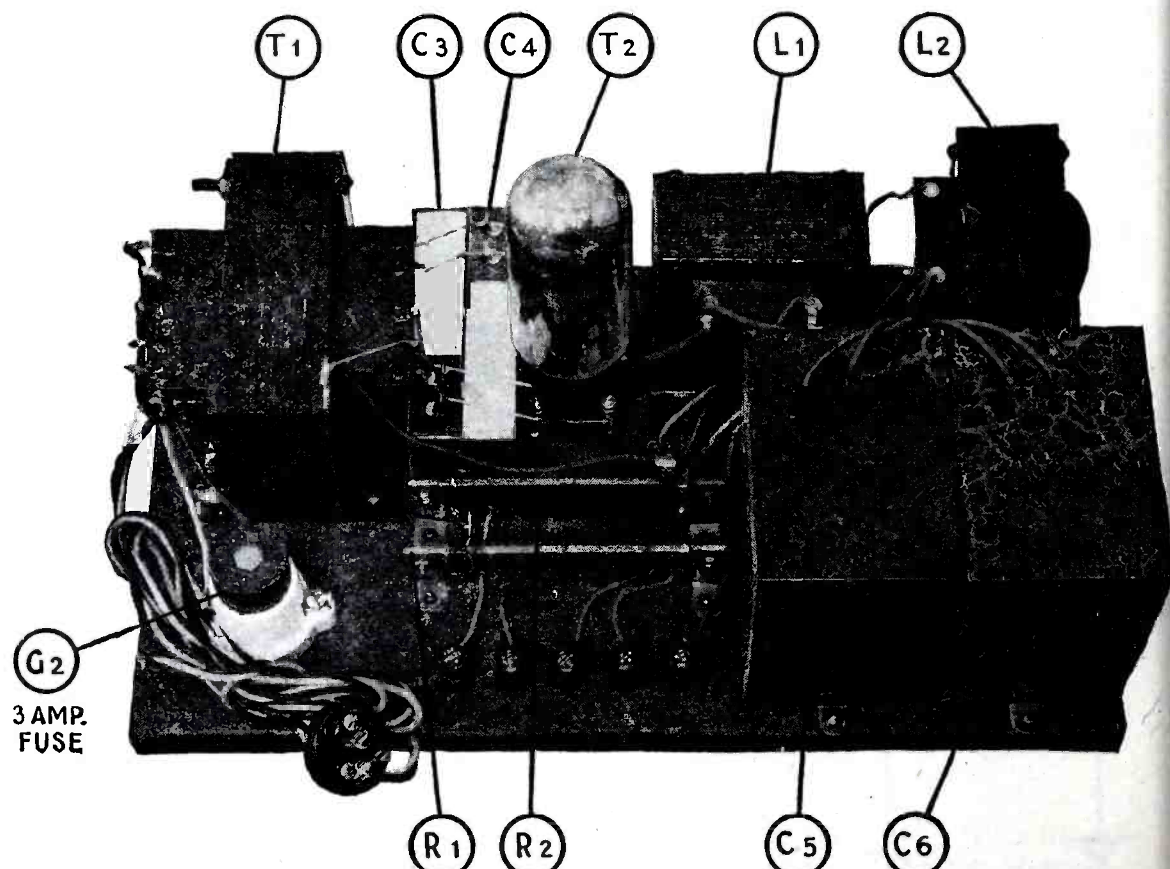
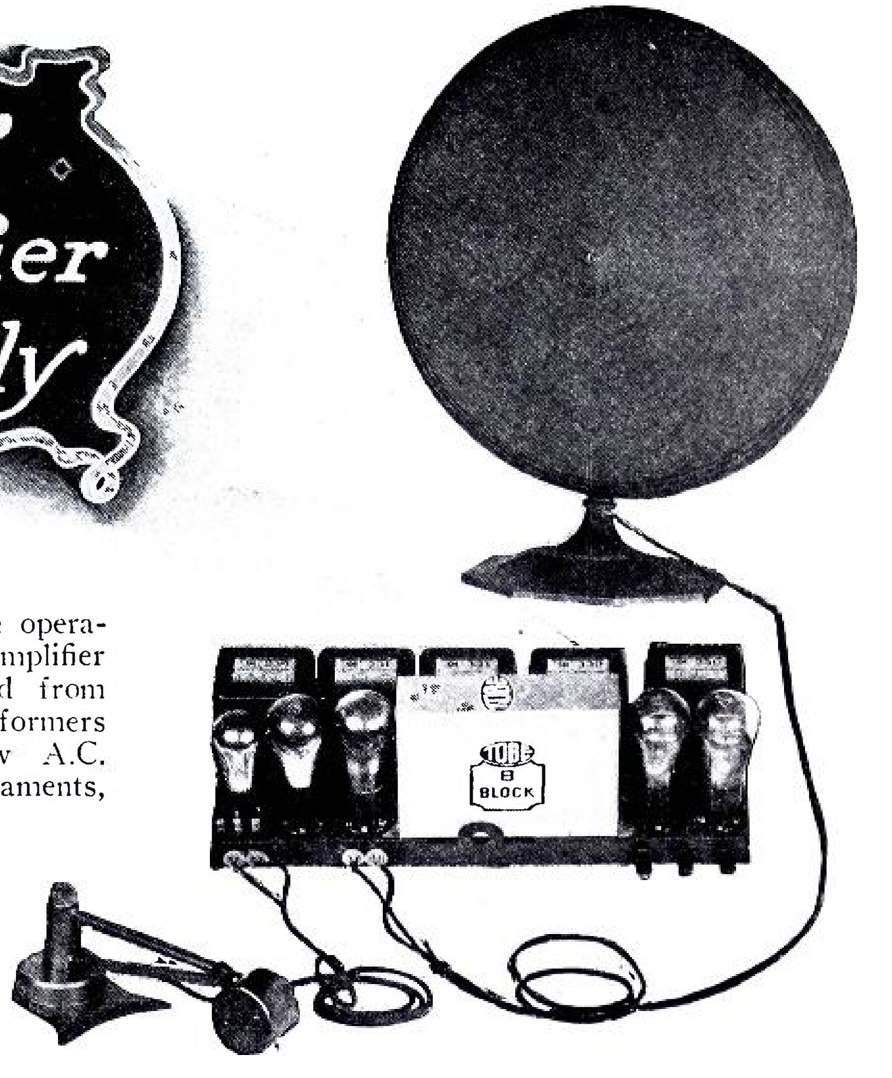


Fig. 3. A photographic view of the parts mounted on baseboard. Components are marked to correspond with wiring diagram Fig. 2.

PARTS FOR THE UNIT

1 Thordarson Transformer, type T-2291, (T1)
2 Fast 250 v. condensers 1.0 mfd. (G1, C8)
4 Fast filter condensers, 600 volts D.C. working voltage, (C1, C2) .1 mfd. each and (C3, C4) 1. mfd. each
1 Q.R.S. 400 Mill Rectifier tube, (T2)
2 Thordarson Choke Coils, type T-2029, 3 to 5 Henries at 300 mills and D.C. resistance 100 ohms maximum, (L1 and L2)
1 Electric lamp socket and one 3 ampere fuse (G2)
2 Carter Voltage control resistance units, 600 ohms each, (R1 and R2) and two 2000 ohm resistors (R3, R4)
3 Fast filter condensers, 400 volts D.C. working voltage, 5 mfd. each, (C5, C6 and C7)
5 Eby binding posts
1 Wooden baseboard 15 x 30 inches
Six feet of electric lamp-cord, socket plug, Acme Celastic hook-up wire.

The "UNIPAC" Power Amplifier and A·B·C·Supply



TODAY, every radio fan realizes that to obtain the finest possible quality of reproduction, not only must his whole receiver be most carefully designed, with particular attention paid to the audio amplifier, but the later must include a high power output tube operated upon four hundred volts or more if good, undistorted reproduction at normal home volumes is to be anticipated. The incorporation of such a powerful output stage in a radio set is both impractical and unsafe—hence the development of the power-pack—a stage of power amplification and receiver B supply combined, the amplifier drawing its power direct from any A. C. light socket.

The unit to be described is an unusually powerful device, and of very wide application, since operated from the light socket, it will provide a stage of practically distortionless power amplification for any radio receiver, B power for any standard set, A, B, and C power for any receiver employing A. C. tubes, or it will, without alteration, serve in conjunction with a magnetic record pick-up and a loud speaker, to convert any phonograph at all into the latest type of electrical reproducing instrument. The universal nature of its uses justifies the term "Unipac" and its many advantages, together with construction and operating details will be described. The Unipac consists of a stage of power amplification, and an ABC power plant in a single metal cabinet. The amplifier consists of a very high grade input transformer feeding a CX310 power amplifier tube, together with an output transformer to prevent damage to a loud speaker due to the high plate current involved. This stage may be joined to a radio receiver as a final high power output stage. For phonograph use, a CX326 amplifier tube is used, connected between the record pick-up and the input transformer primary, thus providing two amplifier tubes in all, the pair serving to develop ample volume for dancing in a small auditorium, or even outdoors, so great is the amplification and undistorted power output.

Power for the operation of the amplifier tubes is obtained from two power transformers which feed raw A.C. direct to the filaments, and which also provide the high voltage necessary for the two CX 316B rectifier tubes, the output of which, properly filtered, is used for plate and grid voltages. A portion of the rectifier output is taken through a voltage dividing resistor, to be used for the B (and C) circuit of any standard receiver. In order to provide constant unfluctuating power to a radio receiver B circuit, a voltage regulator tube is used.

PARTS REQUIRED FOR THE UNIPAC

2—S-M 330A power transformers
1—S-M 331 Unichoke
1—S-M 220 audio transformer
1—S-M 221 output transformer
5—S-M 511 tube sockets
1—Ward-Leonard 16,500-ohm resistor
2—Frost FT64 resistors
4—Frost 253 tipjacks
1—Frost 953 jack
3—Eby posts (Neg., +45, +90)
1—Van Doorn chassis & cabinet (hdwe. included)
1—Tobe 662 condenser block
25 ft.—Kellogg hook-up wire

Tubes Needed

2—CX 316B rectifiers
1—CX310 amplifier
1—CX374 regulator
1—CX326 AC amplifier

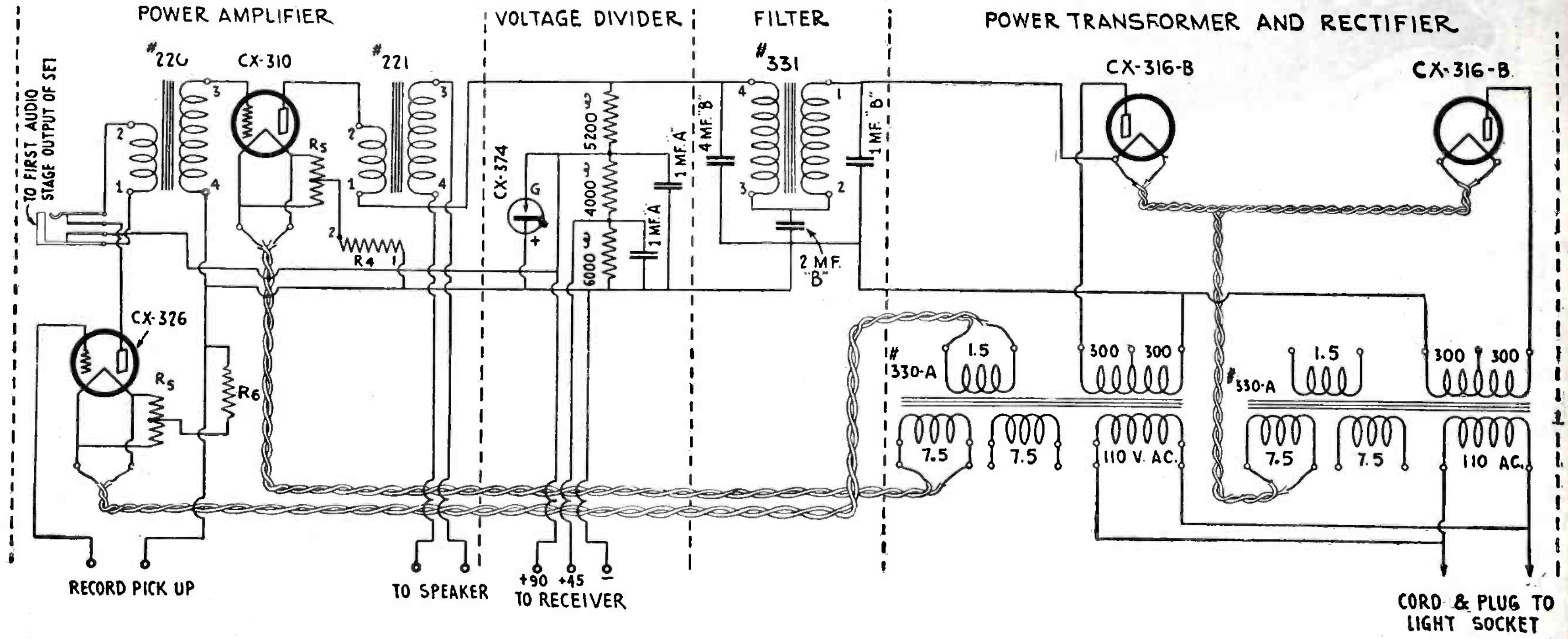
The power transformers each have an extra 1.5 volt winding, one winding of one transformer being used to light the CX326 input amplifier tube filament. This, as well as the other winding, may be used to light the CX326 tubes of a receiver, while both windings also connected in series will serve to light a CX327 detector tube.

The need for a power amplifier output stage in conjunction with any receiver is today generally recognized, for it is now known that none of the smaller receiving amplifier tubes such as the 201A, 112, or even 171 type can possibly deliver, without distortion, the power necessary for home entertainment at ordinary volumes. The maximum undistorted power output of a 201A tube is 55 milliwatts; of a 112, 195 milliwatts; and of a 171 tube, 700 milliwatts. The absolute inadequacy of any and all of the low power amplifier tubes for last audio stage operation is painfully evident when it is realized that from 1,000 to 1500 milliwatts of undistorted power are required at the low frequencies simply for adequate home entertainment volume. In fact, the only tube at present available that, for second or last stage audio operation, will give the 1,000 to 1,500 milliwatts of undistorted power output necessary is the 210 type. In the Unipac a 210 amplifier is employed, with an undistorted power output of from 1500 to 1700 milliwatts—more than can be delivered by any other of the popular "210 power packs." The input and output transformers feeding this tube are the well-known Silver-Marshall 220 and 221 audio and output transformers, which give a rising amplification curve, so that the amplifiers deliver greatest power to a loud speaker such as the Western Electric cone, at 30 cycles. This is desirable since the efficiency of all speakers falls off at low frequencies, and the Unipac amplifier thus tends to compensate for this failing. Above 5,000 cycles, the amplifier rapidly "cuts off," or ceases to amplify. This valuable and exclusive feature means that with the Unipac, receiver selectivity will actually be increased in that ordinary high frequency "hiss" or background noise, as well as the all too prevalent heterodyne whistles of present-day reception, will be almost entirely eliminated.

receiver audio amplifier and ABC power supply.

Despite the popular conception, the use of a 210 power output tube does not do away with distortion—far from it. The superiority and excellent qualities of the 210 only appear at plate voltages above 400—operated at 300 volts or less, the 210 is actually inferior to a 171 from an undistorted power output angle. Ordinarily, a 210

For this reason the Unipac employs not one, but two 216B rectifier tubes, the actual working voltage of which is from 425 to 450 volts, with receiver and input tube current drains considered. Of course, a new type 281 rectifier tube could be used, and one would give the same output voltage as two 216B's, and need but one power transformer. It must be remembered, though, that the filtration of a single-

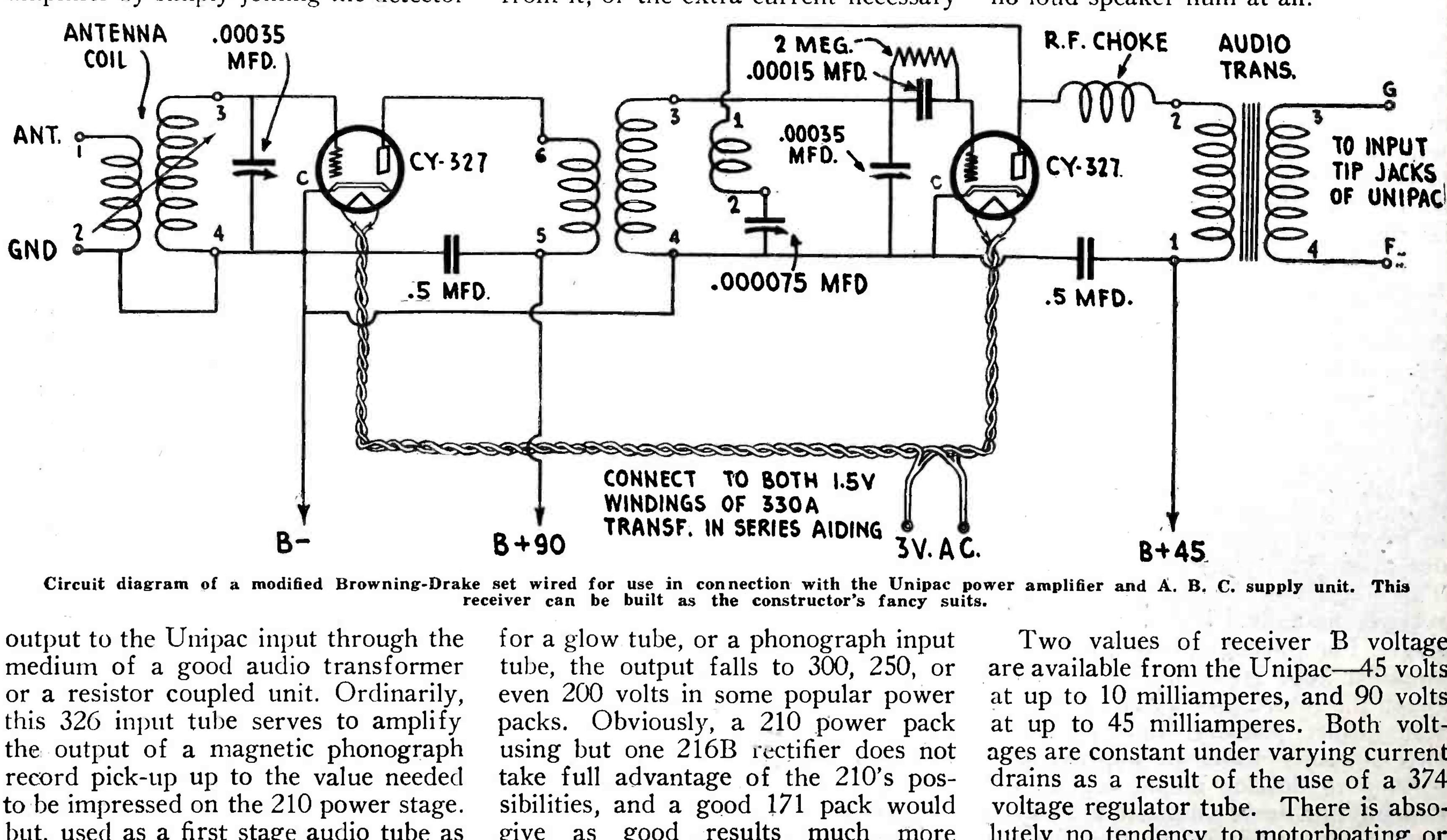


Wiring diagram of the Unipac. All terminal markings are clearly indicated as they actually appear on the apparatus. The completed unit used with a phonograph pick-up device is shown in the photo heading of this article.

The power stage is connected directly to the first stage output of a radio set, but in cases where the receiver has no audio amplifier, or one so old as to be discarded because of distortion introduced, the extra 326 input tube in the Unipac may be used as a first stage amplifier by simply joining the detector

power pack employs but a single 216B rectifier tube, the actual output voltage of which is supposed to be 400 or more. This voltage is obtained when the 216B is used *only* to supply B and C voltage to the 210 tube alone. As soon as receiver B current is drawn from it, or the extra current necessary

wave rectifier is always poorer than that of a two-wave rectifier. Thus, the residual hum of a power pack employing only one rectifier tube, be it 216B or 281, is quite pronounced, and often objectionable. In the Unipac, employing two 216B tubes, there is practically no loud speaker hum at all.



Circuit diagram of a modified Browning-Drake set wired for use in connection with the Unipac power amplifier and A. B. C. supply unit. This receiver can be built as the constructor's fancy suits.

output to the Unipac input through the medium of a good audio transformer or a resistor coupled unit. Ordinarily, this 326 input tube serves to amplify the output of a magnetic phonograph record pick-up up to the value needed to be impressed on the 210 power stage. but, used as a first stage audio tube as well, the Unipac becomes a complete

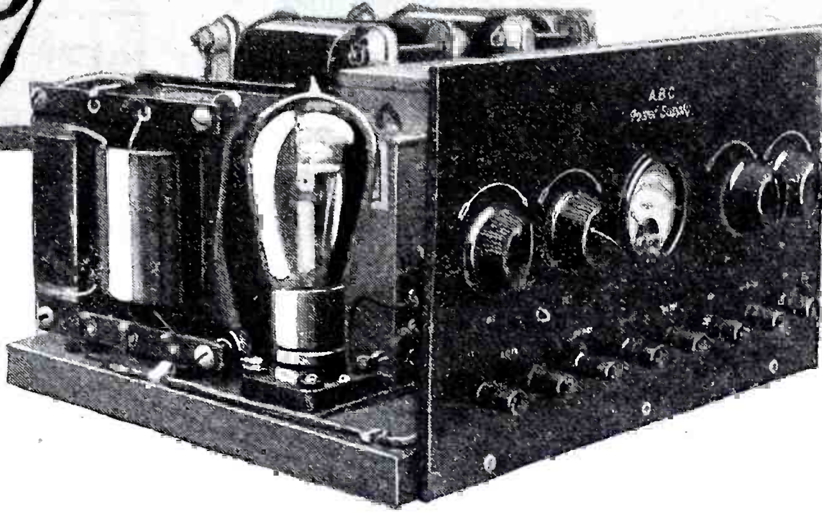
for a glow tube, or a phonograph input tube, the output falls to 300, 250, or even 200 volts in some popular power packs. Obviously, a 210 power pack using but one 216B rectifier does not take full advantage of the 210's possibilities, and a good 171 pack would give as good results much more cheaply.

Two values of receiver B voltage are available from the Unipac—45 volts at up to 10 milliamperes, and 90 volts at up to 45 milliamperes. Both voltages are constant under varying current drains as a result of the use of a 374 voltage regulator tube. There is absolutely no tendency to motorboating or

(*Continued on page* 162)

A Compact A-B-C Power Unit

by Perry S. Graffam



TO operate any radio receiving set direct from the house lighting circuit is the aim of manufacturers. Several nationally known sets are now so arranged. In fact the present season has seen several such arrangements whereby very satisfactory results were attained with the use of 199 type tubes in series.

To use 201-A type tubes is however what the radio public most desires, and with this thought in mind the various manufacturers have been working the past few months on such type of apparatus.

To develop a rectifier of sufficient capacity to carry the current necessary also necessitates the development of a heavy duty filter system together with its heavy duty resistance controls.

The Raytheon B A 350 milliampere tube will rectify enough current to operate 3, 5, 7 or even more, if necessary, 201-A type tubes. The "A-B-C" outfit to be described employs this tube. The only difference in this unit and others previously described for the 199 type tube is that all the parts used must be of a heavy duty type to properly rectify and filter 300 milliamperes of current.

A brief description of these parts will be given.

The transformer used in this unit has a 110 volt primary winding with a heavy duty four ohm resistance in series. This is important to maintain a constant voltage and is essential for the best operation of the completed unit. This resistor also prevents the transformers from drawing an excessive current from the 110 volt line when the unit is turned on and it acts as a protective device to the other parts of the unit in case of a short circuit or a momentary flash-over of the tube. The secondary winding has a step up to 760 volts with a mid-tap. An additional secondary winding of 5.6 volts is provided for lighting the filament of the power tube. A.C. current is necessary for this tube as its current drain is ½ ampere. This is not a disadvantage as superior results will thus be obtained.

The filter system consists of two chokes and two special Tobe "A-B-C" condenser blocks. The choke coils have an inductance of over 10 henries at 300 milliamperes DC and a DC re-

LIST OF PARTS REQUIRED

1 Raytheon BA Tube (T)
1 Acme BA1 Transformer (TF)
2 Acme BA 2 Chokes (H, H-1)
1 Tobe A-B-C Block Unit (C-1)
1 Tobe A-B-C Block Unit (C-2)
1 Tobe condenser block, two 0.1 m.f. (C)
2 Universal Range Clarostats (R-4, R-5)
1 Universal Range Power Clarostat (R-2)
1 Centralab 150 ohm potentiometer (R)
1 Amsco 800 ohm 40 watt resistor (R-3)
1 Tobe Veritas 10000 ohm 10 watt resistor (R-1)
1 Jewell N. 135 0 to 300 milliammeter
1 Benjamin tube socket
8 Eby or X-L Lab. Binding Posts
1 Formica panel 10" x 7"
1 Wood sub-base 11" x 13" x 3/4"
Stained, shellacked and dipped in hot paraffin if possible.
Necessary screws, Acme Celatsite hook-up wire and Kester radio solder.

sistance of 352 ohms for the two, which is a medium resistance and which will safely pass the current necessary.

The condensers are made especially for this unit and are the heavy voltage type. For the home constructor, special care should be given in substituting resistances for others than those used in the unit described. The author has worked many days finding resistors of proper value and capable of handling the current without overheating. The ones used are satisfactory and are of a heavy duty type with the exception of the B plus detector and B plus Int. controls which are the Universal Range Clarostats as used in "B" eliminator power units.

A Jewell No. 135 zero to three hundred milliampere meter control is placed in the unit or in the set itself as it is very necessary that the adjustments of the filaments be kept at 250 milliamperes. The meter should be placed in the A plus lead, as the load of the set will not be over 40 milliamperes and as that together with the filament load will be under the rating of the tube it is not necessary except to observe the load of the tubes.

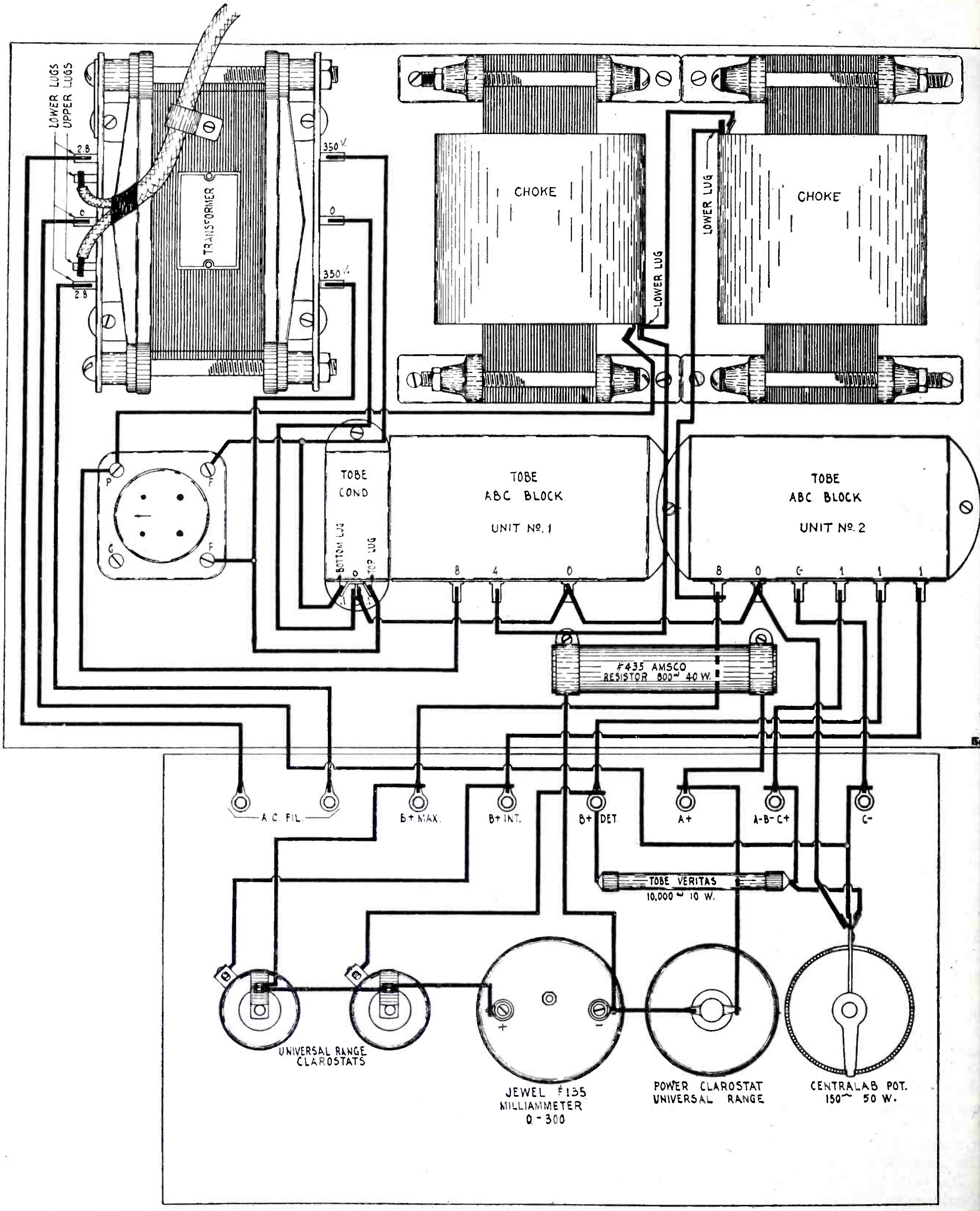
By referring to the accompanying drawings it will be seen that all the various parts are clearly shown and no particular detail description is necessary as to connections.

The parts are mounted on a subbase 11"x13"x¾". The transformer and chokes on account of their weight should be bolted to the base. The other parts may be fastened with wood screws. The arrangement as shown permits an ideal arrangement and ease of wiring. The wire should be copper tinned of 14 or 16 gauge and should have a good insulation; flexible wire is preferred. All joints should be carefully soldered and any excess flux should be removed.

The leads from the AC filament winding of the transformer to the binding posts should be twisted together or run in Belden's flexible copper tubing and when so used the tubing should be grounded to the transformer frame. The transformer chokes and condensers should be wired first, and the panel with its various controls wired separately and then all that remains is to connect the two with 5 short jumper wires.

As it is necessary that the filaments be connected in series a brief description of series filaments and proper grid biasing will be given.

Any set can be converted with these two principles in mind; first the manner in which grid bias is to be obtained and second, the proper order in which the tubes shall be arranged in sequence. The best results can perhaps be obtained by removing all the present wiring from the two filament posts of the sockets. Omit the switch as this is no longer required, it being nected, one rheostat should be removed entirely and a 400 ohm potentiometer or 0-5,000,000 ohm Clarostat substituted in its place, the use of which will should go directly to the detector socket. After that may come the first a.f. and second a.f. in resistance or impedance coupled, otherwise to be fol-



Picture wiring diagram of the compact A-B-C Power Unit. This diagram also shows the arrangement of parts on the panel and baseboard.

necessary to shut off the power supply unit at the house supply end. All ballasts or rheostats should be discon- be described herein. The order in which the tubes are arranged is as follows: The minus B or ground point lowed by the radio frequency stages until the chain has been completed. The last Audio tube which will of course use a ½ ampere filament should be run in twisted paired wire to two additional binding posts.

The method of obtaining grid bias is to place resistance in series with the filaments of proper value, whose voltage drop will give the required grid bias. This value of resistance depends upon the amount required, and is equal to the required voltage multiplied by 4. For example: If 4.5 volts grid bias is desired, this is obtained by a resistance of 4.5x4 or 18 ohms.

These resistors carry the full ¼ ampere of current which the tubes require and may be made from 20 ohm rheostats and then adjusted to any required value. Another satisfactory method is to get the proper grid bias from the tubes themselves. As each tube has 5 volts drop in voltage, placing the grid return on the further side from negative or minus terminal will give a bias depending upon the number of tubes. As it is very easy to become mixed up and fail to make the proper grid bias return it is suggested that the plus and minus markings of the sockets be rigidly followed in making all connections. Series filaments are easier to wire than parallel and the wiring makes a very neat appearance in a set when so arranged.

Each socket filament should be by-passed with a 1 m.f. condenser with the The control of the volume is very de- exception of the power tube socket. sirable and may be made in two ways. By placing a 400 ohm potentiometer directly across the filament of the first R.F. socket, the middle connection and one side of the potentiometer is used. A second way which is very satisfactory is to place a Universal Range Clarostat across the secondary of the first A.F. transformer as shown in wiring of the "Hi-Q" receiver, given above.

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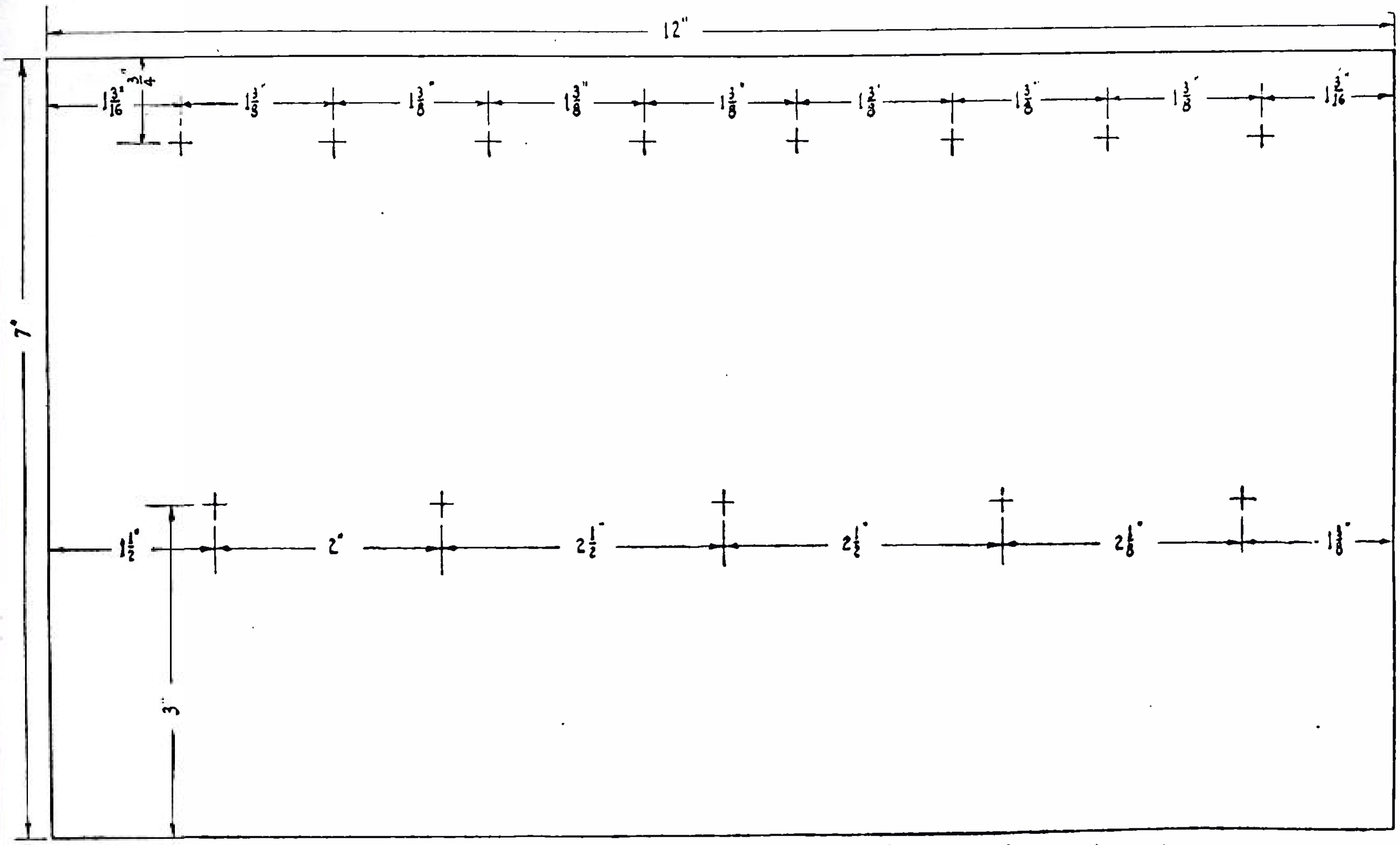
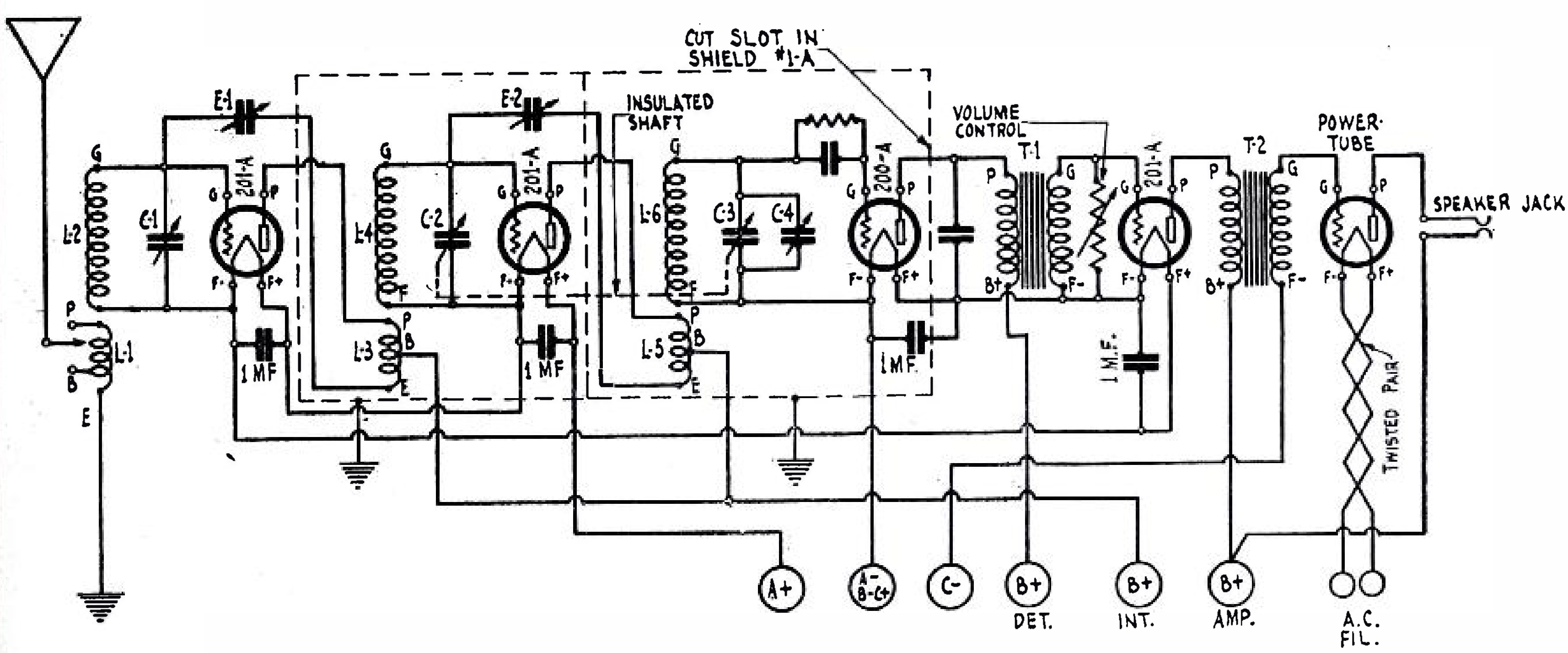
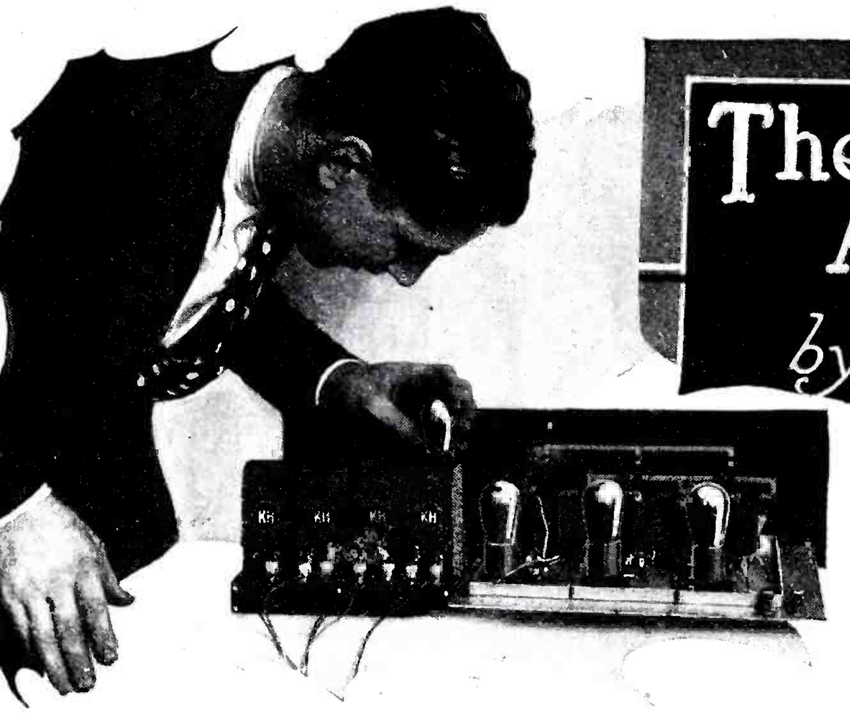


Panel drilling layout. All dimensions are given for the spacing of the hole centers for mounting parts.



Wiring diagram of the Hammarlund-Roberts "Hi-Q" receiver for use with the power unit described herewith.



The Harkness Tuned Audio Amplifier

by Kenneth Harkness

THE tone quality of any receiving set is largely determined by its audio amplifier. If the audio amplifier magnifies signals without appreciable distortion the quality of reproduction will be good. In this respect the audio amplifier is the most important part of the receiver.

In this article we describe a new type of audio amplifier which can be attached to any receiving set by means of a battery cable or mounted directly on the front panel of a receiver to form a component part of the set.

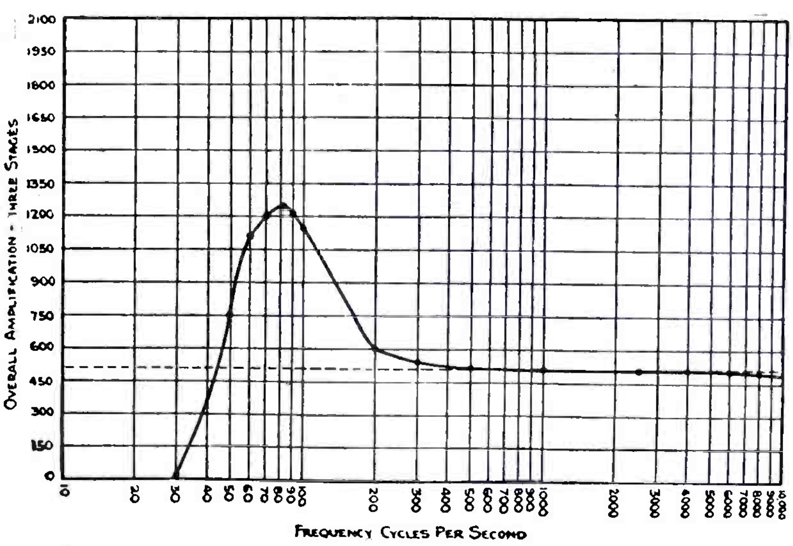


Fig. 1. Frequency characteristic curve of the Harkness tuned double impedance audio amplifier. Note the increased amplification of frequencies between 40 and 200 cycles.

The amplifier uses an entirely new system of amplification on which patents have recently been granted. The system is known as "Tuned Double Impedance." The reproduction of voice and music which can be obtained with this amplifier is quite remarkable. Every musical note, from the deepest bass to the highest treble, is reproduced with full volume and with all its intricate and distinctive tone-color. The loudest passages of music are just as clear and distinct as the softer passages and just as free from distortion.

Moreover, this realistic reproduction is obtained with an ordinary 112 or 171 tube in the output stage. The plate current is supplied by ordinary B batteries or a standard B-eliminator. 135 volts is sufficient, although 180 volts can be used if more power is desired.

The characteristics of this amplifier are interesting and unusual. Briefly, they may be summarized as follows:

1. Uniform *loudspeaker* output from 40 to 10,000 cycles. To offset the poor response of the average loudspeaker below 200 cycles the amplifier is *tuned to give increased amplification of low frequencies.*

2. Complete and automatic elimination of "motor-boating." The amplifier can be used with any B-eliminator without any chokes, resistances or condensers to prevent fluttering or "motor-boating."

3. The undistorted power output of the amplifier is four times greater than that of any other type of amplifier operating under the same conditions. This explains the perfect reproduction of the amplifier with ordinary receiving tubes and comparatively low plate voltages.

4. "Tube blocking" is completely eliminated. The use of impedances as grid leaks prevents all possibility of rectification or tube blocking, common sources of distortion in ordinary resistance and impedance-coupled amplifiers.

LIST OF PARTS REQUIRED

- 1 Formica panel 6⅜" x 9" x 3/32"
- 2 Formica strips 1¼" x 9" x 3/32"
- *3 Benjamin Tube sockets or American U. X. Prong contacts for sub-panel mounting.
- 3 Harkness tuned Double Impedance Couplers (First, second and third stage types)
- 1 Harkness Output Filter Unit
- 1 Pair Silver-Marshall sub-panel brackets
- 1 Carter fixed resistance, 1 ohm.
- 1 Carter short jack (open circuit).
- 1 Saturn toggle switch
- 9 X-L Push-Posts

**In the model amplifier illustrated the tube sockets are riveted to the sub-panel.*

5. High voltage amplification per stage. The amplifier utilizes the maximum voltage amplification of the tubes employed. There are no low resistance grid leaks to reduce the amplification.

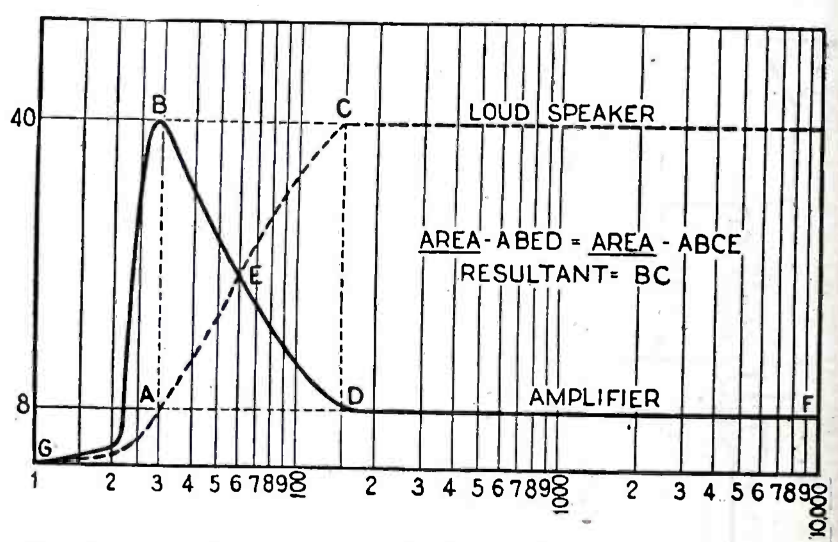


Fig. 2. Frequency characteristic curve of the average loudspeaker plotted against the curve of the Harkness tuned double impedance audio amplifier. The result shows uniform "loudspeaker" output of all frequencies.

The Tuned Effect Described

The first characteristic, outlined above, is decidedly unusual. The average receiving set does not accurately reproduce musical sounds below 200 cycles and most loudspeakers give very poor response at low frequencies. This does not mean that the loudspeaker *cannot* reproduce low tones. A good cone speaker can reproduce musical tones down to 30 cycles. If the energy is available the loudspeaker can reproduce low tones just as well as high tones. It is necessary, however, to supply *much more energy* to the loudspeaker at low frequencies to enable it to operate the loudspeaker at low frequencies is supplied by the amplifier and the sound output is uniform.

The effect of this characteristic on the quality of reproduction can well be imagined. Deep-toned and percussion

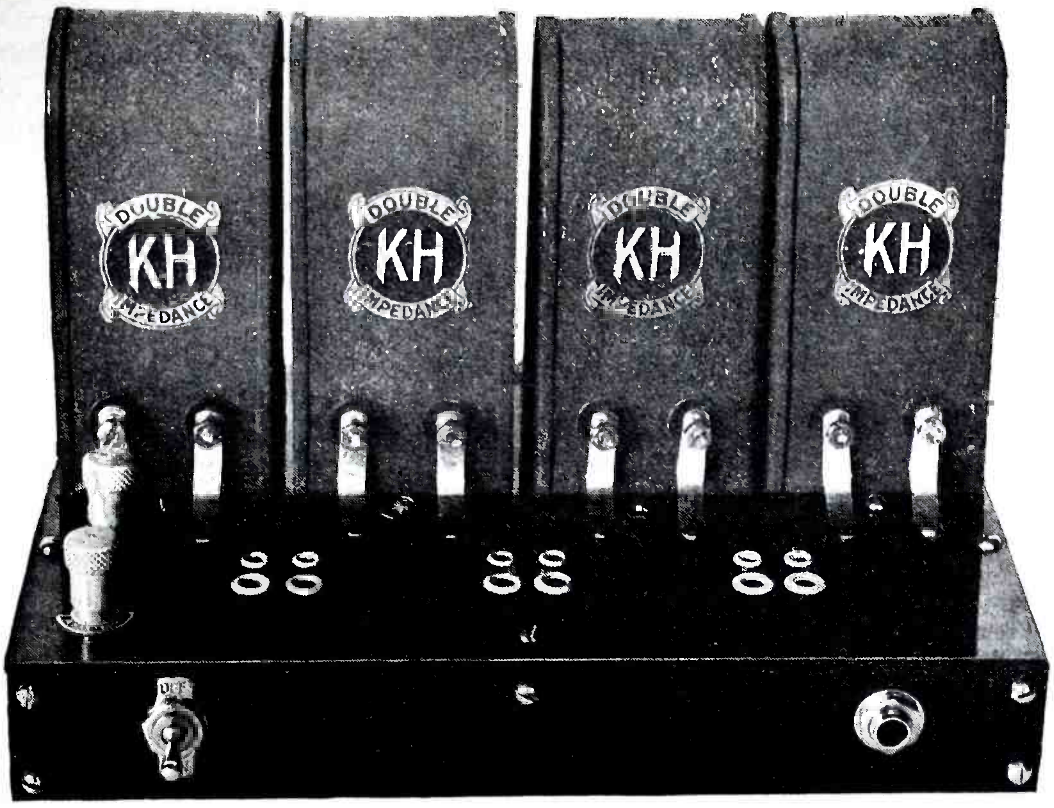


Fig. 3. Front view of the Harkness tuned audio amplifier. The unit on the extreme right is the output filter.

to reproduce these low tones at the same volume as high tones. The ordinary audio frequency amplifier cannot supply this additional energy. The amplification falls off below 200 cycles. Consequently, the important low tones of music are not accurately reproduced.

The tuned Double Impedance amplifier is designed to give greatly *increased* amplification of frequencies between 40 and 200 cycles, thereby enabling the loudspeaker to operate efficiently at these low frequencies. The increased amplification is obtained by tuning each stage of the amplifier by means of fixed condensers connected between the plate and grid of each tube. These condensers are inside the double impedance coupling units and their values are chosen to give the best results when the amplifier is used with the average cone speaker. The condensers, of course, also serve as blocking condensers in the usual manner.

The diagrams Figs. 1 and 2 clearly illustrate and explain this interesting feature of the tuned double impedance amplifier. Fig. 1 is the frequency characteristic curve of the amplifier. Note the increased amplification of low frequencies and the uniform amplification of frequencies above 200 cycles. Fig. 2 shows how uniform *loudspeaker* output is obtained when this amplifier is used with the average cone speaker. The loudspeaker curve falls off below 200 cycles. The amplifier curve, however, rises below 200 cycles. The additional energy required instruments, so essential in orchestral music, are heard with full volume and contribute their true share to the resulting harmony of sound.

Why the Amplifier Does Not "Motor-Boat"

The second important characteristic of this amplifier is the automatic elimination of "motor-boating." The amplifier can be used with any standard B-eliminator and will not motor-boat. "Motor-boating" is a low frequency oscillation caused by the filter system of the B-eliminator. The frequency of this oscillation is always below 30 cycles. If the audio amplifier of a receiving set magnifies frequencies below 30 cycles it will "motor-boat." To eliminate the fluttering it is usually necessary to connect a high capacity condenser across the terminals of the B-eliminator or to insert choke coils and condensers between the eliminator and the set. These precautions, however, are not needed when the tuned double impedance amplifier is used. This amplifier does not amplify frequencies below 30 cycles to any extent. Although the amplification from 40 to 200 cycles is extremely high, the amplification below 30 cycles is practically zero. As shown in Fig. 1 the amplification curve drops to zero at 30 cycles. As there is little or no amplification below 30 cycles the amplifier cannot oscillate below this frequency; in other words, it cannot motor-boat.

Large Distortionless Power Output

The third unusual characteristic of the amplifier is a very important one. As stated above, the undistorted power output of the amplifier is four times greater than that of any other type of audio amplifier operating under the same conditions.

It is recognized that considerable volume, or power output, is necessary to obtain good tone quality. The quality of reproduction obtainable with any audio frequency amplifier depends not only upon the "frequency characteristic" of the amplifier; it also depends upon the "amplitude characteristic." In other words, it depends upon how much volume or power output the amplifier can handle without distortion taking place. The greater the available

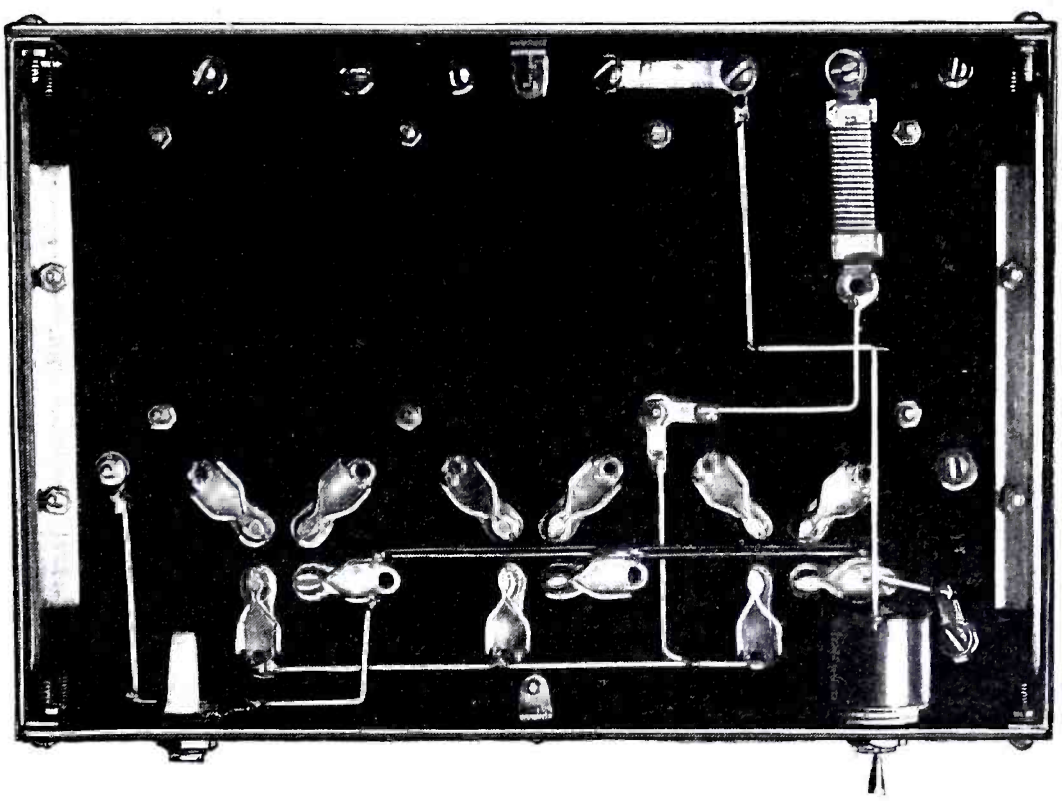


Fig. 4. Bottom view of the amplifier showing the simplicity of the wiring. Note position of the ohm resistor which controls the filaments of all three tubes.

distortionless power output the better the tone reproduction will be, even if all the available power is not utilized. be uniform, indicating that the amplifier should deliver good tone quality. Actually, however, the tone quality ume without distortion. This explains why some resistance and impedance-coupled amplifiers do not reproduce as

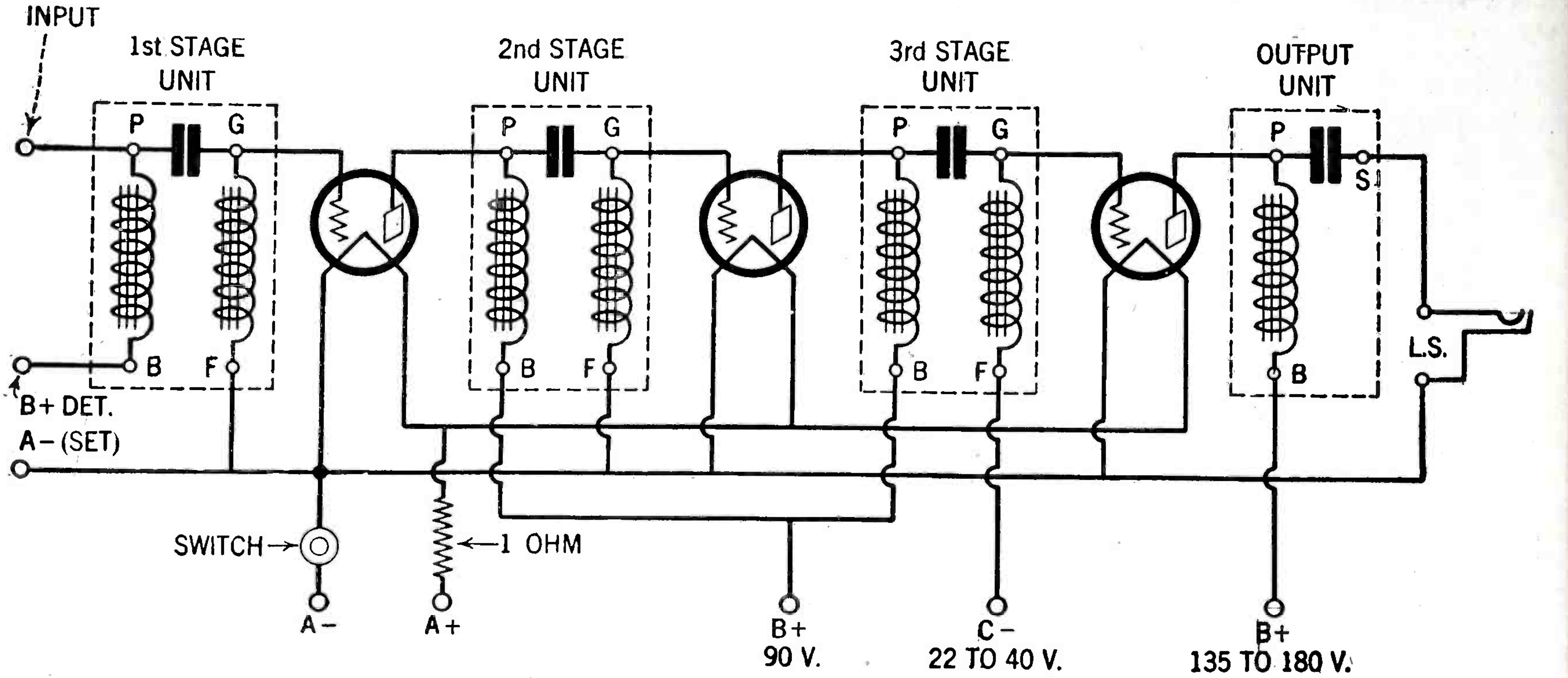


Fig. 5. Schematic wiring diagram of the tuned audio amplifier.

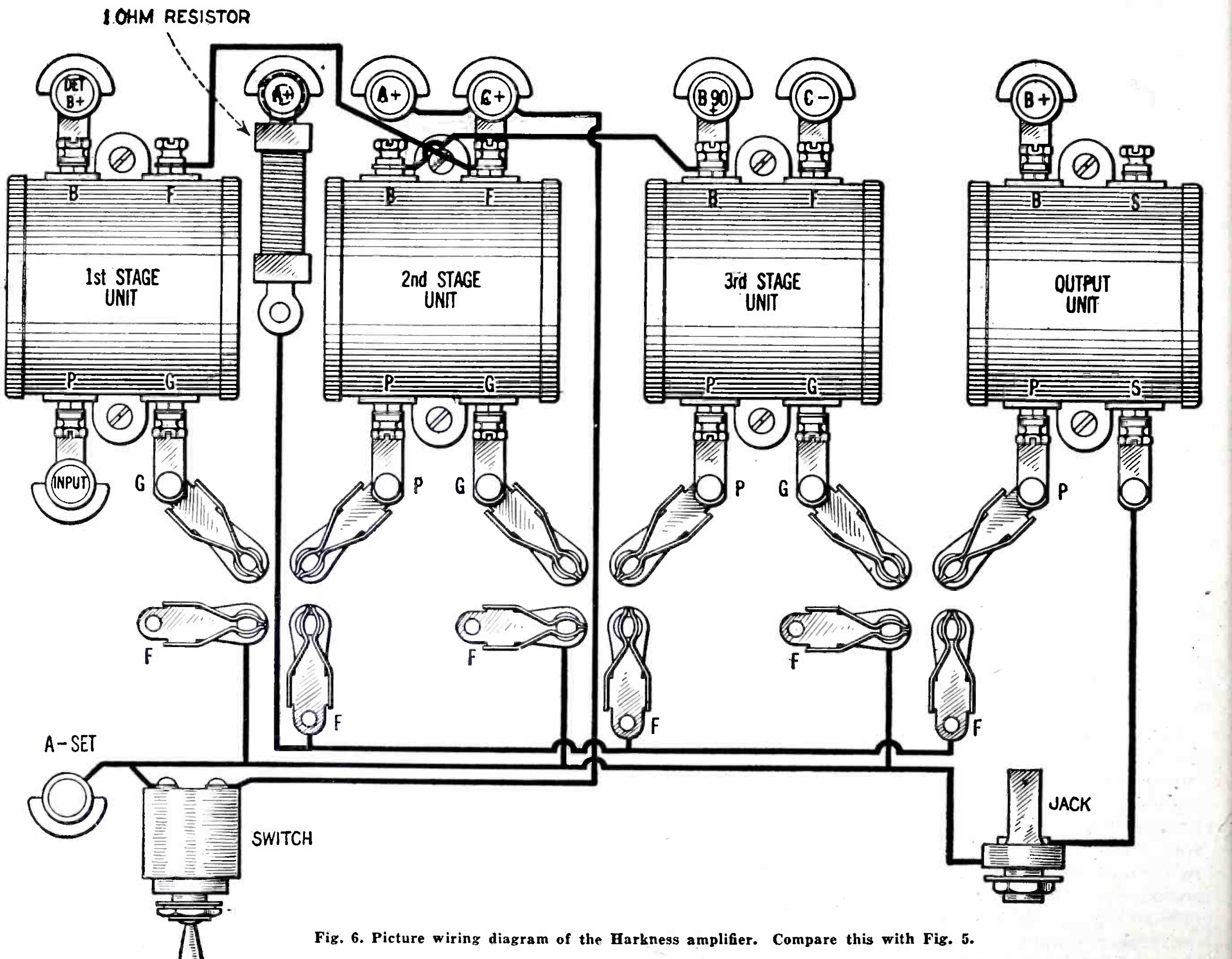


Fig. 6. Picture wiring diagram of the Harkness amplifier. Compare this with Fig. 5.

Some amplifiers may show a satisfactory frequency characteristic; the amplification of all audio frequencies may with even a moderate amount of volume may be very bad, due to the inability of the amplifier to handle volume well as transformer-coupled amplifiers, even though the frequency characteristics of the former are superior.

The amount of distortionless power output which can be obtained from any audio amplifier mainly depends upon the type of tube used in the output stage and the amount of plate voltage employed.

However, the maximum available power output of any tube cannot be obtained with most audio frequency former is partially shorted and the external impedance of the preceding tube is reduced. The voltage across the secondary of the transformer is lowered and bad distortion results.

The power output of the tuned double impedance amplifier is not limited by any of the above effects. The maximum available distortionless pow-

High Voltage Amplification

The maximum voltage amplification of each tube employed in the amplifier is utilized. There are no low resistance grid leaks to cut down the amplification. If a 112 tube is used in the output stage, 201A tubes in the first two stages will furnish ample amplification.

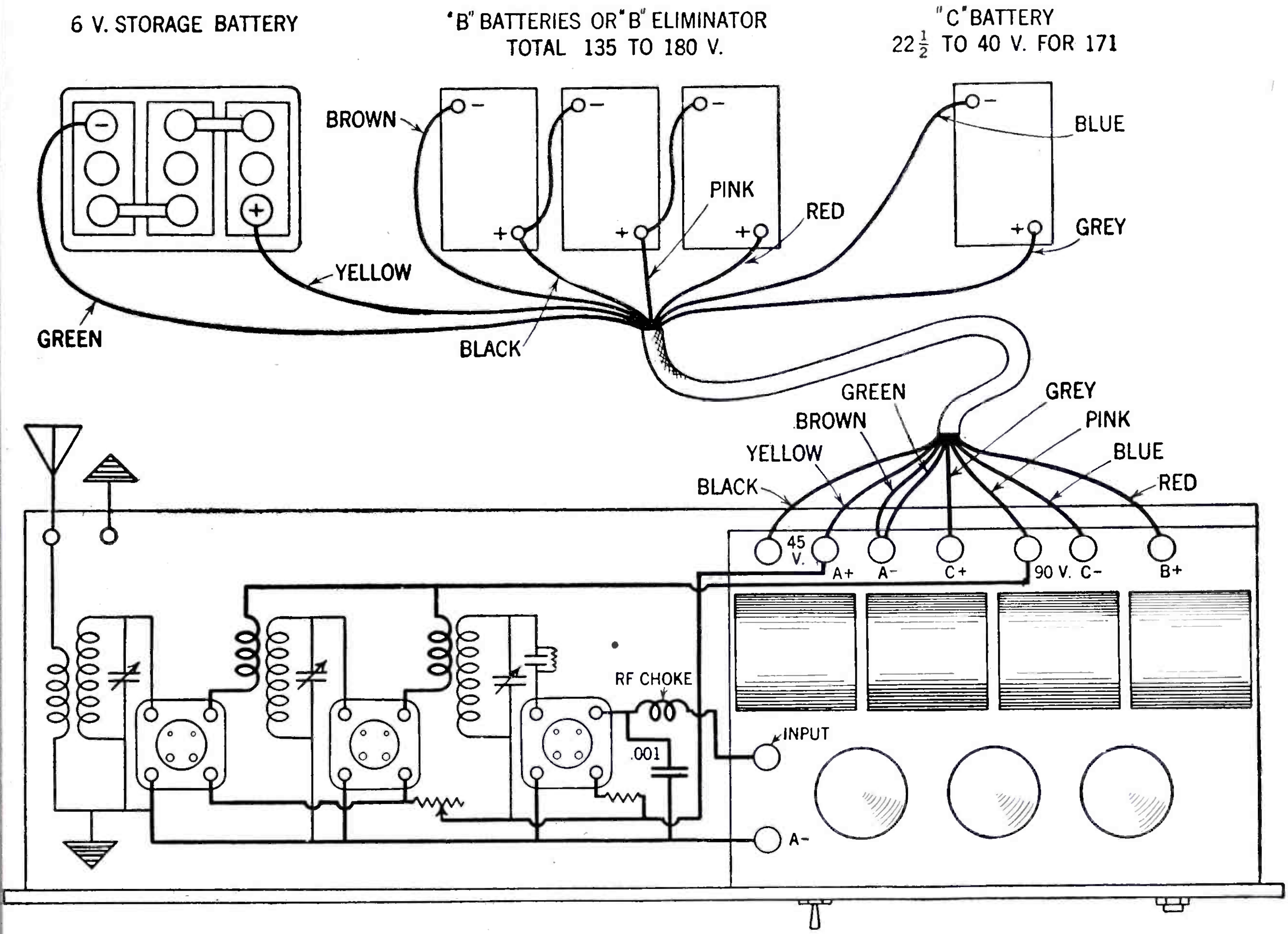


Fig. 7. This diagram offers a suggestion to set-builders who wish to use the amplifier as a component part of a receiver. The amplifier battery switch controls all tubes.

amplifiers. The power output of resistance-coupled and impedance-coupled amplifiers with high resistance grid leaks is curtailed by rectification and "tube blocking" which make it impossible for these amplifiers to handle much power. (Unless low values of coupling condensers are used which, however, affects the frequency characteristic and reduces the amplification of low frequencies). The power output of a transformer-coupled amplifier is limited by the fact that it is necessary to prevent the generation of grid currents. The normal operating potential of the grid must be held at a sufficiently negative value to prevent signal variations of the grid potential from causing the grid to become positive with respect to the filament. If the grid becomes positive, grid currents are generated, the secondary of the transer output of any tube can be obtained. This large distortionless power output is obtained by the use of impedances as grid leaks, and by the elimination of magnetic coupling between the stages of the amplifier. The impedance grid leaks prevent all possibility of rectification and "tube blocking." The absence of magnetic coupling permits the generation of grid currents without distorting the wave form of signals. The normal operating potential of the grid can be adjusted to the center of the straight portion of the characteristic curve of the tube without considering the effects of grid current when the grid goes positive.

The large distortionless power output of the amplifier makes it unnecessary to use more than 180 volts on the plate of the last tube. For most homes, 135 volts is sufficient.

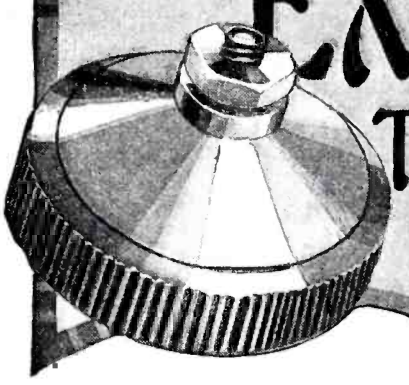
If a 171 tube is used in the output the voltage amplification is lowered, although it is still sufficient. If desired, a Hi-Mu tube can be employed in the first stage to increase the amplification.

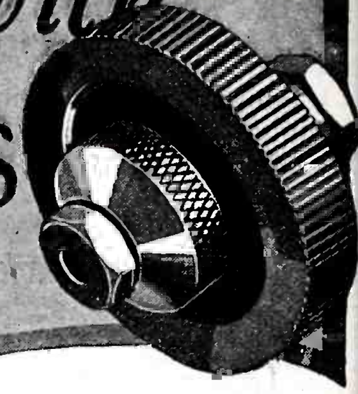
How to Build the Amplifier

The tuned Double Impedance amplifier illustrated on these pages may be built as a separate unit and attached to any receiving set by means of a battery cable. The A and B batteries used to operate the set are also used to supply power to the amplifier. The amplifier takes the place of the audio amplifier of the receiving set. It does not matter what kind of set is used. The amplifier will work equally well with a one-tube set or with a super-heterodyne. Moreover, the amplifier may also be mounted directly on the front panel of

(*Continued on page* 118)

EXPERIMENTS with TRANSMITTER BUTTONS





by Joseph Kraus

SINCE the first article on Experiments with Transmitter Buttons appeared in RADIO REVIEW, numerous questions have been asked as to how the transmitter button can be made to work properly. In each and every case, the answer is simple: "the button has not been hooked up in accordance with directions." There is no electrical circuit that is simpler to couple than an ordinary transmitter button and a receiver. The experimenter should remember that every transmitter button requires a diaphragm of some sort or a substitute therefor. The size of this diaphragm depends entirely upon the work which is to be accomplished or the nature of the matter to be broadcast or amplified.

For ordinary speech, a diaphragm approximately 2½ inches in diameter is better suited than one 14 or 18 inches in diameter. The smaller diaphragm enables the listener to recognize the voice of the person transmitting, whereas the larger diaphragm has a tendency to decrease the pitch of the transmitted voice. But when doing detective work, it might become necessary to attach a transmitter button directly to a large canvas picture. In this particular case the conversation that is picked up is the all-important consideration and one does not care about the quality of the sound just as long as the speech can be recorded.

Now here is a hint to the experimenter which will enable him to make his transmitter buttons react far more sensitively. Take the button apart by turning the large knurled screw to the left. Do this over a sheet of paper so that you will not lose the carbon granules. Then, by the aid of a small pair of pliers, unscrew the polished brass button from the mica diaphragm. You may find that there are two pieces of mica in your button. This is due to the fact that the mica sometimes sticks together and consequently, in modern rapid assembling methods, it is difficult to make sure that only one of them is placed in a button. At other times this is done purposely so as to prevent breakage in shipment. If you locate two mica diaphragms, remove one of them, then reassemble the entire button. Make sure that the mica diaphragm is not broken while doing this; otherwise the sound reproduced will be inferior. Now as to the quantity of carbon granules in this button. Slightly more than half is a splendid proportion. For more sensitive work, the quantity should be decreased and for very crude work, the button can practically be filled up. Therefore, the fewer carbon granules in the button (of course within limits) the more sensitive will be the nature of the pick-up. Coincidentally, a frying noise might be produced when there is not a sufficient amount of carbon granules to properly distribute the current (frying being also due to too much current). At no time should the current through these buttons be so high that it will produce a frying noise. While the previous article advocated the use of a 4½ to a 6-volt battery, the use of telephone transformers was likewise suggested, but for those readers desiring to use the standard radio transformers (audio frequency types) the voltage on the button can be increased to from 22 to 45 volts, dependent upon the resistance in the primary of the transformer. If the reproduced voice develops a frying sound, the button is being overloaded; if not, then the voltage should be increased until it is just below this frying point.

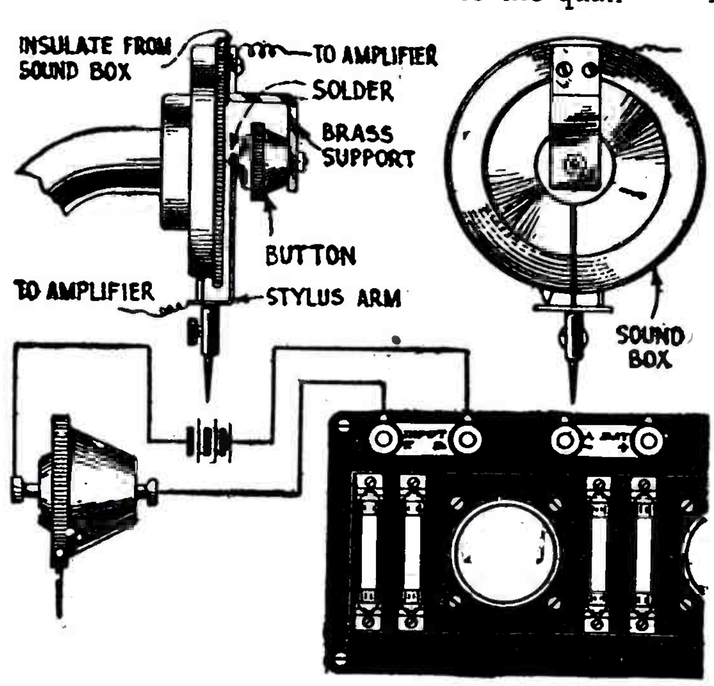


Fig. 1. At the upper left is shown the method of fastening the Skinderviken button to the sound box. The electrical circuit is shown below.

An interesting figure is reproduced here by permission of Mr. Lescaboura who employed the transmitter button with a resistance coupled amplifier for amplifying the sound of the phonograph. The details follow herewith. With a relatively small investment of money, plus a liberal investment of ingenuity, the old phonograph can be brought back into the good graces of the family. The marvelous advances scored in phonographic reproduction can be enjoyed side by side with the best radio has to offer.

The essentials of modern phonographic reproduction are, first of all, the new electrically-cut records which contain the wealth of tone and the full depth of the original studio rendition. The old-time records simply have not the necessary ingredients for quality reproduction, and it is a waste of time and effort to use them for quality reproduction. Secondly, we must have a device to translate the record groove wiggles into corresponding wiggles of an electric current. Thirdly, we must have a means of amplifying the delicate electrical wiggles many times, without distortion. Fourthly, we must have a loud-speaker device fully capable of translating the complex electrical variations into a prototype of the original music.

The simplest means of obtaining the desired volume and quality of amplification is by means of a good audio

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* *Those desirous of obtaining the first article, a reprint from the* RADIO REVIEW, *March,* 1926, *can secure the same by writing to the editor, who will be glad to send a copy to interested readers.*

amplifier such as a resistance coupled unit. A resistance coupled amplifier unit is relatively inexpensive and provides faithful amplification and ample volume for the largest living room, in conjunction with a good cone reproducer.

So far, so good. We are merely following radio practice. But there still remains the problem of the pick-up, or device for converting the needle vibration into electrical variations. Here the simplest method is to take the standard phonograph sound box and attach a Skinderviken button, as shown in the sketch. The results will prove a revelation. The electrical circuit is shown in the lower part of the accompanying illustration. At the upper left, the method of fastening the Skinderviken button to the phonograph sound box is clearly illustrated.

For the information of those who have not as yet experimented with the Skinderviken button, this interesting device is a small carbon grain microphone button, less than an inch in diameter and about a half an inch high, containing a polished metallic button affixed to a mica diaphragm and a surrounding case of brass. The space between the case and the polished button is partially filled with a good grade of carbon granules. The button is very sensitive to sound waves when it is attached to any form of diaphragm.

Another method of attaching the button to the diaphragm of a phonograph is to drill a tiny hole through the mica diaphragm of the phonograph immediately above the center and high enough so as to permit the button to clear the level communicating with the phonograph needle. To do this, the needle stylus must be removed from its holder by loosening the screws holding it in place and then the sound box must be opened so that the mica diaphragm can be removed as a whole. Care should be taken in punching or drilling a hole through the mica so that the mica itself is not cracked. A cracked mica will not reproduce well. The leads from the button are then taken as indicated in the diagram, whence they lead to the primary of an audio frequency transformer in series with a 22½ volt "B" battery. The secondary is then led directly to the grid and negative "C" circuit of a standard audio frequency amplifier. The figure 2 shows another unique variation which might for this article be called the "mysterious music." It will be observed that there are a group of speaker units connected in parallel through the agency of a rheostat in one side of the circuit. The arm on this rheostat is fitted with a grooved pulley wheel and is revolved by some form of a motor drive which might be a clock work or a toy motor geared down so that the arm will not rotate too rapidly. Now then, when the arm assumes the position indicated in the diagram, those speaker units which are nearest it will receive the greatest amount of current, whereas those units further away from the arm will receive very little current. Consequently, the music apparently will come from a different horn every few seconds. At no time is there a complete block in the unit and, therefore, the click usually heard when a loud speaker is thrown into a circuit is not found in this particular arrangement. The units being preferably of the same make, you receive the same amount of current in the divided circuits and therefore the mysterious music coming from them will come from different sources which should preferably be concealed. At no time could the audience in the theatre or the visitors at home tell where the sound is actually coming from. For theatre work or for the large home, and for the radio lawn party, this system can hardly be beaten.

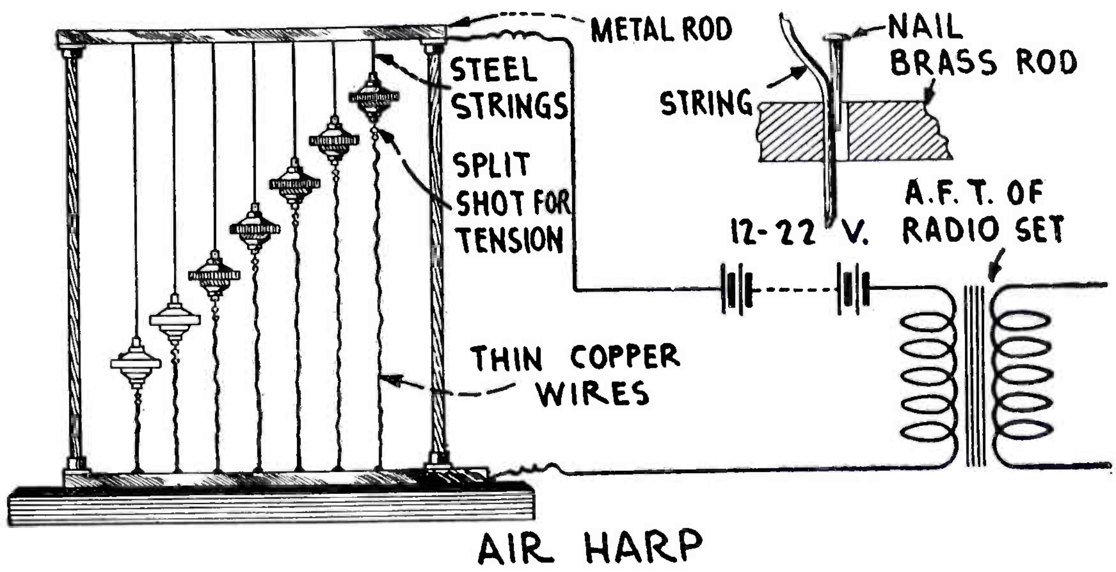


Fig. 3. Here is the layout for the proposed air harp which, when set on the window-sill will produce unusual music, not at all rhythmic, but very melodious, depending entirely upon the way in which the strings are tuned. Observe how the strings are gripped by a nail in place in the top metal rod. The tension of the string is regulated by adding a few split shots. The main tone variation is produced by shortening or lengthening the string.

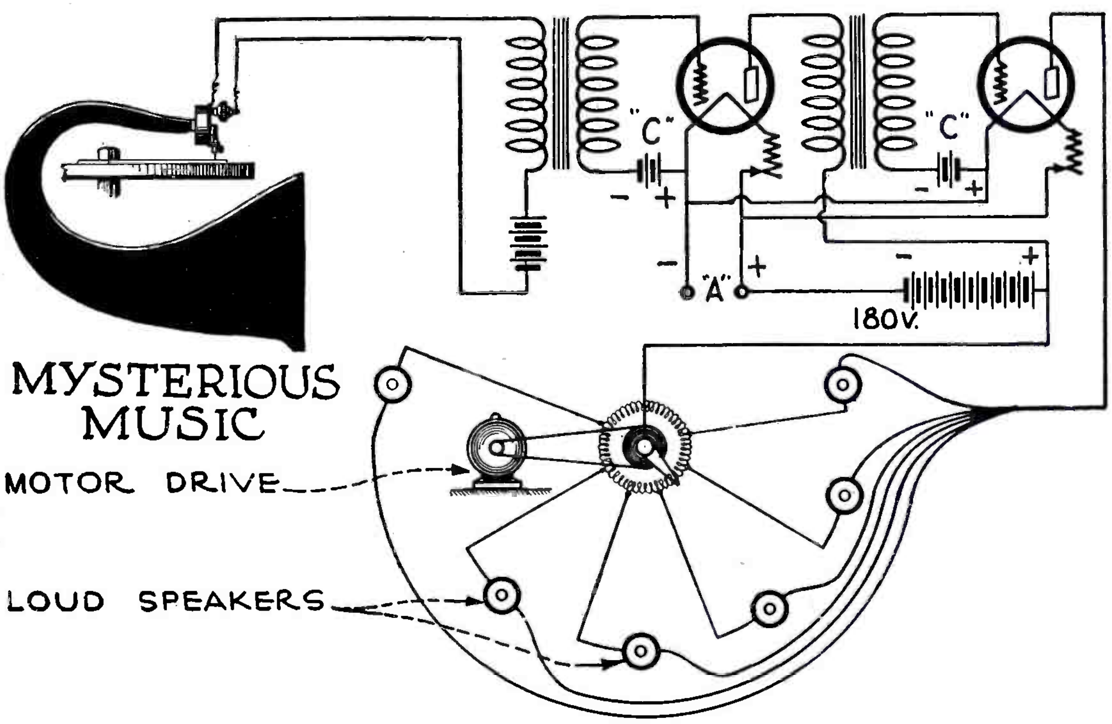


Fig. 2. Here is the layout for mysterious music in which the reproduced sound is picked up by a transmitter button, amplified through a vacuum tube amplifier and then distributed to a number of loud speakers through the agency of a motor-driven resistance-type distributor. At no time are any of the loud speakers thrown out of the circuit, yet the music intensity of any one of them constantly varies.

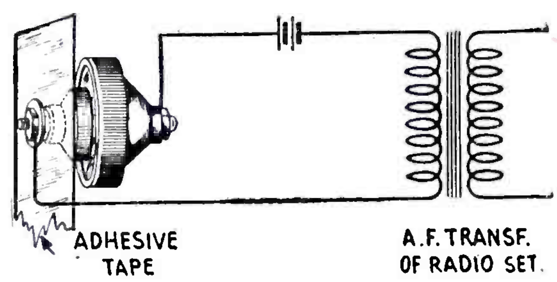


Fig. 5. Attaching the transmitter button to a piece of adhesive tape makes it applicable to any type of musical instrument.

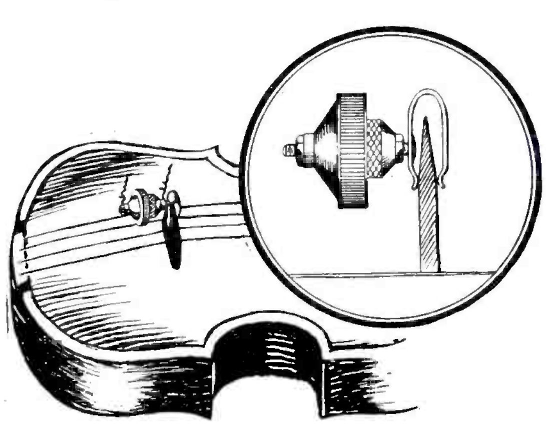


Fig. 4. Here is a method of attaching a transmitter button to the bridge of a musical instrument such as a ukelele, violin or any other similar article.

Singing Harp

An interesting singing harp is indicated in Fig. 3. Here we have two wooden uprights mounted on a suitable base and provided with a metal rod running across the top and likewise one at the bottom. A series of steel strings varying in thickness and the length of which will have to be determined by experimentation are twisted around the metal rod at the top or inserted into holes in the brass rod and locked in place with a small brass nail. This latter system is preferred because it makes a perfect contact with the steel wire, yet at the same time permits variation in the length of the string. To the end of each string we attach a transmitter button and to the bottom of each button a very thin bare copper wire is affixed and then loosely led down to the brass rod at the bottom where the wire may be soldered for a good electrical connection. When any string is lightly plucked, a note is produced which will vary in frequency with the length and thickness of the string as well as the tension thereof, but we do not desire to apply any tension to this device if we intend to place it in the window and let the wind play it for us. In order to vary the pitch of any string, the string should be shortened to raise the note or increased in length to lower it. On the very high notes two or three split shots such as are employed by fishermen in fishing will assist in placing a string under a slight tension. The music from this kind of a harp should preferably be amplified with your radio receiving sets in accordance with instructions to be given subsequently. This same type of harp can be built up and played by the fingers, the strings being but lightly plucked in order to produce the very sweet pure notes which have the peculiar faculty of vibrating much longer than the ordinary harp strings.

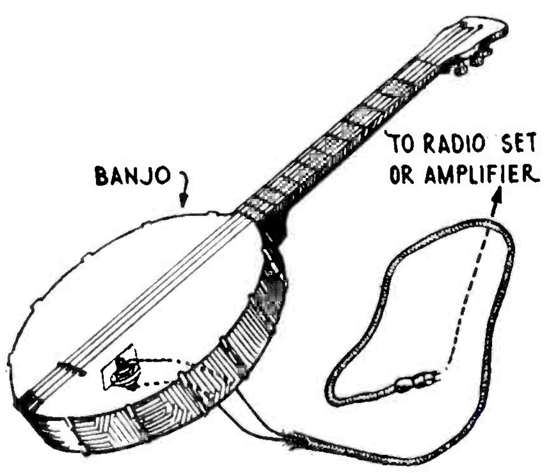


Fig. 6. Here is the way adhesive tape is used to attach a transmitter button to the head of a banjo.

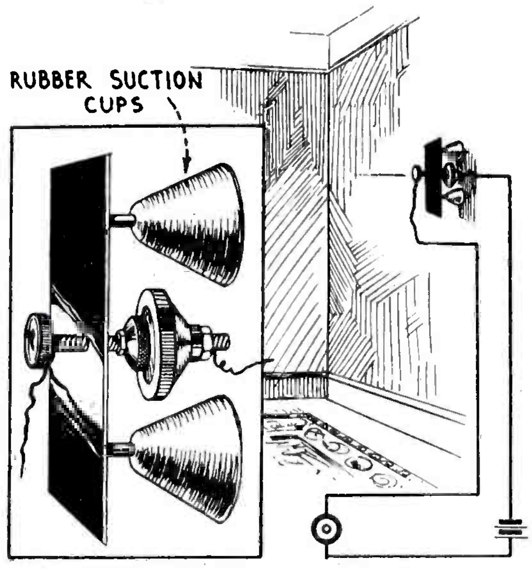


Fig. 8. This shows the layout for making a super-sensitive detectophone with which you can listen through solid walls.

Banjo or Ukelele Amplification

Perhaps you frequently found that when you entertained a crowd of young folks at your home, your ukelele was hopelessly unfit for the occasion. For some reason or other it did not respond loudly enough to be heard above the din and roar of those guests who are having a good time. The first thought comes to your mind, "I'll amplify the music," and then the next, "Yes, but how?" The problem is very simple. Out of a piece of brass make a small spring clip to saddle the bridge of the ukelele. Then run two flexible leads directly from the transmitter button attached to this clip, to the radio receiving set. Practically every home is equipped with one and the only apparatus that you need carry with you is the clip, the button, a rheostat and a wooden plug made in the form of a vacuum tube and provided with four prongs as indicated in Fig. 7. The spring clip itself should be high enough so that the button can clear the strings of the ukelele or the body of this instrument.

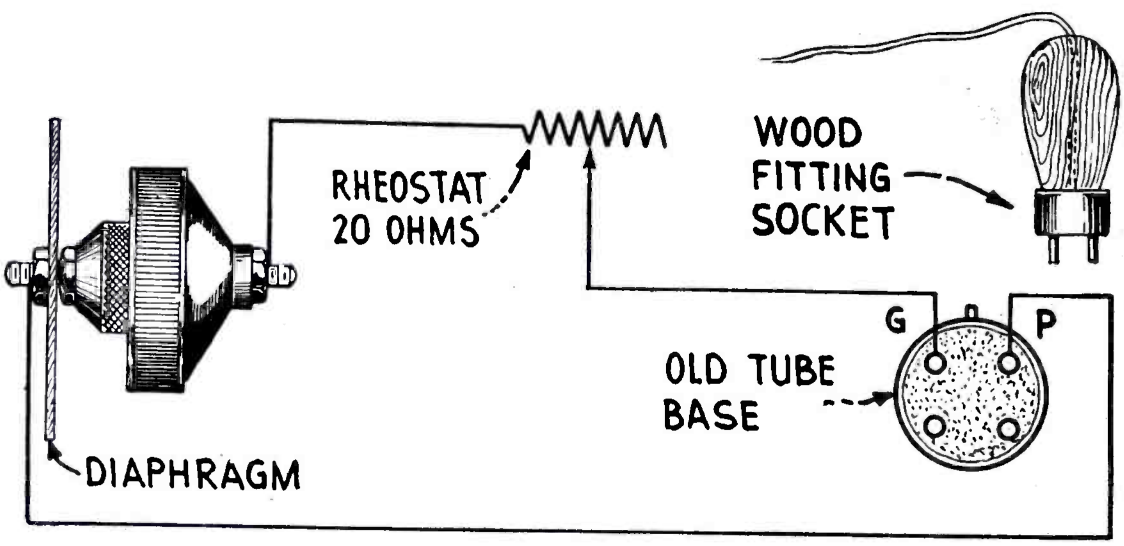


Fig. 7. The method for attaching a transmitter button to your ordinary radio set. A dummy socket provided with grid and plate contacts is substituted for the detector tube. The rheostat regulates the current which is obtained directly from the "B" battery ordinarily in this circuit.

The transmitter button can also be used for amplifying the sound of a banjo. Here, however, the problem which we have to confront is a more difficult one because putting the button on the bridge will interfere with the player's fingers and one could scarcely be expected to punch a hole in the $6.50 pigskin head of the banjo to accommodate the button. The following stunt has been decided upon and it works very well indeed. The transmitter button is fastened directly to

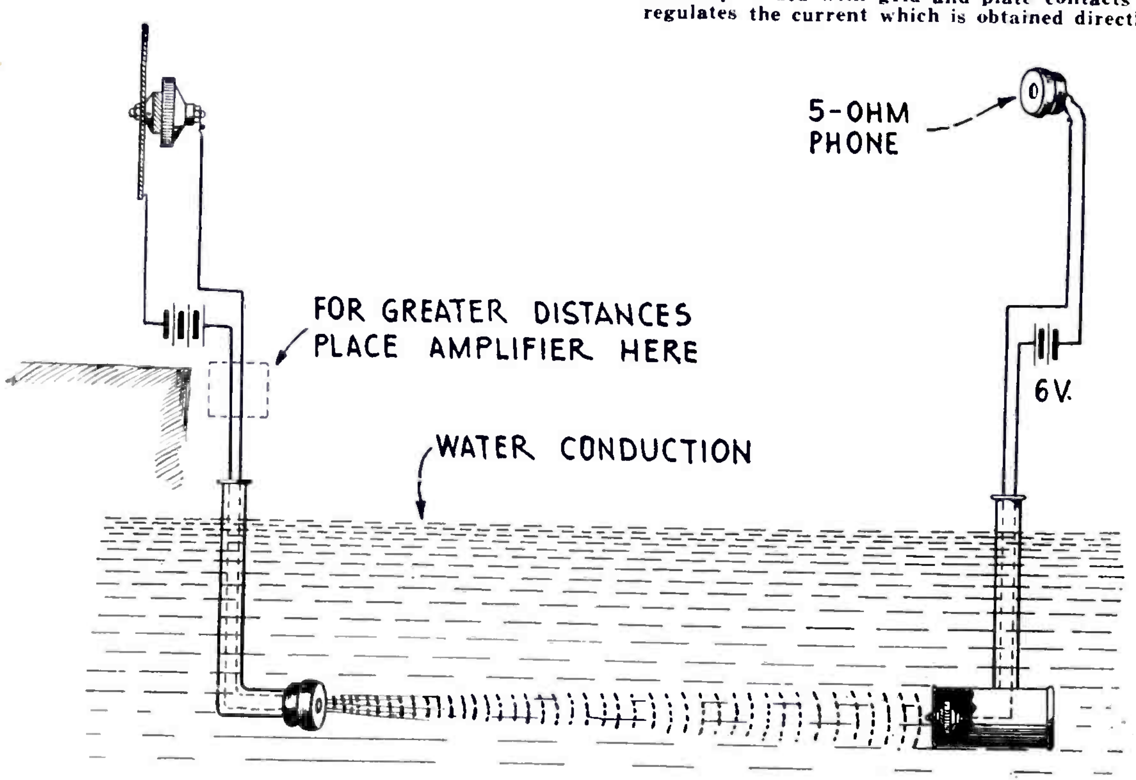


Fig. 9. Conducting sound through water is very easily accomplished, by the layout above indicated.

a piece of adhesive tape. A hole is punched through the tape, then a small metal washer is put upon the end of the screw thrust through the hole, and the bolts are tightened up. A small piece

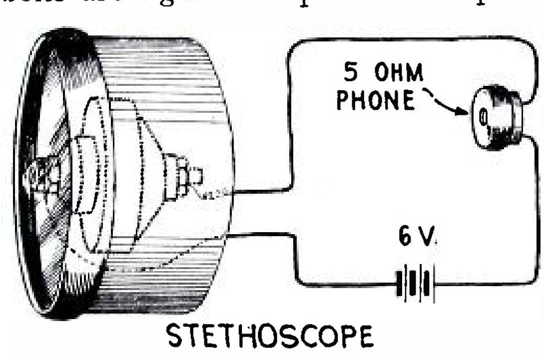


Fig. 10. A stethoscope can be built as indicated in the diagram here, the transmitter button being attached to a diaphragm and being likewise connected in series with a source of current supply and a low resistant phone.

of metal is then placed on the banjo directly beneath the screw and the adhesive tape firmly stuck to the head of the banjo. Two wires leading from the banjo couple directly to the radio set or audio frequency amplifier. To remove the adhesive tape, drop a small quantity of gasoline from the pocket cigar lighter on the end of the adhesive tape, let it soak for a moment and it will come off cleanly. (Figs. 5 and 6.)

Many experimenters have inquired as to how they could connect a transmitter button to the radio set so that the loud speaker of the radio set will reproduce voice or music. The various means of attaching the button to phonographs and the various methods of making microphones have already been described in this and the previous article. Of course, one can build up a complete amplifier to be used purely for transmitting circuit experiments, but ordinarily the experimenter does not know how to wire an audio frequency amplifier or had we better say, he does not care to do this work, nor may he desire to go to the expense of purchasing several other sockets, tubes, rheostats and batteries when he already has these same materials on hand. The question is how to connect the button to the receiving set without opening any other connections and in general mon-

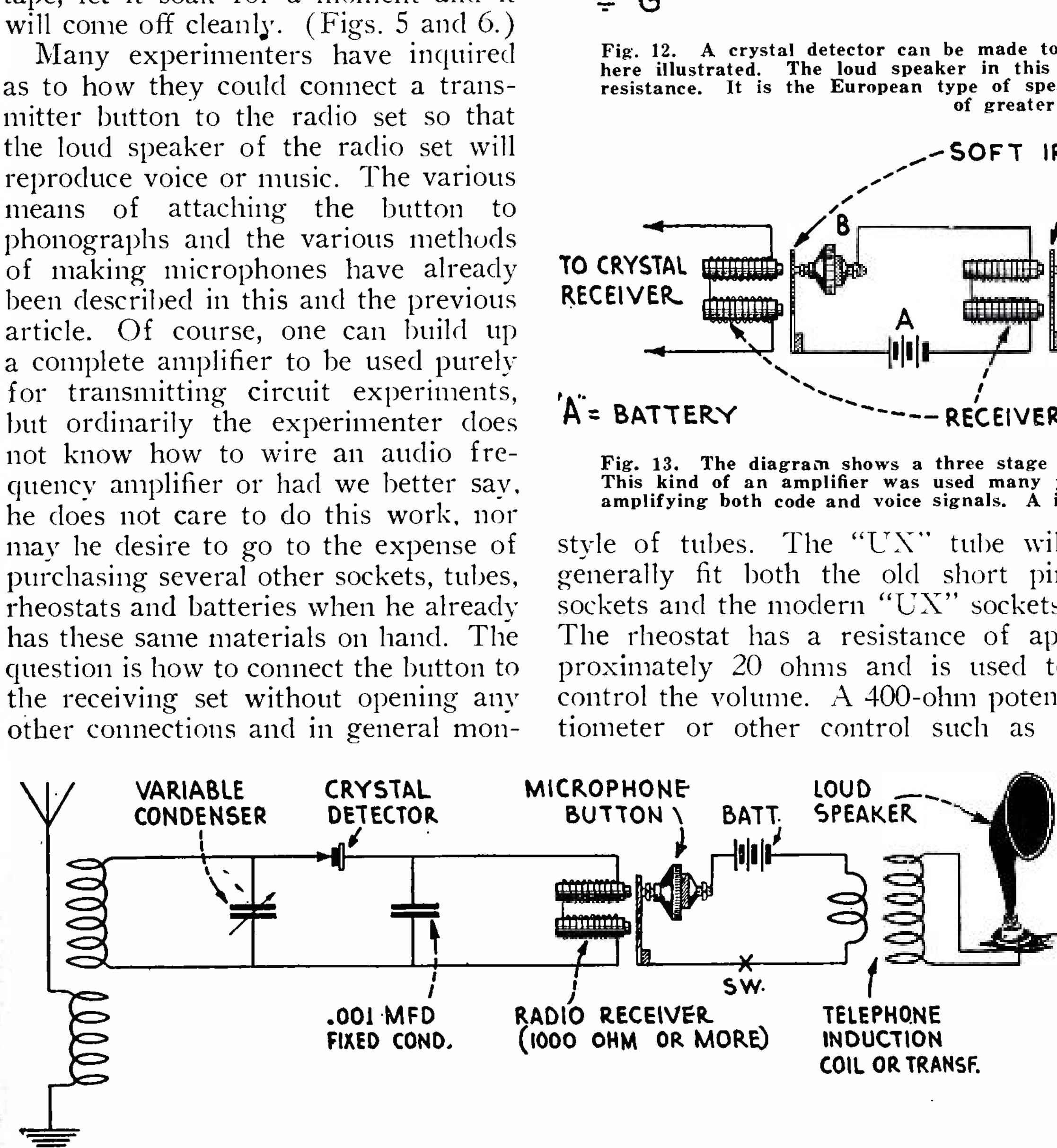


Fig. 11. In this hook-up a telephone induction coil or a transformer is used to step up the voltage so that an ordinary radio loud speaker can be used with a transmitter button amplifier. The circuit shows the operation of a loud speaker from a crystal detector radio receiving circuit.

keying around with what is a perfectly good radio outfit. The answer is simple. Make a wood block about the size of a tube and drive four nails or brass pins into the base in the same positions the prongs of a tube occupy. Round-head wood screws could also be used for this purpose. A pin is then driven in the side and the wires leading from the transmitter button and rheostat are connected to the grid and plate pins as indicated. A far superior way to make this type of a plug is to take an old burnt-out tube, remove the glass and then connect the flexible leads to the grid and plate pins as before. An "UX" tube should be used if possible because some sets are not equipped with sockets to take the old

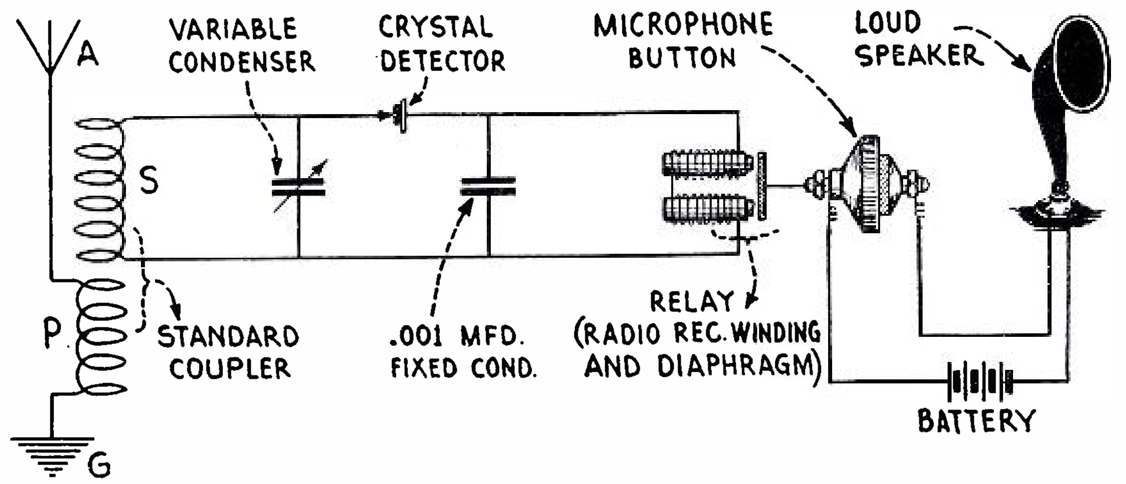


Fig. 12. A crystal detector can be made to operate a loud speaker by employing the circuit here illustrated. The loud speaker in this particular case has a winding of relatively low resistance. It is the European type of speaker, many of which do not possess a resistance of greater than 100 ohms.

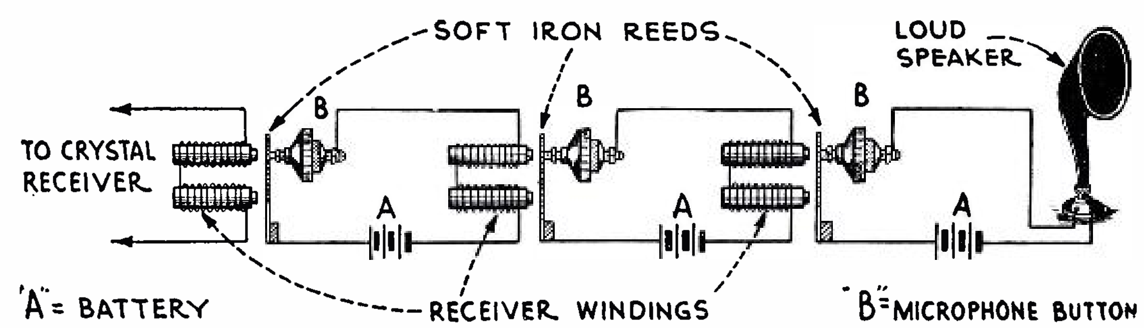


Fig. 13. The diagram shows a three stage audio frequency amplifier of the microphone type. This kind of an amplifier was used many years ago in the large trans-Atlantic stations for amplifying both code and voice signals. A indicates the batteries; B, the transmitter buttons.

style of tubes. The "UX" tube will generally fit both the old short pin sockets and the modern "UX" sockets. The rheostat has a resistance of approximately 20 ohms and is used to control the volume. A 400-ohm potentiometer or other control such as a Clarostat, a Bradley ohm or other variable resistance might well be employed to control the volume of the loud speaker. In this type of circuit the "B" batteries of the set are used and it is preferable to remove the radio frequency tubes from the circuit or else turn off the filaments in those tubes.

Listening Through Walls

In Fig. 8 we show a method for mounting a transmitter button so that it can be employed to listen to what is going on in the room next door. It is well known that when a person places his ear against the partition, he can hear the entire conversation in an adjoining room, provided that the conversation is loud enough and that the wall itself is not sound-proof. This position is tiresome both for the listener as well as impossible for detective purposes. The article described in Fig. 8 is a microphone button which can be affixed to the wall instantaneously. It consists of a small plate of metal, brass or the like, to which two rubber suction cups are affixed as indicated. The transmitter button itself is mounted at the end of a long screw with a thumb or knurled nut for adjustment. In operation, the rubber suction cups are moistened with a little glycerine to make them adhere more firmly to the rather porous wall to which they are to be attached. After the suction cups are firmly in place, the thumb nut is turned to the right until the button just touches the wall. The receiver, which in this case is a 5 to 75-ohm receiver, reproduces the sounds with the proper degree of accuracy. A 4 to 6 volt battery is placed in the circuit and the detective operating the device can sit at a desk and copy down

(Continued on page 144)

A Novel Aerial

Because of the unsightliness of the ordinary outdoor aerial, many radio fans have tried to secure results with loops and indoor antennas. It is well known that they are much less efficient than the outdoor type and their use reduces the efficiency of the receiver.

Manufacturers, from time to time, have placed devices on the market to remedy this condition. The vast majority of these "aerial eliminators" have been condenser arrangements, designed to utilize one side of the commercial lighting circuit by being plugged into the light socket. These aerials are not always very efficient however, because of the varied conditions found in the power circuits.

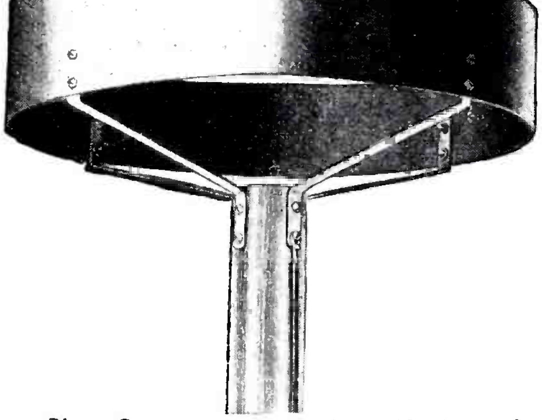


Photo Courtesy American Radio Hardware Co.

The circular antenna.

A prominent radio manufacturer, realizing this, has placed a device on the market which produces the efficiency of an outside installation, without the unsightly wires. As may be seen in the illustration, it is composed of a large cylinder of aluminum, suitably mounted on a pipe so that it may be easily installed on the roof. Another advantage of this aerial is that it is entirely non-directional. Several of these aerials may be installed within a small radius without any interference being experienced.

A Five-Inch Cone Speaker

A very interesting radio novelty which takes the form of a midget cone speaker has been recently placed on the market by an eastern manufacturer. This small speaker, which actually works to perfection, realizing all its limitations, stands only 5 inches in height, has an adjustable unit and reproduces music and voice with a high degree of volume and clarity.

The base and baffle board are made of a soft, non-resonant wood attractively finished to correspond with the cone, which is made of heavy cone paper. The cone driving unit, which consists of a double pole magnetic driver, the armature of which is adjustable and which is directly coupled to the apex of the cone, is sturdily made after the best methods of cone speaker unit construction.

This cone speaker, besides being of great use when the family have retired, when it may be plugged in and a quiet "listening hour" instituted, may also be employed for many forms of amusement. It is so tiny that it can be easily placed inside the set itself, or in a table drawer, or under the dining room table, or in the library table or stuck in the chandelier, and will produce some remarkable results, which a speaker of the usual size could not produce. Due to its sturdy construction it can be handled much more easily than the larger speakers without fear of its being damaged.

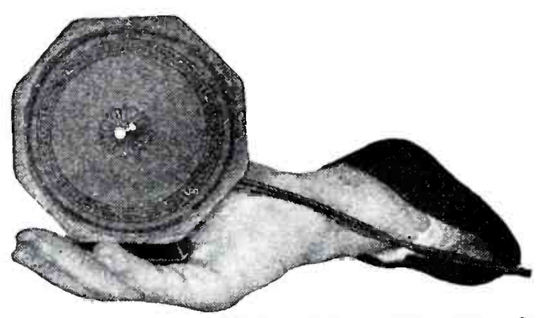


Photo courtesy Alden Mfg. Co.

The small size of the midget cone speaker is evident in this photograph.

Another "B" Power Unit

This "B" battery eliminator has been placed on the market after an extensive survey of the needs, both engineering and merchandising, in the eliminator line. The results of this survey were carefully compiled, after which a unit was designed to meet the conditions. Fixed controls are used, with separate voltage taps, giving ample range as well as enabling the user to definitely know the voltage he is getting. The rectifier uses a full wave system and will supply enough current to operate a ten tube set. The manufacturer has found that by producing every part in quantity, he was able to supply a remarkably efficient eliminator at a reasonable price. Special high voltage tested condensers are used in this eliminator to insure constant use without a chance of breakdown. It will supply 40 milliamperes at 150 volts and is equipped with a 180 volt tap for the new 171 type vacuum tube.

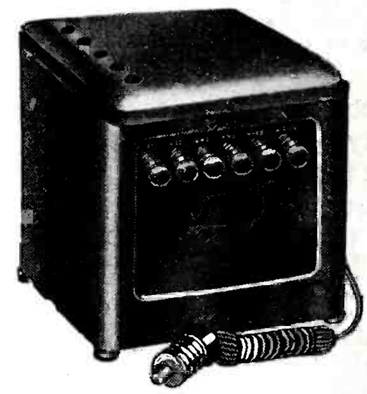


Photo courtesy Leslie F. Muter Co.

The fixed voltage full wave "B" battery eliminator.

An Automatic Switch for Power Circuits

The power switching relay which is illustrated herewith is one of the sturdiest devices of its kind on the market. In general it is a device which automatically switches the 110 volt current used for the A and B circuits to the A and B circuit power lines, or cuts them off when the set is switched off.

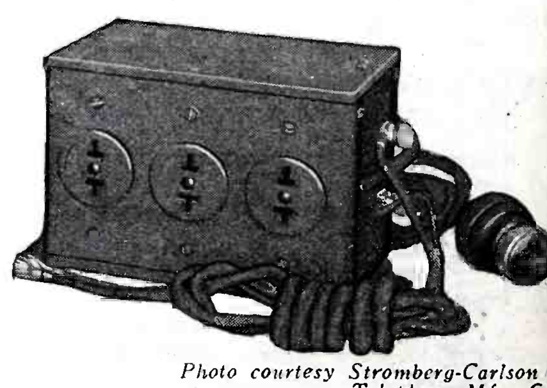


Photo courtesy Stromberg-Carlson Telephone Mfg. Co.

General view of the switching relay.

The relay consists of an electromagnetically operated double pole double throw switch amply insulated to prevent short circuit, encased in a handsome metal case. Three regulation outlets are provided into which there are

(*Continued on page* 166)

The Harkness Tuned Audio Amplifier

(*Continued from page* 111)

a receiving set designed for the purpose. The width of the unit is only 9 inches and the depth 6⅜".

Experienced set-builders will also realize that it is a very simple matter to use this system of amplification in any receiving set without actually building are marked for use in the first, second and third stages respectively. It is important that they be connected in the order indicated as special values of coupling condensers are used in each stage.

The first step in the construction of the amplifier is the cutting and drilling of the panels. Any dealer, equipped for the purpose, will cut the panels to the sizes specified.

The drilling templates are shown in Fig. 8. Lay out the holes to be drilled

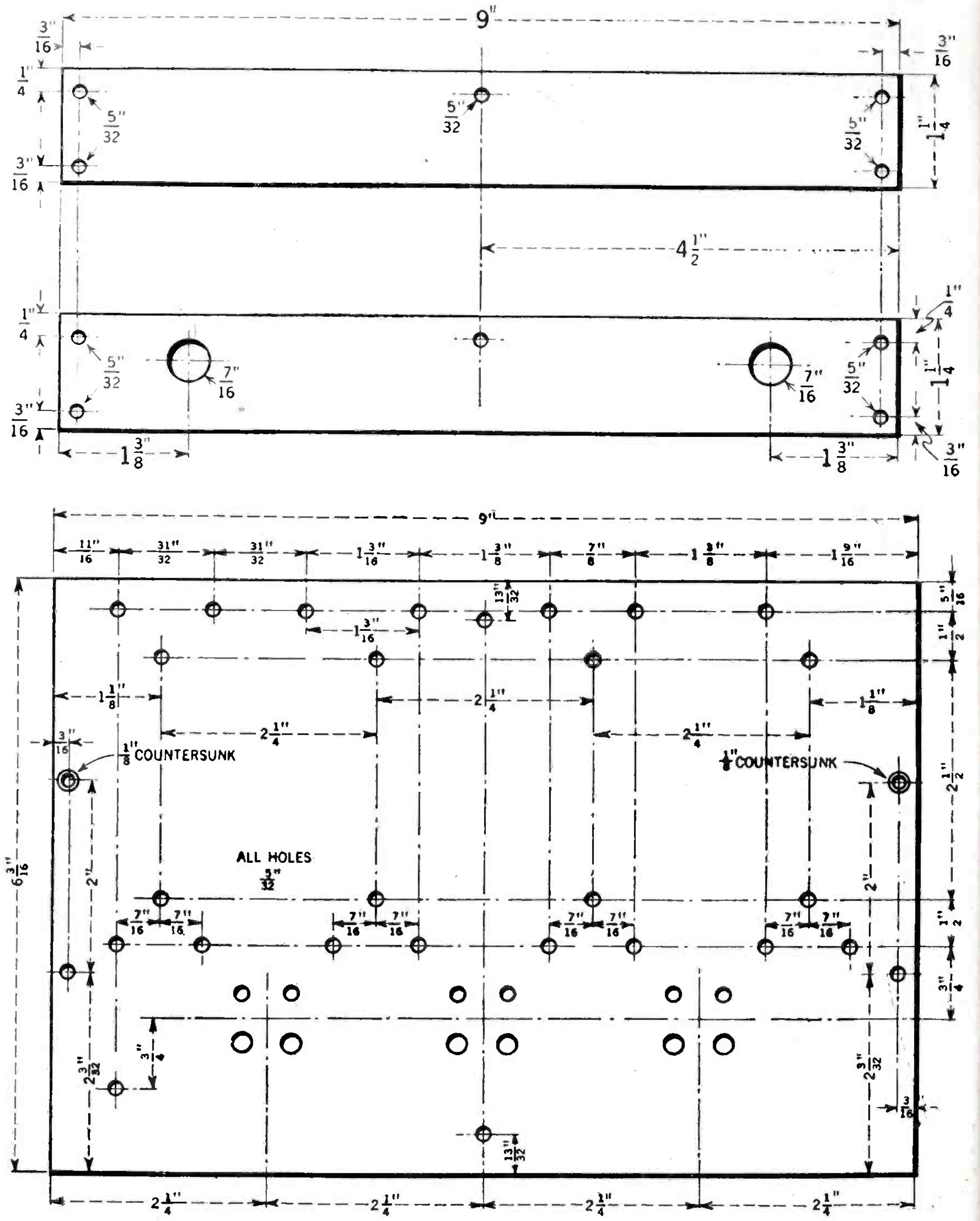


Fig. 8. Drilling templates of the sub-panel and the two bakelite strips. If different tube sockets are used, drill mounting holes required.

a separate amplifier. The three tuned double impedance couplers and the output unit can be mounted directly on the sub-panel or base-board of any receiver and wired as shown in the diagrams. For many purposes, however, it is very convenient to have a separate audio amplifier which may be used with any receiving set (or phonograph) and the construction of the amplifier will be described.

The parts required to build the amplifier are listed in a separate column. The tuned double impedance couplers on the panels; then center-punch the holes and drill as indicated. It will be noticed that the model amplifier illustrated is equipped with sockets which are riveted to the panel. The holes for these sockets are shown in the drilling template. Any tube sockets can, of course, be used. Drill the panel for the type you procure.

When the panels have been drilled, assemble the amplifier as shown in the photographs. First, mount the sub-panel brackets on the large panel; then

(*Continued on page* 155)

New!

THORDARSON POWER TRANSFORMERS

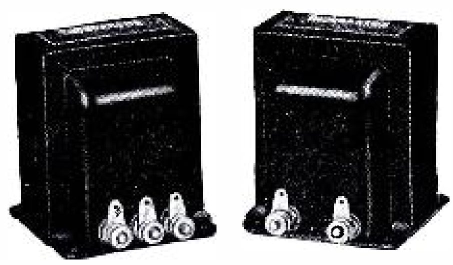
130 M. A. FULL WAVE RECTIFIER

Here is a power unit that will satisfy the ever increasing demand for improved quality of reception. A split secondary 550 volts either side of center, makes possible full wave rectification, using two 216-B or two 281 tubes. Current capacity, 130 milliamperes. The low voltage secondary, 7½ volts, will supply two UX-210 power tubes, enabling the use of push-pull amplification in last audio stage.

The Double Choke Unit 2099 is designed for this power unit. Contains two individual chokes of 30 henries, 130 milli-amperes capacity each.

T-2098 Transformer, 4½" x 5¼" x 5¾"
List Price, $20.00

T-2099, Choke Unit 3¼" x 4⅞" x 5⅝" high
List Price $14.00



POWER PUSH-PULL TRANSFORMER and CHOKE

Quality reproduction that cannot be obtained with straight audio amplification, is made possible through the Thordarson power push-pull combination. This arrangement is designed for use with power tubes only and has sufficient capacity for all tubes up to and including the UX-210. Makes an ideal power amplifier when used with power supply unit T-2098.

Input transformer couples stage of straight audio to stage of push-pull. Output choke is center-tapped with 30 henries on either side of center tap. Dimensions of both transformer and choke, 2½" x 2½" x 3" high.

Input Transformer T-2408
List Price, $8.00

Output Choke T-2420
List Price $8.00

A. C. TUBE FILAMENT SUPPLY

The new R. C. A. and Cunningham A. C. filament tubes will be very popular with the home constructor this season. The Thordarson Transformer T-2445 is designed especially for these tubes. Three separate filament windings are provided.

Sec. No. 1, 1½ volts, will supply six UX-226 amplifier tubes.

Sec. No. 2, 2½ volts, will supply two UX-227 detector tubes.

Sec. No. 3, 5 volts, will supply two 5 volt power tubes.

In addition to the above, this transformer is equipped with a receptacle for the B-supply input plug. Supplied with six-foot cord and separable plug for attachment to the light circuit. Transformer in compound filled, crackle-finished case. Dimensions — 2¾" x 5¾" x 4¾".

A. C. Tube Supply, T-2445
List Price, $10.00

Realistic tone quality, that elusive but much talked of characteristic of radio reception—can be obtained only through the use of apparatus of the finest materials and workmanship. For years Thordarson transformers have been the choice of many discriminating manufacturers of quality receiving sets. Follow the lead of the leaders. If you enjoy good music *specify Thordarson transformers*

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill.
Gentlemen:
Please send me your booklets describing your new power supply transformers.

Name..........

Address..........

City.......... *State*..........

(3562)N

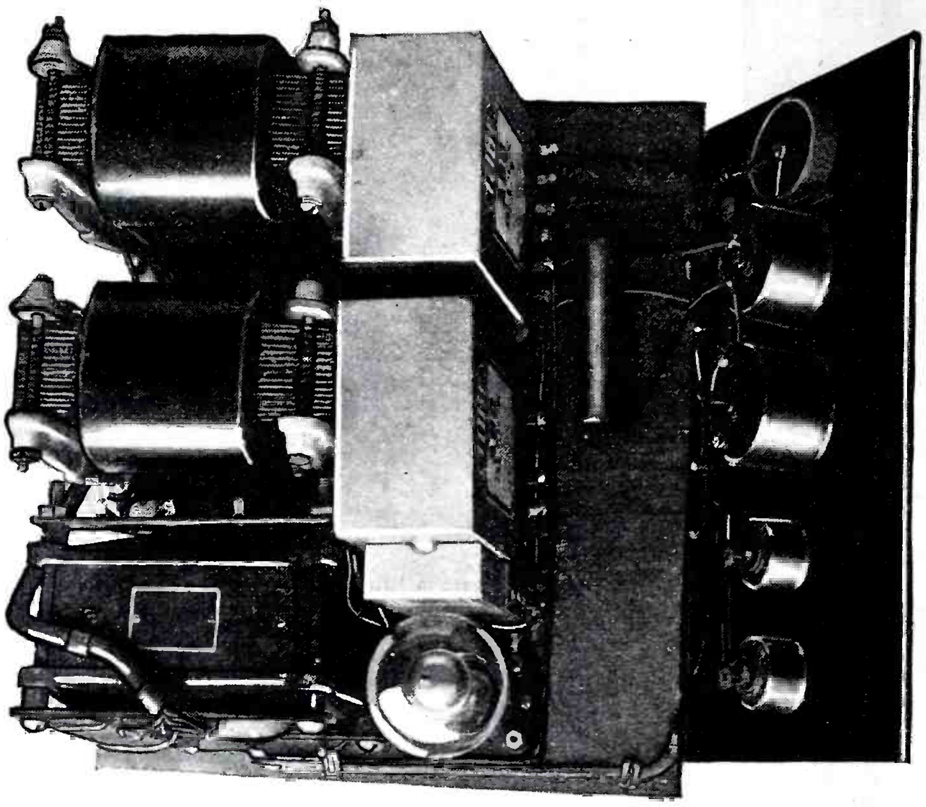
A Compact A-B-C Power Unit

(*Continued from page* 107)

in detail. This diagram of rewiring of the "Hi-Q" will serve two purposes; it will illustrate how this particular receiver may be converted and it can be used as a typical example for converting any radio receiving set to series filaments.

employed in this unit can not be substituted in any of the present "B" eliminators for other types of tubes. This tube will not properly function unless 200 milliamperes of current is drawn, and also the present "B" eliminators are not of the heavy duty type and can not stand up under a load of this nature.

Any set may be converted to series filaments; however, a receiver which uses tandem condensers is perhaps

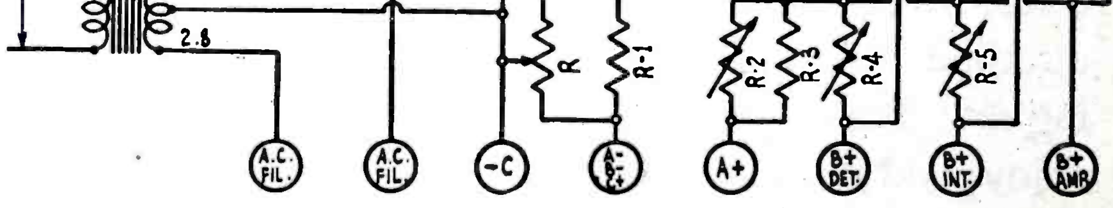


A top view of the assembled A-B-C Power Unit with the front panel tilted forward to show how the Clarostats, meter and variable resistance are mounted.

If all connections are properly made and the "A-B-C" unit built as described, no appreciable hum will be heard in the loud speaker when operated.

more difficult and for this reason the author has chosen a popular receiver of this type, namely the "Hi-Q."

To convert the "Hi-Q" in the first place it is necessary to isolate the two



Schematic wiring diagram of the Compact A-B-C Power Unit. Lettering corresponds to that given in the list of parts in the foregoing part of this article.

A word of caution is always in order when making a device of this nature. Do not work on the unit when the house current is turned on to the transformer. Perhaps it also should be made clear that the rectifying tube as

tuning condensers which have a common shaft and their frame grounded to the shield. This may be done by substituting a Bakelite shaft for the one furnished. To do this, loosen the

(*Continued on page* 153)

The Improved Laboratory Super-Heterodyne

(*Continued from page 96*)

7, kilocycles of powerful locals—a degree of selectivity duplicated by no other set tested. The wavelength range of the receiver with standard coils is from 30 to 3,000 meters. Regular broadcast range coils cover the range of 200 to 550 meters, but it can be seen that the receiver is adapted to any class of broadcast reception by virtue of its wavelength flexibility.

The parts required to build the 1927 Model Improved Laboratory Super have been most carefully selected for the perfect coordination of the operating characteristics of the receiver. It is imperative that the exact parts specified be used in building the set if its truly remarkable performance is to be realized to the fullest possible extent. known and reputable manufacturer, Every item is the product of a well and unconditionally guaranteed.

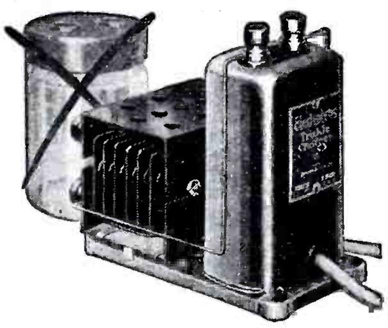
Assembly

Upon the chassis should be mounted the detector and oscillator assemblies, inside the stage shield pans if shields are to be used. The end mounting screw of each 511 tube socket is used to join the A— to the chassis, so a lug should be placed under the screw head, to be soldered to the F— socket terminal, and the under side of the chassis scraped bright for good contact with the fastening nut. One terminal of the .00015 grid condenser should be bent at right angles and fastened directly under the "G" terminal screws. The single long screw holds the 275 choke coil in the detector stage assembly.

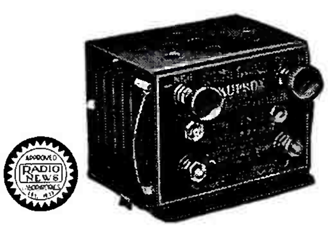
The binding posts mount in the nine holes at the rear of the chassis using the insulating washers to positively insulate them from the chassis, as do the four tipjacks. The "Ground" post grounds to the metal chassis, and the fastening screw of this post holds one end of the second ½ mfd. condenser tightly to the chassis, while the free end must be bent up clear and free of the metal chassis.

The A— connection is made to the amplifier thru a contact between amplifier shield and chassis to which it is fastened with four screws. The two audio amplifier tube sockets mount using their rear fastening screws to connect the F—posts to the chassis. All possible wiring should be done on the chassis before proceeding further, leaving free the wire ends that will connect to the instruments on the front panel; and to the two audio transformers which mount last. The potentiometer should be mounted as shown, using insulating washers to thoroughly insulate its frame from the panel. The

Revolutionizing Radio Socket Power!



Modernize Your Trickle Charger or Power Unit!



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No Bulbs · No Liquids · No Noise

REPLACEMENT UNIT

Eliminates Acids, Liquids and Charging Bulbs

Makes any electrolytic unit dry, noiseless. Requires no watering or other attention. Increases charging rate.

Throw away the acid jar on your present trickle charger or power unit. Install the new KUPROX all-metal Replacement Unit in its place. In less than two minutes banish all the bother of watering and other attention—the danger of ruined rugs and clothing. Very easy to attach. Requires but two simple binding post connections. Makes your charger absolutely dry, and gives a higher charging rate. Fits all standard electrolytic chargers and power units. List Price, complete with full instructions.

$4.50

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No acids, liquids, or charging bulbs.... Dry permanent power that requires no attention

At last, radio power as dependable and permanent as your house current, that requires no more attention than the snap of a switch. KUPROX, the new, dry metallic rectifier supplies all radio power, A, B, and C, constantly, dependably — probably the greatest of all developments in light socket radio power.

With KUPROX Devices your set is truly electric. KUPROX is all-metal—dry—it needs no watching or watering—it cannot wear out. Various models, from Trickle Chargers to the Combinations which supply all radio power from a single compact unit.

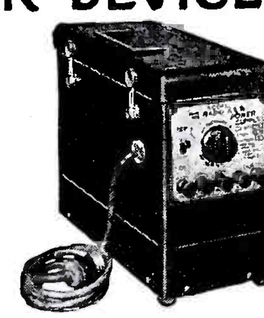
[FREE BOOKLET FOR YOU: "The Secret of Successful Battery Elimination," describing KUPROX Devices, will be mailed Free on request. Write for it.]

THE KODEL RADIO CORPORATION
519 E. Pearl St., Cincinnati, Ohio

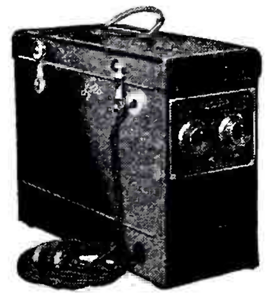
KUPROX

RADIO POWER DEVICES

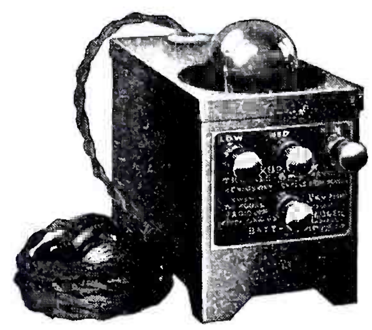
KUPROX "A" TRANSIFIERS—Batteryless, noiseless, electric "A" power. Dry, dependable, needs no attention. Operates any receiver. 4-volt or 6-volt, $28.50 and up.



KUPROX A & B TRANSIFIERS—All radio power from a single unit. Controlled from set switch. Absolutely dry, requires no attention. $57.50 and up.



KUPROX "B" TRANSIFIERS—Dry, permanent, free of hum. Guaranteed voltage at rated output. Models for all sets and circuits, $14.50 and up.



Recharge Your Dry "B" Batteries

Now you can make your dry cell B batteries last many times as long as before. One of the outstanding achievements of the past year in radio is this new system for rectifying ordinary dry cell B batteries.

KUPROX

No Bulbs · No Liquids · No Noise

TRICKL-B RECHARGER

Makes a "B" Power Unit of any set of dry cell "B" batteries. Connected to the light socket it performs like the trickle charger on the "A" battery, supplying new life constantly into the dry cell "B" batteries. With this new system "B" batteries can be made to last indefinitely. Very simple to operate and very economical. Simply attach to your "B" batteries, turn on the light socket and forget it. Uses no acids or liquids of any kind. List price, complete with tube

$10.00

from any Radio Dealer

rheostat and the midget condenser are similarly mounted, except that care is taken to make good contact between them and the panel.

The drive mechanisms of the dials should be dropped into the bracket bearings intended for them, the shafts pushed thru the holes in the front panel, and the two brackets bolted to the panel using the screws provided. One variable condenser fastens to either bracket, using the shaft mounting nut provided. A drum should be slipped over each condenser shaft, with set screw loosened, and pushed up until the drum scale edge is just ready to enter the crack in the drive mechanism shaft. With a knife blade this crack should be widened to receive the drum scale edge, and the drum pushed well up on the condenser shaft. The scale should then be adjusted to read 100 degrees against the indicator points in the panel windows, when the condenser plates are entirely unmeshed, upon which the set screw in the drum dial hub should be tightened on the condenser shaft. With the knobs fastened on the drive shafts, the condenser dials should rotate if the knobs are turned.

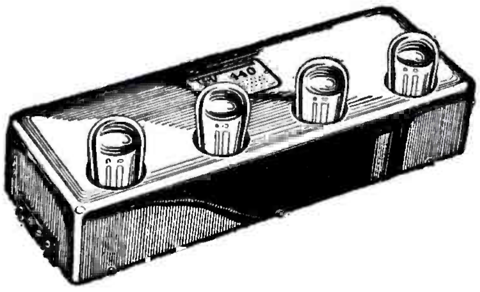
The connections to the condensers, rheostat and potentiometer should be made before fastening the panel to the chassis. After they have been put in, machine screws and nuts serve to hold panel and chassis together. The on-off switch mounts in the one remaining panel hole, with insulating washers to thoroughly insulate it from the panel and chassis. (It may have been previously connected in circuit, and allowed to hang on the wiring until ready to be mounted.) In wiring, a little slack should be left in each connecting wire.

After testing, all wiring may be bunched and laced into neat cables, using very heavy waxed shoemaker's thread. Two leads should not be joined or included in the cable. They are the wires running from the detector stage along the bottom of the chassis and up to posts 1 and 2 of the oscillator coil socket.

Operation

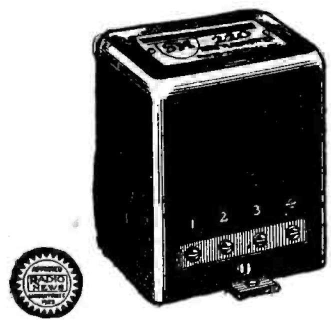
To operate the set, all tubes (a total of six CX301A, one CX340, and one CX371 tubes, are needed) should be inserted, except the first detector tube. The CX371 goes in the right rear socket; the CX340 in the adjacent rear socket. With the on-off switch on, the rheostat should be turned to within 1/8 inch to 1/4 inch of the full right position. If the potentiometer "GAIN" knob is turned to the right, a "plunk" will be heard at some point. This can be detected by varying the oscillator drum, which should cause a number of shrill whistles to be heard. The "GAIN" knob should always be oper-

S-M is ready—for A.C. Tubes or Any New Developments!



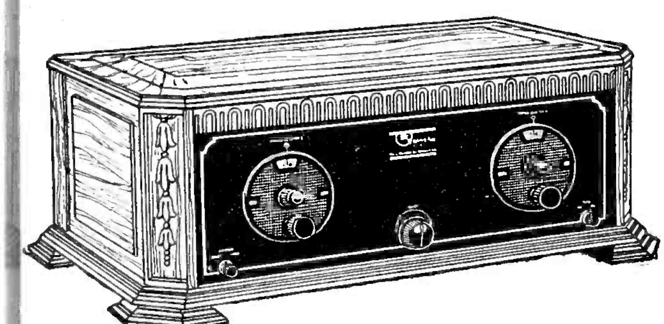
THE 440 time signal amplifier is a fully assembled three stage, 112 K. C., long wave amplifier-detector catacomb. It consists of three air-core low-resistance tuned R. F. stages and detector, with all necessary by-pass condensers, etc., mounted in a copper and brass catacomb providing individual stage and over-all shielding.

Each 440 amplifier is accurately matched in the S-M laboratories to exactly 112 K. C., and every amplifier is guaranteed to within one-half of one percent. The selectivity of the 440 is tremendous—it may be made 10 K. C., or even 5 K. C. at will, while the sensitivity is guaranteed greater than that of any amplifier that might be built of individual parts. Price $35.00.



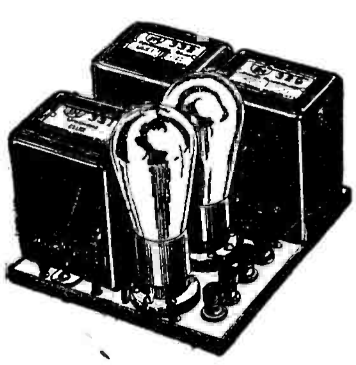
The fall season finds S-M 220 audio and 221 output transformers still the acknowledged leaders in the high-quality transformer field. And they are accorded the sincerest form of flattery—imitation—for this year other manufacturers, profiting by their phenomenal success copy the 220 characteristics introduced by S-M a year ago—5000 cycle cut-off, rising low frequency characteristics, and plenty of iron and copper to make a good job.

But S-M audio transformers stand supreme as the finest available—the only types ever backed by a guarantee of BETTER reproduction or your money back. That's the S-M guarantee—and the return average is less than one in every 4000 sold—3999 satisfied customers out of every 4000. 220 Audio Transformer, Price $8.00. 221 Output Transformer, $7.50.



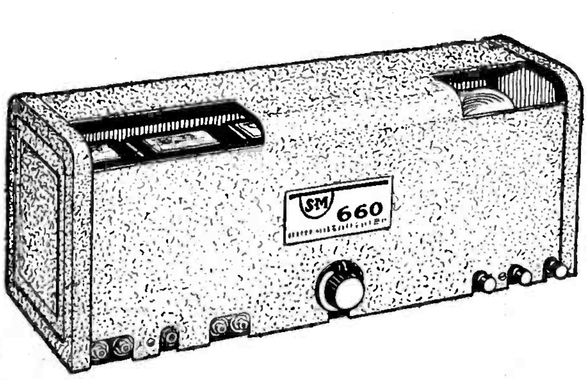
The S-M Unipacs, introduced this June, have taken the country by storm. Everywhere, builders are realizing what true distortionless reproduction really is—for the larger Unipacs (power amplifiers and ABC power supplies) can deliver from 5 to 300 times more—and purer signals—than any standard receiver amplifier, which they replace. Prices range from $62.00 to $93.25 for wired and unwired models.

The new 1927 model Improved Shielded Six has all the points that made the original the most popular high-priced TRF kit ever offered. The new "Six" has greatly improved selectivity—so great that it will allow 10 to 20 K. C. separation of local and distant stations. The volume has been increased. The tone quality of the new 630 is just as fine as last year's model—GUARANTEED UNCONDITIONALLY to be equal or superior to any other set, regardless of price.



The new 630 can be built for battery, eliminator or complete A. C. operation. The A. C. model is absolutely batteryless, and uses the 652A, ABC power supply. (Any 1926 Shielded Six can easily be brought up to date, or adapted for complete A. C. operation). No matter what developments come, the 630 will always be one of the finest of sets, amply satisfying the most discriminating of fans. Price $95.00.

The S-M 652A unit is the famous 652 "Reservoir B" supply, developed into a complete ABC power supply. Thus, with a 652A kit at $36.50, plus as many A. C. tubes as your set needs, you make it entirely A. C. operated, with all batteries eliminated. Or any new set you are building can dispense with batteries if you use the 652A. Or if you want to change over your present B eliminator, new S-M ABC power transformers are available.



We can't tell you the whole story of new S-M developments, so if you'll just fill in the coupon, and mail it with 10c to cover postage, we'll send you free more up-to-the-minute advance radio information than you could buy in a text book.

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ated just to the left of the "plunk" point—to the right of which squeals were heard when the "OSCILLATOR" dial was varied. The receiver is least sensitive when the "GAIN" knob is at the left, and most sensitive when the gain knob is just to the left of the "plunk" point.

The first detector tube should be inserted, and the midget condenser set all out. The antenna coil rotor should be set at 45 degrees—the oscillator rotor all in. A small antenna 30 to 60 feet long should be used, or even a larger one if the set is not too close to powerful local stations. Stations may be tuned in using the two drum adjustments only. Weak stations may be intensified by turning up the "REGENERATION" condenser on the front panel. This condenser functions similarly to the "GAIN" knob, in that, as it is turned to the right to interleave the plates, signal strength on weak stations will increase up to the point where the first detector oscillates, and the signal turns into a squeal. Adjusting the midget condenser will react slightly on the setting of the "ANTENNA" drum. The position of the antenna coil rotor should generally be at about 45 degrees. With a small antenna, it may work best all in—with a large antenna at nearly right angles. The sharpness of tuning of the antenna dial depends upon the setting of this rotor, as well as that of the midget condenser. The oscillator rotor should be adjusted once on a very weak signal at about 300 to 350 meters, and once set for maximum volume, may be left alone.

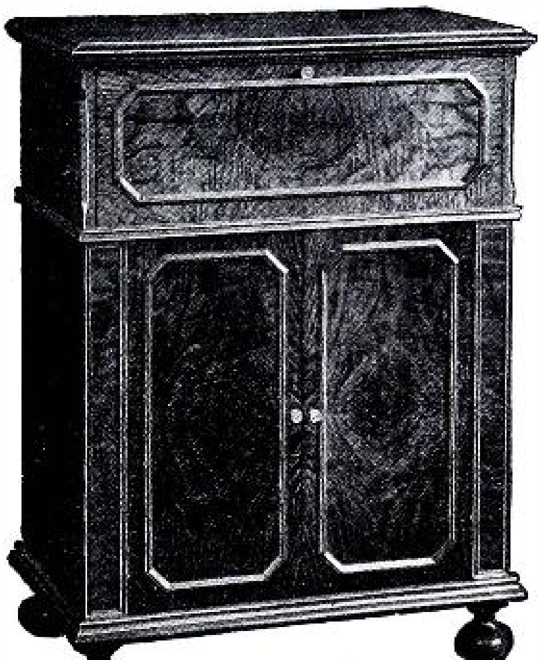
Light Socket Operation

The Laboratory Super-Heterodyne may be operated from standard A, B, and C battery equipment, or it may be operated from light socket power equipment, either partially or wholly—using the standard CX301A, CX340, CX112, and CX371 tubes; either a 6 volt storage A battery with trickle charger (known, when both units are combined, as an "A Power Unit") or from a direct true A power unit such as the new Abox A supply. As there is considerable variation in B power units, a type employing a glow tube voltage regulator is recommended. Dry C batteries should be used. The receiver may be adapted for use with McCullough, Sovereign, or other A.C. tubes.

Power Amplification

It is highly desirable that an output transformer such as Silver-Marshall 221 or 222 be used between the receiver and the loud-speaker. This unit has not been included in the set, since the ideal way to build it is to leave out the audio stages entirely and use, instead, a power pack such as the Unipac described elsewhere in this issue—a

New and Distinctive Radio Consoles from the "EXCELLO" Line



Style R-31

The creation of these smart designs so closely in keeping with the present trend is an achievement to delight all radio fans. These Consoles come with or without horn speaker of long air travel type. Accommodates 22 inch cone type speaker as well as batteries, charger or eliminator.

Style R-29

The sound chamber is so designed that confusing vibrations arising when a cone is enclosed in a cabinet are entirely eliminated. This is accomplished by open grill in front and back. All parts of set and accessories instantly accessible.

Style R-34

Special filler panels are furnished without extra charge for any Excello Console to accommodate Atwater-Kent, Fada, Freed-Eisemann, Grebe, Stromberg - Carlson, Kellogg as well as all other standard receivers.

Quality cabinet work of true Excello type. Doors of 5 ply butt walnut.

DEALERS AND DISTRIBUTORS write for interesting proposition in open territory.

EXCELLO
Radio Consoles

See the new Excello Consoles at your dealer or write us for descriptive catalog.

EXCELLO PRODUCTS CORPORATION

4821-29 West 16th Street, Cicero, Illinois
(Suburb of Chicago)

power amplifier and B supply combined. The first audio tube may be built into the Unipac as a CX326 tube with the first audio transformer in the set itself. In this case, the Unipac would serve beautifully as a phonograph amplifier with a record pick-up connected to the CX326 input tube's grid circuit, or as a two stage amplifier for the radio set with the secondary of the single audio transformer in the set connected to the Unipac in place of the record pick-up by means of a single phone cord.

The Camfield Super-Selective 9

(*Continued from page* 85)

Under the usual conditions existing in tuned radio frequency amplifiers, the current fed back from the plate circuit to the grid circuit through the tube capacity is of such phase as to add to the voltage already existing between the grid and filament of the tube, and therefore cause oscillation. It obviously follows that, if the right phase relation is obtained between the current fed back through the tube and the current existing in the grid circuit, oscillation will not be caused.

Coupling Between Stages Eliminated

It is well known that the phase relation between current and voltage in any circuit or group of circuits depends upon the relative constants of such circuits, namely, the inductance, the resistance and the capacity. In the case of transformers, the mutual inductance and the distributed capacity between the primary and the secondary must also be taken into consideration.

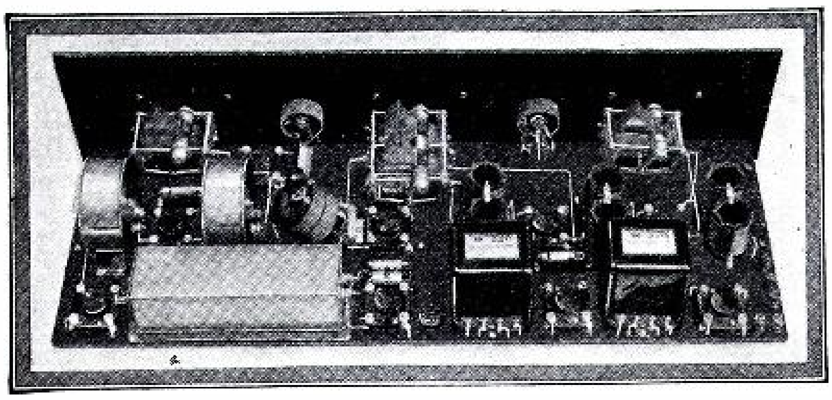
In designing the Duoformer the relative proportions of all the constants mentioned above were arranged in such a manner that the current fed back from the plate to the grid circuit in a manner to prevent oscillations.

This feature, combined with the physical design of the Duoformer Coils, which practically eliminates all electro-magnetic coupling between successive stages, and a circuit design embodying the proper use of by-pass condensers, makes it possible to build a Five-tube tuned radio frequency set that is extremely simple to construct, and that has a high and uniform efficiency over the entire range of broadcast wavelengths.

Three Tuning Controls Provide Greater Efficiency

In the Camfield Super-Selective 9 three tuning controls are used in order to provide for maximum efficiency in

Camfield Super-Selective "9"



Using the Famous Rusco Band Pass Filter is the Most Sensitive and Selective Circuit ever developed.

The circuit used has many features of proven merit never before incorporated in a radio receiving set. Outstanding among these features is the use of the famous Rusco Band Pass Filter in the intermediate frequency amplifier. This filter is designed to pass a band of frequencies 10 kilocycles wide. The amplification over this band is uniform and the cut-off on either side is extremely sharp. The result is perfect selectivity between wave bands of only 10 kilocycle separation in frequency. The uniform amplification over the band maintains perfect tone quality. The selectivity of this device is so perfect that it permits the use of radio frequency amplification ahead of the Super and the operation of the set on an antenna. This makes the Camfield Super-Selective 9 the most sensitive receiver ever developed. The net result is the simultaneous increasing of both sensitivity and selectivity to a degree heretofore considered impossible.

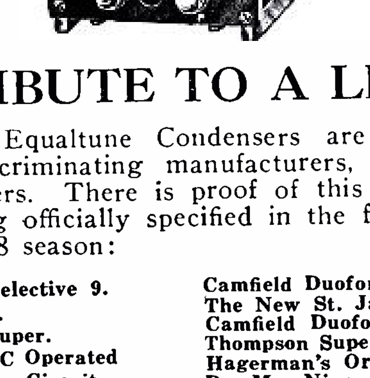
The turning of a switch on the panel converts this set from a five-tube two-control radio frequency receiver for the reception of local stations to a nine-tube super-selective and super-sensitive circuit capable of tuning through powerful local stations and receiving distant stations from coast to coast on a 10-kilocycle separation of frequencies.

This new circuit is easy to construct and simple to operate and comparatively inexpensive. It is entirely free from disturbing oscillator harmonics and it will out-perform any radio set you have ever used.

Camfield EQUALTUNE CONDENSERS

Unequaled for

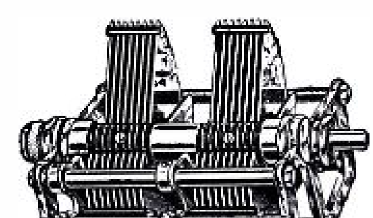
ACCURACY
MECHANICAL DESIGN
ELECTRICAL EFFICIENCY
WORKMANSHIP
APPEARANCE
GENERAL UTILITY



Manufactured in

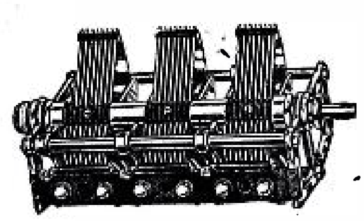
ALL POPULAR CAPACITIES
AND IN UNITS OF
ONE TO FIVE GANGS.
ESPECIALLY ADAPTED
FOR USE WITH THE
NEW TYRMAN DRUM DIAL

"A TRIBUTE TO A LEADER"



Camfield Equaltune Condensers are the unanimous choice of discriminating manufacturers, jobbers, dealers and set builders. There is proof of this in the fact that they are being officially specified in the following circuits for the 1927-28 season:

Camfield Super-Selective 9.
The Tyrman Ten.
Madison Moore Super.
Madison Moore AC Operated Radio Frequency Circuit.
Citizens Super 8.
Camfield Duoformer 7.
The New St. James U240.
Camfield Duoformer 5.
Thompson Super 7.
Hagerman's Organtone.
Dar-Mac Nine.
And many others.



Prices—Camfield Products

Type		Capacity	Price
151	(Single)	.00015	$ 5.00
251	(Single)	.00025	5.50
252	(Two Gang)	.00025	10.00
253	(Three Gang)	.00025	14.00
351	(Single)	.00035	5.75
352	(Two Gang)	.00035	10.50
353	(Three Gang)	.00035	15.00
354	(Four Gang)	.00035	18.00
355	(Five Gang)	.00035	21.00
501	(Single)	.0005	6.00
502	(Two Gang)	.0005	11.50
503	(Three Gang)	.0005	16.00
11	Mounting Brackets (per pair)		.25
22K	(Duoformer Kit)		10.00
620	(Coupling Unit)		3.50

Jobbers, Dealers, Set Builders and Set Manufacturers!
Write for Detailed Information

MEMBER RMA

CAMFIELD RADIO MANUFACTURING COMPANY
35 EAST WACKER DRIVE, DEPT. L. G., CHICAGO, ILLINOIS

the reception of distant stations. It would be possible to use a 3-gang condenser to tune the three Radio Frequency Coils, but this would result in the loss of some of the efficiency due to the fact that it is impossible to make the Antenna Coil tune exactly the same over the full range of wave lengths as the two Radio Frequency Transformers. By providing a separate tuning condenser for the Antenna Coil greater efficiency is obtained particularly in the reception of weak signals from distant stations. This gives the circuit two tuning controls when it is operated as a 5 tube set and three controls when it is operated as a 9 tube set. However, these three controls are not hard to handle even by an inexperienced operator, as will be explained later in connection with notes on balancing and tuning.

The Construction of the Receiver

Substitutions in the accompanying list of parts should not be made except in the case of Rheostats, Switches, Fixed Condensers and Grid Leaks. For these parts any good make may be used provided their electrical characteristics conform to the specifications given.

The 7 x 30 inch front panel and the 10 x 29 inch sub-panel may be purchased with all holes drilled. If the builder prefers to do this drilling the panel drilling layout, Fig 1 can be followed.

The first step in the construction is to mount the sub-panel on the 3 Karas Brackets as shown in Fig. 6. Next mount all of the parts that are to be secured to the sub-panel. Next secure the front panel to the sub-panel by means of the Karas Brackets and then mount the three condensers, the 6 ohm Rheostats, one 400 ohm Potentiometer, the Filament Switch and the transfer switch to the front panel.

The set is now ready for wiring. It is advisable to wire the negative filament and ground circuit first. Next make all of the positive filament connections. The rest of the wiring should be completed by starting with the Antenna circuit and making all of the connections to the first Duoformer Coil, the Antenna tuning condenser and the first tube socket. Next make the grid and plate connections to the second tube and so on throughout the entire circuit, wiring each tube in order. All of the B and C battery leads from the Jones Plug to the various parts of the circuit should be put in last.

The wiring of the set is very simple and no difficulty will be encountered if the builder will closely follow the schematic wiring diagram of Fig. 3 and the actual wiring as shown in the accompanying pictorial diagram.

After the set has been completely wired the wiring should be checked and

re-checked several times to be sure that absolutely no mistakes have been made.

The next step is to hook up the batteries with the Jones Plug using the color code given in the pictorial wiring diagram. After the batteries have been connected insert a tube in the first radio frequency socket. This tube should light up when the filament switch is thrown to the right. It should remain lighted regardless of whether the 5 and 9 tube transfer switch is thrown to right or left. It should also respond to variations of the 6 ohm Rheostat on the right of the panel above the transfer switch. If the tube functions properly in the first socket it should be inserted in each succeeding socket in rotation. Its action in the second radio frequency stage and in the first detector should be the same as when in the first socket.

When the tube is inserted in the oscillator socket it should light only when the filament switch is thrown to the right and when the transfer switch is thrown to the right it should not respond to variations of the rheostat on the panel. This action should be the same when the tube is inserted in both Intermediate Frequency Amplifier sockets and the second detector socket.

When the tube is inserted in the audio amplifier sockets it should light when the filament switch is thrown to the right and remain lighted regardless of the position of the transfer switch and it should not respond to variations of the 6 ohm Rheostat.

After this checking has been done the set is ready for an actual test on the air.

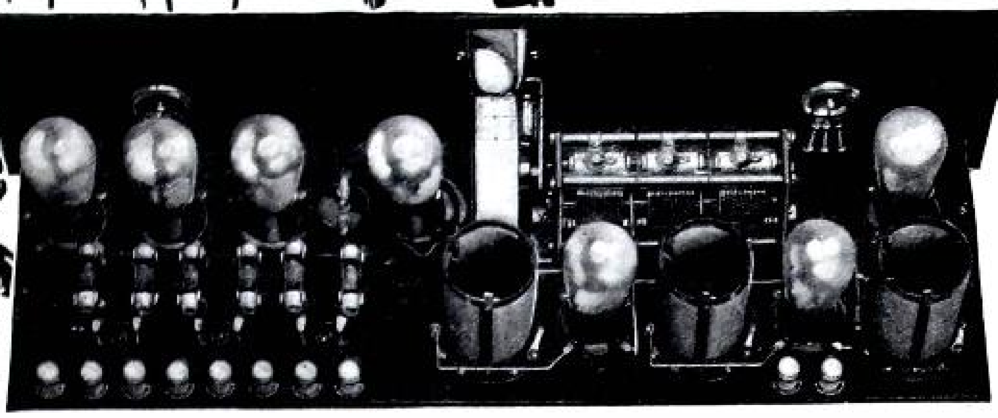
Balancing, Tuning and Operating the Camfield Super-Selective 9

It is important that the 2-gang condenser be installed exactly as received. Do not try to make any adjustment until after the set is in operation. Camfield Condensers and Coils are manufactured with a high degree of accuracy and little or no adjustment of the condenser is required when it is used with the Duoformer Coils.

When the set is completely assembled, wired and ready for test you should first attempt to operate only the 5 tube set. When the jack switch is thrown to the left you will have a 5 tube two control receiver. This part of the circuit should give satisfactory reception on all local stations and outside stations within a radius of two to three hundred miles. After you are satisfied that this 5 tube set is operating satisfactorily on the local stations you should then proceed to balancing the 2-gang condenser. To accomplish this tune in a station on the lowest wave length possible. A weak signal just audible in the loud speaker should be used. When this is obtained tune the second dial, that is, the one on the

AERO-SEVEN RECEIVER

10-Kilocycle Selectivity



Utilizing New 340 Tubes

Unique Features

The Aero-Seven Receiver, which is being featured in the prominent radio magazines and newspapers, is a new tried and tested tuned R. F. circuit, incorporating the most modern radio improvements at a popular price. It is a distinct innovation in a tuned R. F. receiver, utilizing three stages of R. F. and three stages of resistance-coupled audio. Circuit is built around the famous improved Aero Universal Coils, with improved Amsco S. L. tuning 3-gang condenser, S-M single-control drum dial and the tried and tested parts of other famous manufacturers. Such names as Carter, X-L, Westinghouse, Aero, Amsco and Silver-Marshall assure you of a circuit that is the final word in perfection.

Distinct features are: the new Hi-Mu tube at input and in R. F. stages, potentiometer control, higher amplification, 10-kilocycle selectivity and true single control.

The Aero-Seven has a broadcast range from below 200 meters to over 550 meters (1500-500 kc) and requires no shielding as with the small Aero coils, direct pick-up is negligible and coupling between coils is the very minimum. The coils are twice-matched at both high and low frequencies of the broadcast band, thus eliminating many difficulties in single dial control and overcoming one of the principle causes of disappointments.

The adjustable compensators on the Amsco condensers facilitate the equalization of circuits, solving the major problem of tandem tuning.

The extremely sharp selectivity of the Aero-Seven circuit is due to the low resistance of the coils. The high voltage gain per stage, due to the extremely low loss construction, assures extreme distant reception and greatest volume and sensitivity is assured through the high efficiency of the coil windings.

New and Unique Hookup 3 Stages of Radio Frequency 3 Stages of Audio Amplification

The Aero-Seven has a new and unique hook-up that incorporates three stages of R. F. and three stages of Audio. There are two stages of tuned radio frequency and a special coupling stage, the secondary function of which is to prevent antenna detuning, thereby giving single control which is both theoretically and practically perfect. This independent antenna circuit is of a new and efficient design and employs a resistance connected between the antenna and ground inputting to the first grid circuit. Five CX340 tubes are used—3 in the R. F. circuit, one detector and one in the audio.

In the three audio stages, one 171 power tube is used, one 201A tube and the one CX340 tube in the input.

The circuit, therefore, is different from the usual 7-tube R. F. circuits, which variations contribute to its optimum selectivity, perfect quality and thrilling volume.

The combination of all the various parts, the matching of the Aero Universal Coils, together with the Amsco compensating 3-gang condenser, with true single control and potentiometer control, greatly simplifies operation and tuning, while adding efficiency to the circuit.

First Use of New CX340 Tubes— 1-6/10 Times Better

Utilizing the new CX340 Cunningham tubes in place of the usual 201A, gives the Aero-Seven the distinction of being the first circuit using this superior method. CX340 tubes are 1-6/10 times more effective than 201A tubes, having a 5-volt filament and .25 amperes; plate, 180 volts maximum. In this receiver 90 volts is used constantly on the plate for the R. F. circuit, something seldom attempted but efficiently worked out here. It is a High Mu tube, having a high amplification factor (Mu-30) and is used both as a detector and as a radio and audio amplifier. The Aero-Seven is specially designed to operate with this new and better CX340 tube and the results secured will be a pleasing revelation to you. It is surprising what tone and volume is secured with a minimum use of current.

Resistance Coupled Audio Amplification

Resistance coupled audio amplification in the Aero-7 attains a quality of reproduction unapproachable in other systems. It preserves the extraordinary quality consistently achieved by Aero-7's 10-kilocycle selectivity.

10 Kilocycle Selectivity Now a Real Fact

Ten kilocycle selectivity is OPTIMUM Selectivity. It means a receiver that tunes sharply enough to eliminate interference and yet does not tune so sharply as to cause distortion. It is the ideal tuning characteristic. "Optimum tuning," says the engineer, when he means a perfect set.

Why bother with anything but the best? Why put up with anything but 10-kilocycle selectivity, as represented in the Aero-Seven circuit?

Due to the low-loss construction of the coils and condensers in the Aero-Seven and the great selectivity introduced into the circuit itself, you get selectivity so sharp that you cannot get two stations at one time under present broadcast regulations, at the same time providing adequate frequency margin to prevent high "cut off"—distortion.

Imagine what this means in perfect radio reception. Selectivity, the ability to tune in clearly, sharply, without fear of disturbance in getting the station you want whenever you want it—that's something every radio fan has long desired. It is an actuality in the Aero-Seven—a feature that is necessary in an up-to-date circuit—a feature that you get in the Aero-Seven when you build it.

New, Modern, Proved Features in Aero-Seven

10 Kilocycle selectivity.
Resistance coupled amplification.
Uses new CX340 tubes instead of 201A.
3 stages of R. F.
3 stages of audio amplification.

Extreme D-X reception.
Potentiometer control.
Silver-Marshall single drum dial.
True single control.
Aero Coils are twice matched at both high and low frequencies.
Amsco adjustable condensers.
Carter resistances.
Westinghouse Foundation Unit.
X-L Posts.
High quality parts throughout.
Range below 200 to above 550 meters (1,500-500 KC).
Low loss characteristics throughout.

See article in this issue

Perfectly compensated—variation in antenna circuit doesn't affect it.
Wiring underneath sub-panel.
Simple construction.
Easy to build in quick time.
The most popular-priced 7-tube circuit.

The Aero-Seven-tube Receiver assures you of the very latest in radio. It has everything—beautiful tone, 10 kilocycle selectivity—extreme long range and a volume at your command that can be raised to music-hall proportion or lowered to slumbering whispers. The particularly meritorious application of resistance coupling creates a most remarkable tone. It gives you a receiver that is in a class all its own—a real conqueror of space—a companion that you can depend upon absolutely in any emergency. It delivers quality that is quality, and yet its construction is so low in cost as to be almost unbelievable.

An Opportunity for Set Builders

The set builder will find the Aero-Seven a most profitable receiver to build. It is an extremely simple circuit—efficient, high grade and having a record of exceptional performance. It could hardly be duplicated in a factory-built set at double the cost.

You can make big money building this set for your friends and get a real "kick" out of it yourself.

Complete parts, drilled and engraved panels and foundation units are being distributed through the jobbing trade and are available at leading radio stores everywhere. If your dealer cannot supply you, order direct giving your dealer's name and we will see that you are supplied promptly.

A full-size working blueprint and booklet of assembly and operating instructions with complete data is furnished, which makes it both practical and easy to build this circuit quickly. Build yours early—get the jump on the other fellow.

Get the facts. Mail the coupon and 10c stamps for this valuable booklet. Send today—NOW!

Aero Products, Inc.
Dept. 109, 1768 Wilson Ave., Chicago.

Dear Sirs: Enclosed find 10c for which please send me life-size blueprints, assembly diagrams, construction data and all the facts in building the new Aero-Seven Receiver.

Name ....

Address ....

Get the Facts—MAIL NOW

AERO PRODUCTS, INC.
1768 Wilson Ave., Dept. 109 Chicago, U. S. A.

Associated Manufacturers—Amsco, Aero, Westinghouse-Micarta, Silver-Marshall, X-L.

two gang condensers, for maximum volume. Then loosen the set screws on one of the shield plates, move this shield plate back and forth on the rod, adjusting for maximum volume. When maximum volume is obtained tighten the set screws and lock the shield plates in place. Next tune in a station on approximately 300 meters. Then take the tool provided with the 2-gang condenser and loosen the nuts on the righthand side of one of the stator plate sections. Then insert the other end of the tool in the hole between the nuts and move the handle of the tool back and forth, to and from the panel. You will note that this motion shifts the entire section of stator plates. Make this adjustment for maximum signal strength. Leave the stator plates set in the position for maximum signal strength and lock them in that position by tightening the nuts. Next repeat this operation with the other section of stator plates. Then tune in some high wave length station at about 500 meters or higher if possible and repeat the same series of stator plate adjustments but from the left-hand side of the condenser. After these adjustments have been made your two radio frequency circuits will be practically in perfect balance over the full range of wave lengths. A little experimenting will enable one to determine the wavelength range of the circuits in order to make these adjustments.

Changing from Five to Nine Tubes

After the 5 tube set is operating properly leave the first two dials tuned in on some station, throw the transfer switch over to the 9 tube position and pick up the station again by turning the oscillator dial. On all of the lower wave length stations there are two possible settings of the oscillator dial. The correct one to use is the one that occurs lowest on the scale. As soon as this station has been received and tuned in for maximum volume adjust the potentiometer mounted on the sub-panel for the maximum volume consistent with good tone quality. Once this potentiometer is adjusted it may be left fixed for the reception of stations on all wave lengths and the adjustments will not have to be changed until tubes are changed or until the batteries become considerably run down. Next adjust the rotor of the 620 Coupling Unit for maximum volume. This adjustment is not critical, about 50% coupling generally gives best results.

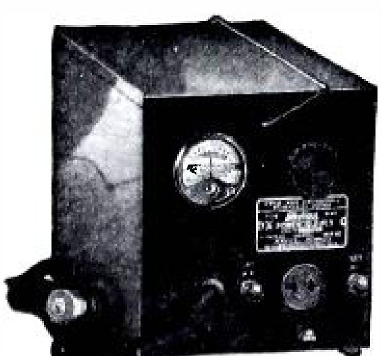
When you are tuned in to any distant station you can in many cases receive the station broadcasting on the next wave length above or below by merely moving the oscillator dial up or down a degree or two. After this station has been received you can then adjust the other two dials for maximum volume.

Complete "A" and "B" Light Socket Power that works

– and Keeps on Working

STERLING Socket Power Units, both "A" and "B", have made good on *performance*. In the homes of hundreds of radio owners they have shown themselves to be as thoroughly reliable as good designing, honest workmanship, fine materials can make them.

"Light Socket" your set the Sterling way and say good-bye to batteries once and forever. Know for the first time the pleasure of continuous full powered light socket operation . . . without batteries, without chargers . . . with nothing more to do than turn on your set switch.



R-96

Sterling "A" Power R-96

This unit entirely takes the place of the storage "A" battery. It uses the famous Raytheon A—the little unbreakable copper cylinder that displaces the rectifying tube. Has a steady output of 6 honest volts. Is meter equipped and fully automatic. Price $47.00 complete.

Sterling "B" Power R-81

For 3 to 8 tube sets including power tube. Output at 35 mils. is 150 volts. All three voltages Detector, Medium and High are adjustable within wide limits. On and Off switch. List Price: including Raytheon B-H tube, $28.50.

R-81

R-94, 4-volt "A" Power unit for Radiolas, $32.00 complete.

RT-41, especially designed "B" unit for Radiolas. Price $27.00 complete.

R-98, a universal "B-C" power supply. Price $38.00 complete.

R-97, "Heavy Duty" "B-C" Model for very largest sets. Price $53.50 complete.

Radio Sterling Products

R-415

Test Your "B" Power Voltage

To get full value from your "B" Power Unit you should know that your Power Unit is delivering the correct voltage to the detector, amplifier and power tubes. Low resistance battery testing voltmeters are worthless for testing socket power units. This specially designed Voltmeter is accurate for both. Tests all D. C. circuits up to 300 volts.

R-415 DC Model, 0-300 volts $8.50

R-417 AC Model, 0-150 volts $7.50

Test Your Radio Tubes

The Sterling Tube Tester shows at a glance whether your tubes are performing at their best or whether they are "all shot". No calculations. Simple to use. For large tubes.

R-411 . . . . $7.50

R-411

THE STERLING MANUFACTURING COMPANY, 2831 PROSPECT AVENUE, CLEVELAND, OHIO

The Improved "Nine-in-Line"

(*Continued from page* 90)

135 volts is available, the use of the 371 type power tube is recommended. Otherwise the 312 type tube should be used. The grid bias voltage values for this stage will depend on the type of tube used.

In spite of the use of nine tubes, the plate current drain on the "B" batteries is no higher than that of the average five tube receiver. This is due to the use of comparatively high "C" battery voltage on the intermediate frequency amplifier tubes. The total "B" battery drain, including that of the power tube in the last audio stage is from 20 to 30 milliamperes, depending on the type of power tube used. This makes practical the use of heavy duty "B" batteries, if desired.

The filament supply voltage is obtained from a six volt storage battery. The two detectors and the oscillator draw their supply through a six ohm rheostat R2. The four intermediate amplifier tubes are controlled through a combination rheostat and battery switch, R1 and S. The audio tubes are provided with a fixed resistance, R4. It is also advisable to include fixed resistances in series with rheostats R1 and R2 to prevent higher than five volts being applied to the tubes, even when the rheostats are turned up full.

The "B" supply is tapped at 22½ volts for the first detector and oscillator and 67½ volts is applied to the second detector. The four intermediate stages are provided with 90 volts. This may in some cases be increased to 112 to good advantage. The second detector is tapped in at 67½ volts. 135 volts is required for the first audio tube, and also for the second audio stage provided a 312 type tube is used. If a 371 tube is used here the "B" voltage should be 180 for best results. In this latter case a separate lead should be brought out from this last tube because this voltage cannot be applied safely to the first audio tube.

It will be found easiest to wire up the instruments on the sub-panel before the front panel is attached. Then the panel may be attached and it will only be necessary to bridge wires over from the panel instruments to their proper connections on the sub-panel.

The appearance of the receiver is considerably enhanced by installing it in a style R-16 Excello radio console. This particular console is of the wall type and is provided with a special tone chamber above the receiver panel space to which the constructor's favorite speaker unit can be attached. In the battery compartment below this console there is ample room for either "A" and "B" batteries or eliminator.

There are many fluxes for soldering but only *one*— is safe for Radio!

FLUX for soldering is a general term; it embraces, as a class, all types of soldering fluxes. To designate a flux as safe for radio construction is specific; *it means rosin.* Chloride pastes, acids and fluid solutions are soldering fluxes, and are well adapted for certain work, *but conductive and corrosive properties forbade their use for radio assembly.* Their active elements, zinc and ammonium chlorides, display spreading, creeping tendencies that promote leakage and will eventually cause increased resistance in the wiring.

Rosin, an organic mixture, *is a non-conductor and non-corrosive.* The glass-like surface of this material does not readily lend itself to the collection of dust (carbon particles) as will the sticky organic greases of paste. Nor will rosin attract moisture from the atmosphere; the chlorides of pastes and fluids will. *Moisture plus carbon particles defeat the best insulations produced. Moisture plus chlorides direct a slow but determined corrosive attach upon supporting metals.* Such slow corrosion in wiring causes a steadily increasing resistance to the flow of electrical energy.

Kester Rosin Core Radio Solder scientifically combines radio's premier flux, Rosin, with a solder alloy of unvarying quality. The use of Kester Radio Solder furnishes the user with a means of accomplishing Safer, Faster, and Cleaner set wiring. Constructors who solder-protect wiring with Kester Radio Solder enjoy increased receptive range, improved tonal quality and the satisfying assurance that their receivers will never be forced into the discard through the corrosive and conductive action of a chloride flux.

A Kester Soldered Receiver Is a Better Set

Manufacturers of Radio Sets and Equipment: Tests conducted with the various types of commercial fluxes are under constant observation in our laboratory. Can we assist you in your soldering problems?

KESTER *Radio* SOLDER

CHICAGO SOLDER COMPANY

4252 Wrightwood Avenue, Chicago, U. S. A.

Originators and World's Largest Manufacturers of Self-fluxing Solder

Convince Yourself Without Expense

USE THIS COUPON NOW!

CHICAGO SOLDER CO., R. R. 9-27
4252 Wrightwood Ave., Chicago, U.S.A.

Gentlemen: Please send me a test sample of Kester Radio Solder, together with descriptive literature.

Name ....

Address ....

City.. State...................

Dealer ....

How to Build the Strobodyne

(*Continued from page* 80)

readjusted later if a whistle is noticed when turning the tuning condenser, but for most tubes this adjustment is about correct.

Next, the balancing condenser connected across the tapped auto-couple coil should be set so that the rotor is equally meshed with each of the two stators; and the long screw on top of the same coil should be turned so that the primary is just out of the secondary. Since the screw protrudes beyond the level of the shield cover, it is necessary to drill or cut a hole in the cover; this hole should be large enough so that the screw does not touch the shield.

Set the equalizer mounted on the forward left condenser to leave a gap of about 1/8 inch between the copper plate and the mica. After these adjustments are made, turn the three rheostats on almost full and set the potentiometer so that the sliding arm is about in the center. Do not forget to turn the volume control up also. Then turn the two dials simultaneously to about the same readings. If the set is working properly, some signals should be heard; especially if the set is installed within a reasonable range of some broadcast stations.

To adjust everything to the point of greatest efficiency tune in a weak signal or use only a few feet of wire as an aerial and listen in with a pair of phones plugged in the first-stage jack. Then readjust the equalizer on the forward condenser with a small wooden-handled screwdriver until the signal is loudest. (Do not touch the metal of the screw driver, as this would produce an increase in capacity.) The weaker the signal, the easier it is to notice the point of best adjustment.

Next readjust the three rheostats for best reception and leave them at this point. Adjust also the balancing condenser and the coupling of the tapped coil, until the weak signal comes in best. These adjustments, once made, need not be varied.

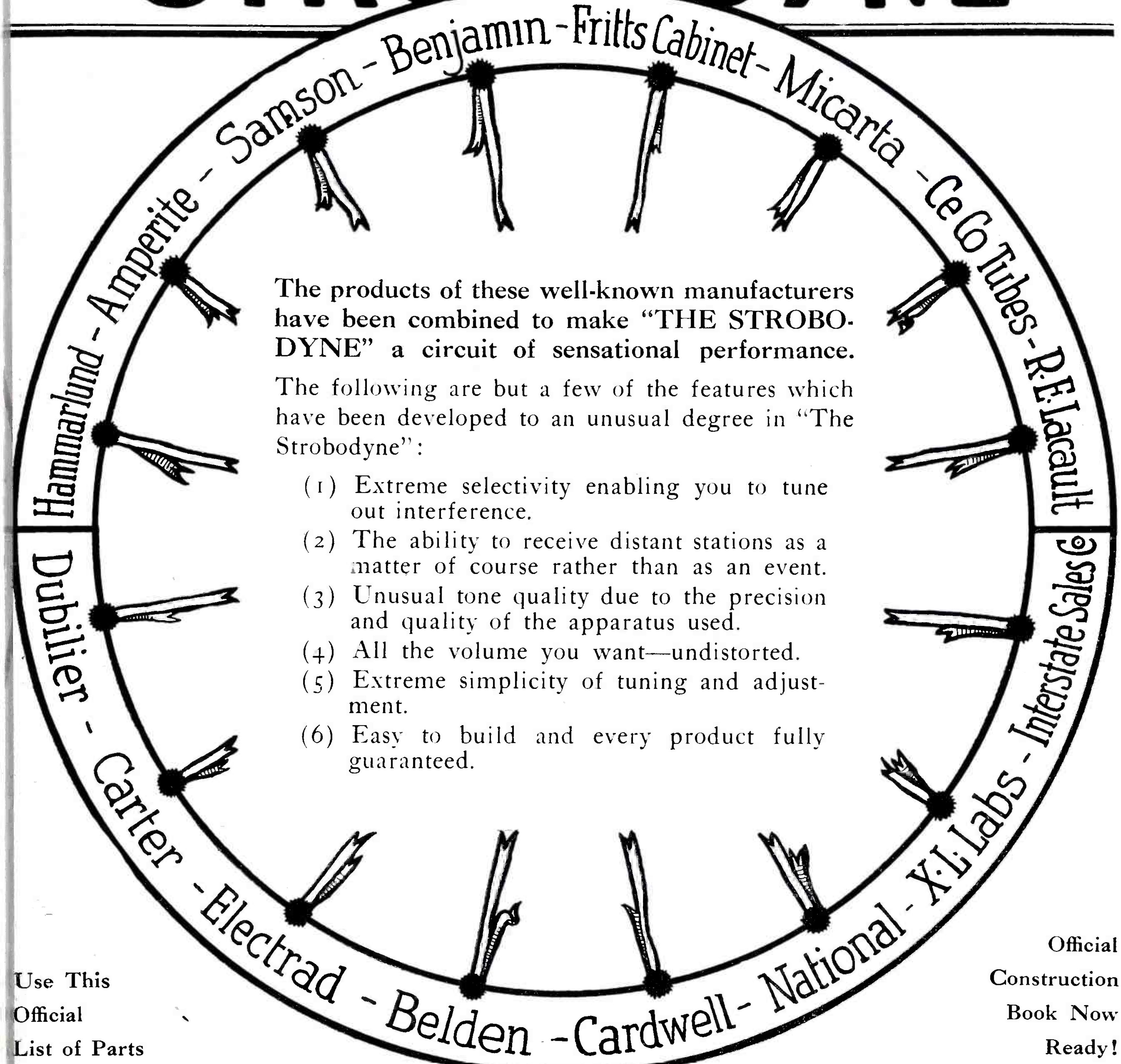
The readings on the two condensers are not exactly alike over the entire scale, but they are sufficiently close to make the tuning easy especially since, after a few stations are logged, it is easy to note the difference between the low and high figures on the scale.

For the more ambitious constructor, who wants to build everything himself, the complete constructional details are given for the coils. In order to have the set work right these should be very carefully made; otherwise the results will not come up to expectation.

Combines the Best Features of Every Circuit

Radio's most amazing set

The STROBODYNE



The products of these well-known manufacturers have been combined to make "THE STROBODYNE" a circuit of sensational performance.

The following are but a few of the features which have been developed to an unusual degree in "The Strobodyne":

(1) Extreme selectivity enabling you to tune out interference.
(2) The ability to receive distant stations as a matter of course rather than as an event.
(3) Unusual tone quality due to the precision and quality of the apparatus used.
(4) All the volume you want—undistorted.
(5) Extreme simplicity of tuning and adjustment.
(6) Easy to build and every product fully guaranteed.

Use This Official List of Parts

Official Construction Book Now Ready!

3 Hammarlund Variable midline condensers .00035 mf.
1 Set Hammarlund Strobodyne coils
3 Hammarlund Shields
2 Hammarlund Equalizing Condensers
1 Hammarlund Brass Shaft 10¼ inches long
2 Samson Symphonic Transformers
1 Samson No. 85 Choke
4 Radio Electric R.F. Units Type F
5 Radio Electric Fixed Matched Condensers
1 Micarta Fabricator Panel 8" x 24" x 3/16"
1 Micarta Fabricator Sub Panel 12" x 25¼" x ¼"
1 Interstate Sales Output Filter
3 Carter No. M-20 Midget Rheostats 20 ohm
1 Carter No. M-400 Midget Potentiometer 400 ohm
1 Carter No. 1 Short Jack Open Circuit
1 Carter No. 2A Short Jack Closed Circuit
1 Carter Imp Battery Switch
1 Cardwell Balancet Type 618A
4 Dubilier By-Pass Condensers .5 mf. Type 907
1 Dubilier Fixed Condenser .002 mf. Type 601
8 Benjamin Sockets UX Type 9040
12 X-L Binding Posts
2 National Co. Dials
4 Radiall Amperites Type 1A
1 Radiall Amperite Type 112
1 Electrad Royalty Variable Resistance Type B
2 25 ft. coils Belden Colorubber
7 CeCo Vacuum Tubes Type 201A
1 CeCo Vacuum Tube Type 112
1 Fritts Cabinet for Panel 8" x 24" x 12⅛"

Address all inquiries to "STROBODYNE," 230 Fifth Ave., New York

"STROBODYNE"
230 Fifth Ave., New York

I enclose 50c. for one copy of the official construction book, giving all data on the STROBODYNE, and all supplementary information.

Name ....

Address ....

City ....

State ....

The Aero-Seven Broadcast Receiver

(*Continued from page 73*)

The Audio End

Thus it is seen that the radio frequency section of the Aero-7 is so designed to provide a high degree of radio frequency efficiency compatible with perfect quality. The entire reproduction of the detector tube is preserved throughout the audio amplifier. Amplification is effected by means of resistance coupling, acknowledged by the majority of engineers to give the closest approach to distortionless amplification.

The accompanying list of the parts are those used in the construction of this receiver. Considering the equalizing problems involved in tandem tuning arrangements, it is recommended that the amateur confine himself strictly to the recommended apparatus, even in such seemingly inconsequential parts as by-pass condensers, rheostats and resistors.

Construction

The actual building of the Aero-7 is best described in the detail photographs and in the instrument layout drawings. (Do not confuse the picture wiring diagram with the layout diagram. The picture wiring diagram spreads the parts in a manner to show most clearly the connections between them, irrespective of the exact spacing of the parts or the exact directions taken by the wires.) Check your wiring against all illustrations and diagrams as the set nears completion.

The condenser is mounted so that the compensating condensers are up. That is with the shaft extending to the right and the rotors opening in toward the front panel.

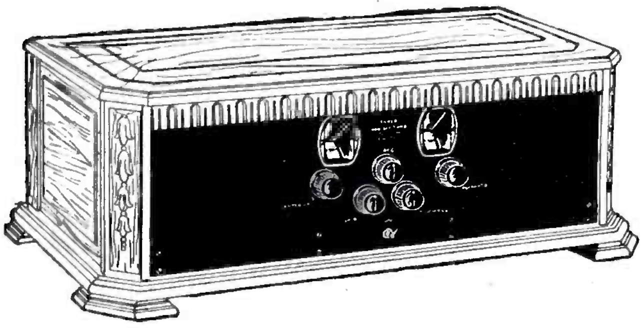
The correct instrument layout will be greatly facilitated by using the specially prepared front and sub-panels.

This receiver is not at all difficult to build—but any job worth doing is worth doing well.

Adjustment

There is only one set of adjustments to be made on this receiver, and these are effected when it is completely finished and wired to the usual power sources for reception. These are the compensating condensers on the Amsco triplet condenser. The condenser leaves the factory with the compensators screwed down tightly. Turn these two full turns counter-clockwise. (It is desirable, in making all adjustments on the compensators, to use a wooden screw driver. This will eliminate over-compensation due to body capacity effects. Any small stick can be shaved down into a satisfactory

The Improved SHIELDED LABORATORY Receiver



FACTS

Sensitivity: The Laboratory Receiver, in direct comparative tests, will bring in with loud speaker volume stations barely audible upon seven and eight tube shielded neutrodynes. Compared to other superheterodynes, it will give greater volume, and generally bring in more stations, than any other eight or nine tube sets.

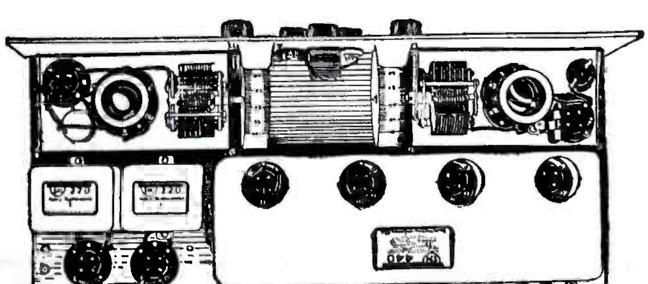
Selectivity: Located in Chicago, the Laboratory Receiver will allow reception of out-of-town stations within 7 to 10 kilocycles of powerful locals. In comparative tests, it will give greater selectivity than any eight or nine tube super that can be built from standard parts. In fact, the set is so selective that it will take a week's careful combing of the broadcast band to log all stations within range!

Range: On short waves below 200 meters, the range is unlimited—5,000 to 12,000 mile reception is not at all unusual. In the 200 to 550 meter broadcast band, the range is 1,000 to 10,000 miles, but is guaranteed equal to or greater than that of any other receiver. Between 500 and 3,000 meters, the range is guaranteed greater than that of any other receiver.

Volume: It can only be stated that the volume of the Laboratory Receiver is equal to that of any standard receiver, and is guaranteed equal or greater than that of any eight to ten tube set.

Wavelength Range: 30 to 3,000 meters with standard interchangeable plug-in coils.

Amplification: The first detector and oscillator give a voltage amplification of 25; the long wave and second detector 10,000 (10 x 10 x 10 x 10 for four tubes); and the audio amplier, 400 (20 x 20 for two stages). The over-all amplification is thus seen to be 100,000,000—about 80 times that of average eight tube superheterodynes; about twice that of the best eight tube neutrodynes, and 20 times that of average seven tube shielded neutrodynes. The one hundred million amplification figure for the Laboratory Receiver is without extremely critical adjustment—critically adjusted for a very weak station, it will go up to a billion times or more!



FROM the Setbuilders Supply Co. you can get all parts for the new Laboratory Receiver, each and every item most carefully inspected and checked, and with a guarantee that your set, assembled from those parts, will give you results you've never had before *on any set*. You can also buy tubes, batteries, cabinets and loud speakers specially approved and tested for the Laboratory Super by McMurdo Silver and Ernest R. Pfaff. It goes without saying that you want to own the Laboratory Receiver, just as you want the *best* of anything. And the Laboratory Receiver *is* the best, for it has features that you won't find in the most expensive factory set you could buy. Take its selectivity for instance—it will tune in out of town stations through local interference that paralyzes ordinary sets. It's so sensitive it brings in these same stations with tremendous punch—when other sets don't even get through. Then, its appearance is in the three to five hundred dollar class, though you're not handicapped by a factory cabinet—you can put *your* set in any cabinet or console that suits your taste.

TESTED AND GUARANTEED PARTS EXACTLY AS SPECIFIED FOR THE LABORATORY RECEIVER

1 Van Doorn panel and chassis unit, pierced, with hardware	$8.50
1 Carter .00015 condenser with leak clips	.50
1 Carter M-200 potentiometer	.75
2 Carter No. 105, ½ mfd. condensers, @ .90	1.80
1 Carter 3 ohm rheostat	.50
1 Carter battery switch	.50
4 Carter No. 10 tipjacks @ .10	.40
1 Polymet 2 megohm leak	.25
2 S-M 220 audio transformers @ 8.00	16.00
4 S-M 511 tube sockets @ .50	2.00
2 S-M 805 vernier drum dials @ 3.00	6.00
1 S-M 275 RF choke	.90
1 S-M 342 condenser	1.50
1 S-M 440 time signal amplifier, 112 K.C.	35.00
2 S-M 515 coil sockets @ 1.00	2.00
2 S-M 111A coils @ 2.50	5.00
9 X-L binding posts @ .15	1..35
2 S-M 320 .00035 condensers @ 3.25	6.50
	$89.45

GUARANTEE

The Setbuilders Supply Company unconditionally guarantees the performance of any receiver built from the parts listed above to be superior to that of any other eight-tube receiver.

Setbuilders Supply Co.

504-C South Peoria St. Chicago, U. S. A.

This Brings All the Details!

Please send me all data on the Laboratory Receiver for which I enclose 10c.

....

....

tool.) Tune in a station, preferably a local. Adjust the compensators, one at a time, by screwing in, until the station tunes the sharpest. Retune with the main dial following every adjustment of the compensators. Temporary adjustment of compensator can be effected by pushing it down slightly with the wooden adjusting tool while the main dial is tuned. This will show immediately what particular compensator should be screwed down. That is all there is to it. Once adjusted, the condenser need never again be touched.

Tubes Used in Set

Either Cunningham or R. C. A. tubes should be used in the Aero-7. Note that high mu tubes are used in the first five sockets. The Aero coils are designed to take advantage of the high amplification constant of 30 which characterizes these tubes. Radio Frequency coils must be especially designed to do this. The second audio stage employs a 201-A tube to add additional stabilization to the amplifier, and to take care of unusual power surges. A 171 type power tube is used in the output stage to provide unusual volume without distortion. It is desirable, though not absolutely necessary, to couple this tube to the speaker through some output arrangement such as the Amsco Orthophone.

Installing the Set in a Console

In the photographic heading of this article the Aero-Seven is shown installed in an Excello style R-31 console which makes the completed set a handsome addition to the furnishings of the modern home. The special loud speaker horn may be used as provided with this model cabinet ready for the attachment of the builder's favorite loud speaker unit; or the constructor may prefer to build in one of the Ensco cone speaker arrangements such as described in a previous issue of Radio Listeners' Guide and Call Book.

Operation

The operation of the Aero-7, in accordance with our opening paragraph, is simplicity itself. It is merely a matter of turning the tuning dial to the selected station, and adjusting the column control to the desired point.

The receiver will operate from any antenna, short or long, indoor or outdoor, excepting a loop. It will operate from A, B and C batteries or eliminators, or any battery-eliminator combination.

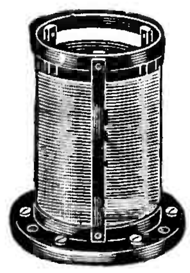
***SEE PAGE* 158**

ANNOUNCING NEW AND IMPROVED

AERO COIL

SUPER-SENSITIVE

INDUCTANCE UNITS



The Improved AERO Universal Coil

At last—a true universal coil. This improved coil is suitable for any straight tuned radio frequency circuit, both bridge and loss balance. It is easily and ideally adaptable to 3, 4, 5, 6 or 7 tube sets and can be used with all types of tubes—201-A, 199, 112, and the new 240 tubes and A.C. tubes.

Sharp selectivity, true tone quality, distance and volume, to a heretofore unknown degree, are assured where these coils are used. For that reason the improved Aero 6, Aero 7, Aero 4, and other circuits built around these coils will be more popular than ever during the coming season.

New AERO Kits Employing the Improved AERO Universal Coil

Code No. U-16

The AERO Universal Tuned Radio Frequency Kit

Kit of 4 Coils (For Improved Aero-Dyne 6)

Kit consists of 4 twice matched units—adaptable to all standard tubes. Tuning range below 200 to above 550 meters. This kit will make any set better in selectivity, tone and range. Will eliminate losses and give the greatest receiving efficiency. Each kit is carefully matched at both ends of the broadcast range.

For .0005 Condenser, Code No. U-16.................................Price $15.00
For .00035 Condenser, Code No. U-163...............................Price $15.00

The AERO Universal Tuned Radio Frequency Kit

Kit of 3 Coils (For Aero-Seven)

Consists of 3 twice matched units. Coils are wound on Bakelite skeleton forms, assuring a 95% air di-electric. Range from below 200 to above 550 meters. Each kit carefully matched at both ends of the broadcast range.

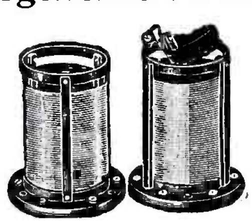
For .0005 Condenser, Code No. U-12.............................Price $12.00
For .00035 Condenser, Code No. U-123...........................Price $12.00

Code No. U-12

AERO Universal 3-Circuit Tuner

In the form of a 3 circuit tuner with a fixed tickler, this Aero Coil will improve any circuit. Adaptable only to 201-A, 199, 112, or the new A.C. Tubes. Has variable primary for governing selectivity. Code U-55 (For .0005 Condenser) or Code U-553 (for .00035 Condenser)..Price $4.00

AERO Radio Frequency Regenerative Kit



The supersensitive kit, used in the new Aero 4 and The Chicago Daily News Receiver, will improve the efficiency of any circuit. For use with 201-A, 112, 199, and the new A.C. Tubes. Use .00025 variable condenser to tune fixed tickler. Code U-95 (for .0005 Condenser) or Code U-953 (for .00035 Condenser)..Price $8.00

AERO Universal Antenna Coupler

A highly efficient low-loss antenna coupler with variable primary; adaptable to 201-A, 199, 112, 240 and the new A.C. Tubes. Code No. U-96 (for .0005 Condenser) or Code No. U-963 (for .00035 Condenser). Price $4.00

AERO Universal Wave Trap Unit

Makes an excellent wave trap due to low distributive capacity and low high frequency resistance. Helps greatly in eliminating interference. Can also be used to improve efficiency of Crystal Sets. Code No. U-4 (for .0005 Condenser) or Code No. U-43 (for .00035 Condenser)....................................Price $4.00

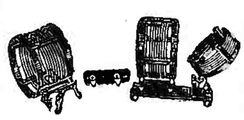
AERO Choke 60

Has uniform choking action over a wide range of wave lengths. Eliminates customary "holes" in the tuning range—so common with ordinary chokes. You will find the Aero Choke 60 perfect in every respect.
Price each.......................................$1.50

AERO Short Wave Kit

The most efficient and satisfactory short wave kit ever offered. Completely interchangeable, and covers U. S. Bands range 15 to 130 meters. Kit consists of 3 coils and base mountings. Code No. L.W.T. 125..........Price $12.50

AERO Transmitter Kits



An interchangeable Transmitter Kit at last! Kit 2040-K has range of 16.5 to 52 meters. Kit 4080-K has range of 36 to 90 meters. Kit includes two mounting bases and two choke coils that are interchangeable. Price (each kit)..........$12.00

AERO Choke 248

Designed for use with Aero Transmitter Kits and other circuits. Presents a high impedance over usual amateur wave lengths.

Price each.............$1.50

IMPORTANT NOTICE

We furnish foundation units, drilled and engraved by Westinghouse Micarta for the Aero Short Wave, Aero 6, Aero 7, Aero 4, Aero Transmitter, and The Chicago Daily News 4 tube circuits. This is a special service for the home set builder. Full working blue prints with each unit. Dealers may secure samples of blue prints to show their trade for 25c each.

Any of these Aero Kits, Coils and Chokes should be available at your dealers. If he cannot supply you, order direct from the factory. Be sure to specify code or key numbers when ordering.

AERO PRODUCTS, INC., Dept. 111
1772 Wilson Avenue Chicago, Ill.

Experiments with Transmitter Buttons

(*Continued from page* 115)

the entire conversation in the otherwise protected room. This form of eavesdropping is far more legitimate than the method of installing detectaphones in rooms to be subsequently occupied by people suspected of a crime.

Conduction of Sound Through Water

Submarine signalling has been employed ever since the war. Microphones placed under the surface of the seas have demonstrated their ability to pick up sounds of submarines and steamers and relay them to those desirous of knowing what was coming down the bay. During the war, German submarines frequently picked up the noises of the propellers by means of sub-sea microphones and coincidentally, one submarine was able to converse with another by this same method. Radio, although operable, possessed the added difficulty of making the presence of its user known to the enemy. By means of the radio compass the enemy could locate the approximate position of a submarine, but with sound signalling, the efforts at location were made much more difficult and only those equipped with sub-sea ears could know what was going on. The same effect can be duplicated by the aid of a microphone button which for this particular purpose is fastened to the lid of a coffee can. Two flexible rubber covered wires are then brought up to the surface, one of them being attached to the microphone button and the other being soldered to the can. The entire apparatus can be coated with paraffin wax to prevent water leakage. A battery is placed in series with the microphone button and then a receiver is connected to the wires as indicated.

At the transmitting end, the transmitter button is on shore and the receiver is placed beneath the surface of the water. The receiver here should preferably be a loud speaker unit, having a resistance of approximately 75 ohms if no amplifier is employed or it could be a regular radio loud speaker unit, if a vacuum tube amplifier is inserted into the circuit as indicated by the dotted box. Much greater distances will be covered with the latter form of device. A Baldwin unit could be used under the water, care being taken to make it impervious to the elements. Paraffin wax will do this or the user might conveniently employ a rubber toy balloon for this purpose. The sound will be conveyed through the water for a distance of four times its audible distance on land. In this way and with apparatus of this nature, one party could talk to another on the other side

of a stream without running a submarine cable between the two points.

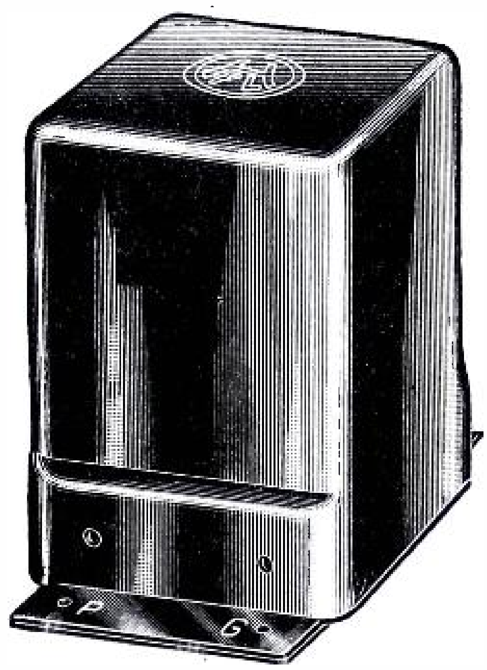
Recently it was the writer's desire to employ a stethoscope for picking up heart beats with the intention of amplifying them for radio broadcasting purposes. A microphone that worked admirably is the one indicated in Fig. 10. This consisted of an ordinary wooden pill box. A diaphragm of heavy paper was stretched across this and the microphone button was then centered and attached to the paper. The cover of the pill box was partially cut away, leaving an opening in the center, but the rim itself was kept intact so as to hold the paper diaphragm as illustrated. The smaller the pill box, the better, and if you can obtain one an inch in diameter, the heart sounds picked up will be clearer. The apex beat will then not be confused with any other valve sounds. An ordinary 4½ volt battery and a 75-ohm receiver or a 5-ohm receiver can be employed in this circuit, or the sounds can be amplified, as they were in our particular experiments, through an audio frequency amplifier, either Western Electric or resistance coupled.

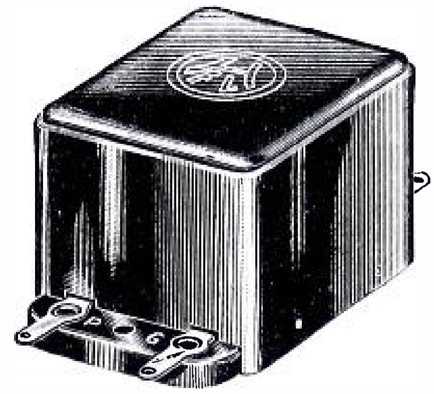
The number of freak musical instruments which can be built and which will depend upon the transmitter button for the reproduction of their sounds is so great that it would be impossible to list them all in this short article. For instance, the button could be attached to the side of a kazoo or to a frying pan, provided with strings and made to imitate a banjo, or a broom can be arranged as a one string violin. The string itself is mounted at the bottom of the broom, runs along the entire length of the broom stick to the tuning peg at the top. A small bridge holding the transmitter button is then placed near the bottom and the handle should be planed down so as to give a flat surface for the fingers and string, making a regular flat finger-board. It would be curious to see an entire band composed of a number of these freak dish-pan and household utensil strings. Everyone of them would have its own microphone button and they could all be brought in to the circuit of an amplifier through a suitable mixing panel. This mixing panel can consist of several 400-ohm rheostats, one for each instrument. By controlling the rheostats, the volume of the electric broom can be made to approximately equal that of the banjo frying pan. With concealed loud speakers such a band might get a handsome offer from some theatrical agency for an engagement on a recognized circuit. When they do, the writer hopes they will not forget to give credit to this publication for which the scheme was originated.

TRANSFORMERS

Endorsed by America's Leading Radio Engineers

Designed to fulfill the exacting requirements of set builders who demand efficiency, sensitivity, precision and high quality





The Supreme Achievement in Audio Amplification

H.F.L. now gives you scientifically perfect audio amplification.

The new H.F.L. Audio Frequency transformer C-16 and the H.F.L. output transformer C-25 together are now introduced to the radio set builders as the most perfect means of Audio Amplification known to the science of radio. These new products are the final achievement of nationally known acoustical experts and electrical scientists. Their work has been enthusiastically endorsed by the most critical and skeptical of listeners.

C-16 and C-25 H.F.L. Transformers will give you audio amplification of almost unbelievable purity. Through them you will get, with absolute fidelity, every note and overtone on the entire musical scale and you will get this perfect amplification at all frequencies and at any volume.

Distortion and "mushiness" are entirely eliminated. Any type of speaker may be used with C-16 and C-25 with absolute safety and with equal perfection.

Electrically, scientifically and acoustically, the new H.F.L. C-16 and C-25 transformers are the finest and most perfect means of audio amplification known to radio.

JOBBERS—WRITE FOR FURTHER DETAILS

Tried - Tested - and Approved

H.F.L. Units have been used, approved and most highly endorsed by Radio News, Citizens' Radio Call Book, Radio Review, Radio Age, Radio Engineering, Radio Mechanics, Chicago Evening Post, the Daily News and others. Thousands of engineers and fans, who have turned to H.F.L. Units for better reception, hail them as the finest transformers known to radio—unexcelled for Power, Selectivity and Purity of Tone.

Perfectly matched, skillfully designed, carefully made, rigidly tested—in a word, H.F.L. transformers are technically correct to the minutest detail.

All H.F.L. transformers are designed for baseboard mounting or invisible subpanel wiring—each unit is enclosed and sealed in a genuine bakelite moulding.

H.F.L. Units are easily connected into the assembly, simplify set construction, and make a beautifully finished job.

PRICES

No. H-210 Transformer	$8.00
No. H-215 Transformer	8.00
No. C-16 Transformer	8.00
No. L-425 R.F. Choke	5.50
No. L-430 R.F. Transformer	5.50
No. C-25 Output Transform.	8.00

Dealers—Set Builders

If your jobber cannot supply you with H.F.L. Transformers, write us direct for nearest jobber's name.

OUR GUARANTEE

We positively guarantee each and every H.F.L. Transformer against any mechanical or electrical defect.

Furthermore, we will exchange—free of charge—any H.F.L. Transformer that fails to give complete satisfaction, providing that the shells and terminals are not damaged.

JOBBERS—WRITE FOR FURTHER DETAILS

MEMBER R.M.A.

HIGH FREQUENCY LABORATORIES

131-A NORTH WELLS STREET CHICAGO, ILLINOIS

How to Operate Loud Speaker from Crystal

Mr. Winfield Secor, managing editor of *Science and Invention,* recommends the following method:

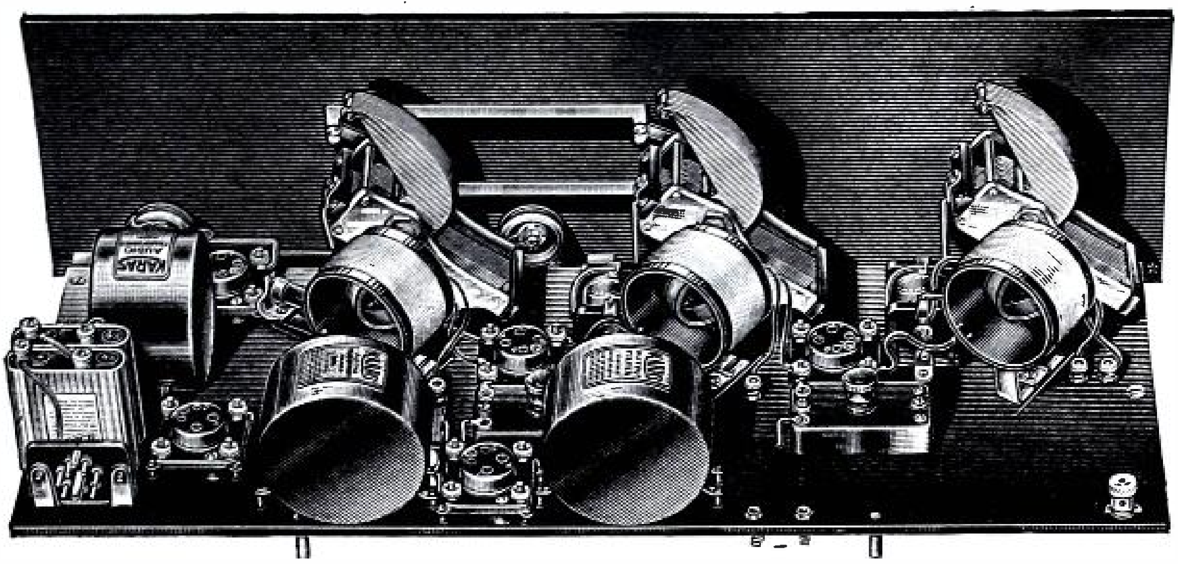
For several years our English cousins have been able to purchase on the open market a radio amplifier of the microphonic type, which enables one to operate a loud speaker from a crystal detector, thus obviating the use of vacuum tubes, "B" batteries, etc.

In the diagram in Fig. 12 there is shown a simple form of circuit utilizing a crystal detector such as galena or iron pyrites, and across the terminals of the fixed blocking condenser or else across the crystal detector, there is shunted in the manner shown, a 1000 ohm or higher resistance radio receiver of the watch-case type. A Baldwin phone is very useful for this purpose as it gives a greater movement of the diaphragm (or reed) for a certain signal strength than do other receivers. If a microphone button is secured to the center of the diaphragm, or else to the reed which actuates the diaphragm, we will have a "microphonic relay." Every time an incoming radio signal actuates the diaphragm or reed attached thereto, the electrical resistance of the microphone button will be varied correspondingly, and the current from the battery in series with the button and the loud speaker will fluctuate accordingly. In the European type of loud speaker used for this particular purpose, the resistance of the windings is made lower than that found in the average loud speaker, so that no excessive voltage is required in the microphone button circuit in order to properly operate a high resistance type speaker.

In the diagram at Fig. 12, there is shown one method of using the ordinary loud speaker, which should by the way, be fairly sensitive, that is, not requiring a lot of energy to reproduce a certain strength of signal. In this hook-up, shown at Fig. 11, a telephone induction coil may be used, or else a transformer which has a fairly low resistance primary winding, such as that found in the Western Electric modulation transformer. In any event, the resistance of the winding, whether it be that of a transformer or speaker, is to be overcome by using a sufficiently high battery voltage in series with the microphone button. On the other hand, it is well to remember that extra high voltages are very undesirable in microphone circuits, as they are liable to cause arcing whenever the carbon grains shift around. Potentials up to 25 volts are fairly common in microphone circuits (24 volts is used in telephone exchange practice) and thus a "B" battery of the 22½ volt type is frequently requisitioned for such purposes as this.

KARAS Scores Again for 1927-28
with the NEW 2-Dial EQUAMATIC Sensation

KARAS PRODUCTS



The 5-Tube Receiver That Leads the World in Performance!

The NEW Karas Type 28 Audio Transformer, Price, $8.00

OUTSTANDING among all of the season's radio receivers is the NEW Karas 2-Dial Equamatic—the 1927-28 Sensation that leads them all in performance. This marvelous new Equamatic has 2-Dial Control, insuring simplified, easy tuning, with maximum and equal efficiency over the entire broadcast waveband.

The Karas 2-Dial Equamatic is completely balanced and perfectly neutralized. It offers set builders who want utmost volume and superb tone quality the very pinnacle of perfection in these two all-important requisites. In addition, the Karas 2-Dial Equamatic makes use of a 24-inch panel and baseboard, thus shortening the set and simplifying its assembly.

The three Karas Type 17 S. F. L. Removable Shaft Condensers are of the latest design. Two of these condensers are operated together by means of the Karas 2-Dial Control System, giving wonderfully accurate tuning in conjunction with the Karas Micrometric Vernier Dials.

For a tremendous volume of round, clear, pure, undistorted, full, mellow tones you will not find a rival to equal the Karas 2-Dial Equamatic. To build this great receiver you will need the Karas parts listed and illustrated here, plus certain other standard parts easily obtainable anywhere. Mail the coupon for complete information about this receiver and about the NEW Karas parts now at your dealer's.

KARAS PARTS FOR THE 2-DIAL EQUAMATIC

3 Karas Equamatic R. F. Transformers	each	$4.00	$12.00
3 Karas Equamatic Type 17 Removable Shaft S.F.L. Variable Condensers	each	5.25	15.75
2 Karas Micrometric Vernier Dials	each	3.50	7.00
2 Karas Type 28 Impregnated Audio Transformers	each	8.00	16.00
1 Karas Output Filter			8.00
3 Karas Subpanel Brackets, set of 3			.70
1 Karas 2-Dial Control System, complete with three extra shafts and all necessary assembly hardware for entire set			3.00

The NEW Karas Output Filter, Price $8.00

The New KARAS Products for 1927-28 are Superlatively Better

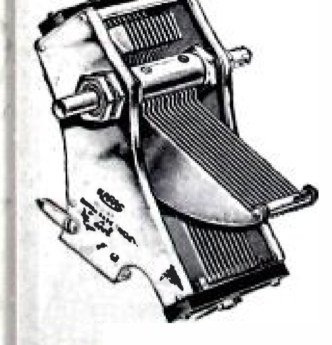
For the 1927-28 Season Karas offers several new products of superlative quality and distinction. Among these is the NEW Karas Type 28 Audio Transformer. This new transformer is scientifically impregnated and is housed in a lifetime steel clad, spun-sealed case which effectively guards its marvelous amplifying qualities. The Type 28 gives full, clear, undistorted amplification of all low notes as well as perfect reproduction of high notes, and has tremendous volume. Two of these transformers are used in the Karas 2-Dial Equamatic.

The new Karas S. F. L. Variable Condensers, Types 11, 17 and 23, have removable shafts, allowing for subpanel, baseboard or single hole mounting from either side, and permitting the use of 0-100 or 100-0 dials. This right or left hand single hole method of mounting is an exclusive Karas achievement. These condensers are true straight frequency line type, separating all adjoining wave-lengths by equal distances on the dial. In the Karas 2-Dial Equamatic 3 Type 17 S. F. L. Condensers are used.

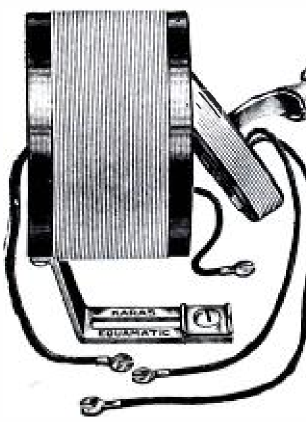
The new Karas Output Filter sweetens and clarifies tone qualities and prevents demagnetization and eliminates chattering of the loud speaker. This new Karas Filter exactly matches our new Type 28 Transformer in size, and because of their compact design two transformers and a filter occupy no more space in the set than is needed for two ordinary large size transformers. The Karas Output Filter is equipped with choke of 100 henrys and a large capacity paper condenser.

You can see and order this new Karas apparatus NOW at your dealer's. Get in touch with him today for these and other Karas parts you will need in building your Karas 2-Dial Equamatic.

KARAS ELECTRIC CO., 4037-I North Rockwell Street, CHICAGO



The NEW Karas S.F.L. Condenser with Removable Shaft, Price, .00025 mfd., $5; .00037 mfd. $5.25; .0005 mfd. $5.50



Karas Equamatic Inductance Coils, Set of 3, $12.00

Karas Micrometric Vernier Dials, Price $3.50

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Fill out and mail the coupon below for complete information about the NEW Karas products for 1927-28, and complete data on the Karas 2-Dial Equamatic Receiver.

KARAS ELECTRIC CO.
4037-I North Rockwell Street, Chicago

Send me complete particulars about your new Radio Products, including data on the new Karas 2-Dial Equamatic.

Name ....

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The diagram at Fig. 13 shows a three stage audio-frequency amplifier of the microphone type. This form of amplifier was used sometime ago in the large trans-Atlantic stations for amplifying both code and voice signals. The winding of the first amplifier may be of 1000 ohms or more in value, while the second and third relay windings may be of much lower resistance, say 75 ohms, such as that found in the ordinary telephone receiver.

The microphone buttons are preferably placed on soft iron reeds. The fluctuations, in the current passing through the receiver windings placed before the iron reeds, cause the latter to vibrate, and in turn the microphone buttons are vibrated also. Thus variations in the resistance of the microphones are occasioned, and the corresponding fluctuations in the battery current cause the successive relays to simultaneously vibrate the microphone buttons, until the loud speaker is reached; and here we will hear either the code signal or the voice reproduced and greatly amplified.

It may require quite a little experimenting and adjusting in order to get the microphone relays to work just the way you want them to, especially for voice reproduction. It is important to mention at this point that frequently it pays to vary the amount of carbon granules in the microphone buttons. It is also possible to improve the operation of such microphone relay apparatus by varying the current passing through the circuits, by inserting a suitable adjustable rheostat in series with the microphone button circuit. In some cases the same result is obtained by shunting a 400 ohm potentiometer across the microphone, and thus shunting more or less of the battery current by it. Where quite high voltage is necessary in the microphone circuit, in order to operate a high resistance relay, loud speaker, etc., a high resistance potentiometer shunted across the button will help to absorb any sparking which may take place between the granules; the same effect being attainable by shunting a suitable size condenser across the microphone button.

The New Karas 2-Dial Equamatic

(*Continued from page* 100)

the tone quality of low-wave reception will be no better than that of the old-time regenerative receivers.

There is a way of getting around these difficulties to a nicety and that is to maintain the efficiency over the entire waveband by varying the inter-stage coupling with the wave-length. At the low wavelengths the coupling may be very loose and still the efficiency may be high. As the receiver is tuned to higher wavelengths where the efficiency would normally be less, the coupling can be increased, thereby providing a greater energy transfer between stages and in this way providing good efficiency, even on the highest wavelengths.

But like all other solutions that appear so simple, there is a hitch in this. To provide this variable coupling between stages means the addition of one more tuning control for each stage of radio frequency amplification. That is, the normal five tube, three control receiver would have six tuning controls instead of three. Such an arrangement would, of course, be out of the question because of the complications in operation. It would require long practice to learn how to operate it, and even then it would be a decided nuisance to have to manipulate six controls every time another station was to be tuned in.

It is here that the automatic coupling of the Karas Equamatic receiver comes in. Variable coupling between stages is provided without the addition of extra controls. Inasmuch as the coupling increase should approximately correspond to the decrease in the frequency to which the receiver is tuned the designing engineers concluded that the logical thing was to attach the variable coupling coils to the shafts of the tuning condensers. Then as the condensers are tuned to the lower frequencies (higher wavelengths) the coupling will increase at the same time. Conversely, as the condensers are tuned down to the lower wavelengths the coupling will decrease. Thus this complicated problem is solved in an extremely simple manner.

Not satisfied with accomplishing the six tuning operations with only three tuning controls, the engineers who designed this circuit went further and designed a device which would permit the operation of two of the tuning condensers with but a single tuning control. This reduced the total number of controls to two. The design and construction of the component parts of the radio frequency amplifier, fortu-

(*Continued on page* 158)

The New World's Record Super 10

(*Continued from page* 93)

nished by the 4½ volt tap on a C battery whose total voltage is 40 to 45 volts, this high value being required for the operation of the 171 tube in the power stage. To effectively curb any stray r.f. in the first and second detector plate circuits, a Remler No. 35 r.f. choke coil is used.

Four Tobe by-pass condensers will be found at the required points, one from the positive 45 terminal to the negative line, one from the positive 90 volt tap, and one from the positive 180 volt terminal. These by-passes, as well as the one spanning the center arm of the 400 ohm potentiometer and the negative, are rated at one microfarad.

In the audio end are found two Thordarson R200 transformers, while an R-76 output transformer is used in the plate circuit of the power tube to isolate the d.c. potential from the speaker windings. Grid bias for the first audio is derived from the 4½ volt C battery tap as shown in the schematic.

Convenience in testing the set as well as simplicity and permanence of wiring, dictated the use of the new Jones base mounting plug, shown at the left in the photograph, Figure 2.

Tubes throughout are of the 201-A type with the exception of the power stage where a 171 is used. When the intermediate units are accurately matched, matching of tubes is not required for excellent results. The only requirement is that the tubes be good ones and not deteriorated from abuse.

Where in previous models the potentiometer method of biasing the intermediate frequency grids has not been used, in the present Super 10 it is permissible since there is considerable filtering effect in the preceding r.f. train so that selectivity is maintained, and enables the intermediates to be operated at the most efficient point. The potentiometer also affords another means of volume control, this added flexibility desired by the true experimenter and distance seeker.

Benjamin sockets of the cushion type for subpanel mounting are used and insure freedom of noise from tubes jarring. A Jewell 0-8 d.c. voltmeter shows the operator the condition of his filament supply at all times and enables him to keep the exact voltage on his tubes.

In connecting up the r.f. couplers to the three gang condenser it is worth noting that the grid returns of the first and second r.f. and 1st detector are to the negative filament. Usually where condenser and grid leak rectification is used, the return is to positive filament, but in this particular receiver better results are secured with a negative return. If desired, a 200-A tube can be used as 1st detector and will give a little more volume on distant stations. However, it is noisier than the 201-A, the recommended tube.

After the set has been completely assembled as shown in the photos and wired according to the accompanying schematic diagram, it is ready for installation in a cabinet. This of course is left to the choice of the builder. The set can be either installed in any of the well made table type cabinets such as can be found advertised in this magazine, or one of the handsome Excello or United consoles.

In the operation of the Super 10, Selector 1 controls the r.f. input (corresponding to the loop condenser on the older models) while Selector 2 turns the oscillator condenser. The set logs readily, its selectivity is above par and the tone quality is such that its owner may well be proud to build it and demonstrate to his friends.

A Compact A-B-C Power Unit

(*Continued from page* 120)

two set screws in each rotor and the screw in the two cams and shaft will then be free. When the present brass shaft has been removed a small slot slightly larger than the space occupied by the condenser nearest the panel should be cut in the aluminum shield (1A). This will not be difficult. Remount condenser to panel as before making sure the condenser does not touch the shield at any place. Insert the bakelite shaft and tighten all set screws.

To wire the filaments in series proceed by running a wire from A minus to F minus of detector socket. Connect F plus to F minus of 1st Audio and F plus of 1st audio to F minus of 1st R.F. socket. Connect F plus to F minus of 2nd R.F. socket and return F plus to A plus binding post. Make the grid return of each R.F. and first Audio to their respective F minus terminals. The detector grid return is arranged for 200-A detector tube and should a 201-A tube be used it will be necessary to make this a positive grid bias and this may be done by connecting to F plus of detector socket instead of F minus as shown. The filament leads for the second audio should be run in twisted paired wire to two binding posts. As the first C minus post is not longer used and the 67 B plus post may be made vacant by connecting the lead to the 90 B plus post, these two posts are now available for the AC filament leads.

The Lynch Suppressor Circuit

(*Continued from page* 69)

Lynch equalizers. Tubes S1 and S2 draw their filament supply through the equalizer R7. In series with this equalizer is a combination 6 ohm rheostat and battery switch (S and R14). The switch part of this unit controls the entire receiver supply while the rheostat portion provides a means for manual variation of the supply to the two tubes S1 and S2. This is the volume control. At first glance it may seem superfluous to use both an equalizer and a rheostat to control these two tubes. The purpose of the arrangement is to safeguard the tubes because, even with the rheostat turned on full, the voltage applied to the tubes cannot exceed their normal working voltage of 5 due to the presence of the equalizer.

The other four tubes are controlled by equalizers. A type 4 equalizer controls the supply to the detector tube; a type 2 equalizer to supply the 1st and 2nd audio tubes; and a type 2 equalizer for the power tube.

It will be noticed that the same plate voltage is supplied to the detector and the first audio stage. This is a rather unusual arrangement but it serves the excellent purpose of eliminating the bugaboo "motorboating" which is frequently experienced when a resistance coupled amplifier obtains its plate supply from a "B" eliminator.

Binding posts are provided for the antenna, ground and battery connections. Marked binding posts are a convenience and also help to guard against wrong connections. The "A" and "C" voltage values have already been discussed. The detector "B" supply should be 45 volts; the radio frequency supply is best at 90 volts. The high voltage can best be 180 volts if a 371 type tube is used in the last audio stage, or 135 volts if a 312 type tube is used. Binding posts are provided for all battery as well as antenna and ground connections.

The construction of the receiver is greatly simplified by the use of the sub-panel, and further through the elimination of neutralizing devices in the radio frequency amplifier. The detailed placement of the various parts on the front panel and the sub-panel is shown in the illustrations. If the two panels are drilled according to the drilling diagrams given herewith, the location of the various instruments will take care of itself as they need only be matched up with the holes provided for them. In mounting the coils it is necessary to mount them by means of a single ma-

(*Continued on page* 157)

The Harkness Tuned Audio Amplifier

(*Continued from page* 118)

attach the two bakelite strips to the front and rear of the brackets, mounting the battery switch and loudspeaker jack on the front strip. Then mount the binding posts, arranging the markings in the manner shown in the picture diagram of Fig. 6. When mounting the binding posts follow this diagram closely, noting particularly the connection strips (supplied with the tuned double-impedance couplers) which slip over some of the binding post screws on top of the panel. Note also that the 1 ohm fixed resistance is attached to the A plus binding post underneath the panel.

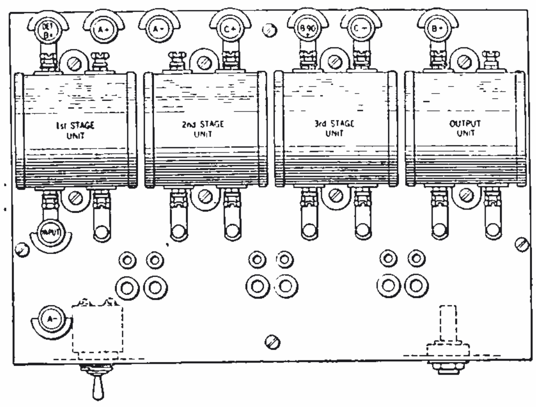


Fig. 9. Actual lay-out of parts on sub-panel.

Finally, mount the three double impedance couplers and the output filter unit on the panel. Mount the couplers with the P and G posts toward the tube sockets and the output filter with the P and S posts toward the sockets.

Wiring the Amplifier

The wiring is very simple. It should not take more than fifteen minutes. The amplifier is arranged so that very little wiring is necessary. The diagram of Fig. 5 shows the actual circuit, but the picture diagram should be followed as this indicates the use of the connection strips in wiring. Before doing any soldering, attach the connection strips as shown in Fig. 6 between the double impedance couplers and the tube sockets and binding posts. Then, on top of the sub-panel, wire the two "B" posts of the second and third double impedance couplers together. Similarly wire together the two "F" posts of the first and second couplers. Then turn the amplifier over and complete the wiring as shown in the picture diagram.

How to Install the Amplifier

To use the amplifier as a separate unit in conection with a receiving set, attach a seven-conductor battery cable to the binding posts along the rear of the amplifier and connect the other end of the cable to the batteries used to operate the set, as shown in Fig. 8. Disconnect the detector B plus connection from the B battery to the receiving set but leave all other battery connections in place in the usual manner. Then, with an insulated flexible wire, join the "Input" binding post of the amplifier to the plate terminal of the detector tube socket in the receiver. In the case of a super-heterodyne receiver it is sometimes advisable to insert a radio frequency choke in series with this lead as suggested in the diagram of Fig. 7. If the set with which the amplifier is used is regenerative, the input binding post connects, of course, to the tickler, which, in turn, connects to the plate of the detector.

When the above connections have all been made, take the tubes out of the audio stages of the receiving set. Then insert two 201A tubes in the first two stages of the tuned double impedance amplifier and a type 112 or type 171 in the last stage. Be sure to use the correct value of C battery, depending upon whether you use a 112 or 171 in the last stage. Fig. 10 indicates the correct values to use. Plug the loud-speaker into the jack at the front of the amplifier.

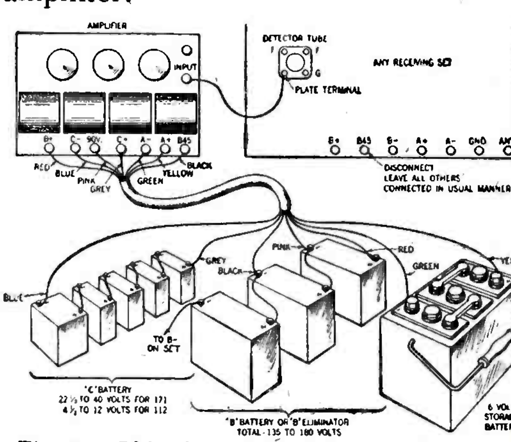


Fig. 10. This shows how to attach the Harkness amplifier to any receiving set. Connect battery terminals of receiver in usual way, omitting the detector lead.

When using this amplifier as a component part of a receiving set the entire amplifier may be mounted directly on the front panel as indicated in Fig. 7. Drill holes in the front panel of the set, using the front strip of the amplifier as a template. When the amplifier is mounted in position the jack and battery switch will protrude through the front panel. The radio frequency amplifier and detector should be mounted to the left of the audio amplifier. The binding posts of the audio amplifier can then be used to connect to the batteries and connections run from the amplifier to supply filament and plate current to the remainder of the set. Fig. 7 illustrates the connections of a typical two stage radio frequency amplifier and detector used with the audio frequency amplifier, behind the same panel.

Any type of receiving set can be built round this audio amplifier in the same manner as suggested in Fig. 7.

The Lynch Suppressor Circuit

(*Continued from page* 154)

chine screw and nut. They should be mounted under the sub-panel in such a way that the primary terminals are next to the sub-panel and the "P" and "F" terminals are toward the end of the sub-panel on which the tone filter is mounted.

The use of flexible, insulated bus wire is recommended for the connections. Practically all of the wiring is underneath the sub-panel and is out of sight. This does not mean an opportunity for slip-shod wiring but it does mean that most of the wires may be run direct between terminals with no necessity for right angle bends and other kinks to improve symmetry of appearance. Where connections terminate above the sub-panel it is best to drop them down through holes in this panel and run them along underneath. So far as possible the wiring under the sub-panel should be kept fairly close to the panel. In no case should it be so far beneath the panel that it will extend beyond the bottom of the sub-panel brackets when the receiver is placed right side up.

The operation of the receiver calls for no detailed instructions. There are the two tuning controls and the volume control. The tuning controls will show similar dial settings for any given wavelength. The left hand control, looking at the receiver from the front, will be the most critical in adjustment, although in tuning in distant stations both dials will tune sharply. To tune in the first station slowly rotate the two dials in unison until a station is heard. Then readjust each dial until the station comes in loudest. During this time the volume control should be turned about half way on. With the station tuned in as loud as possible on the tuning dials the volume control should be adjusted to provide just the desired amount of volume. As this control is turned in a clockwise direction the volume will increase until a certain setting is reached, when the receiver will start to oscillate. The receiver is in its most sensitive condition when this control is set just below the point of oscillation. To turn the receiver "off," it is only necessary to turn the volume control knob all the way to the left.

For local reception the volume control will, of course, be turned well down. In a large room, however, it may be desired to operate the receiver at or near maximum volume. The builder of this receiver is due for a surprise when he does this for the first time. The music comes pounding in in most realistic reproduction and including everything from the shrill treble of the wood-winds to the boom-boom of the kettles and bassdrum.

At the extreme left, in the photographic heading of this article can be seen an Ensco three-foot cone speaker, which has been employed to reproduce these full rich tones. Besides this, the set is shown installed in an Excello style R-31 console, which is equipped with a horn, and is used either separately or together with the three-foot cone for complete fidelity of tone.

The sensitivity and selectivity of the set are of an order that permits tuning in out of town stations with good volume while the local stations are going full blast.

In spite of this perfection and efficiency, the construction of the receiver is so simple that the veriest novice will have no trouble with it. As long as all connections are carefully soldered there seems to be no possibility for trouble of any kind.

The New Karas 2-Dial Equamatic

(*Continued from page* 151)

nately, were precise and accurate enough to permit of this tandem arrangement of two of the condensers.

The coupling coils or radio frequency transformers used in this receiver are unique in design. They consist of the large secondary winding which is equipped with an adjustable metal bracket to permit this coil to be turned at any angle desired after it has been mounted in the receiver. This mounting is accomplished by means of a single machine screw and nut. With this arrangement it is a simple matter to turn the coils of the various stages at just the desired angle in their relation to one another.

The smaller primary coils are not attached to the secondary coils in any way. Instead, they are equipped with a metal arm and collar for attachment directly to the protruding shaft of the variable condensers. Thus when the secondary coil is mounted behind the variable condenser, the primary, or rotor coil, lies within the secondary winding. The desired degree of average coupling is obtained by moving the secondary coil toward or away from the condenser; by changing the angle of the secondary in its relation with the primary, and by changing the angle of the primary by means of the swivel arrangement on which the primary coil is mounted on its metal arm. Once these adjustments have been made they remain fixed, but there is always the advantage that these coupling relations can be changed to adapt the receiver to new tubes or other changes in the receiver which might alter its characteristics and coupling requirements. The important thing is that these angle adjustments are simply to regulate the fundamental coupling range so that it is just right at the highest and lowest wavelengths. When so regulated and fixed, the coupling within the range is varied automatically with the tuning of the receiver.

The Karas Equamatic circuit is shown in schematic form in one of the accompanying illustrations. Here the variable coupling coils are represented as T1, T2 and T3. The secondary windings are tuned by individual Karas variable condensers C1, C2 and C3. One of the reasons for the efficiency and simplicity of this circuit lies in these condensers. They are of rigid and precise construction and have several novel features. In their relation to this circuit probably the most important of these features is the single hole arrangement for panel mounting and the fact that the shafts can be removed entirely by simply loosening two setscrews. This permits moving the shaft back so as to project from the rear of the condenser to furnish means for mounting the primaries of the coupling coils thereon.

In order to facilitate the original adjustment of the variable coupling arrangement the tuned, radio frequency stages are balanced by means of the small variable condensers C4 and C5. This balancing scheme reduces the tendency toward oscillation, thus making the coupling adjustment extremely stable. Radio frequency choke coils RFC1 and RFC2, and by-pass condensers C6 and C7 serve as radio frequency filters to isolate the individual stages and in this way confine the radio frequency currents to their respective circuits.

In the audio frequency amplifier this receiver employs two transformer coupled stages of highest quality. The transformers used are the new Karas Type 28. These are cylindrical in shape and for that reason require less space for mounting than do the ordinary types of transformers. They are completely shielded and are thoroughly sealed in a compound which makes them impervious to moisture and unusual atmospheric conditions.

An output filter, O. F., is used in the plate circuit of the last tube to improve the tone quality and to protect the windings of the loudspeaker from the heavy direct current drawn by the power tube used in the last stage. This filter consists of an iron core choke coil of high inductance and a high capacity bypass condenser. The direct current, which serves no useful purpose to the loudspeaker, passes easily through the choke coil but will not pass through the condenser and therefore cannot enter the windings of the loudspeaker. On the other hand the audio frequency component of the output circuit and this is the portion that actuates the loudspeaker, passes readily through the condenser and into the loudspeaker windings; but cannot pass through the choke.

THE PARTS REQUIRED

- 2 New Karas, Type 28 audio transformers; T4, T5
- 1 New Karas Output filter, O. F.
- 3 New Karas, Type 17 variable condensers; C1, C2, C3
- 3 New Karas Equamatic coupling coils;; T1, T2, T3
- 2 Karas Micrometric dials, 0-100
- 3 Karas subpanel brackets
- 1 Karas control system, including complete hardware
- 2 Karas R. F. chokes, 100 millihenry
- 1 Bakelite front panel, engraved
- 1 Bakelite base panel, drilled
- 1 Carter 10 ohm rheostat and knob with gold engraved arrow; R1
- 1 Carter 20 ohm rheostat and knob with gold engraved arrow; R2
- 1 Carter H-2 filament control resistance, 2 ohms; R4
- 1 Carter H-4 filament control resistance, 4 ohms; R3
- 1 Yaxley No. 69-B interstage switch (gold); S
- 2 Carter tip jacks, No. 10; J1, J2
- 1 Sangamo .00025 mfd. fixed condenser with grid leak clips; C8
- 1 Amsco or Lynch grid leak, 2 megohms; R5
- 1 Yaxley cable plug
- 5 Benjamin cushion sockets; VT1, VT2, VT3, VT4, VT5
- 2 Samson variable neutralizing condensers, range 0 to .0007 mfd. capacity; C4, C5
- 2 Mica fixed condensers, .0001 mfd.; C6, C7
- 1 Mica fixed condenser, .006 mfd.; C9
- 2 Mica fixed condensers, .001 mfd.; C10, C11
- 2 4½ volt "C" batteries
- 3 2 foot lengths insulated sleeving
- 9 2 foot lengths round bus bar wire (tinned)
- 1 XL aluminum binding post with "antenna" marker
- 1 package Kester radio solder
- 1 Table mounting cabinet or "Excello" console cabinet

An automatic switch, S, is included in this receiver. This switch has three positions. When set in one position the receiver is turned off through the breaking of one side of the "A" battery circuit. When the switch is thrown to the second position the last tube is automatically cut out of the circuit and the output filter and loudspeaker are connected directly to the output of the first audio tube. This is for use in the reception of loud local stations where two stages of audio amplification would provide more than enough volume. This constitutes a real saving where the receiver is tuned to locals most of the time because when the last tube is cut out of the circuit the "A" battery consumption is reduced by ⅓. When the switch is thrown to the third position the receiver operates with its full five tubes to provide maximum volume.

Tubes of the standard 301-A type are employed in the two radio frequency stages and in the first audio frequency stage. One may also be used in the detector circuit, VT3, but the use of the new 300-A type tube is recommended here because of its superior sensitivity. A power tube is used in the last audio stage. The 112 type is recommended for this purpose. If it is desired to use one of the 371 type the "B" and "C" battery voltages applied to this tube must be altered accordingly.

Rheostats and fixed resistances are both shown in the diagram, for controlling the current to the filaments of the tubes. It is advisable to use a rheostat to control the filament current of the radio frequency tubes because then this rheostat may be used as the volume control. This is the one shown as R1 in the diagram. The rheostat R2 and the fixed resistances R3 and R4 may be replaced with an amperite if desired. However, if a ready drilled panel is purchased it will be best to stick to the rheostat, as there is a mounting hole provided for it in the panel.

The operation of the receiver is simple. There are only two tuning controls and these are equipped with Karas "Micrometric" dials, which provide a vernier adjustment ratio of 63 to 1. There are no auxiliary adjustments to be made in operating the receiver except the adjustment of the rheostat R1 to provide just the desired degree of volume. The other rheostat, R2, need not be readjusted after its proper setting has once been determined.

The construction and wiring of the receiver are likewise simple. If the front panel and base panel are purchased already drilled the assembly job is simply one of matching the parts up with their mounting holes and all the effort involved in laying out and drilling is eliminated. If the constructor wishes to prepare his own panels it is recommended that the layout shown in the illustrations be adhered to.

It will be noted that no binding posts are used in the receiver with the single exception of the one for the antenna connection. All battery circuit wiring terminates in a Yaxley cable plug at the rear of the receiver. This provides an easier and quicker means of connecting the receiver to the batteries than would be the case if binding posts were used.

Round, tinned bus wire is recommended for use in wiring up the receiver. From the illustrations it will be noted that most of the wiring is underneath the base panel. This does much to add to the neat appearance of the finished receiver and has the further advantage that wires do not have to be bent at all sorts of angles in order to avoid the various instruments, as would be the case if the wiring were done above the base panel. Where there are fairly long stretches of wire, or where wires are run close together, it is advisable to cover such wires with insulated sleeving or so-called "spaghetti." This will preclude the possibility of short circuits later on. In undertaking the construction of this receiver the builder can feel assured that his time and effort will be well repaid. Even without the automatically variable coupling this receiver would be the equal of other present day, standard receivers. It is therefore entirely logical that, with this variable coupling feature, as described above, this receiver should show results considerably superior to those obtained with standard circuits.

When equipped with a suitable cabinet of good quality, or installed in a console cabinet such as the "Excello," this receiver is equal in appearance to the higher priced commercial sets and is a fit adornment for any home. It is an outfit in which not only the constructor but the whole family can take great pride.

The "Unipac" Power Amplifier and A.B.C. Supply

(*Continued from page* 104)

other noises when the Unipac is used as a receiver B power supply. Extra windings on the power transformer provide 1.5 volts for the lighting of the new 1.5 volt A.C. tubes as used in a radio set, while the two 1.5 volt windings of the two transformers if connected in series will also serve to light a standard 2.5 volt heater type detector. (The transformer voltage is then 3, but about ½ volt is lost in the wiring, so that the 2.5 volt tube may be lighted direct from the 3 volt source.)

All in all, the Unipac is an excellent addition to any receiver, or an excellent foundation around which to construct a receiver, for its quality of reproduction and operating features are so far in advance of present designs that it may be relied upon for years to come as a power supply and power amplifier for audio or phonograph operation that cannot be improved upon.

The accompanying list gives parts needed to build the Unipac, all standard and available from any good dealer or mail-order house.

The construction of the Unipac is quite simple. All transformers are mounted on the chassis, leaving the condenser until last (its mounting feet are clamped under two of the tube sockets.) The binding posts and jacks are mounted upon the chassis edge, using the insulating washers accompanying it. The resistor is mounted by having two of its lugs soldered to the +45 and +90 binding posts. The small FT64 resistors are mounted directly on the amplifier tube sockets, the socket mounting screws falling under them being left out.

While no pictorial diagram appears, no difficulty should be found in following the schematic as all terminal markings are exactly as on the instruments themselves. After the Unipac has been wired, it should be carefully gone over to see that no connection errors have been made, and that the twisted filament lines from the amplifier tube sockets to the power transformers are isolated from the rest of the wiring.

To test the Unipac, both attachment plugs should be inserted in a two-way receptacle and all tubes inserted—326 at left, then 310, 374, 316B and 316B. All should light—the 326 very dull, the 310 and 316B's fairly bright, CX374 in the center socket, and the 374 should glow with a pinkish discharge.

With all amplifier tubes also in place, and a speaker connected to the output jacks, a roar should be heard, disappearing if the input tipjacks are shorted, or decreasing to a slight hum if a record pick-up is connected to the input tipjacks. Reversing one of the attachment plugs will probably decrease the hum.

For operation with a receiver, a pair of leads from the first audio stage output should terminate in a plug, to be inserted in the double-circuit jack of the Unipac. This connection drops the input tube, which is then only used with a record pick-up. Of course, the first audio stage receiver tube may be dropped, and the grid lead of the receiver first audio stage transformer connected to the input tipjack connecting to the grid of the 326 tube. The grid return is then made through the negative B connection from Unipac to receiver.

For phonograph operation, a Pacent Phonovox with the regular needle-scratch filter and modulator plug is recommended. The pick-up unit should connect directly to the input tipjacks of the Unipac, with the needle-scratch filter and modulator both connected in parallel across the input jacks. Only electrically cut records will do justice to the quality obtainable from the combination, and these played with a carefully selected grade of needles. It must be remembered that the phonograph reproduction will never have quite the richness or fullness of tone experienced in reception of a good radio broadcast program, though the record reproduction obtained from the Unipac will be equal or superior to that obtained with any of the expensive electric victrolas selling at from five hundred to several thousand dollars.

The Unipac may be used with any good radio receiver, but in order to illustrate the use of A.C. tubes in conjunction with the Unipac, functioning as an ABC power supply, the circuit herewith is given. The receiver shown can be constructed as the fancy suits, and, completely AC operated, will give a quality of reproduction obtainable from no factory-built set. Its selectivity is excellent, and it will bring in stations up to 1,000 miles distant with loud-speaker volume under favorable conditions. The installation is ideal for a simply operated combination phonograph and radio set of superb tone quality.

Power Supply from the House Lighting Current

(*Continued from page* 102)

Two 1.0 mfd. fixed condensers "C1" and "C2" are placed in the receiver running from the positive plate supply to the two radio frequency tubes to the positive A wires on the sockets. A by-pass condenser of .001 mfd. capacity is shown connected from the primary of the first audio transformer to the filament lead.

The remainder of the set is absolutely standard, using air core tuned radio frequency transformers of any reliable construction with variable condensers to cover the broadcasting band. Good apparatus pays and it is poor policy to use poor parts in the construction of the set and blame the power unit later on for poor performance.

Now for the power unit.—This may be assembled on a baseboard 15 x 30 inches with the parts mounted as shown in the picture, Fig. 3. The rear of the board should be occupied reading from left to right as follows: Transformer (T1) buffer condensers (C1; C2; C3; C4) tube socket (T2), and choke coils (L1 and L2). Directly in front of the choke coils should be placed the condenser pack and to the left of that the resistances and binding posts.

Parts should be carefully wired with flexible Celatsite hook-up wire and connections soldered with Kester rosin core radio solder.

A 3-ampere fuse should be placed in the circuit to protect the transformer against overloads. This is shown (G2) in the lower left-hand corner.

This arrangement has been found best, for all wires are short and the current progresses from one piece of apparatus to another without any back wiring and with a minimum of lost space. The usual transformer has a third winding (S3) for lighting the filament of the power tube and supplying the C bias for it. This may be disregarded if one wishes to use a 201A tube in this stage. If one plans to use a power tube, it is best to mount this socket with the rest of the apparatus in the power unit and not in the receiver proper for the reason that short filament and high plate voltage wires may then be made. The power tube is not included in the picture of the baseboard layout nor is the biasing resistance.

As high voltages are to be handled in all wiring, it is best to use only heavy rubber covered flexible wire in making connections.

To construct the power unit the following list of parts is needed: One power transformer (T1) with tapped primary (P1) for operation at 100-110-120 volts alternating current, with three secondary windings. S1 should have a total of 750 volts with a center tap, S2 is a winding delivering four volts and five amperes for the ionizer of the rectifier tube, and S3 a five-volt winding for supplying one ampere of current for a power tube.

Two choke coils (L1 and L2) of 3 to 5 henries inductance at 300 mills and capable of carrying 300 milliamperes of current continually without overloading. Their D.C. resistance should not exceed 100 ohms.

One 1.0 mfd. fixed condenser capable of standing 250 volts (G1); two buffer type fixed condensers of 0.1 mfd. capacity (C1 and C2) for operation at 600 volts D.C. current working voltage; two 1.0 mfd. fixed condensers (C3 and C4 600 volts working voltage); three 5.0 mfd. 400 volts filter condensers (C5) (C6) and (C7); one 1.0 mfd. filter condenser to operate at 250 volts D.C. (C8); one 3 ampere fuse (G2); one 400 milliampere Q. R. S. Rectifier tube (T2).

R1, R2, R3 and R4 are resistances tapped as indicated on the diagram. R1 and R2 must be capable of passing 300 milliamperes of current. R3 and R4 are 2000 ohms resistance and must be capable of passing 70 milliamperes of current, used for the purpose of preventing undue voltage from building up due to the sudden removal of a tube or a break in the circuit. When the set is in operation these resistances draw but 7 milliamperes.

If trouble is experienced in getting the set to operate, if the tubes fail to light up and the circuit has been checked through, investigate all fixed condensers for breakdown. If a condenser breaks down, it places a short in the rectifier tube and prevents building up sufficient voltage to operate the set.

In experimenting with the set it is well to turn off the power to the unit before removing tubes from their sockets or making changes or repairs to the wiring.

The Listeners' Accessory Guide

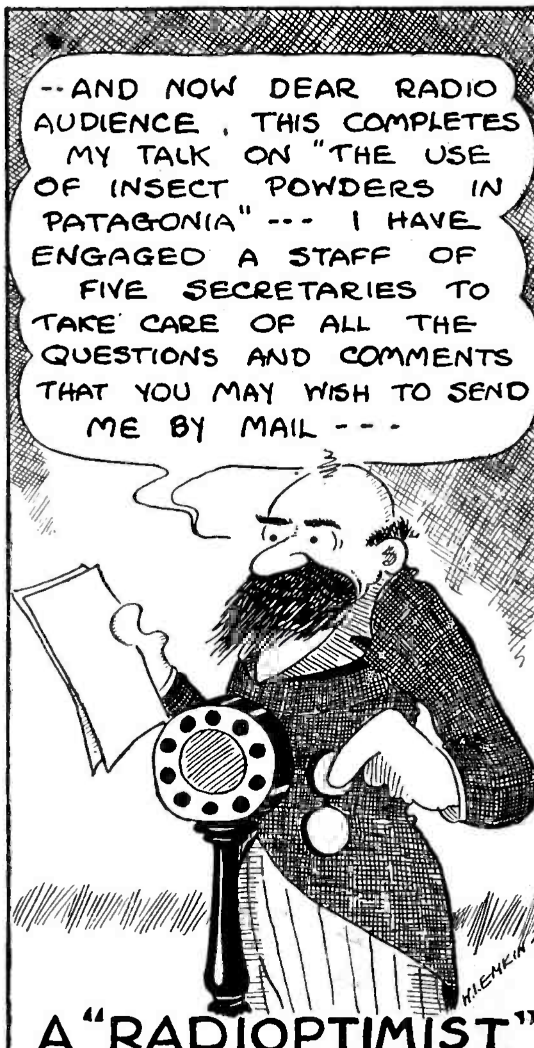
(*Continued from page* 116)

plugged the connector cords of the A and B socket power units, and the charger.

It is the shunt type relay which means the electromagnet that actuates the switch is connected directly across the A battery circuit of the receiver, so that the moment the switch to light the filaments is turned on, it is actuated and disconnects the 110 volts from the charger to the B battery eliminator.

To connect the relay it is merely necessary to plug the socket-power units in the outlets at the side, attach the connector cord to the lamp socket and connect two lengths of flexible wire from the set to the binding posts on the relay.

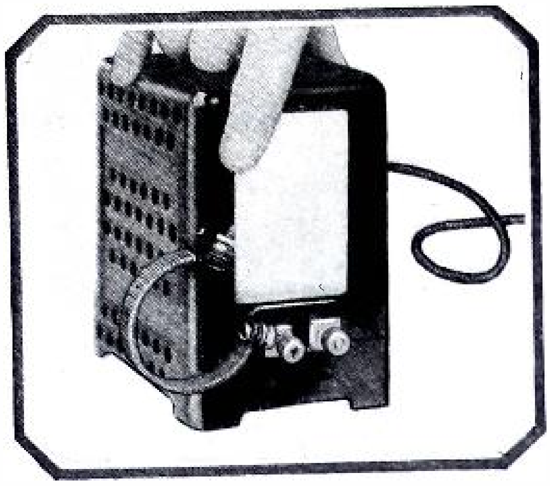
A relay of this type is really indispensable to the owners of receivers who desire real socket-power operated receivers. Otherwise there are a multiplicity of switches to be turned on and off, and possibly a chance of a short circuit and damage to the receiver. By the use of a device of this type, it is impossible to have any occurrence of this sort happen, as should through chance a short circuit occur, it will cause the relay to cease operation which in reality protects the set.



A "RADIOPTIMIST"

Trickle Charging 4 Volt Storage Batteries

A six volt trickle charger can be easily adapted to the charging of four volt batteries, at no great expense to the set owner, and without any changes in its regular construction. It is only necessary to attach the resistance windings of a six ohm rheostat to one of the posts of the charger, as illustrated in the photograph. The unit used in one of the air-cooled rheostats is best for this purpose, as it is easier to remove, has a stouter core and is more sturdy in construction.



The above photo shows how the wire resistance unit from a six ohm rheostat is connected to one of the terminals on a trickle charger.

It will be found that by this means a charger can be made to serve a double purpose, that of a four and six volt trickle charger, and if at any time the set owner decides to use six volt tubes in his receiver instead of the small tubes, it will not be necessary to purchase a new charger, simply remove the resistance and use the charger at its regular rating.

Overhaul Your Antenna

After a set has been in operation for a year or so, it will generally be noticed that reception can be improved by overhauling the antenna system. By this is not meant putting up new wires and insulators, but by cleaning the insulators in carbon tetrachloride, tightening up the connections, and in short, repairing the ravages of time and weather on the installation.

A wire can be strung up and tightened as far as possible, but due to the weight of the wire itself, as well as to the wind and pull of the lead-in, it will in time develop a slack which is harmful to distance reception. This slack should be remedied.

It will be found that by simply cleaning the soot off the insulators that a material improvement is noticed.

Veneered Wood Makes Handsome Panels

Radio set builders are getting away from the use of material which tend to give radio receivers a technical appearance. Hard rubber formed to counterfeit wood, as well as hard rubber with a thin veneer of wood, are being used more and more by the fan who desires the up to date appearance in his set.

How the fan may circumvent the expense involved in this and at the same time use panel material which

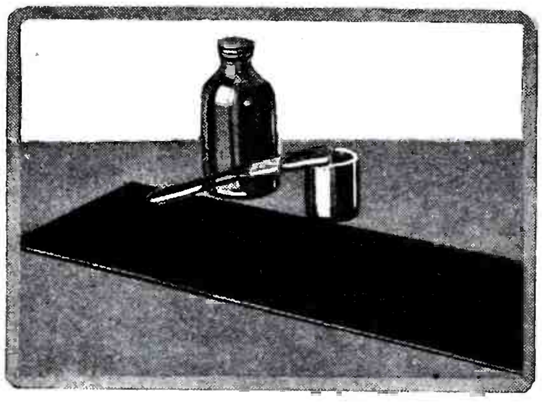


Fig. 1. The veneered panel is carefully stained with a color to correspond with the cabinet to be used.

not only gives the appearance of the grain of the wood—but which is wood—is explained in the following.

Obtain a piece of three or five-ply wood with the grain running crosswise, the length of the panel. Carefully cut it to size and sand the surface. Apply a coat of good oil stain to the surface, and allow it to dry, under the pressure of clamps, such as shown in Fig. 2. When clamping it down, make sure

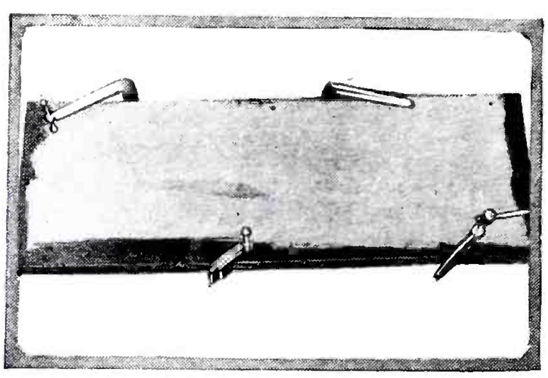


Fig. 2. In drying, the panel is clamped to a dry and heavier board to prevent warping.

that a piece of board heavier than the panel material is used. When the first coat of stain has dried, the panel may be varnished with a good grade of spar varnish and rubbed down with rotten stone and a drop or two of oil. The resulting panel will be found to be far more beautiful than the imitation.

Several manufactured types of receivers employ panels of veneered wood, and if the constructor prefers to take the time and care in preparing a panel as explained above he can produce equally the same appearance with a home-made set.

Don't Overlook Jacks and Switches

The broadcast receiver owner occasionally notices that his set has apparently deteriorated in some peculiar fashion. Signals which used to come booming in are only heard with fair volume, and distance which was clearly heard on the loud speaker is only faintly heard. When the usual test of batteries, tubes, sockets and loose connections has failed to reveal any cause for this condition, look at the jacks and switch contacts in the set.

These are neglected places in the set where trouble originates, yet where very few experimenters look. The double circuit jacks often develop high resistance contacts where the output lugs make contact with the primary transformer lugs. The best way to overcome this is to pass a very fine nail file between the upper and lower contact points a few times, and then see that the tension is perfect. If, due to the constant spreading action of the plug, the upper and extreme lower lug have lost some of their springiness, bend them with a pair of fine-nosed pliers. Of course this should be done with batteries disconnected.

In the matter of switches, a piece of fine sandpaper run over the contacts will usually correct any high resistance connections. Many fans do not realize that a high resistance at the filament switch can cause low signal volume or fluctuating signals, but this is entirely true.

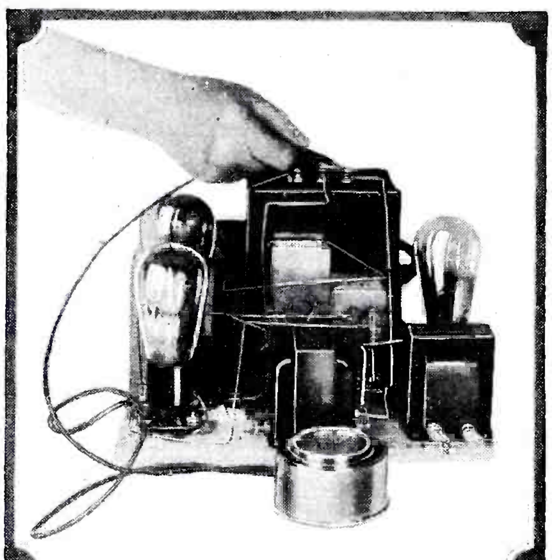
It is especially necessary to see that all these points make good contact after the warm weather. Metal will sweat, due to humidity and heat and cause corrosion in some of the most unexpected places, and it is generally in these unthought of spots that the trouble can be located.

Testing the Voltage of a B Eliminator

A fact not generally known among home set builders is that the pocket type of voltmeter is not at all suitable for testing the voltages of B eliminators. The resistance of these small voltmeters is so low that inaccurate readings always result, and proper voltage regulation is an impossibility.

For accuracy a voltmeter should have a very high resistance per volt reading. Resistance as high as 1000 ohms per volt scale reading are common with the best and most accurate meters, and allow correct scalings to be taken while the set is in operation, due to the fact that they operate at very small current. The smaller meters are accurate enough for readings of B batteries, due to the low resistance, but will not register correctly in the case of the B eliminators.

Before purchasing a voltmeter for testing the B eliminator it would be advisable to explain to the dealer or the manufacturer that you intend using it to test the voltage of a B eliminator, in order that he can therefore advise you as to what type to employ.



The flexible wires of a special voltmeter are touched to the output terminals of the eliminator in order to test the voltage before being encased.

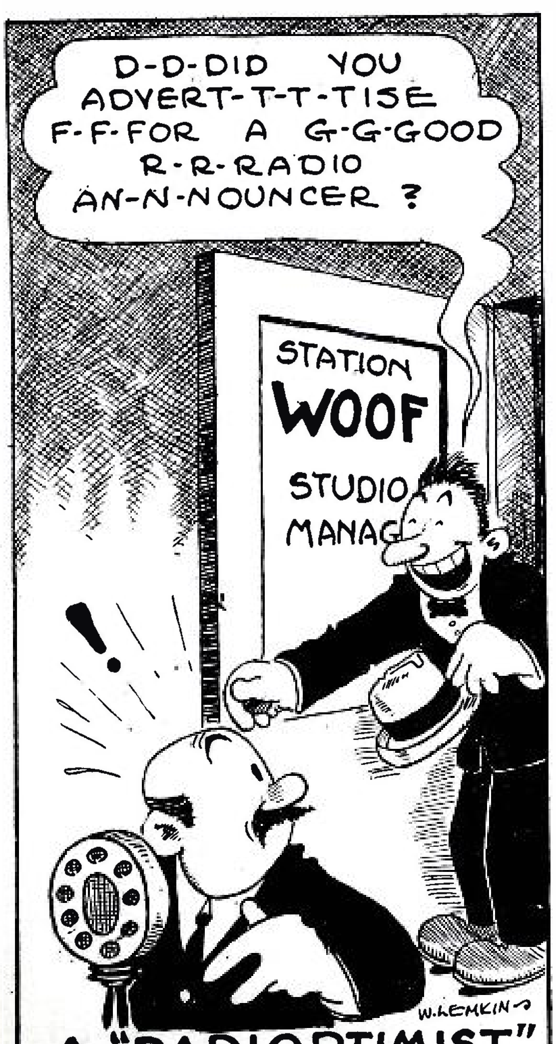
Testing of the voltages should always be done before the completed unit is encased in its protective cover. A popular make of voltmeter with the necessary high resistance qualities is shown in the lower front of the illustration. The test is made from the output of the filter system. This is a much more methodical method of testing than first building the entire unit, encasing it in its shield and then testing, only to find that the voltages are not correct. In the matter of shielding, it is best to encase the entire unit in a metal cabinet, which should be grounded to the minus terminal. This will eliminate any chance of hum being picked up by the set during operation.

Volume Control for Power Tubes

It is often the case when a power tube is used in the last stage of a set equipped with a B eliminator, that the power on most local stations will be excessive. The usual stunt is to turn down on the filament current and thus control the volume. This is bad practice, and from the standpoint of quality of reproduction, it will be found that tones will be unnatural. It has been pointed out numerous times but seemingly to no avail, that it is most important to operate a tube at its correct filament current regardless of the volume desired, and to control the volume through some other means.

Possibly the simplest means of controlling the volume without harming the quality is by the utilization of a fairly high resistance in the plate lead of the last or power tube. A compact pressure resistance such as the Clarostat, Bradleyohm or similar instrument is simply placed in series with the power lead from the B eliminator and this is adjusted until the volume is satisfactory.

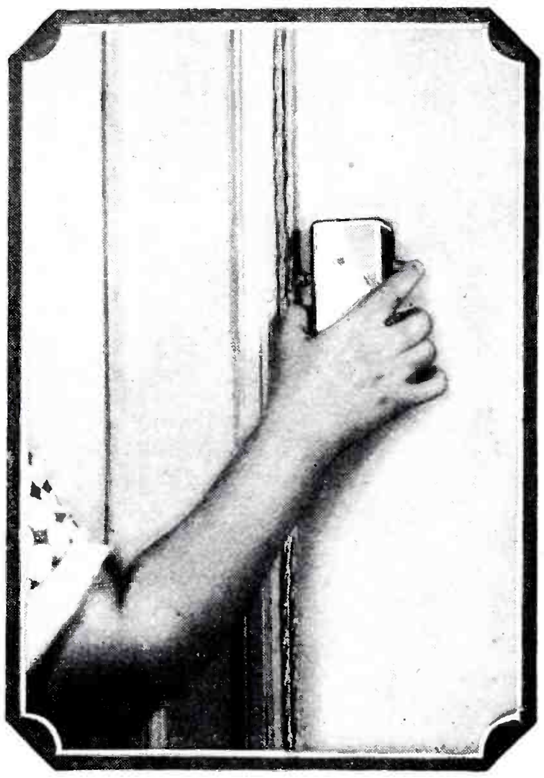
This method controls the volume, and allows the undistorted music, speech or song to go through all the circuits with no chance of distortion due to underfeeding of the tubes.



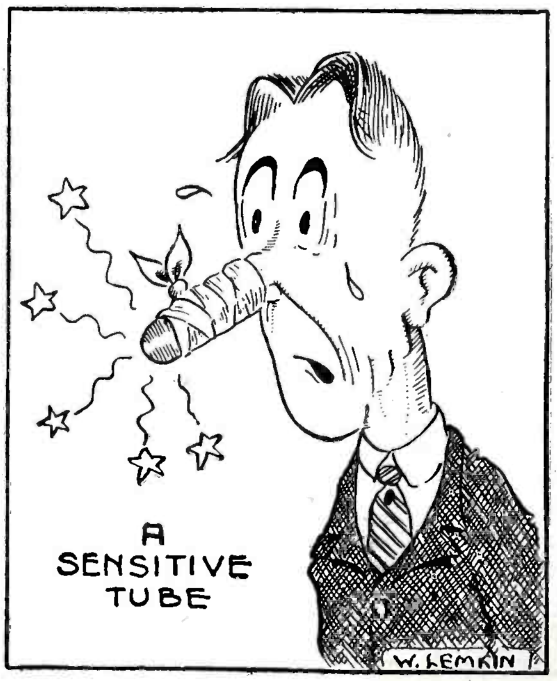
A "RADIOPTIMIST"

A Set Protector

When making changes in his set, the experimenter sometimes has the misfortune of dropping a tool into it and blows out all of his tubes. Of course one way to overcome this difficulty would be to carefully disconnect all batteries and eliminators when making changes. However, a device has recently been placed on the market, which will automatically disconnect the "B" eliminator if anything goes wrong in the set. It is in the form of a cut-out connected in the primary circuit of the eliminator and may be conveniently screwed to the wall or the back of the cabinet where it will not be seen. If the cut-out does open, one merely has to find the short circuit in the set, repair it, and push the button on the right hand side of the instrument. This is a very handy accessory for those fans who are continually changing their receivers.



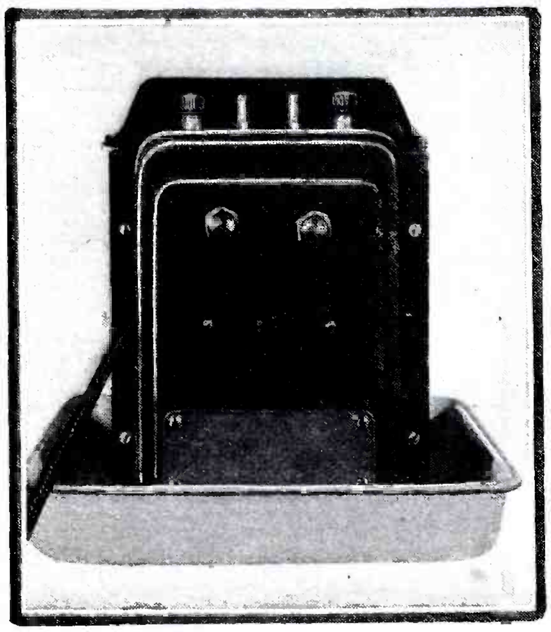
The automatic cut-out can be placed on the wall behind the door or some other remote place.



SEE PAGE 158

Preventing Battery Acid Damage

As many radio set owners have found out to their sorrow, battery electrolyte creeps or spreads if it is given the chance. The ordinary rubber storage battery mat is generally sufficient to keep a storage battery from damaging a cabinet, but it will not prevent damage due to creeping electrolyte in the case of a battery kept up to full charge by means of a trickle charger. In this case, the gassing of the battery causes sprinkling of a acid solution over the top of the battery, and if the charge is heavy enough this sprinkling will overreach the sides of the battery



Stand the storage battery in a large photographic developing tray.

and sprinkle on the floor or base of the battery compartment. After this has happened there is little that can be done, except to wash the damaged parts with a solution of aqua ammonia or some other strong alkaline neutralizing agent.

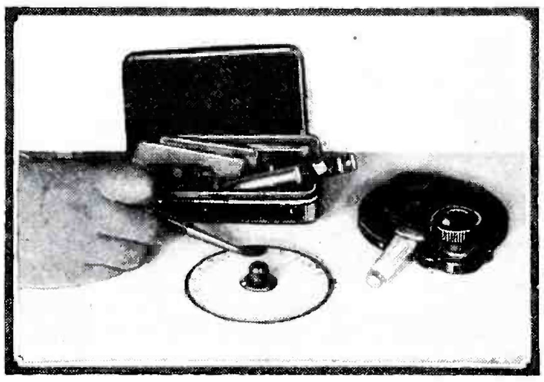
To prevent this trouble from occurring, obtain a large glass or porcelain photographic developing tray, an inch or two larger all around than the diameters of the battery, and stand the cells in the center. Any electrolyte that does splash will be caught in this tray and will not spread, as the acid electrolyte will not spread on glass or porcelain.

Should acid from the battery get on the rugs or clothes, wash them immediately in a solution of aqua ammonia and water, equal parts, or a 20 per cent solution of plain aqua ammonia. Never wash the top of the battery with this solution, however, as ammonia has a strong affinity for sulphuric acid, and if by chance a slight amount is allowed to get into the jars themselves damage to the cells will result. A chemical action will also ensue, causing the formation of ammonium sulphate, the salt produced by the acid combination. Pure water is the safest medium to use in washing a battery case.

A Practical Dial Hint for Combination Dials

It is oftimes very confusing to the uninitiated to operate a set incorporating dials made for both clock and counter-clockwise condensers. Most all of the popular makes of window vernier dials on the market today incorporate this feature, mainly as a protection to the dealer, as it does not necessitate a stock of two types of dials.

This confusion, and oftimes consequent chance of disturbing the settings of the dials, due to turning the dial past the zero or 100 mark, can be eliminated very easily, once the direction of rotation of the dials is determined. How this should be done is clearly illustrated in the photograph. The instrument should first be taken apart, and the unnecessary markings on the dial removed by covering them over with white water paint. If a good match is made between the paint and the dial, it will be impossible to distinguish between the original celluloid and the painted-out figures. This makes it impossible to disturb the dial settings of the receiver due to turning past the end markers.



The half of the dial which is not used is blackened with india ink or chemicals as explained in the text.

In some cases, where the celluloid dial is used as an indicator, with a pilot light showing through the dial, to throw the numbers into relief, the white paint will not hide the numerals on the unused part of the dial completely. In this case, it will be necessary to blacken that part of the dial by using india ink or heavy black water paint. If the dial happens to be of metal, a permanent black finish can be easily etched on the unused part of the dial by the use of any sulphur oxidizing compound of which there are any number. Sulphur dioxide is excellent for this purpose and is easily obtainable at most any drug store or chemical supply house. Care should be taken when it is being applied to just cover the space where the scale is not desired.

A Few Dont's For Radio Owners

Don't connect new batteries in the same circuit with old ones. It is poor economy, as the new cells are forced to use good energy in overcoming the higher resistance of the old cells. It will sometimes shorten the life of new cells or batteries as much as 30 percent.

Don't connect an A, B, C eliminator to a set before first finding out if the minus side of the A circuit of the set is grounded. If such is the case, break the lead between the ground connection and the minus side of the A circuit before attempting to connect the eliminator. Otherwise damage might be caused to the set by a serious short circuit through the light mains.

Don't expect good results from a receiver which you build unless you follow the specifications. Take it for granted that the writer of the article has tried all the possible combinations that you can think of before he allowed the publishing of the material. Changes may seem improvements or innovations, but they are sure to make a difference in the operation at some point.

Don't buy cheap tubes and then complain when your receiver doesn't give good results. A carpenter may be able to build a good house with inferior tools, but a set cannot work unless the tubes are the best that can be purchased.

Don't expect the storage A battery to give unlimited service without charging. A battery that is kept charged always gives longer and better service than one which is allowed to run completely down before being recharged.

Don't expect long service from a speaker if the leads are connected in the wrong manner. De-magnetization will take place and the eventual result will be extreme loss of volume, poor tone quality and finally failure of the speaker to reproduce at all.

Don't use power tubes without proper C battery voltage, and when more than 150 volts are to be put on the plate, see that an output filter system is used. Otherwise damage to the loud speaker windings is sure to result.

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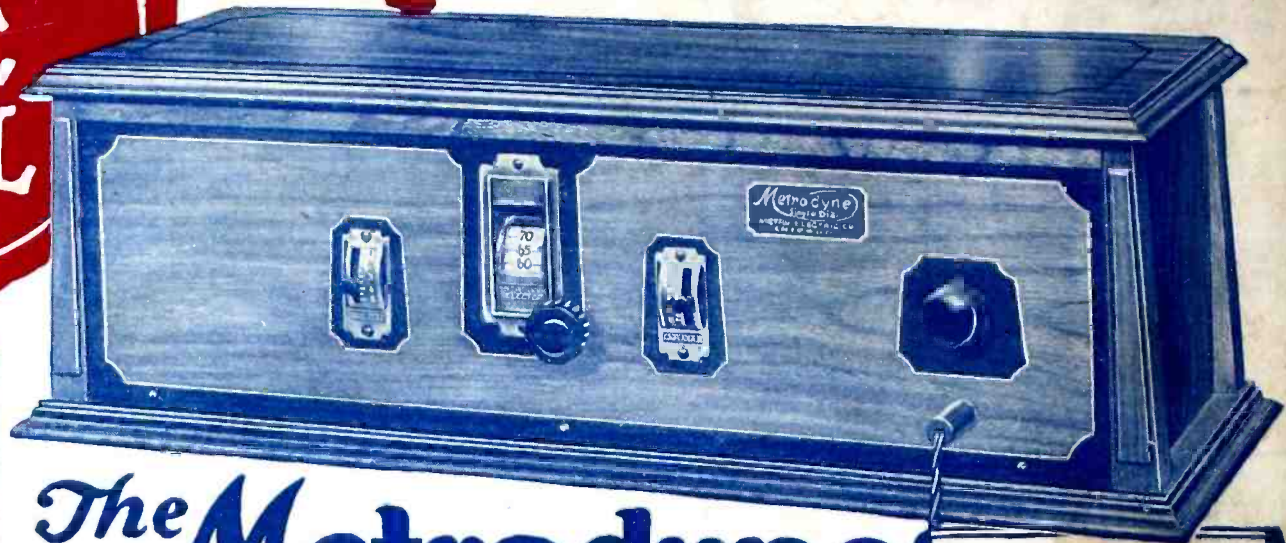
Single Dial Radio



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Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, **1,000 to 3,000 miles on loud speaker!** The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.

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