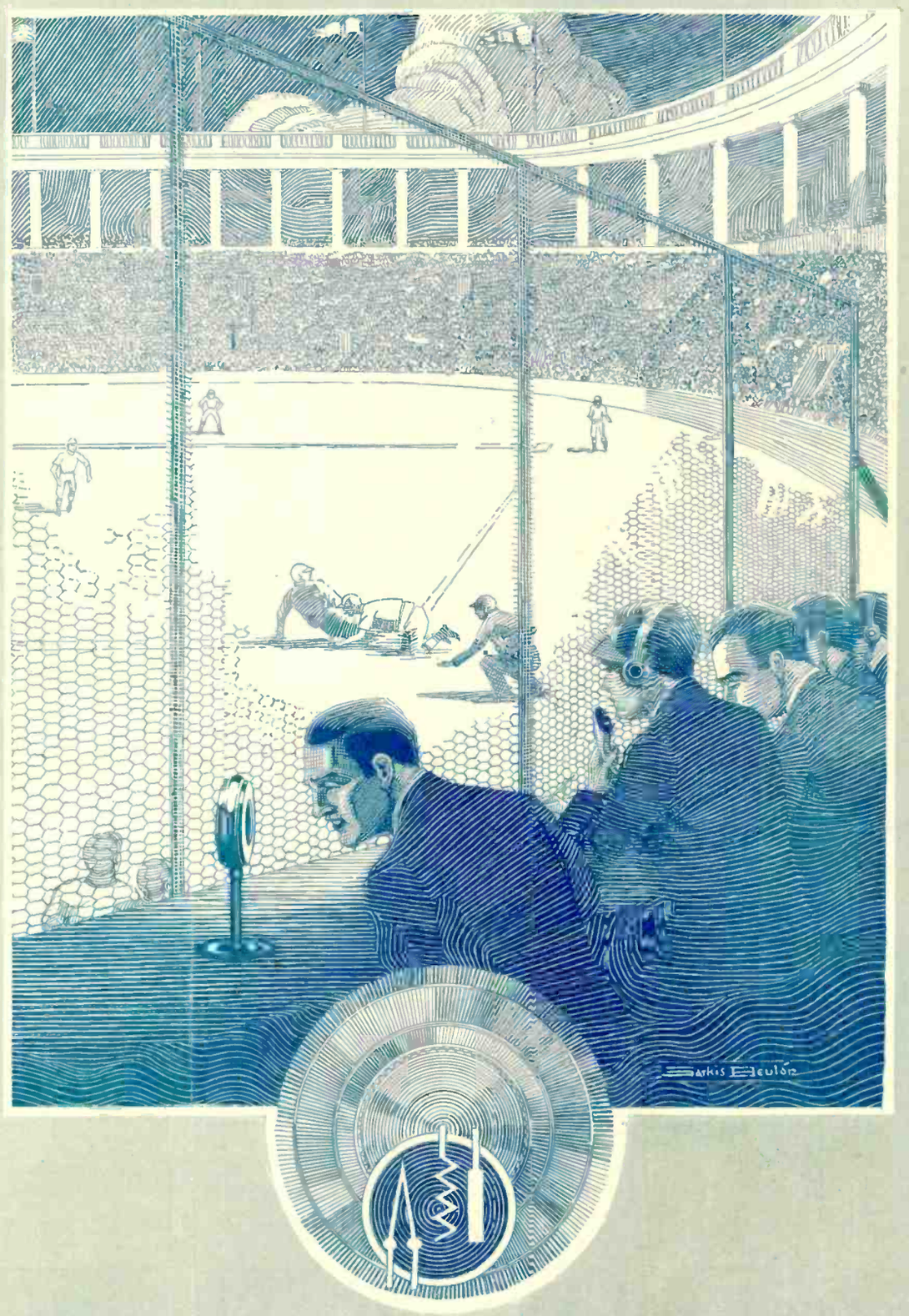
SEPTEMBER, 1928 25 CENTS

RADIO

(REG. U. S. PATENT OFF.)



A MAGAZINE OF NATIONAL CIRCULATION — COVERING THE ENTIRE FIELD

MAGNAVOX "Dynamic" SPEAKERS

Belvedere Model
Two-tone walnut floor screen
For A-Battery Operation . . $50
For AC Operation $65

Beverly Model
Gracefully proportioned cabinet finished in light mahogany.
For A-Battery Operation $55
For AC Operation $70

Other floor and table models up to $175.
Units only; DC $35; AC $50.

"FIRST SPEAKER FIRST DYNAMIC"

DYNAMIC

First place in realism . . . extreme fidelity of reproduction . . . is accorded Magnavox Dynamic Speaker by fourteen makers of fine radio sets. They use it as built-in equipment to assure rich, undistorted reproduction, with great volume.

THE MAGNAVOX COMPANY
Oakland, California Chicago, Illinois

FADA Radio

THE FADA 10 RECEIVER *and* THE FADA 4 SPEAKER

Using The Indirect Heater Tube

They do more than receive—they deliver—*and how!*

These are the leaders of the big radio parade. In a purchaser's home they deliver the four radio essentials—*tone quality, distance, selectivity* and *reliability*. These are the points the consuming public is looking for in a radio set of today. Fada radios deliver permanent radio satisfaction to their owners and—

DELIVER PROFITS TO FADA DEALERS

It is the combination of dollar for dollar value with the utmost in radio results which gives Fada dealers radio profits and Fada owners the utmost lasting satisfaction.

F. A. D. ANDREA, Inc.

Jackson Avenue, Orchard and Queens Streets
LONG ISLAND CITY, N. Y.

CHICAGO SAN FRANCISCO

Prices Slightly Less East of the Rockies

THE FADA 4 CONE SPEAKER

Mantel Clock Type

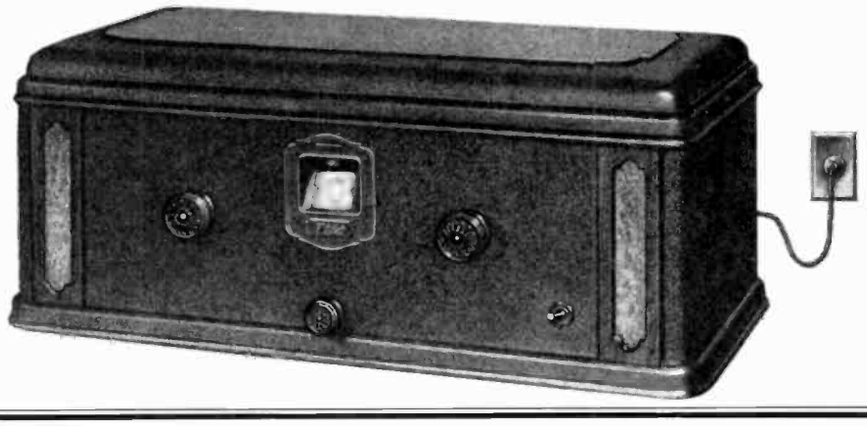
A seven-inch completely encased cone, balanced armature with extra large chrome steel magnet with improved bobbin winding and simplified direct drive.

Price $32.50

THE FADA 10

Operated from A.C. light socket (90 to 130 volts, 25 or 60 cycle) single dial, illuminated station finder, adjustment for long or short antenna, rejector, phonograph attachment jack, with improved circuit and volume control, self-contained in a beautiful metal velvetex cabinet in two tones of gold and brown.

Price $115



RADIO

Established 1917

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VOL. X — SEPTEMBER, 1928 — No. 9

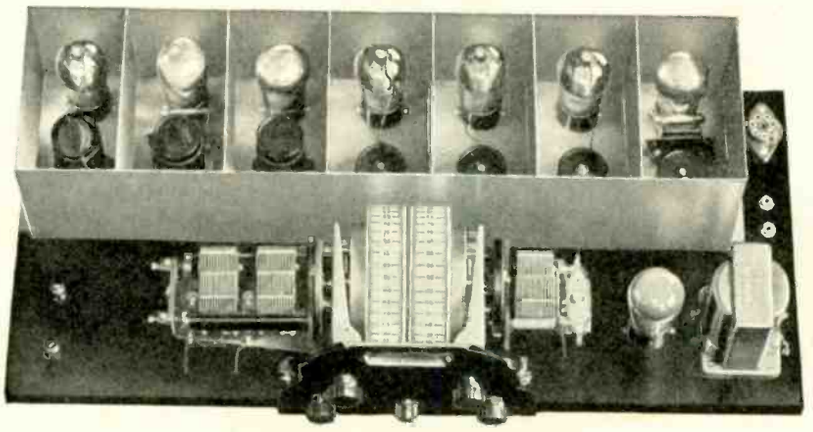
CONTENTS

FORECAST FOR OCTOBER ISSUE

Don C. Wallace interestingly tells how a traveling man keeps in daily touch with his home by means of short-wave radio. G. M. Best describes the rejuvenation of the 45,000-cycle superheterodyne, so as to meet modern conditions. Clinton Osborne illustrates and describes the portable short-wave receiver which is to be used for the Byrd expedition to the South Pole. John P. Arnold discusses the ill-advised publicity about television, describes practical uses of photoelectric cells, and describes miscellaneous devices used in picture reception. Frank C. Jones tells how to build an a.c. screen grid receiver having five tubes. Samuel G. McMeen "finds buried treasure by radio." H. W. Anderson explains the construction of an all-purpose test set. Willis L. Nye has adapted the split Colpitts circuit for use as a short-wave transmitter. R. Wm. Tanner describes a selective short-wave receiver, and A. Binneweg, Jr., discusses the design and construction of ¾, 5 and 10-meter transmitters.


THE New
REMLER
"29"
ARRIVES!

. . . and it is different



Today there are all sorts and kinds of radio receivers. They range in cost from a few dollars to many hundreds. You will find among them scores of good sets—sets that perform creditably.

BUT if you are experienced in radio, if you are musically critical, you know that you are still looking for the ideal receiver. You realize that circumstances force the makers of factory-built sets into many compromises. You cannot see much difference—except in appearance—between one receiver and another. Now turn to the Remler "29," first shown on August 18, 1928, and make some careful comparisons.

Tone may be your first consideration. In the "29" you find tone range and clarity beyond your highest expectations.

Perhaps you demand knife-edge sharpness of tuning. The "29" gives it in fullest measure. In addition you certainly want a set so sensitive that you will be able to enjoy many programs from far distant stations. Then roam the ether with the Remler "29." Here is the receiver that always does what is expected.

The REMLER 29

High Spots

Marvelously Realistic Reproduction . . . Remler Audio System . . . Perfect Control of Volume from Maximum to a Whisper. All the Selectivity that Could be Desired . . . Clean-Cut Separation of Stations on Adjacent Channels. Superheterodyne Sensitivity . . . Shielded Grid Amplification. Easy to build . . . Can be Assembled, Wired and Put into Operation in One Evening. No Special Knowledge or Experience Necessary. Most of the Wiring Completed and the Circuits Balanced at the Factory. Only a Few Wires to be Installed by the Builder in Accordance with Color Code. Eliminator or Battery Operated. Combined Power Amplifier and Plate Supply . . . CX 350 (UX 250) Power Tube . . . Full Wave Rectification Voltage Regulator Provided for. Steel Chassis Amplifier Construction . . . Compact and Rigid. Power Transformer Primary Tapped for Different Line Voltages.

UNIT CONSTRUCTION

And What It Means

Until recently the set-builder was compelled to assemble his parts from a large number of different manufacturers. Shopping for these parts was more trouble than putting them together. In the Remler "29" the more difficult assembly and wiring and the more exacting adjustments are completed at the factory. The No. 712 Shield-Grid Selector-Amplifier is a complete and self-contained unit and is the heart of the receiver.

This type of construction means lower costs to the buyer, and insures operation up to the standards of the designer.

Why a Custom-Built Set . . . . ?

WHILE the majority of people own factory-made sets, the man who thinks for himself and knows what he wants will refuse to follow the crowd and will do his own deciding.

The radio expert fully appreciates the refinements and superlative performance of the custom-built receiver. Now the simplified Remler System makes these advantages available to everyone in the "29." It can be home built in an evening or completed and installed by any professional set-builder.

Parts can be and are chosen and specified solely on the basis of performance—parts, the use of which would raise the cost of a completely built factory-receiver to a prohibitive figure.

Savings effected from the shipment of parts in kit form, due to the elimination of double handling of many of them, to decreased bulk and weight and consequent smaller charges, and savings effected through delegation to the purchaser of the easy tasks of assembly and the installation of a minimum of wiring are passed on to the consumer in the form of prices very much below those which would have to be charged for a commercially-built product of inferior performance.

NEW

LER

The Remler '29' Circuit

The "29" is an 8-tube, shield-grid receiver, including a Selector-Amplifier Unit (No. 712) built, wired, and tested at the factory. Eight tubes line up this way: one stage of shield-grid radio frequency amplification functioning at the frequency of transmission, a regenerative first detector, an oscillator, 3 stages of shield-grid intermediate amplification functioning at a frequency of 115 kc., a second detector and a first audio stage.

Shield Grid Tube Advantages

The latest tube development is the shield-grid tube. It is characterized by its inherent stability of operation and the large amplification per stage which it provides. Four of these tubes are employed in the Remler 29 and they are responsible for its smoothness of operation, its large amplification without sacrifice in quality and to a great extent for its remarkable selectivity. The use of the shield-grid tube is indicative of the forward policy followed of using equipment of special design whenever such equipment is found to provide superior results.

Remler Power Amplifier

The Remler Power Amplifier is built for the CX 350 (UX 250) Power Tube. It makes use of two CX 381 (UX 281) Half-Wave Rectifier Tubes and of one CX 374 (UX 874) Voltage Regulator Tube and in addition to supplying filament current and plate voltages for the rectifier and power tubes will supply plate and grid bias voltages for the Remler 29 Receiver. The Remler No. 921 Second-Stage Audio Transformer, the Remler No. 923 Output Impedance-Compensating Transformer, the Remler No. 950 Power Transformer and Choke and the sockets for the various tubes are all assembled on a drilled and enamelled pressed steel base which is supplied with the No. 952 Power Amplifier Foundation Kit.

With the Foundation Kit are supplied sockets, center-tapped resistors, necessary bolts, screws, nuts, lugs, terminals and wire and a large, easily followed blueprint.

REMLER POWER AMPLIFIER

YOU SIGN THE COUPON WE SEND THE DETAILS

Just published—and hot from the printing press—is Bulletin No. 17 which gives all the constructional details and circuit data on the "29". All the Advance Guard of Radio are writing us for copies. If you like to keep up with the March of Radio Progress, use the coupon below today

AT THE RADIO SHOWS

The Remler "29" will be exhibited for the first time at the San Francisco Radio Show, Civic Auditorium, August 18 to August 25. Next it will be on display at the Los Angeles Show, Ambassador Auditorium, from September 2 to September 8. Other exhibits will be made at the New York Show, September 17 to 22, and at the Chicago Show, October 15 to 20.

Remler engineers will be on the job to explain every detail of construction and operation of our new parts and circuits. Set-builders usually make our booths their Show Headquarters. You are invited to join them and talk over the latest developments in radio.

AIDING THE SET-BUILDER

Remler has pioneered in helping the custom set-builder in both the technical and selling departments of his business. Our Bulletin Service goes to thousands of builders, both professional and amateur, who find it a tremendous help in every way. New circuits are described, parts listed, and advantages pointed out. Merchandising plans are detailed, advertising help is given. In fact, no effort is spared in assisting the builder to render superlative service to his customer. There is no charge for this service. It is part of the Remler Plan to make the custom-built set as popular as it deserves to be.

FOR JUST ONE REASON

The coupon below is inserted for just one reason—to make it easy for you to get complete information on the Remler "29". We have done our part. Now it's up to you. Sign and mail it today

REMLER DIVISION, GRAY & DANIELSON MANUFACTURING CO.
260 First Street, San Francisco, California.

Gentlemen: Please send me:

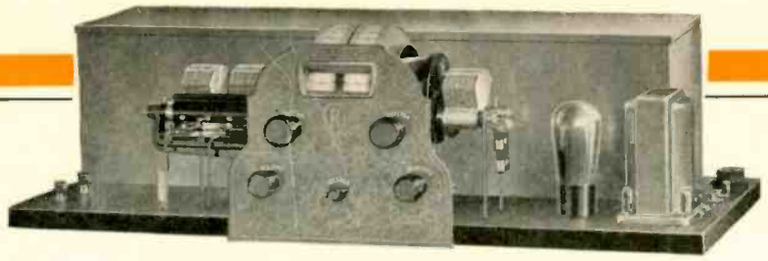
☐ All the "dope" on the "29." ☐ Bulletin Service for Professional Set Builders.

Name ..... *Address* .....

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

Do you build and sell sets? .....

RADIO-9



NEW REMLER "29"

Magnificent In Appearance—Unparalleled In Performance

Ready For Delivery Today—All Parts In Stock

Here is real 1929 radio for you. The finest receiver that money can buy. Latest Remler audio transformers give marvelous tone. New 115 K.C. screen grid amplifier unit, completely built up, wired and balanced in the factory. Metal base, drilled. Beautiful escutcheon plate. Only a few hours' time to build up. Undoubtedly the greatest value in radio. Price for all parts, as pictured above..... **$131.25**

(Usual discounts to dealers and set builders)

Remler No. 950 Power Amplifier

The last word in amplification and tone quality, made possible by the combination of the new Remler audios and output transformer. Special terminal block provided for use of either magnetic or dynamic speaker. Uses 250 Power Tube, two 281 Rectifier tubes and glow tube. It is the only power amplifier system on the market which will operate the dynamic speaker as it should be operated. We guarantee deliveries on this item starting September first. Price for all parts..... **$116.50**

Dealers: We ship by mail, anywhere. When we tell you that deliveries are made immediately, we mean just what we say. These new Remler items will definitely be ready for you on September first, at the latest. Send the coupon now, with $50.00. We will ship your merchandise and you can pay the balance C.O.D.

UNITED RADIO SUPPLIES CO.

1062A Howard Street **San Francisco, Cal.**

THIS COUPON SAVES TIME

UNITED RADIO SUPPLIES CO.
1062A Howard St., San Francisco, Calif.

Per your ad in "RADIO" send me at once the following new REMLER items, for which remittance of $50.00 is enclosed, balance to be paid by me C.O.D.

.....

.....

.....

Name.....

Street and No.....

City and State.....

Remler No. 950 Power Amplifiers & "B" Supply

Distributed In Southern California By Radio Supply Co.

The picture shows the professional design of radio's greatest development in amplification and power supply.

Radio Supply Company, the largest distributor of radio parts on the Pacific Coast, can make immediate delivery on the new REMLER "29" 115 K.C. shield grid receiver and on September first will make deliveries on the new Remler 950 Power Amplifier and B Supply. The new Remler 950 Power amplifier is a year ahead of the times. Because of special arrangement of parts the hum is eliminated. The tone quality is perfect. Very easy to assemble. Price for all parts.....$116.50
New Remler "29" 115 K.C. receiver is a radical departure from the commonplace. The entire screen grid amplifier, r.f. and detector units are all in one large copper case—built complete at the factory, wired and balanced. A magnificent job. Price for all parts.....$131.25

Radio Supply Co.

912 So. Broadway, Los Angeles, Cal.

DEALERS—Let us show you what service means. Mail the coupon today. Regular dealer discounts allowed. C.O.D. orders accepted when $50.00 accompanies orders. You pay the balance when shipment reaches you.

Mail Order Service To All Outside Dealers

RADIO SUPPLY CO.,
912 So. Broadway, Los Angeles, Calif.

Here is a deposit of $50.00 (balance C.O.D.) for which send me the following Remler items *immediately*.

.....

.....

.....

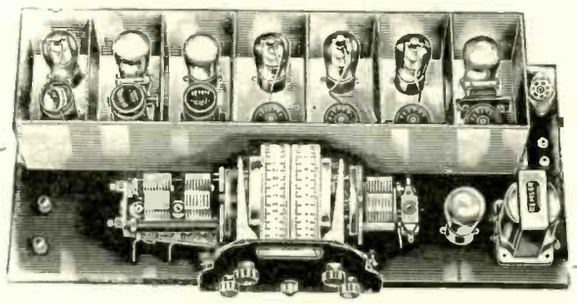
Name.....

Street and No.....

City and State.....

The Sensational Set of the Season

New REMLER "29"



LIST OF PARTS REQUIRED

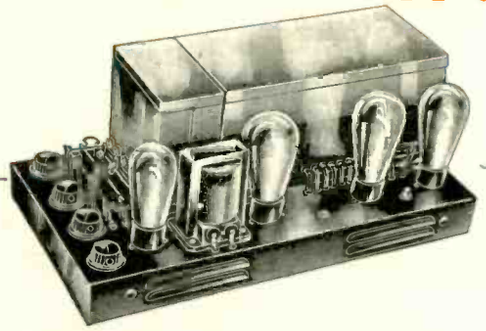
1 Remler No. 712 Shield Grid Selector and Amplifier, including all wiring	$70.00
1 Remler No. 752 Foundation Kit	15.00
1 Remler No. 920 First Stage Transformer	12.00
2 Remler No. 110 Universal Drum Dials	9.00
1 Remler No. 632 Two-in-line Condensers	12.00
1 Remler No. 638 Twin-Rotor Condensers	5.00
1 Frost No. 1895 500,000 Ohm Volume Control	2.00
1 Frost No. 1896 2,000 Ohm Sensitivity Control	2.25
1 Frost No. S1910 10 Ohm Gem Switch Rheostat	1.00
1 Frost No. 780 Cable Plug	2.25
1 Frost No. 782 Cable Plug Socket	.75
Complete Kit List Price	**$131.25**

Complete Parts In Stock--Ready To Ship

AFTER you have read the amazing story of this newest and greatest receiver you will naturally want to build one for your own use. You can easily duplicate the remarkable selectivity, the ease of control, the extreme volume on distant stations and the wonderful tone quality of the original laboratory receiver. No other circuit with such wonderful performance has ever been offered to the public that could be built by the Listener in just a few hours' time. Simple two dial tuning control permits razor edge selectivity. Perfection of tone quality assured with the new Remler Audio Transformers. And just as this new circuit is the logical one for you to build, so also, is the Newark Electric Company the logical place for you to secure your parts. Complete stocks of all parts exactly as recommended—always in stock ready for immediate shipment. Dealers and Set Builders should write at once for schedule of discounts.

REMLER No. 950 POWER AMPLIFIER and "B" Supply

TONE quality has already become the most important feature of radio receiver design. The new Remler power amplifier designed especially for use with the new Remler "29" receiver reproduces the full range of musical frequencies with a vividness and coloring which seems to bring the broadcasting artists into your own home. Many months of engineering research backed by the years of experience in specialized manufacture have brought the new Remler Audio Transformers to a degree of perfection which we feel will make them the first choice of those who truthfully appreciate perfection of tone. The new Amplifier is easily built by anyone in a few hours' time by following the simple blue prints furnished. Complete kits of parts always in stock ready for immediate shipment. Dealers and Set Builders should write immediately for discounts.



LIST OF PARTS REQUIRED

1 Remler Transformer and Choke	$45.00
1 Remler No. 952 Foundation Kit	12.00
1 Remler No. 921 Audio Transformer	12.00
1 Remler No. 923 Output Transformer	20.00
1 Frost No. 300 Resistance Kit	9.00
3 Frost No. 1405, 2 Mfd. Filter Condensers	12.00
2 No. 1104 Frost By-Pass Condensers	2.50
Complete List Price	**$116.50**

NEWARK ELECTRIC CO.

"Nothing but Radio"

226 WEST MADISON STREET
CHICAGO,
ILLINOIS

FROST-RADIO FROST-RADIO

FROST-RADIO

SELECTED FOR THE NEW REMLER "29" SHIELDED GRID RECEIVER

Used in the Remler "29"

Frost-Radio Variable High Resistances No. 1895 and 1896

The selection of these Frost units for the Remler "29" insures 100% stability of operation and perfect control of oscillation and volume. The resistance variation with Frost High Resistances is continuously variable, wonderfully smooth and absolutely accurate. Roller contact arm practically eliminates friction and wear of contact or resistance strip. 2,000 to 10,000 ohms, $2.25. 25,000 to 500,000 ohms, $2.00.

THE season's newest and most remarkable radio receiving set, the Remler "29" Shielded Grid Receiver, came to Frost for several of the most important parts used in its construction. Remler also utilizes Frost-Radio extensively in the famous No. 950 Power Amplifier, to which no introduction is necessary to readers of RADIO. In the Remler "29" the following parts are used:

1 No. 1895 Frost 500,000-ohm Variable High Resistance
1 No.1896 Frost 2,000-ohm Variable High Resistance
1 No. 780 Frost Cable Plug
1 No.782 Frost Cable Plug Socket
1 No. S-1910 Frost 10-ohm Gem Rheostat, with switch

The Frost parts used in the No. 950 Remler Power Amplifier include the following:

1 No. 300 Frost Resistance Kit
3 No. 1405 Frost Filter Condensers
2 No. 1105 Frost By-Pass Condensers

Your dealer can supply you with any or all of these parts, as well as all of the new Frost-Radio parts recently placed at the disposal of set builders.

Frost-Radio 10-ohm Gem Rheostat, with Switch, No. S-1910

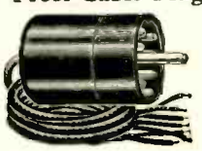
Used in the Remler "29"

This is the famous Frost GOOD little rheostat with the addition of a DC switch rigidly mounted over the contact arm in an ingenious manner. Wiping contact, with positive off position. The Gem Rheostat was designed for continuous service of the hardest kind, and delivers it. Takes up very little space back of panel. Its frame is of metal, and resistance element is accurately wound on die cut flexible Bakelite strip. 3 to 30 ohms, $1.00. Without switch, 75c.

Frost-Radio Gem Variable High Resistances

We put into these Gem Variable High Resistance Units all of the skill and care used in building our famous larger De-Luxe type. Instead of using a 2-inch Bakelite case, ¾ inches deep, as in the larger size, we make the Gem but 1⅝ inches in diameter, and ⅝ inches thick. Thus considerable space back of the panel is saved. A remarkable achievement in a compact, sturdy, exceptionally stable and long-wearing unit. 2,000 to 10,000 ohms, $2.50. 25,000 to 500,000 ohms, $2.25.

Frost Cable Plug No. 780 and Socket No. 782

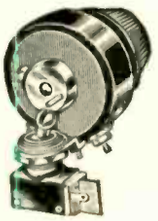


Used in the Remler "29"

Here is a cable plug that will stand the roughest possible treatment. Socket terminals are spun into moulded Bakelite, hence can never work loose no matter how much soldering is necessary. Plug and socket moulded from Bakelite, with color code moulded into material. Best quality cotton braid sheathed rubber covered wires are used in five-foot seven-wire cable.

No. 780 Cable Plug, complete with cable..... $2.25
No. 782 Cable Plug Socket for Sub-Panel mounting, 75c

Frost-Radio Variable Resistance With AC Snap Switch



A new item in the Frost line, and one that will appeal to every AC set builder. The 250-volt 3-amp. approved snap switch is rigidly mounted on case of High Resistance Unit and operates without lost motion, and with no added effort. Switch has widely spaced and thoroughly insulated soldering lugs, and is housed in metal case. 5,000 and 10,000 ohms, $3.00. 25,000 to 500,000 ohms, $2.75.

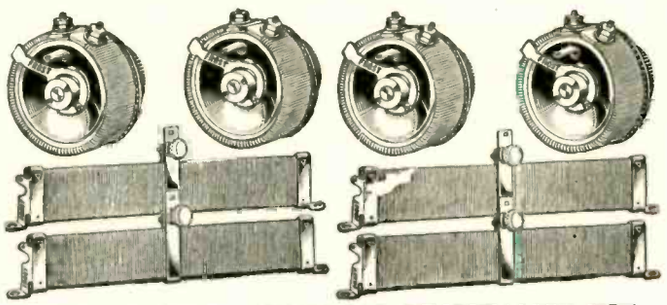
And Also for the REMLER 950 Power Amplifier

Frost-Radio Heavy Duty Filter Condensers

When we designed Frost-Radio Filter Condensers we set out to manufacture the finest condensers ever built—and we succeeded. We use only the very best grade linen paper and the finest foils available. Consequently, the voltage ratings we place on our condensers are conservative. Housed in gold-bronze lacquered metal cases in which the vacuum impregnated condenser is hermetically sealed. For those who want the best, there is nothing finer. .5 to 2 mfds., $1.40 to $7.00.

Frost-Radio By-Pass Condensers

These new Frost-Radio By-Pass Condensers have remarkable durability because of the high grade materials used in their construction. We use only the finest linen paper, and best grades of foils in building them, and we vacuum impregnate the entire condenser before it is hermetically sealed in its metal case. Conservative ratings. Capacities guaranteed accurate. .1 mfd. to 2 mfds. 80c to $2.00.



FROST-RADIO UNIVERSAL RESISTANCE KIT

The Frost-Radio Universal Resistance Kit used in the Remler No. 950 Power Amplifier consists of three fixed resistors of 2,000 ohms each, wound on flexible Bakelite strips, four Frost-Radio 2,000 ohm potentiometers, and one 1,500 ohm fixed resistor. This kit supplies voltages of 0 to 30, 30 to 50, 50 to 70, 90 volts, 135 volts and 180 volts, the latter two voltages being variable between 90 volts and the full power of the amplifier, through the use of sliders on the fixed resistors. Complete, $9.00.

Main Office and Factory ELKHART, IND.

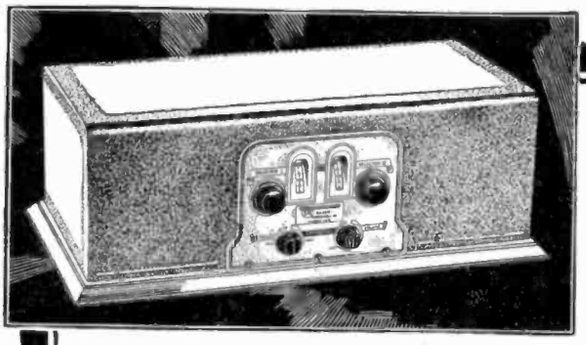
HERBERT H. FROST, Inc.

San Francisco
CHICAGO
New York City

FROST-RADIO FROST-RADIO

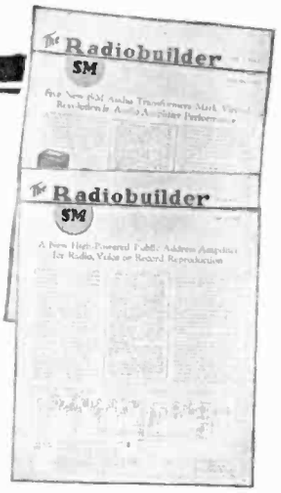
SM

FOREMOST *in* PERFORMANCE

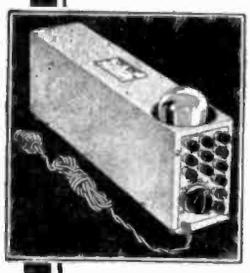


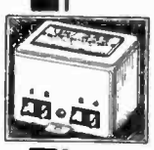
ON this page we present, in conjunction with one of our cooperating distributors, a summary of the most interesting information about kits and parts available to the setbuilder for the 1929 season under the most popular of all kit trade-marks.

Known always as a guarantee of reliability and sure results, the "S-M" mark carries this year an especial message of reduced cost, and of *exceptional eye-value.*



Are you receiving "The Radiobuilder" regularly? Published every month, this little magazine provides you with the earliest information on forthcoming S-M developments and with operating hints and kinks that will help you to get the most out of radio. To S-M Authorized Service Stations, "The Radiobuilder" is mailed each month, free of charge, together with all new Data Sheets and Service Bulletins as they come from press. To all others a nominal charge is made; see coupon.





Power Supplies and Power Amplifiers

FOREMOST among all power devices are the famous S-M Reservoir Power Units and Unipac Power Amplifiers. High undistorted output, and uniform reliable operation are insured by the S-M standards of design and workmanship. All of the models here mentioned use standard tubes (not included in the kit price) and are supplied either in kit form, at prices given, or completely wired at slightly higher prices. Complete information is given in the *big new* S-M catalog.

For sets requiring 180 volts B, type 670B Reservoir Power Unit ($40.50) will deliver up to 60 m.a. of current, with 22, 90, and 135 volts also available, besides 22-90 variable. The 670ABC ($43.00) is similar but supplies also 1½, 2½ and 5 volt A.C. filament current. Type 675ABC ($54.00) gives 450 maximum voltage instead of 180, and has an adapter which allows a 210 or 250 type super-power tube to be used in the last stage of any receiver at all.

Type 676 ($49.00) is a Dynamic Speaker Amplifier; it amplifies output of any receiver through a 250 type tube, as well as supplying power to the speaker field. Adding an S-M 676 to any set having a dynamic speaker requiring 90 to 120 volts D.C. will improve marvelously both tone and volume.

S-M Unipac Power Amplifiers provide power amplification with super-power tubes (210 or 250 type), either single or in push-pull circuit, and all (except the 685) furnish B power also (45, 90, 135 volts) to the receiver. Where A.C. filament power is desired, an S-M 247 or 325 transformer is readily built into the amplifier. The 681-210 (push-pull, $87.00) is the most powerful single-stage amplifier made. The 681-250 at $81.50 uses only one power tube instead of two. Type 682-210 (2-stage push-pull, $102.00) uses a 226 tube in a stage preceding its push-pull super-power stage. Type 682-250 at $96.50 is similar, but with one super-power tube only in the last stage. Type 685 ($125.00) is the popular Public Address Unipac, using three stages for the amplification of microphone, radio, or record pick-ups to cover crowds up to 10,000 people. The 685 is the only such light-socket unit available, and presents a marvelous opportunity.

All S-M Unipacs give to the output not only tremendous volume *when wanted*, but at all times that fidelity in tone quality which is not to be had without super-power tubes. The new S-M catalog gives full information about power amplification, and is sent free on receipt of the coupon below.

Audio Transformers Radically New and Different

ALWAYS foremost in audio amplification, Silver-Marshall brought a surprise to the thousands who have regarded the older S-M audios as the summit of perfection, by introducing an entirely new principle in transformer manufacture—hailed at the 1928 R.M.A. Trade Shoe as the greatest advance in quality of reproduction brought forth in years.

These new S-M audios—the first transformers to give freedom from the hysteretic distortion found in all other types—are available in two sizes. The 225 first-stage and 226 second-stage ($9.00 each) show a curve absolutely without parallel. (See E, below). The 255 first-stage and 256 second-stage (smaller transformers at $6.00 each; see curve D) are still far in advance of any audios hitherto available at eight and ten dollars—such as seen at B, C, and D (actual curves of three well-known high-priced transformers).

Remember it—you can have this finer performance in every set you build!

Silver-Marshall, Inc.
852 W. Jackson Blvd., Chicago, U. S. A.

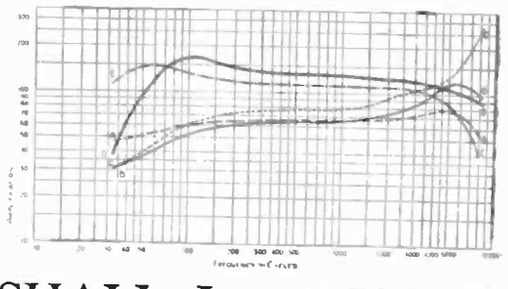
.....Please send me, free of charge, the complete S-M Catalog.
For enclosed.....in stamps, send me the following:
....(50c) Next 12 issues of THE RADIOBUILDER
....($1.00) Next 25 issues of THE RADIOBUILDER

S-M DATA SHEETS as follows, at 2c each:

....No. 1. 670B, 670ABC Reservoir Power Units
....No. 2. 685 Public Address Unipac
....No. 3. 730, 731, 732 "Round-the-World" Short Wave Sets
....No. 4. 223, 225, 226, 255, 256, 251 Audio Transformers
....No. 5. 720 Screen Grid Six Receiver
....No. 6. 740 "Coast-to-Coast" Screen Grid Four
....No. 7. 675ABC Power Supply and 676 Dynamic Speaker Amplifier
....(50c) Sargent-Rayment Instruction Booklet

.....Name
.....Address

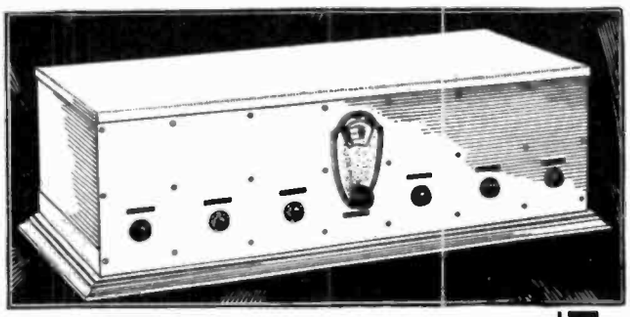
If you don't wish to build, yet want your radio to be custom-made, with all the advantages that this implies, S-M will gladly refer your inquiry to an Authorized Silver-Marshall Service Station near you. If, on the other hand, you build sets professionally, and are interested in learning whether there are valuable Service Station franchises yet open in your territory, please write us.



SILVER-MARSHALL, Inc., 852 W. Jackson Blvd., Chicago, U. S. A.

SM

SUREST SUCCESS *for the* SETBUILDER



IT is with unusual enthusiasm that *Wholesale Radio Service Co., Inc.*, presents such sure-fire winners as the new S-M kits. Setbuilders looking for superior performance will find in them opportunities unequalled.

The 710 Sargent-Rayment Seven

A station tuned in for every ten kilocycles—a hundred stations heard in one summer evening, in the heart of Chicago interference—that is the performance record of the 710 Sargent-Rayment Seven—latest masterpiece of the inventors of the "Infradyne." The 710 is a precision laboratory instrument for the veteran fan. The thick aluminum shielding and chassis, finished in satin silver, give beauty of a strikingly appropriate type. Other features responsible for this unusual performance include five sharply tuned circuits in a four-stage screen grid r.f. amplifier, all tuned by a single illuminated drum, and provided with individual verniers. One knob controls volume from zero to maximum. There are no other controls. Each circuit is individually shielded, bypassed, and isolated from all others. New S-M transformers insure unbeatable tone quality. The set is a joy to build, so workmanlike is its design and layout.

The approved 710 Sargent-Rayment kit, manufactured exclusively by S-M, is priced at $120.00 with cabinet.

The 720 Screen Grid Six

Here is a set which, in appearance alone, is worthy to stand with factory products selling at several times the price. But look further into the Screen Grid Six—examine the four tuned circuits—the new high-selectivity S-M 140 antenna coil—the rigid diecast gang condenser—the screen grid r.f. stages individually shielded in neat copper cans—and finally the marvelous new audio transformers, described on the opposite page. Then you will have some idea of the 720's overwhelming superiority in actual reception.

Try it. See these three screen-grid r.f. stages cut past a powerful local and reach out after a feeble signal a thousand miles away on the next *channel* (only 10 kilocycles difference!) and deliver it with loud speaker volume. And tone quality—well, it takes a vivid imagination indeed to get from the mere amplification curve on the preceding page, remarkable as it is, any idea of the glorious beauty which transformers like these impart to radio music.

So—when we get hold of a set carrying the S-M guarantee, and are able to offer it at a list price of only $72.50 for the complete kit (the 700 cabinet is $9.25 extra)—or the entire set custom-built in this cabinet and tested in the S-M laboratories at $102.00—then we say it's a *bargain*. Order yours now!

The 740 Coast-to-Coast Four

Offers the finest performance yet attained with this remarkable circuit. A screen grid r.f. amplifier stage, regenerative detector, far finer coils than ever before, the new Clough high-gain audio system, and an all-metal assembly make a receiver which cuts through local interference only 10 or 20 kc. away. Unequalled tone quality, and an appearance (in the cabinet) identical with the 720 Six,—yet the price is only $51.00 for the complete approved kit, with the 700 cabinet $9.25 extra. The 740 goes together easily and simply, and will out-demonstrate ready-made sets selling at twice its price.

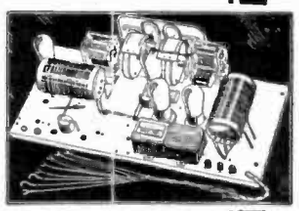
The 730 "Round-the-World"

Have you had your taste of the "thrill band"—the short wave band from 17 to 200 meters? Down there you can hear European broadcasting stations; chain programs through heavy static; *television*—the low-wave band is its busy nursery. You can hear amateurs in almost every country, all in one evening—*if* you have this neat, trim, snappy little receiver—four-tube regenerative (non-radiating)—with one screen grid r.f. stage and two of the S-M high-gain audio stages. Four plug-in coils fit instantly into a 5-prong socket on top of the aluminum cabinet. The complete 730 kit, including cabinet, is $51.00; the 731 (same kit without the two audio stages, at $36.00) converts any set to short-wave reception. The 732 Essential Kit, at only $16.50, contains the condensers, coils, sockets and chokes.

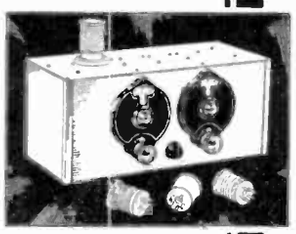
Send for Our Free Dealer Catalog and Discounts!

We are offering, this season as always, America's biggest radio values. Mail the coupon at the right—it will bring you our big new catalog—*FREE*. Maximum discounts to dealers. Immediate shipments from stock.

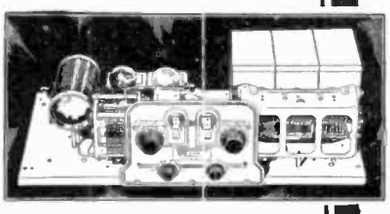
A Station Every 10 Kilocycles: The Sargent-Rayment Six



740 Coast-to-Coast Four: Best Money's Worth in the Fifty-Dollar Class



Five Continents in One Evening: 730 Short-Wave Set



720 Screen Grid Six: The Year's Biggest Value!

WHOLESALE RADIO SERVICE CO., INC.

6 Church Street — New York. N. Y.

Wholesale Radio Service Co., Inc.,
6 Church Street, New York, N. Y.

Please send your new FREE catalog, listing S-M parts and kits as well as all standard brands of merchandise.

Name.....

Address.....

.....

1929's Leading

10 KC!

Selectivity

Ready Aug. 30th

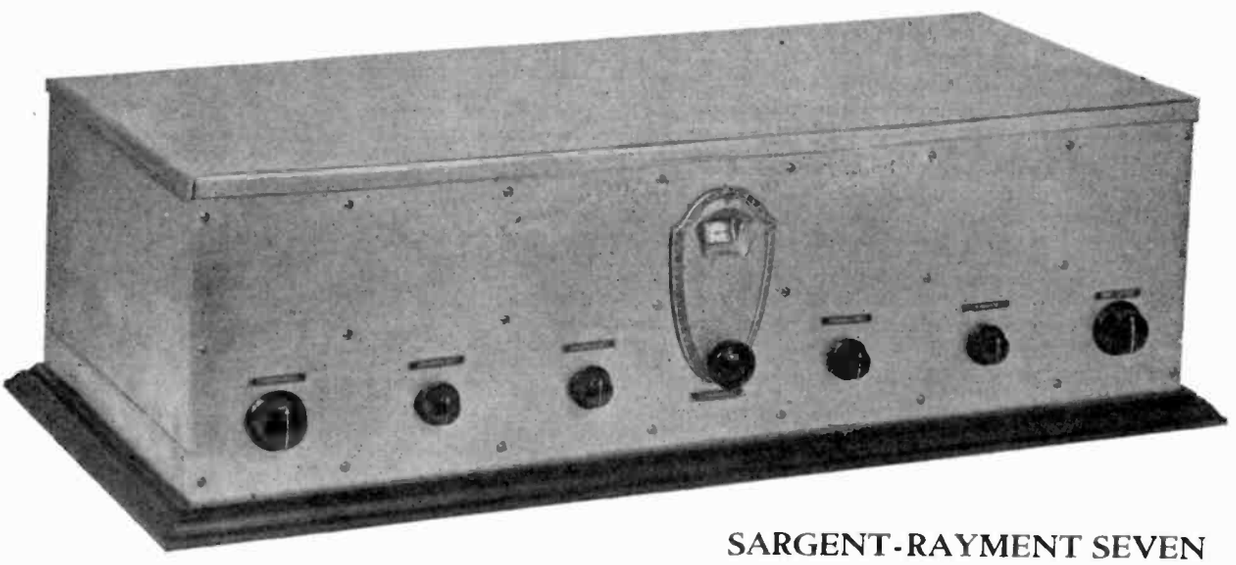
The Sargent-Rayment Seven will be ready for Aug. 30th delivery. Any of the jobbers listed on the opposite page should be able to supply either the built-up set or the kit.

"SELECTIVITY is today the most important requisite of a radio receiver. The present congestion of the ether and the clamor of many prospective broadcasters to get on the air make it imperative that a radio set receive one wave channel—and one only—at a time. This means ten kilocycle selectivity or less.

"In designing the Sargent-Rayment Seven, nothing has been spared to achieve the highest possible degree of selectivity. Not content with the final test in Chicago, the interference centre of the United States, the set was then transported to the West Coast where another complete test was run to make sure that the Sargent-Rayment Seven would operate under all conditions.

"In the Chicago test, West Coast stations were picked up, and in the West Coast test, Chicago stations were heard. This, being done in July, indicates that during the winter months and in a favorable location, reception of stations 2000 to 5000 miles away should be possible. It is reasonable to assume that present distance records will be smashed and some new ones set up before the season is over. The full power of four-screen grid tubes, plus the razor-edge selectivity of the Sargent-Rayment Seven, enable it to outdemonstrate any receiver made, regardless of number of tubes or type of circuit. Why cannot the others do the same thing? Because, the secrets of this circuit are in the design, and they are not being revealed."

(Signed) E. M. SARGENT.



SARGENT-RAYMENT SEVEN

Built by Silver-Marshall Inc.

"CABINET"

The cabinet problem is completely solved in the Sargent-Rayment Seven. The kit, when assembled, forms its own cabinet. The entire outside is finished in grained aluminum, with name plate and panel indicators in black—a distinctive appearance and totally different from the usual run of radio receivers.

For the benefit of those who prefer a darker finish, Radio Constructors Corporation will supply either the kit or the built-up set in a crackle crystalline lacquered finish, the same dark surfacing generally used on metal cabinet radio receivers. An extra retail charge of $10.00 is made for this, and all orders involving it will be delayed in shipment three days to have the special finish put on.

Either the standard or the dark finished kits and sets may be bought through any of our jobbers.

Write for Free Descriptive Booklet

The limited amount of space in this ad does not permit us to go into details about the new features of this circuit. We have therefore prepared a special 16 page descriptive booklet,—"RADIO PAR EXCELLENCE—1929"—which tells about the Sargent-Rayment Seven from start to finish. This booklet, written in plain, understandable language, explains the design of the receiver and shows conclusively just why we are able to make such wide claims for distance, selectivity and tone on the Sargent-Rayment Seven. We would appreciate the opportunity to mail you a copy. Just send in your name and address.

Radio Kit!

Because of Its Selectivity, Tone and Distance Getting Ability

Seven Supreme Features------!

These Features Not Found in Any Other Kit

1. Ten kilocycle selectivity all over the wave band.
2. More power, more amplification, more sensitivity than ever before available in any receiver.
3. All present distance records smashed. Sets a new standard.
4. Efficient all over the wave band. Plenty of power on the long waves.
5. Tone quality unsurpassed. Uses the latest audio transformers. 210 or 250 tube can be used in last stage if desired.
6. Tuning controlled by handsome, illuminated revolving drum. Only one control for master selector. Fine tuning verniers available for use when wanted.
7. Requires no cabinet. Finished in grained aluminum with black and white trimmings, or in brown, crackle crystalline lacquer.

PRICES

FOR THE COMPLETE KIT

The SM-710 Sargent-Rayment Seven Kit is complete in every respect. All parts are inspected at the Silver-Marshall factory for both electrical and mechanical defects and are fully guaranteed by both Silver-Marshall and by Radio Constructors Corporation to be in first-class condition. Everything is carefully packed to withstand shipment. Complete instructions for assembling and wiring the kit are included. These instructions are so explicit and so well illustrated that the novice will have no difficulty in following them.

All hardware, screws, nuts, washers, brackets—everything necessary to build the set—is included. There is nothing additional to be bought. The kit includes even the "cabinet."

Standard Model, Grained Aluminum Finish, Code Word "Mercury"..... $120.00
De Luxe Model, Brown, Crackle Crystalline Finish, Code Word "Venus"... $130.00

FOR THE BUILT-UP SET

The completely built, wired, and tested Sargent-Rayment Seven receiver is carefully packed in a specially cushioned packing case. It exceeds the parcel post size limits and hence must be shipped by express. Full instructions for connecting the set to the power supply and operating it are included.

Standard Model, Code Word "Neptune"..... $150.00
De Luxe Model, Code Word "Jupiter"..... $160.00

DELIVERY

Commencing August 30th, we will be able to make immediate delivery throughout the season on either the kit or the built-up set. Orders will be filled the same day as received. Special attention paid to telegraphic orders.

Exclusive Distributors to the Trade West of the Rockies

Radio Constructors Corporation

357 Twelfth Street Oakland, Calif.

Dealers

These jobbers can supply you with either the kit or built-up set

Washington

Wedel Co., 520 Second Ave., Seattle, Wash.
Harper-Meggee, Inc., South 214 Howard St., Spokane, Wash.
Harper-Meggee, Inc., 4th at Blanchard St., Seattle, Wash.
Inland Radio Co., 922 West First, Spokane, Wash.
Fobes Supply Co., Spokane, Wash.
Love Electric Co., 732 Pacific Ave., Tacoma, Wash.

Oregon

Stubbs Electric Co., 75 6th St., Portland, Ore.
Universal Specialties Co., 40 N. Ninth St., Portland, Ore.

Southern California

Herbert H. Horn Co., 1629 S. Hill St., Los Angeles, Calif.
C. C. Lawton, 1125 Wall St., Los Angeles, Calif.
Pacific Wholesale Radio, Inc., 433 East 12th St., Los Angeles, Calif.
Radio Supply Co., 912 S. Broadway, Los Angeles, Calif.
Radio Mfrs. Supply Co., 1000 S. Broadway, Los Angeles, Calif.
Yale Radio Electric Co., 1111 Wall St., Los Angeles, Calif.
Independent Electrical Co., 928 7th St., San Diego, Calif.
Modern Electric Co., 308 West Center St., Anaheim, Calif.
Sunset Electric Co., 1141 1st St., San Diego, Calif.
Williams and Klentz, 409 5th St., Santa Ana, Calif.

Northern California

Electric Supply Co., 370 11th St., Oakland, Calif.
Frederick H. Thompson Co., 1131 Mission St., San Francisco, Calif.
Gilson Elec. Supply Co., 1106 Madison St., Oakland, Calif.
Kimball-Upson Co., 607 K St., Sacramento, Calif.
Offenbach Electric Co., 1452 Market St., San Francisco, Calif.
Pacific Radio Sales Co., 357 Twelfth St., Oakland, Calif.

Colorado

Vreeland Radio Corp., 1639 Tremont St., Denver, Colo.
Rocky Mountain Radio Corp., 1512 Broadway, Denver, Colo.
Reynolds Radio and Music Co., 1534 Glenarm St., Denver, Colo.

Idaho

Oakley and Sons, 11th and Idaho Sts., Boise, Idaho
Rupert Electric Co., Rupert, Idaho

Nevada

Reno Motor Supply Co., Reno, Nevada

Arizona

Nielsen Radio Supply Co., 311 N. Central Ave., Phoenix, Ariz.

New Mexico

Packard Service Station, 417 West Gold Ave., Albuquerque, N. M.

Utah

Intermountain Electric Co., 43 East 4th South, Salt Lake City, Utah
Radio Hardware Co., Inc., 342 South State St., Salt Lake City, Utah
Lund Radio Co., Fairview, Utah

Montana

Radio Auto Supply Co., 109 4th Ave., Havre, Mont.

Dealers—Set Builders

Get established now in your community as headquarters for the Sargent-Rayment Seven. Fill in the attached coupon and send it to us for full information.

Radio Constructors Corporation,
357 Twelfth Street,
Oakland, Calif.

Please send me at once full details regarding the Sargent-Rayment Seven. I am a dealer or professional set builder and buy my supplies from the jobbers listed below.

Name.....

Address.....

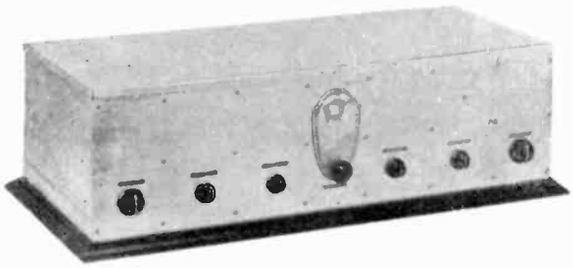
City and State.....

Name of Jobber.....

Name of Jobber.....

$120.00 for the KIT complete with cabinet

Sargent-Rayment Seven *NOW* Ready!



PRACTICALLY EVERY DEALER IN SOUTHERN CALIFORNIA BUYS FROM

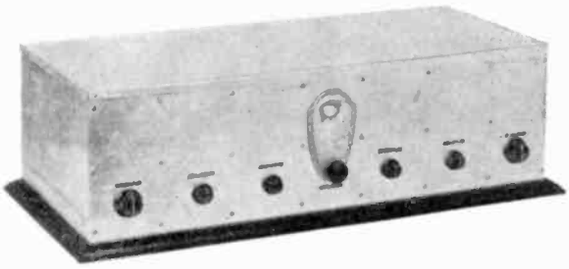
RADIO SUPPLY CO.

because we give *the* service!

The new Sargent-Rayment Seven, built by Silver-Marshall, is one of the outstanding receivers of the season. We carry this popular item, both in kit form and as a completely wired and tested receiver. The kit sells for $120.00, with aluminum cabinet. The completed set sells for $150.00, without accessories. Your orders receive immediate attention. Mail orders solicited from dealers anywhere. The great demand for this new item warrants your immediate order to avoid delay. We also carry all other radio kits in stock and the largest line of parts and accessories on the Coast. Usual dealer prices prevail.

RADIO SUPPLY CO.

912 So. Broadway
LOS ANGELES, CALIFORNIA



The Season's Best Seller

Because of its Spectacular Performance

Get Immediate Delivery from the Pacific Northwest's Jobber—

WEDEL COMPANY

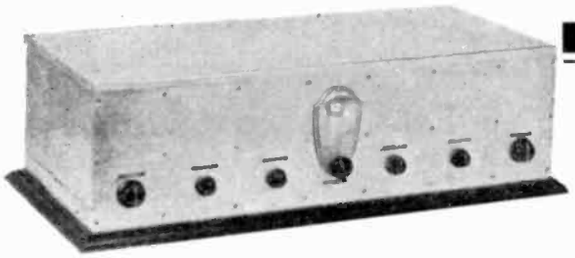
Prompt deliveries of the spectacular SARGENT-RAYMENT SEVEN can be made by us from stock. MAIL ORDER BUSINESS solicited. We serve the Pacific Northwest Territory more promptly and better than any other distributor. C.O.D. orders accepted when $40.00 accompanies order. Balance C.O.D.
The SARGENT-RAYMENT SEVEN kit, complete with beautiful sturdy aluminum cabinet, as illustrated above. All wiring instructions, wire, etc., go with the kit. Now ready for immediate delivery anywhere. 8 hour mail order service on this item.
Price, list..... **$120.00**

THE COMPLETELY WIRED SARGENT-RAYMENT SEVEN, ready to operate. Tested on the air, for selectivity, tone and distance. Guaranteed to perform to your entire satisfaction. A genuine laboratory custom built product, direct from the laboratories of the designer.
Price, without accessories..... **$150.00**

DEALERS: WEDEL COMPANY solicits your business. Out of town orders shipped same day we receive them. Usual dealer discounts prevail. Tubes, speakers and standard accessories in stock.

WEDEL COMPANY

Radio and Electric Jobbers
520 SECOND AVE. SEATTLE, WASH.



Larger Sales than all other Kits combined!

SARGENT-RAYMENT 7

An Instant Success

July quota oversold—orders twice as heavy as anticipated—OFFENBACH has been selling a thousand dollars' worth of these kits a week. The phenomenal buying rush on this new receiver—before it was seen or heard by the dealer—assures its success as the biggest seller of the season. Deliveries now being made.

Offenbach specializes in dealer orders. Our dealer prices give you a fine margin of profit and our service is second to none. A large mail order department is at your service. Write for complete list of parts and accessories handled by us. We represent more than 125 national radio manufacturers as jobbers.

ORDER DIRECT FROM

Radio Dealers Supply Service

Wholesale Division of

OFFENBACH ELECTRIC COMPANY

"The House of a Million Radio Parts"

1452 Market Street San Francisco, California

DEALERS: Send the coupon now for your Sargent-Rayment-Seven kit, or completely wired receiver. Telegraph orders promptly filled. Mail order service to all parts of the world. All tubes and accessories can be purchased from us at regular dealer discounts.

RADIO DEALERS SUPPLY SERVICE
Wholesale Division of
OFFENBACH ELECTRIC COMPANY
1452 Market Street,
San Francisco, Calif.

Send me

V ..... SM-710 Sargent-Rayment Kit, unwired, List $120.00.

V ..... SM-710 Sargent-Rayment Set, completely wired, List $150.00.

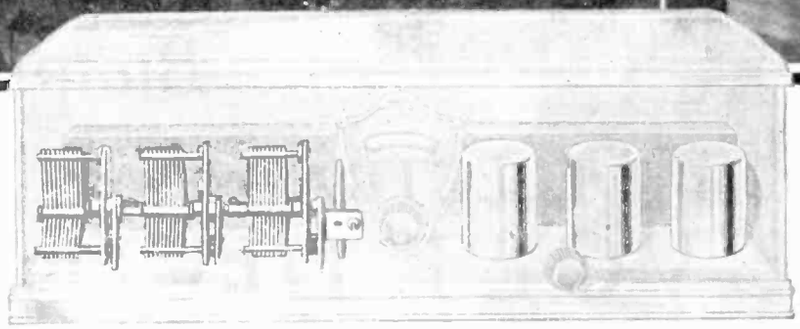
for which I attach a deposit of $40.00, the balance to be paid for C.O.D. upon receipt of shipment.

Name.....

Street and Number.....

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

In the studio of station WEAF, New York, from which some of the most delightful programs are broadcast.



Clearer reception, finer tuning, reduced interference with aluminum equipped receiving sets.

Reception as Fine as the Broadcast

EVERY DAY millions of families throughout the world are listening to delightful broadcast programs with a keener enjoyment because their radio sets are "Aluminum equipped."

Reception is made clearer, tuning made finer, interference reduced to the minimum by designers who have found that this wonderful metal meets the varied needs of radio so admirably.

Aluminum is the ideal radio metal because it combines high electrical conductivity, permanence, beauty and extreme lightness.

Leading radio manufacturers recognize its superiority. So, in many receiving sets you find aluminum shielding, aluminum condenser blades and frames, aluminum foil fixed condensers, chasses, sub-panels and cabinets.

When you see an aluminum equipped set you will know that its manufacturer has done everything he can to bring the true enjoyment of radio to you—to give you reception as fine as the broadcast.

Look for aluminum in the set you buy—if you build a set, by all means, use aluminum. We will be glad to send on request a copy of the booklet, "Aluminum For Radio," which explains in detail the many and varied radio uses to which this modern metal is adapted.

ALUMINUM COMPANY OF AMERICA

ALUMINUM IN EVERY COMMERCIAL FORM

2436 Oliver Building
Pittsburgh, Pa.

Offices in 19 Principal American Cities

ALUMINUM

The mark of Quality in Radio

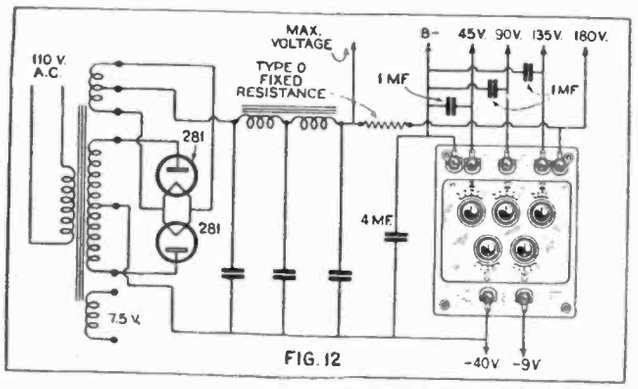


FIG. 12

Takes the Guess Out of Eliminator Building

ELECTRAD TRUVOLT DIVIDER

A Universal Voltage Separator

ELECTRAD'S Newest Radio Achievement! A Complete Truvolt All-Wire Resistance Unit for the Construction of Eliminators. It is so Arranged with Adjustable Contacts That Proper Voltages Can Be Obtained with Any Receiver or Eliminator Combination.

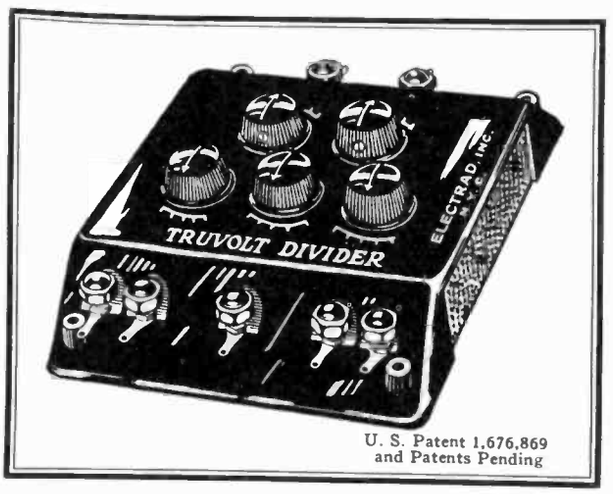
The Truvolt Divider makes the building of an eliminator or power pack extremely simple. Even those who are not versed in the technical side of radio can construct a high grade unit in a fraction of the time required when separate unrelated resistances are used.

By dividing the filter voltage into usable values, it eliminates all necessity of mathematical calculations in constructing a power pack. It does away with a great deal of wiring and the need of voltage regulator tubes. It makes it possible to build a power supply device which is universal in its application.

The Truvolt Divider provides the missing link in power plant construction and any power pack can be built around it. It is designed to take care of any desirable load with a generous factor of safety.

ELECTRAD, INC., Dept. H-A9, 175 Varick Street, New York, N. Y.
Please send me descriptive circulars on the following products and put me on your mailing list for similar literature.
Truvolt Divider Manual (Enclose 10 cents for mailing)
Phasetrols
Tonatrol Volume Controls
Royalty Variable Resistors
General Circular
"Electrad Control Manual" (Enclose 10 cents for mailing)
"What B Eliminator Shall I Build?" (Enclose 10 c.
for mailing)
I am particularly interested in .....
Name .....
Address .....
ELECTRAD, INC., Pacific Coast Office: 905 Mission Street, San Francisco, California

FILL OUT AND MAIL THIS COUPON



U. S. Patent 1,676,869 and Patents Pending

Case made of genuine bakelite, it will add a smart appearance to any unit. Five potentiometer type control knobs show values on a scale of high visibility. Can be mounted on baseboard or sub-panel, or used as the front panel on a metal cabinet, at the same time providing binding posts for all B and C voltages.

PRICE $12.50

Electrad, Inc., Specializes in a Complete Line of Resistance Controls for All Radio Purposes.

They are on Sale at Dealers *Everywhere.*

ELECTRAD Inc

RADIO

VOLUME X SEPTEMBER, 1928 No. 9

Radiotorial Comment

SOME of the catch-penny radio stores are making abortive efforts to sell so-called radio vision receivers. These consist of a resistance-coupled amplifier and a neon lamp to be connected to the detector output of an ordinary radio, and a specially-perforated disk to be driven by a small motor. In the few localities where moving-picture transmitters are yet operated, such equipment may, or may not, dimly show a crude image, little larger than a postage stamp, depending upon the skill and luck of the operator.

This makes an interesting laboratory experiment for a class in high school physics. But as a source of amusement in the home it is a complete flop, unless the family find a joy in the exasperation of the would-be demonstrator. Stores which sell this kind of junk without warning the purchaser as to its limitations might well beware of the Better Business Bureau in their town.

These strictures do not apply to complete transmitting and receiving outfits which are sold for purely experimental purposes, and whose sellers do not attempt to obtain the buyer's money under false pretenses. Nor do they necessarily apply to outfits for receiving still pictures by radio, of which a number will be available before the end of this year. But a lot of energy will be radiated into space before we will see a satisfying radio movie transmitted from a station fifty miles away.

* * *

RADIO is the first of the modern inventions to keep the family at home. Most of the others take the family from the home. That is one reason why the home influence has waned. Radio's combination with the improved phonograph made the home still more attractive. Then came the home movies and soon there will be the home talking-movie, all combined in one instrument for home entertainment.

Arrangements are being perfected whereby photoplays and vaudeville acts may be heard as well as seen in the home. As much of this equipment has been developed from radio principles, its use has a peculiar fascination for the radio fan. In fact one of the best ways to anticipate the eventual radio movie is to become familiar with the methods of recording and reproducing sounds and scenes in the talking movies. Some space will be devoted to these developments in future issues of this magazine, as they are laying the foundation for future radio actualities.

* * *

RADIO experimenters who are using a photo-electric cell for the radio transmission of pictures or other purposes can gain a good idea of its action by thinking of it as a two-element vacuum tube, whose filament emission is caused by light instead of heat. This thought tells the entire story. The emitted electrons are attracted to a plate maintained at a positive potential by a *B* battery, thus causing the flow of a small electric current whose intensity varies with the intensity of the impinging light. This current is amplified with other vacuum tubes in the usual manner.

* * *

AMATEUR call letter prefixes throughout the United States and its possessions become the same as those of the broadcast stations after the first of October. "W" must precede the call letters of stations within the continental limits of the country and "K" of stations in Alaska and the insular possessions. Details regarding this as well as the tentative list of other international prefixes are published elsewhere in these columns.

* * *

WHAT is the "public convenience, interest and necessity" which is named as a prerequisite for the granting of a license to broadcast radio programs? What is the meaning of this shibboleth which is so generally and easily accepted as the basic principle in the law of radio, the principle which so successfully guided the early Radio Conferences in their deliberations?

The Radio Act of 1927 and the 1928 amend-

ment thereto, in which this expression is frequently enunciated, do not define it. Nor is there any definition of it in many state statutes where it is often employed with reference to the regulation of public utilities. Apparently, like Topsy, it "just growed."

Actually it is an outgrowth of the "public be pleased" sentiment which replaced the old "public be damned" policy in business. Big business can no longer successfully ignore the effect of its private dealings on the public welfare. So that now the granting of a franchise for any business which serves the public is predicated upon the benefits to the community served rather than upon possible private profit to the individuals who seek the privilege.

Yet the idea is so relatively new that little provision has been made for its interpretation and enforcement. In radio, for instance, licenses were granted to practically all askers until the broadcast band became so crowded that they began to step on one another's toes. This resulted in poor service to the listeners and a halt was called on indiscriminate licensing. Service to the public became the criterion.

These are the rules of the game which must be interpreted and applied by the Radio Commission. It is up to the Commission to decide what is to the public convenience, interest and necessity.

The Commission, the broadcasters and the public are agreed that there are too many stations on the air. It is undoubtedly to everyone's convenience, interest and necessity that the number of stations be reduced. But it is indeed difficult to decide which stations should be the goats to be sacrificed.

Each station naturally objects to being selected as a goat. It brings great masses of documentary evidence to prove that it has committed no sin which justifies it being sacrificed. It secures thousands of letters and telegrams in praise of its service. Usually this praise is from a local community or from a special group, such as a religious sect or a political following. It ignores the fact that other local communities or special groups, whether a farm, labor or religious bloc, may consider the station neither convenient, interesting, nor necessary.

So the main point at issue, as developed in the many hearings that the Commission has held, seems to revolve about the question as to what constitutes the "public" whose convenience, interest and necessity is to be served. Is it the church people or the sport followers, the farmer or city dweller, the laborer or capitalist, or any other special group? Obviously it is no one of these several differentials. The public to be served is the integration of all of them, or at least of a large majority of them.

This broad and impartial analysis seems to be that followed by the Commission in making its decisions. While special groups may feel aggrieved, they should realize that inasmuch as there is not room for every special group, the smaller special groups must give way to the larger and to the general rather than to the particular interest. The majority should be served.

Nor need any worthwhile minority not be represented. Those stations which are catering to the tastes of the majority are willing to sell time to any minority interest that will put on a program of general interest. Thereby the minority has an opportunity to convert some of the majority to its way of thinking.

This discussion is necessarily abstract, as is any broad statement of general principles intended to apply to all cases. But it is fully in accord with the purpose of the radio law to prevent interference between stations and to recognize that the public interest must be paramount to private profit in broadcast service.

* * *

RADIO is a good and practical answer to the question of what should be done with the greater leisure which the American people have gained as a result of shorter working hours and labor-saving machinery. The lack of culture of which Europeans sometimes accuse us can and is being supplied by radio. And now that Tex Rickard has decided that broadcasting hurts boxing box-office receipts, the stations can find time to broadcast some more cultural form of program.

Radio has already advanced the standard of musical appreciation in America. It can perform the same service as regards art and literature. Many stations are beginning to find a greater public response to programs which combine instruction with entertainment.

* * *

ADVERTISING over the radio has killed the applause card. The listener doesn't give applause when he receives applesauce. Applause is de-cored applesauce anyway.

Flying Radio

By GEORGE T. CONNER

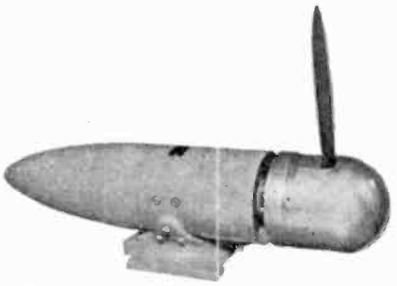
A QUESTION often asked and variously answered is, "Why do not more airplanes carry radio equipment?" Especially was this query manifest during that gloomy period when so many ocean flights were terminating disastrously, when so many venturesome aviators were disappearing without a word to indicate what fate had overtaken them in their daring attempts to prove the superiority of man over time and space. The general public is at a loss to understand why an agency which can so effectively summon aid to the storm-tossed ocean liner cannot with equal facility bring help to a disabled airship.

Why are aviators in general antagonistic toward having their planes equipped with radio? What can be done to reverse their attitude? The average aviator doesn't want radio. He has his hands full, without taking upon himself the additional burden of operating a "wireless station."

Although this condition applies more closely to the *solo* flyer, nevertheless on long trips, such as trans-oceanic hops, it is more than likely that two persons would have enough to do merely keeping the ship aloft and upon her course. In Ruth Elder's vivid account of her unsuccessful attempt to reach Paris in the "American Girl" it is made very clear that handling a plane is anything but child's play. When Captain Haldeman relinquished the controls to her occasionally she could dominate the speeding ship only by exerting every atom of strength and will power she possessed. Nor should we suppose the plane was any more docile when the captain was at the stick. What with manning the controls, keeping a constant watch over the indicators on the instrument board, having one eye on the thermometer, another on the lightning-riven clouds into which they were dashing headlong, feeling out the motor—coaxing it here, humoring it there—always striving with mind and muscle and instinct to avert swift disaster, there was little time left for any sort of sidestepping for either pilot or passenger—a case, we might say, where the passenger certainly earned her passage!

In the event of trouble every moment is precious. The ship must be watched as intently as a new-born babe getting off to a bad start, or an invalid slipping toward a bad end. The craft is a frail thing and small. Whatever steps become necessary for its preservation must be taken without delay, for there is small chance of a long respite after disability during which calls for help may be sent out and answered. So it behooves the pilot to concentrate strictly upon the business of flying, allowing his ears to become attuned to no other signals than the motor's drone and the roar of the wind down the sides of his ship.

From the foregoing it may seem there is nothing to be gained by the lone flyer who would have his plane equipped with radio. Yet, everything depends on how much he demands in return from it. If he is willing to accept one-way signalling for his benefit, or a limited two-way communication, then radio most assuredly deserves a place in the cockpit or cabin.



Wind-Driven Generator for Aircraft Transmitter

The problem of the "air liner," with its comparatively spacious accomodations for an operator *as* an operator, sufficient lifting power so that the weight of radio equipment does not require a sacrifice at some other place, there is no excuse for not having an efficient installation on board. With the smaller planes, however, there is ground for an honorable excuse. Even so, it is deplorable that any ship, whether it carry one or a hundred persons, attempt a flight across trackless wastes of water without this ultra-modern means of contact with land. Is it really of necessity that they do so? Is it because of stubbornness or foolhardiness on the part of aviators? Isn't the reason to be found in the backwardness of radio, perhaps?—its failure to keep pace with the times?

If the *solo* flyer is to carry radio as a part of his equipment it must be well nigh automatic or he cannot use it. Is it possible, then, to build an automatic radio signalling device for the benefit of the "lone eagle"? If so, what should such a set be designed to accomplish? We do not want so much a means of the

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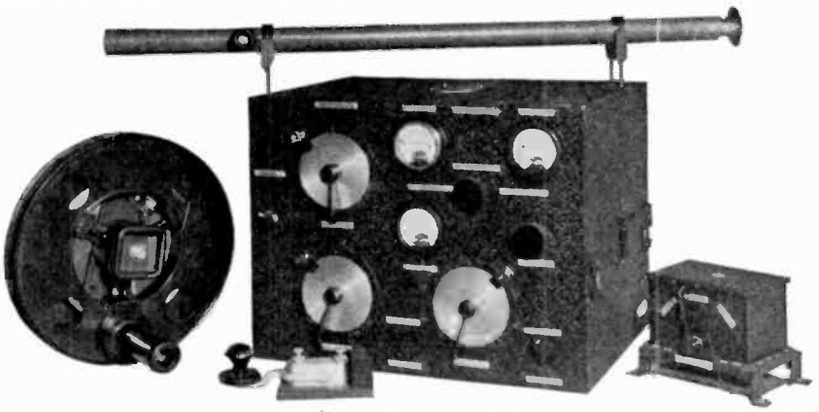
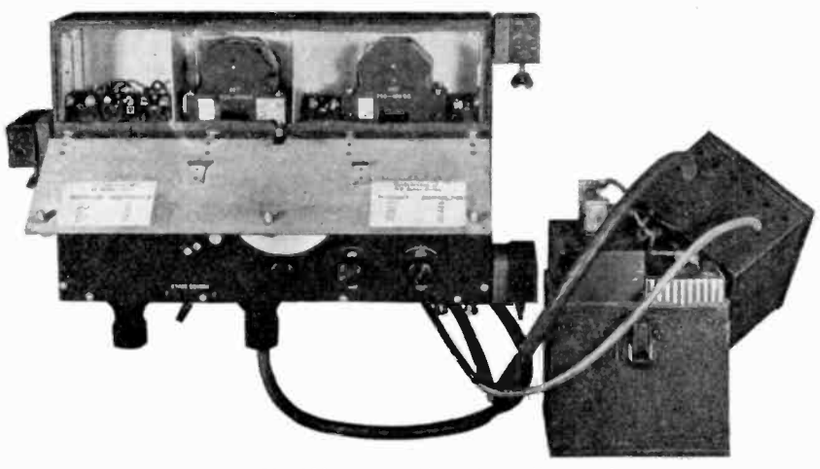


R. C. A. 75-watt Aircraft Transmitter for 45 and 600 Meters. Also Antenna Reel, Key and Send-Receive Switch



R. C. A. 550-850 Meter Aircraft Radio Receiver

An Automatic Field Strength Recorder

By S. R. WINTERS

IS THERE a conflict between the reflected wave, traveling along the upper atmosphere, and the wave skirting the ground, producing well-defined maximum and minimum values of signal intensities with increasing distance? That is to inquire, are daylight radio signals heard with greater clarity at 800 miles than at 500 miles, due to interference between the wave reflected from the sky and the one hugging the earth?

This riddle in radio-wave propagation is the subject of a nation-wide study, enlisting the cooperative efforts of many eminent physicists, including Dr. L. W. Austin of the Bureau of Standards; Dr. Greenleaf W. Pickard of Newton Centre, Mass.; and Prof. C. W. Edwards, head of the department of physics of Duke University, Durham, N. C. The observing instruments will be trained on the long-wave stations of the R. C. of A., chiefly those located at Rocky Point, N. Y., and New Brunswick, N. J.

The results of these observations will be of world-wide significance, since the experiments are prompted by wave-propagation theories that are in disagreement between the different countries. For example, J. Hollingworth, a physicist of England, discovered that the strength of signals received at Aberdeen, Scotland, was three times as great as those intercepted at Manchester, England, although the latter city was several hundred miles nearer the transmitting station than Aberdeen. These daylight experiments, on a wavelength of 14,000 meters, afforded evidence of interference between reflected and ground waves, resulting in increased field strength with increasing distance.

"The measurements which have been made in Washington on the transatlantic stations of the R. C. of A. have not shown any definite periodic change of intensity with distance, at least in the daytime," reports Dr. Austin. These stations, operating on wavelengths between 11,500 and 16,100 meters, are situated at distances of 251 to 660 kilometers from Washington.

"At night," continues Dr. Austin, "there is plenty of evidence of interference between reflected and ground waves, as the signals from the stations at 435 and 660 kilometers have fallen with considerable regularity far below their day values during the summer, while those from the two stations at 281 kilometers have risen slightly at night, or remained fairly constant. The conditions of experiment are, of course, somewhat different from those in England, inasmuch as the signals are measured at one point and the transmitting stations at the various distances transmit on somewhat different wavelengths.

"Nevertheless, since these experiments, some of which have been continued over many years, indicate a regular falling off of intensity with the distance in the daytime, it would seem that they must be held to be in disagreement with the results of J. Hollingworth in England. Therefore, it would seem very desirable to carry out further measurements in other places, some of which might well be on signals over water as over land of different characteristics." These variations in signal strength at varying distances from the transmitting station practically nullify existing radio transmission formulas.

"Since the discovery of the great variability of the signal intensity at different times," points out Dr. Austin, "the general interest in transmission formulas has been much diminished, as it is evident that any formula laying claim to general accuracy would be so complicated that it could hardly be of practical value even if our knowledge of the subject were sufficient to derive it. The most that can be claimed for any formulas thus far suggested is a very rough approximation of the actual results averaged over very long periods. Thus far there has been no attempt to produce a formula applicable to the ultra short waves."

The apparatus employed at the Bureau of Standards for conducting the experiments pertaining to radio-wave phenomena is more intriguing, if not as significant, than the tests. The recorder is automatic, measuring the strength of both radio signals and static. E. B. Judson of the Laboratory for Special Radio Transmission Research, who designed the equipment, describes this unique radio receiving set that tunes itself as follows:

This recording system was designed for the purpose of obtaining some knowledge of the behavior of radio signals and atmospheric disturbances through diurnal periods. With this apparatus it is possible to obtain hourly observations of the field strength of several different stations and atmospheric disturbances throughout 24-hour periods.

The entire apparatus is controlled by a clock which at different five-minute periods during the hour actuates a series of relays, automatically turning on the receiving set and amplifiers and tuning to the desired stations.

The receiving set is the conventional three-circuit type, having a tuning range of from 60 kilocycles (5000 meters) to 12.0 kilocycles (25,000 meters). Two antennæ are used, one having an effective height of 16 meters for reception of trans-Atlantic stations and atmospheric disturbances, while the other has an effective height of 1.5 meters, and is used for nearby American stations. In order to insure a greater constancy of sensitivity, only audio-frequency amplification is used. This consists of two stages of transformer coupling, followed by four stages of resistance-capacity coupling. With this arrangement as long as all the filament currents remain constant and the plate voltages do not

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Automatic Field Strength Recorder at the Bureau of Standards

Improvements in the All-Purpose Tube

By G. M. BEST

DELVING into the history of radio usually makes dry reading, and the reader may find this compilation of historical data in the same category. However, useful information on vacuum tubes is always valuable as a handy reference, and in this particular case, we have found that little is known of the actual improvements which have been made in the mechanical and electrical characteristics of the well-known "A" tube.

In Fig. 1 are shown seven tubes which represent the development of the "A" tube, which, until the advent of a.c. sets, was the most popular tube in use. While some of the changes represent details in the base or glass bulb alone, the picture has been prepared with the idea of enabling anyone to identify any of the tubes he now has in use, particularly as to their approximate age.

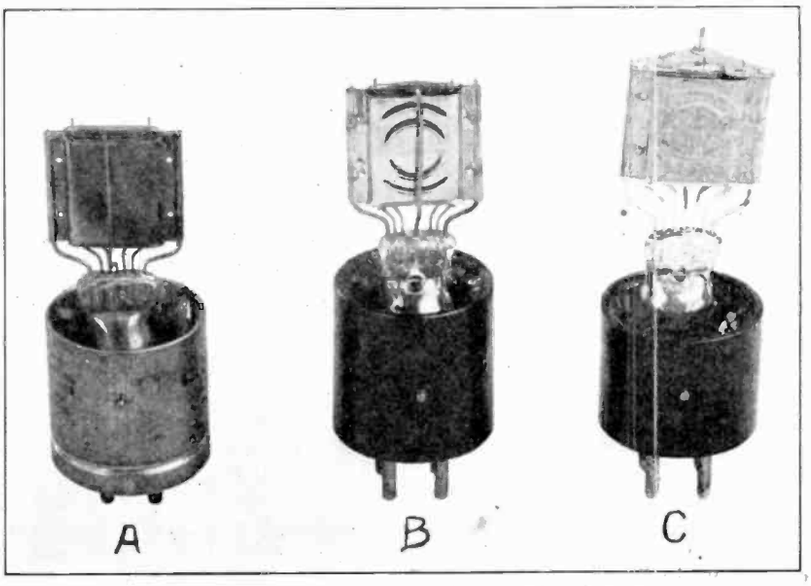

Fig. 2. Changes in Structure of "A" Tube Elements

When broadcasting first became popular, in 1921, the tube then in general use was the type '01, used for all purposes in the sets of that day, except that a special detector of the same mechanical design, with gas filled bulb, was used. The '01 required 1 ampere of filament current at 5 volts, and had about the same characteristics as regards impedance and power output as the present day '99 dry cell tube. If a set had seven or eight tubes, an enormous load was placed on the battery, and even a lowly two-tube set drew as much current as modern eight-tube outfits. The '01 is tube No. 1 in Fig. 1.

In the spring of 1922, this was superseded by the '01-A, tube No. 2 in the picture, having a ¼ ampere filament at 5 volts, a plate impedance of 10,000 ohms, and a mutual conductance of 800 micromhos at 90 volts plate and zero grid voltage. By cutting the filament consumption to one-fourth, a great incentive to multi-tube sets was created, and thereafter five- and six-tube tuned r.f. sets came into general use. The first "A" tube had a tipped bulb, and the interior of the glass was coated with a rainbow-colored deposit, created by the combination of gases within the tube and a compound of phosphorus and magnesium, during the process of manufacture. The base was the so-called "Navy" four-prong standard, of brass, with short prongs for contact with the socket springs.

In 1923, the tube was improved by the use of a tipless bulb, No. 3 in Fig. 1, thus minimizing the possibility of damage due to contact of the tip with other objects. The coating on the interior of the glass was silver in color, as in all present-day tubes, due to the use of magnesium without phosphorus in the "getter" or gas-absorbing material.

In the fall of 1924, electrical, as well as mechanical, improvements were made, and the tube No. 4 in the picture was the result. Besides constructing the base of bakelite instead of brass, the elements of the tube were made more rugged, and the grid and plate structures were moved closer together, and closer to the filament, thereby increasing the mutual conductance of the tube to 1000, and reducing the plate impedance to 8000-8500 ohms. This change, due to the increased mutual conductance, improved the performance of sets using the tube.

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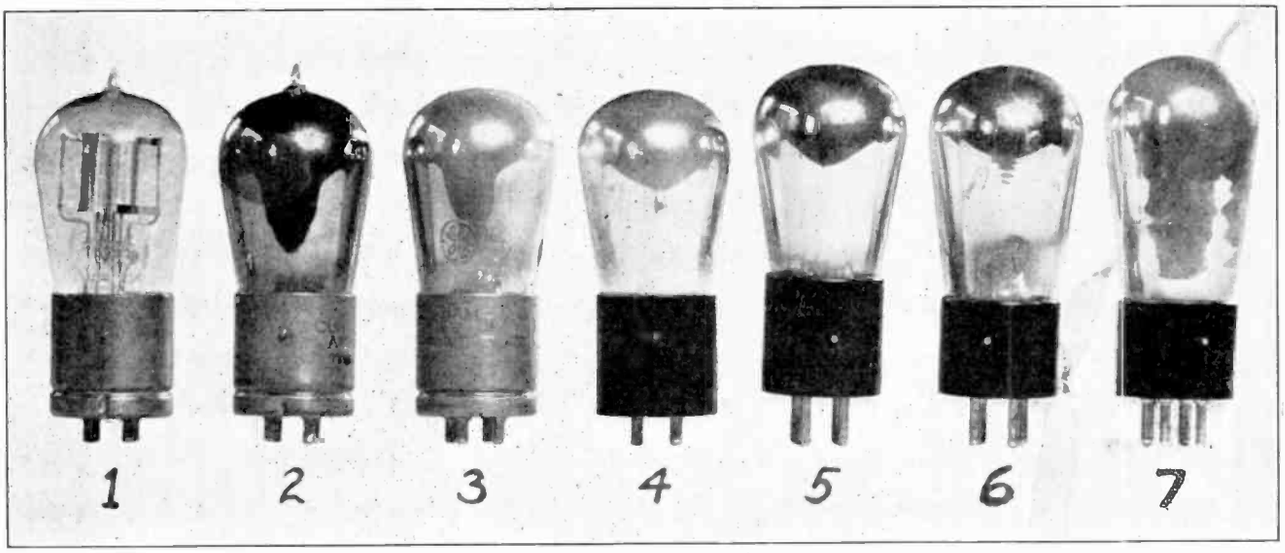


Fig. 1. Progressive Development of the "A" Tube

The Plate Resistor Receiver

Directions for Building a Seven-Tube A. C. Receiver of Unusual Excellence

By FRANCIS CHURCHILL

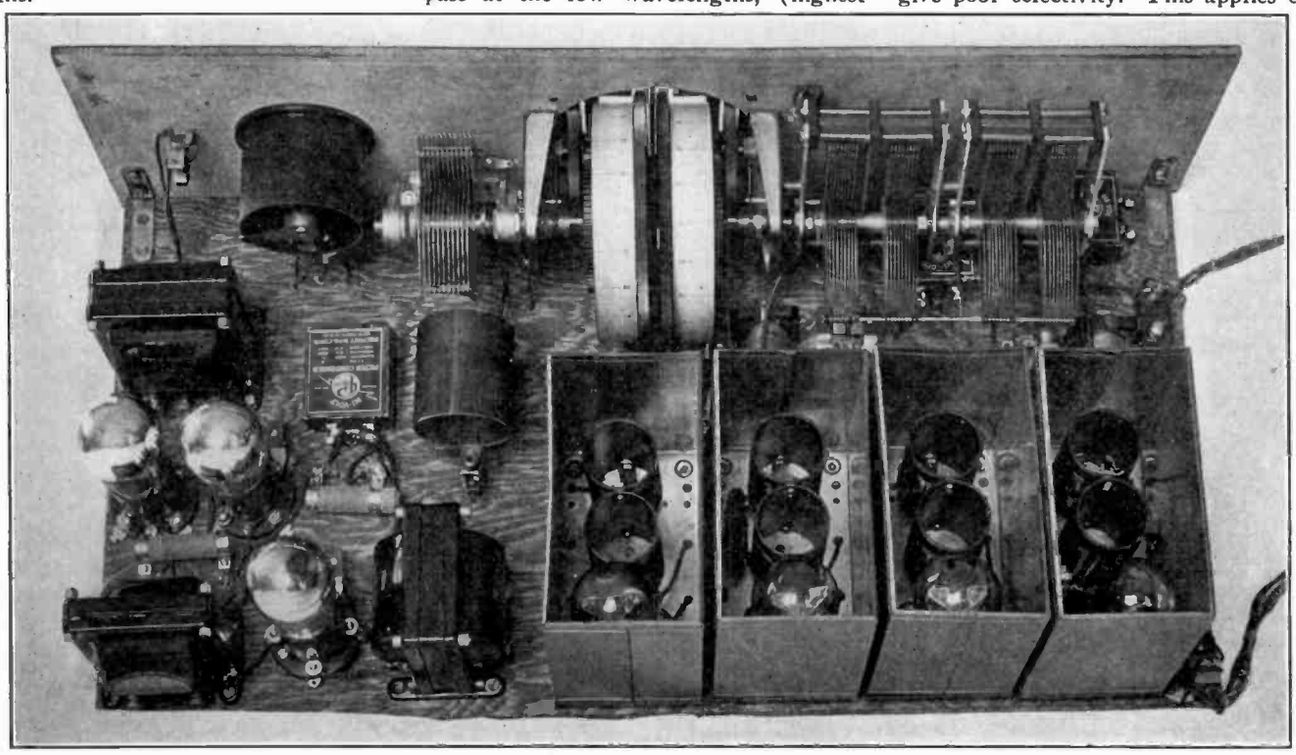
THIS receiver is described because of the rather interesting circuit arrangement of obtaining good sensitivity over the whole broadcast band of from 200 up to 550 meters. The special compensating feature was developed from another circuit, when it was thought possible to apply the idea to r.f. amplifiers. The principle upon which it works is the plate to ground capacitive reactance varying with frequency.

As a general rule, any receiver using one or more stages of radio-frequency amplification in straight transformer coupled circuits is unsatisfactory, because the amplification at the short wavelengths is greater in comparison with that at the upper end, due mostly to regeneration. Another disadvantage is that the selectivity varies greatly over the broadcast band, being very poor at the lower wavelengths. This selectivity of course varies with the volume control adjustment when the latter is ahead of the detector. This means that when the control is set for most local reception, the regenerative effect is not very noticeable and so the selectivity suffers since the resistances of the tuned circuits are greater. This is true because the high frequency resistance of practically all commercial coils or transformer secondaries is several times higher at the short wavelengths than it is at the upper wavelengths.

The circuit, shown in Fig. 1, is not offered as a cure-all for both of the defects of variable amplification and selectivity, but as a step towards bettering this condition. The amplification, with a good r.f. transformer, is nearly constant over the whole tuning range when ordinary d.c. or a.c. tubes are used. The selectivity seems to be more constant also for the reason given later in this discussion.

Referring to Fig. 1, the plate resistances, labeled *R*, are semi-variable from 0 to about 1,000 ohms. On one side of these resistances are the phase changing condensers, if such are necessary, and the r.f. transformer primaries. The phase controlling condensers *C* may not not be necessary with most r.f. transformers and may be replaced with .004 or .006 mfd. by-pass condensers. On the other side of the resistances *R* are the chokes for supply plate voltage, and the plates of the r.f. tubes. The r.f. chokes used have the effect of a small condenser over the broadcast band, the values varying from 4 to 5 micro-microfarads. This capacity is in parallel to the plate to filament capacity of the tube in each case, giving a value of 10 or 12 mmfd. This capacity has a reactance varying with frequency according to the formula $X = \frac{1}{2\pi fC}$, or inversely as the frequency. In other words it is a more efficient by-pass at the low wavelengths, (highest frequencies) than at the upper wavelengths of the broadcast band. The resistances *R* tend to isolate this capacitive reaction from the r.f. transformers, which means that the increased amplification at the lower wavelengths normally present is counteracted by this capacitive reactance. It is simply an electrical scheme to balance the amplification over the broadcast band and so removes the necessity for mechanical equalizers such as variable primary coupling.

It was mentioned previously that the selectivity seemed to be better also. This applies to the case of an amplifier wherein grid resistors are used to stop oscillation. The same reasoning for grid resistors, applies concerning gain characteristics except that the capacitance is between 40 and 100 mmfd. for the grid to filament capacity. This large a capacity, several times that of the plate circuit, tends to by-pass too much of the r.f. energy to filament, as it is of too low an impedance to allow high voltages to build up across the grid to filament. In receivers using grid "suppressors" or resistors, the resistance is generally less than 1000 ohms so as not to entirely isolate this large capacity from the capacity of the tuned circuit. This puts a very inefficient condenser with a differing phase angle across the tuning condenser, and so tends to give poor selectivity. This applies espe-



Top View, showing Shielded R.F. Stages

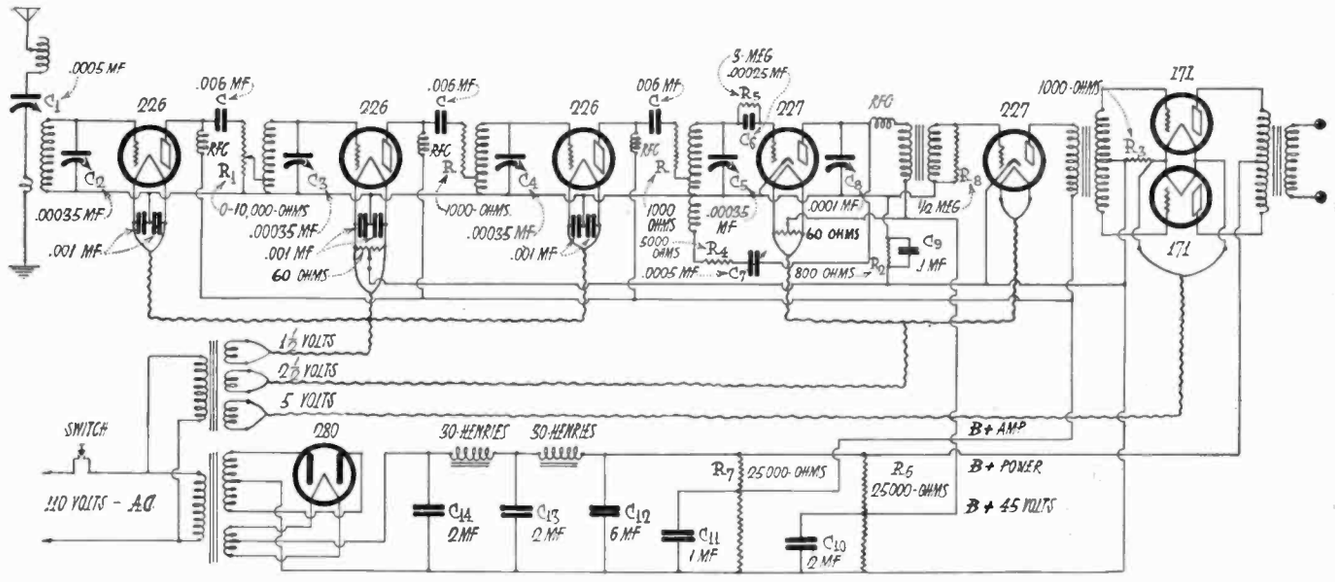


Fig. 1. Circuit of Plate Resistor Receiver

cially to the shorter wavelengths where the value of this poor condenser approaches that of the tuning condenser.

I imagine that there will be several "kick backs" about the above reasoning. Nevertheless it is a fact and the only reason the grid resistor type of r.f. amplifier gets by, is due to regeneration. Regeneration tends to sharpen the tuning; however, when the volume control of the receiver is cut 'way down, there is very little regeneration present. Most volume controls are either filament or plate current control types which reduce the amplification of the r.f. stages. This absence of regeneration makes it difficult to separate one local broadcast station from another, especially on the lower wavelengths.

By using the resistances in the plate circuit instead, the grid to filament capacities are simply in shunt to the tuning condensers and have about the same phase angle, so are purely additive, thereby providing better selectivity, whether there is regeneration present or not.

No special details of this receiver are given, with the exception of the experimental receiver shown in the photograph. Most set builders or experimenters will wish to use parts which they may have on hand. Probably any parts will work satisfactorily or an existing receiver may be modified to incorporate these resistances. For those who are interested in a few details of the experimental receiver shown, the following information will be in order.

The coils are of a double solenoid spaced winding type for use with .00035 mfd. tuning condensers. These coils may be made by winding 130 turns of No. 26 enameled wire on 1½ by 3 in. tubes with each turn spaced slightly. This makes 65 turns for each coil of the double solenoid and the windings should be in such a direction that the top turn of each forms a regular figure eight. The plate tap is taken from the 20th turn on one of the double coils. The detector coil has a tickler feedback coil which consists of 15 turns wound so as to make a continuous winding with the secondary. The first double solenoid has a two turn primary for antenna coupling. The antenna coil itself should have about 150 turns on a 2½ or 2¾ in. diameter for a small antenna. A larger antenna will require a smaller coil and so a tapped coil is a very convenient arrangement. Double solenoid coils were used because of the small external field. This is desirable when using small copper shielding cans such as those shown in the photograph. These cans measure about 3 x 6 x 5½ in. and have the tops and bottoms made to slip on in a manner similar to an ordinary tin-can cover.

The double drum dials are arranged to control the antenna series tuning condenser and the four-gang tuning condensers. The volume control R_1 consists of a 0-10,000 ohm taper-wound wire resistance. The audio amplifier is mounted on the same baseboard but at the opposite end from the detector tube. The audio amplifier consists of a very high quality transformer coupled single stage and push-pull stage. With the particular transformers shown, it was necessary to shunt the secondary of the first transformer with a ½ meg. leak in order to reduce the a.c. hum to an inappreciable amount. This leak does not reduce the signal strength practically any, but it does act as a termination for the transformer and so seems to reduce the "characteristic" a.c. hum when a.c. tubes are used.

The proper values of C bias are obtained by means of semi-variable resistors of the values shown. R_2 should be about 800 ohms for the number of tubes used in this receiver. Since the resistance R_3 is used to provide 40 volts or so bias on the grids of the two 171 power tubes in the push-pull stage, the B power supply unit should be capable of supplying about 40 milliamperes at 220 volts d.c. on the high voltage tap. The 45 and 135-volt taps can be taken off from a single shunt resistor or one from each two resistors; the advantage of using two resistors is that there is less tendency for audio feedback.

The B power pack and filament supply transformer should be mounted on

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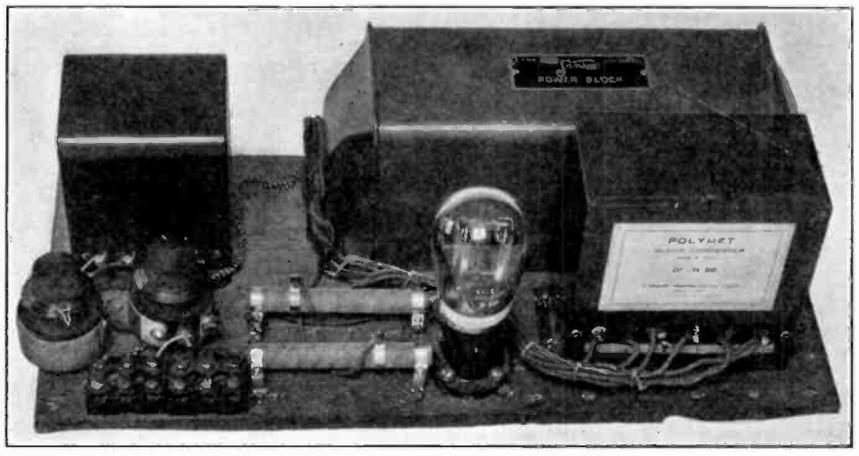


Power Plant Assembly

Rebuilding An Electro-Dynamic Speaker

By WM. BOSTWICK and T. MCLEAN

THOSE who are experimentally inclined will be interested in a description of how an old Magnavox electro-dynamic horn speaker was converted into a cone type unit, thereby rejuvenating an otherwise obsolete unit, and permitting the enjoyment of the latest type of loudspeaker performance at small expense.

The old speaker was of the horn type, with a 6-volt d.c. field, and a moving coil attached to a diaphragm. As the field coil, with its associated shell and core is ideal in the construction of an electro-dynamic cone, this was removed from the old speaker, and the horn and diaphragm assembly discarded. In disassembling the speaker, the spring ring at the throat is removed by taking out the screws, so that the outer cover can be taken off. Next remove the aluminum diaphragm by taking out the circle of retaining screws about its edge, lifting the diaphragm very carefully, straight up. The moving coil will then be seen attached to the diaphragm by a small aluminum spider. Carefully cut the leads from the coil at about ¼ in. from the winding form and free the coil and form from the spider, retaining only the coil for future use. Remove any remaining hardware from the magnet assembly, until the flat top plate, in the center of which is the circular air gap, is exposed. This plate can easily be removed, and the core, around which the field coil is placed, is seen.

In the exact center of the end of this core drill and tap a hole ¼ in. deep, for a 6-32 machine screw, after which the metal plate can be replaced, and no further work will be required on the magnet or its housing. Clean out all metal chips around the air gap, as their presence would cause bad scratching of the coil itself, and impairment of the performance of the speaker.

The construction of the paper cone and its supporting medium is the most difficult part of the job, but should offer no particular trouble if instructions are carefully followed. Fig. 1 shows the completed cone assembly, and can be referred to during the process of manufacture if any points on its construction are not fully understood. A perfect sheet of high-grade drawing paper about a foot square will be required, and it should be laid out in accordance with the dimensions given in Fig. 2, using a compass and ruler to get the dimensions accurately recorded on the paper. Having cut out the cone, including the trimming of the ⅛-in. taps at the apex, the lap should be stuck to the opposite edge of the piece to form the cone, using Dupont's Household Cement for the job. Next place the cone with the base down on a flat surface and bend all the tabs at the apex into a position perpendicular to the cone base. This done, place the moving coil which was removed from the original speaker assembly on the cone so that the tabs are all inside, and so that the coil fits firmly against the shoulder formed by the cone. Cement the tabs against the inside of the coil form, first making sure the coil is true with reference to the cone. Use only enough cement to hold as the inside diameter of the coil form must not be decreased.

Next solder two No. 38 or 40 enamel copper wires to the two leads from the moving coil, and bring them out to the edge of the cone, cementing the wires and joints solidly to the cone at all points. At the edge of the cone connect a pair of heavier flexible wires, which may be run out long enough to reach the output transformer. The leather ring, which can be clearly seen in the pictures, is next fastened to the edge of the cone, completing the cone assembly proper. This ring should be of very thin calfskin, such as is used by pipe organ manufacturers, and the thinner the better, consistent with mechanical strength. It should be cut in three or four sections 3 in. wide, and cemented to the rim of the cone, allowing a ⅛-in. lap all the way around. Where the different sections of cut leather meet, use a plain butt joint, with no lap, if possible.

The paper washer for centering the cone is the last job on the cone, and may be made from the same material as the cone proper. This is cut exactly as

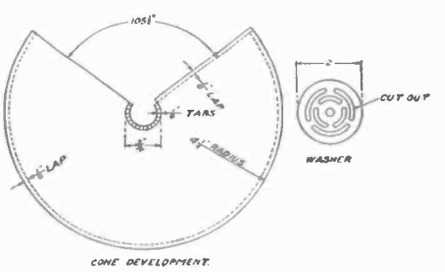


Fig. 2. Layout of Cone and Centering Washer

shown in Fig. 2, using a razor blade or manicure scissors. The washer is cemented solidly to the cone as shown in Fig. 3, taking care that it is parallel to the base of the cone. The exact position of this washer is taken care of by its size, so cut as shown, and place it as far towards the apex of the cone as it will go.

The mounting of the cone may be accomplished in a number of different ways, and in factory built jobs it is usu-

(Continued on Page 57)

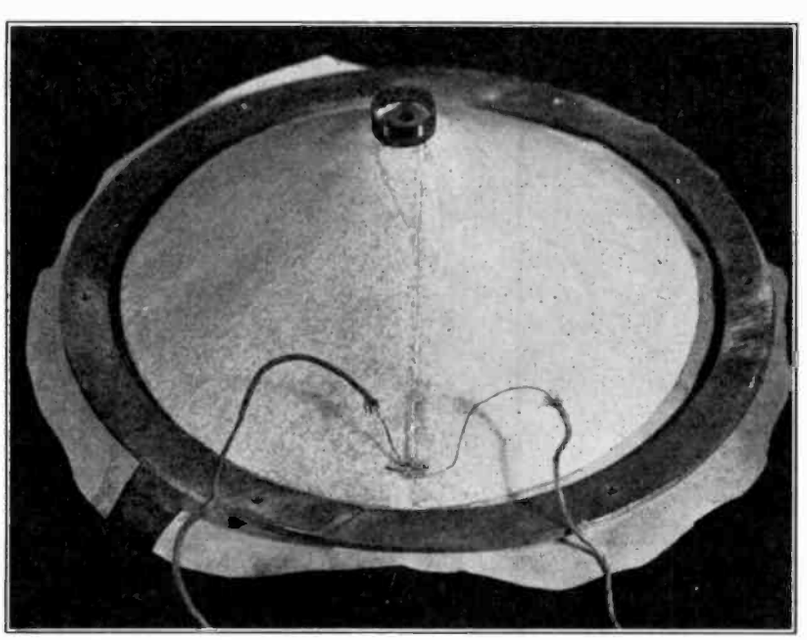


Fig. 1. Cone Assembly, showing Moving Coil with Flexible Leads

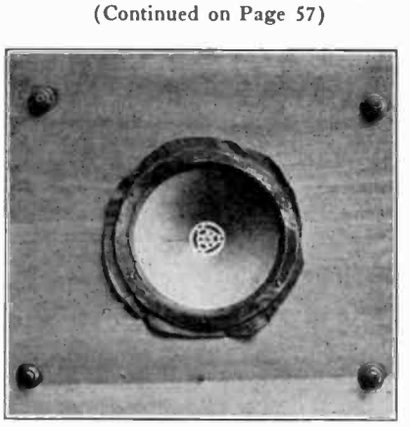


Fig. 3. Cone in Place on Baffle Board

Radio Picture Transmission and Reception

Photoelectric Equipment and Methods for Visual Communication

By JOHN P. ARNOLD, *Departmental Editor*

PICTURE RECEIVING METHODS
II. Latent Images

IN THE first article of this series the common methods of visibly recording a picture transmitted by wire or radio were discussed. Here we consider some photographic methods by which a latent image of the original picture is first received. This involves the subsequent photographic processes of developing and printing before the picture can be seen. The limitations of this latter method have been discussed, especially the fact, as Dr. Ives has pointed out, that the receiving operator cannot, "by using his photographic knowledge and experience, choose the printing media and decide upon the conditions of exposure and development." Although it is possible, by voice communication, for the sending operator to instruct the receiving station in these matters, this not only involves a speech channel between the stations, but does not solve other difficulties that arise when it is not possible to watch the process of recording.

Despite these difficulties, there is no doubt that photographic recording produces pictures of superior quality. We will study two of these methods, one which makes use of a special form of galvanometer and the other a corona discharge acting on sensitive paper.

Berjonneau, Belin and Korn, among other investigators, have recognized the advantage of using some form of galvanometer to control the intensity of a beam of light. Thorne Baker, in the third chapter of his book, "Wireless Pictures and Television," describes the instruments most suitable for picture receiving systems. Among these the most notable are the string type, such as the Einthoven galvanometer, and the moving coil type, as represented by the oscillographs of Blondel and Duddell.

The "light-valve" is a form of galvanometer especially designed for picture receivers. Its operation is based on the familiar principle that a wire, carrying a current in a magnetic field, is displaced at right angles both to the direction of the field and the direction of the electric current. The instrument, shown in Fig. 1, was designed by E. C. Wente and is employed in the Bell system of picture communication. In the drawing, *R* is a flat ribbon carrying the picture signals. This ribbon is deflected to one side or the other of a small aperture in the pole piece of the magnet, *P*, through which passes a beam of light. The complete optical system is shown in Fig. 2.

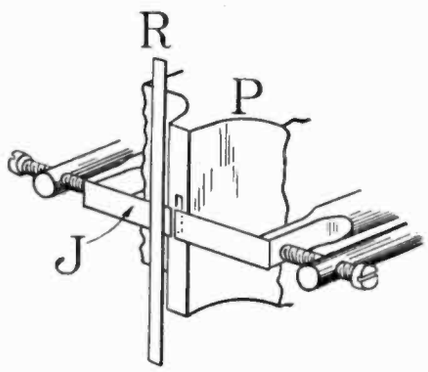


Fig. 1. Details of Light Valve

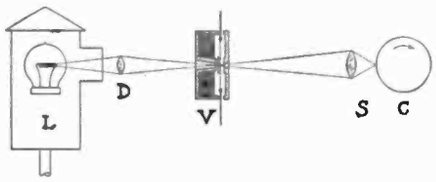


Fig. 2. Optical System Used in Picture Recording

If the field strength of the magnet is constant, the force acting upon the wire will be proportional to the picture signals which, in turn, represent a faithful electrical translation of the light and shade of the original picture. Therefore the movement of the ribbon past the aperture can be made to control the intensity of the light that falls upon a photographic film placed on the receiving cylinder. In the diagram, *V* is the light valve, *C* the receiving cylinder, *L* the light source and *D* and *S* the lens system.

Considering the movement of the ribbon in only one direction past the aperture (as would be the case where the picture signals are represented by varying direct current), it is possible, by changing their relative positions, to have a given signal either close or open the aperture. Thus a positive or negative of the original picture may be recorded on the photographic material. This adjustment also affords a means of controlling the "tone range" of the picture; that is, the ratio of the blackest portions of the picture to the lightest.

When such valves are used for receiving, two radically different types of picture structure may be obtained. These are known as (1) variable width and (2) variable density pictures.

1. This type of picture is obtained when a sharp image of the light valve aperture is formed on the sensitive surface of a photographic film placed on the receiving cylinder. The finished picture is then built up of lines of varying width, but of constant density. This structure, greatly enlarged, is shown in Fig. 3.

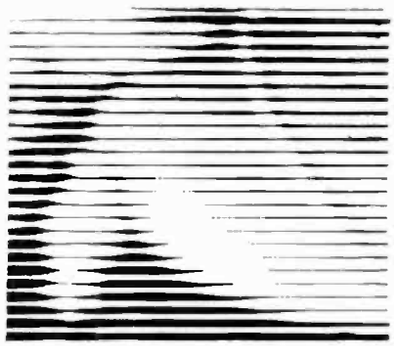


Fig. 3. Structure of Picture Recorded by Variable Width Method

2. Pictures of varying density, but of constant width, are produced when diffused light through an aperture of fixed length falls upon the photographic surface. If a structure of about 100 of these bands per linear inch is secured and the bands are exactly continguous, the completed picture resembles the ordinary photographic print, Fig. 4.

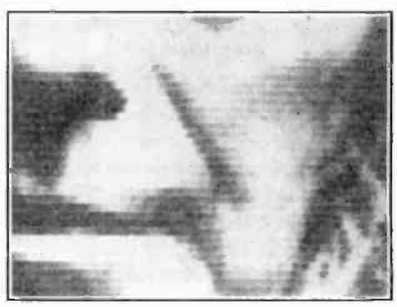
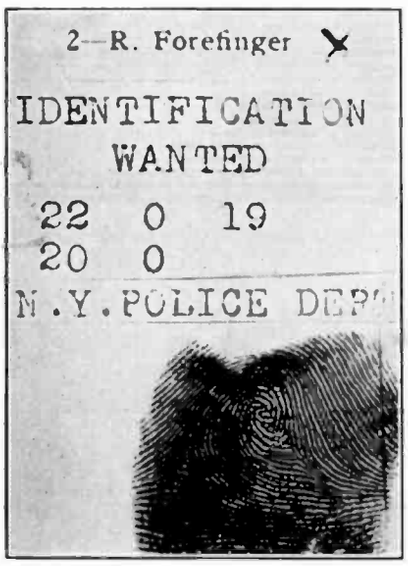


Fig. 4. Example of Variable Density Recording

Of the two methods, at least in the matter of the quality of the results, the variable density pictures are preferable. The variable width pictures are very similar to one type of photo-engraving (the "line cut") used in newspaper illustrations. It is also possible to record the picture with dots, instead of lines, by using a sectored disc between the light source and the photoelectric cell at the transmitter. This would be fairly easy to do in the case of direct current transmission, but is something else again where carrier currents are concerned. However, Dr. Ives, of the Bell Laboratories, recently described a method by which the picture is composed of rectangular dots of various sizes. This is a considerable improvement and much more pleasing to the eye than the variable width picture.

Whether a picture should be received

as a photographic negative or positive is a problem which cannot be discussed at length in this place. It is sufficient to state that, for variable density pictures, a positive transparency is placed on the transmitting cylinder and is received on a photographic negative. For variable width pictures, a positive is employed at the transmitting station and may be recorded as either a positive or negative. As a fact, there are eight possible combinations in sending and receiving pictures with the use of light valves and photographic materials, but the most satisfactory are the methods just described.



Specimen of Commercial Telephotograph Transmission

In the Cooley Rayfoto system, the latent image is recorded on slow photographic paper due to the corona discharge from a needle-point stylus riding over the surface of the paper. The direct action of the discharge eliminates the necessity for a complicated optical system or the use of light valves. Since it is possible to use rather insensitive photographic papers due, probably, to the actinic qualities of the spark (i. e., rich in ultra-violet rays), the recording can be carried on without resorting to dark room illumination. An oscillating circuit feeds into a Tesla coil and the high potentials produce the corona discharge at the point of the stylus, thus affecting the photographic paper. It is understood that the manufacturers of this apparatus also expect to take advantage of the visible printing methods described in the previous article. This will merely require the substitution of a paper which will be discolored by the corona discharge in accordance with the variation of the picture signals.

M. Belin reports that China has taken to picture transmission. It only remains for some demon historian to discover that the Chinese invented phototelegraphy and had progressed toward television about the time Marco Polo left the court of the Great Khan.

STANDARDIZATION OF PICTURE TRANSMITTING EQUIPMENT

IT WOULD seem rather early, one might say to advocate the standardization of picture communication apparatus. The radio manufacturers, it may be argued, found little necessity for conforming to restrictive standards of design or construction until after the industry had been well established; moreover, in the case of "still" pictures, there is yet no intensive production at all. Such facts must be admitted, but considering the immediate future, they do not fit the case. Presently we shall see why.

The present status of the picture communication art must be understood to grasp the fact that the broadcasting of pictures will soon be an actuality. It is well known that the commercial service of transmitting facsimile messages, drawings, and photographs over telephone and telegraph lines, over submarine cables and by radio, has been established for some time. This is purely point-to-point communication for which the users may be paying $16 per lineal inch of picture. Decency suggests that the radio public do not make a party wire of these transmissions; for a lack of secrecy naturally hurts the companies engaged in this work.

Of greater interest to the radio listener is the fact that enterprising broadcasters are beginning to recognize the program value of pictures. Already several Eastern stations have established this as a part of their regular features and it is rumored that in all 150 stations have indicated their intention of installing picture transmitters. One manufacturer has just begun the production of reception apparatus and several other companies are known to be developing systems of their own.

With this indication that the broadcasting of pictures will soon become a fact, we are in a better position to understand the need for standardization. In comparing aural and visual communication, we must note a fundamental difference. In the design of a speech receiver we have little need for taking into account the type of transmitting apparatus or the method of transmission. In the reception of pictures, however, the design of the receiver is largely governed by the transmitting system, of which there are many. The various systems are so radically different that, if a number of them should be developed for radio broadcasting, the possessor of one type of receiver would be in somewhat of the same position as the man who has a radio set which will tune to only one station. Obviously this is not a very satisfactory state of affairs.

In pointing out the necessity for standardization, no attempt has been made to indicate how this may be accomplished; for that would require a thorough understanding of along just what lines the various manufacturers are working. It does seem, however, that some agreement could be reached in regard to synchronism, scanning, the mechanical details of printing apparatus, and the size and structure of the pictures, without stifling individuality in designing the apparatus.

Such concessions or self-imposed restrictions, which are necessary to insure uniformity, should not work any serious hardship upon the individual manufacturer; but, in any case, it can hardly be questioned that the matter of standardization must be considered at this time if the broadcasting of pictures is to become a popular form of entertainment.

PICTURE TRANSMISSIONS

BELOW is given a list of broadcasting stations which are, or have been, transmitting pictures in one form or another. These transmissions are sporadic, especially in the case of television tests. As yet, nothing in this field is very definite.

"Still" Picture Transmission

WOR (422 m.)—Kearny, N. J.
WMCA (370 m.)—New York, N.Y.

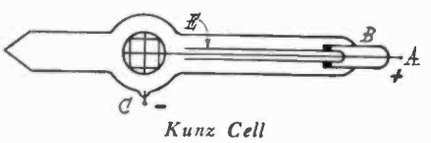
Television Tests

WGY (380 m.)—Schnectady, N. Y.
WRNY (370 m.)—New York, N.Y.
WLEX (40 m.)—Lexington, Mass.
WCFL (484. m.)—Chicago, Ill.

WGY television broadcasts are scheduled for 1:30 to 2:00 p. m. on Tuesday, Thursday and Friday and for 10:15 to 10:30 p. m. on Sunday, on 379.5 and 31.4 meters. The speed of the 24-line scanning disc is 20 revolutions per second.

II. LIGHT SENSITIVE CELLS

Kunz (Phys. Rev. 7, p. 62, 1916; Astrophys. Jour., 45, p. 69, 1917) has designed a cell which is quite free from "dark currents." The central bulb, of glass or quartz, is 3.5 cm. in diameter,



Kunz Cell

on the silvered inner walls of which is deposited an alkali metal making contact with the cathode terminal *C*. The anode is a platinum ring, 2 cm. in diameter, across which are stretched fine wires of platinum or silver. The long quartz sleeve *E* and the platinum "guard ring" *B*, (the latter being grounded) reduce leakage currents to a minimum. Such cells are adaptable for accurate measurements as well as for picture transmission and other general applications.

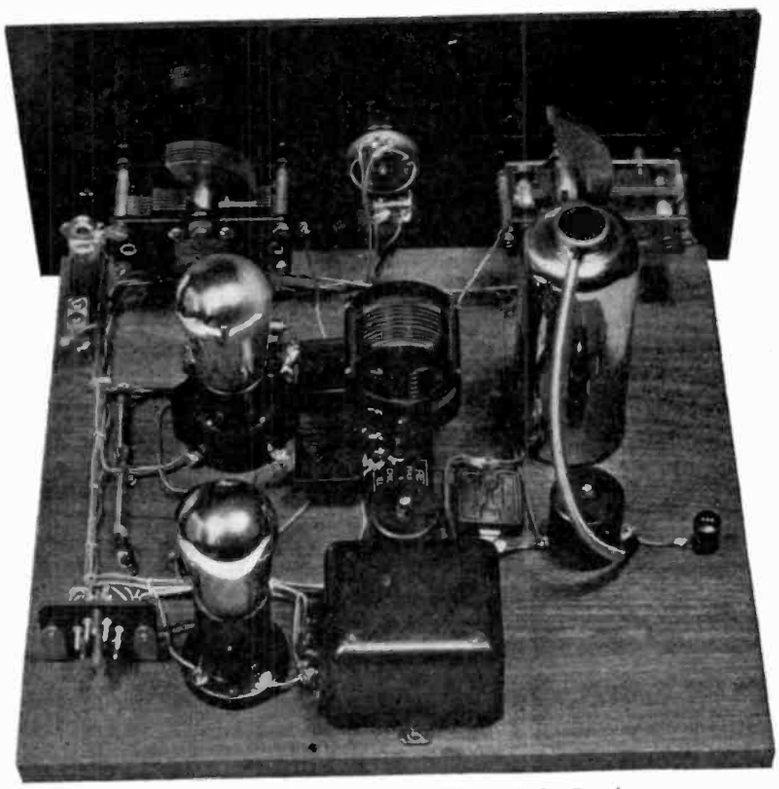
Shield Grid Tube As Short Wave Amplifier

Directions for Building An Efficient Non-Radiating Three-Tube Short Wave Receiver

By G. M. BEST

TO INCREASE the range of short wave receivers is the earnest wish of all amateurs, as the use of the r.f. amplification ahead of the already perfected regenerative detector has not proved to be satisfactory with three element tubes, at frequencies higher than four or five million cycles. Short wave superheterodyne receivers have been very satisfactory in many instances, but are usually complex in construction and operation. Hence, the shield grid tube has afforded a happy solution to the problem, and it is coming rapidly into general use as an amplifier at the short waves.

Several excellent circuits using the shield grid tube as an r.f. amplifier have been developed during the past year, and recently several manufacturers have announced kits for building short wave receivers employing a single stage of shield grid r.f. amplification, with regenerative detector and the usual audio frequency amplifier equipment. But there are other reasons besides increasing the sensitivity of the receiver, for using the shield grid tube, the principal one being to insulate the regenerative detector circuit from the antenna system.



Arrangement of Apparatus in Three Tube Receiver

All regenerative short wave receivers radiate energy into the antenna system when the detector is oscillating, and hence will produce annoying squeals or whistles in neighboring short wave receivers. Up to the present time this has not proved objectionable due to the relatively few short wave sets in use, and these are scattered over a wide area. But as short wave reception becomes more popular, particularly with experimental television in view, single circuit regenerative receivers will become as unpopular as they were on the broadcast band three or four years ago. It is particularly important to prevent radiation from a short wave receiver due to the fact that such radiation is quite likely to travel phenomenal distances, as witnessed by the records made by Col. Foster at Carmel, Calif., with a single '99 tube.

Aside from prevention of radiation, and increase in sensitivity by the use of the shield grid amplifier, we also have the elimination of an annoying effect caused by the antenna on the operation of the regeneration control. When the receiver is tuned to a wavelength corresponding to the fundamental wavelength of the antenna system, or any of its harmonics, sufficient energy is drawn from the tuned circuit by the antenna system to stop the tube from oscillating, so that it is necessary to increase the capacity in the tickler condenser by a considerable amount at any of these points. This is particularly annoying when moving rapidly over a waveband while hunting for stations. By placing a radio frequency amplifier tube between the regenerative circuit and the antenna system, this effect is entirely eliminated.

Most of the shield grid short wave sets so far described in radio publications have used a completely shielded r.f. amplifier, with tuned input circuit as well as tuned plate, and thus requiring two completely shielded units. This also required two sets of plug-in coils for any given waveband, for one unit consisted of the antenna coil, with associated tuning condenser, and the shield grid tube, while the other unit consisted of the regenerative r.f. transformer, r.f. chokes, and the detector tube. If the r.f.

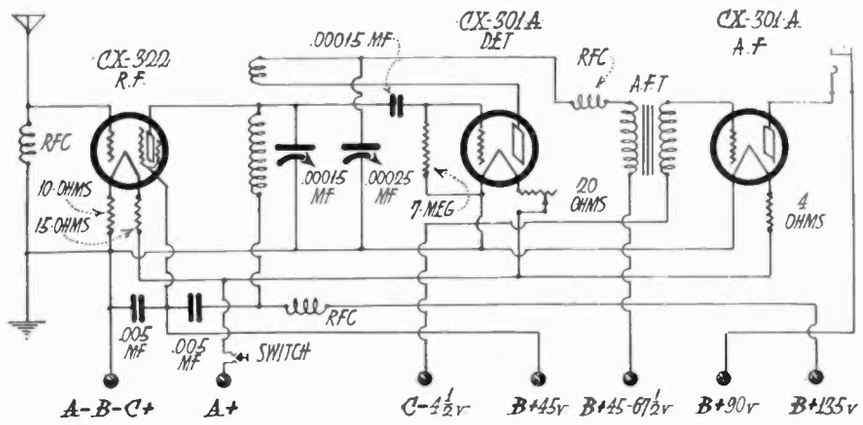


Fig. 1. Three-Tube Short Wave Receiver for Shield Grid Tube

stage is not well shielded, coupling between tuning units will occur, and the set will be unstable, as well as being a bad squealer, as the r.f. stage will surely radiate into the antenna system. Also, unless this shielding is good, the antenna effect noted above will still impair the operation of the feedback control.

Of course with a well shielded tuned r.f. amplifier like that of Don Wallace, which was described in detail in May 1928 RADIO, and with the antenna coupled to the input circuit of the shield grid tube through a small condenser, unusually good results with extreme distance reception are had. But it is not always practical to build a completely shielded set, and many do not like the extra control which is thereby introduced. In Mr. Wallace's receiver, the tuning of the antenna coil is sufficiently broad so that the dial can be set roughly for the waveband which is to be received, and left in that adjustment while the fine tuning is accomplished with the condenser shunted across the plate coil. For anyone who requires maximum selectivity and freedom from interference from nearby short wave transmitters, Mr. Wallace's arrangement is to be highly recommended.

For receiving short wave broadcast stations, television experiments, or transmission of radio pictures, the shield grid tube can still be used to advantage on the short waves without the use of elaborate shielding, by using the circuit shown in Fig. 1. Here the tuned input circuit to the r.f. tube is replaced by an r.f. choke so designed that it has the smallest possible amount of distributed capacity, and thereby makes an excellent aperiodic input circuit for the average outdoor antenna. This choke is used through all the short wavebands, and the only coils which have to be changed when switching bands are the tuned plate and tickler coils, which can be obtained as a plug-in unit ready made. A receiver using this circuit is shown in the picture, which indicates the arrangement of baseboard and panel apparatus.

The two tuning controls, detector filament rheostat, switch and the output jack are mounted on a 7 x 14 in. panel, with a baseboard about a foot square for the rest of the equipment. The plate tuning condenser in the r.f. amplifier circuit is at the right of the panel, looking at the picture, and in back of it is the shielded grid tube and input choke. The tube is enclosed in a copper shield, with special mounting for the socket, the leads being brought out through holes in the baseboard. While this tube shield is not strictly necessary, it keeps the shield grid tube isolated from the rest of the circuit, and prevents instability due to the close proximity of the tuned circuit to the elements of the tube.

The two inductance coils are mounted in a single unit, in the center of the baseboard, with detachable construction so that several coils may be used for different wavebands. The plate feedback condenser associated with the tickler coil is at the left-hand end of the panel. The detector tube is in back of the tickler condenser, with a cushioned socket to prevent trouble from microphonic tube noises.

As shown in the circuit, Fig. 1, there are two other r.f. chokes required, one in the *B* battery return lead to the plate of the r.f. amplifier tube, and one in the plate circuit of the detector. The former is mounted to the right of the coil mounting, and the latter to the left, in the picture of the set. A .005 or .006 mfd. bypass condenser is connected between the *B* battery end of the tuned plate coil and ground, and another condenser of the same size is used to keep the shield grid at ground potential, insofar as high frequencies are concerned.

LIST OF PARTS FOR SHORT WAVE RECEIVER

1 Panel 7x14x3/16 in.
1 Baseboard 12x12x3/4 in.
1 .00015-mfd. variable condenser
1 .00025-mfd. variable condenser
2 Tube sockets
1 Cushioned socket
1 Audio transformer
1 Set of plug-in coils, with mounting (see text)
2 R.F. chokes, 1¼ m.h.
1 R.F. choke-special for antenna circuit
1 .00015-mfd. grid condenser
1 7-meg. grid leak with mtg.
2 .005-mfd. by-pass condensers
1 4-ohm fixed resistance
1 10-ohm fixed resistance
1 15-ohm fixed resistance
1 20-ohm rheostat with switch
1 Output jack
1 Cable plug with terminal
2 Vernier dials
1 Binding post for antenna
1 Copper tube shield, with flexible connector (shield optional).

A grid bias of 1½ volts negative, for the shielded grid tube, is obtained by means of the voltage drop across a 10 ohm fixed resistor placed in the negative filament lead to the tube, and an additional resistance of 15 ohms is placed in the positive filament lead to keep the total voltage across the tube filament at approximately 3.3, when a 6-volt battery is used.

The audio transformer shown in the picture was an old Western Electric coil made for the Signal Corps during the war, and now widely used by amateurs on account of its 9 to 1 turns ratio. It has been a favorite item in army surplus stock sales in recent years, and has no advantages over any other good high ratio audio transformer. If the receiver was to be used for music or speech only, it would be better to use two stages of audio with high quality transformers of lower ratio, but for telegraph purposes principally, for which this particular set was intended, a high ratio transformer with one stage of audio makes a satisfactory combination, and saves one tube.

In wiring the set, the leads were made as short as possible. The filament wires, *B* battery return leads, and everything except the grid and plate wires were cabled together, so as to reduce the potential between wires, at high frequencies, as much as possible by means of the capacity between them. As can be seen in the picture, the connections between the various bypass condensers, grid condenser and leak, and other important high frequency leads were made as short as possible, in some instances the apparatus itself becoming the connecting lead between two other pieces of equipment. Battery connections were brought to the set through a flexible cable and connector plug, but any arrangement suitable to individual needs may be used.

The ground connection can be made at the negative *A* battery, and the antenna is connected to the grid of the shield grid tube, at the point where the flexible grid connector joins the r.f. choke terminal. The control grid connection to the shield grid tube is made at the tip of the bulb, and the *G* terminal of the socket into which the tube is plugged is the shield grid, which is connected to the 45-volt *B* battery.

The tuning coils used in this set were all wound on 2 in. low loss forms, the coil for the 20-meter band having 3 turns of No. 18 enameled or silk covered wire for the tuned plate coil, and the same number of turns of No. 26 silk covered wire for the tickler coil. The tickler coil is placed inside the tuned plate coil, at one end, and is about 1¾ in. in diameter. For the 40-meter band, the tuned plate coil has 8 turns, while the tickler has 4 turns, and for the 80 meter band the tuned plate coil has 19 turns and the tickler 5 turns. By the use of a small diameter form, the field of the coil is limited to a short space, and reduces the interference due to direct induction from local stations.

A negative grid bias of 4½ volts is supplied to the audio amplifier tube, through one of the battery cable leads. This battery is not strictly necessary for code reception, but it permits greater undistorted output, and greatly prolongs the life of the tube, since the plate current is cut in half. A 4-ohm fixed resistance keeps the filament voltage at 5 volts or less, and this tube as well as the shield grid tube have not other filament adjustments, the rheostat controlling only the detector filament.

In tuning this set, the same procedure is followed as that for a receiver having

(Continued on Page 59)

A High Range Vacuum Tube Voltmeter

Constructional Details of a Novel Instrument Having a Range of 0-500 Volts

By HARRY B. LUBCKE

BY UTILIZING the properties of the vacuum tube to the fullest extent it is now possible to build a self-contained, single-tube, single-metered vacuum tube voltmeter with a useful overall range of 0-500 volts. As is the case with the ordinary vacuum tube voltmeter the instrument draws no current from the external circuit and operates equally well on d.c. or a.c. of any frequency.

With the instrument all ordinary laboratory measurements employing a vacuum tube voltmeter can be made and many others in addition because of its extended range. All radio receiver and socket-power voltages can be measured, including the high-plate voltages of the new 210 and 250 type power tubes. All receiver plate currents can also be measured by virtue of 0-1, 0-10, and 0-100 m.a. ranges provided for the indicating meter and brought out to terminals for external use.

A low range of approximately 0-10 volts uses the vacuum tube in the conventional voltmeter hookup, the voltage measured being impressed on the grid and the increase in plate current due to rectification read on the meter. For the intermediate and high ranges, of 0-100 and 0-500 volts, an inverted vacuum tube connection originated by Terman of Stanford University is used. Here the voltage measured is impressed on the plate, a positive potential is placed on the grid, and the change in grid current noted. The change in grid current is a decrease, due to the fact that a negative charge is given the plate from the measuring or external circuit.

The limit of input voltage with the conventional vacuum tube voltmeter is reached when the grid begins to swing positive, for precision work at least, since a current drain from the measuring source cannot be tolerated.

By inverting the vacuum tube, however, i. e., making the plate the control electrode instead of the grid, this limitation is removed. The grid is maintained at a positive potential by a suitable battery and the indicating meter inserted in this circuit. The plate is made negative by the impressed voltage, its potential affecting the grid current but to a much less extent than the grid voltage; by an amount approximately the reciprocal of the amplification factor of the tube.

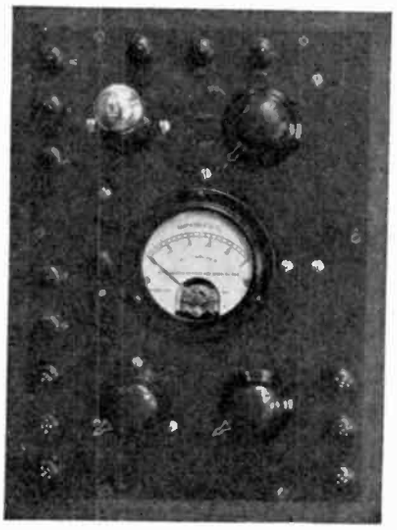


Fig. 2. Panel View

It was found that by varying the resistor in the grid circuit the input voltage range covered by a given tube and meter could be changed from some low value of perhaps 0-50 volts for no grid resistance to practically an infinite value for a very high resistance.

Since the negative charge on the plate tends to decrease the grid current, the IR drop in the grid circuit series resistor is a maximum for zero input, the meter reading some arbitrary maximum value. Increasing the value of input potential decreases this current, consequently decreases the IR drop and increases the absolute grid potential, all of which tends to keep the grid current constant. It is evident that a large value of series resistance makes this variation in grid potential great, nullifying the effect of the plate in a large measure, and thus making the input voltage range corresponding to a given meter scale-length great.

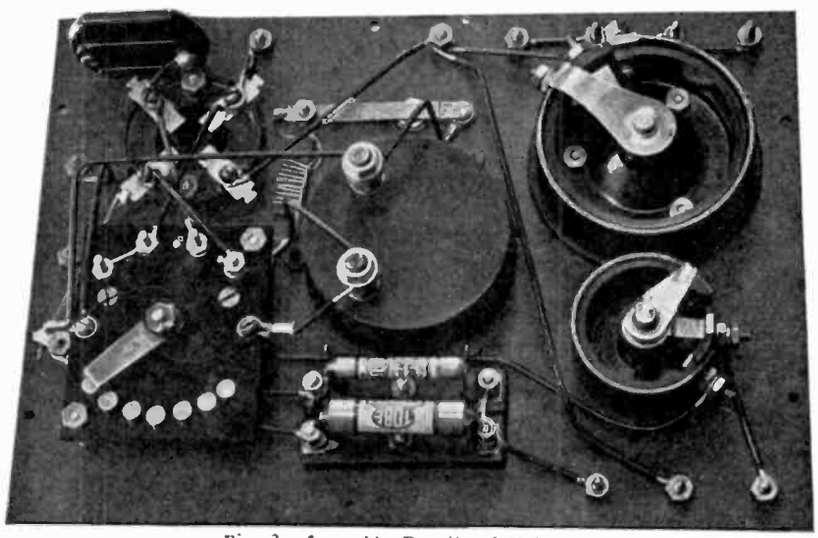


Fig. 3. Assembly Details of Voltmeter

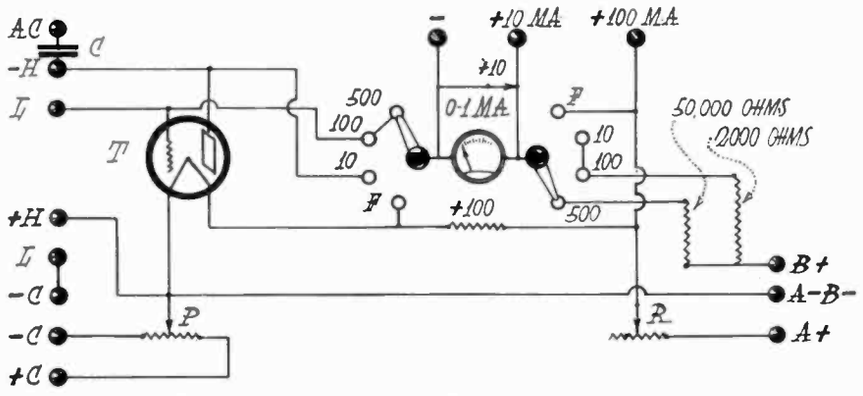


Fig. 1. Circuit Diagram of Vacuum Tube Voltmeter

With the 199 type tube used and the 0-1 m.a. meter a 2000-ohm grid series resistance gave a 0-100-volt range, and a 50-000-ohm resistor a 0-500-volt range. By using values of one or two megohms it will be seen that ranges up to several thousand volts are easily obtainable, the limit being the flashover voltage of the

tube, a factor susceptible to increase through the use of a larger tube.

The diagram of connections of the instrument is shown in Fig. 1. The two switches flanking the milliammeter represent the single range-change switch shown on the panel in the upper right-hand corner of Fig. 2 and in the lower left-hand corner of Fig. 3. The upper position of this switch, "500," connects the 50,000-ohm resistor and meter in series with the grid for the 0-500-volt inverted vacuum tube range; the next

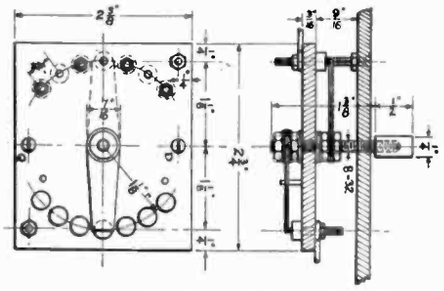


Fig. 4. Construction of Tapped Switch

position, "100," the 2000-ohm resistor for the 0-100-volt range; the third position, "10," the 2000-ohm resistor and meter in series with the *plate* for the normal vacuum tube 0-10-volt range; and the bottom position "F," a 100 m.a. shunt in the filament circuit across the meter for indicating the filament current of the tube.

The switch proper is of double arm rotary construction as shown in the detailed drawing, Fig. 4. Each arm passes over a set of 7 contacts located on the subpanel around which the switch is built, and consists of two spring bronze blades, both bearing on the contacts to give a constant resistance assembly. The lower arm is insulated from the shaft by bakelite or fibre washers and connection made to it by soldering on a flexible "litz" pigtail. Connection is similarly made to the upper arm by soldering to the shaft at its lower extremity, both pigtails being soldered to the external circuit wires and held under 6-32 screws marked *D* and *Q* in Fig. 4. Connections are made to alternate switch-points among the group of seven, giving the four positions required while the intervening ones serve as dead points to prevent short circuits. The subpanel is held to the main panel by two 1 in. 6-32 screws.

The panel drilling details are given in Fig. 5; the placing of the apparatus being evident from the pictures. The socket is mounted beneath the panel, only the top extending above, for sake of neatness. The wiring was done with celatsite insulated bus rather than stranded wire to secure permanence of calibration.

The 0-100 m.a. shunt is soldered between the "+100" external binding post of the meter and the + filament terminal of the socket. Two No. 30 B & S Advance resistance wires in parallel have the proper resistance for the make of meter used. The 10 m.a. shunt is soldered between the spring leaf of its push-button switch shown at the side of the meter, and one terminal wire of the meter. This shunt is permanently across the meter save when the push-button is pressed for taking readings and is a vital protection aid. Approximately 12 in. of the No. 30 wire is required, which is wound on a piece of 1/16 x 3/8 x 1 in. fiber non-inductively; that is, the wire is bent in the middle and wound on double.

The shunts are adjusted to their proper resistance by scraping and changing the length of wire for the 100 and 10 m.a. sizes, respectively. A calibration circuit consisting of a storage *A* battery, a variable resistance of the clarostat variety, an accurate 0-100 m.a. milliammeter as standard, and the instrument

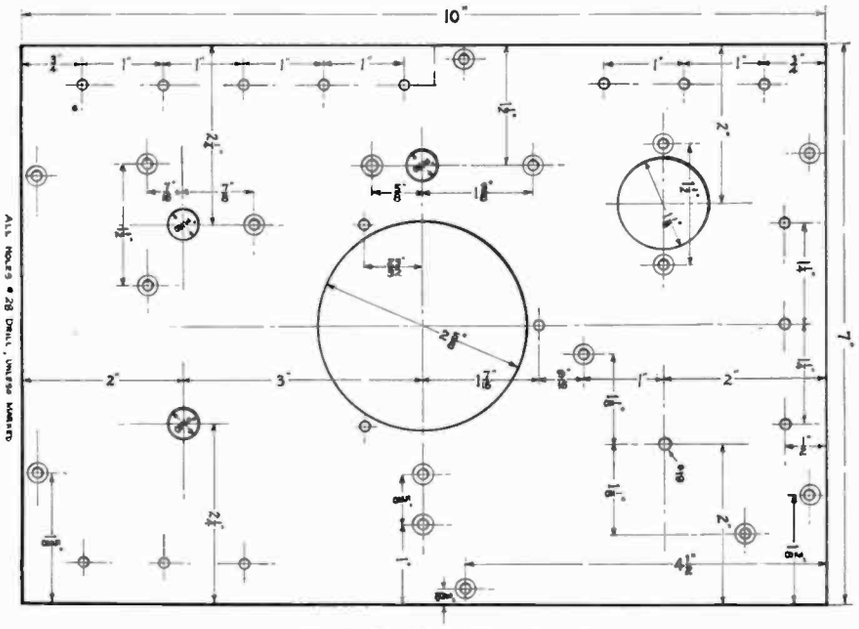


Fig. 5. Panel Drilling Details

meter with shunt, are all connected in series and the shunts adjusted until both meters read the same.

With the ordinary vacuum tube voltmeter connection several calibration curves are possible of attainment by imposing widely different values of *A*, *B* and *C* batteries. However, an optimum calibration range exists for any given tube and meter which utilizes the scale of the meter to the maximum, the tube to cut-off, and maintains the grid always negative. This range has been determined for this instrument and is secured with 60 m.a. filament current, 90-volt *B* battery, and 13½-volt maximum *C* battery.

For this calibration a source of a.c. potential of variable, known magnitude is connected to the "low" input terminals marked L—L, on the instrument and in Fig. 1. This can best be a small step-down transformer with secondary shunted by a potentiometer, and a 0-10-volt a.c. voltmeter connected between one end and the slider, which terminals are also attached to L—L.

Before the power is turned on the filament current is set to 60 m.a., using the instrument meter by turning the switch to "F" and adjusting with the rheostat "R." The 90-volt *B* battery is connected, the range switch placed on "10," and the *C* battery voltage adjusted with the potentiometer "P" until a small current is flowing, say .05 m.a., the first meter division, which value is always taken as the zero reading. Then the power is turned on and the input voltage varied in approximately ½-volt steps, the input voltage and corresponding meter reading being noted and recorded.

The 0-100 and 0-500-volt ranges are calibrated with a variable source of d.c. voltage and suitable high range voltmeter. A block of used *B* batteries or a *B* socket-power device is suitable. The voltmeter need be accurate, but not necessarily of the high resistance type. The + side of the source is connected to the "+H" binding post, the negative to the "—H."

The filament being set at 60 m.a. and the input shorted, the *B* battery voltage is adjusted to give a full scale reading of 1 m.a., which takes about 9 volts for the 0-100-volt range and 50 volts for the

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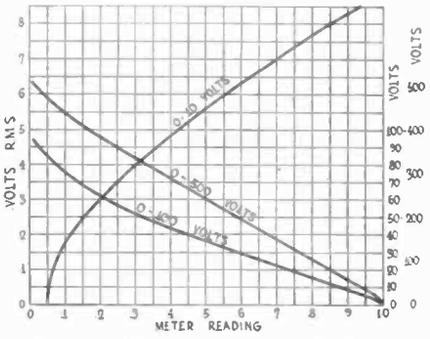

Fig. 6. Calibration Curve of Voltmeter

R. F. Chokes and Methods of Testing

By G. F. LAMPKIN

A COMMON use for radio-frequency chokes is in transmitting sets, where they are used to feed operating voltages to the plate, or grid, of the tube oscillator. In such a case the d.c. battery, generator, or rectifier-filter, is usually in parallel with all or part of the r.f. circuit, and to prevent shorting the radio currents a choke in the d.c. branch is necessary. There are particular advantages that are gained by using the shunt method of feeding voltages to the tube. The r.f. and d.c. circuits are thereby made independent; the tuning condenser and inductance are not hot with dangerously high-plate voltage; the d.c. supply may be picked up from any convenient point, such as biasing resistor, voltage divider, etc., independently of the r.f. return path.

This latter point is of particular interest in r.f. amplifiers. Just as in audio amplification speaker filters are used to separate a.c. and d.c. components, so in radio amplification filters may be used and advantages of the same sort realized. The r.f. plate currents from two or more amplifiers find a common path in the plate supply unit, and if this common path has appreciable impedance, undesirable couplings that may give rise to instability are had. The r.f. chokes can be used to return each r.f. current directly to its respective filament, and the d.c. alone will flow through the common impedance. With the shield-grid amplifier more or less juggling has to be done to keep the direct and alternating currents in their proper places.

The three principal functions of r.f. chokes might be stated in a negative way: For an oscillator, connecting the choke across the r.f. circuit must not decrease the strength of oscillations; in the r.f. amplifier, connecting the choke for shunt feed must not cause a loss in output voltage; and in filtering, the choke must let little or no r.f. current flow through it. The first two statements are more or less equivalent—the one case is for a self-excited, and the other for a separately excited oscillator. All three statements give the requirements of a choke in terms of effect, rather than cause. As the optimum choke is best determined by experiment, the basis of choke comparison should be in terms of effect rather than in terms of cause—causes such as impedance value, positive or negative reactance, r.f. resistance, natural period, and so on. Obviously desirable qualities for a choke, also, are that it be physically compact, and that it be effective over a wide wave range.

A choke might be measured for r.f. leakage by a circuit such as that in Fig.

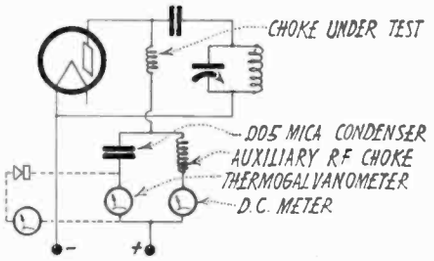

Fig. 1. Circuit for Testing R. F. Chokes

1. The choke is connected in its normal position in an oscillator, and the d.c. and r.f. components through it are separated by another choke and a condenser. A .005-mfd. or larger mica condenser prevents d.c. from flowing in the a.c. branch and registering on the thermogalvanometer. The condenser reactance is around 32 ohms at 1,000 KC., so that the auxiliary choke need be only of indifferent construction to shunt the greatest portion of the r.f. into the condenser and thermogalvanometer. The d.c. meter, if desired, measures the d.c. through the circuit. The thing that must be watched is that the capacity and inductance of the filter elements are not such as to resonate at or near the working wave. If so, a circulating current would be built up around them and the reading of the thermogalvanometer would be no measure of the r.f. leakage through the choke under test. As a rule the leakage will be too small to read accurately on the ordinary 100-milliampere thermogalvanometer, except in the case of the relatively high-power transmitters. It is possible to get relative readings at small powers, however, by using a fixed crystal detector and low-range milliammeter in the dotted circuit of the diagram for indicating the leakage current.

The statement that a choke should not decrease the strength of oscillations, nor cause a loss in output voltage, gives a clue to a very good method of testing r.f. chokes. The various chokes which it is desired to test may be put in an oscillating circuit, and the resulting strengths of output for each determined. This method was followed when it was desired to find a more compact choke than a single layer of No. 32 enamelled wire wound on a 1x5 in. cardboard tube, which had been in use in the units of a crystal-controlled transmitter. The transmitter was capable of operation anywhere from 50 to 100 meters, and it used the second harmonic of the crystal, so that the total wave range over which a choke was desired to operate was 50 to 200 meters.

That versatile instrument, a grid-meter driver, was at hand, made up in

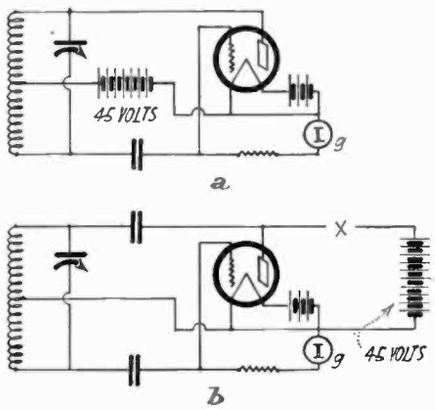

Fig. 2 (a). Series Feed Hartley for Comparison Test
(b). Shunt Feed Hartley for R. F. Choke Test

the Hartley circuit of Fig. 2a. A General Radio 1000-mmf. variable condenser, a plug-in coil of ten turns of No. 14 DCC 3-in. in diameter, a CX-

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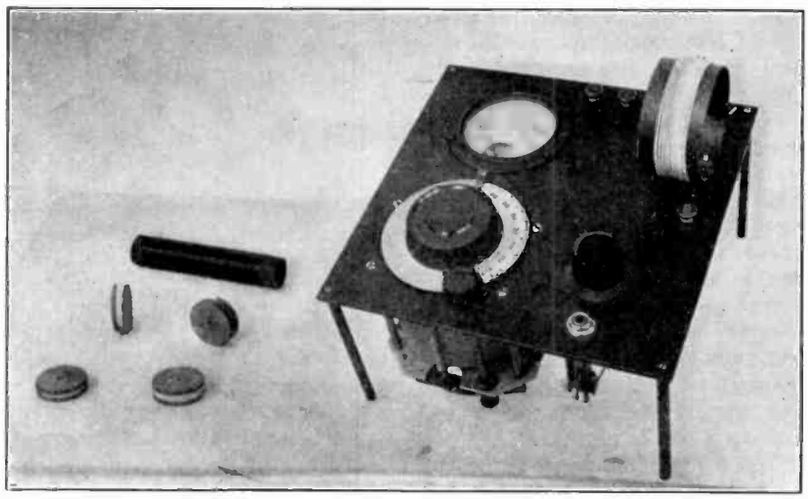


Circuit Driver with Test Chokes

TECHNICAL BRIEFS

This department replaces the former Queries and Replies page, and in addition to containing answers to questions of general interest, a considerable amount of technical and semi-technical information will be included each month. New radio developments, useful data on radio theory and practice, and on subjects allied to radio will appear in each issue. Where personal answer to questions is required, a fee of 25 cents per question or diagram should be sent. Special diagrams, requiring an unusual amount of time to prepare will carry an extra charge, and the correspondents will be notified of the amount of this charge before answer is made.

SEVERAL queries have been received in regard to the circuits or nature of the amplifying equipment and loudspeakers used in Movietone and Vitaphone talking movie installations. While detailed information on these systems is not yet available, a brief description of the equipment used is herewith published for those who are interested, and undoubtedly these data will be of interest to experimenters, especially those working with power amplifiers.

The Vitaphone and Movietone systems differ principally in the manner of making a permanent record of the sounds associated with the episodes which are to be filmed. The Vitaphone places these sounds on a phonograph record disc almost identical in character with those sold for general use, except that their diameter is often larger, due to longer periods of continuous recording, frequently exceeding ten minutes time. The Movietone photographs the sounds on a small strip of the film used for taking the pictures, so that the picture appears on the screen as a square rather than a rectangle, due to the voice strip taking up a small amount of the available space ordinarily occupied by the picture. The audio frequency amplifiers, at the projection end, in the theatres are the same for either type of installation, except in the manner of converting the sound into electrical impulses. The relative space occupied by the picture and sound record is clearly seen in Fig. 1.

In the Vitaphone an electro-magnetic reproducer converts the mechanical vibrations of the phonograph needle into electrical impulses, the same as in the Electrola or the Panatrope, and a five-stage audio frequency amplifier magnifies these impulses to an amount sufficient to operate from four to six loud speakers, which are placed on the stage in back of or to one side of the screen. The amplifier consists of three stages of resistance coupling, in one unit, with a non-microphonic type of tube, followed by a push-pull fourth stage using transformer coupling, and a push-pull fifth stage power amplifier. The fourth stage uses tubes of the Western Electric 205-D type, having a power output of approximately 1½ watts per tube, and the fifth stage uses Western Electric 211-D tubes, commonly known as the 50-watt size,

Fig. 1. Section of Movietone Film

but actually delivering about 7 watts of undistorted power at audio frequencies per tube. To supply power to the last two stages individual rectifier systems are employed. The push-pull fourth stage is supplied by a full wave rectifier using two of the same type tubes as are used in the associated amplifier, and the fifth stage is also supplied by a full wave rectifier using two 50-watt tubes, with the grids and plate connected in parallel. Neither of these rectifiers are used to supply any of the other stages, the first three resistance coupled tubes receiving their plate supply from dry cell batteries.

The filaments of the tubes in the last two stages are operated from raw a.c. through a step-down transformer, while those of the preliminary stages are connected in series and operated from a storage battery. The input equipment of the Vitaphone consists of a phonograph turntable and synchronizing equipment for starting the record at the same instant that the beginning of the motion picture film is projected on the screen, together with the electro-magnetic pick-up. The spiral groove on the record starts at the center of the disc and works out to the edge, the opposite from the system used for standard disc records for public use. This is supposed to produce less wear on the groove, and to prevent jumping of the needle. The record travels at half the speed of ordinary disc records. The output of the electric pickup is connected to the five-stage amplifier, and the amplified output supplies the horns back of the screen.

In the Movietone system the sound waves are photographed in the form of parallel black lines on the film, and to reproduce these lines the film is passed in front of a narrow aperture in the form of a slit in a metal plate, a powerful, concentrated filament mazda lamp providing the illumination at the aperture. The optical system is shown in Fig. 2. The variation in the intensity of the light caused by the passage of the photographed record of the sound on the film across the aperture, causes a variation in the intensity of the beam of light which is projected on a photoelectric cell. These light variations in turn produce fluctuating currents in the output of the photoelectric cell, and are magnified by the five-stage amplifier so as to operate the loud speakers. Due to the fact that the motion picture film, while being projected on the screen, is pulled across the picture aperture intermittently at the rate of 16 times a second, the sound waves are recorded slightly out of step with the corresponding pictures, so that at the instant the picture is being pro-

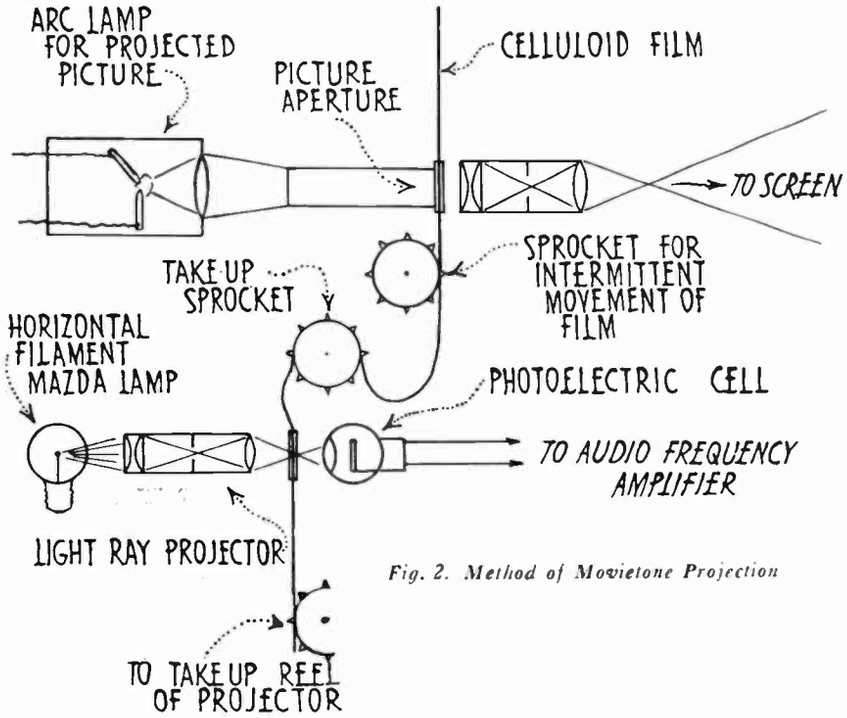


Fig. 2. Method of Movietone Projection

jected on the screen the piece of film having the associated sound record is being pulled smoothly past the photoelectric cell aperture, about a foot below the picture aperture.

The loud speakers are controlled by individual rheostats, so that the volume of any individual units may be adjusted. The units are built on the electrodynamic principle, except that an exponential horn is used instead of the customary cone. According to published statements this unit has a conversion efficiency from electrical to sound energy varying between 10 and 50 per cent in the frequency range of 60 to 7500 cycles, with a 50 per cent efficiency through most of its range. The moving coil consists of a single layer of aluminum ribbon wound on edge, the turns being held together by insulating lacquer, the coil being fastened to a diaphragm made of a piece of aluminum alloy, two thousandths of an inch thick. The horns are equivalent in performance to a straight projector over ten feet long, but due to being designed on the reflex principle occupy a much smaller amount of space without losing their effectiveness.

A SURPRISINGLY small amount of information is available about the properties and characteristics of the dry type filter condensers, such as is used in *A* battery eliminators. With capacity ratings which range from 1500 to 3000 mfds., it is a source of wonder to the uninformed as to how such a high capacity can be attained in so small a space, since most of them are no larger than an ordinary 1½-volt dry battery.

Most of these condensers consist of sheets of foil wound around a core of impregnated compound, which provides a considerable leakage path between the two plates, as much as several hundred milliamperes at the load voltage. In a recent bulletin issued by the Aerovox Company, some interesting data were given. It appears that the capacity varies with the voltage applied across the terminals. Whereas a condenser might measure 2000 mfds. at 6 volts, it would have about 1500 mfd. capacity at 12 volts, and only 100 mfd. at 90 volts. To determine the capacity of the condenser at any given working voltage, a.c. is applied to its terminals, but with an ammeter in series with the line and a voltmeter across it to measure the impressed voltage and current drawn by the condenser. The capacity of the condenser is then found from the formula

$$C = \frac{I \times 10^6}{2 \pi f E}$$

where C is the capacity in mfds., I the current in amperes, E the impressed voltage, and f the frequency of the alternating current source.

The dry *A* condenser is polarized, which means that it behaves normally if connected to the output of the rectifier with the proper polarity, but if reversed, the leakage current through the condenser will be so great that the condenser will soon heat up and become damaged. The condensers may be connected either way when first put in use, but once they are placed in the circuit under working conditions, they should not be reversed thereafter. Most of the condensers now on the market have a conservative capacity rating at a given voltage, and at the customary commercial frequency of 60 cycles.

A READER asks why it is that a received signal which is too weak to operate a detector tube is able to operate a tube used as an r.f. amplifier. Also why antenna circuits of factory-built sets are as a rule untuned.

Van der Bijl found that the ordinary detector tube, for a readable signal, required a high frequency voltage of between .01 and .05 volt, so that when voltages below .01 are impressed on the grid, the detected signal would be inaudible. Hence, to obtain an audible signal, it is customary to place amplifiers ahead of the detector, to step up the voltage to that required for readable signals. Even though the signal was inaudible in the detector output, it might still be there in measurable quantities, and by placing audio frequency amplifiers after the detector tube, the signal could again be heard. However, this is not as practicable as amplifying the signal before it enters the detector circuit, since the amount of amplification obtainable from existing audio frequency apparatus is limited. Many of the signals received by the average broadcast receiver have effective voltages of only a few millionths, which, while sufficient in amplitude to operate a tube as a radio frequency amplifier, will not furnish the detector grid with sufficient voltage to have a readable signal at the output.

Practically all factory-built receivers use aperiodic antenna coupling, with an untuned coil of few turns, closely coupled to the first tuned circuit. Undoubtedly, better selectivity could be obtained by tuning the antenna circuit, but this would require a separate control, as the tuning curve of the antenna tuning condenser, and that of the condensers across the secondaries of the r.f. transformers, are entirely different in slope, so that a gang condenser could not be used. The usual antenna tuned circuit consists of a loading coil, variable condenser, and a coupling coil, all placed in series between the antenna and the ground. To tune the antenna system through the broadcast band, and yet use a gang condenser for all the tuned circuits including the antenna, a different type of tuning condenser would be required for each individual antenna system, and this would be commercially impractical. Thus the system of untuned antenna and three or more tuned circuits in the r.f. amplifier, used to obtain sufficient selectivity, is the almost unanimous choice of the radio manufacturers today.

A correspondent asks what is meant by giving the 115-kilocycle superheterodyne the designation "115 K.C. Super." The average superheterodyne circuit or kit uses the frequency of the intermediate amplifier as the trade name or circuit designation, and since this time-honored practice originated with this magazine in 1924, when the 45-K.C. superheterodyne was first annqunced, the intermediate frequency designation has been used ever since.

With the Amateur Operators

DESIGN AND CONSTRUCTION OF 5 AND 10-METER RECEIVERS

By A. Binneweg, Jr.

With successful two-way communication already accomplished on 10 meters, experimenters are centering their attention on the 5-meter band. Receivers for these bands require considerable attention for effective operation. The circuit for 5-meter use is shown in Fig. 1.

The grid condenser and the grid-filament capacity are in series and the resultant capacity is in shunt with the tuning condenser, thus decreasing the allowable inductance or capacity in the tuning circuit. The series arrangement consisting of the grid condenser, the grid-plate capacity and throttle condenser is also in parallel with the tuning circuit and gives rise to somewhat the same result. To minimize these "loading" effects, the tube capacities should be as small as possible; the smaller they are, the less the detuning of the tuning circuit when the throttle condenser is operated. Since the throttle-control is in series with two fixed condensers, the detuning effect can be practically eliminated, even at 5 meters, by using tubes of small internal capacity, a fairly small grid condenser, and by using a comparatively large throttle-condenser, operated near a maximum setting. This applies, in a degree, to all short-wave receivers. The size of parts necessary will depend upon the frequencies used.

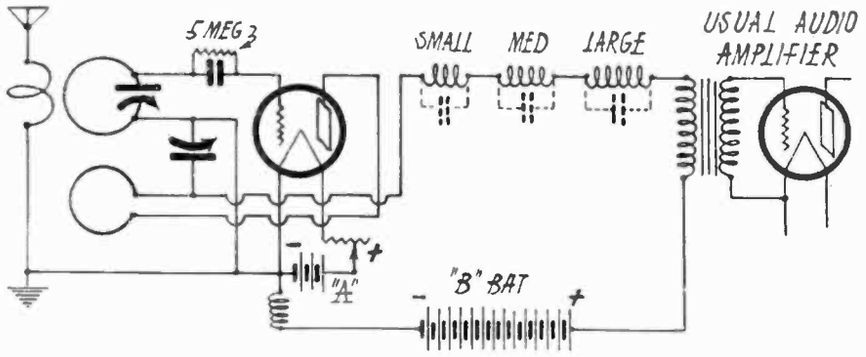


Fig. 1. Circuit of 5-Meter Receiver

Experiments show that best all-around results are secured with small grid condensers in spite of a possible small decrease in grid voltage. Regeneration is easier, and some tube filaments, under amateur operating conditions, do not deactivate as quickly, probably due to the decrease in oscillating current passing through the filament. Capacities of 5 and 10 mmfd. have given good results, and these are readily constructed as small air condensers. Stiff leads are soldered at right angles to two small ½-in. diam. round plates and fitted into small binding posts, which securely hold them, when once adjusted.

The r.f. chokes should be arranged as shown in Fig. 1. The self-capacitance of a winding can be reduced by winding it in sections and separating them, since there is capacity between each and every turn in the winding. The final result is a series of parallel circuits having a high *L/C* ratio and a minimum possible circulating-current loss. The arrangement acts as a series of wavetraps, in this case, and if the number of turns in each trap is chosen so that the frequency-characteristics "overlap," a high impedance is obtained over the entire tuning range. The chokes should be used at positions of low voltage wherever possible. A small 20-turn Lorenz winding in the filament lead helps out.

Since the two condensers are close together, the dials on the panel will interfere. One can either allow the dials to overlap, use a small knob on the throttle-control, or else set the shafts, and the two sections of panel, at a slight angle. A vernier dial is necessary as the set will be adjusted to tune over a fairly large frequency range. If properly adjusted, very little change in throttle-control capacity will be necessary, over the range used.

A conventional type of short-wave antenna will serve, but the coupling-coil should consist of 1 or 2 turns about 2 in. in diameter. A series condenser if used, should not be over 100 mmfd.; at 5 meters, 30 mmfd. max. is plenty. Due to high resistance, antenna "dead-spots" are often very broad and cause regeneration troubles; the antenna should be disconnected while adjustments are made, and coupling should be very loose when it is used.

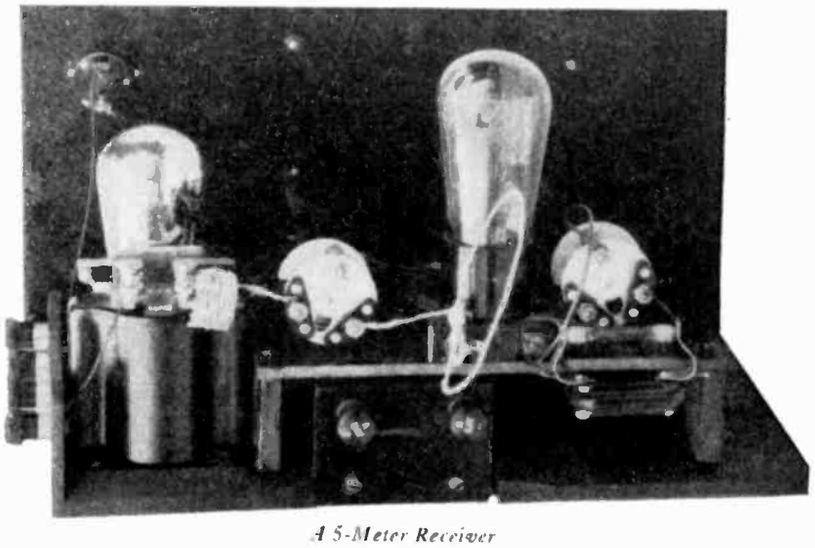
These receivers often require excessive "feed-back" for proper regeneration, showing that the losses in the tuned circuit are high, or that there is an r.f. leak somewhere; the choke may be poor or some metal part may be too close. With the proper choice of parts, and care in placing these, very good results will be obtained.

The ordinary, short-wave condenser is too large for 5- and 10-meter use, even though cut down. For short leads, compact arrangements, and all-around efficiency, midget condensers should be used. The inductances should be made small in diameter, should be mounted on the backs of the condensers and away from the front of the set. The most logical arrangement is to have the tube socket mounted between the two condensers so as to give the shortest possible leads. The tuning condenser should usually have a capacity of about 15 mmfd. and it is convenient for 5-meter work to have the throttle control about 45 mmfd. max.

Extension handles on the condensers are necessary; ¼ in. bakelite rods fitted into commercial attachments for this purpose serve very well. With some types of midgets, a short length of brass rod can be threaded to fit the shaft and the extension handle. If midgets are used, and the inductances are properly proportioned, a 6-in. extension handle will do. The receiver is already so small, that this increase in depth is not noticed. The panel is provided with the proper holes for the shafts and these are fitted with bushings.

At 5 meters high plate voltages are often necessary to secure proper regeneration. By careful adjustment, good results are secured with 45 volts on the detector; it is advisable to start with a 112 as detector and about 67½ volts on the plate; this tube oscillates easier than the 99, for instance, but requires less tuning inductance. One can make small frequency changes by withdrawing the tube-pins from the socket, moving the coils relative to each other, slightly bending them, or changing tubes. Different tubes regenerate over different ranges for given values, so that the receiver should be built around the particular type of tube used.

One should not overlook the reflector for reception. Very large increases in signal strength are possible with a properly designed system of wires arranged in the form of a parabolic cylinder. At 5 and 10 meters, these are of convenient size, and a simple system would consist of four wires, each one-half wave long, three of them being arranged vertically around a horizontal parabola and spaced one-half wave apart, with an antenna at the vertex and the actual receiving aerial at the focus. Means for tuning the wires, or else simply tune them to the middle of the band, could be provided as the tuning has been found not sharp. The same system could be used for transmitting. A reflector system would allow a minimum of power to be used, a less sensitive receiver, or both.



A 5-Meter Receiver

AN 80-METER AMATEUR PHONE AND C. W. TRANSMITTER

By G. E. West, nu 7ZU

The 80-meter phone and C. W. set described herewith is both simple and inexpensive. The average amateur can build and adjust it with ease. Many experimenters will find enough parts lying around the radio shack to build the whole set. Besides working well on 80 meters, the set will tune down to 40 or even 20 meters, and by merely inserting a key, it becomes an excellent C. W. code transmitter.

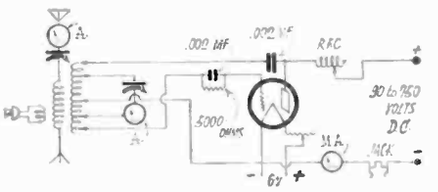


Fig. 1. Circuit Diagram of 80-Meter Phone Transmitter

The circuit diagram is shown in Fig. 1. The circuit used is the familiar, loose-coupled Hartley. The picture shows the complete set built up in the convenient "bread board" arrangement. The primary inductance consists of 7¾ turns of ¼ in. edgewise wound copper ribbon, 6 in. in diameter, spaced ¼ in. The secondary inductance consists of 5½ turns of similar ribbon, 4 in. in diameter. The primary is mounted on a hinge so that the coupling may be varied at will. The primary and secondary variable condensers are old Cardwell, 43-plate condensers with every other plate cut out. The alternate plates of the stator are sawed out by the use of a scroll saw. The rotor is disassembled and every other plate removed. In order to keep the spacing of plates equalized, each rotor plate removed is trimmed with a pair of tin snips, leaving only the lug through which the shaft passed. These lugs are used as spacers or washers when reassembling the rotor.

The fixed grid and plate condensers are .002 mfd. 3000-volt units, and are placed near the base of the tube so as to keep the leads short. The grid leak is a standard Radio Corp. 5000-ohm resistor. The radio frequency choke coil consists of 300 turns of No. 28 d.c.c. copper wire wound on a 1 in. cardboard tube. Taps are provided every 75 turns. The best number of turns to use should be determined by experiment, the number changing with the different wave lengths used. Three measuring instruments are provided. The aerial ammeter is an 0-1.5 thermocouple instrument. The tank circuit ammeter is an 0-10 thermocouple instrument, although an 0-5 scale would be more suitable. The plate circuit milliammeter has a scale reading from 0-200 mils. The telephone jack in the plate circuit is arranged so that a key may be inserted for C. W. signalling.

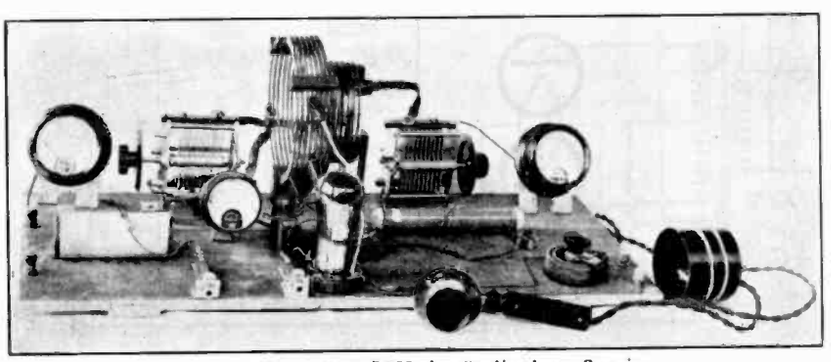
Absorption loop modulation is used because it is the simplest of all systems of modulation and at the same time gives excellent quality for low power sets. The absorption coil consists of two turns of No. 12 d.c.c. copper wire wound on a bakelite tube 3 in. in diameter. The ends of the coil are soldered directly on to the microphone leads. A 4-button Magnavox microphone is used in this set, although satisfactory results may be obtained with any good microphone.

The plate supply should be pure direct current. If rectified alternating current or motor generator supply must be used, then a good filter should be connected in, to smooth out the ripples. Best results will be had from a *B* battery supply. A well filtered motor generator supply is also satisfactory. Any voltage from 90 to 750 may be used, depending upon the type of tube available.

To tune up the set, place the plate clip at one end of the primary inductance and the grid clip near the other end. The filament clip should be between and somewhat nearer to the grid clip. Shunt the tank circuit condenser and ammeter across about six turns, three turns on either side of the filament clip. These settings are shown roughly in the wiring diagram. Light the filament, close the plate circuit and note the reading of the plate meter. With the aerial disconnected, vary the tank circuit condenser and move the clips slightly until the tank circuit ammeter shows the circuit to be oscillating. Continue these adjustments until maximum current is obtained on the desired wave length. The settings which give minimum plate current, consistent with reasonable radio frequency current in the tank circuit, will be best. Now connect in the aerial, adjust the coupling, and tune the aerial condenser until the maximum aerial current is obtained. A coupling of 2 in. or more is desirable, even though the aerial current may fall off somewhat. Slight readjustment of the primary circuit may be helpful.

Now insert the modulation loop and move it in and out until the modulation seems best. An actual test with another amateur fifty or more miles away is the only reliable way to make this adjustment. Mark the tube at the critical position so that it can be removed and replaced at will. Ordinarily the loop should be removed when using code.

The maximum power that can be successfully modulated by the loop absorption method is about 7½ watts, and hence nothing larger than a UX-210 tube should be used. This set is designed for low power and will give excellent results if it is constructed with reasonable care and operated within the limits of its capacity.



Transmitter at nu 7ZU, for Radiophone Service

A 20-METER AMATEUR PHONE

By R. William Tanner

In building a radiophone transmitter to operate on 20 meters, it is necessary to keep in mind that the modulated r.f. output into the antenna circuit must be extremely steady, so that a conventional oscillator circuit such as has been customary at higher wavelengths is not advisable. It has been found preferable to use a low-power battery supplied oscillator, which can be kept constant in frequency, feeding an amplifier of higher power. The modulation system should preferably be the added voltage method, it being the easiest to adjust.

The added voltage system is merely a speech amplifier followed by a power amplifier which feeds the modulated current into a step-up transformer, the secondary of which is in series with the plate supply of the tube or tubes to be modulated. This adds an a.c. voltage (at the frequency of the speech) to the d.c. This system was invented by Heising, but is not to be confused with the constant current method.

The circuit for a constant frequency amateur phone transmitter is shown in Fig. 1. It will be seen that there are five tubes, namely, 201A oscillator, 171 intermediate power amplifier, 210 power amplifier, 201A speech amplifier and a 171 modulator (this is, in reality, an audio power amplifier, but will be termed a modulator to distinguish between it and the S. A.). A 201A battery operated oscillator was desired, but as the output was not high enough to furnish sufficient excitation to the grid of the 210, a 171 stage was placed between the oscillator and the power amplifier.

Small r.f. chokes are connected in the filament leads of the P. A., I. P. A. and oscillator tubes. Each choke consists of two separate layers of No. 18 d.c.c. wire. The bottom layer has 21 turns and the top 20. The winding form is 1 in. in diameter and about 2½ in. long. One layer is connected in each side of the filament supply close to the socket. There are six other chokes of different construction, three in the plate supply to the r.f. tubes and three in the grid leak circuits. These consist of 100 turns of No. 34 s.c.c. wire on a ¼ in. wooden dowel, which has been previously "boiled" in paraffine to exclude all moisture.

This may seem like an unnecessary number of chokes, but it must be remembered that at such a high frequency the r.f. currents like to go anywhere but the right place; therefore, we must post our little guards to keep the unruly r.f. currents in their proper paths.

The oscillator is of the shunt feed Hartley type. This was chosen for no special reason other than the ease of obtaining oscillations. The inductance L_2 is 4 turns of No. 14 enamel wire, 2½ in. in diameter tapped in the center for connection to the filament. The tuning condenser has a maximum capacity of .0003 mfd. A blocking condenser of .0025 mfd. is connected between the plate and one end of the inductance. The grid bias is obtained through an r.f. choke and 10,000 ohm resistance. Both plate and filament are supplied from *B* batteries. An 0 to 6v. voltmeter is across the filament close to the socket so that it is possible to keep the voltage constant. The grid condenser has a capacity of .0005 mfd. The plate voltage may be between 90 and 135.

The grid excitation for the first or intermediate power amplifier is obtained by taking the voltage drop across the plate half of the oscillator inductance L_2. The plate uses the shunt feed arrangement. A condenser of .0025 mfd. (C_6) prevents the short circuiting of the plate supply. The inductance L_3 consists of 3 turns of No. 14 enamel wire 2½ in. in diameter, and is tuned by a .00025 mfd. condenser. R_1 is a 200-ohm potentiometer,

and is used in place of a center tap on the filament transformer. Two condensers of .01 mfd. may be connected from the center of the potentiometer to each side of the filament if desired. Two small *B* batteries, each of 22.5 volts, provides the grid bias, and C_8 is a grid blocking condenser of .0005 mfd. This amplifier is neutralized by the Rice method, C_7, and the grid half of L_3 being the neutralizing circuit.

The main power amplifier differs from the intermediate in that it is series fed and a grid leak of 10,000 ohms provides the grid bias instead of a *C* battery. Inductance L_4 is wound with 6 turns of No. 14 enamel, a tap being taken off at the center; the diameter is the same as the other coils. Part of this coil is used in conjunction with C_3 for the purpose of neutralizing the plate-grid capacity of the 210 tube, and the other half is used as the plate coil, tuned by a condenser similar to the one in the intermediate amplifier. The r.f. is bypassed across the plate supply by means of a .0025 mfd. condenser. *R* is a 200-ohm potentiometer, the reason for using potentiometers instead of a center tap on the filament winding being to provide a shorter path for the r.f. currents. Sometimes the filament transformer is placed a few feet from the tubes, which might be o.k. for the higher waves, but "not so good" on 20 meters. A milliammeter with a range of 0 to 100 m.a. is used in the plate supply as a help in tuning. Grid excitation is obtained by taking the voltage drop across the intermediate plate coil.

The number of turns in the antenna coil will depend on the size of the antenna and counterpoise, two or three usually being sufficient. The coupling may be fixed at about 1 in. Condenser *C* has a capacity of .0001 mfd., and an 0 to 1 amp. hot wire ammeter is connected in the counterpoise lead; as the antenna current was never over .3 amps, probably an 0 to .5A meter would be more suitable. This meter is not necessary as the plate milliammeter will indicate resonance perfectly. The antenna used with the writers' set was a single wire 18 ft. long, and the counterpoise was also a single wire, but only 14 ft. long. This is not the most efficient type of aerial system, but it worked fairly well.

The modulator and speech amplifier is merely a good audio amplifier. Transformer *T* is of a special construction and is made as follows: the cross section of the core is 1 in. by 1 in. The primary consists of 2000 turns of No. 34 enamel wire, and the secondary has 4500 turns of No. 28 enamel, which gives a turns ratio of 2¼ to 1. If the builder has plenty of time and ambition, he may wind the coils in layers, but the writer didn't have much ambition, as both primary and secondary were scramble wound, which seemed to work very well. The core should be provided with an air gap to prevent saturation, as both coils carry fairly heavy d.c. currents, between 1/16 in. and 1/8 in. is about right.

T_1 is an audio transformer with a 2 to 1 ratio, which gave a very good quality of speech. T_2 is a modulation transformer, and a 250,000 ohm resistance R_3, of the grid leak type, is connected across the secondary of this transformer. The volume control R_6 is a 500,000 ohm variable resistance, and R_7 is a power Clarostat to lower the high voltage to about 180 for the plates of the modulator and intermediate amplifier. A W. E. single-button microphone is connected in series with the primary of the modulation transformer, together with a 6-volt battery and switch. The *C* bias voltages are 4.5 and 40.5 for the 201A and 171 respectively, and the same *C* battery is used for the I. P. A. and modulator. It is well to place an 0 to 25 milliammeter next to the plate of the modulator, as this makes it easy to get the correct voltage on the plate. The 171 tube draws 20 mills at 180 volts. This meter has another use, for while speaking into the microphone the reading should not change; if it does, distortion is present and the resistance of the volume control should be lowered until the meter is steady.

The parts for the modulator and speech amplifier should be mounted separate from the transmitter so that the movement of the operator, while varying the resistances, will not change the emitted frequency. Capacity effects at 20 meters are very great, and a good plan is to place the transmitter close to where the antenna and counterpoise enters the house. The audio unit may then be placed on the table next to the receiver at least 4 or 5 ft. from the r.f. units.

When designing the transmitter a small compact power supply was desired as space was at a premium, so the circuit shown in Fig. 2 was used. Two transformers are needed, one with a secondary of 5 volts to light the filaments of the two 171 tubes, and the other with three secondaries to supply the filaments of the 210 and rectifier tubes, and for the high voltage. The latter is wound in two equal sections of 550 volts each. After rectification by means of a pair of '81's, the output voltage is 470 at 100 mills; when drawing only 90 mills the voltage is 485. Two 30-henry chokes are shown, being a double choke of 30 henries each. The filter condensers are of 2 mfd. each and should be able to stand at least 800 volts. The last condenser may well be increased to 4 or 6 mfd. The parts are mounted on a baseboard 10 by 16 by 1 in. thick, which makes a compact and neat appearing power supply.

It is preferable to mount the transmitter in the breadboard fashion until the operator

(Continued on Page 40)

LIST OF PARTS

C—.0001 mfd. variable condenser.
L, L_1, L_2, L_3—See text.
C_1, C_5—.00025 mfd. variable condenser.
C_2, C_6, C_{10}—.0025 mfd. fixed condensers.
C_3, C_7—.00005 mfd. neutralizing condensers.
R, R_2—200 ohm potentiometers.
R_1, R_3—10,000 ohm grid leaks.
RFC—See text.
C_4, C_9, C_{11}—.0005 mfd. fixed condensers.
C_8—.0003 mfd. variable condenser.
R_4, R_5—20 ohm rheostats.
R_6—250,000 ohms.
R_8—Volume control 500,000 ohms.
R_7—Power Clarostat.
T—See text.
T_1—2 to 1 ratio audio transformer.
T_2—Modulation transformer.
5 UX sockets.
1 210 tube.
2 201A tube.
2 171 tube.
0 to .5 hot wire ammeter.
0 to 100 MA milliammeter.
0 to 6V d.c. voltmeter.
Core and wire for transformer T.
Western Electric 284W microphone.
Microphone switch.
Baseboard for transmitter.
Transformer, 2 7.5V windings, 1 1100V winding tapped in center.
5 volt filament transformer.
Double choke, 30 henries 120 m.a. each.
3 800-volt 2 mfd. filter condensers.
2 UX sockets.
2 UX 281 rectifier tubes.

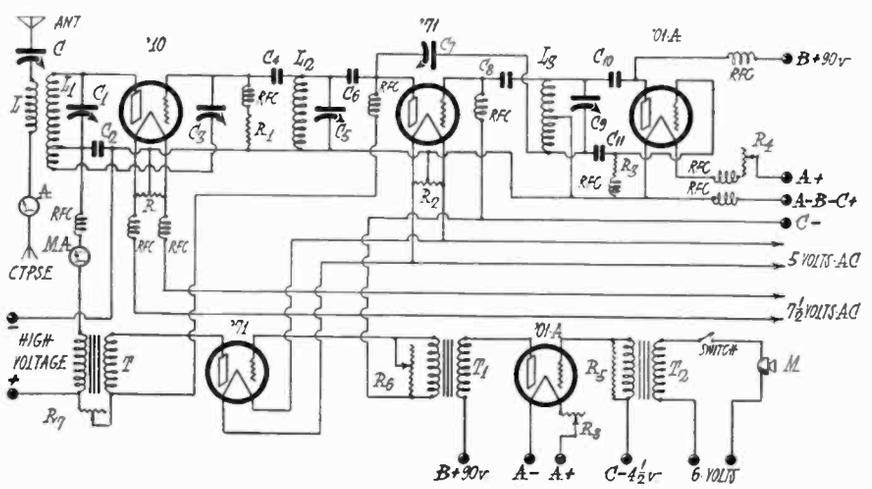


Fig. 1. Circuit of 20-Meter Radiophone Transmitter

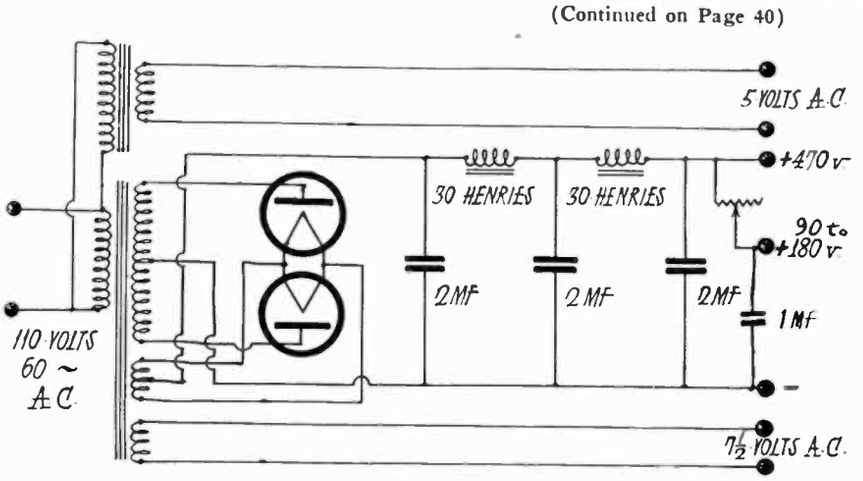
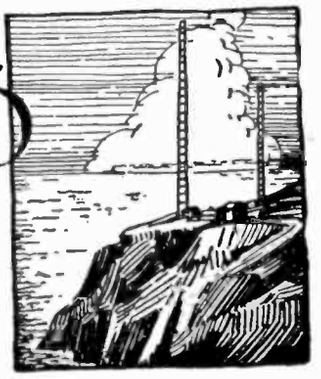


Fig. 2. Diagram showing Power Supply Connections

The COMMERCIAL BRASSPOUNDER

A Department for the Operator at Sea and Ashore



Edited by P. S. LUCAS
R. O. KOCH, *Assistant*

For four months we have been running this department without a single constructional article. Does this mean that none of the gang is doping out any new ideas along this line, or merely that those who are experimenting with improved receivers and transmitter appliances are indisposed to write them up for us? We have half a hunch that the trouble lies in the experimenter's modesty; that you fellows who do use your think-tanks (discriminating expression) become so familiar with the results of your work that you believe it "old stuff" and not worth writing. Well, if it is, we'll not be able to use it, of course, but we have found that in the majority of cases, what is old to 10 per cent of the gang is entirely new to the rest. And certainly that 10 per cent is willing to spare a little space for the benefit of those who can make good use of an idea which is new to them.

New radio frequency circuits, loading systems, coil mountings, short wave rigs, wave meters, are always in order. Mechanical ideas such as relays, switching arrangements, antenna stays, etc., often find a home in some other operator's brain. And you can bet every word will be appreciated by somebody, for this is one sure way of keeping the game alive.

AWW

No, there is no exclamation mark after that heading. AWW is a call—and a snappy, swinging one at that.

We were attending to some business in Wilmington the other day, and as usual, had set aside an hour or two to cast our eyes over the ships lying there. Passing up the usual coastwise steamers and looking longingly at a couple of old square-riggers and a schooner, we finally decided to argue our way aboard a semi-loaded freighter displaying a Norwegian flag from her poop. She was the M/S *Skramstad*, out of Oslo, Norway, and bound for Yokohama and Kobe, and she signed, as we soon discovered, the radio call "AWW."

Luck was with us on two points. The customs officers had gone to lunch and the op was in the shack. T. W. Christensen was the latter's name; holder of a Norwegian first-class radio operator's license as well as a first officer's ticket; operator and third mate of the M/S *Skramstad*.

We have mentioned in other articles that the Scandinavian countries have been doubling up on these two jobs. It seems that there are no longer any shipping companies that employ an operator for full time services as such, except for the passenger ships, of course, but demand third mates who can handle the radio equipment. This means that men who want third mates' berths must obtain a radio operator's license, stand a watch on the bridge, take care of the radio apparatus and handle what message traffic, weather, time and press the captain desires. A regular watch in the radio shack is out of the question.

Such is the case on the *Skramstad;* and here we find a third mate, who, although it is impossible to spend much time in the shack, is very much interested in his work as a radio operator. That point was evident as soon as we stepped into the room; evident from the shining brasswork and the meticulously clean batteries. Mr. Christensen might well be proud of the condition in which he has kept his radio apparatus.

The transmitting equipment is a 1 kw. Telefunken spark, which, in its unusualness, is interesting to talk about. It was apparently built for compactness, although in this case it covers quite a lot of territory. The quenched gap stands about 6 in. high and measures 3 in. in diameter. It consists of three cylindrical units very similar to the Simpson. The secondary condenser consists of three Leyden jars 3 in. in diameter, mounted upon the bulkhead just above the gap. The O. T. coils are of the pancake type, covering the range from 300 to 800 meters. During the 300 meter days, however, the fundamental of the antenna had to be lowered by the use of a series condenser. This unit is still on the bulkhead, and should be kept there as a curiosity. It consists of two banks of four small Leyden jars, each measuring 1 in. in diameter and 1 ft. in length. The banks are connected in series parallel. An auxiliary transmitter is also carried in accordance with the Norwegian law. This outfit is merely a husky spark coil, operated by a set of Exides, with an auxiliary key. The same oscillatory circuit is used.

The original crystal receiver, which requires as much space as the transmitter, is no longer used. It is a massive thing, as all the old ones were, and differs from the American-made receivers in that instead of being housed in a cabinet it is built on a framework of ½ in. bakelite and mounted like a modern transmitter. Crystal holder, variable condenser, and coils are removable.

Contrasting with this impressive piece of architecture is the diminutive one-tuhe receiver now in use. This is a Telefunken type E 266 and measures almost 4½ in. square. The Telefunken tube is smaller than a UV 199, and as may well be imagined, is allowed no extra space. As far as results go, the receiver holds its own with the average aboard the American freighters. It is very sensitive, but with a single dial and a coupling arrangement it couldn't very well be expected to be too selective. The most interesting feature of the receiver is the plug-in coil arrangement, which beats everything we have ever yet seen. Each of two coils is enclosed in a small, flat mahogany case and made fast to a pivoting arrangement at the bottom. Four plugs on the base fit into their respective jacks, and the coupling of the two coils is varied by sliding one forward in the style used by the old spider-web arrangements. Coils varying the range of the receiver from 200 to 25,000 meters are available; and if they work as efficiently as they look they are some workers.

Well, the dinner bell finally broke up a pleasant conversation, so we took leave of Opr. Christensen and started for home. Probably in a couple of months the crew of the *Skramstad* will be reading press from 2UO, for Mr. Christensen is very much interested in short waves.

MEXICAN WEATHER

By J. P. DUNHAM, UIZ
(Fr. S. S. Argyll)

So many ship operators are at a loss for weather forecasts between San Diego and Balboa, that I am submitting for approval the following:

Mexico City XDA, sends at 10:53 a. m., PST., cq, CZA qsd until 10:55 a. m., PST., and then proceeds with the time tick in the same fashion used in the United States.

With a lapse of about two or three seconds after the time tick, is sent, qst y CZA, followed by the word "Meteorológico" (Meteorological) following with names of districts and the ordinary number code for winds, etc.

Immediately after this, the weather is sent in Spanish, something as follows:

PREVISION	
GOLFO DE MEXICO	
REGION OCCIDENTAL	Vientos moderados sureste
REGION SUR	Moderados noroeste
COSTA DE YUCATAN	Moderados este
PACIFICO	
COSTA OCCIDENTAL DE BAJA CALIFORNIA	Moderados del oeste
GOLFO DE CALIFORNIA REGION NORTE	Moderados del oeste
REGION SUR HASTA EL CABO CORRIENTES	Moderados del suroeste probable turbonada
COSTA SUR DEL PACIFICO	Algo Fuertes norte rolando al sur
GOLFO DE TEHUANTEPEC	Moderados este mal tiempo

Translated, this would read:

FORECAST	
GULF OF MEXICO	
REGION WEST	Moderate southeast winds
REGION SOUTH	Moderate northwest
COAST OF YUCATAN	Moderate east
PACIFIC	
WEST COAST OF LOWER CALIFORNIA	Moderate west
GULF OF CALIFORNIA REGION NORTH	Moderate west
REGION SOUTH TO CAPE CORRIENTES	Moderate southwest probably squall
SOUTH COAST OF THE PACIFIC	Somewhat strong north changing to the south
GULF OF TEHUANTEPEC	Moderate east bad weather

Of course, the weather specifications are changed, but will give an idea as to the system used. You will note that the word "Vientos" does not appear in all the fore-

casts, sometimes it is omitted altogether and again it appears in each one. The word "Occidental" is occasionally abbreviated as "Occ."

Below, is the translation of the words most used in the forecast:

AL	To the
ALGO	Somewhat
BAJA	Lower
CABO	Cape
COSTA	Coast
DE	Of
DEBILES	Weak
DEL	To the (of the)
ESTE	East
FUERTES	Strong
GOLFO	Gulf
HASTA	Until (to)
LLUVIAS	Rain
MODERADOS	Moderate
MEJORANDO	Better (ing)
NORTE	North
NORDESTE	Northeast
NOROESTE	Northwest
OBSCURO (or Nublado)	Cloudy
OCCIDENTAL	Occidental (or west)
OESTE	West
PREVISION	Forecast
PROBABLE	Probably
REGION	Region (portion)
ROLANDO	Changing
SUR	South
SURESTE	Southeast
SUROESTE	Southwest
TIEMPO	Weather
TURBONADA	Squall

Following wx from XDA, the coast stations in Mexico, beginning with XAG, XAF, thence down the coast to Salina Cruz, all repeat the weather in Spanish with the exception of XAN, Salina Cruz, who is good enough to give it in English, repeating each word twice during the summer months.

However, if any of the fellows should not be able to get any of these stations, I will be very glad, while in Mexican waters, to have them call me—U1Z—and will repeat in English or Spanish.

A few more words about getting qso with the Mexican stations.

I have just been told by the operator at Santa Rosalia, XAG, that they, XAG, are now working on 2100 meters, spark, and that XAF, La Paz, is working in 1100 meters cw. and is practically receiving all morning from other Mexican stations on either that wave or short wave up to the time of broadcasting the weather, which is done, the last time I heard, on 600 meters spark.

All of the Mexican stations, after broadcasting the weather, cq for traffic and listen on 600 meters. However, let me warn those with messages for these stations, be sure and get qso immediately after they cq. If they don't, they might just as well file it until the next day when they cq again. I can appreciate that from experience! ! !

I wonder how many of the operators, traveling the Pacific Coast, have now noticed the lack of qrm from the said Mexican stations? Things are certainly peaceful along the Wabash.

LETTERS TO THE EDITOR

Sirs: Here is a whole-hearted outburst of appreciation of RADIO and its Brasspounder section—there is nothing like it for the sea-going operator.

As a suggestion, I believe quite a number of the gang would like a description of station 2UO. What a relief it is to copy his press after struggling with alleged "news" spewed forth by some of the dot factories.

Your declaration of war against LV QRM'ers is something needed for a long time. The more embarrassment you can cause those birds the better. Hope to have my call on the roll if caught jamming, and will certainly write up any QRM'ers I hear from now on.

June 19, 1928.

73s,
QT KDML

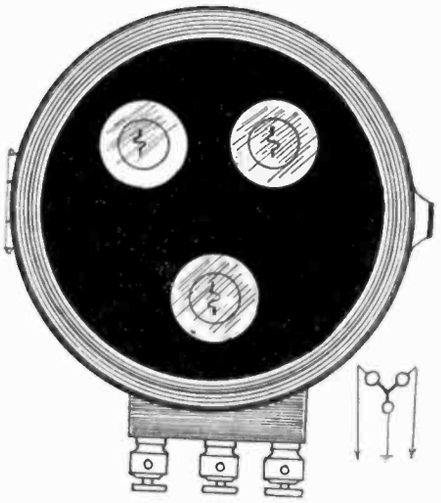
Thanx, OM. Now, how about somebody writing up 2UO. It's a long way from California, you know. Don't let Bill do it; do it yourself.

—Dep't. Ed.

GROUND INDICATOR

By JACK BRONT

Especially on the older ships, swinging grounds are a source of so much trouble that they are generally referred to in terms not used in the most polite society. These grounds have the diabolical ability to immediately disappear once a determined search is instigated to locate and destroy them, but bob up again at the most critical moments. The mere mention of a "swinger" is enough



Ground Indicator

to throw the old-time telephone or telegraph testman into a mild epileptic fit.

After relentlessly pursuing swingers for weeks at a time and discovering their complete disappearance once the hunt was initiated, the writer requisitioned a discarded brass clock case and, using bulbs originally intended for the gyro compass, built the instrument shown in the illustration. The unit is very compact on account of the small size of the bulbs used—these not being much larger than auto headlight globes.

In star connection they were placed on a bakelite panel within the brass case, the glass front of which was obscured with jet black enamel except for circular spaces immediately before the individual bulbs. Of course the hinged cover of the case may be opened for inspection of the interior.

This mechanical Sherlock may be connected to any 110-volt line and the swinger or any steady ground located by elimination. It may be constructed in half an hour and sometimes saves hours and days of search. Left attached to any suspected line, the current consumption is small. Mounted on the bulkhead it is out of the way, but always ready for use.

AN EVENTFUL VOYAGE OF THE TRAWLER "OCEAN"

By G. W. TRUDEAU, Ex-S/T "OCEAN"

Two p. m. Thursday, November 13, and the air is rent by a deafening whistle just outside the office of the Bay State Fishing Co. at their dock at East Boston, Mass. Recognizing it as the signal informing any of the crew of the fishing trawler *Ocean* who are ashore, that she is ready to sail, I reluctantly arose from the comfortable chair where I had been parked for the last hour meditating upon such unpleasant things as ships that sail thirty-six hours after arriving, and a sea-going op's life in general, and gathering up my books, papers, etc., for reading and study during the coming trip to the fishing grounds, I went aboard. Soon the *Ocean* was steaming down Boston Harbor, beginning what proved to be the most interesting trip of the eight months I had been sailing on her.

To give a general idea of what kind of vessels these fishing trawlers are: The *Ocean* has a 22½-foot beam, is 137 feet long, and her net tonnage is 91 tons. She has a low house running over the after three-fourths of the deck, atop of the forward end of which is the miniature pilot house overlooking the expanse of deck where the fish are dropped from the net, there to be cleaned and packed in ice below. The galley, which is also the mess room, is located aft down within the hull; over it runs the after part of the house, consisting of the engineer's quarters and the radio shack and operator's quarters combined. Altogether she hasn't a prepossessing appearance inside or out, and is far from the expectations of the new operator just out of school.

However, to go on with my story: Passing to the westward of the regular fishing grounds, Georges Banks, where the trawlers usually go, we began fishing Friday forenoon off Nantucket Lightship, where fish had been reported, and the following two days were uneventful.

The fishing was fair, each haul of the huge net showing about a ton of haddock, which is the principal kind caught, and small quantities of other kinds. The writer kept fairly busy despite the popular supposition that radio ops never work, for there is really more traffic handled on these trawlers than on most freighters, due to the fact that each boat must keep in touch with the other twelve radio-equipped boats of this company, copying, and reporting to the captain all messages that each boat sends or receives. So with keeping track of myself, and ten or twelve others eight hours per day, the time was not slow in passing.

However, Sunday night things began to move more rapidly. In fact everything that was not tied down moved more or less, mostly more, for a nor'wester set in, and while there undoubtedly have been worse storms, this one was no mere squall by any means. The advantage of my rather small quarters now became apparent; it was possible to grasp something solid on all sides, and therefore save myself from being thrown around very much. About midnight it became too rough for further fishing, and we began to jog, as heading into the wind with just enough speed to maintain headway is termed, and continued jogging throughout the night, and the next day.

During this period it was a case of sit tight and hold on, as the trawlers become rather lively in a storm and the deck is no place for anyone desirous of staying dry. Ye op was so inclined, but Monday morning had to go out atop the house to fasten a loosened guy wire in order to get off the

(Continued on Page 42)

Inside Stories of Factory Built Receivers

I. The Gilfillan Neutrodyne

The design and construction of the Gilfillan a.c. Neutrodyne are based upon a thorough laboratory study of the frequency characteristics of the several component parts and of the final assembly. Thus it is possible to produce a receiver which gives uniform amplification of all tones between 50 and 5000 cycles. A brief description of the methods employed by W. W. Lindsay, Jr., chief engineer Gilfillan Bros., Inc., appears at the end of this story.

As a result of these tests, the new Gilfillan line comprises two models of chassis, each of which is housed in various types of cabinets. The chassis for Model 33 is shown in Fig. 1 and its circuit diagram in Fig. 2. It employs three stages of r.f. amplification, detector and two stages of audio. It uses '26 type of a.c. tubes in all stages except the detector, which is a '27 heater, and the second audio, which is push-pull with two '12A tubes. The power plant with its '80 rectifier tube is an integral part of the chassis. The circuit diagram shows the provision that has been made for exciting a dynamic speaker field and for a phonograph pick-up input jack.

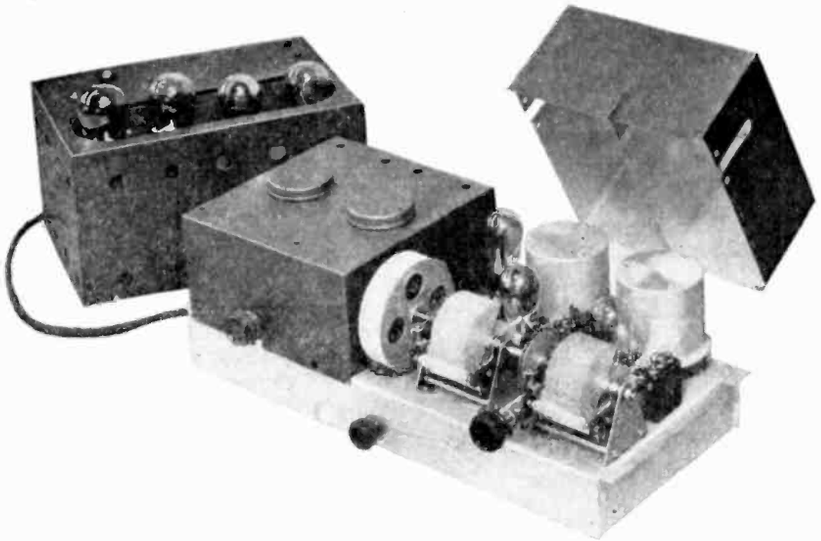


Fig. 1. Chassis for Model 33 Gilfillan Neutrodyne

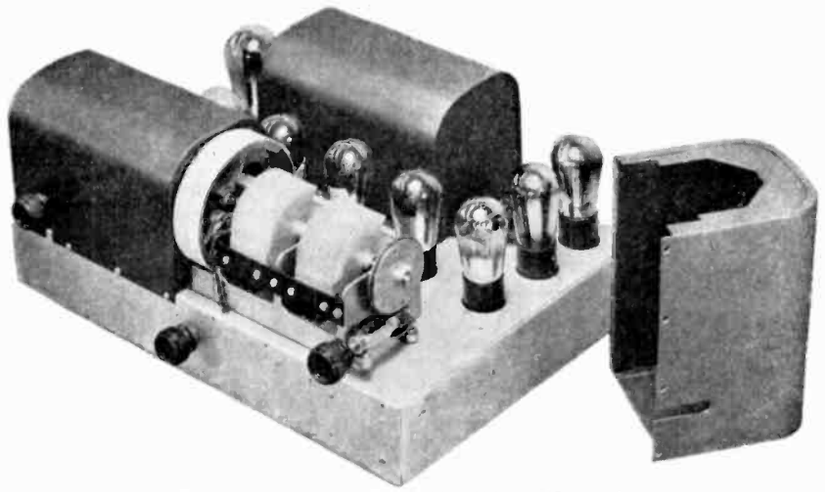


Fig. 3. Chassis of Model 66 Gilfillan Neutrodyne

It will be noted that the antenna input circuit employs a volume control and an input coil designed to give a rising voltage to the grid of the first r.f. tube with decrease in tuning frequency. This tends to compensate for the droop at the lower frequencies in the following stages and results in uniform sensitivity throughout the broadcast band.

Fig. 3 shows the chassis for the Model 66 and Fig. 4 is its circuit diagram. This has four stages of tuned r.f. and uses '10 power tubes in the last push-pull audio stage. This allows greater selectivity and sensitivity as well as greater volume, the distortionless output being five times greater than that of the Model 33, which is 700 milli-watts. The power plant and audio amplifier is contained in a separate unit. Otherwise the two models have the same features of worm-drive tuning, antenna compensation, and high and low a.c. line voltage control.

Fig. 5 shows the schematic arrangement of master-oscillator power-amplifier type of transmitter used in testing the receiver. This transmitter is modulated at various pure audio frequencies between 30 and 6000 cycles and a portion of the resulting modulated carrier is fed into an attenuation network and phantom antenna and thence to the receiver under test. Another portion of this carrier is fed into a percentage modulation meter

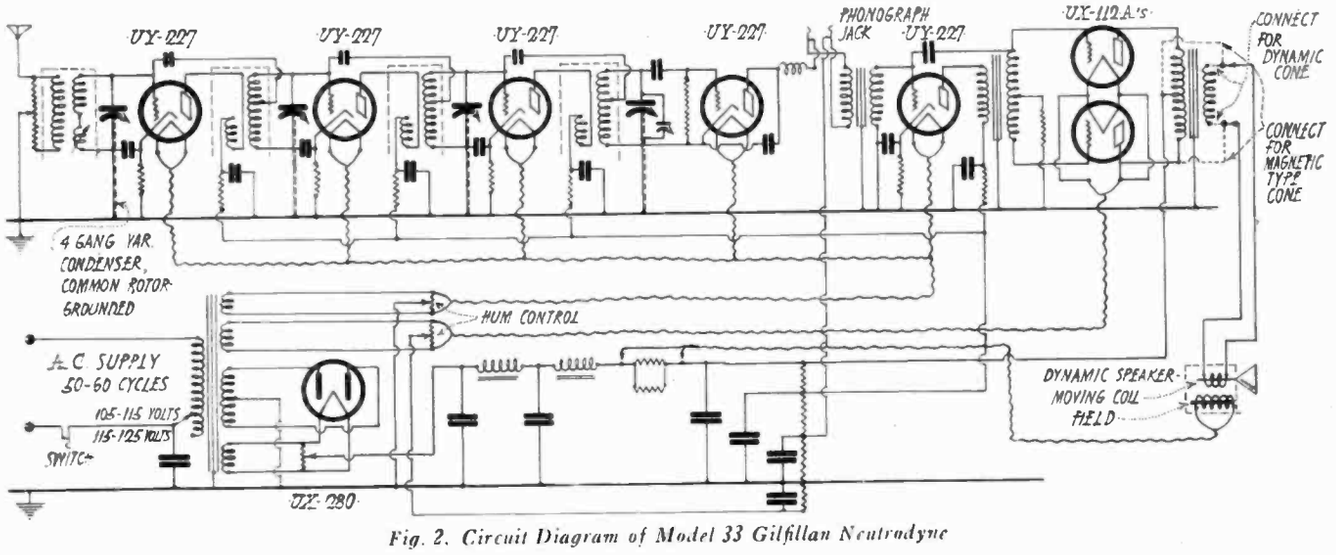


Fig. 2. Circuit Diagram of Model 33 Gilfillan Neutrodyne

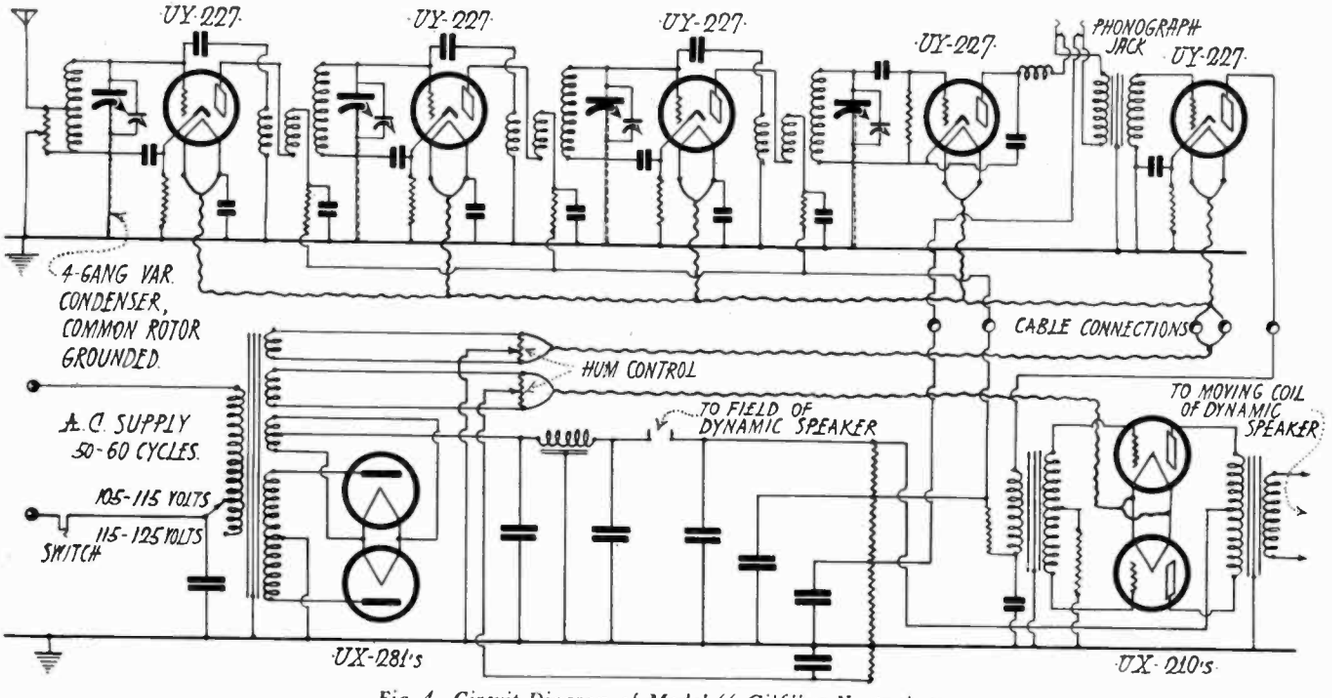


Fig. 4. Circuit Diagram of Model 66 Gilfillan Neutrodyne

calibrated over the range of audio frequencies to be used.

At the output terminals of the receiver an equivalent loud-speaker load and measuring meter is used. By noting the deflections corresponding to various tone frequencies applied to the transmitter with constant percentage modulation it is possible to determine the variation in fidelity of the entire receiver. This, of course, includes the suppression of the higher audio frequencies caused by the sharpness of the tuned radio frequency circuits as well as the discrimination against

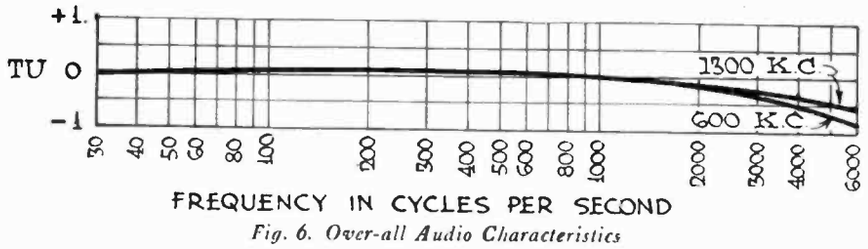


Fig. 6. Over-all Audio Characteristics

these higher frequencies by the detector grid leak-condenser combination.

Measurements are, of course, made at various radio frequencies to determine any variation in quality at the extremes of the tuning range of the receiver. Other measurements include the sound pressure output of the loud speaker in its cabinet as well as the percentage of harmonics present.

The over-all audio characteristic of such a transmitter and associated input equipment is shown in Fig. 6. The reduction of the higher audio frequencies is apparent and allowance is, of course, made for this fact.

A 20-METER AMATEUR PHONE

(Continued from Page 36)

is familiar with the function of each part, after which it can be mounted in a better manner. The power supply and modulator-speech amplifier may be made permanent in the beginning as there are no critical adjustments here. In wiring the audio unit keep the transformers well spaced and shorten the grid and plate leads from the sockets to the transformers as much as possible, for unless this is done howling may result. The resistance R_5 helps greatly in preventing this and may be reduced to 100,000 ohms if the howling persists. It may also be necessary to connect a 1 mfd. condenser from the B positive terminal of transformer T to the center of R_2. When the C batteries get old the internal resistances increase sometimes, causing a howl, so that 1 mfd. condenser across these batteries will eliminate the trouble. Mount the oscillator and r.f. amplifiers on a 24 by 10 in. baseboard ¾ in. thick, and keep the different units well spaced to prevent feedback. No details will be given for the layout of these parts as some amateurs prefer certain makes of condensers, meters, sockets, etc., while others prefer other makes. Amateurs are notorious for not building according to the "blueprints," so it is sufficient to say to keep all inductances at right angles and well separated. Do likewise with the r.f. chokes.

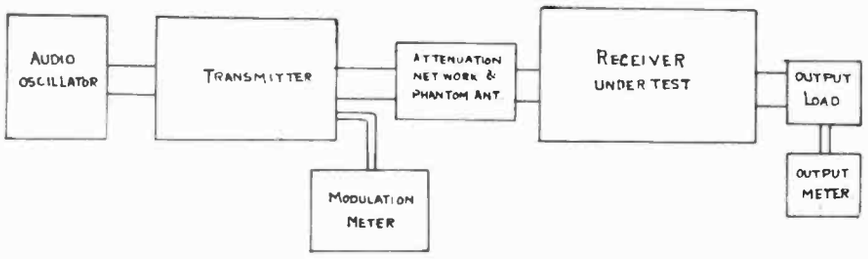


Fig. 5. Schematic Arrangement of Testing Equipment

When all of the parts are mounted and wired, procure four rubber bath sponges and glue one to each corner of the baseboard, and make all connections with flexible wire. Vibration of a 20-meter transmitter has a tendency to sound like an unfiltered plate supply, and the rubber sponges and flexible connections will eliminate the difficulty.

In making the initial adjustments the audio unit may be left out of circuit entirely. Connect all leads except the positive of the high voltage going to the power amplifiers, and place the hot wire ammeter in series with the tuning condenser C_5. Set the oscillator by means of a wavemeter or calibrated receiver, somewhere between 20.68 and 21.4 meters, as this is the band where phone is allowed. Now vary C_8 until a reading shows on the meter. If meter remains at zero it is possible that C_7 is set correctly, but if a reading is obtained vary C_7 until it remains at zero at any setting of C_5, which proves that the grid-plate capacity of the tube is neutralized. Now place the meter in series with C_1 and go through the same procedure. For this operation the 180 volts must be connected to the plate of the I. P. A. tube and L_2, C_5 tuned to the same wave as the oscillator. After this is done replace meter in the antenna circuit and connect B positive to the P. A. Tune C, C_1 and C_5 for highest antenna current. Now connect in the modulator and speech amplifier. When speaking into the microphone both the plate current on the 210 tube and the antenna current should increase slightly.

Modulation by added voltage and constant current was tried at first on the 171 I. P. A. but did not work well, sometimes making the oscillator unstable, due, perhaps, to the tube not being completely neutralized. The writer hopes to soon hear a large number of amateur phones on 20 meters. It is surely great sport to be able to talk across the continent in the daytime on low power.

Radio Kit Reviews

THE REMLER 29

THE Remler 29 is a 115 kilocycle superheterodyne using eight tubes. Four of these, those in the one radio frequency stage and three intermediate frequency stages, are of the shield grid type. Four of them, those in the oscillator, first and second detector, and first audio stage, are of the '01A type. It is ultra-sensitive, has 10 kilocycle selectivity, and fine tone quality. It has two tuning controls, a volume control and a control for sensitiveness and selectivity. It uses an aerial. A separate kit provides a second stage of audio and a power amplifier and plate current supply if needed.

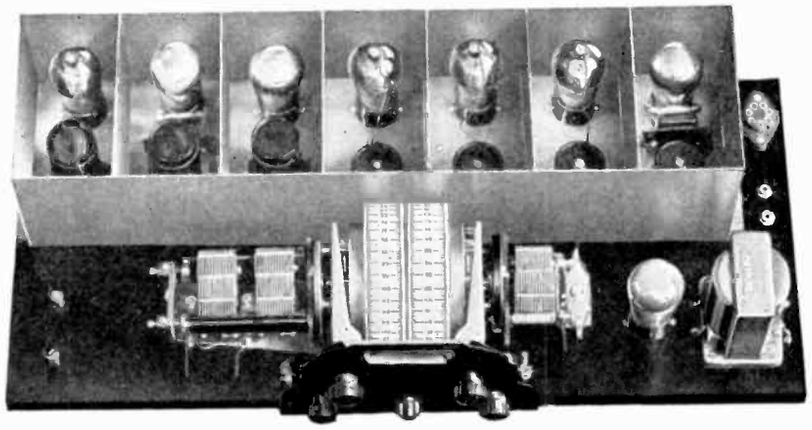
The kit is designed for easy assembly from several units. These consist of the No. 752 foundation kit, the No. 712 shield-grid selector and amplifier unit, drum dials and tuning condensers, variable resistors, first stage audio transformer, and battery cable and connections.

The foundation kit includes a pressed steel base and panel which are drilled and a bronze control panel. All necessary small parts, such as fixed and compensating condensers, jacks, binding posts, knobs, washers, bolts, nuts and screws, as well as a full-size blue print, are furnished in this kit.

The selector and amplifier kit is a single copper case completely wired at the factory with the r.f. and i.f. transformers and tube sockets, the oscillator circuit, and the two detectors. Each individual circuit, in turn, is fully shielded. The necessary coded wire for sub-base connections is included with this kit.

A shield-grid tube is used in the first r.f. stage because it gives a stability to the circuit which no regenerative tube would give. It is used solely to add selectivity, as ample gain is secured in the three i.f. stages. Regeneration is introduced into the first detector circuit by inductively coupling the tube's plate and grid circuits by means of a third winding in the r.f. transformer, which is shunted by a 2000-ohm variable resistor so as to control the amount of regeneration. Maximum regeneration is used only for reception of distant stations.

Further selectivity is secured in the three i.f. stages by keeping the gain per stage relatively low, though it is far greater than could be obtained from an amplifier using '01A tubes instead of the '22 tubes here employed. This amplifier is operated well below the point of oscillation so as not to cut the side bands.



New Remler "29" 115 K.C. Super

Both detectors are of the grid-leak, grid-condenser type with '01A tubes. This type of tube may also be used in the first audio stage, although a '12A tube gives a somewhat better relation between the impedances of the tube plate and the primary of the second audio transformer. The first audio is either a Remler 900 or 920 transformer, depending upon the power amplifier.

A panel rheostat with a limiting resistance in series controls the filament current to the shield-grid tubes. Filament control of the other tubes is automatic. The total filament drain is 1.6 amps. at 6 volts, from either a storage battery or *A* eliminator.

The r.f. and first detector circuits are tuned with a Remler 632 two-in-line condenser provided with adjustable balancing condensers to compensate for circuit capacity differences. The oscillator circuit is tuned by a Remler 638 twin-rotor condenser. Both condensers are controlled by illuminated drum dials and cover the broadcast band from 200 to 550 meters.

The antenna compensator is a small variometer whose rotor is mounted inside the secondary form of the antenna coupler. It is connected in series with the antenna coupler secondary and is included in the tuned circuit controlled by the first section of the two-in-line condenser. It allows equalization of the inductances of the two tuned circuits and is adjusted once and for all when the receiver is installed.

The plate voltages required are 67½, 90 and 135, the maximum plate current drain being 24 m.a., including one stage of audio with '12A tube. This can be secured either from dry batteries or from an a.c. power supply unit.

PARTS REQUIRED FOR THE REMLER 29 SHIELD-GRID SUPERHETERODYNE

1 REMLER No. 712 Shield-Grid Selector and Amplifier. (All wire necessary for the complete receiver is included with this unit.)

1 REMLER No. 752 Foundation Kit Incorporating:
- 1 Pressed Steel Base
- 1 Pressed Steel Instrument Panel
- 1 Bronze Escutcheon Plate

All necessary fixed and compensating condensers, cord-tip jacks, binding posts, bakelite knobs, insulating washers, bolts, nuts and screws.

2 REMLER No. 110 Universal Drum Dials

1 REMLER Type 632 Two-in-Line Condenser

1 REMLER Type 638 Twin-Rotor Condenser

1 FROST No. 1895 500,000-ohm Variable Resistor (Volume Control)

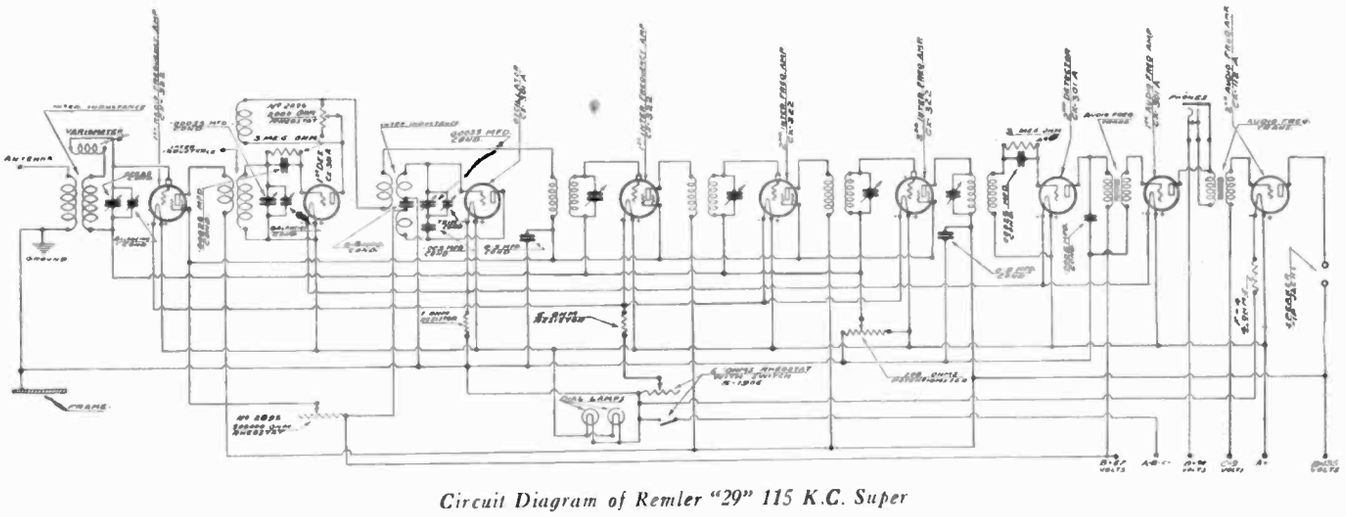
1 FROST No. 1896 2000-ohm Variable Resistor (Sensitivity Control)

1 FROST No. S-1910 10-ohm Rheostat and Switch

1 FROST No. 782 Battery Cable Plug Socket

1 FROST No. 780 Battery Cable and Connector

1 REMLER No. 900 or 920 First-Stage Audio Transformer



Circuit Diagram of Remler "29" 115 K.C. Super

This latest development of the superheterodyne circuit is exceedingly simple to operate and surprisingly low in cost. It gives clean-cut separation of stations in adjacent channels and has but one oscillator dial setting for each station, due to the 115 kilocycle intermediate frequency. With the recommended power amplifier for the second stage it gives the utmost fidelity of sound reproduction at great volume. The entire receiver can easily be assembled and wired in a few hours and can be housed in any cabinet designed for a 7 by 25-inch panel and 11 by 25-inch base.

Remler Power Amplifier and B Supply for 350 Tubes and Dynamic Speaker

The Remler power amplifier is built for a '50 tube and uses two '81 half-wave rectifiers and one '74 voltage regulator. It will supply filament current and plate voltages for the rectifier and power tubes as well as plate and grid bias voltages for the Remler 29 receiver. It includes a Remler No. 921 second stage audio transformer, No. 923 output impedance-compensating transformer, and No. 950 power transformer and choke.

PARTS REQUIRED FOR THE REMLER POWER AMPLIFIER

1 REMLER No. 952 Power Amplifier Foundation Kit, incorporating:
- 1 Pressed Steel Base
- 4 REMLER No. 50 Sockets
- 2 Frost No. FT 64 20-ohm Center-Tapped Resistors
- 1 Set of Blueprints and Instructions. Necessary bolts, nuts, screws, lugs, terminals, and wire.
- 1 No. 1832 Frost Potentiometer 200-ohm

1 REMLER No. 950 Power Transformer and Choke
1 REMLER No. 921 Second-Stage Audio Transformer
1 REMLER No. 923 Output Impedance-Compensating Transformer
1 FROST No. 300 Universal Resistance Kit
3 FROST No. 1405 2 mfd. Heavy Duty Filter Condensers
2 FROST No. 1104 1 mfd. By-Pass Condensers

These with the necessary sockets may be assembled on a No. 952 foundation kit to give a compact unit which can be mounted in a console cabinet with the receiver or encased in a No. 954 cover. This outfit is intended for use with a dynamic cone speaker and calls for a Remler 920 transformer in the first stage. If a smaller power tube is to be used without a power amplifier a first stage No. 900 and second stage No. 901 with a No. 922 output transformer can be built as an integral part of the complete receiver.

AN EVENTFUL VOYAGE OF THE TRAWLER "OCEAN"

(Continued from Page 38)

daily message to Boston, accomplishing it without getting very wet, despite the fifty-mile gale and downfall of sleet. Other trawler operators also had their individual mishaps, for I remember overhearing one chap remark that his tuner had come loose during the night, and that he tried to sleep and hold it in place at the same time. Another op told of finding the amplifier box on the floor upon arising. Fortunately, commercial apparatus is built to withstand such hard knocks as those.

The first incident of the trip occurred Sunday afternoon while we were still jogging. A heavy sea struck our rudder, and turning it quickly, also violently spun the wheel in the pilothouse. The helmsman, caught off his guard, was thrown over the wheel, and bruised so badly that he was forced to stay in his bunk the remainder of the voyage.

The sea and wind had both abated considerably by daylight, Tuesday, and we resumed fishing at that time. At 8:30 a. m. a motorboat was sighted, drifting with something flying from her short mast.

Completing the tow upon which we were engaged, the net was hauled aboard, and we steamed toward the motorboat. As we came alongside two badly frightened fishermen indicated that they wished to be taken off, whereupon our captain asked if they also wished us to endeavor to save their boat, and the reply was: "To Hell with the boat, save us!" And they fairly tumbled on board the *Ocean* in their eagerness to reach safety.

So completely unnerved were they by their recent experience that it was some time before we could obtain the details of their perilous trip, but finally, after being warmed and fed, they talked. They told of how the motor had been disabled by salt water getting into and short circuiting the ignition system late Sunday afternoon as they were trying to reach shelter from the storm; then of tossing wildly, a plaything of the wind and waves, for thirty-six hours; of drifting helplessly a distance of over eighty miles, seeing the shore lights pass, one after another, expecting any moment that their forty-foot vessel would be swamped or driven onto the rocks; and finally, of passing Nantucket Lightship during the night, and knowing that from then on the wind would carry them directly out to sea. Truly an unenviable experience.

A few hours after picking up the two men we received orders to proceed to Boston with our catch for Thursday's market, and shortly afterward I heard a broadcast from another ship which gave the position of an abandoned two-masted schooner, the *Rebecca D. Whilldin*, with a cargo of lumber. Realizing, from the position given, that she was near the course we would travel on the way to Boston, I gave the information to the captain, who was quite interested, and requested me to watch for further reports. I kept pretty close to the set for the rest of the day, but heard nothing more of the schooner until early evening, when a broadcast from the steamship *Beacon Oil* told of passing her, and gave her position at the time.

A little more excitement was furnished shortly after midnight when the steamship *West Inskip* was reported in distress, but after sitting up until 3 a. m. Wednesday, and nothing having developed, I turned in for a couple of hours sleep.

The wind had decreased steadily during the previous day, and Wednesday dawned bright and clear; one of those days after a storm that more than compensate us for the past discomfort. Starting early for home we took a course that would bring us near to where the schooner was last reported. By this time everyone aboard was cognizant of the schooner's plight, and the magic word of the sea, salvage, was heard frequently. Nothing occurred all morning, which seemed slow in passing, but at noon, the mate, who was on watch, reported a two-masted vessel just discernible ahead. This caused a rush to the deck, followed by an anxious hour until we were close enough to perceive that it was in fact the *Rebecca D.*

She lay, deserted and rather forlorn looking, with bow low in the water, one sail half lowered and flapping in the gentle breeze as she slowly rolled with the motion of the sea. Her deck load of lumber, gleaming dully in the sun, was piled high above her rail, overtopping our own rail by several feet.

Soon we were alongside and then followed a scene which might have been drawn from a novel of freebooters in the days of the Spanish Main; some twenty-odd men in all varieties and manner of dress scrambled over the rail and onto the deck of the *Rebecca*, recalling for a fleeting instant vivid word pictures read in pirate tales when a boy.

After thoroughly inspecting the vessel from stem to stern, finding a foot of water in her cabin, where chaos reigned, furniture, clothing, food, and what not being strewn around due to the heavy buffeting she had received, the sail was lowered and our crew fell to work making ready and fastening the towing lines. Both anchors had been dropped, evidently in an attempt to hold the vessel during the storm, but had failed and were now hanging loose, the depth of water being too great for them to touch bottom. The donkey engine for raising them was out of commission, making it necessary to cut the chains, but at last, about 2 p. m., the lines made fast and all in readiness, we began the thirty-hour tow into Boston.

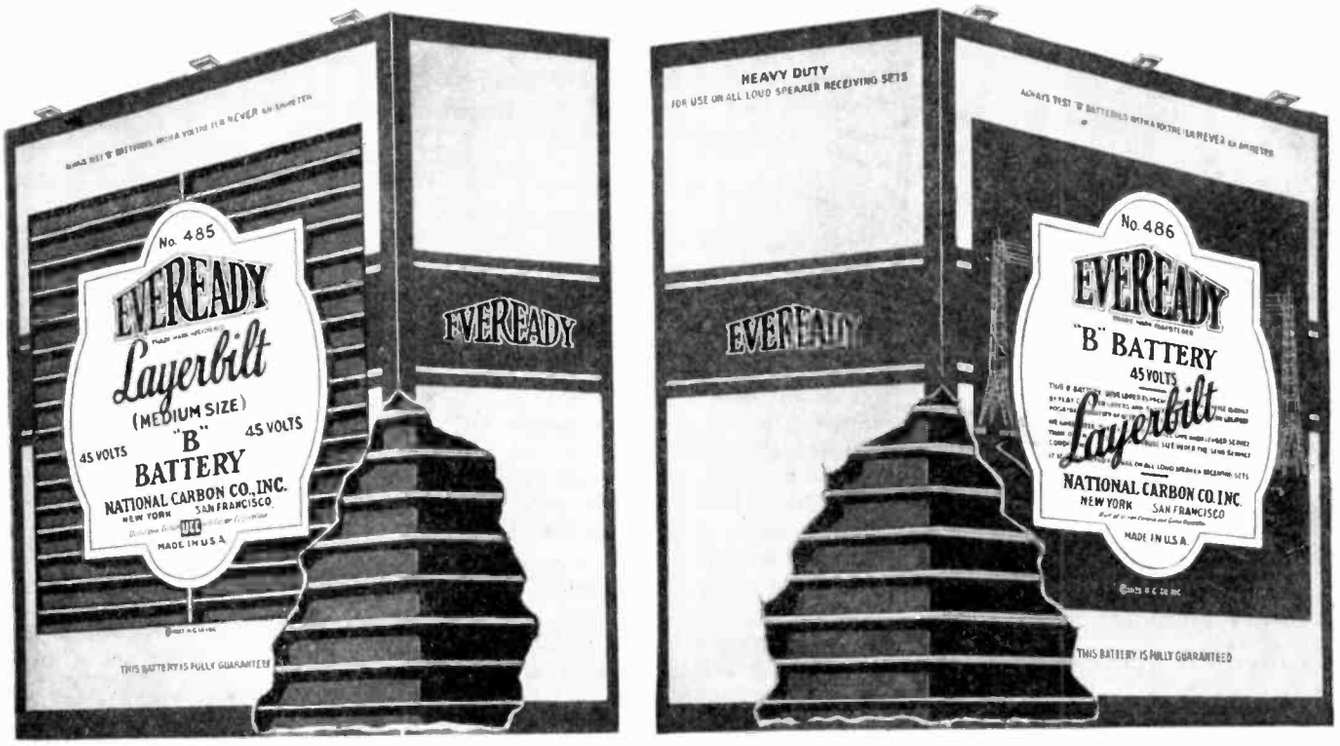
Fortunately the wind continued moderate, and we accomplished the remainder of the trip without incident, arriving at our starting point in East Boston at 6 p. m., Thursday; having failed to make the market for that day because of our salvaging activities, but with everyone happy in the knowledge of an extra night at home.

The following spring, in March, a check was received for my share of the salvage money. A perfectly good check 'twas, too, but the amount it was drawn for read "Seven dollars and sixty-nine cents." Hi!

medium size **$2.95**
Eveready
Layerbilt No. 485

heavy duty **$4.25**
Eveready
Layerbilt No. 486

cost but little more



and last much longer

EITHER of these Eveready Layerbilt "B" Batteries costs only a few cents more than cylindrical cell batteries of the same size, but last much longer.

Longer life — much less frequent renewals — greater economy—greater reliability—greater convenience—those are the things the Eveready Layerbilt construction gives you.

Since the Eveready Layerbilt comes in two sizes, the many advantages of Eveready Layerbilt construction can be had by everyone. One of these batteries is the famous Eveready Layerbilt No. 486, the original Eveready "B" Battery to be made of flat cells instead of cylindrical ones. This is the largest of the Eveready Layerbilts, and lasts longest. It costs only 25 cents more than the cylindrical cell Eveready of the same size.

The other is the newer Eveready Layerbilt No. 485. It comes in the same size as the Eveready "B" Battery No. 772, which uses cylindrical cells. The flat cells of the new No. 485 make it last much longer. It is the most economical medium size Eveready "B" Battery, and costs only 20 cents more than the No. 772.

These two batteries will fit the needs of about 99% of modern receivers.

The flat cells of which Eveready Layerbilts are made fill all available space within the battery case, avoiding the useless holes between the cells of a cylindrical cell battery. More materials mean longer life. For the greatest possible economy, convenience and satisfaction from "B" batteries, buy Eveready Layerbilts.

NATIONAL CARBON CO., INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night
East of the Rockies
8 P. M. Eastern Standard Time
Through WEAF and associated N. B. C. stations
On the Pacific Coast
8 P. M. Pacific Standard Time
Through N. B. C. Pacific Coast network

EVEREADY
Radio Batteries

Layerbilt construction is a patented Eveready feature. Only Eveready makes Layerbilt batteries.

FLYING RADIO

(Continued from Page 19)

land communicating with the ship, as we want an arrangement whereby the ship can communicate with land stations. In other words, it would be of little advantage to call the pilot of an airplane, except upon rare occasions; on the other hand, there would be a decided advantage in having an airplane send out its "call letters" at regular intervals, as these could be picked up by land stations and would indicate unmistakably that the ship was still on the wing.

It is possible to build a small, simple, self-acting transmitter deriving its power from a wind-driven dynamo, having for a part of its mechanism a rotating metal disc, also geared to the windwheel, upon the edge of which are contact pieces corresponding to the ship's call letters. While the plane is in motion this arrangement will send out its call in the wireless code with every revolution of the disc. In the event the signals stopped it would be taken for granted the flyer was down. His position could then be estimated from the length of time he had been out, the speed of his ship and the direction in which he was known to have been flying. Land stations could communicate either directly or by relaying with ships in the vicinity of the airplane in the hope of effecting a rescue.

Such a set would in no way interfere with the pilot, the weight would be almost nothing and the space it occupied would be negligible. If the construction were sturdy and the instrument rigidly attached to the plane in such a manner as to avoid straining and twisting, the set should require no attention whatever and should prove absolutely reliable. What the transmitter lacked in power would be compensated for by the use of sensitive receiving apparatus at the land station where a few tubes and batteries more or less would not bring about the problem encountered in the flying ship.

This arrangement practically amounts to a reversal of the idea involved in the radio beacon. For here the pilot, instead of listening to the beacon signals and trying to keep his ship riding down the crest of the "beam," so to say, sends out his own signals, automatically of course, and the stations on land do the listening, following his progress through the sky. Neither system, however, need interfere with the use of the other, should an aviator desire to take advantage of both simultaneously.

For the plane carrying more than one person the above arrangement should be modified somewhat. Imagine a set wherein the same coils, condensers, tubes and batteries (or wind dynamo) are used for both transmitting and receiving. Here would be two-way communition at a minimum of expense, space, weight and apparatus. By re-arranging

(Continued on Page 48)

New Cabinets of Extraordinary Beauty

A YEAR ago the Jensen Dynamic Speaker inaugurated a new era of radio reproduction. Today the market is flooded with quickly designed and hastily assembled dynamic speakers, but Jensen holds undisputed leadership. No single event in the radio industry holds such significance as Peter L. Jensen's development of the dynamic speaker and we predict that no other manufacturer will be able to duplicate such established supremacy without years of research and manufacturing experience in the dynamic speaker field.

The new Jensen models recently announced introduce an entirely new vogue of cabinet design. A new perfection of beauty has been attained surpassing all previous standards of radio furniture design. These new models are equipped with a small toggle switch instead of a clumsy feed-through switch, and the cords are silk covered to match the cabinet finish. These and all the other distinctive Jensen qualities and exclusive features are possible because Jensen Dynamic Speakers are built to a quality standard with price a secondary consideration. Volume production and manufacturing experience account for their moderate cost.

When you visit the Jensen Exhibits at the leading Radio Shows, you will appreciate the extra value—at no extra cost—which is inbuilt in every cabinet. We believe you will agree to our claim, "The Jensen Dynamic Speaker, the Finest in Radio."

SEE IT AT THE SAN FRANCISCO AND LOS ANGELES RADIO SHOWS

New Model

JENSEN DYNAMIC SPEAKERS

D-4	Jensen Dynamic Speaker Unit for 6 volt Operation	$40.00
D-5	Jensen Dynamic Speaker Unit for 90 to 180 D. C. volt Operation	43.00
D-4AC	Jensen Dynamic Speaker Unit for 110 volt A. C. Operation	55.00
D-64	Jensen Model 6 Cabinet with D-4 Dynamic Speaker Unit	55.00
D-65	Jensen Model 6 Cabinet with D-5 Dynamic Speaker Unit	58.00
D-64AC	Jensen Model 6 Cabinet with D-4AC Dynamic Speaker Unit	70.00
D-74	Jensen Model 7 Console with D-4 Dynamic Speaker Unit	75.00
D-75	Jensen Model 7 Console with D-5 Dynamic Speaker Unit	78.00
D-74AC	Jensen Model 7 Console with D-4AC Dynamic Speaker Unit	90.00

Jensen Radio Mfg. Co.

212 Ninth Street
OAKLAND

338 North Kedzie Avenue
CHICAGO

Jensen Dynamic Speakers are made in types to operate with 110 volt A.C. house current, 6 volt storage battery, "A" eliminator or trickle charger, 110 volt D.C. house current and 90 to 180 volt D.C. current as provided by many of the late model radio sets. The sensitivity of the instruments is the same in any case.

JENSEN

DYNAMIC·SPEAKER

"The Finest in Radio"

A special two-color folder describes the complete line of Jensen Dynamic Speakers. Write for a copy.

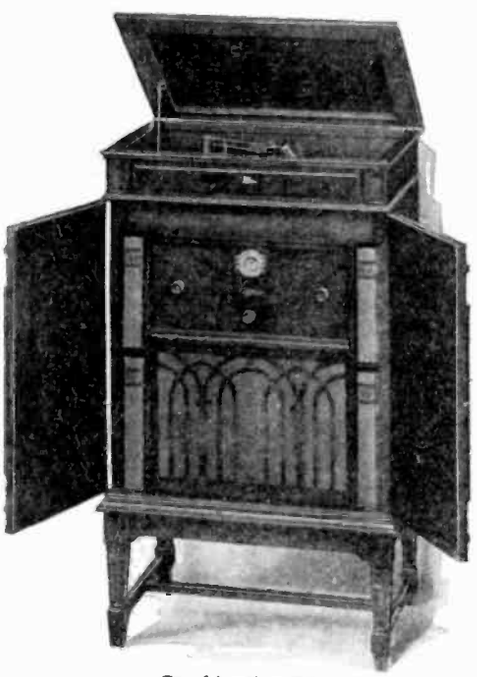
Licensed under Magnavox Patents

Gilfillan

New Model 33 and Table

New Radio Principles

VERY decided improvements and new features have been designed and built into these new models. They of course, are A C operated but with the "hum" eliminated by a two "hum" controls. They have maximum selectivity—all oscillation being prevented by our neutrodyne feature. They are highly sensitive to weak distant stations. Our electric wave filter prevents severe interference. Extra safety factors and a 2-way switch are provided to prevent overloading and to compensate for variations in line voltage. Single tuning dial, volume control and Antenna Compensator Control are shown on the panels. Push-pull amplification with power supply of our own design and manufacture. All models are furnished with pick-up jacks for playing phonograph records. Jensen Dynamic speakers are used and every set is bench-made, thoroughly inspected and tested by expert engineers.



Combination 77

See These New Models!

They lead the field for radio and mechanical designing and excellence of workmanship which is the assurance of their leadership in performance.

See these New Models at the San Francisco and Los Angeles Radio Shows.

GILFILLAN BROS., INC.

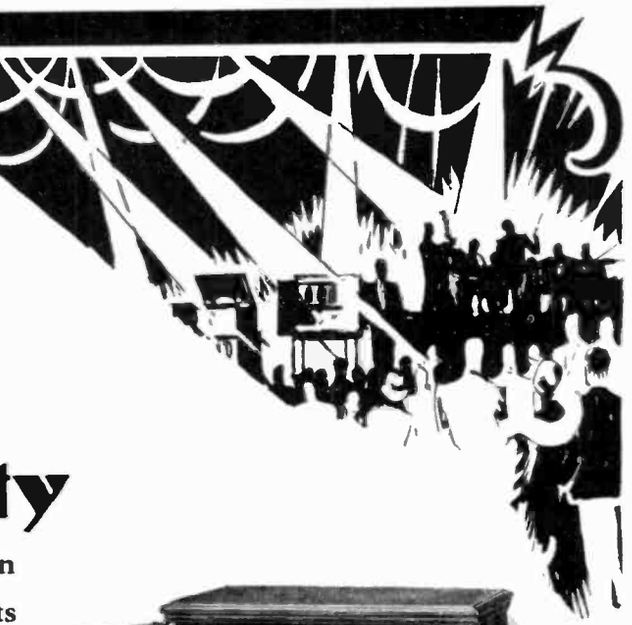
1815 Venice Boulevard, Los Angeles

536 Mission Street
SAN FRANCISCO

Republican and Terry Streets
SEATTLE

THE RICHEST TONE IN RADIO

Radio



New Tone Beauty

TONE has always been the basis of Gilfillan reputation. But this year, new refinements and features have been made to improve and widen the range of Gilfillan tone quality. The widest range of tone reproduction has been accomplished. A uniformly amplified audio range of 50 to 5,000 cycles reproduces with utmost fidelity all the over-tones and tone shadings of voices or instruments making the most realistic and natural radio reproduction. The entire tone range of a full symphony orchestra is reproduced as brilliantly and distinctly as though the orchestra were in the same room. Even the playing of individual instruments can be recognized. Its realism is astounding—no other radio tone equals it's richness and clear enunciation.

New Model 66

New Model 44

Hear This New Tone!

Some very good Dealer's franchises open—Write us at once.

It is the Tone Triumph of the year. Write us and let us give you the name of the Gilfillan dealer nearest you, where you can hear this richest radio tone.

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536 Mission Street
SAN FRANCISCO

Republican and Terry Streets
SEATTLE

BUILT FOR WESTERN RECEPTION

FLYING RADIO

(Continued from Page 44)

the circuits somewhat, by accepting a compromise between perfect transmission and perfect reception in order to gain compactness and simplicity, a practical working machine may be created which will put short wave signals through the air for a distance of many miles. The set—in fact, any set—should be placed far back from the motors of the ship in order to avoid interference from the ignition system. It should be completely shielded. Through a metal conduit, grounded to the frame of the plane, wires could be run to the headphones and transmitting key at the operator's seat. Also, there should be a lever located beside him for operating the throw-over switch, the switch itself being located within the metal shielding box. This lever should have three positions, the first cutting in the automatic signalling device, the second cutting in the transmitting key when the operator desired to send a message, the third position allowing the operator to listen in during two-way communication with shore stations or, perhaps, ships below him. No doubt a fixed-tune arrangement would be the best—would at least simplify any attempt at two-way communication from the viewpoint of the operator aboard the plane—all transmitting and receiving at both ends of the "line" being carried on over the same wavelength, thus eliminating the necessity for tuning. If the ship were making regular trips over long distances, all batteries should be replaced entirely after each flight, if batteries were used. A long single wire lowered from a reel and held taut by a weight constitutes the aerial, and this would be coupled to the grid side of the tube, or to the plate side, by means of the throw-over switch, according as the operator were receiving or sending.

This is a worthwhile field for experimentation. Whosoever perfects a reliable and *acceptable* means of linking the airplane with the earth by means of radio not only covers himself with glory, but bestows a blessing upon all of those who fly and those who anxiously wait below.

TUBE IMPROVEMENTS

(Continued from Page 21)

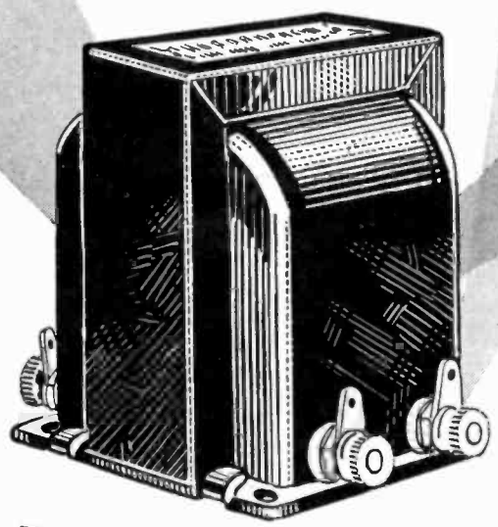
Only a very slight increase in grid-plate capacity resulted from the change.

The next change came in 1925, when the X type base was announced, this tube being shown as No. 5 in the picture. No change was made in the construction of the tube, and its characteristics were the same as its predecessor. In 1927, however, the length of the bakelite base was shortened, and the bulb made longer, to improve the appearance of the product.

This tube, No. 6 in Fig. 1, continued

(Continued on Page 50)

A NEW NOTE IN AUDIO AMPLIFICATION



THORDARSON R-300 AUDIO TRANSFORMER

SUPREME in musical performance, the new Thordarson R-300 Audio Transformer brings a greater realism to radio reproduction. Introducing a new core material, "DX-Metal" (a product of the Thordarson Laboratory), the amplification range has been extended still further into the lower register, so that even the deepest tones now may be reproduced with amazing fidelity.

The amplification curve of this transformer is practically a straight line from 30 cycles to 8,000 cycles. A high frequency cut-off is provided at 8,000 cycles to confine the amplification to useful frequencies only, and to eliminate undesirable scratch that may reach the audio transformer.

When you hear the R-300 you will appreciate the popularity of Thordarson transformers among the leading receiving set manufacturers. The R-300 retails for $8.00.

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.

Power Supply Transformers

These transformers supply full wave rectifiers using two UX-281 tubes, for power amplifiers using either 210 or 250 types power amplifying tubes as follows: T-2098 for two 210 power tubes, $20.00; T-2900 for single 250 power tube, $20.00; T-2950 for two 250 tubes, $29.50.

Double Choke Units

Consist of two 30 henry chokes in one case. T-2099 for use with power supply transformer T-2098, $14; T-3099 for use with transformer T-2900, $16; T-3100 for use with transformer T-2950, $18.

Power Compacts

A very efficient and compact form of power supply unit. Power transformer and filter chokes all in one case. Type R-171 for Raytheon rectifier and 171 type power tube, $15.00; Type R-210 for UX-281 rectifier and 210 power tube, $20.00; Type R-280 for UX-280 rectifier and 171 power tube, $17.00.

Speaker Coupling Transformers

A complete line of transformers to couple either single or push-pull 171, 210 or 250 power tubes into either high impedance or dynamic speakers. Prices from $6.00 to $12.00.

Screen Grid Audio Coupler

The Thordarson Z-Coupler T-2909 is a special impedance unit designed to couple a screen grid tube in the audio amplifier into a power tube. Produces excellent base note reproduction and amplification vastly in excess of ordinary systems. Price, $12.00.

THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill. 3583-G

Gentlemen: Please send me your constructional booklets on your power amplifiers. I am especially interested in amplifiers using.....tubes.

Name.....

Street and No......

Town.....*State*.....

TUBE IMPROVEMENTS

(Continued from Page 48)

in use until the spring of 1928, when another, and to date the last, improvement in the tube was made. This tube, No. 7 in the picture, employed a new construction, known as the "mica disc" principle of filament suspension. This change can be seen more clearly in Fig. 2. Tube *A* is the original "A" tube, as of 1922, with the bulb removed so as to show the structure of the elements. Tube *B* is the improved tube, with closer spaced elements and more rugged construction, and Tube *C* is the new mica disc type. By changing to the new method of filament suspension, and arrangement of the grid and plate structure, the tube is practically free from liability to damage during shipment, and the microphonic noises have been greatly reduced. The contact pins were nickel plated, insuring better contact with the socket springs.

The improvements in construction of the tube have been accompanied by greatly improved production methods, enabling savings to be made which have been rapidly passed on to the user. For this reason the improved rugged tube available today costs only a little more than one-eighth as much as the first "A" tubes, which sold at $9.00 for a short time after their introduction.

FIELD STRENGTH RECORDER

(Continued from Page 20)

change the system retains its calibration with sufficient accuracy (within 10 per cent) over periods of several months.

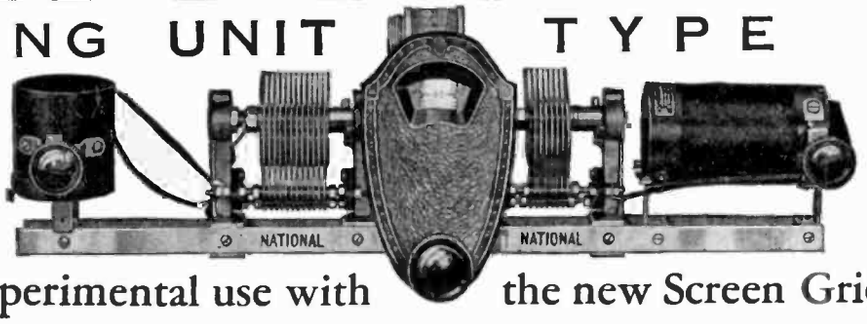
The last audio-frequency amplifier is coupled to a rectifier circuit, containing the recording galvanometer, through an air-core audio-frequency transformer. A three-electrode tube having the plate and grid connected is used for rectification. Generally, tubes used in this manner give a slight galvanometer deflection, when no signal is present, due to the initial velocity of the electrons. This current, however, can be balanced out by a reversed electromotive force across the galvanometer if it is comparable to the current received from signals. Records of variations of signals and atmospherics are made with a Cambridge-Paul Thread Recorder.

This instrument is essentially a sensitive recording galvanometer having a moving coil arranged to give a series of instantaneous records of the deflections of the galvanometer pointer. The moving coil of the galvanometer is suspended between the poles of a magnet and has attached to it a pointer which overhangs the drum. Between the pointer and the drum an inked thread is stretched parallel to the axis of the drum, at a short distance above its surface. A presser bar is situated above the galvanometer pointer. This bar is normally held free

(Continued on Page 52)

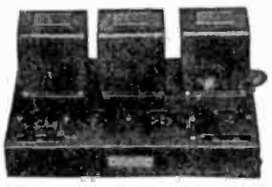
NATIONAL

TUNING UNIT TYPE 222



For Experimental use with the new Screen Grid Tube

A NEW NATIONAL Browning-Drake Transformer, together with a new and beautiful Velvet Vernier Drum dial, Type F, brings out the good qualities of this highly efficient tube in a manner that is both pleasing and inspiring to the experimenter. Perfectly stable operation is obtained without the use of cumbersome shields or other energy-absorbing devices. The rigid workmanlike construction of this unit makes its installation simple and permanent. No cutting of sub-panel is required. Everything goes into place with a minimum of fitting and wiring. You will be agreeably surprised at the efficient results derived with this tuning-unit when used with the UX 222 tubes. *List Price type 222* **$25.00.** Two other types also available.

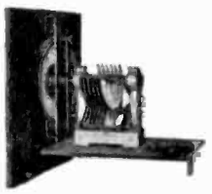


NATIONAL PUSH-PULL AMPLIFIER-for 210 or 250 tubes.

For the fidelity and volume of distortionless audio reproduction now required by modern radio standards and now made possible by recent speaker developments. The curve is "flat" over practically all audio-frequencies, the power output sufficient for the largest hall. The design is compact—the quality is NATIONAL.

NATIONAL SHORT-WAVE EQUIPMENT for use with 222 tube

This NATIONAL Velvet Vernier Dial Type E and special Equicycle Short-Wave Condenser are now offered by NATIONAL CO. INC., for experimental work in short-wave reception of broadcast, code and television signals. Also offered are newly designed short-wave R. F. Transformers in a set of 4, covering the bands from 15 to 115 meters, R. F. Choke, H. F. Impedance, special Panel and sub-Panel with all sockets and mounting clips.



Send for new Bulletin 130-P

We shall be at the Pacific Radio Show, San Francisco, Don Wallace in Charge. Booth No. 123. Look us up.

NATIONAL CO · INC · W · A · READY · PRES · MALDEN · MASS ·

Two radio magazines for the price of **ONE!**

Hundreds and hundreds of readers of "RADIO" have availed themselves of our special money saving offer whereby you subscribe to two radio magazines for the price of one. "CITIZENS' RADIO CALL BOOK" and "RADIO"—both magazines sent to your address for a full year for the price of a one year subscription to "RADIO"—$2.50. The next issue of the "CALL BOOK" will be out on September first. Better subscribe now to avoid missing it. "RADIO" will be sent to you for 12 months, starting with our September issue, out on August 25th. Save $2.50 by subscribing today.

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Here is $2.50. Send me "RADIO" and "CITIZENS' RADIO CALL BOOK" for one full year starting with the SEPTEMBER issue of both magazines.

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Street and No.....

City and State.....

MODERN

THE tremendous increase in popularity of powerful amplifiers and power units has brought with it an insistent demand for modern condensers and resistors, built to rigid standards and according to all improved methods.

Aerovox condensers and resistors are meeting the most rigorous tests imposed by modern power equipment. They are built to stand up under the severest service conditions.

Write for "The Research Worker" a free monthly publication that will keep you abreast of the latest developments in radio.

AEROVOX

68-A WASHINGTON ST.,
BROOKLYN, N. Y.

FIELD STRENGTH RECORDER

(Continued from Page 50)

of the pointer by a cam and its follower. At regular intervals the cam makes a half revolution, first allowing the presser bar to fall upon the pointer and immediately raising it to its normal position. As the presser bar falls it depresses the pointer on the drum, dipping the inked thread between the pointer and the paper, producing a dot on the paper making a visible record of the deflection of the galvanometer at the moment. The drum of the recorder is arranged for two speeds, one giving a complete revolution in 24 hours and one giving a revolution every two hours for short time records. For the present purpose the 24-hour revolution is used.

The clock controlling the entire system has its face plate equipped with twelve brass segments arranged in a circle, each segment representing five minutes. A spring on the end of the minute-hand makes an electrical connection with each segment as it passes over. The cam allows the presser bar to depress once every 30 seconds, making ten dots on the paper for one five-minute segment.

For the present purpose, the first five-minute segment in the hour is connected so that when the minute-hand contact passes over it, a relay closes, turning on the receiving set, tuned to the station having the highest frequency of those to be measured. The amplifiers, the rectifier tube and the presser bar control are switched on simultaneously by means of other relays.

The following segments operate the same relays as the first, but are arranged to close other relays which connect parallel variable capacities across the primary and secondary tuning capacities of the receiving set. This allows the receiver to be tuned to other frequencies effective only for a certain clock segment.

The entire system is slightly sensitive to change of pitch of a signal. The pitch of signals being recorded is, therefore, set to 1000 cycles by means of an electrically-driven 1000-cycle tuning fork. A 30-ohm damping resistance across the galvanometer coil slows its period so that it is little affected by change of speed in transmission. Absolute calibration of the system is obtained from a radio-frequency oscillator feeding into the antenna circuit; while the amplifiers and rectifier may be checked at any time by connecting them to the output of the telephone comparator. The deflection-current curve of the galvanometer is nearly straight over the usual range of observations. As a protection against heavy atmospherics the deflection is limited just below full scale by limiting the output of the last amplifier tube.

Continuous records of several stations and atmospheric disturbances have been made at this laboratory since 1926.

Replace your old radio!

Seven and a half million sets now obsolete

1928 Features

Few radios AT ANY PRICE combine ALL of these features which are essential to today's new radio reception.

AMPLIFICATION
Neutrodyne 10×10×10-1000
Other systems 5×5×5-125

Crosley Radios tune efficiently
Crosley Neutrodyne circuit is sharp, sensitive and selective. Distant stations are easily found. Local stations tune without squealing.

Crosley Radios are shielded
Each element shielded from each other provides maximum selectivity and *is featured* in the most expensively made sets.

Crosley Radios are selective
In crowded districts where many local stations fill the air you find in Crosley radio a means of listening to ONE at a time.

Crosley Radios have volume
Volume may be increased to tremendous proportions without distortion. This provides plenty of volume for power speakers.

Crosley Radios can be softened to a whisper
A positive volume control enables operator to cut any program down to faint and scarcely audible reception.

Crosley Radios fit any kind of furniture
Outside cases are easily removable and chassis are quickly fitted into any type of shape console cabinet.

Crosley Radios have illuminated dials
The modern way enables you to see clearly in the dusk or in shadowy corners.

Your set has served you well *but* you will *not be satisfied* with *its strained stringy tones when* you hear a *new full toned power speaker* Crosley *set*

$25 New Dynamic DYNACONE *Amazing Speaker*

6 tube GEMBOX AC ELECTRIC $65

FIVE DAYS FREE TRIAL IN YOUR OWN HOME

Crosley originated the idea of a national policy of home demonstration. Home is the place to buy a radio set. Compare a Crosley radio set with any other that you are contemplating buying and you will choose the Crosley. If you have electric current in your home, your set should be a modern, AC electric receiver. A converted battery set is out of date. If you pay more than $65.00 for a radio set, it should have two 171 output tubes, push-pull instead of one, eight tubes instead of seven. To be up-to-date, your new radio set should be designed to take and supply the current for a power or dynamic type of speaker. Crosley sets are so designed. Other sets designed for power speaker use are much more costly. You should demand the tone quality and the performance resulting from high power output coupled with dynamic speaker. Your set should be completely shielded and incorporate the highly sensitive, genuine, neutrodyne circuit. It should have a modern illuminated dial. An examination of Crosley radio sets will show you many other modern exclusive features.

$25.00 NEW DYNAMIC DYNACONE AMAZING SPEAKER!

The Dynacone is a new revolutionary speaker at a price less than many good magnetic speakers. The first minute you hear this new reproducer, it will thrill you to a new conception of what radio broadcast reception should be. Crosley manufacturing speed and straight line methods permit the extremely low price.

WHY PAY MORE THAN CROSLEY PRICES?

We urge you to listen to a Crosley radio set, try it, put it to any test you can think of. No sets that approximate Crosley prices can compare in performance. Why pay a high price for a set that can compare favorably with Crosley–

SIX TUBE GEMBOX AC ELECTRIC, $65.00

Self-Contained AC electric receiver. It utilizes two radio, detector, two audio and a rectifier tube—171 power output tube. Designed for use with the new Crosley Dynamic power speaker. Operates from 110 volts 60 cycle AC house lighting current.
Crosley prices do not include tubes.

1928's greatest radio

8 tube SHOWBOX $80

Genuine Neutrodyne, 3-stages radio amplification, detector, 3 stages audio (last two being 171 push-pull power tubes) and 280 rectifier tube.

8 tube JEWELBOX $95

Genuine Neutrodyne, 3 stages radio amplification—227 detector tube, 3 stages audio frequency, and 280 rectifier. Shielded coils, modern illuminated dial, highly selective and powerful.

6 tube BANDBOX $55

An improved model of the 1927 receiver that led the world to better radio. Genuine Neutrodyne—every modern fitting and refinement including illuminated dial. The set you can safely buy where AC current is not available—selective, sensitive.

5 tube BANDBOX JR. $35

Operates entirely from dry cells and is especially designed where no electric current is available either for AC radio or recharging storage batteries.

Improved MUSICONE $15

The outstanding Magnetic type speaker available, still maintaining its leadership, today, as from its inception in 1925. Improved, it is without question the greatest speaker value you can find.

CROSLEY

The Crosley Radio Corporation
Powel Crosley, Jr., Pres.
Cincinnati, Ohio

Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.

Your name.....

Address.....

5 DAY FREE TRIAL COUPON

Mail this coupon to the factory. Nearest dealer will bring you receiver checked.

Please let me try receiver and proper speaker, I have checked, in my own home without obligation for 5 days.

JEWELBOX ☐ SHOWBOX ☐
GEMBOX ☐ BANDBOX ☐ BANDBOX JR. ☐

SEVEN-TUBE A.C. RECEIVER

(Continued from Page 23)

a separate baseboard several feet from the receiver to eliminate a.c. induction and two cables should be run to the receiver. One cable supplies 5 volts, 2½ volts and 1½ volts a.c. for the filaments, and the other cable furnishes the *B* power. In wiring the receiver the filament leads should be twisted and bunched together towards the rear edge of the baseboard. This latter arrangement keeps the a.c. leads away from exposed grid leads. The use of variable center-tapped filament resistances is another important item in constructing an a.c. tube receiver. The use of a heater-type tube in the first audio stage and push-pull amplification in the second stage of audio, helps to keep a.c. hum down to a minimum. The problem of a.c. hum is important when an audio amplifier is used which amplifies frequences down as low as 60 cycles nearly as well as at 1000 cycles. That factor and the use of a good dynamic type of loudspeaker, which will actually reproduce the real low tones, may be sources of grief to a constructor unless some of the suggestions mentioned are followed. Nevertheless, the use of an excellent audio amplifier and dynamic loudspeaker

LIST OF PARTS

C—.006 mfd. fixed condensers.
C_1—.0005 mfd. variable condenser.
C_2, C_3, C_4, C_5—.00035 mfd. variable 4-gang condenser.
C_6—.00025 grid condenser.
C_7—.0005 mfd. max. variodenser.
C_8—.0001 mfd. max. variodenser.
C_9—.1 mfd. by-pass condenser.
C_{10}—2 mfd.
C_{11}—1 mfd.
C_{12}—6 mfd.
C_{13}—2 mfd.
C_{14}—2 mfd.
R—1000-ohm semi-variable resistances.
R_1—0-10,000-ohm volume control.
R_2—800-ohm resistor.
R_3—1000-ohm resistor.
R_4—5000-ohm semi-variable resistor.
R_5—3-megohm grid leak.
R_6, R_7—25,000-ohm voltage divider resistors.
R_8—½-megohms leak.
4—R.F. transformers (see text).
1—Antenna coil.
1—Double drum dial.
1—7 x 24 in. walnut veneer panel.
1—12 x 24 in. baseboard.
1—Audio transformer.
1—Input push-pull transformer.
1—Output push-pull transformer.
6—UX tube sockets.
2—UY tube sockets.
3—UV 226 tubes.
2—UY 227 tubes.
2—UV 171 tubes.
1—UV 280 tubes.
1—Power pack (power transformer and two 30-henry chokes).
1—Filament transformer.
4—80-millihenry radio-frequency chokes.
6—.001 filament r. f. by-pass condensers.
2—Variable center tap filament resistors.
1—Fixed center tap filament resistors.

is to be greatly recommended in order to fully enjoy good musical programs.

The adjustments of the receiver are simple. C_7 should be adjusted by means of a wooden screw driver until very little detector regeneration is present; that is, at minimum capacity. The trimmer condensers of C_2, C_3, C_4 and C_5 should be adjusted until the set is most selective on some local station. The resistors R should be about 1000 ohms or somewhat less. The variable center-tap filament resistors should be adjusted until the a.c. hum disappears or is a minimum. The 45 and 135-volt taps should be adjusted, with the tubes operating, until the correct values are obtained as measured with a voltmeter. The variodensers C_7 and C_8 and the resistance R_4 should be adjusted after the other adjustments have been completed. These three adjustments should be made so that the detector will spill into oscillation over entire broadcast band when C_7 is turned up a little too far. This automatic detector regeneration scheme is a circuit which was recently developed by Mr. Clement.

Since the antenna circuit is tuned, and three tuned r.f. stages with a regenerative detector are incorporated into the receiver, the selectivity and sensitivity are very excellent. It is possible to receive distant stations through local ones with very good quality. The quality on local stations is excellent.

QUESTIONS AND ANSWERS

What changes will I have to make in my 45 kilocycle superheterodyne, so as to use the type A tubes throughout?—L. J., Brantford, N. D.

Diagrams showing how to make this change have appeared in these columns several times during the past three years. Where the transformers peak at 45 kilocycles with type 99 tubes, the frequency is lowered to 40 kilocycles with type *A* tubes. If the i.f. transformers peak at 52 k.c. with the 99 tubes, then they will peak at about 45 k.c. with the type *A* tubes. If the transformers are two or three years old, they are probably 45 k.c. with 99 tubes, and when the *A* tubes are installed the size of the filter condenser should be increased from .00025 mfd. to .0003 mfd. If they are the 52 k.c. type, then the condenser should be .00025 mfd. instead of .0002 mfd., the latter tuning the filter to 52 k.c. The 25-ohm volume control rheostat controlling the filaments of the first two i.f. tubes should be omitted, and the filaments of all eight tubes controlled from a single 1-ohm rheostat. Volume should be controlled by shunting a 0-50,000-ohm variable resistance across the primary of the second i.f. transformer. If trouble from oscillation is experienced, it may be necessary to shunt the primary of the third i.f. transformer with a 12,000-ohm fixed resistance, as the amplification per stage with the type *A* tubes will be considerably greater than is possible with the 99 tubes, and this increased overall gain may cause the amplifier to oscillate badly when the volume control rheostat is set near maximum.

R. F. CHOKES

(Continued from Page 31)

301A tube, a 0.05-megohm grid leak, and a 1:5-milliampere d.c. grid meter, were parts of the layout. It was proposed to run the driver first as a series-feed oscillator, Fig. 2a, and take the readings of grid current at each dial setting as a measure of the strength of oscillations. This was perfectly permissible, for, with other factors constant, the flow of grid current is directly dependent on the r.f. voltage across the oscillating circuit. These data, using series feed, were taken as the standard of comparison to see how much introduction of the choke in shunt feed lowered the strength of oscillations.

The new chokes for test were jumble-wound on small wooden spools in a variety of winding dimensions, numbers of turns, and so on, data on which are given in Fig. 3. Each choke in turn was connected in at X in the shunt-feed circuit 2b, and was submitted to the oscillation strength test; the resulting readings appear in graphical form in Fig. 3. As may be seen, the best choke of the lot was No. 3; No. 6 choke gave exactly the same curve—it was really two of the No. 3 chokes on one form. The other chokes were worse in varying degrees. No. 1 choke, which had a narrow, deep winding, was worse at the lower waves; No. 5 choke, also with a narrow, deep winding, but plain enamelled wire, was bad at the higher waves, though only slightly more so than No. 4, with a wide shallow winding. It is pointless to try to assign reasons for the various performances of the chokes—perhaps the particular way in which the turns jumbled had as much as anything to do with the results.

The No. 3 wooden-spool choke was not as good as the single-layer-solenoid choke over most of the band, as the tests showed. However, it did not at any point show a series-resonance dip such as the single-layer speciman did at 62 meters. The oscillation strength with either choke was not as high as with series feed. The average difference between the wooden-spool and the single-layer choke was about the same as the difference between the single-layer choke and series feed.

The picture shows the Hartley grid-meter driver and some of the chokes that were tested. The operating range of a choke can be extended by winding two or more different-dimensioned sections in series, each section to be particularly effective over one portion of the wave range. The forms for the chokes can be made from sections of spools, with end flanges of cardboard of thin formica. Thus chokes can be developed to order in a short time if only a grid-meter driver is at hand.

Television Picture Frequencies

THERE seems to be some confusion as to the number of images which must be transmitted per second to eliminate the "flicker" in television. Some investigators recommend the transmission of ten to twenty images per second, depending upon the efficiency or the inherent limitations of their systems. The conventional picture frequency is usually stated to be 16 images per second, which is substantially correct, although Dr. Ives, of the Bell Laboratories, points out that the actual image repetition necessary to extinguish flicker is proportional to the logarithm of the field brightness. It is hardly possible that objects scanned at intervals greater than 1/16 second would give results comparable with the modern moving picture.

Know Your Metals

SELENIUM, of course, is a metal," reports *Television*, our British contemporary. "Selenium is undoubtedly non-metallic," avers Smith's "General Chemistry." All right-thinking gentlemen will prefer the latter statement. At the time of its discovery, selenium was thought to be a metal; but, then, selenium was discovered in 1817. Chemists now group the element with sulphur and tellurium although in some of its physical properties it does resemble the metals.

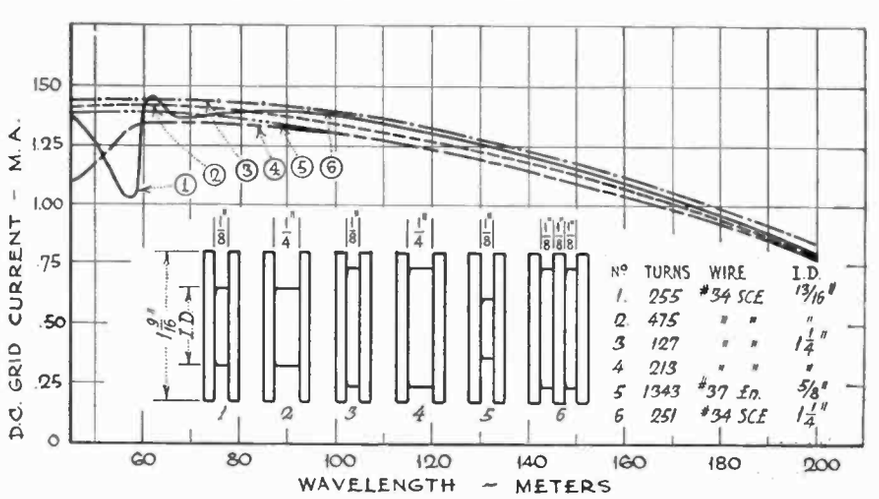

Fig. 3. R.F. Choke Test Data

VACUUM TUBE VOLTMETER

(Continued from Page 30)

0-500-volt range. The *C* battery is not used in these ranges and can be used alone and in conjunction with one 45-volt block to give these voltages. As before, the input voltage is varied in convenient steps and the meter readings noted for the 0-100-volt range and again for the 0-500-volt range.

These data are then plotted, securing curves as shown in Fig. 6. For quick reference, and especially for service use, the calibration chart shown in Fig. 7 is useful. It is made through the use of the calibration curves; the even voltage values, say every ½ volt with the 0-10-volt scale, being picked off on the curve and projected down the "meter reading" scale. This gives two scales, that of the meter and the corresponding value of voltage, on opposite sides of a line making reading easy and rapid. The 0-100 and 0-500-volt curves can be treated similarly and their scale placed above the other as has been done in Fig. 5.

PARTS USED

1 '99 type vacuum tube.
1 0-1 m.a. milliammeter.
1 25-ohm rheostat.
1 400-ohm potentiometer.
1 UX socket.
14 lettered binding posts: +A, —A, +B, +C, 2 —C, 3 +, 3 —, 2 plain.
1 2000-ohm resistor.
1 50,000-ohm resistor.
2 Resistor mountings.
1 .001 molded mica condenser.
1 set switch parts; 14 sw. points, 2 laminated switch arms, 1 knob, 1 pc. 2 3/8 x 2 3/4 in. panel, 6-32 bolts.
3 lengths insulated bus wire, assorted colors.
1 7 x 10 x 3/16 in. panel, black.
1 7 x 10 x 2 in. (inside) walnut case.

It will be noted that the scales are legible and open at the lower end instead of folded as is usually the case. This fortunate characteristic makes possible accurate readings at low inputs and does much to preserve the continuity of the 0-500-volt overall range.

The a.c. high range scale employing the series condenser wherein the input is connected between the "+H" and "AC" binding posts theoretically measures the peak value of the a.c. wave. Actually, however, it measures some value less than this due to the fact that available condensers are not ideal and pass some leakage current. Since the root-mean-square value is the value meant when an a.c. voltage is mentioned, it is best that these ranges be calibrated to read r.m.s. values.

In operation, the filament current is always set to 60 m.a. and the *C* or *B* voltages adjusted to give the correct zero reading. In the case of the 0-10-volt range where the *C* battery potentiometer is used to set zero, variation of *B* voltage as great as 20% has no effect on the calibration, making the use of two 45-volt blocks satisfactory almost regardless of their condition; while for the high ranges, a *C* battery is not used and the zero setting maintained with the *B* battery. Provision is thus made for all the operating adjustments within the instrument; making the use of external ammeters, voltmeters, or other instruments unnecessary.

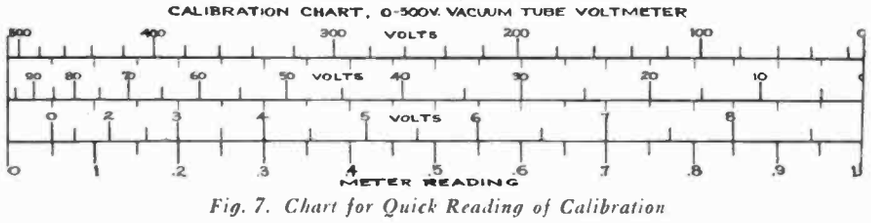

Fig. 7. Chart for Quick Reading of Calibration

ELECTRO-DYNAMIC SPEAKER

(Continued from Page 24)

ally held in place by a metal framework and ring which is a part of the metal housing of the field coil. But for the experimenter a combination such as is shown in Fig. 4 will be easily built without having to work up a sheet metal assembly, and only requires two boards about 2 ft. square, of 1-in. non-warping stock. One board acts as the baffle, and has a 7-in. hole cut in the exact center, while the other board is used to mount the field coil. If there is noticeable reflection from the rear board holes can be

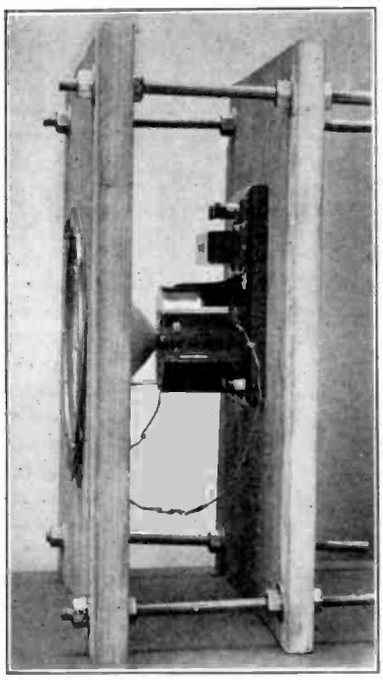

Fig. 4. Completed Speaker in Wooden Frame

drilled in it around the coil mechanism until this reflection becomes negligible. A metal ring is required to hold the cone to the baffle board, and this may be made of strip brass, with an outside diameter of 8¾ in. and an inside diameter of 7 in., using stock about ⅛-in. thick. Holes are drilled in the ring to accommodate seven or eight wood screws, and are shown in the diagram of the cone details.

The instrument is now ready for assembly, and four holes of a size large enough to pass a ½-in. bolt are drilled at the four corners of the two boards, and the boards are then fastened together as shown in Fig. 4., each thickness of board being bounded on each side by a washer and nut. Bolts 10 in. long and ½ in. full thread are required. Adjust the nuts until the boards are exactly parallel, and 7 in. apart. Now place the structure so that the board with the 7-in. hole is parallel with the table, and on top, and place the cone through this hole, centering it and attaching it to the board by means of the metal ring placed over the leather edging of the cone. Do not stretch the leather tightly, as the cone should be free to move at least ¼ in. back and forth when in operation. The two input leads can be fastened to a terminal block on the back of the front board, with sufficient slack to allow free movement of the cone.

Now place the field assembly on the bottom board and adjust its position until the moving coil fits exactly over the air gap around the core, and so that it would not touch the inner or outer edges of the gap at any point, if the boards were to be moved closer together. Now fasten the base of the field coil firmly to the back board, and pile ⅝ in. of brass or copper washers on top of the core of the magnet, arranging them so that all their holes lie in line with the drilled and tapped hole in the center post. Now screw the two boards toward each other by loosening the nuts on the under side of the baffle, and guide the moving coil into the air gap. Bring the two boards closer together until the paper centering washer comes in contact with the pile of washers on the center post. Now place a 6-32 machine screw having a brass washer under the head, through the hole in the paper washer, and into the tapped hole in the core of the magnet. Then note the position of the coil with respect to the air gap, which should be so that you can just see the top turn of its winding flush with the top plate of the magnet structure. If this turn cannot be seen, the coil is too deep, and another spacing washer or two are required between the paper centering washer and the pole piece. If two or more turns are seen, brass washers should be removed from the pole piece until the right adjustment is obtained.

The adjustment of the moving coil as to exact center is next made, loosening

the 6-32 screw, but not removing it. Place the speaker in a vertical position, and with one hand in front and one behind, move the coil around in its gap until you think you have it centered. Then, holding it there, get someone to tighten the screw, and then move the cone in and out, listening for any scraping sounds. If none are heard the coil is clear of both edges of the gap and is in its correct adjustment.

The moving coil must be connected to an output transformer having a turns ratio of at least 25 to 1, as the impedance of this coil is only a few ohms, whereas that of the power tube is several thousand. An output transformer of that type accompanies the old horn type speaker, but if the frequency characteristic of this transformer does not suit the user there are several of correct size which are now obtainable in the open market.

SHORT WAVE RECEIVER

(Continued from Page 28)

no r.f. tube, the wavelength control being the plate tuned circuit of the r.f. amplifier, and the regeneration or oscillation control being the detector plate condenser. The detector filament should be operated at a voltage such that smooth regeneration and spill-over into oscillation takes place, without clicks or howls. If a loud squeal occurs when the set is turned on, the tickler condenser is probably advanced too far, and the capacity should be reduced. If trouble is had with the r.f. amplifier tube oscillating, which may be indicated by numerous loud heterodyne whistles with the antenna disconnected, it can sometimes be eliminated by slightly reducing the plate voltage to the shield grid tube. A change in shield grid voltage will also affect the tube's oscillation point, but as no trouble of any sort was had with the experimental set shown in the picture, it is anticipated that no difficulty of this sort will be experienced by those who build it.

An "electric set," according to the R. M. A. standard nomenclature, is a radio receiver operating from the electric light line, without using batteries. If it employs tubes which obtain filament or heater current from an a.c. line without the use of rectifying devices, but with built-in tube rectifier for plate and grid voltages, it is an "a.c. tube electric set." If it uses current supplied by a d.c. line it is a "d.c. tube electric set." If it is designed to be operated from batteries it is a "battery-operated set." If the latter is connected from a power unit operating from the electric light line and supplying filament and plate potentials to the tubes, it is a "socket-powered set."

Amateur and Special (Experimental and Technical Training School) Station Calls To Be Changed

Under section 2, paragraph d, of article 14 of the International Radiotelegraph Convention, Washington, 1927, call signals of private experimental stations (which under article 1 are "(1) a private station intended for experiments with a view to the development of radio technique or art; (2) stations used by an 'amateur'—that is to say, a duly authorized person who is interested in the radio technique solely with a personal object and without pecuniary interest) shall consist of the letter or letters indicating the nationality and a single figure followed by a group of not more than three letters."

While the requirements of the convention are not actually effective until January 1, 1929, it has been deemed advisable to change the call signals effective October 1, next, as the division desires to show the new signals in the annual list of Amateur Radio Stations of the United States, edition June 30, 1928, rather than to change the calls effective January 1, 1929, and publish the new calls in the June 30, 1929, edition.

Therefore, beginning that date, all stations in the classes above named within the continental limits of the United States are hereby ordered to add to their call signals the letter "W," and those in Alaska, Hawaii, Porto Rico, and the Virgin Islands, should add the letter "K." These letters should precede the call signal; for example, station 4ABC, if within the continental limits of this country, becomes W4ABC and, if in Porto Rico, becomes K4ABC.

International Prefixes for Call Signals Of Amateur Stations Tentatively Assigned

CI. Chile.
CF. Canada.
CL. Cuba.
CN. Morocco.
CP. Bolivia.
CR. Portuguese colonies.
CS. Portugal.
CV. Rumania.
CW. Uruguay.
CZ. Monaco.
D. Germany.
EA. Spain.
EI. Ireland.
EL. Liberia, E.
ES. Estonia.
ET. Ethiopia.
F. France and colonies.
G. England.
HA. Hungary.
HB. Switzerland.
HC. Equador.
HH. Haiti.
HI. Dominican Republic.
HJ. Colombia.
HP. Honduras.
HS. Siam.
I. Italy.
J. Japan.
K. United States.
LA. Norway.
LO. Argentina.
LZ. Bulgaria.
M. England.
N. United States.
OA. Peru.
OH. Finland.
OK. Czechoslovakia.
ON. Belgium and colonies.
OU. Denmark.
PA. Holland.
PJ. Curacao.
PK. Dutch East Indies.
PP. Brazil.
PZ. Surinam.
RA. Russia.
RV. Persia.
RX. Panama.
RY. Lithuania.
SM. Sweden.
SP. Poland.
SU. Egypt.
SV. Greece.
TA. Turkey.
TF. Iceland.
TG. Guatemala.
TI. Costa Rica.
TS. Sarre.
UH. Hedjaz.
UI. Dutch East Indies.
UL. Luxemburg.
UN. Yugoslavia.
UO. Austria.
VE. Canada.
VH. Australia.
VO. Newfoundland.
VP. English colonies.
VT. India.
W. United States.
XA. Mexico.
XG. China.
YA. Afghanistan.
YH. New Hebrides.
YI. Iraq.
YL. Lettonia.
YM. Danzig.
YN. Nicaragua.
YS. San Salvador.
YV. Venezuela.
ZA. Albania.
ZK. New Zealand.
ZP. Paraguay.
ZS. South Africa.

CALLS HEARD

By NU 6QL. J. R. Wells.
Patton, Calif., U. S. A.

oa-2ap, oa-2bb, oa-2dy, oa-2fx, oa-2jy, oa-2lm, oa-2rf, oa-2rx, oa-2sa, oa-2ss, oa-2tm, oa-2yi, oa-3ca, oa-3cp, oa-3ew, oa-3hl, oa-3jc, oa-3jk, oa-3jo, oa-3kr, oa-3lp, oa-3ls, oa-3ut, oa-4ab, oa-4at, oa-4bb, oa-4bd, oa-4fw, oa-4go, oa-4lj, oa-4mn, oa-4pn, oa-4rb, oa-4rg, oa-4wa, oa-4ws, oa-5bg, oa-5hg, oa-5rj, oa-5mb, oa-5wh, oa-5wp, oa-5wp, oa-5hw, oa-5dx, oa-6sa, oa-6mu, oa-6dh, oa-7ch, oa-7bq, oa-7lj, oa-7rl, oz-1ap, oz-1ar, oz-1at, oz-1fe, oz-1fj, oz-2ae, oz-2ai, oz-2am, oz-2aq, oz-2be, oz-2bg, oz-3ar, oz-3au, oz-3aw, oz-4ae, oz-4am, eg-5by, eg-6qb, ef-8fc, ef-8fd, ef-8fk, er-5aa, ei-1cr, sa-hx2, sa-dq4, sa-fa6, sb-1aw, sb-1ak, sc-2ab, sc-2as, sc-3ak, sc-cnag, se-2ah, sh-bzl, sv-1xc, su-1hu, fm-tun2, fl-1ab, fo-a3v, fo-a4e, fo-a6r, ac-1ax, ac-1cl, ac-2ff, ac-2ck, ac-8ag, ac-8zw, ac-gdvb, ac-gmov, ai-2kt, aj-2by, aj-4bk, aj-4zz, aj-8sq, aj-jxax, aj-jxcx, aj-jxix, aj-7eb, am-1ab, am-3ab. nj-2pa, nq-5il, ns-1fmh, ny-1aa.

Amateurs can add to the reputation of their stations and become better known if they put up their call letters on a board fastened to the aerial pole. A piece of half-inch board, one by two feet, painted black and with the call letters in white, would attract many visitors and brother amateurs to the stations. Ordinary house paint can be used for the letters and background. The white letters should be put on first; then the black background painted around them.

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$1597 In Five Months

"The N. R. I. is the best Radio school in the U. S. A. I have made $1597 in five months. I shall always tell my friends that I owe my success to you."
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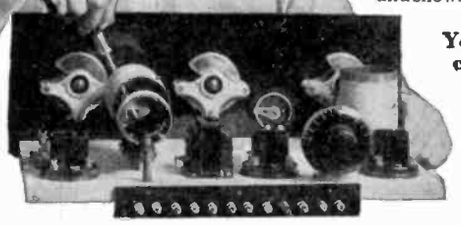

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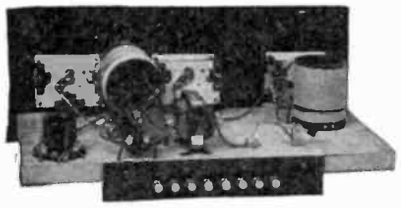

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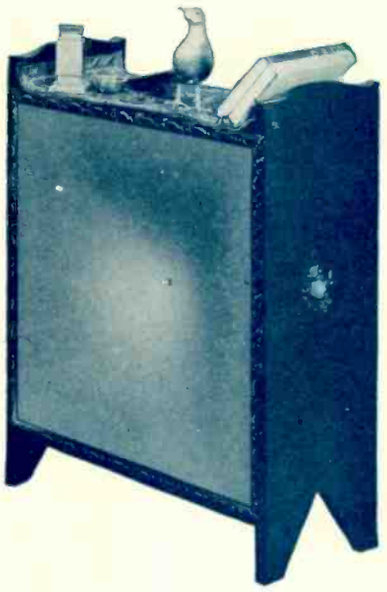

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