DEC. 23 1933

RADIO WORLD

REG. U.S. PAT. OFF.

15c Per Copy

The First and Only National Radio Weekly

613th Consecutive Issue — Twelfth Year

SHORT WAVE SETS AND CONVERTER

RADIO BUDAPEST!

Radio Budapest

A rare announcement, even for the most hardened short-wave Fan to hear, yet Capt. Hall, with his stock model **POSTAL INTERNATIONAL**, received Budapest on the loud speaker with an R7 signal.

You, too, can step out with a new **POSTAL INTERNATIONAL** Short-Wave 9-Tube Superheterodyne. Featuring a Tuned R. F. Pre-Selector Stage, 180 degree band spread on the 25 and 49 meter band, etc. Money back guarantee.

Be sure to see and hear the **POSTAL INTERNATIONAL**. On demonstration from 9 A.M. to 12 Noon. Open until 7:30 P.M., or send 3-cent stamp for **FREE DIAGRAM** and circular describing the **INTERNATIONAL**.

POSTAL RADIO CORP.

135 W. LIBERTY ST., NEW YORK
REctor 2-0328 Room 305

BOTH FOR ONE FULL YEAR

RADIO WORLD and "RADIO NEWS"

$7.00

Canadian and Foreign, $1.50 extra.

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first national radio weekly and the leading monthly for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks, is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total 64 issues for $7.00.

RADIO WORLD, 145 West 45th Street, New York, N. Y.

MODERN TUBE INDEX, all tubes, all the dope, all manufacturers, socket connections, everything. Most complete of all. Sheet 21 x 27 inches. Price 25c. RADIO WORLD, 145 West 45th Street, New York, N. Y.

METAL-WORKING

LATHE

$7.50 COMPLETE

Precision equipment for the small shop. New designs and manufacturing processes make this amazing bargain possible. Complete metal-working lathe with compound slide-rest, combination face-plate and independent chuck and tail center: 6" swing: 24" length, 20 lbs. Send $1.00, Balance plus postage C.O.D. Lathe for wood-turning alone, $4. Attachments for milling, grinding, sanding, saw-table, etc., available at low prices. Order from ad at once and have a complete machine shop. American Machine & Tool Co., 200 Broadway, New York, Dept. R.8.

A Symbol

THE Yule log—symbol of Christmas through the ages. On the great holiday the lord of the manor threw wide the doors, and misery and squalor were forgotten in the cheer of the boar's head and wassail.

Customs change, but the Christmas spirit is ageless. Today millions express it by the purchase of Christmas Seals—the penny stickers that fight tuberculosis—still the greatest public health problem. Your pennies will help.

BUY CHRISTMAS SEALS

Vol. III of RIDER'S MANUAL (A New Book)

Just out, John F. Rider's Vol. III Manual weighs nearly 11 lbs. and has 1,100 pages, all diagrams of commercial receivers, etc. (no text). Sets announced up to May 1st, 1933, are included—and complete information on every one, including resistance values. The volume is original and necessary and does not repeat data that are in Vols. I and II.

A Chronological Catalog and Index of all nationally-advertised radio receivers manufactured and sold in the United States between January, 1921 and January, 1933 are contained in Volume III. This list will be of tremendous aid in the identification of receivers for which the model number is not known.

Complete data include schematic wiring diagrams; chassis wiring diagrams; parts layouts; photographic views of chassis; socket layouts; voltage data; resistor values; condenser values; location of alignment and trimmer condensers; alignment and trimmer adjustment frequencies; intermediate-frequency amplifier peaks; alignment and intermediate-frequency adjustment instructions; color coding; transformer connections; point-to-point data; continuity test data; parts list with prices; special notes.

Complete tabulation of tube data showing electrical characteristics and constants for all of the tubes employed in radio receivers and amplifiers since 1921. Also a table of interchangeable types.

A complete table of I-F. peak frequencies as used in radio receivers. This list augments the information of this type shown upon the diagram pages. Intermediate-frequency amplifier peak information is very important because quite a few of the manufacturers employ more than one figure in their year's production. A wrong guess on your part means trouble.

Order Cat. RM-3 @ $7.50. Remit with order and we pay postage. Order C.O.D. and you pay postage.

Volume II—Order Cat. RM-2 @ $6.50

Volume III of Rider's Manual has a page sequence in accordance with Vols. I and II, and is not sumulative, or repetitive of the earlier volumes. However, it contains an index for all three volumes.

HENNESSY RADIO PUBLICATIONS CORP.

145 WEST 45th STREET, NEW YORK CITY

Powertone Wallace Short Wave Receiver

The battery operated short-wave set which won the Hoover Cup for premier short-wave design and performance; well designed both electrically and mechanically. Built of the finest precision parts, each operating at maximum efficiency at all times; the Wallace has many features to recommend it to all interested in short-wave reception. Among these features are:

1. Band spread tuning for the crowded bands, controlled by a single panel switch. 2. Ultra Low-Loss coils wound with silver ribbon. 3. Each circuit individually controlled. 4. Highly efficient tuned antenna system. 5. Zero body capacity. 6. 15-200 meter tuning range.

The set is for earphone operation, using two 230 tubes, which require a 2-volt filament supply and 45-90 volts of "B" battery.

The receiver uses four plug-in coils whose tuning ranges are:

No. 1. coil—20-32 meters
No. 2. coil—40-60 meters
No. 3. coil— 75-150 meters
No. 4. coil—150-200 meters

Complete kit of parts, with one coil $14.70
Each additional coil 1.15
Wiring and testing (if desired) extra 3.23

Guaranty Radio Goods Co., 145 W. 45th St., New York, N. Y.

RCA INSTITUTES

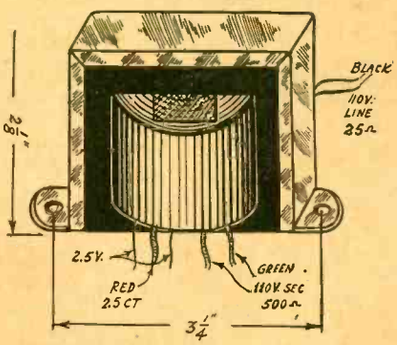
Recognized Standard in Radio Instruction Since 1909

Technical Training Courses in Radio and Associated Electronic Arts

RESIDENT SCHOOLS NEW YORK AND CHICAGO
Illustrated Catalog on Request
EXTENSION COURSES FOR HOME STUDY
under convenient "no obligation" plan.

RCA INSTITUTES, INC.
Dept. WR-1
75 VARICK STREET, NEW YORK
1154 MERCHANDISE MART, CHICAGO

SPECIAL
SMALL POWER TRANSFORMER



Filament-plate transformer, for oscillators, 1 or 2-tube sets, etc.
Primary, 110 volts a-c.
Secondary A, 2.5 volts, center-tapped; stands up to 3 amperes.
Secondary B, 110 volts, not center-tapped.
Excellent for test oscillators with a-c in plate.

Price, $1.10

RADIO WORLD
145 West 45th Street New York, N. Y.

Quick-Action Classified Advertisements

7c a Word—$1.00 Minimum

AIR CORPS TRAINS 600 MEN yearly free; flying, radio, mechanics. Information for appointment, 25c. Lieut. Carroll, Box 533R, Taunton, Mass.

"MODERN STORAGE BATTERY PRACTICE," by A. D. Althouse and Carl H. Turnquist, of Cass Technical High School, Detroit. A new and practical handbook prepared for the beginner and experienced battery man alike, and includes methods, materials, equipment, tables and special data, also index for quick references. 277 pages, 258 illustrations, flexible binding. Price $2.50. RADIO WORLD, 145 W. 45th St., New York City.

"WILLCOX AUTO ELECTRICIAN'S WIRING MANUAL"—Complete wiring diagrams for all U. S. cars made in 1928-1929-1930-1931-1932. Complete data on ignition systems, generators, starting motors, batteries and lighting. Printed on tough, wear-resisting paper that can be washed with gasoline without injury to print or paper. Loose-leaf style in sturdy covers. Size 11 x 12". 300 wiring diagrams. Price $10.00. RADIO WORLD, 145 W. 45th St., New York City.

"AUTOMOBILE REFINISHING," by C. E. Packer, Member of S.A.E. For the car owner and professional refinisher. A practical handbook on the materials, methods and equipment used. 148 pages, 41 illustrations. Price $1.50. RADIO WORLD, 145 W. 45th St., New York City.

"SPECIALIZED AUTO RADIO MANUAL," Vol. I, by John F. Rider—loose leaf—about 300 pages—up to the minute. Letter press printed. All diagrams clear and the figures easy to read. Covers old and new auto radio receivers, and includes recently announced auto radio installations. Price, $3.50. RADIO WORLD, 145 West 45th Street, New York, N. Y.

"RADIO AND TELEVISION," by James R. Cameron. Over 540 pages, 275 illustrations; cloth bound. The subject of radio and television covered in such a manner that it is easily understood even by a beginner. Price $4.00. RADIO WORLD, 145 West 45th St., New York City.

"THE FORD V-EIGHT—'B'-FOUR—'BB'-TRUCK," by C. B. Manly. A New and Practical Book for Everyone Interested in the Construction, Adjustment, Upkeep and Repair of The New Fords. Over 250 pages, 125 illustrations. Complete cross index. Pocket size, flexible leatherette cover. Price $2.00. Radio World, 145 W. 45th St., New York, N. Y.

SPECIAL GIFT ISSUE

Reliable Radio Tips

Watch for This Special Page Weekly

RELIABLE RADIO RUNS GIANT HOLIDAY SALE!!

FOR A PRACTICAL GIFT SUGGESTS GIVING A RADIO—LET THE ENTIRE FAMILY ENJOY IT

Reliable Treasure Chest Receiver

A Handsome Four-Tube "Treasure Chest" model receiver which is a splendid piece of furniture and a high quality midget receiver. The beautifully designed cabinet built by craftsmen will satisfy the most critical person. Tubes used: 1-57, 1-58, 1-80 and 1-47 power pentode. Uses a full sized dynamic speaker. Price **$9.50**

4 tubes $1.45

Reliable 4 and 5 Tube A.C. Midgets

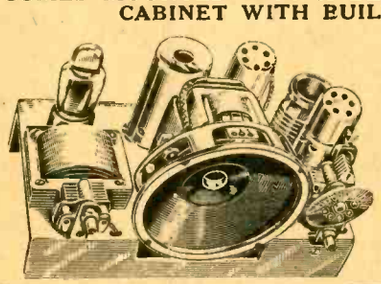
A practical gift for the entire family. The most advanced features are embodied in these receivers. Quiet, smooth, distortionless reception.

Four-tube receiver uses 1-57, 1-58, 1-80, and 1-47 pentode; five-tube set uses 1-57, 1-58, 1-80, and 2-47's. Both models use a dynamic speaker especially designed for the output of the pentodes. The receivers are encased in a beautiful hand-rubbed walnut cabinet. Price, 4-tube A. C. receiver **$9.95**

4 tubes $1.45
Price, 5-tube A. C. receiver.....$12.95
5 tubes $1.95

Four Tube A.C. Short Wave Receiver

COMES MOUNTED INTO A BEAUTIFUL MODERNISTIC CABINET WITH BUILT-IN SPEAKER



Looks like a midget broadcast receiver. Will tune in short wave stations from all parts of the world with ease. Uses four coils to cover the short wave bands from 15 to 200 meters. The built-in power supply is entirely free from hum or disturbing line noises. Uses an ultra-sensitive dynamic speaker to aid in tuning in the weaker signals. Kit of parts..... **$17.50**

Wired and tested.....$2.00 extra
Kit of tubes.....$1.95

Powertone Sending Key

The most practical gift to one who has just become interested in amateur radio. Widely used as a code practice key. Well balanced and fully adjustable. Price.. **75c**

Stromberg-Carlson Phonograph Pickup

Makes any radio a modern up-to-date phonograph radio combination. Instruction sheet furnished with the outfit makes it simple to install. Volume control mounted on the pick-up enables one to control the volume, without adjusting any part of your receiver. Special Holiday price **$5.50**

A Handy Manual Published for SERVICEMEN AND SET DEALERS

Full of information, hookups, charts, trouble shooting hints, etc. Reg. $1.00 **25c**

For The Beginners

Rocket Two-Tube Short-Wave Battery Receiver

Economical! Uses two 2-230 tubes, which assures long battery life. Tunes from 15-200 meters. Pulls in amateurs, police calls, etc. Kit of parts **$5.50**

Wired..$2.00 extra Tubes.....$1.50
Batteries $2.25

Powertone Two-Tube Battery Receiver

Enclosed in a handsome crystal finished metal cabinet. Can be built by any one. Beautiful full vision modernistic vernier dial aids in logging weaker stations. Will receive all types of short-wave signals, police, amateur, ship-to-shore, airplane, etc. Kit of parts..... **$7.95**

Wired..$2.00 extra Tubes.....$1.95
Batteries $2.75

A Power Pack That Converts Any Battery Operated Receiver Into an A.C. Receiver

Will convert any battery receiver to operate on a 110 volt A.C. line. All voltages terminate at binding posts on the chassis. Output; 2½ volts at 10 amperes, 180 volts tapped at 135, 90, and 45. Supplies clear hum-free power regardless of circuit sensitivity. Price including 280 rectifier tube. **$5.95**

POWERTONE SHORT WAVE WORLD RECEPTION A.C.-D.C. RECEIVERS

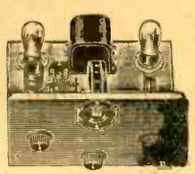
For A.C. and D.C. Operation

Will work anywhere that 110 volt A.C. or D.C. is available. U. S. amateur reception is assured on loudspeaker by the use of a 43 power tube in the output.

With headphones the entire world is at your finger-tips. Chassis is completely encased in a beautiful crystal finished cabinet. Covers the short wave, band form 15-200 meters. Uses 1-78, 1-25Z5, and 1-43 tube.
Price kit **$8.95**

Wired..$2.00 extra Tubes.....$3.25

Beginners Twin Two-Tube Short-Wave Battery Receiver



A more advanced short-wave receiver for the beginner. Letters from builders verify foreign reception. Uses highest quality parts throughout. Complete with four plug-in coils to cover the entire short-wave band from 15 to 200 meters. Easy to build.
Kit of parts..... **$8.95**

Wired..$2.00 extra Tubes.....$1.50
Batteries $2.50

GIFTS FOR THE SERVICEMAN

Majestic 70 and 90 Condenser Blocks

Replacement condenser blocks for the Majestic 70 and 90 series receivers. Built to the exact specifications of the original. Absolutely guaranteed.
Price $1.35

4 and 8 mfd. Electrolytic Condensers

High quality electrolytic condensers. Can be used as a replacement in many receivers without fear of breakdown. Wet type—thus cannot be injured by slight overload or polarity. Inverted mounting.

4 mfd 35c
8 mfd. 40c

RESISTORS

Assortment of 50

An assortment of 50 R.M.A. color coded resistors. Composed of 1/3, ½ and 1 watt resistors. All popular sizes are included in the kit ranging from 100 ohms to 10 megohms.

FREE

A beautiful bakelite case—a souvenir of the Chicago Century of Progress Exposition.

Price $2.50

Farrand Inductor Dynamic Speaker Chassis

Not to be confused with the various models now on the market and labeled Farrand Inductors. These models are genuine factory-built Inductors.

Two models are available, a 12" model and a 9" model. Mounting brackets are placed on both models.

Price, 9" model.....$3.95 Price, 12" model.....$5.95

EXTRA! SHORT-WAVE SETS

ACCLAIMED THE IDEAL GIFT FOR RADIO-MINDED FOLKS

If you really want to please your radio-minded son, father, mother, brother, sister or friend this Christmas, give a short wave receiver. On this page are several very fine receivers for both the beginner and the more advanced short wave enthusiast, yet all at extremely low prices.

RELIABLE RADIO COMPANY, 143 West 45th Street, New York City

ROLAND BURKE HENNESSY
Editor

HERMAN BERNARD
Managing Editor

RADIO WORLD
REG. U.S. PAT. OFF.

The First and Only National Radio Weekly
TWELFTH YEAR

J. E. ANDERSON
Technical Editor

J. MURRAY BARRON
Advertising Manager

Vol. XXIV | DECEMBER 23d, 1933 | No. 15. Whole No. 613

Published Weekly by **Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y.**
Editorial and Executive Offices: 145 West 45th Street, New York
Telephone: BRyant 9-0558

OFFICERS: Roland Burke Hennessy, *President* and *Treasurer*; M. B. Hennessy, *Vice-President*; Herman Bernard, *Secretary*.

Entered as second-class matter March, 1922, at the Post Office at New York, N. Y., under Act of March 3, 1879. Title registered in U. S. Patent Office. Printed in the United States of America. We do not assume any responsibility for unsolicited manuscripts, photographs, drawings, etc., although we are careful with them.

Price, 15c per Copy; $6.00 per Year by mail. $1.00 extra per year in Foreign countries. Subscribers' change of address becomes effective two weeks after receipt of notice.

SERIES CONDENSER

In Antenna Circuit Improves Short-Wave Sensitivity Considerably

By Einar Andrews

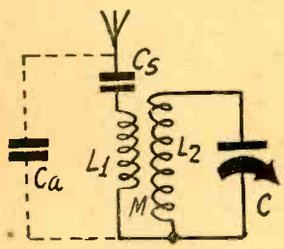


FIG. 1
A common method of coupling the antenna to the tuned circuit in a short-wave set, a small series condenser Cs being used to "shorten" the antenna.

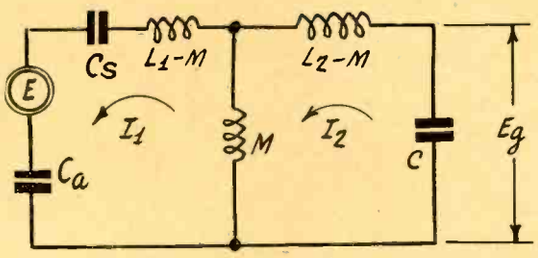


FIG. 2
This is the equivalent circuit of Fig. 1 showing how the mutual inductance couples and how the signal voltage is applied in series with the antenna capacity.

THOSE who have played with short-wave receivers have found out that the performance of the circuits depends much on the value of the antenna series condenser. In Fig. 1 we have a typical arrangement of an antenna and tuned winding such as is used in short-wave receivers. The series condenser in question is Cs, L1 is the inductance of the primary winding, L2 is the secondary inductance, C the tuning capacity, M is the mutual inductance between L1 and L2, and Ca is the antenna capacity. This last factor is usually lost sight of because it is not strictly a circuit element. Nevertheless, it plays a very important part in the performance of the circuit. Resistances are not indicated, but there is a resistance in series with the antenna and another resistance in the coil L2. Moreover, there is distributed inductance in the antenna, but this may be assumed to reside in the primary L1. The mutual M is the mutual between the coils L1 and L2 only. We shall assume that the distributed inductance is small.

The signal voltage is in series with the antenna condenser Ca and in the equivalent circuit in Fig. 2 it is indicated by E. The effectiveness of the arrangement is the ratio between Eg, the voltage across the tuning condenser, and E, the signal voltage picked up. If Zm is the impedance of the mutual, Za the impedance of the antenna condenser, Zs the impedance of the series condenser, Z1 the impedance of the primary, and Z2 that of the secondary, and Zc that of the tuning condenser, the ratio Eg/E is given by the expression

$$A = ZmZc/[(Za + Zs + Z1)(Zc + Z2) - Zm^2]$$

If we neglect the resistances and express the impedances as reactances, this expression becomes

$$A = M/[L_2C/C_a + L_2C/C_s + L_1 + (M^2 - L_1L_2)\,w^2C - (1/C_a + 1/C_s)/w^2]$$

A being regarded as amplification. A is greatest at the frequency that makes the quantity within the brackets least. This occurs when w has the value given by the expression

$$w^4 = [(1/C_a + 1/C_s)/(L_1L_2 - M^2C]$$

Therefore the frequency of resonance depends on Ca, Cs, L1, and M as well as on L2 and C. Therefore we can tune the circuit to some extent by varying the coupling M and the series capacity Cs, and that is a common experience. Indeed, the series condenser is often used for tuning.

Of especial interest is the value of the amplification when the circuit is tuned to maximum response, that is, when the terms containing the frequency cancel each other. This amplification is

$$A = MC_aC_s/[L_2C(C_a + C_s) + L_1C_aC_s]$$

Therefore the gain is directly proportional to the mutual inductance. It also increases as Cs increases. This also is common experience.

An Incomplete Tale

But the expressions given above do not tell the whole story because the resistances were neglected. If they are taken into account the frequency of maximum gain is slightly different, and the gain is vastly different. Only in degree, however. The main effect of the resistances is to decrease the selectivity. As the gain is increased as indicated above, that is, by increasing the mutual inductance and by increasing the capacity of the series condenser, the selectivity goes down. It is more important, as a rule, to have high selectivity than high gain. Therefore the main function of the series condenser is to increase the selectivity of the circuit, which is accomplished by reducing the value of Cs.

Another Arrangement

Another arrangement that is often used on short-wave sets is that shown in Fig. 3, the equivalent circuit of which is given in Fig. 4. In this case the maximum gain is obtained when

$$w^2 = (1/C_s + 1/C_a)/L[1 + C/C_s + C_a]$$

Therefore in this case also the tuning is

affected by the series condenser. The smaller Cs is the more nearly does the frequency of resonance coincide with the natural frequency of the LC circuit, and, incidentally, the greater is the selectivity.

When the circuit arrangement in Fig. 3 is used it is especially important that the series condenser be small because there is no mutual inductance that can be varied to obtain the same effect as that obtained with a small condenser.

Distributed Inductance

When the coupling between the antenna and the tuned secondary is close, whether the closeness is obtained by means of a large series condenser, or no condenser at all, or a large mutual inductance, the resistance in the antenna is transferred more or less into the tuned circuit, and the selectivity is decreased in proportion to the amount of resistance so transferred. It is possible to have an arrangement such that there is no selectivity at all in the tuned circuit. That occurs when the antenna circuit is in resonance with the frequency to which the secondary is supposed to be tuned. The antenna capacity, the series capacity, the antenna distributed inductance, and the primary inductance resonate with the frequency. In such cases the selectivity of the receiver can be improved by putting a high resistance in series with the antenna lead.

The distributed inductance of an antenna may be entirely negligible when the antenna is used for broadcast reception, yet it may be much larger than the lumped inductance of the primary when the circuit is used for short-wave reception. An outdoor antenna about 75 feet long may have an inductance of the order of 20 microhenries. Indeed, that is the inductance of the standard antenna, and they have not selected the maximum distributed inductance for the standard. The inductance of the primary of a short-wave coil may not be more than a few microhenries. Consequently the distributed inductance cannot always be neglected.

Natural Frequency

Every antenna has a certain natural frequency of resonance, which is determined by the self capacity and the distributed inductance. The capacity might be of the order of 300 mmfd., and therefore, if the inductance is 20 microhenries, the natural frequency of resonance would be about 2 million cycles per second. Thus it would resonate with that frequency and if the secondary were tuned to the same frequency there would be practically no selectivity, unless the coupling between the two tuned circuits were very loose.

If the frequency of resonance does fall in the tuning range of the secondary circuit, it can be changed by means of the series condenser and thus the difficulty of broad tuning is avoided. Suppose, for example, that in series with the antenna specified above a condenser of 50 mmfd. were connected. This would change the effective capacity in series with the circuit to 43.4 mmfd. and the natural frequency of resonance to 5.4 million cycles per second. That would make the antenna useful for frequencies up to about 5 million cycles per second. Of course, 50 mmfd. is not the lowest value that can be used if it is necessary to go lower.

Use of Short Antenna

Putting a small condenser in series with the antenna is called shortening the antenna because it has the same effect as actually making the antenna shorter, at least as far as the effective capacity is concerned. An actual shortening of the antenna would also reduce the distributed inductance, which the series condenser does not do.

Therefore when short waves are to be received it is best to use a short antenna, one that has both low self capacity and distributed inductance. If a good short outdoor antenna cannot be erected it would be better to use an indoor antenna.

When regeneration is used in a short-wave receiver next to the antenna, it is found that the smaller the antenna series condenser the more easily does the circuit oscillate. This is just additional evidence that the antenna resistance is transferred into the tuner, for when there is high resistance in the tuner the circuit does not oscillate so readily as when there is very little resistance.

It is also found in many receivers that are not supposed to oscillate that they do so when the series condenser is reduced in size. The damping effect of the antenna resistance when the condenser is large is just sufficient to offset the feedback in the amplifier that causes the oscillation. This is still more evidence that the small condenser in the antenna "shuts out" resistance.

A Direct Coupled Circuit

Sometimes the antenna is connected to the tuned coil in the manner shown in Fig. 5. The equivalent circuit may then be represented as in Fig. 6. The effective inductance in the tuned circuit is L1 + L2 + 2M, that is, it is the total inductance of the coil across which the tuning condenser C is connected. The antenna circuit is then connected in series with the inductance M as indicated. If the distributed inductance in the circuit must be taken into account it is in series with Ca, and hence in series with M and Cs. The mutual inductance in this circuit is negative and, therefore, it partly nullifies the distributed inductance.

In this case, also, it is clear that the antenna capacity and the series capacity affect the tuning. In order to reduce the effect of the antenna resistance on the tuned circuit and also the antenna reactance on the frequency, the value of M should be made low and also the value of L1. That is, the antenna condenser should be connected to a tap on the coil that is very near ground. Besides this the series condenser Cs should be small, as in all other cases.

The only way to do anything about the value of the antenna capacity Ca is to make the antenna shorter, but that is hardly a practical method of operating a receiver. But, as was stated before, if the antenna capacity is small the series capacity is not needed, except as a means of varying the volume and the selectivity.

Not Too Short, Please!

While reducing the antenna height reduces the capacity Ca and also the distributed inductance, it also reduces the value of the signal picked up, that is, it reduces E. Hence it will not do to use a too short antenna, either. One of fifteen feet running straight up in the air is all right when the short-wave receiver is sensitive. This applies to any case, regardless of the particular method employed in getting the signal from the antenna to the tuned circuit.

Loop antennas are not used extensively on short-wave receivers because they are clumsy and inconvenient. But if they are to be used at any time, it should be when short waves are received, because their efficiency increases rapidly as the frequency of the signal increases. For the shorter of the short waves a loop about a foot on the side is quite effective, and the loop could be the first tuning inductance. Besides a high selectivity in the loop, it has the advantage of directional selectivity.

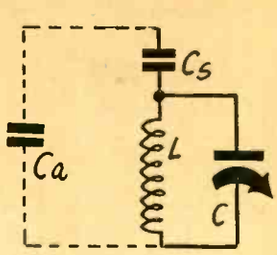


FIG. 3

This is also a common method of coupling the antenna to a short wave tuner. The series condenser is placed between the antenna and the tuned circuit.

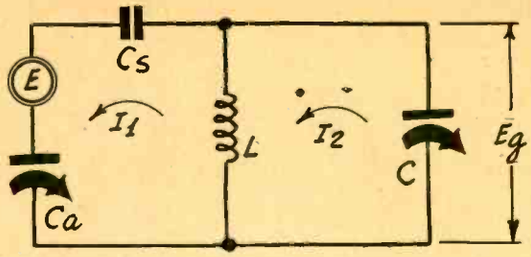


FIG. 4

The equivalent circuit of Fig. 3, showing how the signal voltage is applied in series with the antenna capacity and the series capacity, all in shunt with the tuned circuit.

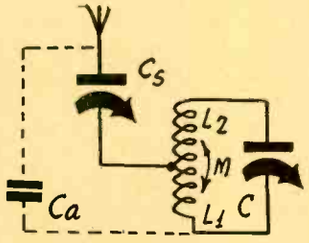


FIG. 5

Sometimes the series condenser is connected to a tap on the tuned coil as in this case. The lower the tap the looser the coupling and the smaller the series condenser the greater the selectivity.

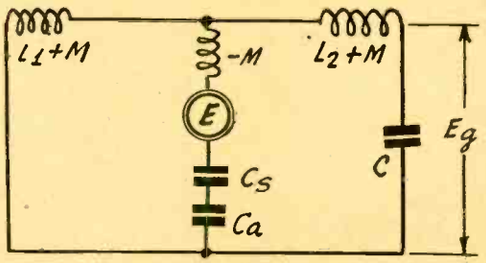


FIG. 6

This is the equivalent circuit of Fig. 5. As in all cases the antenna and series capacity affect the frequency of resonance, and the selectivity and the sensitivity of the receiver.

DUAL CONTROL

Of Regeneration for Easiest Access to Highest Sensitivity

By Calvin Edward Laight

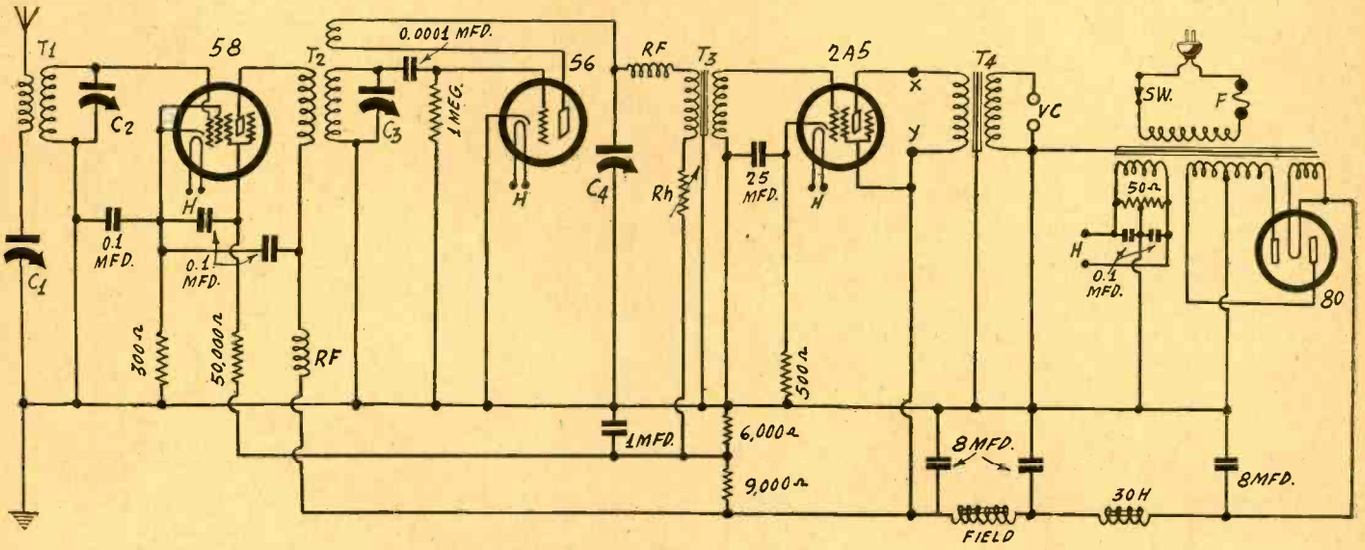


FIG. 1.
The circuit of a four-tube regenerative short-wave receiver employing a 58 radio frequency amplifier, a 56 detector, a 2A5 power amplifier, and an 80 rectifier.

HERE is a four-tube regenerative short-wave set utilizing a 58 as a tuned radio frequency amplifier, a 56 as a detector, and a 2A5 as a power amplifier. An 80 in a regular rectifier circuit is employed as the power supply.

When regeneration is employed in a short wave receiver the most critical part of the circuit is the feed back control. The performance of the receiver depends on the smoothness with which the regeneration can be controlled. There are two provisions in this circuit for varying the amount of feedback, one a 140 mmfd. condenser C4 and the other a rheostat Rh of 50,000 ohms. The variable condenser is used for fine control and the variable resistor for course control. The object of Rh is to vary the effective voltage on the detector plate and thus vary the oscillation and detection efficiencies of the tube.

It may be that for a given voltage on the plate the regeneration cannot be controlled smoothly with the variable condenser. The effective voltage should then be decreased by increasing the resistance in Rh. The thing to avoid is sudden starts and stops of oscillation, for when the set is in that condition it is not possible to take advantage of all the regeneration.

The Input Tuner

A radio frequency transformer T1 is employed between the antenna and the first tube, and this should preferably be of the plug-in type. A small variable condenser C1 of not more than 100 mmfd. is put in series with the antenna to adapt it to the short waves and also to act as a selectivity and volume control. The condenser is put on the ground side in order to permit grounding the rotor plates. Ordinarily this is not done, but it can be done without difficulty if there are four independent terminals on the plug-in coil.

The tuning condenser C2 placed across the secondary of the transformer should have a capacity of 140 mmfd. This condenser may be ganged with the condenser C3 across the secondary of the regenerative coil, provided that the circuits are trimmed accurately. There would have to be one trimmer condenser built into each plug-in coil in order to have the circuits track regardless of which coil pair were plugged in. In case it is not desired to put so many trimmer condensers into the circuit the trimming will have to be done with a small condenser available from the panel and connected across the secondary of either T1 or T2. It should first be put across the C3 for it is most likely that the capacity in this circuit will be less than that in the first circuit.

If C2 and C3 are not ganged all trimmer condensers are unnecessary but then it is slightly more difficult to tune the circuit, for there will be two main controls to manipulate. Of course, if the coils are equal and the coupling in T1 is not too close, and

(*Continued on next page*)

LIST OF PARTS

Coils

T1—One set of four-terminal radio frequency coils of plug-in type, for 140 mmfd. condenser
T2—One set of six-terminal radio frequency coils of the plug-in type, for 140 mmfd. condenser
RF—Two 10-millihenry radio frequency choke coils
One 30-henry audio-frequency choke
T3—One audio frequency transformer
T4—One loudspeaker for 2A5 tube with output transformer and field coil
T5—One power transformer having one 2.5-volt winding, one 5-volt winding and center-tapped high-voltage winding

Condensers

C1—One 100 mmfd. variable condenser with knob
C2, C3—Two 140 mmfd. variable condensers, ganged and provided with a vernier dial, or two condensers with two dials (If a two-section gang is used a trimmer condenser is required)
C4—One 140 mmfd. variable condenser with knob
Five 0.1 mfd. by-pass condensers
One 0.0001 mfd. grid condenser
One 1 mfd. by-pass condenser
One 25 mfd., 35-volt electrolytic by-pass condenser
Three 8 mfd. electrolytic filter condensers

Resistors

One 300-ohm bias resistor
One 500-ohm bias resistor
One 50-ohm. centertapped resistor
One 50,000-ohm resistor
One one-meghom grid leak
One 50,000-ohm variable resistor with line switch attached and with knob
One 6,000-ohm, 3-watt resistor
One 9,000-ohm, 3-watt resistor

Other Requirements

Antenna and ground binding posts
One four-contact socket
One five-contact socket
One medium six-contact socket
One small six-contact socket
One one-ampere fuse
One grid clip
One small four-tube chassis

Dual Control of Regeneration

if the two tuning condensers are also equal, the condensers will track fairly closely, and in tuning it is only necessary to keep the dials reading together.

Regenerative Transformer

Transformer T2 between the radio frequency amplifier and the regenerative detector is of the three winding type and if plug-in coils are used this one must have six pins on the base. For high selectivity the coupling between the primary and the tuned windings should be loose. For example, if the two are wound on the same form end to end there should be a space of from ¼ to one inch between them. But for less selectivity and greater sensitivity the coupling may be much closer. If the coupling is close the circuit is not quite so critical to tune. Most commercial coils designed for this purpose have approximately the best coupling.

The tickler winding is more critical, for if the coupling is too loose the circuit will fail to oscillate, and if it is too close there is danger of blocking in the grid circuit and difficulty in adjusting the regeneration. It is because of this criticalness that the two regeneration controls have been put in. Especially it is the reason for the use of the variable resistance in the plate supply lead.

Filtering

The radio frequency currents in the first tube are prevented from escaping by the usual filters. Thus there is a 0.1 mfd. condenser for each of the return leads, that is, grid, screen, and plate, and in each case the condenser is connected to the cathode, which is the source of electrons. The only reason for by-passing the grid lead is the presence of the 300-ohm bias resistance.

The regeneration control condenser C4 can be regarded as a variable by-pass condenser which provides an easier or more difficult path for the radio frequency current in the plate circuit according to the capacity of the condenser.

Aross the 500-ohm bias resistor for the 2A5 is a 25 mfd. condenser of the electrolytic type. A large value of capacity is required here because the 2A5 has a very high amplification factor and for that reason the reverse feedback will be large even in a small bias resistance. There is a suitable electrolytic condenser available having the capacity specified and a voltage rating of 35 volts.

Across the 2.5-volt winding serving the heaters is a combination of two 0.1 mfd. condensers connected in series, the junction being connected to the center of a 50-ohm resistor, also across the winding. The junction is also connected to ground. The object of the condensers and the centered resistance is to eliminate hum, which may be considerable in a high frequency circuit even when heater tubes are used, unless these precautions are taken.

In the filter we have three 8 mfd. electrolytic condensers and two choke, one of which may be the loudspeaker field. The thorough filtering of the B supply is essential because hum easily gets into the high frequency signals as a modulation. Besides the three large condensers there is a 1 mfd. condenser across the supply to the screens. Since an electrolytic condenser is not good on high frequencies and the intermediate voltage serves only tubes operating at high frequency, this condenser should not be of that type, but it should be large.

The rectifier employed is an 80 tube and the rectifier circuit is typical, the full wave type being used. A power switch is put in the primary winding and this may be mounted on the regeneration control rheostat to avoid an extra knob on the panel. Besides the switch there is one-ampere fuse in the primary to protect the circuit against accidents.

The voltage division is accomplished by means of two resistors, one of 9,000 ohms on the high potential side and another of 6,000 ohms on the ground side. Three-watt resistors are quite heavy enough for this purpose.

Forum

Editor, RADIO WORLD:

I DON'T KNOW if you've tried selling radio sets to sheiks in the desert, to Egyptions, and to Greeks. It's exciting work.

I've only just finished my first lap. I've been through twenty-three countries with a car, travelling for a firm making radio sets. Not a bad feat for a girl, is it?

I've had the most curious adventures, and I've a good many photographs. Had some unpleasant brushes, too, with bandits and scoundrels stopping the old car. Twice I've lost my complete little stock; and in Egypt I was knocked unconscious by a thug who mounted the car from behind and robbed me. Running over the plains round Athens, too, is a nervy experience for a girl driving alone. The shepherds are risky. Woe betide you if their wolf-like dogs come for you; the shepherds make no attempt to call the dogs off, unless you pay them to do it.

The desert has gone very much modern. Bandits attack convoys travelling from Damascus, and use high-powered cars, with machine-guns fitted to fire through the windscreens. I've seen some of it, so I know. The sheiks still show real hospitality. I've had the most pleasant stays at Bedouin encampments; the Bedouin aristocrat is surprisingly light-skinned, has often travelled in Europe, and speaks at least English and French. Hence a great interest in radios of the portable kind.

I've come across, in my travels, one or two astonishing cases of people who have been reunited through the radio, and of its use in emergencies.

The whole thing has been a magnificent experience, full of adventure.

(Miss) B. GOODWIN-SMITH,
21 New Street, Woodbridge,
Suffolk, England.

* * *

Faults

Editor RADIO WORLD:

AS A WEEKLY publication RADIO WORLD most surely does fill a real need to the earnest radio experimenter or service man who means to keep up with the extremely rapid developments of the art in these days. But why in the world do you not insist on checking over proofs of the weekly matter, before it is finally printed? R. W. has too many typographical errors. Mistakes in the diagrams illustrating articles are, perhaps, not common. It is quite impossible to take up any of your articles and read for one's information, without constantly keeping the weather eye open for misprints.

I really find RADIO WORLD both interesting and instructive. The point is that faults exist.

One feature which I think is of outstanding value (and which, incidentally, is most extraordinarily free from the typographical hand-springs referred to) is the weekly "Review." This should be as good as the average correspondence course to any student of radio who has sufficient common sense to follow it through.

SYDNEY R. ELLIOTT,
Princeton, B. C., Canada.

Proud Joints From Good Irons and Solderers

When using an electric soldering iron it is very important that the entire surface of the four squares of the tip be "tinned."

Turn on the current and let the iron heat up for five or six minutes.

Now dip the copper tip into soldering paste to a sufficient depth to cover the entire surfaces of the four squares of the tip. Next apply the solder to the four squares of the tip, covering their entire surfaces. The copper tip of the iron is now "tinned" and the iron is ready for soldering operations.

Parts or wires to be united should be dipped in soldering paste, or the paste otherwise applied to them, before applying the soldering iron. The paste eats off the thin film of tarnish or oxide that covers brass or copper wires and parts. If the metal part or wire cannot be dipped use a small brush or piece of cloth to apply acid at the spot where soldering is to be done. If using soldering paste instead of acid a small piece of wood is used to apply the paste. Sometimes in case of metal pieces very heavily tarnished it is necessary to clean off such tarnish before attempting to solder. Use a piece of emery cloth, sandpaper, or a file.

Where a soldering iron is to be used continuously at production work in a factory care should be taken by the operator to keep the entire surface of the four squares of the copper tip always well "tinned." The copper tip should be dipped in acid or acid applied with a brush, covering the entire surface of each square of the tip, once every half hour. If this is not done the heat in the tip will after awhile form a hard, black scale to which solder will not stick. If such a scale should form through neglect of following the above instruction it should be filed off or ground off on an emery wheel.

To remove tip, hold soldering iron upright and drop oil into barrel. This removes corrosion around thread and tip is then easily unscrewed.

When using a soldering iron do not bear down heavily with the iron on the parts you are attempting to solder. Heat is what does the work, not force. Apply the iron firmly at the spot to be soldered, leaving it rest without *movement* for a few seconds. It is necessary for the heat in the tip to penetrate the part to be soldered before the solder will run off the copper tip and adhere to the parts being united. In the case of larger surfaces or large metal pieces it will, of course, be necessary to allow your iron to rest much longer in order to heat the parts enough to get the solder to stick to them.

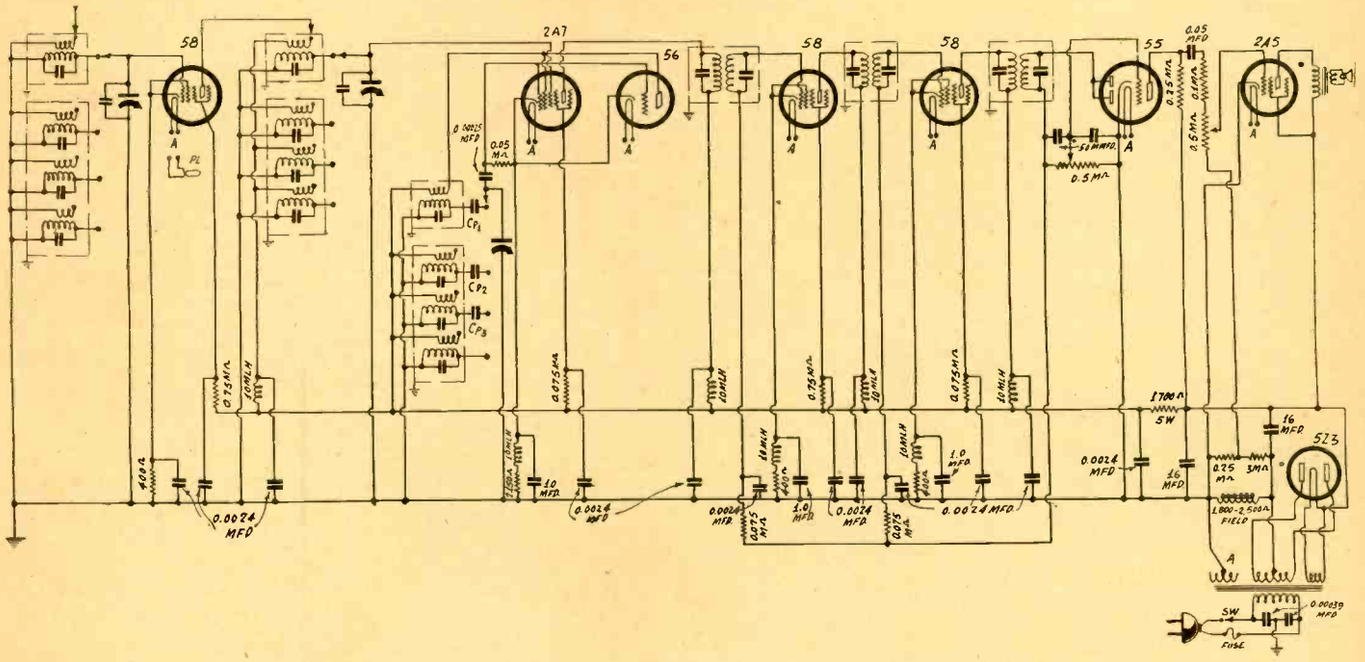
If an operator will carefully follow the above instructions he or she will very quickly become an expert solderer, says Jackson Electric Corporation, and will take considerable pride and satisfaction in the neat and skillful work. Home-made radio set builders keenly enjoy using an electric soldering iron of good quality and if the results of their labor are neat and workmanlike they are delighted.

Be sure your iron is large enough for the work you are trying to do, otherwise poor joints will result from insufficient heat available from the iron.

Trimmer for Each Secondary

Found Necessary in Set for Wide-Frequency Coverage To Enable Excellent Tracking in a Superheterodyne

By Watson Fulton



The author constructed this receiver with each coil for the broadcast band on a separate form and in a separate shield, but with the short-wave coils on a single form, one shield for each tuned stage. He found that separate trimmers were necessary across each secondary, and gives the values whereby he obtained excellent results.

THE construction of a wide-frequency range receiver presents some difficulties that experimenters may not be able to solve readily, and as I have had considerable experience with the receiver shown, I would like to state requisites for duplicating the splendid results I am getting.

I built a switch type superheterodyne, using a three-gang condenser obtained with a subscription for RADIO WORLD, and found that with the requisite trimming capacity, the maximum stood at or near 450 mmfd. Therefore I wound the broadcast signal-carrier level coils for an inductance of 200 microhenries, using 25-turn primaries wound over secondaries, three layers of insulation between. Then I used two tuned circuits for t-r-f reception, and verified the frequency coverage, which slightly exceeded what I have set forth in a table.

Broadcast Coils Separate

The oscillator coil presented no trouble, as the intermediate frequency was 465 kc and the oscillator had to tune to 2,085 kc with a 50 mmfd. minimum, or, 110 microhenries would suit the purpose. The calculation for the padding condenser, Cpl, yielded 470 mmfd., and actually the condenser used was very close to that. I shall take up later the verification of the capacity.

I used separate coils for the broadcast band, in separate shields taken from commercial coils, the shields being aluminum, 2 1/16 inch outside diameter, height 2.5 inches. Since nearly all r-f coils are for lower capacities, almost any commercial coil may be used experimentally for the signal-carrier level, and turns taken off until 540 kc comes in very close to maximum capacity, say, at 99 on the dial. Then only the oscillator for the broadcast band will have to be wound, the secondary inductance and turns being stated in the table, the tickler consisting of 20 turns of any fine wire wound over the secondary with 0.02" insulation between, or, if you can't accommodate that requirement, use three turns of wrapping paper.

There was no advance doubt about the necessity of padding for the second band, and the capacity figured out, again verified, was 670 mmfd. However, there was a surprise in store for me on the next band, for at the low-frequency end the tracking was not exceptionally good, so I put a precision condenser in series with the oscillator condenser, and turned it until nearly 1,000 mmfd. was registered.

Separate Trimmers

Then I did my computing and came to 925 mmfd., and then read the precision condenser accurately, and it was 930 mmfd. The difference was small and even if encountered in practice of course would not matter.

The tuning condenser one starts with is important, and it is well to learn from one who has done the work, rather than attempt it himself, if he hasn't the instruments to check up, and the mathemetical knowledge necessary to give theoretical results which practice is to verify (or disprove!). So this Scovill condenser may be used and a great deal of work avoided.

It so happens the condenser is not equipped with trimmers, which is just as well, for another thing I found out was that this business of having the same trimming apply to all bands is no go, and the reason is that position of connecting wires differs, likewise coil capacities differ, and so each separate secondary must have a separate trimmer. It is even practical to put the trimmer inside the shield for the broadcast coils, while for the short-wave coils, also contained as a group in a similar shield, the trimmers may be arranged on a bakelite piece at bottom, or one trimmer put inside, under the top of the shield, and two at the bottom. The position is not so important as the individual inclusion.

Capacity Check-Up

After the broadcast band it is not necessary to have dissimilar inductance, as at the high-frequency end of the second coil. The frequencies are r-f = 4,860 kc and oscillator = 5,325 kc, which difference can be taken care of by the separate trimmers, in fact must be, if good tracking is to prevail. Likewise, a series padding condenser is necessary, and this has been discussed.

To check up on capacities, I built a one-tube regenerative broadcast set, for earphones, let it oscillate continuously, and struck beats with local stations and some semi-distant ones, and by using also harmonics of broadcasting stations thus ran a curve which any one can do, so that the whole band is represented as to all the dial settings and equivalent frequencies. It is

LIST OF PARTS

Coils

Two shielded radio-frequency transformers for broadcast band, as described.
One shielded oscillator transformer for broadcast band, as described.
Two shielded coil assemblies, two forms, six windings on each form, for r-f level, short waves.
One shielded assembly, six windings on one form, for oscillator level, short waves.
Six 10 millihenry radio-frequency choke coils
Three shielded intermediate-frequency transformers, primary and secondary tuned; for 465 kc.
One power transformer.
One speaker for pentode output, with output transformer built in, also field built in, 1,800 to 2,50 0ohms. The biasing resistors in the output stage are for 2,500-ohm field.

Condensers

One three-gang 0.0004 mfd. tuning condenser.
Twelve trimming condensers, 35 mmfd.
Three padding condensers: Cp1=0.0047 mfd., Cp2=0.00067 mfd., Cp3=0.000925 mfd.
Twelve 0.0024 mfd. mica condensers.
Three 1.0 mfd. bypass condensers.
One 0.05 mfd. mica condenser.
Two 50 mmfd. mica condensers (0.00005 mfd.).
Two 16 mfd. 500-volt electrolytic condensers or four 8 mfd. electrolytic condensers.
Two 0.00039 mfd. mica fixed condensers.
One 0.00025 mfd. mica condenser (oscillator grid).

Resistors

Three 400-ohm pigtail resistors.
One 150-ohm pigtail resistor.
Four 0.075 meg. (75,000-ohm) pigtail resistors.
One 0.05 meg. (50,000-ohm) pigtail resistor.
Two 0.25 meg. pigtail resistors.
One 1.0 meg. pigtail resistor.
One 3 meg. pigtail resistor.
One 0.5 meg. potentiometer, insulated shaft type.
One 1,700-ohm, 5-watt resistor.

Other Requirements

One chassis.
Six tube shields.
One vernier dial with escutcheon and pilot lamp bracket.
One pilot lamp.
Five grid clips.
Five six-hole sockets, one two five-hole sockets (extra UY is for speaker plug), one four-hole socket, one medium seven-hole socket.
One a-c cable and plug.
One 1-ampere fuse.
Tubes: One 56, three 58's, one 55, one 2A7, one 2A5 and one 5Z3.

just as well to use this small set as an oscillator as the curve is more regular then, due to absence of detuning effects due to tickler adjustment.

With the known inductance of the oscillator in the "big" receiver, 110 microhenries, wound as directed, and shielded, shield grounded, since grid leak and stopping condenser are used, harmonics may be used, whether generated in the one device or the other, and therefore all one need know is what the curve is relating capacity and frequency to 110 microhenries. The following information is sufficient to enable a practical curve:

110 Microhenries

Mmfd.	*kc*	*Mmfd.*	*kc*	*Mmfd.*	*kc*
1,000	480	600	620	4,300	890
900	500	500	680	200	1,000
800	540	400	750	150	1,240
700	580	350	800	100	1,520

With the little set going, and coupled to the oscillator in the big set, second harmonics of the big-set oscillator, with large capacities, will beat with broadcasting stations, within the capacity range stated useful, for station frequencies of 960 to 1,080 kc, after which the broadcast band may be used directly, and even this assumes 540 kc could not be received well, which may not be true in your particular location.

Coil Data

The secondary inductance requirements will be found in the following table, with primaries not critical, so suit yourself, but ticklers large enough to insure oscillation (1-to-4 or greater ratio):

Signal-Carrier Level

kc	*L*	*Turns on 1" Diam.*
540-1,620	200.0	110 of No. 32 enamel
1,620-4,860	22.2	28 of No. 28 enamel
4,860-14,580	2.47	9.5 of 18 enamel
14,580-43,740	0.27	2.5 of 18 enamel

Oscillator Level

kc	*L*	*c p*	*Turns on 1" Diam.*
1,005-2085	110.0	1 = 470 mmfd.	81 of no. 30 enamel
2,085-5,325	22.2	2 = 670 mmfd.	See s-c level
5,325-15,040	2.47	3 = 925 mmfd.	See s-c level
15,040-44,205	0.27	0	See s-c level

The manual volume control is the one in the grid circuit of the 2A5 output tube. The other control is not actuated from the front panel, but is simply set once, and constitutes a means of accommodating the receiver to the sensitivity possibilities in the particular location where it is to be used.

If there are strong local stations about, particularly one that is troublesome, as happens frequently in urban localities, the 0.5 meg. potentiometer in the load circuit of the diode is adjusted so that when the load is tuned in with the regular volume control full on, the reception is not cut out by virtue of saturation of the triode of the 55. That adjustment is made once and need not be altered later, unless the tubes get old and lose some of their sensitivity, whereupon the sensitivity control may be readjusted.

The Triode Limitations

The diode will stand a considerable input voltage, in fact, won't show a curvature until the voltage is around 100 volts, but the triode of the 55 is limited to 20 volts, and in fact gives better quality if not much more than 12 volts are put in, therefore it is advisable to have this extra adjustment as a choice both for satisfactory all-around operation and for quality particularly.

The resistors that apportion the drop in the negative-leg field coil are selected on the basis of a 2,500-ohm field coil, but if less than 2,500 ohms are to be used then the voltage drop will be less, and the resistor marked 3 meg. may be reduced, or if it is left at 3 meg. then the 0.25 meg. next to it may be increased. The plate current test is made for about 30 milliamperes at no signal, for this type of bias, for the 2A5.

Insulation of Electrolytics

The usual precaution must be taken that the negative of one of the 16 mfd. filter condensers, if electrolytics, or both negatives if two 8 mfd. are used in parallel in this position are not connected to chassis, since B minus is not grounded. The potential that is grounded is higher than B minus by the amount of the voltage drop in the field coil. Hence if condensers are used next to the rectifier that have can or shield common with negative electrode of the condenser, an insulating bushing or washer must be used to protect the condenser from chassis continuity, otherwise the choke would be shorted out.

The type of condenser that has two leads emerging permits can connection to chassis, the black wire lead being connected to B minus and the red to positive. By the negative-leg choke method of course positives of all filter condensers go directly to positive of rectifier.

DX From Above Clouds Assured

Checking of data obtained during the Settle-Fordney stratosphere ascent reveals definite proof that long-distance communication can be maintained with aircraft above the atmospheric levels, according to Charles W. Horn, general engineer of the National Broadcasting Company.

"If stratosphere planes ever are developed," Horn said, "it will be possible to keep in constant communication with them. We were able to maintain a two-way voice circuit with Commander Settle and Major Fordney from the time they took off until they dropped their batteries to lighten their load."

Ground Reflections Absent

Seven times during the record-breaking ascent the NBC broadcast conversations with the balloonists over its networks, so that listeners could hear the voices from the stratosphere.

The specially-built transmitter carried in the ascension had an energy radiation of only one watt, Horn said, yet it was picked up strongly by the widely separated stations of RCA Communications at Riverhead, Long Island, and Point Reyes, California.

Stations in Akron, Pittsburgh and Washington were in constant touch with Settle and Fordney, and may other points reported hearing a clear signal. The eight-pound receiver and twelve pound transmitter were built by C. P. Sweeney and C. K. Atwater, respectively, under the direction of Robert Morris, NBC experimental engineer. The transmitter operated on a frequency of 15,760 kilocycles.

Horn explained that it was possible to send so far on such low power from the stratosphere, because of the absence of ground reflections. This changes the angle of reflection from the Heaviside layer, greatly increasing the range of coverage.

Encouraging Outlook

Regarding the possibility of airplane travel through the stratosphere, Horn said that it would be possible to use much more powerful transmitters in planes. In the balloon it was necessary to carry batteries, whereas in a plane the set could be operated on the regular generator.

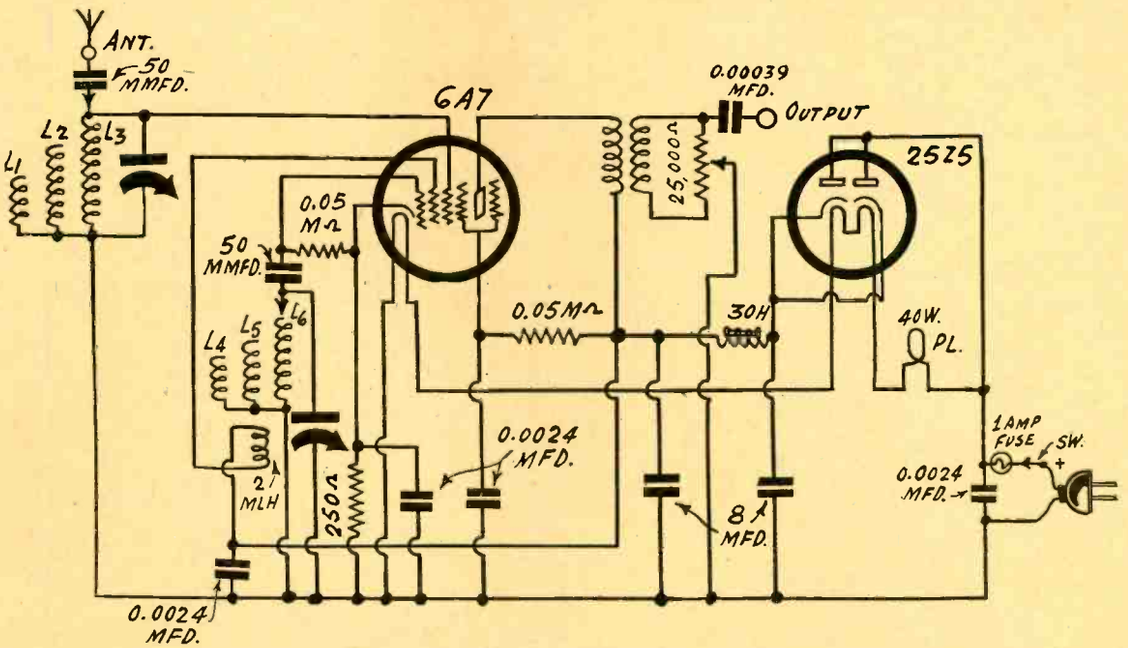
"We are greatly pleased with the results of our experiment," the NBC engineer said, "and look forward to an opportunity to go further, when the next stratosphere flight is made."

The Settle-Fordney ascension was sponsored jointly by the NBC and the Chicago "Daily News."

A SHORT-WAVE CONVERTER

That Works on Any Frequency of the Receiver

By Herman Bernard



This general type of converter has been highly successful, as separate tuning condensers are used. The capacities are high at that, 0.00035 mfd. rating. This reduces the number of secondary windings, in fact, enables tuning from 1,500 to around 7.5 meters. The text fully discloses why the efficiency is high.

THE general experience with short-wave converters during the three years they have been on the scene has been that they are only fair, though it is true some of them are excellent. Of the several converters produced by the staff of RADIO WORLD, the one that worked out the best had two separately-tuned circuits (no ganging) and even used large condensers, considering the frequencies. In fact, there never was any complaint from any one who built this type of converter, although for purposes of economy a plain wooden box was used, and band shifting done by using tube socket holes as jacks and inserting tip plugs.

Since the day, nearly three years ago, when this type of converter was brought out, tube improvements have been introduced, and so the circuit may be presented in a more effective form. In doing this, also, it is worth-while to recall the considerations that prompted the selection of such a converter, and to restate the reasons why the operation was so splendid.

Only Three Bands

It can be seen from the diagram that the antenna coil consists of a single winding for any given band, and there are only three bands, due to the wide frequency coverage of each. Since the antenna stage tuning is unaffected by anything that follows, a knob may be placed on the shaft of this condenser, and a scale affixed, with proper calibrations on it, in three tiers, so that one can set this dial, in conjunction with the pickup of the proper coil terminal, and then adjust the oscillator until the station is heard.

The tuning of the antenna stage is put into the control grid of the 6A7 mixer tube. The expression "pentagrid converter" will not be used to describe this tube, because the device in which it is used is a short-wave converter, and there would be confusion over the word converter.

The oscillator also has three separate coils for secondaries, but may have a common tickler. The feedback winding may be a small honeycomb r-f choke coil of a few hundred turns inside the main form on which the three oscillator secondary windings are put. This is something of a compromise, but if the circuit oscillates over the three bands, no more need be asked, and it is the method used in the original model three years ago, except that the tickler winding was put on the main form and was not an r-f choke.

Insuring Oscillation

If the same practice is to be followed, the tickler may be next to the largest secondary and consist of 15 turns of fine wire. The next secondary would be put on the opposite side of the tickler and the final secondary next to the second one. By this method, the connections that produce oscillation in the largest secondary should be just the opposite for the next two secondaries, providing the wire is wound always in the same direction. If oscillation is present in one winding and not in the others, or in two windings and not in the third, reverse the connections to any non-oscillating secondary.

The chief advantage of the system lies in frequency. It is understood that the converter must be used with a broadcast receiver. Also, it is true this particular type works with either superheterodyne or tuned-radio-frequency receiver.

Let us assume that 1,500 kc is to be the lowest receivable frequency by operation of the converter. Let us assume the receiver tunes from 1,500 to 500 kc, although hardly any receivers go as low as that. Selecting 500 kc simply imposes a stiffer requirement on the converter, and it will be shown that even this requirement will be met in practice.

Capacities in Circuit

The tuning condenser, two separate ones, remember, need not have any trimmers, and in fact if they have trimmers it is just as well to remove them. Assume that condensers commercially rated at 350 mmfd. are used. Assume the actual maximum is 400 mmfd., due to stray capacities and to tube and coil capacities. A minimum capacity total of 44.4 mmfd. may be allotted, although it is unreasonable to assume the minimum will be quite that large. A capacity ratio of 9 will prevail, or, with any coil, a frequency ratio of 3.

Since the desired frequency of oscillation is to be higher than the carrier frequency of the station being received, let us determine whether the oscillator may be set at any required position to meet the conditions imposed by the signal-carrier level. If the r-f tuning ratio is 3, then, starting at 1,500 kc, the end is at 4,500 kc for the first or largest secondary, in the antenna circuit.

If the receiver is set at 500 kc (the extreme unlikelihood), the oscillator should be at 2,000 kc. If the receiver is set at 1,500 kc, the other extreme, the oscillator should be at 3,000 kc. Thus the oscillation frequency values are 2,000 and 3,000 kc respectively.

Again a Frequency Ratio of 3

Now take the high-frequency end, 4,500 kc for the signal-carrier. For 500 kc in the receiver the oscillator should be at 5,000 kc, and for 1,500 in the receiver the oscillator should be at 6,000 kc. Therefore, taking the lowest and highest frequencies of the combination of requirements, we have 2,000 and 6,000, or a frequency ratio of 3, which is just what the condenser will yield in the tuned circuit. Hence all we need do is to select the proper inductance for achieving the proper frequencies, and that inductance for the oscillator, lowest frequency band, 2,000 to 6,000 kc, is 16 microhenries. The carrier-signal inductance is considerably larger for this band.

Now let us consider the second of the three bands. The carrier-signal level is en-

LIST OF PARTS

Coils

Three modulator coils on one tubing 2 inches in diameter x 3 inches long; three windings as described.
Three oscillator coils on one tubing 2 inches in diameter x 3 inches long; three windings as decribed.
One 1-millihenry choke coil (200-turn honeycomb), or separate winding on oscillator form, for feedback. See text.
One output transformer, made of two tightly-coupled honeycomb coils of a few hundred turns each.
One 30-henry choke coil. (Current will not exceed 15 milliamperes).

Condensers

Two 50 mmfd. mica fixed condensers.
Two 0.00035 mfd. single tuning condensers.
Four 0.0024 mfd. mica fixed condensers.
One 0.00039 mfd. mica fixed condenser.
Two 8 mfd. electrolytic condensers.

Resistors

Two 0.05 meg (50,000-ohm) pigtail resistors.
One 25,000-ohm potentiometer, insulated shaft type, or grounded slider type, with a-c switch attached.
One 250-ohm resistor.
One 40-watt lamp.

Other Requirements

One front panel.
One chassis.
Three knobs.
Two dials.
One grid clip.
One a-c cable and plug.
Two binding posts: antenna and output.
Switching arrangement. See text.
One medium seven-hole socket, one six-hole socket, one Edison-base socket (for series lamp).
One 6A7 tube and one 25Z5 tube.

compassed by 4,500 to 13,500 kc, so at 500 kc intermediate frequency the extremes would be 5,000 and 14,000 kc for the oscillator, and at 1,500 kc i.f. would be 6,000 and 15,000 kc. The extremes of the combination are 5,000 and 15,000 kc, again a ratio of 3.

For the third band the carrier level is 13,500 to 40,500 kc, and for the oscillator the frequencies for 500 kc are 14,000 kc and 41,000 kc, and for 1,500 kc are 15,000 kc and 42,000 kc. The possible 3 to 1 frequency spread is more than is needed now, so, to favor the high-frequency end with better spreadout, the inductance is selected for 14,000 kc, instead of for 15,000, also to prevent the oscillator from outrunning the modulator tuning, and of course since there is no padding the choice of 14,000 kc then would be required because it is 42,000/3.

Full Choice of I. F.

All of the foregoing in respect to modulator and oscillator tuning may be summed up as follows: The modulator tuning may be calibrated and will stay put. Moreover, the modulator is not a critically-tuned circuit, to any extraordinary degree. The oscillator need not be scaled at all, but should have a vernier, because this circuit should be critical, if the receiver is selective. The modulator dial is set at the desired carrier frequency, and the oscillator is turned blindly, though carefully, and no matter at what frequency the receiver is set, the signal will come through.

Thus you have your choice, and may change the i.f. at will. It is often necessary to make such a change. Sometimes the most favored spot on your receiver dial, best as to sensitivity for instance, develops interference due to a local at or near that frequency going on the air, and a shift is imperative. Where the locals are, in your location, can not be something to which the manufacturer can attend, so if the converter may be used at any i-f level, one of the principal problems is solved.

Overlap is Assured

Without trimmers the capacity ratio should exceed 9, hence the frequency ratio exceed 3, hence all-sufficient overlap will exist, although not recognized in the tabulation herewith, giving the information for coil-winding on 2 in. diameter tubing, for a commercially-rated 0.00035 to mfd. condenser, actual maximum taken as 0.0004 mfd. and minimum as 44.4 mmfd.

Modulator Coil

kc	*L (mh)*	*Turns on 2"*
1,500- 4,500	L3 = 28	17 of 28 enamel
4,500-13,500	L2 = 3.3	6 of 18 enamel
13,500-40,500	L1 = 0.37	1.9 of 14 enamel

Oscillator Coil

2,000- 6,000	L6 = 16	12.5 of 28 enamel
5,000-15,000	L5 = 2	4.5 of 18 enamel
14,000-42,000	L4 = 0.34	1.75 of 14 enamel

On the question of switching, the method previously mentioned, although rather crude, does the trick. The front panel is drilled for the two mounting holes for each of the two sockets, and also for three of the four socket holes, since the fourth socket hole is not needed.

The Special Holes

The three holes for connections may be 3/16 inch each in diameter. This way the appearance is better than if the usual single circle were cut out to expose all the socket connecting area. There is a flexible lead, with phone tip, for each condenser stator, and a hole for each such lead to emerge.

Also, a double-pole, triple-throw switch may be used, of the insulated shaft type, the coils mounted on the opposite sides of the switch. Even allowing for space to accommodate brackets, the axial length of each of the two forms need not exceed 3 inches in any event.

A refinement is a volume control on the converter, not present in the first model. To enable a grounded slider a transformer is used, consisting of two closely-coupled choke coils of a few hundred turns each, the secondary of this output transformer not being connected to ground directly, but to one extreme of the potentiometer, the arm of which is grounded.

Interference due to broadcasting stations getting through the converter to the set, so that though the converter is in service, the set when tuned brings in all the locals, is minimized or prevented by the small series condenser, 50 mmfd. (0.00005 mfd.) in the antenna circuit. The only other source of such interference would be due to a long connecting wire between converter and receiver acting as aerial, or to direct pickup by the receiver because it is not sufficiently shielded in respect to its degree of sensitivity.

The pickup due to antenna effect of the lead from converter to set is most easily minimized by keeping this lead down to 2 feet or so. If this can not be done, shielded wire may be used, and sheath grounded, but not the usual wire with tightly-hugging sheath on the outside.

There must be a thick band of insulation between the inside conductor and the outside shield, which yields a total diameter of about ½ inch, the type of shielded wire commonly used in connection with antenna safeguards in automobile receivers.

Precaution on D. C.

The 6A7 tube has been selected so that no transformer would be needed in connection with the power, and also incidentally so that the converter may be used on d.c. as well as on a.c. The resultant B voltage, more than 100 volts, is ample, and in fact may yield quieter reception than application of the more usually prescribed voltages.

For d-c use, if the B filter condensers are electrolytics, care must be exercised not to connect to the line in the wrong direction, lest the condensers be damaged. The a-c plug should have its positive identified, and the positive of the line should be known or ascertained. The correct story can be read from a meter of known polarity. When the needle deflects in the correct direction positive of the line is the side connected to positive of the meter.

Notes on Rectifier

The rectifier is a 25Z5, which has a 25-volt 0.3-ampere heater in series with the other (6.3-volt, 0-3-ampere) heater. The series resisistor necessary to drop the line voltage to a total of 31.3 volts for the two heaters (25 + 6.3) is 300 ohms, and this is taken care of if a 40-watt electric light bulb is used, especially as there is no more heat generated that way than any other, for the same wattage dissipation.

The rectifier tube is as a resistance to the a-c line, but also of the same resistance to the d-c line, hence the B voltage gets to the cathode of the rectifier either way.

For d-c use the positive side of the line is denoted on the diagram. For a-c use the plug may be inserted in the convenience outlet in either direction.

The diagram shows the heaters of the rectifier at bottom, the cathodes above the heater, and the two parallel plates on top. Actually the cathode connections on the socket are those in line with and farthest from heater, while the plates are next to the heater, but the diagram is shown the other way for ease of reading, and the warning here given the diagram is not literal in that minor respect.

Shape Factor in Short-Wave Coils

The general impression seems to be that short-wave coils on small diameters are inefficient. This is not true, as the same diameter may be favorable instead of unfavorable. To be sure, the size wire should be larger the higher the frequencies, but the rule that the axial length of the winding should be smaller than the diameter still prevails, whether the wavelength is short or long. The so-called ideal shape factor is about 2.5, meaning that the coil is best when the total diameter (outside of wire to outside of wire) of a solenoid is 2.5 times the axial length of the winding, or what is more commonly called the winding space, or height of the winding.

Thus, suppose that the form diameter is 13/16 inch and the wire causes the diameter to be a total of ⅞ inch. The axial length of the winding then should be 0.875/2.5 or 0.35 inch. For the shortest wavelength to be received, somewhat under 10 meters, this length, of about one-third of an inch, would be achieved with four turns of No. 16 enamel wire, and the coil would be a good one. This relates to the secondary. A primary, if in the antenna circuit, should be of large diameter wire, but if in the plate circuit may be, as is a tickler, of finer wire.

If the same diameter tubing is used the shape factor may not be good for the lowest frequency band, so a larger diameter may be used for this. It is well to remember that for ultra frequencies small diameter coils are used and the inductance varied by changing the spacing between turns, the tube capacity, etc., being used as the tuning condenser.

Series Plate Resistor Ends R-F Squeals

A plate series squelch resistor will depend on the degree of oscillation as well as on the region of oscillation. In fact, if the oscillation is due to inductive feedback and is at the low-frequency part of the tuning and not at the high-frequency end at all, then the series resistor method will not work satisfactorily. If the trouble is at both ends, and not in the middle, the resistor will assist at the high-frequency end. Let us assume a circuit of the t-r-f type, with two stages of t-r-f and tuned input to the detector. A suitable method would be to use a high-inductance choke (10 muh or higher) in series with the plate return of the first tube, and a capacity of 0.002 mfd. or higher from high side of the choke to ground (not B plus to ground. The choke is preferred in this position as the plate current is not reduced more than trivially. For minimum of noise the plate current in the first tube should run pretty high. The next plate circuit may have a 2,000-ohm resistor in series with it, not bypassed. If oscillation persists the value of this resistor may be increased. Usually at 5,000 ohms all oscillation disappears, but do not make the resistance any higher than circumstances require. Test at the highest frequency to which the receiver responds, and when the trimmers are adjusted at this test frequency. It is well to use a 10,000-ohm variable resistor as a rheostat in this position, adjust it until the trouble ceases, measure the resistance, and replace with a fixed resistor of about the same value. One added effect of the series resistor is to level the r-f amplification, but it should be remembered that selectivity is adversely affected if the series resistor is too high.

A 55 FOR

Power Conserved by Us

By J. E.

THE 55 duplex diode triode tube can be used advantageously in an oscillating rectifying circuit for supplying grid bias voltages for any amplifier tubes that are usually employed in radio receivers, even when the bias required is of the order of 100 volts. When it is important to conserve the voltage available for the plates the C supply is especially suitable, for it makes possible a much higher output power for the voltage that is available.

There is nothing complex about the C supply. It is just a high frequency oscillator such as is used in any superheterodyne. Its frequency may have any value of reasonable magnitude, say from 10,000 cycles per second to 500 kilocycles. We are showing the circuit in Fig. 1. The transformer has three windings, the usual tuned grid winding, the tickler winding, and a rectifier winding that is centertapped. If the coil is wound solenoid fashion the grid winding may be on the inside, the tickler winding next, and the rectifier winding on the outside. There should, of course, be good insulation between adjacent windings because the voltages will be rather high.

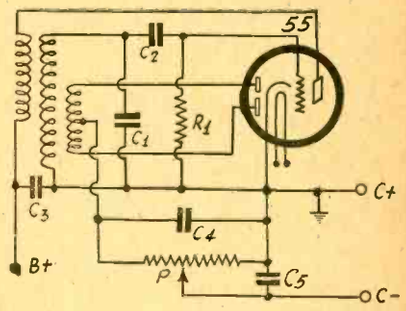


FIG. 1

The circuit of a C supply based on a 55 used as oscillator at high frequency and as full wave detector. Voltages up to 100 volts are easily obtainable.

Coil Assembly

There is nothing critical about the coil or the tuning condenser C1, but the primary and secondary windings should be approximately equal and the ratio of the inductance to the capacity should not be too small. That is, for a given coil, a small condenser should be used. Coils used in intermediate frequency transformers would be all right if the two windings are pushed very close together and if the tuning condenser across the plate winding is removed.

If such a transformer is used the centertapped winding can be made of two equal coils, one at each side of the other and placed close to them. The inside wire of one of these should be connected to the outside of the other to insure that they will be in proper phase, and they must also be so placed that the windings are in the same direction. But even if this is not done the rectifier will work, not as a full wave rectifier however, but as two rectifiers in parallel.

Fine Output fro

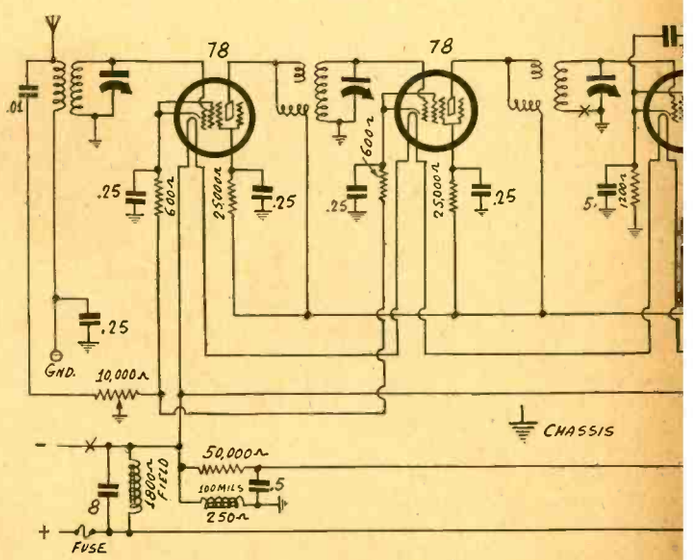
This d-c receiver is capable of very high selectivity and sensitivity, and as to power output ability it is quite on a par with a-c receivers utilizing 250 volts on the plates of the power tubes. This is due to the use of the 48's in push-pull, tubes specially designed for this purpose.

THOSE who have used the 48 tube in a push-pull amplifier in a d-c receiver are unanimous in their praise of the tube, for it gives a volume comparable with that obtained on a-c operated receivers using the ordinary power tubes and much higher plate voltages. In other words, the 48 tube on a plate voltage of about 100 volts is on a par with a-c power tubes using around 250 volts on that plate. Because of the fine performance of the 48 those who live in d-c districts need no longer apologize for the fact when they turn on their radio receiver, provided they use 48's in the set.

One fact users of the tube have found is that it is not practical to connect the heaters of the 48's in series with the heaters of the other tubes, even though a suitable shunt is used for the difference in current, because there is also a difference in the rate at which the filaments heat up and consequently in the time it takes for the filaments to reach their final hot resistance. It is for this reason that the heaters of the 48's and the other tubes in the Manhattan d-c receiver have been put on separate circuits. The two heaters of the 48's, as will be seen on the diagram, are connected in series with each other and also in series with a 150-ohm, 50-watt ballast.

The Parallel Circuit

The circuit thus formed is put directly across the line. A simple computation will show that the current will be 0.4 ampere, which is correct for the 48's, when the line voltage is 110 volts. Another computation



C SUPPLY

ng Triode as Oscillator

nderson

The stopping condenser C2 can have a value of about 0.001 mfd., and this is large enough even if the frequency is as low as 10,000 cycles per second. It should be of the mica dielectric type that will stand high voltages.

C3 is a by-pass condenser of about 0.1 mfd. used for the purpose of filtering. In order to prevent more thoroughly the escape of the oscillation into the rest of the receiver a radio frequency choke should be placed in series with the plate lead of the oscillator. Its value need not exceed 85 millihenries.

C4 is the usual filter condenser across the load of the rectifier. In this instance thorough filtering is required and there is no limitation on the size of the condenser because only d-c is involved. It might well be one microfarad. An electrolytic condenser, however, is not suitable because that would not have a high capacity at the oscillation frequency and it would have a high resistance. C5 is only an additional filter condenser which may or may not be used. If used, it can have just as large a value as C4.

Resistors

The grid leak R1 should be about 10,000 ohms, as this is low enough to insure stable oscillation without blocking. If blocking should occur a lower value should be employed, and if there is no blocking even a higher value than 10,000 ohms might be used.

P is a potentiometer used for load on the rectifier and also for varying the bias taken from the device. There is another way of varying the bias and that is to put a rheostat in series with the filament of the tube. This lowers the amplitude of oscillation and for that reason varies the voltage across the load potentiometer.

By means of the rheostat it is possible to have two variable voltages. One can be taken from the negative end of the potentiometer resistance where the voltage is highest, and this can be varied by means of the rheostat. The other can then be taken from the slider of the potentiometer, and this can be varied to any value up to the maximum determined by the rheostat. If the resistance of the rheostat is made too high, oscillation may cease. This suggest another desirable way of varying the output voltage which is not subject to the danger of oscillation stoppage, at least not so soon. That is by varying the applied plate potential. Oscillation will occur, as a rule, in a circuit of this type when the plate potential is as low as 10 volts, and there will be violent oscillation when the voltage is raised to 250 volts. The voltage across the potentiometer is nearly proportional to the applied plate potential, assuming that the emission is constant.

Economy of Device

A C supply of this kind costs very little to add to a receiver, and it adds very little to the cost of operation. But there are cases where a C supply is essential. Therefore this oscilator-rectifier type of circuit is well worth considering when planning a receiver.

Sound Studio Making Film For Television

In preparation for television, the Freeman Lang sound studies in Hollywood have started to produce a sample film to accompany each electrical transcription series which leaves its studios.

For the initial performance in each recorded series, artists and actors appear in costumes of the times and scenes which they portray. The film library will be indexed and catalogued and, on order, complete filming will be done for any transcription series.

Freeman Lang's power cruiser, "The Dierdre," which is used as a floating audition boat at stated intervals up and down the Pacific coast, has been pressed into service for a sample transcription and film. This is in addition to the current practice of filming one episode of each recorded series.

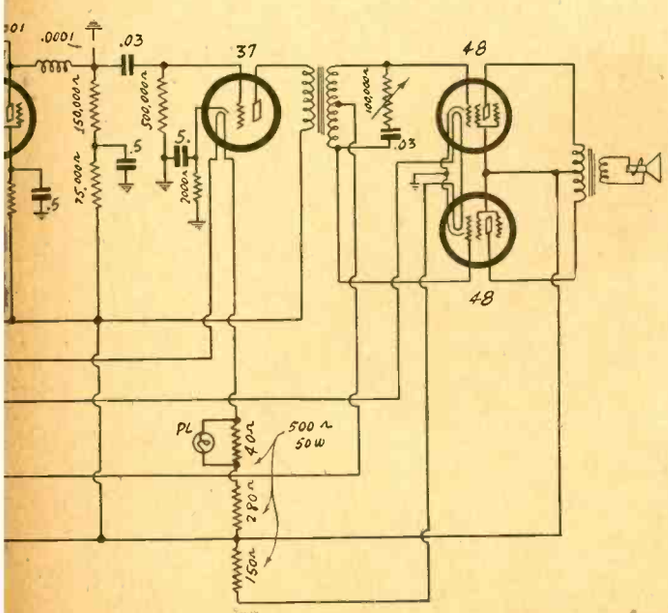
Aboard the craft a sample film was made when Mr. Lang caught a huge swordfish off Santa Cruz Islands. The film shows marine scenes and the transcription furnishes the running narrative.

While television, when it is finally released to the public in more or less finished form, will undoubtedly make considerable use of live talent from studios with scenes broadcast direct, it is believed that transcriptions, too, will be pressed into service with the use of films to show the talent and action.

In preparation for this, the new television department at the Freeman Lang studioes will start production from the film angle.

Especially sharp film delineation with sound track will be effected.

n Push-Pull 48's



Safety of operation was kept in mind by the designer of this receiver, for a large factor of safety has been used in selecting ballast resistors and ground has been isolated from the chassis. Besides, the filter condensers used will not be damaged by accidental application of the voltage in the wrong direction.

will show that in the allowance of 50 watts for the ballast, the safety factor is over 100 per cent.

The other heaters, those of the two 78's, the 77, the 37, and the pilot light, are also connected in series and then connected across the line through a 280-ohm ballast. These tubes get a little more than 0.3 ampere, but the current is well within the safe rating of the tubes. A 50-watt ballast is used in this circuit also, which allows a safety factor of nearly 100 per cent.

Pilot Lamp Shunted

The pilot light employed is designed for 6 volts. But this lamp does not take as much current as the tubes. For that reason a 40-ohm resistor is connected across it. This shunt is also rated at 50 watts, although normally the power dissipation in it will be very small. The heavy rating is a safety measure against the possibility of burn-out of the pilot light, for when that burns out the shunt resistance takes the full load. It might get unduly hot if its rating were not high.

Attention is called to the connection of the cathodes of the 48's and the grid returns to insure suitable bias on the power tubes. The two cathodes are grounded; that is, they are connected to the chassis, and the grid returns of the two tubes are connected to the negative side of the filter choke, through a resistance of 50,000 ohms. The resistance of the choke is such that with the d-c flowing through it the voltage drop is just right for the bias for these tubes.

Radio University

A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6 without any other premium.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Insulation for Wire in Coils

WHAT is the best insulation for wire used in winding coils? We have a choice of double cotton, single cotton, double silk, single silk, enamel, silk enamel, and no insulation.—W. B. N.

The best insulation is dry air. That is, the best coil is wound with bare wire spaced. The wire should be supported at as few points as possible on high-grade insulators. Enamel is a good insulator provided that the enamel does not absorb moisture. Silk enamel is next and then silk, although there is very little difference between these two. Cotton is not good because it absorbs moisture. A coil wound with cotton-covered wire should be boiled in wax for a long time so that all moisture is driven out. A coil boiled in wax until all the moisture is out has a constant resistance to one frequency, whereas a coil not boiled varies in resistance according to the moisture in the atmosphere. This applies mainly to cotton-covered wire coils.

* * *

Band Pass Fallacy

IT IS usually said that doubly-tuned circuits such as those used in up-to-date superheterodynes are a band pass filter. If they are to be band pass filters is it not necessary that the two circuits be tuned to the same frequency when one is not in the presence of the other? If that be so, the coupler will certainly not be a band pass filter when first one and then the other be tuned for greatest response.—T. L.

That is correct. If the true band pass effect is to be obtained one circuit should be tuned to maximum response when the other is open. This can be done by opening the condenser of one while the other is tuned. If the condenser on the grid side is opened the primary can be adjusted and then the coupler is a tuned plate. When this has been done the plate condenser can be opened and the grid condenser connected. This then is adjusted so that the circuit is most responsive when the coupler is of the tuned grid type. When this has been done the plate condenser should be connected, and then the circuit should be tuned correctly as a band pass circuit. This method of tuning is not used for practical reasons, but it is the correct way.

* * *

Bandspread Tuning

PLEASE suggest a simple method of introducing bandspread tuning in a receiver that is to cover the entire short-wave region. For a small band of frequencies I can use a band spread condenser but this is not applicable to a receiver that is to cover several bands.—W. R. B.

One simple way of introducing band spread is to shunt the main tuning condenser with two other condensers connected in series, one of very small value and the other of a larger and variable capacity. The smaller the small condenser in relation to the large, the greater is the band spread. The calibration of the main condenser should be made at a definite setting of the band spread condenser, say with that condenser set half way. The frequency can then be varied in both directions by means of the band spread condenser. Another way of introducing band spread is to connect a small variable condenser across a few turns of the tuning coil. Varying this condenser has the effect of varying the effective inductance of the coil, for the turns shunted by the condenser become more or less effective as the shunting capacity is decreased and increased. This method is used in some short wave receivers. It is the simpler way but the other method is probably superior.

* * *

Spectral Composition of a Wave

WHAT is meant by the spectral composition of a radio wave? I thought that "spectral" referred to something to be seen, from a ghost to a spectrum of the sun.—W. R. E.

The term is applied to both audio and radio frequencies by analogy with the light spectrum. By spectral composition is meant the relative distribution of energy in the fundamental and the harmonics. If it relates to a complex ratio wave the spectral distribution is adequately expressed by giving the amplitudes of the fundamental and of all the harmonics. The relative distribution can be given as the ratio of the amplitudes of the harmonics to that of the fundamental.

* * *

Oscillator with Minimum Harmonics

WHAT kind of oscillator would you recommend when it is of first importance that the harmonics be as low as possible? Is there a way of getting rid of all the even harmonics by means of a push-pull oscillator?—B. W.

The first thing to do to get an oscillator of low harmonic content is to arrange the circuit so that the grid oscillates about the steepest point of the grid voltage plate current curve. This practically eliminates all the even harmonics. If the oscillator contains two equal tubes in push-pull the even harmonics are more thoroughly eliminated. This is true whether or not the tubes are operated at just the right bias, but it is best to make the bias right. There seems to be no way of getting rid of the odd harmonics higher than the fundamental. They may, however, be reduced by selecting a highly resonant circuit and by using low feedback so that the tube oscillates over a narrow range of grid voltage. That will reduce all harmonics. Then there is an advantage of using a Colpitts oscillator in preference to any other type. Large condensers and a small coil should be employed. This will not only loosen the coupling but it will make the radio frequency resistance of the tuned circuit low. Great improvement is also effected by stabilizing the Colpitts oscillator.

* * *

Construction of Shunts and Multipliers

WHAT kind of resistance wire should be used in the construction of standard resistances, meter shunts, and voltage multipliers?—B. M.

For standard resistances Manganin wire is usually employed because the resistance changes very little with temperature. Multipliers and shunts should be constructed of the same wire if accuracy of meters is highly important. For less accurate meters Nichrome wire is all right. Nichrome has a much higher specific resistance than Manganin and not so much of it is needed to give a specified resistance. Another important thing is that the wire used for multipliers should not be too fine, for the finer it is the more it will heat up. This is more important for Nichrome than for Manganin.

* * *

Use of Litz Wire Coils

IS THERE any advantage in using Litz wire for coils to be used in a broadcast superheterodyne? If so, should the coils be wound in solenoid or compact fashion? The coils, of course, are to be shielded.—W. F. L.

The advantage of Litz wire over solid wire ceases before the broadcast frequencies are reached. There would be no advantage, therefore, in making the coils of Litz. This is particularly true when the coils are to be shielded. Solenoids of a single layer are better than compact coils. For the intermediate frequency transformers the Litz-wound coils would be better for, at the intermediate frequencies ordinarily used, the Litz wire still has the advantage over solid copper wire, for the same cross section area of the wire. But if selectivity is needed it can be obtained by adding another tuner. It is better to have several tuners of moderately high selectivity than to have few tuners of high selectivity, the selectivity near the carrier frequency being the same in the two instances. The sidebands will not be cut nearly so much when several moderately selective coils are used as when fewer coils of higher selectivity are used.

* * *

Choice of Diode and Amplifier

IF YOU were to choose a diode detector tube would you select a 55, a 2B7, or a 2A6? What are the advantages and disadvantages of the three tubes?—W. E. M.

The choice of tube depends on what kind of audio amplifier that is to be used. If there is to be a push-pull stage using a pair of high-gain pentodes, the choice would be a 55, for that can be operated effectively into a transformer and it will stand a signal that will load up the push-pull stage. Even if there is to be an intermediate audio voltage amplifier with transformer coupling to the detector this tube would be a 55. If the audio amplifier is to be a high gain pentode with resistance coupling between this tube and the detector, the choice would be either a 2A6 or a 2B7. There is little choice between the 2A6 and the 2B7, except that the 2A6 is less critical. There is no need of worrying about the screen voltage when that is used because the tube has no screen.

* * *

Bias Supply for Class B Amplifier

WILL YOU kindly explain how a simple C supply for a Class B amplifier in which the tubes are to be operated at high bias can be constructed?—T. K.

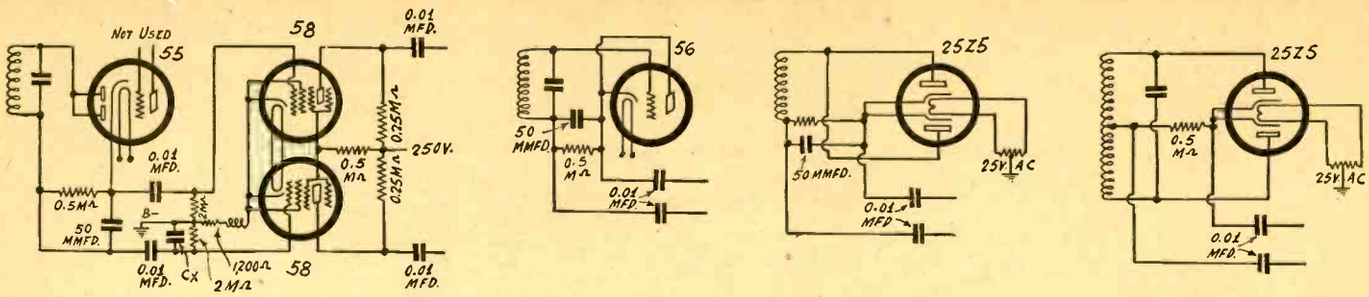
One of the simplest C supplies is a radio frequency oscillator and rectifier. The 55 tube can be used for both functions. The triode element would be used for the oscillator and the diode element for the rectifier. Bias voltages over 100 volts can easily be obtained when required. You will find a description of such a supply on pages 12 and 13 of this issue.

* * *

Beat Note Oscillator

HOW SHOULD an audio beat note oscillator be constructed so that the calibration will hold and so that the frequencies can be read accurately? What kind of radio frequency oscillators should be used?—D. A.

First of all, the radio frequency oscillators should be stabilized as to frequency. Second, they should be made as nearly equal as possible. The Colpitts oscillator is suitable. Third, it should be made to oscillate feebly by using large condensers and small coils. Fourth, the two oscillators should both be variable but in opposite directions that is, by decreasing the capacities in one and increasing them in the other. This can be done with a gang of four variable condensers of opposite rotation and placed on the same shaft. To spread out the frequencies over a long scale, the variable condensers should be only a small fraction of the main condensers and they should be rotatable over a wide angle as possible. The



A diode is used to develop a push-pull or symmetrical circuit for feeding the drivers of the output stage.

frequency of each oscillator at zero beat should be high in comparison with the highest beat frequency. For example, if the highest beat is to be 10,000 cycles per second the high frequency of each at zero beat should be over one million. If the small variable condensers can be turned through 270 degrees and the scale is calibrated in degrees and if there is a vernier scale, it is possible to read to one part in 2,700. Thus at 10,000 cycles it would be possible to read to 3.7 cycles per second.

* * *

Temperature Compensation in Oscillator

WOULD it be possible to prevent frequency variations due to temperature in an oscillation generator? If so, will you kindly explain how it might be done?—W. L. S.

It might be done on the principle of the thermostat. A short length of metal might be made to control the capacity of a tiny condenser which is in parallel with the tuning condenser in the oscillator. The wire can be made to increase the capacity when the frequency increases and to decrease it when the capacity decreases. If the change in capacity is proportional to the change in the frequency, this should just about compensate and hold the frequency constant. This is true because the change in frequency with temperature is linear and the change in the capacity of the temperature controlled condenser is also approximately linear. Moreover, if the frequency changes involved are very small compared with the frequency of oscillation, the change in frequency is proportional to the change in capacity. The order of change would not amount to more than about one part in 1,000.

* * *

Soldering Tip Plugs

WHAT IS the method used commercially to solder phone tips to cords so that the plating will not be injured, there will be no solder exposed, and the insulation on the cord will be clean after the soldering operation?—I. F. C.

We are indebted to Blan, the Radio Man, a former electrician, who reports that the method was shown to him by a telephone company engineer. A pair of pliers would be used to hold the tip plug, a piece of cardboard bent into a V so that the cardboard is between the pliers and the tip plug, to prevent unnecessary dissipation of heat. Usually it is necessary to get some one to hold the tip plug tightly in the pliers when the actual soldering is to be done. Thin round solder of the uncored type is used, and two small lengths cut, so that when the pieces are put side by side inside the cup of the tip plug, they do not come any higher than one-eighth inch below the top. Soldering paste may be applied sparingly to the tops of the solder, just enough to provide the thinnest possible layer of flux. The cord insulation is bared for one-quarter inch, tinned, by applying a little solder to the bared end, using a trifle of flux, and then the iron is applied to the outside of the tip plug, with pliers now held by another, until the solder melts, when the tinned end of the cord is inserted all the way, the iron removed, and the joint allowed to harden. The tip is now cleaned with a rag.

* * *

Experimental Push-Pull

CAN NAT THE 55 be used to develop a push-pull output, feeding drivers that swing 2A3's in push-pull?—M.J. McM.

Yes, it is theoretically possible, but the results we have had with such experiments are not encouraging. You mention the 55 and it is shown at top left, but as the amplifier part is not used, therefore any tube may be used simply as a diode. The trick is done in the load resistor. Do not ground this resistor. Then one end may be connected to one grid in a following stage and the other end to the other grid, as in the case of the 58's, and you have a push-pull relationship which may be continued through resistance coupling to the output tubes. The circuit is shown for your information, but is not recommended for duplication except for purely experimental purposes. Three other methods are revealed.

* * *

Volume and Tone Controls

PLEASE SHOW particularly the use of a suitable volume control for a battery-operated receiver, with a tone control also. It is desired that 2-volt tubes be used in a t-r-f design.—o O.C.S.

The volume control and tone control as you request are shown in the diagram on this page. The set is a good one, and will give very satisfactory tonal results, also, if high-class audiio transformers are used.

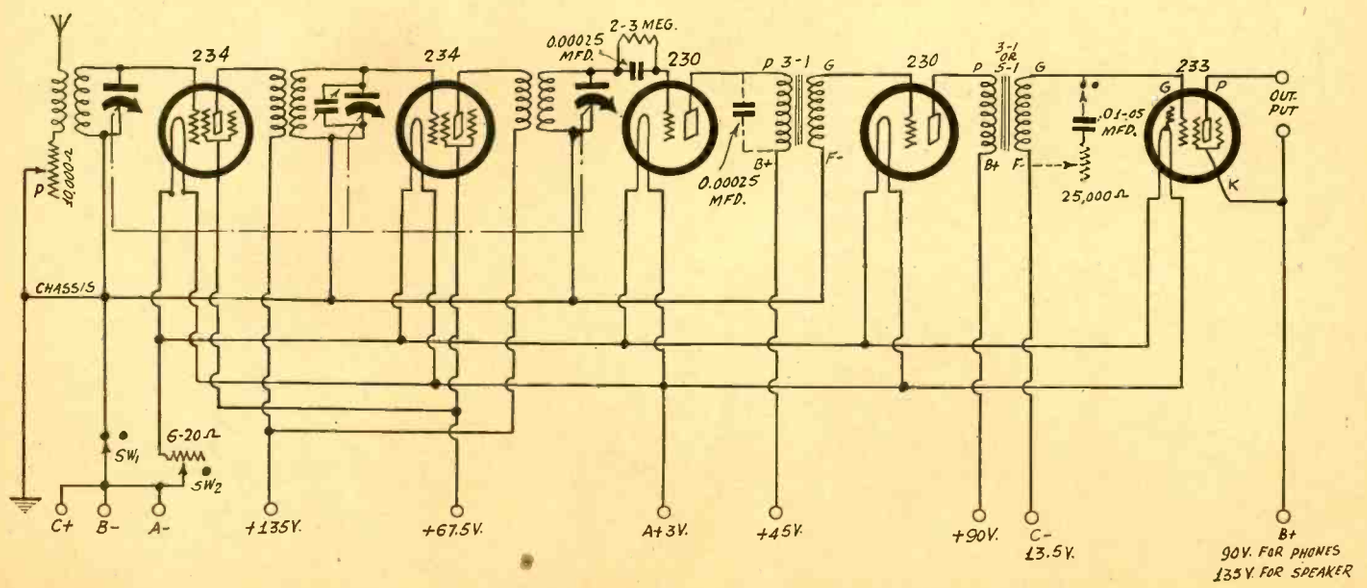
* * *

Tracking Condenser for All Waves

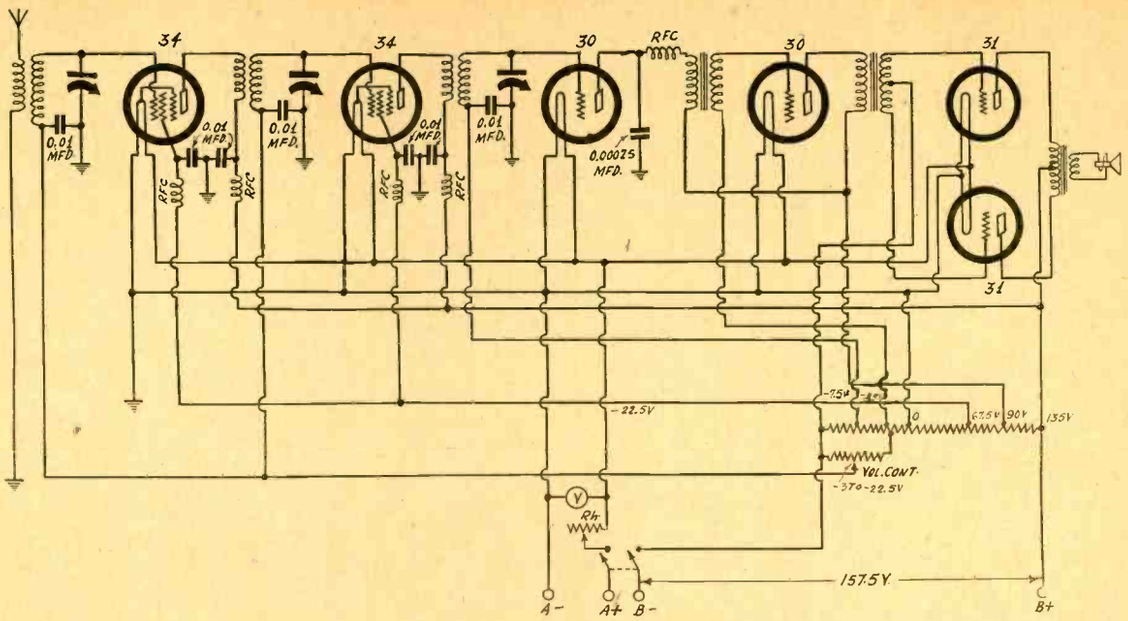
AS I HAVE a tracking condenser made by General Instrument Company, I was wondering whether this could be used in an all-wave set I desire to make. The reason I ask is that the three-gang condenser has two sections of 0.00035 mfd. and the tracking section of perhaps around 150 mmfd., intended for an intermediate frequency of 456 kc, for broadcast-band use. Kindly elucidate this problem for me.—K. E. S.

The method you propose can not be worked practically, because it would require vastly different intermediate frequencies. Therefore if you desire to use the tracking section for the oscillator in the broadcast band, total of three tuned stages (r-f, modulator input and oscillator), then for the higher frequencies you would have to use two tuned stages (modulator and oscillator only, with no r.f.) and pad for the first short-wave band at least, tracking section now disregarded. Reverting to your original suggestion, to show how impractical it is,

(*Continued on next page*)



A five-tube tuned radio-frequency receiver, using the 2-volt series of tubes. The r-f amplifiers are screen grid tubes with remote cutoff, the detector is the first 30 and the driver is the second 30. The output is a 33.



A tuned-radio-frequency set, using two stages of screen grid 34 r-f, 30 detector of the negative-bias type, 30 first audio amplifier or driver, and 31 triode push-pull output. The biases are derived from the B supply through a resistance network.

(*Continued from preceding page*)

the intermediate frequency would have to be shifted by the frequency ratio of the signal-carrier level. Suppose that the ratio is 3. Then, starting with 456 kc intermediate for the broadcast band, for the first short-wave band the i.f. would have to be 1,368 kc, for the next short-wave band, 4,104 kc and for the next 12,312 kc. How and where to get these divergent intermediate frequencies would constitute the problem.

* * *

Bias in a Battery Set

WILL YOU PLEASE clear up the situation for me regarding the use of resistors for biasing, in a battery-operated set, and state what is the current-conserving method? —P.W.C.

In a battery-operated set, since there is considerable current drain on the B batteries during operation, and no current drain on the C batteries, the resistance of the B batteries increases with use as well as with age, and therefore the result of this increased resistance when current is drawn, is to produce a lower terminal voltage. But the C batteries do not wear out, in that sense, since they supply only potential, and no current is drawn, therefore their life is approximately equivalent to their shelf life. The result in practice is that the B voltage goes down but the C voltage stays put, hence if the biasing voltage was selected for the B voltage as it was originally, the bias will be too high for subsequently lower B voltages. The way suggested for overcoming this is to introduce a high resistance network across the B batteries, and make cathode connection to a point above B minus, and biased loads returned to points below cathode. This usually means grounded filament, but not grounded B minus. Thus as the B voltage changes, so does the C voltage change proportionately, and true proportionality is the desired end. The precaution to take is that the resistance network should not be across the B batteries when the set is not in use, but this is easily solved by using a single-pole, double-throw switch. See diagram. Also, the resistance network should be of high enough total resistance so that the current drawn by this shunt across the B batteries will be small.

* * *

Paralleling Oscillators

WHAT IS THE OBJECT of putting two tubes in parallel, suggested sometimes for short-wave work? Does this not increase the capacities in the circuit that should have lowest possible capacities?—K.W.S.

The object of putting two tubes in parallel is to increase the mutual conductance. The slightly increased capacity effect is unimportant. Assuming equal mutual conductance in each tube, the resultant is a doubled mutual conductance. For a vacuum tube as an oscillator the mutual conductance may be taken as the figure of merit, or standard of comparison, and thus with doubled mutual conductance the situation may be regarded as twice as good from the viewpoint of the parallelism as an oscillating medium. This comes in very handy at the higher short-wave frequencies, for sometimes a single tube will stop oscillating at 10 meters or even higher wave, whereas by doubling up there may be oscillation to 7 meters or so. It is usual to recommend that a triode of the same series be used for paralleling. Thus, take the 2A7 pentagrid converter. The conventional circuit is shown at left in the diagram on this page. The companion triode, paralleled with the oscillator section of the 2A7, would be the 56. For the 6B7 the tube would be the 37. For the battery-operated 1A6 pentagrid converter tube the companion triode is the 30, and this is shown at right in parallel with the oscillator section of the 1A6. The pentagrid converter tubes afford electron coupling.

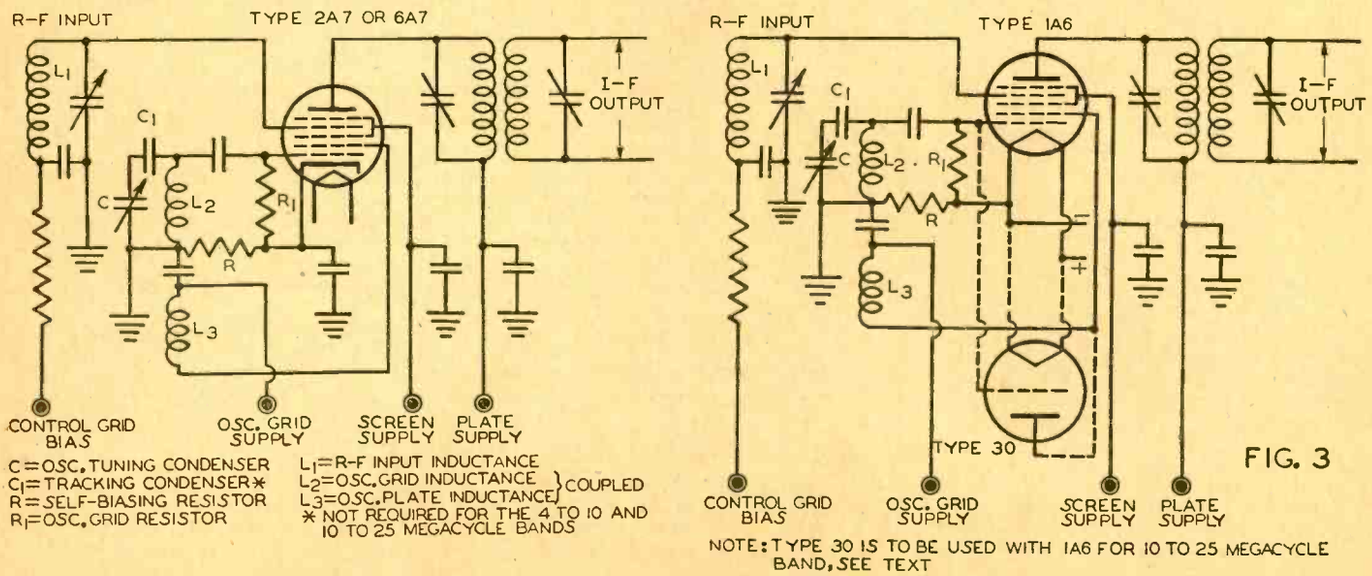
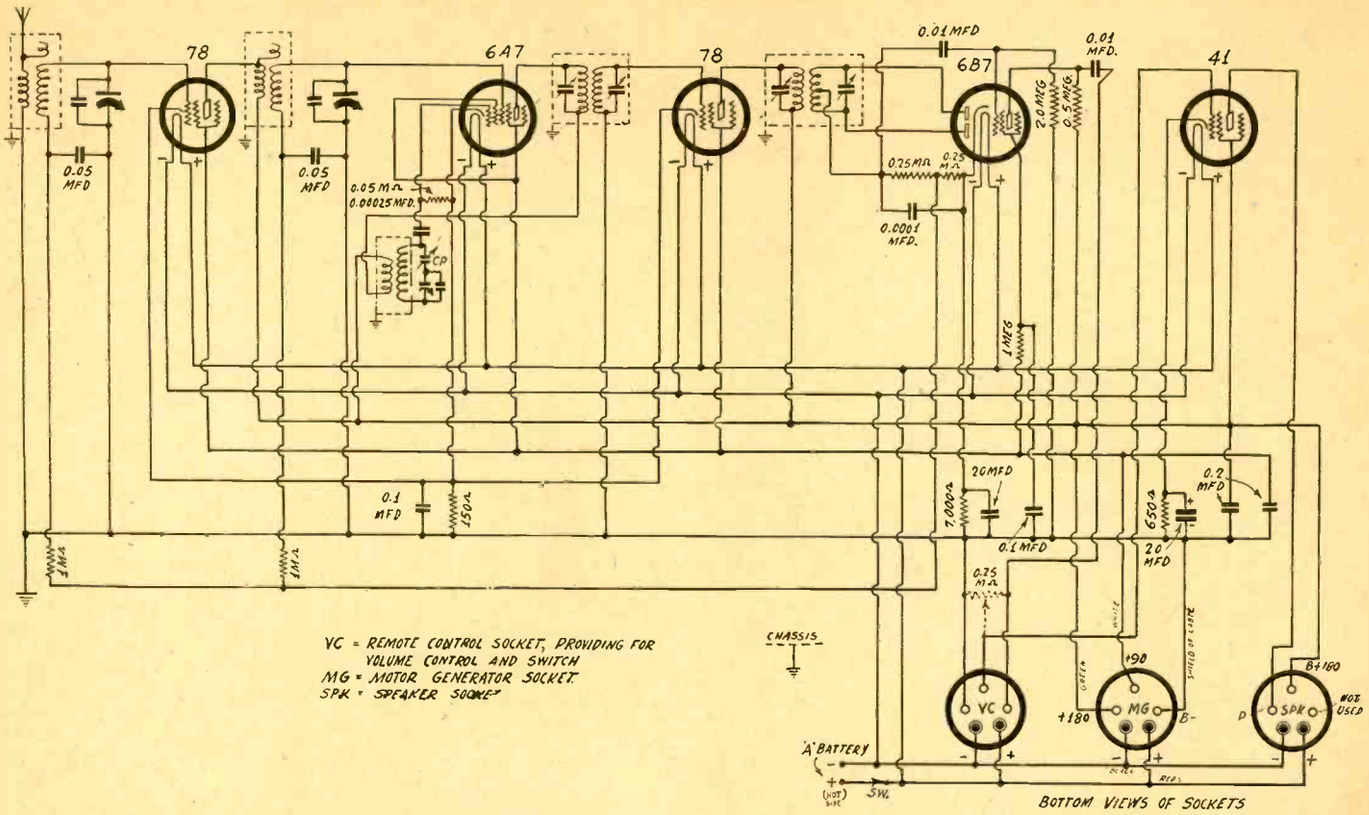


FIG. 3

A single oscillator tube is shown at left, either the 2A7's or the 6A7's oscillator, these being parts of pentagrid converter tubes. If it is desired to improve oscillation, especially at the higher frequencies for short waves, a 56 may be put in parallel with the oscillator section of the 2A7, or a 37 in parallel with the oscillator section of the 6A7. At right is shown the 1A6 pentagrid converter tube for battery operation with the companion triode in parallel being a 30. If paralleling is needed to supply high frequency oscillation it may be harmlessly retained for the lower frequencies



A five-tube superheterodyne for automobile use, or for use in the home with 6-volt storage battery, either way with B batteries or motor generator.

Auto Set

FOR OPERATION from a 6-volt storage battery, and with B batteries or generator supply, please show a circuit using the 6-volt tubes.—O.H.

The circuit of a five-tube receiver of the type requested is shown on this page. The radio-frequency amplifier is a 78 remote cut-off tube, or super-control tube. The 6A7 pentagrid converter is used as mixer tube. A three-gang condenser is used, and therefore the rotor or frame of the oscillator tuning condenser is automatically grounded, although the ground symbol is omitted from this condenser in the diagram. The single intermediate amplifier tube is also a 78, while the 6B7 is used as the detector and first audio amplifier. The driver is resistance-coupled to a 41 pentode output tube. For auto use a remote control unit (VC) would be included and speaker plugged into a socket. The symbols for these are included, also connections. For motor generator the connection is to MG. The ground symbol represents the chassis. For auto use the switch is in the VC unit. The volume control has switch attached.

* * *

The 58 as a Detector

DOES THE 58 tube make a suitable detector? I thought that it had a distinctly amplifying characteristic, and if this is true I can not see how detection can be good, especially at little more than the negative bias voltage recommended for amplification. —T.W.S.

The 58 makes a good detector. However, impedance factors differ in different circuits, and therefore the plate load resistance should be experimented with. Usually 0.25 meg. is all right. It is practical to use twice that resistance. However, sometimes volume increases sharply if the resistance is 100,000 ohms, or even less, so make the experiment. It is assumed that a resistor will be used in the plate circuit and succeeding grid, because it is difficult or expensive to get a satisfactorily high inductance load. Any condenser from plate to ground would have to be lower as the plate load resistor is higher, or may be higher as the plate load resistor is lower, so that the high frequencies of the audio component will be suitably protected. One way of getting good tone is to bias the r-f amplifiers at about 4 or 4.5 volts negative, and use the same bias on the detector, by joining the detector cathode to an r-f cathode. The anomaly you point out is orthodox. No amplifier tube fails to detect, not even the 58, or, to put it another way, the characteristic curve is non-linear. Heightening the negative bias on the 58 detector does permit it to handle a greater input voltage, but 4 to 4.5 volts are a considerable input to a detector, especially to drive a pentode tube directly, for at 20 volts negative bias on the pentode (to allow a bit extra), if the detector's efficiency were only 5 the input voltage to the detector would not have to exceed 4 volts of r-f signal to load up the power tube. The tube while detecting performs an audio-amplifier function, too.

The Review

Questions and Answers Based on Articles Printed in Last Week's Issue

Questions

1. Describe a method of measuring low resistances, using the standard high-resistance measurement circuit as a basis.

2. Since a meter has a finite resistance, is this to be considered in connection with series multiplier resistors for voltage measurement, and if not, why not, or if so, when?

3. State a method of making current shunts for a meter.

4. Is shielding practical or desirable for short-wave circuits? If so when? What are two of the objects, if it is used?

5. State the effect of putting a resistor between screen and ground, in addition to a resistor in series with the B feed and the screen.

6. Give three methods of increasing the regenerative effect.

7. State a method of checking bias loss in a power tube due to overloading by signal voltage, and classify the type of tubes and circuit to which the remedy is important.

8. How is quality in an audio amplifier affected by the value of the bypass condensers across biasing resistors and by the value of the stopping condensers in resistance coupling?

9. State the effect of regeneration in audio amplifiers, particularly on the value of bypass capacities, and stopping condensers if the audio is resistance-coupled.

10. State the theory of operation of a short-wave converter.

11. Is it true that the higher the aerial, the better the reception? What is a good rule for antenna selection? Why?

12. What type of aerial is non-directional? What type of antenna is highly directional?

13. What is a blind-spot antenna system? Of what is such a system composed?

14. Describe the transposed leadin and the preferred method of utilization, with requirements.

15. Due to the trend in modern receiver design, what is the type or size of aerial that often gives better results, and why?

16. What is a doublet antenna? In what way may the two elements be classified?

17. What makes a neon tube oscillate? What is the relationship between frequency and light intensity, if the light is fed to a photo-electric cell, in the output circuit of which is a neon oscillator?

18. State how a photo-electric cell and neon oscillator can be used by the blind so that they can read by sound instead of by sight.

19. State distance, frequency and power in a recent notable example of good radio communication from a great height.

20. Should the radiation resistance of a resistance of a transmitting antenna be high or low? What is your answer as to a receiving antenna?

Answers

1. As the standard method for measuring high resistances is to have a meter, a series limiting resistor to prevent injury to the meter, and a fixed voltage source, the current through the meter differing due to the unknown resistance, and this difference calibrated, since the meter has a known or ascertainable resistance, if the high-resistance-measuring posts are shorted, an unknown low resistance can be determined if this unknown shunts the meter. This is true because the current through the meter becomes less and less the lower the value of the shunt. With a good 0-1 milliammeter resistances as low as 1 ohm can be read accurately by this method, and as high as 100 ohms, with usual limiting series resistor and battery.

2. The resistance of a meter used for measuring high voltages is usually of no consequence, because so low in respect to the series resistor, even though the meter resistance is necessarily a part of the total resistance in circuit. However, for low-voltage scales, where the accuracy of the reading is ½ per cent. or better, the meter resistance may have to be considered.

3. A method of making your own shunts is to use the meter as it is and put through it just enough current for full-scale deflection, then introduce a shunt until the current is reduced in the proportion desired. Thus, if the meter is a 0-1 milliammeter, allow 1 milliampere to flow, and to extend the range to 10 milliamperes, introduce a shunt until the reading with 1 ma flowing, instead of being full-scale, is one-tenth of full scale. The shunts may be calculated if the meter resistance is known. A chart of resistance values in ohms, for the various sizes of wire, enables selection of approximately the correct resistance, preferably more resistance than necessary, and reducing the wire experimentally by connecting it across the meter terminals. After the test the wire may be wound on a bobbin or spool.

4. Shielding is practical for short-wave circuits, but the shield should be larger than for broadcast practice, that is, there should be more room between the coil and the inside wall of the shield. Shielding is desirable particularly when there is a stage of tuned radio frequency ahead of the detector or modulator. Two objects of shielding are to improve selectivity by reducing the pickup due to the loop effect, and prevention of inductive feedback.

5. The effect of putting a resistor between screen and ground is to establish a low enough voltage the moment the set is turned on, since sufficient reduction of the total B voltage to the screen value may not be effectuated by the series resistor that leads to B plus until the current has reached its steady value. Sometimes a set squeals for a few seconds due to too-high starting screen voltage, and the resistor to ground (75,000 ohms or so) prevents this. The resistor to ground reduces the screen voltage generally, and the series resistor has to be selected with this fact in mind. For a single stage the resistance values may be, series=50,000 ohms, parallel=75,000 ohms. The maximum voltage is assumed to be 250 volts and the negative bias standard.

6. Regeneration may be increased (a) by increasing the value of the grid leak in the regenerative detector, (b) by increasing the plate voltage and (c) by decreasing the value of the series antenna condenser, or, if there is no such condenser, by introducing one, as this reduces the antenna resistance.

7. A method of checking bias loss in a power tube is to apply the standard elemental voltages (screen, plate, suppressor) and adjust the bias until the current flowing equals the amount stated for the required bias at the other voltages. Then introduce a strong signal, and if the plate current increases considerably beyond the normal (say, 50 per cent.), reduce the grid resistor in the power tube circuit until the plate current's rise is not more than 20 per cent. The bias loss occurs in pentode output tubes that have a high d-c resistance in the grid circuit, for the grid resistance is so high that when grid current flows, since there is no stopping condenser in the grid circuit proper, the voltage developed across the resistor bucks the bias. In general, not more than 1 meg. should be used in this grid circuit with pentode output tubes having self-bias.

8. The quality of the amplification in an audio circuit is affected by the value of the bypass capacity across a biasing resistor because if the capacity is not high enough the degenerative effect (negative feedback) causes attenuation of the low notes, to which the condenser allows the resistor-capacity circuit to present too high an impedance. With stopping condensers in resistance-coupled circuits the effect is in the same direction, although not due strictly to negative feedback, though still to impedance factors.

9. The effect of regeneration in audio amplifiers is to improve the low-note response, and this effect is one constituting a low impedance to the low frequencies in the signal circuit, hence bypass condensers across biasing resistors may even be omitted, and stopping condensers in resistance-coupled amplifiers may be smaller than otherwise.

10. The theory of operation of a short-wave converter is that the short-wave carrier frequency is tuned in by a selector circuit, an oscillator generates a frequency differing from the carrier, and the resultant mixture or beat frequency is put into a broadcast receiver. When the beat frequency is equal to the frequency to which the broadcast receiver is tuned, response results. Therefore the broadcast receiver contains the intermediate amplifier, even if the broadcast set is of the t-r-f variety.

11. The general rule that the higher the antenna the better the reception is not strictly true, as the best reception may be expected when the antenna impedance is matched to the input impedance of the receiver. What is generally considered the best height is that equal to one-quarter the wavelength of the frequency desired to be received, for then the current near the ground is greatest, and it is near ground that the current is picked off in practice.

12. A vertical wire antenna is non-directional. A loop antenna is highly directional.

13. A blind-spot antenna system is one that picks up nothing whatever in a certain given direction (both poles). This blind direction may be changed at will, as the system consists of a loop and a vertical wire antenna in combination. Two small adjoining circles constitute the reception pattern of the loop. A large enclosing circle constitutes the non-directional pattern of the vertical wire. The blind spot direction is at right angles to the direction in which the loop points and includes both poles of direction.

14. A transposed leadin consists of a transmission line, that is, a strictly conducting device that of itself does not supply pickup, and may be constituted of twisted pair, or of wires crossed numerous times from roof to insulator at the set, or of shielded wire, sheath grounded. One of the wires always is grounded at both ends. The other is connected to aerial in at one extreme and to set at the other. The preferred method of utilization is in connection with impedance-matching shielded transformers at the roof and receiver ends.

15. The short aerial, even only a few feet of wire indoors, may give improved results with highly-sensitive receivers, particularly modern superheterodynes, because the selectivity is so much greater by the short-aerial method that interference due to heterodynes with local carriers that feebly get by the tuner to the oscillator is avoided.

16. A doublet antenna is an antenna, usually horizontal, with take-off at the exact center. The antenna wire from center to one extreme may be considered at as the antenna proper and the wire from center to the other extereme as counterpoise.

17. Oscillation is produced in a neon tube by virtue of the fact that the starting voltage is higher than the extinguishing voltage. The relationship between frequency and light intensity, when the neon oscillator is used in conjunction with a photo-electric cell, is practically linear.

18. The blind can read by sound instead of by sight, if a photo-electric cell and neon oscillator are used conjunctively, by

(*Continued on next page*)

Station Sparks

By Alice Remsen

INTERESTING THE KIDDIES

Frank Novak, who made a reputation for himself in radio as a one-man band, has turned out to be an excellent entertainer for children. His knowledge of child psychology is amazing, although he has never studied children in particular. He just applies common sense to his memories of his own childhood; the result is very satisfying, judging from those "Wizard of Oz" programs which Frank writes and directs. He starts on a new series soon—that of "Raggedy Ann," a character I have always loved. Thanks, Frank, for bringing my old friends to the radio; we grownups like to be reminded of the days of our own childhood—at least I do! . . . Another child psychologist is Peter Dixon; he goes in more for the Western cowboy type of program—real he-boy escapades—which proves that he is a boy at heart; all men are, for that matter—or so women think! Anyhow, Peter's "Bobby Benson and Sunny Jim" characters are the delight of boys of five years old and up; I like 'em, too!

WHAT WILL RUDY GIVE US?

And so Vallee journeys to the flicker metropolis of Hollywood, leaving his band behind him—like the little sheep's tail; it will be interesting to note what he does with his baton behind a new set of boys, and also what sort of talent he manages to dig up out there; usually the programs emanating from out that way are pretty sad, but there must be plenty of talent waiting at studio gates—more talent outside than inside, we opine. Anyhow, Rudy will have a chance to find it. If television were further advanced we might see Gary Grant doing his old stilt-walking stunt, Jimmy Cagney twisting his legs around, and a few other things like that. . . .

INSTRUMENTS THE MAESTROS PLAY

According to a census taken by Columbia, the most popular musical instruments among orchestra leaders are piano, violin and saxophone, at least these are the instruments which most maestros studied before taking up the baton. Among the ranks of pianists are Jack Denny, Little Jack Little, Vincent Lopez, Eddie Duchin, Claude Hopkins, Isham Jones, Joe Haymes, Lennie Hayton, Don Voorhees, Nat Shilkret, his brother Jack, and Willard Robison. Isham Jones, by the way, also plays sax extraordinarily well. . . . Among the fiddling maestros are Mark Warnow, Erno Rapee, Rubinoff, George Hall, Enoch Light, Vincent Sorey, Max Smolen, and Leon Belasco. Guy Lombardo, who always holds a fiddle as a "prop," really played the instrument as a boy, and could probably drag out a tune now if he tried. . . . The saxophone contingent has quite a few distinguished members; Glen Gray, who occupies the first saxophone chair in his Casa Loma Orchestra; Wayne King, the waltzer; Carmen Lombardo, who often takes his brother's place with the baton, and many others. Frank La Marr makes a bid for originality as a xylophone manipulator; Freddy Martin and Abe Lyman turn to the drums; and we might mention the renowned Rosario Bourdon, conductor of the Cities Service Orchestra, who is a cellist of no mean ability and who often gives the radio audience a treat by playing a solo or two. . . .

SOME PROGRAM CHANGES

Abe Lyman is known as "Musical Tarzan," he is so tall and broad-shouldered. . . . George Hall's augmented orchestra moves to a new schedule; is now heard six days a week from the Hotel Taft, New York; this will include a late spot on Wednesdays, 12:30 a.m. . . . Another change has been made in the Harlem Serenade program, the all-star negro revue featuring Aida Ward and the celebrated Hall-Johnson Choir. Luis Russell and his orchestra replaces that of Claude Hopkins, and the program will originate directly from the Roseland Ballroom, instead of the WABC studios; each Thursday at 10:45 p.m. . . . Howard Barlow may now be heard in bi-weekly concerts over a WABC-Columbia network; Mondays and Wednesdays; his New World Symphony Orchestra on Mondays from 4:30 to 5:00 p.m.; and his Musical Album of Popular Classics on Wednesdays at 4:00 p.m. . . . Nino Martini will make his Metropolitan Opera debut on December 28th, and the role that of the Duke in Verdi's "Rigoletto" . . . Jane Froman makes her Broadway debut in the "Follies" this week; in the spotlight beside her will be her husband, Don Ross. . . . Ella Logan, who sings those "hot hotcha songs" with Abe Lyman, was born and bred in Scotland, of all places; she can sing a Scotch song, too. . . . It is nice to have "The Voice of Firestone" back on the air with such singers as Lawrence Tibbett and Richard Crooks on alternate Mondays, WEAF, 8:30 p.m. . . .

And now it comes out; Irene Beasley will not sing if she is wearing a solid black dress. My advice to Irene is to be sure and NOT wear a solid black dress; silly, isn't it? . . . . John Brewster's favorite meal is lobsters, beer and camembert cheese. Wonder what kind of dreams John prefers; a meal like that would give most of us the nightmare! . . .

ANN GREENWAY DOING WELL

Irving Mills and his artist bureau are placing plenty of artists these days. The latest placement is Ann Greenway, whom Mills has put at the smart London Club, the Monseigneur. Ann has already made a name for herself in such entertainment places as the Central Park Casino, the Park Avenue, the El Patio, and others, besides adding to her laurels as a musical comedy favorite in "Yours Truly" and "Face The Music." Ann is really an exquisite songbird both in appearance and voice. . . . Mills has also signed Cab Calloway and his Cotton Club Orchestra for a spring tour of Europe, which will include a four-week engagement at the Palladium in London. . . . Irene Taylor was placed on the Camel program through the Rockwell-O'Keefe agency. . . . WMCA is getting along nicely, thank you. Bob Haring, leader of WMCA dance orchestras, is turning out some good programs; incidentally Bob has a twelve-year-old son who is leader of his boy scout band. A chip of the old block. . . . Robert Hood Bowers, director of the WMCA concert and symphony orchestra, is busy writing a new musical comedy with his old partners, Harry B. and Robert Smith, who wrote "Lonely Romeo" with Mr. Bowers in 1919. This was a Lew Fields production and contained quite a few catchy numbers. . . .

MARGE TO BE MARRIED

News comes from Chicago that Marge, of "Myrt and Marge," will be married some time during the Christmas holidays to Gene Kretzinger, of the radio team of Gene and Charlie. . . . Ernest Schelling's concert broadcasts for children have started on their fourth consecutive season and will be heard six times during the winter. The first time was December 16th, the others being January 13th, January 20th, February 10th, February 17th and March 10th, Saturdays at 11:00 a.m. . . . King George V of England will send Christmas greetings to the American people via WABC and Columbia network at 9:00 a.m. on Christmas morning. . . .

WHAT WILL YOU DO?

And so far as Christmas presents go: Marge of "Myrt and Marge," would like an expensive car, any make; Babs Ryan would like a nice large diamond ring; Nino Martini wants a horse-saddle, of course; Boake Carter would like a sail-boat; Budd Hulick a barrel of German beer; Bing Crosby, a good-looking pair of pajamas or a tie; Jacques Renard, an aeroplane; Tom Waring, a hothouse; Gladys Rice, a sable coat; Norman Brokenshire is very modest in his desires, as he wants only a tennis racquet; Louis Dean, just a few bottles of Pommery Sec; Evan Evans would also like some wine, but a selection of different kinds, Burgundy predominating. Do you think you can fix it? . . . Me? Oh, I'd like just a trip to dear old London in time to hear Big Ben pealing out the hour at New Year's! . . . Have you listened to the Phantom Strings, with the Don Hall Trio, on Sundays at 11:45 a.m. over WJZ and network. A very worthwhile program. . . . And while I'm about it must tell you that my old pal, Bob Bennett, is back from a ten-month stay in Europe, where he and his band had a jolly good time, besides garnering a few shekels; Bob is now at the Boca Raton Club in Florida . . . and I'd better go to Florida myself if I don't hurry up and get this over to West 45th St., so here goes for a plunge into the subway.

The Review

(*Continued from preceding page*)

exposing the reading matter to light and having this light reflected into the cell. The differences in the amount of dark area for the different letters of the alphabet produce differences in light put into the cell, and as light differences linearly control the frequency of the oscillator, the individual letters can be heard as distinctive frequencies, instead of requiring that they be seen.

19. Good reception at a great height can be attained with small power on high frequency, as witness the ascent of Commander T. G. W. Settle, U. S. N., who went up in a balloon about 11 miles, and communicated with land stations, using 5 watts rated output tube, 1-watt actual dissipation, for transmission on 15,760 kc.

20. The radiation resistance should be as high as possible if the transmitting aerial is to radiate well, for the radiation resistance is a measure of the capability of the antenna to radiate. If the radiation resistance is high when the antenna is used for transmission it is also an effective collector of energy radiated from some other antenna. Any device that is a good radiator of light, heat or radio waves is also a good absorber. As was stated above, the radiation resistance is a measure of the energy radiated from the antenna. The resistance of the antenna is a measure of the total energy lost in the antenna, whether the loss is caused by radiation or by losses in the wire or in dielectrics around the antenna. Energy lost by radiation should not really be called a loss, for the sole purpose of the antenna of a transmitting station is to radiate energy. The receiving antenna should have high radiation resistance. Neither aerial should have high radio-frequency resistance.

Better Comedy Heard; Unknowns Lead Way

Comedy is improving on the large stations in New York City, hence including chains. Some of the lesser-known acts are funnier than the famous ones, and less given to puny puns.

For radio, due to absence of the privilege of seeing the comedian's antics, the comedy lines must be better than for stage work, a fact just beginning to be appreciated.

VARIETY RULES SUNDAY AIR AS SERMONS WANE

Not so very long ago, sermons and speeches constituted a large part of the Sunday afternoon radio fare, but a cursory survery of the WABC-Columbia's current Sunday schedules shows a diversity of entertainment. From noon until midnight the CBS schedule offers more variety than that of any other afternoon in the week.

This variety has been largely caused by the capitulation to radio of many of the outstanding personalities of the stage. Microphone performances on Sunday, their day of rest in the theatre, avoid conflict with theatical engagements and keep them from working in both media at once.

Helen Morgan Heard

The CBS Sunday schedule includes Helen Morgan, a regular afternoon fixture on "Broadway Melodies," Ethel Waters, of "As Thousands Cheer," who is heard in "The American Revue," and George Beatty, vaudeville headliner.

Two headliners of the Broadway musical stage, Katherine Carrington, of "Face the Music," and "Music in the Air," and Milton Watson, of the "Vanities," "Strike Me Pink" and other revues, are starred on "An Evening in Paris," together with the French star, Claire Majette, who has performed in every medium from vaudeville to grand opera and in almost every country in the civilized world. Opera singer Nino Martini, Jane Froman of the current "Follies," and the stage comic Julius Tannen comprise three of the stars of "The Seven-Star Revue."

Drama with Real Actors

"Roses and Drums," the Civil War dramatic series, continues to enlist Guy Bates Post, Henry Hull, June Walker, Pedro de Cordoba, Reed Brown, Jr., Elizabeth Love, John Griggs and others. Francis X. Bushman, movie idol for many years, lends his talents at narration to "The Rin-Tin-Tin Thrillers." Patri's "Dramas of Childhood" and the Columbia Dramatic Guild are other scripts of the day interpreted largely by veteran actors of the stage.

Columbia's Sunday programs offer practically every existing type of radio entertainment. Popular tunes of today and of the past decade are offered by Helen Morgan and Jerry Freeman's orchestra and chorus, by Abe Lyman's orchestra and singers, by Frank Crumit and Julia Sanderson, by Ethel Waters and Jack Denny's orchestra, and by Nat Shilkret's orchestra and the singers of An Evening in Paris. Symphonic music is played by the New York Philharmonic-Symphony Orchestra in two-hour concerts. Minstrel songs are the vehicle for Irving Kaufman in his appearance as Lazy Dan, the Minstrel Man.

Sentiment Included

Sentimental favorites of long ago are revived by Oliver Smith, Muriel Wilson and Jacques Renard's orchestra in the period, "Songs Your Mother Used to Sing." National and international affairs are dealt with by H. V. Kaltenborn and "The Conclave of Nations." Smiling Ed McConnell's cheery songs and philosophy and Willard Robison's "Syncopated Sermons," built around music of the deep Southland, add to the contrast of Sunday's microphone.

Studio Insights

What makes a broadcaster? Consider the career of James Wallington, who at 26 is the 1933 diction medal winning announcer: He went to college to prepare himself for the ministry. Then, in turn, he studied medicine, geology, music and English. Graduating, he became an opera singer, then an actor and later a salesman. He didn't find his niche in life until he became an announcer.

* * *

Irene Beasley, NBC's girl from Dixie, enjoys broadcasting tremendously. "If you're having half as much fun as I'm having, you're having a good time," she told listeners the other night. Miss Beasley's fan mail the next few days assured her the surmise was correct.

* * *

Plainsmen may go in for plaintive ballads but they prefer those concocted in Tin Pan Alley to those indigenous to the soil. At least, that's the conclusion reached by John White, NBC's Lonesome Cowboy, after a vacation spent in Death Valley and other points West. The only popular cowboy songs he found out there were those originating in the wide open spaces of Times Square.

* * *

NBC's studio pick-ups: One hundred and thirty-one hours were spent by Ed Wynn preparing the inaugural script for his return to the air—a program which took him fourteen minutes to deliver . . . Carolyn Rich, contralto, returned home from a hospital stay to find an admirer had presented her with a cocker spaniel puppy.

* * *

Mary Small, 11-year-old star, returned to make a personal appearance in her home town, Baltimore. Her radio schedule was not in conflict.

* * *

Harry Lee, playwright, publicist and poet, who won the Poetry Society of America award for 1927 with "The Little Poor Man," while visiting the new NBC studios in Radio City delivered himself of the following pronouncement:

"Never since the days of Charles Dickens has anyone appeared with such an aptness and gift for naming characters as Amos 'n' Andy."

* * *

Even before the National Broadcasting Company had completed its move to Radio City the staff was invited to form a team and join a brand new bowling league. Other teams were those of RCA, RKO, Rockefeller Foundation, Westinghouse and Westinghouse International. The NBC team was formed and made the sixth. all domiciled during business hours in Rockefeller Center. George Milne, New York division engineer, was made manager of NBC's team.

* * *

The day that Commander Settle and Major Fordney made their balloon flight into the stratosphere eleven miles above the earth's surface, Burke Miller, in charge of NBC special broadcasts, kept the wires hot trying to locate the lost airmen. One of his calls dug up the report that they had been seen coming down near Elmer, N. J. With one voice the staff in the big main control room at Radio City took up the cry: "Where's Elmer?"

THREE FAMOUS DRAMAS AIRED FOR CHRISTMAS

Three well-known Christmas stories, especially adapted for radio, will be heard over an NBC-WJZ network on Thursday, Friday and Saturday, December 21st, 22d and 23d, at 7:15 p.m., E.S.T.

The three Christmas dramas will follow "The Three Musketeers" in the series sponsored by the Jeddo-Highland Coal Company, and in turn will be succeeded by a serial dramatization of "Robin Hood."

"The Bishop's Candlesticks," a celebrated one-act play, based on an incident in Victor Hugo's "Les Miserables" and dealing with the redemption of a convict on Christmas Eve, will be the drama broadcast on Thursday, December 21st.

A radio dramatization of O. Henry's famous story, "The Gift of the Magi," will be heard on the second day, Friday, December 22d. This popular story has become one of the best known Yuletide legends ever written in America.

"Why the Chimes Rang," a one-act playlet by Elizabeth A. McFadden, based on a story of the same title by Raymond McDonald Alden, will be broadcast on Saturday, December 23d. This drama tells a story of the perfect Christmas gift.

All three of the plays for the week have been adapted for broadcasting by Nan Murphy, well-known radio writer, and will be directed by Joe Cross, adapter of "The Three Musketeers" and "Treasure Island" serials previously offered by the same sponsor.

Rupert Hughes' Son Busy Going Places

Rush Hughes, son of Rupert Hughes, famous novelist, and who is the voice of the Langendorf Pictorial, goes almost everywhere in search of material for his air column heard over an NBC network every afternoon except Saturday and Sunday.

The energetic radio reporter spent all of one Sunday and part of Monday morning on a San Francisco pilot's boat, gathering yarns and color from some of the old salts who spent years on the briny deep, before they turned to piloting big ships through San Francisco's Golden Gate.

On a following week-end Rush will be out with the coast guard that scours the Pacific shore near San Francisco, and he hopes to sandwich a descent into the depths of one of the enormous caissons on which the San Francisco Bay Bridge is being erected the week after that.

Human Sound Effect

One of the oddest microphone occupations is that of Sylvano Dale, NBC tap dancer who appears regularly on the Magnolia Minstrels and any other programs where any kind of dancing sound effect is required.

STAFF ENLARGED

Baltimore Radio Company, New York City, has enlarged its laboratory staff, and is devoting much more floor space to the testing of various special apparatus it features in its catalog. This company is working on a special 100,000 mailing to be made early in February.

ROOSEVELT ON AIR 20 TIMES AS PRESIDENT

During 1933 the National Broadcasting Company presented 35,000 programs, involving 400,000 individual appearances before the microphones by singers, musicans, actors and speakers, said M. H. Aylesworth, NBC president.

One of the most important developments of the year was the growth of radio's use as a means of direct contact between the people of the United States and their government, especially the head of the government.

During his first nine months in office, President Roosevelt was heard through stations of the National Broadcasting Company networks twenty times. The most important of his addresses were those in which he reported directly to the people on matters of wide national significance, such as the banking moratorium, the general polices of the administration, farm relief and progress under the NRA.

Whole Cabinet Represented

In addition to the President, every member of the cabinet spoke over NBC networks during the year, as did numerous Senators and Representatives.

As far as the broadcasting industry itself was concerned, 1933 was climaxed by the opening of the world's largest and finest studios, in Radio City. The inauguration of the new NBC headquarters was marked by the celebration of Radio City Week, during which scores of famous persons faced the microphones, and greetings from many nations were brought to the networks by short waves.

One of the outstanding broadcasts of the year occurred on March 4th when President Roosevelt's inauguration was flashed all over the world by NBC, and his inaugural address was heard in the far corners of the earth.

Litvinoff's Chat

The most unusual NBC programs of the year, from a technical viewpoint as well as in listener interest, were the broadcasts from the stratosphere by Commander Settle and Major Fordney, who were heard over NBC networks as they floated ten miles up in the sky, and the two-way conversation held between Maxim Litvinoff, Russian Commissar of Foreign Affairs, in Washington, and his wife, in Moscow. This latter program fittingly marked the day on which Russian recognition was announced.

Other unusual broadcasts carried by NBC were those from the Graf Zeppelin, en route from South America to Chicago, and from the scene of the Akron disaster off the New Jersey coast. The Century of Progress in Chicago also offered material for a large number of special programs.

NBC broadcasts of exceptional interest also were those from the House of Representatives, during debate, from the scene of the California earthquake, from the Vatican, from the World Monetary and Economic Conference in London, from the Bridgeport hospital room where the Mollisons described their trans-Atlantic flight and subsequent crack-up, and from Edmonton and Floyd Bennett Field during Wiley Post's round-the-world flight.

Music Well Represented

Famous musical organizations heard during the year over NBC networks included, among many others, the Metropolitan Opera Company, the Boston Symphony Orchestra, the Sistine Chapel Choir, the Berlin Symphony Orchestra, the Minneapolis and Rochester Symphonies.

Sports followers of all sorts had a big year, with such events to listen to as the Rose Bowl game, the Boston Marathon, the Penn Relays, the English Derby, the Kentucky Derby, the Preakness, the national golf and tennis tournaments, the Harmsworth Trophy races, the World Series and the major football games.

Famous persons presented to listeners by NBC during the year read like an international who's who. They include, in addition to American governmental leaders, King George, the Prince of Wales, Dr. Albert Einstein, the Marquess of Lothian, Al Smith, Mikhail Kalinin, Sir Arthur Salter, Pope Pius XI, Senatore Marconi, Chancellor Hitler, H. L. Menken, Stanley Baldwin, Cardinal Hayes, President Grau San Martin of Cuba, George Bernard Shaw, David Lloyd George, Auguste Piccard, G. K. Chesterton, Sir Ronald Lindsay and literally hundreds of others whose names are known around the world.

"With the opening of its Radio City headquarters, the National Broadcasting Company is by far the best equipped organization of its kind in the world, and during 1934 plans to use its improved facilities for the further entertainment and service of its listeners," says an announcement.

Old Air Police Station Given Up by N. Y. City

WPY, the radio station atop Police Headquarters in New York City, has been closed, after an existence of seventeen years, according to an announcement by Police Commissioner Bolan, who stated that the station no longer had any value.

The station was erected during the regime of Commissioner Arthur H. Woods as a possible aid in police work and later was used in attempts at locating rum-carrying vessels at sea, but the bigger radio stations along the Atlantic Coast could pick up messages better, and the usefulness of the police station was minimized. In recent years the station has been manned by three shifts of first-grade patrolmen, who have been receiving a yearly salary of $3,000 each. They have now been transferred to the broadcast station in the same building that serves the radio squad cars.

TIBBETT BACK, REPEATING FOR THOSE IN WEST

Lawrence Tibbett, young Metropolitan Opera baritone, made his first appearance of the season in the "Voice of Firestone" programs over a National Broadcasting Company network.

The series opened over an NBC-WEAF network, featuring Tibbett and Richard Crooks, Metropolitan Opera tenor, in alternate groups of recitals on Monday nights at 8:30 p.m., E.S.T.

Tibbett, who recently was awarded the American Academy of Arts and Letters medal for good diction on the stage, will be heard in the Voice of Firestone programs on Christmas night, after which Crooks will return for another group of broadcasts.

Harvey S. Firestone, Jr., vice-president of the Firestone Tire and Rubber Co., sponsors of the program, will continue his series of talks on "The Story of Transportation." Firestone's talks, heard each week, are based on an extensive study of the romance of the evolution of transportation through the ages.

For his first recital of the season, Tibbett, accompanied by William Daly's orchestra, sang "Siboney," "Good Ale," by Winter Watts; "The Hand Organ Man," and "Di Provenza il Mar," from Verdi's "Traviata." The orchestra opened the program with Chopin's "Polonaise Militaire."

The broadcasts are repeated for listeners in the West over an NBC-Pacific coast network at 11:30 p.m., E.S.T.

REPEAL AND RADIO SALES

Some of the radio business men in the Cortlandt Street district say that business would be even better had not prohibition ended just before Christmas buying was to start. They base their argument on the fact that the customers have just so much money to spend, and the new practice of drinking legitimately has steered some customers from radio stores to wine and liquor stores. Three places that recently opened in the district, serving drinks on the premises, did enormous business. One averaged receipts of $2,000 a day for the first ten days of repeal.

TRADIOGRAMS

By J. Murray Barron

Something unique and attractive in the way of cabinet design or container for the chassis of a radio has made its appearance in the form of a globe. It's a superheterodyne circuit, housed in a revolving globe map, with built-in loudspeaker. It is a true geographic orbit with countries, cities and oceans. Also it shows the seasonal positions of the sun and also is capped with a chronological meter so one may determine the relative time. Amateur and police signals as well as the complete broadcast band may be tuned in.

* * *

The friends of Sydney Bass, advertising manager for the chain of Try-Mo Radio stores, all located in New York City, were agreeably surprised to learn that he celebrated the Thanksgiving Day with a wedding. Miss Sylvia Barnett was the bride in a ceremony at the Casa Del Rey in Brooklyn, N. Y.

* * *

Universal Microphone Co., Ltd., Inglewood, Calif., is now marketing three models of hearing aid devices. There are real prospects for a device that will aid the hard of hearing in every town. Servicemen and radio experimenters should find this type of business comparatively easy to locate. As has been demonstrated in many instances, there are numbers of persons just waiting for some actual assistance. A desciptive circular and full detailed information may be had by addressing the Universal Co. direct.

* * *

Servicemen who may have the type 547 Weston and other similar testers should be interested in a plan for rewiring these three-meter set testers. Jacob Grand, of Sun Radio Co., 227 Fulton Street, New York City, has the diagrams. The necessary parts may be had at any radio retail store.

* * *

Every day one finds the short wave entering more homes. That the interest is becoming more popular daily can easily be verified from the number of manufacturers who are putting short-wave sets on the market. There is a hand full of really first-grade type short-wave receivers for the fellow who wants the best, something that will give him loudspeaker volume on foreign stations. Most of these sets are sold direct from the manufacturer to the buyer, except perhaps a few put out by the larger manufacturers. However, one should not overlook the fact that there is a number of smaller sets that will give plenty of thrills. The smaller type headphone set is really remarkable in performance. For the experimenter there are a number of short-wave kits. It all depends upon just how deeply one is interested in the subject. The beginner who wants to construct his own will find at many of the radio retail stores and mail order houses kits from one tube up. Likewise he can put these same outfits wired in various combinations, such as with tubes and headphone or without. If he has a good radio receiver he can purchase a number of worthwhile short-wave converters. A variety of no less than half a dozen is now showing in the retail stores. Again if he wants to log the world and can afford a really professional iob, there are several sets that will give him consistent and really enjoyable reception from all over the world. All these types of kits, converters, small and professional outfits, may now be bought either through the retail radio stores or mail order houses, except in a few instances when they would have to be bought direct from the manufacturer.

* * *

A short wave converter recently described in RADIO WORLD has proven its right to be classed with the worth-while ones, hence is now enjoying an exceptional popularity, to the extent that the factory is behind on production but will still be in a position to make deliveries for the holidays.

* * *

W. F. Tait, president of the Republic Radio Mfg. Corporation, 82 Coit Street, Irvington, N. J., announces the appointment of S. Jack Helsper as sales manager. Mr. Helsper was formerly vice-president of the Ceco Mfg. Co., Providence, R. I.

* * *

Notwithstanding the large number of small shortwave receivers and kits are sold direct and through the mail order houses, the larger short-wave outfits are not being overlooked by any means. To one in contact with the organizations marketing them the reports show large sales.

* * *

Cortlandt Street in New York City reports a good increase in business. The variety of sets and kits is large, with a bigger range than last year. Many receivers swing toward the Moderne design and are exceedingly attractive, and quite a relief from the packing-case models so often displayed. More radio firms are going in for short waves and where the sets are not strictly short-wave they are circuited to tune from the police to the broadcast range. There are some excellent combinations that perform very well for the home.

* * *

The ham or professional in short waves prefers the custom-built receiver, with the various units and gadgets that are so necessary to get consistent reception. They are not just satisfied with England or Germany, they must tour the world and do, with astonishing distant reception. In the short-wave field the coil assembly as put out by the Postal International is making a considerable hit.

* * *

Mariogold Cassin, a pioneer in radio script writing, has joined the Chicago office of Erwin, Wasey & Company, as assistant to the director of radio. For the past two and a half years she has been with the continuity department of the Columbia Broadcasting System.

* * *

Blan the Radio Man has brought out a coil system for use in short-wave receivers so that waves higher than the broadcast band can be tuned in. Careful calibration was made of the coils, so that they would give exactly the desired results with condensers of different maximum capacities, including 0.00035 mfd. and 0.00014 or 0.00015 mfd. The coils are wound of Litz wire in bank formation for these longer waves, which are in the realm of frequencies usually encompassing the intermediate levels of broadcast superheterodynes.

WBNX Begins Sending From New Bronx Plant

WBNX has begun to broadcast from its new studios and executive offices in the Melrose Central Building, 260 East One Hundred and Sixty-first Street, Bronx, New York City. W. C. Alcorn is vice-president and general manager.

The establishment of the main studios of WBNX in the Bronx, brings to that borough its first full-time independent broadcasting station. It is planned to make WBNX a medium for cultural, educational and entertainment activities and facilities of the Bronx. Local artists will be sought and encouraged and an attempt will be made to give spot news coverage on important events in the Bronx.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, 145 West 45th Street, New York, N. Y.

K. D. Hodge, Orthopedic Ward, U. S. Naval Hospital, San Diego, Calif.
W. D. Shull, New Brookland, S. C.
Henry W. Hoffman, Perul, Ill.
Everett Fry, Rector, Ark.
F. M. Hughes, P. O. Box 217, Olney. Texas.
P. C. Nelson, 121 Monticello Ave., Piedmont, Calif.
J. Tomboda, Box 65, Arcade Station, Los Angeles, Calif.
E. P. Cross, General Delivery, Powell River, B.C., Canada.
John Strong, 333 Connors Ave., Detroit, Mich.
Pedro Rodriguez, Radio Service, P.O. Box 182, Jourdanton, Texas.
O. G. Messenger, 909 Leader Bldg., Cleveland, Ohio.
A. P. Seidel, 2218 Pasadena Ave., Los Angeles, Calif.
R. F. Voth, 4320-42nd Ave., So., Minneapolis, Minn.
E. P. McKenney, Federal Reserve Bank, Birmingham, Ala.
Leo Freni, 1241 Wolf St., Philadelphia, Pa.
Don's Radio Shop (Don C. Kinzle), 2439 Davenport Ave., Davenport, Iowa
Harold Johnson, 222 West Broadway, Urbana, Ohio
Chas. J. Adams, 84 S. Lansdowne Ave., Lansdowne, Pa.
Otto's Radio & Television Shop (Otto Vavra), 1216 Fifth Street, N.W., Cedar Rapids, Iowa
Ted Love Radio Service (Radio & Television), Trenton, Mo.
Frazier's Radio Repairs, 2112 Clary Ave., Houston, Tex.
Adelard Lentendre, Box 452, Plainfield, Conn.
C. J. Parsons, Box 146 Sabraton, West Va.
J. W. C. Wetmore, P. O. Box 475, Woodstock, New Brunswick, Canada.
Peter A. Reilly, Lee Ave., Aiken, So. Car.
M. Mickelson, 3229 Bloomington Ave., Minneapolis, Minn.
Arthur Losleben, Lemon Cove, Calif.
Jack Holtz, 1406 Morgantown Ave., Fairmont, W. Va.
J. W. Keistler, 723 11th Street, Waynesboro, Va.
E. L. Horne, General Repairs, Batesburg, S. C.
Matthew Morris, Jr., Elliot Ave., East Greenbush, N. Y.
Wm. Bibey, 1116 Meadow Lane, Chester, Pa.
A. Lawson, 1749 Atchison Ave., Whiting, Ind.
Ted C. Reid, Radio W7HR, Orofino, Idaho
R. P. Unbeurist, R. D. 2, Watervliet, N. Y.
L. Cowley, 1715 Ethel St., Alhambra, Calif.
Ben Mackelprang, 854 So. 1st St., West, Salt Lake City, Utah
E. H. Peck, 3460 Simpson St., Montreal, Canada
J. F. Harter, 424 Tyler St., Sandusky, Ohio.
Eugene Walker, c-o Bobbs-Merrill Co., 724 N. Meridian St., Indianapolis, Ind.
Little Star Radio Shop, P. O. Box 804, South Bend, Ind.
R. H. Knighten, Costa Mesa Radio Service, 1801 Newport Road, Costa Mesa, Calif.
E. J. Pratt, 7073 Waverly Street, Montreal, Canada
Meyer Levin, 304 Balboa St., San Francisco Calif.

CORPORATION ACTIVITIES

BANKRUPTCY PROCEEDINGS
Compositions Confirmed

Musique Radio Co., Inc., 142 Liberty St., New York City, 40%.

PETITION

Grigsby-Grunow Co., Chicago, Ill., involuntary.

A THOUGHT FOR THE WEEK

THIS IDEA IS NOT A NEW ONE; neither is the Christmas holiday season, which for thousands of years has been the most beautiful and colorful of all the world's celebrations: do you know of some dear shut-in who cannot afford a radio set or whose present set is out of date? Do you want to make life more bearable for that poor soul? Then go to your dealer and select a set that fits in with your budget and explain the circumstances. It's ten to one that the dealer will give you a small extra discount and charge the difference to his good will account. Of course, be sure you convince the dealer that it is really a matter of charity with you—and it's very likely you'll find he's as human as you are. Try it!

Valuable Gifts with Subscriptions for RADIO WORLD

A *NEW* TEST OSCILLATOR

That Works A.C., D.C., or Batteries!

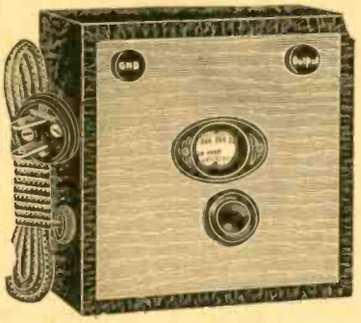
A NEW TEST oscillator, Model 30, has been produced by Herman Bernard, so that all the requirements for lining up broadcast receivers, both tuned radio frequency and superheterodyne types, will be fully and accurately met. This device may be connected to 90-120-v a.c., any commercial frequency, without regard to polarity of the plug, and will function perfectly. It may be used also on 90-120-volt d.c. line, but plug polarity must be observed. One of the plug prongs has a red spot, denoting the side to be connected to positive of the line. If you don't know the d.c. line polarity, you may connect either way, without danger. The oscillator will work on d.c. only when the connection is made the right way. Moreover, 90 volts of B battery may be used instead of either of the foregoing, simply by connecting two wires between the plug at the batteries, observing polarity. No separate filament excitation is required. The oscillator is modulated with a strong, low note under all circumstances. It uses a 30 tube.

THE dial of the Bernard Model 30 Test Oscillator is directly calibrated in kilocycles, so there is no awkward necessity of consulting a chart. The fundamental frequencies are 135 to 380 kc, so that nearly all commercial intermediate frequencies as used in present-day superheterodynes are read on the fundamental. The points for other intermediate frequencies, e.g., 400, 450, 456 and 465 kc, are registered on the dial also, two harmonics, with which the user need not concern himself, being the basis of these registrations. Besides, the broadcast band is taken care of by the fourth harmonic and the dial is calibrated for that band, also.

The divisions on the dial for the fundamental band, 135 to 380 kc, are 1 kc apart from 135 to 140 kc, 2 kc apart for 140 to 180 kc and 5 kc apart for 180 to 380 kc. For the broadcast band, 10 kc apart from 550 to 800 kc, 20 kc apart from 800 to 1,500 kc.

The test oscillator may be used also for short waves, by resorting to higher harmonics.

SHOWN ONE-THIRD ACTUAL SIZE



Over-All Size Is Only 5x5x3"! Dial Reads Frequencies Directly!

Send $12 for 2-year subscription for RADIO WORLD and order Cat. BO-30 sent free, with tube (prepaid in United States and Canada).

Another model, BO-30-S, same as above, except frequencies are ten times as high, hence instrument is for short-wave work only, is available on same basis.

540-4,500 kc Tuning Units

The Tuning Units consist of a four-gang 0.00046 mfd. condenser, with trimmers on it, ¼-inch diameter shaft, 1⅛ inches long, mounting spades, condenser closing to the left; and a set of four shielded coils. The condenser is the same for tuned radio frequency sets or superheterodynes, but for superheterodynes a series padding condenser is supplied also. For t-r-f sets the four coils are alike. For supers three coils are alike and there is a different coil for the oscillator, with a selection for 175 kc, 456 kc or 465 kc intermediate frequency.

For t-r-f construction, three stages of t-r-f and tuned detector input, four equal shielded coils, tapped for the police band and properly matched to the tuning condenser which is supplied also. Order Cat. TRFTU, which will be sent free, postpaid, on receipt of $10.00 for 86-week subscription for RADIO WORLD (86 issues).

For superheterodyne construction, two stages of t-r-f, tuned oscillator and tuned input to modulator, three identical coils and an oscillator coil, with the proper padding condenser and the four-gang condenser, are supplied as noted below:

175 kc—For use with 175 kc intermediate frequency. Unit includes four-gang condenser, three r-f coils, the proper oscillator inductance and 800-1,350 mmfd. padding condenser. Send $12.00 for two-year subscription and order Cat. SUTU-175, which will be sent postpaid.

456 kc—For use with 456 kc i.f. order Cat. SUTU-456. Padding condenser is 350-450 mmfd.

465 kc—For use with 465 kc order Cat. SUTU-465. Padding condenser is 350-450 mmfd.

Those desiring to use the short-wave feature will want a switch, which is sold outright and separately. This is a long switch that has sections very close to where the wiring would have to be, and thus insures short leads. The switch is Cat. 4GSW @ $2.25 postpaid.

SOLDERING IRON

A reliable soldering iron of 40-watt capacity, suitable for radio work, and equipped with a long cable and a snappy plug. This iron may be used in either alternating current or direct current, 85 to 135 volts. It is a serviceable iron and has stood up well, as we have been offering this iron for three years and have yet to receive a complaint about its value and dependability. Send $2.00 for 16-week subscription for RADIO WORLD, order Cat. SO, and get this soldering iron free (postpaid). Please remit with order.

"The Inductance Authority"

By EDWARD M. SHIEPE, B.S., M.E.E.

THE ONLY BOOK OF ITS KIND IN THE WORLD, "The Inductance Authority" entirely dispenses with any and all computation for the construction of solenoid coils for tuning with variable or fixed condensers of any capacity, covering from ultra frequencies to the borderline of audio frequencies. All one has to do is to read the charts. Accuracy to 1 per cent. may be attained. It is the first time that any system dispensing with computation has achieved such very high accuracy and at the same time covered such a wide band of frequencies.

A condensed chart in the book itself gives the relationship between frequency, capacity and inductance, while a much larger chart, issued as a supplement with the book, at no extra charge, gives the same information, although covering a wider range, and the "curves" are straight lines. The condensed chart is in the book so that when one has the book with him away from home or laboratory he still has sufficient information for everyday work, while the supplement, 18 x 20 inches, is preferable for the most exacting demands of accuracy and wide frequency coverage.

From the tri-relationship chart (either one), the required inductance value is read, since frequency and capacity are known by the consultant. The size and insulation of wire, as well as the diameter of the tubing on which the coil is to be wound, are selected by the user, and by referring to turns charts for such wires the number of turns on a particular diameter for the desired inductance is ascertained.

There are thirty-eight charts, of which thirty-six cover the numbers of turns and inductive results for the various wire sizes used in commercial practice (Nos. 14 to 32), as well as the different types of covering (single silk, double silk, single cotton, double cotton and enamel) and diameters of ¾, ⅞, 1, 1¼, 1½, 1⅝, 1¾, 1⅞, 2, 2¼, 2½, 2¾ and 3 inches.

EACH turns chart for a given wire has a separate curve for each of the thirteen form diameters.

The two other charts are the tri-relationship one and a frequency-ratio chart, which gives the frequency ratio of tuning with any inductance, when using any condenser the maximum and minimum capacities of which are known.

The book contains all the necessary information to give the final word on coil construction to service men engaged in replacement work, home experimenters, short-wave enthusiasts, amateurs, engineers, teachers, students, etc.

There are ten pages of textual discussion by Mr. Shiepe, graduate of the Massachusetts Institute of Technology and of the Polytechnic Institute of Brooklyn, in which the considerations for accuracy in attaining inductive values are set forth. These include original methods.

The curves are for close-wound inductances, but the text includes information on correction factors for use of spaced winding, as well as for inclusion of the coils in shields. The book therefore covers the field fully and surpasses in its accuracy any and all mechanical aids to obtaining inductance values.

The publisher considers this the most useful and practical book so far published in the radio field, in that it dispenses with the great amount of computation otherwise necessary for obtaining inductance values, and disposes of the problem with speed that sacrifices no accuracy.

The book has a flexible colored cover, the page size is 9 x 12 inches and the legibility of all curves (black lines on white field) is excellent.

Send $4.00 for 34-week subscription for RADIO WORLD and order Cat., PIA sent free, with supplement, postpaid in United States and Canada.

RADIO WORLD

145 West 45th Street New York, N. Y.

What Radio World Is

RADIO WORLD, now in its twelfth year, is a weekly periodical devoted to the scientific side of radio, and presenting accurately and promptly all the news of the latest developments and circuits in radio, for broadcast and short-wave frequencies. Receiver and test oscillator construction are featured in its varied aspects. Testing in all its branches is given authentic and extensive treatment. Not only how to build, but how to measure what you've built, are featured regularly, and all receiver and test oscillator construction includes coil-winding data, if the coils possibly can be wound at home or in the ordinary laboratory or shop. Articles by leading authorities are augmented by carefully-checked station lists. A subscription for RADIO WORLD is one of the first requisites for the service man, home constructor, experimenter, student and teacher. Leading schools and laboratories subscribe for it and you will be in excellent company. Send in your subscription NOW.

An Extraordinary Bargain!

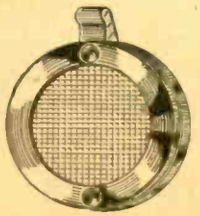
Three-Gang Condenser FREE with 13-week Subscription @ only $1.50

THE highest grade commercial gang condenser made, die-cast frame, brass plates, ⅜" diameter shaft extending at both ends. Condenser can be used therefore with either direction of dial rotation. Rigidity is of highest degree. Rotors can be shifted on shaft and locked tight for peaking at high-frequency end of band, thus dispensing with trimmers. Capacity, 0.0004 mfd. Full band coverage 1,500 to 540 kc (and more) with coils intended for 0.00035 to 0.00041 mfd. Premium sent express collect (shipping weight 5 lbs.) on receipt of $1.50 for 13 weeks subscription for Radio WORLD (13 issues).

The condenser measures 4 x 6½ inches, overall frame size; shafts extend 1 inch beyond frame.

RADIO WORLD, 145 West 45th Street, New York, N. Y.

LAPEL MICROPHONE



A single-button carbon-granule lapel microphone, impedance 200 ohms, requiring 4.5-volt excitation, of good frequency characteristics, and both handy and inconspicuous. Outside diameter, 1⅝ inches. The case is chromium-plated brass. The excitation may be provided by introducing the microphone in a cathode circuit carrying around 20 to 25 milliamperes, or a 4.5-volt C biasing battery may be used. Net price, $2.95.

RELIABLE RADIO COMPANY

145 West 45th Street, New York, N. Y.

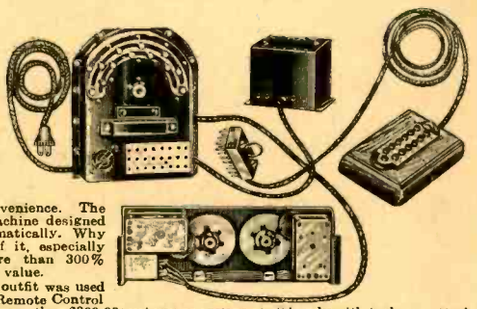
RTC's Big January SPECIALS

Every month we list on this page a few STAR★ items which are not listed in our catalog. These are all specials on which the quantities on hand are not sufficient to catalog them. *Once sold out, no more can be had.* ORDER NOW—TODAY.

No One in Radio Undersells Us!

STOP SHOPPING—the lowest prices are right on this page. *No one undersells us.* We meet any price on any new merchandise. Order direct from this page and save money. 100% satisfaction on every transaction. Take advantage today of these special offers.

★ Colonial Remote Control Attachment
COMPLETE . . . NOTHING ELSE TO BUY



Imagine the convenience of just sitting back in an easy chair or lying in bed and merely by pressing a series of buttons, starting the radio located in a far off room or hidden away in the basement. Not only that, but selecting one of ten stations from a remote point. If this is the machine age, it is also the age of convenience. The remote control is a machine designed to tune your radio automatically. Why not take advantage of it, especially when it is priced more than 300% below its original list value.

This remote control outfit was used on one of the Colonial Remote Control receivers which sold for more than $300.00; yet you or anyone at all handy with tools can attach it to your own radio. You can then hide the radio either in the closet, basement, or some other out-of-the-way place and extend wires to any number of speakers strategically located in various parts of your apartment. Imagine the surprise of your friends or guests at dinner or at special gatherings, when, by merely pressing a button the room is gradually flooded with beautiful music or other entertaining programs, by the hidden speakers. Aside from being a novel idea it is also a very practical one.

RADIO SERVICE MAN and CUSTOM SET BUILDER—HERE IS YOUR OPPORTUNITY

You need but mention the words "remote control" to your customer and immediately you command his entire interest and attention. You are able to do this because the idea to him, is new and because it immediately implies expensive equipment. However, when you inform him that you can construct or ADAPT HIS RECEIVER FOR REMOTE CONTROL OPERATION for only a few dollars more, his interest will most certainly materialize into an order. We need not give YOU any more talking points on this subject because you probably can muster up more than we.

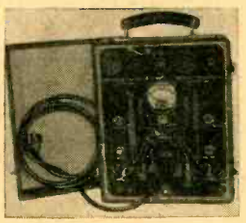
EXTREMELY SIMPLE TO OPERATE

The outfit comprises two small motors (one for turning the tuning condenser and the other for turning the volume control), a 10-position commutator switch for selecting 10 different stations, a step-down transformer for energizing the motors and a 13 button control board (10 buttons for the 10 stations, two buttons for increasing or decreasing the volume and one button for silent tuning). A pilot light in this control board indicates when the receiver is operating.

If the shafts of the tuning condenser and volume control of your present receiver can be extended so that the commutator switch section and one of the motor gears can be slipped over the tuning condenser shaft and the other motor gear on the volume control shaft then you can easily adapt this outfit to your receiver DIRECTLY, without any further changes. With some sets it may be necessary to remove the volume control entirely from the chassis and mount it directly on the gear of the volume control motor. Custom set builders need have no headaches about this remote control, inasmuch as they can design the physical layouts of their sets to conform with this equipment. The illustration clearly shows all component parts of this complete remote control system Shipping weight 18 lbs.

No. 1789 Colonial Complete Remote Control Outfit
YOUR PRICE, Only..... $5.95

BUILD THE "NEW DEPENDABLE" TUBE TESTER
Sold Either Wired or in Kit Form



Here indeed is your opportunity to build one of the finest tube checkers ever designed—an instrument which is MODERN in every sense of the word. Will test all the latest type tubes, including those with 7 AND 8 PRONGS—DIRECTLY—without the use of a single adapter!

The "NEW DEPENDABLE," despite its high degree of accuracy, is extremely simple to operate. Both plates of the 80—82—83 and other rectifier tubes are readily tested without the use of a "second plate" button.

The instrument employs a high-grade, D'ARSONVAL TYPE, MOVING-COIL METER, insuring thereby extreme accuracy. This instrument will check more than 120 different tubes and even those which have not as yet been placed on the market. The tube tester is amply guarded against tube "shorts," which condition is indicated by the flashing of a small pilot light. All component parts are mounted on a beautifully etched panel and the entire instrument placed in a sturdily constructed, leatherette-covered, carrying case. For operation on 105-125 volts, 50/60 cycles, A.C. This instrument is available either in kit form or completely wired and tested, ready to use. Shipping weight 9 lbs.

NO. 303 "New Dependable" Tube Tester, completely wired and tested.
YOUR PRICE..... $18.77

NO. 303 A "New Dependable" Tube Tester in kit form.
YOUR PRICE..... $14.77

NEW NEW NEW
Service Men's Wire Wound Fixed Resistor Kit
Only 100 Kits Left

You have probably never seen a resistor of this type before. It is new. it is radically different from other resistors. both in construction, accuracy and maintainance of calibration. These resistors are *"armored"* in the strictest sense of the word. A heavy steel covering around the fine wire resistance element Protects it indefinitely and prolongs its life. *A resistor of this type may be used over and over again from set to set without losing its calibration, or wearing out.*

The kit consists of 84 resistors, only four of which are duplicated. In other words there are *more than 80 different values.* If these units were bought individually, they would cost more than $6.50.

CONTENTS. The kit contains each of the following values. 20 ohms C.T., 40 C.T., 60 C.T.; 50 ohms. 100. 150. 250. 300. 400. 600. 1250. 1500. 2000. 2500 and 3000; and two each of the following, 200 ohms, 500, 750 and 1000.

No. "Mu-Kit" Service Men's Wire Wound Fixed Resistor. YOUR PRICE..... $2.76

A Real Microphone at the Price of a Toy

Here is the largest value ever offered in a commercial type microphone! An unusually large two-button microphone, ruggedly constructed and designed especially for broadcast purposes. *Frequency range 30 to over 5,000 cycles*—adequate for all speech and music reproduction. *EXCELLENT FOR PUBLIC ADDRESS WORK.* Stretched cushioned diaphram of duralium with pure gold center contacts on buttons and diaphram. Standard 200 ohms per button. Finished in beautiful polished chrome. Net weight 1¾ lbs. Ship weight 2¾ lbs.

No. "F" 2 Button Mike YOUR PRICE..... $4.94

FREE RADIO AND SHORT WAVE TREATISE

Avail yourself now of the opportunity to receive the FREE 1933 Edition of our Radio and Short Wave Treatise—**116 solid pages of useful information, radio items, diagrams and illustrations.** Positively the greatest book in print—**NOT JUST ANOTHER CATALOG.** Contains a large editorial section with valuable information not found anywhere else. Special consideration has been given to the radio beginner in this issue. Among the new technical information listed are the following:

HERE IS A PARTIAL LIST CONTENTS

Fundamental Principles of Radio—Ohm's Law—Discussion of New Tubes—Constructing a "Triple-Twin" Amplifier—All about Superheterodynes—Eliminating Man-Made Static—Constructing a Two-Tube Short-Wave "Globe-Trotter" Receiver—$3.00 Prize Suggestions—Radio Kinks, etc., etc.

WRITE TODAY. Enclose 4 cents for postage. Treatise sent by return mail.

Over 100 New Hook-Ups, Etc. 1000 Illustrations.

NEW READRITE MODEL 710 ANALYZER
TESTS LATEST TYPE 6 AND 7 PRONG TUBES
NINE METER SCALES AVAILABLE

This new Readrite Precision instrument embodies features which have always been desired in any instrument built for service work: (1) low cost; (2) simplicity of design; (3) accuracy of measurements; (4) ruggedness of the complete unit. It is needless to add that the kit is capable of testing anything from old battery models to the latest screen-grid. Pentode. and multi-mu receivers.

The "Model 710" is an extremely compact device. The outside dimensions of the carrying case are only 10¾ by 7¾ by 3¾ inches. The analyzer contains a D.C. voltmeter, an A.C. voltmeter and a milliammeter. The D.C. voltmeter has four ranges: 0 to 10; 0 to 60; 0 to 300 and 0 to 600 volts. The A.C. voltmeter has three ranges: 0 to 10; 0 to 140; and 0 to 700 volts. The milliammeter has two ranges; one for 15 mill. reading and the other for 150 mil. **This variety of ranges makes it possible to test every conceivable radio circuit;** high voltage secondaries of power transformers, current drain of all radio tubes. including the high power 250 and 210 tubes, etc.

CONVENIENT SELECTOR SWITCH—The instrument is equipped with a ten position bi-polar selector switch; by means of which readings may be obtained of "C" volts "C" volts reversed, "K" volts, "K" volts reversed, plate volts, screen-grid voltage, etc. A 4½-volt battery is supplied with the analyzer. to provide "C" bias. for grid tests. continuity tests. etc.

TEST PENTODES—"MULTI-MUS" '57's and '58's—'80 RECTIFIERS, Etc.—There are four sockets on the panel of the analyzer to take care of the four, five, six and seven Prong Tubes. There is a "grid-test" push-button. Pin jacks are available for the individual use of all meters, externally, in every range. There is a screen-grid pin jack, and there are two pin jacks for connecting the external battery. Both plates of the 80-type rectifier may be tested by use of a special adapter furnished. Charts are provided for measuring resistances and capacities. The Analyzer is furnished complete with test leads, connecting cables. Burgess 4½-volt battery, several battery leads, UY to UX adapter, '80 rectifier adapter and resistance and capacity charts. Shipping weight, 8 lbs.

Model 710 Analyzer. List Price, $27.50.
YOUR PRICE..... $16.19

WE ARE A WHOLESALE HOUSE AND CAN NOT ACCEPT ORDERS FOR LESS THAN $3.00.

If C.O.D. shipment is desired, please remit 20% remittance, which must accompany all orders.

If full cash accompanies order, deduct 2% discount (except on Readrite 710 Analyzer). Send money order—certified check—U. S. Stamps.

ORDER FROM THIS PAGE You will find special prices from time to time, in this magazine. Get our big FREE catalog for the greatest Radio Bargains.

Should you wish goods shipped by parcel post, be sure to include sufficient extra remittance for same. Any excess will be refunded.

Radio Trading Company 100-R Park Place New York, N. Y.