JUNE 2
1928

FOUR TUBE PORTABLE

15
CENTS

LURE OF THE PICKUP

PLAYLET FOR BROADCASTING

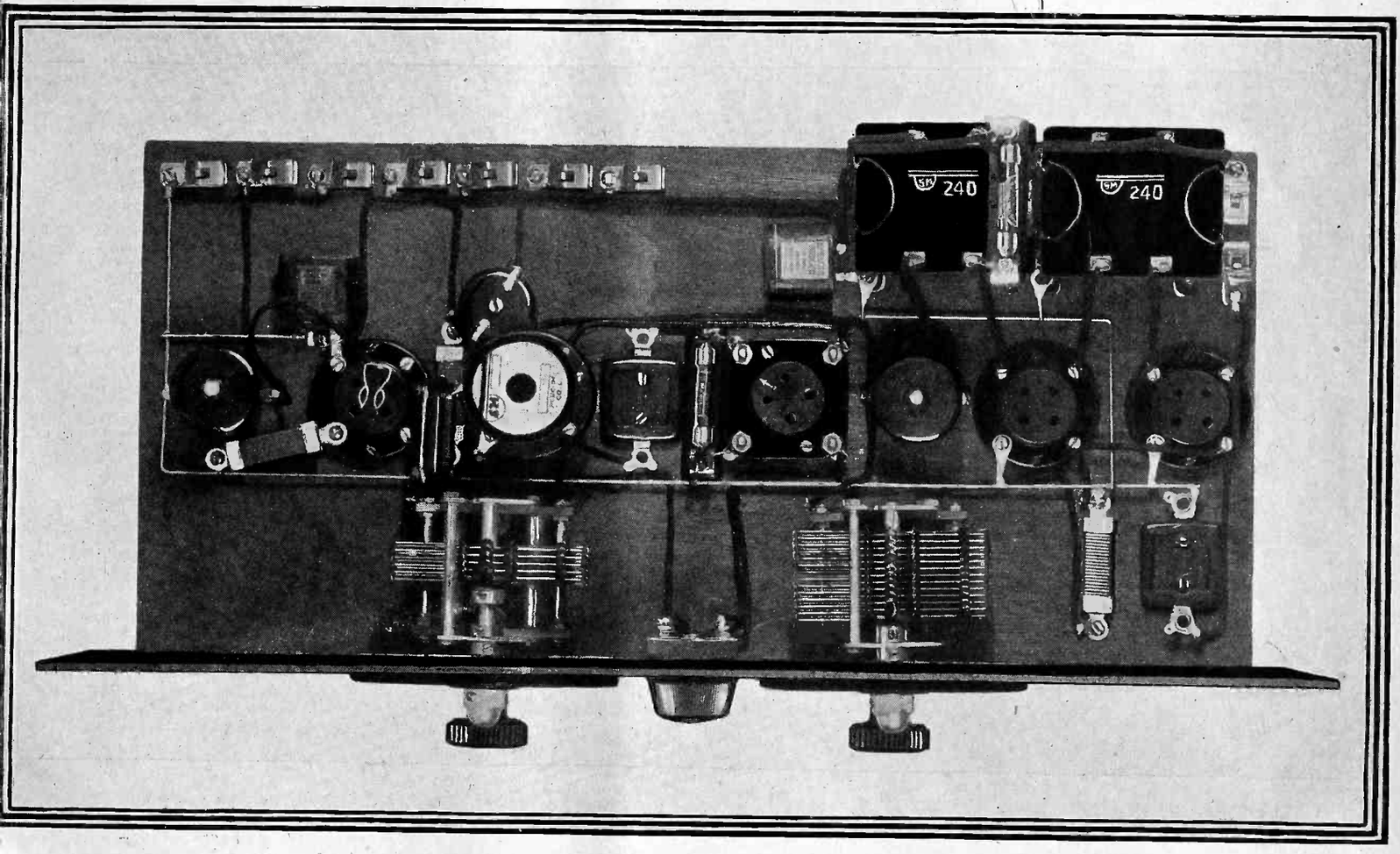
RADIO WORLD
REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

323rd Consecutive Issue—Seventh Year

Vol-13 No-11

'ROUND WORLD 4 FOR SHORT WAVES



A screen grid RF tube is used ahead of the detector in this brand-new model short-wave set. See page 3.

AN EXTRA STAGE OF AF FOR SETS

SCIENCE'S CONQUEST OF RECTIFIERS

SM ROUND-THE-WORLD SCREEN-GRID FOUR

The "Radiobuilder"

S-M is getting out a new house organ, to be published every month, we hope. We will be glad to send you the first issue for 4c in stamps to cover mailing. In it you will find data on the new 685 Public Address Unipac, the "Round the World Four," the "130 series" coils, 638 shields, the short wave super that KMOX used to bring in English 5SW for re-broadcasting, and other bits of information as well.

Number 2, out early in June, will contain all data on the new Clough audio invention. You really can't afford to miss it, for in it you find out how to build an A.F. amplifier with doubled amplification, ideal frequency characteristic, and at half average costs!

THE "Round the World Four" Short Wave Receiver is made possible by the new compact "130 series" of S-M plug-in coils, available about June 1st. The "Round the World Four" is the finest short wave set to be designed primarily for long distance *telephone* and *broadcast* reception, and for code secondarily. It applies screen grid R.F. amplification to short waves, with but one tuning dial, and is the most sensitive short wave set so far offered for simple home construction. With it, you can listen in on the world. Amateur station 9VS reported loud-speaker reception from six *continents* in an evening. Station 9BBW, operating the set, conducted amateur two-way communication with Germany, France, England, and Italy in one evening. In daylight, east and west coast amateur stations are heard in Chicago, Nauen, Germany and England come in like locals. Five, ten, fifteen, and fifty watt amateur telephones all over America and Canada are regular reception on the "Round the World Four."

The new S-M 732 essential kit, containing RF chokes, tuning and regeneration condensers, and four coils and socket tuning from 17.4 to 204 meters, costs but $18.65 with all instructions. The new short wave coils for 17.4 to 204 meters are 131T, 131U, 131V, and 131W, costing $1.25 each, wound. All fit the standard 512 socket at 75c. Type 130 unwound forms are available at 50c each, either smooth, or threaded for broadcast coils. Complete construction data is in S-M Data Sheet No. 3, mailed on receipt of 2c.

Please send me the following, for which I enclose stamps:

.....(4c) Radiobuilder, No. 1
.....(4c) Radiobuilder, No. 2
.....(2c) Power Unit Data Sheet No. 1
.....(2c) Short Wave Data Sheet No. 2
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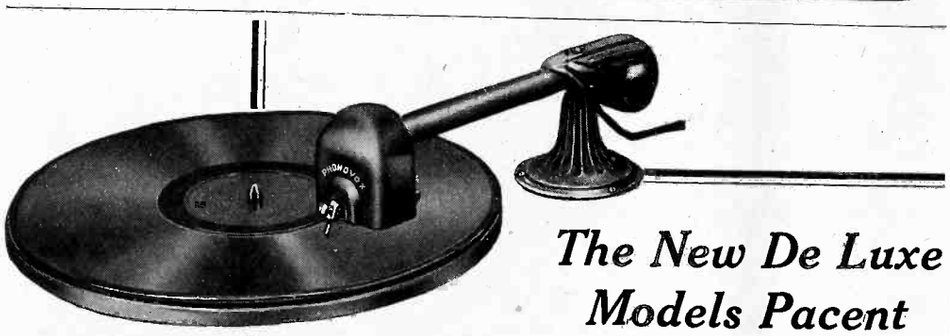

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No. 40—For testing A and B batteries, dry or storage, but not for B eliminators; double reading, 0-8 volts and 0-100 volts DC scale.. 2.25
No. 42—For testing B batteries, dry or storage, but not for B eliminators; 0-150 volts DC scale 2.00
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No. 326—For reading DC voltages, 0-6 volts.. 1.65
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(See No. 348 under "Pocket and Portable Voltmeters.")

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No. 350—For reading 0-50 milliamperes DC.. 1.65
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No. 394—For reading 0-400 milliamperes DC.. 1.65

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A Screen Grid Circuit for Short Waves

Round the World Four Is Non-Radiating, Sensitive Receiver Especially Good for Receiving Programs— Has Television Possibilities

By F. Edwin Schmitt

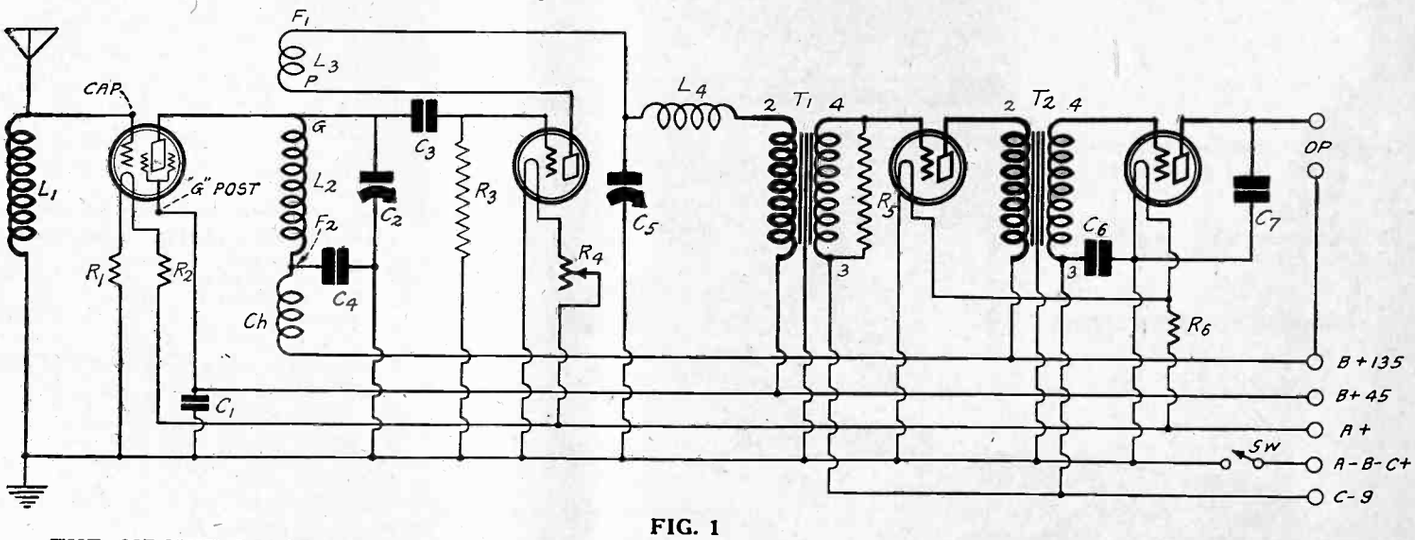


FIG. 1
THE CIRCUIT DIAGRAM OF THE S-M ROUND THE WORLD SHORT WAVE FOUR TUBE RECEIVER.

THERE is no doubt that one particular circumstance, among others, has seriously mitigated against short wave broadcast reception enjoying a duplication of the wild burst of public enthusiasm that swept radio broadcasting out of the laboratory and into almost every American home in the past eight years—the lack of satisfactory receivers. Were short wave television to arrive today, it would most certainly be handicapped by this lack.

With thousands of short wave regenerative receivers in daily use, these statements may seem at first to be inaccurate and incorrect. They are well borne out by a single startling fact—that this type of set, once the most popular of all broadcast receivers, is now not only almost extinct for broadcast reception, but is actually barred by more intelligent municipalities, and in England totally tabooed by the post office department. This is because regenerative tuners ruin programs for nearby receivers.

A single dry battery operated receiving tube when oscillating has been heard thousands of miles on short waves. Think, then, of the chaos that would accompany general use of short wave regenerative receivers!

A Sensitive Circuit

For amateur code reception (CW) such a set is quite sensitive enough to bring in stations half way round the world; but not so for broadcasting reception (modulated CW). The distance at which a CW heterodyne note from a transmitter can be heard may be 1,000 miles while the program service area will extend for only 25 miles, or 1/40 this distance!

It is apparent that the great sensitivity of the short wave regenerator for code is almost entirely lost for broadcast program reception, and that for voice or modulated reception (NOT code) a much more sensitive set is needed, and a non-radiating set is essential to avoid interfering with other sets.

Further, the average regenerative detector set as used by amateurs is additionally poor for voice reception, since for such work regeneration control, and detector regeneration is today a necessity on short waves, must be smooth and gradual.

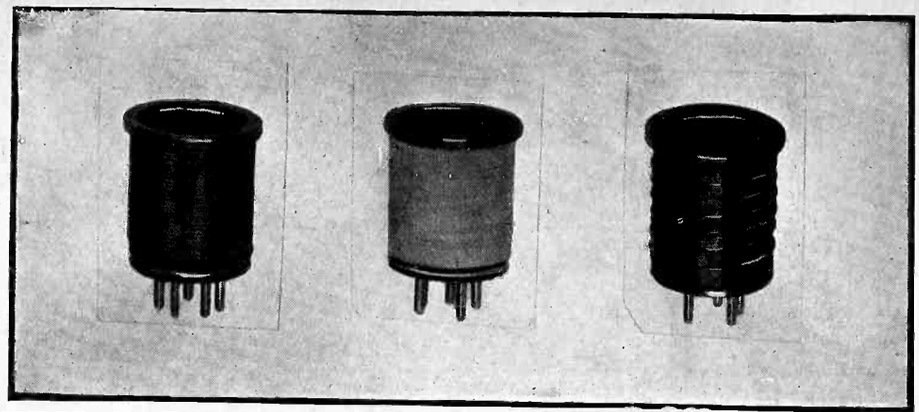
This calls for a new technique in receiver design, particularly the addition of an RF amplifying and blocking tube, for such characteristics are generally lacking in ordinary short wave reeivers which, always oscillating for CW code reception, do not make good regeneration control a prime necessity.

Smooth Regeneration

The Round the World Four receiver has been designed expressly for listening in on far-away short wave broadcasts and for code reception without radiation. Its tickler control is so smooth that one can sneak right up on a station, pushing regeneration right up to the ragged edge—and seldom get the usual dismal oscillation "plop" blotting out the critically sensitive regenerative region, which is just below oscillation.

Instead, the Round the World Four slides into oscillation without any "sticki-

(*Continued on next page*)



THREE OF THE SHORT WAVE COILS IN THE S-M SET OF COILS. LEFT IS THE 131-V, MIDDLE 131-W AND RIGHT 131-T.

(*Continued from preceding page*)

ness" or loss of that tremendous sensitivity associated with critical regeneration just below oscillation. And that sensitivity is available with all its tremendous amplification to put "punch" into a modulated signal that may not even be audible on the usual short-wave tuner.

Much of this results from the ideal conformation and design of the new S-M plug-in coil forms.

The 222 screen-grid RF amplifier materially boosts signal strength, and eliminates re-radiation and all "holes" or "dead spots" at which ordinary sets often fail to oscillate.

The set is almost independent of the type of antenna used!

A quite considerable gain in sensitivity, all had through the carefully executed application of RF amplification to the set, pushes its sensitivity up to the point where English and other foreign amateurs are received fairly regularly in Chicago.

The man who builds the Round the World Four opens up for himself a veritable fairyland of long distance reception stretching beyond the horizon of America, over to England, to eastern Europe, South Africa, Australia and Japan. Almost any point in the world boasting a low wave broadcaster of fair power is "in range" for the Round the World Four.

This fairyland is just like any good story book fairy realm—in it things erratic and unusual become the usual.

Sometimes a station nearby maybe can't be heard at all, while another with a fraction of the power and thousands of miles away may be clocklike in the regularity with which it gets through. A strong station will fade in or out, or it may be heard in the morning and not in the afternoon. All manner of strange and unexplained things are there for the observing—in radio's almost virgin field for experimentation, the limitless region of short waves.

Television is but one. For short wave television a radio receiver of an unusually dependable degree of performance is the first requisite. The Round the World Four provides it and the man who builds the set now and "breaks in" on the delights of short wave experimentation will have the jump in a practical ground-work of experience, and a receiver of proven performance, upon which to start his television experiments—when and if television gets here.

Construction Hints

The front cover photograph, circuit diagram, wave chart and parts list tell the story. The set is remarkably easy to construct, *if* the circuit is exactly followed, the exact parts specified used, and the baseboard layout followed to the letter.

The coil socket is elevated on 1 inch hollow brass studs. The heavy A— wire in the diagram is short, direct and serves as a common ground lead to which condenser and transformer frames are tied. The heavy leads in the detector grid circuit must be short and direct.

If these precautions are observed, the set will be smooth in regeneration control while if not, and if other parts are substituted a bit of tampering with different size grid leaks, extra by-pass condensers and resistors may be necessary to get the set to slide smoothly into oscillation as the .00035 tickler condenser is advanced. However, S-M coil forms are cheap, and an evening spent in "trimming" tickler coil windings and juggling resistances and condensers is not only sure to be well repaid, but is lots of fun besides.

Tuning Ranges

The tuning curves for four coils are given and, though approximate, are close enough to show at about what dial settings to find the "ham" bands and different short wave broadcast stations. Coils may be home wound on No. 130 forms which can be had at 50c each, or bought ready wound at $1.25 each at 131-T, 131-V, 131-U and 131-W short wave coils, all fitting the No. 512 five-prong tube socket.

Operation is simple, the .00014 condenser doing all tuning, the .00035 condenser controlling regeneration. Both should be equipped with Mar-co 100-0 vernier dials (NOT Mar-co drum dials). Any good batteries, but NOT eliminators may be used. Eliminators are too noisy on short-waves.

The antenna may be anything from a ten-foot wire to a good sized broadcast antenna.

There is little more to write—the Round the World Four is as efficient and simple as it is cheap. And the thrill its operation gives to the jaded experimenter is a thrill indeed! Canadian, Mexican, English, French, German, Italian South African, Australian and Japanese stations are nightly fare—most all of them on the speaker!

(Other illustration on Front Cover)

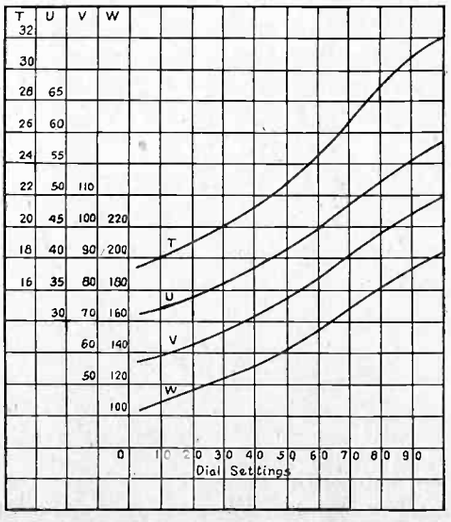
* * *

[The author has kindly consented to answer questions regarding this new short wave receiver. Address F. Edwin Schmitt, 136 Liberty Street, New York, N. Y.]

LIST OF PARTS

L1, L4—Two Aero No. 60 radio frequency choke coils
L2, L3—One set of Silver-Marshall short wave coils, as described in text
Ch—One Silver-Marshall No. 275 RF choke
T1, T2—Two Silver-Marshall No. 240 audio frequency transformers
C1, C6—Two Sprague ¼ mfd. by-pass condensers
C2—One Silver Marshall No. 317 .00014 mfd. condenser
C3—One Sangamo .00015 mfd. grid condenser
C4—One Sangamo .005 mfd. condenser
C5—One Silver-Marshall No. 316A .00035 mfd. condenser
C7—One Sangamo .002 mfd. condenser
R1, R2—Two Yaxley 10 ohm resistors
R3—One Lynch 5 megohm grid leak with mounting
R4—One Yaxley 20 ohm midget rheostat
R5—One Lynch .25 megohm grid leak with mounting
R6—One Yaxley 2 ohm resistor
Sw—One Carter filament switch
Two Mar-co dials (not drums)
Four Silver-Marshall No. 130 blank coil forms
Four Silver-Marshall No. 511 tube sockets
One Silver-Marshall No. 512 five-prong socket
Nine binding posts or Fahnestock clips
One 8 x 17 x ½ inch wood baseboard
One 7 x 18 x ⅛ inch bakelite panel

Chart Finds Waves and Dial Settings



CALIBRATION CURVES FOR THE SM SHORT WAVE RECEIVER COILS

Dial settings from 0 to 100 are shown on the horizontal scale and wavelength readings on the four vertical scales. The short wave coil, T, covers the range from 32 to a little under 18 meters. Coil U covers the range from 58 to 31 meters, coil V from 110 to 57 meters, and coil W from 202 to 102 meters.

The curves may be used for determining the wavelength of any station picked up at a given dial setting and for determining at what dial setting a station of given wavelength should come in.

For example, what is the wavelength of a station which comes in at 50 on the dial, using coil U? Run up along the vertical line 50 to curve U and read the wavelength in the column headed U. The reading is approximately 41.5 meters.

Again suppose we wish to set the dial to tune in a station operating on 90 meters. Coil V covers this wavelength. Hence we run along the horizontal line marked 90 in column V to curve V. The intersection with the vertical lines is just below 70. Hence the dial setting should be about 69. Again suppose we wish to set the dial for 24 meters. Coil T covers this wavelength. Hence we run along the horizontal line marked 24 in the column headed T over to curve T. The intersection with the vertical lines is at 58. Hence that is the dial setting sought.

An Extra AF Stage

By Cromwell Parsons

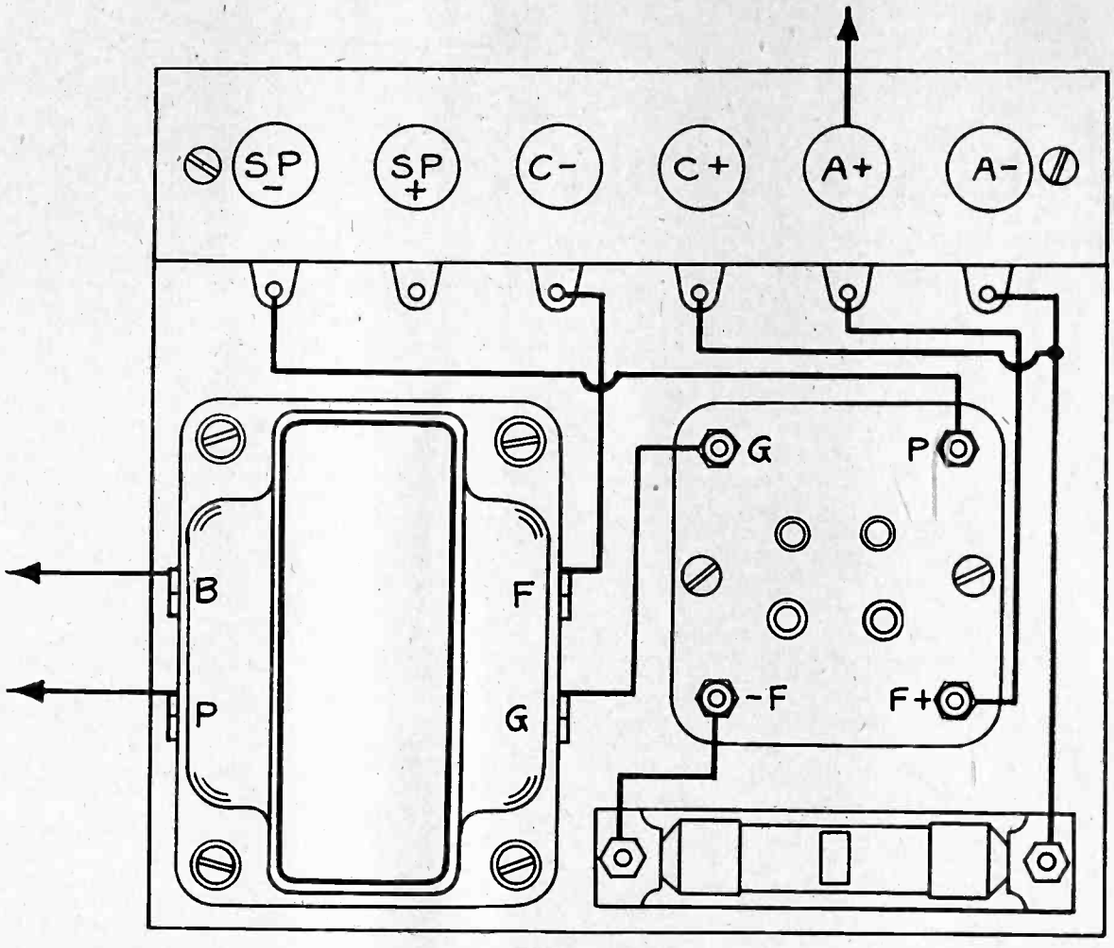


FIG. 1

PICTORIAL DIAGRAM OF AN EXTRA STAGE OF TRANSFORMER COUPLED AUDIO, TO PROVIDE GREATER VOLUME FOR DISTANT STATIONS, OR TO WORK A HEAVY-DUTY POWER TUBE NEARER ITS MAXIMUM UNDISTORTED PERFORMANCE. NO OUTPUT FILTER IS SHOWN, SINCE ONE NEED MERELY CONNECT AN OUTPUT TRANSFORMER OR AN ASSEMBLED CHOKE AND CONDENSER COMBINATION TO THE SPEAKER PLUS AND MINUS POSTS. B+ POWER GOES TO SPEAKER +. B MINUS IS ASSUMED CONNECTED IN THE RECEIVER PROPER.

MANY persons would like to obtain greater input into the last audio tube, either because they use a type —50 tube and want to work even strong stations at maximum, or because they have a fondness for distance reception loud enough to compare with locals, or are in a poor location. For them an extra stage of audio amplification is the thing.

The type —50 tube was originally intended to provide a maximum undistorted power output (of the order of 4,000 milliwatts) so that great volume without distortion could be provided for halls, demonstration rooms, lodges, auditoriums, etc. It was not intended primarily for use in the home. But experimenters have to do most of their listening in their homes, and the type —50 tube fascinated them, so there are many such tubes in homes today. Since they stand so much more than any previous output tube, it is fitting to work them somewhere near their maximum, and an extra stage of audio is the solution. It is assumed that a two-stage transformer coupled audio amplifier already is in use, or a three-stage resistance. impedance or equivalent circuit.

Use 1-to-1 Transformer

By introducing a transformer to couple the present last stage with the new last stage, and arranging biasing according to the data sheet supplied in each tube carton, the result is achieved. The transformer should be of 1-to-1 ratio, and an output transformer, if already in the set, and of that ratio, may be used, the extra socket, new output, Amperite, etc., being additional. In such a case the transformer shown in Fig. 2 would be an output transformer again, and wired accordingly, the plate of the new socket going to the P post, the B plus power voltage (the highest B voltage you have) to the other post on the same side of the transformer, the speaker being connected to the two posts on the other side.

The same system may be followed if the output tube is a —10 or a —71 or —71A, in which case the extra volume is used on distant stations only, since locals would overtax the output tube.

The way to use the extra volume for distance only is to locate the volume control ahead of the detector as usually it is in receiver, or have two volume controls, one at the radio frequency level, the other at the audio frequency level, say a 500,000 ohm adjustable across the secondary of the first audio frequency transformer. The set is normally worked far below maximum volume, except for distant reception.

The picture diagram, Fig. 1, shows the wiring for adding a stage of transformer coupled audio to an existing receiver which has a 112, —01A, —20 or —99 as the present final audio tube. The outfit is 5 inches wide by 4½ inches deep and is placed in the console or radio table along with the B supply.

No output device is shown, because the one stage of additional audio may be desired for a one-tube set, such as a short wave receiver, to bring up the earphone volume.

But if a power tube is used in the last stage, all one need do is to connect the output device to the speaker plus and minus posts. Such as a device as the National Tone Filter or some output transformer serves nicely.

The extra audio stage should be constructed according to the diagram. If DC filament supply is used a suitable Amperite is inserted as shown. This might include any output tube up to the —71, which requires a 112 Amperite or the —71A, which requires a 1A Amperite because the A type draws only a quarter of an ampere, instead of half an ampere.

The AC Heated Filament

Output tubes like the —10 and —50 always are AC heated. To provide the necessary voltage and current for the filament, connect the F minus and F plus posts of the new socket to the 7½ volt

(*Concluded on page* 17)

A Portable that Perks

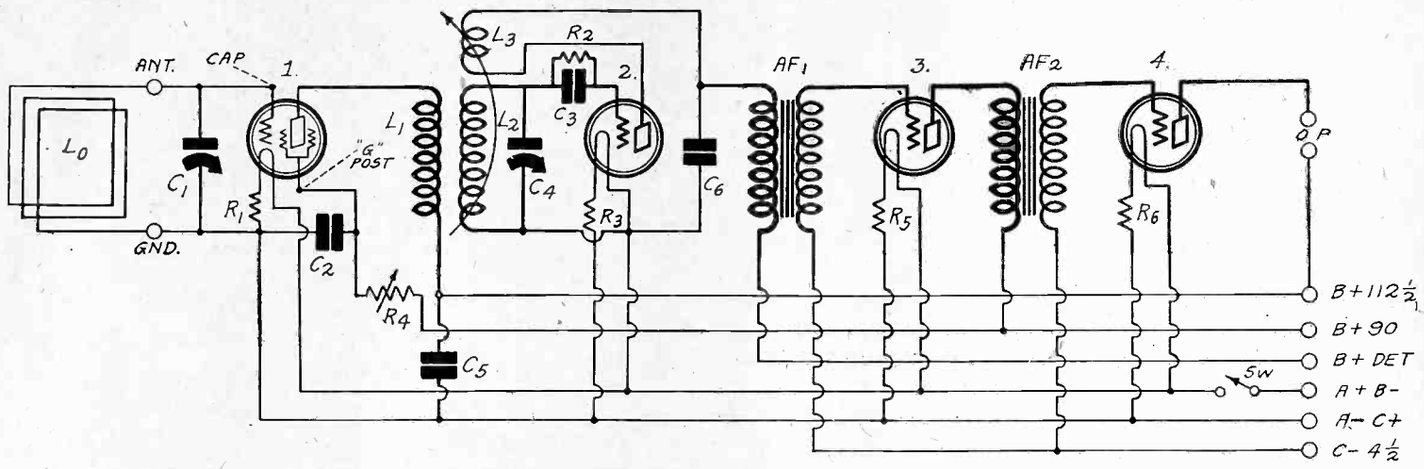


FIG. 1

AN EXCELLENT DESIGN FOR A PORTABLE, SINCE HIGH RF AMPLIFICATION IS OBTAINED, AND FAIRLY GOOD AUDIO AMPLIFICATION, WITHOUT REQUIRING EXCESSIVE WEIGHT. THE FIRST TUBE IS A SCREEN GRID. THE REST ARE —99 TUBES. THE TOTAL FILAMENT DRAIN IS THEREFORE 312 MILLIAMPERES. THE —99 TUBES AS AF AMPLIFIERS LIMIT THE AMOUNT OF AF AMPLIFICATION.

Four-Tube Circuit Uses One Screen Grid Tubes—How Weight and

By Walter

[*The design of a circuit useful as a portable requires maximum amplification and minimum weight. Such a circuit is described this week. This receiver may be built into a portable carrying case with handle, as will be described next week.*]

* * *

IN building a portable the main problems are sensitivity and lightness. Even with more than 500 broadcasting stations, you still may be several hundred miles away from the nearest one, a condition you may never have faced before with a set. Therefore extraordinary precautions must be taken in favor of sensitivity.

The B battery voltage and the filament current affect the weight problem seriously. To obtain good volume you need adequate plate voltage, which means weighty batteries. This is independent of the plate current problem, which has to do mainly with the life of the B batteries, not their weight.

Again, the filament circuit, if a big juice eater, compels weight and short life of batteries. Therefore we compromise, so as to get high sensitivity with a radio amplifier that rates well above the average, and take such audio amplification as the limitations of weight permit.

The Tube Situation

Stating the same situation in terms of tubes, we use a screen grid tube for the radio frequency amplifier, a —99 tube as the detector, for in that respect it, too, is entitled to good rank, and use two of the 99 variety as audio amplifiers, sacrificing some volume in the audio channels. Thus the filament current of the entire set is 312 milliamperes and circumstances compel us to draw this current from three No. 6 dry cells connected in series. The conservative general purpose recommendation is that the drain from such batteries be limited to 250 milliamperes (one-quarter ampere), but what with radioless vacations threatening unless we do something about it, we accept the slight excess drain and expect somewhat shorter life from the No. 6 cell than otherwise.

On the plate voltage side we have three 45-volt B batteries, also series connected, giving us really 117 volts total, since we tie minus B to A plus, thus making the voltages of the two battery sources cumulative. That's just a little trick but a scientific one, handy to use when you need to crowd on all the plate voltage within reach.

This highest voltage of 112½ apparent, but 117 actual, is used on the plate of the screen grid tube and on the plate of the last audio tube. This is somewhat more voltage than intended for the 99 to assure rated tube life of 1,000 hours, but we are not seeking maximum tube life.

A Good Compromise

The 99 tube, even with 117 volts on the plate, may be expected to last one through a month's vacation, and maybe all summer, so as this is an expedition on pleasure bent, the dickens with the maximum-rated-life-hour experts! We want a portable set, one that will do something for us, without making us hire a truck to get it where we want to tune in, and so here it is, with a little too much voltage here for volume's sake and a little too little there, for weight's sake.

There's one recommended exception: When you tune in a station on this portable, on the porch of the Clearview Summer Retreat, close by the bosky dell and

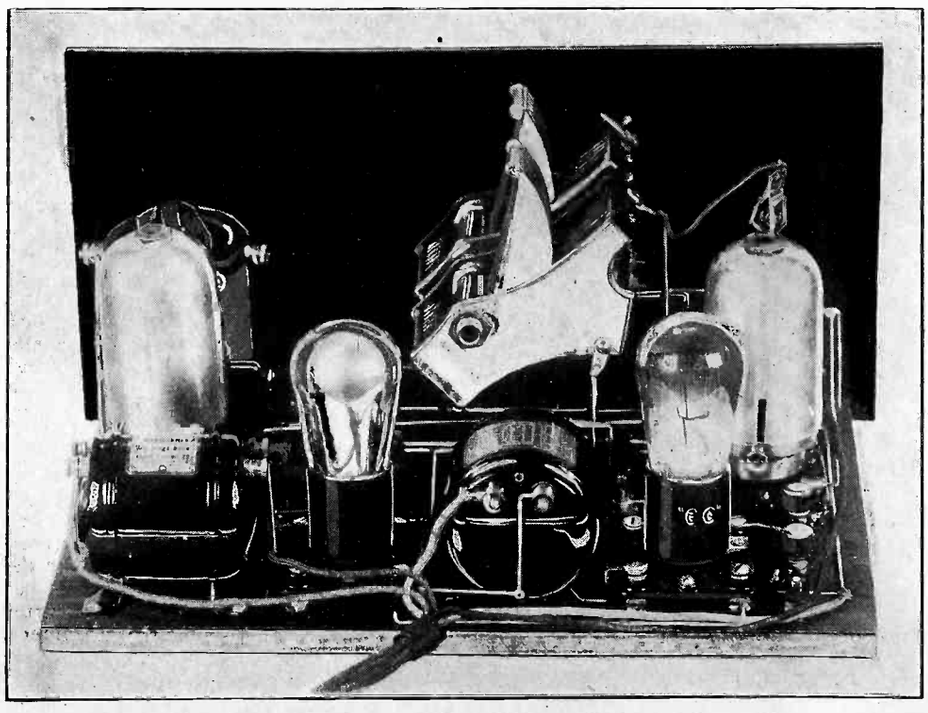


FIG. 2

THE PORTABLE RECEIVER AS BUILT IN THE LABORATORY, WHERE IT IS SHOWN OPERATED WITH SCREEN GRID, —01A AND 112 TUBE. THE —99 TUBES STACKED UP WELL ENOUGH IN THE COMPARISON.

Even in Stubborn Places

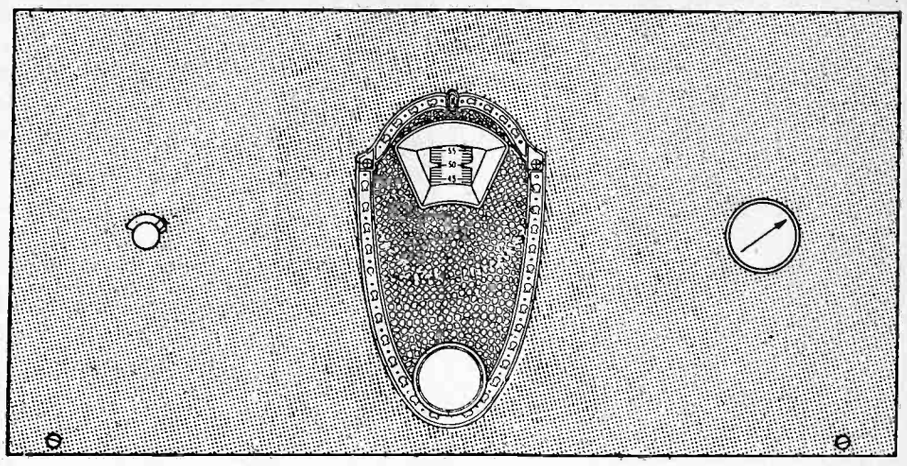


FIG. 3

OVERALL DIMENSIONS OF FRONT PANEL ARE 7 X 14 INCHES. THE NEW NATIONAL TYPE E DIAL IS LOCATED AT CENTER. A HOLE 2½ INCHES IN DIAMETER IS DRILLED IN THE PANEL FOR THE WINDOW. LOCATE THIS CENTER OF THIS HOLE ABOUT 3 INCHES DOWN FROM THE TOP OF THE PANEL. THE SMALL KNOB TO THE LEFT IS THE SWITCH, AND A HOLE ⅜ INCH IN DIAMETER IS DRILLED FOR THIS, 2 INCHES IN AND 3½ INCHES UP. THE KNOB TO THE RIGHT CONTROLS THE REGENERATION

LIST OF PARTS

Lo—One loop.
C1, C4—Two .0005 mfd. tuning condensers, ganged (Karas).
L1L2L3—One three-circuit tuner with large primary for shield grid tube (Bruno SG tuner).
AF1, AF2—Two audio frequency transformers (Karas Harmonik).
C2, C5, C6—Three .001 mfd. mice fixed condensers (Aerovox).
C3—One .00025 mfd. grid condenser with clips (Aerovox).
R4—One standard Clarostat.
R1—One No. 20 Amperite.
R2—One Lynch 5 meg. metallized grid leak.
R3, R5, R6—Three No. 4v199 Amperites.
SW—One Yaxley No. 10 switch.
1, 2, 3, 4—Four sockets (Frost).
Ant., Gnd.—Two XL bakelite push posts.
OP—Two X-L bakelite push posts (speaker +, speaker —).
One 7x14 inch front panel.
One 9x13 inch baseboard.
One National type E dial (not drum).
One small knob for tickler shaft.
One 222 Vac-Shield and one 201A Vac-Shield.
One No. 45 Universal peewee clip and 5 inch flexible wire.

perates from Loop ube and Three-99 rformance Balance

McCord

babbling brook the advertising resort catalogue mentioned more than casually, if you can get what seems to you as much volume with 90 volts on the plate of the last tube, use 90 all the time. Or it may work the other way 'round—with 117 on the first audio plate you may get more volume—hence would use that voltage on booth audio tubes. All —99 tubes are not made identical.

Try switching tubes about in the last detector and audio sockets as part of this test.

Best at Night

Very few portables are much on daylight reception over areas hundreds of miles around, and in lakeshore valleys, or densely wooded hillocks, so one should not count too heavily on getting much reception then but at night it is possible to traverse several hundred miles with this receiver with the aid of an antenna wire. The circuit is shown as loop operated and it does work well on a loop but even a short antenna wire helps when flung over a high branch of a tree the free end of the wire connected to grid.

Yet the loop itself is handy since it permits you to take the set along with you on canoe, train, steamboat, automobile and airplane, and work it to the surprise of your friends and maybe yourself.

Good operation is made possible under adverse conditions because of the high amplification of the screen grid tube, and the action of the tickler in the detector circuit.

Not Overtaxed

The screen grid tube is not worked to its fullest advantage, as this would require an extra B battery, and the results were fine enough without requiring that extra weight. Even so, the improvement over any other radio amplifier tube is astonishing.

Fortunately the filament of the —22 tube draws only 132 milliamperes at 3.3 volts, and is not critical. We actually operate it at 3.2 volts by using a 220 Amperite. This device is otherwise used to drop a 4½ volt source to 3.3 volts for the 220 tube, which draws 120 milliamperes.

B Batteries Last Well

The amount of plate current a portable set draws is of considerable importance, since it determines the life of the B batteries.

The current required by the screen grid tube at the voltage used is about 4 milliamperes, two for the screen grid and two for the plate. The detector tube takes about ½ milliamperes. The first audio tube requires approximately 3 while the last tube takes about 5 milliamperes. Thus the set takes a total of 12½ milliamperes. While this is considerable, the dry cell B batteries will deliver this for several months, certainly for the length of the average vacation.

It is possible to reduce the drain to some extent without impairing the quality on moderate volume or to reduce the sensitivity.

This is simply done by decreasing the plate voltage applied to the first audio tube.

Instead of giving this 112 or 90 volts it can be operated on 45 volts.

The voltage on the last tube should not be reduced below 90, for that would result in impaired quality.

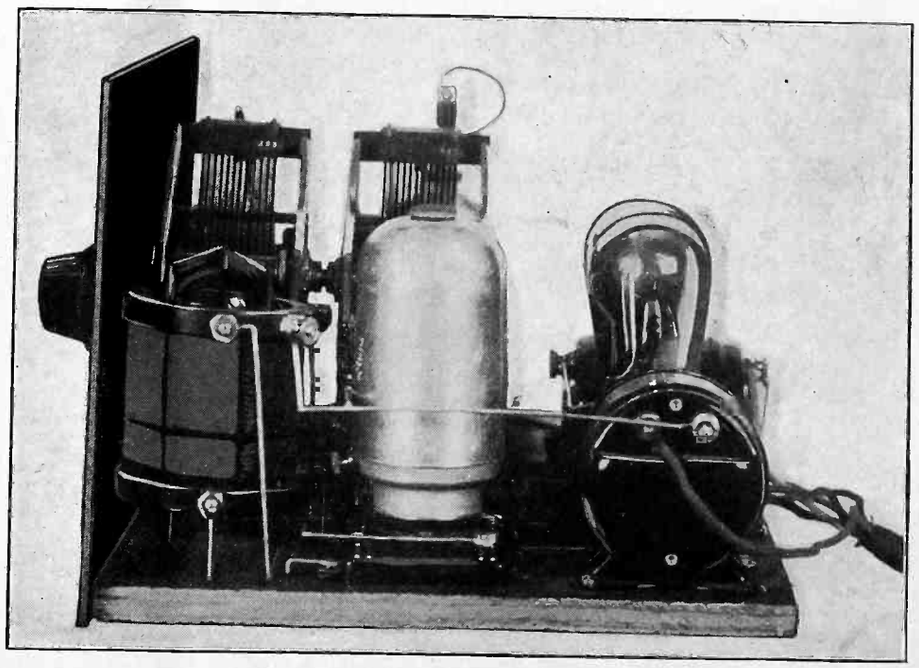


FIG. 2

A SIDE VIEW OF THE CIRCUIT BEING TESTED WITH LARGE SIZE TUBES.

Lure of the Pickup

LESS than two years ago radio and the phonogroph joined hands for their common good. The wedding has been an outstanding success. Closely allied now, and working for a common cause, radio and phonograph engineers have done unceasing work on the ways and means of bringing out the best possibilities of both radio and recorded entertainment.

One field today cannot be satisfactorily investigated and studied without a close and careful analysis of the other. The quick and widespread acceptance, on the buying public's part, of radio as a double entertainer has compelled both radio and phonograph engineers to turn their thoughts to bettering each field in itself, and with practically equal emphasis to bettering the combination of the two.

From the public's viewpoint, undoubtedly the most interesting part of the combined efforts of radio and phonograph engineers has been the definite attempt to provide, by means of the radio set, recorded entertainment which would compare favorably with that given by radio phonograph combinations selling for hundreds of dollars. The big demand has been and is today for simple means of using the home radio set with a good speaker to obtain quality of reproduction comparable with that of high-priced combination machines.

Better Results

In radio we have seen the advent of better and more powerful tubes, which have been immediately adopted on their merits, and used not only in radio, but in the power amplifiers of expensive radio-phonograph combinations. We have also seen worth-while advances in the design of power amplifiers, made possible largely through the design of high-voltage power supply devices working from the lighting mains without batteries.

Fewer than three years ago records were mechanically recorded, and the results, compared with those of today, were sadly lacking. Research men in both radio and phonograph laboratories put their heads together and the result was the wonderfully improved electrically cut record, made possible by means of a microphone pick-up feeding into an audio amplifier, with the final recording far superior to anything a mechanical method could offer.

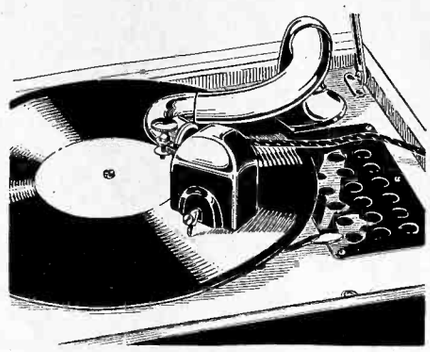
By the new microphone-audio amplifier method of recording, much was put into records that was never there before. The question was how to bring out all the possibilities of tone and range reproduction. The answer is found at the starting point, simply that the record was produced by radio methods, so why not bring out its full new scope by means of radio methods.

Audio Greatly Improved

Now, fortunately, the audio amplifier of the commercial radio receiver of today is miles ahead of that of three years ago. This is especially true where power tubes such as the 10 or 50 are used with their high undistorted milliwats output, giving a depth and range of reproduction impossible with tubes employing less plate voltage.

Few owners of a high grade set are going to alter the audio channel for purposes of reproducing records. The problem boils down then to utilizing a means outside the radio set to bring out the full possibilities of the improved electrically cut record when played through the audio amplifier.

The ends to which radio and phonograph research men have gone to work



out their joint problems is little short of amazing. Tests, which to the layman may seem trivial, have turned out to be of real importance in their final applications. It is no exaggeration to say that more true progress has been made in quality reproduction of records during the past four years than in all previous years put together.

Seventy Models Compared

In the laboratory of the Pacent Electric Co., manufacturers of the Phonovox, a magnetic type pick-up, may be seen more than seventy models of a single type pick-up, all of them built simply to test the effect of different weights applied to records in relation to the result upon reproduction obtained with a good radio amplifier.

To go with these pick-ups in experimental work various types of counterbalanced tone arms have been necessary. More than a dozen different types have been tried extensively, with different weights of pick-ups, always with a critical ear to the quality obtained with various combinations of pick-up and tone arm.

At first thought it might seem that the ordinary tone arm, such as used on a majority of phonographs, would do satisfactorily for reproducing records through the radio set. It works well enough on the home phonogaph, why not on the magnetic pick-up used with the radio set?

The reason lies in the difference between the mechanical type reproducer and the more efficient magnetic pick-up. The mechanical reproducer never reproduces below certain audible frequencies, and its natural period was such that it did not interfere with the audio or musical range.

But try to use this same tone arm with the more efficient magnetic pick-up, and failure is the result, with the pick-up unit even jumping off the record! The fault is in the tone arm, not in the pick-up.

In working towards the design of a really satisfactory tone arm to go with the new design or the Phonovox, just released to the trade, engineers concluded that a constant weight at the needle point must be applied to the record for best results.

The spring method of securing correct applied weight is successful within limits, but it has obvious disadvantages. It works on the principle of restraining weight to a definite figure, rather than applying a definite mass and correct weight, unfettered by tension with its possible variation, to the record groove. But most important is the fact that differences in height at which the pick-up was applied to the record would mean differences in applied weight at the needle point.

The one way to make certain that pressure at the needle point of the pick-up will always be constant is by the principle of dead weight. A special device with a plunger one-half inch square is employed to calibrate the correct dead weight, by applying a number of small dead weights and comparing results and rechecking.

Avoids Engraving Record

There is another factor involved in the combined design of an efficient pick-up and tone arm, and that is the matter of wear and tear on the record. Excessive weight means that the record will be damaged by the needle more than it would under normal conditions of usage, thereby shortening the record's useful life. On the other hand, insufficient weight means that the record will be "playing too light," that is, all its range and tone will not be reproduced, particularly on the bass side, due to lack of applied weight in the grooves of the record.

For best results from records played through the audio amplifier, an efficient pick-up with a properly balanced tone arm, computed by dead weight methods for a constant applied weight to the record, is essential. While good results have been obtained from magnetic pick-ups working with any tone arm available, the reproduction will be vastly superior with the specially engineered tone arm of correct design.

Takes Steel or Fibre Needles

Improvements are constantly going on in the field of magnetic pickups, as well as in the field of accessories for use with them. The Pacent Company announced that its new Phonovox model is equipped to take either fibre or steel needles.

The advantage of fibre needles with certain records is well known. Needle scratch is practically done away with, increased tone range is assured, due to the lessening of the scratch, and music is softer, better rounded and well defined in many cases.

Today the radio set owner can get at small expense, actually less than fifteen dollars, the equipment needed to provide splendid quality of reproduction from records played through his audio amplifier, the music coming out of the speaker. Where power amplifier equipment is available, the quality will compare most favorably with that from high-priced combination radio-phonograph machines. In any event, he will be well rewarded by the additional entertainment afforded by the radio set and such records as he selects from the vast number which go to make up the realm of music, from classical to jazz.

Why the Electrical Recording is Better

The superiority of the electric method of recording phonograph records over the older mechanical method lies in the equalization of the signal.

The mechanical method was limited by the moving parts from the diaphragm on which the sound first impinged to the needle that cut the groove.

A small diaphragm could not respond to low notes as well as to the high and consequently these low notes were not even transmitted to the engraving needle. The high notes were hampered by the inertia of moving parts. Hence they were not faithfully transmitted.

These limitations are also present in the electrical system of recording, but they can be and are equalized or corrected.

An AC Harness for the Lynch-Aero 5

By Zeh Bouck

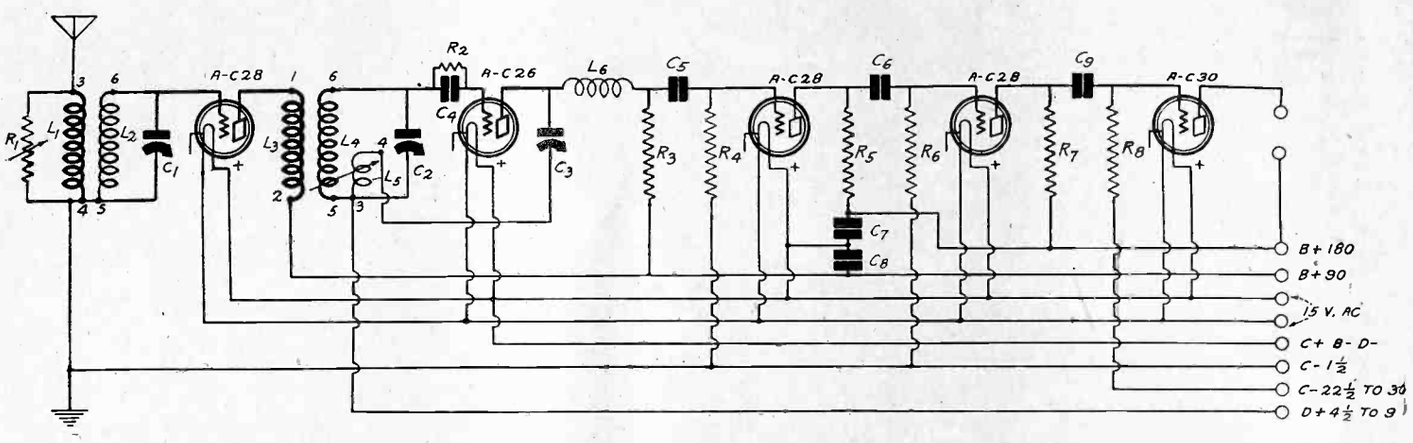


FIG. 1

THE Lynch-Aero Five receiver, described in the February 4 issue of RADIO WORLD, can be adapted to the use of AC tubes without actually changing the wiring of the receiver itself.

The adaption is effected by means of an AC harness and AC tubes.

The following additional parts will be required:

One Corwico AC Harness, type A

One step-down transformer having a 15 volt secondary, such as the Ives, type 203, Thordarson type TY121 and the Dongan type 6513.

Three Arcturus 28C cable type amplyfying tubes

One Arcturus 26C cable type detector tube

One Arcturus 30C cable type power amplifying tube

One Power Clarostat.

These parts are used in conjunction with the usual C and B batteries or any efficient eliminator.

How System is Worked

The harness outfit consists of the harness, having red, black, green and blue leads from the power end, and six twisted red and black leads and one green lead on the set end. A volume control and a small clip are also included in the outfit.

The Arcturus cable type tubes have two small screws on each side of the base, to which the paired red and black leads from the harness are fastened. These tubes have a standard four prong base and fit the UX sockets in the receiver without adaptors.

As the Corwico harness provides for a six tube receiver, the twisted red and black pair nearest the power end of the harness is clipped off close to the braid. The remaining leads are distributed, one to each of the sockets, with the main part of the cable between the sockets and the binding posts (Fig. 1).

Remove the Leak

The twisted red and black leads are cut off to the proper length, i. e., so that they are just long enough to permit the base connections to the tubes. This results in a form fit, with the elimination of all unnecessary harness wiring, making a neat and efficient job of the conversion.

The detector grid leak is removed from the mounting. The green Braidite lead is cut so that, when fastened to the clip provided with the harness outfit, it just reaches the grid leak mounting prong connected to the grid terminal on the detector circuit.

This clipped connection automatically takes care of the detector grid leak, by means of a special resistor incorporated in the harness.

Make These Changes

Before connecting the tubes to the harness, and inserting in the sockets, changes should be made in the battery wiring of the set. It is assumed that the receiver is connected up with the usual A battery, and with C and B batteries or an eliminator. Make the following changes in these connections:

Disconnect the A battery. Short circuit the A posts with a piece of wire.

Disconnect C battery plus and B battery negative.

Disconnect Det. B Plus, and short this post over to the next post marked B bat. plus.

All other connections remain unaltered.

Watch the Red Wire

The tubes may now be inserted in the receiver and the harness leads connected to the bases.

The Braidite covering on the leads (that have been cut to the proper length) is pushed back, the wires bent into a loop, and inserted under the connection screws.

Care should be observed always to connect the red wire to the connection screw on the right hand side of the base, with

(*Continued on page* 17)

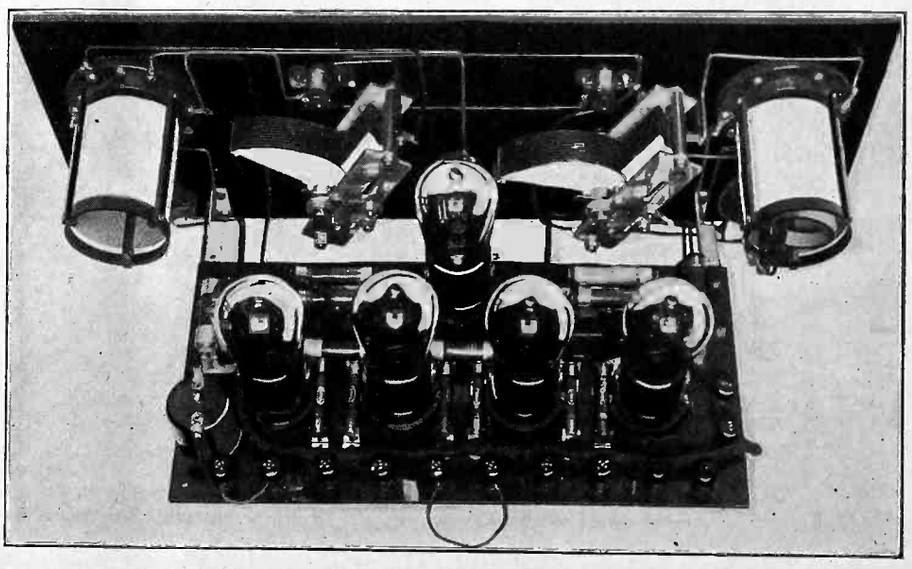


FIG. 2

The Conquest of

Wrests the Secrets Mother Nature's

By D. E.

Raytheon Manufa

IT is interesting that there seems to exist an inverse ratio between man's increasing dependence upon the practical applications of scientific principles in his everyday life, and his knowledge of that fact.

Today he obtains his information regarding what is going on in the world about him through the newspapers, leans heavily upon the telephone and telegraph as means of establishing contact with his fellow man, does his traveling by railroad or steamship, and looks to his radio for entertainment, in the vast majority of cases without bestowing a thought on the reason *why* these things, which he has come to look upon as utterly commonplace, are so.

The watch ticks and keeps time—and that is all he cares about. He enthrones Lindbergh and rightly invests him with a halo of respect, but remains oblivious of the fact that if some chap, whose name he had never heard, had not supplied a most precise coordination of brain and drawing implements in the design of a successful aircraft, even the wonderful Lindbergh could not have soared above the ground.

A Gift of the Gods.

And so it is that the average radio fan today takes his set as a gift of the gods, little considering what years of tedious, painstaking experimentation of the trial and error variety lie behind it all.

Let us confine our attention to the B power unit of a modern AC receiver which performs the same function as the B batteries did in the old sets.

In the B power unit alternating current available at the electric light socket is stepped up by a transformer and converted by a rectifier, which acts as a one-way turnstile, into pulsating direct current. This rectified current is smoothed out very thoroughly by a filter network of condensers and choke coils, and sent on through a resistance network for distribution to the radio receiver at the proper voltages.

This sounds simple, yet before this result was possible an intricacy of technique had to be mastered.

There was research work by many engineers on filtering, much of it done in the laboratory of the American Telephone & Telegraph Company of New York City. We will focus our attention on the very interesting problems that have been met and mastered by the research physicists in the development of satisfactory rectifiers.

AC Used Throughout U. S.

Due to the ease with which alternating voltages may be stepped up or down with minimum loss, this alternating form of electrical energy is used for distribution throughout practically the entire United States. Only in a few compact cities, and in isolated power plants where transmission distances are short, do we encounter direct current.

But modern radio reception, which is capable of detecting and amplifying very delicate signals with their wealth of minute details, requires a smooth, unvarying supply of direct current.

Alternating current cannot be applied directly to the plate circuit of radio tubes. Therefore, in making the B power unit a reality it has been necessary (1) to convert the alternating current obtained from the electric socket into direct current, and (2) to iron out the ripples in the direct current delivered by the rectifier to obtain smooth, unvarying DC energy.

There are many fundamental types of rectifiers available—chemical type, mercury vapor, motor-generator; bi-metallic, such as the Kuprox, Rectox and others; thermo-couple, thermionic or filament type, gaseous or Raytheon type, as well as others. However, in this paper we shall confine ourselves mainly to the two outstanding types, the thermionic or filament type, and the gaseous or Raytheon, with just a passing word regarding the more important features of the others.

The chemical type of rectifier has enjoyed considerable popularity in the past and is still used some, although it is being rapidly replaced with rectifiers of the dry type.

Those Good Old Days!

We all recall the good old radio amateur days of 1910, when many of us constructed chemical rectifiers with scrap pieces of lead and aluminum, dipped into glasses containing a solution of plain borax. Since those days there has been considerable development and these rectifiers can be consistently divided into three types—acid, non-acid and fluoride type. The names indicate the type of electrolyte used.

In the acid type the tantalum lead-sulphuric acid combination with a lead iron in the acid has been found the most practical. Other rectifiers of the acid type have been put out but have in general given trouble from the moment they left the hands of the manufacturer.

The non-acid type of rectifier is of the aluminum, lead, borax or ammonia phosphate combination, and rectification is due to the formation of aluminum hydroxide on the plates.

The fluoride type of rectifier is a combination of magnesium and nickel electrodes immersed in a fluoride solution.

All these types are particularly limited in the amount of voltage that can be safely applied to them and the amount of current limitation is due to the heat effect, which greatly accelerates the attacks on the electrodes in every type.

Bi-Metallic Rectifiers

Another difficulty which has been encountered in the physical make-up of these rectifiers is the inability to procure pure electrodes, as the presence of impurities shorten the life very rapidly. These disadvantages, together with the necessary bulk and the danger from damage by the electrolyte, have limited their usefulness for radio work.

The bi-metallic variety of rectifier, as exemplified by Rectox, Kuprox and others, is apparently a newcomer into the field of radio power supply, although the principle involved is the same as that used in our old friend the crystal rectifier.

In the bi-metallic rectifiers a variety of materials is used. The oxides and sulphides of better conductors, such as copper and silver, in the main have proven the most satisfactory for this service.

In this connection a very interesting experiment can be done by taking a piece of silicon and pointed copper wire in series with a suitable source of alternating current. By touching the copper pointed wire on the silicon, spots will be found where currents as high as two amperes can be rectified.

Limited to Low Voltages

This bi-metallic principle, however, in its present form is limited to low voltages, three discs being used to rectify a voltage of six volts, and while these discs are very satisfactory as a rectifier for low

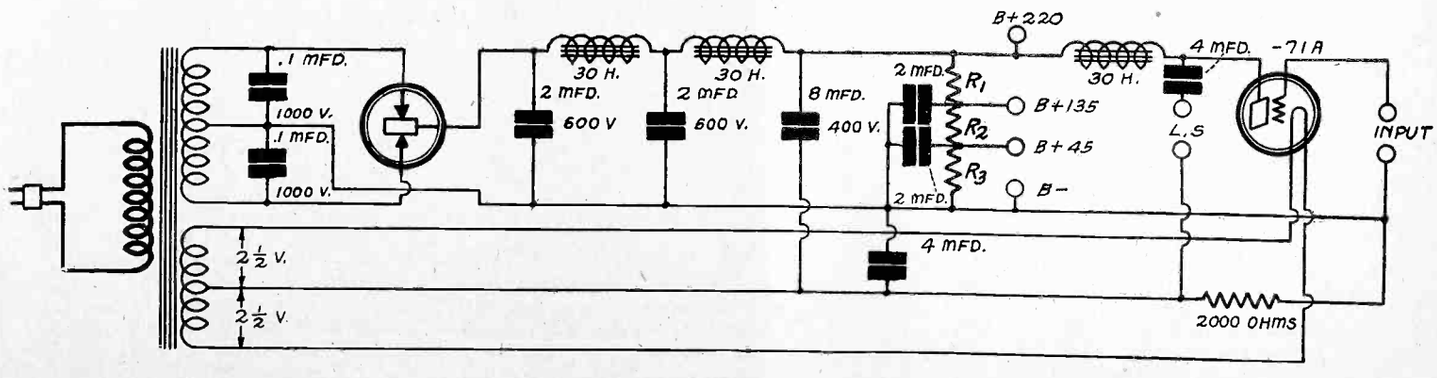


FIG. 1

A VAST AMOUNT OF INTRICATE TECHNIQUE HAD TO BE DEVELOPED BEFORE THIS POWER SUPPLY AND AMPLIFIER WERE PERFECTED. THE RECTIFIER TUBE IS THE HEART OF THE CIRCUIT.

Scientific Mysteries

of Rectifiers from Reluctant Lips

Replogle

uring Company

voltage filament current, quite a large pile of them in series would be necessary to supply plate voltages. Though undoubtedly B power units using this method of rectification will appear, high voltage is necessary and real reproduction will be very difficult to obtain.

The mercury vapor rectifier has been put to real work. It has long been employed as a rectifier for serious work of the electric power companies and large power users as well as in large storage battery rechargers. However, for the rather modest requirements of radio reception its advantages are not marked and it is not as well suited as other rectifiers which are more readily available.

In several laboratories at present there is being developed a rectifier which is a combination of a hot filament in mercury vapor. This rectifier shows a very low voltage drop, making for high efficiency. Whether it will become practical or not remains to be seen.

The motor-generator type of rectifier is handicapped, because of moving parts with subsequent wear and tear, the servicing necessary to keep it in good repair and the mechanical noise made in operation.

Too Much Ripple

Seemingly this is an ideal source of A, B and C voltages for receivers but, practically, the ripple in the output is so great as costly a filter is required to smooth the output as is necessary with other rectifiers. This method, however, is receiving a trial this year, as one manufacturer is producing a small motor-generator to supply power for a radio receiver.

The thermo-couple type of rectifier is very inefficient. In reality it is a generator of electricity rather than a rectifier, and the highest efficiencies which have been obtained are 3%, although 1½% is considered good. From many of its aspects it seems an ideal source of radio power, as it can be operated from gas, gasolene or electric heat.

Its most outstanding advantage is that the output from such a power unit requires no filtering and it is so isolated from the power lines that any extraneous noises picked up there are not carried to the radio receiver through the power unit.

Several attempts have been made to develop power units using large thermo-couples made of such material as constantine, iron and specially patented combinations which comprise hundreds of junctions with the heat supplied electrically. With the most efficient unit over six hundred watts were necessary to supply the A filament of a typical AC receiver.

The Filament and Gaseous Types

The means for holding the temperature of a thermo-couple constant is a real problem not yet solved. Obviously such a method is not economical, although in Europe thermo-couple power units have appeared operated by the heat of an alcohol lamp or gas stove.

Having disposed of these types of rectifiers it will be of interest to discuss more thoroughly the two types most commonly used in this socket power area, namely the thermionic or filament type, and the gaseous or Raytheon type of rectifier.

The thermionic or filament type rectifier, while a relatively new development in radio, is actually far older than the vacuum tube. It traces its direct ancestry back to the observations and experiments of Edison in the 'seventies, when that wizard was working on his first electric lamps.

The story is told how Edison was puzzled by the rapid blackening of his glass bulbs on the inside, and particularly by a thin clear line through the carbon deposit. It soon became apparent that the clear line was the "shadow," so to speak, of the positive leg of the hair-pin filament. But why such a "shadow"?

Edison's Good Work

Edison set out to investigate. He inserted a wire in the lamp, in addition to the hair-pin filament. Then he discovered an amazing phenomenon: the vacuum gap between filament and wire could be spanned with current, just so long as the filament was lighted. With the filament cold, the vacuum was a non-conductor. Also, he noticed that current could be passed from filament to wire, but not in the opposite direction. He had, in fact, a good rectifier.

The matter simply rested in the voluminous notebooks of Edison, although he made his observations known and the phenomenon became known as the "Edison effect."

Years later, in 1904, an English scientist, Professor J. A. Fleming, applied the Edison effect successfully in the rectification and detection of radio signals. And taking the work of Edison and Fleming as a foundation, the American radio pioneer, Dr. Lee de Forest, introduced a third element or grid, giving us our present-day vacuum tube.

The first socket power application was the B eliminator to replace B batteries, for it was easier to filter the rectifier output at higher voltages and when the current drain was comparatively small than to build a low voltage high current A power unit.

In connection with vacuum tube transmitters, requiring high-voltage direct current, certain two-element tubes or kenetrons had been developed just for this purpose. Serious problems arose in the way of providing a satisfactory filament.

Ruggedness vs. Long Life

On the one hand it was essential that the filament possess sufficient ruggedness for normal handling without breakage. On the other, it was essential that the filament have a life of a thousand hours or more for economical operation and competition with B battery operation.

In providing the necessary long life,

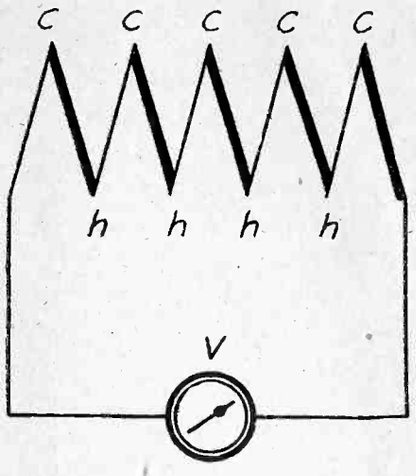


FIG. 2

THERMO-COUPLE TYPE OF BATTERY ELIMINATOR. THE LIGHT LINES REPRESENT ONE METAL, THE HEAVY LINES A DIFFERENT METAL. THE PIECES ARE CONNECTED IN SERIES AND MOUNTED SO THAT HALF OF THE JUNCTIONS, C, CAN BE KEPT COLD AND THE OTHER HALF, H, CAN BE KEPT AT A HIGH TEMPERATURE. THERE WILL BE A VOLTAGE DIFFERENCE ACROSS THE "THERMOPILE" AS INDICATED BY THE VOLTMETER V.

the filament had to be carbonized, which made it fragile. Consequently, serious filament breakage was encountered in the early rectifiers. In fact, the first B power unit was introduced in 1923 and shortly abandoned because of rectifier filament troubles.

Late in 1924 various B power units were introduced, utilizing standard vacuum tubes as the rectifiers. Some units made use of a single tube of the well-known —01-A type, with an output of something like 10 to 15 milliamperes at 90 volts. Others made use of two —01-A tubes, with full-wave rectification for an output of 20 to 30 milliamperes at 90 volts. However, the standard tube performs as a rectifier only when the filament emission is at the peak. The slightest falling off in emission is immediately noticeable in the marked reduction of output current and voltage. Hence mediocre results were obtained with the early B power unit employing standard tubes.

Much Progress Made

Since then the development of filament rectifiers has gone a long way forward. The difficulties encountered have been in obtaining a good filament and proper degasifying the materials used and in obtaining high vacua. In order to obtain long life a brittle composition of filament material was necessary. Tungsten was used as a filament for quite a while, but did not have very long life, and could not carry much current.

To insure long life a very brittle filament was necessary, so other materials have been developed which meet the requirements more satisfactorily, and today we find the filament type of rectifier giving good service and employing a ribbon filament which is coated with nitrates or carbonate of barium or strontium, which has been found more satisfactory.

This coating is put on in a series of

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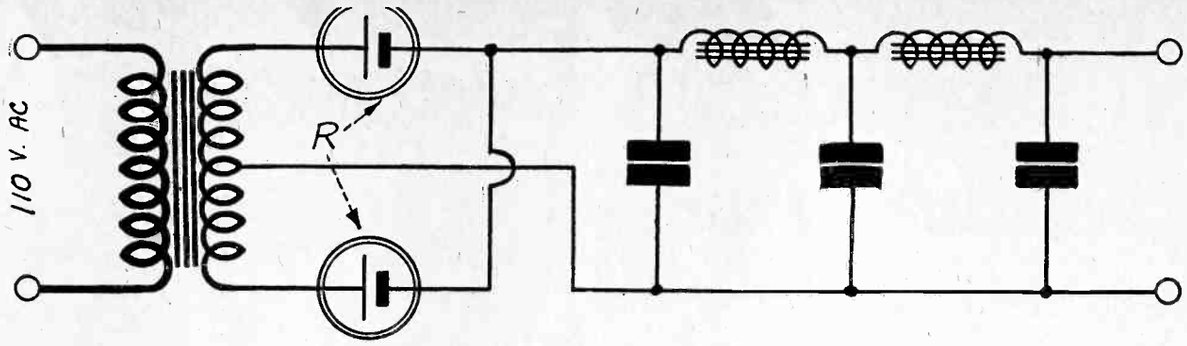


FIG. 3.
A chemical type rectifier. Two jars containing an electrolyte and two dissimilar metals for the rectifying elements.

(*Continued from preceding page*)

baking and dipping processes, and during the manufacturing process of the tube, the nitrates or carbonates are converted entirely over to oxides. During the exhaustion of the manufacturing processes, the filament must be degasified and it must be bombarded in an atmosphere of hydrogen, or even better, carbon monoxide, to absorb all the impurities in the material.

This new filament material has an emission over two thousand times that of the best emission of former materials and is a real step in advance.

Work Still Remains

There are still problems to be solved. One is the better preparation of the oxide on the filament so that it does not fall off. Another difficulty which must be met is the holding of the elements in their geometric positions so that the characteristics of the tubes will remain constant.

At the critical period in radio broadcast history, when socket power was receiving its baptism of service, the gaseous rectifier or Raytheon type rectifier made its debut. Without filament, liquids, moving parts, delicate contacts or other factors to cause trouble, this rectifier immediately gained public favor. Indeed, more than any other cause, the Raytheon gaseous tube served to bring about the present socket power era.

New to the radio art, gaseous conductivity is nevertheless an old story to the physicist. As far back as thirty years ago we find the predecessor of the present gaseous rectifier, for Sir Oliver Lodge, in the course of his extensive scientific research, developed a gaseous rectifier utilizing ordinary air with a large cathode and a small anode, for obtaining one-way conduction, and the well-known Tungar type, comprising Argon gas and a heated wire and cold plate, dates back as far as 1905, so far as the technique is concerned.

Puzzle to Scientists

The electrical properties of gases have long been known. However, why a normal gas should be a non-conductor, and then, under certain treatment, become an almost perfect conductor, has long puzzled scientists. Only within recent years, since we have delved into the very foundations of matter and discovered the wonderful structure of atoms and electrons and ions, have we found explanations for mysteries of the past.

Now gases may, in various ways, be put into a state in which they conduct electricity readily. They acquire this conductivity when X-rays or rays from radioactive substances pass through them, or when they are traversed by cathode or positive rays.

Ultra-violet light of very short wavelength can impart this property to a gas, while gases recently driven from flames or from near arcs or sparks, or bubbled through certain liquids or passed slowly over phosphorous, also possess this property.

It loses its conductivity if it is sucked through glass-wool, or made to bubble through water. The conductivity may also be removed by making the gas traverse a strong electric field. The removal of the conductivity by filtering the gas through glass-wool or water shows that the conductivity is due to something mixed with the gas which can be removed by filtration, while the removal of the conductivity by the electrical field shows that this something is charged with electricity and moves under the action of the electric force.

Ionization Fascinating

Since the gas when in the conducting stage shows as a whole no charge of electricity, the charges mixed with the gas must be both positive and negative. We conclude that the conductivity of the gas is due to the presence of electrified particles; some of these particles are charged positively, others negatively. These electrified particles are called ions, and the process by which they are produced, ionization.

Ionization is probably little understood because the quantities dealt with in the study of it are so minute. Take for instance, the helium gas which is used almost exclusively in gaseous rectifiers. The atom or particles of this gas have a diameter of approximately one billionth of a centimeter. This atom is still farther subdivided into four positively charged particles and four negatively charged particles or electrons, and in every cubic centimeter of gas at the pressure commonly found in tubes now used, there are approximately three billion billion such atoms.

Ionization consists in releasing one of the negative charged electrons from the helium atom, and it is this released electron that acts as a carrier of electricity from negative to positive.

These figures will serve to show the minute quantities with which the physicist has to deal in his study of gaseous conduction.

Gaseous Condition Important

The subject of gaseous conduction is of such importance that the Encyclopaedia Britannica devotes eighteen full pages to the electrical properties on gases. Entire separate volumes have been published on the subject.

A few years ago a student was studying the astronomical spectrum and became interested in knocking off two electrons from the helium atom to obtain a spectrum matching that of a certain astronomical spectrum. These experiments in pure science soon caused C. G. Smith to apply his knowledge to making a gaseous conductor amplifier with a magnetic control. He selected helium as the gas. This is the gas, scientists tell us, that blankets the sun. It is almost as light as hydrogen and is non-inflammable, being quite commonly known for its use in balloons.

Choice of Helium

At the time that Mr. Smith began his experimentation with helium gas it was very rare and costly. Only a limited supply was in evidence and most of this was commandeered by the government for military purposes. Whatever was available sold for $1,500 a cubic foot, while today the same gas sells for seven cents a cubic foot.

Helium was selected for these gas conduction experiments for several good reasons. In the first place, it has a longer free path than any other gas, and by this is meant that the helium atom must travel farther than any other gas atoms in attaining sufficient velocity to strike hard enough to liberate an electron or become ionized. This free path proved to be five or ten times what theory predicted.

The helium atom is also small so that more of these atoms can be present with a minimum chance of collection. Also there are limited ways in which the helium atom can be struck to knock off an electron, reducing still farther the chance of collision. These factors make possible the use of more helium gas in the rectifier, thus insuring longer life.

In practice the use of other gases would mean a higher starting voltage to ionize the gas which is, of course, an undesirable rectifier characteristic.

The mechanics of what happens in a gaseous rectifier is of interest. The potential applied to the electrodes causes so much activity among the helium atoms that they strike each other and knock off electrons thus ionizing the gas.

Dissimilar Electrodes

The gas atom, now positively charged, seeks the cathode or negative element, from which it picks up another electron and returns to its original state to be re-ionized by collision with its fellows and again to pick an electron from the cathode. The electrons which are lost seek the positive terminal of the tube, hence a flow of electrons or electricity occurs from the cathode to anode through the external circuit.

Were the anode and cathode of the same dimensions current would flow equally freely in each direction.

By making one electrode small in comparison with the other, the positively charged atoms may readily strike one electrode and pick up electrons while with the potential in the opposite direction, their ability to strike the small electrode and obtain necessary electron, is greatly diminished, and in their attempt to do so they build up around the small electrode a positive charge which tends to repel their fellows.

Some, however, do strike the small electrode, and the ones that do cause a small back current or reverse current to flow. By careful and competent engineering, the result of a lot of research, this back current can be reduced to a negligible factor.

In the commercial form of rectifier, each atom of helium is ionized in the neighborhood of a million times in a typical radio year or one thousand hours of operation.

The Early Efforts

A refinement early introduced in the Raytheon gaseous rectifier is that two anodes in the form of pins or points are used with one large cathode. These two anodes are so connected that alternately

one and then the other passes current, which gives rise to full-wave rectification.

The first gaseous rectifiers were made up very carefully, and by this we mean the use of extremely pure gas which must be purified much farther than any available on the market.

The use of very efficient high vacuum pumps gave tubes that, when placed on life racks in constant service, gave a minimum of 10,000 hours, life after which, although helium is an inert gas, there appeared a tendency of the helium atoms to combine or rather mix with the materials of the anode or cathode in such a way that these particles were lost and refused to become ionized. Thus the bombardment of the cathode element became weakened and the current output consequently fell off.

It was found that long life in a gaseous rectifier depended upon the purity of the helium used, the amount of gas in the rectifier and precautions taken in removing the last vestige of impurities from the materials of the rectifier, and preventing the surface of the electrodes from being ripped apart under the bombardment of the gas atom. Also the applied voltages and the current passed were reflected in the life.

The S Tube Appears

The first commercial result of Mr. Smith's work on the helium gaseous rectifier was the well-known S tube, which became a favorite of radio amateurs in pre-broadcasting days. This was a single wave rectifier having a small and a large electrode, helium gas and a suitable lavite insulator between electrodes. It proved a good rectifier, although the voltage drop through the tube was rather high and there was a tendency for discharges to occur between the electrodes in the tube, giving rise to external disturbances.

In 1923 Dr. Bush, of the Massachusetts Institute of Technology, with Mr. Smith, designed a more workable model. In this tube the two anodes were introduced.

At this point Mr. Smith decided to make use of the long mean free path of the helium gas and he discovered that it was necessary for the helium atom to travel a considerable distance before it would collide with another atom with sufficient force to ionize or knock an electron off.

This phenomenon enabled Dr. Bush and Mr. Smith to construct the tube so that where the anodes protruded through the cathode, a small spacing of the gas itself was left between the two. Across this spacing the gas would not ionize because of the short distance, while along the longer paths the gas did ionize and become conductive.

Technical Difficulty Met

In this way the short path insulation assured ionization only between the working portion of the anode and the cathode which kept all the action within the enclosed area of the cathode itself.

This was important, because it was found that the energetic bombardment often ripped particles from the cathode and deposited them on the glass and elsewhere in the tube. This, of course, was undesirable because of the deteriorating effect.

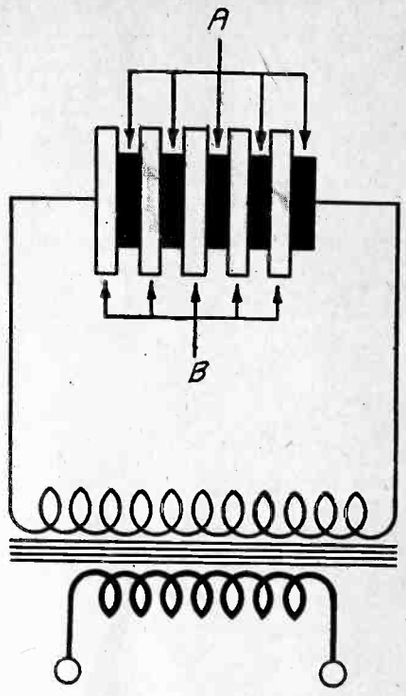


FIG. 4.

AN OXIDE TYPE RECTIFIER. THE RECTIFYING ELEMENT IS THE OXIDE THAT FORMS AT THE SURFACES SEPARATING THE DISSIMILAR METALS A AND B.

With an enclosed cathode, particles ripped from one side of the cathode were deposited on another side and deterioration was prevented.

Since this development research has continued along the lines of most suitable materials to be used for anode and cathode. A study of means of neutralizing the large drop that occurs around the anode and cathode due to space charge built up around these electrodes developed a special treatment and the material used in the tube was worked out so that it largely neutralized these electrode drops and made the starting and working voltage drop across the rectifier much lower.

Production Problem Mastered

From experiments which have been conducted a new anode material was discovered that resisted bombarding very highly and the use of which increased the life of the rectifier considerably.

The gaseous rectifier, even if free of a filament, is an intricate device in which there are many variables, all of which interact.

Thus, changing one changes all, and it is necessary to bring back the entire collection into the desired balance once more. The difficulties of manufacturing such a produce are obvious. The physicist would be appalled if asked to work out the gaseous tube by classical methods, yet Raytheon tubes are manufactured by tens of thousands, through the most ingenious methods that reduce variables to an absolute minimum.

And side by side with the Ratheon factory are the Ratheon laboratories, devoted not only to testing materials, working out new designs, developing suitable circuits, and testing proposed circuits and devices, but also undertaking endless tests on tubes so as to check up on actual production.

The factory, in fact, is simply an outgrowth of the laboratory, and serves to make tubes in quantities where the laboratory can make but one at a time.

At Work All the Time

The Raytheon tube laboratory has the necessary personnel and equipment to develop and produce gaseous tubes of all kinds. Mr. Smith, aided by his associates in charge of these activities, is constantly working on gaseous conduction and rectification.

It is a fact that an idea in the morning becomes a finished tube by the afternoon, complete in every detail, even to the base ready for insertion in a tube socket. Skilled machinists make the necessary metal parts. Skilled glass-blowers work out the necessary designs in glass and build up separate pieces into elaborate stems and bulbs. Steel cylinders and sealed glass bulbs contain helium, argon, neon and other gases. "Getters," or chemical brooms to sweep out the air remaining after pumping, are available in many different forms. Vacuum and mercury pumps are at hand. Complete tubes are turned out for test under laboratory supervision. Only the final products are passed on to the factory for the necessary multiplication.

In the Raytheon factory one sees rows of machines automatically assembling the elements of the rectifiers into glass stems which are passed under flames and squeezed into shape.

These stems are in turn passed over to operators of other machines where they are inserted and automatically sealed into glass bulbs.

These bulbs are now taken to a pump which exhausts the gas in the tube. The elements then are heated up by passing current through the tube itself until they are incandescent. This drives all the impurities out into the evacuating pump and leaves the materials pure.

The Chemical Broom

Now, in certain types of rectifiers a pill composed of what is called a "getter" is exploded. This "getter" is in the nature of a chemical broom which combines with what impurities cannot be taken out by the pump, and helium gas is then let in to the desired pressure and the tube is then sealed up ready for cleaning, basing and testing. Through all these processes the strictest kind of tests and inspection are maintained to insure the proper operation in the finished rectifier.

Of interest to the amateur are several types of new rectifiers now being developed in the Raytheon Laboratories. Among them are a 2,000-volt single rectifier, a 1,000-volt single wave rectifier, a 1,000-volt full-wave rectifier, a 500-volt full-wave rectifier, and a Neon lamp for a source of light in television reception.

Indeed, we believe that we are just on the threshhold of a wide range of service which gaseous conduction can be made to give.

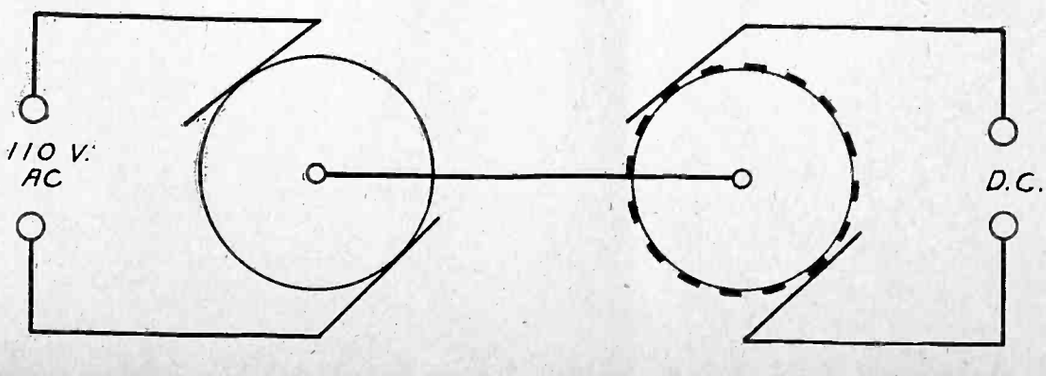
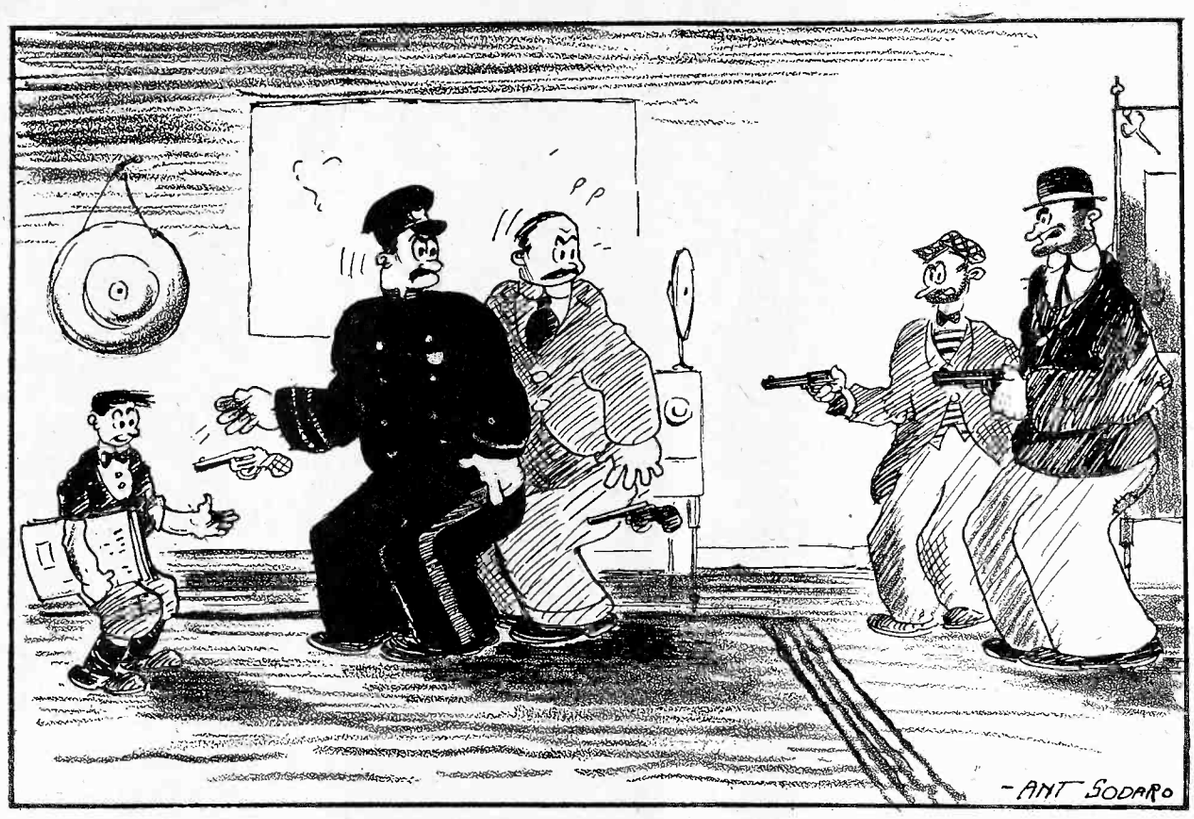


FIG. 5

A motor-generator type of rectifier. An AC motor drives a direct current generator.

The Soft Side

By James



"DROP DEM CAP PISTOLS, GENTS! WE GOT YE COVERED WID A PAIR OF REAL GATS AN' ONE FALSE MOVE AN' WE LETS DAYLIGHT TRU YER."

How the Cross Purposes of Informal After-Midnight Visitors at Grosskopf's Radio Salon Were Charitably United—A Comedy Playlet for Broadcasting, in Which All Characters are Radioists

Copyright 1928 by James H. Carroll

ANNOUNCER: Ladies and gentlemen, we will now present "Brothers Under the Skin," a one-act play by James H. Carroll of RADIO WORLD, presented by the Fernald Players. The action takes place in the demonstration "salon" of Ginsberg's Electra Radio Palace at midnight. The characters are, in order of appearance, "Spike," a brainy cracksman; "Bull," a muscular cracksman; Grosskopf, a watchman; McGonigle, a policeman; "Bolivar" Brown, a newsboy, and Sol Ginsberg. The play will now begin:

Crash of cymbals—Silence for a second—then a scratching sound, growing louder, followed by a tinkle of glass.

SPIKE: Turn on de flash, yuh dumbell; dey can't see nothin' from de street, de front is covered, an' don't drop de soup like yer did on date job wit' Fingers—dey never did find enough of him ter bury. I don't mind dyin' wid me boots on, but I'd like ter be buried in one piece!

BULL: Aw close yer trap an' don't be harpin' on spilt soup. Can't a guy make one mistake? Fergit it. Gee, on de level, Spike. I'm worried becuz we didn't find dat burglar alarm. Squinty had it marked right over dat winder.

SPIKE: Gowan, don't be always pullin' dat old granny business. Yer gettin' so dat yer ascared of yer shadder. Git busy wit de glim an' find de safe. Dere's one hundred thousan' bucks wort' of sparklers in it. Dis is no phony joint. Dis guy is in dere wid de goods.

BULL: Ouch! Somepin' poked me in de stummick. Ow! hellup, hellup! Spike, I got me foot in a trap.

SPIKE: Holy Smoke! I've a mind ter bump yer off right now. Yer a fine bum ter be a peterman. Lemme see. Hold up yer hoof.

BULL: Have a heart! Yer pullin' me leg out by de roots.

SPIKE: Yeave ho, me hearties. (I loined dat wen I was a sailor on a bumboat. Der yer are. Wot in tunder is dis ting? Hold de glim. Strike me pink, it's a rubber box wit' a handle an' it sez on it "Westinghouse A Battery Case!" Wot's dat doin' in a foist-class joolery store?

BULL: Lookahere! A radio—and annudder radio—Gee! de joint is full of dem. We're in de wrong dump. Squint gave us a phony plant!

SPIKE: Wait till I lay me hands on dat guy. I'll croak him if it's de last ting I do on eart'.

BULL: I'm de guy wot'll measure him for a wooden overcoat—de double-crosser!

SPIKE: Say, wot end of de alley did we come in? Wuzn't it de nort' end, right offa de main stem?

BULL: Sure, dat's de way it wuz marked on Squint's map.

SPIKE: Yea, an dat's de way I'll mark it on your map, you rummy! It's your fault. Dat's how we went wrong; we shoulda come in de udder end an' counted four houses from de corner. We're on de wrong end of de block. Come on, let's beat it. We got time yet.

BULL: Not on yer life. We're here, now—de joint is soundproof an' lightproof from de street, an' I'm goin' ter see de radio show an' maybe glom myself a new receiver.

SPIKE: Yeah, over my corpus yer will. Come on, snap outer it!

BULL: Try an' make me. You an' yer whole fambly couldn't tear me off!

SPIKE: Ye goof, I'll bean yer one!

Sound of scuffle.

SPIKE: Le' goa me, yer choking me. Hully smoke! dere goes de soup!!

BULL: Ha, I caught her. Babe Ruth wouldn't make so many homers if I wuz in center field. Now, be a gent an' lay offa me while I look dese babies over.

SPIKE: Say, bo, be yerself. Yeh know we bot' swore offa radio becuz we were gettin' ter be such bugs. Radio interfered wit' our business, so we hadda give up our business. Radio an' boiglary don't mix. Why, we wouldda reformed if we'd a kept on buildin' sets.

BULL: Aw, gowan, you wuz woice dan I wuz. Oh, looka dis pretty job, a screen gridder er I'm a gump.

SPIKE: Aw, get out; come here an' see dis 250 power pack. De foist one I ever glimmed. I'm goin' ter toin her on an' see how she woiks.

BULL: Don't be a sil'. You'll have all de flatfeet in town on our necks.

SPIKE: Dis can't be hoid outside in de store. Looka here, annuder screen grid job.

# of Hard Hearts

H. Carroll

Dey intrigues me severely. Holy smoke! Looka dis AC Super. An' here's a DC job. Gee, she's a beaut!

BULL: Aw, be sensible—looka dese TRF sets. Me fer dem. Say, run out an' git Jack ter bring his truck right down. I'm goin' ter clean up. We'll each take a few of dese sets, a coupla good power packs an' a half dozen of dem kits apiece so we can build new coicuts.

SPIKE: Aw, have a heart. We're passin' up a good job dat will put us on easy street fer most's. If we does dat, we won't woik fer a year. An' besides, pop said he'd put us out if we kept de speaker goin' so much in de daytime wen de udder honest crooks were tryin' ter ketch up on der sleep. Wot do yer tink he'd say if we were operatin' one of dem 250 power packs wid a ten tube super ahead of it?

BULL. We should worry about dat. We'll do this job up brown an' hire us a house in Joisey. Maybe we could run a radio store on de side, downstairs.

SPIKE: Sure, you got all de qualifications for a foist-class radio dealer. You'd not only take all de customer's jack, but you'd take his shoit.

BULL: Aw, I'd givem a jitney fer carfare an' I'd be doin' de Johns a favor at dat. Dey couldn't spend deir coin on anyting better dan radio, nowhere. Come here! Looka dis Super; 14 tubes an' all shielded like a battleship—de front panel looks like de control board of Lindy's plane——

SPIKE: Gee! She sure is a wow—she's all hooked up too—dey been woikin' on her. Let's try her out. I bet we kin get de Fiji Islands on dat machine!

Sound of door slamming in distance.

BULL (*in hoarse whisper*): Douse de glim—grab yer rod—de cops is comin'!

SPIKE: (*in hoarse whisper*): Here, let's git behind dis big console.

Sound of door slamming nearby.

GROSSKOPF: Vell, here are ve, Irish. Now ve vill haf it a nice leedle mittagessen mit moosic in dese nice varm saloon, yah?

McGONIGLE: You sid a mouthful, Dutchy. Here's the hot cawfee. Set it on ther haiter an' don't spill it. Did ye git ther sandwiches an' poi?

GROSSKOPF: Shure, de sendvitches I haff undt der strudel is razzleperry, der dellicatessener sagt. Here, ketch!

McGONIGLE: Phew! Phot the divvle is dis? It schmells ter high Hivin, so it do. Phaugh! Limberger! Bad cess to ye. Oi've a mind ter crown ye wit me nightstick! Do ye want ter pizen me?

GROSSKOPF: Ha! ha! Dot is goot fer Irish cops. Id machts dem strong, yust like Dootchmans. But I vill shange mit you. Here is der lieberwurst ones, und I vill make a magic trick. I vill turn de limbairger sendvitch into a Vatchman.

McGONIGLE: Here, gimme a drought o' thot cawfee. Oi'm nearly froze, thot Oi am. Turn on a radio—see if you kin get Dublin.

GROSSKOPF: Ha! ha! Ve get a hotter blace if Ginsboig effer ketches us playin' mit hiss radios und eatink in his balace!

McGONIGLE: Roight ye are. Ye ought ter be ashoimed av yerself. 'Tis a foine watchman ye are, entoirely. Foolin' around wid radios an' atin' instid av dooin' yer dooty.

GROSSKOPF: How apout yourselluf? Vot a fine cop you shouldt pe. A radio buck cop!

McGONIGLE: Well, you're a radio bug, too. Ony yer too stupid ter build a set roight!

GROSSKOPF: Bummer, vot you are; I can puildt it a petter set as you can, any day an' twict on Sontag!

McGONIGLE: Bow, wow, says the puppy! Wot a foine hash ye made outa thot lasht screen-grid Diamond ye thried ter build. Ye nivver got a worrud out uv it. Whoy, ye couldn't aven get it ter hoscillate!

GROSSKOPF: Osculate, shure, she osculate too mooch, dot's de trubble. I got all de wires gemixed. Vell, Irish, I make you a betchu. Ve each shall puildt it a screen-gridder, you de fife tube an' me de four tuber, for fife tollars, for who iss de besser undt qvicker.

McGONIGLE: Yer on, me bye, fer a tin-spot. We'll aich take home a kit wid us, an' ther foist an' best one built, cops ther coin.

SPIKE (*in hoarse whisper*): Dere goes our kits!

BULL (*in hoarse whisper*): Not if I has ter hit 'em bot! De noive, uv dem!

Click of radio switch. Orchestra is heard playing "Blue Danube Waltz."

GROSSKOPF: Ach, Himmel! Aint dot sveet? I bet dot's Yarmany; no odder moosic iss so bootiful!

McGONIGLE: Whist, ye ought ter hear the bagpipes, fiddles an' foifes av ould Oireland!

GROSSKOPF: Come on, Irish. ve valtz.

Sound of shufflin feet in time to music.

BULL (*in hoarse whisper*): Kin ye beat it?

SPIKE (*in hoarse whisper*): Naw, don't waste good lead on 'em, just trow de soup at 'em.

BULL (*in hoarse whisper*): Hey, lay off de soup, willya!

Orchestra switches to medley of Irish airs, beginning with the "Irish Washerwoman."

McGONIGLE: Whoop! Begorra, there's music for ye! Gangway, Dutchy, Oi'll show ye some stips.

Sound of lively jig steps.

GROSSKOPF: Fine, Irish fine. (*Claps hands.*) Du bist some chigger!

Music fades away—silence—sounds of tinkling glass followed by thud.

GROSSKOPF: Golly! GHOSTES!

McGONIGLE: Ghosts, yer granny. 'Tis burglars, be golly! Turn off the set. Out wid the loights. In here wid ye, in dis closet. Here's where Oi git 'em.

Sound of uncertain shuffling feet.

BOLIVAR (*piping boy's voice*): Here's de electric light switch right under me nose. Gee! What a beautiful dump! No wonder Ginsboig calls it de radio Palace. Gee! if me poor brudder could only see dis. (Sighs.) But de poor guy will never see again, ner walk, neider. He give his sight an' his leg fer his country an' dere he lies on his back, widout even de pleasure of his radio, all fer want uv er grid leak an' detector tube. An' de doc says it's all what keeps him alive. I writ de Guv'mint at Washin'ton a letter askin' fer dem an' dey never answers me.

BULL (*in hoarse whisper*): Aw, de poor kid!

SPIKE (*in hoarse whisper*): Sh—ya rummy, dey'll hear ya.

Sound of shuffling feet as Bolivar wanders around.

BOLIVAR: Wow! Here's a boid! Here's annudder. Dis one is de cats pajimmies! An' dis one is de real gravy. Gee, here is some grid leaks. I'd better take a two meg an' a three meg; an' here's a bully gas-filled detector. Aw gee! It's not stealin'. I'll send de dough in ter Ginsboig as soon as I get a good day. All de coin I made dis week had ter go fer eats an' medicine.

Sound of crash and thud as McGonigle and Grosskopf burst out of closet.

McGONIGLE: Hands up, me Bucko! An' kape them up. 'Tis aisy ter see yer a disperate character. Startin' airly, aren't you?

GROSSKOPF: Up mit der honts, und don't start not'ink odder I shoot!

BOLIVAR (*tearfully*): Aw, gee, Mr. Cop, I aint no boiglar, honest. Cross my heart, I aint. I'm ony a newsy.

McGONIGLE (*sternly*): Pfhat are ye doin' here, thin? Take thim radio parrts out av yer pocket. Breakin' an interin' thot's who it is. Ye'll do a nice long stretch, ye will.

GROSSKOPF: Shure. Cough it up der sthuff. Qvick. Ve vill see dot you get life, und ve get medals.

McGONIGLE: Shut up. I'm doin' this. Tell me, pfhat are ye doin' here?

BOLIVAR: I found de winder in de alley open, Mister, an' I came in. I needed ter git a grid leak an' a detector tube fer our tree tube set. Me brudder wuz gassed an' shot in de war an' de radio is de on'y ting wot keeps his interest in life. An' de set wuzn't woikin'. De old tube boined out an' I hadn't de price of a new one. I'm de main support of de fam'ly, me mudder helps out by scrubbin', an' I meant to slip de dough ter Ginsboig tru de mail, honest, I did.

McGONIGLE: Tell thot ter the marines. Come along, now wit' ye. 'Tis pinched ye are!

Sound of terrific scrambling.

SPIKE: Drop dem cap pistols, gents. We got ye covered wid a pair of real gats, an' one false move an' we lets daylight tru yer.

Sound of pistols dropping to floor.

GROSSKOPF: Himmel! shoot not! I surrender!

McGONIGLE: Who the divvle are you fellers?

BOLIVAR: Gee, a couple of Sandy Clawses!

BULL: Never mind, we're a coupla knights, out ter foil de villins. You're a fine coupla bums, youse are. Pickin' on a poor kid wot's tryin' ter save his brudder's life, after mussin' up dis place an' monkeyin' wid de guy's radios when yer should be patrollin' yer beats. Shall I salivate dem, Spike?

SPIKE: Naw, let dem live. Dey're de kind dat makes business safe fer honest crooks. Stop wrigglin' dem arms, ya rummies. Beat it, kid, an' take de stuff wid ya!

GINSBERG: Vaita minit. Hends hup, everybody, an' dot means you, too, big feller.

Chorus of exclamations.

GINSBERG: Ha, ha! Keep 'em hup. I got six lifes at my finger tips. I seen dot at der mofies; an' I got Saint Witus dence in de tricker finger. EXPLANATION YOURSELLUFS! Vot means dis in mine pelace uf radio?

All start talking at once.

GINSBERG: Stop, stop! Von at a time. De cop, I know, also de vatchman, Grosskopf, shouldt pe dumbkopf. But de poy I never seen. An' you two fellers, who iss you?

SPIKE: We wuz passin' an' we saw de door open an' dese two rummies holdin' up de newsy wid deir rods. So we came in ter stop it. Dis gentleman is a prominenk surgeon, an' I'm his assistant.

GINSBERG: Ha, a sturgeon—a cutter-up. He looks it. My, vot a big feller!

McGONIGLE: An' where, moight I ashk, did ya get the pair ov automatic pishtols?

SPIKE: We sawr a guy holdin' up a feller, an' we knocked him over an' took 'em away frum him. (*Continued on next page*)

Success Marks Playlet By a Crippled Woman

Out of the Rocky Mountains, from the pen of a little cripple, has come a one-act play called "Just Plannin'". The play was broadcast from WGY recently by the WGY Players, under the direction of Frank Oliver. It was first produced a few months ago by the KGO Players from the Oakland, Calif., station and won many congratulatory letters.

Author is 27

The author is Helen Norris. She was born in Portland, Me., in 1901 and twelve years later moved with her family to Medford, Oregon. An attack of infantile paralysis left her legs useless. Her brother Bob became her "legs" and carried her from classroom to classroom. Instead of becoming discouraged, unhappy and bitter, Miss Norris developed a philosophy which has surmounted personal affliction. She sought gamely a medium by which she might express herself, and the radio drama has proved one outlet.

Hears Own Play

She has enrolled in the extension division of the University of Oregon, and is seriously set upon a literary career. Her radio play has brought her to the attention of many talented writers who have taken an interest in her ambitions.

WGY's short wave station, 2XAD, carried the play and Miss Norris heard the WGY Player's interpretation of her first radio play.

Baffle Board Aids Small-Sized Speakers

Small-sized reproducers usually are deficient in low-notes, so a baffle board is usually provided, or some equivalent. This sound-chamber improves low-note emission. The same effect is obtained if a small speaker is put inside a console, which is provided with an opening for emitting the sound.

If microphonic sounds are produced they are usually due to acoustical coupling Changing the position of the speaker often cures this. For instance, the speaker may be placed upside down, since it is hidden, anyway.

The Soft Side of Hard Hearts

(*Concluded from preceding page*)

McGONIGLE: An' phawt wor ye doin' out so late?

SPIKE: Dis is not late fer us, it's de time we regularly woiks. We wuz out on a big operation. Dere wuz about twenny-five grand in it.

BULL: Naw, a hundred thousan'.

SPIKE: Not fer our bit' youse knows dat.

GINSBERG: Come, poy, vot vas you doing herein an' who iss you?

BOLIVAR (*tearfully*): Aw, me name is Brown, I'm a newsy an' de kids calls me "Bolivar" becuz I eats 'em up—

GINSBERG: Yes, go on. For vy you preak into mine saloon?

BOLIVAR: Aw, I didn't break nawthin'. De winder wuz busted an' I came in (*sobs*). Please don't send me ter de hoosegow!

SPIKE: His poor brudder wuz gassed in de war an' lost a pin an' de radio is all dat keeps de poor guy livin.' Dere set wuz on de blink an' de kid horns in ter borry a detector an' a tree meg leak. Let 'im go an' I'll pay fer de junk.

BULL: Yer will, like run, I'll pay fer it.

GINSBERG: So, so, de pore feller! Say, I knowed yer brudder. Mine Abie vos in his Company an' he treated him fine. Abie writed me dot he promoted him to K. P. Vos not his nicknamen "Machinery Gun Prown?"

BOLIVAR: Dat's him. He pretty near won de war. He's got t'ree medals!

GINSBERG (*excitedly*): Oi, oi, tink of it. Shouldt it pe? De poor hero. He shouldt have it de best in de vorld—

SPIKE: Hey, Ginsberg, stop waiving dat cannon aroun'. Do ye want ter bump us all off?

Sound of terrific explosion.

SPIKE: Dere, you've done it. Blowed out der wall.

Crash of statio—loud music.

ANNOUNCER'S VOICE: "This is Holland!"

SPIKE (*yells*): Holy Smoke! He shot de big Super an' made it play an' it brung in Holland, foist crack!

BULL: Dat's mine. How much for de Super, Ginsboig?

SPIKE: Looka here. Dere wuz a loose connection an' de slug shot it tergedder. Wot der yer know about dat!

GINSBERG: By golly, dot's so. An' Abie an' Solly woss woikin' on it fer tree veeks an' couldn't make it vork. Here, Polivar. See dis fife tube chob. It's de National Screen Gridder Fife, mit all de tubes in, includink de screen-grid CeCo tube. An' here iss de National powerful peck mit Pacent Phonovox. Take dem home to de brudder. Dey vill make him lifely. An' I sand Abie over soon to see him!

BOLIVAR: Aw, honest? Gee, Ginsboig, youse is a prince!

SPIKE: Hol' on a minit, kid. Gimme yer dicer, Bull. It's bigger dan mine. I'm gonna pass de hat, an' I'm startin' it off wit a coupla tens.

BULL: Here's two tens and a finiff. Come on, youse guys, kick in!

McGONIGLE: Begorry, no medico can bate me. Here's two tins an' a foive an' two singles, all Oi hov wit' me. Come across, Dumbkopf!

GROSSKOPF: Grosskopf is de namen, nodt Dumbkopf. Here iss ein, swei, fife—here, take it all. Vait, here iss fife more der cheweller gave me ter keep a good vatch tonight undt tomorrow night.

BULL AND SPIKE IN UNISON: Termorrer night!

GROSSKOPF: Yah, tomorrow he gets more shewelry in. Varrum?

SPIKE: Nothink, ony we jus' remembers dat we has ter operate on a jeweler termorrer night.

McGONIGLE: Come on, Grossy, let's take de lad home an' see thot he doesn't get held up wit' all thot long green. An make yerself useful. You carry ther power pack an' Oi'll carry ther set.

BOLIVAR: Gee whiz! Youse guys is soitenly all right. I aint got de woids ter thank yer, but God bless yer all!

(*Sound of footsteps—McGonigle whistling "When Johnny Comes Marching Home." —Slamming of door.*)

GINSBERG (*sniffling*): Py Golly, idt giffs me a tear mine eye in ven I tink off dot poor hero an' de prave leetle kid brudder makink sooch a hardt stroogle mit life.

SPIKE: Well, ginks, we did one good toin fer oncet in our lives, anyway.

GINSBERG: I betcha; budt I guess you sheltlemens iss alvays doink goot——

BULL: Yea, we does em' good, awright!

GINSBERG: Ouch! Vot iss in diss plack pag?

Sound of clanking metal.

BULL: DON' KICK DAT BAG! De soup is in it!

SPIKE: Ya rummy, dat soup will be de deat' uv us, yet!

GINSBERG: Zoop? Dot's funny!

SPIKE: Oh. dem's de Doc's tools fer operatin'. An' he allers carries a special soup ter give de patients so he kin open 'em up easy like.

BULL: Aw, for de lovea mud, yer'll drive me dippy about dat soup. Gimme it, an' I'll put it on me hip——

SPIKE: Naw, naw, not dere. Ya knows how liable I am ter slip yer a swift kick oncet in a while; beside, ya know how hard ya sits down.

BULL: Quit yer kiddin'. Pour it down de sink fer all I care. Say, Ginsboig, put a rope around dat Super. I wants it. How much?

GINSBERG: You are sooch a fine gentlemans, I make you a pargain. Let me see—

BULL: Lay offa de blarney. If ya wuzn't such a good guy, I'd take it. Come on, how much cush does yer want fer de set an' de pack?

GINSBERG: Actual spot cash price, vun hundred fer de set, an' vun hundred fife fer de peck—an' I'm losin' money——

BULL: Sold. Here's de dough, count it. No mistakes refunded atter leavin' de cashiers' vinder. Don't be afraid. It's good money, I made it meself.

SPIKE: Hey, I wants dese two kits. De four an' five tube screen-grids an' dis pack. How much?

GINSBERG: Ninety-five fer de vun. Soxty-nine-fifty for de odder, an' de pack, vun hundert-ten, two-seventy-four-fifty, an' I giffs you dwenty per cent. off, vun-sefenty-nine, sixty—ve takes off de sixty cents, hein?

SPIKE: Right, here you are.

BULL: Hey, don't I get er discount, too?

GINSBERG: Dot stuff costs me more, but I giffs you dwenty, also—here.

BULL: Aw, right. Les beat it. I wants ter try dis baby out good. Here, hist de Super on me back, an' I'll take de packs, one in each hand. Spike you take your kits an 'de bag. So long, Ginsboig, we'll come in ter see ya.

SPIKE: Sure, we're friends an' customers, too. Mebbe we'll go inter de radio business ourselves. Dere's no excitement in dis operatin' no more. Toodle oo.

GINSBERG: Go in good health, an' good luck!

Sound of heavy footsteps. Voices fading away.

SPIKE: On de level, Bull, how about dat store—wot do yer tink?

BULL: Wait till I sees how dis Super woiks out, den I'll tell yer. If she woiks good an' I gets some real DX, mebbe I'll go yer.

Sound of door slamming.

GINSBERG: Vell dem was two good goys, even if dey did look more like boiglars dan sturgeons. I made me some gooot profit at dat. A feller sold me dot Super for fifteen pucks, he vos so disgusted mit it. So I don't lose nothink on de set I giff pore leedle Polivar.

MAJESTIC AC SET ANNOUNCED

Grigsby-Grunow Company, of Chicago, who became famous as the makers of Majestic B supplies, have gone into the manufacture of an electric set. K. W. Radio Company, Inc., New York City, Majestic distributors, announce that sets will be shipped from the Chicago factory for delivery to dealers' floors. The set uses AC tubes, push pull audio and dynamic speaker.

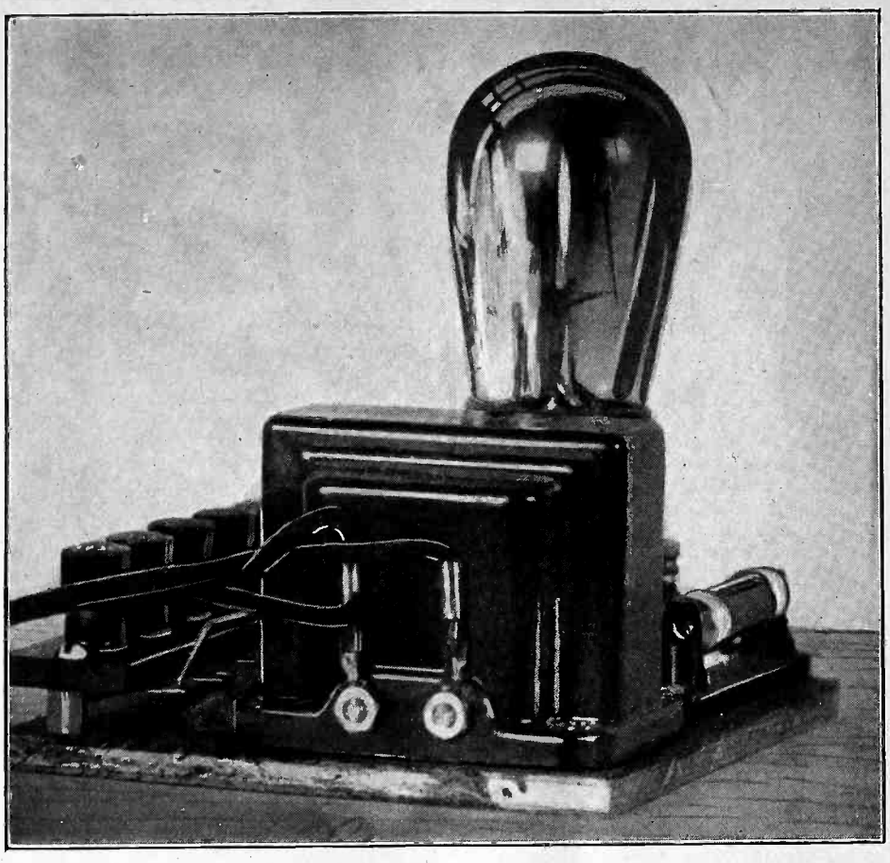


FIG. 2

A PHOTOGRAPH OF THE BUILT-UP UNIT. THE CORD LEADS ARE PERMANENTLY ATTACHED TO THE P AND B POSTS OF THE NEW TRANSFORMER AND ARE INSERTED IN THE PREVIOUS OUTPUT OF THE EXISTING RECEIVER

AC HARNESS FOR RECEIVER

(*Continued from page* 9)

the base pin away from you and the tube upright in its normal position.

When these connections have been effected, the receiver is ready for wiring to the transformer and C batteries.

Battery Voltages

The plus terminal of a 22.5 volt C battery is wired to ground, and the negative side to the minus C post on the receiver. If a combination B and C eliminator is used, the plus C terminal is taken care of automatically, it being necessary only to wire the minus side to the post as indicated.

The red and black wires are connected to the secondary of the transformer. The remaining connections are shown in Fig. 2.

The Power Clarostat should be included in series with the primary of the transformer to provide adequate adjustment of secondary potentials, compensating variations in line voltage.

It is a good idea to bypass the C battery potentials with 1 mfd. condensers such as the Polymet type C904 which are provided with flexible leads convenient for this purpose.

The volume control is connected by clipping it across the antenna and ground posts, and is used as an auxiliary control in conjunction with the usual regeneration adjustment.

Building A C Set De Novo

There are doubtless many readers who will be interested in building the AC set directly, dispensing with the harness conversion, and for their benefit the complete AC wiring diagram is shown in Fig. 3. The following shows what is required for the construction of this receiver:

LIST OF PARTS

One Lynch five tube De Luxe deck, including five Eby de luxe sockets, three 0.1 meg. Lynch resistors, three 0.55 meg. Lynch resistors, one 2.5 meg. Lynch resistor, three special cartridge type coupling condensers, one special cartridge type grid condensers, four sets of special mountings for resistors and condensers, all assembled and ready to wire.
Two National type C dials
One Aero Coil kit, U-95 (2 coils)
One Aero RF choke, No. 60
Two Amsco S. L. Frequency condensers No. 1223 .0005 mfd.
One Precise midget condenser, .00001 mfd.
Twelve Eby binding posts
Two S. M. mounting brackets
One box red solid Braidite
One box black solid Braidite
Two Polymet 1 mfd. condensers
One Volume Control Clarostat.

ACCESSORIES

Three Arcturus AC 28 amplifying tubes
One Arcturus AC 26 detector tube
One Arcturus AC 30 power tube
One fifteen volt secondary transformer
One Power Clarostat
One 22.5 volt C battery
One 7.5 volt C battery
Four 45. volt B batteries

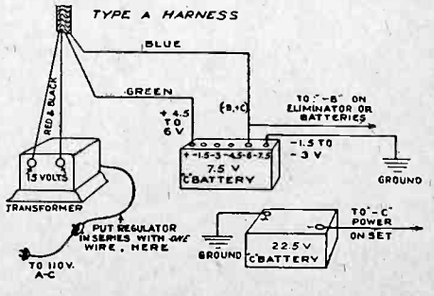
[Note: Any efficient eliminator may be substituted for the B and C batteries.]

The construction of the A-C receiver is practically identical with that of the DC model, and the reader is referred to the original article for details. The filament or heater wiring should be effected with twisted red and black Braidite, care being observed always to connect the red wire to the plus filament or heater prongs.

The current to AC tubes is turned on and off by breaking the circuit through the primary of the transformer. This can be accomplished in several ways, such as by pulling out the 110 volt plug, by turning off the socket switch, or by including a special switch in series with the primary lead as is suggested in Fig. 2.

When operated at the correct voltage, it will take just 30 seconds for the Arcturus tubes to heat to the normal operating temperature. This adjustment can be secured by changing the taps on the transformer (when provided with such) and by turning the power Clarostat knob.

The variable resistor should be so adjusted that a voltmeter across the secondary leads shows a potential of exactly fifteen volts.



EXTRA AUDIO FOR YOUR SET

(*Concluded from page* 5)

winding of the power transformer, and connect one side of a Clarostat to the center tap of this winding and the other side of the Clarostat to the C minus post of the terminal strip and to B minus of the eliminator. Put a 4 mfd. bypass condenser across the Clarostat. Disregard the C plus post on the diagram.

With any of the other popular output tubes, such as 112, 112A, —71, —71A and —20 the DC filament heating may be retained and grid battery biasing used, as provided, instead of the voltage drop in a resistor. The C plus post is used in this case.

Do not forget that in adding the stage of audio as diagrammed it is necessary to remove the output tube from the receiver and place it in the socket of the additional audio stage. In the vacant socket put a suitable tube, depending on the constitution of your receiver. The next to last audio tube may be of the same type as the first audio tube or the RF amplifiers (unless screen grid RF is used). In other words, an —01A, —99 or the like will suffice. Rearrange the bias on the second from the last audio tube to comply with tube data sheets, since this socket no longer holds the output tube.

Modernization

The diagram is particularly suitable if you want to modernize your receiver by not only including a power tube but also by providing extra volume, on account of poor location, desire for greater audibility on distant stations already receivable although too faint for full enjoyment, or because you want to use a greater capacity output tube considerably nearer its maximum power handling capabilities.

LIST OF PARTS

One AF transformer, 1-to-1.
One 5x4½ inch baseboard.
One Amperite with mounting.
One pair phone cords.
One 1x5 inch terminal strip with six XL bakelite push posts
Six lugs.
One socket.

A THOUGHT FOR THE WEEK

SAID the representative of a national advertiser who is about to send out a program over the air to a well-known and conservative music publisher: "Let us use this number (naming a piece that won lasting fame for its composer) and we'll give it the greatest boost anything of its kind ever received." Said the music publisher to the representative: "Your ten million dollar concern has to pay for its broadcasting and its talent—and it even has to pay you. If you want that number, make me an offer and I'll consider it."

And that was very much that!

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Radio World's Slogan: "A radio set for every home."

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Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

New Dubilier Office

The Dubilier Condenser Corporation has established an office at 10 East 43rd Street, New York City, for its sales and advertising departments, formerly at the Dubilier factory, Woodlawn, N. Y. C.

At the new office are W. H. Lipscomb, the recently elected president; G. E. Palmer, general sales manager; J. A. Fried, industrial sales manager, and J. George Uzmann, advertising manager.

Chains to Put Both Conventions on Air

A nationwide radio hook-up for broadcasting the proceedings of both the Republican and the Democratic National Conventions is now a certainty, according to an announcement by Merlin H. Aylesworth, president of the National Broadcasting Company.

"Our plans will make it possible for radio listeners to hear every phase of the conventions," said Mr. Aleysworth. "A special pick-up panel will be installed in the convention halls. Microphones on the platforms will catch the speeches. Another group of microphones will send out the band music, while others will be placed in advantageous positions to pick up the murmurs, roars and the colorful sound pictures of the assemblies. From a point where he can watch the entire convention, Graham McNamee will direct each broadcast and give the running story of each event.

Big Staff on Job

"A large technical staff will go to Kansas City and Houston in charge of E. F. Grossman, operating engineer. The reporting staff will include veteran political writers and analysts who have attended other conventions and who will explain and interpret the proceedings so that the radio audience will be kept abreast of every happening and will know the significance of every move. Marley Sherris, announcer, will assist Mr. McNamee.

"More than seventy stations will carry the convention broadcasts to every section of the United States. The National Broadcasting Company will utilize more than 10,000 miles of special radio telephone circuits, including two transcontinental lines.

On Short Waves, Too

"Short wave broadcasts from KDKA in Pittsburgh and WGY in Schenectady will make the Amercian political events available to radio listeners in South America, Europe, Asia, Australia and New Zealand."

The Columbia Broadcasting System's chain of sixteen stations also plans to broadcast both conventions. Its representative said yesterday that definite plans would be announced within a few days.

It is believed in radio circles that the total number of stations in the convention chains will be close to one hundred by the time the broadcasting begins.

Campaign Broadcast Appeals to Intellect

"Will radio debunk the coming campaign?" is a question asked in "Farm and Fireside."

"Keep tuned in on the conventions this month and the fireworks that will follow. The voice and the ideas of the next President will come directly into your home. Never before have farmers had such an opportunity to size up a campaign. Unswayed by personal presence and red fire, the voter will listen. The candidates will have to rely on the force of ideas. This is going to do something for politics. What?

"Bryan would have considered that Coolidge couldn't 'make a speech to save his life,' whereas Hoover cannot raise his voice far above a whisper, and yet Coolidge and Hoover are our most popular radio speakers. Our biggest chain of hotels, which gives radio with its rooms, recently had its guests ballot to see who was the most popular radio speaker and Coolidge won, with Hoover second.

"Something already has happened to politics, and that something is radio. And when a speaker brings his facts to you, you have nothing to do but sit there and think. You judge his sincerity and facts and then you meet a neighbor and chin it over, just like your fathers did.

"Personal magnetism cannot be shot over the ether; a politician who wishes to convince you must talk turkey. 'Radio comes into the home divorced from mob psychology,' says General Harbord, president of the Radio Corporation of America.

"Assuming that two candidates speak to 2,500,000 persons, then the presidential audiences since 1900 have totaled 17,500,000.

"The radio will debunk politics, kill oratory, tend to make folks talk issues out to a crystallized opinion."

McQuhae Finds Jazz Losing to Stand-bys

Allen McQuhae, the Irish tenor who sang the summer series of Atwater Kent concerts two years ago, and broadcast the first of his 1928 summer concerts recently, says the real music lovers are middle aged.

"You have to tell the people the story in your own way," said McQuhae, "and let your blood pulses run through it—sing right out from the heart. After all, the simple heart songs will ever remain the most popular.

"Song writers have unfortunately come under the spell of the dance enthusiasts, the jazz-mad crowd of youngsters throughout the country, forgetting that the great music-loving population of America is middle-aged.

"The steady increase in radio concerts by the world's greatest opera and concert stars, and the constant improvement in broadcasting generally, are making a swing back to the kind of songs that has gone down through the ages, the old folk-songs, ballads and popular lyrics.

"The reason for this is that broadcasting stations and those investing millions of dollars annually in sponsoring radio entertainment must present programs of the widest possible appeal to warrant the enormous investments in radio today. Jazz is losing out."

The summer series is broadcast every Sunday night at 9:15, Eastern Daylight Time, by the National Broadcasting Company and associated stations.

NEW CORPORATIONS

Automatic Radio Corp. of New York—Atty., R. L. Smith, Woodside, L. I., N. Y.

Gayety Radio Shop—Atty., S. C. Davidson, 1006 Fresh Pond Road, New York, N. Y.

Wagner Radio Broadcasting Co., Colonial Charter Co., Wilmington, Del.

Radio University

A QUESTION and Answer Department conducted by RADIO WORLD, by its staff of experts, for University members only.

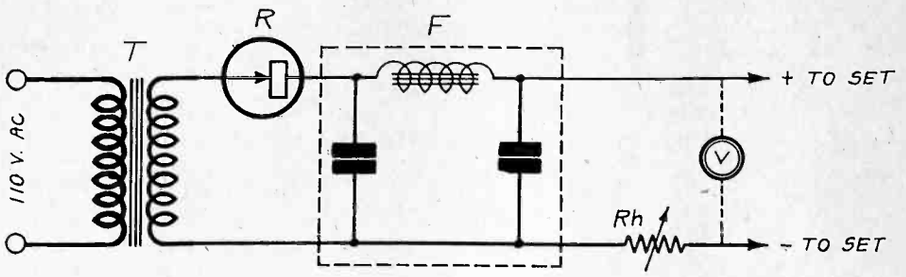

FIG. 670

THE CIRCUIT DIAGRAM OF AN A BATTERY ELIMINATOR MADE OF A BATTERY CHARGER AND A HEAVY DUTY FILTER. TWO ELECTROLYTIC CONDENSERS AND ONE CHOKE COIL ARE USED. CIRCUIT REQUESTED BY JESSE OVERTON.

PLEASE SHOW me a circuit diagram of an A battery eliminator, making use of two electrolytic condensers, one choke coil and a 2 ampere charger.

(2)—Is it necessary to use a 2 ampere charger when the DC portion of the circuit requires .632 ampere?

(3)—If not, what charger would you recommend?

(4)—What should the capacity of each of the two electrolytic condensers be?

(5)—What inductance is necessary in the choke coil and how heavy should the wire be?

JESSE OVERTON,
Trenton, N. J.

(1)—Fig. 670 shows the circuit diagram.

(2)—A charger delivering a current of ¾ ampere is large enough, hence a trickle charger of such capacity would suffice.

(3)—Any type of charger which will deliver this current is all right. A vibrating type is not so good as some of the other types now available because its output is more difficult to filter.

(4)—At least 1,000 mfd. Electrolytic condensers of much higher capacity are available for such low voltages as are met in chargers.

(5)—One fourth of a henry is suggested. No 18 double cotton covered or enameled wire is suitable. Rh in the drawing is a rheostat of 20 ohms.

* * *

PLEASE EXPLAIN why I get as good results when I connect the ground lead to the antenna binding post and the antenna to the ground as when I connect the two in the proper way.

ALFRED BURT,
New Bedford, Conn.

(1)—That is true when the ground binding post is neither grounded nor connected to the filament circuit.

* * *

WHAT IS THE SIZE of the scanning disc used by the General Electric Co., in the television receivers?

(2)—What is the speed of rotation and how many scanning lines are used?

(3)—What is the size of each hole and how are the holes in the scanning disc disposed?

FRANKLIN MOORE,
Philadelphia, Pa.

(1)—The diameter of the disc is 24 inches.

(2)—The disc rotates 18 times per second and 24 scanning lines are used. That is, there are 24 holes in the disc.

(3)—The diameter of each hole is 35 mils. The holes are disposed in a spiral 15 degrees apart. The distance between the first and the last holes, measured along the radii, is 1½ inches. This makes the image on the viewing screen a square 1½ x 1½ inch. Synchronization of the receiving scanning disc with the transmitting disc is effected manually by means of a rheostat.

WHAT IS A band pass filter?

(2)—Could one be used in a Super-Heterodyne to prevent side band cutting?

(3)—Can such be made of Super-Heterodyne transformers?

F. W. RICHARDS,
Salt Lake City, Utah.

(1)—A band pass filter is a combination of inductances and condensers with such electrical characteristics that a band of frequencies is transmitted with almost equal intensity, while outside these frequencies practically nothing is transmitted.

(2)—One or two could be used in a Super-Heterodyne to advantage. In fact, both selectivity and quality may be retained in a Super-Heterodyne in this way.

(3)—Yes, if no condenser is connected across either of the windings internally. The condenser and the inductances have to be connected in a special way.

* * *

PLEASE EXPLAIN HOW to connect a screen grid tube so as to use it as a space charge tube.

(2)—Can the space charge tube be used in resistance coupled amplifiers to good advantage?

(3)—What voltage should be used on the various elements of the tube when it is used as a space charge amplifier.

HEINRICH MUTI,
San Francisco, Calif.

(1)—The screen grid is used as control grid, that is the signal is impressed on the screen grid. The inner grid, or cap, is used as space charge grid. The plate is used in the regular fashion.

(2)—Yes, a voltage amplification of as high as 60 may be obtained with it. The outstanding advantage of the tube when used in this manner is that the mutual conductance is high, which is due to a great reduction in the plate to filament resistance.

(3)—The voltage on the control grid (outer) should be from 1 to 3 volts negative. The inner grid (cap) should be kept at 22½ volts positive. A voltage of 135 volts should be applied to the plate. Resistance coupling is especially suitable and the plate coupling resistor should be about 300,000 ohms.

* * *

PLEASE EXPLAIN the construction and functions of an oscillograph.

(2)—Can an oscillograph be used to determine the quality of a radio receiving system?

KARL ELMENDORFF,
Racine, Wis.

(1)—There are several types of oscillograph. One is constructed on the principle of the galvanometer. A coil on which a small mirror is mounted is suspended in the field of a strong electromagnet. As an alternating current is sent through the coil, the coil and the mirror vibrate in the same manner as the current. A beam of light is thrown on the mirror and reflected to a screen, or to a photographic plate. The light beam traces a curve on the screen which shows the wave form of the current through the coil.

The other type employs electrons. It is a special type of vacuum tube in which electric potentials are used to deflect a beam of electrons from a filament. The screen is a phosphorescent material deposited on the flattened end of the tube.

(2)—The mirror type oscillograph is not suitable for high audio frequencies because the coil and mirror are too heavy to follow the current. The cathode ray oscillograph can be used for both audio and radio frequencies. It can be used for measuring performance but it is not so suitable for this as are other instruments. Its primary purpose is to show the wave form, hence whether or not the amplifier introduces harmonics.

* * *

PLEASE GIVE THE formula for converting wavelength in meters into the equivalent number of kilocycles.

ANTONIO GONZALEZ,
El Paso, Texas.

(1)—The product of the wavelength in meters and the number of kiloycles is a constant number and is equal to 300,000. Divide this number by the wavelength in meters and the results is the number of kilocycles. Thus 600 meters is equivalent to 500 kc for 300,000/600 equals 500. The formula is WF equals 300,000.

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Table of Resistances for Bias Voltages

Many experimenters desire to know offhand what value of resistance to use where the voltage drop, due to plate current of that tube, is required for grid bias. The following table gives the answers:

Tube	No. of Tubes	Resistance	Plate voltage
— 99	1	1,800	90
— 99	2	900	90
— 99	3	600	90
— 01A	1	3,000	135
— 01A	2	1,500	135
— 01A	3	1,000	135
112A	1	1,286	135
112A	2	643	135
112A	3	429	135
— 71A	1	2,025	180
— 71A	2	1,012	180
— 71A	3	675	180
— 71A	4	506	180
— 10	1	1,688	350
— 10	2	844	350
— 50	1	1,527	450
— 50	2	764	450
— 27	1	1,286	135
— 27	2	643	135
— 27	3	429	135
— 26	1	1,500	135
— 26	2	750	135
— 26	3	500	135
— 40	1	15,000	180
— 40	2	7,500	180

These resistances are approximate only. The nearest commercial size usually may be used. The values are based on the supposition that no other current flows through the resistor than that from the tubes involved.

If two or more tubes are on the same grid bias resistor a very large by-pass condenser must be used across it to prevent feedback through it, except in push-pull. Even when a single tube is on a resistor a by-pass condenser should be used to prevent suppression of amplification.

The resistances given for the high mu tube presupposes the use of a 150,000 ohm coupling resistor in the plate circuit. The resistance drop method of obtaining bias is not recommended for high mu tubes. It is much better to use the drop in the filament ballast or else a grid bias battery.

While the resistances are given only for those plate voltages which are used most frequently they apply also to other plate voltages. However, when higher plate voltages are used slightly lower resistance values may be employed and when lower voltages are used, slightly higher values.

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A handy manual of 36 pages and cover—with 88 illustrations and over 20,000 words of practical, concise, understandable text—prepared by Austin C. Lescarboura and our engineering staff. Just the thing to show you how to get better radio results. It's yours for 25 cents—either from your dealer, or by remitting stamps or coin to

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Using General Purpose Tubes

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5 Tubes Same RF and detector as the other, but has one transformer and two resistance coupled audio. Especially suitable for B battery operation. (Not Shielded Grid Diamond.)

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Please send me one newly printed official blueprint of the—

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and the textual data giving full directions for construction.

Enclosed please find 25 cents to defray all expense.

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BLUEPRINT
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EVERY FRIDAY at 5.40 P. M. (Eastern Daylight Time) Herman Bernard, managing editor of Radio World, broadcasts from WGBS, the Gimbel Bros. station in New York, discussing radio topics.

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When you work from the official wiring diagram you find everything so delightfully simple that you marvel at the speed at which you get the entire receiver masterfully finished. And then when you tune in—more marvels! 'Way, 'way up, somewhere around the clouds, instead of only roof high, will you find the amplification!

Great stability! No neutralization required! No shielding necessary!

You'll be overjoyed. But you should place every part in exactly the right position. Stick to the constants given, and, above all, wire according to the blueprint!

When you work from this blueprint you find that every part is shown in correct position and every wire is shown going to its correct destination by the ACTUAL ROUTE taken in the practical wiring itself. Mr. Herman's personal set was used as the model. This is a matter-of-fact blueprint, with solid black lines showing wiring that is above the subpanel, and dotted lines that show how some of the wiring is done underneath.

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How to Use a Tester on Screen Grid Tubes

Screen grid tubes cannot be tested in the ordinary tester for three-electrode tubes because of the different disposition of the elements in the screen grid tube. But a very simple adapter can be built with which the screen grid tube may be tested on the ordinary tester.

The only parts necessary for the adapter are a standard UX socket, the base of an old UX tube, two clips and a little wire.

Remove the base from a defunct UX tube and clean out the holes in the prongs. Cut off four lengths of insulated, flexible wire such as Celatsite, long enough to reach from the tube tester to the socket of the UX socket. Two feet should be long enough. Solder one of these to each of the prongs in the UX socket.

Connect the leads from the F minus and F plus prongs to the corresponding terminals on the UX socket. Connect the lead from the P prong to the plate terminal on the socket.

Attach a clip to the end of the wire connected to the grid prong. Also connect a wire about three feet to the grid terminal on the socket and terminate this wire in a clip. The adapter is now ready for use.

Insert the base plug into the socket of the tester. This automatically makes three connections between the tester and the socket of the adapter. There remain two leads, each terminating in a clip . Connect the clip K1, Fig. 1, to a voltage source of 45 volts and connect the clip K2 on G of the plug to the cap of the screen grid tube inserted in the socket.

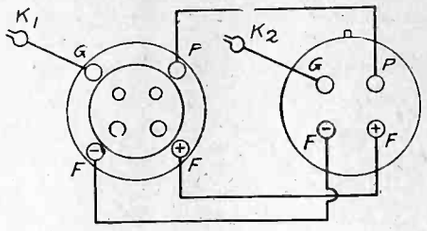

FIG. 1

THE DIAGRAM OF AN ADAPTER BY MEANS OF WHICH SCREEN GRID TUBES CAN BE TESTED ON STANDARD TUBE TESTERS. K1 AND K2 ARE TWO CLIPS FOR CONNECTION TO PLUS 45 VOLTS AND THE CAP GRID OF THE SCREEN GRID TUBE, RESPECTIVELY.

The voltage applied to the filament binding posts on the tester should be 4.5 volts and this should be adjusted by means of the rheostat on the tester until the filament voltmeter reads 3.3 volts. The voltage applied to the B plus terminal on the tester should be 135 volts, and the voltage applied to the C minus post on the tester should be —1½ volts.

By varying the grid bias by known amounts it is possible to obtain static curves of the screen grid tube.

Constant Filament Voltage

AMPERITE alone keeps tube filament voltage constant despite variations in "A" supply. Tube efficiency demands it. Indispensable with battery eliminators. Eliminates hand rheostats. Simplifies wiring. *FREE—Amperite Book of latest construction data and circuits. Write Dept. W. 10*

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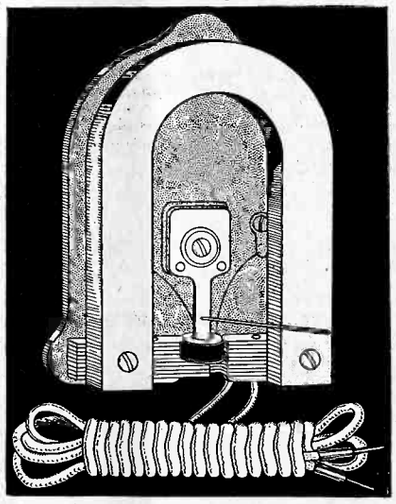
That Drives Any Cone Speaker and Reproduces Fine Tone at Great Volume!



This unit has a full floating armature, which means that armature is mounted so that it acts like a plunger between two sets of magnets or pole pieces. As the magnetization of the armature changes under the influence of the signal it plunges first toward one pair of pole pieces and then toward the other.

The large field magnet used insures a strong and permanent polarizing flux, which protects against loss of sensitivity from self-demagnetization to which some loudspeaker units are subject.

The cone driving pin is directly coupled to the full floating armature at that point on the armature where the force is greatest. This insures against loss of power through complicated levers.

The sturdy construction and heavy weight of the assembled unit prevent motion of the unit itself and insure that all the power is transformed into sound.

The armature is adjustable from an exposed knob in the back.

Apex, chuck and thumbscrew supplied with each unit!

This unit stands 150 volts unfiltered. With filtered output the unit has stood up to 550 plate volts continuously without damage.

Each unit is supplied with an apex, consisting of two metal plates, so that any type of airplane cloth or cone speaker may be built; also with each apex are supplied a threaded chuck and thumbnut for engaging the pin. The screw firmly grips the pin. Besides, a 60-inch cord with tips, is also supplied with each unit.

The Powertune Giant Unit, complete with apex, chuck, screw and 60" cord; total weight, 3 lbs. (Cat. No. 1098).....$3.75

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The wooden frame, with coping of decorative moulding, may be purchased in standard sizes and used as such, or may be cut down from a larger standard size to a smaller special size, and cloth cut by purchaser accordingly. The frames come complete with moulding and hardware, in factory sealed carton.

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"New York being the shipping center of the United States," said Mr. Matcheller, "it naturally follows that a large number of vessels come into this port using their spark transmitters and cause interference. However, there is nothing we can do in conection with this class of interference.

"There is an effort being made now to equip all ships with continuous wave transmitters, and during the past year 600 ships have been so equipped. It is not expected, however, that spark code interference can be dispensed with until all of the ships are converted to continuous wave transmitters."

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J. H. C.

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Issue of June 9 will contain manufacturers' announcements of new parts exhibited at the trade show at Chicago next week. Surely get this first-hand news in the June 9 issue of Radio World.

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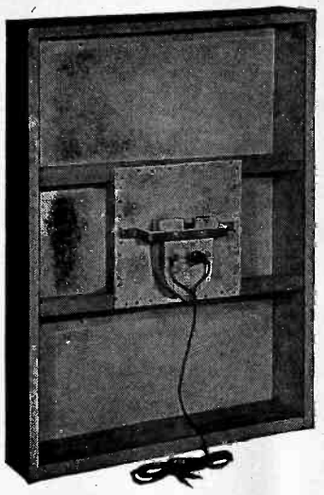
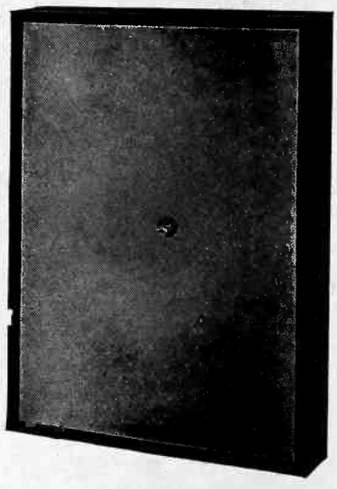
Special size 16½" x 22½", (Cat. 1086) Price, Including Unit

Kit Consists of airplane cloth, frame, moulding, unit, stiffening fluid, apex, crossarm, bracket, long cord, apex, hardware and instruction sheet.



Rear View of the HBH Airplane Cloth Speaker
Size, 16½x22½ Inches



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For $1 Extra We Build It for You!

If you do not want to build the speaker yourself, at $1 extra cost you can quickly receive the factory-built speaker in your home, all ready to play. Size 16½x22½" (Cat. 1086B).... **$8.00**

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The unit is the Powertone model, which provides high degree of volume and is very sensitive. Stands great strain. Used successfully in all radio receivers, including power pack installations up to 550 volts on the plate. Up to 135 volts DC may be passed through coils of unit without damage. For higher voltages filtered output is recommended, but unit has long stood up to 180 v. unfiltered.

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Genuine HBH Stiffening Fluid, secret compound, with superlative effect on tone quality. Large sized can, enough for three coats. Cat. No. 1097, $1.50.

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WHAT YOU GET:

(1) One newly-designed Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
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(4) One 5-prong plug with 30-inch cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 5-prong socket.
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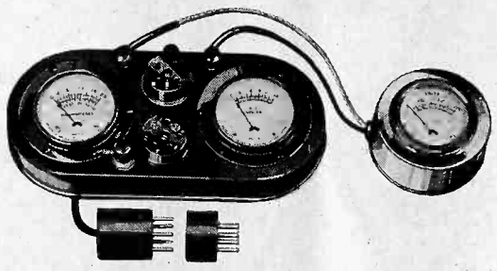
(8) Three binding posts.
(9) One handsome noire metal case.
(10) One instruction sheet.

[Outfit consists of two units, one being the 0-300 voltmeter (Cat. No. 346), the other the tester with enumerated parts built in. (Cat. No. 215.)]



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Trouble-Shooting Amazingly Simplified!

Instead of bearing the expense of an assortment of meters, service men, custom set builders, home constructors, experimenters, teachers, students and laboratories can now fulfill their set-testing and tube-testing needs with the Two-in-One Test Set.

If you want to test a tube or associated circuit, remove the tube and insert it in the proper socket of the tester. You can't make a mistake, because the number of prongs on the tube base confines you to only one of the tester sockets:

Now insert the plug in the vacant socket of the receiver—using the four-prong adapter if the tube came out of a four-prong socket. Attach 0-300 voltmeter to two binding posts. Turn on the receiver. *Presto!* You read filament voltage (AC or DC), plate current and plate voltage!

Absolute 5-Day Money-Back Guaranty!

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