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FIFTEEN
CENTS

*New Curves Reveal
Screen Grid Mysteries*

RADIO

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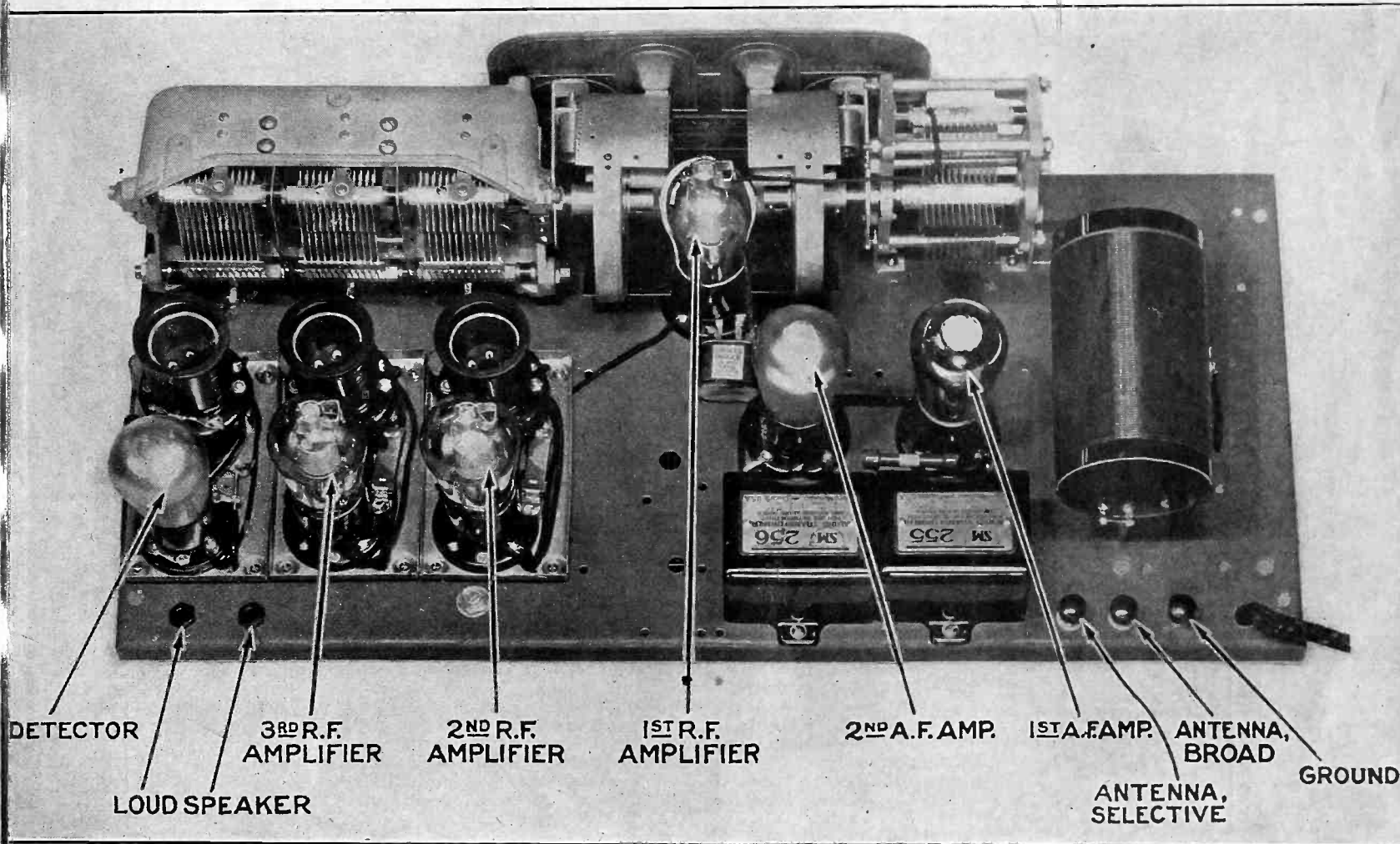
WORLD

*Two B Eliminators
Advised for Each Set*

*Rating in Horsepower
Proposed for Stations*

The First and Only National Radio Weekly
334th Consecutive Issue—Seventh Year

NEW SCREEN GRID SIX!



Here is a receiver remarkable in its appeal to eye, ear and purse—the new S-M Shielded Grid Six, No. 720, designed by McMurdo Silver. See article on pages 3, 4 and 5.

STATIONS SYNCHRONIZE SUCCESSFULLY ARE CHAIN PROGRAMS A NUISANCE?

SM

S-M LEADERSHIP means Better Radio



IN four short years Silver-Marshall, Inc. has forged up from obscurity to the position of dominant leadership in the radio parts and kit field—interesting, you say, but just what does that mean to you?

S-M leadership means just one thing—better radio for less money. Ask any one of the thousands of listeners and experimenters who have used and recommended S-M into supremacy. They'll all tell you that S-M leadership means better radio at less cost. And S-M will lead again in 1928 and 1929 by giving you new developments that enable made-to-order or home-built radio sets to equal in external finish the finest factory productions, parts that place the performance of such sets utterly beyond competition, and, thru knock-down kits, radio receivers that will consistently outperform all ready-made sets at anywhere near their amazingly low prices.

New S-M Offerings Now Ready

Never has there been a design which so perfectly fulfills the requirements of the setbuilder as does the new Silver-Marshall 720 Screen Grid Six—successor to the famous Shielded Grid Six of such unparalleled popularity during early 1928. The 720 Screen Grid Six is a six-tube dual control screen grid receiver using three screen grid tubes in individually copper-shielded r. f. stages and two audio stages with the marvelous new S-M transformers—a set absolutely unequalled at the price.

On a summer evening test in Chicago, 41 stations (two on West Coast) were logged, 5 of which (in N. Y., N. J., Fla., Ga., and La. respectively) were on adjacent channels (only 10 kc. apart) to locals then on the air. The 720 Kit, complete without cabinet, is priced at \$72.50. Custom-built complete in cabinet as illustrated, it costs \$102.00.

And at \$51.00 S-M offers the 740 "Coast to Coast" Screen Grid Four—a kit that is a revelation in four-tube results. Type 700 metal shielding cabinet as illustrated is but \$9.25 additional, for either set, finished in duo tone brown; it marks a new standard of style and distinction.

The Sargent-Rayment Screen Grid Seven, type 710, is the wonder set of the season, and S-M offers, exclusively, the approved kit at \$120.00. It is complete with aluminum shielding cabinet and will bring in 100 stations on any average evening.

The S-M "Round the World" Short Wave sets are the trimmest, most efficient short wave sets yet, priced from \$36.00 to \$51.00 complete with shielding cabinet. New S-M condensers are marvels of rigidity and flexibility in Universal single, and triple types. The 685 Public Address Unipac—the first really high-powered amplifier yet offered—is priced at only \$160 wired, or \$125 for the kit. It will turn out music or voice that can be heard by 1000 to 10,000 people. Other Unipacs and Power Supplies take care of every power need.

Of course, the most startling audio development of the last two years would logically come from S-M laboratories, as it did two years ago. The new Clough audio transformers were deservedly the sensation of the June radio trade show. In open comparative tests, S-M 255 and 256 (\$6.00 transformers) have excelled the performance of all competitive types tested, regardless of cost. The 225 and 226 transformers at \$9.00 each simply leave the most skeptical marveling.

These and many other startling new S-M parts leave small wonder at S-M leadership. They prove that you can get the best radio for the least cost from S-M.

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

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..... No. 1. 670B, 670ABC Reservoir Power Units

..... No. 2. 685 Public Address Unipac

..... No. 3. 730, 731, 732 "Round-the-World" Short Wave Sets

..... No. 4. 223, 225, 226, 255, 256, 251 Audio Transformers

..... No. 5. 720 Screen Grid Six Receiver

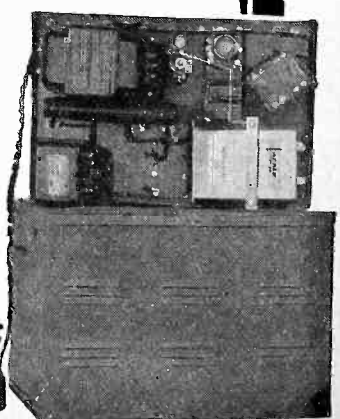
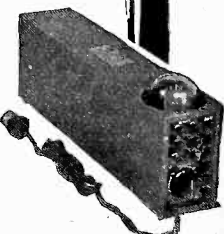
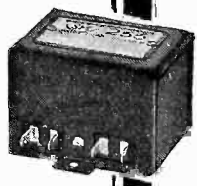
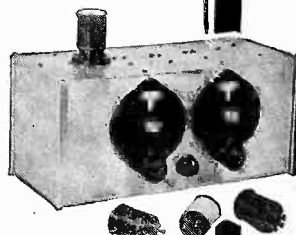
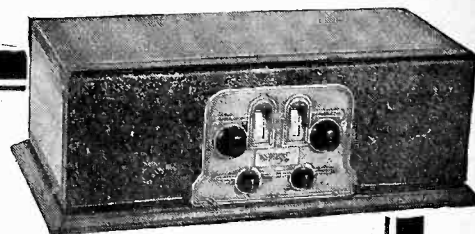
..... No. 6. 740 "Coast-to-Coast" Screen Grid Four

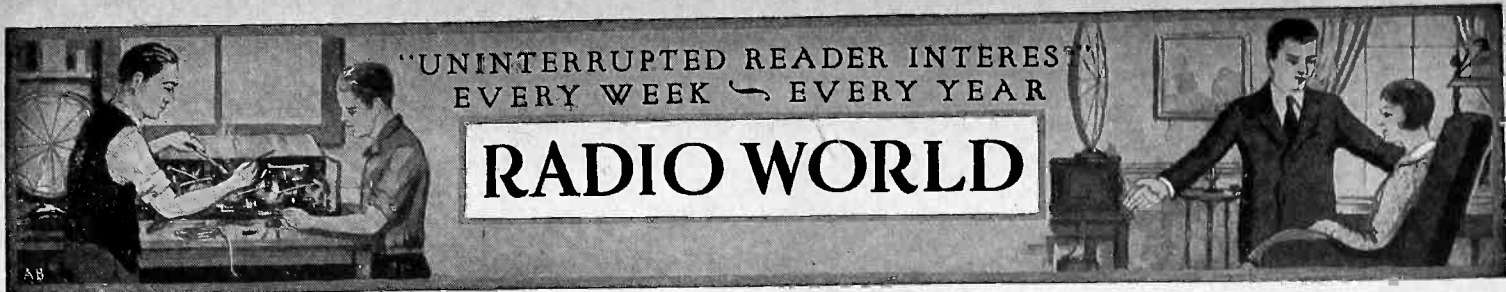
..... No. 7. 675ABC Power Supply and 676 Dynamic Speaker Amplifier

..... (50c) Sargent-Rayment Instruction Booklet

..... Name

..... Address





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McMurdo Silver's Latest

A REMARKABLE AND SENSITIVE DEVELOPMENT

The 720 Screen Grid Six

By *McMurdo Silver*
 Head of Silver-Marshall, Inc.

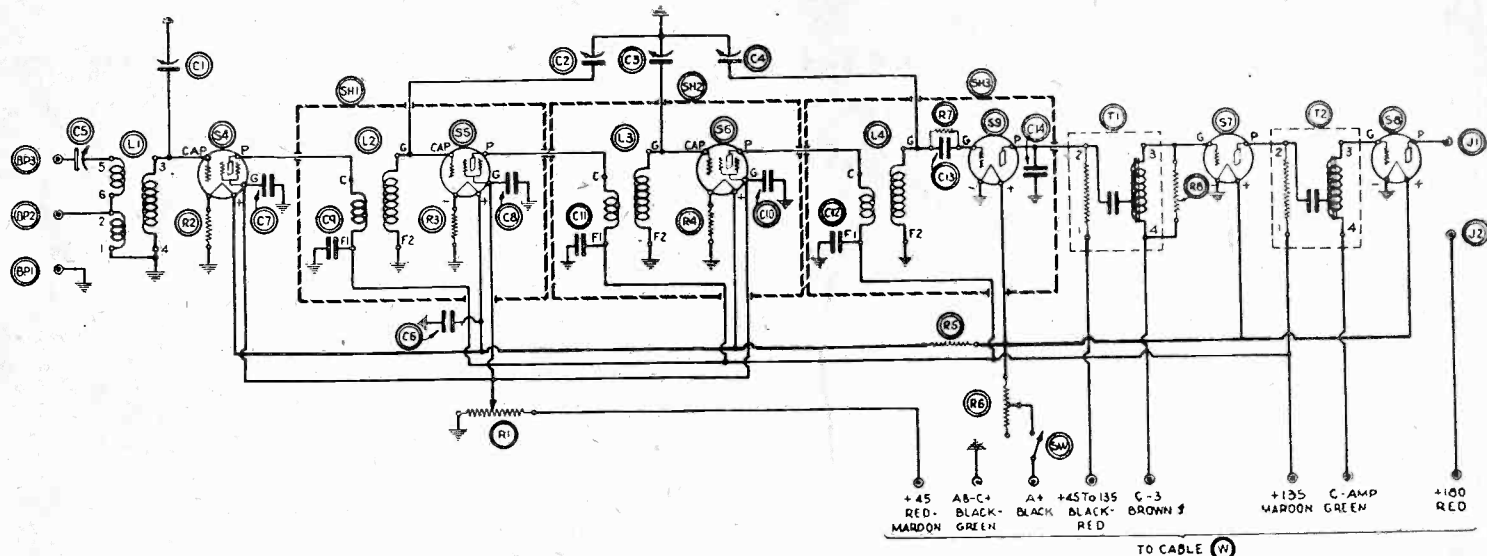


FIG. 1

THE SCHEMATIC DIAGRAM OF THE SM-720 SCREEN GRID SIX, McMURDO SILVER'S LATEST CIRCUIT, PUBLISHED HEREWITH FOR THE FIRST TIME. THE PARTS ARE CODED AND THE SAME CODE REFERENCE OBTAINS IN THE LIST OF PARTS. NEXT WEEK THE PICTURE LAYOUT WILL BE PUBLISHED WITH THE SAME CODE REFERENCES.

[Presented herewith for the first time is the new S-M 720, a screen grid, shielded six tube tuned radio frequency receiver, designed by McMurdo Silver, of Silver-Marshall, and constituting one of the most exceptional designs to emanate from the brilliant scientific mind of this design-master. The circuit uses three TRF stages of screen grid amplification, a detector tube and two stages of Clough auto-transformer coupling, with options as to which power tube to use as output. Selectivity of from 10 to 15 kc. is provided, tuned stages are individually copper-shielded, two tuning dials (plus a selectivity booster in one optional form of antenna coupling) and a potentiometer in the first audio for volume control, are used. The complete kit is available in factory-sealed cartons, list price \$72.55. Type 700 shielding cabinet, \$9.25 list price extra. Total of both \$81.80 list price.—EDITOR.]

PART I

A RECEIVER of such low cost, compared with the results obtained, as to intrigue every one interested in the construction of a superb radio receiver is the new Screen Grid Six. Why the receiver is outstanding I shall relate, with special and detailed emphasis on the qual-

ity and degree of amplification, at both radio frequency and audio frequency levels.

So that first you will have a brief word picture of the receiver, the following epitome is offered:

There are three high-gain radio frequency stages, using screen grid tubes, a detector tube stage and two steps of Clough transformer-coupled audio. There are four tuned circuits, the first, or input

circuit, being separately tuned, and the remaining three jointly tuned.

The results obtained are 10 to 15 kc. selectivity, a quite regular reception range of 2,000 miles, by proven demonstrations, a closer approach to realism than hitherto obtained, and the stability of operation due largely to the individually copper-shielding of the tuned stages.

Fine Eye Appeal

Add to these points a standardized assembly cautiously designed to present the most attractive appearance, and you have the situation in a nutshell.

But let us crack open the shell with the clenching curiosity with which all of us concerned with radio as a life work, side line or pastime are endowed.

From a mere examination of the circuit diagram and photographs the Screen Grid Six may not strike any one as unusual, although at this writing there is no known ready-made set incorporating the full advantages of screen grid RF amplification.

If there is anything at all unusual about the set, it is the fact that the three RF tubes have been made to average about 250 times the amplification obtained from this same number of tubes in an ordi-

(Continued on next page)

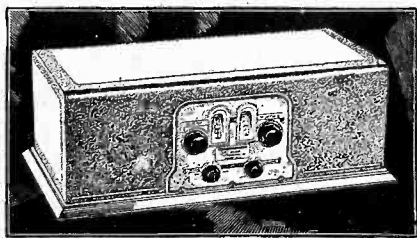


FIG. 2

The front view of the completed receiver, in a type 700 shielding cabinet. Antenna tuner knob is at left, RF tuner knob at right, selectivity booster for DX at lower left, volume control at lower right.

41 Stations Heard Loudly On Hot Night

The S-M 720 Screen Grid Six was operated one warm June evening in a typical residential section a few miles from Chicago's twenty-odd stations. A 35-foot antenna was all that was used. Distant stations gave practically local volume. Here is a list of the 41 stations tuned in, with location, right-hand dial setting (left one may vary a trifle) and frequency in kilocycles:

Station	Location	Right Dial	Kc.
WNBA	Forest Park Ill	1	1440
KSTP	St. Paul, Min.	4	1360
WJKS	Gary, Ind.	6	1290
WGES	Chicago	8	1240
WOK	Chicago	12	1190
QJAZ	Chicago	19	1140
WTAS	Elgin, Ill.	18.5	1090
WENR	Chicago	23	1040
WTMJ	Milwaukee	24	1020
KMOX	St. Louis, Mo.	26	1000
WHT	Chicago	28.5	980
KDKA	Pittsburgh	31.5	950
KFAB	Lincoln, Nebr.	32.5	940
KOA	Denver, Colo.	34.5	920
KFQB	Ft. Worth, Tex.	36	900
WSM	Nashville, Tenn.	37	890
WLS	Chicago	32	870
WEBH	Chicago	47	820
WDAF	Kansas City	47.5	810
WOC	Davenport	50	800
WGY	Schenectady	51	790
WBBM	Chicago	54	770
KWKH	Shreveport, La.	55	760
WTAM	Cleveland	57	750
WCCO	Minneapolis	59.5	740
WGN	Chicago	62	720
WOR	Newark, N. J.	63.5	710
WLW	Cincinnati	65	700
WQJ	Chicago	71	670
WJZ	New York	73	650
KRLD	Dallas, Texas	75	650
KFI	Los Angeles	77	640
WSB	Atlanta, Ga.	79	630
WCFL	Chicago	82	620
WEAF	New York	84.5	610
KTHS	Hot Springs	86.5	600
WOW	Omaha, Nebr.	89	590
WFLA	Clear Water, Fla.	92	580
KYW	Chicago	95	570
WHO	Des Moines	98	560
KSD	St. Louis, Mo.	100	550

[Both dials tracked very closely, but the input tuning circuit may be a little "off" in some instances, due to different fundamental wavelengths of antennas used. Since this log was compiled a much larger number of stations was tuned in at the same location.]

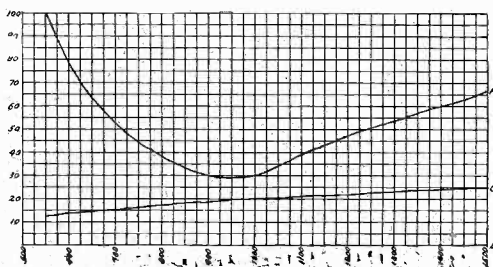


FIG. 3

Fig. 3—Curve A shows the voltage step-up of the tuned antenna input. Curve B shows an untuned antenna input. Curve C is the measured voltage amplification of one individual stage.

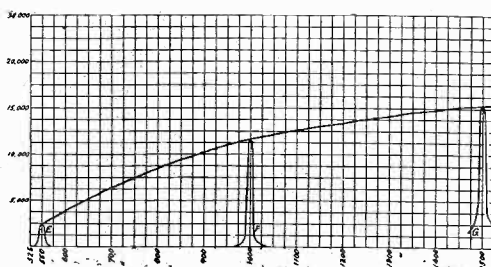


FIG. 4

Fig. 4—Curve D is the over-all voltage amplification of the three tuned stages following (but not including) the antenna stage. E, F and G are the selectivity curves of the three individual stages ending with the detector.

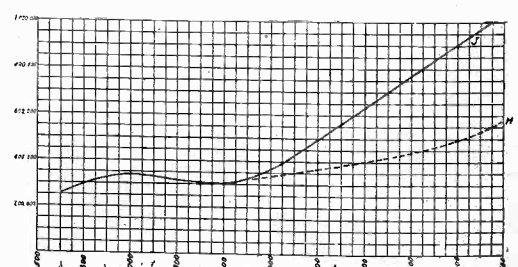


FIG. 5

Fig. 5—Curve H represents the actual performance of the radio frequency channel of the receiver. The dotted line shows the flattening effect of the volume control on the high frequency amplification use. The abrupt rise is a vice as it brings instability or kills signals entirely, so curve H represents a distinct practical gain over curve J.

2,000-Mile and 10 to 15 kc. S

Outstanding Features of Silver's Latest Circuit

The predominating features of the new S-M 720, the extraordinary six-tube receiver designed by McMurdo Silver, follow:

- 10 to 15 kilocycle selectivity.
- Regular receiving range, 2,000 miles.
- Realistic reproduction, due to the new Clough auto-transformers.
- Moderate cost of factory-sealed kit.
- Three stages of screen grid RF, each stage individually copper-shielded.
- 40 to 100 stations a night on a 30-foot antenna, a station for almost every degree of the dial.
- New low-resistance, almost ideal RF coils.
- Stability of operation.
- Versatility of power tube choice.

(Continued from preceding page)

nary set, while the audio gain has been about doubled.

How this is done is quite easily seen by taking as a typical example a representative ready-made six-tube set costing about \$150.00. In this common type of set the first RF tube has its grid circuit connected across a small RF choke directly in the antenna circuit, across which is developed the signal voltage.

Other Set Not Much Good

This type of coupling gives no voltage step-up between antenna and first RF tube, and does not contribute in any way to selectivity.

The first tube, with the TRF transformer that follows it, in such a factory-made set, shows an average amplification of less than 10 times between 200 and 550 meters. This figure is quite generous. Two additional RF tubes, with two more TRF transformers, give a gain of 10 per each stage. Thus, $10 \times 10 \times 10 = 1,000$, shows the amplification between antenna and detector grid circuit in the factory-made set.

Following the detector are the audio tubes, a UX201A and a UX112A, having mus of about eight, operating with trans-

formers, which, while deficient on base amplification, show an average ratio of 1-to-3. Thus, the AF gain is $3 \times 8 \times 3 \times 8 = 576$, though from a sensitivity angle only the RF gain need be considered.

Now, compare the results. For the Screen Grid Six a tuned antenna input circuit was designed having the very best possible characteristics which could be attained in practice. This circuit consisted in final form of a very low resistance coil having 39 turns of No. 20 enameled wire upon a threaded bakelite form 4 inches long and $2\frac{3}{4}$ inches in diameter.

Coil Well Designed

The values of 3.3 ohms RF resistance at 550 meters and 11.5 ohms at 200 meters, obtained upon this coil tuned by a .00035 mfd. condenser, represent an unusually good circuit.

The coil itself has a "figure of merit" practically double that of the best commercial coils found on the open market.

This input coil, L1, is tuned by a single condenser, C1, actuated by the left-hand drum, D1. A representative antenna of 400 mmfd. capacity, 25 ohms resistance and 28 micro-henries inductance was coupled to the input coil through an optional small primary coil of 20 turns, or a

Steady Range Selectivity Attained

large primary of 60 turns in series with a 75 mmfd. junior condenser, C5, which was used to regulate selectivity.

What the Curves Show

Curve A of Fig. 3 shows that the voltage step-up provided by this tuned antenna input circuit varies from 64 at 200 meters (1,500 kc.) to 28 at the middle of the broadcast band and rises to 100 times at 550 meters. As 550 meters is where the greatest step-up is always needed, for the amplification of any practical RF amplifier always falls off at high waves, as will be shown, this reversed characteristic flattens the general amplification curve by the gain method.

The shape of the first stage curve is not wholly ideal, but there is certainly no comparison between the voltage amplification that can be had from this circuit with its one additional tuning dial, as compared to curve B of Fig. 3. (Curve B, representing the voltage amplification of good untuned antenna coupling choke, is hardly distinguishable from the base line of the curve of Fig. 3!)

The dip in the center of curve A shifts with different size antennas and may further be shifted by adjustments of the midget antenna coupling condenser, C5, so that it is seldom necessary to operate the receiver with as low a voltage step-up in the antenna coupler as is shown by the lower bend of curve A.

This dip is shown as it would be were condenser, C5, left untouched in tuning throughout the broadcast band, which is, obviously, not an obligatory condition.

Three Circuits Identical

The antenna input circuit is followed by three identical tuned circuits, each housed in individual copper shielding cans SH1, SH2, SH3. These circuits employ small plug-in inductances L2, L3, L4, the secondaries of which consist of 98½ turns of No. 29 enameled wire wound upon a threaded moulded bakelite form 1½ inches in diameter and 1½ inches long. Two of these tuned circuits feed the two remaining screen grid amplifier tubes, S5 and S6, while the third circuit feeds the detector tube S9.

The actual measured voltage amplification of one individual stage is shown in Curve C, Fig. 3, and is seen to vary from 14 per stage at 550 meters to 30 at 200 meters.

While this amplification may seem very low for a screen grid RF amplifier stage, it must be borne in mind that the high amplification that may be obtained from them in practice—the maximum voltage gain which can be had from these tubes in the broadcast band with practical circuits—will vary between 30 and 65 per stage, and that in order to obtain such amplification selectivity must be sacrificed.

In the Screen Grid Six, this sacrifice purposely has not been made. The effective amplification of the three shielded RF amplifier stages has been purposely held so that selectivity would be high.

Antenna Capitalized

The over-all voltage amplification of the three screen grid stages, neglecting the antenna coupler, is shown by Curve D of Fig. 4, and will be seen to vary from 2,500 times at 550 meters to 15,500 times at 200 meters (Curve D is simply

Wiring Easy By Blueprint

The wiring of the S-M Shielded Grid Six, the new receiver developed by McMurdo Silver, head of Silver-Marshall, Inc., is made easy indeed by following the official blueprint, with its clear, explicit exposition of every part, lead, wire and connection, and revealing the simplest, most attractive method of doing the wiring.

Besides the great help of the blueprint—which of itself is a fund of information on the circuit—there is an official eight-page instruction booklet on the building of this most remarkable receiver. In addition to this there is a clear, large schematic wiring diagram.

Therefore anybody who wants to build this set may do so by following the blueprint, and of course it is a good plan to read the fascinating constructional details so carefully set forth in the booklet, as well as consulting the big schematic diagram to round out to extreme fullness one's knowledge of the theory and construction of this circuit.

the cube of Curve C of Fig. 3). It would, of course, be ideal if Curve D could be made flat, but, unfortunately, in a practically stable RF amplifier, this cannot be accomplished sufficiently effectively to justify the complications the effort would introduce.

The few means which have been devised for flattening out the curve have not been wholly successful, to judge from the popular desuetude into which they have fallen.

In the Screen Grid Six advantage is taken of characteristics of the antenna circuit in a unique way to flatten out gainfully the over-all amplification curve.

Note the relative selectivity of the three-stage RF amplifier unaided by the antenna circuit (which contributes a very high degree of selectivity in itself.)

Three measured selectivity curves for the three tuned circuits shielded in the small copper cans is shown by Curves E, F and G of Fig. 4, and it will be seen that they are in themselves ample to provide 10 kc. selectivity.

The addition of the selectivity provided by the antenna input circuit tends to sharpen up the "skirts" of Curves E, F and G, and result in a more rectangular curve, which, in turn, results in a clean "chop-off" of unwanted signals more than 10 to 15 kc. off resonance.

In Fig. 5, Curve H, is shown the calculated RF amplification from antenna to detector grid for the Screen Grid Six.

This amplification was calculated because of the practically impossible task of measuring the over-all gain of such a sensitive receiver.

The curve is based upon the actual measured amplification for individual amplifier stages, and corresponds to Curve D multiplied by Curve A.

As regeneration is not seriously present (Continued on page 18)

List of Parts Follows Code of Identity

The number of items is at left, the code numbers as shown in the diagram come next, then the description, and finally the list price.

1—B	—S-M 701 Universal pierced chassis....	\$3.00
1—E	—S-M 809 dual control escutcheon....	2.75
1—D1	—S-M 806L (left) vernier drum dial....	2.50
1—D2	—S-M 806R (right) vernier drum dial..	2.50
1—C1	—S-M 320R .00035 mfd. Universal condenser	4.00
1—C2-C3-C4	—S-M 323 .00035 mfd 3-gang condenser..	13.50
1—C5	—S-M 342B .000075 mfd. midget cond..	1.75
3—SH1-SH-2 SH3	—S-M 638 copper stage shields @ \$1.50	4.50
1—L1	—S-M 140 antenna coil	3.00
3—L2-L3-L4	—S-M 132A plug-in RF transformers @ \$1.25	3.75
3—S1-S2-S3	—S-M 512 5-prong tube sockets @ \$0.60	1.80
5—S4-S5-S6-S7-S8	—S-M 511 tube sockets @ \$0.50	2.50
1—T1	—S-M 253 first stage AF transformers..	6.00
1—T2	—S-M 256 2nd stage AF transformer...	6.00
1—W	—S-M 708 10-lead, 5-ft. connection cable	1.75
1—	—S-M 818 hook-up wire (25 ft. to carton)50
1—R1	—Yaxley 53000-P 3,000 ohm junior potentiometer	1.25
1—SW	—Yaxley 500 switch attachment40
2—J1-J2	—Yaxley 420 insulated tipjacks @ \$0.125..	.25
3—R2-R3-R4	—Carter RU10, 10 ohm resistors @ \$0.2575
1—R6	—Carter AP-6, 6 ohm sub-base rheostat..	.50
1—R5	—Carter H1½, 1½ ohm resistor25
1—C6	—Potter No. 4 type, 1 mfd. bypass cond..	1.00
6—C7-C8-C9-C10-C11-C12	—Sprague or Polymet ¼ mfd. midget condensers @ \$0.75...	4.50
1—C13	—Polymet .00015 mfd. grid condensers with clips50
1—C14	—Polymet .002 mfd. bypass condenser..	.40
1—R7	—Polymet 2 megohm grid leak50
1—R8	—Durham .15 megohm resistor with leads50
1—S9	—Naald 481XS cushioned tube socket.	.65
3—BP1-BP2-BP3	—Moulded binding posts consisting of 8/32 screw, nut, and moulded top @ \$0.1030
1—	—Set hardware as listed below:	1.00
		\$72.55

* * *
[The above list of parts is the official one, specially verified and corrected, so that all who purchase the kit will know exactly what they should receive.]

New Curves Hidden Secrets of

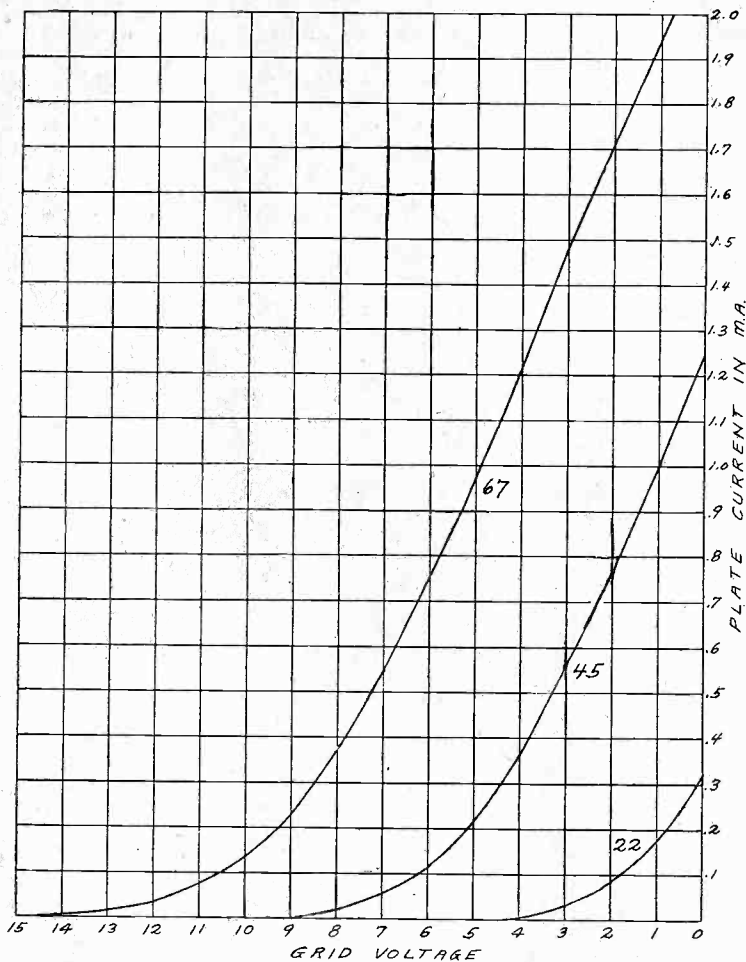


FIG. 1
GRID VOLTAGE, PLATE CURRENT CURVES OF A
SCREEN GRID TUBE WITHOUT LOAD IMPEDANCE.
THESE ARE STATIC CURVES

STATIC curves of vacuum tubes are usually taken without any load on the tube. Since a tube will never be operated in this manner such curves are not so instructive as dynamic curves but they do give an indication of the capabilities of the tube, hence they are interesting.

The three curves shown in Fig. 1 were taken on a screen grid tube operating with 3.3 volts on the filament and with negligible resistances in the grid and plate circuits. The resistance in the grid circuit was only that of the 400-ohm potentiometer used to adjust the grid bias and this for most of the readings was considerably less than 400-ohms. The resistance in the plate circuit was only that of the millimeter and the dry cell batteries, a total of less than 50 ohms. Hence the curves are the characteristics of the tube itself.

Curves Are Regular

The curves are taken only on the negative side of the grid voltage axis, for the tube should never be operated with a positive bias.

The plate voltage for all the curves was kept at 130 volts. The lowest curve at the right is that obtained when the screen grid voltage was kept at 22 volts, the middle curve that obtained with a screen grid voltage of 45 and the highest curve that obtained with a screen grid voltage of 67 volts.

All the curves are regular and in every respect similar to those obtained with three-electrode tubes. The slope of the curves, which indicates the amplification, is not as high as was expected. On the middle curve at a bias of $1\frac{1}{2}$ volts the slope is 235 microamperes per volts. The slope of the highest curve at a bias of 4 volts, where it is greatest, is 253 microamperes per volts. These slopes are the respective mutual conductances. The rated value is 300/850,000, or 353 microamperes per volt, or micromhos. The difference might be due to a lower amplification constant of the tube used or to a higher internal plate resistance.

It does not seem that the use of 22 volts on the screen grid is conducive to much amplification. Suppose the grid bias is adjusted to $\frac{1}{2}$ volt. The slope at this point for a signal amplitude of $\frac{1}{2}$ volt is only 142 micromhos. Besides there is considerable curvature, so that the tube would detect.

With 45 volts on the screen grid good amplification is indicated with any bias from zero to about 4 volts. If the bias is obtained by tapping a 20-ohm ballast in the center the bias is 1.35 volts, assuming that the voltage of the filament battery is 6 volts. At this point the mutual conductance is 235 micromhos. If the grid return is connected to minus A the bias is 2.7 volts. At this point the mutual con-

Under Given Conditions Negative
is Critical to .1 volt—Exploration
Knees and Heels—How

By J. E.
Technical

ductance is 210 micromhos. Thus as far as these curves show there is little difference between the amplification of the two returns of the grid. The lower bias favors the amplification and the higher draws less plate current.

At 2.7 volts bias on the highest curve the mutual conductance is 245 micromhos. This is not far from the maximum on that curve. Therefore when the screen grid voltage is 67 volts the grid return should be to the negative end of the filament battery. This makes the simplest connection. The curve for 67 volts screen voltage shows good amplification from zero to 7 volts bias.

These conclusions do not hold when there is considerable resistance in the plate circuit for this would change the shape of the curves.

Dynamic Curves

In Fig. 2 is shown a set of four curves taken on the same screen grid tube when a resistance of 1 megohm was connected in plate circuit. These curves give the relation between the grid bias and the voltage developed across the plate resistor. The filament and applied plate voltages are the same as in the case of the grid voltage, plate current curves in Fig. 1. The four curves are for four different screen grid voltages as indicated.

Although these curves were taken by static means they are also dynamic since the load was a pure resistance. For high radio frequencies the curves do not represent the performance of the tube because at these frequencies the load impedance could not be considered as a pure resistance. They apply for practically all audible frequencies.

The output voltages were measured with a vacuum tube voltmeter as explained in the August 11th issue of RADIO WORLD, using a -50 tube with 450 volts on the plate.

The first curve which appears in the lower right corner of the graph is particularly interesting. This curve was obtained when the screen grid was connected to the positive side of the 6 volt filament battery. While this curve is labeled 6 the voltage on the screen grid relative to the negative end of the filament was only 3.3 volts, the drop in the filament.

High Detecting Efficiency

Throughout this curve shows considerable curvature and therefore detecting efficiency. The curvature is greatest at about 1.35 volts bias. Thus the tube may be operated as a grid bias detector by connecting the grid return to the mid-tap of the 20 filament ballast. This is very

Uncover Screen Grid Tubes

and Bias for Amplification
 reveals Ample Detection
 10 mu results

Anderson

itor

convenient as no special provision of a grid battery need be made, and no lead need be run from the screen grid to the plate voltage supply. The G post on the socket is simply connected to the F plus post on the same socket. The curvature on the curve is as great as that on any of the others. The only limitation is the voltage swing which is permissible. This is somewhat smaller for this curve than for the others.

If this arrangement is to be utilized for amplification it may be done without much waveform distortion by using a bias less than 1/2 volt. For example, if the bias is made 1/4 volt a signal amplitude of this magnitude is permissible and the amplification will be nearly 20 times. When radio frequency is involved a little waveform distortion is of no consequence but unfortunately then the amplification will not be that indicated, for the impedance is no longer one megohm.

It is clear that if the screen grid voltage is raised a little the (6) curve will move to the left. The points of best detecting and amplification efficiency will be shifted to the left also. This shifting may be done by putting part or all of the ballast in the positive leg of the filament and connecting the screen grid to plus A. If all of the ballast is put in the positive leg the screen grid voltage will be six volts but then there will be no grid bias, and more will be needed both for amplification and detection. Other curves will be taken with the object of finding the best combination.

Other Screen Grid Voltages

The upper portions of curves (22), (45) and (67) were published last week (August 11th issue) under nearly the same conditions. While the same batteries were used in taking those curves as the curves in Fig. 2, the voltages were slightly different, due to temperature differences. The plate voltage is 130 volts for all the curves in Fig. 2 and the screen grid voltages are those indicated.

There are several interesting regions in each of these curves. One is at the lower bends. Curve (22) shows high detecting efficiency at 5 volts negative bias. A large permissible voltage swing is indicated, thus giving large undistorted output voltages, provided that the input is high. The (45) curve shows high detecting efficiency at about 10 volts bias, and the (67) curve at about 15 volts.

Each of these curves shows a double bend region where high detecting efficiency is possible. But at these points the input is quite limited. Each curve also has an upper bend where the detecting efficiency is high. The point of adjustment on any bend is where the curvature is greatest.

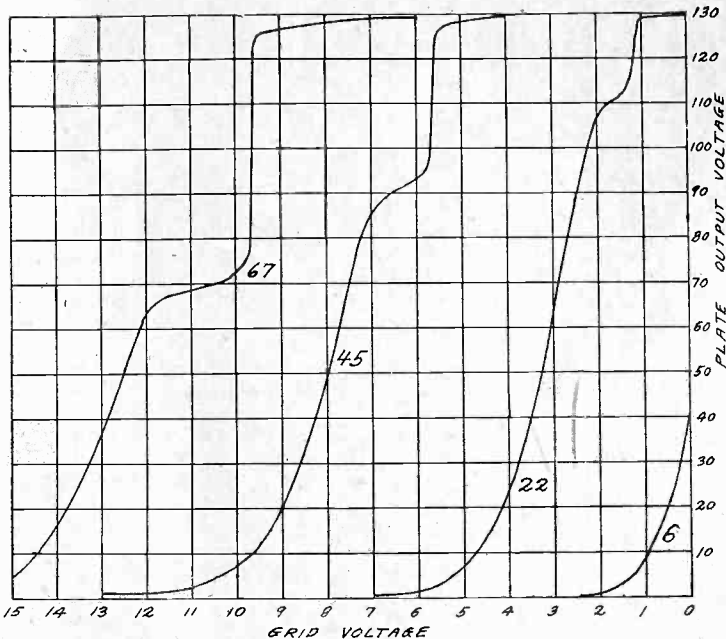


FIG. 2
 GRID VOLTAGE, PLATE OUTPUT VOLTAGE OF A SCREEN GRID TUBE WORKING INTO A RESISTANCE OF ONE MEGOHM

Each curve also has two regions in which amplification is possible. Thus on the (22) curve with a bias of 3 volts the curve is relatively straight and the slope is great. The amplification is 48.2. At 7 1/2 volts on the (45) curve the amplification is 42. At 12 1/2 on the (67) curve the amplification is 26.5.

Most Interesting Region

Perhaps the most interesting region in each curve is the straight vertical portion of each curve just below the upper knee. The output voltage drops abruptly as a waterfall. In fact on the (67) curve the drop is practically vertical. On the other curves there is an appreciable slope.

Enormous amplification is indicated at these points. On the (22) curve at 1.15 volts bias the amplification indicated is 90 with a signal amplitude of only .05 volt. At 5.65 bias on the (45) curve the amplification is estimated at 240. On the (67) curve at 9.6 volts it is still greater. But these values cannot be taken too seriously, for the grid voltage readings were only taken .25 volts apart and the drop in the curves take place inside .1 volt. A much more sensitive voltmeter than that employed would have to be used in taking the curves and a much finer voltage adjuster.

Maximum Obtainable

The maximum voltage amplification obtainable with a screen grid tube is the product of the mutual conductance and the load impedance. Thus if the mutual conductance of the tube is 350 micromhos and the plate load resistance is 1 megohm, the voltage amplification possible is 350.

It is doubtful whether the steep portions of the curves can be utilized in a practical receiver because of the extremely critical grid voltage adjustments necessary. The most practical adjustment would seem to

be that indicated by curve (22) with 3 volts bias.

The curves in Fig. 2 hold only for the screen grid tube when the applied plate voltage is 130 volts and the load resistance is one megohm. If the applied plate voltage is higher the curves will move to the left a little and they will go considerably higher before they flatten out. In any case they flatten out just before the voltage drop in the output resistor is equal to the applied voltage.

Lower Resistor

If the plate coupling resistance is lower, the amplification will not be so high at any point, and the detecting efficiency will not be as great. But both the amplification and the detection will be more nearly equal for all frequencies in the audible scale.

Different Results

It must be remembered that all the curves in Fig. 2 were taken with 1 megohm in the plate circuit. The curves will not have the same shape when lower values are used. That is they would not coincide if two sets were plotted to the same scale on the same graph. This is because the internal plate resistance of the tube would bear a different ratio to the load resistance. The slopes would not be so great, indicating lower amplification, and the effective voltage on the plate would be higher.

More Curves

Curves will be taken by the same method on the same tube with plate resistors of .5 and .25 megohm so that the curves may be compared. Such curves would be useful because many times it is desired to hook up a circuit with these values. Special type or circuits will also be developed in which use is made of these curves.

A Set with Practical R

By Gera

Full-Blooded Na

Two Separate B Units End Motorboating

It is now fully understood that motorboating and many other troubles in resistance coupled amplifiers are caused by the common impedance in the plate circuits, or by the impedance of the B battery eliminator. Harsh-sounding output is also often caused by the B battery eliminator, especially when the eliminator has not been designed to operate with high current drain such as is required when a power tube of the -50 type is used.

There are many methods available reducing the value of the common impedance. One is to connect large condensers across the voltage divider. But ordinarily this method is not practical because it requires too large condensers. Another method is to power the receiver with a storage battery. This is the best of all from the quality point of view, but most persons object to the use of such a battery because it requires constant attention.

The next best thing is to use fresh dry cell batteries. But here the question of replacement deters many. Also, when high voltage and a tube of the -50 type are used, B batteries throughout are out of the question.

Separate Voltage Supply

There is really only one way of eliminating the common impedance, and that is to use a separate voltage supply for each tube in the circuit. This may be done with either batteries or with battery substitutes.

But it is admitted that this is no more a practical solution than the use of very large by-pass condensers. Still it is more effective and it deserves consideration. If it is not practical to use a separate battery or a separate battery eliminator for each tube in the circuit it is practical to use two eliminators and distribute the load between them so that the common impedances which are left do not cause any trouble.

It is common difficulty with nearly all eliminators that they cannot deliver the

power required. They are rated in terms of voltage, not power. The regulation of these devices is so poor that the instant a considerable load is thrown on them the voltage drops badly. This simply means that the internal impedance, or resistance, is high. And it is just that which causes motorboating.

Now there are thousands of B battery eliminators on the market and in use which are rated at 135 to 180 volts when moderate currents are drawn from them. These small eliminators may be obtained for a small price.

Small Eliminators Useful

Although these small B battery eliminators cannot deliver enough power for all the tubes in the high quality sets in use today, they can be utilized to good advantage in a resistance coupled amplifier to power some of the tubes. For example, one of them might power the detector and the first audio amplifier. The same eliminator may also be used to supply one or two radio frequency tubes. Another B battery eliminator of greater current capacity and higher voltage then may be used to power the power tube and one of the resistance coupled tubes.

The common impedance has no significance in the radio frequency part of the circuit, for the by-pass condenser used across the voltage divider is large enough to render the impedance to radio frequency currents negligible. Then only the detector and one audio tube remain on the small B battery eliminator. Although the common impedance at low audio frequencies is considerable, there is not enough feedback from the first audio tube to the detector to cause much trouble. And the feedback will be in reverse phase so that the amplification is reduced by a small amount, but this never causes any appreciable distortion. Only at the extremely low frequencies, sub-audible, is it possible for the feedback to be in phase to increase the amplification by a small amount. If the time constant of the resistance coupler is high even this will not occur.

Power Supply for Power Tube

When the detector and the first audio tube have been powered by one B battery eliminator there remain only two tubes to be taken care of by another power supply. These two tubes will have a common impedance, but it won't be high for it is assumed that the power B battery eliminator will have good regulation.

QUALITY of a high order may be obtained either with resistance or with transformer coupling in the audio amplifier. But if the quality obtained with the transformer coupled circuit is to be comparable with that obtained with resistance coupling the transformers must be of the very highest grade.

Resistance coupling units take very little room and they are not expensive. If metallized resistors and good mica coupling condensers are used, little trouble will be experienced with the amplifier and the results will be good provided that suitable resistance and capacity values are used in the circuit.

Motorboating Possible

It is true that motorboating is often encountered in resistance coupled amplifiers. It is also met in transformer coupled circuits of the same quality and of the same overall amplification in the audio channel. It may not be an actual oscillation in the transformer circuit but it usually appears as a frequency distortion. In such events very high amplification peaks may result.

Another factor against the resistance coupled circuit is that one more tube is required to get the same amplification. But this is not serious, for tubes are not expensive either to buy or to operate. And if high mu tubes are used in the circuit the amplification will be considerably higher. In fact the amplification per stage in properly designed resistance coupled circuits is about 20, which is about the same as in a transformer coupled stage using a good transformer.

In favor of the resistance coupled circuit is the fact that a much lower plate current is required. This not only lengthens the life of the amplifier tubes but also that of the rectifier tube or tubes.

How to Banish Trouble

An object of this article is to show how trouble in a resistance coupled amplifier may be banished, or how it may be reduced to a negligible amount. The method to be described holds also for transformer coupling but it will be applied to a resistance coupled receiver which has been giving superb results for six months without the slightest trouble,

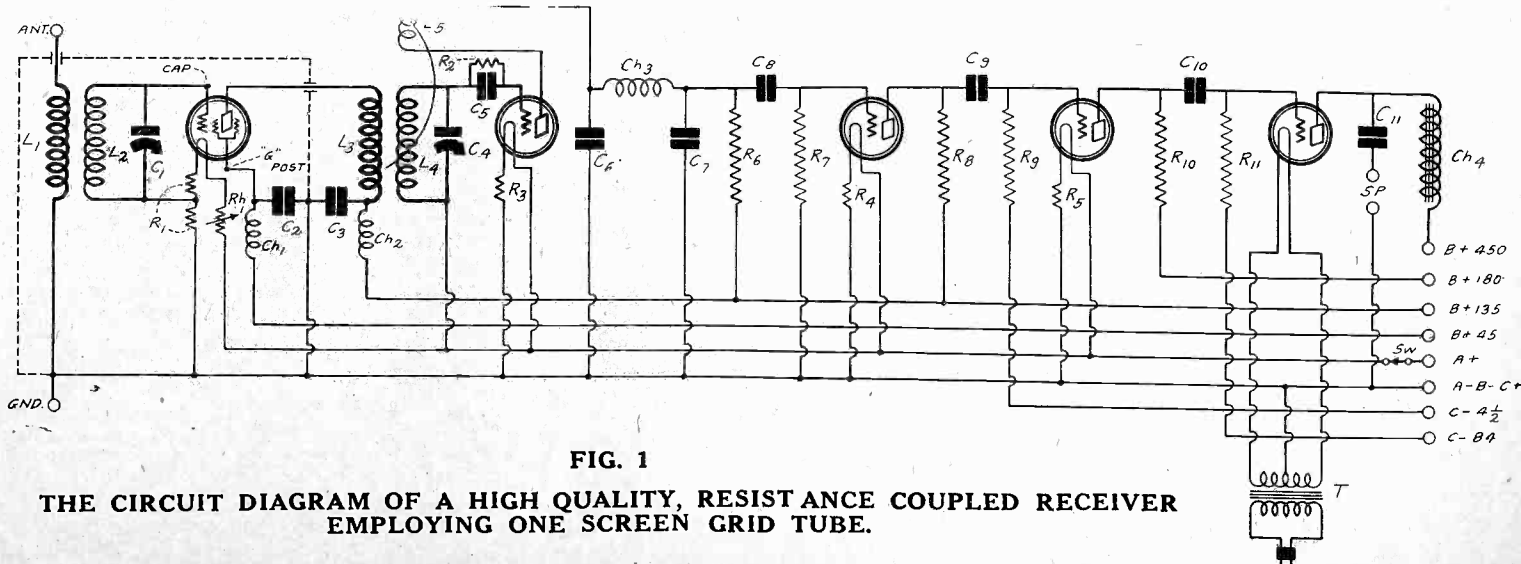


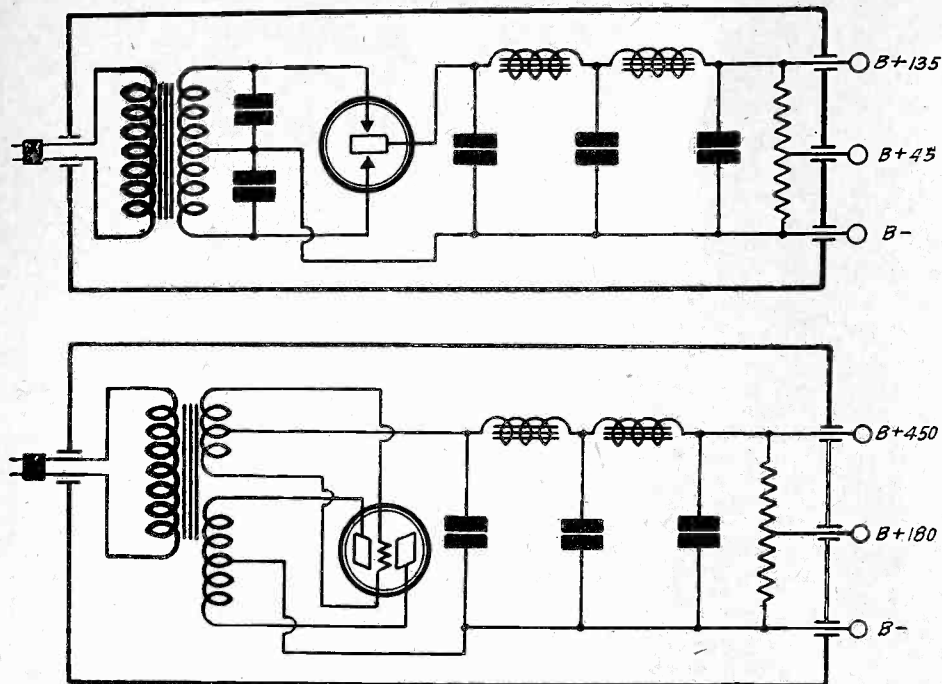
FIG. 1

THE CIRCUIT DIAGRAM OF A HIGH QUALITY, RESISTANCE COUPLED RECEIVER EMPLOYING ONE SCREEN GRID TUBE.

Distance Coupled Audio

rk

n Indian



AT TOP IS AN ELIMINATOR OF LOW OUTPUT VOLTAGE WHICH MAY BE USED FOR POWERING THE RADIO FREQUENCY, DETECTOR AND FIRST AUDIO TUBES (FIG. 2).

THE DIAGRAM (FIG. 3) OF A HIGH VOLTAGE B BATTERY ELIMINATOR WHICH MAY BE USED FOR POWERING THE LAST TWO TUBES IN THE QUALITY RECEIVER OUTLINED IN FIG. 1.

that is, trouble from motorboating and frequency distortion.

Fig 1 shows the circuit diagram of the receiver proper. It contains one stage of screen grid RF amplification. This stage is shielded, as shown by the dotted lines surrounding the first tube, the associated coils and condensers.

The circuit operates on an indoor antenna for local and medium distance stations. For distant stations it would be preferable to use an outdoor antenna, although it need not be so long and high as some antennas in use for TRF sets. It is important to run the antenna lead so that there is a minimum coupling between it and the three circuit tuner. An alternative is to shield the detector and its associated tuned circuit as well as the first stage.

The first tuning coil in the circuit L1L2 may be any good commercial coil the secondary of which is wound to cover the broadcast band with a .0005 mfd. variable condenser C1. R1 is a midtapped 20 ohm resistor, the purpose of which is to limit the filament current to .132 ampere when the filament battery voltage is 6 volts. The tap is used to provide a suitable grid bias for the screen grid tube.

A rheostat Rh1 is put in the positive leg of the filament for the purpose of varying the volume. It controls the RF amplification in the first tube. Its value may be 20 ohms.

Controlling Oscillation

The shielding is not always sufficient to prevent radio frequency oscillation in the circuit. Hence an 85 millihenry coil Ch1 is put in series with the lead to the screen grid and a condenser of .01 mfd.

or greater value is connected between the screen grid post and ground. This combination acts as a radio frequency filter which keeps the voltage on the screen grid constant.

A similar filter, Ch2 and C3, is connected in the plate lead. It acts to keep the RF voltage on the low side of L3 constant. Another object of these two filters is to prevent RF currents from getting into the voltage supply. This tends to reduce any possible hum when the regeneration is advanced, due to inter-modulation of RF currents with the residual ripple in the plate voltage. Only one of the chokes Ch1 and Ch2 should be in the same shield.

The three circuit tuner L3L4L5 may be any good commercial coil provided that the primary L3 has been wound for the screen grid tube. If it has not been, more turns may be added. There is no fixed number of turns which is best, for the number of turns depends on the size of the tubing and on the turns on the secondary L4. The secondary turns should be counted or estimated closely and then the primary should be made to contain about five-sixths as many turns. Cut one end of the primary, connect any kind of insulated wire in series with it and wind the extra turns in the same direction as those already on. Fine wire is better than heavy.

Turns may also have to be added to the tickler, but this depends on the tube used for detector. Only enough turns should be used on the tickler to make the tube oscillate at all settings of the tuning condenser C4.

(Constructional information next week.)

Speaker Return Made to Center of the Filament

The feedback from the last audio tube to the previous tube is such as to reduce the amplification by a small amount, just as in the case of the detector and first audio tube. Hence there should be no oscillation at any frequency, and only a negligible change in the frequency characteristic.

The use of a choke coil and condenser in the output circuit will reduce the amount of feedback from the power tube to the preceding tube to a small fraction, provided that the speaker is returned to the filament directly. Trouble may possibly occur at very low frequencies, but any sub-audible oscillation will be feeble and may be stopped by small changes in the couplers.—J. E. A.

These changes are based on the idea of reducing the amplification at the sub-audible frequencies, without at the same time reducing it on the low audio frequencies appreciably.

One of the simplest methods of doing this is to reduce the grid leak of the power tube input.

A better way, though not so easily effected, is to reduce the stopping condenser between the two last tubes.

LIST OF PARTS

- L1L2—One RF transformer wound for .0005 mfd.
- L3L4L5—One three circuit tuner wound for .0005 mfd.
- Ch1, Ch2, Ch3—Three 85 millihenry RF choke coils.
- Ch4—One filter choke of 30 henrys or more to carry 55 milliamperes.
- T—One 7½-volt winding of a power transformer.
- C1, C4—Two .0005 mfd. tuning condensers.
- C2, C3, C8, C9, C10—Five, .01 mfd. mica condensers.
- C5—One .00025 mfd. grid condenser with grid leak clips.
- C6—One .0005 mfd. fixed mica condenser.
- C7—One .00025 mfd. fixed condenser.
- C11—One 4 mfd. or larger condenser, 1,000 volt test.
- R1—One 20-ohm midtapped ballast resistor, or two tens in series.
- R2—One 2 megohm metallized grid leak.
- R3, R4, R5—Three 1A amperites.
- R6, R8, R10—Three .25 or .5 megohm metalized plate resistors with mounts.
- R7, R9, R11—Three 2 megohm metalized grid leaks with mountings.
- Rh1—One 20 ohm rheostat.
- Sw—One filament switch.
- Five standard UX sockets.
- Twelve binding posts.
- Two condenser dials.
- One tickler knob.

Early and Late Radio Annoys Sleepy Folk

Washington

The Summer or "open window" season brought into the Federal Radio Commission scores of complaints from individuals who condemn early morning "calisthenics" and late night musical broadcasting as interfering with their rest, because of the undesirability of shutting windows during warm weather, and the consequent 'annoyance'.

At the same time it was stated orally at the Commission that the Commission, as a Federal body, has no authority to curtail such broadcasts. Commissioner O. H. Caldwell, of the First Zone has stated in reply to letters he has received that appeals should be made to local authorities for protection against such nuisance.

"The Commission has no control over a matter of this kind," he writes.

One of the letters received, from M. Fields, of Brooklyn, N. Y., asked for the Commission's action if within its jurisdiction, to prevent musical programs after 11 p. m., with the possible exception of Saturday nights. "I ask you this out of consideration of those who would like peace after that time so that they may enjoy a restful sleep," he wrote. "This matter may seem humorous in a way, but it is detrimental to the general health if radio stations are permitted to broadcast jazz music until 12 or 1 a. m., as some of them do. It is comparable to a jazz band standing outside one's door and playing to that hour every night.

"Multiply this over hundreds of thousands of loudspeakers, each speaker within annoying distance of hundreds of people, and you get a better conception of this menace."

Synchronization Ends Stations' Heterodyne

Washington.

Experiments in wave synchronization, by which two radio stations assigned to the same wave-length would be enabled to operate simultaneously without interference, conducted by WAIU Columbus, Ohio, and KMOX, St. Louis, have proved successful to a marked degree, according to a report received by the Federal Radio Commission from H. V. Akerberg, chief engineer of WAIU.

Mr. Akerberg requested permission to extend the experimental privileges accorded the stations "so that we may continue development of the various theories not yet placed in practical operation."

Commissioner O. H. Caldwell stated orally that he would recommend that the stations be allowed to continue the tests. He explained that synchronization could only be effected now during periods when the same programs were broadcast by the stations parties to the experiments.

Text of Report

The full text of the report, addressed to Commissioner Caldwell, follows:

"We have your kind telegram of July 14, authorizing the writer to continue the experimental synchronization at WAIU, Columbus, and KMOX, St. Louis. We have accomplished the following results:

"On July 3, between 8 and 10 p. m., we conducted the first of these series of experiments, and since have repeated the tests on each succeeding Tuesday.

"As far as we can determine, from care-

Britain Starts Eight Stations, of 50 kw each

The British Broadcasting Company has just approved the installation of eight stations of 50,000 watts each, said Louis G. Pacent, president of Pacent Electric Company of New York, on his recent return from a trip to England. The transmitters are to supplement the twenty-one stations now operated by the B.B.C. throughout the British Isles. The new plan also involves generous use of short-wave transmitters operating simultaneously to carry the British programs regularly to the colonies and to foreign countries, he said.

"The new development is part of a growing plan to improve the general tone and quality of English radio offerings," he added. "About 75 percent of the programs now consists of talks or speeches and most of the presentations are poor in quality. The radio manufacturers recognize the conditions and are doing everything possible to get the broadcasters to change things for the better."

One reason, according to Mr. Pacent, for the poor quality of received programs is that the listeners are taxed according to the number of tubes in the sets. Hence everybody strives to get the greatest "gain per tube" used. Therefore sets made in England are superior to American sets economically but inferior in respect to quality. The tubes are seriously overloaded.

With eight new high-power stations in addition to those already in service a much better geographical distribution of entertainment can be effected so that the great majority of British listeners will be within good reception range of a station. This will enable the listeners to receive satisfactorily with small sets without overworking the tubes.

corrections. These corrections are made at once at the transmitter.

Heterodyning Absent

"We find that there is an entire absence of heterodyning and the only problem that we have not yet quite overcome is that of cross-talking during announcements. We have worked out a plan whereby we are dividing the announcing time—each station utilizing half of the 15-second intervals allotted by the chain for our local announcements.

"We are very carefully studying the distortion factor. As yet we have experienced no serious distortion of audio frequencies due to time lag, or due to either one of the two transmitters being slightly out of phase.

"We would very much like to carry on these experimental tests employing thermostatically controlled crystals. For your information, we have been successful in beating two thermostatically controlled crystal oscillators for a period of seven days with the result of no more than a 5-cycle deviation over this period of time.

Suspended Cages Used

"It is my opinion that this method could be very successfully applied to the synchronization of two stations—another noteworthy factor in the ability to hold our transmitter to a given frequency continually is an unusual type of antenna design. We are using at the present time, and have found it by far the least susceptible to frequency changes due to variation of capacity, atmospheric changes, etc., a system comprising two 40 ft. 8 inch diameter, 6 wire horizontal cages.

"These cages are suspended between towers 200 feet high. They are tightly stretched between the towers. This tension being maintained by an automatic compensator, the down lead after much experimentation is composed of a 50 ft. 4 inch 6 wire cage at the upper end.

"At the bottom of this vertical cage the 6 wires are bunched, continuing 130 feet straight down to the coupling house. This so-called rat tail lead is composed of 6 No. 10 enameled copper wires woven together. This lead is also under tension.

"The fundamental of the antenna system is in the neighborhood of 326 meters. The series condenser is used to work it at 1,000 kilocycles and 1,000 kilocycles.

"We have found this type antenna indispensable in maintaining an exact frequency. The counterpoise system is used due to very high ground resistance.

"I am working with KMOX at the present time to have them install a temperature controlled crystal so that we may further develop that idea.

Surprising Deviations

"I would appreciate very much if the Radio Commission would extend our experimental privileges during the Summer months so that we may continue development of the various theories not yet placed in practical operation. If you wish, I will forward within the next few weeks the detail reports of each transmission as soon as we have compiled them. They are very interesting and very instructive and will show surprising deviation of frequency of some of our major broadcasters in the country. These observations have been made after a long period of time and have proven very valuable.

"Will you kindly take up the matter of extension of our privileges so that it may cover the Summer months? If you require additional information will very gladly forward it to you at once."

"Synchronization of two or more stations transmitting the same program at the present time seems to be the only possible solution of the problem of ether congestion," said one expert. "If it proves practical most of the stations now operating could continue without time-sharing. But to be successful it would seem that the synchronization would have to be automatic as well as exact"

fully placed observation points covering the territory between Columbus and St. Louis, the experiments have been successful to a marked degree.

"The method we have been using is as follows: WAIU transmitter during these experiments is not crystal controlled, the usual crystal oscillator being replaced by a manually controlled master oscillator completely shielded, and accurate in maintenance of frequency to within 15 cycles over a period of five hours.

Beat Tests Made

"KMOX employs a standard Western Electric 4-A transmitter which has been found to be accurate within 25 cycles over a like period of time. We determine their variation of frequency by the usual method of beating their carrier with a constant frequency oscillator located in Columbus.

"During the actual synchronization we use a calibrated local oscillator at the transmitter. This oscillator is absolutely accurate at 1,000 kilocycles. We beat our carrier against this local 1,000 kilocycle oscillator instead of against KMOX at St. Louis.

"Our observers listening in give us the correction before the program starts. This correction, usually in the neighborhood from 100 to 500 cycles, is easily made at the transmitter—the local constant frequency oscillator corrected accordingly and the program continued. At intervals during the program the observers give us additional

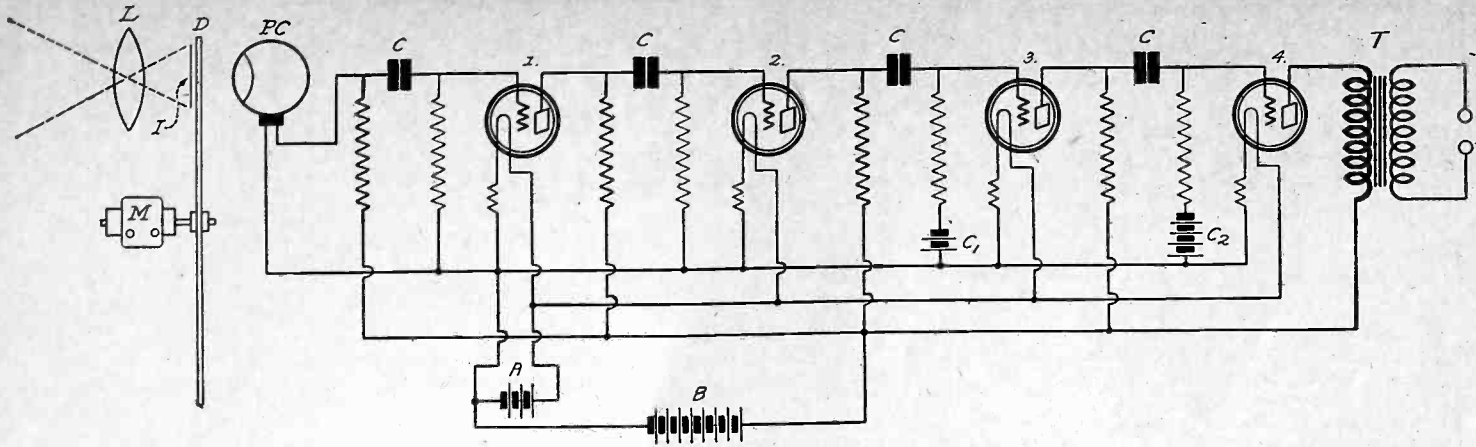


FIG. 706

A RESISTANCE COUPLED AMPLIFIER DESIGNED TO AMPLIFY TELEVISION SIGNALS BEFORE TRANSMISSION. IT SHOULD BE POWERED WITH BATTERIES AS INDICATED AND THE STOPPING CONDENSERS SHOULD BE LARGER THAN .01 MFD. CIRCUIT REQUESTED BY FORE ST HOLLIS.

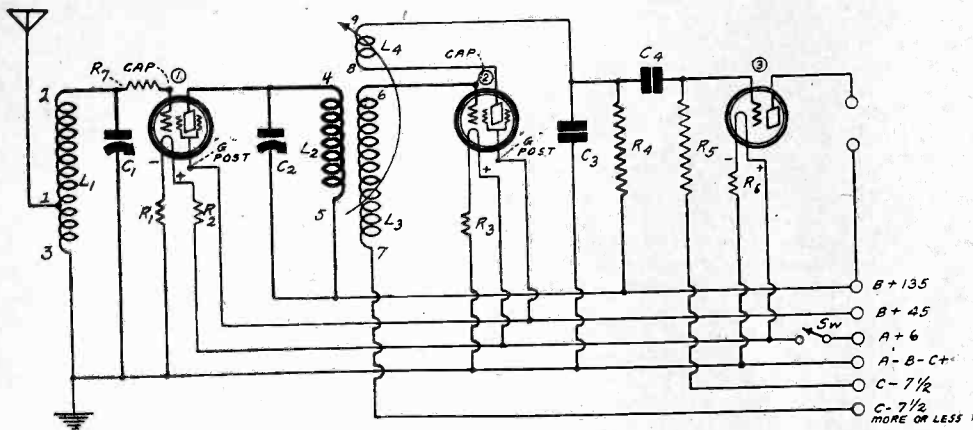


FIG. 707

THE CIRCUIT DIAGRAM OF A RADIO FREQUENCY AMPLIFIER, REGENERATIVE DETECTOR AND RESISTANCE COUPLED AMPLIFIER SUITABLE FOR INPUTTING A PUSH-PULL AMPLIFIER. CIRCUIT REQUESTED BY FOREST HOLLIS.

50-kilowatt station would then be rated at 66 horsepower.

(3)—A watt is the power of one volt-ampere. That is, if a current of one ampere flows through a resistance and the voltage across that resistance is one volt, the power dissipated in the resistance is one watt. A kilowatt is one thousand watts. A horsepower is defined as the power required to raise the weight of one pound 550 feet in one second, or 33,000 feet in one minute.

* * *

I HAVE OBSERVED a peculiar effect in my resistance coupled amplifier. When I first turn it on it works perfectly for about fifteen minutes. The quality gradually gets worse until after the fifteen minutes it is terribly bad. I have checked and rechecked the circuit and can find nothing wrong. What is my trouble?

PATRICK MOORE,

Boston, Mass.

(1)—This is an effect often caused by stray leakage from the plates or plate coupling resistors to the grid of an amplifier tube, usually the power tube. The grid gradually goes positive because the leakage from the positively charged parts is greater than the leakage from the grid battery. The condition is often coincident with hot or moist weather. Dust on the insulator surfaces is also a contributory cause. The quickest remedy is to use a lower value of grid leak. A test whether positive leakage is the trouble is to put a milliammeter in the plate circuit of the suspected tube and observe the plate current. It will creep up gradually. In a —50 tube it may creep up from 50 to 100 milliamperes.

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PLEASE PUBLISH a circuit suitable for the amplification of transmitted signals in television. I wish to experiment with transmission as well as with reception.

(2)—Also please publish a circuit of a radio frequency amplifier, detector and one stage of audio suitable for inputting a push-pull power amplifier which I now have.

FOREST HOLLIS,
Troy, New York.

(1)—See Fig. 706 for such an amplifier. It shows the connection of the photoelectric cell as well as the position of the scanning disc relative to the cell.

(2)—Fig. 707 shows such a circuit in which screen grid tubes are used both for radio frequency amplifier and detector. The audio tube should be of the —12A or the —01A type since the push-pull stage will be coupled to it by means of a transformer.

* * *

WHAT is the ratio between a kilowatt and a horsepower?

(2)—Could not the power of a broadcast station be listed in horsepower and if it could, would not this be a more easily understood designation?

(3)—How is a watt defined? How a horsepower?

WILLIS K. BRADFORD,
Racine, Wisc.

(1)—A horsepower is very nearly equal to .746 kilowatt. For approximate work

a horsepower may be regarded as three-quarters of a kilowatt.

(2)—Yes, it could be, and no doubt many people would understand the designation better than the electrical unit. A

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President, Lord & Thomas and Logan
Advertising Agents

Broadcast advertising has an entirely new technique. Things that are orthodox in printed advertising are taboo in radio, and you may do things in radio that are impossible on the printed page.

For radio advertising we have had to develop a new method of copywriting. We have had to train program builders, continuity writers and other specialists. We have had to devise new methods of checking reader, or, I should say, listener interest and response. We have had to study the stage and the screen to determine program appeal.

In fact, we have had to develop an entirely new art of advertising.

We are beginning to assemble for broadcast advertising minute statistical information.

We know, for example, that radio programs are listened to from 7 in the morning until midnight, with varying degrees of circulation volume. The biggest audience, of course, is in the evening, from 6 to 11, with the peak between 8 and 10. The evening peak is later in the cities than in the rural districts.

There is another midday peak, between 12 and 1, which is greater in the rural districts, than in the cities.

Cities Gay, Farmer Sleeps

It is interesting to note, by the way, that while the farm audience fades rapidly after 10 p. m., the city and town audience is still very large between 10 p. m. and 11 p. m.—larger, in fact, than at any other time of the day except the three previous evening hours.

So far as we have been able to determine from preliminary surveys, radio sets are in use an average of 850 hours a year. More than two-thirds of the radio sets of the country are in use from two to six hours a day.

Winter audiences, like winter circulations of magazines, are larger than summer, but investigation shows that fully one-half of the radio audience makes as much use of radio in the summer as in the winter, while another large section of the audience uses radio all summer, including vacation trips, but for shorter daily periods.

Public Tastes Known

Program building is not a difficult art. There is not much guesswork about it. The likes and dislikes of the radio public are very definitely known. There is now abundant experience of scores of national advertisers, as well as six years of studio experience with all kinds of programs, to guide the new radio advertiser in program planning.

The radio audience, as we have found, is very critical—far more so than the audience in a theatre. It is now so accustomed to hear programs of the highest character by artists of the first rank that anything mediocre falls with a thud.

When the radio audience doesn't like the program, it either turns the dial to some other station or else turns off the switch.

An audience will stay through a poor show in the theatre, trying its best to get its moneys worth, but it don't stick around listening to an inferior program on the air, for which it has paid nothing.

10,000,000 to 15,000,000 Hear

First-night audiences of popular musical

programs by national advertisers run from ten to fifteen million listeners. The most popular feature on the air is classical music by the world's great composers, and the most unpopular is jazz.

Compared with the growth of broadcasting, our amazing American progress in the use of the telephone, the electric light, automobiles and other American inventions has been slow, indeed. The radio audience has grown rapidly in the past six years. The appeal of radio is universal.

Any means of advertising pays if it offers the seller of goods an economical means of making his goods favorably known to the people that can use them. That is axiomatic.

Why Radio Is Included

If the potential market is nation-wide—a market of millions of people—then the manufacturer naturally turns to those means of advertising that most quickly, surely and economically reach this broad market. That is why the trend of advertising expenditures is more and more toward newspapers and magazines of the largest circulation and coverage.

And that is why experienced national advertisers—many of the most successful advertisers—are now including radio, with its enormous audience and tested listeners' interest, as an integral part of their advertising expenditures.

Radio offers them a new means of reaching the national market, of entering the homes of the people—quickly, surely and economically.

Now Only An Auxiliary

Let me say right here that, despite the great reliance we place on broadcasting as a new sales force in American business, we would not recommend to any advertiser that he place all or any very large proportion of his advertising expenditure in this new medium.

The time may come when some advertisers can profitably use radio exclusively but we have no data today that would justify such a policy. Broadcasting for the present at least, must be an adjunct to printed salesmanship—and it is a mighty powerful adjunct.

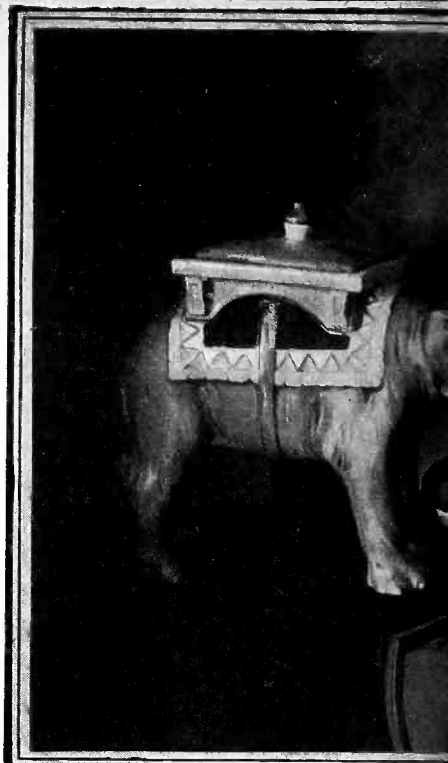
Newspapers, magazines and billboards have been tried and proved to be effective. Each has established its definite place and its definite value.

Fourth Greatest Help

Broadcasting has become the fourth great auxiliary force in the tremendous task of national distribution. If used properly, it will play its useful part in the economics of distribution.

I am quite willing to risk my reputation as a prophet in saying, while it is here to stay, it will not and can not replace the printed page. The printed page is the firm foundation of all profitable advertising. It is the bedrock upon which our modern merchandising structure has been so successfully built.

I have heard it said that there are some poor souls who allege that they tune out the advertisers' programs. By the same token, I suppose, they carefully tear out the advertising pages of the popular magazines as soon as they leave the newsstand, and walk in the middle of the avenue so as not to see the goods displayed in the shop windows.



**A MAN AND HIS WIFE PATCH UP
DESPITE THEIR DIFFERENT PO
FIFTY-FIFTY LISTENING IN T
SPEECHES, AND BY SYMBOLIZ
BOUDOIR INDIAN ELEPHANT A
THEIR TABLE MOD**

Perfect Repro

John F. Rider, for the Hiler Audio Corporation, released the following:

So many loudspeakers have been heralded as being the ultimate, the only one offering fidelity of tonal reproduction, that it is time to doubt. Excessive enthusiasm invariably breeds suspicion. But what is it? Do we need a perfect loudspeaker? Is perfection possible?

According to E. A. Hiler, an American engineer and inventor of the tuned double impedance system of audio amplification, the perfect loudspeaker is far removed from the horizon.

"Why is there so much talk about perfect loudspeakers, when one of the greatest telephone engineering organizations in the world calls 50% operating efficiency a success?" asks this engineer. "The reproduction of sound is their forte, yet those who really know do not herald perfect reproducers.

"After all, do we need a perfect speaker—perfect insofar as its frequency characteristics and operating efficiency are concerned?"

"The prime subject for discussion in the radio press has been the frequency characteristic. Concerted clamor for improvements resulted in successful changes without a doubt loudspeaker operation has been improved. How much farther must we go?"

"We must not overlook the fact that the loudspeaker is an inherent part of the radio installation; that its performance is governed by the performance of its associated equipment.

"Suppose that a perfect speaker is produced. What changes will be necessary in radio receiver design? In the first place a square-topped resonance curve for the radio frequency system will be imperative. Distortion in the detector tube must be eliminated. The operating characteristics of the audio amplifier must be flat.

"The next problem is the possibility of these developments consistent with commercial radio practice.

"All of the above are possible—but when—and who will pay for them? What will happen to the millions of radio re

Pair's Political Odds on Radio Evened Up

By Jim Joyce

A politico-radio situation developed in Ed Harris's household.

Ed has been a Democrat since ten years before the party was born, to hear him tell it, while his wife once made a speech in behalf of a Republican candidate for Alderman and has been for the protective tariff ever since. So Ed is for Al Smith for President and his wife is for Herbert Hoover, and between them, and their radio, too for that matter, there is the polite dickens to pay.

Ever since the couple have been married, some six years, they have gotten along well, and there's no chance of politics disrupting the equanimity of the home. But it does create a situation, for in politics life is nothing unless a situation develops.

To be frank, neither of them is politically wise, and the wife in particular, whose name is Winifred, is somewhat cloudy on political ways and manners. It is recalled by discreet friends who listened to the broadcast of the Democratic National Convention in Ed's home, with his wife serving all the lemonade and most of the conversation, that she lamented the fact that the Democrats were making a clean sweep.

Not One Republican

"It looks like a clean sweep for the Democrats," she remarked as not one Republican was even remotely suggested for either of the two high offices. "But wait! Our turn will come!"

Her husband reminded her that the Republicans a few weeks previously had fought shy of nominating any Democrat, and he coyly remarked that it was only to be expected that any political group would favor only its own kind.

There was no problem during the conventions, since no conflicting hours of political broadcasting were experienced, but with campaign speeches it is different, since one man will spout for one party and another for the other party, at the same time, from different stations—and there's the "situation."

Insists on Even Break

Mrs. Harris insists that the Republicans must be given an even break on the tuning in, and her husband, always chivalrous, admits that's no more than fair, but his wife does not openly assure him that the speakers for the party of her choice will not be given preference when he's not at home.

"Why should I sit for hours listening to orators of your party," she asks, "when I'm alone in the house with the non-partisan canary? We'll go fifty-fifty on the hours of reception for political speeches of the two parties when you're home, and that may induce you not to take so many nights off. But when I'm alone I insist on doing as I please, because you're not here to listen."

This seemed fair enough to Ed, as he is concerned mostly about what visitors will think, or neighbors say, if his wife completely rules the roost when he's home. His idea is that neighbors, as such, never think, but that visitors sometimes may do so, although this, too, is doubtful. He knows neighbors don't think, because one of them wrote to the Federal Radio Commission complaining that he has his set going until after midnight six days a week, at a frightful cost of sleep to said complainant, but Ed feels the neighbor was selfish not to mention Ed's own loss of sleep in a good cause.

Symbolic of the truce that's been patched up, whereby the rule of fifty-fifty politics

prevails when they're both home, and all-one-way politics when either is home alone, the couple have ornamented their radio installation with a fitting display.

This consists of a boudoir elephant, representing the Republican Party, and China "tiger", which Ed thinks is the Democratic Party's informal emblem. He was born and bred in New York City, as was Smith, and when anything savoring of the Democratic Party is broached, he always thinks of the tiger that is representative of Tammany Hall, the New York branch of the Party.

It so happens that his wife says she bought the ornament for the drawing-room table and was told it was a puma, whatever that is, but Ed assured her a puma is a tiger, and anyway, it's the principle of the thing that counts, seeing as he hasn't been to the zoo these many years.

The Hindu elephant was depleted of the trinkets it had contained when it had graced Mrs. Harris's boudoir table, but it looked just as sullen when it was burdened with those riches as it does now that Ed secretly uses the interior as an ash receiver.

Their Expressions Analyzed

The elephant seems to have something of a scowl, Ed thought, and said so, but his wife said an elephant's an elephant, and that the fellow who fashioned this one from clay didn't have in mind the unique purpose to which his work of art would be put.

"Well, the elephant is on the warpath, and it shows its stern determination to be victorious," said Mrs. Harris.

"I'll say for the tiger," piped Ed, "that it seems to be sniffing the air with joy—more or less indifferent to the elephant's scowl, and for all the world enjoying the confident pose of the happy warrior!"

Recently the couple at breakfast time heard Republican setting-up exercises and at bedtime listened to Democratic slumber music.

"The exercises were better for the state of the union," said Mrs. Harris, who was born in West Branch, Iowa.

Convention Broadcasts

By N. B. C. Cost \$181,000

Spending \$115 a second to broadcast the Democratic National Convention, the National Broadcasting Company and associated stations are believed to have set a new high record in radio public service, said M. H. Aylesworth, president.

The Democratic convention was on the air for a total of 25 hours. The total cost of the Democratic broadcast over the coast-to-coast network of 43 radio stations was \$104,000, or \$27,000 more than the Republican convention broadcast.

"While it is true that a few shorter programs have cost more per second than the Democratic convention report, these broadcasts have been commercially sponsored," Mr. Aylesworth said. "The convention broadcasts, on the other hand, were paid for by the N. B. C. and associated radio stations and were not revenue producing."

"We believe that the broadcasts of the Republican and Democratic conventions are outstanding examples of the service radio can render the nation as a whole."

The total cost of broadcasting both conventions, shared by the N. B. C. and associated stations, was \$181,000.



FOR A PEACE IN THEIR HOUSEHOLD, POLITICAL FAITHS, BY AGREEING TO A REPUBLICAN AND DEMOCRATIC THIS FAIR DIVISION WITH A HAPPY-WARRIOR TIGER ATOP RADIO INSTALLATION

Receiver Needed?

receivers already in use? Produce a perfect loudspeaker and you must change the radio frequency system, the detector and the audio frequency systems in these receivers.

"Is it not simpler to forget the talk about perfect loudspeakers and to adjust the audio amplifier to compensate for the deficiency of the radio frequency system, the detector and the loud speaker? Laboratory experiments prove this contention. Laboratory experiments covering the other arrangements are yet impossible because there are no perfect loudspeakers.

"After all, the perfect loudspeaker and the perfect receiver will combine to perform the function now being performed with the audio amplifier tuned or designed to qualify the operation of radio frequency amplifier, the detector and the loudspeaker. It is much simpler to adjust one circuit, according to the deficiencies of three, than to adjust three, to equal the perfection of one.

"That audio amplifiers can be matched to meet the requirements of the public when used with good speakers is being daily displayed by the organizations that produce and sell loudspeakers with their receivers. They recommend their loudspeaker with their receiver. The reason is simple. They know the characteristics of their loudspeaker and they can design their audio amplifying system to compensate for the loudspeaker deficiency.

"If the speaker is deficient on low frequencies, they tune their audio amplifier to compensate for this deficiency. If the same speaker is also deficient on some of the frequencies of the upper audio register, they adjust the same audio amplifier to accentuate the required frequency and, the required amount. Why worry about perfect loudspeakers? The perfect loudspeaker is unnecessary.

"The low frequency deficiency found in speakers of today is not lack of response due to inability to function at the low frequency, but rather to variations in power necessary to actuate the parts. Accentuation of these low frequencies within the audio amplifier acts correctively."

Board Investigates 'Domination' by Chains

Washington.

It is becoming "increasingly evident" that the 90 broadcasting wavelengths available to the United States can carry only 150 full-time stations of 500 watts and over, if the principles of good radio reception are to be preserved, and therefore division of broadcasting time by stations apparently must be imposed to a large extent said Commissioner O. H. Caldwell, of the Federal Radio Commission.

The statement was made in connection with a questionnaire sent to all of the approximately 650 broadcasters in the country, by the Committee on Reallocation, comprising Commissioners Caldwell and Sam Pickard.

Commissioner Caldwell explained that the Reallocation Committee desires to get the latest data as to the hours actually used by broadcasting stations so that proper time-sharing may be scheduled in the forthcoming allocation plan without undue hardship to any broadcaster.

The allocation plan is made mandatory by the Davis amendment to the Radio Act, requiring equal distribution of radio broadcasting time and facilities among the five radio zones.

Queried on Chains

The questionnaires must be sworn to by station owners and must specify, in addition to hours of operation, the number of hours of "chain" programs and the type of apparatus used to insure that the station keeps within its assigned frequency and does not disturb stations broadcasting on neighboring channels.

The full text of the statement follows: "Reallocation Committee desires to get latest status of the hours actually used by broadcasting stations, in order that proper time-sharing can be scheduled in

the new allocation plan, without undue hardship to any broadcaster.

"Stations being required to state under oath hours used each night (7 to midnight, which are valuable commercial hours), also total such hours used during past six months, and proportion of such night hours of chain programs. Information to be ready when Commission resumes reallocation discussion.

"As reallocation work progresses it becomes increasingly evident that our 90 broadcasting wavelengths can carry only 150 full-time stations of 500 watts and over, if the principles of good radio reception are to be preserved. With some 300 licensed transmitters to be accommodated, it is evident that time-division must be imposed to a large extent, and the questionnaire will provide basis.

"The seriousness of the present duplication of chain programs on 10 to 20 channels with each chain now in operation is another factor which the reallocation committee is carefully studying, in the light of thousands of protests received during the year by the commission and by members of Congress.

"The committee desires to get the latest facts of actual 'chain' time used by each station.

"Proposal has been made that only one station of 5,000 watts and over in each zone be permitted to broadcast commercial chain programs. Another recommendation urged is that chain programs be permitted only on stations of 500 watts or less, using shared channels.

"Regulations permitting repetition of chain programs on high-power only with a distance interval of 1,000 miles or so, have also been suggested. The actual facts concerning 'chain domination' of the broadcasting hours will be obtainable from replies to questionnaire."

in fact, by a cross-section of America's population.

A program unacceptable to the listeners of any group of stations would cause those stations to drop from the system for the period it was on the air. No station is compelled to take any program it does not care to take, nor, as a matter of fact, could the National Broadcasting Company force it to do so. There are only three stations in the country over which the company has any control. These are WEA, in New York, which it owns, and WJZ, New York, and WRC, Washington, which it manages for the Radio Corporation of America.

No Compulsion

Operating these three stations, however, is only incidental to the real business of the company, which is the production and distribution of programs of national interest. Its sustaining programs are designed with the idea of making them so attractive to network stations that they will be willing to pay for the privilege of receiving them over network wires and broadcasting them. If a sustaining program should be poor, it would not sell to the network stations, and the producing company would receive no financial return from it.

Nor is any network compelled to broadcast any particular program sponsored by a commercial enterprise. When such a program is contemplated and the sponsor wishes to have his program heard in certain areas the National Broadcasting Company telegraphs each station, describing the program and asking the station if it will accept it. If it does, the station receives a fee, but if the manager of the station believes the program unsuitable for its own audience he refuses the program and that is the end of this matter.

Each of the stations associated with the system as well as non-associated stations receives frequent opportunities to join in broadcasting public events of outstanding national importance. In most instances these programs are offered to the stations without cost and the National Broadcasting Company bears the expense of providing the facilities.

Kickers Not Bashful, Alas!

The continuance of network broadcasting, in truth, rests upon whether or not the National Broadcasting Company, or any other company engaged in producing and distributing broadcast entertainment on a national scale, can retain the goodwill, not only of individual stations, but also of large bodies of listeners. If the listeners did not like the network programs they would soon let the stations hear about it, and very soon these would drop off the networks.

Kickers Keep Chains On Pins and Needles

By Walter C. Stone

of the Publicity Department, National
Broadcasting Company

Every broadcast program on the air today is there because thousands of listeners throughout the country desire its continuance. In the last analysis it is the radio audience that determines what programs shall be presented. The whole broadcasting business, with its millions of dollars invested in equipment and running expenses, depends on the likes and dislikes of the listeners for its existence.

If an unwary broadcaster should put on the air a program which did not please a large group of listeners, that single error of judgment would result in a flood of protests from every part of the country. Continuance of the one offending program would mean the loss of a very considerable group of listeners.

Like everyone else whose success depends on the good-will of the public, broadcasters keep one ear constantly tuned to catch murmurs of disapproval. These, if there is something to evoke them, are manifested in several ways.

First of all come the general letters from listeners. The National Broadcasting Company receives half a million or so of these a year. Many come direct, and others, in which there is reference to net-

work programs, are forwarded by associated stations through which these programs have been heard. Each of these letters is read and those which offer criticisms and suggestion are noted.

Alert on Published Kicks

Newspaper comments from all parts of the country are another fruitful source for the broadcaster looking for public reaction to programs. At least a dozen officers and members of the staff of the National Broadcasting Company read each newspaper review with a view to correcting the bad impression any one program may have made on more than one or two reviewers and to find constructive suggestions for the future.

In addition, there are the wishes of the stations associated with the networks to be considered. Before each program goes on the air, it must be analyzed to discover how well it is adapted to the needs and desires of stations in widely separated parts of the country. Network broadcasting, to be successful, must please not only listeners to stations in metropolitan areas, but also must be liked by farmers, ranchers, miners, merchants in small towns—

Chicago Opera on Air Weekly this Season

Selections from the performances of the Chicago Civic Opera Company will be heard over radio once every week during the 1928-1929 operatic season, the National Broadcasting Company announced. A network of stations of the broadcasting company will be connected with a bank of microphones placed on the stage of the Chicago Auditorium to pick up the music.

The broadcast will begin on October 31, and will continue until January 23, 1929, with one performance every Wednesday between 9 and 10 p. m., Central Standard Time. The programs will be sponsored by the Fansteel Products Company, radio set manufacturers.

KOBER IS APPOINTED

Paul A. Kober, formerly engaged on television experimental work for General Electric Co., and former assistant to E. F. W. Alexanderson, has been appointed television engineer of the Davenport Radio Co., Newark, N. J.

Are Chains a Blessing Or Infernal Nuisance?

WELL SATISFIED

IN your issue of Aug. 4, you publish a letter by Mr. A. S. McBryde, of Detroit, in which he complains of the present broadcasting situation. He blames the Radio Commission for his failure to enjoy radio as he did at one time. He also complains of the quality of the reception on relayed chain programs, and of the nature of the programs themselves.

As this is only one of many similar letters I have seen in print (with regret), I am venturing to state that I believe 99.99% of the radio listeners are entirely satisfied.

With regard to the chain programs, either direct or relayed through the three principal Detroit stations, I have found them, at most times, exceedingly clear as regards reception, and far superior to the locals as regards program.

Although complaint is made of the selection of chain programs, I cannot see how they can well be improved, so long as it is necessary to cater to listeners of so great a diversity of tastes. Personally I would prefer a little more weight in the programs, and less "jazz," but I appreciate that I am in the minority.

Regarding Mr. McBryde's alleged inability to get certain stations (KDKA, WTAM and WLS) when the Detroit locals are on, I am at loss to understand, as I have no such difficulty. Last night I received without difficulty all of the stations named in his letter, first making sure that WWS, WJR and WGHP were all working. This was on an old Radiola 25. Then I picked up each of the stations specifically named, on a Browning-Drake, operated on an light-socket antenna, (by no means a selective arrangement), which I have on account of the exceptional quality it gives with a push-pull amplifier on the locals.

Then a T. R. F. receiver with three unneutralized R. F. stages was tried, and the three stations named were easily brought in without any interference. Then the Radiola 25 was used again, this time with an extra stage of push-pull audio added. The stations complained of (WLS, WTAM, KDKA and WLW), were brought in with tremendous volume in an effort to pick up side band interference. There was none detectable. Then the Browning-Drake was tried again on WTAM, which is between WWS and WJR. Using a ground antenna, WTAM came in very loud and in such good quality that I kept it on the rest of the evening.

As I am just as near to WWJ as Mr. McBryde, and nearer by some miles to WGHP (which is not in Detroit, but in Mt. Clemens), I feel that he should look for his troubles nearer home, and not blame the Radio Commission, which is making as good a job as anyone could out of the mess Congress has handed it.

Incidentally, the heterodyne whistle on WGHP I was unable to detect, when accurately tuned, and suspect that the difficulty arises from some oscillating receiver in Mr. McBryde's neighborhood. A local station, WBMH, which has a tendency to wander a bit, interferes, now and again, with its harmonics. It is a very poor station which I am glad to say the Commission has slated for discard.

If Mr. McBryde's receiver will not tune sharply enough to pick up the stations named when WGHP, WWS and WJR are working, he must have about the most broadly tuning set in Michigan. It would scarcely be possible to place the stations in the broadcasting band where they would be less likely to interfere. In fact this is so evidently the case that I sus-

pect Mr. McBryde of attempting to strengthen a case whose weakness he suspects, by adding a little testimony not unimpeachable. This is borne out by his later statement that he tuned in "five different DX stations and heard the same program from each of them."

I should be glad to see a list of five stations, on the same chain, which would be farther from Detroit stations than WTAM.

PHILIP M. C. ARMSTRONG,
Detroit Club, Detroit, Mich.

BLAMES POOR SETS

Editor RADIO WORLD:

I HAVE just finished reading your last issue and do not quite agree with two of your readers' views of radio conditions. Kansas City has two chain stations, WDAF and KMBC. Chain programs reach here clear and undistorted and are superior to any local program, both in character and tone. I hear these with two good receivers.

Many radio fans rap programs and stations when they are using poor sets, cheap speakers and sets in poor condition.

I have a log of more than 300 stations, have no trouble tuning out locals and am rarely bothered with a heterodyne whistle, which gets the blame of all reception troubles.

KWKH has 3,500 watts, so we get its music louder.

A receiver several years old cannot be expected to have the selectivity, power and tone of a new AC set.

L. H. RAINES,
Apartment 209, 425 W. 46th St. Terrace,
Kansas City, Missouri.

"LOCAL" TROUBLE

EDITOR RADIO WORLD:

IT seems as if there was something I decidedly "local" causing the poor quality reception which your correspondent A. S. McBryde mentions in his letter published in RADIO WORLD. It is quite apparent that he dislikes chain programs and that is probably the reason he gets poor reception.

There was a time when a program from the Pacific Coast or even from Chicago (sent to New York and rebroadcast) had a "canned" sound—but not lately.

Anything more natural or less "canned" sounding than the two conventions (on either chain) it would be hard to imagine.

Either the engineers at the Detroit stations don't understand amplification (which is doubtful) or the writer of the letter has one of those dollar ninety-nine speakers which sound like Fourth of July tooters.

A rabid chain Program fan,
H. I. SMITH, Hanover, Mass.

Western Chain Opens Office in N. Y. City

Believing that de luxe chain programs are most popular, the American Broadcasting Co., operating a network of Pacific Coast stations which may be extended further Eastward soon, has opened offices at 119 West 57th Street, New York City, which will be maintained in addition to the main headquarters in the Lloyd Building, Seattle, Wash.

It is understood that a Salt Lake City station will be added shortly to the network, which comprises KJR, Seattle, Wash.; KEX, Portland, Ore.; KGA, Spokane, Wash.; KYA, San Francisco, and KMTR, Los Angeles, linked up by Postal wires.

North Americans Meet to Codify Short Wave Use

Washington.

Radio officials of the Canadian, Mexican and Cuban governments met in Washington to discuss policies in respect to the control and allocation of continental short waves.

The purpose of the conference was primarily to coordinate the general policies with respect to the control and wave allocations on the North American continent so as to minimize interference that would result through haphazard allocation of short wave or high frequency channels without consideration of other countries on the continent.

The Radio Commission recently took steps to set aside certain specialty selected high frequencies for specific classes of usage, for types of services in which several stations may share channels to advantage. Information as to such assignments was requested by the Committee on Short Waves, comprising Commissioners E. O. Sykes and O. H. Caldwell, prior to the allocation of radio high frequency channels for continental use.

The North-American conference was expected to further a plan for such short wave allocation. A legal discussion as to the public service of short wave allocations for specialized uses has been progressing within the Commission, it was pointed out.

Among these special classes that would be granted licenses are communication between airplane; and ground stations communication between ships and ship to ship and coastal stations by radio telephone; for police department; marine calling frequencies for tentative use until international agreement is secured; experimental frequencies; geophysical work; railway communication between engine and caboose of long freight trains; scientific expeditions; portable stations and power line control, has been the subject of some discussion, it was stated. It involves short wave radio service for power lines for emergency use.

WEAF Stuttering Due to Moths in Condensers

Something was wrong at the WEAF transmitter of the National Broadcasting Company. Engineers at the Belmore, Long Island, radio broadcasting plant couldn't figure out why the transmitter wasn't functioning as it should.

O. B. Hanson, manager of plant operation and engineering, ordered an investigation. The trouble was located in an intermediate amplifier. Hundreds of tiny moths had crawled between the condenser plates and had been electrocuted. Through the moths were dead, their execution had resulted in a short circuit in the amplifier.

Now the condenser, previously illuminated by a bright light which attracted the moths, is in darkness. And as an additional precaution, the entire apparatus is surrounded by fine-mesh mosquito netting.

"INSIDE" INTERFERENCE

Much heterodyne interference complained of originates right in the receiver either because it oscillates uncontrollably or because it is an improperly designed Super-Heterodyne. Some receivers of this type squeal and growl as soon as there are two or more stations on the air. The squealing is due to the fact that in every Super-Heterodyne any station comes in at two dial settings, the so-called "one-spot" not excepted.

A THOUGHT FOR THE WEEK

SOMEbody gravely announces that during the coming Fall and Winter one million owners will exchange their present sets for something newer and better—or, at least for something different. What's to become of the old sets? Perhaps the radio trade will resort to something like the method adopted by the music trade a good many years ago when the old square piano was a nuisance. Piano manufacturers and dealers called convention, which was held in Atlantic City, where square pianos from all over the country were destroyed in a bonfire. Result: the price of a square fell 100 per cent below par the day following the bonfire. Why not try the scheme for radio?

RADIO WORLD

The First and Only National Radio Weekly

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

TELEPHONES: BRYANT 0558, 0559

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James H. Carroll and Capt. Peter V. O'Rourke

SUBSCRIPTION RATES

Fifteen cents a copy. \$6.00 a year. \$3.00 for six months. \$1.50 for three months. Add \$1.00 a year extra for foreign postage; Canada, 50 cents. Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

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CLASSIFIED ADVERTISEMENTS

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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.

Karas Brothers Win

The sailing yacht "Siren," owned and sailed by the Karas brothers, L. L. and A. E., recently won the Mackinac race, the Lake Michigan classic, for the second consecutive year. Both sailors are vice-presidents of Karas Electric Co., prominent radio parts manufacturers, 4040 N. Rockwell Street, Chicago.

Rating in Horsepower Favored for Stations

Washington

Requests made by Commissioner O. H. Caldwell of the Federal Radio Commission, for an improved method of expressing the power of broadcasting stations, because of recent public discussions of the "tremendous power" of such stations has brought from the Commission the suggestion that all radio stations be rated in the "old familiar term of 'horsepower.'"

In a letter, Commissioner Caldwell pointed out a "20-horsepower station," like WBZ, of East Springfield, Mass., WGN, of Chicago, and KOA, of Denver, "seems not nearly so formidable as one called by the uglier term of '15 kilowatts.'" One horsepower equals 746 watts.

"A sixty-horsepower station, like WEA-F of New York or KDKA of Pittsburgh," he said, "is not such a terrifying thing when compared to any seven-passenger automobile, which radiates almost exactly the same amount of power," he said.

Text of Letter

The full text of the letter, made public without the name of the addressee, follows:

"In answer to your several requests for an improved method of expressing the power of broadcasting stations, it might be well, in view of recent public discussions of the 'tremendous power' of such stations, to rate all radio stations in the old familiar by-gone terms of 'horsepower.'"

"Speaking of a station in terms of its 'horsepower' would probably give a clearer conception of the actual power quantities involved, to the minds of the Radio

Commissioners, the general public, and the Radio leaders of Congress.

"One horsepower equals 746 watts. Knowing this ratio, one can readily translate bothersome electrical terms into familiar farmer and shop language.

"Thus, a '20-horsepower station' (like WBZ, KGN or KOA) seems not nearly so formidable as one called by the uglier terms of '15 kilowatts.'

One-Horse Stations

"And, a 60-horsepower station,' like WEA-F or KDKA, is not such a terrifying thing when compared to any seven-passenger automobile, which radiates almost exactly the same amount of power.

"If a familiar comparison for the 20-horsepower station is called for, it can be found in the domestic electric range and water heater installed in hundreds of thousands of American homes, and which similarly consumes about 15 kilowatts, or 20 horsepower.

"The only drawback to this nomenclature lies in the possibility of some wag referring to broadcasters like WGR (Buffalo), WBT, (Charlotte, N. C.), WHA, (Madison, Wis.), etc., as being 'One horse stations,' which, of course, they are—their output of 750 watts being almost exactly one electrical horsepower.

"Expressed in such homely language as horsepower, familiar to every farmer and mechanic, the mystery of kilowatts and such gibberish is gone; the lay listener will no longer be mystified and impressed by ranters against high power; and the cause and opportunity for much political oratory this winter will be automatically removed."

Board Puts Check on Experimental Waves

Washington.

The Federal Radio Commission will not grant applications for experimental broadcasting licenses unless it is determined that the research is designed to accomplish a definite purpose and to further the art of broadcasting, Commissioner Orestes H. Caldwell announced.

Many requests for experimental licenses have been received, said Mr. Caldwell, and there is not room to grant all applications. Therefore, he said, the decision had been reached only to grant such license when it is known and when an applicant can prove beyond doubt that he is setting out to discover facts or acquire information not already available to the art.

Text of Letter

The full text of the body of a letter sent by Commissioner Caldwell to an applicant for an experimental license, setting forth in general the Commission's views follows:

"The Commission has asked me to report to it upon recommendation in the case of your application for an experimental license.

"As you are aware, the Commission is being overwhelmed with requests for experimental licenses by all groups of people, many of them wholly unequipped to carry on experimental work, or without definite purpose as to what such work shall accomplish.

"I have read over carefully the state-

ments filed with your application but I cannot find any definite reference to the work which you intend to accomplish, if granted this license.

"I believe the Commission is forced to limit such licenses to cases where the applicant shows beyond doubt that he is setting out to discover facts or information not already available to the art.

Board Is Careful

"The Commission keeps a careful cross reference of the various classes of research work being done and often it is possible to refer applicants to other work which has been accomplished by earlier experimenter without issuing a special experimental license.

"Of course, you will understand that I thoroughly encourage experimental work of all kinds. The development of radio has come from experimentation and any check upon the freest use of such experiments would be fatal to the further progress of the art.

Novel Research Encouraged

"On the other hand, with the limited number of wavelengths available, and with the great congestion in all parts of the band, it is necessary to observe the greatest possible scrutiny of every application to make sure that the work contemplated is along wholly new and novel lines and does not merely duplicate investigations, the result of which are already well known to the art."

The Radio Trade

Manufacturer Stops Resale Price-Fixing

Washington
Resale price maintenance on radio receivers and parts will be discontinued by a manufacturer of such apparatus according to terms of a stipulation agreement between the company and the Federal Trade Commission, it has been announced. The statement regarding the stipulation, No. 236, follows in full text:

"This company sought the cooperation of dealers in maintaining resale prices and enforcing them.

"In several instances it traced price cutters by means of serial numbers and secret symbols placed on its products when shipped out. In other instances the manufacturer entered into contracts, agreements or understandings with customers, who had been cut off from their supplies, for maintenance by such customers of resale prices as a condition to the reopening of accounts.

Practices Described

"The radio apparatus manufacturer agreed to discontinue the following practices:

"(a) Entering into contracts, agreements or understandings with dealers to the effect that such dealers, in reselling the products purchased by them from the respondent, will adhere to any system of resale prices fixed or established by said respondent.

"(b) From securing or attempting to secure assurances or promises from dealers that they will observe the prices established by the respondent for resale of products purchased from respondent by dealers; and

"(c) From securing or attempting to secure the cooperation of dealers in maintaining or enforcing any system of resale prices whatsoever, and

"(d) From acting upon information received from its cooperating dealers by

threatening to refuse, or refusing to sell its products to any dealer because of such dealer's failure to adhere to any such system of resale prices; and

Cooperation With Dealers

"(e) From soliciting the cooperation of dealers in reporting dealers cutting prices or alleged to be cutting prices of respondent's products, and acting upon information thus obtained by cutting off or threatening to cut off such offenders; and

"(f) From soliciting promises or assurances from such offenders that they would thereafter maintain the suggested resale prices as a condition to further supplying them with products; and

"(g) From directly or indirectly carrying into effect, by cooperative methods, any system for the maintenance of resale prices eliminating or having a tendency or capacity to eliminate price competition on its products."

Armor Tubes in New Home

The Armstrong Electric & Manufacturing Co., Inc., has removed to its new plant at 187 Sylvan Avenue, Newark, N. J., from 351 Halsey street, the same city. The Sylvan Avenue factory is of the most modern type and is located in North Newark, near the Erie Railroad. The output of Armor tubes is more than quadrupled, due to the larger space and extra machinery installed.

The plant has been working full time all summer. G. A. Armstrong of the company, predicts a splendid radio season. This concern makes a full line of radio tubes for all uses, including AC, rectifier and power tubes. New information on the use of tubes may be had for the asking from the above concern. Mention RADIO WORLD.—J. H. C.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

RADIO WORLD,
145 West 43th St., N. Y. City.

I desire to receive radio literature.

Name

Address

City or town

State

- R. E. Hawk, 2440 Askew, Kansas City, Missouri.
- H. I. Viets, 808 W. Monroe St., Belleville, Illinois.
- John J. Fischett, 208 Willoughby Ave., Brooklyn, New York.
- Carl Hann, 3073 W. 114 St., Cleveland, Ohio.
- Wh. Wallace, Dufferin Ave., Wallaceburg, Ontario, Canada.
- C. Eugene Taylor, 16 Maple Place, Port Chester, N. Y.
- Paul A. Hagen, 1530 Jeniter, Madison, Wisconsin.
- A. W. Hiz, 335 E. 209 St. (Apt. 20), New York City.
- P. J. Selzle, 4142 South 12th St., Omaha, Nebraska.
- Franck S. Myers, P. O. Box 194, Berkeley, California.
- Randall Sharwell, 5 Van Eyk Ct., Lyndhurst, New Jersey.
- W. B. Allen, 9006 Quincy Ave., Cleveland, Ohio.
- W. T. Hale, 539 Moss Ave., Boston, Massachusetts.
- Frank M. Taylor, 58 Corey St., Everett, Massachusetts.
- Eugene Payor, 325 Bush Street, San Francisco, Calif.
- J. G. Brohl, P. O. Box 309, Hayward, Calif.
- New Smyrna Auto Electric Co., 202 N. Orange St., New Smyrna, Fla.
- F. L. Hutchins, Tumbledown Mt. Forestry, Skinner, Maine.
- Gordon Battery Co., 126 W. Albany St. Herkimer, N. Y.
- S. Jupp, 3367 Wellington St., Verdun, Quebec, Canada.
- Meyer D. Walters, 202 Aisguith St., Baltimore, Md.
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- Robert S. Burgess, 1118 E. Douglas Ave., Nashville, Tennessee.
- Chas. E. Hilts, 241 Main Street, Reading, Mass.
- Eric Strahl, 726 E. 227 Street, Bronx, N. Y.
- Al Bloom, 67 E. 105 St., N. Y. City.
- E. A. Clardson, Stewards Dept., S.S. Leviathan, Pier 86, N. Y. C.
- Jacob Averbach, 122 E. 111 St., New York City.
- Lewis Brunett, Enunclau, Washington.
- Geo. T. Euard, Bradford, Illinois.
- M. Rubenstein, Dield & Co., DeKalb, Illinois.
- Herberts McClure, 2909 A Kossuth, City of St. Louis, Mo.
- J. J. Glade, 94 W. 52nd St., Bayonne, New Jersey.
- Carl A. Berger, 503 Delaware Ave., Albany, N. Y.
- G. M. Williams, 1700 Golden Ave., New York City.
- Brown's Radio, 1139 St. Clair W., Toronto, Canada.
- Albert E. Taylor, 803 So. 2nd Street, Maquoketa, Iowa.
- R. B. Coffman, U.S.S. Relied, c/o Postmaster, San Pedro, Calif.
- Ted. V. Tazeau, 2855 G. G. Avenue, San Francisco, Calif.
- Del E. Atcheson, 14882 Kentucky Ave., Detroit, Michigan.
- O. F. Buchner, 69 Moffatt Street, Brooklyn, N. Y.
- J. W. Farrar, Yakima, Washington.
- Morris S. Cohen, 469 Pennsylvania Ave., Brooklyn, N. Y.
- C. E. Blausen, Oil City, Penna.
- L. P. Matte, Ban of Montreal, Quebec, Canada.
- J. Verlin Hunt, 628 So. 11th St., Richmond, Indiana.
- C. C. Lingo, 1052 Camp St., New Orleans, Louisiana.
- Doyle L. West, 2002 W. 7th Ave., Corsicana, Texas.
- Louis Ruziecke, Jr., 848 West 42nd Pl., Los Angeles, Calif.
- Peter J. Schmitt, 847 Glenwood Ave., Buffalo, New York.
- V. J. Patterson, The Commodore, Seattle Washington.
- E. J. Walker, 124 Washington St., Carbondale, Penna.
- C. L. Stooksberry, 1301 East 31st St., Savannah, Georgia.
- Robert A. Brooks, Route 2, Box 50, Martin, Tennessee.
- Cameron Mill, Carrollton, Kentucky.
- Ray Lee Defries, Memphis, Tennessee.

Penn's New Speaker Goes in for Colors

Since the inception of the first sound reproducing apparatus, George R. Penn has been a leader in this field, inventing, experimenting, perfecting and making units and loudspeakers of all types. He, therefore, knows all the contributing factors that make for perfect reproduction and has brought out several remarkable speakers.

In line with his production of better reproducers, he has brought out two new speakers for the coming season. One is the Fabricone Wall Speaker, that gives wonderful tone reproduction on any type receiver, electric or direct current. This speaker is made of a special fabric treated with liquitone, both creations of Mr. Penn.

The speaker is fifteen inches in diameter, comes in beautiful colors, is bound in silk cordings with hangings and lovely decorative tassels. It is highly ornamental.

The driving motor of this speaker is the famous G. R. P. Cone Unit with sturdy, dependable horseshoe magnet with four pole

pieces and double adjustment, rendering it adjustable to all outputs. It matches filter and tube impedances so well that, coupled to any of them, it will please the most fastidious ear.

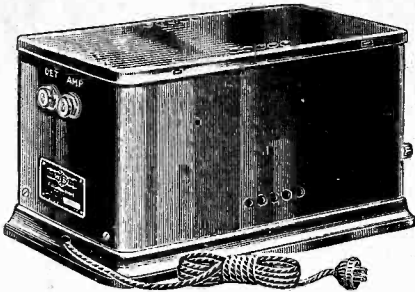
Mr. Penn also has ready the latest perfected development of his 30-inch double cone speaker. This comes in kit form, but with the advantage that the work is already done, all that is necessary being to open the cone, which comes all ready cut and pasted, insert the unit and brackets which are tightened almost instantly, and the cone is ready to play. The cone is beautifully decorated and the same fine unit is furnished with the kit.

Both these speakers are rigidly guaranteed. Fans are therefore fully protected on their orders. This company has a good proposition for dealers and jobbers who are invited to correspond with George R. Penn, 231 Mercer Street, New York City. Mention RADIO WORLD.—J. H. C.

ELIMINATE BATTERIES!

NO Change in Set Wiring
NO Change in Tubes

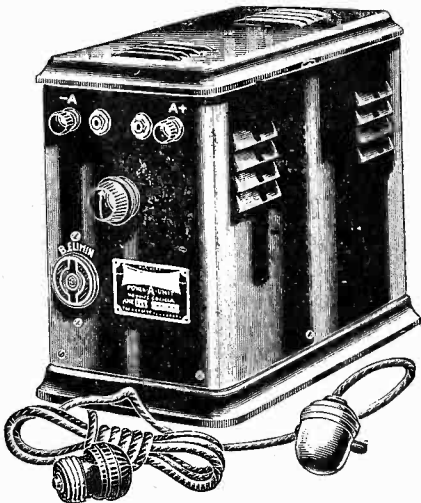
"B" Eliminator, Using Raytheon Tube, Replaces "B" Batteries and Gives Great Satisfaction.



No. B16—"B" Eliminator for 50 to 60 cycle, 105 to 125-volt AC house current. Max. voltage, 180, with one variable detector and one variable intermediate voltage. Weight 16 lbs. Size, 6 x 6 1/2 x 11 1/2". Quiet, economical. Requires no attention. Sold only with Raytheon tube. Price, including Raytheon BH125 mil. tube and built in connector cord and plug. **\$16**

Famous Raytheon Tube With Each "B" Eliminator

"A" Eliminator, Using Dry Plate Rectification, Current Well Filtered; Replaces "A" Battery.



No. A22—"A" Eliminator. Supplies up to 2 1/2 amperes at 6 volts. Variable resistance permits adjustment to number of tubes in set. Supplies A current and voltage to sets using from 4 to 10 quarter ampere tubes, or equivalent current drawn by any other combinations. Tip jacks for voltmeter readings. Receptacle for "B" eliminator plug. Pendant switch controls everything. Set switch needn't be touched. Device requires no attention. Uses no tube. Size: 10 1/2" high, 6 1/2" wide, 11 1/2" long. Shipping weight, 27 lbs. **\$22**

CUSTOM SET BUILDERS SUPPLY CO.,
168 Washington Street, New York, N. Y.
Please ship at once—

- One 180-volt maximum "B" eliminator, with variable detector and variable intermediate voltage (three different voltages in all); equipped with one Raytheon BH tube, 125 milliamperes rating. I will pay \$16, plus a little extra for freight, on receipt of goods, which are to be on approval for ten days (money back, if desired after 10-day trial).
- One "A" eliminator, 2 1/2-ampere maximum at 6 volts, using dry plate rectification, large choke and large capacity condenser, AC switch, receptacle for any "B" eliminator plug, variable resistor, all built in for which I will pay \$22, plus a little extra for freight.
- Both the "B" eliminator and the "A" eliminator, at total of \$36, on same approval basis.

Note: If fast express shipment is preferred, rather than slower freight, put a cross here

Name.....
Address.....
City..... State.....

ALL SHIPMENTS MADE ON APPROVAL FOR TEN DAYS

All prices quoted are NET!

Flat Amplification Was Designer's Goal

(Continued from page 5)

ent on the higher wavelengths there is every reason to believe that the curve represents the actual performance of the receiver above 300 meters.

The rapid rise in amplification of the

calculated curve below 300 meters is offset by the fact that on these lower waves there is a tendency for the receiver to oscillate, which is in turn offset by reducing the potential on the screen grids of the RF amplifier tubes by adjusting potentiometer, R1.

The effect of this reduction is to increase the plate impedance of the RF tubes, which, in turn, decreases the effective amplification and increases the effective selectivity. The net result is a flattening off of the over-all amplification curve much as shown by the dotted lines of Curve H, Fig. 5.

Curve H represents the actual performance of the receiver. It is seen to be quite flat, although the individual curves composing it were anything but flat to start with.

At this point it is interesting to go back and compare the RF amplification of the

(Continued on next page)

NEW CORPORATIONS

Salt City Radio Service, Syracuse.—Attys., Moot, Sprague, Brownell & Marcy, Buffalo, N. Y.

Espey Mfg. Co.—Attys., Hays, Podell & Shulman, 39 Broadway, New York City.

Simplex Radio Supply Co., Chicago, Ill.—Colonial Charter Co., Wilmington, Del.

Baird Television Corp., Wilmington, Del.—Corp. Trust Co. of America, Wilmington, Del.

Baird Parent, Inc., Wilmington, Del., patents, Corp. Trust Co. of America, Wilmington, Del.

Martwel Sales Co., radio apparatus—Attys. Bijur & Herts, 19 West 42nd St., New York, N. Y.



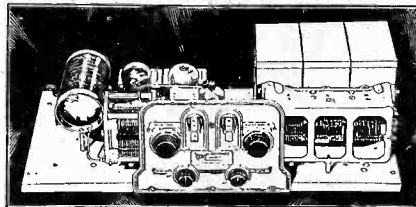
No. 720
Screen Grid
SIX KITS

LIST PRICE **\$72.55**

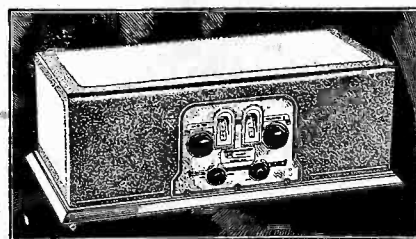
Custom Set Builders!
Cash in on this Fine Opportunity to Build an Outstanding Performing Set!
No. 700 Shielding Cabinet, \$9.25 extra, list price.

IN OFFICIAL FACTORY-SEALED CARTONS

THE OFFICIAL PARTS



The beautiful chassis of the newest kit-set sensation, the S-M Shield Grid Six.



The set as it looks in a No. 700 shielding cabinet This cabinet alone lists at \$9.25.

Only the official kit of tested parts, in factory-sealed cartons, is sold by us, all parts exactly as specified by McMurdo Silver.

These parts consist of:

Designation	Nature of Parts	List Price
B	One S-M 701 Universal Pierced escutcheon	\$ 3.00
E	One S-M 809 dual control escutcheon	2.75
D1	One S-M 806L (left) vernier drum dial	2.50
D2	One S-M 806R (right) vernier drum dial	2.50
C1	One S-M 320R .00035 mfd. Universal condenser	4.00
C2-C3-C4	One S-M 323 .00035 mfd. 3-gang condenser	13.50
C5	One S-M 342B .000075 mfd. midget condenser	1.75
SH1-SH2	Three S-M 638 copper stage shields @ \$1.50	4.50
SH3	One S-M 140 antenna coil	3.00
L1	Three S-M 132A plug-in RF transformers @ \$1.25	3.75
L2-L3-L4	Three S-M 512 5-prong tube sockets @ \$0.60	1.80
S1-S2-S3	Five S-M 511 tube sockets @ \$0.50	2.50
S4-S5-S6		
S7-S8		
T1	One S-M 255 first stage A. F. transformer	6.00
T2	One S-M 256 second stage A. F. transformer	6.00
W	One S-M 708 10-lead, 5-foot connection cable	1.75
	One S-M 818 hook-up wire (25 ft. to carton)	.50
R1	One Yaxley 53000, 3,000 ohm midget potentiometer	1.25
SW	One Yaxley 500 switch attachment	.40
J1-J2	Two Yaxley 420 insulated tipjacks @ \$0.125	.25
R2-R3-R4	Three Carter RU10, 10 ohm resistors @ \$0.25	.75
R6	One Carter A6, 6 ohm sub-base rheostat	.50
R5	One Carter H1 1/2, 1 1/2 ohm resistor	.25
C6	One Potter 104, 1 mfd. bypass condenser	1.00
C7-C8-C9		
C10-C11-C12	Six Sprague 1/4 mfd. midget condensers @ \$0.75	4.50
C13	One Polymet .00015 mfd. grid condenser with clips	.50
C14	One Polymet .002 mfd. bypass condenser	.40
R7	One Polymet 2 megohm grid leak	.50
R8	One Durham .15 megohm resistor with leads	.50
S9	One Naald 481XS cushioned tube socket	.65
RPI-BP2	Three Moulded binding posts consisting of 8/32 screw, nut, and moulded top @ \$0.10	.30
BP3	One Set hardware as listed below	1.00

UNUSUAL OFFER!

(Applies to this kit only!)

WE extend not only the regular business courtesy to custom set builders, but also make the unusual offer of FREE technical information and advice on the SM-720 Screen Grid Six. Any question concerning this circuit will be promptly answered. Write, telegraph, or visit us.

When you buy from us you have expert consulting engineers at your command!

SPECIAL!

Full-sized pictorial blueprint of the wiring, large schematic diagram and 8-page detailed building instruction booklet.

\$1.00

HARDWARE SET CONSISTS OF:

One 3/4"x1/4" hollow condenser studs; eight 1 1/2"x1/4" hollow coil studs; eight 1 1/2"x6/32 R. H. machine screws; six 1"x6/32 R. H. machine screws; twenty-nine 3/8"x6/32 R. H. machine screws; thirty-seven 6/32 nuts; forty-six Shakerproof lock washers; four 1/2"xNo. 10 R. H. wood screws; three lengths of spaghetti; four lengths bus-bar; two sets binding post insulating washers; three sets instrument insulating washers; two tipjack insulating washers; one metal washer; eighteen long soldering lugs; three grid clips.

8-page detailed Building Instruction Booklet, full-sized picture blueprint and schematic diagram FREE with each kit order.

GUARANTY RADIO GOODS COMPANY
145 WEST 45TH STREET
NEW YORK CITY

[A Few Doors East of Broadway]

(Continued from preceding page)

Screen Grid Six, ranging as it does from 250,000 times up, with the gain of the representative set measured and described previously.

The reason for the remarkable performance of the Screen Grid is easily appreciated when its voltage amplification of 250,000 times is compared with the 1,000-fold gain of the ready-made TRF sets.

Before passing on from the RF amplifier, it is well to mention that every precaution has been taken to render the performance of this portion of the receiver as stable and dependable as possible. This can be easily realized from an examination of the design, which reveals individual copper stage shielding for the tuned RF amplifier circuits, individual bypassing of all B supply leads by condensers directly in the stage shields, and the isolation of all RF currents from any common paths which might cause coupling and instability.

No Stray Pick-ups

The antenna input circuit is thoroughly shielded from the three remaining RF circuits, and when the receiver cabinet is in place, it is thoroughly shielded from extraneous interference. It is then practically impossible to receive the strongest local signal if the antenna lead-in wire be removed from the set.

Yet with a one-foot wire for an antenna added, many stations come in with ample loudspeaker volume, so great is the pick-up of the set.

To compensate for varying antenna characteristics, the option of two methods of antenna coupling is provided and one is equipped with a variable selectivity control in the form of a 75 mmfd. antenna series condenser, CS. The single tuning condenser C1, tunes the antenna circuit, and the triple gang condenser, C2, C3, C4, tunes the three remaining RF circuits housed in shields SH1, SH2, SH3.

The construction of this condenser is such that its accuracy is permanently assured through the use of a heavy die-cast frame which adequately protects and permanently aligns all plate assemblies, which are double-spaced. The condenser accuracy is guaranteed by the manufacturers to within 1% over the upper half of the dial and to within 1 mmfd. over the lower half of the dial, which accuracy is more than ample to provide 10 kc. selectivity (1% plus and 1% minus is usual tolerance for the finer ready-made sets).

Compensators' Function

Three compensators are provided upon sections C2, C3 and C4, which allow compensation, once the set is assembled, for variations in tube and circuit capacities.

Oscillation over the lower portion of the broadcast band, and volume over the entire band, is controlled by the potentiometer, R1, which varies the potential on the screen grids of the RF amplifier tubes, S4, S5, S6.

The detector, S9, presents no unusual features, being the conventional grid-condenser (C13) and leak (R7) type, with negative filament return, since this was found to give better results in the Screen Grid Six.

Other Illustration on Front Cover

[This concludes Part I of McMurdo Silver's two-part article on the new Screen Grid Six. Part II will be published next week, issue of August 25th. In subsequent issues others will present facts they have gleaned from personal operation of the receiver over a period of two months.—Editor.]

Recent Issues of RADIO WORLD, 15 cents each. Any number published in 1928 available for a short while. Six issues 75 cents, 10 issues \$1.00. Send stamps, coin or money order NOW, before the issues are sold. RADIO WORLD, 145 West 45th Street, New York City.

Selectivity Is Preferred To Higher Gain Per Stage

Practical considerations of selectivity have been invoked in the S-M 720 so that inter-station interference will be absent, heterodyne interference reduced to a practical minimum, since this is largely independent of receiver characteristics, and maximum gain per stage is somewhat sacrificed to attain 10 to 15 kc. selectivity.

The choice was dictated by experience, since a receiver is to be judged on its actual performance rather than on theoretical calculus. For instance, a gain of 14 per stage at 550 meters and of 30 per stage at 200 meters, was an expert and deliberate choice, since the 30 to 65 gain per stage easily attainable would destroy the selectivity.

The gain at the tuned input (antenna coil) is somewhat greater.

The Aerovox Research Worker is a free monthly folder that will keep you abreast of the latest developments in Radio. A postcard will put your name on the mailing list. Write today. Aerovox Wireless Corp., 72 Washington Street, Brooklyn, N. Y. Includes an image of a radio set.

THE SHOW NUMBER of Radio World will be published under date of September 15th. This issue goes to press Wednesday, September 5th. It will contain extra features, is assured of extra circulation, and commemorates the Fifth Annual Radio World's Fair, Madison Square Garden, September 17th to 22nd. Advertising rates in the Show Number will not be advanced over usual rates. See editorial page of this issue for rates. RADIO WORLD 145 West 45th Street, New York, N. Y.

THE DIAMOND OF THE AIR Using General Purpose Tubes 4 Tubes Set uses three type A tubes and one 112 type; has TRF stage, regenerative detector and two stages of transformer coupled audio. (This is not Shielded Grid Diamond.) 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.)

Guaranty Radio Goods Co., 145 West 45th Street, New York City. Please send me one newly printed official blueprint of the— [] 5-tube Diamond of the Air [] 4-tube Diamond of the Air (Check off one you want.) and the textual data giving full directions for construction. Enclosed please find 25 cents to defray all expense. NAME ADDRESS CITY STATE (These are not Shielded Grid Diamonds.)

A New Fabricone Wall Speaker

Designed by Penn

Made of special fabric treated with liquitone which revolutionizes reproduction. Fifteen inches in diameter, in beautiful colors, bound in silk cordings, and highly ornamental. Driven by the famous G.R.P. Cone Unit with sturdy horse shoe magnet, four pole pieces and double adjustment which renders it adaptable to all outputs.



Shipped in Kit Form.

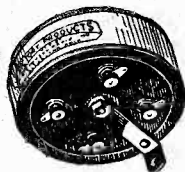
\$11.50

Easily and Quickly Assembled.

Send check or money order for immediate delivery.

GEORGE R. PENN CO.

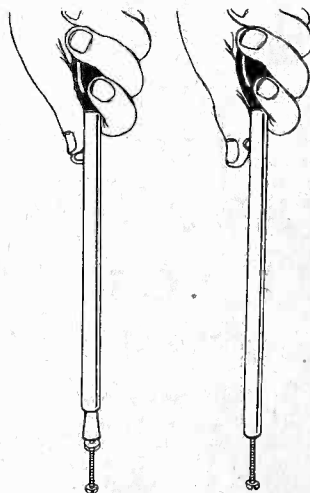
Dept. A 231 MERCER STREET NEW YORK Catalogue of Wall Speakers and accessories on request.



VICTOREEN Super Coils

Geo. W. Walker Co. 2825 Chester Avenue Dept. B Cleveland, O.

Socket Wrench FREE!



Push out the control lever with knob (as at left) and put wrench on nut. Push down on handle only (at right), then turn nut left or right.

One of the handiest tools for a custom set builder, service man or home constructor is a BERNARD socket wrench. It consists of a 6 1/2" long metal tubing in which is a plunger, controlled by a knob. The plunger has a gripping terminal (called a socket, hence the name "socket wrench") that may be expanded or contracted to fit 6/32, 8/32 and 10/32 nuts, the most popular sized nuts in radio. Use the knob to push out the plunger, press down on the handle to grip the nut, then turn the nut to left for removal or to right for fastening down. Total length, distended, including stained wooden handle, 10". Gets nicely into tight places. Send \$1 for 8 weeks' mail subscription for RADIO WORLD and get this wrench FREE. No other premium with this offer. Act NOW!

RADIO WORLD

145 WEST 45TH ST., N. Y. CITY A few doors east of Broadway

Industries Banquet To Be Held Sept. 18

The Fifth Annual Radio Industries Banquet, sponsored by the three great groups composing the radio industry, will be held Tuesday, Sept. 18, at the Hotel Astor, New York City. The groups are the National Association of Broadcasters, the Radio Manufacturers Association and the Federated Radio Trade Association. Linked together, from 10 to 12 o'clock,

eastern daylight saving time, on this occasion, will be all of the station of the Red, Blue and Pacific Coast networks of the National Broadcasting Company, the chain of the Columbia Broadcasting System, and, in addition, a large number of other stations not included in either chain, but members of the National Association of Broadcasters.

The Banquet is an annual affair held in conjunction with the Annual Radio World's Fair at Madison Square Garden. The Fifth annual Fair will take place this year Sept. 17 to 22.

DOUBLE SHIELD PORTABLE BLUEPRINT

Actual size, clear wiring in picture form, after H. G. Cisin's pattern, exactly as described in this issue. Indorsed by him.

PRICE \$1.00

Send Check or M. O. for Immediate Delivery or Come in Person

Guaranty Radio Goods Co.

145 WEST 45TH STREET
NEW YORK, N. Y.
(Few Doors East of Broadway)

McCULLOUGH TUBES NOW PLENTIFUL

For some time, the McCullough AC tubes were reported as scarce. The A. C. Neon Corp., at 122 Greenwich Street, New York City, announces that it can supply all demands. Those desiring detailed information should address the above concern. Mention RADIO WORLD—J. H. C.

Recent Issues of RADIO WORLD, 15 cents each. Any number published in 1928 available for a short while. Six issues 75 cents, 10 issues \$1.00. Send stamps, coin or money order NOW, before the issues are sold. RADIO WORLD, 145 West 45th Street, New York City.

Kiley's Best Seller

Under the direction of Pat Kiley, known from coast to coast, sales of the B. B. L. unit in the red box with the yellow label, are steadily increasing. The volume of sales has been kept high even during the hottest weeks. The unit is manufactured by the Best Manufacturing Company, of Irvington, New Jersey, represented in New York City by the Sanford Radio Corporation, 122 Greenwich street.

Mr. Kiley is the chief district sales manager, with offices at 30 Church Street, New York City. He has a novel sales plan for dealers that he explains masterfully. Fans that want to know what this unit can do for them in the line of tone quality also may address Mr. Kiley. Mention RADIO WORLD—J. H. C.

New Sonatron Tube

The Sonatron Tube Company, 108 W. Lake St., Chicago, Ill., makers of radio receiving tubes, announced the X171AC, especially designed for output tube in receivers operated on alternating current, as a replacement tube for the -71 type. It is claimed that the new tube offers a longer life, improves tone and increases volume. Those who are interested in the new and specially designed AC tube should write Sonatron Tube Co., 108 W. Lake St., Chicago, Ill. Mention RADIO WORLD.

Bakelite Front and Aluminum Subpanel for the

4-Tube Screen Grid

DIAMOND OF THE AIR . . .

\$5.00

Five-Day Money-Back Guarantee

View of the Completed Receiver, using Drilled Front Panel and Aluminum Subpanel

Finest eye appeal results from construction of the 4-tube Screen Grid Diamond of the Air when you use the official panels. The front panel is bakelite, already drilled. The subpanel is aluminum, with sockets built-in, and is self-bracketing. Likewise it has holes drilled in it to introduce the wiring, so nearly all of it is concealed underneath set. Make your set look like a factory job.

Front panel alone, bakelite, drilled.....\$2.35
Aluminum subpanel alone, drilled, with sockets built-in..... 3.00
Screws, nuts and insulating washers supplied with each subpanel.

GUARANTY RADIO GOODS CO.

145 WEST 45TH STREET

[A few doors east of Broadway]

NEW YORK, N. Y.

Take Your Choice of 5 Other Publications

For NEW RADIO WORLD Subscribers Ordering NOW

Radio World has made arrangements

—To offer a year's subscription for any one of the following publications with one year's subscription for RADIO WORLD—

RADIO NEWS or SCIENCE and INVENTION or BOYS' LIFE or RADIO DEALER or RADIO (San Francisco).

This is the way to get two publications

- for the price of one:
- Send \$6.00 today for RADIO WORLD
- for one year (regular price
- for 52 numbers)
- and select any one of the other
- six publications for twelve months.
- Add \$1.00 a year extra for
- Canadian or Foreign Postage
- Present RADIO WORLD subscribers
- can take advantage of this offer by
- extending subscriptions one year
- if they send renewals NOW?

Radio World's Special Two-for-Price-of-One Subscription Blank

RADIO WORLD, 145 West 45th Street, New York City.

Enclosed find \$6.00 for which send me RADIO WORLD for twelve months (52 numbers), beginning and also without additional cost, Radio News, or Science and Invention, or Radio Dealer, or Radio (San Francisco), or Boys' Life (or \$10.00 for a two-year subscription to one address), thereby getting RADIO WORLD and the other selected magazine, BOTH for two years. No other premium with this offer.

Indicate if renewal. Name

Offer Good Until Street Address

September 15, 1928 City and State

NO OTHER PREMIUM OF ANY KIND WITH THIS OFFER

BIG OFFER!

Radio World for **50c**
Four Weeks . . .

Blueprint FREE!

of 4-Tube Screen Grid Diamond of the Air

At 15c per copy RADIO WORLD costs you 60c for four weeks. But if you send 50c NOW you get the first and only national radio weekly for four consecutive weeks and a blueprint FREE!

This blueprint is life-sized and shows in easy picture diagram form how to mount parts and wire this super-sensitive receiver. One screen grid tube is used as radio frequency amplifier. The rest of tubes are two—01A and one 112A.

This circuit gives you distance, tone quality, ease of performance. No shielding, no neutralizing required!

ACT NOW!

This offer holds good only until August 30th and coupon below **MUST** be used as order blank.

Radio World, 145 West 45th Street, New York City

Enclosed please find 50 cents (stamps, coin, check or money-order) for which please enter my name on your mail subscription list for the next four issues of RADIO WORLD, and send me FREE at once a blueprint of the Four-Tube Screen Grid Diamond of the Air (front panel and subpanel wiring, schematic diagram and parts list.

Name

Address

City State

Renewal.

If you are a mail subscriber for RADIO WORLD you may extend your subscription four weeks. Put a cross in the square in front of the word "renewal," to show you are a subscriber already.

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, mostly television.

Real MUSICAL Instruments Are Made of Wood!

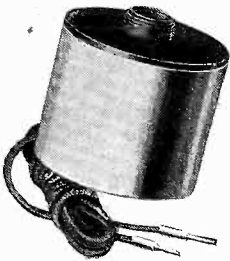
THE SWEET MELLOWNESS OF WOOD GIVES REAL MUSIC!

THE finest reproduction is made possible by the long tone chamber horn loudspeaker, for then you hear the true sounds, without over-emphasis or under-emphasis, in other words, without distortion. Violins, pianos, flutes, cellos and the like are not made out of paper or cloth, but out of wood. Nature chose wood as the unsurpassed vehicle of sound. Man utilized the long tone chamber to make the sound supremacy of wood available for radio reproducers.

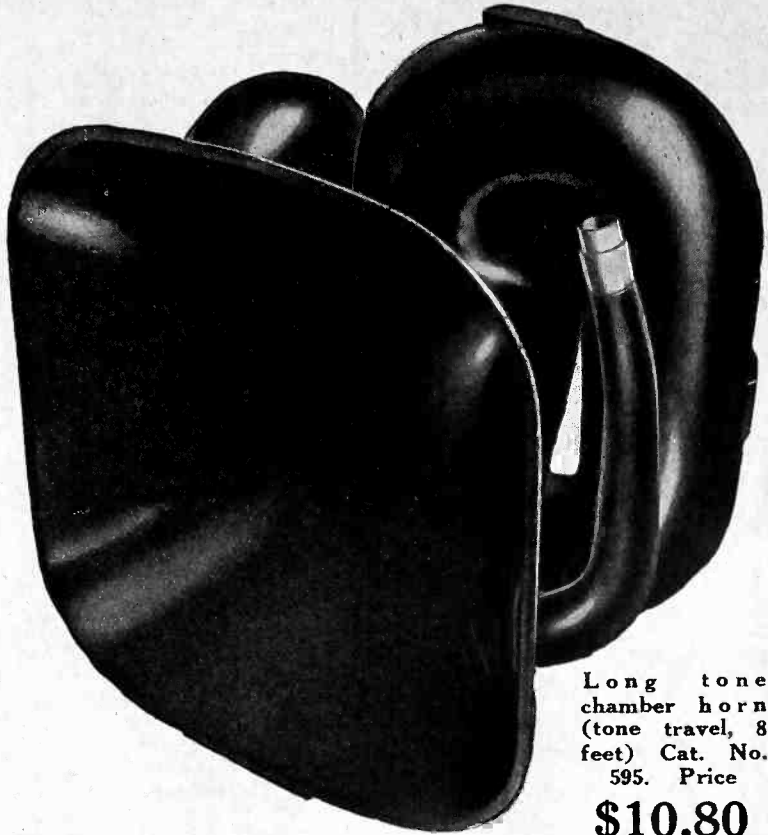
With fine quality moulded wood formed into a long tone chamber you hear the orchestral instruments stand out individually,—sounds from the boom of the bass drum, the zoom of the cello, to the sweet, high notes of piccolo and clarinet. And the human voice is natural, real. The hissing sounds of speech—high audio frequencies—come through as realistically as the guttural.

Use a long tone chamber horn, like the No. 595 illustrated at right, with a specially sensitive and faithful motor, (Cat. No. 112), shown at left and enjoy the best. Cat. No. 595, horn loudspeaker, tone travel 8 feet; over-all dimensions, 21 1/4" high, 18" wide, 13" or 15" deep. Nozzle takes standard size unit. Price \$10.80.

Felt-padded Baffle Board FREE with each order for a No. 595. The baffle is used as the inside shipping box. No need to remove the horn from the box. Use the outfit as you receive it, inside a cabinet, or in any other place you desire.



Horn Motor, Cat. No. 112. Price \$4.20.



Long tone chamber horn (tone travel, 8 feet) Cat. No. 595. Price \$10.80

Smaller Model Meets Space Economy Needs

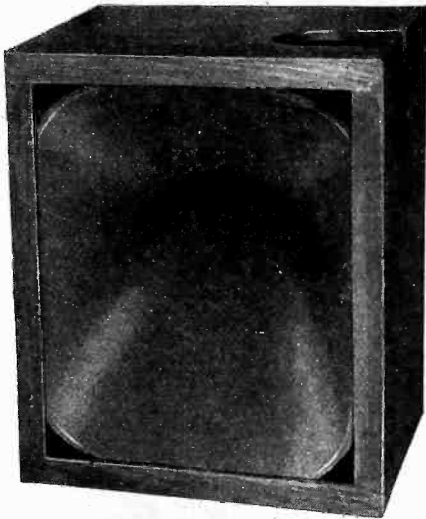
WHERE space requirements limit you to a smaller size horn, use Cat. No. 570, illustrated below. The tone quality of this medium-sized model far surpasses that of the usual cones, but does not quite come up to that of the No. 595 on the extremely low register (40 cycles and less). However, it is a very satisfactory horn, as good as can be made for the smaller space.

Your mounting problems are solved completely with this model, as with the other, due to the inclusion of a FREE baffle board with each order.

No one need hesitate ordering the smaller model if space limitations compel such choice, for the result will be charming beyond expectations.

Cat. No. 570 horn loudspeaker, tone travel 6 feet; over-all dimensions 15" high, 12" wide, 12" deep. Nozzle takes standard size unit. Price \$7.80.

Felt padded baffle board FREE with each order for a No. 570.



Baffle Board FREE with each horn order!

FREE Baffle Board with Each Order

THE long tone chamber moulded wood horns are sold with an offer of a FREE baffle board that is felt-padded so that the horn is felt-suspended and doubly protected against possibility of rattles. This is the final point of protection and perfection.

What DeForest Says:

"I do not consider any of the cones now on the market come anywhere near the perfect loudspeaker. Cones invariably favor some frequencies at the expense of others and most of the cones, while over-emphasizing the bass, put a mask of paper rattle over the higher frequencies. There are certain types of non-metallic horns now on the market which, with proper loudspeaker units, give far better reproduction than any 18-inch cone. I strongly advocate a radio set built into a large console cabinet with sufficient room to take in one of the larger exponential horns."

—Dr. Lee DeForest in "Radio News" for April, 1928.



Medium sized tone chamber horn (tone travel, 6 feet) Cat. No. 570. Price \$7.80.

Why saddle a good set to a poor speaker?
Travel 8 feet and get somewhere! Travel 6 feet and outstrip the others, anyway!

SEND NO MONEY!

ACOUSTICAL ENGINEERING ASSOCIATES, 143 West 45th Street, N. Y. City
Please ship me at once the following (check off):

- One No. 595 at \$10.80 plus a little extra to defray shipping costs; also send FREE baffle board. 15" width will be sent unless 13" is specified by a cross in this square
- One No. 570 at \$7.80 plus a little extra to defray shipping costs; also send FREE baffle board.
- One No. 112 horn motor (universal nozzle) at \$4.20 plus a little extra for shipping.

Name

Address

City State

5-Day Guarantee of Money Right Back if Not Delighted—
No Stalling—No Questions!

United Fruit Company Asks Suit Dismissal

Washington.
The United Fruit Company, one of the eight respondents named by the Federal Trade Commission in its complaint of monopoly and unfair methods of competition in the radio equipment and accessory field (Docket No. 1115), filed with the Federal Trade Commission a brief in support of its motion to dismiss the complaint. The brief, submitted by William K. Jackson, J. Harry Covington, and John L. Warren, charged that "erroneous" inferences and conclusions regarding manufacture of radio apparatus and radio communication as they affect the United Fruit Company had been made. The brief was in reply to that filed by Edward L. Smith,

counsel for the Commission, and supplemented the oral argument of counsel for the Company made June 19th. Other respondents in the case are the Radio Corporation of America, the General Electric Company, the American Telephone & Telegraph Company the Western Electric Company, Inc., Westinghouse Electric & Manufacturing Company, the International Radio Telegraph Company, United Fruit Company and the Wireless Specialty Apparatus Company.

NEXT WEEK'S ISSUE

Among the articles in next week's issue of RADIO WORLD will be one on the construction of an AC or DC short-wave adapter. The value of Series Filaments will be discussed in another article. The S-M Screen Grid Six will be featured again in the second instalment. Pointers on modulation will be printed.

N. Y. AND CHICAGO SHOW DATES

The Fifth Annual Radio World's Fair will be held in Madison Square Garden, New York City, September 17th 22d. The Seventh Annual Chicago Radio Show will be held at the Coliseum, October 8th to 14th. These shows are for the public.

SUBSCRIBERS!

Look at the Expiration Date on Your Wrapper

Please look at the subscription date stamped on your last wrapper, and if that date indicates that your subscription is about to expire, please send remittance to cover your renewal.

In this way you will get your copies without interruption and keep your file complete.

Subscription Dept., RADIO WORLD, 145 West 45th Street, New York City.

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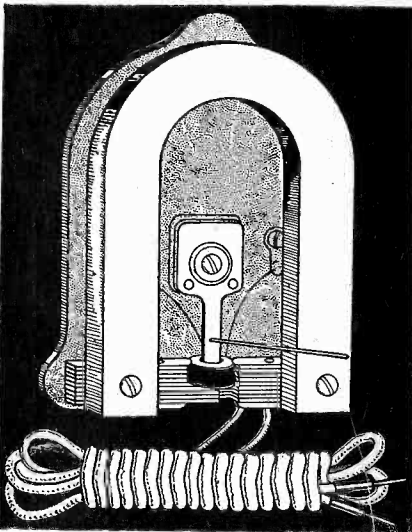
ARE YOU INTERESTED IN DX?

It's by no means a lost art. Greater distances than ever before can be covered today—if you know how. Try some of the ingenious stunts described in "The Gateway to Better Radio"—that big, unselfish, understandable manual of 20,000 words and 88 illustrations, which is yours for 25 cents a copy. Get yours today from your dealer or direct from

CLAROSTAT MANUFACTURING CO., Inc.
285 North Sixth St. : : Brooklyn, N. Y.

CLAROSTAT
REG. U. S. PAT. OFF.

A Strong, Rugged Loud Unit 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

SEND NO MONEY!

GUARANTY RADIO GOODS CO.,
145 West 45th St., New York City.

Please send me one cone speaker unit (Cat. 1098), as advertised, with apex. I will pay postman \$3.75, plus few cents extra for postage. Your 5-day money-back guaranty is accepted.

Name

Address

CityState

5-DAY MONEY-BACK GUARANTEE!

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

10 cents a word — 10 words minimum — Cash with Order

FOR SALE: Sentinel Dry A-B-C power unit with tubes \$44.50. 8 foot orthophonic horn size 24 1/2 x 18 x 15 inches, with Temple unit \$8.00. Fritts super cabinet, panel size 7" x 24" \$12.00. Multi-valve receiver \$5.00. Aerial kit \$.98. SM 222 output trans. \$3.00. Utah upright type piano speaker \$4.00. Everything guaranteed new. Charles Frick, 311 N. Cherry St., Van Wert, Ohio.

RECENT ISSUES of Radio World, 15c each. Radio World, 145 W. 45 St., N. Y. City.

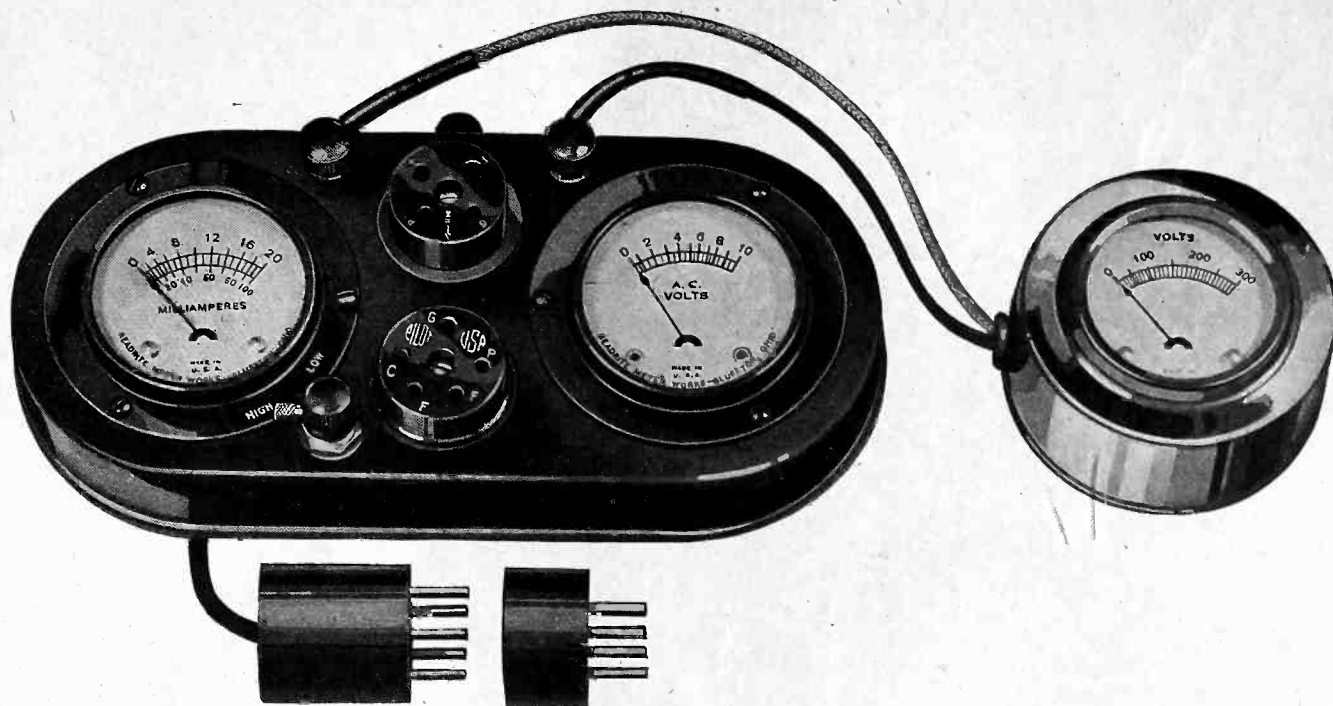
ARTISTS and Art Students are printing 250 signs or pictures an hour without machinery. Sample and particulars 10c. Staco, 1014 Mulberry, Springfield, Ohio.

SCREEN GRID TUBES, famous standard manufacturers. no bootleg, \$4.50 each. Special three circuit tuner, high primary impedance for screen grid tuned plate, \$2.50. Antenna coil for screen grid circuits, adjustable primary, \$2.00. Aluminum shield caps fit over entire screen grid tube, \$1 each, C.O.D. only.—Philip Cohen, 236 Varet Street, Brooklyn, N. Y.

BLUEPRINTS of National Screen Grid Five, 4-tube Screen Grid Diamond and Karas 3-tube Short Wave Set—three blueprints—one dollar. Guaranty Radio Goods Co., 145 W. 45th St., N. Y. C.

Recent Issues of RADIO WORLD, 15 cents each. Any number published in 1928 available for a short while. Six issues 75 cents, 10 issues \$1.00. Send stamps, coin or money order NOW, before the issues are sold. RADIO WORLD, 145 West 45th Street, New York City.

12 VITAL TESTS In Only 4½ Minutes!



The Handsome Outfit, Shown One-Half Scale

With this Scientific Trouble Shooting Combination AC and DC Tester (at left) and the high resistance voltmeter (at right) twelve vital tests were made of tubes and receivers, in 4½ minutes; because the combination can be used quickly for the following purposes:

- (1) to measure the filament voltage, up to 10 volts, of AC and DC tubes.
- (2) to measure the plate current of any one tube, including any power tube, from less than 1 milliamperes up to 100 milliamperes;
- (3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more). Open common A and B of set and connect to P of tester socket and to P prong under adapter plug;
- (4) to measure the B voltage applied to the plate of tube; the voltage across B batteries or B eliminators, up to 300 volts.
- (5) To determine the condition of a tube, by use of the grid bias switch.
- (6) To measure any tube's electronic emission (tester cuts in at no load, hence plate current equals filament emission).
- (7) To regulate AC line, with the aid of a power rheostat, using a 27 tube as guide, turning rheostat until filament voltage is 2.5 or 2.25 volts.
- (8) To test continuity of resistors, windings of chokes, transformers and circuits generally.
- (9) To find shorts in bypass and other condensers, as well as in inductances, resistors and circuits generally.
- (10) To read grid bias voltages, including those obtained through drops in resistors (bias read by noting plate current and voltage and consulting chart).
- (11) to determine the presence of distortion and overloading, by noting if milliammeter needle fluctuates.
- (12) to determine starting and stopping of oscillation, as milliammeter needle reads higher current for oscillation and lower for no oscillation.

GUARANTY RADIO GOODS CO.,
145 West 45th Street, New York City.

Please send me at once, on a five-day money-back guaranty, one complete Two-in-One (AC and DC) scientific trouble-shooting test set, consisting of one No. 215 and one No. 346, for which I will pay the postman \$13.50, plus a few cents extra for postage.

- If 0-500 v. high resistance voltmeter No. 347 is preferred, put cross in square and pay \$14.50, plus postage, instead of \$13.50, plus postage.
- One No. 215 alone, \$10.00.
- One No. 346 alone, \$4.50.
- One No. 347 alone, \$5.50.
- Two adapters for UV-199 tubes, \$1.00.

NAME

ADDRESS

CITY..... STATE.....

Service Men, Custom Set Builders, Home Constructors, Experimenters, Teachers, Students, Laboratories

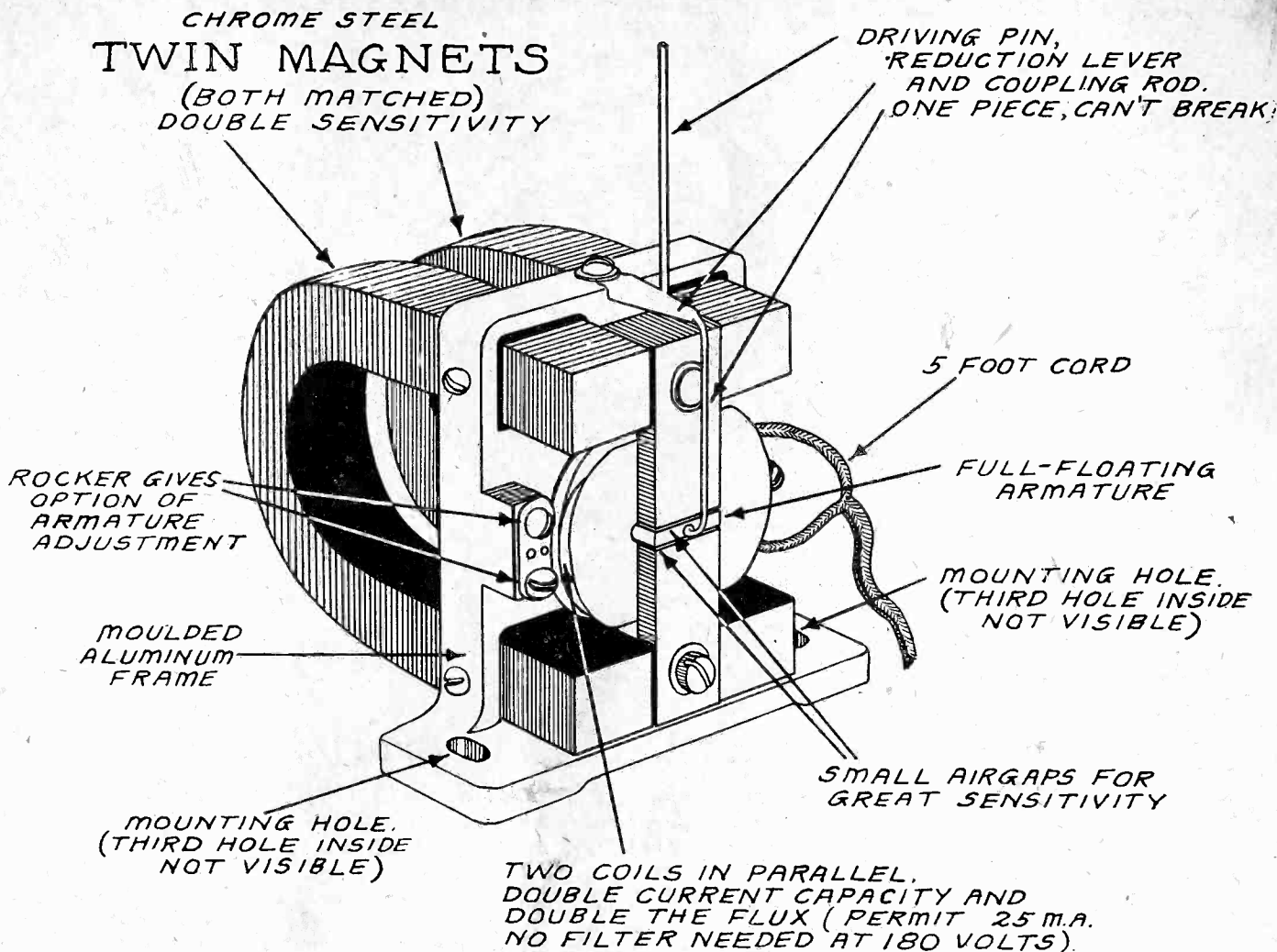
Order one of these combination 215 AC-DC testers and 346 meter 0-300 volts. Send no money. Just fill out coupon. If after five-day test you're not delighted, return and purchase price will be promptly refunded! Here's what you get for only \$13.50.

- (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.
- (2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.
- (3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.
- (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.
- (7) One 4-prong socket.
- (8) Two binding posts.
- (9) One handsome noire metal case.
- (10) One instruction sheet.

\$13.50
SEND NO MONEY

[If 0-500 voltmeter No. 347 is desired instead of No. 346, price of combination is \$14.50.]
No. 215 Universal AC-DC Tester Alone.....\$10.00
No. 346 high resistance 0-300 voltmeter alone.....\$4.50
No. 347 high resistance 0-500 voltmeter alone.....\$5.50

BY STORM!



The Polo Unit is shown $\frac{3}{4}$ actual size. It weighs three full pounds.

SO obviously superior are its advantages that the New Polo Duo-Magnetic Unit has taken the country *by storm*. Such enthusiastic success has immediately greeted few radio devices as attended the recent introduction of the Polo Unit.

Everybody who has the slightest knowledge of what a unit should be could see at a glance that expert design at last realized what others vainly sought for years.

If you want a unit to improve your present speaker, or to make the speaker you are about to build do more than you could reasonably expect, a unit giving you the *utmost* in volume, the *finest* in tone, capable of handling even the output of two —50 tubes in push-pull, and, of course, any smaller output, then use the Polo Duo-Magnetic Unit.

POLO ENGINEERING LABORATORIES,
57 Dey St. (Suite 6), corner Greenwich St.,
New York, N. Y.

Enclosed please find ten dollars for which send me one Polo Duo-Magnetic Unit, with five-foot cord, moulded metal bracket, apex, chuck and nut. YOU ARE TO PAY SHIPPING CHARGES. If after a 10-day trial I return the unit YOU WILL QUICKLY REFUND THE TEN DOLLARS.

NAME

ADDRESS

CITY STATE

[Note: Shipments Begin on August 25, Orders Filled in Sequence of Their Receipt]

Scientific minds combined their ingenuity and skill to produce the finest—and the popular verdict proves the boundless measure of their success.

POLO ENGINEERING LABORATORIES

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