JAN. 7 1928 #302 15 Cents

RADIO WORLD
REG. U.S. PAT. OFF.
America's First and Only National Radio Weekly

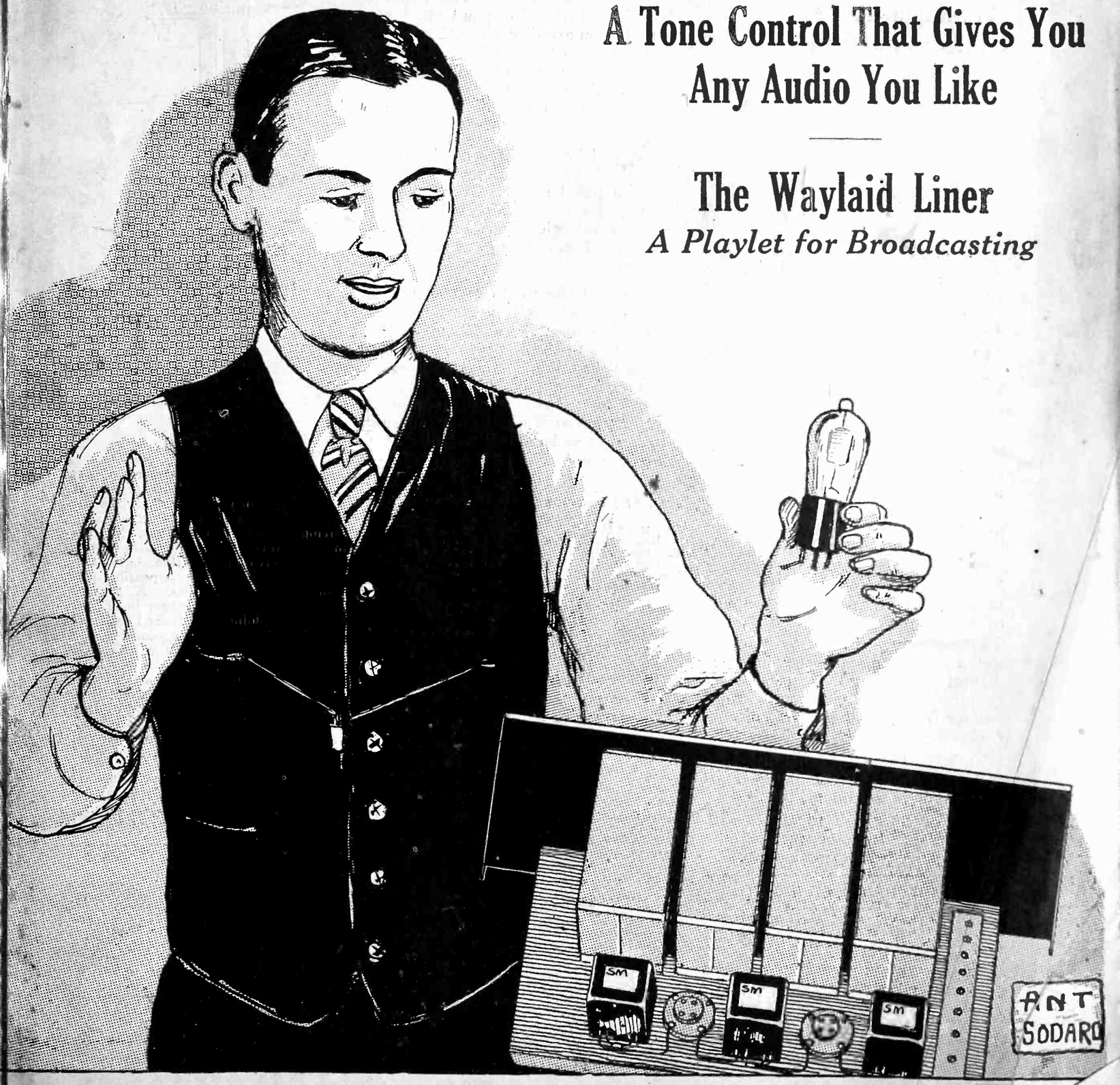
McMurdo Silver's Circuits for Shielded Grid Tube

A General Radio Power Amplifier and 210 Push-Pull Unit

A Tone Control That Gives You Any Audio You Like

The Waylaid Liner

A Playlet for Broadcasting



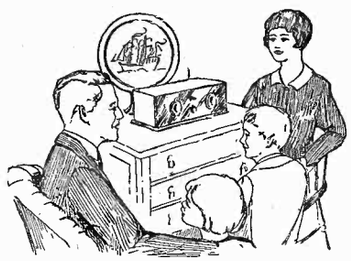
THE SHIELDED GRID TUBE NEEDS A CIRCUIT SPECIALLY DESIGNED FOR IT. SEE PAGE 3

Coil-Tenna

the wonder AERIAL

WILL improve any radio set regardless of price—because it reduces interference to a minimum, improving tone quality, provides sharper tuning, and separates the stations, as it is non-directional.

So Simple—A $4 child can put it up!



"Did you ever hear anything so perfect, dear? Just think, that $4. COIL-TENNA shuts out interference and brings in one station at a time clearer, stronger and richer than we ever heard them. COIL-TENNA surely is a wonder!"

THE COIL-TENNA requires but one pole any length, preferably ten feet or over, depending on location. Storms will not affect it.

The supports and braces are of the best kiln dried ash, boiled in a special solution to provide thorough insulation against dampness, such as rain, snow and ice. It will not ground. The copper wire used is heavily enameled to prevent corrosion.

Simply remove from carton, screw to pole and erect on roof—outside of window—or on porch.

The moment you hook to it, you'll get a gratifying surprise in more distant stations and sharper, clearer tuning. And it's up to stay without danger from snow, ice, wind or corrosion.

Diameter, 14 inches; height, 14½ inches; weight, 4¼ pounds, packed for complete shipment.

Pole, 15 inches high, furnished with each order; also mounting screws. Nothing needed except lead-in.

GUARANTY RADIO GOODS CO.,
145 WEST 45TH ST., N. Y. CITY

Please send me at once, one COIL-TENNA, for which I will pay the postman $4.00, plus a few cents extra for postage, on receipt.

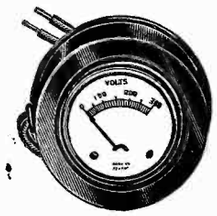
NAME .....

STREET ADDRESS .....

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

"Double R"

Panel Meters Rugged and Reliable Assets for Your Sets



TUBES last longer when the voltages are right. The panel meter is just the thing you want for that. If you are discriminating you want the finest tone quality. A 0-50 milliammeter in the plate circuit of the last tube serves that object admirably. Mount the meter on the panel.

You will be delighted at the enjoyment that will be afforded by the use of a panel meter. The **Double R** meters are sturdily built and accurate, yet priced very modestly.

You send us nothing yet we send the meters.

All you have to do is to let us know what meters you want. Order by catalog number, which appears on the left in the list printed herewith. When the postman delivers the meter you pay him the price listed below, plus a few cents postage. Then you will put your meter into action and enjoy the fruits of your wise buy. Note AC meters for new AC tubes.

DC PANEL MILLIAMMETERS

	Price		Price
No. 311—0-10 milliamperes	$1.95	No. 390—0-100 milliamperes	$1.65
No. 325—0-25 milliamperes	1.85	No. 399—0-300 milliamperes	1.65
No. 350—0-50 milliamperes	1.65	No. 394—0-400 milliamperes	1.65

DC PANEL VOLTMETERS

	Price		Price
No. 326—0-6 volts.	$1.65	No. 342 — 0 - 1 5 0 volts	$1.75
No. 335—0-8 volts.	1.65		
No. 310—0-10 volts	1.65	No. 340 — 0 - 8, 0 - 100 volts (double reading)	2.25
No. 337—0-50 volts	1.65		
No. 339—0-100 volts	1.75		

DC PIN JACK VOLTMETERS

	Price
No. 306—0-6 volts for No. 25, 28 Radiolas	$2.50
No. 308—0-6 volts for No. 20 Radiolas	2.50
No. 307—0-6 volts, desk type with cord	2.50

AC PANEL VOLTMETERS

	Price		Price
No. 351—0-15 volts	$1.75		
No. 352—0-10 volts	$1.75	No. 353—0-6 volts	1.75

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

Please send me Double R meters catalogue numbers ....., for which I will pay the postman on receipt of meters, plus a few cents extra for postage. These meters are to be received by me on a 5-day money-back guaranty.

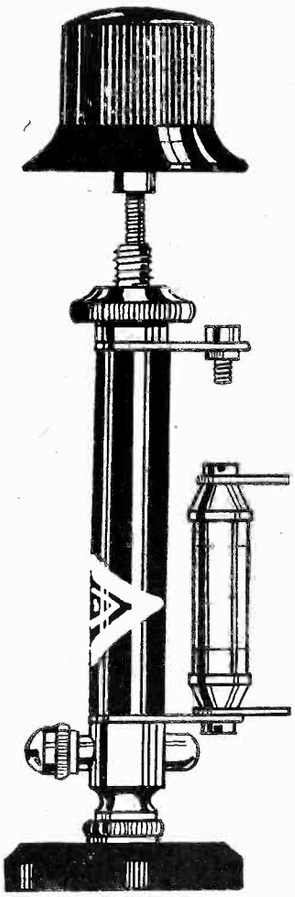
Name .....

Address .....

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

BRETWOOD

Variable Grid Leak De Luxe Model



BETTER BY FAR, than any fixed leak in the detector circuit is the Bretwood Variable Grid Leak.

Why?

Because it allows adjustment of grid voltage to maximum sensitivity for reception of far-distant signals, while permitting faster discharge of electrons when receiving strong local stations, thus preventing distortion due to this. Therefore, a Bretwood Variable Grid Leak means more miles plus best possible tone, without any extra tubes. A patented plastic and fool-proof plunger insure permanence in holding any desired resistance setting from .25 to 10 megohms, as well as the very long life of the leak itself. As no grid leak can function any better than its grid condenser, be sure that you employ a leak-proof Bretwood Bullet Condenser of mica dielectric and of .00025 mfd. capacity. This precision product is accurate to within one-tenth one per cent.

FREE

hookups are supplied with each purchase.

DON'T SEND A SOLITARY CENT!

The Bretwood Leak may be baseboard or panel mounted. Works the same in any position. No fluid used.

Guaranty Radio Goods Co.,
145 West 45th Street, N. Y. City

Please mail me at once one New and Improved 1928 Model De Luxe Bretwood Variable Grid Leak with one Bretwood Bullet Condenser attached, for which I will pay the postman $2.25 on receipt. Both must be the genuine Bretwood articles, imported from England.

Name .....

Street Address .....

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

SIXTH YEAR

RADIO WORLD

REG. U.S. PAT. OFF

Technical Accuracy Second to None.

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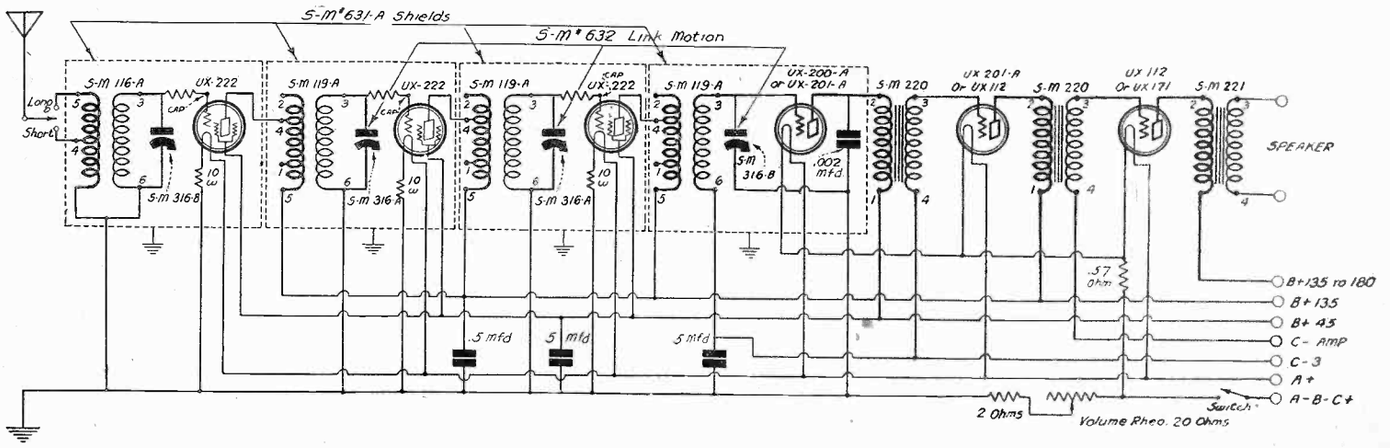
The Shielded Grid Six

The First National Presentation of the Loop and Antenna Models Utilizing the New Tubes with Their Strong Amplification

HEREWITH is presented the first tuned radio frequency receiver to be featured in a national radio magazine utilizing the new shielded grid tubes. After careful tests of many designs of his own devising Mr. Silver selected two—one for antenna, the other for loop operation. Mr. Silver's absorbingly interesting discussion of these receivers, in this week's issue, will be followed by other enthusiastic presentations on the same fascinating subject, during consecutive weeks, so don't fail to get next week's issue.

He discusses the circuit from a most practical aspect. For instance, he discards as impractical the theoretical maximum amplification obtainable from the shielded grid tube. Instead of 150 or so, he finds that 30 is all that the usual limitations will permit—but oh, what a powerful kick resides in that thirty! What his sound engineering reasons are will be found carefully related in the following.

Read every word of it.



The Shielded Grid Six

By McMurdo Silver

THE new Silver Marshall Shielded Grid Six receivers, type 630-SG (antenna operated), and type 630-LSG (loop operated) are probably among the most outstanding radio receivers of the day, for through the use of the new "shielded" or "screened" RF amplifier tubes, these sets provide a degree of sensitivity, selectivity, and tone unequaled by any commercial factory-built sets, and all with an antenna or loop so small as to equal or exceed the performance of other sets in or above the price class of the Shielded Grid Sixes.

These remarkable receivers and their construction, testing and operation are described in the following paragraphs.

The performance of the 630-SG receiver using a fifteen to thirty foot indoor antenna, and of the 630-LSG receiver using a small loop antenna, is practically identical, though the loop-operated 630-LSG model is recommended as providing generally more satisfactory selectivity, since only too frequently the enthusiastic builder of the 630-SG antenna-operated model will try to use too long an antenna, with resultant poor performance.

It is safe to say that either set operated with suitable antenna and accessories will outperform any commercial factory-built set on the market in a direct comparative test. Thus, were a 630-LSG set to be tested against a seven or eight tube neutrodyne or tuned radio frequency receiver, irrespective of the latter's cost, the results obtained from the Shielded Grid Six should *at least* equal those of the more expensive set.

The 630-LSG receiver, compared against any eight, nine or ten tube Super-Heterodyne, should give far finer tone than can be obtained from any Super, and about equal distance and volume.

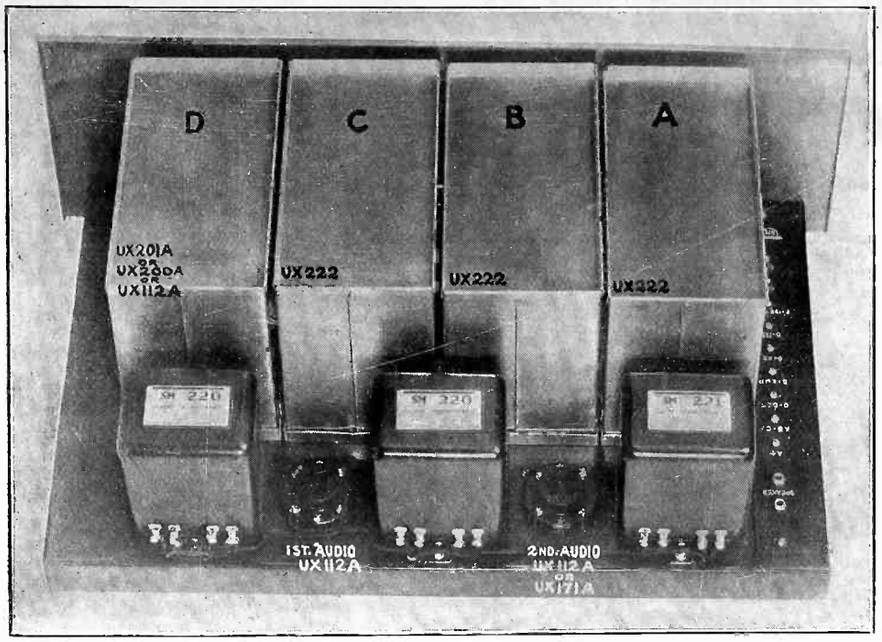
Selectivity should average about the same, since stations are heard at only one dial point on the 630-LSG or 630-SG sets, instead of at two or more points as on a super-heterodyne oscillator dial. Assuming a "one-spot" super-heterodyne, with its very considerable signal loss in changing frequencies, a 630-LSG or 630-SG receiver should give greater signal volume, greater distance, finer tone and about equal selectivity.

In technical terms, such performance is made possible through the fact that the "figure of merit" or measure of value of the 222-type screen grid tubes (UX222, CX322, Shieldplate 122, or equivalent) is just twice that of the UX201A. Actually, in an RF amplifier circuit in which the greatest possible voltage amplification obtained in practice with a UX201A tube is, say, 10 per stage the amplification for equivalent selectivity of a UX222 tube will be about 30 or more. In a three stage RF amplifier averaging 30 per stage, the overall gain is 30 x 30 x 30, which equals 27,000 compared to 1,000 for a UX201A amplifier.

This, in turn, results in increased sensitivity, and about double signal strength under average conditions on weak stations. To the fan who thinks of the UX222 tube as having an amplification factor of 250, an actual voltage amplification of only 30 looks quite low, and is accounted for by several drawbacks of the UX222 tube; i. e., its high plate impedance and plate to filament capacity.

These factors usually limit the amplification at broadcast wavelengths to 20 to 30 per stage if a useable value of selectivity is to be retained.

Thus it is safe to say that any broad-



AS THE SET APPEARS FROM THE REAR.

cast receiver boasting amplification of much over 30 per stage is so broad in tuning as to render its high amplification more than useless—always the result of using tuned impedance coupling. This selectivity factor is very important, and the real value of the UX222 tube lies in a compromise which it makes possible—increased amplification and selectivity to a point where average performance is twice as good as that of UX201A type tubes.

Picture a set with a 500 mile range, or about 805,000 square miles, containing an average number of broadcasting stations, let's say.

If the range of the set be doubled, the selectivity must go up nearly four fold, for the available receiving area is over 3,000,000 square miles, with a proportionate increase in number of stations brought within range of the set.

Therefore, in the 630-SG and 630-LSG sets, a compromise has been made with the UX222 tube characteristics, first to increase amplification, but second to increase selectivity to a far greater extent.

Examples of Performance

As examples of what Shielded Grid Sixes will do, the following reports, all of reception in or about Chicago, are given:

A 630-LSG loop set, operated in the heart of a Chicago manufacturing district in the worst possible conditions, brought in more stations with less interference and better tone than four nationally known, factory-built, six tube one-dial sets all operating on an outdoor antenna!

Comparison with the most popular eight tube Super-Heterodyne of the 1927-28 season showed the 630-LSG set to give about equal volume, greater effective selectivity and better tone.

An eight tube "one spot" Super, loop operated, failed to bring in at all certain stations audible on the speaker of the 630-LSG set. The 630-LSG, on its loop inside a steel and concrete building, brought in stations over a one thousand mile radius between 5 P. M. and 9 P. M. in the evening, including stations not heard on the other TRF sets and the "one spot" Super.

A 630-LSG set, operated in a steel frame apartment hotel within one mile of WCFL and WMBI, and within two miles of WMAQ, WQJ and KYW, brought in KFI, WDAP, WSB, WMCA, WEAF, WJZ, WSM, WSMB, KMOX, WOAI, KRLD, WTAM, WGY, WBZ, and many other stations, all with such great volume as to annoy guests in adjacent rooms and to provide a list of over 50 stations received in two evenings—through all Chicago locals!

Remarkable Range

Expensive factory-built set of six, seven and eight tubes either failed to equal the 630-LSG's performance, or barely equaled it in distance, but never in tone. KFI was received night after night, consistently, whenever the noise level was low enough not to drown out the signal, so sensitive was the receiver.

A 630-SG set operated in Oak Park, Ill., near Chicago, brought in stations from Texas to Mexico, and the Atlantic and the Pacific coasts, with more than ample loudspeaker volume, using a thirty foot length of wire.

Compared with an especially engineered eight tube Super, laboratory built and adjusted, the 630-LSG, at the hands of the operator experienced with his Super, but never having seen the 630-SG receiver, gave equal volume and distance, and better tone, and 15 kilocycle selectivity against 7 kilocycle selectivity for this Super, which was so sharp as to cut sidebands badly.

Using no antenna, but with the operator's finger upon the antenna post of the 630-SG, stations on the East Coast and as far as Texas and Denver came in with ample loudspeaker volume.

A 630-SG set in Highland Park, Ill., compared with a standard 630-AC Shielded Six, would give equal results using a two foot wire for an antenna, the 630-AC set operating from a 75 foot outdoor antenna. By "equal performance" is meant loudspeaker volume on stations all over the United States—New York, Boston, Montreal, Schenectady, Buffalo, Cleveland, Philadelphia, Pittsburgh, Jacksonville, Nashville, New Orleans, Atlanta, Dallas, Fort Worth, St. Louis, Omaha, Denver, Los Angeles, etc. However, to get ample volume on KFI to be heard all over a large house, the 630-SG antenna had to be lengthened to fifteen feet, when its volume surpassed that of the 630-AC set and a popular eight tube Super also used in the test!

To go on would merely be repetition. Suffice it to say that a number of tests conducted against the best commercial sets available indicated the performance of the 630-SG and 630-LSG sets to be equal at least to that of any set on the American market when properly assembled, using standard accessories in any fair comparative test.

The 630-SG and 630-LSG sets are six tube, fully shielded, tuned radio frequency receivers employing three sharply tuned RF amplifier stages, and a tuned detector stage, giving a total of four tuned filter circuits (not to be confused with one dial, three tuned circuit sets), followed by a two stage transformer coupled audio amplifier.

In the 630-SG antenna model, the tuned antenna RF stage consists of a .00035 modified SLF tuning condenser and a plug-in antenna coil with a switch allowing the selection of two values of primary coupling for different antenna lengths. This stage is housed in an aluminum stage shield.

In the 630-LSG loop model, the antenna coil and stage shield, as well as the coil socket, are omitted.

The remaining two RF stages, and the detector stage are practically identical, consisting each of a .00035 tuning condenser and low-loss space wound RF transformer having three values of primary coupling available which allow adjustment of selectivity if desired.

Effect on Detector

Each RF transformer is of the plug-in type, and all are available in three ranges for different wavelengths from 200 to 3,000 meters. The antenna or loop condenser, STATION SELECTOR I dial, is tuned independently of the other circuits, but because of the similarity of these other circuits, all three right-hand tuning condensers are connected through a mechanical link, and are tuned by the STATION SELECTOR II dial.

The RF amplification of the three RF stages is enormous—on the order of 30 per stage through the use of UX222, CX322 or Shieldplate 122, shielded grid tubes, as compared with the average gain of six to twelve for 201A or AC-tube-equipped RF amplifiers. Three thousand ohm resistors are used in the RF amplifier grid leads, operating to render amplification at all waves more uniform than would be possible if they were omitted.

LIST OF PARTS

630-SG ANTENNA MODEL (Kit Price $97)

Four S-M 631A stage shields @ $2.00	$8.00
Two S-M 316A condensers, matched, @ $4.50	9.00
Two S-M 316B condensers, matched, at $4.50	9.00
Four S-M 515 coil sockets @ $1.00	4.00
Six S-M 511 tube sockets @ .50	3.00
Three S-M 119A RF transformer coils, matched, @ $2.50	7.50
One S-M 116A antenna coil	2.50
Two S-M 220 audio transformers @ $8.00	16.00
One S-M 221 output transformer	7.50
One S-M 632 triple link motion	2.50
One S-M 636SG terminal strip, with terminals	2.00
One S-M 633 drilled and engraved metal panel 7 x 21 inches	8.50
One S-M 634 steel chassis, 12 x 19¼ x1½ inches	6.00
One Frost 20-ohm rheostat	.50
Three Yaxley 3,000 ohm grid resistors at .50	1.50
One Carter No. 105 ½ mfd. condenser	.90
One Carter .002 mfd. condenser	.50
Two Carter tipjacks No. 10 @ .10	.20
One Carter 2 ohm resistor (H-2)	.25
Three Carter 10 ohm resistors (H-10) at .25	.75
One Carter .57 ohm resistor (H 4-7)	.25
One Carter No. 22 Imp short jack switch (antenna)	.60
One Carter No. 2 Imp battery switch	.50
Two Fast 1 mfd. condensers at .90	1.80
Two Mar-Co walnut vernier dials at $2.50	5.00
One coil (25 ft.) S-M hookup wire	.50
One Blueprint Packet, with instructions	.25
One set hardware (screws, lugs, nuts, etc.)	.25
	$99.25

LIST OF PARTS

630-LSG Loop Model (Kit Price $91.50)	
Three S-M 631A stage shields at $2.00	**$6.00**
Two S-M 316A condensers, matched, at $4.50	**9.00**
Two S-M 316B condensers, matched, at $4.50	**9.00**
Two S-M 220 audio transformers, at $8.00	**16.00**
One S-M 221 output transformer	**7.50**
Three S-M 515 coil sockets, at $1.00	**3.00**
Six S-M 511 tube sockets, at .50	**3.00**
Three S-M 119A RF transformer coils, matched, at $2.50	**7.50**
One S-M 632 triple link motion	**2.50**
One S-M 636SG terminal strip with terminals	**2.00**
One S-M 633 drilled and engraved metal panel, 7x21 inches	**8.50**
One S-M 634 steel chassis, 12x19¼ x1½ inches	**6.00**
One Frost 20 ohm rheostat	**.50**
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One Carter .002 mfd. condenser	**.50**
Two Carter tipjacks No. 10, at .10	**.20**
One Carter 2 ohm resistor (H-2)	**.25**
Three Carter 10 ohm resistors (H-10) at .25	**.75**
One Carter .57 ohm resistor (H-4-7)	**.25**
One Carter No. 22 Imp short jack switch (antenna)	**.60**
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One set hardware (screws, lugs, nuts, etc.)	**.25**
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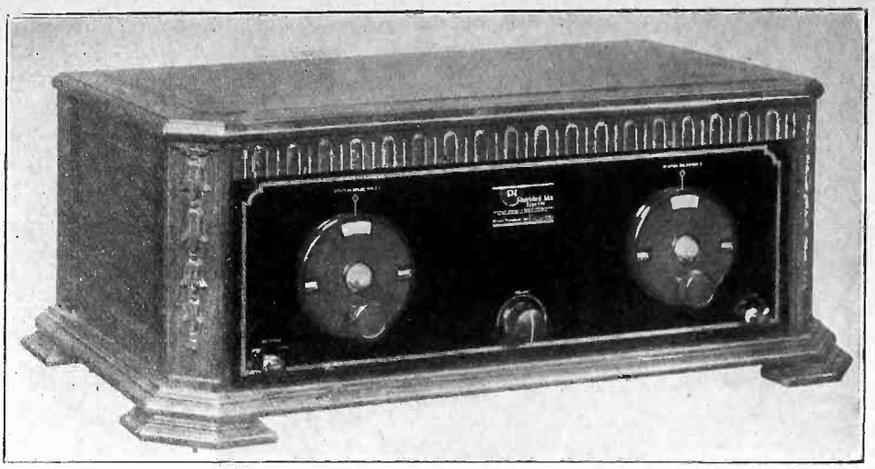
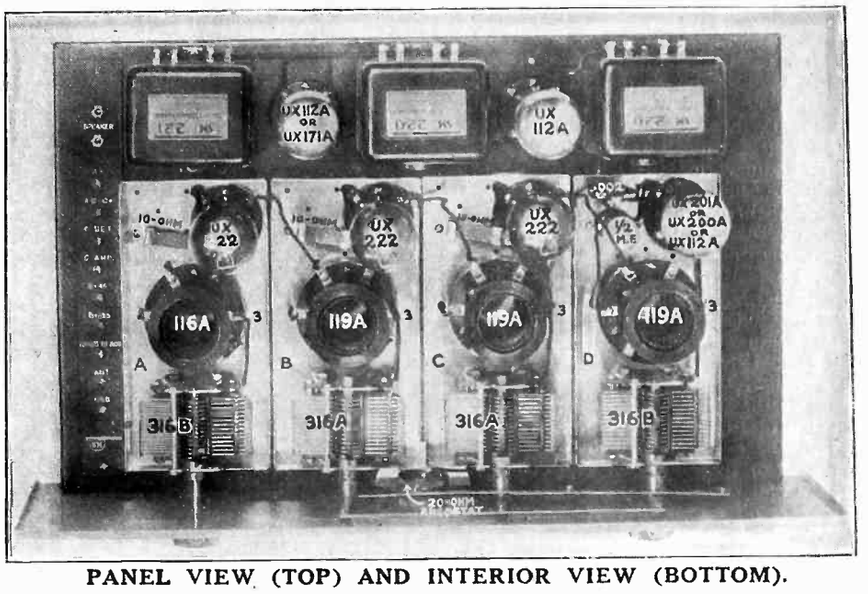




PANEL VIEW (TOP) AND INTERIOR VIEW (BOTTOM).

The RF amplification of the three RF stages, 30 per stage, or about 27,000 as compared with 1,000 for three ordinary RF stages, is important, since the output of any detector tube is proportional to the square of the input voltage.

Obviously, if the RF amplification is doubled, the detector output goes up four times—in the 630-SG and 630-LSG sets the RF gain is about 27 times that of other three stage tuned RF amplifiers.

Like the popular belief that will grow up that the UX222, because of its amplification factor of 250, should give this gain in practice, there will grow up a kindred belief that the UX222 will not oscillate. Both beliefs are absolutely fallacious.

Any amplifying device has an inherent tendency to oscillate, which increases as the amplification goes up. It is quite true that a UX222 may be made to give greater amplification without oscillation or regeneration than a UX201A, but just like a UX201A, its amplification can be further increased by judicious application of regeneration. This has been done in the 630-SG and 630-LSG sets, though they can be operated absolutely without oscillation, and for the discriminating fan, regeneration can be introduced through primary coupling adjustments with far greater gain as a result than can be had from non-regenerative screen-grid amplifiers.

Volume is controlled by a 20 ohm rheostat in the filament circuit of the three UX222 amplifier tubes, this control smoothly cutting down volume on even the most powerful local station to an absolute zero. Suitable fixed resistors are provided to control all filament voltages and prevent their rising above proper values.

The UX222 RF amplifiers are operated at a maximum of 3.3 volts filaments, 1.32 volts negative C bias, 45 volts on the screen grids and 135 volts on the plates. The detector, preferably of the UX200A type, is operated at 5 volts filament, 45 volts B, and 1.5 to 3 volts C bias to insure maximum handling capacity for strong signals.

The two stage AF amplifier, using the S-M220 audio and 221 output transformers, employs a UX112 or UX112A tube in the first stage at 135 volts plate and 1.5 to 3 volts negative C bias (to insure low plate impedance and, consequently, unusually good bass note reproduction).

Old Squealer Becomes Good-Behavior Set

EDITOR RADIO WORLD:

But a few short years ago the majority of the radio fans were up in arms against a common enemy who was almost universally known as "that squealer." The possessor of a regenerative set that squealed was as welcome in any neighborhood as typhoid fever.

Yet at one time the possessor of the powerful regenerative squealer was a proud chap, for with it he could get all kinds of distance (DX) on even a one tube receiver. The only trouble he had was keeping the tube just below the oscillating point.

However, in his excess of zeal to get DX he would often turn the rheostat a wee bit too high and the set would spill over with oscillations at that particular wave length. But in the course of events radio fans multipled and these sets that at times acted as miniature broadcasters squealed horribly into friend neighbor's set.

Everything might be set to a hair and a dozen friends might be at hand to listen to the program when some chap would turn on the rheostat of his squealer a bit too much and bingo—the whole night was spoiled! So it was only just and human that these receivers should be relegated to the dust of the cellar or attic in the interests of the community at large.

With the advent of the amperite, the self-adjusting rheostat a solution to the squeal problem was found. However, by this time regenerative receivers had received such a black eye that constructionists steered clear of the shoals. Manufacturers hailed this positive control for the regenerative detector with joy. By selecting the proper amperite for each tube circuits could be permanently balanced. The lay fan however was slow to follow the lead.

Nevertheless, the regenerative receiver can this day be retrieved from its dusty hiding place and made to behave by employing amperites. The amperite, self-adjusting rheostats will keep the tubes from overloading since it automatically keeps the filament temperature at the proper point. Moreover, tubes thus controlled will be long lived since they cannot be ruined by over or under-heating.

JOEY RUBY,
490 Monroe Street,
Brooklyn, N. Y.

Where Shield Grid Tube Gets Its Terrific Kick

By J. E. Anderson

Technical Editor

A NEW tube, the UX-222, CX-322 or Shieldplate 122, has just made its market debut. It is supposed to be endowed with peculiar and outstanding properties which give promise of exceptional performance. This tube works on a different principle, not a new one, for the principle has been known in scientific circles for many years. But it is new to most of us who are interested in radio reception.

With the new tube new phrases and terms have been thrust upon the radio public, which is asked to assimilate "shielded grid tube," "space charge grid tube," and "shield grid," and others. Perhaps we should also mention "space charge," although that has been used in connection with the older tubes.

The main structural feature of the new tube is that it has an extra electrode, or an extra grid. The added grid has been assigned to the position on the base where the old control grid was, and the control grid lead on the new tube has been brought out at the tip of the glass bulb and connected to a metal cap.

The Two Functions

The new tube has two functions and we shall first consider it as a "shielded grid tube." Later we shall look at the tube as a "space charge grid tube."

As is well known, there is electrostatic capacity between the elements of the three electrode tube, for example, between the grid and the plate, between the plate and the filament and between the grid and the filament. In nearly all applications of the tube these capacities are detrimental. The capacity between the grid and the plate is particularly a nuisance, for it is the major cause of self-oscillations in a radio frequency amplifier and it is directly responsible for much squealing and blocking and distortion in radio receivers.

And how does this come about?

Let us first consider the electron stream from the filament to the plate. This stream is set up because the hot filament shoots out the electrons and the plate attracts them, since the electrons are negative and the plate is positive. This stream of electrons constitute the plate current, or more properly the space current. The rate at which the electrons flow to the plate depends on the value of the potential, or voltage, on the plate. The higher it is, the faster the electrons get to the plate, and the greater the current.

The Grid Governs

Now suppose we insert the grid between the filament and the plate and give it a potential of its own. If it is made positive the grid will help the plate to get the electrons away from the vicinity of the filament and thus the plate current will be great. This is true although the grid will take some of the electrons for itself. If the potential of the grid be made negative the grid will repel the electrons and tend to keep them on or near the filament. Hence the plate will not get so many electrons and the plate current will be low.

Thus for constant plate potential the plate current will depend on the potential of the grid. The grid controls the flow of plate current. That is the normal operation of the tube.

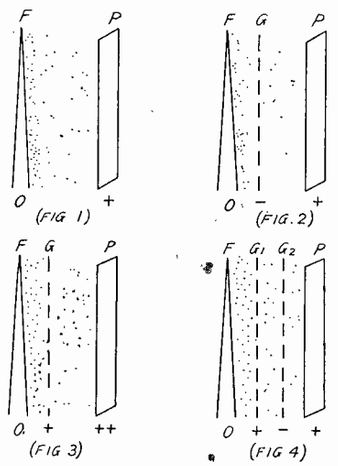


FIG. 1—THE APPROXIMATE SPACE CHARGE DISTRIBUTION BETWEEN THE PLATE AND THE FILAMENT WHEN NO GRID IS INTERPOSED. MOST FREE ELECTRONS ARE NEAR THE FILAMENT.

FIG. 2—WHEN A NEGATIVE GRID IS PLACED BETWEEN THE PLATE AND THE FILAMENT THE ELECTRON DISTRIBUTION NEAR THE FILAMENT IS INCREASED AND THAT NEAR THE PLATE IS DECREASED.

FIG. 3—WHEN THE GRID IS GIVEN A POSITIVE POTENTIAL THE DENSITY OF ELECTRONS NEAR THE FILAMENT IS DECREASED AND THAT NEAR THE PLATE IS INCREASED.

FIG. 4—WHEN A POSITIVE GRID IS PLACED NEAR THE FILAMENT THE SPACE CHARGE NEAR THE FILAMENT IS GREATLY DECREASED AND THE ELECTRONS ARE GIVEN A GREAT VELOCITY TOWARD THE PLATE. THE MUTUAL CONDUCTANCE OF THE TUBE IS GREATLY INCREASED.

But under practical conditions the plate potential does not remain constant as the plate current changes. As the plate current increases the plate voltage decreases. This change not only affects the plate current through the change in the attraction, but it also affects the grid potential through the grid to plate capacity. And since the grid potential is affected by the change in the plate potential, the plate current is also affected. This is ordinarily called feedback through the grid to plate capacity.

For or Against

But just how the grid voltage is affected by the changes in the plate potential depends on the type of load in the plate circuit of the tube. The feedback may be positive and so cause the grid voltage change to be increased or it may be negative and so cause the grid voltage change to be decreased. For positive feedback we have the condition for oscillation in the tube. This occurs when the load on the plate of the tube is highly inductive. It will occur on the inductive side of a parallel tuned circuit when this is the load, or it will occur when the load is an inductance coil of high value and low resistance.

If a shield could be interposed between the plate and the control grid which would shunt the plate voltage fluctuations to ground before they could affect the grid the troublesome feedback would be neutralized. But this shield should not at the same time be a complete barrier to the movement of the electrons or the tube would become inoperative.

The Shield Grid

The shield interposed between the plate and the control grid therefore takes the form of another grid through which the electrons can pass from the filament to the plate as directed by the control grid. The shield grid is connected to a point of positive potential with respect to the filament but considerably lower than the positive potential of the plate. The shield grid therefore, aids the plate in attracting electrons from the filament through the control grid. But as the shield grid is positive it attracts some of the electrons to itself that otherwise would go to the plate, and thus decreases the plate current. This has the effect of greatly increasing the effective plate to filament resistance.

Although the shield grid is at a positive potential for the static condition, or steady state, i.e., in reference to DC, it is at filament potential for alternating or varying potentials. Hence any plate potential variations will be grounded by the shield grid and the effect will not reach the control grid. That is, there will be no feedback from the plate to the control grid. The current through the capacity between the plate and the shield grid will vary the current in the shield grid to filament circuit, but as there is no impedance in this circuit there will be no voltage fluctuations on the shield grid and the control grid is effectively shielded.

Since the shield around the plate is a grid and not a solid shield there will naturally be a little residual interaction between the plate and the control grid, but in practice this is so small as to be negligible even for very high frequencies.

The Shield Grid Tube

Since the shield grid surrounding the plate nullifies the feedback through the grid-plate capacity it is possible to take full advantage of the high amplification factor of the tube in circuits especially designed for the tube, circuits which are entirely impractical with three element tubes. For example, a circuit can be built in which the couplings between the tubes are by parallel tuned circuits of very low resistance. Such a circuit has a very high resistance at resonance frequency, a necessary condition for getting a high step-up of voltage with the tube, circuits which are entirely im- oscillation, within reasonable mu limits,

since there is no feedback through the grid-plate capacity.

It is also possible to use a very high pure resistance as a coupler between two tubes, or a choke coil of high inductance, without any oscillation. With the ordinary tube it would be impossible to use either a parallel tuned circuit or a choke coil.

Precautions Must Be Taken

But the shielding effect of the shield grid does not extend beyond the tube itself. In order that full advantage of the high amplification of the tube may be taken it is necessary to shield thoroughly the grid circuit from the plate circuit, as well as to shield the tube itself. Thus the input circuit to the tube, including coils, condensers and leads, must be carefully protected from the plate circuit with a substantial metal case. Similarly, the plate circuit must be shielded. If there are more than two stages of amplification the parts belonging to every stage should be shielded separately, so that there is no chance of stray feedback from any plate circuit to any of the preceding grids.

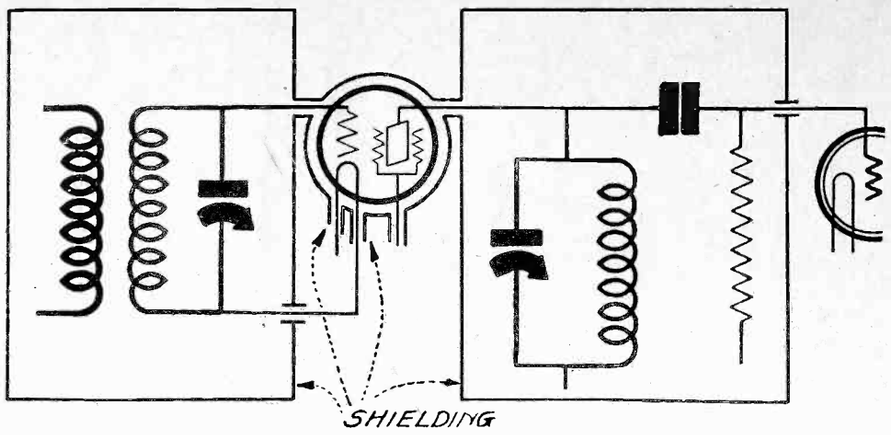
The amplification constant of the shielded grid tube is not a definite quantity, unlike the condition in ordinary triodes. The mu largely depends on the conditions of operation, and it may be as high as 200 to 300 times. But this does not mean that a voltage amplification of 300 fold can be obtained from a single stage employing the tube. The high internal resistance and the finite possible load impedances put severe limitations on the amplification. But it is not difficult to get a voltage step-up per stage of from 30 to 50. This compares with 5 to 15 with the ordinary tube.

Effect of Square Law

The advantage of such voltage step-up at radio frequencies takes on great importance when more stages than one employing this tube are used. If the step-up of one stage is 30, that of two is 900; and this is equivalent to an audio frequency step-up of 810,000, in view of the square law characteristic of the detector.

With the shielded grid tube in several thoroughly shielded stages it is possible to get an RF voltage step-up of 100,000 and more, a gain which would be utterly impossible with ordinary tubes.

The new tube can also be used as a "space charge grid tube," as was stated above.



(FIG. 7)

FIG. 7—THE EFFECT OF THE SHIELD GRID DOES NOT EXTEND BEYOND THE TUBE ITSELF, AND THEREFORE CAREFUL SHIELDING OF THE EXTERNAL PARTS OF THE CIRCUIT MUST BE DONE.

When it is, the shield grid becomes the control grid and therefore no special change need be made in the circuit. The inner grid, which is brought out at the tip of the glass tube, is used as the "space charge grid," a function not hitherto discussed.

Before the purpose of the space charge grid can be explained it is necessary to consider the "space charge."

What the Space Charge Is

The heated filament or cathode shoots off electrons, which are negative. All the electrons shot out would return to the heated surface if they were not attracted to and caught by something else. Some of them do not wander far from the cathode. They are safe from capture. But some shoot out a long way, and they are enticed still farther away by the attractive force of the positive plate.

It is obvious that close to the filament there are many free electrons per unit volume, and as the distance from the filament increases the lower is the electron density. This distribution might be compared with the distribution of air around the earth. Near the earth the air density is great and high up the air is greatly rarified. The air is scattered in the space around the solid earth and the density of the air is greatest near the earth.

The electron distribution can be represented roughly by the dots in Fig. 1.

Every electron in the space between the filament and the plate has a definite negative charge of electricity. The sum of all the charges is the space between the two electrodes. The density of the space charge is greater near the filament than near the plate, and the density at any point is proportional to the number of electrons in unit volume at that point.

Effect of Grid on Space Charge

If a grid is interposed between the plate and the filament the distribution of the space charge will be altered depending on the potential of the grid. If the grid is negative the concentration near the filament will be greater and the electron density between the grid and the plate will be less, as shown in Fig. 2. If the grid is given a positive charge the electron density between the grid and the filament will be decreased and that between the grid and the plate will be increased, as shown in Fig. 3.

A figure of merit of any tube is the mutual conductance of the tube. The higher this mutual conductance is, the better is the tube, as a rule. The mutual conductance is the ratio of the amplification constant of the tube divided by the plate to filament resistance. The amplification is largely a matter of geometry and can be made almost any desired value. The resistance between the filament and the plate largely depends on the amount and distribution of the space charge. As a rule, the closer the grid is to the filament the higher the amplification constant and the higher the plate resistance. This is due to the intense concentration of the space charge near the filament, and the great throttling effect the grid exerts on the electron stream.

When the grid is placed near the plate the mu of the tube is low and so is the plate resistance.

What Plate Resistance Is

Suppose a single electron leaves the filament and falls into the plate. It meets no resistance. But suppose a second electron starts right behind it in the same or nearly the same path. That meets much greater resistance until the first electron has reached the plate. Not only does the first electron cut off some of the attractive force between the plate and the second electron but the first electron repels the second.

A third electron would find it still more difficult to move toward the plate because the shielding would be more complete and the repulsive force would be much greater. Thus the more electrons there are between the plate and a particular electron, the harder it will be for that electron to move

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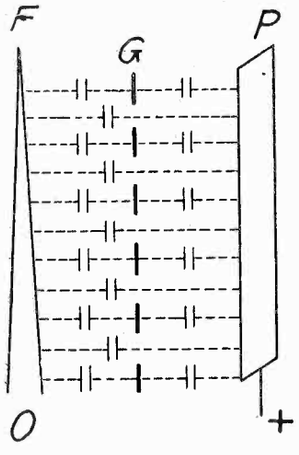
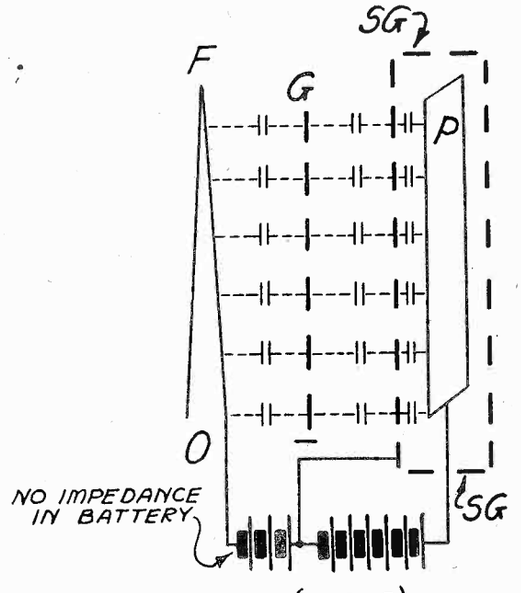


(FIG. 5)



(FIG. 6)

FIG. 5—THE INTER-ELECTRODE CAPACITIES IN AN ORDINARY TRIODE GIVE RISE TO DETRIMENTAL EFFECTS, NOTABLY OSCILLATION BY FEED BACK THROUGH THE PLATE-GRID CAPACITY.

FIG. 6—IN THE SHIELD GRID TUBE THE CAPACITY BETWEEN THE CONTROL GRID G AND THE PLATE P IS ELIMINATED BY THE INTERPOSITION OF A GROUNDED SHIELD GRID SG. IT IS GROUNDED TO VARIATIONS IN POTENTIALS BUT IS POSITIVE TO STEADY POTENTIALS.

(*Concluded from page 7*)

along. And the more work the plate battery has to do to overcome the mutual repulsion. This work is the plate resistance, and obviously it depends on the electron distribution between the filament and the plate, or on the amount of the space charge.

The retardation of the electrons by those that precede can be compared with the retardation of traffic in a crowded thoroughfare. The more traffic units ahead, the slower the procession.

An Extra Grid

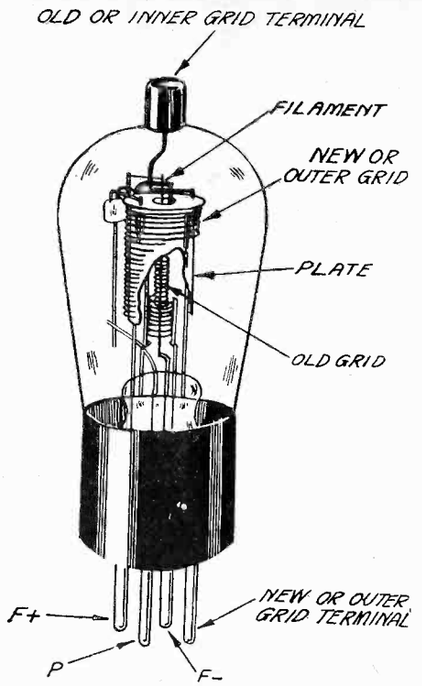
By the insertion of a second grid and by maintaining this at a positive potential relative to the filament it is possible to effect a redistribution of the space charge and so lower the effective filament to plate resistance. The extra and positive grid is placed near the filament and the control grid is put between the positive grid and the plate.

The positive grid, being near the filament, takes hold of the electrons as soon as they are ejected by the filament and gives them a greater velocity. It keeps the space charge between the filament and itself at a low value. Of course, it appropriates to itself some of the electrons, but most of them pass through its meshes, owing to their increased velocity and owing to the attraction from the more positive plate.

The positive grid does part of the work required to overcome the space charge and in that way it decreases the resistance between the filament and the plate. Thus the mutual conductance of the tube is increased and the tube becomes a more effective amplifier.

Control Grid Negative

The distribution of the space charge in the space charge grid tube is shown in Fig. 4, in which G1 is the positive grid and G2 is the control grid. The control grid simply controls that part of the electron stream which gets through the space charge grid; the control grid is always kept at a negative potential with respect to the filament whether the tube is used as a shield grid tube or space charge grid tube. The other grid is kept at a positive potential relative to the filament. Under all conditions of usage the plate is considerably more positive than any of the other elements.



THE ABOVE ILLUSTRATION LUCIDLY SHOWS HOW THE SHIELDED GRID TUBE IS CONSTRUCTED.

The Salient Features of Screen Grid Tubes

The screen grid tube fits into a regular push type socket.

It has an extra electrode, hence a total of four elements. The new or outer (screen) grid connection is to the socket by post. The old or inner grid is brought out to the cap atop the tube. The tube draws .132 ampere. It requires a filament terminal voltage of 3.3 volts.

The shield plate, shield grid, shielded plate, shielded grid and double grid tubes are the same in principle.

The resistance of its filament is 25 ohms.

The tube can be connected across a 6 volt battery provided that a resistance of 20 ohms is connected in series with it.

It can be connected across a 5 volt source provided that a resistance of 15 ohms is connected in series.

The resistor should always be placed in the negative leg.

The screen grid tube can be operated in either of two ways: As a screen grid tube or as a space charge grid tube.

When it is operated as a screen grid tube the inner grid is the control grid, and when it is operated as a space charge grid tube the outer grid is the control grid.

For radio frequency amplification the tube should be used as a screen grid tube.

For audio frequency amplification—resistance, impedance and transformer coupled—it should be used as a space charge grid tube.

The control grid, whether inner or outer, should be operated at a negative bias with respect to the negative end of the filament.

When the tube is operated as a space charge grid tube the inner grid should be given a positive bias of 22½ volts with respect to the filament. Another point of caution is that when the tube is operated as a screen grid tube the outer grid should be given a positive bias of 45 volts with respect to the filament.

As a screen grid tube (RF amplifier) the plate potential should be from 90 to 135 volts.

As a space charge grid tube the plate should be given a positive potential of from 135 to 180, preferably the higher. But it should be applied through a resistor of from 100,000 to 250,000 ohms.

When the tube is used as a screen grid tube at radio frequency extreme shielding precautions must be taken. The tube itself must be inclosed in a metal can which extends at least as far as the base, and it must come within 1/16 of an inch from the control grid at the top. The shield should be connected to one end of the filament. Of course the top grid must be carefully insulated from the shield.

All elements of the circuit pertaining to the grid circuit must be shielded from all elements in the plate circuit, and the shielding must be thoroughly grounded.

An RF voltage amplification of 30 is practicable with the tube. The amplification constant of the screen grid tube is between 200 and 300 times. But it is not practical to use these high factors for broadcast reception.

The grid bias may be obtained by tapping the 15 ohm filament resistor about ten ohms down from the negative end of the filament. The bias should be from —1 to —1½ volts.

The grid bias for the space charge grid tube adjustment should be from 0 to —1½, and it can be obtained with a battery or by tapping a voltage divider.

Former Co-Worker Gets Pickard's Old Position

Morse Salisbury, editor of the press bureau of the University of Wisconsin, has been appointed temporarily as chief of the radio service, United States Department of Agriculture, pending a new examination and certification of eligibles from it.

The position has been vacant for some months, since the resignation of Sam Pickard, who became secretary, and later a member, of the Federal Radio Commission. Mr. Pickard was the first incumbent of the office.

Mr. Salisbury was for some time associated with Mr. Pickard when the latter was director of KSAC, the radio station at the Kansas State Agricultural College.

Lord Elected President of New Protective Body

Arthur D. Lord of the DeForest company was elected president of the Radio Protective Association, Laboratories, Inc., at a meeting of the directors.

The Laboratories plan the investigation of new radio circuits and also the development of circuits and improvements that may be suggested by members of the Association who are stockholders in the Laboratories. Louis Mandel, of Metro Electric Company of Chicago, was elected vice president and E. A. Tracey, of the Northern Manufacturing Company, was elected treasurer of the Laboratories.

Walter A. Russ has been employed as secretary and patent counsel of the Laboratories, which will have offices both in Chicago and in the East, with the main research laboratory in an Eastern city.

Swedish Writers Win Pay for Broadcasts

Stockholm, Sweden.

The national Swedish broadcasting agency, Radio Service, Inc., in the future will pay Swedish novelists, poets and playwrights fifty cents for each printed page that is put on the air.

The minimum compensation is $2.68, while the maximum is $16, excepting for dramatic works, when $21.44 will be paid. When the author reads their own works, this arrangement does not hold true.

TWO MORE CZECH STATIONS

Washington.

Plans are under way for the construction of a station at Carlsbad and another at Mahrisch Ostrau, both in Czechoslovakia.

SHORT WAVES IN VENEZUELA

Washington.

A powerful short wave station has been erected by the Venezuelan government, at Maicatea, near La Guaria. The cost of the station is about $5,000.

AUSTRIAN LINES HAVE RADIOS

All trains on the Austrian lines, which run for more than five hours, now have a radio carriage attached. Passengers can listen in, in this carriage, at the cost of a shilling an hour.

Make Controls Simple But Not Too Simple

By Charles Golenpaul

American Mechanical Laboratories

Radio becomes simpler as it becomes more nearly perfect. Some of us can recall the elaborate tuning coils with sliding contacts, the sliding plate and sliding tube condensers, and the crystal and electrolytic detectors which required a watchmaker's skill to adjust, in pre-broadcasting days.

Even in our present broadcasting era, we recall the early receiving sets, with their multiplicity of knobs and switches for the one to three tube receiver, which often made the owner envy the monkey because of the latter's extra pair of hands which might be put to good use in the pursuit of radio happiness.

Today we have achieved simplified control, in most cases without sacrificing efficiency.

However, there is always the grave danger of going too far in simplified operation as in any other good thing.

Let us see whether we can define simplified operation of the radio set:

Filament Resistors

In the first place, it is good practice to eliminate unnecessary controls.

For instance, in these days of standardized vacuum tubes it is hardly necessary to have separate rheostats for each tube, with the exception of the detector.

A common rheostat for several tubes, or again an amperite for a group or for separate tubes, will eliminate many controls which are not necessary.

Switches should only be employed where absolutely necessary, especially in the radio-frequency and the audio-frequency and the audio-frequency circuits, for a switch offers not only an added bit of control but also another source of high resistance in the circuit to reduce the efficiency.

Tuning condensers, if sufficiently well matched, may be driven in a group, either by having the units arranged in tandem, or with the shafts connected by gearing, chain or other transmission. With closely matched condensers, no vernier or supplementary adjustment is required.

Present-day tuning, fortunately, is handled by varying the capacitance of the circuit rather than the inductance.

Hence the inductance remains a fixed quantity in most radio circuits. Surely it is simpler to vary the capacitance than the inductance.

Achieves Compensation

Aside from capacitance and inductance, the third factor in radio operation is resistance. Here the trend towards simplified control often oversteps the bounds, with the result that reception is handicapped. In principle, resistance should be fixed wherever possible, but variable where variable conditions are encountered.

Resistance usually serves to compensate for changes in a given circuit, such as line-voltage fluctuations, changes in tubes, varying signal strength, and so on. Variable resistance acts as the compensating medium in restoring a given circuit back to normal operating order.

Fortunately, from the old-time sliding resistances which required much room—and much labor—for covering a resistance range, we have achieved compact resistances of hundreds of thousands of ohms in a few cubic inches and in the simple turning of a knob.

In the compression type, such as the clarostat, we have a resistance range of millions of ohms in several turns of the knob.

Turn Only When Necessary

Because of the wide separation between minimum and maximum adjustments of the knob, the resistance range is spread out in such a manner that precise resistance settings are readily obtained.

The purpose of a variable resistance is not, as many suppose, to add an extra control to complicate the operation of the receiver. The variable resistance is intended to be adjusted only when necessary to compensate for altered conditions in the circuit, after which it is left alone as in the case of fixed resistance.

NEW STATION AT BANGKOK

A 20 kilowatt station is to be erected at Bangkok by theTelefunken Company of Berlin. The service will be controlled by the Siamese government. It is expected that the station will be in operation in about six months.

Of unusual interest are antenna masts which are approximately 190 feet high.

Current Meter Ranges

A current meter having range extension arrangements is very convenient. Sometimes it is desired to measure a low current accurately and it may be that the needle for a reading just goes out of range. The range can then be doubled to bring it back, and still the reading will be accurate.

Just as in the case of the voltmeter the calibration of this meter should be done just before using because of possible variations in the rheostat.

High Resistance Voltmeter

A milliammeter having a range of 0-1 milliampere can be used for measuring the output voltage of B battery eliminators as well as the current, and when they are used for this purpose they will give more accurate results than voltmeters of the common variety. For this purpose a voltmeter of high resistance must be used, and a voltmeter improvised out of a 0-1 milliammeter will have a resistance of 1,000 ohms per volt, which is a satisfactory sensitivity.

Can Use Grid Leak

For the series resistance in this case a plate coupling or grid leak resistor can be used. Suppose the desired range is 0-100 volts. Then the series resistance should be 100,000 ohms. If the desired range is 250 volts then the series resistor should be 250,000 ohms, and so on. In every case with this 0-1 milliammeter the required resistance expressed in kilohms is equal to the range.

But the commercial resistors cannot be depended on for accurate work. Each resistor must be calibrated before using. The calibration is accomplished with the aid of another meter, both being connected across the same voltage at the same time.

Latest Complete List of Concerns Licensed by R.C.A.

The complete list of set and power supply manufacturers, licensed by the Radio Corporation and its associated companies, revised up to the time of going to press, is given herewith, the Enterprise Mfg. Co., being a new addition:

SET MANUFACTURERS

(1)—Zenith Radio Corporation, 3620 Iron Street, Chicago, Ill.

(2)—All American Radio Corporation, 4201 Belmont Avenue, Chicago, Ill.

(3)—Splitdorf-Bethlehem Electrical Company, Newark, N. J.

(4)—Stromberg-Carlson Telephone Manufacturing Company, 1060 University Avenue, Rochester, N. Y.

(5)—The Crosley Radio Corporation, Cincinnati, Ohio.

(6)—Freed-Eisemann Radio Corporation, Junius & Liberty Avenues, Brooklyn, N. Y.

(7)—F. A. D. Andrea, Inc., 1581 Jerome Avenue, New York, N. Y.

(8)—Federal Telephone Manufacturing Company, Buffalo, N. Y.

(9)—American Bosch Magneto Corporation, Springfield, Mass.

(10)—Charles Freshman, Incorporated, 240 West 40th Street, N. Y. City, N. Y.

(11)—Howard Radio Company, 451 North Ohio Street, Chicago, Ill.

(12)—Gilfillan Bros., Incorporated, 1815 Venice Boulevard, Los Angeles, Calif.

(13)—Wm. J. Murdock Company, 347 Washington Avenue, Chelsea, Mass.

(14)—Bremer-Tully Manufacuring Company, 520 South Canal Street, Chicago, Ill.

(15)—Steinite Radio Company, Atchison, Kan.

(16)—Day Fan Electric Company, Dayton, O.

(17)—Mohawk Corporation of Illinois, Diversey at Logan Boulevard, Chicago, Ill.

(18)—King Manufacuring Company, Buffalo.

(19)—Atwater-Kent Manufacturing Company, 4700 Wissahickon Avenue, Philadelphia, Pa.

(20)—United States Electric Corporation, Chicago, Ill.

(21)—Phanstiehl Radio Company, Waukegan, Ill.

(22)—Federal-Brandes Co., Inc., Newark, N. J.

(23)—A. H. Grebe & Company, Incorporated, Richmond Hill, N. Y.

(24)—Consolidated Radio Company, c/o Wells-Gardner & Co. Div., 1720 N. Robey Street, Chicago, Ill.

25)—Stewart-Warner Speedometer Corp., 1826 Diversey Boulevard, Chicago, Ill.

POWER SUPPLY

(1)—Radio Receptor Company, Inc., 106 Seventh Avenue, New York City, N. Y.

(2)—General Radio Company, 30 State Street, Cambridge, Mass.

(3)—Martin-Copeland Co., Providence, R. I.

(4)—J. S. Timmons, Incorporated, 339 East Tulpehocken Street, Philadelphia, Pa.

(5)—National Company, Inc., 61 Sherman Street, Malden, Mass.

(6)—Farrand Manufacuring Company, Incorporated, Long Island City, N. Y.

(7)—Harold J. Power, Inc., Medford Hillside, Mass.

(8)—American Transformer Company, 174 Emmet Street, Newark, N. J.

(9)—Zenith Radio Corporation, 3620 Iron Street, Chicago, Ill.

(10)—William J. Murdock Company, 347 Washington Avenue, Chelsea, Mass.

(11)—Mohawk Corporation of Illinois, Diversey at Logan Bollevard, Chicago, Ill.

(12)—Gilfillan Bros., Incorporated, 1815 Venice Boulevard, Los Angeles, Calif.

(13)—Howard Radio Company, 451 East Ohio Street, Chicago, Ill.

(14)—Stromberg-Carlson Telephone Manufacturing Company, 1060 University Avenue, Rochester, N. Y.

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(16)—Federal Telephone Company of Buffalo, Buffalo, N. Y.

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(19)—Phanstiehl Radio Corporation, Waukegan, Ill.

(20)—United States Electric Corporation, Chicago, Ill.

(21)—Crosley Radio Corporation, Cincinnati, O.

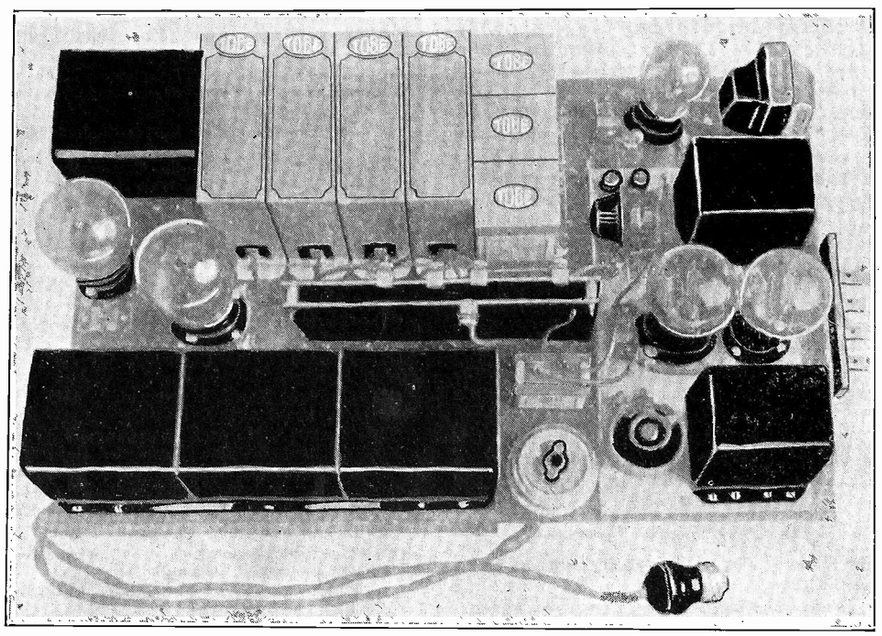
(22)—A. H. Grebe and Company, Incorporated, Richmond Hill, N. Y.

(23)—Consolidated Radio Company, c/o Wells-Gardner & Co. Div., 1720 N. Robey Street, Chicago, Ill.

(24)—Stewart-Warner Speedometer Corp., 1826 Diversey Boulevard, Chicago, Ill.

(25)—The Enterprise Manufacturing Company of Pa., Third and Dauphin Streets, Philadelphia.

An AC Amplifier with 210



LOOKING AT THE AC UNIT, WITH ITS B SUPPLY AT LEFT AND PUSH-PULL AMPLIFIER AT RIGHT. THE THREE TRANSFORMERS ARE SERIES CONNECTED TO GIVE THE DESIRED HIGH VOLTAGE. THE TOBE CONDENSERS ARE EXPERTLY PLACED.

LIST IF PARTS

Three General Radio type 365 transformers.
One General Radio type 366 choke.
One General Radio type 441 push-pull amplifier (completely wired).
Two General Radio type 446 resistance units.
One General Radio type 285 D transformer.
Three General Radio type 349 sockets.
Two General Radio type 439 centre tapped resistance units.
One General Radio 6 ohm resistance strip capable of carrying one ampere.
One 2000-volt 2 mfd. condenser (Tobe).
Three 1,000-volt 4 mfd. condensers (Tobe).
Three 500-volt 1 mfd. condensers (Tobe).
One 1 mfd. condenser (Tobe).
One variable resistance 2,000 ohms (Centralab).
One baseboard 12 x 20.
Miscellaneous wire screws, bolts, etc.

By A. R. Wilson

Service Department, General Radio Company

FOR those persons who demand the most nearly perfect reproduction obtainable, a power amplifier is a necessity. A power amplifier is not intended primarily to increase the volume of a set but rather to make use of amplifying tubes capable of many hundred times the power delivery of the ordinary 201-A type. When a large amount of energy is delivered to the speaker, low notes and overtones, which heretofore have been either inaudible or distorted, are heard with a fidelity that is really remarkable.

Now we are concerned, prior to the input of the last tube, with obtaining a voltage amplification gain, but at the end of the amplifier we have a device, our loudspeaker, which requires real physical energy to operate it satisfactorily; hence, the power tube.

Advanced Quality

The introduction of the UX-210 power tube has meant much in the advancement of quality reproduction and when this type of tube is used in a push-pull system, which has the advantage of minimizing or eliminating most of the harmonic distortion caused by the tubes themselves, the reproduction becomes almost perfect. The push-pull system also has the advantage of increasing the power output four or five times. To a certain extent, the greater the power output the better the quality. An unusual fortissimo passage finds the tube handling it with ease, like the hill-climbing ability of a high powered motor car. There is enough energy to give the bass notes color and intensity with some to spare.

Why all this power? Let us draw an analogy. Today there is less and less opportunity of driving fast on the public highways and yet greater power is a feature of all motor cars. It is much more comfortable to drive a seventy mile-an-hour car at thirty-five miles an hour than to drive a fifty mile-an-hour car at the same speed. It is the flexibility, the sense of reserve, which makes the more powerful car desirable. This applies to radio. With the 210 type of tube the reader is literally loafing along, even when strong volume is being used.

All AC Operated

The General Radio power pack is a complete two stage AC operated amplifier, adaptable for use after the output of the detector tube or with a phonograph magnetic pick-up, utilizing transformers with a UX-226 tube in the first stage and two UX-210 tubes in the last stage. The rectifier system has been designed to furnish approximately 750 volts DC when two UX-281 rectifying tubes are employed.

The voltages placed on the plates of the two UX-210 tubes have been made adjustable over a wide range as it was felt that the common practice of connecting the plate of the last stage tube directly to the high voltage side of the rectifying system was not in keeping with the maximum efficiency.

In similar devices the grid voltage for the last tube is usually obtained by the voltage drop through a resistance placed in the grid return. This resistance is usually variable and any adjustment of it affects the plate voltage, consequently the final adjustment is more or less an arbitrary value for both grid and plate voltages. By making the plate voltage variable over a wide range, it permits the tubes to be operated at their maximum efficiency regardless of the load.

Passes 200 Milliamperes

The direct current available from the rectifying system is approximately 200 milliamperes. A high current output makes for better voltage regulation and will easily supply sufficient current to operate a multitube set with a great reserve of power.

The construction and placement of parts in the General Radio power pack is evident from Fig. 1. The 110-volt supply from the house lighting mains is fed into the transformers, which step the voltage up fifteen times. And this high voltage alternating current is then rectified by two UX-281 rectifying tubes and passed through a filter consisting of one Type 366 choke, two 4 mfd. and one 2 mfd. condensers.

The output is pure direct current such as could be obtained from a sufficient supply of B batteries. This high voltage is then passed through two Type 46 resistors connected in series, which makes any desirable voltage available by means of adjustable sliders.

The last stage amplifier, is the General Radio Type 441 Push-Pull Amplifier. This consists of two transformers, sockets,

Operated Push-Pull Output

and all necessary parts, completely wired and mounted on a metal baseboard. This simplifies construction somewhat as it eliminates quite a bit of wiring.

Guard High Voltage Side

The wiring is all straightforward and simple. The only precaution needed is to place some sort of guard over the high voltage side of the power transformer and to use rubber covered wire for all connections. Under no circumstances should anyone attempt to make any adjustments without first turning off the electric curent.

For convenience the 2,000 ohm variable resistor is mounted by means of a metal bracket directly to the B—binding post of the Type 441 Push-Pull Amplifier.

When AC is used to light the filament of the tubes in this amplifier it is a simple matter to utilize part of their plate current to obtain a grid bias voltage. This is accomplished by connecting the C— binding post directly to B— and inserting a resistance, which in this case is a variable 2,000 ohm resistor between the C— and the B— binding posts. By passing this resistance by a condenser is sometimes helpful in reducing hum.

The filament of the rectifier tubes, together with the filaments of the amplifier tubes, are lighted from the low voltage secondaries of the type 365 transformers. In the case of the UX-226 tube a fixed resistance of 6 ohms capable of carrying at least 1 ampere is inserted in one of the filament leads underneath the baseboard.

Operating Data

To operate this device it is simply necessary to connect the output of the detector tube or a phonograph magnetic pick-up to the primary of the type 285 D transformer. The reproducer is connected to the terminals marked output on the type 441 Push-pull Amplifier. If it is desired, the push-pull stage alone may be used by connecting the output of another amplifier directly to the input terminals of the push-pull amplifier.

Under normal operating conditions the tubes, especially the two UX-281 rectifying tubes and the two UX-210 together with the resistance unit, should get decidedly warm.

If the plate of the two UX-210 amplifying tubes should get red after a period of use it is an indication that the grid bias voltage used is improper and the biasing resistance should be adjusted until this condition disappears.

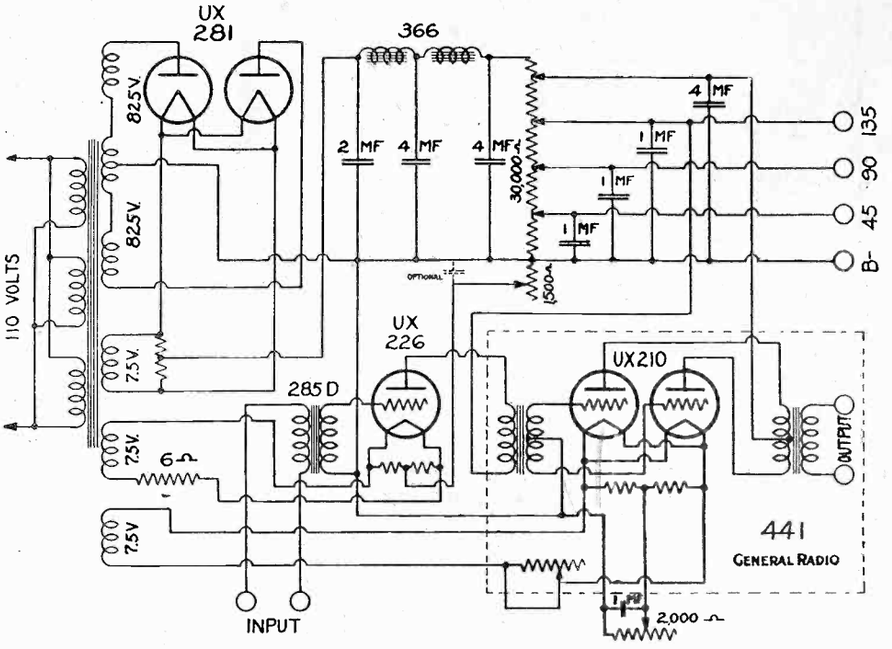
It is almost a positive indication that one or more filter condensers are defective if the plate of the rectifier tube turns red.

Under operating conditions, with the primary of the type 285 D transformer open, a hum should be heard in the reproducer.

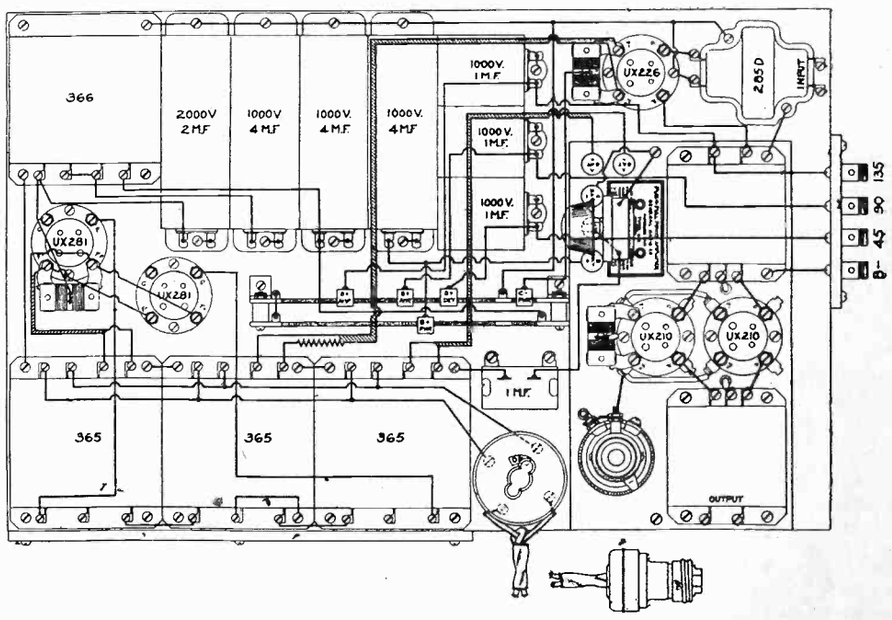
Hum Disappears

This, however, should almost disappear when the two input terminals are shortened or a reasonable load placed on them. In an AC operated device of this sort it is extremely important that the plate and grid voltages of the amplifying tubes be adjusted properly as this helps materially in reducing hum; also the cases of the various parts should be grounded to B—.

When using a phonograph magnetic pickup with this device it is sometimes helpful in removing needle scratch to shunt the input terminals by a fixed condenser. The proper value can only be determined after experimentation, but will usually be around .01 mfd. A 60 mh choke coil in series will also help.

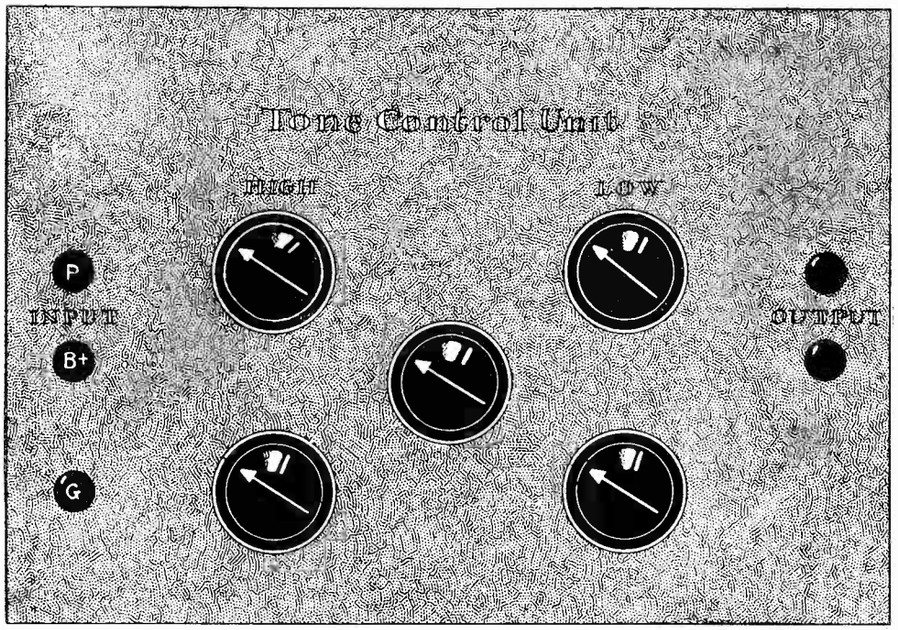


COMPLETE CIRCUIT DIAGRAM OF THE PUSH-PULL AMPLIFIER AND POWER SUPLY DESCRIBED BY MR. WILSON. AN OUTPUT VOLTAGE OF 750 VOLTS DC IS PROVIDED FOR.



THE PHYSICAL LAYOUT OF THE PUSH-PULL AMPLIFIER AND POWER SUPPLY OF WHICH THE OTHER DIAGRAM SHOWS THE ELECTRICAL ARRANGEMENT. COMPACTNESS IS AN OUTSTANDING FEATURE.

A Tone



UPPER KNOBS—VARIABLE CONDENSERS. CENTER KNOB—VARIABLE RESISTANCE. LOWER KNOBS—SWITCHES.

By Bert E. Smith

Allen D. Cardwell Co.

MOST radio fans do not realize that for an expenditure of two or three dollars and the cleaning up of a few old parts to be found in every experimenter's junk box, they can have a "tone control" which will enable them, by the turn of a knob, to reproduce their own choice of high, low, or middle tones from the loudspeaker. The squeakiest of ancient horns can be made to sound sweet, when volume is not too great; and the most booming, resonant cone can be made to bring out the trill of the flute with fidelity.

A few weeks ago a friend asked me to purchase a loudspeaker for him, requesting a particular make which has of late attained a rather high degree of popularity, and is variously reported as having wonderful "tone." Upon its arrival in the laboratory, it was immediately plugged in to the output of an amplifier which, while it undoubtedly does not produce "perfect" music, approaches nearer to it than most others.

Sad Case

And—disappointment! It was totally lacking in the clear, high tones which make the reproduction of the really good cones so beautifully natural.

Perhaps I don't know harmony from cacaphony, and a little after the time in question I was sure of it, for when my friend came for his speaker, and heard it in comparison with one that sounded well to me, he was loud in his praise of the beautiful "tone" of his instrument, which was so superior to the standard. Maybe he was right, but a little private satisfaction was afforded by the fact that the Western Electric and Peerless cones could be made to sound just like the other one by filtering out the high notes. Eaxtly like it!

So, he, and undoubtedly many others, worship the beautiful "tone" of their speaker. I, personally, don't want my speaker to have a tone of its own. If its job is the reproduction of a piccolo, I want it to sound like a piccolo, not a steamboat whistle or like a loudspeaker. I don't crave at all the "refreshingly superior tone" or a "full rich tone with delicacy" that speaker makers advertise, or anything else of the kind.

I want all the harshness and discord which are audible in the studio, the thin clear notes and the big fat booms, but apparently I'm out of step, and even so, maybe the contraption which aids me to keep out of step will please others by keeping them in.

Not Nearly Perfect

It is a none too well known fact that *there is no speaker on the market or even in use, which even approaches perfection.* A true performance chart on any of them show numberless hills and valleys which indicate that some notes are brought out with several times the volume of others. Some have their high points in the middle register, a very few are high, and many are strongest at the low end of the scale.

This last class includes most of the home-made cones of the three foot variety, which give very soft, melodious reproduction, pleasing to the ear but by no means natural. Their shortcomings are very apparent to the ear when a lecturer is at the mike, but they surely do make a male quartet sound attractive.

The advent of the "power tube" has added but one small unit to almost every set extant—either an output choke or a transformer. And in this output device we have an opportunity to make any loudspeaker sound the way which is most attractive to us. Or we can "lower its tone" for passages where we like it low, and raise it when we want it high. We can have the deep resonant booming of a band or the "elfin horns, so thin and clear" that the Scottish poet loved. And all out of the same speaker, provided we have a GOOD audio amplifier with LOTS of power.

The output unit of the choke—and—condenser type contains all the elements necessary to tune up the output beautifully. The resistance to the telephone current offered by the choke is in accordance with the formula.

Reactance = 2 frequency x inductance, and the resistance of the choke is by

$$\text{Reactance} = \frac{1}{2 \text{ frequency x capacity}}$$

Take a Look

Now look at Fig. 1. In one branch of the circuit P—L we have the impedance L only. In the other branch we have the impedance S, which represents the speaker winding, and the capacitative impedance C, which is the coupling condenser.

The direct current resistance of either S or L is several thousand ohms, so if we calculate that the value of C at its maximum (which will be at the lowest frequencies) reactance is only, say, a thousand ohms, it will be negligible in its effect on the circuit, and in its effect on the course of the audio frequencies we are exploiting. At 25 cycles the impedance of a 4 mfd. condenser, by the above formula, is only about 1,400 ohms, and at 75 cycles, the limit of the average ear; at 75 cycles, the impedance is less than 500 ohms. (No, you don't hear 60 cycle house current; the diaphragm jumps on both high and low sides, so the hum is 120 cycle)*.

If we ignore C, the proportion of current through S and L will be

$$\frac{\text{current through S}}{\text{current through L}} = \frac{\text{reactance of L}}{\text{reactance of S}}$$

and as we cannot very well monkey with S, the loudspeaker winding, we just put the maximum impedance at L, so that the impedance will be far above C plus S, and most of the current will flow through CS.

Real Tone Control

Now we come to the chance for "tone control." Let us say the "critical impedance" at C is 1,500 ohms. That is, when its impedance to a frequency gets to that figure, that frequency stops. Of course, it actually doesn't, but gets weaker and weaker, never disappearing. To all intents and purposes however, that figure will serve.

As we said before, the impedance of 4

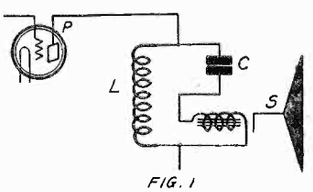


FIG. 1

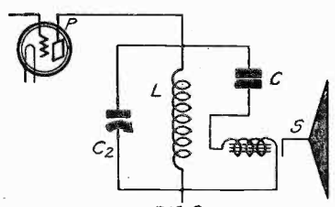


FIG. 2

FIG. 1—CIRCUIT DIAGRAM OF AN OUTPUT FILTER AND A LOUD SPEAKER. BOTH THE CONDENSER C AND THE CHOKE COIL L TEND TO SUPPRESS THE LOW TONES. FIG. 2—SIMILAR CIRCUIT WITH A CONDENSER C2 CONNECTED ACROSS THE CHOKE COIL. THIS CONDENSER BY-PASSES THE HIGH FREQUENCIES AND PREVENTS THEIR REPRODUCTION.

Control

"NO SPEAKER IS PERFECT"

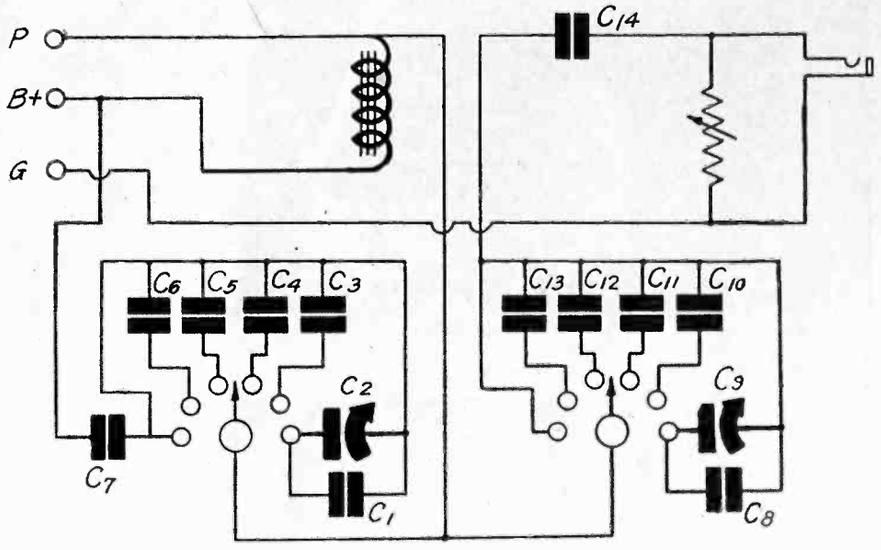


FIG. 3—DIAGRAM OF A CIRCUIT ARRANGEMENT WHEREBY CONDENSERS OF VARIOUS CAPACITIES CAN BE CONNECTED IN SERIES OR IN PARALLEL WITH THE LOUD SPEAKER FOR TESTING THEIR EFFECT ON QUALITY. THE CONSTANTS ARE C1 = .00025 MFD. C2 = .001 MFD. VARIABLE; C3 = .0025 MFD.; C4 = .01 MFD.; C5 = .1 MFD.; C6 = .5 MFD.; C7 = 2 MFD.; C8 = .0005 MFD.; C9 = .001 VARIABLE; C10 = .0025 MFD.; C4 = .025 MFD.; C12 = .25 MFD.; C13 = 1 MFD.; C14 = 4 MFD.

mfd. at 25 cycles is about 1,400 ohms. So, with 4 mfd. at C we pass everything. But suppose we only use 2 mfd.? 50 cycles becomes the low limit. One quarter mike? 400 cycles—all our really low notes are gone. So, by putting a variable condenser at C we can filter out low notes to "raise the tone" of our speaker. It doesn't actually change any of the tubes, but simply refuses to pass the slower vibrations, so that the low notes are proportionately much subdued.

Now, to reduce the high notes, or to "lower the tone" of the reproduction, our filter system must work the other way, and leave the slow vibrations in the circuit, while progressively blocking out the high ones.

Reference to Fig. 2 shows a circuit which is divided into three branches containing capacity, inductance, capacity and inductance in series.

The first of these, C_2, represents a variable condenser. The second, L, represents the plate circuit impedance. The third, SC, represents the coupling condenser and speaker winding.

Now by reference to the formulas we find that the higher the frequency, the less resistance to its flow is offered by a given condenser, and the more resistance by a given inductance.

Therefore, the shunt capacity C_2 will tend to bypass the high frequencies when the impedance it offers is lower than that of L and SC_2. So by increasing the capacity of C_2 we can progressively subdue the high tones, leaving only the lower notes. Or by varying both C and C_2 we can subdue both the very high and very low, and retain the full round tones of the middle register.

Let us look at the practical application of these two diagrams. We cannot very well have a condenser continuously variable from .0005 to 4 mfd. for C, or from .00025 to 1 mfd. for C_2.

So we will start in both cases with a .001 mfd. variable which can still be procured without a great deal of difficulty, and will give us the required 3 to 1 or 6 to 1 continuous change, and thereafter will be satisfied with steps, particularly as with the increase in capacity the ratio change requires larger and larger ones.

In our series condenser we find the requisite steps for full control to be

.0005 to .0015
.0025
.025
.25
1 mfd.
4 mfd.

For the parallel job we need similar steps, but not reaching so high. Say

.00025 to .00125
.0025
.01
.1
.5
2 mfds.

The fixed condensers used in this tone control were Carter and the variable condensers were Cardwell.

In both of these units, the voltage across the condenser is considerable but we can economize by putting which ever we are using in series with the largest one of that chain. This will protect the rest and the effect of so much capacity in series will not change the smaller capacity appreciably.

The arrangement of the leads is immaterial, as is the grouping of the parts. There is only one thing to remember—the positive plate leads carry lots of volts and the wire used should have sufficiently heavy insulation to keep the sparks from flying.

The volume control resistance is shunted across the whole arrangement, and is for use if the speaker and Tone Control are in one room and the set in another.

How to Move the "Bump" In Tuned AF Coupling

Radio fans who are using the Hiler system of tuned audio frequency amplification—Muter, Harkness, Ford Mica, Kelford or Paragon units—will doubtless be interested in the following operating suggestions.

The design of these units is such that a peak or "bump" is found on the low frequency end of the amplifying characteristic curve, the function of this preponderance of amplification being to compensate for the low frequency deficiency of the average speaker, and bring out the harmonious, deep chords.

Sometimes, the design of the complete receiver-speaker installation is such that less low frequency amplification is desired. This state can be attained in an easy, inexpensive manner. Simply insert a 25,000 ohm variable resistance in series with the filament end of the grid choke, between the terminal marked F and the negative filament lead, if C batteries are not used, and between the terminal F and the C minus, if a C battery is employed. The function of this resistance is to lower the amplitude of the resonant peak. Vary the resistance control until the desired amount of low frequency amplification is being obtained.

By reversing the connections to the plate and grid chokes of the tuned double impedance unit, it is possible to retune the system by inserting a new coupling capacity. When the original connections are reversed, the effect of the coupling capacity within the case is nullified, and an external coupling capacity between the plate of one tube and the grid of the succeeding tube can be added.

When the standard units are reversed, to try various values of coupling capacity, the 25,000 ohm variable series resistance should be connected between the grid of the tube and the new grid terminal, otherwise the coupling capacity within the case will nullify the effect of the variable resistance.—JOHN F. RIDER.

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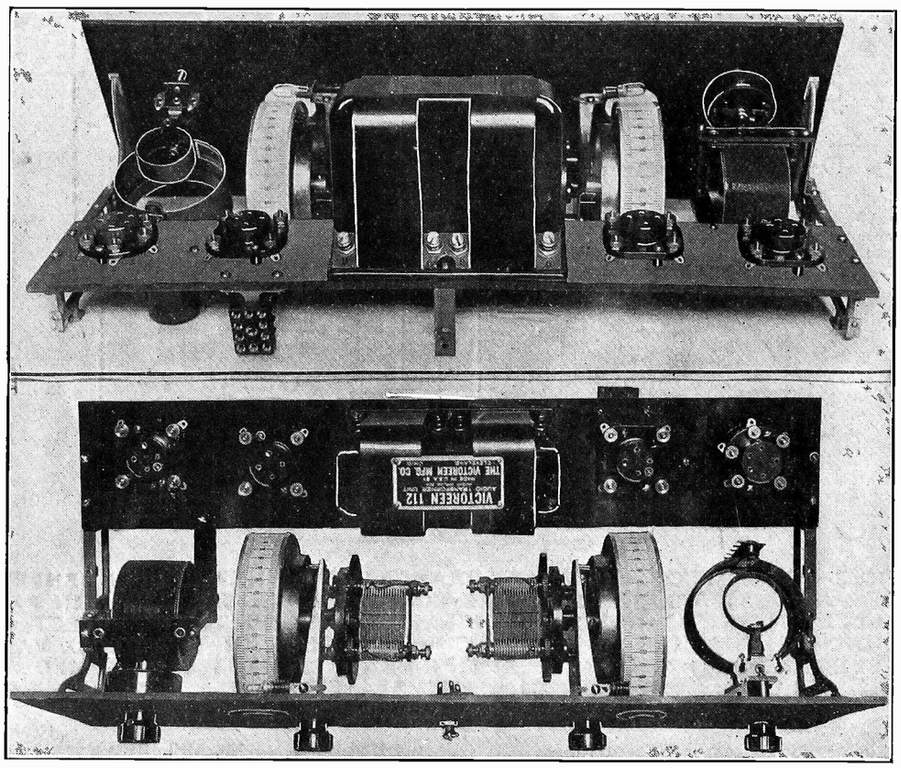


FIGS. 585 AND 586
THE AC300, SHOWING HOW THE PARTS FOR THIS RECEIVER ARE PLACED. THE VICTOREEN 112 AUDIO UNIT IS AT CENTER ON THE SOCKET STRIP.

I HAVE a variometer, a three-circuit tuner and a tuned radio frequency coil, as well as two .0005 mfd. variable condensers, two low ratio audio frequency transformers, sockets, tubes, etc. I wish to build a three-tube receiver, using a regenerative detector and two stages of transformer coupled audio. Which would it be advisable to employ in the detector, the three-circuit tuner, or the variometer and the radio frequency transformer?—HAROLD MYRON, Albany, N. Y.

The results with either will be about the same. It is mostly a matter of space. With the variometer you will need a larger panel.

* * *

FOR THE past week we have been arguing as to the synonymy of "radio" and "wireless." Will you please set us straight on it?—FRANK WILLERT and JAMES MELSON, New Orleans, La.

The words are synonymous. Radio is the more up-to-date name.

* * *

A FRIEND recently informed me that some time ago you published a circuit diagram of a regenerative wave trap. I am interested in this, and would like to know if it is possible to obtain a copy containing the data.—TRIAD H. FORMAN, East Pittsburgh, Pa.

Yes. The data appeared in the December 25, 1925, issue of RADIO WORLD.

* * *

I WOULD like to know if a tickler can be fixed in one position and then shunted by a variable condenser to control regeneration. The tickler in my tuner contains 40 turns and is wound on a two inch tubing. Would I get better results?—DAVE ORNAMERWITZ, Bx., N. Y. City.

This can be done but the results will not be as satisfactory as when an adjustable inductive tickler is used.

* * *

MY RECENTLY CONSTRUCTED five-tube receiver, in which a single stage of tuned radio frequency, non-regenerative detector and three stages of resistance coupled audio frequency amplification are used, is now giving me trouble. When I get down to the low waves I canot stop the set from squealing. I think it is due to the coils. They are of a standard make, containing 12 turns on the primaries and 55 turns on the secondary. Both windings are on a 2¾ inch tubing and wound right next to each other. All the tubes are controlled by a single rheostat.—THOMAS LOOK, Syracuse, N. Y.

First, separate the primaries from the secondaries, so that they are about ¼ inch from each other. Second, take three turns off the primaries. Third, insert a 20 ohm rheostat in series with the filament of the first radio frequency tube.

* * *

I HAVE a 60 ampere storage battery. We use it three hours a day on a six-tube receiver, using 201A tubes throughout. How often should the battery be recharged? I have been told that it should be done every week and a half. Is this correct?—PHILIP MILLIN, Haskell, Okla.

Yes, that is all right. Be sure to add a little distilled water every month.

* * *

WAS THE circuit diagram of the Reinartz short wave receiver, together with coil data, ever published in RADIO WORLD? I am very interested in short waves and understand this receiver is excellent for this type of work.—LOUIS RONALDSON, Atoka, Okla.

Yes, in the November 28, 1925, issue of RADIO WORLD

* * *

WOULD IT be advisable to throw 45-volt B batteries away, after they have reached 35 volts?

(2)—I have an audio transformer, having a ratio of 2½ to 1. Approximately how many turns would there be in the primary and secondary windings of such a transformer. Also what would be the resistance of these windings?—MORRIS UTTERSON, Edwardsville, Ill.

(1)—Not necessarily. The batteries should be discarded only after they fail to render good service.

(2)—There are about 4500 turns in the primary and 11,000 turns in the secondary. The resistance of the primary is about 1100 ohms, while the secondary resistance is 3680 ohms.

* * *

I AM going to build the AC 300 receiver described in the December 24 and 30 isues of RADIO WORLD. I would appreciate knowing exactly how to place the parts.—JOHN TRENDLER, Philadelphia, Pa.

Figs. 585 and 586 clearly show the placement of all the parts. The filament transformer, you will notice, is not placed on the subpanel carrying the sockets, but the Victoreen 112 audio unit is. The filament transformer is placed underneath the set, say on the shelf of the table, on which the set is placed. All the wiring on the set, is done underneath the subpanel. For the filament leads use No. 18 rubber covered. These should be cabeled and brought through a small metal hook, screwed down in the rear of the subpanel.

* * *

THREE MONTHS ago I built a seven-tube set. Three tuned radio frequency stages, a detector and three stages of double impedance audio coupling are used. A triple condenser is used in the second and third radio frequency stages and the detector. The first radio stage is tuned by a single condenser. Now the set works all right, but I am troubled with body capacity. That is, as soon as I place the palm of my hand near the dial controlling the triple condenser and the dial controlling the single condenser, the signal waxes and wanes. The —01A tubes are used. How could I remedy the trouble?—SIDNEY MORTIMER, Kansas City, Mo.

First see that no grid or plate leads are running close to the panel. Check up on the connections of the variable condensers. See that the grid leads are connected to the stationary section of the condenser, not to the rotary. The grid return connections should be made to the rotary sections. See that the P and G posts of the sockets do not face the panel. Ground minus A.

* * *

WE HAVE the circuit diagrams of a six-tube receiver about which we would like to have some information.

(1)—The first radio frequency stage is untuned, the next two are tuned. Transformer audio coupling is used. A double condenser is used in the tuned stages. Could we omit the untuned stage?

(2)—We have been told that variable primaries improve the set. We have several one and three inch diameter tubings. Could you describe how to make radio frequency transformers with variable primaries using .00035 mfd. variable condensers? Three will be necessary.

(3)—What type of filament control would you suggest? We intend using CeCo type A tubes throughout.

(4)—Would a 6 megohm grid leak give satisfactory results?

(5)—Using 135 volts on the plate of the last tube, is it necessary to use an output choke coil and condenser?—HENRY and JOHN KILSOMER, Los Angeles, Calif.

(1)—Yes, you can omit this stage. Suggest you use the double condenser to control the detector and second tuned radio frequency stage. A single condenser should be used to tune the first stage.

(2)—Yes, variable primaries are a great help. The one inch tubings can be used to hold the primary windings. These pri-

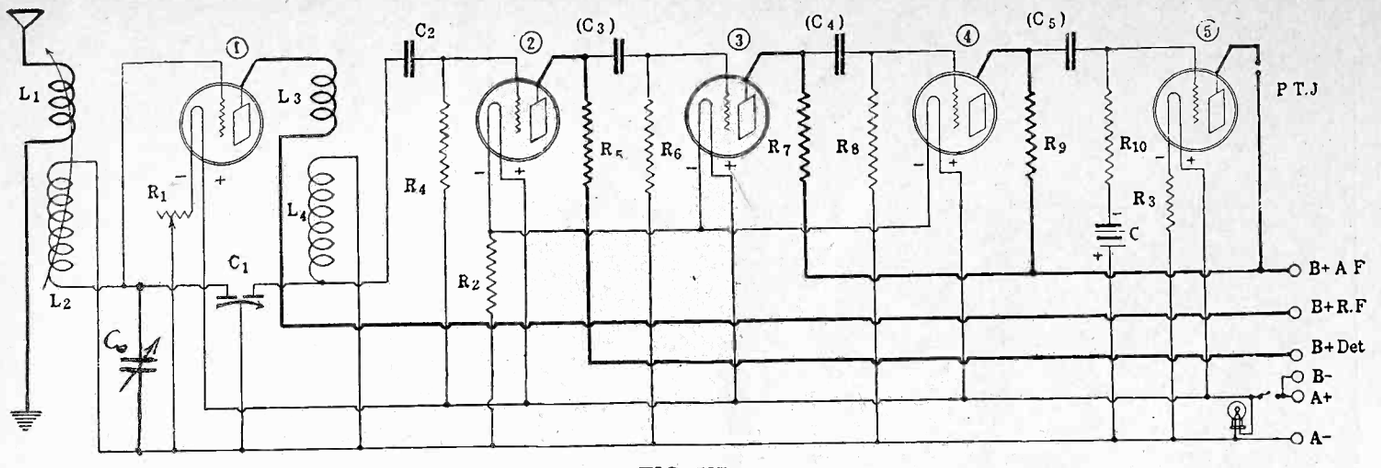


FIG. 587
The 5-TUBE RECEIVER REQUESTED BY NATHAN BRANDON.

maries should consist of 20 turns of No. 26 single silk covered wire.

Each secondary winding should consist of 59 turns. The primaries should be inserted at one end of the tubing, not in between the winding. The results are not necessarily bettered in this way, but the coil becomes simpler to construct. Use No. 22 double cotton covered wire for the secondaries.

(3)—Suggest you use a 1A Amperite in series with the filaments of each of the filaments. In series with the 1A Amperite in the first RF stage, insert a 15 ohm rheostat.

(4)—Yes.

(5)—It is wise to use one. The choke coil should be of the 30 henry type, while the condenser should have a capacity of 4 mfd.

* * *

IF I USE two —01A type tubes in my transformer coupled audio amplifier, can I use a common B voltage, say 135?

(2)—If I do this, can I use a 9 volt C bias on both tubes, or should I use a 9 volt C bias on the last tube and 4½ volt C bias on first tube. I say this, because it seems that the voltage drops in the primary of the second audio transformer, so that really only 90 volts are applied to the first audio plate, instead of 135. Is this correct?

(1)—Yes.

(2)—Yes.

* * *

I WOULD like to build a 5-tube set from the following parts: One .0005 mfd. variable double condenser; one tuned radio transformer with a variable primary and one without the variable primary; one midget .00004 mfd. variable condenser; a 3-stage resistance coupled audio amplifier; a pilot light and switch, and sockets. Please show the circuit diagram of a receiver using these parts.—NATHAN BRANDON, St. Paul, Minn.

See Fig. 587, for the circuit diagram. L1 is the variable primary, and is, as you will notice, inserted in series with the antenna circuit. C1 is the double circuit jack. C0 is the midget condenser, used to balance up circuits. C2 is a .00025 mfd. fixed condenser, while R4 is a 3 meghom grid leak. R1 is a 20 ohm rheostat. R2 is a ¾ ampere ballast resistor. R3 is a ¼ ampere ballast. The pilot light is shunted across the plus and minus A posts. The —01A tubes should be used throughout the set.

* * *

WE HAVE had for the past five months a three-tube set with a regenerative detector and two transformer audio stages, which has worked very well. I would now, like to improve the quality reproduction, by adding the push-pull amplifier described by John F. Rider in the Sept. 24 issue of RADIO WORLD.

(1)—How many stages of straight audio are needed to feed into the push-pull amplifier? The transformers I now use have a ratio of three to one.

(2)—Could the entire unit be built in the same cabinet with the 3-tube set?

(3)—Are C1 and C2, .1 mfd. fixed condensers?

(4)—Can the meter in the B plus 180 volt lead, be left out?—EDGAR G. CRONTON, Chicago, Ill.

(1)—One stage is enough.

(2)—Yes. Keep all the plate and grid leads short.

(3)—Yes.

(4)—Yes.

* * *

SOME TIME ago I built a 3-tube reflex. The radio frequency stage is reflexed. This is followed by a regenerative detector, using a 3-circuit tuner. I am not satisfied with the results. It is too noisy and difficult to tune. I would like to rebuild the set, so that I will have a straight three tube set. Please explain how this can be done. The transformer in the reflexed stage has a ratio of 4 to 1, while the other one has a ratio of 2 to 1 using —01A tubes.—BILL WADSTON, Butte, Mont.

First, sever the leads coming from the secondary winding of the reflex transformer to the grid return and F posts on the RF tube. Then sever the leads coming from the end of the primary of the three circuit tuner to the primary of the regular audio transformer. Connect the primary lead of the tuner, which has just been cut, to the B plus 67½ volt post. Break the F and G posts on the transformer in the regular audio stage. This will completely disconnect this transformer. The G post of the audio transformer which was previously in the reflexed stage, is now connected to the G post on the third socket. The F post on this transformer is connected to the minus post of a 4½ volt C battery. The plus post of this battery is brought to the minus A. The plate of the new last tube is connected to a binding post, while another binding post is connected to the plus B 90. Between these two terminals, the speaker is inserted. Use a 1A Amperite to control the filament of the new last tube.

* * *

I AM THINKING of constructing the Winner, described in the October 1, 8, 15, 22 and 29 issues of RADIO WORLD and would therefore appreciate getting some information on it.

(1)—Can the coils, sockets, transformers, etc., be placed on a subpanel, eliminating the shields?

(2)—Can I use a pilot light? Would it be connected across the battery line?—JOSEPH KETRANSKY, St. Louis, Mo.

(1)—No.

(2)—Yes.

* * *

I HAVE been told that by inserting a variometer in series with the antenna connected to my 4-tube receiver, consisting of a non-regenerative detector and three stages of resistance coupled audio, the volume would go up considerably. Is this true?—JOHN WENGER, Philadelphia, Pa.

The volume would go up a bit. The selectivity would also be bettered.

* * *

I HAVE a coupler, containing 20 turns on the primary, tapped every fourth turn and a 60 turn secondary tapped every twelfth turn. Would I get better results, if I used this coil, than an untapped radio frequency coil, in a standard crystal set?—WALLY MALONE, Jersey City, N. J.

The tapped coupler will work better.

WINNERS VISIT COOLIDGE

(International Newsreel)

THE WINNERS IN THE ATWATER KENT NATIONAL RADIO AUDITION VISITED THE WHITE HOUSE TO PAY THEIR RESPECTS TO PRESIDENT AND MRS. COOLIDGE.

Electric Set Defined As One Without Batteries

By Hugo Gernsback

An electric radio receiving set is understood to be a receiver which can be connected to a light socket, the tubes in the set being of the so-called alternating current type. Such a set contains no batteries. It contains no liquids. It uses a B power-unit, which furnishes plate current by converting house current into suitable form.

By an electrified set is meant a light-socket-operated set wherein no changes have been made from the model operated by batteries. It uses the standard battery type vacuum tubes; but, instead of a storage battery, an A socket-power unit is employed; and for the B current a B power unit is provided. These devices replace entirely the A and B batteries, and therefore require no recharging, only infrequent renewal of tubes.

It is possible, also, to use a storage battery which has attached to it a charging device. The charging is done automatically, and the battery then need not be removed from its place to be charged.

There are sections of the country where, though alternating current is used, it is not of 60-cycle frequency, but some other, such as 25. As a rule, neither electrifying accessories nor electric sets can be used with such current; although some manufacturers are making special appliances to meet such conditions.

In the country, particularly on farms, there are a great many 32-volt private lighting plans. Neither the electric set nor the standard electrified set can be worked from this 32-volt current.

Which is better, a battery-operated set, or electrified, or an electric set? These types work about alike. As a rule, the electrified and electric sets can deliver more power. On the other hand, a battery-operated set is likely to be somewhat quieter, in the present stage of the art. To the average user, the trifling line noises that occur in electrified or electric sets are of no consequence; particularly when the volume control is turned on full, such slight noises as occur when nearby lights are switched on are as a rule never heard. The battery-operated set, though admittedly somewhat quieter, requires constant care in the charging of the A battery and renewal of the B batteries. The need for attention disappears almost entirely with the other two forms of sets.

Time-Sharers Who Re-Sell Own Time Censured

Upon being informed from many sources that stations dividing time were selling the time they were not using to their channel sharing-partners, the Federal Radio Commission issued a statement, in which the act is severely criticized, saying that it is "wholly indefensible as trafficking in a public commodity."

N. Y. Stations Quickly Silent On S O S Flash

The New York District broadcasting stations were recently extolled for their extreme swiftness in shutting down on receipt of SOS calls, by Commander A. Y. Lamphier, District Communication Superintendent of the Third Naval District.

"It is imperative that the broadcasting stations in the East sign off immediately when an SOS is flashed, although some listeners apparently do not understand why they should be deprived of entertainment when the SOS is on the 600-meter wave, above the broadcast **band,"** stated Commander Lamphier.

"It is obvious that the call from a vessel in distress may come a long distance and be very weak. In such a case it is necessary to have absolute silence so that what may be the last message from a partly disabled transmitter may be successfully intercepted.

Board's Executive Power Will End on March 15

Washington.

On March 15 the Federal Radio Commission will conclude its duties as an administrative body and relinquish its work to the Department of Commerce.

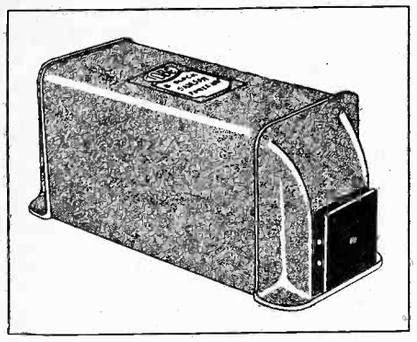
Within the very short time left, the Commission will try to settle three very important problems. They are the life of broadcasting licenses, short wave allocations and elimination of stations not serving the public need.

Until now the Commission has granted only sixty-day licenses. They or the licensing authority that succeeds them can license the stations for three years.

The reports made by inspectors will aid to a large extent in arriving at solutions to the three problems.

The Radio Trade

Tobe Makes Blocks for Samson Units



TOBE POWER BLOCK FOR SAMSON CHOKE-TRANSFORMER COMBINATION.

Working in conjunction with the Samson Electric Company of Canton, Massachusetts, the Tobe Deutschmann Company has developed condenser blocks of a new design and construction, which are meeting with widespread popularity throughout the radio trade.

The Samson Company have developed power transformer and filter choke combinations in beautiful steel casings for use with various types of power amplifiers using either a single power tube or a pair of power tubes in push pull combination. These power blocks, as Samson calls them, are of different lengths. In each case the Tobe Deutschmann Company has developed a filter condenser block suited to the official Samson power circuit and in each case the condenser block exactly matches the power block of the Samson Company. This pair of blocks makes a highly attractive ensemble for the constructor.

Weil Named Manager of Freshman Advertising

After being actively associated with radio from the advertising agency viewpoint for more than five years, Paul S. Weil has accepted the offer from The Chas. Freshman Co. Inc. to assume charge of their advertising and sales promotion.

This will be not exactly a new venture, for he has handled the Freshman advertising account ever since the company started in business. For more than four years Mr. Weil was associated with Frank Kiernan & Co. and for the past year and one-half with Albert Frank & Co., New York advertising agencies. Mr. Weil has been identified with the advertising also of DeJur Products Co., Polymet Mfg. Co., Audak Co., Ambassador Sales Co., Cornish Wire Co., Yorkville Radio Co. and many other representative concerns. For the past few years all the advertising for the Radio Manufacturers Association Trade Show and the Radio World's Fair in New York was placed by Mr. Weil.

NEW CORPORATIONS

Silbox Producing Corporation, radio presentations, N. Y. City; 100 shares common. (Atty., J. W. Searles, 45 West 47th St., N. Y. City.)

Reynolds Radio, N. Y. City; $20,000. . (Attys., Zalkin and Cohen, 49 Chambers St., N. Y. City.)

O'Neil Radio Corporation, West New York, N. J.; 1.000 shares common. (United States Corporation Company.)

Radiovision Corporation, N. Y. City; $25.000 preferred, 150 shares common. (Attys., Zalkin and Cohen. 49 Chambers St., N. Y. City.)

Radio Filament Corporation, N. Y. City; 200 shares common. (Atty., T. J. Blake, 50 Broadway, N. Y. City.)

All-Direction Antenna Made by Hardware Co.

The engineers of the American Radio Hardware Co., 135 Grand Street, New York City, have perfected the new American All-Direction Antenna. This is a solid copper ring 14 inches in diameter and of proportionate depth and thickness to produce the utmost in induction. The copper used is of the purest and is durable and weatherproof. It occupies very little space and is easily and quickly installed. It receives signals from all directions and of all wavelengths. It can be mounted on the roof or from a window and can also be installed on a flag or clothes pole.

A spring clip is provided for the lead-in so that no soldering is necessary. The engineers of this concern claim amazing results for this antenna and that it gives clearer reception, greater volume and DX, eliminates interference and distortion, and that it improves summer reception. The price is low and full information may be had for the asking from the above concern.

Data on New Tubes Put in 32-Page Book

Presenting in convenient form much information not readily available elsewhere about the newer types of radio tubes and their use, a 32-page booklet on "How to Get the Best Results from Your Radio Tubes" has just been published by the Gold Seal Electrical Co., Inc. manufacturers of Gold Seal tubes.

It gives a clear account of the function of radio tubes in simple language and tells how the newer type tubes were developed to meet present day conditions in broadcasting. How to select and install these tubes is fully explained, with illustrations and diagrams. There is also a section of technical data for the expert. Copies of this informative book may be had on request to the Gold Seal Electrical Co., Inc., 250 Park Ave., New York, by mentioning Radio World.

One-Man Show Gets Good Trade Response

The country's first "one man radio show" was introduced in Chicago by Fred C. Garner, Midwest representative of the Daven Radio Corporation. Radio editors of all Chicago and suburban newspapers, as well as representatives of more than 200 dealers and jobbers, witnessed Garner's demonstration of the Daven AC conversion circuit, Daven AC tubes, and Davohm wire wound resistors, at the Hotel Bismarck. In order to put over his demonstration, Garner had to use a motor generator to develop AC.

Now Try for K F I

Los Angeles.

At the request of the Federal Radio Commission, WRC, Washington, D.C., will close down at 11 p. m., E. S. T., every night except Wednesdays. The Commission made the request that listeners in Washington and surrounding territory might tune in on KFI, Los Angeles, which operates on the same wavelength, 468.5 meters. On Wednesdays WRC will be on the air until 11:30 p.m., with operas in tabloid.

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 45th St., N. Y. City.

I desire to receive radio literature.

Name .....

Address .....

City or town .....

State .....

B. Godball, 409 24th Ave., N. E., Calgary, Alberta, Canada.
Leo Weiser, Niles, Mich.
J. L. Wellhorn, Pendleton, S. C.
R. W. F. Chin, St. Stephen's College, Hongkong, China.
S. Haimowitz, Orlando, Fla.
Earl G. DeHaven, 5136 Victoria Ave., Los Angeles, Calif.
W. C. Raddant, 800 5th Ave., Coraopolis, Pa.
K. P. McLean, 900 West Court St., Pendelton, Ore.
C. C. McElfresh, 2040 N. 7th St., Kansas City, Mo.
F. W. Vogel, 909 Jones St., Detroit, Mich.
Harry Johnson, R. 2, Box 46, Ortonville, Minn.

Samson Booklet Shows Road to Better Quality

Samson Electric Co., Canton, Mass., has issued a 24 page booklet on the Samson broadcast units which is replete with information of great value to all who are interested in the betterment of quality in telephonic transmission and reception by radio or wire.

The booklet deals primarily with transformers for use with telephonic equipment, but it also contains valuable data on attenuating networks and methods for volume control.

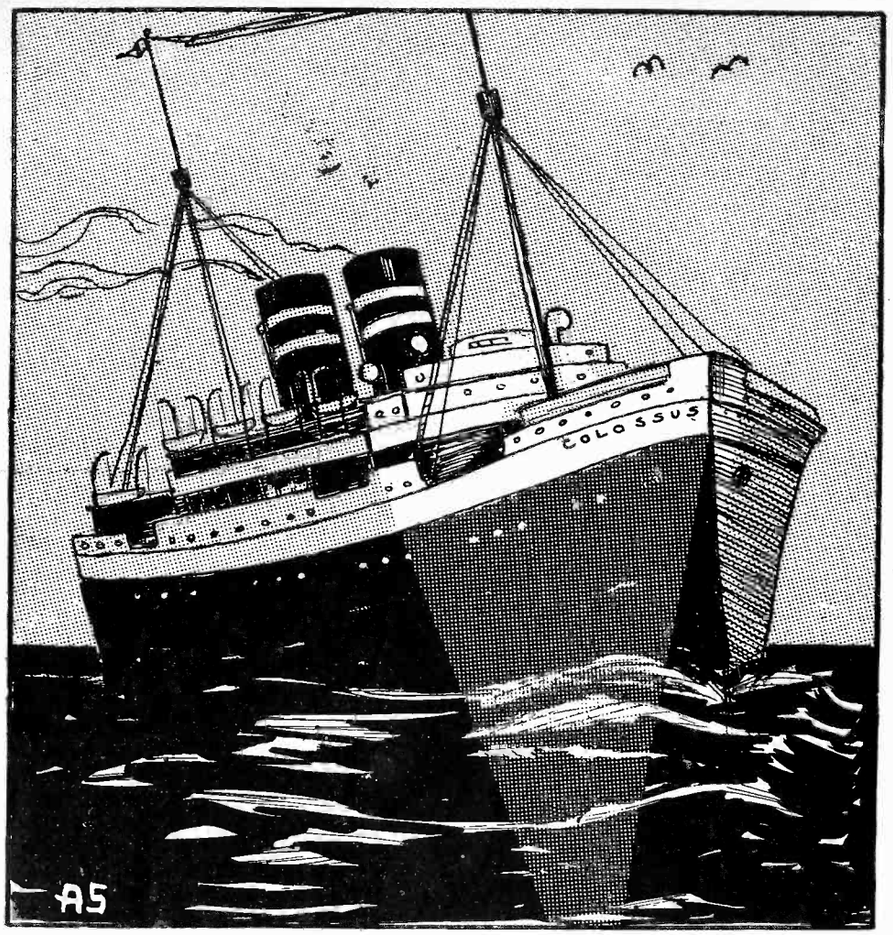
Under transformers are discussed microphone-to-tube, microphone-to-mixer, microphone-to-line, tube-to-line and tube-to-tube transformers with a consideration of the impedances involved and the necessary conditions for obtaining the greatest output and retaining the quality to the highest extent.

A notable feature of the booklet is that the only volume control shown is by the voltage divider method, i.e., the potentiometer method. This is the only method applicable in most cases which does not introduce distortion or disturbances in the impedances. Under volume control designs of voltage dividers are given which change the volume in steps of 1 and of 5 transmission units.

Under attenuating networks, or pads, are given illustrations and design formulas of sections of artificial lines by means of which the volume can be decreased by any number of predetermined number of transmission units when the sections are interposed between two given impedances. This portion of the booklet is especially of value to those who are interested in amplification or attenuation measurements.

The contents of the booklet is of such a nature that it should always be within handy reach of every radio and telephone engineer, or of everyone interested in the technical side of telephonic practice in all its varied forms.

The



LOCAL ANNOUNCER: Ladies and gentlemen of the radio audience, you are now about to hear the presentation of "The Waylaid Liner," by the Hartzell Players. The action takes place on board the British steamship *Colossus,* the greatest steamship ever built. She is on her maiden voyage to New York, carrying thousands of passengers and ten billion dollars in gold for the Federal Reserve Bank. The characters are, in order of appearance, Captain Hartford; Chief Mate Strong; Sparks, the wireless operator; Huggins, the steward; H. B. Herman, an American radio engineer, homeward bound; Count Le Noir, a mysterious passenger. Incidental characters are sailors, passengers, etc. The time is early evening the month of May, 1930. The play will now begin.

(*Strains of soft music are heard.*)

CAPTAIN HARTFORD: God direct me! For forty-eight hours we have been drifting in this strange mist; our compass is out of commission—and now the wireless. (*Knock on door.*) Enter! Well, Mr. Strong?

MATE STRONG: I regret to report, Captain, that we cannot do anything with the compass. It is ruined—it looks like foul play to me!

CAPTAIN HARTFORD: Start an investigation at once. Bring me the names of the men who had the last two tricks at the wheel.

(*Foghorns, bells and sirens are heard.*)

MATE STRONG: Aye, Aye, Sir—Ah, here is Sparks!

CAPTAIN HARTFORD: Wait a moment, Strong. Well, Sparks, what have you to report?

SPARKS: (*excitedly*) My transmitter is ruined, and the receiver is a solid mass. Everything is fused as if by a lightning blast. And, the spare parts—

HARTFORD AND STRONG (*in unison*): And the spare parts?

SPARKS: Are missing, sir!

HARTFORD AND STRONG: Missing!

STRONG: See, now, Captain, just as I said. It is surely foul pl—

CAPTAIN HARTFORD: Hush! Now, Sparks—(*knock on door*) Come in. What is it, Huggins?

(*Muffled sound of fog-horns is heard, growing stronger as steward enters, rising to a high pitch and diminishing as door closes.*)

STEWARD HUGGINS: Bli' me, sir, the pasengers is gettin' fair nervious, now, fer a fac'. That fat vidder, Blaine, wot occupies the Bridal Suite, just now took off in a fit of 'ighstrikes, she did! Hand then they hall started into hasking me hall sorts of questions has to whether we wos in doinger hof sinkink immedjut hor not. Hand whether they orter put on the blinkink loife-preservers, huntil they got me hall in a bloomin' fluster, so they did—

CAPTAIN HARTFORD: Pipe down, Huggins. Mr. Strong, hasten forrard and start a dance on the foredeck. Hustle the ship's orchestra down and get some of the younger officers started dancing with the debs. Then get the ship's band aft and start a concert. Get some of the passengers to sing. Ask Chief Steward Ballyn to start the ball arolling with some of his sea chanteys. We'll pull through, somehow. A panic MUST be averted and the passengers' courage kept up! Make haste!

MATE STRONG: Aye, aye, sir.

(*Sound of door closing; incidental sounds of fog horn, also ship's bell, as before.*)

CAPTAIN HARTFORD: Now, Sparks, have you anything to suggest? We must get in touch with the outside world.

SPARKS: Well, Captain, I've done all I could. I cannot think of any expedient. I've racked my brains—

HUGGINS: I sye, 'ow habout that bloomin' little ridio set yer used ter brag habout—a whatyemaycallit—a three circus bloomer—

SPARKS: A three-circuit tuner—

(*Band is heard playing, finishing strains of "God Save the King," then swinging into "The Star Spangled Banner."*)

CAPTAIN HARTFORD: Uncover, Huggins, uncover!

HUGGINS: Hunder the cover, sir; hunder wot cover, sir?

CAPTAIN HARTFORD (in thunderous tone): Take off your cap, you numbskull!

(*Music dies away.*)

SPARKS: By Jove, that's a good idea! I'll dig out the old set, string up a temporary aerial and see if I can pick up any messages. Every ship on the ocean must be trying to pick us up by this time.

CAPTAIN HARTFORD: Good! Step lively. Get any help you need. We rely upon you. Britain expects every man to do his duty and your Uncle Sam is watching you.

SPARKS: Aye, aye, sir. I'll put some pep into it—watch my smoke.

(*Sound of door opening and closing, during which strains of "Captain Mac" are heard sung by a rich baritone voice, increasing and diminishing as door opens and closes.*)

CAPTAIN HARTFORD: Now, Huggins, brace up and be a man. Remember, you are a Briton. Follow the example set by Sparks. You cannot afford to let your American cousin get ahead of you in point of bravery. Get below, now, and hearten them up, crew and passengers; scintillate with wit, laugh at all suggestions of danger. Tell them that Davy Jones's locker is locked for aye, and that the good ship *Colossus* is invulnerable to the whims of Neptune. Butter them up, Huggins, butter them up. Snap into it, as the Yankees say. Off with you!

HUGGINS: Hye, hye, sir. Hi'll toffey 'em up, sir, bli' me, Hi will. Hi'll put some pepper hinto it. H'observe my conflaguration.

(*Sound of door opening and closing, bringing in strains of music mingled with wails of fog horn. Sound of dull thud, followed by crash and simultaneous gasps.*)

MATE STRONG: Confound you, Huggins, why don't you go where you're looking? You've barked my bally shin and spoiled my polish.

HUGGINS: Hexcuse me, sir. Hi was merely tryin' to put some Hamerican pepper hon hit, 'urryin' to be a 'ero loike Nelson, sir. Hand you 'ave put a bloomin' dent hin my corporosity wot ten stone hof bully beef wont fill hout, hif hever.

MATE STRONG: That will do, my man, be off with you—make haste!

HUGGINS (mumbling): 'Aste his my middle noime. Hassimilate my steam.

(*Sound of door closing, with incidental strains of music.*)

CAPTAIN HARTFORD: Well, Mr. Strong?

MATE STRONG: I have the honor to report, Captain, that I followed your instructions and all is well with the passengers at present. By the way, I have had my eye for some time on that swarthy looking Count Le Noir—he's as black looking as his name, and I've caught him acting suspiciously several times.

CAPTAIN HARTFORD: Tut, tut, Mr. Strong; your suspicions are becoming obsessions. We have simply run into some freak of nature.

MATE STRONG: Do you believe the smashed compass and the destroyed radio apparatus freaks of nature? Be-

Waylaid Liner

A Playlet for Broadcasting

By James H. Carroll
Contributing Editor

sides, have you not noticed the bally mist? It is not natural—put out your hand and no moisture condenses on it. It does not move, there are no air eddys. It is like a pall and is absolutely impenetrable—Ah! Here is Sparks again.

(*Sound of door.*)

SPARKS (excitedly): Captain, I regret to report that I cannot make the old set work. The ether seems to be dead. It's the first time she ever failed me.

CAPTAIN: You cannot pick up any code?

SPARKS: No, sir, not a spark. Nothing but a dim crackling, so faint it is barely perceptible.

(*Door slams loudly.*)

CAPTAIN: Well, steward, what's the bad news, now?

HUGGINS: Bli' me, Captain, the passengers was all becalmed like little lambkins, asingin' hand dancin' hand henjoyin' theirselves, when hall hof a sudden someun tips hover the happlecart and theyre has bad has they wos before. 'Iggins, me 'elper, a good Vitechapel boy, tells me 'e 'eard that there Count Le Noir vispering to a fat old doime that the bally ole ship was sinkin', sir, hand—

MATE: See, sir, what did I tell you?

CAPTAIN: Damme, I've a mind to clap the duffer in irons!

MATE: We cannot do that, sir, we have no proof. He could say he was spoofing her.

CAPTAIN: If only we could get in touch with land or ship by radio—

HUGGINS: Hi begs yer pardon, sir, hi 'ave han hidea—

SPARKS: Can it! We have a hard Winter before us.

CAPTAIN: That will do, Sparks, this is no time for levity. What is your idea, Huggins?

HUGGINS: Hi just 'appened ter think. That Hamerican, Haich B. 'Erman in suite AA, 'e's a ridio hengineer, hand 'e 'as ha set—ha super-'eterodinger, 'e calls hit—

SPARKS: A Super-Heterodyne!

HUGGINS: That's hit. A Victoreen is 'er noime. Must 'ave been called hafter Queen Victoria—

CAPTAIN: That's not a bad idea. We might be able to raise something with it—

SPARKS: I doubt it, sir. If my old Betsy can't do it, nothing can.

HUGGINS: Huh, hold Betsy cant 'old a candle to this 'ere contraption. She looks like a bloomin' tabernacle she does, hall lit hup with helectricity—

SPARKS: Tush! No Super on earth could raise a spark in this blanket from Inferno.

CAPTAIN: Silence, Sparks! In our predicament, anything is worth a trial. This H. B. Herman is an expert in his line. If anyone can help us, he can. Go at once to his cabin, Sparks. Explain the situation briefly and ask him if he will be good enough to bring his Victoreen and apparatus up on the bridge at once.

SPARKS: Very well, sir.

(*Door slams.*)

CAPTAIN: Have you any other suggestions, Strong?

MATE STRONG: Perhaps we had better adjourn to the bridge where we can keep an eye on things while we experiment with Mr. Herman's set.

CAPTAIN: Good, let us do so at once.

(*Tramping feet and opening of door. Sounds of outdoors, rattling chains, hissing of steam, whistles, fog horn, ship's bell, strains of music, distant voices.*)

H. B. HERMAN: Good evening, gentlemen. The steward has explained the situation. I understand it thoroughly and will be glad to help in any way I can.

CAPTAIN: Thank you, Mr. Herman, on behalf of my ship and my passengers. I gladly welcome your aid.

SPARKS (antagonistically): What do you think *you* can do?

HERMAN: Well, I believe we can make the Victoreen act as your ship's compass and guide you through this mist, safely into port. At any rate, we can surely pick up a message.

(*Sound of feet on iron.*)

CAPTAIN: Good! Let's proceed. Lend a hand, Sparks.

HERMAN: Set the Victoreen Power Supply down under this socket, steward. I will put the set up here. Do you generate surgeless AC?

SPARKS: Aboard any ship everything surges.

(*Sound of thud.*)

HUGGINS: Bli me, she's 'eavy. She horter pack some power, she hort. Wot's this contraption hof wires, sir? A blinkink fishin' net?

HERMAN: That's the new Victoreen model Vee-dee loop. It opens easily, so—Gently, now. There she is, all set up. I'll plug her in. Now, kindly plug the Power Supply in that socket, Sparks. The tubes are lit. We're all set to go.

SPARKS (excitedly): Try the upper end of the dials. Where's your phones. Is she powerful enough to pick up such distance on the speaker?

HERMAN: I'll say she is.

HUGGINS: Wot's this bloomink pitcher froime fer?

HERMAN: That's my Balsa wood speaker, as fine a diaphragm as one can use. Put those taps in here, Sparks. Now, listen.

(*Silence. Then sound of heavy breathing becomes audible, broken by heavy crashes of static from speaker. Code is heard.*)

VOICES (excitedly): Ah! There she blows!

HERMAN: Hush—

VOICE OF KDKA ANNOUNCER: This is Westinghouse Station, KDKA. All listeners are requested to be on the alert, especially QST's and those who can read code, for signals from the SS *Colossus*—out of touch for over 36 hours—please stand by for further announcement—

VOICES: Ah!

HERMAN: Silence, gentlemen! I will try higher on the dials.

WOR ANNOUNCER: This is station WOR, Newark, New Jersey. No messages have as yet been reported from SS *Colossus*. Fear is expressed for her safety. Excitement is at fever heat. We will give you news as fast as it is received from Universal Service.

(*Sound of fog horns, ship's bell, intermingled with strains of music.*)

CAPTAIN: We cannot be far from the coast.

HERMAN: No, Captain, the loudness of these signals is no criterion with this set. I picked up American stations, over 2,000 miles away, with as much volume. I'll try again.

VOICE: —crowds are besieging the steamship offices for news. A bulletin from the Associated Press states that a dispatch has been received from the USS *Dolphin,* from off the Grand Banks, stating that a mysterious yacht had been sighted apparently laying a smoke screen. When fired on, the strange vessel disappeared into a fog of its own making. On investigation it was found that the apparent smoke screen was an odd mist, impenetrable and entirely unlike the usual fogs prevailing there. All available destroyers have been ordered to the spot and will patrol the misted area, which seems to extend for miles. This may have some connection with the disappearance of the Colossus. This is Station WJZ, managed and operated by the National Broadcasting Company. Please stand by for further announcement—

(*Chorus of exclamations; sound of ship's whistle; fog horn; soft music, dying away into absolute silence.*)

VOICE OF WEAF ANNOUNCER (excitedly): Ladies and gentlemen, an unusual bulletin has just arrived concerning the Steamship *Colossus.* In a waterfront row, on West Street, New York City, a drunken sailor was arrested. Suspicions were aroused when several thousand dollars in bills were found on his person, also mysterious cipher messages and charts. In his babble he dropped hints relative to a certain Black Band, led by a Captain Black—

CAPTAIN HARTFORD and MATE STRONG: Black!—Le Noir, the Black—

WEAF ANNOUNCER: It is believed that this modern organization of pirates has attempted to steal the *Colossus* bodily under cover of a screen of mist laid by their vessels, a mist composed of some strange chemical mixture. Acting on this theory the government has ordered every war-vessel within reach to proceed under full steam to the Grand Banks. Foreign warships have been asked to cooperate. This is the most gigantic attempt at piracy in history. It is also believed that emissaries on board must have succeeded in disabling the ship's sending apparatus. In the hope that they are still able to pick up a message we shall continue to broadcast all night after our regular program is concluded, in the hope

(*Continued on page* 22)

"HE STARTED AN ATTACK, BUT WE NIPPED IT IN THE BUD AND WE NABBED HIM."

A THOUGHT FOR THE WEEK

WHO'S that man over there with the sidewhiskers, riding a high bicycle and reading a copy of the New York "Post" of 1872? Why, he's the chap who refuses to buy a radio set until he is sure that no more improvements are coming along.

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

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

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James H. Carroll, John Murray Barron 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.

ADVERTISING RATES

General Advertising

1 Page, 7¼"x11"	462 lines	$300.00
½ Page, 7¼"x5⅛	231 lines	150.00
½ Page, 8¼' D. C.	231 lines	150.00
¼ Page, 4⅛" D. C.	115 lines	75.00
⅛ Page, 4⅛" S. C.	57 lines	37.50
1 Column, 2¼'x11'	154 lines	100.00
1 Inch		10.00
Per Agate Line		.75

Time Discount

52 consecutive issues	20%
26 times consecutively or E. O. W. one year	15%
13 times consecutively or E. O. W.	12½%
4 consecutive issues	10%

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities, ten cents per word. $1.00 minimum.

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

Marconi to Use Beam For Telephony Also

London.

At the annual meeting of the Marconi Company, William Marconi stated that within a very short time he will inaugurate a telephone service over his beam system which now only carries code messages.

CZECHS GROW ENTHUSIASTIC

Washington.

Radio is growing in popularity in Czechoslovakia. At the beginning of the year, 200,000 sets were in use, while in October, there were 206,800 sets.

Every Night a First Night

By Bertha Brainard

Eastern Program Director, National Broadcasting Company

Every night is a first night in radio.

Broadway first nighters are justly proud of the title and get a genuine thrill from attending the premiere of a theatrical or moving picture production. But every one owning a radio receiver can attend the first and only performance of a radio presentation any night in the week. Every program on the air celebrates its premiere and only showing in a single performance.

In the case of the play producer his observation of the reception given his play in the out of town try-out has convinced him that it has a chance for some measure of success or else he would not bring it to Broadway. In radio there is no "trying it out on the dog." Some one suggests an idea for a program. It is worked out by the National Broadcasting Company Planning Board and then continuity writers polish it. Music for the production is arranged, rewritten, and, in many cases transposed for the individual performers. Weeks are consumed in securing just the right voices for the characters, for without colorful costumes and scenery, the entire radio stage must be set in voices rich in quality and character.

When everything is worked out to the satisfaction of the N. B. C.'s planning board—and with a number of departments to be consulted in its preparation many new thoughts are suggested which must be given consideration—the program is rehearsed time and again, for not only must every thought be given to performance, but in addition the time element must be watched. A net-work feature must begin and end promptly so that the stations may dis-engage from the chain and go on with their other announced programs. The theatrical manager need not give this factor any consideration for, should he run over a few minutes, the only complaint will be from the fair members of the chorus who are anxious to get away from the theater.

And so the program goes on the air to be praised or condemned in a single showing. For the radio audience does not, as a whole, desire an encore on any feature, no matter how splendid. If the planning board has guessed right the program is a success—but what of it? Unlike the producer, with a success established, the radio program director cannot sit back for a long run, but good or bad, the feature must be dropped and other presentations created so that next night's program will again satisfy the listeners who have kept their dials untouched for continued entertainment.

Grand Opera Singers Are Fervent Listeners

Do grand opera singers ever listen in on the radio?

"Yes indeed," answered Kathryn Meisle, popular contralto of the Chicago Civic Opera. "You have no idea what pleasure my radio affords me during the opera season, when I'm away from home and need a little recreation."

KATHRYN MEISLE

"All kinds of music and lectures" she said interested her, when asked as to her favorite program. She said she had two receiving sets in her home in Philadelphia, and that her hotel room in Chicago was also equipped during the opera season. Miss Meisle sang during an Atwater Kent Hour in November.

RESULTS

EDITOR RADIO WORLD:

In RADIO WORLD of December 10th I had the pleasure of reading an article by J. E. Anderson, Technical Editor, describing about all of interest relating to Magnaformer 8-9 and in passing may I compliment him on his mode of description, the story being splendidly told and well calculated to compel the most critical fan to take notice.

May I tell you my opinion is entirely in accord with Mr. Anderson's, as I have built two of these sets, one for my son and the other for a close relative, and both of these functioned wonderfully. May I also advise you I am about to construct another one for my own use and this time I desire to subpanel wire it (the other two were wired above the base board which gives a chance to make beautiful work.)

The photographs in your article show very plainly just how to insert this form of wiring.

Thus far I have not been able to get beyond U. S., Canada, Cuba and Porto Rico, although I have pulled hard to reach Rio Janeiro.

I have built about all the Supers since the advent of the original Super-Heterodyne quite a number of years ago and it is a revelation to listen to this one perform. I thought the Madison-Moore was the last word in these sets and while the latter is a magnificent instrument, the Magnaformer is better in tone and selectivity and is more brilliant in reproduction and quick to determine the presence of an approaching station in tuning.

I am a simon pure experimentalist in radio and devote much of my leisure time playing with it. I am also a subscriber for RADIO WORLD as well as for all the other radio publications printed in the United States, England and France.

A. B. HEYL,
Cincinnati, Ohio.

* * *

EDITOR RADIO WORLD:

I thank you for the tip in Lewis Winner's article on his set, called the Winner. I have owned at least eight good sets, including that wonder set, "Fenway's Super," and in all my experience in building sets I must say that you have brought me to realize that unless you properly bypass the radio and audio circuits you never will realize real reception.

I have not heard anything outside of New York, but who does? Everybody listens to the best stations he can get easily and generally they are WEAF or WABC, etc.

In your future articles I would suggest that you demand that people not build until they have bought plenty of bypass condensers. I heard that years ago but I thought it was only a selling proposition. Experience teaches.

A. JOSEPHS,
New York City.

New German Station Radiates 120 Kilowatts

A 120 kilowatt broadcasting station at Zeesen, fifteen miles south of Berlin, was opened recently. The station, the most powerful in Germany, operates on a wave length of 1,250 meters.

A gigantic antenna system is used. The masts, about 700 feet high, support a five-wire antenna, 920 feet long. One of the other features of unusual interest is the grounding system. A massive finely woven net of copper mesh, buried forty feet beneath the surface, is used.

Due to the many ten and twenty kilowatts tubes employed, a huge cooling system, with 4,000 gallons of water is necessary. A special air-cooling apparatus, with an exhaust of 50,000 cubic yards hourly, is also used.

Radio World's CLASSIFIED ADS *for Quick Action*

10 Cents a Word—10 Words Minimum—Cash With Order

TROCARFOR-IV-RADIOSET 10-550, designed and tested at the tropics. Agents wanted. Antonio Fornieri, San José, Costa Rica.

WANTED: MEN TO WORK with National Radio Service Organization. No selling scheme. Co-operative Radio Doctors, Dept. W., 131 Essex Street, Salem, Mass.

EVERY FRIDAY evening, beginning at 5:40 P. M., a ten-minute talk on radio topics is delivered by Herman Bernard, managing editor of *Radio World*, from WGBS, the Gimbel Bros. station, New York Listen in.

DON'T BUY A RADIO until you have tried my beautiful two-dial, five-tube, long-distance receiver. 30 days free. Price, complete, assembled, $16.00. **General Radio Sales Co., Oklahoma City, Okla.**

DIRECT FACTORY SALE—Wholesale prices. Tremendous Savings. Selling direct to you. Here are some of our many items: 30 Henry Choke, 100 M.A., $2.19; 10 Henry Choke, 400 M.A., $5.48. Power Transformers for all kinds of Eliminators and for all types of A.C. Tubes, at Special Low Prices. EVERY ITEM FULLY GUARANTEED. Promptly shipped, upon receipt of order. Send for free illustrated catalog today. Todd Electric Co., Inc., (Manufacturers) 36 West 20th Street, Dept. D, New York City.

THE WINNER, a superb 4-tube receiver, was full described in the October 1, 8, 15, 22 and 29 issues of RADIO WORLD. Send 75c for the complete series or begin your subscription with any of the issues. RADIO WORLD, 145 West 45th Street, New York City.

EDISON "A" BATTERIES—Three-cell, 20-ampere-hour; in neat metal cases. Price, $3.50 each; ten or more, $3.00 each. Cash with order. Department "B," 25 East South Street, Indianapolis, Indiana.

HOW TO BUILD RADIO WORLD'S Four-Tube Universal Receiver fully described by Herman Bernard in the March 12, 19 and 26 issues of RADIO WORLD. Send 45c. RADIO WORLD, 145 West 45th St., N. Y. C.

HERMAN BERNARD, managing editor of *Radio World,* discusses radio topics of popular interest every Friday at 5:40 P. M. from WGBS, 348.6 meters, the Gimbel Bros. station in New York City. Listen in.

COMPLETE DETAILS on the Laboratory-Super appeared in the Nov. 19, 26 and Dec. 3 issues of RADIO WORLD. Send 45c for these issues.

Good Back Numbers of RADIO WORLD

The following illustrated articles have appeared in back issues of RADIO WORLD in 1927.

MAY 21.—Part I of a three-part article on the Victoreen Portable receiver, by Capt. P. V. O'Rourke. Data on the new Raytheon cartridge.

MAY 28.—A three-tube reflex, using a special low pass filter system, by Edgar B. Francis. Part II on the Victoreen portable receiver with layout data, by Capt. P. V. O'Rourke.

JUNE 4.—Part III of a three-part article on how to construct an efficient portable Victoreen Super-Heterodyne, by Capt. P. V. O'Rourke. A complete discussion on the RCA AC tubes.

JUNE 18.—The six-tube Equamatic, a neutralized two-stage tuned RF, three-stage AF resistance coupled set, by Herbert E. Hayden. How to get the low notes with transformer or impedance AF, by Dennis J. O'Flaherty.

JUNE 25.—The Lindbergh Plane Speaker, an excellent cone type reproducer, by Herbert E. Hayden. A tube and set tester, by Herman Bernard.

JULY 2.—The Planofier 7, single control super-sensitive set using resistance AF by R. F. Goodwin and S. S. Bruno. Discussion on the new Freshman Equaphase, by Robert Sagala. Data on the six types of units used for loud speaker operation, by J. E. Anderson.

JULY 9.—How to build a DC A supply where the line voltage is 220 or 240, by Frank Logan. Important data on RF choke coils, by Horatio W. Lamson.

JULY 16.—How to use a voltmeter as a milliammeter, by D. Barretti. How to build a 4-tube, 2-control regenerative portable set.

JULY 23.—Building a 7-tube Super for your auto, using Victoreen IFT, by John F. Rider (Part 1). How to build a 6-tube neutralized set, using three tuned RF, two transformer AF, by John F. Rider. Inside dope on motorboating, by J. E. Anderson.

JULY 30.—A 5-tube standard TRF set adapted to AC operation by the use of the QRS 400 mill rectifier tube, with the aid of series filament connections, by RF Goodwin and S. S. Bruno. Shielding the 11-tube Melo-Heald Super-Heterodyne receiver, by Clifford Denton. Part II of the two part article on the Super in the auto by John F. Rider. How to control volume in AC sets by D. Ferrup.

AUG. 6.—A three-tube regenerative portable with portion of the cabinet as the speaker, by M. J. O'Reilly. The Cashbox Unitune, an ingeniously contrived four-tube quality receiver by Wendell Buck. How to use AC tubes by C. T. Burke.

AUG. 13.—Hints on constructing a portable set, by Herbert E. Hayden. A seven-tube, two-control AC operated receiver by Capt. P. V. O'Rourke. Obtaining the C bias in an ABC unit, using the BA Raytheon 85 mill tube.

AUG. 20.—The Four AC, a four-tube regenerative set employing AC tubes. Tim Turkey's argument on why rheostats should not be used as volume controls. The Drum Powertone, a five-tube single control set, using resistance coupled audio.

AUG. 27.—Part 1 of a four part article on building the 1-Dial Witz, a single control, voluminous selective 5-tube set, by A. Irving Witz. A detailed explanation of the exponential type of horn by H. B. Herman. Details on the revolutionary Reisz condenser type of speaker. Constructional data on a special 5-tube, 2-dial regenerative set, with three stages of AF, by Tim Turkey.

SEPT. 3.—Part I of a four-part discussion on the new 1928 Victoreen Universal, a super-sensitive 8-tube Super-Heterodyne, by Capt. P. V. O'Rourke. Complete data on the three types of phonograph pickups, by J. E. Anderson. Part II of the 1-dial Witz, wiring hints emphasized.

SEPT. 10.—The Puratone AC set, a 6-tube duo-control receiver, using AC tubes, by R. F. Goodwin and S. S. Bruno. Part 11 of the 1928 Victoreen Universal, discussing the placement of parts. Part III of the 1-Dial Witz on the special placement of the coils.

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The Waylaid Liner

(*Continued from page* 19)

that we thus shall be able to help them lay a course and keep up their morale. Please stand by—

CAPTAIN: Run, Mr. Strong. Arm the crew secretly. Then follow this man, Le Noir. Attach yourself to him, and at the first suspicious move arrest him. Go with him, Sparks and Huggins, to lend a hand.

MATE AND HIGGINS: Aye, aye, Sir.

(*Sound of hurrying feet on iron.*)

CAPTAIN: Thank you, most heartily, Mr. Herman! You and your Victoreen have saved the ship. Have you any suggestions?

HERMAN: I suggest, Captain, that you proceed half speed ahead in the direction the loop is pointing. It is leveled directly at Bellmore, L. I., which is just outside of New York City. I believe the mist is thinning. The Victoreen is acting as your compass. If you keep the loop pointed in the direction of the WEAF signals you cannot go wrong.

CAPTAIN: Good. I'll telegraph the engine room.

(*Clanging of bell.*)

CAPTAIN: Let her go East by North. Hold it until further orders.

DISTANT VOICE: Aye, aye, Sir.

HERMAN: Hello! A sudden commotion below. Looks like fighting.

(*Shots, screams, men yelling; scuffling feet on iron drawing nearer.*)

MATE STRONG (panting): Here's the rascal, Sir. I have him. He started an attack, but we nipped it in the bud and we nabbed him and all his pirate crew—

CAPTAIN: And the passengers?

MATE STRONG: Are all reassured, sir. We gave them the bulletin and told them help was coming. They felt the ship under way and all is now serene.

CAPTAIN: Well, Count LeNoir, or Mr. Black, what have you to say for yourself?

LE NOIR: Nothing. Unhand me, Mr. Strong. I'll make no further trouble.

CAPTAIN: Don't release him. Watch him closely and chain him tightly.

LE NOIR: Ah, I see Mr. Herman is on the job! He and his Victoreen have cost me ten billion in gold.

WEAF ANNOUNCER: This is Station WEAF. A radio message just received from the USS *Dolphin* states that in an engagement with the supposed pirate craft two of the craft were disabled and captured. Other destroyers have arrived on the scene and a general engagement is in progress which can have but one ending. Please stand by—

LE NOIR: My fleet, too!

(*Booming of distant guns.*)

MATE STRONG (excitedly): Captain, I see searchlights and the flash of guns quite clearly. Observe, sou' sou' west. The mist is breaking fast and the visibility is higher.

CAPTAIN: Thank God! Safe at last. Put LeNoir in irons, I said. Off with you!

LE NOIR: You should have been my captives. C'est la vie!

(*Sound of feet on iron.*)

HUGGINS: Bli me h'Im hall a shiver. I do believe me bally 'air 'as turned vite.

CAPTAIN: I believe we are all a bit shaky. Huggins, do your duty. Gentlemen, a toast to Mr. Herman, our friend in need—

HERMAN (modestly): To the Victoreen!!

VOICES: Three cheers, Rah, Rah, Rah and a Tiger!

MATE STRONG: Look, a ship, flying the Stars and Stripes!

(*Sound of passengers cheering; band playing "The Stars and Stripes Forever."*)

VOICE OF LOCAL ANNOUNCER: Ladies and gentlemen of the radio audience, the Hartzell Players have just entertained you with an original radio playlet, "The Waylaid Liner." Now that the seas have been made safe, we will hear the studio quartet sing, "My Bonnie Flies Over the Ocean."

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