

RADIO WORLD

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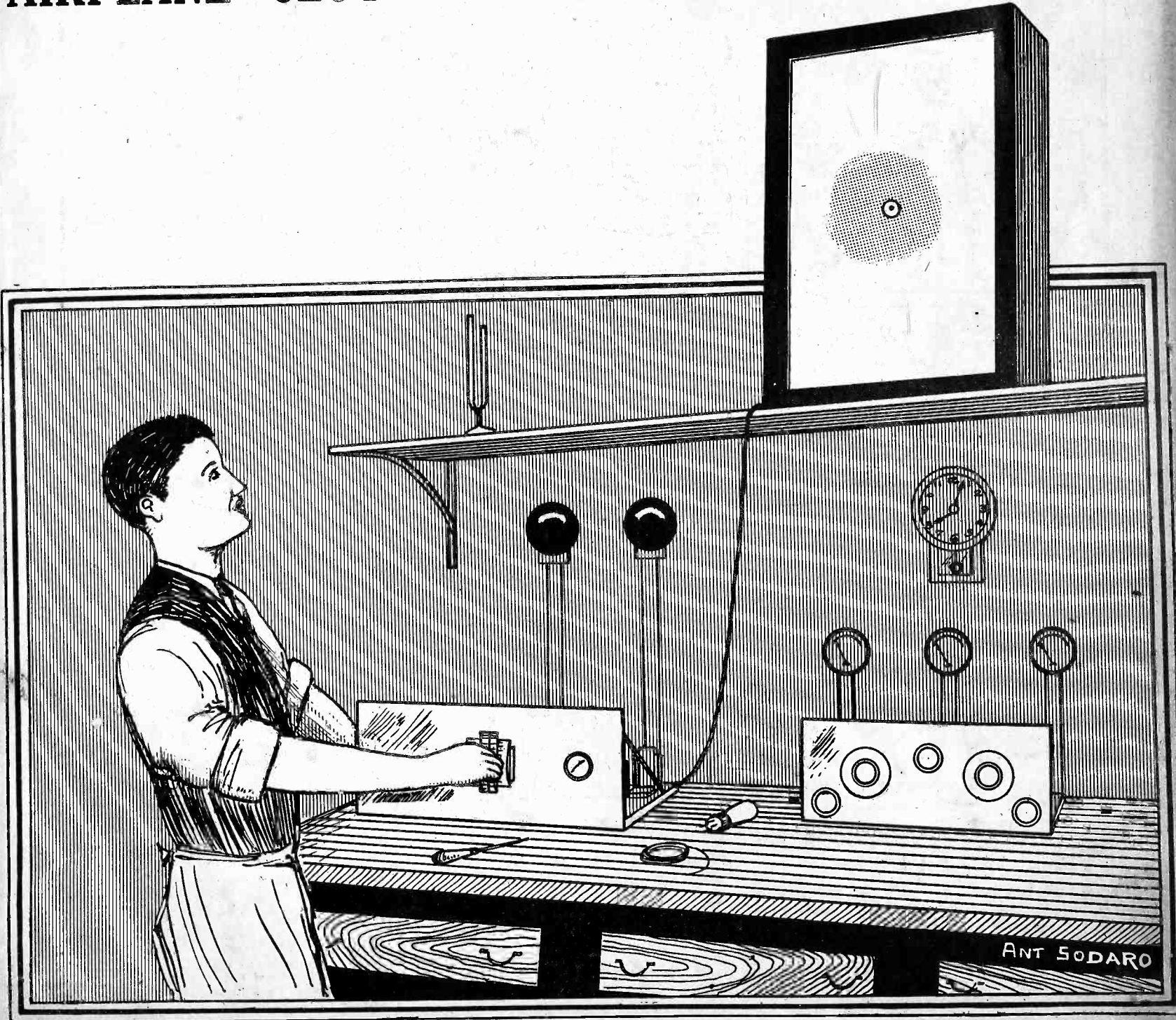
The First and Only National Radio Weekly

Screen Grid Tube
Analyzed for Novices

5-Tube S-G Diamond

Custom Set Builders
Earn Big Profits

AIRPLANE CLOTH SPEAKER PROVES SENSATION



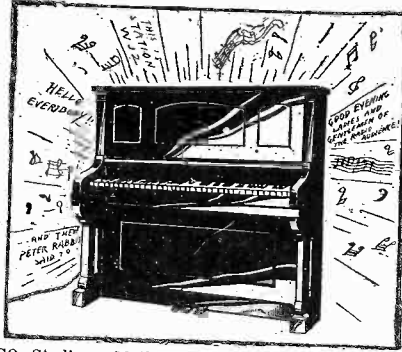
Airplane Cloth Speaker Proves Outstanding in Tests. See pages 4 and 5

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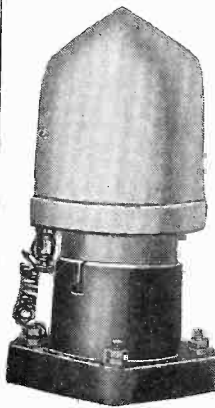
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The New Shielded Grid

4-TUBE DIAMOND OF THE AIR

Designed by H. B. HERMAN and described by him in the February 4, 11 and 18 issues of RADIO WORLD.

The favorite four-tube design, simple as can be, takes a great step forward, so that home constructors of radio receivers, and custom set builders, can build a distance-getting and voluminous set, the parts for which list remarkably low.

The new shielded grid tube is used as the radio frequency amplifier. That is why the amplification is boosted forty times over and above what it would be if an -01A tube were used instead.

Such simplicity of construction marks the receiver that it can be completely wired, skillfully and painstakingly, in two and a half hours.

All you have to do is to follow the official blueprint, and lo! a new world of radio achievement is before you! Distant stations that four-tube sets otherwise miss come in, and come in strong. No tuning difficulty is occasioned by the introduction of this new, extra powerful, startling tube, but, in fact, the tuning is simplified, because the signal strength is so much greater.

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

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

Front Panel, Subpanel and Wiring Clearly Shown

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

Everything is actual size.

Not only is the actual size of the panel holes and instruments given, but the dimensions are given numerically. Besides, it is one of those delightful blueprints that novice and professional admire so much—one of those oh-so-clear and can't-go-wrong blueprints.

Be one of the first to send for this new blueprint, by all means, and build yourself this outstanding four-tube receiver, with its easy control, fine volume, tone quality, selectivity and utter economy. It gives more than you ever expected you could get on four tubes—and the parts are well within the range of anybody's purse.

The circuit consists of a stage of tuned RF shielded grid tube amplification, a regenerative detector, and two transformer coupled audio stages.

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New-50 Power Tube Takes 84N Negative Grid Volts!

By Chisholm W. Parker

WERE vacuum tubes endowed with consciousness and were they subject to jealousy, they would all be emitting a green glow of hatred at this time.

A new king of power tubes has risen. And what is this new king? It is the new —50 power tube, the latest addition to the radio "balance of power."

The characteristic table follows:

| | | Recommended | | | Maximum | |
|----------------------------|------|-------------|------|------|---------|--------|
| Plate voltage | 250 | 300 | 350 | 400 | 450 | volts |
| Negative grid bias | 45 | 54 | 63 | 70 | 84 | volts |
| Plate current | 28 | 35 | 45 | 55 | 55 | m. a. |
| Plate AC resistance | 2100 | 2000 | 1900 | 1800 | 1800 | ohms |
| Mutual conductance | 1800 | 1900 | 2000 | 2100 | 2100 | micro- |
| Voltage gain factor | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | mhos |
| Max. Undistorted output... | 900 | 1500 | 2350 | 3250 | 4650 | milli- |

Filament: 7.5 volts, 1.25 amperes (oxide coated).
 Max. overall: height 6 3/4 inches, diameter 2 11/16 inches.
 Base, large standard push type (X)
 Rating: as amplifier, max. 4.65 watts; oscillator, 25 watts.

In looking over this table of normal characteristics one is struck by the many similarities between this tube and the —71. In fact it seems like the —50 is an overgrown —71. The amplification constant of the new tube is 3.8 while that of the —71 is 3. The internal plate AC resistance of each is about 2,000 ohms for the recommended grid and plate voltages. The mutual conductance of the —50 is considerably greater than that of the —71, indicating that the new tube is a superior power amplifier.

Where Similarity Ends

When the —50 and the —71 tubes are compared with respect to power handling capacity the similarity ceases. The new tube is in a class by itself. With 450 volts (maximum) on the plate of the —50 tube the maximum undistorted output is 4,650 milliwatts while that of the —71 with 180 volts (maximum) on the plate is only 700 milliwatts. Thus the maximum output of the new tube is about 6.6 times as great as the maximum output of the other.

Of course, a much higher voltage is required on the plate of the —50 than on the plate of the —71.

While the new tube has been compared with the —71, it was really developed to replace the —10 power tube, and therefore the new tube should be compared with that also.

We find that the —50 takes the same filament current as the —10 and that the

required filament terminal voltage is the same. Thus the new tube can be used in any circuit designed for a —10 power, except that the coupling coil in the plate circuit must be able to stand a far greater load.

Current Question Serious

The new tube's physical dimensions are

slightly larger, but in few cases will the substitution be frustrated for lack of room.

The recommended and the maximum plate voltages are about the same for both the —50 and the —10 tubes. Therefore plate voltage supply units developed for the —10 power tube can also be used for the —50 tube as far as voltage goes, but some of them may not be able to deliver the necessary plate current and maintain a high voltage.

The first thing that one should ascertain in this respect is whether the plate choke coil or the primary of the output transformer will carry all the current necessary. The carrying capacity has to be more than double the current carrying capacity of a coil or transformer designed for either a —71 or a —10 power tube. Few coils now available will carry enough current to supply one of the new tubes, but more will appear soon. The current required for the higher plate voltages is 55 milliamperes, almost enough to heat the filament of a —99 type tube.

The maximum undistorted power output of the —10 tube with 425 volts on the plate is 1,540 milliwatts and the corresponding output of the —50 tube with 450 volts on the plate is 4,650. That favors the new tube in the ratio of 3 to 1. Thus for a given output power the distortion in the —50 will be about 1/9 as great as that in the output of the —10 tube, assuming

that the input to the —50 is as pure as that to the —10 tube.

The low amplification constant of the —50 tube requires that the input voltage be much higher than that for the —10 tube for equal output. Hence there is a greater chance for distortion to creep into the signal in the stages preceding the power tube. But in this respect the —50 is much superior to the —71 tube.

Also because of its low amplification constant the required grid bias on the —50 tube must be high for given plate voltages. Thus when the plate voltage is 250 the negative grid bias should be 45 volts, and when the plate voltage is 450 the required grid bias should be 84 volts.

The grid bias can be obtained in any one of several ways. The two most common are the dry cell battery method and the drop-in-resistance method. The former is electrically the better in all cases but it may be objectionable on the ground of space requirements. This is accentuated in the case of the —50 tube. The negative grid bias at 450 plate volts is almost as high as the last tube plate voltages common two years ago.

The Stage Ahead

If a resistor is used and the plate current from a single —50 tube flows through that resistor, then the value of the resistance should be about 1,500 ohms. This is also the resistance required for a —10 tube so that no change is necessary when substituting tubes, provided that the resistance already in the circuit can carry 55 milliamperes. Somewhat lower values of resistance may also be used, especially when the lower plate voltages are used. The 1500 ohm value was based on a plate voltage of 450 volts.

When this tube is used it is necessary to make sure that the tube preceding it is able to handle all the AC voltage required without distortion. It has hardly ever been necessary to raise this point in connection with previous power tubes.

Since the plate current in the new tube may be as high as 55 milliamperes it is obvious that no present loudspeaker can be connected directly into the plate circuit without burning it out. A coupling device is necessary, and this may be either a transformer or a choke and condenser filter.

The tube is suitable for reproduction in halls, clubs, auditoriums, theatres, and in institutions having dozens of telephone receivers. Home conditions hardly require its use.

An Airplane Cloth

NOT since the highly developed cone forced the old-fashioned horn out of the throne of popular favor has a parlor speaker appeared that for modest outlay offers such advanced performance as the box type speaker made with airplane cloth diaphragm.

The speaker looks like a box kite, and indeed it could be used as such, particularly as it is so generously equipped with a high-flying diaphragm—an airplane cloth surface 18 by 24 inches.

Wings, and sometimes fuselage, of airplanes are made of this material. Indeed, the Spirit of St. Louis itself was so equipped when Col. Charles A. Lindbergh flew that famous craft alone across the Atlantic, and, more recently, on a goodwill trip to South America.

So you may well imagine that airplane cloth, to withstand such use, is durable. Also it is light. Moreover, it is not expensive. But not its durability, its economy or its lightness constitutes its outstanding asset for the chief purpose we have in mind. Rather, its performance when used as the sounding "board" of a reproducer.

And when we investigate that, we find it is the most intriguing medium of all.

Stretch It Tight

Purity of tone, clarity beyond one's previous experience, almost take our breath away, for we had passed through seven years of radio reception without enjoying the eye-opening realism made possible by this sensational speaker.

Indeed, one must dip into past experience to bring forth the new airplane cloth speaker, the HBH model of which is illustrated herewith.

One takes standard airplane cloth, of best quality, and stretches it upon a rectangular wooden frame, on the back of which is a small square of the same cloth, so that as the centers of the two pieces are drawn tightly together and sealed by the two meeting apexes, the necessary strong tension upon the large diaphragm thus being assured.

The old principle of using two diaphragms is not invoked, since modern engineering practice has discovered loopholes aplenty in the theory that a larger diaphragm responds to the low notes and a smaller one to the high notes, so that the combination gives almost ideal reproduction. Indeed, the two-diaphragm might well give ideally miserable results, with two strong resonance peaks, one high, one low, to torment the listener with booming and trilling that persist after the original notes have ceased.

Elliptical Dead Spot Discovered In Speaker

One of the peculiar facts concerning the Airplane Cloth Speaker is that, when constructed with the diaphragm pulled in by the tension of the small sheet, there is an elliptical part of the surface, about six inches from the center, where the diaphragm hardly vibrates at all.

For instance, at the center, just around the apex, the vibration is strong, and it continues to be so for several inches, when there is a gradual reactive decline. Then suddenly comes the round area where there is next to no vibration. Progressing toward the frame, one finds great activity again.

The tightening of the diaphragm, by

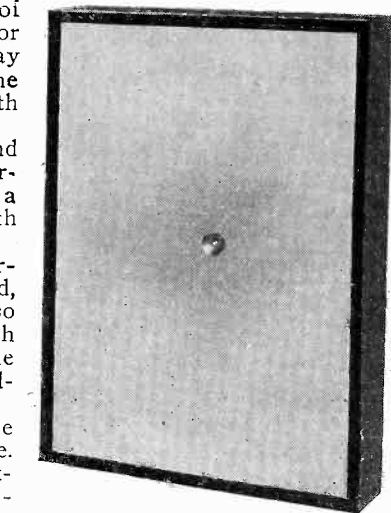


FIG. 1
FRONT VIEW OF THE
HBH AIRPLANE CLOTH
SPEAKER THAT REPRO-
DUCES WITH SUCH
AMAZING PURITY AND
CLARITY OF TONE THAT
IT HAS BEEN HAILED AS
A SENSATION

No, it is not in any double diaphragm that the airplane cloth speaker gets its plenitude of virtues, but in the tautness to which the treated light, responsive cloth is stretched. It is assumed a good unit is used, and of course it must be of the pin or stylus type, with the rod sticking out so that it will move the speaker diaphragm.

Builder Treats Cloth

Treatment of the cloth by painting or spraying it with a special preparation gives the stiffness required for reproduction purposes. When the tautness is supplied by flexing the tension of the larger oblong span against the smaller square one, you have a speaker that will give you low notes that you have never heard before, and also will afford excellent reproduction on the highest notes.

The frequency characteristic, while not flat, is wider in effective range than almost anything you have ever heard, and certainly surpasses anything else that can be purchased or assembled for a few dollars. Real quality at next to no cost is what you get, and you acquire a speaker that not only fills you with pride and delight as you listen to its marvelous work,

stretching it almost as much as possible with the unaided hands, causes stress to be exerted principally on that part of the cloth where the bend toward the center begins. The pull is inward, while the edges of the speaker tend to resist this pull. Hence where the pull begins to converge into the resistance, or where the opposite forces meet, a form of acoustical neutralization sets in.

This you can verify by passing your fingers about the cloth when the speaker is operating.

When you feel next to no vibration you will know you've "hit the spot."

New Vista

How a Kite Model Reproduces with a Rich, Clear, Pure

By H.

Accu

but which wins the praise of all guests privileged to hear your set work this speaker in your home.

A great deal of engineering thought has been centered on proper reproduction of low notes, and the point soon was reached where receivers were better able to do justice to low notes than were the generally available commercial speakers. Such is the case even now. Audio transformers amplify low notes and have relatively even amplification throughout the scale of useful frequencies. Other forms of amplification do as well or better, but speakers have curves that look much like the teeth of a bucksaw.

At the lower end of the audible frequency spectrum the response is very feeble.

Lo, the Low Notes

With a properly constructed airplane cloth speaker the low notes get a more sympathetic reaction than do the high notes, so that the slight unbalance existing in reproduction, due to the receiver characteristics, so justly composed for, and amazing reproduction is obtained even down to 30 cycles, which is about the lower limit of audio frequency modulated by broadcasting stations.

You can hear the tuba on the airplane cloth reproducer so that it has individuality, character and force all its own, since the fundamental brings forth active response from this newly adopted diaphragm whereas under normal conditions you depend on a distorted harmonic of that low fundamental note for any response you might get from the speaker.

The organ sounds just as an organ should sound, and if the transmission is down to 16 cycles, the minimum of the organ, and if your receiver can handle this extremely low frequency, you can rely on a properly constructed airplane cloth speaker of the kite type to pick up the note and toss it to you in as delightful a fashion as one's fondest expectations could concoct. The bass viol stands out, too, as do all the other low-note instruments. Since the faithful reproduction of low notes gives character and life to music, you get an absolutely new and superior form of enjoyment from listening to such a speaker.

Some Fundamental Tests

If you flick the taut diaphragm with your finger you will hear a response much like what you get from a drum. It therefore follows that the bass drum and the kettle drum beat their enspirited tattoo upon your eager ears, and make you fidget with keen delight in your listener's chair.

If you will build yourself such a speaker and, holding it at the top, let the bottom board of the frame strike the floor,

Speaker That Opens

of Delight

Reproducer Brings Out Notes
That Astonishes All

Herman

Expert

you will hear a sound somewhere around 150 cycles, and this is approximately the natural period of the speaker, provided the diaphragm is stiff and taut.

But if the diaphragm is loose, or without being loose is still not tight enough, there will be an acute resonant peak that will boom forth unpleasantly as the aftermath of any note struck at about the fundamental frequency; also the quality throughout the scale will be thin and lifeless. The reason is that the airplane cloth is more useful for reproduction purposes the greater the tension and stiffness—and it easily acquires both of these, while still retaining lightness, thus making the most acceptable combination.

The Four Steps

The speaker is so easy to make that almost anybody can complete the entire construction in an hour and a half, and that includes every piece of work and presupposes a leisurely and painstaking manner of construction. There are four essential moves:

- (1) Construction of the frame.
- (2) Placement of the crossarms.
- (3) Placement, stiffening and tautening of the big diaphragm and the small square tension guard.
- (4) Mounting the unit.

Each operation is as simple as possible, there is next to no possibility of failure, if the stated precautions are taken, and the result is that for a few dollars you get as fine a quality reproducer as you would want. And after you've listened to it delightedly you may decide to drape it with brocade, chintzes or the like, so that it may occupy a niche of importance on the moulding of your parlor, or adorn a marble table or, indeed, squat on the Chinese rug that graces your most tastily appointed room.

How to Assemble

The outside frame is assembled as shown by Fig. 1. The cloth is then cut of sufficient size to cover the front, stretched on and tacked.

The manner of stretching is very important and is as follows:

Place the cloth on the frame and tack at the center of the left-hand side. Now take hold of the cloth at the lower left-hand corner of the frame, stretch down tightly toward the left-hand corner and tack. Fill in between with tacks about one-half inch apart.

With the right hand take hold of the cloth at the center on the right-hand side of the frame, stretch across tightly and tack down. Then take hold of the cloth at the upper right-hand corner and pull upward tightly and tack. About one-half inch apart place tacks in between. You now have the main stretching done.

It doesn't matter just where you take hold of the cloth now, but stretch on

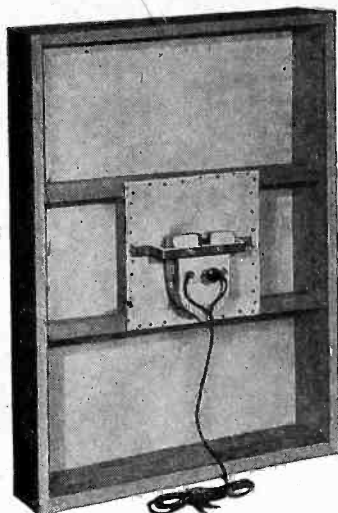


FIG. 2
THE REAR VIEW SHOWS THE CROSS-ARMS, TENSION GUARD (THE SMALL SQUARE), BRACKET AND UNIT. THE PIN IS ON THE OTHER SIDE OF THE UNIT, POINTING AWAY FROM YOU.

tightly all around and fill in, always remembering that the tighter you stretch the better your speaker will be.

Now assemble the rear frame. Take the two long narrow wooden pieces and measure out the center point on each. Measure off 3 inches on each side of the center of both of these. Now place the two short narrow wooden pieces between these long ones so that the inside of the small pieces is six inches apart, forming a square six inches large. Nail together in this position, using only one nail for each joint.

The Rear Piece

The small rear cloth or tension guard is then cut and tacked on in the same manner as the large one.

DON'T PLACE THIS SMALL FRAME INSIDE THE LARGE ONE YET.

You are now ready to insert the apex, consisting of two pieces, one for the center of each cloth.

The center of each cloth is found by laying a yard stick across the diagonal corners and drawing light lines near the center. Where these lines meet is the center. Pierce a small hole at the center in each cloth.

NOW place the large frame face down

on a table and the small one face up inside the large one, with the centers over each other. The apex is now inserted, one plate on the outside of each cloth, and both pointing toward each other. The center of the apex is inserted with the adjustable part on the front.

Feller Needs a Friend

Now you need the help of a friend. Ask your friend to stand on each side of the speaker and take hold of the two legs of the small frame, one leg in each hand. You do the same on the other side. Now both of you pull up slowly, stretching the cloth until the small frame is flush with the edge of the large frame. You now have to let one leg go, to nail the other one up. The one you let go will drop a little, of course, but after you sink the first nail you can draw up the leg and finish nailing it.

All Finished

Now go over to your friend's side and nail up that side. This causes the two cloths to converge.

Now apply two coats of the special stiffening fluid, allowing each coat to dry for twenty minutes. The bracket is now assembled to the unit (Fig. 2). Screw the bracket to the frame as shown. First put the pin of the unit inside of the apex. Tighten the apex.

The moulding is now placed on the front of the speaker, over the tacks. The speaker may be painted any desired color, or may be otherwise decorated.

[Follow the articles in RADIO WORLD from week to week on the new and fascinating Airplane Cloth Speaker.]

Still Picture Receiver

Under Way by R. C. A.

A commercial form of radio still picture receiver for sale to home users is being developed by the Radio Corporation of America group of manufacturers, according to Dr. A. N. Goldsmith, chief broadcast engineer of America.

Two types of receiver are contemplated, one which combines visual and aural reception and one which can be plugged into any good radio receiver to convert that to a picture receiver.

The first public demonstration of the system was made on Jan. 27 when the photograph of Mayor James J. Walker of New York was transmitted over WEA-F and received by Dr. Goldsmith in his home in New York. The transmission of Mr. Walker's photograph required ninety seconds.

Sensitive Reproducer Coupled Through Air

The usual practice in cone speaker construction is to have the diaphragm point outward, that is, toward the point of the pin or stylus of the unit. But in the Airplane Cloth Speaker the real sounding board, that is, the large surface, points inward, and, incidentally, so does the small cloth guard.

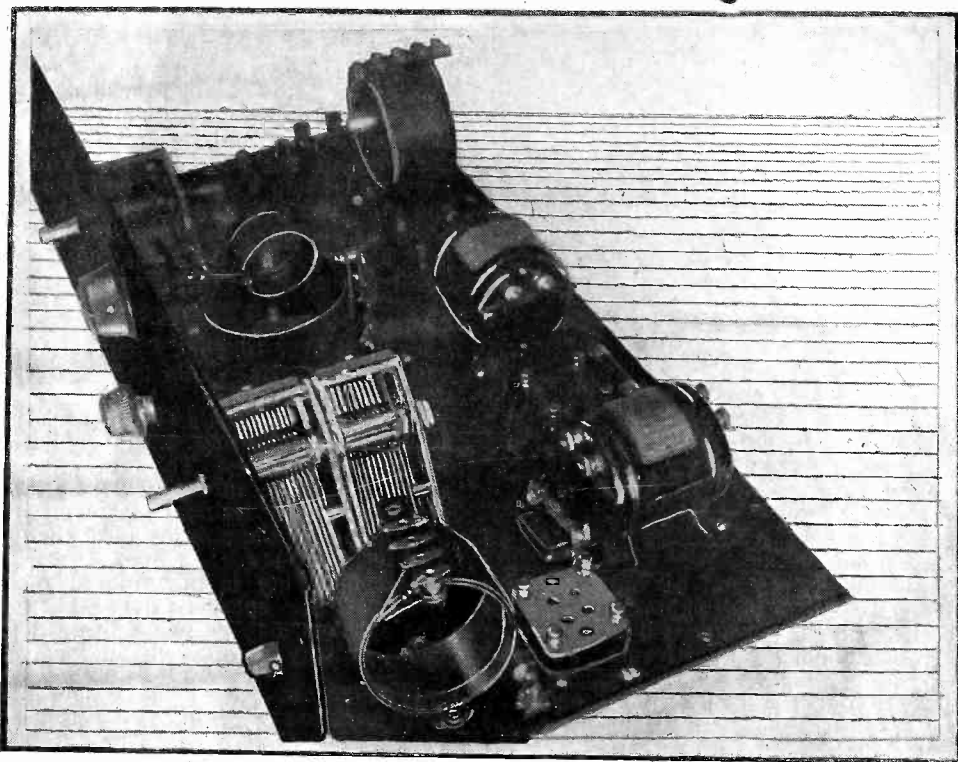
In effect, the large surface takes up most of the vibration, in fact, nearly ten times as much as the smaller one. The pull and the armature is almost exclusively by the large surface, since the smaller one serves as a brace, and the fact the smaller guard takes

up vibration is purely incidental and unavoidable.

Indeed, were another speaker of the same type as the airplane cloth model placed even a few feet away, while the first speaker was actuated by the output of a receiver, the second speaker would send forth reproduction on its own account, having taken up vibration from the first one. This is acoustical coupling and is of about the same order of non-intensity when the distance of the two is one foot as is the coupling between the large diaphragm and the small tension guard.

How to Add to the Shield

By Keith



A SIDE VIEW OF THE FIVE TUBE SHIELDED GRID DIAMOND OF THE AIR. THE EXTRA TUBE ADDS NO TUNING CONTROL OR ANY OTHER VARIABLE OF ANY SORT TO THE FRONT PANEL DEVICES.

A FIFTH tube may be added to the Four Tube Shielded Grid Diamond of the Air, if subpanel dimensional instructions given in the February 4 and 11 issues of Radio World were followed.

The subpanel, if 10 inches deep, with all parts placed according to the blue-print pattern, permits of the addition of a stage of tuned radio frequency amplification between the first RF tube and the detector.

You do not have to alter the front panel in any way. In fact, the total work concerns these additions: fifth socket behind the tickler coil; third tuning condenser in tandem with the second tuning condenser, by using one shaft running through both; a coil, just like the antenna coil, placed at right of the ganged condensers; a No. 622 Amperite with mounting, placed near the new socket.

The wiring is changed only so far as connecting to these parts.

The added tube may be a shield grid tube, so that you have two stages grid RF amplification, regenerative detector and two stages of transformer coupled audio—a five tube set of remarkable sensitivity and selectivity. The same tone is preserved.

Volume Control Option

The volume Control, R4, is left in the same position on the front panel, but as a tendency toward self-oscillation may arise in the first tube when the fifth tube is added, it is optional to connect the volume control in series with the first RF B plus lead, as diagrammed; or you may leave

it across the secondary of the first audio transformer.

The fifth tube, utilized as described and diagrammed, adds about 500 miles to the receiving range.

There are a few pointers on installation that should be watched carefully.

The main one concerns the ganging of the Karas condensers.

This is done by mounting the new condenser right back of the detector tuning condenser, but securing the new one to the subpanel. The existing tuning condenser, attached by single hole mounting to the front panel, is thus kept firmly in place, and probably has not been bolted to the subpanel.

The condenser frame, at bottom, has holes that easily pass 6/32 screws. The half-inch length type is plenty long enough. Use two on the new condenser, but be sure to find the drill hole locations with strict accuracy, otherwise the two condensers will not team up properly.

How to Rectify Mistake

If you drill a hole in the wrong place you are up against it, for the hole will not permit of a new one right next to it, in fact half including it, since the drill will slip into the existing aperture. Probably as good a remedy as any under the circumstances would be to drill the erroneous hole sufficiently oversize to pass the screw properly, and tighten a large hex nut against the underneath plans of the subpanel to get the proper "bite."

Should the condensers not be in alignment there will be torque on the common

LIST OF PARTS

Vital Kit

L1L2, L3L4L5—Hammarlund HR 23, consisting of one antenna coupler and one three-circuit coil, both for .0005 mfd. tuning.

LLo—One Hammarlund RF transformer, same as antenna coil above.

C1, C4—Three Karas .0005 mfd. SFL condensers, type 23.

AF1, AF2—Two Karas Harmonik audio frequency transformers.

R, R1—Two No. 622 Amperites with mountings.

R3, R5, R6—Three No. 1A Amperites with three mountings.

R2—One Lynch 5 meg. grid leak.

R4—One Volume Control Clarostat.

C2, C5, C7—Three Aerovox .006 mfd. fixed mica condensers.

C3—One Aerovox .00025 mfd. mica grid condenser, with clips.

C6—One .001 mfd. Aerovox mica fixed condenser.

S—One Yaxley No. 10 battery switch.

PL—One Yaxley No. 310 pilot light bracket (with lamp extra).

PJ—Two Frost phone tip jacks, No. 253.

Five Frost Bakelite sockets, No. 530.

One 5½" shaft, ¼" diameter.

Two Eby binding posts (Ant., Gnd.).

One 7 x 21 inch front panel.

One 10 x 20 inch subpanel or baseboard.

Two Mar-co dials.

Two Pee-Wee clips (No. 45 Universal clips).

Set of three Karas subpanel brackets.

ACCESSORIES

Two shielded grid tubes, Ce Co RF22, for sockets 1 and 5.

Two Vac-Shields for shielded grid tubes.

One Q. R. S. 200A detector tube or CeCo type H, for socket No. 2.

One CeCo type A for socket No. 3.

One CeCo type F (112) for socket No. 4.

One roll flexible Acme Celatsite.

One 7-lead Acme battery cable.

One set of cable markers.

A, B and C supplies.

shaft. This would bend a metal shaft. A hard rubber or Bakelite shaft will take up a little torque nicely. If a brass or other metal shaft is used the most extreme care must be taken to get the condenser mounting holes precisely right.

Separate Grid Return

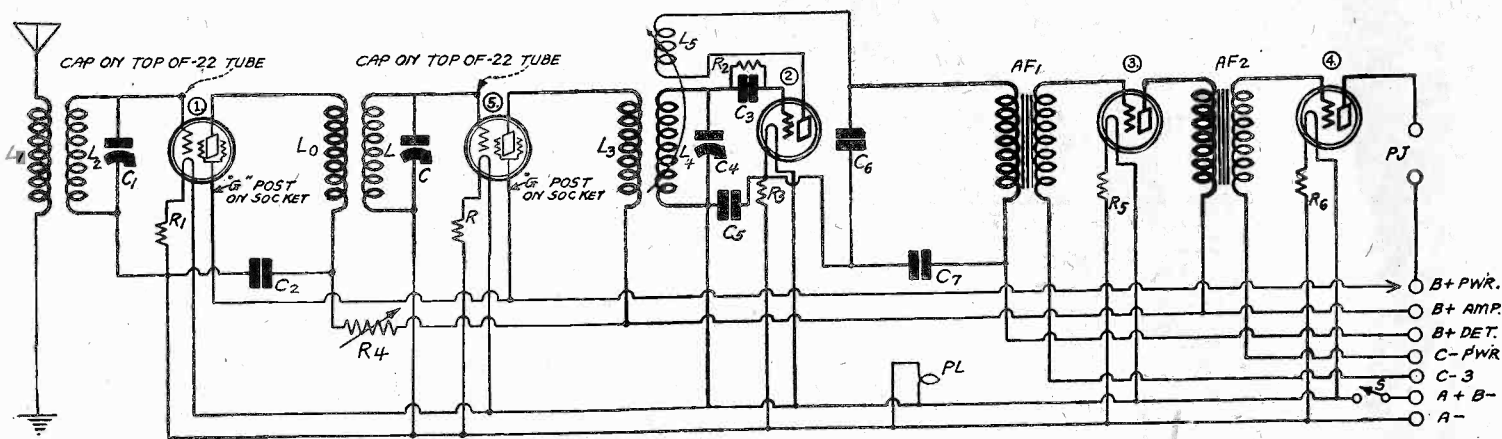
It is therefore preferably to use Bakelite or hard rubber shafting, 5½ inches long. That also affords complete insulation between rotors of the teamed condensers.

Naturally, when mounting the second condenser you will not permit the front part of its frame or the bushing thereon to touch the corresponding part of the back of the existing condenser. But if metal shafting is used, this precaution is useless.

The advantage of the insulated shaft is that it permits the detector grid return to be made to negative F for the special de-

a Fifth Tube Grid Diamond

Lauderdale



THOSE WHO HAVE BUILT THE FOUR TUBE SHIELDED GRID DIAMOND OF THE AIR AND WHO DESIRE TO ADD A FIFTH TUBE, SO AS TO INCREASE THE RECEPTION RANGE ABOUT 500 MILES, MAY DO SO BY MAKING THE FIFTH TUBE THE SECOND RADIO FREQUENCY AMPLIFIER. THIS IS SHOWN ABOVE AS A SCREEN GRID TUBE. (5) THE CHANGE IS EASILY MADE.

detector tubes, while the RF tube's grid is returned to minus A. Therefore the RF tube gets a free bias equal to the voltage drop in R, or 2.7 volts (6 minus 3.3). With 135 volts on the plate of the RF tube, or even a little less, this is a suitable bias, and heightens the selectivity.

Of course, with separate grid returns made possible, the detector may be returned to F+ for any tube, including Q. R. S. 200-A or other special detector. Sometimes signals are made louder.

Should a metal shaft be used a different connection for the grid leak would have to be made. Instead of the clips on the grid condenser being utilized for leak mounting, a special mount must be provided, and it is connected from the G post of the detector socket to the F minus (or F plus) post of the same socket. Then the leak is mounted in the new holder.

System Excellent

The system of ganging the Karas condensers works out excellently, especially

since the tickler of the Hammarlund coil has a sufficiently high inductive effect upon the adjoining secondary to afford compensation, if such is necessary. In most cases the simultaneous tuning of these similar stages with a single motion works out with splendid balance, requiring no trimmers.

The best way to include the fifth tube is to get the blue-print of the Four Tube Shielded Grid Diamond, lay out all the parts as shown thereon and add those previously mentioned in this article. (The list of parts includes all save the extra mounting for grid leak if a metal shaft is used.) Connect up the filament wiring, then wire the new stage first and continue from the blueprint with the rest. Visually it turns out to be very simple, although words may make it seem harder than it is.

Build the Four First

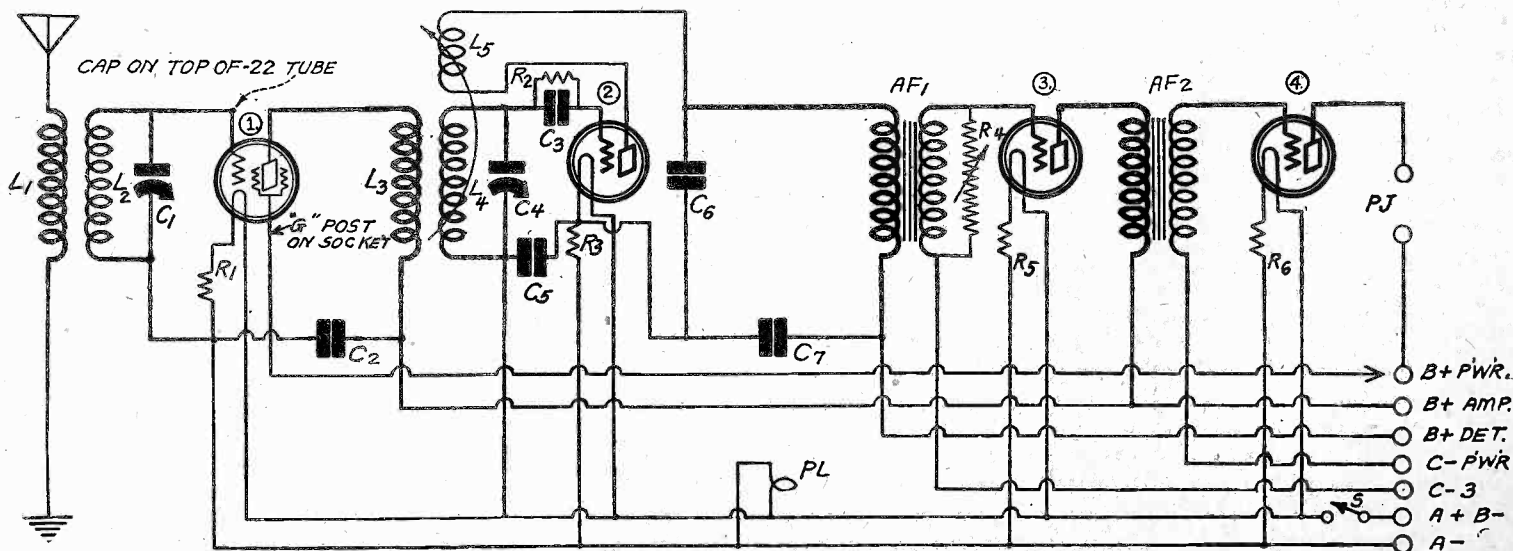
How to incorporate a fifth tube is described here solely for the benefit of those who have already built the Four Tube S-G

Diamond. The changes are so few and so simple that any one starting anew should still build the four tube model first, and make the change later if he desires.

So extraordinary is the performance of the four tube model that many will not care much about making the addition. Yet the fellow who hungers for that extra 500 miles, which may bring him Denver from New York regularly, instead of only Chicago through locals, may set his heart on that fifth or specially DX tube.

Still another option presents itself. If you desire to use three shield grid tubes you may use the third one as the detector. Change over to a 622 Amperite here, also. Connect the cap of the shield grid tube to B plus 22 to 67, and use resistance coupling in the first audio stage. Followed by a Karas transformer, this gives sufficient volume.

The incorporation of a shield grid tube as a space charge detector was fully described, for the first time anywhere, in the February 18 issue.



THE FOUR TUBE MODEL. WHEN THE FIFTH TUBE IS ADDED IT IS PLACED ELECTRICALLY JUST AHEAD OF THE DETECTOR. THE VOLUME CONTROL CLAROSTAT IS PUT IN THE B+ AMP. LEAD AT THE ANGLE OF THAT LINE JUST BELOW WHERE C2 JOINS IT.

The Screen Analyzed for

By J. E.

Technical

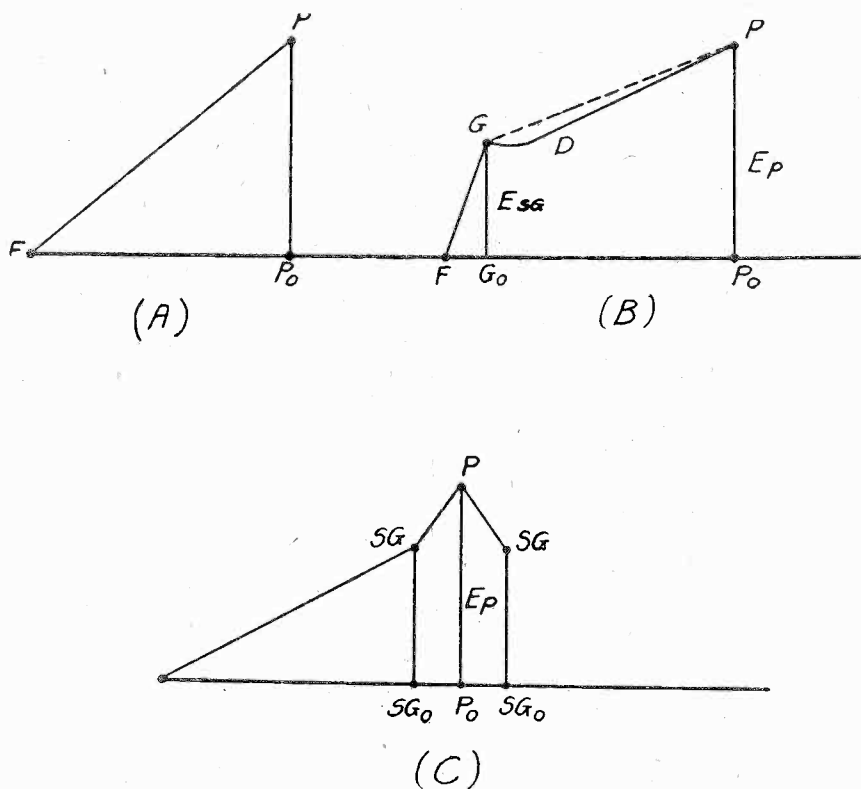


FIG. 1

A CURVE SHOWING THE CHANGE IN POTENTIAL (ELECTRICAL ALTITUDE) BETWEEN THE FILAMENT AND THE PLATE IN AN ORDINARY VACUUM TUBE.

CURVE SHOWING THE CHANGE IN POTENTIAL BETWEEN THE FILAMENT AND THE PLATE WHEN THE INNER GRID IN A SCREEN GRID TUBE IS GIVEN A POSITIVE POTENTIAL.

THIS CURVE SHOWS THE POTENTIAL DISTRIBUTION BETWEEN THE FILAMENT AND THE PLATE IN A SCREEN GRID TUBE WHEN THE OUTER GRID IS GIVEN A POSITIVE POTENTIAL.

It helps in the understanding of the screen grid vacuum tube to draw analogies and to visualize the happenings inside the tube in terms of familiar analogous phenomena.

Potential is not easily visualized and for that reason it is not widely understood. The term voltage probably came into use because it was easier to understand something about the divisions on a voltmeter than to understand "the total work done against the electrical forces in carrying unit charge from infinity up to the point," which is the definition of electrical potential at that point. We can not understand the functioning of a vacuum tube without understanding potential, and we can not dispose of the matter by saying that potential is voltage, for it is not.

The volt is only a practical unit for measuring electric potential, potential difference and electromotive force, and voltage is a quantity of any one of these expressed in volts.

Analogous to Altitude

But altitude is clearly understood by everybody, and we can with a few reservations liken electric potential to that.

If a stone is dropped from an airplane it falls straight to earth. If an electron is released from the filament of a vacuum tube it falls straight to the plate, if the plate is charged positively. The laws of fall in the two cases are very much the same. But if

we are to carry the analogy through we have to assume that the positive plate is at a lower potential (altitude) than the filament. That assumption is merely to avoid the necessity of saying that the electrons fall upward.

Then an electron released from the filament falls down to the plate just like a stone released from an airplane falls down to earth. The greater the potential of the plate, the greater will be the speed of the electron when it hits the plate. Likewise, the higher the airplane when the stone is released, the greater will be the speed of the stone when it strikes the earth.

The Inclined Plane

In Fig. 1A FP_0 represents the distance between the filament and the plate of any vacuum tube. Let E_p represent the potential of the plate. The line FP shows how the potential falls between the filament and the plate, that is, the vertical distance between this line and the base line FP_0 at any given point between F and P_0 measures the potential of that point with respect to the filament. This is clear by our analogy.

Suppose FP is an inclined plane down which a ball rolls. The plane determines the altitude of that ball at any time between the two points. The ball might represent an electron falling from the filament to the plate.

It is possible to alter the distribution of

potential between the filament and the plate by interposing other electrodes and giving them a different potential. Instead of having one long inclined plane FP we can have a short plate FG and a somewhat longer plane GP to connect the two points F and P as in Fig. 1B.

Now the distribution of potential (altitude) is different between the two points. Between F and G_0 the slope is steep while between G_0 and P_0 it is gentle. Now if a ball is started rolling it will not accelerate as rapidly between G and P as it will between G and F .

If the ball is an electron it will accelerate rapidly between F and G_0 and slowly between G_0 and P_0 .

The distance G_0G represents the positive potential E_{sg} applied to a second electrode interposed between the plate and the filament.

Another Distribution

In Fig. 1C the interposed electrode has been erected closer to the plate. The long inclined plane with the gentle slope is now between the filament and the added electrode and the short plane with the steep slope is now next to the plate. An electron moving from the filament to the plate will accelerate slowly at first and then after it has passed the point SG much more rapidly.

How are these slopes and planes connected with the screen grid tube? Look at Fig. 2. There are five concentric circles in it. They represent the elements in the screen grid tube. The central solid black circle F is the filament of the tube. The dotted circle G is the inner grid, or the grid which is connected to the top of the glass bulb. The two dotted circles SG are the screen grid, or outer grid, which is terminated on the grid post on the socket. The solid line circle P is the cylindrical plate of the tube.

Suppose all the grids are absent or that they are wholly ineffective. The distribution of electrical potential between the filament F and the plate P is then as shown in Fig. 1A, neglecting the effect of the electrons themselves.

Electrons First Accelerated

Now suppose that the outer grid SG is absent or ineffective and that the inner grid be given a positive potential E_{sg} , considerably lower than the potential of the plate. Then we have the case illustrated in Fig. 1B. The electrons are greatly accelerated between F and G as is shown by the steepness of the line FG . Between G and P the distribution can no longer be represented by a straight line, or a straight inclined plane, GP , but has to be represented by the curve GDP .

If the positively charged grid G ceased to attract electrons the instant they pass it, the dotted line GP would still represent the fall of potential, but it does not. The grid G attracts them even after they have passed and thus retards their progress. It is this retardation which causes the dip downward in the solid curve.

It is obvious that as the grid G attracts the electrons some of them will be trapped by it, that is, that they will fall into the

Grid Tube the Novice

Anderson
Editor

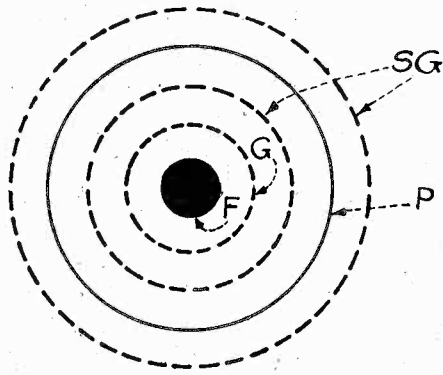


FIG. 2

THIS SHOWS A SCHEMATIC PICTURE OF A SECTION OF A SCREEN GRID TUBE IN WHICH F IS THE FILAMENT, G THE INNER GRID, SG THE DOUBLE OUTER GRID, AND P THE PLATE. THE SOLID LINES REPRESENT CYLINDRICAL SPIRALS AND THE DOTTED LINES REPRESENT CYLINDRICAL SPIRALS.

grid instead of the plate. The slowest moving electrons will thus be caught. The faster will shoot past G and be attracted into P. There will thus be a current both to G and to P, and the relative amounts will depend on the relative distances and potentials. If the potential of G is equal to or higher than that of P very few electrons will get to P.

Effect of Trapped Electrons

If the electrons that fall into the grid G cannot escape to the filament as soon as they reach it, the potential of the grid will soon be lowered to that of the filament and even lower. The curve representing the fall of potential between the filament and the plate would start from F and run along FG and then go up to P, or else it would start from F and dip down under G and then curve up to P.

Fig. 1B represents the case in which the screen grid tube is used as a space charge grid tube. The inner grid is given a positive potential to give the electrons an initial start.

Now suppose that the inner grid is absent or ineffective and that the outer grid be given a positive potential somewhat lower than that given the plate. The potential distribution is then as in Fig. 1C. The electron acceleration between F and SG and between SG and P it is rapid as is indicated by the slopes of the lines joining these points.

Fewer Reach Plate

The shield grid SG takes a considerable portion of the total number of electrons leaving the filament and therefore, the number reaching the plate is greatly reduced. That is, the plate current is reduced by the shield grid. It is for this reason that the plate AC impedance of this tube is very high.

The amplification constant has no significance until the control grid is also added. The tube has one amplification constant when

it is operated as a space charge grid tube and another when it is operated as a screen grid amplifier.

Either of these gain factors depends on the values of the potentials on the two positive electrodes as well as on the relative distances.

Neither is a definite quantity. For the screen grid connection, that is, when the inner grid is the control grid, the potentials on the screen grid and the plate can be manipulated so that the effective amplification constant is very high. They can also be manipulated so that the tube does not amplify at all. Many of the failures with the screen grid tubes have been due to the use of improper potentials on these two electrodes.

It seems that the radio fans who have become excited about the possibilities of the screen grid tube have disregarded the recommendations of the makers of the tube with respect to uses and methods of use.

The instructions say both implicitly and explicitly that the tube operated as screen grid tube should have a very high load impedance if any considerable gain is to be expected from its use. These have been ignored almost entirely. The recommendations are also that the plate should be given a potential of 135 volts and the screen grid a potential of 45 volts, with minor variations permissible. Yet many have even gone so far as to reverse these potentials, use the tube with a load insufficient for even a -01A tube, and then complain that the results are not satisfactory.

The main object of the outer grid is to screen or shield the control grid (inner) from changes in the plate potential of the tube, particularly those changes caused by changes in the plate current which in turn are caused by changes in the control grid potential. Putting it another way, the object of the screen grid is to prevent feedback through the plate to control grid capacity.

If the screen grid is to be effective it must be grounded as far as these voltage changes are concerned. That is, if it is to be used effectively at radio frequency the screen grid must be ground for radio frequencies. This can be done by a condenser of .001 mfd. or higher value.

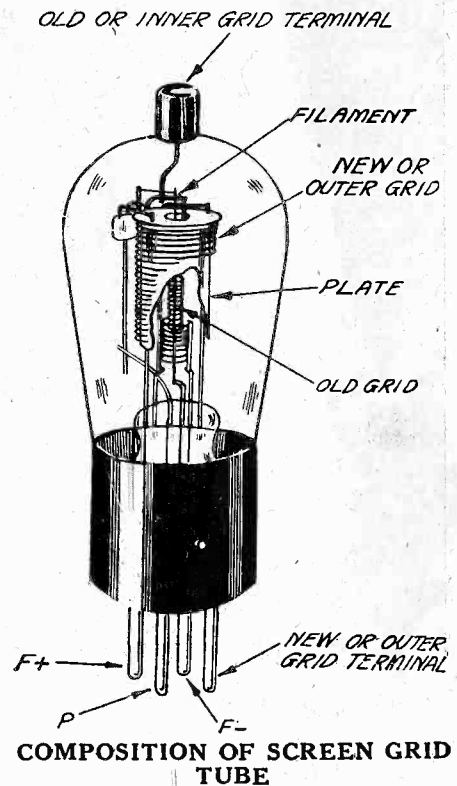
If the screen grid tube is to be effective at audio frequency it should be grounded at audio frequency. This is not so easily done with a condenser, since, for the lower audio frequencies an enormous condenser would be required.

Need Not So Great

Fortunately the need for grounding at audio frequency is not so great as it is at radio frequency, and then also if the screen grid maintained at a steady positive potential by means of a battery the electrode will be practically grounded for all audio frequencies.

But when the screen is kept at a positive voltage by means of a B battery eliminator the only way of grounding is to use larger condenser.

It should be emphasized that no impedance whatever should be interposed between the screen grid and the source of steady positive potential, for this would cause a voltage drop which would change the functioning of the tube.



COMPOSITION OF SCREEN GRID TUBE

Sometimes a variable resistor is placed between the voltage source and the screen grid for the purpose of varying the effective screen grid voltage.

Since a current flows in the screen grid circuit the voltage is varied a little, but nevertheless, the resistor should not be used unless it can be incorporated without nullifying the purpose of the tube.

And the main purpose is only served when the screen grid is at filament or ground potential to the changes in the electrode potentials.

If the screen grid tube is used as a space charge detector the cap is connected to B plus and the G post of socket to grid condenser, as with other tubes. Some precautions should be observed.

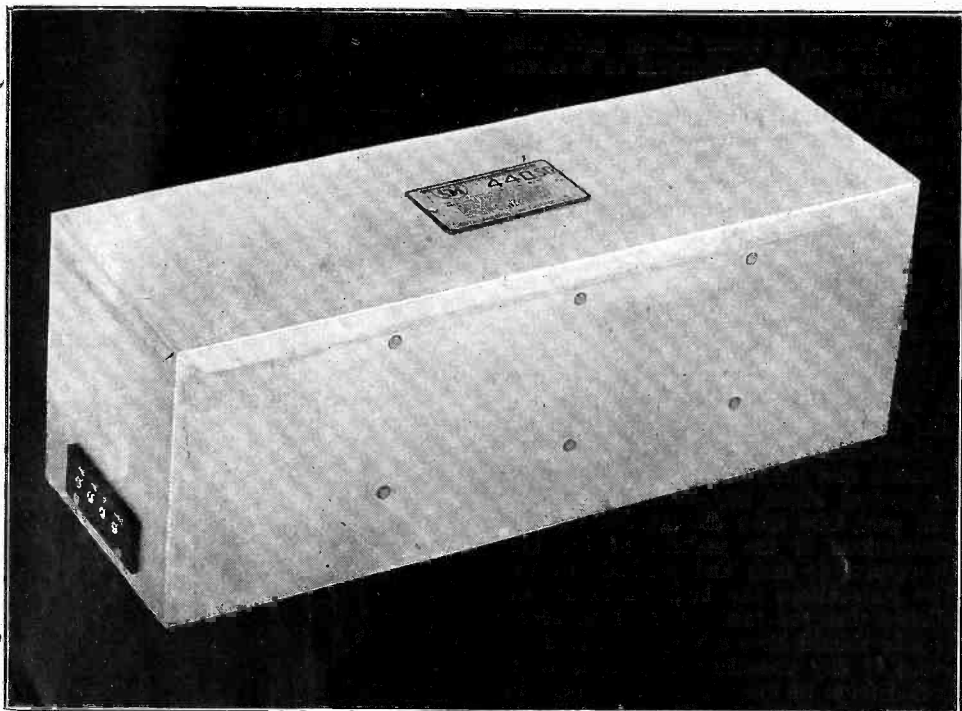
The volume output from the detector circuit depends considerably on the value of the plate resistor. The .1 meg. usually employed in resistance coupling works fairly well, but half that resistance (50,000 ohms) is very much better both from the viewpoint of increased volume and low note reproduction. Also middle and high notes are not slighted.

In choosing plate resistors for any such circuit if the chosen ohmage is too high not only will the volume be reduced but the notes will be slighted and the low notes, too. Theoretically, the higher the resistance of the load the greater the amplification, but it does not work out that way. Experimenters should accept 50,000 ohms as standard, but may try out even lower values of resistance. The difference may be noted simply by listening. For instance, .1 meg. resistor gives only about half the volume as the 50,000 ohm resistor.

The space charge tube for RF amplification did not work well, it may be stated now for the benefit of those who wonder about that aspect.

Scientific Layout and Shield Grid Model

By Ernest



THE ETERNAL APPEARANCE OF THE SM 400 SG TIME SIGNAL AMPLIFIER IN WHICH THREE SCREEN-GRID TUBES ARE USED.

[Part I of this constructional article was published last week, issue of February 25. The conclusion follows.]

PART II

THE construction of the screen-grid Laboratory Model receiver is a simple task, indeed. The steel chassis and panel are completely and accurately pierced so that the different parts need simply be placed on them, in the positions in which they appear in the illustrations last week and this week. The parts are bolted down with machine screws and nuts.

A few precautions should be observed. The 6 ohm rheostat R2 placed in the "filament" hole of the front panel and the 20 ohm rheostat R1 placed in the "gain" hole of the front panel should be carefully and thoroughly insulated from the panel, using a pair of extruded fiber washers for each.

The "On-Off" switch Sw need not be insulated from the panel.

On the other hand, it is desirable that the bushing of the midget condenser C3 shall make good, positive contact with the metal panel and that a small space around the "sensitivity" hole in the panel should be scraped free of enamel.

Likewise, the lower rear side of the panel and the front edge of the chassis should be scraped at several points to make a good electrical contact between panel and chassis.

Removable Shafts

If variable condensers of the removable shaft type are used, they may be screwed down to the chassis by means of the two mounting feet provided. Both condensers should be put in with their shafts projecting to the right.

The two lock collars on the oscillator-condenser shaft should then be loosened and the shaft pushed through to the left so that it projects from the back of the

condenser instead of the front. The lock collars should be tightened after this operation.

If condensers of the standard type are used they are mounted on the dial brackets, which support them entirely. A small extruded brass washer accompanying the dials serves to adapt the small shaft bushing of the condensers to the large holes in the dial brackets.

The dial brackets themselves are fastened to the front panel with the drive mechanism slipped into their bushings and projecting through the front panel.

The drum scales should be fitted on the condenser shafts to read 100 when the condensers are entirely interleaved, so that readings will decrease with decrease in wave length.

Arrangement of Parts

The arrangement of the parts of this receiver is clearly illustrated in the photograph of the interior of the set. In the middle of the panel can be seen the midget condenser C3 above and between the two rheostats, which are just above the edge of the metal box of the 440 SG amplifier. The positions of the dial lights can be seen near the top of the panel by the sides of the drum dials, which in turn are at the extremes of the open, central compartment.

Just back of the panel are two aluminum cans, one at each end of the set, and these contain the oscillator and the first detector. The oscillator is at the left and the detector to the right, looking from the rear of the set.

All the parts, such as the tube, the condensers, the coils and resistors, pertaining to the oscillator or the detector are in the appropriate can.

The SM 440 SG amplifier is contained in the large metal box back of the row of binding posts. This amplifier is completely wired and all that is necessary to hook it in the circuit is to make the appropriate connections to the terminal screws on the ends of the amplifier box.

The order in which connections should be made is shown in the circuit diagram published in last week (Feb. 25 issue).

The audio amplifier appears at the left front corner of the photograph of the interior, looking from the rear of the set. It comprises two SM 220 audio transformers and two sockets. The four output binding posts can also be seen in this corner of the photograph. Two of these are for the first audio tube and moderate volume and two for the last tube and maximum volume.

Wiring a Piece of Art

The wiring in this receiver is unusual and deserves special attention as a model. First look at the wiring on top of the baseboard, that is, at the photograph of the interior of the set. There is not much of it visible. There are only a few short wires about the audio amplifier and the panel-mounted controls. Were the lids of the shield cans to be removed, the same brevity of leads and the same orderliness would be apparent. (See Fig. 2, page 4, Feb. 25 issue). This is the result of expert planning in laying out the parts.

While the wiring on top of the subpanel is orderly and direct, that under the subpanel is a radical and happy departure from ordinary wiring practice. Note the attractive cabling of the wires of the subpanel. All the leads carrying low frequency currents or direct current are bunched up and bound together with strong twine. The cable runs close to the binding post strip and many of the conductors in the cable terminate on these binding posts. In other case a conductor merely "picks up" a terminal as it passes on to some other terminal that must be picked up also by the same conductor.

Wiring in this manner requires a little more wire than is required when the ordinary point-to-point method of wiring is used and it also demands the use of flexible leads.

It is the method used in telephone practice.

Making the Cable

A cable of this type is usually made before it is connected in the receiver. A full-size plot of the wiring may be made on a sheet of paper or the blueprint may be used. Those desiring blueprints should communicate with me by letter. Address: Ernest R. Pfaff, care of Radio World, 145 West 45th Street, New York, N. Y.

On this the exact locations of all terminals and bends are made. Then the paper is fastened to the top of the workbench and a nail is driven wherever a terminal or a wire bend is indicated on the paper. Then the wire is run as required by the circuit diagram.

The end of the flexible stock wire may be twisted around the nail representing 180 volt binding post as a starter. The twisting is done merely to anchor the end of the wire. Then the wire is run

Wiring Signalize Laboratory Super

R. Pfaff

to the appropriate point, in this case one of the loud speaker terminals, by way of a corner nail or more if the layout so requires. The wire is twisted around the nail representing the loud speaker terminal for security and then cut. All the other wires are run the same way.

In case one conductor picks up more than two terminals, as the 135 volt lead for example, the wire should be started at one extremity and run to the other, picking up all intermediate points by means of loops run from the main cable to the points to be picked up. To maintain a neat cable it is usually necessary to drive a nail wherever the loop leaves the cable. The tip of the loop is not cut but the insulation is removed so that a connection can be made finally to the point to be picked up.

Sewing of the Cable

When all the wires that are to go into the cable have been run, with all the required loops and terminals provided, the cable is "sewed" together with a strong cord. The sewing is begun at one end of the cable and continued to the other extreme. The branch lines are sewed up by beginning at the junction of the main cable and continuing as long as there are two or more conductors that need joining.

The sewing consists of throwing a single knot around the bunched conductors about every inch, and drawing up tightly. Every knot should be thrown in the same direction, or the sewing will not be neat.

When the cable has been sewed up and the terminals of the twine have been securely fastened, the nails may be pulled out of the work bench and the completed cable picked up. It will be firm and easily handled. It can now be transferred to the sub-panel position where it is to be connected to the various terminal posts.

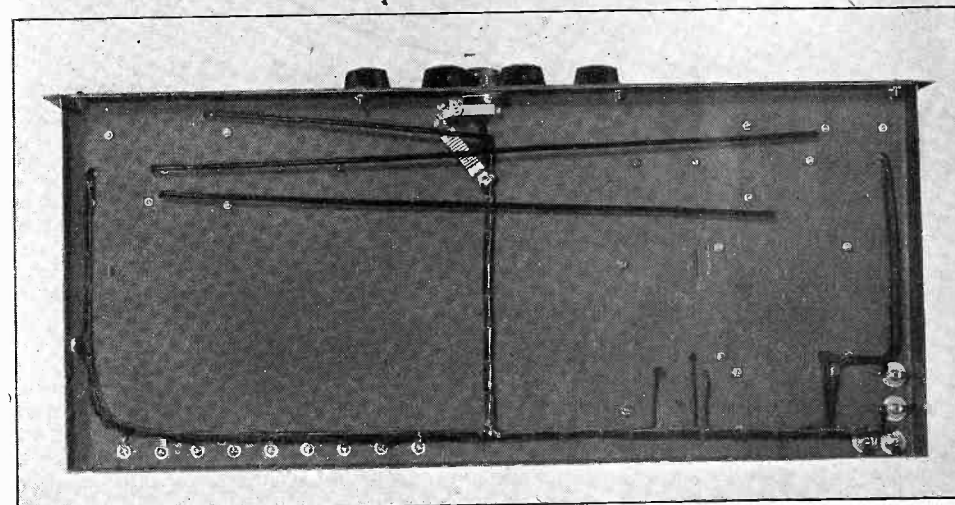
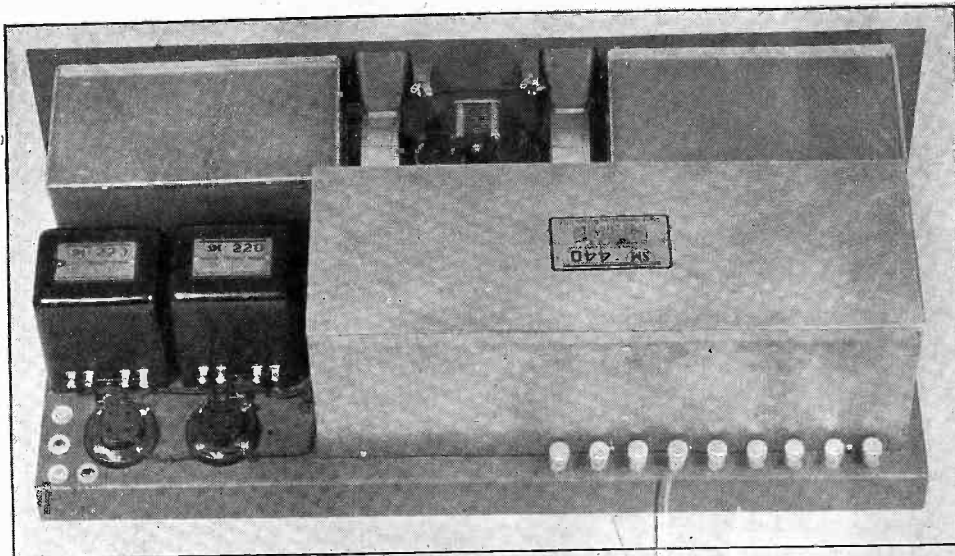
If the job has been done accurately there will be a terminal in the cable opposite every terminal on the set, and it is only necessary to remove the insulation and make the connections. The cable terminals may be a bit too long but that is easily remedied with a pair of snippers.

Bus-Bar Wiring May Be Used

The cabling idea may deter some from tackling this job and these prospective builders may prefer to use bus-bar wire throughout. There is no reason why they should not do so, for the receiver is equally efficient with either type of wiring.

When the wiring has been completed the receiver should be carefully checked against the circuit or wiring diagram to make certain that no error has been committed. With this disposed of the circuit is ready for hooking up to the power source and the antenna.

The probability is that the circuit will start off with a bang and work as expected from the beginning or after a few simple adjustments suggested by any possible difficulty. But in a few cases the receiver will not work to the entire satisfaction of the builder. In that case do not attribute the difficulty to the circuit or to the parts. The circuit is all right and the parts are very likely in a perfect condition, or were when the job was begun. There is a fault in the wiring which defies visual inspection.



THE INTERIOR VIEW OF THE SCREEN-GRID LABORATORY MODEL RECEIVER SHOWING THE DRUM DIALS, THE ALUMINUM SHIELDS HOUSING THE OSCILLATOR AND THE FIRST DETECTOR, THE SM440 SG AMPLIFIER AND THE TWO STAGE AUDIO AMPLIFIER. THE SUB-PANEL VIEW SHOWS THE UNUSUAL NEATNESS WHICH CAN BE ATTAINED BY CABLING THE VARIOUS LEADS.

tion. Locate this fault and the circuit will work perfectly.

Live RF Excluded

Leads on the live side of a radio frequency circuit should not be included in the cable because the capacity between one such lead and ground would reduce the effectiveness of the circuit. Even two live audio frequency leads should not be bunched in the same cable for the same reason. The live side is the grid side, and to a less extent the plate side. The grounded side of any circuit is not sensitive.

In addition to the cable there are three bus-bar wire leads visible on the photograph. One of these leads serves to connect post 5 of the antenna coil socket (4) to the stator lug of the midget "sensitivity" condenser C3. The other two leads serve to connect posts 1 and 2 of the oscillator coil socket (L2) to post 3 of the antenna coil socket (L1) and the first detector grid condenser C4. All of these leads should be made of bus-bar in spaghetti, put in so that they are at least 3-4 inch away from the metal chassis or re-

ceived assembly at any point where they run parallel.

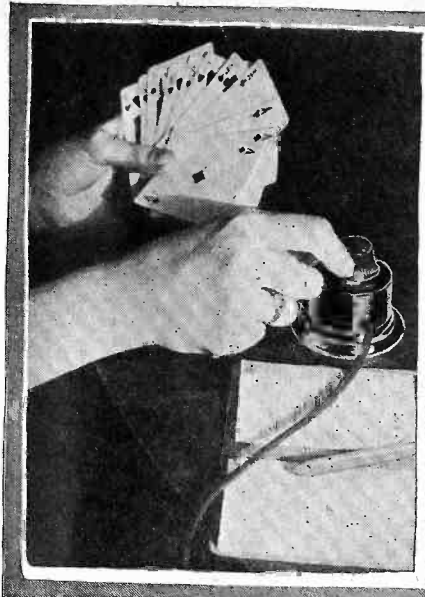
When both filament rheostats R1 and R2 are turned to the left, that is, to the "Off" position, and the "On-Off" switch is turned on, the two audio tubes and the second detector tube should light. As the filament rheostat R2 is slowly turned to the right, the first detector and the oscillator tubes should light. And as the "Gain" knob is turned to the right the three screen-grid tubes should light.

The three flexible leads terminating in clips should be connected to the tops of the shield grid tubes, or no signal can be expected.

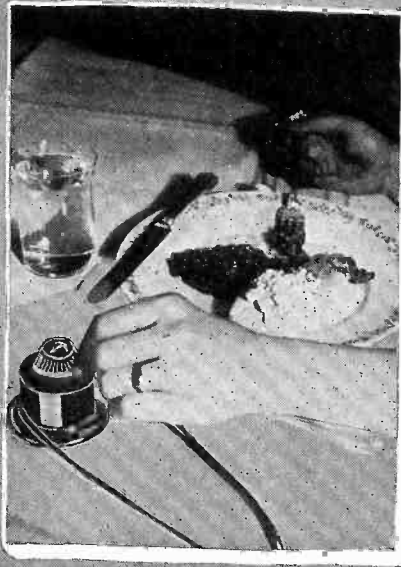
[This concludes the constructional article. Tuning and operating data will be published next week.]

A. R. JOHNSON IN NEW POST

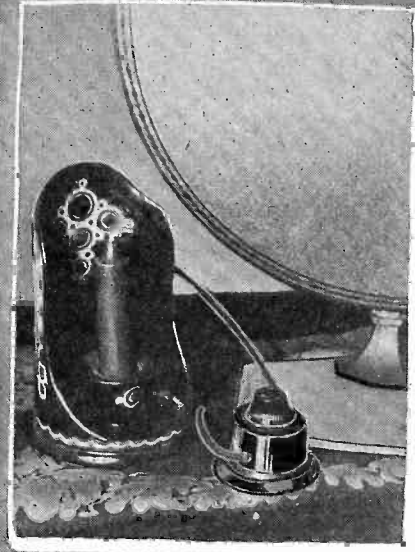
A. R. Johnson, engineer in charge of the transmitter at South Schenectady developmental station of the General Electric Company, has been engaged as engineer in charge of the transmitter power house of stations WENR and WBCN, operated by the Great Lakes Radio Broadcasting Company, at Chicago, Ill.



IF THE RADIO IS SO LOUD AS TO INTERFERE WITH CARD PLAYING THE VOLUME CAN BE CONTROLLED FROM THE CARD TABLE BY MEANS OF A REMOTE CONTROL DEVICE THAT GOVERNS VOLUME.



THE DINNER MUSIC FROM THE RADIO CAN BE CONTROLLED FROM THE DINNER TABLE. THE HOSTESS MODULATES THE MUSIC AS REQUIRED AND SUITS VOLUME TO HER GUESTS' MOOD.



THE CONTROL CAN ALSO BE PLACED NEAR THE LOUD SPEAKER WHEN THAT IS PLACED AT SOME DISTANCE FROM THE SET. THE CONNECTION MAY BE SERIES OR PARALLEL.



OFTEN WHEN DESIRABLE THE VOLUME A REMOTE CONTROL REGULATOR READER EN

Damrosch Music Course Wins Schools' Thanks

That there is a national demand for a radio course in music appreciation was strongly indicated by telegrams received from all parts of the country expressing gratitude for a program presented by Walter Damrosch, conducting the New York Symphony Orchestra.

The program, put on the air by the National Broadcasting Company and associate stations, was the final of a series of demonstrations of the Damrosch plan for a music course by radio. The music and explanations offered in the broadcast were selected to appeal to young people of high school and college age.

Telegrams began to arrive while the programs still was in progress. Other messages poured in for hours after the demonstration.

In New York City, auditoriums of high schools were crowded with quiet, appreciative students who listened attentively to the music. In public School 30, on East Eighty-eighth Street, 900 boys crowded into one auditorium to hear the broadcast. More than 100 youngsters had to seat themselves on the floor. In three other smaller rooms, more than 500 additional boys heard the program.

Six hundred girls at Washington Irving High School heard the program in the huge auditorium. They were instructed to take notes on the broadcast and write a report as part of their music course work.

Thousands of other New York youngsters listened in at various schools in the city, it was reported.

Special amplifying and reproducing equipment was installed in the auditorium of the Junior Vocational High School of Bayonne, N. J., by the Radio Corporation of America so that its 2,200 students could listen in.

C. C. Nickle, principal of the Fort Dodge, Iowa, high school, telegraphed that more than 1,000 students and teachers in his school enjoyed the program.

Telegrams also were received from Pulaski, Tenn., and Norfolk, Nebraska, before the hour's broadcast had ended. Congratulations were wired from St. Mary-of-the-Woods College in Indiana.

Mr. Damrosch was elated over the success of his experiments.

"I believe there is a sincere desire on the part of the youth of America for the best in music," he said. "The many reports I have had from schools throughout the country indicate that the experimental programs have been received with the greatest attention and enthusiasm by the students.

"I have made tentative plans for series of music appreciation programs for students in the intermediate grades and for high school students, these programs to begin next Fall.

"If the very important matter of financing the programs can be worked out, I believe we will have taken a long step forward toward establishment of my dreamed-of radio university of music."

Damrosch also pointed out that the reception of the experimental programs should silence many of the critics of the younger generation.

"They point fingers at them and call them the jazz mad generation," Damrosch said. "If they could only see these youngsters as they listen, with eyes shining, to those marvellous old melodies, they would form a different opinion of the boys and girls of today. The youngsters want good music. Something in their souls cries out for good music. Music they must have.

"Jazz is easier to obtain than symphonic orchestrations and it is natural for jazz to be popular because of its availability. But if we can give them symphonies over the air, the higher form of music will reach its proper place in their lives."

The officials of the N. B. C. agreed with him heartily.

Airy P

Featuring Super and

By James

Contri

SUPER—Hello, Het, whither bound?

HET—Greetings, Super, I'm on my way to the furniture store. I got some of those new screen grid tubes. I want to get a Japanese screen for them, and might as well get something artistic of it in the way of a design. My wife thought it would be a good idea.

SUPER—Yes, you might get them to paint a couple of dumbbells on it. But what's the big idea?

HET—Well, we thought that they were kind of delicate tubes and that they should be shielded from draughts, moisture and so forth.

SUPER—Sure, and the odor of steak and onions would surely kill them. Boy, you're sure dumb. These tubes should be shielded and grounded.

HET—Is that so? Too bad! I've only got one ground around the house. Will the radiator do?

SUPER—They should be grounded and shielded in the circuit. But there's no use trying to tell you, you wouldn't understand.

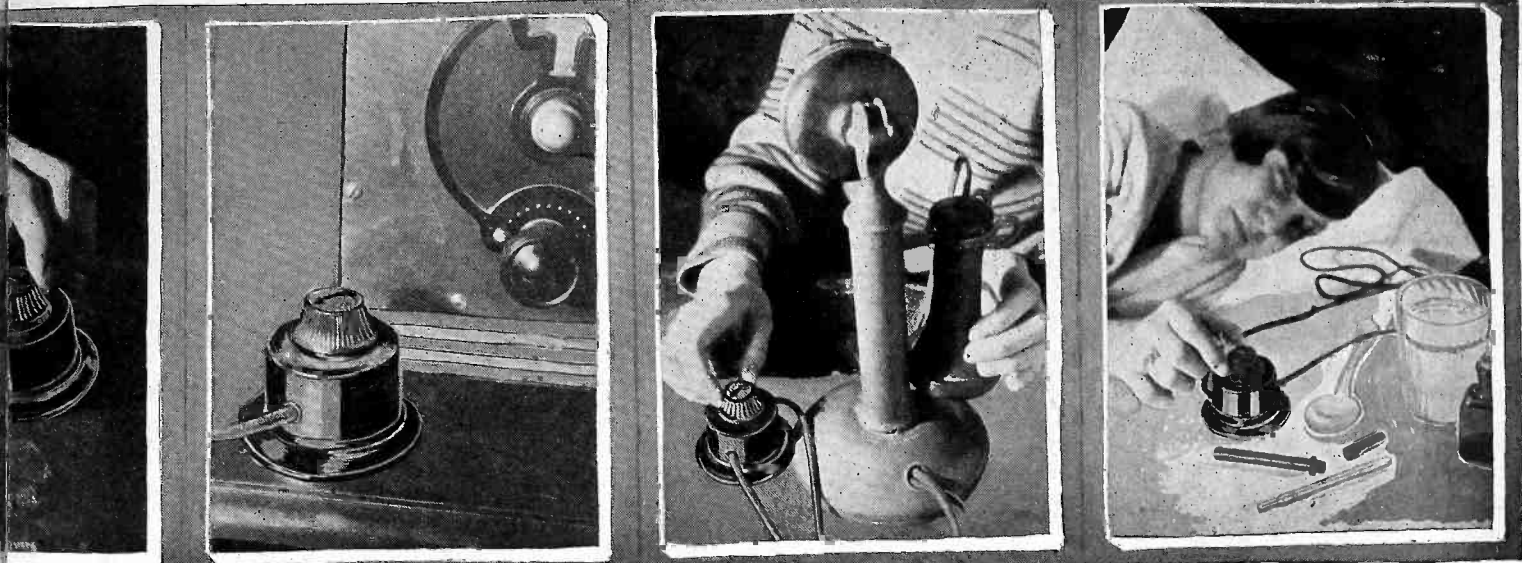
HET—Is that so?

SUPER—Yes, sir, and then some. Why you don't even know who Faraday was!

HET—Sure, I do. He was the guy who was cast away on a desert island and then wrote Robinson Crusoe.

SUPER—And then, I suppose, he invented radio.

he made the first radio set out of coconuts and broadcast his latitudination and



...NDING IT IS
...RN DOWN
...HE RADIO.
...L VOLUME
...IDE THE
...S ADJUST-

IF THE RADIO RECEIVER IS NOT PROVIDED WITH AN ADEQUATE VOLUME CONTROL, THE SAME DEVICE, PLACED BY THE SIDE OF THE RECEIVER, SOLVES THE PROBLEM VERY EASILY.

IF THE RADIO INTERFERES WITH A TELEPHONE CONVERSATION, REDUCE VOLUME WITH THE REMOTE CONTROL BESIDE THE TELEPHONE. THIS IS HANDY INDEED IF YOU'RE VERY POPULAR.

THE REMOTE CONTROL CLAROSTAT IS A BOON TO THE SICK FOR IT ENABLES THEM TO REGULATE THE VOLUME OF A RADIO SET FROM THEIR SICK BED ALTHOUGH SET IS REMOTE.

...siflage

Talkative Tinkerers

Carroll

Editor

gevity, and that's how they came to
k him up.

PER—What did he run it on, the
"ice" of the cocoanuts?

ET—Why, he made a kite and drew
electricity from the clouds to operate it.

PER—Fine, boy, your wires are cer-
tainly crossed. I suppose all the ships

are equipped with wireless at that time
and probably the Swiss Navy rescued

him?

ET—No, the Swiss had no navy at that
time. I'm not sure, but I think it was an
American battleship. That's where they
turned their radio.

PER—No, my good fellow, the Ameri-
can Navy went to a better radio school.

was in the Navy once. That's why I
know so much about radio.

ET—Then tell me how to control the vol-
ume of my loudspeaker.

PER—Stuff your ears with cotton and
keep pushing the cotton in for softer recep-
tion and pulling it out to make it louder.

ET—I can't do that.

PER—Why not?

ET—Because the cotton might reach
my brain, if I pushed the cotton too far in.

PER—No matter how far in, my dear
boy, there's little risk that you'll ever
reach your brain. It would take an ex-
plorer to find it.

ET—Well, when I was a child I had
a frightening of the brain, so I must have a
rain. I need one, to conduct the ordi-
nary affairs of life. So you see I'm right.

All Nations Save Two Rate Radio Necessity

Throughout the world, as in the United States, radio is almost universally regarded by governments, officials and presumably the public, as a "necessary" and not a luxury, according to U. S. official information just received by the Radio Manufacturers Association. World-wide radio tax information, furnished the Radio Manufacturers Association, Inc., by the U. S. Department of Commerce, shows that tax classification of radio as a "necessity" in modern life is almost unanimous.

Few countries or governments regard radio as a proper subject of taxation. Of all the nations and countries of the world, only two, France and Spain, legally class radio as a "luxury" in their taxation programs, according to the Foreign Tariff Division of the Department of Commerce.

Only a few other countries, the Department of Commerce stated, impose sales, or public consumption, taxes on radio apparatus which is imported. About a dozen countries impose sales, or excise, taxes, levied generally on almost everything, including radio products.

Of the entire family of nations, the only two countries which regard radio as a taxable luxury do not levy severe

charges. Spain has a 5 per cent ad valorem rate, while that of France is 12 per cent on the more expensive radio receiving sets and apparatus, cheaper products bearing only a 2 per cent sales tax.

Senate Reverses Itself On Sykes Office Term

The National Association of Broadcasters, in a bulletin, says:

"The situation in regard to radio legislation in Washington at the present moment is one of the worst our industry has ever faced.

"The Senate has appropriately passed a bill extending the life of the Commission another year, but, unfortunately, has burdened it with one of the most amazing amendments in the history of legislation. The amendment requires the reappointment of all Commissioners at the end of another year, notwithstanding the fact that Judge Sykes, the one remaining member of the original Commission, whose appointment has the seal of Congressional approval, was confirmed for four years by the last Congress."

Child's Radio Essay Gives Teacher a "Kick"

A teacher marked this composition by a 10-year-old 95 per cent.:

The radio has one, two or three dials. The place you have to turn it on is a little button that you have to pull it out so the radio is on. There is other kinds of things to turn.

A radio is wonderful. In the set there is a lot of wires. They have to be connected with other wires. Some

wires have to be connected with sockets and other things to make a set go.

There is an aerial and a ground. The aerial has to be up high or it is in the house. When it is in the house it is called a loop. The aeraills are from one end of the house to the other.

There are little waves in the air. It is not straight but in little waves like on a lake before a storm.

Organized Effort Beckons Set

By Robert H. W. McCord

EVER since I started to feature in RADIO WORLD the work of the professional set builder, or custom set builder as he is now more generally called, I became doubly convinced of the opportunity presented to the radio wise to make a fine competence from this work. Not only are the established custom set builders faring well, but persons who are skillful in building sets, but who do the work for the love of it, are "turning professional," as they should. A man is worthy of his hire even if he loves his work.

You will note from articles published herewith the work pays well and presents a real opportunity.

As I stated before, the proposition before the house is whether to form a club of custom set builders, national in scope. The present custom set builders could thus exchange experiences, get first-hand and accurate information on latest kits, discuss administrative as well as electrical problems, and finally wind up making more money.

Needs Proper Medium

Some medium for the dissemination of this information would have to be utilized or developed, since personal attendance by all hands at meetings is out of the question.

Skilled radiotricians who now work without compensation, are professional set builders, nevertheless, for they do buy parts, do build sets, do service sets, the only difference being they don't get paid for their work. This method hurts not only the brother set builder who works for pay but hurts the pocketbook of the gratis worker, as well.

What would the medical profession or the legal profession do if there were a lot of free doctors and free lawyers?

A club would enable the gratis worker to learn how to go about making money. The field needs development. A club could do it. The present professional would get more business if everybody charged for work done.

Write What You Think

I would like readers who are interested in the subject to fill out and return the coupon published on this page, also to send in suggestions of a name for the organization, membership requirements, dues (if any), medium to be used for dissemination of technical information, hookups, service data, blueprints, etc. You can see now that I am almost convinced a club should be started without delay, and if a few more hundred coupons were sent in I'd be assured of adequate backing, hence would be in a good position to start.

Here are some of those who most recently sent in coupons:

Julius Bahr, 331 West Side Ave., Jersey City, N. J.

Clive G. Sharpe, Scott City, Kansas.

Percy Hough, Stone, Ky.

E. L. Crump, 1907 Vine St., Chattanooga, Tenn.

Charles Lanx, 1718 Linden St., New York City.

W. X. Soboslay, 730 S. Duquesne Ave., Duquesne, Pa.

J. Miller, 302 E. 7th St., Clovis, N. M.

E. Francis Fannin, 1309 N. Tennessee Ave., Palestine, Texas.

Leo Giese, 1629 S. Prensa St., San Antonio, Texas.

G. O'Connell, 126 1-2 East Main St., Freeport, Ill.

Tifton Simmons, 214 Adams Bldg., Port Arthur, Texas.

Otto H. Ziegenbeim, 69-168 Place, Jamaica, L. I., N. Y.

A. N. Kingsafer, 137 Vernon St. (Rose-land), South Bend, Ind.

Walter W. Simpson, 745 Stewart St., Salem, Ore.

Frederick G. Gentner, 2850 Palethorpe St., Philadelphia, Pa.

Louis Japecki, 2735 Augusta Sta., Chicago, Illinois.

Edward G. Wible, 56 Paul St., Pittsburgh, Pa.

James Madison, care O. V. San, Olive View, Calif.

Charles P. Poitras, 33 Notre Dame Ave., Hicksville, L. I., N. Y.

James A. Malloney, 3 Smithfield Ave., Pawtucket, R. I.

Theodore Olson, 248 18th Ave. N., Minneapolis, Minn.

Herbert A. Dahline, 203 S. Indiana Ave., Auburn, Ind.

E. E. Hartman, 738 Garfield Ave., Kansas City, Kans.

Louis Larson, 150 7th Ave., N. W., No. St. Paul, Minn.

John L. Collins, 165 Claremont Ave., N. W., Canton, Ohio.

Carl C. Johnson, 505 3d St., Fort Myers, Fla.

E. W. Brown, 29 Wade St., Boston, Mass.

Alvin M. Kempe, 320 N. Boulevard, Cape Girardeau, Mo.

Vernon V. Vaupel, 2106 Lunt Ave., Chicago, Illinois.

A. Waivada, 167 E. 99th St., New York, N. Y.

Edward L. Gross, 1148 Robeson St., Reading, Pa.

W. H. Martin, 151 Whitehall St., S. W., Atlanta, Ga.

Otto Safstrom, 10832 Ave. J., Eastside, Chicago, Ill.

R. W. Deck, 406 Center St., Sandusky, Ohio.

R. F. Schatzman, 8238 Avalon Ave., Chicago, Ill.

C. F. Miller, 991 Rupley Drive, N. E., Atlanta, Ga.

V. L. Daniels, 1918 Thurston Ave., Racine, Wisc.

Mitchell Ross, 1974 Grand Ave., New York City.

Heck Radio Service, 2801 Indianola Ave., Columbus, Ohio. Attention D. J. Heck.

F. E. Miller, 116 N. C. St., Wenatchee, Wash.

Howard W. Page, Carrier No. 104 Post Office, Minneapolis, Minn.

D. W. Kemble, 108 Ash St., Parsons, Pa.

Clarence A. Bradt, Columbine, Ohio.

John H. Hargett, 1711 Woodmont Ave., Arnold, Pa.

L. G. Cole, 1607 East 97th St., Los Angeles, Calif.

R. Q. Ferguson, 1004 South 2d St., Temple, Texas.

Thomas J. Lubenau, 191 Schaeffer St., Brooklyn, N. Y. City.

Fred C. Shivers, Lexington, Nebraska.

Norman E. Brown, 391 Lyceum Ave. (Roxboro), Philadelphia, Pa.

Geo. Fry, 1525 Chestnut St., care A Pomerantz Co., Philadelphia, Pa.

to Make

Professional Cites

By Thomas

Associate, Institut

I HAVE built many, many receiving sets during the past eight years, even crystal sets away back in 1907 and 1908 when we used to copy code, ship positions, news, etc. The size of these sets, both receiving and sending, were quite cumbersome those days, but then our variable condensers consisted of ten or twelve home-made fixed condensers buried in a cigar box filled with parafin, on the outside of which were ten or twelve taps, across which a contact arm was rotated.

With the knowledge gleaned from radio periodicals during the past eight years I have a fairly well set idea of the kind of a receiving set I would like to own and have my clientele own. And I can say I make good money at my sideline as custom set builder.

After my many experiences I wrote up my Ten Commandments of a receiver, and here they are:

- 1—Loop operation.
- 2—Real sensitivity.
- 3—Selectivity.
- 4—Good quality.
- 5—Two tuning controls, no more, no less.
- 6—Not more than ten tubes.
- 7—Compactness.
- 8—Up-to-date in appearance.
- 9—Economical in operation.
- 10—Work well on B batteries or B eliminators.

A Large Order

Now I can hear you say: "It can't be done. Eight sets together wouldn't contain all of the above."

I'll admit it is a large order, but after diligent search I found my box of tricks

Bernard McGreevy, 611 Fourth St., Braddock, Pa.

H. C. Hathe, 762 E. Burnside St., Portland, Ore.

Max Marzgraf, care Johnston Printing and Advertising Co., 1901 McKinney Ave., Dallas, Texas.

Graham Bros. Radio Service (E. & L. Graham), 200 West 118th Place, Los Angeles, Calif.

Chas. W. Yeager, 1316 So. Date Ave., Alhambra, Calif.

B. F. Zinser, P. O. Box 245, Chillicothe, Illinois.

John Sporna, Escatawpa, Alabama.

Frank J. Bleskachek, 1031 Milwaukee Ave., Racine, Wisc.

H. M. Ramsey, 922 Terrace 49, Los Angeles, Calif.

Anthony DelleRose, 3132 S. Beechwood St., Philadelphia, Pa.

Bartley P. Kelly, 176 Crendenny Ave., Jersey City, N. J.

F. R. McMath, 320 N. 4th St., St. Louis, Mo.

Ernest C. Lorenz, 227 Louisburg St., San Francisco, Calif.

Builders to Real Opportunity

By Hugo Gernsback

Editor, "Radio News"

Money

Ten Commandments

F. Meagher

f Radio Engineers

in my favorite hookup. Let me discuss the circuit under the enumeration system used above.

1—Any desire to operate the set on an outside aerial is absent, because the set surely does perform on a loop, and it's heaps easier to install.

2—It is so sensitive I like to call it the nerve center of the air.

It is selective enough to tune in three stations between 455 and 492 meters from New York City when those channels are working, and four between 422 and 455 meters, from the same location, while they both are working. I used to cheer when I could get one channel between them.

4—The quality is so good that I can tune in WEAF and note quality and volume, and then pick out five of WEAF's chain stations, and the quality and volume remain unchanged.

5—It has only two tuning controls, and I mean just two, no compensating condensers to twist, no trimming condensers to twist, nothing else to tune with.

6—It has less than ten tubes.

7—It is twenty-six inches long, and I've seen five tube sets thirty or more inches long.

8—It is a 1929 model for appearance, on the front panel can be found only two rheostats, and the two knobs to operate the two tuning controls, which are of the drum style. The point of vision is illuminated.

9—A 150-ampere hour A battery will stand up at least ten days if the set is used at the rate of five hours a day. The total drain on the four B batteries is only sixteen milliamperes. Four heavy-duty batteries should last six to seven months or longer.

10—It will perform equally well on a B eliminator built to supply the plate voltage and current for nine of the one-quarter ampere tubes.

This set when coupled with a good speaker will reproduce as near perfection as is possible this year.

Fine Demonstrations

It is the set I have been able to demonstrate to a prospective customer and can call my shots on. I'll tell him or her: "Now I'll get Chicago, now Cincinnati, now Florida, now Texas, etc." It never falls down. It does everything I ask it to do, does it well with volume, quality and clarity. The southwest coast never fails. A 250 watt station out West comes in strong. A 10 kilocycle separation of station is assured.

That's all I have room to say here. Anybody desiring further details may obtain them by addressing me as follows: Thomas F. Meagher, 7765 Seventy-fifth Street, Glendale, N. Y. City.

EVER since radio became popular, the vogue of the home-built set has shown a gradual but healthy increase. When broadcasting first started it was impossible, in many cases, to buy ready-made sets, because at that time there was none to speak of on the market. It took several years for set manufacturers to develop the multi-tube set and, in the meantime, radio constructors and amateurs all over the country were making their own. Of course, as in everything of this kind, the first attempts were more or less crude. The niceties of careful workmanship and good materials were not considered essential in those days. A set was built for only one purpose, and that was to deliver radio broadcast entertainment. Whether the set was made to last was no consideration at all, because, nine times out of ten, the builder made the set for his own use and knew every little intricacy of it.

If anything went wrong, it did not take him much time to find the trouble, and to make the required repairs—even rebuild the set entirely.

A Single Incentive

When ready-made sets did finally come along, in overwhelming numbers and at practically all prices, home set building naturally took a set-back. The incentive for people to build their own was no longer so great; yet even today the home-made-set builder, who now is known also as the custom set builder, has not vanished, by any means. Quite the contrary; his tribe is increasing steadily.

The reason is not difficult to explain.

In the first place, it should be understood that the radio constructor who builds only an occasional set, and the custom set builder, are two distinct entities. The occasional constructor builds for his own use and enjoyment; while the custom set builder builds not only for himself but, rather, for his friends and for hire. But the two classes of home builders must be considered, more or less, together; because the incentive which urges set building, whether for profit or for one's own amusement, remains practically the same.

The radio art is in constant flux; it is foolish in the extreme to think of it as stabilized. It will never be "stabilized"—certainly not more than the automobile business is "stabilized" today.

Custom Sets Right In Step

But, particularly in the radio art, which is comparatively so new, practically every day brings along new inventions and improvements of one kind or another; these are frequently discussed in the editorial pages of radio magazines. From the very nature of things, it must be seen, set

manufacturers cannot change their models overnight. It takes a long time to get ready for production, and once you are in production, you can not stop to equip the set with the latest wrinkle or the latest invention that comes along.

Therefore, the large set manufacturers are usually "behind" the radio art, anywhere from three to six months—which is only natural and is to be expected. By this I do not mean to say that the manufactured sets are not as good, or are behind the times; but it does mean that in this country there are several hundred thousand people who must, perforce, have constantly the latest wrinkles, the latest improvements in radio sets.

And this army of radio pioneers has a great influence upon the radio market as a whole.

If a new circuit is described in radio publications there are upwards of 200,000 individuals in this country who will immediately start building such sets. But that is not all; there is another class of individuals, perhaps as large, who know about the latest improvement and desire to have such sets, but have neither the time nor the inclination to build them. So they, usually, have them built by the professional custom set builders who, as a rule, realize a profit from the transaction.

It is easy to see that there is an excellent economic justification for the custom set builder, for not only the reasons stated, but a number of others.

Individuality Obtained

For instance, as very frequently happens, a man has a special cabinet, a book-case, a phonograph console, or a special closet, in which he desires to place a radio set. It is frequently almost impossible to find a suitable factory-built set to fit such a space in the desired manner. Here is where the custom set builder "shines" and where a really worth-while job can be performed.

Not only will the custom set builder construct an excellent model incorporating the latest available circuit, but he will make the set harmonize with its surroundings.

If the customer wants a mahogany-colored panel, the custom set builder will have no trouble in getting it; if the customer wishes it engraved with gold lines in a certain manner, again the custom set builder will oblige. But that is by no means all; frequently well-to-do customers require special radio installations and, in this respect, the custom set builder performs the same duty as the body builder when a rich man wishes a special automobile built to fit his requirements.

A number of cases that have come to
(Concluded on page 19)

Robert H. W. McCord,
c/o RADIO WORLD,
145 West 45th Street, N. Y. City.

I am a custom set builder and would like to join you in the formation of a national organization of custom set builders. Please list my name and address. I am one of the indorsers. This does not obligate me in any way.

ADDRESS
CITY STATE.....
NAME

A THOUGHT FOR THE WEEK

WHERE are the shouters among the mechanical instrument dealers who declared that the end of the business due to radio's popularity?

SIXTH YEAR

RADIO WORLD

The First and Only National Radio Weekly

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

TELEPHONES: BRYANT 0558, 0559
PUBLISHED EVERY WEDNESDAY

(Dated Saturday of same week)

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Fifteen cents a copy. \$6.00 a year. \$3.00 for six months. \$1.50 for three months. Add \$1.00 a year extra for foreign postage. Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

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CLASSIFIED ADVERTISEMENTS

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

One Tuning Point

Baffles Experts

The freak condition that results in a Super-Heterodyne bringing in nearly all stations better at the lower frequency dial setting of the oscillator than at the optional higher frequency setting for that circuit is mysterious indeed. Some experts say that it is due to the phases being ripe for one setting producing better results, yet when the phases are shifted by reversal of connections to the pickup coil the same anomaly often continues.

Others hold that the better reception one way is due to strange advantages accruing from mixing the modulator and oscillator frequencies to favor lower oscillator frequency. They do not say why that is a reason for better reception, although some hint that the absorption effect is lessened. It is a subject that Super-Heterodyne experts are pondering over.

Aylesworth Tells How Listeners Now Pay

The radio listener, according to a statement made by Merlin H. Aylesworth, President of the National Broadcasting Co., in an address at a recent meeting of the Merchants' Association, New York City, pays for broadcasting. In most other countries a tax is levied on the listeners with which the cost of broadcasting is met, he said, but in this country they pay for broadcasting by their response to the advertisers who sponsor the various programs.

"Fifty-six large American industries sponsor many of the programs over the National Broadcasting Company's systems, which are made up of fifty-five associated radio stations," Mr. Aylesworth

stated. "The business leaders of the United States have quickly grasped this new instrument as a constructive force in the development of better understanding, sympathy and support for the industry and its products by American families.

"National radio broadcasting has become a new dimension in industrial advertising. It is quite different than newspapers, magazine or billboard advertising and accomplishes different results, with a service that is easily distinguishable from the others. Radio advertising has no conflict with the newspaper or the magazine. These types of service are entirely different and all serve their important purposes."

Jagel, New Great Tenor, Thanks the Microphone

For Frederick Jagel, young tenor of the Metropolitan Opera House, who sang in the Atwater Kent Hour recently, radio was a stepping stone to success.

Prior to his study abroad, young Jagel had broadcast on numerous occasions, and was building a reputation for himself nationally as a radio tenor.

He began his career as a boy soprano in his father's choir at the Bishop Littlejohn Memorial Church, Brooklyn, singing later at St. Paul's Episcopal Church. Six years ago, while singing in a church in Far Rockaway, he attracted the attention of Samuel Eiseaman, who assisted him in his studies abroad. Under the name of "Jagelli" he sang leading roles in Italian

opera, and toured Holland and other European countries.

Jagel was engaged by the Metropolitan Opera Company less than a year ago, when Giulio Gatti-Casazza, general manager of the Metropolitan, pronounced him "a very promising and a very serious artist."

Jagel is a close personal friend of Capt. Peter V. O'Rourke, contributing editor of RADIO WORLD, and the two are members of the same luncheon club. Jagel has sung the leading tenor roles at the Metropolitan this season—his first—and thus has taken parts sung on the same stage by Enrico Caruso.

His diction is fine, too.

Broadcast Listeners Hear Talk Over Sea

Schenectady.

For the first time in radio history, a person sitting in his home and employing an ordinary receiver was able to "listen in" on a wireless telephone conversation between two operators, one in England and the other in America, at a test conducted recently.

WGY broadcast a two-way communication between 2XAD, the General Electric Company's short wave station here, and 5SW, the British Marconi Wireless Company's station at Chelmsford, England.

The conversation between two technical operators was broadcast on a wave of 379.5 meters.

Doom of Heterodynes Is Sounded By Horn

The end of radio heterodyning is near, according to C. W. Horn, radio engineer of the Westinghouse Electric & Manufacturing Co.

"We have synchronization of stations pretty well licked," he said. "We will announce something good soon. We have succeeded night after night in running KYW, Chicago, on a frequency generated

at KDKA, Pittsburgh, by means of short waves.

"However, I do not think synchronization is practical for the networks at present. It would necessitate rebuilding of transmitters, and new lines would have to be installed by the telephone company for the synchronizing signal. This is too big an undertaking."

New Unit Drives Piano Board

By James H. Carroll

Contributing Editor

THE search for real tone quality and true radio reproduction goes merrily on. Fans still rush around seeking the low notes. Driving units have taken great strides forward. Every possible material and combination of materials, it would seem, have been used for diaphragms.

It is a recognized fact, however, from the time that man first began to make the first crude musical instrument that wood is a fine medium for reproducing musical frequencies.

The piano, cello, violin and woodwinds, rated the most important musical instruments because of their properties of producing the most mellow and entrancing tones are all made of wood, for this reason.

It is true that wood has been used in many ways for loudspeakers, but it was only recently that a group of engineers realized the advantages of the piano sound board, actuated by a properly designed unit. Here is a seasoned and balanced instrument to which the piano owes all of its exquisite tonal beauty. It is obvious that this accomplishment gives us a loudspeaker superior in tone and range and practically perfect in point of fidelity of reproduction.

12,000,000 Have Pianos

Statistics show that approximately 12,000,000 homes in this country have pianos, a good majority of these pianos unused for months at a time.

In all of these pianos, whether upright, grand, player or reproducing type, there is a highly developed soundboard, the result of many years of development work to bring it to a plane of perfection in an acoustic sense.

It requires no technical knowledge fully to realize the possibilities if this reproducing medium as adapted to radio reception. Many complicated devices have been produced with this aim in view, but elaborate attachments which could not be standardized were not suitable for general application. The solution was found in a device recently placed on the market and which can be attached to any type of piano in a few moments. This was accomplished by the Engineers' Service Co., makers of the famous Enesco Cone Kit, in the form of the Enesco Piano unit.

Unit of Unique Design

The drive mechanism is essentially a cone drive unit of unique design. To do away with distortion of a mechanical nature in the unit itself the armature is flat and employs a direct-drive feature.

The gap being in the center of the coil and hence in the center of the flux field, the losses are negligible and great power is possible without any complicated balancing of the armature or pole piece.

This direct-drive, center flux principle is a feature of the basic patents issued to Clyde J. Fitch covering cone speaker units. Motion is direct, with no possibility of side-sway when power is applied. This permits use of every ounce of energy with no variation in the direction of motion.

THE MOTOR CAR ANALOGY

A simple analogy may make this point more clear. In the average drive unit the pole piece or armature is balanced between two other pole pieces, the gap being on the outside of the coil and away from the point of greatest flux density. To make up for this loss of power it is necessary to use some means of reducing the motion and thus increasing the power again. At the same time the pin or arm which drives the

cone or sound-board will thus have a rocking motion, this sway increasing as the power increases.

When your auto is driven in high gear it is connected almost directly to the source of power and a minimum of vibration results. Now try to run at high speed with the gears in second or low and you will have an approximate idea of the cross vibration and mechanical distortion that are likely to be present in a balanced armature unit if the unit is to be used to push the sound-board of a piano.

Has Versatility

A feature of importance in a piano loudspeaker, with proper unit, is the possibility of wide pitch regulation. In the average loudspeaker the pitch is standard and fixed, irrespective of its range of audibility. That is to say, the tone characteristic is fixed. If the pitch or tone is low it remains so for all frequencies or if it is high it remains high.

Of late radio fans have lost the so-called "phonograph ear," a term which engineers use to describe the ear attuned to the old type phonographs which were incapable of reproducing bass notes. With the advent of modern types of receivers and the improved phonograph we have come to have a better conception of frequency range.

If one does not have a piano in the house there may be a phonograph of the console

type. If so, the unit can be mounted somewhere in the cabinet and the results will be well worth while. Even the front panel of a console radio set can be made to reproduce good tones.

For a novelty the unit may be mounted in a chair, bridge table or even the dining room table.

A fan had the novel experience of playing radio bridge as per the lessons broadcast over one of the big chains, the plays being made known by the broadcast speech, and reproduced directly from the table on which he was playing.

Food Talk from Table

At a late breakfast one morning he also listened to a talk on food by Alfred McCann, the talk emanating from the center of the dining room table.

Somewhere in your home you have the nucleus of a real loudspeaker and you can now make use of it?

One thing that may be of interest to the owner of an expensive piano or phonograph is that the use of such a unit will not injure the piano or other instrument in any way. It will be out of sight and furthermore it will not prevent your using the piano for the purpose originally intended.

I will be glad to answer any questions on this subject. Address: James H. Carroll, care RADIO WORLD, 145 West Forty-fifth Street, New York, N. Y.

Speaker's Long Journey Is 30 to 10,000 Cycles

"What is the function of a loudspeaker?" The answer is simple. . . . "It must faithfully convert into sound, the electrical impulses passed into it from the output amplifying tube.

Unfortunately, this is more easily said than done. The vision is easier than the achievement, particularly so when the scope of the device is as great as that of the average loud speaker. Bear in mind that the frequency requirements are from 30 to at least 8,000 cycles. With the development of a radio frequency amplifying system where 10,000 cycle sidebands are possible, and with the development of audio amplification where perfect response at 10,000 cycles is possible, the operating scope of the speaker is augmented to 10,000 cycles. From 30 to 10,000 cycles is a long journey.

At that, the magnitude of the frequency band is not the all-important consideration. The relative response at the frequencies within this band is of even greater import. The ideal speaker would have a flat response curve, that is to say the sound pressure due to the moving air columns set into motion by the vibrating speaker diaphragm should be equal at all frequencies for a uniform electrical signal input to the speaker windings. With fidelity audio reproduction a prime motif in radio receivers, the loudspeaker plays a tremendously important role.

The improvement of loudspeakers is not found solely in the widening of the frequency operating band, but also in the attainment of more uniform response. The significance of uniform response is more easily explained by an analysis of the

energy distribution on the fundamental and the harmonic frequencies of notes played on various instruments; also by an analysis of the overtone characteristics of musical instruments. For example, J. P. Minton shows that the higher the note played the less its harmonics. He shows how the low notes on the piano are very rich in overtones and how the higher notes are not so rich. To this we must add the energy distribution data tabulated by Helmholtz.

The table shown below illustrates the energy distribution on the fundamental (first harmonic) and three multiple harmonic frequencies of a note played on the piano, harp and violin.

| Instrument | 1 | 2 | 3 | 4 |
|------------|------|-------|-------|-------|
| Piano | 100% | 99.7% | 8.9% | 2.3% |
| Harp | 100% | 81.2% | 56.1% | 31.6% |
| Violin | 100% | 25.0% | 11.0% | 6.0% |

A study of this table shows how important it is to use a speaker with a response curve that is the closest approach to a curve of uniform amplitude. If, for example, we consider the piano, we note that the intensity of the second harmonic is practically equivalent to that of the first or fundamental. On the other hand, we note that the third harmonic possesses an energy intensity of about 9% of the fundamental and the fourth harmonic only about 2.5%.

In direct contrast we find that the energy distribution of the third harmonic of a note played on the harp is approximately 56% and the energy distribution on the fourth harmonic is approximately 31.5%.

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

- A. McDonald, 1507 N. 30th St., Philadelphia, Pa.
- Pvt. H. Griffith, 15 S. S. Co., Fort Monmouth, N. J.
- Jno. C. Thomas, 600 Atlantic Ave., McKeesport, Pa.
- Bernard MacKenna, 13 Rena St., Worcester, Mass.
- Art. J. Warren, 1928 Bradley Pl., Chicago, Ill.
- S. Lampe, 1157 11th St., Santa Monica, Calif.
- Chas. W. Yeager, 1316 S. Date Ave., Alhambra, Calif.
- L. W. Carpenter, 717 Rosemont St., Los Angeles, Calif.
- Brewer & Franklin, Sinton, Texas.
- Oscar E. Loper, 355 East 8th St., Horton, Kansas.
- Ring's Radio Service, 4016 Nebraska Ave., Tampa, Florida.
- A. Kelley, 6 Burr Oak St., N. W., Grand Rapids, Mich.
- Harold D. Royston, Earlville, Ill.
- Charles Funsch, Jr., 117-34 132d St., South Ozone Park, L. I., N. Y.
- J. C. Austin, 23 Marsh Rd., Wilmington, Del.
- E. L. Crawley, 40 Halls Heights Ave., Youngstown, Ohio.
- O. H. Bennett, 106 3rd Ave., Hinton, West Va.
- E. L. Crump, 1907 Vine St., Chattanooga, Tenn.
- Frank P. Fox, 2099 Lewis Drive, Cleveland, Ohio.
- L. L. King, 1835 Hoffman, Philadelphia, Pa.
- H. L. Davis, 2167 Chestnut St., San Francisco, Calif.
- J. L. Collins, 165 Claremont Ave., N. W., Canton, Ohio.
- F. M. McDaniel, 925 W. 9th St., Wilmington, Del.
- J. R. Steen, 978 Sea St., Quincy, Mass.
- J. D. Andrew, 803 N. College St., Charlotte, N. C.
- Edw. Hahnle, 726 Renwich Ave., Syracuse, N. Y.
- J. O. Desrochers, 16 Labadie, Montreal, Quebec, Canada.
- J. A. Biron, 45 Ogdén St., Hammond, Ind.
- L. Honsbane, 1587 East 47th St., Cleveland, Ohio.
- Carl E. Andrews, Maruell, Ark.
- A. Waivada, 167 E. 99th St., New York, N. Y.
- Elmer Rundus, Belleville, Kansas.
- W. P. Cowans, 801 E. 144th St., New York, N. Y.
- Frank Finn, 448 Maple Ave., Elizabeth, N. J.
- Herman Pfuderer, Jr., 190 Pike St., Port Jervis, N. Y.
- S. W. Bain, 2010 Kalorama Rd., N. W., Washington, D. C.
- Edward L. Towers, 7318 Hamilton Ave., Pittsburgh, Pa.
- E. S. Hillery, 46 Vroom St., Apt. 34, Jersey City, N. J.
- E. L. Seymour, 243-73d St., Brooklyn, N. Y.
- E. Penrod, c/o Wunderlich's, Sycamore, Ill.
- E. Williams, 2300 Loring Place, New York.
- Otto H. Zeigenbein, 69-168 Place, Jamaica, L. I., New York.
- August Kuehn, 611 Brainard St., Detroit, Mich.
- Hugo Bruenlinger, 4401 Market St., Philadelphia, Pa.
- Gilbert Robin, 106 S. Fairmont St., Pittsburgh, Pa.
- Ben. Frankenstein, 419 Penna Ave., Brooklyn, N. Y.
- Louis Larson, 150 7th Ave. N. W., North St. Paul, Minn.
- Mrs. C. Rutledge, 7132 Sopth St., Maplewood, Mo.
- Bert Griffith, 1224 W. Cedar St., Denver, Colo.
- F. H. Lohnle, 76 Linden Ave., Irvington, N. J.
- W. M. Morrison, 410 1st Ave. West, Seattle, Wash.
- I. Cebis, 230 19th St., Brooklyn, N. Y.
- Howard W. Page, Carrier No. 104, Post Office, Minneapolis, Minn.
- Chester Severson, 514 N. 11th St., Eau Claire, Wis.
- H. R. Anderson, 92 S. Paddock St., Pontiac, Mich.

The Radio Trade

\$10,000,000 Suit by Tube Independents

Suits for damages in excess of \$10,000,000 against the Radio Corporation of America are to be filed by the group of independent radio tube manufacturers, S. E. Darby, Jr., chief patent counsel for the De Forest Radio Company, announced. The actions are based on the decision of Federal Judge Hugh Morris at Wilmington, Del., granting an injunction restraining the Radio Corporation from enforcing clause 9 of its license contract with manufacturers of tuned radio frequency sets. This clause provides that R. C. A. tubes must be used initially to make the sets operative.

The General Electric Company, Westinghouse Electric and Manufacturing Company and American Telephone and Telegraph Company are charged by the Radio Protective Association as being parties to a trust. The R. C. A., through contracts with General Electric and Westinghouse, acts as selling agent for the radio products manufactured by these corporations.

Does Only 10 Per Cent Business

The decision of Judge Morris, with the temporary injunction granted De Forest and the other companies, held that R. C. A. through Section 9 of its licensing agreement to twenty-five of the largest radio manufacturers in the country, was violating Section 3 of the Clayton anti-trust law. Such violations may be penalized by actions for treble damages. The independent tube manufacturers charge losses ranging from \$3,500,000 to \$6,750,000, according to Mr. Darby.

"In one single instance," he said, "the business of an independent tube manufacturer totalling \$500,000 a year found its sales decreased to \$50,000 annually when R. C. A. began to enforce the provisions of paragraph 9 of its licensing agreement."

The De Forest Company was joined by the Northern Manufacturing Company, the United Radio & Electric Corporation, the Televocal Corporation and Harry Chirelstein, doing business as the Sonatron Tube Corporation as plaintiffs.

Allege Fairness Denied

These independents alleged that their rightful proportion of the manufacture and sale of the 50,000,000 radio tubes now in use in the United States and requiring almost annual replacement had been affected by R. C. A.'s enforcement of clause 9.

John W. Davis, Democratic candidate for President in 1924, who represented the Radio Corporation, contended that its licensees were limited to the use of R. C. A. tubes only in sets made in conformity to the corporation's licensed circuits, and that even in these circuits such licensees might use the tubes of any other manufacturer for replacements.

Injunction Stayed

On petition by counsel for the Radio Corporation, Judge Morris stayed the execution of the injunction and restraining order until March 15 to allow time for an appeal from his decision. It will become operative on that date if such appeal is not perfected.

Bucking Competition With Other Industries

Milwaukee.

Radio as an industry is today surrounded by more vigorous and formidable competitors than ever before and among other things faces a competition from luxury industries spending more than \$10,000,000 during 1928, Alfred E. Waller, Managing Director of National Electrical Manufacturers Association told the Federated Trades Association meeting recently.

He urged the explosion of various myths surrounding radio, for instance, that radio sets will not operate satisfactorily in the Summer; that a large percentage of the population do not use their sets in the Summer; that good programs will not last; and that radio will not stand on its feet as a utility device.

Urges Organization

He urged the organization of dealers, Waller referred was described by him as being competition from "single cylinder" industries, that is by industries producing a single product. They are not confronted with the multi-cylinder problems or powers of the electrical industry.

He urged the organization of dealers, jobbers and manufacturers through national associations to the end that service for radio sets may become as regular and satisfactory as that for automobiles; and that accurate knowledge of the pub-

lic's taste and preference for radio products be obtained through the use of statistics from jobbers and dealers such as are now being collected by the Department of Commerce in co-operation with the National Electrical Manufacturers Association.

Effect of Socket Power

"We must debunk our selling and our advertising and recognize that the novelty of radio has passed, and with it much of the mystery and glamor which first surrounded it," he said. He urged a mutual understanding of the radio problems between the man who makes the radio sets, the man who sells, the man who services, the man who runs the power house, the man who installs motors, electric ice boxes, oil burners, and others active in the industry.

"On the day that radio became a socket power device and plugged into the power lines of the central stations, it also plugged into the National Electrical Code with all the responsibilities and consequences which this act implies, and I want to say that whether all the radio manufacturers recognize the true extent and intimate relationship which they bear to other branches of the industry, that these other branches are definitely aware of it."

A Great Opportunity for Set Constructors

(Concluded from page 15)

my attention might very well be mentioned. There was one of a millionaire on Park Avenue, New York City, who wished to have his entire apartment so wired that every room could have an outlet for a radio loudspeaker. Not only that, but the requirements were that more than one program could be received at the same time.

A Large Order

Evidently a single receiver could not do this; so a custom set builder was called in, and one set was installed in a Louis XIV inlaid cabinet, with a black-and-gold inlaid panel to match. The other was placed in the library and had to be built into a sectional bookcase. A switching arrangement was provided, so that every loudspeaker in the house can be switched on to either radio set as desired. This was a special requirement, and unusual; but the custom set builder did a neat job.

In a well-known New York restaurant, a custom set builder was called in to do another unusual job. The requirements included eight loudspeakers, distributed throughout the restaurant in such a way that none would show. Furthermore, enough power was needed to fill the entire restaurant, which is of a tremendous size, with a good volume of music. It was desired, furthermore, that either radio or phonograph music could be supplied to the loudspeakers, at the option of the owners. No ordinary manufactured set on the market could possibly have been used, because of the enormous output required.

It was necessary to build into a closet a special 10-tube Superheterodyne receiver, with a power amplifier, and a switching arrangement for the phonograph, the music of which had also to be amplified to a high degree to deliver sufficient volume to the loudspeaker. All this required special treatment and, to the credit of the custom set builder who finally completed the job, he accomplished a most satisfactory installation.

The Yearning for Distance

Then, of course, there is always—and this applies more to the country than to the city—a big market for efficient DX sets that, under fair conditions, will bring in stations from coast to coast. Most factory-made sets—of course there are exceptions—are not made for such work; and, indeed, most set makers do not claim extraordinary distance reception for their sets. The trend in the cities, where most factory-made sets are sold today, is towards a demand for sets that deliver excellent quality on local stations, with a minimum of trouble. Accordingly, the ready-made set builders bear this in mind, and manufacture such sets; but largest stations, there is a big and steadily increasing demand for special sets that will reach out and get their station, and still deliver good loudspeaker volume.

It is here, particularly in the smaller localities, where radio has not made the inroads which it has made in the larger cities, that the custom-made set builder comes into his own. He may start out, innocently enough, by simply building a set for himself but, sooner or later, a friend or neighbor will drop in and hear it perform.

As a rule, he does not have to use any salesmanship at all, because his friend or neighbor will want the set and offer to buy it; and that is how many custom set builders actually were started. There are in this country today any number of custom set builders who are assembling re-

ceivers to order for their friends and acquaintances, and making a regular business out of it—a small business, but a business nevertheless.

First-Class Work

And let no one think that the custom set builder sells cheap merchandise. As a rule, such sets range from \$100 upwards, because there is not a custom set builder worth his salt who does not wish to be proud of his work.

If he knows anything at all about the game he will have found out (and often to his sorrow) that a single low-priced set causes him more trouble and annoyance, in order to satisfy its purchaser, than several which are built of first-class materials, and sold at a much higher figure.

[Broadcast from WRNY]

DOG'S AIR HOWL FROM U. S. UPSETS ARCTIC HUSKIES

Pittsburgh.—When Lloyd C. Thomas, now commercial manager for Westinghouse Radio Broadcasting Stations, was managing KFKX, Hastings, Nebraska, he introduced two novelties during a Far North broadcast.

One was the singing of canaries, whose voices were transmitted for the first time above the Arctic Circle.

The other was when he brought in Queenie, a police dog, and had her bark over the radio. This came out over the loudspeakers in the North, and huskies in Baffinland started to howl. It was nearly a quarter of an hour before the Esquimos could quiet the dogs enough to hear the rest of the performance.

WAVE TRAP, \$1.50



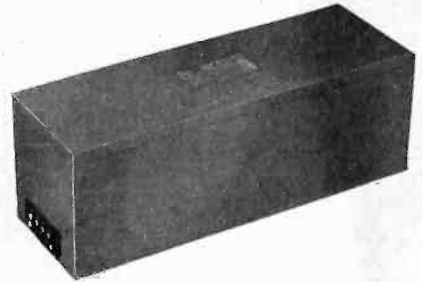
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The following issues of Radio World, 15c each:

OCT. 29—The Victoreen Power Supply with Audio Channel, by J. E. Anderson; Beauty of Sound and Appearance in Reproducers, by H. B. Herman.

NOV. 5—Part I of a two-part article on The Fenway Electric Concertrola; The Lynch Five, by Arthur H. Lynch; The How and Why of 3-Ft. Cone, by James H. Carroll.

NOV. 12—The New Nine-in-Line Receiver, by John Murray Barron; Part II on how to construct the Electric Concertrola; Unbiased Facts About Underbiased Grids, by Roger C. Brooks; Data on Meters, by Frank De Rose.

NOV. 19—Part I on how to build the Improved Laboratory Model Super-Heterodyne (Silver-Marshall Jewelers Time Signal Amplifier), by E. R. Pfaff; Part III of a four-part article on the Electric Concertrola; New Model DC Set, by James H. Carroll.

NOV. 26—The Four Tube DX Fountain, by Herbert E. Hayden; concluding installment on the Fenway Concertrola; A Squealless 5-Tuber, by Joseph Bernsley; Secrets of DX in a Creative Receiver, by J. E. Anderson.

DEC. 3—How to Modernize the Phonograph, by H. B. Herman; Part I of two-part article on the Everyman 4, by E. Bunting Moore; Efficiency Data on 4 and 5-Tube Diamond (not Screen Grid Diamond), by Campbell Hearn.

DEC. 10—Seven-page article on the Magnaformer 9-8, the best presentation in the history of radio literature, by J. E. Anderson (this article complete in one issue); The Object of a Power Amplifier, by C. T. Burke, engineer, General Radio Co.; Constructional Data on the Everyman 4 (Part II); The 2-Tube Phonograph Amplifier, by James K. Carroll.

DEC. 17—Complete Official Call Book and Log; How I Tuned In 98 Stations in Six Nights with Magnaformer 9-8, by Thomas F. Meagher; Startling Facts About Harmonics, by H. B. Herman; The G.R. Amplifier and B Supply, by Stuart S. Bruno.

DEC. 24—The AC 300 (four tubes); How Service Men Cheat Radio Builders; Part I of two-part article on the Victoreen Power Supply with one audio stage.

DEC. 31—How DC Sets Are Converted to AC Operation, by W. G. Masson-Burbridge; Cures for Uncanny Noises, by J. E. Anderson; Part II of two-part article on the Victoreen with a Stage of Audio; Complete Driver for an AC Set, by Robert Frank Goodwin.

JAN. 7, 1928—The Shielded Grid Six, first national presentation of loop and antenna models of the new Silver-Marshall circuit, utilizing the new tubes of strong amplification, Part I, by McMurdo Silver; How to Build a Power Amplifier and 210 Push-Pull Unit, by A. R. Wilson, of General Radio Co.

JAN. 14—Assembly and Wiring of Shielded Grid Six, Part II, by McMurdo Silver; Meter Range Extensions, by Bramhall Torrence; Uses of B Batteries and Power Devices, by E. E. Horine, National Carbon Co.; A 5-Tube Set Costing but 2 Cents an Hour to Run, by Capt. Peter V. O'Rourke.

JAN. 21—Bias Resistor Fallacy Exposed, by J. E. Anderson; The Shielded Grid Six, Part III (conclusion); How the "Victory Hour," Reaching 30,000,000, Was Broadcast, by Herman Bernard.

JAN. 28—How to Build the AC Five, a Batteryless Receiver, by H. H. Chisholm; Technique of Home Television Machine, by Dr. E. F. W. Alexander; A Quality Analysis of Resistance Coupling, with Trouble Shooting, by Herman Bernard.

FEB. 4—Tyrman "70" with Shielded Grid Tubes (Part I of four-part article), by Brunsten Brunn; The Four Tube Shielded Grid Diamond, by H. B. Herman; Television's Stride, by Neal Fitzalan, Radio Vision Editor.

Any copy, 15c. Any 7 copies, \$1.00. All these 15 copies for \$2.00, or start subscription with any issue. Any 8 of these numbers sent as premium with NEW yearly subscription. No other premiums allowed.

RADIO WORLD
145 West 45th Street New York City

Cuban Schools to Use Custom-Built Sets

Washington. Materials for the construction of radio receiving sets will be provided to all centers of learning in Cuba, that pupils throughout the country may receive the benefit of a series of popular lectures to be broadcast from the ministry of public instruction, the Bureau of Education, Department of the Interior, stated.

The distribution will include all centers "from the University of Havana to the smallest school," it was said. The receiving set for each school will be made by the pupils of the school. According to the Bureau, the subjects to be presented in the lectures will include agriculture, industry, commerce, science, literature and civic questions.

NEW CORPORATIONS

Television Corp. of America, electrical machinery—B. Friedelbaum, att'y., 47 West 34th St., New York, N. Y. \$3,000.

Bropell Radio—A. Greenberg, att'y., 26 Court St., Brooklyn, N. Y.

Rochelle Battery and Service, New Rochelle—L. Ferrara, att'y., New Rochelle, N. Y. \$5,000. Radio Finance Corp. or America, Newark, \$125,000

Jamaica City Radio Store, I. Sack, 285 Madison Ave., New York, 200 shares common

Hyde Music Co., Jersey City, N. J., loudspeakers, amplifiers, \$125,000.

Jackson Heights Battery and Radio Co., \$9,000; Jackson Heights, N. Y.

Wireless Radio Corporation, capital increased from 100 to 2,500 shares, of which 500 are preferred, \$100 each, and 2,000 common, no par.

Lexington City Radio Store—I. Sack, 285 Madison Ave., New York, N. Y.

Steinite Co., Wilmington, Del., radios, radio equipment—Corp. Trust of America, Wilmington, \$500,000.

Blan the Radio Man, radios—I. Ehrman, 41 Park Row, New York, N. Y., \$30,000.

Kodel Radio Corp., Wilmington, Del.—Corp. Trust Co. of America, Wilmington.

Master the air, where fortunes are being made in radio. Big opportunities. Our money-making plan gets the business for you. Be first to get the facts. Send for complete booklet and guide, FREE, and learn of rich rewards awaiting you. BARAWIK CO., Dept. 883, Chicago, U. S. A.

MANY PROSPER IN BUILDING CUSTOM SETS

Many of the so-called radio bugs and circuit hounds of a few years back have found in their hobby not merely a fascinating pastime, but a means of embarking in business on their own account, according to the Radio Parts Committee of Radio Manufacturers Association, Inc. Many of these experimenters, as custom set builders, are enjoying incomes of from \$10,000 to \$15,000 yearly.

It is estimated that 20 per cent. of the receivers now in operation in the United States have been built by these specialists, who frequently operate from their own homes, from small shops or from radio, hardware or electrical stores. They are, for the most part, highly qualified individuals who serve a discriminating clientele that requires its radios, like its furniture and interior decorations, to be distinctive and individual.

The case is cited of one man who builds approximately 300 sets a year. He operates from his home. He reports that last year he netted over \$10,000 profit.

For some time one manufacturer has realized that the market for radio parts has been changing considerably, and, decided custom set builders were buying very many parts.

BLUEPRINT and Instruction Sheet for the Silver-Marshall Shielded Grid Six
The New Receiver Utilizing the New Shielded Grid Tubes with their **25 Cents** Powerful Kick.
Guaranty Radio Goods Co.
145 WEST 45TH STREET
NEW YORK CITY

Take Your Choice of 7 Other Publications

For NEW RADIO WORLD Subscribers Ordering NOW

Radio World has made arrangements

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

RADIO NEWS or POULAR RADIO or SCIENCE AND INVENTION or BOYS' LIFE or RADIO DEALER or RADIO (San Francisco) or RADIO AGE.

This is the way to get two publications

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

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

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

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

Indicate if renewal. Name
Offer Good Until Street Address
April 15, 1928 City and State

Voices Across the Sea As Engineers Meet

One recent morning the members of the American Institute of Electrical Engineers met in New York and in the afternoon of the same day the members of the British Institution of Electrical Engineers assembled in London, to hold a joint meeting through the medium of radio telephony.

The meeting began at 10:30 A. M., New York time, and at 3:30 London time. Speeches were made alternately from New York and London. Bancroft Gherardi, president of the American institute, opened the meeting by saluting Archibald Page, chief engineer of the Central Electric Board of London.

"Good morning, Mr. Page."

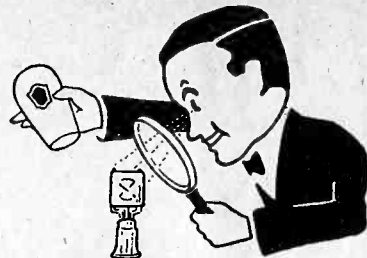
"Good afternoon, Mr. Gherardi."

The voices came through clearly, so that every one at either end of the circuit could hear perfectly.

Following the greeting, Mr. Page, acting chairman of the joint meeting, introduced Mr. Gherardi, who gave a resume of the developments that had made transatlantic radio telephony possible. Col. F. T. Paves, chief engineer of the British post office; John J. Carty, vice-president of the American Telephone & Telegraph Company, and Sir Oliver Lodge spoke.

The connection used for this joint meeting surpassed anything that had ever been attempted before and the occasion was

the first time that large audiences had communicated without the aid of the individual telephone equipment.



Inside Information

In buying radio tubes outside appearances count for nothing.

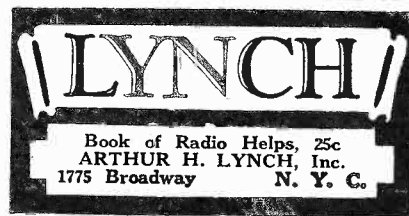
An ordinary test shows only that the tube is operating—it cannot tell you the quality of its performance, nor how long it will wear.

But in making CeCo tubes we make sure IN THE PLANT that the quality and wear are there before any CeCo tube is released to the trade or public.

You never gamble when you buy CeCo. They are as reliable as a fine, expensive, American-made watch.

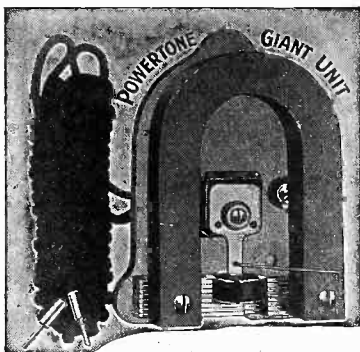


C. E. Mfg. Co., Inc.
Providence, R. I., U. S. A.



POWERFUL UNIT

Drives Any Cone Speaker
and Produces Delightful Tone
at Great Volume



Try It for Five Days!

If not delighted with it, return it
and your money will be refunded.

A Superb Creation
At a Price That
Fits All Purses **\$3.75**

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

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

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

Tyrman "70" Shielded Grid Amplimax

OFFICIAL SERVICE STATION

We Supply Tested Parts. Sets Custom Built to Your Order. Shipped Anywhere. Also MAGNAFORMER 9-8, New Shielded Grid DIAMOND OF THE AIR. H. & F. RADIO LABORATORIES, Inc. 168 Washington Street New York City

RECENT ISSUES of Radio World, 15c each. Be sure to give date of issue when writing. Radio World, 145 West 45th Street, New York City.

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

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

CUT STATIC 50 to 90 per cent. Use Staal's Underground Antenna. Plan and instruction. The only cost sent postpaid \$1.00. J. T. Staal, 4005 Woodland Ave., Kansas City, Mo

RADIO KITS—Complete Sets, Magnaformer, Tyrman Ten, etc. Write for prices, state list wanted. Rex Radio, 2141 Sedgwick, Chicago, Ill.

FOR SALE: Bremer Tully 6, latest model Sonora Light Six and Sonora Shielded Six. Closing out at cost. S. M. Strain, Brookfield, Mo.

NEW SHIELDED GRID TUBES for Diamond, S-M Six or Laboratory Super, Tyrman 70. Price \$5 each. Philip Cohen, 236 Varet St., Brooklyn, N. Y.

OLD 4 OR 5-TUBE DIAMOND—Easily changed to Shielded Grid Diamond. Send \$1.00 for blueprint showing old and new hookups, with changes emphasized. A. Bashen, 520 Jerome St., Brooklyn, N. Y.

"**RADIO THEORY AND OPERATING**," by Mary Texanna Loomis, member Institute of Radio Engineers, Lecturer on radio, Loomis Radio College. Thorough text and reference book; 886 pages, 700 illustrations. Price \$3.50, postage paid. Used by Radio Schools, Technical Colleges, Universities, Dept. of Commerce, Gov't Schools and Engineers. At bookdealers, or sent on receipt check or money order. Loomis Publishing Company, Dept. RW, 405 9th St., Washington, D. C.

RADIO FURNITURE, direct from factory to you. Receiving set cabinets, any size. Consoles and tables. Free catalogue on request. Fulbright Cabinet Co., Hickory, North Carolina. W-2-18

WANTED—MEN to work with National Radio Service Organization. No selling scheme. Co-operative Radio Doctors, Dept. W, 131 Essex St., Salem, Mass.

SEND \$1 for 8 weeks' subscription to Radio World, 145 W. 45th St., N. Y. C.

TELEGRAPHY—Both Morse and Wireless taught thoroughly. Big salaries. Wonderful opportunities. Expenses low; chance to earn part. School established fifty years. Catalog free. Mention Radio World. Dodge's Institute, Cour St., Valparaiso, Ind.

RADIO SETS built to order. Sets repaired. Superhets a specialty. Sweeney Radio Shop, Dept. RW, Pearsall, Texas.

LARGE MANUFACTURER of popular priced Radio Cabinets wants representatives selling radio dealers. Models listing at \$13 and up. Well made in large modern plant. Quantity sellers. Straight commission basis. For full details, address Drawer RW 10, Boonville, N. Y.

RECENT ISSUES of Radio World, 15c each. Be sure to give date of issue when writing. Radio World, 145 West 45th Street, New York City.

DISCOUNT ANYTHING radio. Mention wants. Write RADIOMAN, LAKE, NEW YORK.

FOREIGN POSITIONS—Men interested working beautiful, Sunny South America write South American Service Bureau, 14,600 Alma, Detroit, Mich.

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

MAKE YOUR RECEIVER do all the manufacturer claims it can! The answer is a practical, proven fact—Scott's Single Pole Tuned Radio Antenna—no trick—description FREE. Scott, Dept. RW, 719 1st St., New Orleans, La.

ELECTRIC FUN! Seventy cents, 110 volts, \$1. Cooperco, Campbell, Calif.

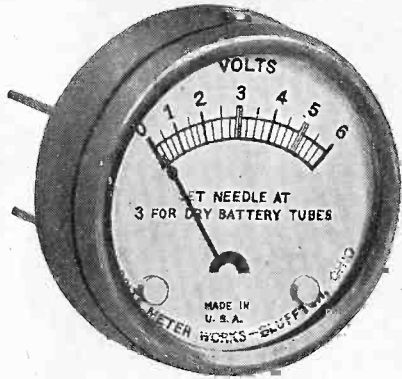
MAGNAVOX M7 cone speaker, List \$15, A1 condition, used two weeks. Fine tone. Price, including bale, \$9. Send M. O. on 5-day many back guarantee. I. Andersen, 118 Goodrich St., Astoria, N. Y. City.

ELECTRIC FUN! Seventy stunts, 110 volts, Guaranteed. Money back if not satisfied in three days' trial. F. J. Benert, 367 75th St., Brooklyn, N. Y.

"Double R" Meters Improve Your Set

Use Them to Maintain Accurate Voltages and Currents So That Maximum Reception Efficiency is Assured

Pin Jack 0-6 Voltmeter for A Battery Measurement



This 0-6 voltmeter, No. 306, is especially useful for the No. 25 and No. 28 Radiolas, because it is equipped with pin jacks which fit into the plugs with which those sets are provided. The meters may be used in any home-constructed set, too, where the builder desires to place tip jacks on the front panel, so the meter can be plugged in for obtaining reading. The meter may be kept permanently in circuit, if desired.
No. 306, 0-6 volts DC.....

\$2.50

Also Track Down Trouble in a Jiffy and Permanently Cure It with the Aid of These Fine Meters

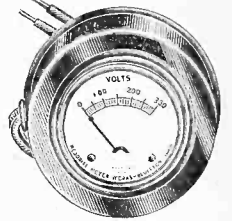
It is absolutely necessary to use a high resistance voltmeter in measuring the voltage of B eliminators, either across the total output or at any intermediate voltage. A low resistance meter at least partly short-circuits the eliminator and causes the voltage reading to be away off. Sometimes the reading is as little as 25 per cent of the total actual voltage.

All "Double R" meters are accurate to 2½ per cent, plus or minus, and all, except the ammeters Nos. 1 and 338, may be kept permanently in circuit.

Panel meters take 2 5/64-inch hole.

Our Complete Meter Catalogue is contained in this advertisement.

High Resistance Meters for B Eliminators

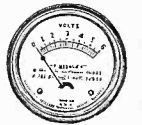


Here is the meter you've been wishing for! A 0-300 DC voltmeter with a very high resistance. Specially made that way so it will test the output voltages, from maximum to any intermediate voltage, of any B eliminator or grid biasing resistor. It also makes all the measurements of any other meter of its voltage range, hence will give correct readings of B batteries, C batteries, cells, or any other DC voltage source not exceeding 300 volts. Full nickel finish. Portable type (fits in sack coat pocket easily). Accurate to 2½ per cent, plus or minus. Fully guaranteed. Requires 35 different dyes to make. Furnished with long connecting cords and convenient tips. May be kept permanently in circuit.

\$4.50

No. 346
[Note: 0-500 volts, instead of 0-300 volts, is No. 347. Tests ALL power packs—Price \$5.50.]

PANEL VOLTMETER FOR A BATTERIES



One of the most popular meters, the 0-6 panel voltmeter, DC. May be kept permanently in circuit. Panel model.

\$1.65

No. 326

MULTI-TUBE SET MILLIAMMETER



Panel model. Recommended for sets having six tubes or more, particularly if a -71, -10 or -50 tube is used as the output. May be kept permanently in circuit. For DC measurements.

\$1.65

No. 390

POCKET AMMETER

No. 1 For testing dry cells, 0-40 ampere DC scale pocket meter. \$1.50

POCKET AND PORTABLE VOLTMETERS

No. 8 For testing A batteries, dry or storage, 0-8 volts DC scale \$1.65

No. 10 For testing A batteries, dry or storage, 0-10 volts DC scale 1.65

No. 13 For testing A batteries, dry or storage, 0-16 volts DC scale 1.65

No. 50 For testing B batteries, dry or storage, but not for B eliminators, 0-50 volts DC scale 1.65

No. 39 For testing B batteries, dry or storage, but not for B eliminators, 0-100 volts DC scale 1.85

No. 40 For testing A and B batteries, dry or storage, but not for B eliminators; double reading, 0-8 volts and 0-100 volts DC scale 2.25

No. 42 For testing B batteries, dry or storage, but not for B eliminators; 0-150 volts DC scale 2.00

No. 348 For testing AC current supply line, portable, 0-150 volts 4.50

VOLTMETERS

No. 18 For testing amperage of dry cell A batteries and voltage of dry or storage A batteries, double reading, 0-8 volts, and 0-40 amperes DC. \$1.85

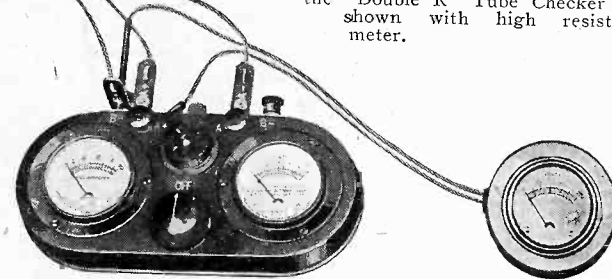
No. 35 For testing amperage of dry cell A batteries and voltage of B batteries (not B eliminators); double reading, 0-50 volts, 0-40 amperes DC. 2.00

TROUBLE-SHOOTING TEST SET



The best inexpensive combination for trouble-shooting is a "Double R" Tube Checker, comprising a 0-10 milliammeter, a 0-6 voltmeter, a switch, a rheostat and a socket. Add a high resistance voltmeter (0-300 or 0-500 v.). With these it is advisable to use a plug, so that all you need do is remove a tube from a receiver that you're testing, put the plug in the empty socket and the removed tube in the socket of the tester. You can immediately find any open or short circuits, broken or flimsy connections, reversed connections, etc.

The "Double R" Cord and Plug, and the "Double R" Tube Checker are shown with high resistance meter.



SERVICE MEN!

No. 210 Tube Checker, consists of 0-6 volts DC Voltmeter, 0-10 DC Milliammeter, Grid Bias Switch, Rheostat, Socket, Binding Posts (with instruction sheet). \$6.50
No. 21, cord and plug. For connecting meters in A and B leads of a receiver without any disconnections. Terminals correspond with posts on No. 210 tube checker. \$1.85
No. 346 DC Voltmeter (high resistance)..... \$4.50
No. 347 DC Voltmeter (high resistance)..... \$5.50

The cord terminals of the plug leads correspond with the binding posts of the tube checker.

Now connect the 0-300 or 0-500 volts high resistance voltmeter from A+ to B+ posts and you get all necessary readings. You can test plate voltage from B eliminators, or any other B supply, DC plate current and DC filament voltage, as well as the efficacy of the tube, by throwing the grid bias switch, for the plate current should change within given limits, depending on the type of tube.

Equip your testing outfit with the indispensable combination that constitutes the Trouble Shooting Test Set and Time-Saver. You quickly locate trouble while others fumble about.

Complete Combination Nos. 21 and 210 (with 0-300 Voltmeter, No. 346) ..\$12.00
Complete Combination Nos. 21 and 210 (with 0-500 Voltmeter, No. 347) ..\$13.00

PANEL VOLTMETERS

No. 335 For reading DC voltages, 0-8 volts.....\$1.65

No. 310 For reading DC voltages, 0-10 volts..... 1.65

No. 316 For reading DC voltages, 0-16 volts..... 1.65

No. 337 For reading DC voltages, 0-50 volts..... 1.65

No. 339 For reading DC voltages, 0-100 volts..... 1.75

No. 342 For reading DC voltages, 0-150 volts..... 1.75

No. 340 For reading DC voltages, double reading, 0-8 volts, 0-100 volts..... 2.25

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

Please send at once your meters, catalogue numbers:

.....
for which I enclose price. You are to pay all shipping charges.

Name.....

Address.....

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

RW-28

ALL METERS SOLD ON FIVE-DAY MONEY-BACK GUARANTY.

Homes and Shops Worst Interference Sources

Cedar Rapids, Ia. The extent and thoroughness with which inductive interference, or so-called man-made static, has been combatted by various agencies in the interest of broadcast reception, was disclosed in a paper read before Iowa Section of the National Electric Light Association. The author, J. O. Smith, of the Radio Corporation of America, spoke of the nation-wide campaign to suppress inductive interference, in cooperation with local organizations and individuals.

Mr. Smith's paper brought out the highly specialized character of the campaign, which amounts to what might well be termed radio detective work. According to Mr. Smith the Radio Corporation of America has for a number of years employed a highly trained staff of men to study and correct causes of broadcast interference in collaboration with power companies, railways, telephone and telegraph companies, radio clubs, broadcast associations and others. The extent of the campaign may be judged by the fact that during 1927 some 500 investigations of reported cases of inductive interference were conducted.

Main Cause

According to this authority, the principal cause of inductive interference is the electrical equipment owned and operated by industrial concerns and by the average household. Practically all kinds of electrical equipment are potential sources of inductive interference, and, in such instances, it is more difficult to obtain cooperation from owners or operators of the devices in clearing up the trouble than in the case of power companies or other large organizations that cater to public good will.

As a result of over 1,500 investigations extending over several years the R. C. A. found, according to Mr. Smith, that there has been too much tendency on the part of the public to blame power companies for everything in the way of inductive interference.

A study of numerous cases has proved that power company lines and equipment are responsible for only a negligible percentage of the interference, and when such interference is found, the power company is generally prompt to correct it. Railways have also shown a willing attitude in this respect. Likewise with telephone and telegraph companies.

Electrical equipment of all categories, employed in factory, shop or home, is often a prolific source of radio interference. Here the campaign has taken the form of correcting faulty equipment; providing suitable interference suppressors for existing equipment at cost; and urging electrical manufacturers to produce non-interfering devices.

Manufacturers Help

Certain electrical manufacturers have gone so far as to include condensers and other supplementary devices in their products for the purpose of suppressing inductive interference.

In his paper Mr. Smith brought out that as broadcasters have increased signal strength interference has been minimized or overridden completely. He pointed out that signals of sufficient intensity are now available in many localities to override the normal noise level. It is only when the broadcast listener aims at extremely distant reception in unfavorable seasons that the noise level becomes a factor in a given locality. Mr. Smith is of the opinion that when broadcasting power has

been more generally increased interference will disappear even more.

The work of the radio detective in running down inductive interference, according to Mr. Smith, consists of two broad methods.

The Two Ways

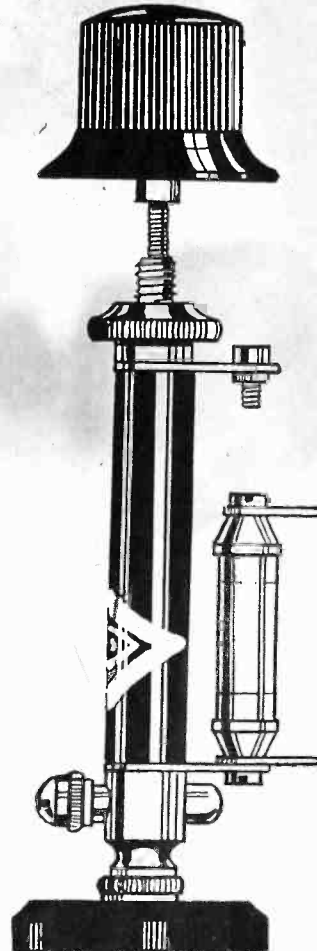
First, where the interference is being radiated directly over a large area, independently of wire circuits, the directional qualities of the loop antenna of a portable Super-Heterodyne are used to obtain bearings, which are transferred as lines to a map of the territory. The common meeting point of the lines is generally the place where the interference originates.

Secondly, where interference is not being radiated directly but is in evidence only in the proximity of transmission lines, the intensity test method is employed. Reception with a set, calibrated in signal intensity, is undertaken at different points in the territory traversed by the lines under investigation, until the point of greatest intensity is located. The cause of the interference is then found in short order.

Many organizations have taken part in this important work and as a result broadcast interference has rapidly diminished in the last few years to a minor problem.

BRETWOOD

Variable Grid Leak
De Luxe Model



BBETTER 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.....

KARAS PARTS

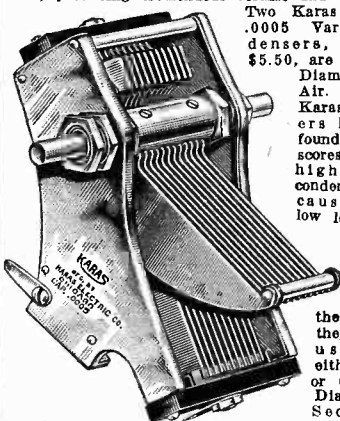
Specified for the

SHIELDED GRID DIAMOND

IN the Diamond of the Air described in this issue of Radio World, Karas Harmonik Audio Frequency Amplifying Transformers and the NEW Karas S. F. L. Removable Shaft Variable Condensers are specified. Be sure to order these parts for your



of the Air when you build this receiver. The Karas Harmonik Transformer, price \$5, gives the maximum of distortionless audio frequency amplification, producing tremendous volume and superb tone.

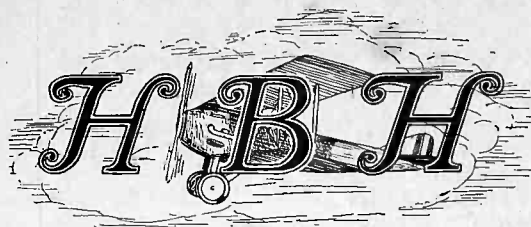


Two Karas S. F. L. .0005 Variable Condensers, price, each \$5.50, are used in the Diamond of the Air. These new Karas Condensers have been found superior to scores of even higher priced condensers because of their low losses, absolutely

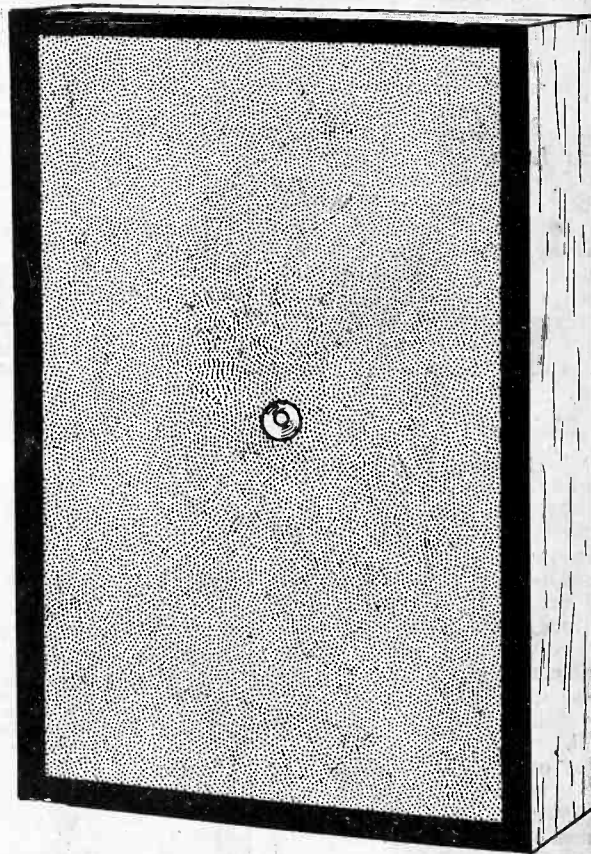
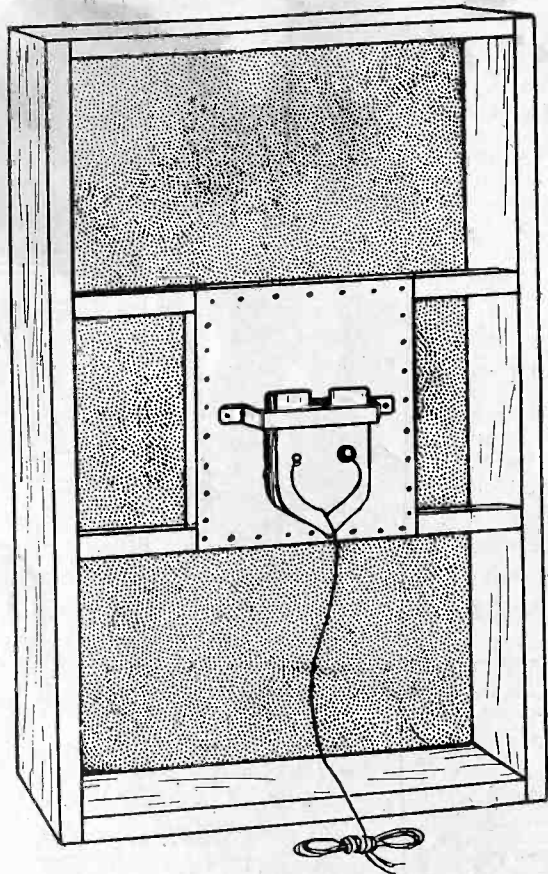
straight frequency line tuning, and the fact that they may be used with either 100-0 or 0-100 type Dials. Secure these Karas parts for your Diamond of the Air from your dealer today.

KARAS ELECTRIC CO.
4039-N North Rockwell St., Chicago

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



Airplane Cloth Speaker



Complete Kit for HBH Airplane Cloth Speaker, in official factory-sealed carton, including *everything* necessary to build this reproducer, WITH UNIT

\$10.00

“The Speaker That Speaks for Itself”

Words scarcely can do justice to the rich, pure, clear, sweet reproduction of this speaker. So we make this

Remarkably Generous Offer!

Send \$10 for the complete kit, by filling out and mailing coupon at right, prior to March 31, 1928, and we will ship kit immediately. Build the speaker. If not overjoyed at the results, in five days return the shipment in good condition and ALL your money will be refunded.

The speaker is *positively outstanding*, and you can convince yourself of this without risk! We back up our confidence by this unparalleled offer. Instead of dwelling on how wonderful the speaker is we will let the speaker speak for itself.

Send in your order NOW and be one of the first to have a genuine HBH Airplane Cloth Speaker!

Guaranty Radio Goods Co.
145 West 45th Street
New York City

Get the genuine, official kit, indorsed by H. B. Herman, acoustical expert, and enjoy pure reception—low notes, high notes, middle notes.

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

Enclosed find \$10 for which ship me at once, without any additional cost to me whatever, one complete kit, including unit and stiffening fluid, for making an HBH Airplane Cloth Speaker. Provided this order is sent by me before March 31, 1928, if I am not delighted with results, and return the shipment in good condition in five days after receipt, you will refund the full \$10.

Name

Address

CityState

Date: March . . . , 1928 (Be sure to fill in date)