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RADIO WORLD
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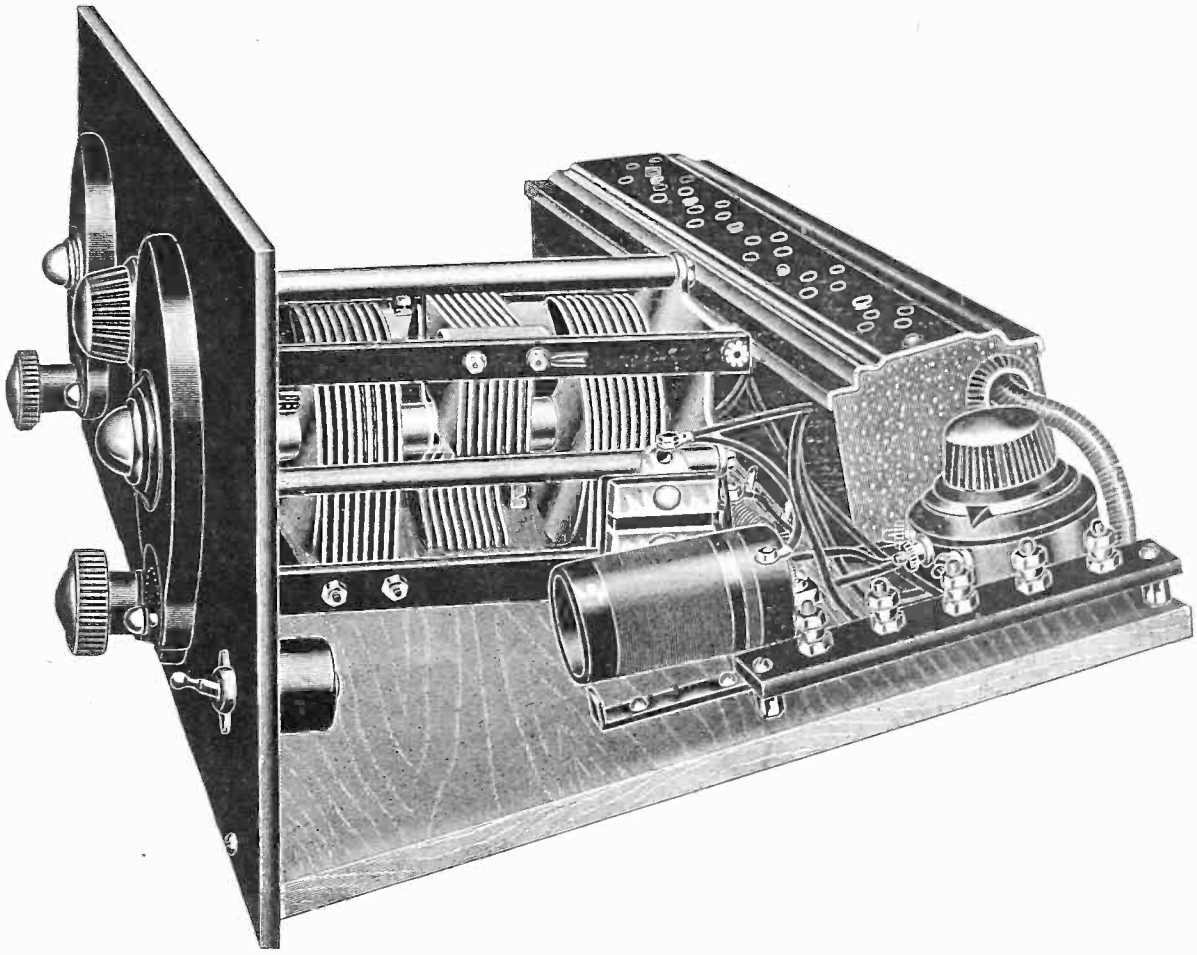
A Big Idea on Balsa Wood Speakers

An Analysis of Output Tubes

The Toto Power Well

# AC TUBES MAKE 7-VALVE SET BATTERYLESS



[By I. E. Corp., Special Wood Process]

SIDE VIEW of the AC Receiver (above), wit h catacomb assembly at rear. See page 4

*(DISTORTION FOREVER—See page 7)*

## TROUBLE SHOOTING IN RAYTHEON B ELIMINATORS

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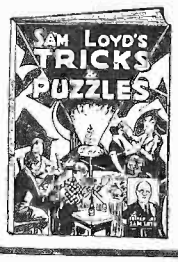


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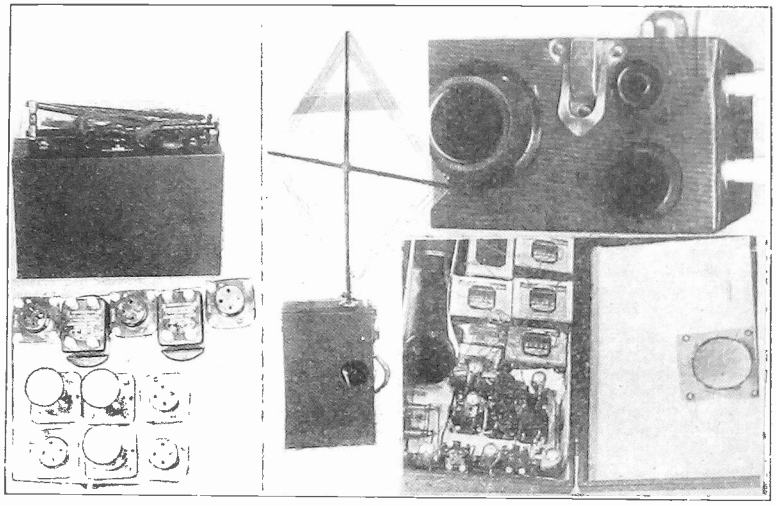
# *Some Hints on the Construction of*

# A Portable Receiver

*By Herbert E. Hayden*

**Photographs by the Author**



(Hayden)

**HOW a portable appears in ready-to-carry position is shown in the upper left-hand photograph. The lower picture at left shows the arrangement of the fixed radio and audio transformers. In the center is a view of the set in an operating condition. Note the speaker aperature in the cover. In the upper right hand photograph is a closeup of the front panel or case. The condenser knob is at left, with two rheostats at the right. The last photograph to the right shows the "inside works" of the set. Note the speaker opening and mesh over it, on the cover.**

HINTS on the successful construction of a portable set often result in space conservation and also a gain of efficiency.

A stage of tuned radio-frequency amplification, one of fixed radio frequency amplification, a non-regenerative detector and three stages of low-ratio transformer-coupled audio-frequency amplification make up a good combination. Only one tuning control is necessary.

A small suitcase, such as used by week-enders, houses the receiver, tubes, batteries, speaker and loop. How the parts should be laid out is shown in the lower left-hand photo.

The radio frequency and detector sockets are placed in the rear of a piece of pine, this being the baseboard. The audio frequency portion is the front. This part of the circuit is wired before being placed in the case.

### Flexible Wire Used

The variable condenser is then put on the side of the case, where the lock appears. Volume controls, in the form of a pair of rheostats may also be placed here. The complete set can then be wired up, using flexible wire.

The A and B batteries are placed alongside of the set. For A batteries, 4½-volt C batteries are used, while small 22½-volt batteries are used for B supply (90 volts). A loudspeaker unit and midget horn are used to make up a reproducer, this being placed between the batteries and the side of the case, carrying the tuning condenser.

So that it will not be necessary to open the case every time you desire to listen in, an opening is made in the cover, directly opposite the opening of the horn. Wire mesh should be employed to hide the raw edges of the cut portion and prevent injury to the interior. This is shown in the lower right hand photo.

For best results a large folding type loop is recommended. It is then possible completely to dissemble the loop and carry the complete receiver around in comfort. How compact it appears, when in this shape is shown in the upper left-hand photograph.

The center photograph shows how the receiver appears when in operation. A jack, placed at the battery end of the case, receives the plug of the loop. Binding posts are placed near this point, should it be desirable to use an external speaker.

To hold the batteries in place, aluminum stripping is located along the edges close to the speaker.

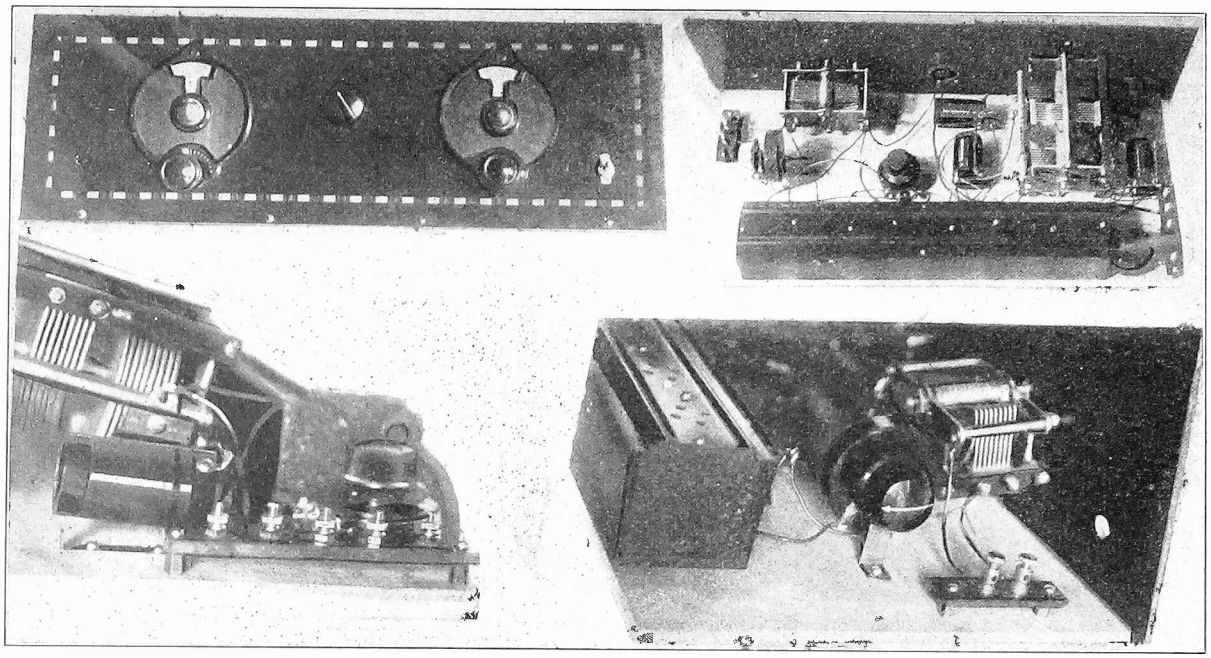
### Constants Discussed

When shaving insulation off the wire, be careful not to take off too much, for there will then be the danger of the bare portion touching some joints and causing a short, since at many points it is necessary to lay the leads in close positions.

One rheostat is placed in series with the negative legs of the two radio frequency tubes. The other is placed in series with the negative legs of the detector. Three 4V-199 Amperites control the filament of the audio tubes.

The grid leak resistance should be about 6 megohms, while the grid condenser should have a value of .00025 mfd. Any type or size variable condenser may be used, as long as it matches the loop to be used. Generally the .0005 or .00035 mfd. type loop is employed, with condenser to match.

# AC TUBES *Make This* 7-Tube *Set*



**FOUR VIEWS of the AC receiver. The front panel has two National dials, a volume control (at center), a switch and a pilot light. A view from the top discloses the layout of parts. At bottom (left) is the binding post strip for filament leads, with the common center point connected to post at extreme left. The opposite side of the set (right) is the input, where the loop is connected. The final audio biasing resistor is in full view.**

THE introduction of AC tubes on the market initiated a slow revolution in radio design which will ultimately replace the storage battery as completely as the automobile has replaced the buggy. The new tubes are thoroughly practical, and any troubles can always be traced to lack of technique on the part of those who have had the trouble.

There are many makes of AC tubes, just as there are many makes of direct current tubes. There are also many different characteristics of these tubes. The ones used in the set about to be described were Armor AC 100, except that in the last stage was an Armor 71.

One of the outstanding facts about the AC tubes is that the filament is almost invariably short and heavy, requiring a low terminal voltage and a high heating current. The reasons for such a filament are that it retains its heat better than a finer filament and that the voltage difference between the mid-point and either end is smaller, thus minimizing chances for the introduction of hum in the signal. The majority of AC tubes require a filament voltage of one volt and a filament current of from one to 2½ amperes, depending on the electron emission desired.

### Use Heavy Wire for Filaments

When building an AC tube receiver, or in adapting an old set to the new tubes, it should be remembered that the filament leads must be very much heavier for the new tubes. If AC tubes be put into the sockets of an old set and the voltage at the filament terminals is changed to suit, nothing but failure can be expected.

The voltage drop in the leads will be so great that there will be very little filament current.

Very heavy leads are necessary, and these leads must be heavy throughout the filament circuit, from the secondary of the supply transformer to the tip of the AC filament. This necessity can easily be realized when it is recalled that an 01A tube requires only one-tenth the current required by one of the new AC tubes.

Countless fans will want to built their own AC tube sets. Herewith is such a receiver, of seven tubes, in which all the filaments are heated with alternating current.

There are one detector and five amplifiers which require 1 volt, and one amplifier which requires 5 volts on the filaments. Hence the supply transformer must have at least two low-voltage windings.

### Armor Tubes Universal

With some other AC tubes it is necessary to have the detector on a separate winding, requiring 2½ volts, as against 1 volt, so three separate filament leads from the set are desirable, to afford this versatility. One of these should be from the 5-volt tube, one optional from the detector, and the third from the 1-volt tubes in the set. The leads for the power tube and the detector need not be of so heavy wire as those for the amplifiers. The windings on the transformer should correspond with respect to voltage and size of wire to the requirements of the set. The National power transformer for AC tubes meets all these winding requirements.

There are two potentiometers employed in the filament circuit of the set. One of these, P1, is connected across the filaments of the 1-volt tubes, with its slider connected to the point corresponding to C plus. The slider is set at the electrical mid-point on the resistance of P1 for minimum hum.

### When to Use P2

The second potentiometer P2 is left unconnected in the diagram but is located so that it can be placed across the de-

# *B Eliminator Costs*

NON-TECHNICAL owners of radio receivers in which all or a part of the plate voltage is obtained from the lighting circuits often look with suspicion at the radio set as a booster of the monthly light bill.

They just know that it is the radio set which is responsible for the great increase in the bills, because before the set was installed the bills were just a fraction of what they are now. But the radio set is an innocent victim of this misplaced suspicion.

Let us take a typical example to show how gross was the injustice of blaming the set. The set in particular had five tubes. Two of these tubes were operating on dry cells entirely, and therefore they drew no power from the house line.

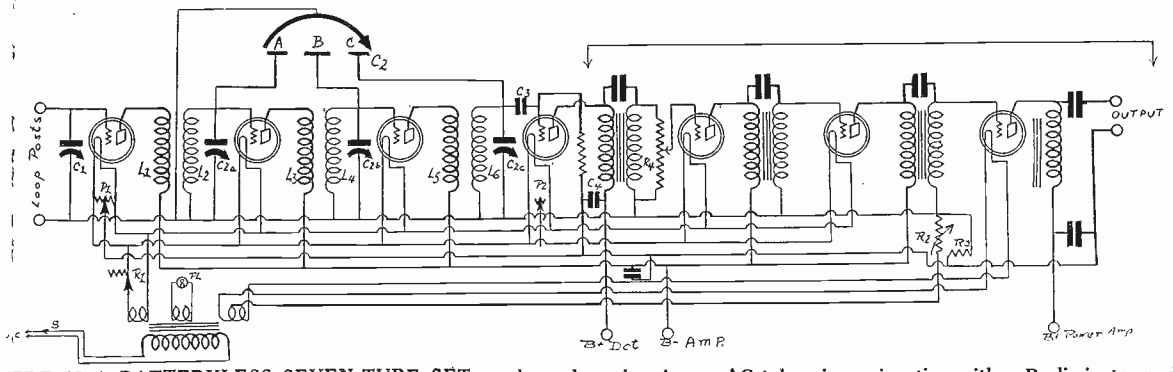
The total plate current drawn by the other three tubes was about 15 milliamperes. This is a conservative estimate because one was resistance coupled and drew less than one milliampere and the other two tubes were properly biased and the total plate voltage was only 170 volts. The voltage of the house line at the terminals was 120 or less. Hence the power supplied by the line to the radio set was 1.8 watts.

### Cost 1½ Cents per Month

The set was used an average of four hours daily or a total of 120 hours every month. Hence the energy taken from the line per month was 1.8 x 120 watt-hours,

# BATTERYLESS

*By Capt. Peter V. O'Rourke*
Contributing Editor




**ERE IS A BATTERYLESS SEVEN-TUBE SET, made so by using Armor AC tubes, in conjunction with a B eliminator and l drop C elimination. A loop picks up the RF energy and is tuned by a .00035 mfd. condenser. The next three stages are tuned l a three-gang condenser C2, the sections being A, B and C. Across the A and B sections is a double balancing condenser ca C2b. In the detector circuit C2c is a separate midget. Three RF, detector and three Hiler double impedance AF constitute the circuit.**

tor filament in the same manner that is connected, in case an AC detector the cathode heater type is used. The sition of P2 is indicated. Of course, th Armor tubes throughout, the AC is for detection as well as for amplication.

Since the voltages across the potentioters are low and the currents through filaments are high, it makes very little ference if the potentiometers draw a all additional current. Therefore the entiometers may have low resistances. enty ohms would be sufficient if such entiometers can be obtained. Certainly higher resistances than 200 ohms need used.

No potentiometer is needed for the ment circuit of the power tube because 5-volt secondary winding has a cen-tap which serves the same purpose.

### Affords Variety

The grid bias voltage for the power e is obtained from the voltage drop a resistance R2. This should be varle and its maximum value may be 000 ohms so that the correct grid bias be obtained for a variety of tubes and ate voltages. The grid bias for the ner amplifier tubes is likewise obtained m the voltage drop in a resistor, R3. e value of this resistor need not be re than one or two ohms. The grid urn of the detector tube is to the midint of P1 (or P2 if that is used) and erefore the grid is kept at the average tential of the filament. It can be kept a small positive or negative potential with respect to the mid-point by inserting a small battery in series with the grid leak.

There are three stages of radio frequency amplification and a detector—four tuned stages—in this receiver. Three of these are tuned with a single control, a three-sectional Cardwell condenser being used. The coils in these tuners are Powertone. The first tuner consists of the pick-up loop and a single unit Cardwell condenser. As a means of keeping the three-gang condensers in step a midget condenser is connected across one section and a double midget across the others.

### Catacomb Assembly Used

The audio frequency amplifier is of the double impedance type and contains three stages with an output filter. The stopping condensers and the various audio chokes together with all the seven sockets are built into one unit or catacomb. This forms a very compact assembly which occupies little space. Even the output filter is built into the catacomb, an Alden Truphonic unit.

The volume is controlled by means of a 500,000-ohm Electrad potentiometer, R4, placed across the grid impedance following the detector tube. This is the logical form of volume control placed in the best position.

The pilot light is connected in series with the 2½-volt winding when the detector is not on this winding, otherwise the pilot light is connected in parallel with the detector tube filament. Pilot lights of this voltage requirements can be obtained in any electrical supply store.

The filament switch S is connected in series with the primary of the AC filament supply transformer and also the B eliminator transformer. This completely controls the power supply and no relays are necessary. It can be placed on the panel.

A rheostat R1 is shown in the diagram. It is connected in series with the 1 volt winding for limiting the filament current. It must be of very low resistance and very heavy wire because the current which it will normally carry is high and the voltage drop in it must always be comparatively small. About .5 ohm is recommended.

A loop serves as the collector of energy. The next two RF stages have a single two-section Cardwell Balancet (double midget) across the tuning condensers, and a separate balancer across the remaining part of the three-gang capacity.

# 1½¢ per Month to Run

.216 kwh. The cost of electric energy this case was approximately 7 cents er kwh. Therefore the total cost of the nergy taken by the set per month was ightly over 1½ cents.

Of course, the initial outlay and dereciation must be considered in the total ost.

But the electric bills in the house had dvanced from about $3 to $6 per month. Where did the extra power go to? Well, here were 16 lights in the house going n average of 4 hours daily. Most of hese lights had originally been 25 watters. hey had been replaced by 50 watters. ow, what is the cost of the energy necssary to keep sixteen 50-watt lights oing four hours a day for 30 days? The wattage is 800 watts. The number of hours per month is 120. Hence the energy used per month is 96 kwh. At 7 cents the bill should have been $6.72. This figure is within a few cents of the bill actually rendered by the electric company one month.

### Excluded Items

The cost of 1½ cents given above for the operation of the radio set was only for the power taken from the line by the plate circuits of the tubes. Of course it does not include the cost of the dry cell B battery, which was used to boost the plate voltage and to supply the RF and the detector tubes. Neither does it include the cost of charging.

## One Soprano Voice Gets Over, Anyway

With three ears training under G. S. DeLuca, Myra Bender is able to demonstrate a soprano voice well adapted to broadcasting. It has been said that sopranos do not register well on the microphone. However, the mellow quality of Miss Bender's voice makes it possible for her to number her radio audience of attentive listeners away up into the thousands.

**Myra Bender**

Her first appearance was in an operatic program under Mr. DeLuca in the studio of WSM, Nashville, Tenn., more than a year ago. Since that time at frequent intervals she has broadcast. While she does not engage in any of the so-called jazz numbers her work has gradually developed into the field of the popular numbers. Light opera and musical comedy selections are treated nimbly by her interpretations.

Miss Bender sings each week for WSM at 10 P. M. on Monday.

# A BIG Idea In Building a Lata Balsa Wood Speaker

*By H. B. Herman*

**Acoustical Expert**

THE paradox of lightness and rigidity is an essential of the type of speakers operated by an extending stylus, e. g., cones and flat surfaces. For the flat type Lata Balsa wood furnishes all the lightness that one would require. It is light beyond expectation, being only half as heavy as cork, and if you toss a slat of the speaker sounding board into the air it will waft to the floor something like a feather.

The rigidity is supplied by lateral arms or fins, which are cemented to the thin slats on the 3/16-inch edge of the fins.

By the terms of such an outline it is possible to construct a Balsa Wood speaker that does any number of things, even one that slights the low notes and has a natural period somewhere above 400 cycles.

### Will Work the Other Way

Also it is possible to favor the low notes immensely, and hardly be able to catch the hisses and other sibilants. One wants them, too, for they are the readiest indices of the high audio frequencies.

When we try to judge by ear alone the operation of any speaker we naturally listen for the low notes—those of the oboe, bassoon, contra-bassoon, organ, bass viol, and drums—and again for the consonants of speech, especially the *th, s, z.* Next our ear perhaps inquires into the middle range. Never do we find—if our ear tells us the truth, which it doesn't do always—that any speaker handles all notes equally well. Such a speaker has not been built yet to perform by the electromagnetic method and never will be, unless the laws of physics are amended.

The response obtained from the Balsa Wood speaker that I built is entirely satisfactory to me and delights all visitors. The method of construction is applicable to the Balsa Wood kits as now obtainable, and may be used on any of the three standard sizes. My own speaker frame measures 43 x 24 inches.

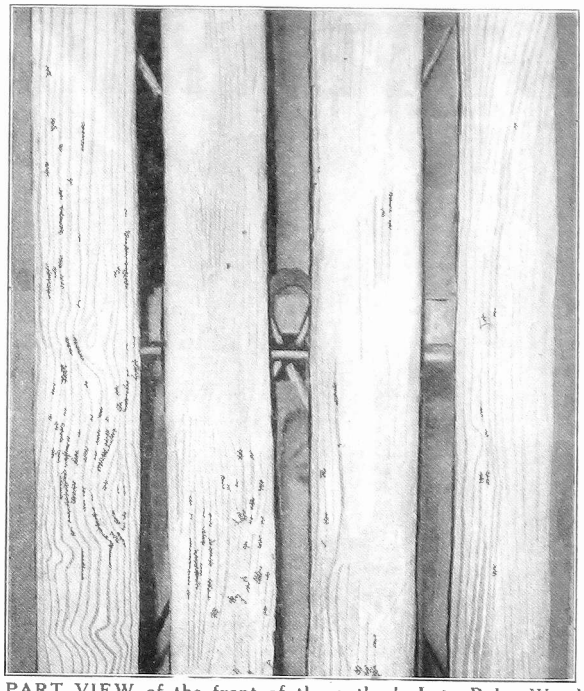
### All-Around Service

There is a well-rounded low note response, delightful to hear, because orchestras, including symphonies in particular, are lost without full reproduction of the low notes that lend character and personality to the music.

The middle register is well taken care of, but has pronounced resonance peaks. These are not objectionable in actual practice, for they simply make the amplification stronger on some few notes, or within some few narrow regions and generally go unnoticed. Trained acoustical ears will hear these peaks and acoustical engineers will remark upon "the hump in the curve," but there isn't any speaker made that uses a sounding board as diaphragm, nor horn type, either, that hasn't its peaks and hollows.

In the higher audible frequencies these peaks are less pronounced than in the middle register of the Balsa as I made it. No doubt it would be possible to lower these peaks, and a suede or felt baffle would do it, but my own speaker is so satisfactory that I don't think I'll even attempt to improve it in that direction, but prefer instead to outline how it was built, so that others may follow the directions to the delightful goal.

**HOW** to build the Balsa Speaker with genuine Lata Balsa Wood, fully described, including acoustical theory, by H. B. Herman in the June 11 issue. Send 15, for copy. Radio World, 145 West 45th Street, New York City.



**PART VIEW of the front of the author's Lata Balsa Wood speaker. The sides of the frame are at left and right. Four slats are used, instead of the conventional five, thus allowing greater spacing between slats, improving response. Part of the speaker magnet is shown at the crossarm. The protruding points are not the magnet poles, but the ends of the two upper fins.**

The central idea is that the sounding board, consisting of the slats and the fastening ribs, should be stiff without being inert, hence there must be extraordinary freedom of movement of the sounding board where the stylus or driving pin is fastened to the thumb-nut. The small slab of wood—Balsa or otherwise—into which this thumb-nut fixture is driven, may be half an inch square, or larger.

The lower frequencies will not ordinarily be slighted, so attention is focused momentarily on the higher frequencies. If we use a good receiver, with a fine audio amplifier, we should be able to hear hisses (like escaping steam) with great effect. And this we will do, if we take advantage of the higher frequency response of the individual slats.

### Individuality Preserved

Instead of doting on the idea that in union there is strength, we accept that as an incidental fact and try to get as much of the individual character of each slat into the sum total as is possible. Let each individual slat preserve its own identity, so far as possible, rather than to merge its individuality into a general ensemble of low-note reproduction and sacrifice of higher pitches.

By widely spacing the individual slats, as shown, the easy swing is achieved, and less power is required to drive the sounding board. By the same process better high note response is attained, as well as an improved result in the middle range. Undoubtedly some "humps" are caused by this very means, that is, intensity somewhat over-pronounced, but this may be regarded as a shifting, rather than as an addition.

The humps are transferred from one range to another, without being materially increased numerically.

Besides, the speaker is thus able to operate with a given natural period of 310 cycles, or slightly lower than that of the Western Electric 540 AW, which the Balsa Wood speaker, properly made, is quite likely to outperform, when a Western Electric or a Lata Balsa unit is used. The speaker was made of four slats, the extra room being taken up in the spacing between slats, so that one slat was left over from the kit supply. The ribs number five, one across, and four semi-diagonally.

The wide piece of wood showing in back of the speaker is the crossarm, and this is of heavy wood. To this crossarm the unit is attached. The stylus is affixed to the small wooden slab. It is important to avoid having these semi-diagonal fins contact directly with the cross-fin. An annoying source of rattles is present when these joints are improperly made, and also if the stylus or driving pin is not firmly fastened, or the slab that holds the thumb-nut catching the pin is not cemented firmly. There is no inherent or mysterious rattling tendency in the speaker, for if rattles occur you can trace them down and get rid of them.

A glance at the photograph shows how the semi-diagonal fins terminate. Nearly half an inch separates the fin terminals from the cross-fin. The slab will have to be big enough to cover the four points handily. Imagine the black square in the center of the photograph to be the slab and you will get the idea.

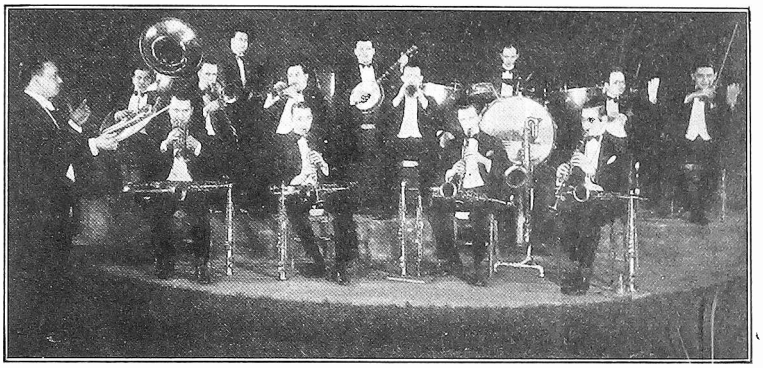
### All Rattles Are Curable

As for rattles, these arise from loose joints or splits. Look to the ends of the fins. Unless carefully cemented down, these surely will get loose and rattle. Inspect the whole length of the fins, and tug slightly at them, in searching for loose joints.

Do not forget the corners of the slats, as these will get loose, if not properly cemented down. In fact, after building the speaker, and letting the cement dry, it is well to use a little pressure on the cemented joints, to make sure everything is down tight, and if it isn't, to do some more cementing, and some more waiting, until everything is dry and tip-top, for then you will have one of the finest speakers in the world.

# ME FOR Distortion Forever!

*By Tim Turkey*



**ORCHESTRAS (like Vincent Lopez', shown above) are full of low notes. Tim Turkey dotes on them and explains in a novel article why he is in favor of one kind of distortion.**

MOST radio receivers show the characteristics of a dromedary; they have a big hump in the middle. Some receivers show the characteristics of a camel; they have two humps on top. Many receivers are nondescript mongrels which partake of the characteristics of both the above types.

The characteristics of all loudspeakers are very humpy and bumpy. The difference between a good loud speaker and a bad one lies mainly in the distribution and intensity of the humps. Some of the speakers have nothing to show below 100 cycles. Others rise to great heights just beyond the 50 mark. Most speakers of the so-called better variety are perfectly dumb above 5,000 cycles, while some of the worst speakers are as silent as a giraffe up to 500 cycles. Those of the mediocre variety are just like the majority of the receivers; they have a hump in the middle, or a series of humps in the middle, with nothing to show at either end.

When the characteristic of a receiver is combined with the characteristic of some loudspeaker a very indefinite overall characteristic results. The overall may be much better than either of the components, or it may be infinitely worse.

### Matter of Psychology

It will be better if the humps of the one coincide with the hollows of the other; it will be worse if the humps of the one coincide with the humps of the other. But even when two mediocre characteristics combine most favorably, the result is not far from mediocrity.

But whether the output of a radio installation pleases the listener or not has nothing to do with the number and intensity of the humps and hollows. It has nothing to do with the distribution of energy in the highs and the lows or in the middles. Nothing at all; it is purely a psychological matter. A person can become accustomed to like almost anything, no matter how atrocious it may be to the senses at first exposure. The senses become fatigued and do not care what goes on around them.

Quinine is bitter on first taste, but it loses its bitterness after a short exposure to the tongue. Sugar is sweet at first, but only for a little while. The senses of touch, smell, sight and hearing respond to stimuli in a similar manner. So when a person has been exposed to an especially atrocious radio reproduction for a while, his much punished auditory nerves have become exhausted and no longer give heed to the stimulus, while the nerves which have not been subjected to much activity are still alert and take it all in.

### Set Bad, Owner Innocent

So it comes about that the person who possesses a very bad radio installation can innocently and conscientiously rave about the unexcelled quality of his set. His friend, whose ear is still undefiled, cannot disillusion him, because hearing is believing, and as the two do not hear the same thing in the same way, there is no common basis of argument.

The only way to convert the man with the bad set is to expose him unknowingly and exclusively to the reproduction of a really good set for some time. After such a course of treatment, the first thing the patient would do on hearing his own set would be to plug his ears. But it would be better for everybody if his first act would be to throw it into the furnace.

There is some form of distortion in a radio installation which is really not an offense to the listener. Suppose that the reproduction is such that the lowest tones are greatly exaggerated in comparison with the higher, but that the falling off toward the higher is even and gradual. Also suppose that the tubes in the set are large enough to handle all the energy required for the low notes. Such reproduction is preferred by many persons because of the so-called mellowness. Even persons with highly sensitive ears will not take offense at such reproduction. At no time is a crime committed against the eardrums.

### Plea for the Low Notes

After all, the low notes in the music constitute the foundation upon which the composition rests, and the higher notes are often only embellishments.

*Instruments may show that the low notes are exaggerated and the higher are suppressed and thus that there is considerable distortion in the reproduction, yet I prefer to listen to such music just because the low notes can be heard. I have not yet been able to enjoy any reproduction in which the high notes were accentuated to the detriment of the low.*

Some persons may prefer to listen to the receiver which brings out the soprano well and does not bring out the basso at all. Such sopranophile individuals are fortunate, in that they need not buy a first-rate receiver nor even a fair loudspeaker to satisfy their demands. It is the individual in each case who determines whether the reproduction sounds good to him.

The judgment of quality also depends on what type of broadcasts is being listened to. Orchestra music is best when the receiver gives due emphasis to the lower tones, say, the bass viol, the tuba, the bassoon and the drum. This is particularly true of dance orchestras. Band music is also best when the low notes are not slighted.

### Violin and Voice

The violin sounds best when the higher notes are brought out, and it does not make much difference whether the lows come out at all, because they are not in the original. The same applies to sopranos.

Reproduction of the speaking voice, whether of high or low pitch, sounds all right if it is intelligible. For intelligibility the notes below a 100 are not necessary, but the highest audio notes are very desirable. If the *esses* stand out clearly, no particular effort is necessary to understand what is being said. The sibilants like *s*, *th* and the like require notes up to about 10,000 cycles.

### Statement of Likes

An excellent orchestral combination to listen to is the Balalaika orchestra, where only large sized mandolins are used. The middle frequency is mostly used, with a frequent dip into the bass. And when they go down there it's really wonderful. I could sit for hours and hours and listen to them. String ensembles are also good bets.

Especially do I enjoy the above combinations when they render pieces written in the bass portion of the scale.

The most delightful thing to listen to, I think, is a song requiring string plucking in the bass scale and played by a cello or bass viol.

# Bias In An A B C Unit

## *How It Is Obtained In the Toto Power Well*

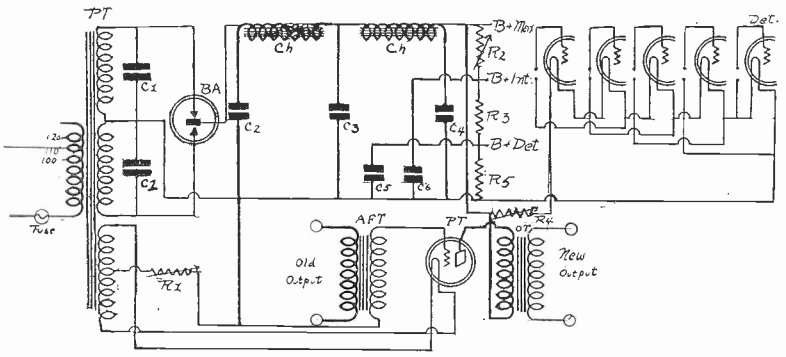



FIG. 2

**The diagram of the Toto Power Well, including series filament connections of the receiver, and grid biases.**

*[Part I of this article on the construction of the Toto Power Well—an ABC eliminator—was published last week, issue of August 6. Part II, the conclusion, follows.]*

### PART II

THE grid bias for the power tube in the Toto Power Well is obtained from the drop in the resistance R1. The resistor used is a 2,000 ohm Amsco Duostat. One end of this resistor is connected to the most negative point in the eliminator and one of the sliders is connected to the mid-point of the secondary of the heating transformer. By moving the slider away from the negative end, the entire filament, so to speak, is lifted in potential by the voltage drop in the resistance.

Since the grid return is connected to the negative end there is established a voltage difference between the mid-point of the filament and the grid, with the grid negative. The value of this bias is the product of the plate current in the power tube and the resistance of that part of R1 which is used. Since the plate current in the 371 tube with 180 volts on the plate is about 20 milliamperes, the voltage drop in the 2000 ohm resistance will be about 40 volts, the correct value under the circumstances. If the plate voltage increases, the required grid bias is also greater, but this does not necessarily require a change in the setting of the resistance R1.

#### Automatically Changes

The adjustment is more or less automatic, because as the plate voltage increases the plate current also increases; and as the plate current increases the voltage drop in R1 increases. However, when a different tube is inserted into power socket it is necessary to readjust the setting of R1, even when a new tube of the same type is inserted. If it were not for this fact the resistor R1 could be made fixed.

In Fig. 2, which is a clarified copy of Fig. 1, is shown how the filament circuits of the other tubes in the circuit should be connected. They are all in series, so that all the tubes get the same amount of filament current. The current is controlled with rheostat R4 (a Power Clarostat). The voltage drop in R4 must be the difference between the output voltage of the filter and the voltage required by the tubes in the amplifier. In the case shown there are five filaments and these require a voltage of 25 volts. Suppose that the voltage across the output terminals of the filter is 220 volts, the drop in R4 must be 195 volts. The current flowing through the rheostat should be about .25 ampere. Hence the resistance should be 780 ohms. It should be variable up to at least 1,000 ohms so that the correct adjustment can be obtained.

The power dissipation in rheostat R4 will be nearly 50 watts. Hence it is necessary to have a rheostat which will stand a considerable current.

#### Methods of Getting Bias

The manner in which the grid bias voltages are obtained in the series connected tubes is interesting. The detector tube is placed at the bottom of the series, that is, next to the negative side of the filter. The grid return is connected to the positive end of the filament. No negative bias could be given this tube without inserting a resistor in series with the filament below the detector tube. The other tubes in the circuit are amplifiers and need negative bias.

Each tube can be given a bias of at least 5 volts by connecting the grid return to the negative end of the filament next below, as has been done for all of them in the drawing. For three of the tubes the bias can be made at least 10 volts by connecting the grid return to the next filament below but one. The first two tubes from the positive end can be given a maximum grid bias of 20 and 15 by connecting the grid returns of these to the negative side of the filter. From this possibility it would appear desirable to make the first tube on the positive side a semi-power tube to feed into the output tube and to obtain its plate voltage from the B plus max binding post. This tube must not take more than .25 ampere on the filament.

The plate voltage available for the output power tube is about 180 volts, since 40 volts of the 220 volts output are used for grid bias. The maximum plate voltage available for the first tube in the series, counting from the positive end, is 200 volts, since 20 volts have been used by the four filaments below it. The low tube in the series, that is, the detector in this case, could be given a plate voltage of 220 volts if desired.

#### Constants Discussed

However, the proper voltage for the detector is much less and the correct value is obtained from the drop in the resistance R5, an electrad 25-watt Truvolt, 1,500 ohms. R3 is an Electrad Truvolt of 10,000 ohms, 25 watts. R2, another 25-watt Electrad Truvolt, should have a maximum resistance of 5,000 ohms, and should be variable.

The rectifier is a double wave BA Raytheon which is capable of delivering a current of 350 milliamperes. The power transformer PT is an Acme 200 watt capacity. It has a tapped primary for adjusting the input to various primary voltages. It has also two center-tapped secondaries, one for the rectifier and one for the filament of the output tube.

The Flechtheim buffer condensers C1 are of .1 mfd. and capable of withstanding 1,000 volts continuously. C2 is a 4 mfd. Flechtheim condenser of the same voltage rating. C3 and C4 are 8 mfd. units, each made up of two 4 mfd. blocks. The remaining condensers, C5, C6 and C7, 1 mfd. each, need not have a rating higher than 250 volts.

The filter chokes Ch are two Acme BA2 heavy duty chokes each having a resistance of 166 ohms. This low resistance, 332 ohms, makes the regulation of the filter satisfactory even for currents greater than 300 milliamperes.

The parts of the Toto Power Well are assembled on a 20 x 10 inch wooden board.

#### LIST OF PARTS

**BA—One Raytheon Type BA tube.**
**PT—One Acme Apparatus power transformer for BA tube (.2 kw).**
**AF—One Acme Apparatus audio transformer.**
**OT—One Acme output transformer.**
**C1, C1—Two 1,000 volt Flechtheim buffer condensers, each .1 mfd. (one unit).**
**C2—One 4 mfd. 1,000-volt Flechtheim condenser.**
**C3, C4—8 mfd. each, made up of four each of C2 type.**
**R1—One Amsco Duostat, 2,000 ohms.**
**R2—One Electrad 5,000-ohm 25-watt Truvolt variable resistor.**
**R3—One Electrad 10,000-ohm 25-watt Truvolt variable resistor.**
**R4—One Power Clarostat.**
**R—One Electrad 1,500-ohm 25-watt Truvolt fixed resistor.**
**C5, C6, C7—Three Flechtheim 1 mfd. 250-volt by-pass condensers.**
**Two Acme Apparatus Co. choke coils for BA tube (BA2).**
**Eleven binding posts.**
**One 5-ampere fuse and one porcelain fuse socket.**
**One extension cord and lamp socket plug.**
**Two vacuum tube sockets.**
**One CX-371 tube.**
**One 20x10-inch board.**
**One shielded case (optional).**

# How Well—Not How Far

## *Quality Rules and Power Tubes Play Big Part*

*By A. R. Wilson*

**Engineering Department, General Radio Co.**

AS the novelty of radio has gradually disappeared, and more interest is taken in it purely as an instrument to reproduce with fidelity both music and speech, the listener and engineer have given more and more thought to the tonal qualities of the broadcast receiver. The vast radio audience today is first of all concerned in how **well** it can hear. How **far** is a secondary consideration.

It would seem to the average listener inexperienced in radio experimentation that all that is necessary to increase volume is the addition of a stage or two of audio frequency amplification to his existing equipment. This is true to a certain extent, but as we are interested only in **quality volume,** the design of the apparatus used in the "stage or two" of audio frequency amplification is of great importance.

A speaker, which does the actual reproducing of sound, is an energy operated device and as the energy is derived from the last audio tube alone, the undistorted volume obtainable from a speaker is usually dependent upon the energy output of this tube and no other.

**Handling Ability Compared**

The energy is measured in milliwatts and the following table gives the power output of the tubes now in common use, with the plate voltage necessary to obtain full output:

| Tubes | Undistorted Output | Plate Voltage |
|---|---|---|
| UX 120 | 110 | 135 |
| UX 226 | 160 | 180 |
| UX 112 | 195 | 157 |
| UX 171 | 700 | 180 |
| UX 210 | 1500 | 425 |

In order to obtain the maximum power output that a tube is capable of delivering, it is necessary that a sufficiently large voltage be placed on the grid of the tube to operate at its maximum output.

At the same time certain conditions, however, must be satisfied to prevent distortion in the tube itself. First, the grid must not be allowed to become sufficiently positive to draw any appreciable amount of grid current, and second, the plate current must at no portion of the cycle be allowed to fall so low that distortion be caused by curvature of the plate current curve. The input voltage which may be applied safely to a tube without causing grid distortion is fairly well indicated by the grid bias voltage. Actually the effective grid swing permissible in volts

$$\text{R. M. S. is } \frac{\sqrt{2}}{2}$$

or .707 times the grid bias.

**Things to Guard Against**

The solution of the problem of quality volume is threefold, embracing tubes, transformers and speakers wherein distortion of various sorts and causes tends to develop.

It may be well to state here that there are two apparent forms of distortion to guard against in any audio amplifier: frequency distortion and waveform distortion. Frequency distortion, which really is not distortion at all, but the relative differences in the amplification of different frequencies, is caused by one of two things, either a coupling device that is not capable of even performance over the audio range, or the improper matching of impedances of the different circuits.

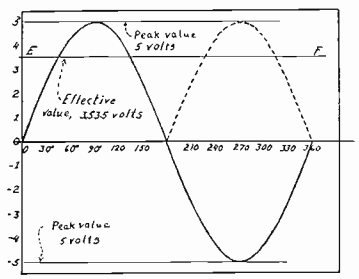



**FIG. 1**

Diagram showing the relationship between the peak and effective values of an alternating voltage. The full curved line represents a wave of alternating voltage having an amplitude of 5 volts. The dotted loop represents the effect of the negative halt of the wave on an alternating current voltmeter. The effect is positive and is equal to the effect of the positive half of the wave. The peak value is the amplitude, in this case 5 volts, and this is the value that is measured on a peak voltmeter. The effective value of the voltage, or the root mean square (R.M.S.) value, is equal to .707 times the peak value. In this case the R.M.S. value of the wave is 3.535 volts. It is the effective value of the voltage that is measured on practical AC voltmeters. When the AC voltage has been measured on such a meter, the reading must be divided by .707 to get the peak value. The peak value determines the electric stress on condensers. It is also the voltage that should be regarded as the input voltage to vacuum tubes when adjusting grid bias.

It is extremely important from a frequency viewpoint that the impedances of the various circuits bear a definite relation to each other.

To obtain a maximum transfer of voltage from one circuit to another (and we are interested in this respect only in voltage and not in energy), the impedance of the transformer primary should be at least two or three times that of the tube circuit at the lowest frequency which we wish to amplify.

**Waveform Distortion**

Waveform distortion in the amplifier itself is caused by either an over-loaded tube or saturation of the core of the audio transformers.

With the present-day standards of transformers, however, saturation from a practical standpoint may be entirely disregarded. Obviously the remedy for an overloaded tube is the reduction of the input signal or the increase of grid bias and plate voltage, thus permitting the tube to be worked on the straight portion of its grid voltage plate current curve.

Assuming one to have an audio amplifier and tubes of the standards of two or three years ago, the most radical improvement in quality would be brought about by the replacement of the last audio tube by one of the new power tubes, such as the UX 171 or UX 210.

This would increase the power handling capacity of the amplifier 50 to 100 times and this power handling capacity of an amplifier is something that is not very well understood by the average man, yet it is extremely important if faithful reproduction is to be obtained.

In order to produce the same intensity to the ear, say at 60 cycles, many times as much power is required as at 1,000 cycles.

**Need of Power**

A somewhat disconnected yet fitting illustration would be the comparison between a tuba player and a cornet player in a brass band. The tuba player expends much more energy, but to the ear the cornet is louder. In the case of the loudspeaker far greater power is needed to supply the energy than was heretofore thought necessary to reproduce bass notes properly, and it is even very doubtful if the tubes on the market today are capable of supplying to the speaker enough energy to reproduce these low frequencies with the same intensity as the higher frequencies, unless a 50 or 100 watt power tube is used. This would require a type of plate supply device, which from an economic point of view, would be entirely out of the question.

While it would seem that increasing the energy output of an amplifier would result in extremely loud reproduction, this is not necessarily true.

A loud sound may be doubled in intensity—that is, the energy doubled—and the ear may hardly detect the change. This fact will explain in some measure why many people are not able to note the difference in the volume produced by a UX 171 and UX 210 tube, although the maximum output of the UX 210 is double that of the 171.

**Tube Fixes Limitation**

Everything else being equal, the reproduction, when using the UX 210, should appear much better on the lower frequencies—actually it is about the same, because the lower plate impedance of the 171 permits a greater transfer of energy from tube to speaker at these frequencies.

The power handling capacity of an amplifier using present day transformers is more or less limited by that of the tubes used, since the largest possible portion of the negative side of the grid voltage plate current curve is available for the actual plate voltage used. While resistance or straight impedance coupled amplifiers are better from a purely frequency standpoint, the power handling capacity is decidedly limited, as there is a certain rectifying action of a strong signal caused by the time action of the grid condenser and leak, and their purpose, even from a frequency standpoint, is often defeated by the improper use of tubes.

**Sound Economies**

A man will quite frequently pay from $10 to $20 for an impedance coupled amplifier only to use a 201A tube in the last stage, and it is very doubtful if the improvement in quality in this case is even noticeable to the ear. This is only another example of insufficient power required to reproduce bass notes, although

**(Continued on next page)**

# Righting Anything Wrong In a B Power Supply

[From Raytheon Manufacturing Company]

There are few elements to cause trouble in the Raytheon-approved radio power unit using the B or BH type of tube. More often the trouble is to be found in the associated receiver and wiring. However, when genuine trouble does develop, it may be readily located and remedied; and the following suggestions are offered by the Raytheon engineers as an aid to radio enthusiasts and radio service men alike in facilitating such work.

**Inoperative Receiver:** If the cause, through a process of elimination, is found to be in the radio power unit, then the following suggestions may be considered. However, as often as not the trouble is primarily in the receiver itself, or more likely in the connections and wiring between the receiver and the radio power unit. Sometimes, when a B power unit is connected it a receiver where the grids of the amplifying tubes are not biased with a C battery, the high voltage may soon paralyze the tubes. This may be remedied by inserting proper values of C battery for each tube.

**No Voltage At Given Tap:** The logical place to begin the hunt for trouble in a radio power unit is at the resistor bank, and then work backwards through the filter, rectifier tube, and finally the transformer. It is assumed, of course, that the 110-volt alternating current is known to be flowing through the transformer primary when the radio power unit is turned "on," and that the rectifier tube is not visibly damaged in any way. Of course the current is turned "off" before any part of the radio power unit or associated wiring is handled, to avoid dangerous shocks, excepting output voltage tests.

An open-circuited or burnt-out resistor will result in no voltage from the tap it controls. If the 10,000-ohm fixed resistor becomes open, in the case of the B power unit, the detector voltage will immediately increase so that in the tuned radio frequency receiver the signal strength will be greatly diminished, while in the regenerative receiver there will be constant oscillation.

The simplest method to locate a defective resistor is by means of a high-resistance voltmeter, connected to each tap in turn. In fact, this device is essential in adjusting B power voltages to any receiver, in place of the cut-and-try method. In the absence of this device, a 15-watt, 220-volt incandescent lamp may be employed. It should glow a dull red on the full output and on the intermediate tap of the B power unit. If it lights equally bright on the detector tap, it is an indication of an open or defective 10,000-ohm fixed resistor.

If the tap voltages are found satisfactory, and the receiver still does not operate well, the trouble may be due to an open or an omitted by-pass condenser. A short-circuited by-pass condenser will act the same as a short-circuited resistor.

**No Voltage at All Terminals:** This condition can be caused by an open circuit in the wiring, transformer, choke coils or a broken-down filter condenser.

With power disconnected from the B power unit and the Raytheon tube removed, a click should be heard in the testing telephone when connected in series with battery between plate terminal of rectifier socket and the **plus** B of the power unit. A click should also be heard between either filament terminal of the rectifier socket and the **minus** B of the B power unit. These clicks should be of equal strength. If one filament terminal gives a much louder click than the other, it generally indicates a defective buffer condenser. If no click is heard on either filament terminal, then the transformer secondary is open-circuited, or the center tap of the transformer does not connect to the **minus** B side as it should.

The circuit continuity of the transformer itself may be tested by the click between the two filament terminals of the rectifier socket, with tube removed. If the transformer secondary tests O.K. on the foregoing procedure, there must of necessity be an open circuit in the **minus** B lead.

A short-circuit in the secondary of the transformer can be most easily checked by connecting a 25-watt, 110-volt lamp in series with the primary. The current is now turned on in the usual **way, but with** the rectifier or Raytheon tube removed from the socket. The incandescent lamp should glow dull, if at all. If it glows bright, either the transformer secondary or one of the 0.1 mfd. buffer condensers is broken down. With the lamp still in the primary, the rectifier tube is inserted in the socket. If the secondary connections are O.K., and the Raytheon is operative, the lamp will increase in brilliancy. The buffer condensers, if suspected, may be disconnected from transformer secondary and rectifier socket, so as to be tested separately for short-circuit.

**Testing the Raytheon:** All Raytheon tubes are thoroughly tested and aged at the factory under full rated load before being packed and shipped. Thus a new Raytheon can be depended upon to function properly. It should provide satisfactory service for about a year of normal use—at least a thousand hours of radio entertainment. After serving nearly its full life, the voltage output of the Raytheon, previously maintained at a uniform high level, begins to drop off. When such condition obtains, the voltage controls can often be adjusted to bring the voltage up again to the desired value, and many weeks or months of good reception enjoyed before the tube is finally discarded. If the Raytheon gets warm when the B power unit is in operation, it is sufficient indication that the rectifier tube is operating. If there is any doubt about the proper functioning of the Raytheon, the simplest check is to replace it with a new Raytheon and note the results with the radio receiver left unchanged for a fair comparison.

**Excessive Hum:** This condition may be caused by an incorrect connection in the filter circuit, such as a condenser bypassing a choke coil. The hum should increase when either choke coil is short-circuited in turn. If the hum does not increase, the circuit connections to that choke coil should be checked, and if found correct, then the choke coil should be replaced by another of similar characteristics. Make sure that one side of the A battery is grounded.

**Importance of High-Resistance Voltmeter:** Those desirous of operating a B power unit or a Raytheon A-B-C radio power unit, as the case may be, should have a voltmeter whose resistance is at least 100,000 ohms, with a full scale deflection of 200 or 250 volts. Such a meter will permit of adjusting the resistances for the proper output voltages when connected with a given radio receiver. Not only is this of great benefit when the initial installation is made, but it will later be of use in making adjustments to take care of line voltage fluctuations, changes of receiving tubes, etc. Correct readings are impossible with inexpensive, low-resistance type of voltmeter.

**Motorboating,** or troublesome audio oscillations which cause fluttering in the loudspeaker, are generally due to conditions in the audio amplifier, and may be corrected by satisfactory adjustment of the amplifier.

**Replacement Tube:** It is of utmost importance that the existing tube in the radio power unit be replaced by the same type of tube. The substitution of another type may lead to serious trouble.

# Station and Loudspeaker Limit the Tone Quality

(*Continued from preceding page*)

the frequency characteristic of an impedance or resistance coupled amplifier is essentially a straight line from 30 cycles upward.

A very interesting laboratory experiment along these lines proved that where a pure 60 cycle note from a vacuum tube oscillator was fed directly into the grid of a UX 210 tube, the full output of this tube did not produce even an audible sound at this frequency. All low frequencies are not entirely lost, however, as their harmonics are reproduced, but with much less intensity, and the fundamental pitch is usually obtained by the beat note of a second and third harmonic.

### Watch Last Stage Tube

In reviewing the subject of power handling capacity of an amplifier, there are many other more important phases to consider than the particular method of coupling (transformer, resistance, or impedance). It is a well-known fact that no better quality can be expected than is radiated from a broadcasting station or that can be faithfully reproduced by the loudspeaker — regardless of what coupling method or combination of methods may be used.

Bearing in mind that the frequency range of the better broadcasting stations is something like 80 cycles to 5,000 cycles, and the better loudspeakers cut off at 80 cycles at the lower end and 7,000 cycles at the upper end, also remembering that the better transformers in use today are capable of even amplification between 60 cycles and 6,000 cycles, the selection of the amplifier tubes and proper operation for maximum efficiency of those tubes should receive more consideration than is generally given to amplifier tubes, particularly the last stage tube from which the loudspeaker is operated.

## SPLITDORF INSURES EMPLOYEES

Splitdorf-Bethlehem Electrical Co. of Newark, N. J., has insured each of its employees for $1,000. Announcement of this group insurance contract was made by Walter Rautenstrauch, president.

# Eliminator Condensers' Functions Are Analyzed

The usual B eliminator comprises a transformer to step up the voltage, a rectifier to convert the alternating current into direct current, a filter circuit to smooth out the remaining irregularities or ripples in the rectified current; and finally, a resistance network which divides up the output into the various voltages required for the radio set. Of these various elements, none is more important than the filter system, which determines the true worth of the B eliminator or radio power unit, as well as its useful span of life.

There are just two elements in the filter system—the choke coils and the condensers. Little can go wrong with the chokes, provided they are properly designed in the first place, and of ample inductance and carrying capacity for the job at hand.

But there is no end of possibilities for trouble with the condensers, if they are not properly selected in the beginning. It is false economy to install cheap, undersized condensers in a B eliminator or radio power unit. Not only is there likely to be excessive hum, due to improper filtering, but the life of such condensers is relatively short, resulting in the early discarding of the entire B eliminator unless it is torn apart and rebuilt. Good filter condensers, more than any other item, determine the cost of the really good B eliminator, which proves cheapest in the long run.

### Basis of Buffer Figuring

In the first place, the filter condensers should have sufficient dielectric to withstand the full voltage of the device over many years of service, and also to withstand the occasional peaks or surges which may run two or three times the maximum output voltage.

It is wise practice, therefore, to employ filter condensers of about twice the output voltage; in other words, for the 200-volt maximum output B eliminator, the filter condensers should be of 400-volt *working* voltage rating, and so on. The condenser nearest the rectifier is subjected to the greatest electrical strain, since the current at this point is not entirely straightened out and therefore has decided peaks in voltage. It therefore follows that the first condenser in any B eliminator should have ample dielectric strength. If condensers of different dielectric strength or voltage rating are employed, then the first filter condenser should rate highest as a measure of protection.

There are three filter condensers in the usual two-section filter system. The first condenser, or that nearest the rectifier, does not have much influence on the hum or smoothing of the output current. It is intended rather to maintain the output at a fairly fixed voltage, despite the fluctuating current drain. It serves for the regulation of the rectifier.

### What Second and Third Do

The second condenser controls the degree of hum, and any increase in the capacity of this condenser, within reasonable limits, reduces the hum in conjunction with the proper choke coils.

The third condenser controls the tone quality at full volume, because it acts as the virtual electrical tank of the B eliminator, by providing an ample reserve of energy to meet the unusual drains, particularly the deep, bass notes, placed on the B supply. This condenser should be as large as possible, say even up to 8 mfd. or more. The usual manufactured B eliminator can be materially improved by placing additional condensers, say 4 to 6 mfd. in capacity, across the minus B and plus maximum B terminals, in building up the last condenser in the filter system for the best tone quality.

In the case of the Raytheon rectifier, the buffer condensers are of real concern. Only too often the B eliminator manufacturer or builder will employ ordinary .1 mfd. condensers of lowest voltage rating for the buffer condensers, not realizing that these little units are subjected to the greatest strain of all, inasmuch as they are across the split secondary of the transformer, receiving ½ the AC output.

The buffer condensers for the Raytheon B should be of 400-volt AC rating. The Raytheon BH should call for 600-volt AC rating condensers, while the Raytheon BA, or A-B-C radio power unit, should call for 1,000-volt AC rating condensers. As these buffer condensers are of very small capacity (0.1 mfd.), the added cost of the higher voltage rating is very slight, and it will prove more than worth while to use the highest possible voltage rating in order to have the added safety.

### Point of Upright Mounting

With ample dielectric strength in the buffer condensers, the radio enthusiast is assured of long life for his B eliminator or radio power unit, without worrying about broken-down buffer condensers and the dangerous shorting of the transformer secondary.

The Dubilier engineering staff has given special attention to the buffer condenser problem, and has worked out a design with the two sections carefully balanced and mounted in a case that provides the necessary shielding for the prevention of external field.

It is good practice to mount condensers in an upright position, although this is not imperative. However, the centilation of condensers is an essential too often overlooked, even by some manufacturers of radio power units. Condensers should not be subjected to the heat from the rectifier tube or the resistors, although it is not uncommon to find filter condensers exposed to a heat of 130 degreesFahrenheit.

Paper condensers, with the impregnating compound necessarily of low melting point, cannot stand up under continuous heat. They should be protected from any heat in the radio power unit by sufficient spacing, by partitions, or by ample ventilation, if safe and long operation is sought.

## CIVIL SERVICE

The United States Civil Service Commission announces the following open competitive examination:

JUNIOR PHYSICIST, $1,860 A YEAR

Applications must be on file with the United States Civil Service Commission, Washington, D. C., not later than September 3. The examination is to fill vacancies in the United States Naval Research Laboratory, Bellevue, D. C., in the Bureau of Standards, and other branches. The entrance salary is indicated above. Higher-salaried positions are filled through promotion. Subjects to be rated: General physics, 30%; mathematics through calculus, 30%; practical questions on each optional subject chosen, 40%. The optional subjects are electricity, heat, mechanics, optics, physical metallurgy, and radio. Senior students will be admitted to the examination but will not be certified for appointment until after their graduation.

Full information may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of United States Civil Service Examiners at the post office or customhouse in any city.

## Trade Body to Run Show in Cleveland

Cleveland.

Cleveland's third annual radio show has been scheduled for November 8 to 13, inclusive, and will be produced under the backing of the newly organized Radio Trade Association of Northern Ohio. The show will be managed by Herbert Buckman, who has been elected as secretary of the association with the show management as his principal duty. Buckman managed the annual Cleveland Automobile Show for the last five years for the Cleveland Automobile Manufacturers' and Dealers' Association.

This year's show will be a new undertaking for the association. Previous radio shows have been held without organization backing, as private enterprises. Members of the Radio Trade Association of Northern Ohio have guaranteed the estimated cost of the show and will share pro rata in its profits. The show is to be held in Cleveland's municipal auditorium. Headquarters for the association have been established at the office of its managing director, 5005 Euclid Avenue, Cleveland. Officers of the association are: President A. H. Baier, Cedar-Lee Radio Co.; vice-president, H. W. Seabury, Lake States General Electric Supply Company; treasurer, Louis N. Talkes, Cleveland Storage Battery Company; and the following directors: Warren R. Cox, Radio Apparatus Company, and William Bowie, Dreher Piano Company.

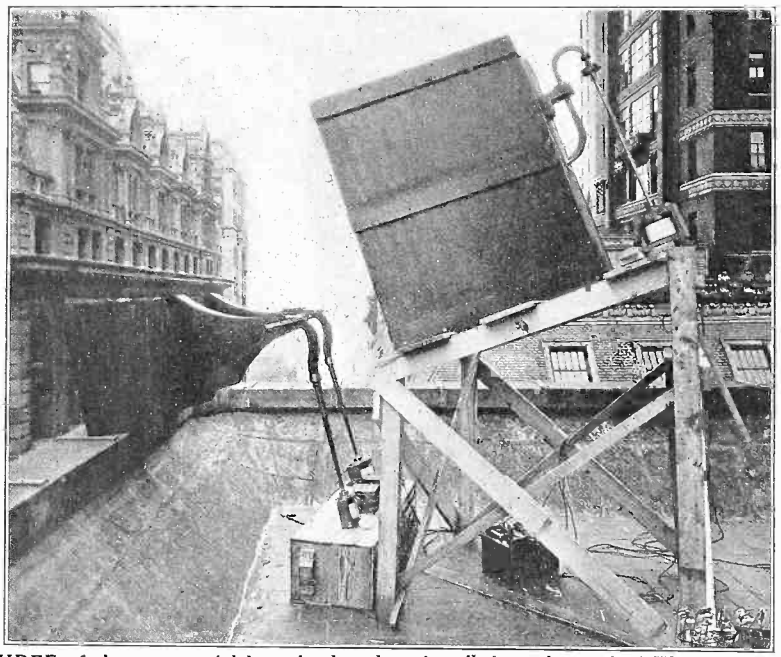
## Tyrman Opens Up With Bang-Up Line

Ernst Tyrman, noted radio expert and designer of high-quality radio apparatus, has designed an entirely new line of precise parts that will assure the users of efficiency, accuracy, simplicity and beauty. These are produced under his supervision in the laboratories of the Tyrman Electric Corporation, Chicago, and are carefully tested before shipment.

First in the line are the new Tyrman vernier drums for one and two control receivers. A beautiful large escutcheon encloses the drums and verniers; the center knurls enable fast tuning of both controls in single movement, while the two verniers on the side provide hairline adjustment. A new accomplishment of Tyrman genius is a fine line of radio frequency transformers, type 8-70, 200 to 560 meters, type 8-71, 160 to 360 meters, type 8-80, long wave type. The new Tyrman audio transformers are a decided achievement in tone and volume. There are three types, one a 3:1 ratio; a power input transformer and a power output transformer. To add the final touch of efficiency there is the line of Tyrman shielded sockets for all types of tubes.

These parts are all of the highest quality, reasonably priced and are designed to fit the terminals of the new Kurz-Kasch Capacity connector which is an extremely utile terminal device which eliminates approximately 80% of wiring and soldering and acts as by-pass condenser. Mr. Tyrman has also designed the Tyrman Ten, a powerful receiver which is said to give wonderful results, using all these parts and allowing a clear 10 kilocycle separation with confining of all necessary fields. It is also reported to have one-spot advantages. Mr. Tyrman is President of the Company and A. Hintze, Jr., vice-preside-nt.—J. H. C.

# Crowd's Roar Dwarfed By Skyscraper Horn



**THREE of the exponential horn loudspeakers installed on the roof of Westinghouse Building on the occasion of the landing of Commander Richard E. Byrd and the other transoceanic flyers.**

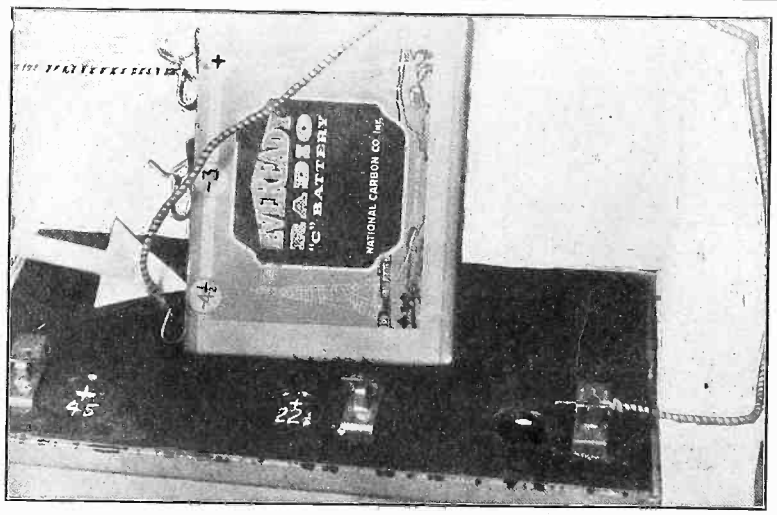
When Commander Richard E. Byrd, his crew and Clarence Chamberlin landed at Pier A in New York from a reception committee boat the crowds along lower Broadway were informed of their movements by a battery of gigantic loudspeakers installed on the roof of Westinghouse Building, 150 Broadway. These speakers were connected to a radio set tuned in on a wave carrying a description of the event. Thus the people in the street who were not able to get close enough to the landing place to see for themselves could follow the event as Graham McNamee saw it.

The loudspeakers were so powerful that the words of the announcer could be distinctly heard over the din in the street three-quarters of a mile away.

The speakers used were of the exponential horn type, a development of Dr. Joseph Slepian and Clinton R. Hanna of the Westinghouse research staff, and were 14 feet long.

"The horn is based on the fact that a horn does not amplify sound, as is popularly supposed," said Mr. Hanna, one of the inventors, "but increases the amount of sound radiation by permitting a greater load to be placed on the vibrating diaphragm at the small end. With this point established, it was shown mathematically by Dr. Slepian and myself that the exponentially shaped horn is the most uniform sound radiator and hence provides a maximum volume of sound without distortion.

"The horn used for the Byrd celebration has an effective length of 14 feet and can reproduce sounds ranging from the lowest notes on the tuba to the highest notes on the piccolo."




**IT IS possible with the aid of a 45-volt B battery and a 4½-volt C battery to obtain the necessary 40½-volt bias for the 171 or 371 power tube when using 180 volts on the plate. The 4½-volt battery, which is a regular C battery, is simply reversed in connection. That is, instead of connecting the plus of the 4½-volt battery to the minus of the 45-volt battery, the minus of the 4½-volt battery is connected to the minus of the 45-volt battery. The plus of the 4½-volt battery is then connected to the regular C connection in the amplifier.**

# Tests Waves Till Exhausted

Reports of the results of the short wave tests conducted by the General Electric Company from May 28 to June 4 are being received from all over the world, indicating the complete success of the tests.

Radio auditors had been asked to observe reception of special transmissions over two twenty-four hour periods, a week apart. The engineers were interested only in reception at great distances, since the short wave signals usually skip the first 400 to 500 miles. Beyond this distance and up to 12,500 miles radio listeners reported what kind of reception they got. Such details as volume, fading, distortion, intelligibility, static, carrier intensity quality and modulation were noted. By careful analysis of the reports now coming in from all over the world the engineers will try to learn what wavelength, what power and what time of day are best for reaching a definite objective.

W. A. Waters, engineer and manager of the Manawatu-Oroua Electric Power Board, of Palmerston North, New Zealand, gave a most exhaustive log and graph showing the comparative strength of the 22 and the 32.77 meter transmissions. The concluding line of his report for June 5 was: "Went to bed, unable to keep awake any longer."

An exhaustive report was also received from G. S. Daughtin of Stratton & Co., Ltd., radio manufacturers of Birmingham, England. Mr. Daughtin reported that one or the other station was audible over the entire twenty-four hours during which the tests were conducted. During daylight hours Mr. Daughtin recorded better reception from 2XAD, while 2XAF operated on 32.77 meters was received best during hours of total darkness. When it was dark at the receiving end and light at the sending end, 2XAD was received best. When it was light at the receiving end and dark at the sending end the 2XAF signals were most reliable.

## FIDELITY MEASUREMENTS WIDE

The standard of fidelity is now measured between frequencies of 4,000 and 10,000 cycles. The input voltage is held constant to give normal output at 4,000 cycles modulation, and with a modulation of 30% for all frequencies.

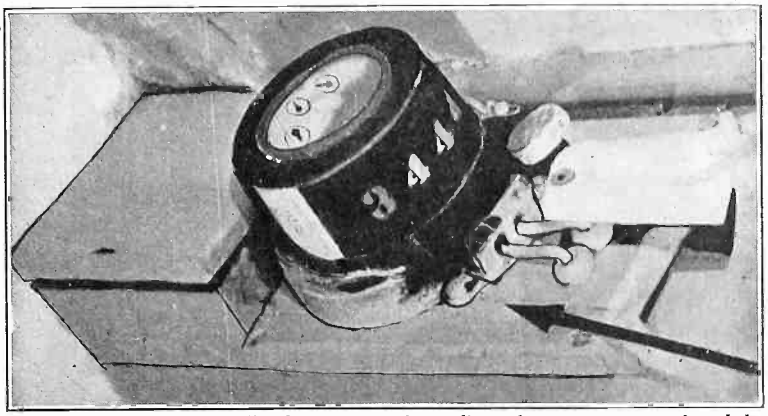
# Static to Save Human Life

Static is to become a benediction to mankind. It is to be put to work to forecast the weather, to save life and property at sea, on land and in the air. A new device which automatically measures the intensity and direction of static will be the means of transforming radio from curse to a blessing.

Lieutenant F. W. Reichelderfer, in charge of the Aerological Section of the Bureau of Aeronautics, United States Navy Department, disclosed the immediate plans for installing half a dozen radio weather indicators, or devices for measuring the intensity and the direction of static atmospheric disturbances. They are to be placed at the following naval air stations: Pensacola, Florida; Coco Solo, Canal Zone; Guantanamo, Cuba; or the Weather Bureau station at San Juan, Porto Rico; Anacostia, D. C.; Lakehurst, N. J.; and Hampton Roads, Va.

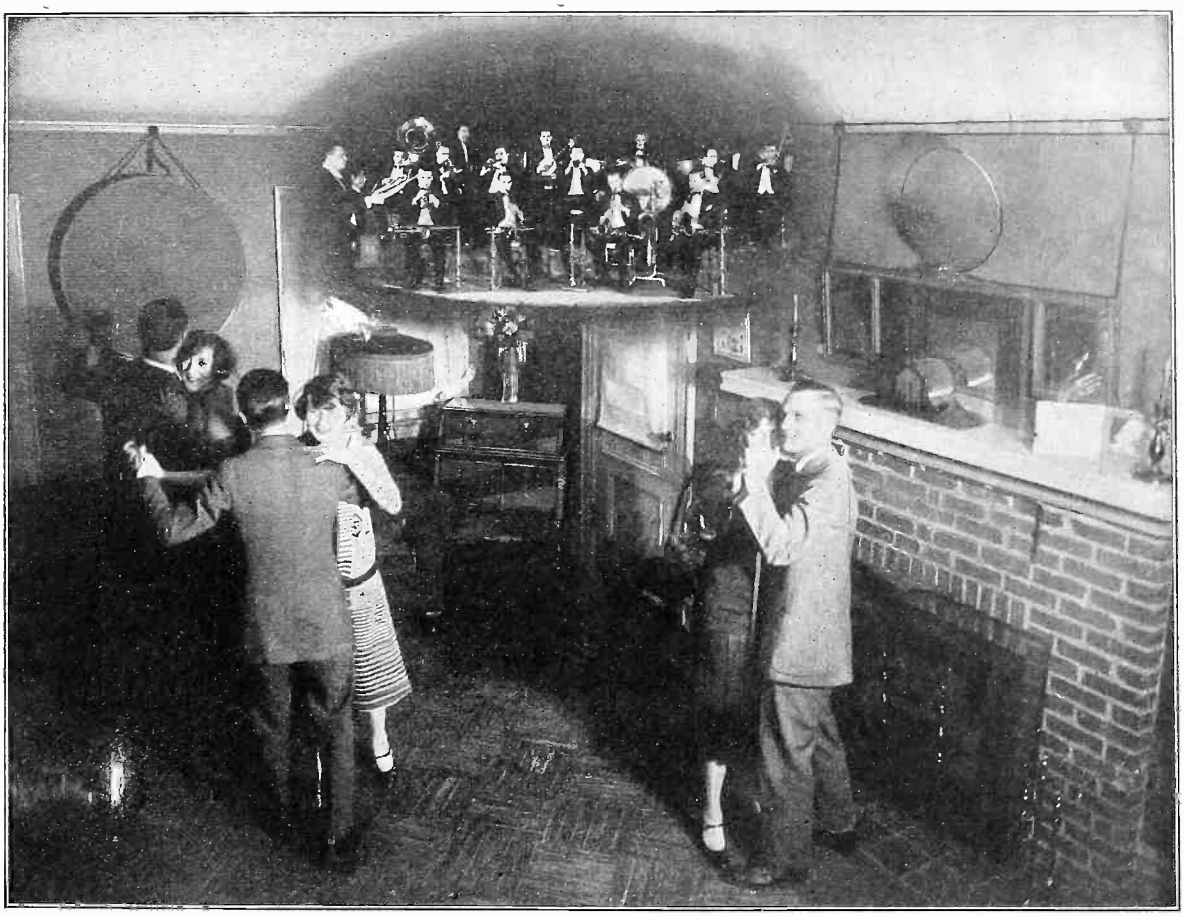
The type of static recorders used extensively in European countries will be installed at these naval air stations. In fact, the device adopted by the Aerological section of the Bureau of Aeronautics is a design of an Englishman and it is being manufactured in France.

The Hydrographic Office of the Navy Department with the cooperation of Bell Telephone Laboratories have also made efforts to transform static from the bane of radio reception to a blessing. H. T. Friis, one of the radio engineers of Bell Laboratories, has developed a static recorder. This instrument and another special design developed by Lieutenant E. H. Kincaid of the Hydrographic Office, will be represented in the static recorder installations on board ships.



**HOUSE WIFE bought a B eliminator and, reading above wattmeter, found her electric bill increased to $6 a month from $3. She used her set 100 hours a month, or 1½c worth of juice. The solution was that she had changed all her house lamps from 25 watts to 50 watts.**

## EXPERT SAYS DISTORTION IMPROVES HIS DANCING



**AN ACOUSTICAL EXPERT, residing in the lower East Side of New York City, recently reported to Radio World's engineering department that he found that distortion in dance music improved his dancing to a great extent. This, he stated, he had checked up with the aid of a cathode ray oscillograph, part of his elaborate laboratory in the cellar of his home. The expert is shown at left rear, beside the Ensco 3-ft. cone, dancing with his lady friend, who is all smiles. The expert is none other than Tim Turkey, whose article entitled "Me For Distortion Forever," is published in this issue.**

# C Battery Eliminator Is a Four-Point "Pot"

*By Buck Zeymar*

One of the most useful devices brought out recently is the multiple slider, wire-wound potentiometer. It can be used for getting almost any desired values of grid bias for different types of tubes and modes of operation of them. How this can be done in one case is illustrated both pictorially and schematically in Fig. 1.

Point (1) is connected to the negative end of the filament or to the negative terminal of the A battery, as indicated. The other points are connected to the various grid return leads according to the value of grid bias required.

The bias is obtained from the voltage drop in the resistance of the potentiometer. Therefore there must be a direct and steady current flowing through the resistance. This current is usually obtained from the sum of the plate currents of the tubes in the receiver, after this current has been filtered and smoothed out. The value of this current is not the same in all sets, hence a generous voltage drop is established in the resistance of the potentiometer, means being provided for varying the voltage drop used for bias.

### Sliders Tap Whole Range

It is here where sliders come in. Any slider can be set so that the voltage drop between it and the filament end of R, at (1), has any value between zero and the full voltage drop in the potentiometer resistance. And it is possible to get as many different grid bias voltages as there are sliders.

The highest grid bias required in ordinary receiving sets is 40.5 volts, which is the correct value of a 171 tube with 180 volts on its plate. Suppose that the sum of the plate currents is 25 milliamperes. This current is sent through the potentiometer as shown. Suppose now that the total resistance in the potentiometer is 2,000 ohms. The voltage drop in it will be 50 volts. But only 40.5 is necessary for the power tube. The slider connected to point (3) is then set so that the voltage drop between (1) and (3), is 40.5 volts. This requires 1,620 ohms between (1) and (3). It may be that another value of grid bias also is required in the set, say 10.5 volts. This can be obtained by setting the slider connected to (2) so that the voltage drop between (1) and (2) is 10.5 volts. The resistance required between these points is 420 ohms. Any other values less than 50 volts can be obtained if desired.

Of course, it is not easy to set the sliders by any known resistance value, nor to regulate the total current flow to govern proper bias.

### May Decide by Ear

The best way of determining the values of the bias is to measure them with a high resistance voltmeter, as the ordinary type of voltmeter will not do. The sliders are set according to the voltmeter reading. However, few experimenters have such voltmeters, so can use instead the characteristic curve of a tube or, what is much the same, a vacuum tube voltmeter. The plate voltage being assumptively known, a bias is introduced in the grid circuit by means of a battery, and the plate current is read. Then when the same plate voltage is applied to the receiver tube, assuming the same tube or same type of tube and the slider is varied until the plate current reading on a milliammeter is the same as it was when the battery biasing test was made.

However, it is possible to make quite satisfactory settings by ear, hence one may build a total C eliminator, consisting only of such a potentiometer, and put it into use simply by making the potentiometer the common connection of A and B sources, so that the plate current flows through it.

### An Economical Hint

The plan works out very well as diagrammed, when B eliminators are used, particularly eliminators of the 180-volts-at-60-mils type, or equivalent high-powered variety. But where B batteries are used, or for any other reason it is desired to drop less than the total voltage occasioned by all the plate current passing through 2,000 ohms (the potentiometer R), then instead of connecting B minus of the eliminator or battery to the point indicated in Fig. 1, this point (4) is left blank, and the potentiometer is made partly a rheostat by that action. The B minus lead from battery or eliminator is connected instead to point (3), and this becomes the most negative, yet only so much so as its setting determines.

Thus the total voltage drop, all of which is at the expense of the B supply anyway, is kept to a minimum.

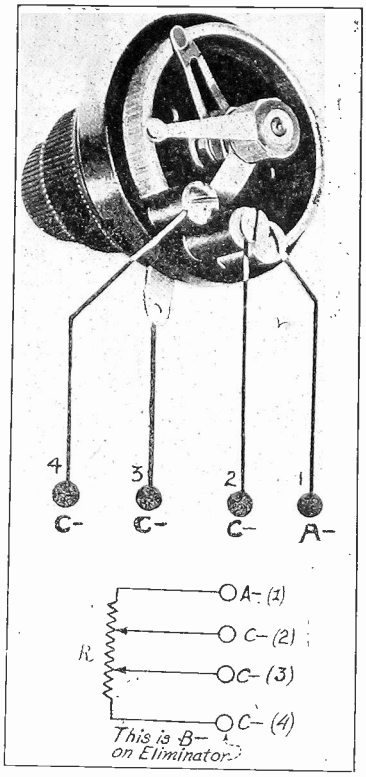
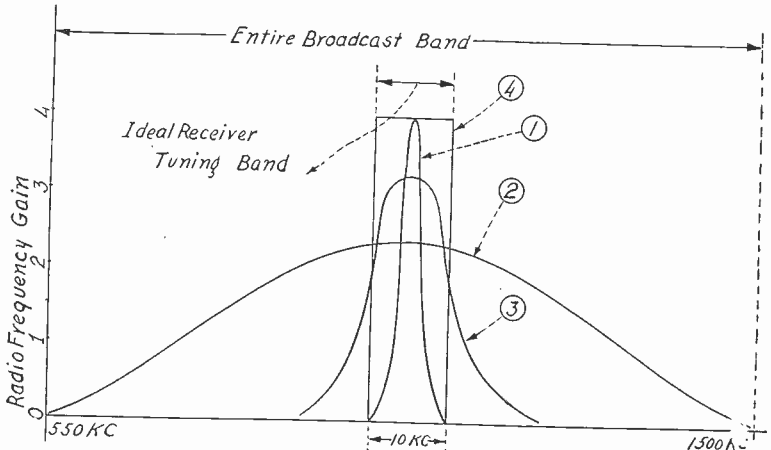



**FIG. 1**

**A photograph of a double slider potentiometer used for obtaining two values of grid bias in a receiving set, and the schematic diagram of the total C battery eliminator.**

# Quality and Selectivity Must Not Be Exceeded




**CHARACTERISTIC CURVES exemplifying the effect of the selectivity of circuits upon quality reproduction. It will be noted that where the selectivity is very good, the quality is quite poor, while with no selectivity, the quality is good. The ideal curve, where both the selectivity and quality are good, is also shown.**

# Radio University

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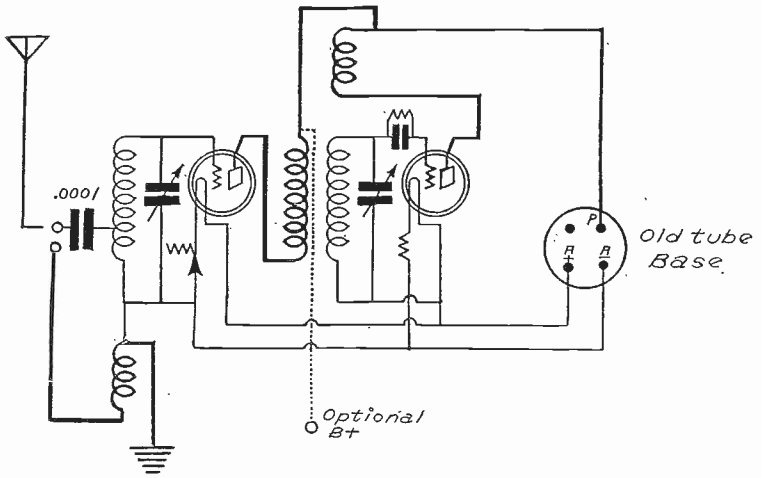


FIG. 555

**A diagram showing how to put a series condenser in the antenna circuit to adapt the receiver to the shorter waves in the broadcast band.**

**MY SUPER-HETERODYNE** is great for volume and selectivity but it will not bring in many stations without a squeal. Is there any way of clearing up the signal and what is the cause of the squeal? —ROBERT L. TAGGART, Jacksonville, Florida.

You will find a discussion of this subject on page 8 of last week's issue (August 6). Remedies are suggested in that article.

* * *

**WHAT IS** the cause of a growling noise in my reflex receiver when I tune in a station? The trouble occurs when both circuits are tuned to resonance.

(2)—Body capacity is very troublesome in my receiver and it is particularly annoying when the set is in the growling condition. What can be done to relieve this situation? —TABOR WILLIAMS, Newark, N. J.

(1)—The growling noise is undoubtedly due to radio frequency oscillation which is not strong enough to produce a high pitched squeal. One remedy for radio frequency oscillation is to put a resistor of about 5000 ohms in the plate circuit of the tube which is oscillating—usually the RF tube preceding the detector.

(2)—By-pass condensers across the audio transformer windings will help in this case because these condensers will lower the RF potential of the rotors of the condensers.

* * *

**MY RECEIVER** works fine on the longer waves but it is not good on shorter waves. How can I improve the sensitivity of the receiver on the short waves?—JOHN SNIVELY, Emporia, Kansas.

One method of making your set more sensitive on the short waves is to insert a series condenser of .0001 mfd. in the antenna circuit as illustrated in Fig. 555. For long waves the regular primary winding is used, but for the shorter waves a few turns of the secondary are used as the primary. A simple switch can be installed to make switching from one connection to the other.

* * *

**I AM** desirous of building a single tube regenerative circuit with which I can get all the local stations on a headset. Will you please publish a diagram and baseboard layout of such a circuit?

ELMER SWANSON, Chicago, Ill.

* * *

**IS IT NECESSARY** to make any changes in the connections of a TRF set to adapt it to the use of the new detector tube, that is, the CX-300 A? My set employs unified control.

CHARLES RITTER, Waupun, Wisc.

The only change you need to make is to connect the grid return from the detector to the negative end of the filament instead of to the positive. See Fig. 557.

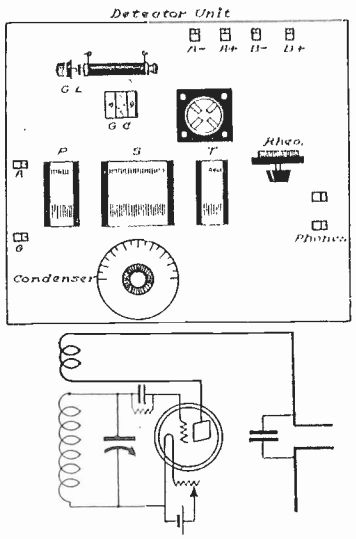


FIG. 556

**The circuit diagram and the baseboard layout of single tube receiver requested by Elmer Swanson**

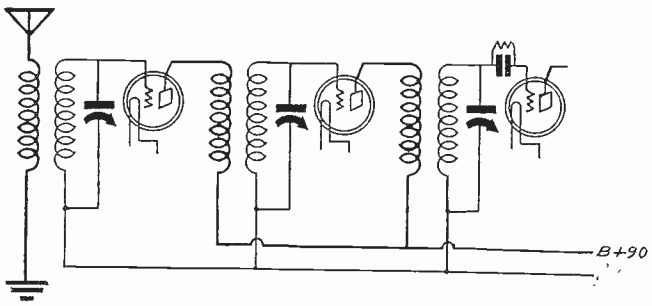


FIG. 557

**The correct connections in receiver employing unified control and a C-300A detector tube.**

SIXTH YEAR

# RADIO WORLD

*The First and Only National Radio Weekly*

Member, Radio Publishers Association

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

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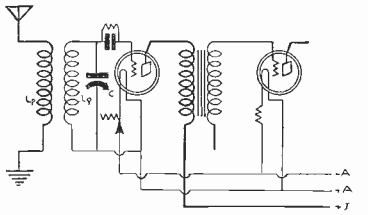
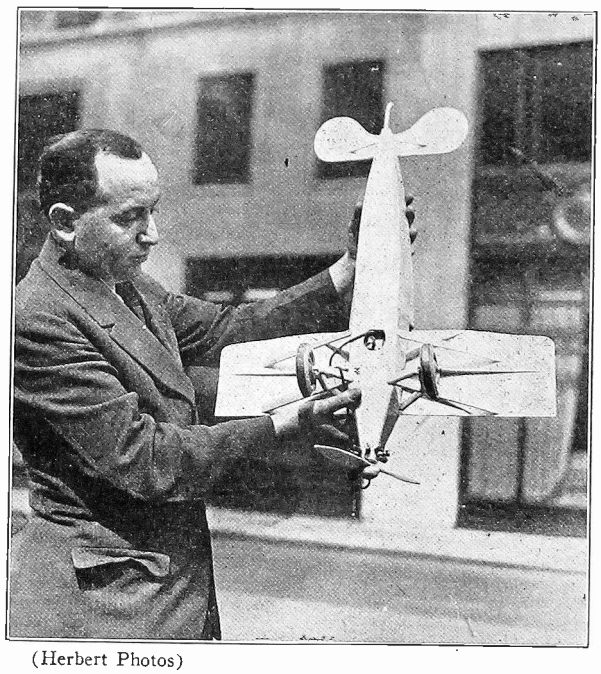
Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.



**CIRCUIT DIAGRAM of a standard non-regenerative detector and one stage of transformer coupled audio frequency amplification, wherein hard (01 A type) tubes are used.**



(Herbert Photos)

**A SPEAKER, modelled after Col. Charles A. Lindbergh's plane, The Spirit of St. Louis, and made of Lata Balsa Wood exclusively. That quaint and commanding figure in metropolitan commerce, known as Blan, the Radio Man, is exhibiting the pride of his ear.**

# Music Tastes Being Tested

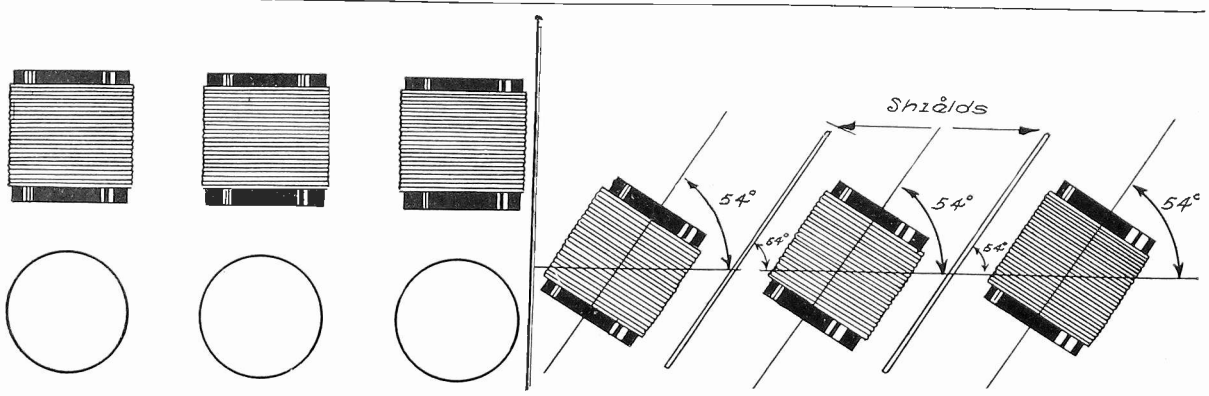
Radio audiences in New York and the East are now being given an opportunity to name their favorite composers, to tell what types of music they prefer, what kind of announcements they like, and to indicate in other ways their tastes in broadcasting, in answer to a questionnaire being distributed in connection with The New York Edison Hour.

The questionnaire is believed to be the only one of its type ever sent to the radio fans. It is based on two years of broadcasting experience during the Edison Hour, which now goes on the air every Tuesday night over WRNY.

Seventy-five thousand of the questionnaires are being distributed. The answers, which will be carefully tabulated, are expected to yield much valuable information concerning the tastes of the radio listeners. They will show, for example, whether Schubert or Sullivan or some other composer leads in popularity, and whether music like H. M. S. Pinafore, by Sir Arthur Sullivan, or the Overture to Tannhauser, by Richard Wagner, is the favorite type of music.

The answers to these and to other questions will be used in preparing the future programs of the Edison Ensemble, directed by Josef Bonime. Quesions relating to broadcasting at other hours, such as household talks and cooking classes, are also included.

A long list of the world's most famous composers is submitted so that everyone will have an opportunity to vote for his favorite. Names like Mozart, Bach, Beethoven, Brahms, Mendelssohn, Kreisler Rachmaninoff, Rubinstein, Sullivan and Verdi are a few of those furnished to voters.




**THE DIAGRAM at left illustrates the wrong way to place coils if you are attempting to construct a non-oscillatory receiver. At the right, the correct method is diagrammed, e.g., the popular Neutrodyne angle method. Shields may be used to aid the killing off of any stray energy which may feed back, and cause oscillation.**

# Daily Weather Reports to Aid Airmen in West

Washington.

Because of the pressing need of an early morning aviation weather forecast for the Pacific Coast, steps are being taken by the Department of the Navy to arrange a daily broadcast that will serve this area, the Office of Naval Operations of the Department announced.

The statement pointed out that shortage of funds prevents immediate establishment of this service, but "at the latest, the broadcast should not be delayed beyond the next session of Congress."

The full text of the statement follows:

"The Navy Department is taking steps to arrange a daily aviation weather broadcast to serve flying activities on the Pacific Coast.

**Will Be Like NAA Signals**

"The broadcast will be similar to that established in April of this year, which is transmitted from the Naval Radio Station at Arlington, Va. The Pacific broadcast probably will be transmitted from San Francisco at an hour just prior to the beginning of regular flying operations.

The need for such a broadcast has been recognized for some time, and efforts to bring about early action have recently been given impetus by communications from the Commander-in-Chief pointing out the inadequacy of the present broadcast.

"The new broadcast would be designed to meet the needs peculiar to the Pacific Coast.

**Wants Early Action**

A number of reports from vessels in the Pacific would be included in order to give information of storms approaching from that ocean and some of the Alaskan and Aleutian Island reports would also be included for the same reason.

Owing to shortage of funds for this specific purpose, it is uncertain as to when complete arrangements can be made, but at the latest, the broadcast should not be delayed beyond the next session of Congress, when that body will be requested to appropriate a sufficient sum to make the broadcast possible."

# *Crystal Control Keeps Stations to Legal Wave*

An oscillating crystal is not to be mistaken for a crystal detector capable of sustaining oscillations in an electric circuit like a tube amplifier. An oscillating crystal is a crystal driven at one of its natural frequencies by a vacuum tube oscillator. It is no different from a loudspeaker driven at one of its natural frequencies.

An oscillating crystal can be used in an electrical circuit to replace both inductance and capacity. The elasticity of the crystal takes the place of the capacity and the mass of the crystal takes the place of the inductance. The advantage of the crystal over an equivalent electrical circuit is that it has a negligible resistance or power loss. It is extremely sharp in tuning as a consequence.

**Kept Close to Frequency**

A broadcasting station which is crystal controlled can be held to its assigned frequency to within a few hundred cycles by virtue of the extreme selectivity of the crystal, whereas a station controlled by an electrical circuit will often wander into the frequency territory assigned to another station.

The Federal Radio Commission announced that one of the New York stations strayed 25.6 kilocycles from its assigned frequency. Had this station been crystal controlled it would have stayed within 500 cycles of the assigned frequency, the maximum deviation allowed by the Commission.

**What Governs Response**

High frequency communication employing frequencies above 10,000 kilocycles has been made possible by crystal control.

The frequency or frequencies to which a crystal responds depends not only on the material of which it is made but also on the dimensions. Hence a crystal which has been ground in the shape of a square cornered block will have three fundamental natural frequencies. It will also have many harmonics of these frequencies.

The usual crystal employed for crystal control is quartz, because this remains most constant during temperature changes and is the most selective.

## Half of Stations Off Waves, Says Bellows

Washington.

The result of the survey of the broadcasting situation by members of the Federal Radio Commission shows, according to Commissioner Henry A. Bellows, that 50 per cent of the stations have failed to comply with the ruling prohibiting them from deviating more than 500 cycles from their assigned frequencies.

Aug. 15 has been set as the deadline for corrections of the mechanical defects responsible for the deviations. Those stations which have not adjusted their frequencies by that time will not get the new sixty-day licenses which will be issued that day.

Stations have come to realize the seriousness of their situation and are trying hard to right matters.

## Commission Threatens Frequency Violators

Washington.

The Radio Commission intends to enforce strictly the order requiring that stations remains within half a kilocycle of the frequency assigned to them.

The commission has not specified any particular method of holding the wave constant. Stations are at liberty to choose any system which is effective. The best method is by means of quartz crystal control. Crystals are now plentiful on the market and they are inexpensive. A station can also employ the method in which a meter is so arranged that it rings a bell as soon as the frequency of the station nears the deadline of 500 cycles either side of the assigned frequency.

## Bullard Will Attend Parley as Delegate

President Coolidge has appointed Rear Admiral William G. Bullard, Chairman of the Federal Radio Commission, as delegate to the International Radio Conference to be held in Washington Oct. 4. Secretary of Commerce Herbert Hoover heads the American delegation.

More than 50 countries will be represented at the conference, at which problems relating to international radio and telegraph communications will be taken up.

## New Station in Brooklyn

WLTH, succeeding station WFRL, operating on 218.8 meters, opened on Aug. 1 in the Leverich Towers Hotel, Brooklyn, N. Y., by permission of the Radio Commission. The station is under the supervision of S. J. Gellard. The chief announcer is J. Leon Sherman. J. A. Birch has charge of operation and management.

The transmitter is located in the Jamaica Bay section of Brooklyn to insure clearness in broadcasting. Besides the main studio in Leverich Towers Hotel there is a branch in Manhattan.

# *Automatic Set Picked By Bertaud for Flight*

Lloyd W. Bertaud and James D. Hill, planning a non-stop flight to Rome in a single motored Fokker monoplane, decided to carry a complete radio installation, according to B. E. Smith of A. D. Cardwell & Co., Brooklyn, constructors of the radio equipment. The operation of the transmitter will be entirely automatic and will be carefully guarded against breakdown. The call letters WRHP will be sent continuously, interspersed by dashes, to enable ship and shore stations to obtain bearings of the plane at all times.

**A CW Set**

The transmitter will be of 100 watts and of the continuous wave type. It will be adjusted for transmission on 600 and 800 meters. The electric generator which will furnish the power is located on one of the wings of the ship, in conformity with recent practice. The generator will have two windings to furnish both high and low voltages for the operation of the tubes without any intermediate apparatus. The total weight of the transmitter will be eighty-two pounds.

The receiver to be installed on the ship will be a two-tube, battery-operated, regenerative set which will cover the wave band between 450 and 900 meters.

**Value to Be Great**

The radio installation should prove of great value to the flyers in case of unfavorable weather, and it will undoubtedly be the means of saving the flyer's lives in case they should be forced down in the ocean.

# Brooklyn Station Sold to Klan Weekly Forum

The Federal Radio Commission has authorized the sale of station WTRC, Brooklyn, to the Independent Publishing Company, Washington, D. C. This company is publishing the Fellowship Forum, a weekly newspaper largely devoted to the furtherance of the principles of the Ku Klux Klan.

Although the Commission gave permission for the transfer of ownership and location of the station it has not yet issued a license to the new owners. It is thought, however, that the approval of the transfer of the station implies that the Commission has decided to issue a license for operation of the station on the old wave of 1,470 kc and the power of 50 watts in Washington, D. C.

The programs to be broadcast by the Fellowship Forum station, according to James S. Vance, publisher of the Forum, will be of a patriotic and fraternal nature.

WTRC shares the wave on share time with fifteen other broadcasters.

## Morrissey in Touch With World by Radio

The George Palmer Putnam expedition to the Arctic is keeping in constant touch with the world by means of radio. The radio operator, Manley, has been in conversation with both European and American stations. At the time of the Dempsey-Sharkey fight the expedition picked up the New York Times broadcast and learned almost as soon as the ringsiders of Dempsey's victory.

## Jewelers Sue WHN

Summons and complaint have been served in a suit brought by Schwartz Brothers, jewelers, against Marcus Loew Brooklyn Agency, Inc., which controls station WHN. An effort will be made to collect $10,000 damages for alleged failure by the defendant to broadcast hourly the time and to mention each time the name of Schwartz Brothers for one year.

The service was discontinued, it is alleged, on the ground that the stipulated price of $1,000 was too low.

## Interesting Fallacies

A loudspeaker can be operated with the output of a —99 type tube without any distortion whatever.

* * *

It is not necessary to use a grid battery because the quality and volume are just as good without it.

* * *

I receive signals from transcontinental stations without any interference of any kind and the signals are perfect.

* * *

Last minute substitute programs are the most popular, especially when the listeners are kept in ignorance of the cause of the substitution.

* * *

Practically all new ideas in radio have been contributed during the last three years.

* * *

Marconi was the first man to transmit electromagnetic waves.

* * *

The best way of controlling volume is by throttling down the filament current of the power tube, because in that tube the volume is the greatest.

* * *

A current of 10,000 volts was sent through the line, or putting it analogously, a current of 10,000 feet flowed through the river.

## Speaker Impedances Are Easy to Compare

In the output of a push-pull stage the currents in the two tubes are in opposite phase. When the loudspeaker is put in the common plate supply lead no signal can be heard unless the two are unbalanced, because only the difference between the outputs of the two tubes is effective in the speaker.

When two speakers are connected at the same time to the output tube of a receiver they should be connected in series. This insures better quality than if the speakers are connected in parallel, particularly if a tube with high output resistance is used. Connecting the speakers in series usually about doubles the impedance of the load, while connecting them in parallel cuts the load impedance in two.

When two speakers are connected in series to a tube the output power is divided between the two in proportion to their impedances. If one speaker has twice the impedance of the other it will take two-thirds of the output.

When two speakers are connected in parallel they share the power inversely as their impedances. That is, if the impedance of S1 is twice that of S2, then S2 takes twice as much of the power as S1.

## Voltage Is the Thing in Interstage Coupling

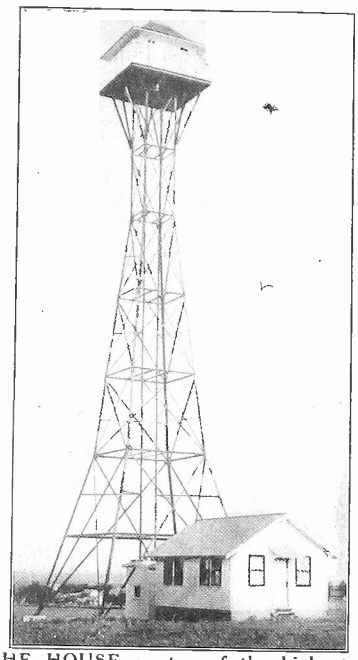
In designing devices for coupling one tube to another in an amplifier we are not in the least interested in transfer of energy or power, but only in voltage. We so design the circuit that the greatest voltage step-up per stage is effected with the least distortion of the waveform and the least difference in amplitude gain from the lowest to the highest essential frequency.

To talk of matching transformers to the tube impedances for greatest step-up in voltage is nonsense. Yet for seven years we have heard it repeated parrot-fashion several thousand times.

## DeMille in Debut Lauds Radio Influence

Los Angeles—Cecil B. de Mille, moving picture director and producer, made his microphone debut recently over KNX. He accredited radio as being one of the greatest forward movements of the day and declared that it had gone a great way in molding the viewpoint of the American nation to better things.

## "LAB" 525 FEET UP



**THE HOUSE on top of the high steel tower is a new radio research laboratory adjunct of the great factory of Steinite Laboratories Co. This unique laboratory is electrically heated and it is perched 525 feet over the Missouri River.**

## Bouck on Resistors Published by Amsco

The importance of reliable resistors in radio reception has stimulated several manufacturers to the publication of booklets on the uses of these important units. The latest of these is "The Amsco Resistor Handbook." (Amsco Products Inc., 416 Broome Street, New York City, 25c.) This booklet covers the characteristics of resistors in general and the Metaloid type in particular.

"The Amsco Resistor Handbook" has been prepared for the manufacturer by Zeh Bouck and contains a wealth of information interesting and instructive to the amateur. An endeavor has been made to tabulate the various data relevant to B and C eliminator design in a form readily applicable to the requirements of the amateur designer. Progressive tables have been prepared which enable the builder of an eliminator to calculate, first the approximate current which his receiver will draw from the line power device, secondly the output voltage under this load, thirdly the ohmage of the various resistors required to drop this maximum voltage to the optimum potentials of the various tubes (RF, detector, etc.) and lastly the wattage dissipation requirements of the chosen resistors.

## Glee Club Heard

Thirty members of the Glee Club of the University of North Carolina broadcast a program of songs from station WEAF featuring five negro spirituals and work songs. The singers were en route to England to visit the birthplace of William Shakespeare at Stratford-on-Avon, to sing the same songs broadcast from WEAF. The trip is sponsored by Ambassadors Alanson B. Houghton (Great Britain) and Myron T. Herrick (France). The proceeds of the concert will go to defray the expenses in replacing the Shakespeare memorial theatre which was ruined by fire more than a year ago.

# THE RADIO TRADE

## R. C. A. Sues Another Over Atwater Kent

The Radio Corporation of America brought suit against E. B. Latham & Co., jobbers, 550 Pearl Street, New York City, to recover damages and profits because of sale of Atwater Kent receivers. The suit is for patent infringement and is on the Alexanderson tuned radio frequency patent No. 1,179,073, which was recently sustained by Judge Thacher in New York against E. J. Edmond & Co., an Atwater Kent distributor.

It is claimed that E. B. Latham & Co. must account to the Radio Corporation for large profits on many thousands of radio receivers, which were not licensed under the Radio Corporation patents. Many important radio manufacturers are licensed under these patents, but no license has been given to the Atwater Kent Company.

## Pacent's Latest Is Neat Phonovox

**THE PACENT PHONOVOX placed on top of a phonograph record. The volume control (left) and the plug for insertion in the detector socket of a radio set, also are shown.**

The Phonovox is the latest addition to the well-known Pacent line of radio essentials. It is an electric pick-up or connecting link between radio and the phonograph. When it is placed on a revolving phonograph record and connected to the radio amplifier, the record will be reproduced on the loudspeaker with all the advantages of modern audio amplification loudspeaker reproduction.

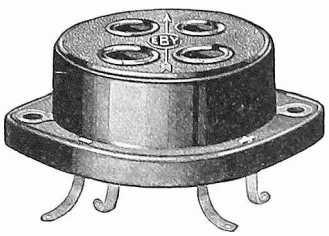
The Phonovox is based on the operation of a balanced loudspeaker armature and partakes of all the sensitivity and distortion-free characteristics of such arrangements. The unit is highly efficient, light in weight and attractive in appearance. For hookup particulars write to Louis G. Pacent, 91 Seventh Avenue, New York City, and mention RADIO WORLD.

## Freshman Sales Expert Makes Trip

Martin Zatulove, supervisor of sales of the Charles Freshman Company, manufacturers of Freshman radio receivers, is making a flying trip through the Southwest and Pacific Coast States.

Mr. Zatulove is acquainting authorized Freshman dealers with the sales promotion plans of the Freshman Company for the coming season.

## Eby Has a New Socket With a Spring Contact



The H. H. Eby Manufacturing Company, Inc., 4710 Stenton Aye., Philadelphia, Pa., prominent binding post and socket manufacturers, are now producing an improved model universal type socket. It has a three-point wiping spring contact, which is the full length of the prong, thus giving a perfect contact. It is moulded in Phenolic material, with a stipple finish. The top of the socket is exactly the same size as the tube base. It may be mounted either above or beneath the subpanel.

## Lynch Distributes Lata Balsa Line

The Balsa Wood Reproducer Corporation announced that Arthur H. Lynch, Inc., 1775 Broadway, New York, will distribute Lata Balsa kits, reproducer units and art model reproducers.

In commenting upon the contract recently signed, Mr. Lynch said: "Lata Balsa reproducers, either made up from the kits or in the very attractive art models which are now being offered in complete reproducers, produce a mellow tone which is very pleasing. When used in combination with a resistance-coupled amplifier, they reproduce music and speech with wonderful fidelity.

"Many manufacturers of cone speakers are beginning to realize the advantages offered by Lata Balsa from the viewpoint of acoustic properties and the advantages of attractive designs which these new reproducers make possible. Our engineering staff will be pleased to consult with any speaker or set manufacturers interested in applying Lata Balsa to their present or future models.

"Our combination with the Balsa Wood Reproducer Corporation and the Balsa Wood Products Company is very attractive and conducive to large sales. All of the sales—domestic, foreign, jobbers and manufacturers—from now on will be made through our New York office, 1775 Broadway."

## White Will Direct At Industries Fete

Major J. Andrew White will act as master of ceremonies at the fourth annual radio industries banquet at the Astor Hotel in New York on September 21st, the week of the New York Radio World's Fair.

More than sixty broadcasters will carry the program from the banquet to listeners throughout the country.

## 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 .....

E. Helecker, 2606 East 22nd St., Oakland, Calif.
Birger Ericson, Box 17, Orebro, Sweden, Europe.
R. F. Burton, U.S.S. New Mexico, Bremerton, Wash.
C. E. Ruppelt, 302 Hutchinson Ave., Canonsburg, Pa.
William Bryant, 425 Inero St., Frankfort, Ky.
J. F. Scanlon, 675 Ingraham Ave., Calumet City, Ill.
James P. Beattie, 9432 Hayes Boulevard, Detroit, Mich.
G. Warren, Goose Lake, Iowa.
Charles R. Smith, 628 East Lehman St., Lebanon, Pa.
John G. Frank, P. O. Box 276, Hudson, Mass.
N. Chiafery, 83 Pansy St., Rochester, N. Y.
R. J. Kirkman, 116 W. 45th St., N. Y. City, N. Y.
Julian Crowley, 326 Elizabeth St., Monroe, Wash.
C. Bloedorn, 1304 Detroit, Denver, Colo.
Spencer Gay, 27 Pleasant St., Waverly, N. Y.
V. S. Black, 427 Myrtly, Monrovia, Calif.
J. E. Witcherm, Box 832, Willows, Calif.
Chester L. Davis, Ph.D., School of Engineering of Milwaukee, 163 East Wells Street, Milwaukee, Wisc.

### NEW CORPORATIONS

Advertisers Broadcasting Company, Newark, N. J. 60 shares, common. (Atty., Theodore Silver, Newark, N. J.)

## New Yaxley Line Ready

The new line of Yaxley approved radio products for the season of 1927-28 is now ready for the trade and the fan. Among the newest features is a highly efficient automatic power control for switching B Eliminator and trickle charger, or either, thus making any receiver a power-operated set. It comes in two types, the No. 444, that keeps the voltage drop less than 2-10th volt, when used with sets having a current draw equivalent to four .25 ampere tubes and up to eleven .06 ampere tubes, and No. 445 multiple type, having no voltage drop, suitable for all set, and especially recommended for multi-tube sets.

Cable connector devices, air-cooled rheostats, including types with filament switch, convenience outlets, midget battery switches, inductance switches, two-stage switches, jack and junior jack switches, jacks, pup jacks, plugs of every description, nameplates, cable markers, a line of pilot lights and grid resistances, filament resistances and resistance units furnished in seventeen sizes from one to 400 ohms, all accurately rated. An illustrated price list covering the entire line will be sent to those interested upon application to the Yaxley Manufacturing Company, 9 South Clinton Street, Chicago, Ill.—J. H. C.

# Wire-Wound Variable Resistors Delight Moss

"The adoption of all variable wire resistances for use in battery eliminators and electrified receivers, is one of the greatest steps toward the general acceptance of eliminators by radio fans," said Arthur Moss, of Electrad, Inc.

"Ever since the advent of battery eliminators there has been a need for variable power resistances which could be inserted into a battery eliminator and make possible for the fan the adjustment of his eliminator to suit the requirements of his receiver. With fixed resistances, the fan was obliged to use the available voltages, whether or not they suited his needs. This ofttimes resulted in the application of excessive voltages to some tubes in the receiver and insufficient voltages to other tubes. Some fans were fortunate and the eliminator just matched the receiver.

With fixed wire resistances in the eliminator available, the set builder was definitely limited with respect to the number of tubes he could use in the contemplated receiver. But with variable resistances in the eliminator, the only limiting factor is the current output of the eliminator, since by adjusting the voltage controlling resistances he can obtain any desired current and voltage output combination within the limits of the eliminator. A like condition is existant with tapped wire resistances. While tapped wire resistances afford a certain freedom of operation, they are not equal to continuously variable units, since the number of taps is definite and additional taps are impossible.

"Hence it will be of utmost advantage for the constructor of a battery eliminator to utilize variable all-wire resistances in place of fixed resistances for reducing the output voltage to the required value. It is not a matter of the present need, although this is great enough, but rather of viewing the future and making provision without an additional cost for what may follow. The fact that a resistance is variable does not detract from its degrees of efficient operation. It can be made to carry any value of current or wattage, and in practical value of resistance."





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RADIO WORLD, 145 West 45th Street, New York City (Phones: Bryant 0558-0559)

# AIR ORCHESTRA FOR FAIR

(Herbert Photos)

**THE WORLD'S first flying orchestra, which will shortly make a jazz tour of the United States. They will stop off at the leading cities, playing at broadcasting stations and special functions. Listeners to WFI, Philadelphia, have already been entertained by this organization, headed by Harry MacDonald. Four planes are used.**

## BIG VOLUME FROM PICKUP

When the electric pick-up used for putting a phonograph record on the radio amplifier and speaker is efficient the volume will be very much greater than when the detector tube feeds the amplifier. An adequate and suitable volume control is essential if the reproduction is going to be satisfactory. This volume control can be associated with the electric pick-up or it may be in the amplifier.



HOW TO BUILD RADIO WORLD'S Four-Tube Universal Receiver fully described by Herman Bernard in the March 12, 19 and 26 issues of RADIO WORLD. Send 45c and get these three numbers. RADIO WORLD, 145 West 45th Street, New York City.







## Hands Off, Navy Policy

The Navy Communication Service has made it knows that it does not approve the request made on it for relaying inbound communications in competition with domestic commercial companies as being against the policy of the United States' Government.

The Navy Communication Service will handle messages addressed to members of the Naval personnel at sea from their families. This is necessary because of the great difficulty met by commercial companies in locating the person addressed.

# Good Back Numbers of RADIO WORLD

**The following illustrated articles have appeared in back issues of RADIO WORLD, 1926-1927:**

## 1926

Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.

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Dec. 25—A New Coupling Device, by J. E. Anderson. Function of Eliminators, by Herman Bernard.

Jan. 1, 1927—The 2 Tube DeLuxe Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.

Jan. 8—Tuning Out Powerful Locals, by J. E Anderson. A Choice Superheterodyne, by Brunsten Brunn. The 2-Tube De Luxe Receiver, by Arthur H. Lynch (Part 2).

Jan. 15—The DeLuxe Receiver, by Arthur H. Lynch (Part 3). The Simplified Meter Test Circuit by Herbert E. Hayden. The Superheterodyne Modulator Analyzed, by J. E. Anderson.

Jan. 22—The Atlantic Radiophone feat. by Lewis Rand. An Insight Into Resistors, by J. B. Anderson. A Circuit for Great Power, by Sidney Stack.

Jan. 29—The Harkness KH-27 Receiver (Part 1), by Kenneth Harkness. Use of Biasing Resistors, by J. E. Anderson.

Feb 5—5-Tube, 1 Dial Set, by Capt. P. V. O'Rourke. The Harkness KH-27 (Part 2), by Kenneth Harkness. What Produces Tone quality, by J. E. Anderson.

Feb. 12—Phone Talk Put On Speaker, by Herbert E. Hayden. All Batteries Eliminated, by Herman Bernard. The Harkness KH-27 Receiver, by Kenneth Harkness (Part 3). Conclusion.

Feb. 19—The 6-Tube Victoreen, by Herman Bernard (Part 1.) The Big Six Receiver, by Wentworth Wood. "B" Eliminator Problem, by Wm. P. Lear. The Phasatrol Circuit, by Capt P. V. O'Rourke. The 3-Tube Victoreen, by Herman Bernard (Part 2). Conclusion.

Feb. 26—The 5-tube Diamond in a Phonograph, by Hood Astrakan. How To Read Curves, by John F. Rider. Proper Tubes for 5-Valve Receiver, by J. E. Anderson.

Mar. 5—Introduction of 4-tube Universal, by Herman Bernard. Discussion on DX, by Capt. P. V. O'Rourke. Sensible Volume Control, by Chas. Gribben.

Mar. 12—Ten Tell-Tale Points, by J. E. Anderson. How To Figure Resistors, by Frank Logan. The 4-tube Universal, by Herman Bernard, (Part .)

Mar. 19—Psycho-Analyzing Circuits by Thomas L. McKay. The Universal, by Herman Bernard (Part 2). How To Use a Wave Trap, by James H. Carroll.

Mar. 26—The Universal, by Herman Bernard, (Part 3). Flow of Current in a Vacuum Tube, by Radcliffe Parker. Broadcasting Hypnotism.

April 2—Facts Every Experimenter Should Know, by J. E. Anderson. A Ship Model Speaker, by Herbert E. Hayden. The 3-tube Compact, by Jasper Henry. The Nine-in-Line Receiver, by Lewis Rand (Part 1.)

April 9—A 5-tube Shielded Set, by Herbert E. Hayden. The Power Compact, by Lewis Winner. The Nine-in-Line Receiver, by Lewis Rand, (Part 2.)

April 16—The Schoolboy's Set, by Wally Frost. The Melo-Heald 11-tube Set, by Herbert E. Hayden. The Nine-in-Line Circuit (Part 3), by Lewis Rand.

April 23—The Melo-Heald Set, by Herbert E Hayden (Part 2). The Nine-in-Line, by Lewis Rand. (Conclusion). How Frequencies Are Cut-off, by J. E. Anderson.

April 30—A 1-tube Portable, by Jasper Jellicoe. A Ship Model Receiver, by Smedley Farnsworth. A Double Three Foot Cone, by W. H. Sinclair.

May 7—The Adams-Griffin 6-tube Set, by Dana Adams-Griffin (Part 1). A 2-tube Portable, by Hood Astrakan. How to Improve Superheterodyne Sets, by John L. Barrett.

May 14—A 3-tube Portable, by Herbert E. Hayden. The Adams-Griffin Receiver, by Dana Adams Griffin. (Conclusion).

May 21—The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. A Low-Pass Filter, by J. E. Anderson.

May 28—The Console Cone, by Thorvald Larsen. The 3-tube Reflex by Edgar B. Francis. The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. (Part 2).

Any copy, 15c. Any 7 copies, $1.00. All these 32 copies for $4.00, or start subscription with any issue. Any 7 of these numbers sent as premium with NEW yearly subscription. No other premiums allowed. RADIO WORLD, 145 West 45th Street, New York City.

# Rickard Says Fight Broadcast Hurts Sale of Cheap Seats

EDITOR RADIO WORLD:

Tex Rickard, the boxing impressario, is still of the opinion that broadcasting of fights hurts the "gate." He maintains that it keeps the prospective purchasers of the cheaper seats away from the ringside. There may be something to that, but anybody who ever had one of the cheaper seats knows that it was not broadcasting which kept him away from the ringside but that it was rows upon rows of higher priced seats that kept him away.

He prefers to listen in because by so doing he can hear what is going on about the ring which he probably could not do were he occupying one of the cheaper seats.

He listens in because he can not afford to pay the price for a seat close enough to the ring to see without a telescope and to hear without an amplifier.

But Mr. Rickard's idea of solving the problem is interesting. He suggests that the listeners-in contribute freely of the coin of the realm for the entertainment which they get, and to pay in proportion to the degree in which they feel themselves entertained. The promoter would assume the role of the waiter who lives by a meagre salary and bounteous tips, or the preacher who lives by what he can get out of the hat that has been passed around.

No doubt if every radio fan who listened in on a fight sent in a dollar in appreciation of the entertainment there would be enough coin to pay expenses, with a little left over for the stockholders. It would not be necessary to sell any tickets but all the ring side seats as far out as the Palisades could be turned into compliments.

This would be a solution of the rising cost of boxing promotion only once. After that one fight the fighters would not be satisfied with a paltry half million for their services, but they would demand five million each. The others rendering service in connection with the fight would make proportionate demands.

J. H. MESH,
Fulton, N. Y.



COMPLETE DETAILS on what ohmage resistances may be used with B eliminators to also obtain C bias, were given by Frank Logan in the March 12 issue of RADIO WORLD. Either send 15c for his issue or begin your subscription with this issue. RADIO WORLD, 145 West 45th St., New York City.



**Be sure to take RADIO WORLD along with you on your vacation, or read it while you are at your summer home so that you will not miss a copy; send $1.50 for three months subscription and RADIO WORLD will be sent to you all summer. RADIO WORLD, 145 W. 45th St., N. Y. C.**

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# THE INQUIRER

**IN THE RECEIVER** described in the July 16 issue of RADIO WORLD by Brunsten Brunn can the taps in the primary of the supply transformer be used for a volume control? What is the best method of volume control? Please give the values of R2, P1, the condensers used in the circuit and the inductance of coil L9.—Lloyd E. Jones, Walla Walla, Washington.

The control placed in the primary of the power transformer can be used to control the volume of the receiver if desired, although this is not recommended. There are better methods of controlling the volume. R2 inserted in the plate circuit of the first radio frequency amplifier is used for this purpose. It throttles the current in the plate circuit of the tube and thus prevents the transfer of energy to the second tube grid. P1 is a high resistance potentiometer by means of which the input voltage to the first audio frequency amplifier is controlled. R2 should have a resistance of about 200,000 ohms and P1 should have a resistance of at least 500,000 ohms. These two controls taken in conjunction with the control in the primary of the power transformer are adequate to control the volume. The values of the condensers in the circuit should be as follows: C1, .00025 mfd.; C2, C4, C6, each to match the coil with which it goes; C3, .0005 mfd.; C5, .005 mfd. or higher; C7, 4 to 10 mfd.; C8, C9, each .1 mfd.; C10, C11, each 4 mfd.; C12, 8 mfd. or higher; C13, 4 mfd. The total inductance of the choke coil L9 should be about 50 henrys and it should have a low resistance both to direct and alternating current, that is, it should be wound with heavy wire on a good sized silicon steel core.

**IN AN ARTICLE** by Robert F. Goodwin and Stuart S. Bruno in the July 16 issue is a description of a compact eliminator. There are three resistors connected to A— which are marked 3,000, 2,000, 150 ohms, the 150-ohm unit being tapped. Will you kindly explain the purpose of these?—George Bizek, Butte, Mont.

The 3,000-ohm resistor regulates the plate voltage to the detector tube, since the voltage drop in it is 45 volts. The 2,000-ohm resistor supplies the grid bias to the power tube, since the voltage drop in this is 40 volts, the required value of a 371 tube. The tapped 150-ohm resistor supplies the bias to the other amplifiers.

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Dec. 25—A New Coupling Device, by J. E. Anderson. Function of Eliminators, by Herman Bernard.

Jan. 1, 1927—The 2 Tube DeLuxe Receiver, by Arthur H. Lynch. The Twin-Choke Amplifier, by Kenneth Harkness.

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May 7—The Adams-Griffin 6-tube Set, by Dana Adams-Griffin (Part 1). A 2-tube Portable, by Hood Astrakan. How to Improve Superheterodyne Sets, by John L. Barrett.

May 14—A 3-tube Portable, by Herbert E. Hayden. The Adams-Griffin Receiver, by Dana Adams Griffin. (Conclusion).

May 21—The Victoreen Portable Receiver, by Capt. P. V. O'Reurke. A Low-Pass Filter, by J. E. Anderson.

May 28—The Console Cone, by Thorvald Larsen. The 3-tube Reflex by Edgar B. Francis. The Victoreen Portable Receiver, by Capt. P. V. O'Rourke. (Part 2).

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# Rickard Says Fight Broadcast Hurts Sale of Cheap Seats

EDITOR RADIO WORLD:

Tex Rickard, the boxing impressario, is still of the opinion that broadcasting of fights hurts the "gate." He maintains that it keeps the prospective purchasers of the cheaper seats away from the ringside. There may be something to that, but anybody who ever had one of the cheaper seats knows that it was not broadcasting which kept him away from the ringside but that it was rows upon rows of higher priced seats that kept him away.

He prefers to listen in because by so doing he can hear what is going on about the ring which he probably could not do were he occupying one of the cheaper seats.

He listens in because he can not afford to pay the price for a seat close enough to the ring to see without a telescope and to hear without an amplifier.

But Mr. Rickard's idea of solving the problem is interesting. He suggests that the listeners-in contribute freely of the coin of the realm for the entertainment which they get, and to pay in proportion to the degree in which they feel themselves entertained. The promoter would assume the role of the waiter who lives by a meagre salary and bounteous tips, or the preacher who lives by what he can get out of the hat that has been passed around.

No doubt if every radio fan who listened in on a fight sent in a dollar in appreciation of the entertainment there would be enough coin to pay expenses, with a little left over for the stockholders. It would not be necessary to sell any tickets but all the ring side seats as far out as the Palisades could be turned into compliments.

This would be a solution of the rising cost of boxing promotion only once. After that one fight the fighters would not be satisfied with a paltry half million for their services, but they would demand five million each. The others rendering service in connection with the fight would make proportionate demands.

J. H. MESH,
Fulton, N. Y.



COMPLETE DETAILS on what ohmage resistances may be used with B eliminators to also obtain C bias, were given by Frank Logan in the March 12 issue of RADIO WORLD. Either send 15c for his issue or begin your subscription with this issue. RADIO WORLD, 145 West 45th St., New York City.



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# THE INQUIRER

**IN THE RECEIVER** described in the July 16 issue of RADIO WORLD by Brunsten Brunn can the taps in the primary of the supply transformer be used for a volume control? What is the best method of volume control? Please give the values of R2, P1, the condensers used in the circuit and the inductance of coil L9.—Lloyd E. Jones, Walla Walla, Washington.

The control placed in the primary of the power transformer can be used to control the volume of the receiver if desired, although this is not recommended. There are better methods of controlling the volume. R2 inserted in the plate circuit of the first radio frequency amplifier is used for this purpose. It throttles the current in the plate circuit of the tube and thus prevents the transfer of energy to the second tube grid. P1 is a high resistance potentiometer by means of which the input voltage to the first audio frequency amplifier is controlled. R2 should have a resistance of about 200,000 ohms and P1 should have a resistance of at least 500,000 ohms. These two controls taken in conjunction with the control in the primary of the power transformer are adequate to control the volume. The values of the condensers in the circuit should be as follows: C1, .00025 mfd.; C2, C4, C6, each to match the coil with which it goes; C3, .0005 mfd.; C5, .005 mfd. or higher; C7, 4 to 10 mfd.; C8, C9, each .1 mfd.; C10, C11, each 4 mfd.; C12, 8 mfd. or higher; C13, 4 mfd. The total inductance of the choke coil L9 should be about 50 henrys and it should have a low resistance both to direct and alternating current, that is, it should be wound with heavy wire on a good sized silicon steel core.

**IN AN ARTICLE** by Robert F. Goodwin and Stuart S. Bruno in the July 16 issue is a description of a compact eliminator. There are three resistors connected to A— which are marked 3,000, 2,000, 150 ohms, the 150-ohm unit being tapped. Will you kindly explain the purpose of these?—George Bizek, Butte, Mont.

The 3,000-ohm resistor regulates the plate voltage to the detector tube, since the voltage drop in it is 45 volts. The 2,000-ohm resistor supplies the grid bias to the power tube, since the voltage drop in this is 40 volts, the required value of a 371 tube. The tapped 150-ohm resistor supplies the bias to the other amplifiers.