NEW SYSTEM OF TUNING

See Page 5

JULY 20th, 1929 15 Cents

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382d Consecutive Issue—EIGHTH YEAR

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HOW TO GET DX ON SHORT WAVES

Firmness of hand is necessary to tune in distant short-wave stations. In the illustration the elbows are resting on the chairarms. **See page 8.**

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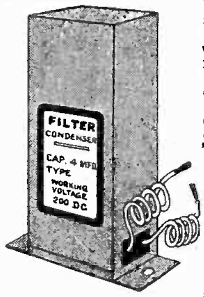

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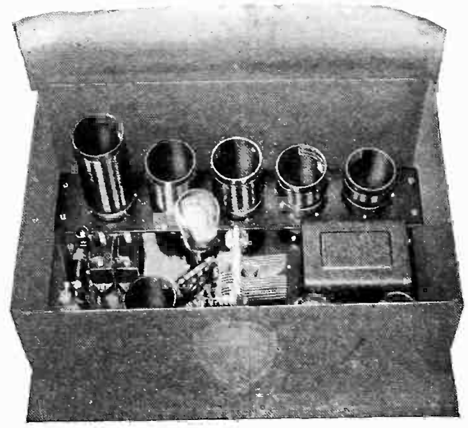

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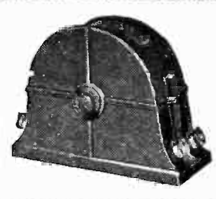

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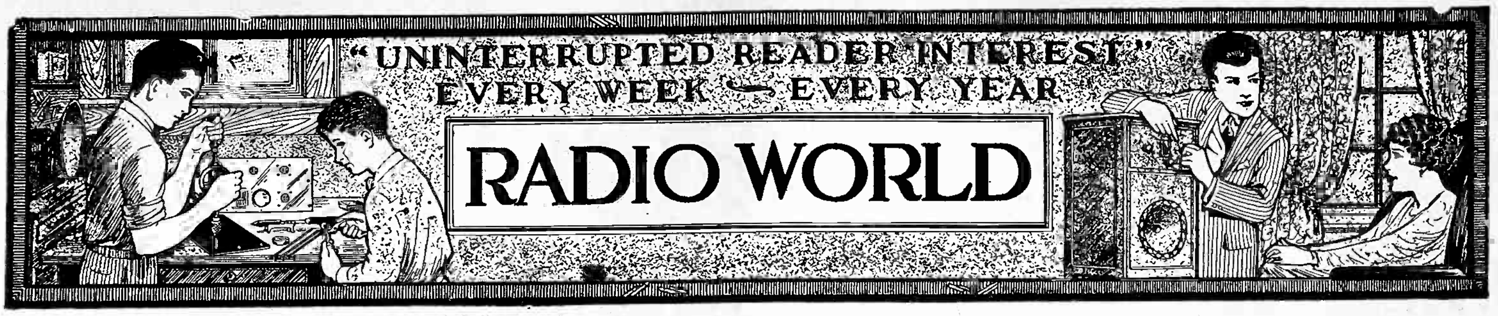

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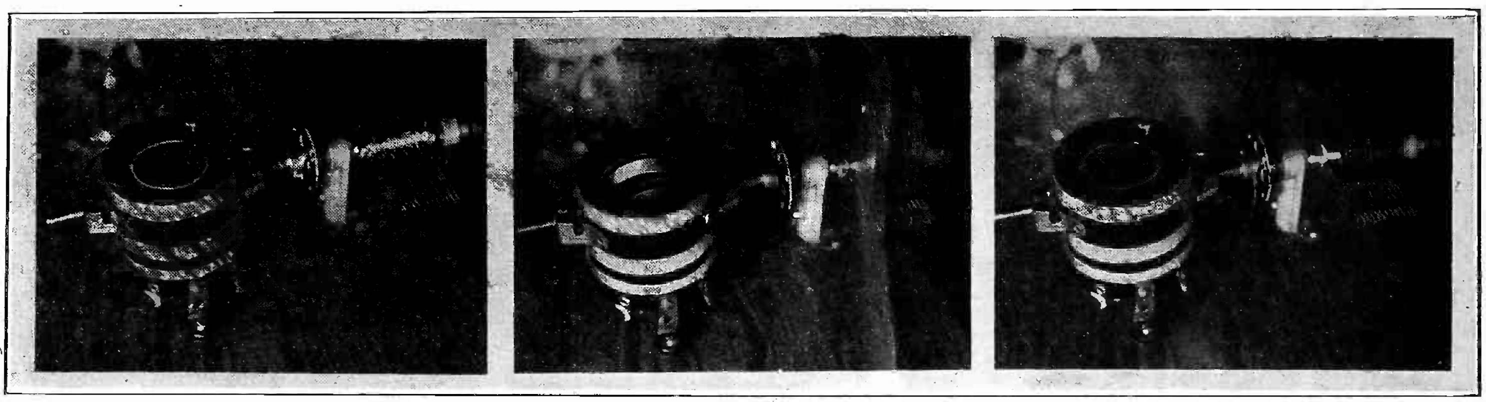
THE BERNARD TUNER

Frequency Range of Receiver Extended

By Herman Bernard
Managing Editor



A B C

FIG. 1.
FIRST PUBLISHED ILLUSTRATIONS OF A NEW SYSTEM OF TUNING, WHEREBY THE FREQUENCY RANGE IS CONSIDERABLY EXTENDED, WITHOUT RESORT TO PLUG-IN COILS OR EXTRA CAPACITIES, AND SELF-STABILIZATION AT RADIO FREQUENCIES RESULTS. THE TUNING EFFECT OF A ROTATING COIL IS COMBINED WITH THAT OF THE VARIABLE CONDENSER, SO THAT EVEN ON A RECEIVER THAT TUNES IN THE WHOLE BROADCAST BAND, SHORTER WAVES ARE RECEIVABLE.

A NEW method of increasing the frequency range of a tuning system, and providing several other advantages, consists of joining a rotary coil to a variable condenser shaft, and having this coil a part of the tuned circuit across which the condenser is connected. Thus the rotation of the condenser in the process of tuning automatically changes the position of the rotary coil, since one motion controls both. In the illustration a flexible coupler is shown joining the shafts of the rotary coil and of the condenser.

In Fig. 1A the condenser is illustrated with plates entirely in mesh, and with the rotary coil physically parallel with the other winding of which it is an electrical part. The rotary coil is electrically in series with the fixed spit winding, and must be so placed that when the forms are physically horizontal, as shown, the fields of the two parts of what are electrically one coil will aid each other. That means the windings must be in the same direction and the rotor connections must join the inside ends of the twin stationary winding in the same direction. In this position, therefore, the two fields must not buck. The test will be explained later in this article.

How the rotary coil turns with the condenser is illustrated pointedly in Fig. 1B, where the condenser is at an angle of 75 degrees, the coil being at the same angle, although a photographic illusion seems to make the coil appear retarded a trifle. In fact they both turn equally together, and as the condenser has end-stops, limitating its rotation to 180 degrees, the coil is automatically limited in the same fashion. This limitation without having any end stops of its own applies only to the illustrated example, for of course systems can be worked in which the coil rotation is at a different pace than the condenser rotation.

Wide Range of Choice

In Fig. 1C the rotating coil again is shown physically parallel with the twin fixed winding to which it is connected, but of course electrically the two coils are reversed, that is, they buck. This effect of aiding fields at maximum capacity with consequent increased inductance, but with zero effect of the rotating coil at the 90 degree angle, and bucking effect from more than 90 to 180 degrees, gives the coil system a tuning effect all by itself, in variometer fashion, but the connection of the tuning capacity across the entire coil system gives the advantage of two-in-one tuning. How effective this doubling method shall be is merely a matter of coil design and depends on the relative inductances and the tuning capacity. If the rotor coil is small its contribution will be small, whereas if it is large its effect will be large, the only provision being that the fixed winding always should be of greater inductance than the moving coil.

The effect of this system, where the rotor has about one-fourth the inductance of the other under conditions as described, is to extend the tuning range of a broadcast receiver to about 150 meters. The maximum receivable wavelength is 550 meters under these conditions. If it is desired to tune to higher wavelengths than 550 meters, at the expense of not going below 200 meters, that can be arranged simply by increasing the fixed coil's inductance.

200 Meters at 25 on Dial

Using the experimental outfit shown in Fig. 1, 200 meters came in at 25 on the dial, instead of the previous reading of 5, and below 25 it was possible to pick up television broadcasts, amateurs and some other transmitters operating between 200 and 150 meters. It must be remembered that the rotor coil was small physically and inductively, and no special attempt was made in this instance to extend the frequency or wavelength range very much. But other coils were constructed that made it possible to tune from 136 meters to 550 meters, from 1 to 99 on the dial, therefore the much-enlarged tuning range of frequencies was not at the expense of adding any capacities or changing the identities of coils. The system was completely self-sufficient.

Tried out on the short-wave band, the same system worked very

LEVEL AMPLIFICATION

Rising TRF Characteristic Automatically Cured

(*Continued from preceding page*)

well, enabling one to double the frequency range without any trouble, therefore a wide band of frequencies could be tuned in without adding or subtracting the use of any capacity or resorting to plug-in coils.

While the models shown are not production models at all, nor more than a slight resemblance to them, they attested to the usefulness of this new system of tuning, which I have reduced to practice after long experimentation. The construction shows the rotor coil at the upper end of the wider tubing. There are two equal windings plainly observable, and these are connected with the rotor coil as the link. Hence no external lugs give access to the rotor coil, but to the beginning and end of the twin winding. The two other lugs terminate the windings of the primary, used for coupling.

Great for Tuned Primaries

A particularly valuable use of this type of coil is for receivers using screen grid tubes in which the plate is tuned. The greatest radio frequency amplification is obtainable from the screen grid tube, either the battery type 222 or the AC type 224, when the plate is tuned. But one drawback sometimes present is that the high preliminary capacity developed by reason of the great potential difference between the tuned primary and the pickup coil that goes to the succeeding grid, and by the self-capacity to the two coils, defeats coverage of the entire broadcast band of frequencies.

Therefore, while the antenna circuit tuning is orthodox, the tuned plate circuit or circuits, using the same inductance, will not tune in the lower wavelengths, or, if the inductance is reduced to reach the lower wavelengths, then the higher ones will be missed. This is due to the large starting-capacity, contributed by the plate circuit itself and the distributed capacity of the pickup coil added to that of the tuned circuit's own distributed capacity.

Hence a maximum capacity of .0001 mfd. is not unusual. The condenser may have .00005 mfd. at minimum setting, and the total of .00015 mfd. is the general minimum, with .00065 total maximum with a rated .0005 mfd. condenser. This is a ratio of a little better than 4-to-1, which is not nearly a large enough ratio of maximum-to-minimum capacity to permit covering the broadcast wavelength band with any fixed inductance.

Fine Results and No Squeals

As for other advantages of the new system of tuning, it lends itself to gang control by uniting separate tuning elements in a row, with self-trimming features; it tends to level out the amplification at radio frequencies, which amplification otherwise has a rising characteristic, being higher at the higher frequencies; and contributes stability, because of the positive resistance of the bucking coil. Level radio frequency amplification and stability arise principally from the same cause: the reduced effective transformation ratio at highest frequencies, and increased ratio at lowest frequencies.

Three stages of screen grid RF and a screen grid power detector were worked, single control, with this system of tuning, without shielding, and no squealing resulted. Distant stations rolled in as sweetly and smoothly as any one ever could desire, and fine balance was struck among the tuned circuits, for exact resonance prevailed without the use of any external trimmers, since a slight permanent shift of the position of the rotor coils would give a setting that provided adequate trimming to equalize the circuits to resonance throughout the frequency spectrum.

Circuits embodying this system of tuning have been worked out, from four tubes up to many tubes, for battery operation and for AC. Their publication is expected to begin in an issue of RADIO WORLD late in August or early in September.

Meanwhile any who desire to try out this system for their own personal experimental use only, and not for commercial purposes, may do so from the following data: Tuning condenser, .0005 mfd., any type, i. e., straight wave line, straight frequency line, straight capacity line, modified line or midline. Stator coil form 2½" diameter 3" high or more. Rotor form, 1¾". Use No. 24 wire, insulated. Wind 20 turns for each of the twin upper sections illustrated, and wind 24 turns or more on the rotor form. For the primary, use 30 turns for screen grid plate circuits, 14 turns for the plate circuits of other tubes. Separation is ¼" between primary and adjoining winding. The rotor winding is connected at random between the inside terminals of the 20-turn twin windings. The position if "aiding" is determined for the rotor coil be noting that it is the one that requires less capacity of the tuning condenser to be attuned to any given frequency. Put a red mark on top of rotor form for identification of the "aiding" position. At the upper end of a dial, using midline tuning, this difference is about 5 degrees. At the lower end it is 20 degrees or more. The bracket shown at rear of the coils is not essential, but project the rotor coil's shaft through the rear, letting it "float," if you like, if gang tuning is desired for cascaded circuits.

The above directions do not apply in full if a tuned primary in the plate circuit is to be used. If it is, then wind 50 turns or more for the pickup coil, or, if you can fit another fixed form inside the other, put on all the No. 24 wire that you can, no less than 50 turns on 2", however. By using a shorter fixed insert coil than the fixed outer form, contact between the rotor form and the other inside form will be avoided.

Application to Universal

These data are given in dimensions most readily at hand for experimenters, although the production model coils probably will be 1⅞" outside diameter.

Those who possess receivers using the Universal circuit and who have trouble covering the whole wave band can adopt the new method. The large self-capacity of the plate circuit must be duplicated by a fixed trimmer across the first tuned circuit, which consists of antenna coil and a condenser.

[*Further details concerning the Bernard system of tuning will be published in* RADIO WORLD *next week, issue of July 27th.—Editor.*]

How to Choose Condensers

By James H. Carroll

Contributing Editor

Some tuning condensers that have been used in previous receivers are likely to cause failure of a new circuit. The plates may have been buckled or bent in tearing down the new receiver, the shaft forced and loosened, the pigtail connection broken or excessive heat applied in unsoldering.

The bearings may have been badly worn, although the condenser itself may appear to be in perfect condition. Many types of bearings will be found in condensers and almost any style will give good service if rightly designed and properly manufactured. It is always best to use a standard make, advertised and guaranteed by a well-known manufacturer.

The best types of condensers have some means provided for regulating the bearings to compensate for wear. Some have shafts of steel with a protective coating to provide against rust. Others have a yoke which supports the two bearings and can be adjusted by means of a screw with a hollow point which forms the end bearing. Care should be taken in adjustment of this type, so that the bearing is made just tight enough to prevent the rotor from slipping. If the bearing is made too tight undue wear is caused and frequent adjustment becomes necessary.

Other condensers will be found with a small leather brake band, with the tension adjusted by means of an adjusting screw. Any good modern condenser, made by a standard maker, will be found to have a well made bearing, accurately fitted together, however, and should give good service during a long life.

In selecting a condenser, one possessing soft material in the bearings should be rejected. In a condenser rigidity and rugged construction are requisite. Extraordinary pressure should not cause the rotor and stator plates to touch or the plates to buckle.

Most condenser troubles are due to loose bearings, unadjusted bearings or lack of mechanical rigidity, resulting in touching plates or poor contacts obtained in the circuit. Dirt often gets into the variable condensers, forming a gummy film between the plates, and this film can be cleaned out with an ordinary pipe cleaner.

TUBE PARABOLISM

Why Grid Bias is Critical or Otherwise

By J. E. Anderson

Technical Editor

IN dealing with vacuum tubes mathematically it is customary to assume that the characteristic curve is parabolic. This means that if the voltage be measured from the point at which the current is zero the plate current is proportional to the square of the voltage. This holds true whether the curve is a relationship between the plate current and plate voltage or between the grid voltage and the plate current.

In Fig. 1, the curve labeled I=kE2 is a parabola with the origin at the point of zero voltage. It will be noted that this curve is strikingly similar to a curve expressing the relationship between the grid voltage and the plate current, so that the assumption that this relationship is parabolic is not much in error.

Close though the recemblance may be, there are certain applications of the tube where the parabolic shape cannot be assumed. Yet it is done, and many properties of the tube are deduced from it. When the tube is used as a grid bias detector the assumption is made and it leads to the result that the detected voltage is proportional to the square of the impressed radio-frequency voltage.

How Detector Works

It is a well known experimental fact that detecting efficiency of a tube depends on the grid bias. For very high bias values the efficiency is now—zero in fact. As the bias is decreased the efficiency increases up to a maximum point. Then it decreases again to nearly zero, and finally goes through another rise and fall. If the curve were a parabola the detecting efficiency would be independent of the grid bias.

It can be shown mathematically that the detecting efficiency of the tube at any grid bias value, no matter what the shape of the curve, is proportional to the second derivative of the plate current with respect to the grid voltage. The second derivative means simply the slope of the slope of the curve. The first derivative is the slope of the curve.

The slope of the parabola shown in Fig. 1 is the straight line labeled I=2kE. The fact that this curve is a straight line shows that the slope of the parabola is proportional to the voltage, measured from the point indicated in the figure.

Slope is Straight

The slope of any straight line is a constant, and that of the straight line I1=2kE is given by the line I2=2k. This has the same value for all values of the grid voltage. Since 2k is the slope of the slope of the curve representing the relationship between the grid voltage and the plate current, it is also proportional to the detecting efficiency of the tube in question. As 2k is independent of the grid voltage, it is clear that the detecting efficiency does not depend on the grid voltage.

If the curve is a parabola there would not be any need of adjusting the grid bias for maximum detecting efficiency, for any value between zero bias and the bias at which the plate current is zero would give the same result as any other. This is contrary to experiment, and therefore the assumption that the curve is a parabola is not valid. Yet the assumption is made nearly always in dealing with detection and modulation.

It is true that over a very limited region the actual curve fits a parabola quite closely. If the range of operation is limited to this region the results obtained from the analysis based on the assumption of parabolic shape will fit the facts as closely as the curve fits the assumption.

Most dynamic vacuum tube curves contain a point of inflection in the operating range. At this point the curve changes its upward curvature to a downward, and for a very short distance it remains straight. If the tube be operated as a detector at this point, no detection results. However, if the tube be operated at that point as an amplifier, the amplification is the greatest and the distortion is the least. A parabola has no point of inflection, for it always curves in the same direction. Hence if the characteristic is a parabola, the tube cannot be operated as an amplifier without introducing distortion.

Push-Pull Amplification

It is well known that a push-pull amplifier eliminates the even harmonics. Or it would be more nearly correct to say that the even harmonics generated in the two tubes are balanced out by the amplifier. If the characteristic curve is strictly parabolic and the two tubes well matched, this elimination is complete. Suppose that the equation of the characteristic referred to the point where the plate current in zero is I=kE2. The curve of each tube in push-pull is the same. Let the grid voltage on one tube be increased by *e* and the voltage on the other decreased by the same amount. Let the changes in the plate currents of the two tubes be *i*. Then the current in one becomes I+*i*=k(E+*e*)2 and that in the other I—*i*=k(E—*e*)2. Expanding the two expressions and subtracting the second from the first we obtain 2*i*=4kE*e*. That is the sum of the two plate current changes is equal to 4kE*e*.

In this expression E is not the usual grid bias on the tubes, but is the voltage measured from the point where the plate current just disappears. If Eo is the bias necessary just to reduce the plate current to zero and Eg the grid bias at the operating point, E=Eo—Eg. Hence the expression for the change in the plate current produced in the push-pull amplifier by a change of *e* volts on each grid is 2*i*=4k(Eo—Eg)*e*. This shows that to increase the output current the bias Eg should be made small, assuming that the value of *e* is so small that the operation remains within the parabolic portion of the curve.

There is a relation among amplification factor of the tube, the plate voltage applied and the value of Eo. If u is the amplifi-

(*Continued on next page*)

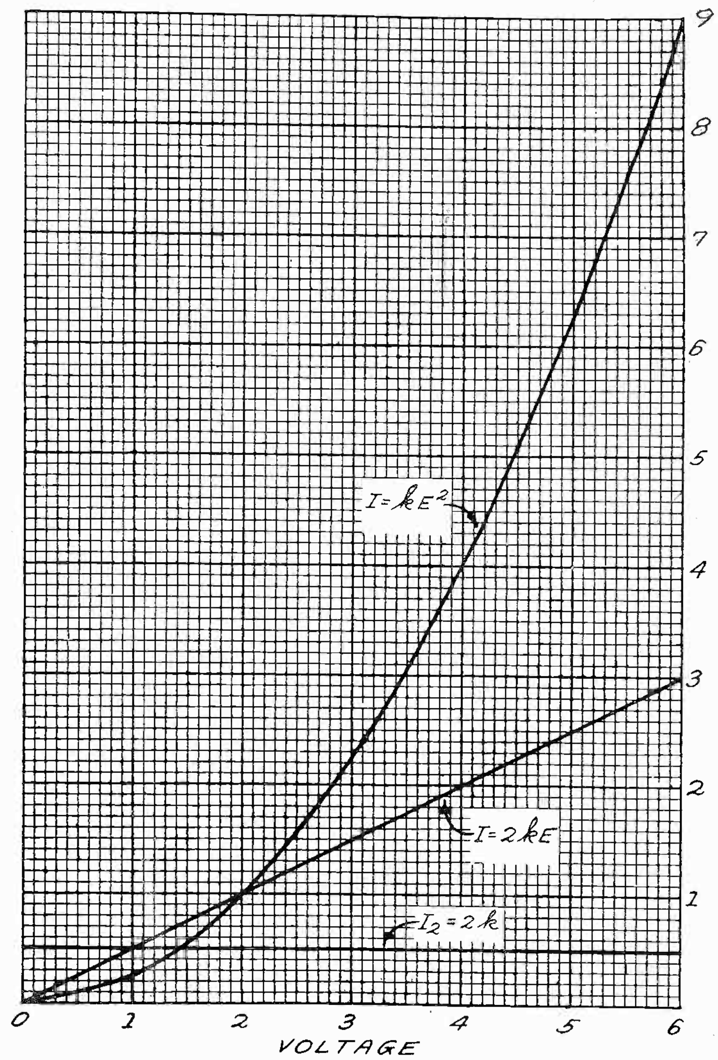


FIG. 1

A GRID VOLTAGE, PLATE CURRENT CURVE IS SIMILAR TO A PARABOLA AND IN MANY INVESTIGATIONS A PARABOLIC SHAPE IS ASSUMED. THE CURVES SHOW A PARABOLA, ITS SLOPE CURVE AND THE CURVE OF THE SLOPE OF THE SLOPE.

TUNING SHORTLY

Steady Hand Required, so Arm Rest is Essential

By Roger Wadsworth

TUNING in of distant short-wave stations is a fine art which can be acquired by practice. Adjustments necessary for greatest sensitivity are almost micrometric, and to make them requires skill and a steady nerve. There is one way that a distant short-wave set can not be tuned it with success, and that is the way a local broadcast station is tuned in.

It is true that the same principles are involved in tuning in both instances. A condenser is turned until the desired station comes in with greatest volume. It is also true that the tuning condenser is turned with the same type of dial, and usually the dial contains a fine adjustor, ordinarily miscalled a vernier. But the similarity ends there.

About as much difference exists between tuning in local broadcast stations and distant short-wave stations as between shooting at a point a mile away with a rifle and blasting away at a barn door with a shot gun. In one instance it is very difficult to hit the object; in the other it is almost impossible to miss it. The difference lies in the accuracy with which the tuning, or the sighting, must be done to hit the mark. In one instance a steady hand and nerve are required, in the other no steadiness at all is required. Just as it is difficult to avoid hitting the barn door so it is difficult to avoid getting the local station.

It takes practice to hit the small mark a mile away with a rifle. It takes almost as much practice to get the distant short-wave station every time it is tuned for. Many who have tried short-wave receivers without much luck did not learn to tune before they reported failure.

Micrometric Adjustment

The first requisite for tuning in distant short-wave stations with a sensitive and selective receiver is a dial with a fine adjustment feature, a dial with which it is possible to turn the condenser by the minutest amounts without the slightest backlash. If the condenser can not be turned by extremely small amounts with steadiness, the condenser is likely to jump past the mark where the desired station is. If there is any backlash between the turning knob and the condenser there is practically no hope of effecting fine and accurate tuning.

The next requirement is a steady hand. It is practically impossible to tune accurately if the hand is not resting on some firm support while turning the dial. If the table on which the receiver stands extends some distance in front of the dial knob, there is no better support for it than the table top. But many receivers stand on a table that is just large enough for the set, leaving no room either at the front or back.

In such cases a convenient and steady rest can be obtained by pulling up a chair and putting the elbows on the arm rests of the chair, as in the illustration. This affords sufficient rest to make micrometric tuning possible. If no chair with arm rests is available, the arms may be rested on the knees. The National Thrill Box is shown in the accompanying illustration and on the front cover.

When these two requirements have been met, namely, a micrometric adjustment feature without backlash and a steady hand, the set may be tuned with the assurance that distant stations will be brought in if external conditions are propitious. To bring in a station advance the regeneration control until there is a feeble oscillation. Then turn the condenser until a squeal is heard. Reduce the regeneration until this squeal stops, all the time keeping the condenser in tune. If the signal comes from a short-wave broadcast station it will be heard after the oscillation has stopped. and the signal will be loudest at a point just below where the oscillation stops, assuming that the condenser is kept accurately in tune.

It should be pointed out that a short-wave receiver like the National Thrill Box can be made to oscillate without radiating, because the first grid circuit is not tuned and the receiver as a whole is shielded. Hence there are no objections to tuning in this set by the squeal method.

The accuracy with which the condenser must be kept in tune in order to bring in distant short-wave stations can be realized when it is known that turning by less than one-tenth of a division on the dial will change the signal strength from maximum to zero. The signal comes in with full volume at one point and at another point, separated from the first by the width of a hair, there is no signal audible at all. This shows clearly the importance of absence of backlash, the need of a fine adjustment feature, and of a steady hand.

Code Reception

When code signals are desired the regeneration control must be kept far enough advanced to make the detector tube oscillate all the time, for only when there is oscillation can most of these stations be heard. The tuning for maximum signal strength, or rather for greatest readability of the signals, is much simpler in this instance. The condenser is turned until the beat note is the clearest. Since turning the condenser changes the pitch of the note, and the readability depends on the pitch, it is only necessary to turn the condenser until the note has the desired pitch. The intensity of the beat note is greater the lower the frequency, because when it is low the circuit is most closely in tune with the carrier. However, as the note is decreased in frequency the ear loses its sensitivity at a greater rate. Hence clearest signals will be obtained when the circuit is at about 1,000 cycles off tune.

[*The construction of the National Thrill Box was described in the June 29th and July 6th issues. In the July 13th issue a report was given on how foreign stations sound on the Thrill Box.*—EDITOR.]

High Mu or Screen Grid Best Detector

(*Continued from preceding page*)

cation factor and Eb the applied plate voltage, the relation is uEo=Eb. Putting this into the formula for the plate current change we get $2i=4k(Eb/u-Eg)e$. Hence in order to get a high value for i for a given voltage input, the plate battery voltage should be high. These conclusions are not new; they are merely obtained from a new point of view.

When a single tube is operated as an amplifier over the parabolic portion of the curve we have $I+i=k(E+e)2$, in which i is the change in the plate current produced by the voltage change e. Expanding this expression we have $I+i=k(E2+2Ee+e2)$. It is evident that $I=kE2$, because that gives the steady plate current before the voltage e was introduced. Therefore $i=k(2Ee+e2)$, which is the total change in the plate current due to the voltage e.

This change in the plate current is composed of two parts, $2KEe$ and $ke2$. The first of these is the true amplification, because it is proportional to the first power of the input voltage e. This part may also be written $2k(Eb/u-Eg)e$. The second part is distortion current when the tube is operated as an amplifier, and it becomes the detection component when the tube is used for detection. It is the square of the signal voltage, and therefore it is always in the same direction as the square does not change sign when the quantity itself changes sign. It contains a steady component and a component which fluctuates with a frequency twice that of e. That is, it contains the second harmonic. If the curve of the amplifier tube is a true parabola, this is the only undesired harmonic present.

It will be observed that the distortion term is independent of the bias and that it depends only on the input voltage and on the constant k. The conclusion that the detection or distortion terms is independent of the bias was previously reached by a different method. The fact that the detected voltage is proportional to the square is brought out by the present formula.

As the detected component depends on k, and k is related to the steepness of the parabola, it is clear that the detected component depends on the rapidity with which the parabola rises. The more rapidly it rises the higher is the curve $I2=2k$ in Fig. 1, and the greater is the detecting efficiency. The same conclusion was reached before by considering the slope of the slope of the characteristic curve.

In order to get a high detecting efficiency it is clear that a high mu tube should be used for detection, for its characteristic rises rapidly as the voltage on the grid increases. The best tube of all for this purpose is the new AC screen grid tube, which has an amplification constant of 420. This will be used increasingly as a detector in the future. Its characteristic curve also can be made to approach a parabola very closely by adjusting the different voltages in relation to the load impedance of the tube.

POWER AMPLIFIERS

(This series was begun in the June 1 issue and has continued each week. Herewith is Part VII. Next week Part VIII will be published.—Editor)

Fig. 45 shows the performance of an AC screen grid tube under the conditions stated on the graph. The curve bends upward continually to within .25 volt of zero bias. Thus when the tube is used as an amplifier under these conditions all harmonics will be produced. If two of such tubes be used in push-pull, the output will be symmetrical about the operating point, and therefore only the odd order harmonics will appear. The output current is the difference between the currents in the two tubes at any given unbalance of the grid voltages. Or in terms of the output voltage, the output is the voltage difference between the two plates. To illustrate the nature of the symmetrical output of a push-pull amplifier, the curve in Fig. 46 has been prepared from the curve in Fig. 45. The bias on the two screen grid tubes was one volt, so that this is the point of symmetry. The symmetrical curve itself is referred to the operating point, and therefore the point of symmetry coincides with the origin. The amount of unbalance is given as plus or minus. The difference between the plate currents is in either one direction or the other, depending on the direction of the grid voltage unbalance.

It will be observed that the curve is practically straight over the voltage range shown, that is, one volt in either direction. There is a slight bending downward for the higher values of voltage unbalance, but the curve is perfectly symmetrical about the origin, which shows that there can be no even harmonics in the output. The fact that the curve is very nearly straight shows that there will also be very little odd harmonic distortion.

While the curve in Fig. 46 was obtained on the assumption that the two tubes had high resistance loads in the plate circuits, the curves obtained when the load is inductive are similar.

Let us investigate a little more closely how the push-pull amplifier works and how the straight line in Fig. 46 was obtained. Fig. 47 shows a simple push-pull circuit in which the input voltage is divided equally between the two grids by two equal resistors Ro. The tubes have a common bias Eg, which determines the operating point, and a common plate voltage Eb. Each tube has a plate resistance R1. The output is taken from the terminals indicated "output."

The voltage for any state of unbalance in the grid circuit can be measured across the output terminals with a vacuum tube voltmeter, or else it can be obtained by measuring the plate currents in both tubes, multiplying them by R1 and taking the difference. It will be necessary to consider the direction of the difference. If the difference is taken as positive when the current in the upper tube is greater, it is negative when the current in the lower tube is the greater.

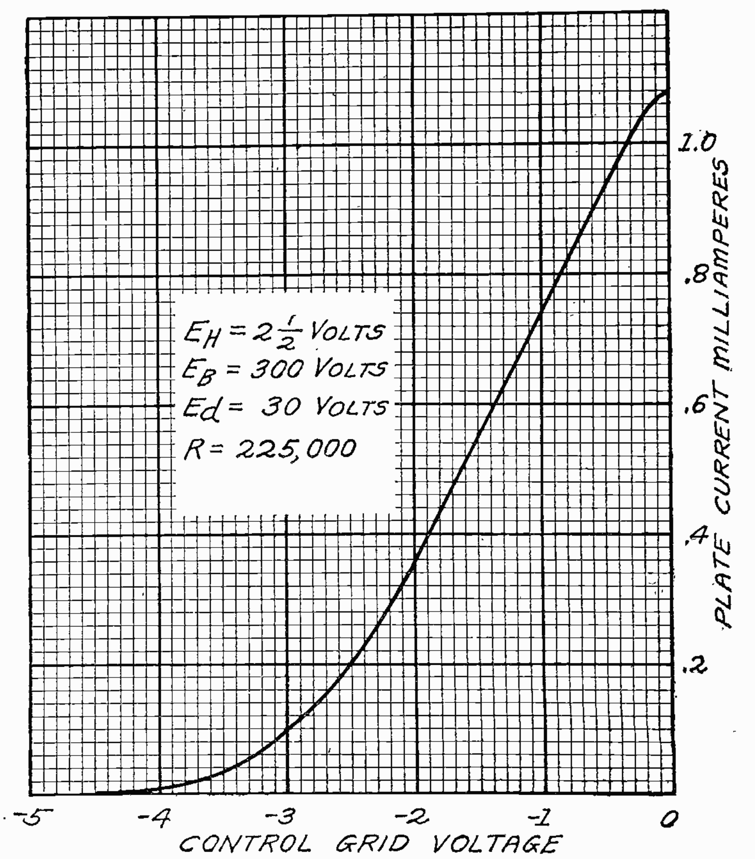


FIG. 45

AN EXPERIMENTAL RESPONSE CURVE FOR A SCREEN GRID TUBE, SHOWING THE RELATIONSHIP BETWEEN THE GRID VOLTAGE AND PLATE CURRENT. THE UPWARD CURVATURE INDICATES THAT ALL HARMONICS WILL BE GENERATED.

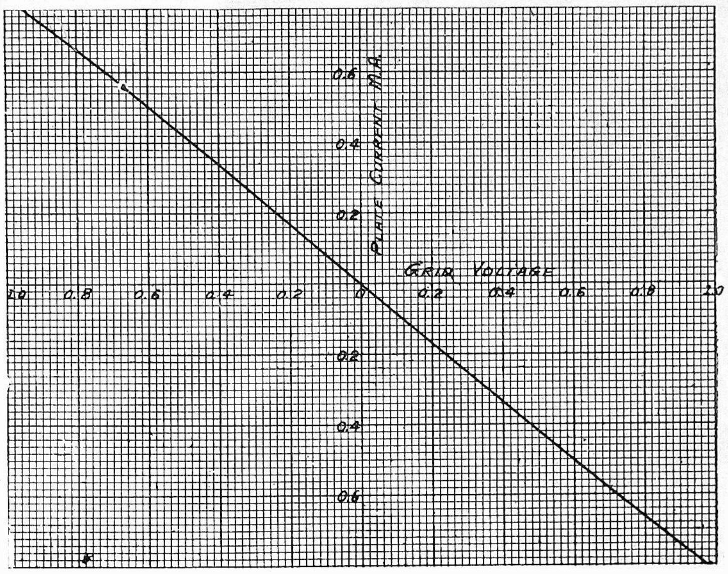


FIG. 46

THE RESPONSE CURVE OF TWO SCREEN GRID TUBES OPERATED AS THAT IN FIG. 45 BUT IN PUSH-PULL CONNECTION. THE CURVE IS SYMMETRICAL ABOUT THE OPERATING POINT. EVEN HARMONICS ARE ABSENT AND THE ODDS HIGHER THAN THE FIRST ARE VERY WEAK.

Suppose a voltage is impressed across the two input terminals, say by means of the secondary of a transformer. A current will flow through the two resistances Ro, say in the direction indicated by the arrow. There will be a voltage drop in each of the two equal resistors Ro, because the same current flows through both. However, the effects of these drops on the two grids will not be the same. The lower grid will be made less negative by the drop ioRo and the upper grid will be made more negative, because the current io flows in opposite directions with respect to the common filament.

The operating point of the two tubes is determined by Eg when no current flows in the two grid resistances. But when current flows the operating point of the upper tube will be shifted toward the negative by the amount ioRo, and that of the lower tube will be shifted toward the positive by the same amount. When current io flows the voltage on the grid of the upper tube will be (Eg+ioRo) and that on the grid of the lower tube will be (Eg—ioRo). That is, the current io causes an unbalance equal to 2ioRo. This unbalance varies both in magnitude and direction as io varies in magnitude and direction.

What happens in the plate circuit? Since the bias on the lower tube is decreased the plate current in that tube is increased, and since the bias in the upper tube is increased the plate current in that tube is decreased. This is indicated by drawing the arrows il toward the plate in one instance and away from it in the other. The currents il represent changes in the plate current rather than the total currents.

When current io is zero the voltage is the same on both grids and therefore the plate currents are the same. The drop in the two R1 resistances is the same, so that there is no voltage difference across the output terminals. This means that the steady voltage is eliminated from the output terminals, and the steady voltage is what is called the zeroth harmonic, which is even.

As io produces an unbalance in the grid voltages, the plate currents are correspondingly unbalanced. The changes occur as indicated by the arrows in the plate circuit. Now there is a voltage drop Rlil in each of the plate resistors, and since the drops are in the same direction, they produce a voltage difference across the output terminals equal to 2Rlil. It can be shown mathematically that 2Rlil contains all the odd harmonics and none of the even.

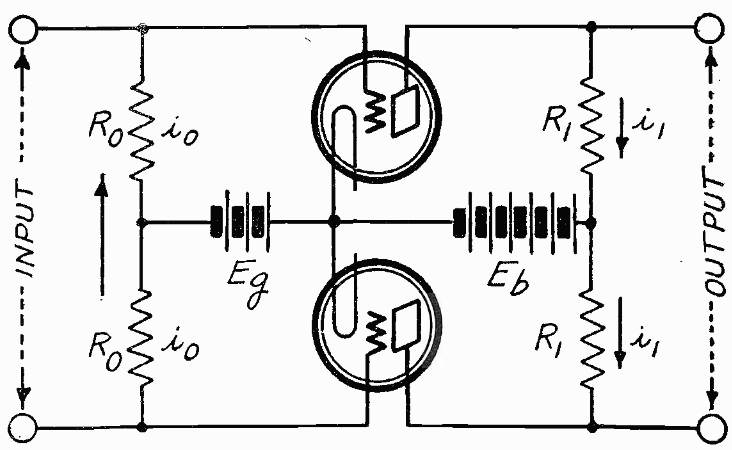


FIG. 47

A RESISTANCE COUPLED CIRCUIT FOR ILLUSTRATING PUSH-PULL ACTION.

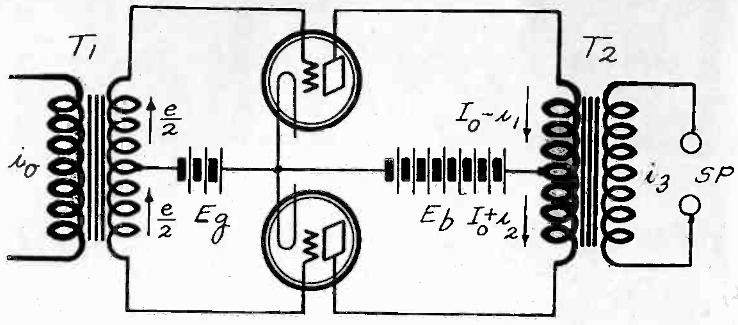


FIG. 48

A STAGE OF TRANSFORMER COUPLED PUSH-PULL AMPLIFICATION OF THE USUAL TYPE, SHOWING THE DIVISION OF THE INPUT VOLTAGE AND THE FLOW OF DIFFERENTIAL PLATE CURRENTS.

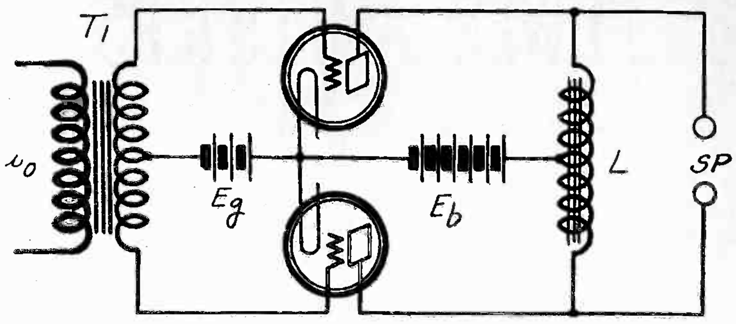


FIG. 49

A STAGE OF PUSH-PULL AMPLIFICATION IN WHICH THE OUTPUT TRANSFORMER HAS BEEN REPLACED BY A CENTER-TAPPED CHOKE COIL L. TRUE PUSH-PULL ACTION IS OBTAINED.

All the even harmonics balance out just as the steady voltage did. This assumes that the two sides of the circuit are equal and that the grid voltage unbalance is symmetrical.

It should be stated here that if the coupler connected across the output terminals is grounded at the mid-point, the push-pull action will not be realized fully. The primary of a push-pull input transformer or even a loudspeaker may be connected across the terminals without upsetting the push-pull action.

If Rl, Rl are the two sides of the primary of a push-pull coupling transformer full value of the push-pull action is realized. This is true even if the secondary of that transformer is center-tapped and the tap grounded or connected to some grid bias voltage. The two resistors Ro, Ro may be replaced by the secondary of a push-pull input transformer and the same push-pull action takes place. It is assumed, of course, that the voltages induced in the two sides of the transformer are equal in magnitude.

In Fig. 48 is shown a typical push-pull amplifier employing push-pull input and output transformers. The current io in the primary of T1 induces a voltage e in the secondary. This voltage is divided equally between the two tubes in the push-pull amplifier. The voltage on the grid of one tube at any instant becomes Eg+e/2 and that on the other Eg—e/2. The current in one tube becomes Io—i1 and that in the other Io+i2. The two change currents, i1 and i2, which are equal in magnitude, combine in inducing a voltage in the secondary of transformer T2, resulting in a current i3. The current i3 flows through the loudspeaker and gives rise to the sound.

The arrows beside i1 and i2 give the direction of the changes in the currents, the one pointing toward the battery being negative. The total current in either tube flows toward the plate. The steady current components Io produce no effect on the output transformer T2, not even a saturation effect on the core. Likewise the even harmonics produce no effect on the transformer, for at any given instant they flow in the same direction with respect to the tubes, either toward or away from, but in opposite direction through the primary with resepect to the mid-tap. Thus even harmonics from one tube nullify the effect of the even harmonics from the other tube all the time.

All the higher odd harmonics act toward the transformer as the fundamental. Hence current i3 contains all of them. However, even the third harmonic is so small as to be negligible unless the tubes are very much overworked.

In place of using an output transformer in a push-pull amplifier a center-tapped choke coil, Fig. 49, L is sometimes used, with the loudspeaker connected across the terminals of the choke, that is, from plate to plate. True push-pull action is obtained in this instance, as has been stated already, provided that the mid-point of the speaker is not grounded, or any other point for that matter. This provision may seem superfluous for it is not often that the speaker is grounded, especially at some mid-point. However, there are speakers which have a mid-point available which sometimes is grounded, and it is recommended often that one side of the speaker be grounded. When the speaker has a mid-tap available the speaker should be connected in the position of L.

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 at bottom may be used, or a post card or letter will do instead.

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145 West 45th St., N. Y. City.
I desire to receive radio literature.

Name ....

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Dr. Geo. B. Thompson, 2400 West Pico St., Los Angeles, Calif.
F. L. Harness, Blackwell, Okla.
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Chas. W. Anderson, Box 2, Grantsville, Utah.
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Andrene Radio Studio, 1495 W. Grand Blvd., Detroit, Mich.
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A. F. Abel, 1110 Euclid Ave., Cleveland, Ohio.
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A. Fladhammer, Wilton, Minn.
G. W. Stephenson, Box 863, Tampa, Fla.
L. E. Groce, 17 So. Plum St., Richmond, Va.
Radio College of Calif., 921 W. 6th, Los Angeles, Calif.
W. B. Minson, Box No. 1, Mulberry, Kans.
Percy B Childs, Box 224, Lowell, Wash.
John Marshall, 1535 Newman Ave., Lakewood, Ohio.
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COLORED TELEVISION

Bell Telephone Laboratories Give Demonstration

By Neal Fitzalan

Television Editor

COLORED television is the latest achievement in the art of seeing at a distance. It was announced and demonstrated by the Bell Telephone Laboratories. Just a year ago the same company announced and demonstrated television out of doors, which was a notable contribution to the art. Television in natural colors is an even greater achievement.

The reproduced picture is about the size of a postage stamp, but it is clear and in natural colors. Such objects as the Stars and Stripes, the Union Jack, a geranium in bloom, a pretty girl in bright colors, a sliced watermelon, an orange, and many other colored objects were reproduced not only in form and motion but in natural colors. So clear and distinct was the little picture that there could be no mistake in the interpretation of even the finer details.

System Like Black and White

The system producing colored television pictures is not unlike that producing black and white pictures. The same size scanning disk is used, the same electrical transmission system, the same synchronizing apparatus, the same receiving mechanism.

The new system differs from the old in that instead of one transmission system three systems are used, one for each of the primary colors, red, yellow and blue. The colors are separately picked up and the corresponding part pictures transmitted over separate channels. At the receiving end three pictures are formed and later combined into one by a system of mirrors.

The new system owes its success to the development of a new sodium type photo-electric cell uniformly sensitive over the visible spectrum. Former cells have been sensitive to certain colors. Much of the work on the new cell has been done by A. R. Olpin and G. R. Stilwell, under the direction of Dr. Herbert E. Ives, in charge of light studies at the Bell Laboratories.

Statement by Dr. Ives

Dr. Ives said that three sets of photo-electric cells of the sodium type are used in the colored television. A set of filters is used to separate the different colors. Before one cell is a filter of an orange-red color, which transmits to the photo-electric cell the red light from the object. Before a second cell is a yellow-green filter which admits to the cell light of this color. Before the third cell is a greenish-blue filter which admits this light to this cell.

In discussing the new development Dr. Ives said:

"The outstanding contributions that have made colored television possible are a new photo electric cell, new gas cells for reproducing the image and the instruments associated directly with them. To render the correct tone of colored objects it was necessary to obtain photo electric cells which, like the modern orthochromatic or panchromatic plate, would be sensitive throughout the visible spectrum. This requirement has been satisfactorily met. Through the work of Messrs. Olpin and Stilwell a new kind of photo electric cell has been developed which uses sodium in place of potassium. Its active surface is sensitized by a complicated process using sulphur vapor and oxygen instead of by a glow discharge of hydrogen, as with the former type of cell.

"The response of the new cell to color, instead of stopping in the blue-green region, continues all the way to the deep red."

How Receiver Works

"The receiving apparatus consists of one of the sixteen-inch television disks used in our earlier experimental work. Behind it are the three special lamps and a lens system which focuses the light into a small aperture in front of the disk. The observer, looking into the aperture, receives, through each hole of the disk as it passes by, light from the three lamps—each controlled by its appropriate signal from the sending end. When the intensities of the three images are properly adjusted he therefore sees an image in its true colors, and with the general appearance of a small colored motion picture.

"Color television constitutes a definite further step in the solution of the many problems presented in the electrical communication of images. It is, however, obviously more expensive as well as more difficult than the earlier monochromatic form, involving extra communication channels as well as additional apparatus."

The great obstacle in the way of applying colored television to radio is that it requires so much space in the ether—three radio channels 20,000 cycles wide.

Right or Wrong?

(Answers on page 16)

1.—The frequency of oscillation in a resistance coupled amplifier, that is, the frequency of the motorboating, is determined by the distributed capacity and inductance of the leads in the amplifier.

2.—The greatest undistorted output from a power tube which is coupled by means of an output transformer to the loudspeaker is obtained when the impedance of the primary of the transformer is equal to the internal impedance of the tube.

3.—The inductance of two coils on the same core is equal to the sum of the two inductances.

4.—The frequency of an oscillator is determined entirely by the inductance and capacity in the tuned circuit.

5.—The dynamic characteristics of a resistance coupled amplifier are the same as the static characteristics at low frequencies.

6.—The DC plate resistance of a vacuum tube is approximately equal to twice the value of the AC resistance. Hence the AC resistance at any grid and plate voltage may be estimated by measuring DC values.

7.—The amplification obtainable from a screen grid tube is limited only by the plate resistance that can be used.

8.—When the grid of a vacuum tube is left free, the potential of the grid is zero.

9.—If pure tones of 900, 1,000 and 1,100 cycles are impressed on a telephone at the same time, the three tones are heard separately.

10.—The amplification constant of a screen grid tube does not depend on the screen grid voltage.

BARRY GIVES ADVICE ON RADIO SPEAKING

Oakland, Calif.

John D. Barry, noted lecturer and author, who discusses "What's Happening in the World," every Sunday afternoon over KGO, the General Electric station, was one of the first public speakers to go on the air, six years ago. He says that at first he found the experience somewhat trying. Though he had already been a public speaker for a good many years, he was disconcerted by not being able to see his listeners. He had the feeling that no one was listening until he kept getting reports from many distant points that he was making new friends.

"I now receive letters from people who live in places I never heard of," he says. "The good will in those letters is very stimulating."

What Mr. Barry found most difficult in the work was striking the right pace. Early nervousness made him talk much too fast. He profited by the warnings that came, all of them friendly. He learned to calm down.

"Now when I approach the microphone," he says, "I find myself getting into a definite mood. I speak quietly and slowly. I'm careful about using the pause. When there is a word that I want to be particularly careful about, I pause before it and I pause afterward. In this way I play it up, and give it emphasis without increasing the sound."

Mr. Barry tells of several occasions where strangers have introduced themselves to him and spoken about his radio talks over KGO. They explain that they recognize him by his voice. It is an individual one. "In some ways voices are more distinctive than faces," Mr. Barry continued. "At any rate, on many minds and memories they register much more sharply. A good many people have acute ears and a great faculty for carrying associations with sounds."

On learning how to speak well he said:

"Anyone can learn to speak clearly if he wants to. The laws are very simple and very easily mastered. And there are special laws, of course, for speaking in large auditoriums and on the air, all readily utilized. I often wonder why more speakers and actors are particularly deficient in this regard. They are often the means of obscuring the lines that they're supposed to light up, lines that authors have slaved over."

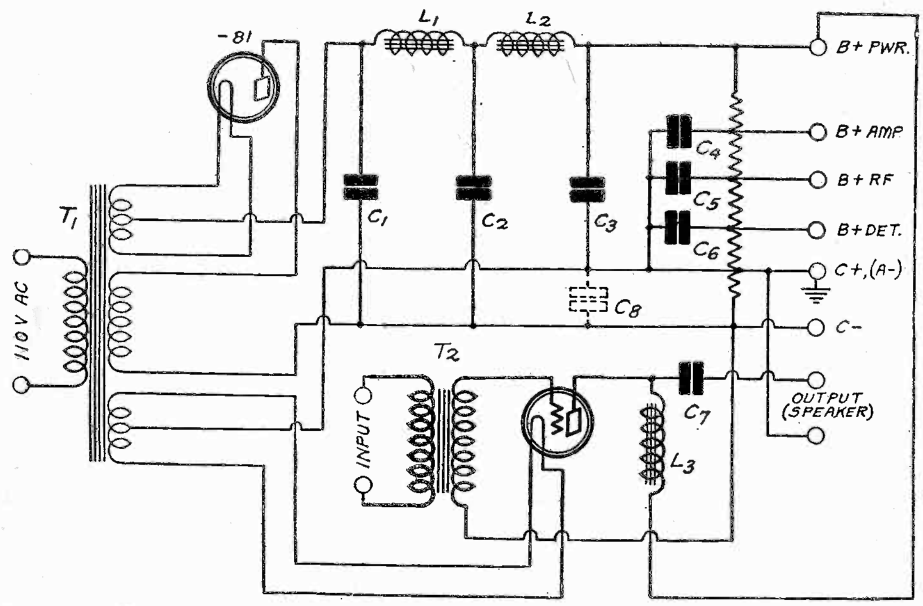
The New Comp[a]

Rectification and

Both Work Toward Same End

By Capt. Pe

Contribu



A HALF-WAVE RECTIFIER TUBE IS INACTIVE FOR EACH ALTERNATION (HALF CYCLE) AND ACTIVE DURING THE OTHER ALTERNATION. IT IS ACTIVE WHENEVER THE PLATE IS POSITIVE IN RESPECT TO THE FILAMENT, WHEN THE VOLTAGES ARE VIEWED IN VACUOUS SPACE. IN EXTERNAL PERFORMANCE THE PLATE IS ALWAYS NEGATIVE IN RESPECT TO THE FILAMENT. A SINGLE-SIDED AUDIO OUTPUT IS SHOWN

TWO concomitant questions concerning a power supply are (1) shall full-wave or half-wave rectification be used, and (2) shall the output stage be single-sided or push-pull? There is a similarity between the two because full-wave rectification in converting AC to DC has the same general effect as does push-pull, although the performance is different.

Present trend in radio may be taken as the answer to these problems. The B supplies almost invariably uses full-wave rectification. Push-pull for the last audio stage likewise is strongly favored. Full-wave rectification and push-pull audio output are coming to be almost a rule!

What are the reasons? Is a mere fad in vogue, or are there substantial engineering considerations behind the choice?

It is obvious that in factory-made receivers the public was not the direct deciding factor, but the engineers were. They selected full-wave rectification because a smoother output was obtained at less cost, and the chokes and condensers did not have to be so large in the filter section. It was easier to remove hum and other extraneous noise. This was reason enough for the choice. The public became conscious of the improvement simply as a performance factor, without knowing the reason why.

The push-pull audio output was another engineering choice. The public that buys factory-made radio sets to-day does not know, as a rule, that the receiver has push-pull audio, or, if informed, doesn't know what push-pull is, or why it is used, but it appreciates the results, which again are quieter performance, better tone, plus increased volume-handling capacity without distortion.

It must not be supposed that half-wave rectification is no good, or that fine results are not obtainable with it. Neither must one assume that there is a vast superiority of push-pull over a single-sided output. The improvement that is more readily attained with full-wave rectification is largely an economic advantage, for just as good results at greater cost could be obtained from a half-wave rectifier.

As for push-pull audio, it is not easy to determine from listening whether push-pull is used or not. But the ear, of course, must not be relied on as a measuring instrument. Its action as a meter is erratic. Its resistance per ohm must be 'way off! Real meters show that push-pull is superior, and mathematics corroborates it, so the question must be deemed scientifically settled. The ear helps out, because when attention is called to the operating differences between a single-sided and a push-pull circuit, the ear will turn political, and be one of the "original push-pull men."

What the Diagrams Show

The two diagrams herewith show, in one instance, a half-wave rectifier, using the 281 tube and a single audio stage which is not push-pull, and in the other instance a full-wave rectifier using two 281 tubes with a push-pull audio stage. The 281 tubes are used here, also, but they are connected with their respective plates going to the extreme terminals of the high-voltage winding of the power transformer, this center-tap being minus, and filament center being plus. This is the same connection as would be made if one full-wave rectifier tube like the 280 were used, the only physical difference being that the one tube has one filament and two plates and the two tubes have two filaments and two plates. Electrically there is a greater difference: the two 281s will stand a much higher voltage, up to 750 volts with easy safety, and will deliver 250 milliamperes (.25 amp.). On the other hand, the 280 is rated at 100 milliamperes at 300 volts.

Therefore if the output tube is to be a 210 or 250, worked at rated voltages for highest effectiveness, then either a single 281 as a half-wave rectifier, or two 281s as full-wave rectifier, would have to be used. The reason is that the heavy current and high voltage are needed—the large wattage—and these are not obtainable from the 280. As the smoothness of performance is important, half-wave rectification, to supply all B currents and voltages, with the last audio stage in push-pull, would be a good combination, since the push-pull stage would help the filtration action in its own individual way, the elimination of the even order of harmonics.

For full-wave rectification, using two 281s, the voltage across the total winding must be twice as much for the half-wave method. That is obvious from a comparison of the two diagrams. Where half-wave rectification is used the total high voltage winding is connected, one side to the plate of the tube, the other side to the negative lead of the B supply. That is another way of saying that the plate is negative, which it always is in the circuit external to the rectifier. The filament is the positive side. So, discounting the voltage drop in the tube itself, the total voltage difference is between the filament and the plate. The action of the tube connects the plate and the filament in series.

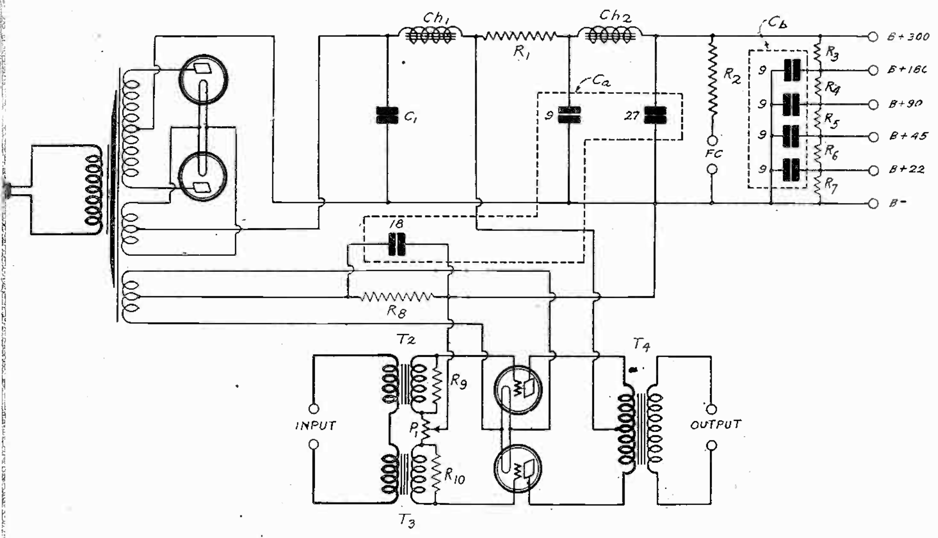
Therefore for half-wave rectification there is one high voltag[e]

...nionship: Full-Wave Push-Pull Audio

...Smooth Output and Clear Tone

...V. O'Rourke

r



FULL-WAVE RECTIFICATION, WITH A PUSH-PULL AUDIO OUTPUT. THE TOTAL VOLTAGE ACROSS THE HIGH-VOLTAGE SECONDARY IS HALVED, BY USE OF CENTER TAP AS THE NEGATIVE LEAD. IN THESE SYSTEMS, FULL-WAVE RECTIFICATION AND PUSH-PULL AUDIO AMPLIFICATION, THERE IS CONSTANT ACTIVITY OF AT LEAST ONE TUBE. PUSH-PULL TUBES ARE ACTIVE ALL THE TIME.

...nding, without center tap, and the total voltage across the winding ...effective.

Now, with full-wave rectification there is a center-tapped high ...ltage winding, and the extremes of this winding go to the respec...e plates of the rectifier tube or tubes, while the midtap is negative and the filament is positive. Hence again we see that the plates ...e negative and the filament positive. But what has happened to ...e total voltage across the high winding? The filament is positive ... respect to the plates, but each plate obtains an effective voltage ... only half the total voltage across the high winding. Instead of ...e extreme of the high winding being used for the negative B ...ad, the center tap is used, and therefore the voltage is half of ...at across the total winding. This is no problem, however, and ... loss. If a 300-volt input to the tube is desired, the high voltage ...nding is made 600 volts across extreme terminals, and is center...pped, so that from midtap to either terminal the voltage is 300.

Work in Equal Shifts

The operation of a full-wave rectifier is such that during half a ...cle (one alternation) one tube or plate is inactive while the other ... active, and during the next alternation the previously active ...be or plate takes a rest, while the other one goes to work. The ...cles are usually 60 per second, that being the predominant fre...ency of AC house wiring lines.

Push-pull action differs from this, because both tubes are at ...rk all the time. While one is handling the negative alternation ...e other is handling the positive alternation, the voltages being ...ual but opposite in phase.

In a half-wave rectifier the rectifier tube is inactive half of the ...ne, so that it furnishes current and voltage only half the time, ...d nothing the other half. This would be a very serious drawback, ...cept that means of overcoming this difficulty are readily supplied ... the filter condensers. These store up electricity so that the load ...cuit can draw on the condensers during the half cycle when the ...be is inactive.

The condensers are very important in a B supply. They should ... of adequate capacity and should be worked well within their ...ted voltage. A condenser usually has two ratings, one for AC, the other for DC. For instance, the rating will read: "2 mfd., 600 volts AC working voltage, 1,000 volts DC working voltage." If only one rating is given, for instance, "1,000 volts working voltage," without disclosure of the type of current, alternating or direct, at which this rating was established, always assume that the rating is DC, the higher claim, and to determine the rating at AC, as a matter of safety, divide by 2. Thus the "1,000-volt" condenser would be used for not more than 500 volts AC. The more conservative you are, the better will be the results and the longer the life of the B supply. A wise choice will result in a B supply that will last for twenty years, nothing to be replenished except rectifier tube or tubes.

Another point about condenser ratings is that some are based on a "test." If the only rating given is a "test" rating, divide by 5 to obtain the DC working voltage and by 10 to obtain the AC working voltage, for a rating by "test" only is one to put you on your guard. The only valuable information is "working voltage," which means that voltage at which the condensers may be worked uninterruptedly for an indefinitely long period, approaching infinity. A "test" voltage is a disclosure of one fact only—that a flash test was applied and it so happened the condenser did not puncture then.

An excellent way to rate a condenser is by its DC working voltage, its AC working voltage and a test voltage, for then the word "test" is not deceptive. For B supply needs the test voltage rating has no particular significance.

How to Reduce Condenser Strain

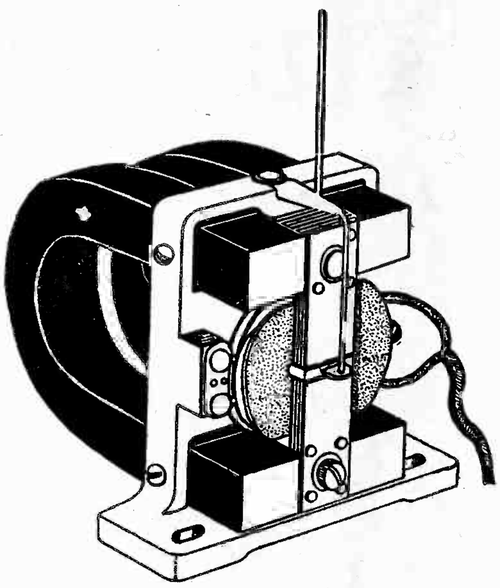
Condensers should be worked well within their rated working voltage, but if it is desired to use condensers of lower voltage than the output of the rectifier furnishes, then a resistor may be introduced in series with the positive leg of the filter system (R1 in Fig. 2), to enable use of lower-rating condensers subsequently. Thus C1 could be 2 mfd., 1,000-volt AC working voltage, while the 9 and the 27 mfd. condensers could be of the 400-volt working voltage type. R1 drops the voltage. If the rectifier tubes afford 500 volts, and the current is 150 milliamperes, then R1 is 666 ohms., 30 watts rating.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Those not answered in these columns are answered by mail.

RADIO UNIVERSITY

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

FIG. 771
A MAGNETIC UNIT CONSISTS OF A MAGNET COIL OR WINDING, A PERMANENT MAGNET WITH POLE PIECES, AN ARMATURE AND A DRIVING PIN. THE SIGNAL CURRENT THROUGH THE COIL SETS UP A CORRESPONDINGLY VARYING FIELD THAT ACTUATES THE DIAPHRAGM OR ARMATURE.



PLEASE explain the action of a magnetic unit. I am confused about the various components. How does the unit work?—J. M.

See Fig 771. The assembly consists of a frame, in this instance, holding two permanent magnets. The coil is placed between the poles of this polarizing magnet. The ends of the coil are connected to the output of a receiver. Between the poles of the magnets are pole pieces to direct the flux to the moving part, which is the armature. This armature is secured at the opposite end. To the armature is attached a driving pin. When signal current from the output tube or filter is passed through the winding of the unit this winding becomes an electro-magnet. That means that lines of force are emitted by the coil, and return to the coil, constituting a magnetic field. This field's behavior duplicates the fluctuations of the signal, and thereby the armature is caused to move in the slot or small opening between pole pieces, the movement being the mechanical counterpart of the changes in the electrical field of the coil. A pin attached to the armature conveys this motion to a cone or other diaphragm attached to the end of the pin.

* * *

IS THERE any resistor I can use in an A eliminator to work from the 110-volt DC line that will provide the correct necessary voltage taps no matter if I use one or eight tubes, that is, draw .25 or 2 amperes?—L. B.

No. The resistance has to be changed for each different current drain. This may be the series resistor that drops 110 volts to 5 volts. At 2 amperes the resistance should be 105÷2, or 52.5 ohms. The wattage is 105x2 or 210. At .25 ampere the resistance would have to be 420 ohms. The wattage would be 26.25. The resistance would have to be eight times as great and the wattage one-eighth. You might use an adjustable rheostat, but would have to be careful of two things: (a) not to use the too low resistance value when few tubes are in circuit, otherwise the voltage on the tubes will be high enough to damage or burn out the filaments; (b) obtain a resistor of suitable wattage rating. A power Clarostat, 25 to 500 ohms, 250 watts actual use, could be used this way. It gets hot but there is nothing in it to be damaged. The only other way out would be to use a fixed resistor of 52.5 ohms, and put a variable resistor across the A plus and A minus leads from points on the A eliminator. This rheostat would reduce the voltage, but the full 2 amperes would be flowing all the time, that part of them not flowing through the tube filament flowing through the shunt resistor. Drawing 2 amperes to waste 1.75 and use .25 is expensive, as your electric bills would prove.

* * *

DOES voltage drop in an inductance in a circuit as well as in a regular resistor?—M. L.

Yes. The direct voltage drop through an inductance is usually small. A DC resistance of 400 ohms is common in the primary of an audio transformer. This compares with 100,000 ohms minimum for a plate resistor. So in DC measurements quite a disparity exists. But the inductance of the primary of an audio transformer, or the inductance of a cored choke coil, as in impedance coupling, comparatively drops signal voltage on the basis of the impedances. The impedance of the resistor is about the same for all useful frequencies. The impedance of the audio coil is very low at low frequencies and rises as the frequency is increased, hence its impedance is a function of the frequency. When these facts are appreciated, arguments used against resistors in plate circuits usually collapse.

* * *

BAND pass filters are suggested from time to time. A separation of 10 kc. is required. If a filter has a separation of 10 kc. at the highest frequency (1,500 kc.), has it the same separation at the other extreme (550 kc)?—L. H. W.

No. The separation is different at all different frequencies. Therefore only in a fixed frequency amplifier, as in the intermediate channel of a Super-Heterodyne, does a band pass filter function in practice as desired. If the separation is 10 kc at 550 kc, then the ratio is 1 to 55. At 1,500 kc the separation or band passed would be 27 kc. This would account for lesser selectivity at higher frequencies. Also, for an equal number of tubes the sensitivity would not be so great with the filter used as without it, because the amplitude of the signal wave is much lower than the separate amplitudes of each of the two component frequency circuits. But the quality may be excellent, and from this viewpoint the band pass filter method may be highly acceptable. Possibly most receivers of the few years hence will incorporate band pass filters. However, threshold sensitivity will have to be pressed to a still higher degree before the amplification drain occasioned by tuned radio frequency band pass filters will be generally applicable.

* * *

A SOCKET antenna is being used on my set instead of an outdoor aerial. Results are only fair. The volume is less, the selectivity more. What shall I do?—L. J.

The socket antenna has to be tried out on a receiver before the question as to whether satisfactory operation from this device can be obtained. The reason is that the socket antenna will pick up less energy than a good outdoor aerial. That accounts both for the lessened volume and the increase in apparent selectivity. Light lines provide uncertain degrees of pickup, depending on where they run and how they are connected. Therefore unless you have a sensitive receiver you may not be able to get good results from a socket antenna in your location. Try reversing the socket antenna in the wall convenience outlet, as you may be connecting its sole prong at present to the grounded side of the AC line. Virtually all the highly sensitive screen grid receivers of to-day work well from lamp socket antenna.

* * *

I WOULD like to put a dial on my set that has the scale calibrated in kilocycles. Then all I need do to tune in a station is to look up that station's kilocycles and turn the dial until I read that number. I built the set myself. It has two tuning controls, with .0005 mfd. condensers.—A. M. J.

A dial with scale calibrated in kilocycles is not universally applicable. The calibration is based on the degree of variation of a particularly shaped condenser with respect to a coil of definite inductance. While you know the capacity of your condensers you do not know the inductance of the coils. As calibrated dials are made for particular combinations of condensers and coils, these dials are not for all sets. You could tune in fifteen or twenty stations on each present dial, note the frequency from the published programs or from RADIO WORLD's list (published June 22d). Plot a curve on graph paper as your guide. You could then draw up your own scale. If you use drum dials this drawing could be done on a translucent strip, as for instance celluloid. You'd have a dial calibrated in frequencies applicable to your set.

* * *

HOW can a single control Super-Heterodyne be practical, if the radio frequency tuner requires one tuning curve and the oscillator a different one, as I understand this is really the theoretical if not the practical requirement?—M.K.W.

High sensitivity may be developed in the intake tuner, and then small discrepancies between the oscillator tuner and the other will not be important. A sacrifice in sensitivity is made, but how important this is depends on how high are selectivity and amplification at intake frequencies. If the condensers are ganged, for instance three for the RF amplifier and modulator, and one for the oscillator, making four sections, good results could be obtained, but not so good as if the two were separately tuned. A way out would be to put a vernier condenser across the oscillator tuning condenser. One advantage of single control in a Super-Heterodyne, besides convenience, is that the repeat tuning points may be avoided without using a sacrificially high intermediate frequency. If the aforementioned trimmer condenser across the oscillator is too large, the repeat tuning would be present despite the ganged tuning. The absence of repeats would be due, in the other circumstances, to inability to turn the oscillator condenser to obtain an alternate frequency which when combined with the intake frequency would produce the intermediate frequency.

* * *

NEUTRALIZATION of screen grid receivers seems to be a thing never done. Why can not neutralization be resorted to, if the receiver has a tendency to squeal? I thought the screen grid tubes were not supposed to squeal, anyway?—H.E.D.

The capacity bridge method of neutralization is based on the elimination of feedback caused by stray capacity coupling. Thus, if the capacity coupling is 10 mfd., a capacity of equal amount is connected so that the voltage is 180 degrees out of phase, in the same circuit, and the two voltages being equal but opposite in phase. With screen grid tubes the inter-electrode capacity is so extremely small that oscillation from stray capacity back-coupling is not to be expected. The tubes, when properly shielded and voltaged, will not self-oscillate, unless the amplification is pressed beyond all reasonable limits. However, oscillation, when present, is largely due to imperfect shielding, or no shielding, so that the coils back-couple. The attempt to neutralize stray inductive back-coupling by the capacity method would not prove successful.

* * *

SHORT waves fascinate me. I do not know much about them. One night recently at a friend's house I tuned in some short waves, for the second time in my life. Is it worth while getting a short wave set? What can I expect?—D.E.Z.

There is lots of fun and new excitement in tuning in short waves, even if you are interested only in programs. There are plenty of short-wave stations repeating long-wave musical programs, although not nearly so many as send out on long waves alone. No one can promise you honestly what you will receive. Some locations are much better than others. Foreign reception is enjoyed by about half of those who have short-wave sets of good design. The other half seldom hear anything outside of the United States, and seldom much beyond a few thousand miles, due to their location being unfavorable to short-wave reception or to their own inability to tune the set, or both. Borrow your friend's set, if you will, and see how you fare. If you get some respectable distance you will be overjoyed to own a short-wave set. Do not expect too much, however. Stations do not come in as loud on short waves as on the broadcast waves. One safe precaution is to purchase a set that has been tested for foreign reception. Then you know you have a fine receiver and that you will enjoy all the short-wave reception that your locality and tuning ability permit. You must be more careful tuning in short waves, for a fraction of a division of the dial may mean the difference between fine reception and no reception of a particular station. Also remember that dial settings may change slightly, due to the detuning effect of any regeneration device used in the receiver. At broadcast frequencies this detuning is not enough to upset the dial readings, but on short waves it may be. The stations always will come in at approximately the same settings of the tuning device. The regeneration knob setting may have to be different. Short waves provide real enjoyment that nobody who has acquired familiarity with their reception ever would want to miss.

* * *

WHICH type of condenser is best—straight frequency line, modified straight frequency line, straight wave, modified straight wave, straight capacity line or modified straight capacity line?—E.R.

The terms you use are rather confusing, as some of them would mean the same as other terms included in your list. But in general there is no "best." What type condenser to use, so far as gradations of capacity are concerned, depends on taste in frequency distribution on the dial. It is fair to state that few persons have any definite taste on the subject, unless it be that they do not want overcrowding. The straight frequency line was designed to separate the stations in their dial positions at the higher frequencies at the expense of crowding the lower frequencies. At present the condensers most in use are not strictly straight frequency line but are modified so that somewhat greater separation is obtained at the lower radio frequencies, while the higher frequencies are tightened up correspondingly, as compared with straight frequency line. This is known as midline tuning.

* * *

SHOULD the primary be tuned or the secondary, when using a screen grid tube? I have heard that tuning the secondary produces larger amplification. Are there any difficulties involved?—L. K.

Where the primary in the plate circuit is tuned, and the secondary is a closely-coupled pickup coil to feed the succeeding grid, the amplification is about two and a half times as great as where the windings and tuning are switched about. The circuit has a greater tendency to oscillate, and also, if the pickup coil feeding the grid is inductively large and tightly coupled, there will develop a large minimum capacity across the tuned circuit, about 100 m. mfd., and the entire wavelength band may not be covered, unless .001 tuning condensers are used with proportionate coils, or some other system is introduced for extending the frequency range despite the high minimum capacity. A turns ratio of about 1-to-2, primary to secondary, with untuned primary in the plate circuit, is generally used, because the problems are avoided, but greater results are attainable by solving the problems and using the higher amplification method. A commercial disadvantage of the higher efficiency method is that it attains greater results with fewer tubes, and the quantity of tubes in a receiver or design is one of the big talking points these days.

* * *

IS it necessary that I use a power tube larger than a 112A? I have a six-tube circuit, with usual radio frequency, and three-stage resistance-coupled audio, all worked from batteries. Would it improve matters if I used a 245 tube?—L. J.

The 112A is not rated as a power tube, but as a junior member of the firm of semi-power tubes. Nevertheless it is ample for the receiver you have and it will stand enough of a load to permit as much volume without strain that any one normally would desire in a home. The 245 can not be used economically with your receiver, as it is costly to feed its filament from an A battery, and to attempt to supply its plate current from B batteries that serve the rest of the receiver.

* * *

OFTEN I see the term "thermionic" used, especially in connection with a radio vacuum tube. What does "thermionic" mean? Has it any relation to electricity?—K. W. E.

It means ions produced by heat.

* * *

PLEASE state whether a bypass condenser from plate to filament is necessary in a detector circuit, and if so what should be its capacity?—Q. A. S.

It is not always necessary, in fact, sometimes is a drawback. In general, it is advisable in circuits using transformer coupling for the first audio input, and the capacity should be .00025 mfd. to .001 mfd., certainly no higher. When high mu tubes are used, including screen grid tubes, this condenser is usually unnecessary, as a large enough capacity develops across the plate load to offer a low impedance to radio frequencies and a high one to audio frequencies. Always try the condenser in and then out and decide for yourself.

* * *

THE negative grid bias recommendations, as contained in tube data sheets furnished by tube manufacturers, state that a certain bias should be used for a certain plate voltage, but without making any mention of the effect that the plate load will have on fixing that bias. For instance, in a resistance-coupled stage the plate resistor may be 100,000 ohms and the current 2 milliamperes, so that there is a 200-volt drop, and if the applied voltage is 180 the effective plate voltage is minus 10. Anyway, the load on the plate, whether a coil or a resistor, has DC resistance and reduces the applied voltage so that various biases should be given for various effective voltages, the lower effective voltages calling for less negative bias.—M. J. C.

The bias recommendations for stated values of applied plate voltages on three-element tubes, regardless of the type of load, are correct. The reason is that if you take a characteristic curve showing plate current and grid voltage, with no load, and take other curves with various types of loads, these curves approximately will cross at the same point of rated bias. When a high impedance load is used the bias may be made more negative than recommended, but not less negative. Your assumption that 200 applied volts become minus 10 at the plate, due to 2 milliampere flow through 100,000 ohms, is erroneous. The milliampere flow is in a circuit consisting of the plate load (100,000 ohms) and the DC resistance of the plate itself, which we will take as 80,000 ohms for a high mu tube, so the 180 volts are dropped across 180,000 ohms, 100 volts in the plate and 80 volts in the load. The current is 1 milliampere, not 2.

* * *

IS the bias on the screen grid tube, type 222, considered critical as a radio frequency amplifier? How about detection on the bias basis?—J. E.

Yes, it is critical. For instance, at a plate voltage of 135 volts, with a screen grid voltage of 45, the negative grid bias should be 1.5 volts. In this way the tube is most sensitive, that is, best as an amplifier. If the bias is increased to 2.5 volts the sensitivity is reduced about 15 per cent. The same is true if the bias is made zero. If any oscillation is present at 1.5 volts, it may be removed by altering the bias. Therefore while 1.5 volts negative is the correct operating point for maximum sensitivity, it is permissible to use a variable bias as a volume control and squeal-checker, or a higher bias than 1.5 volts for the avowed purpose of using the tube at less than its full amplification, in the interest of stability not provided for by other and better means. For detection the same critical aspect of negative bias applies.

* * *

IS it possible to obtain excellent sensitivity and selectivity from a four-tube receiver? Would amplification be sufficient?—R. D. C.

Yes. It is possible to construct a four-tube receiver that will give everything in sensitivity, selectivity and tone that any one of reasonable expectations would want. However, the four-tube design has declined greatly in popularity in the past two years, and during the past year particularly. The set manufacturers are making a

(Continued on next page)

(*Continued from preceding page*)

drive for the AC market, and are doing little for the battery-set market, so that even battery sets begin to run into six, seven and eight tubes, which tends to make their upkeep cost prohibitive. And many of these battery-operated receivers of quantity tubes do not give as good results as a well-designed four-tube receiver.

* * *

PLEASE give dimensions, size of wire, number of turns, etc., for a pair of coils to tune a two-tube receiver, RF only, with one screen grid tube and one detector tube.—T. R. C.

On a 2½" diameter tubing, 2" or more high, wind 14 turns for the antenna primary winding, 48 turns for the secondary, separating these by ¼", and using No. 24 covered wire, silk, cotton, etc. For the other coil wind 24 turns for the primary, 48 for the secondary, same size diameter, same size wire. These data are for .0005 mfd. tuning condensers. For .00035 add 12 turns to the secondaries.

* * *

REGARDING the MB29 receiver, recently described in RADIO WORLD, what is the sensitivity of this outfit as compared to the general run of receivers of the kit-type or factory-made? Statements have been made that this outfit is very sensitive, and if these are true, why is an audio amplifier needed? Can not the speaker be worked directly out of the detector?—W. C. B.

The MB29 is one of the most sensitive broadcast receiver designs, more sensitive by far than nearly every other. The audio channel is used so that distant stations will come in with fine volume. The circuit actually has been worked from detector direct to loudspeaker, and strong local stations were fairly loud. It is impossible to capitalize in full the distance-getting faculty of this hookup without using suitable audio.

* * *

IN choosing a B eliminator for my storage-battery-operated receiver, how should I select the proper one, in regard to drain?—B. M.

Determine the total plate current drain of your receiver and purchase an eliminator that is rated in excess of this drain. This current can be measured by a milliammeter connected between B minus and the common terminal on the A battery, usually A minus. Tube data charts will give you the current through the plate of each tube at stated grid and plate voltages, and you can add up these currents to obtain the result, should you have no milliammeter but only a voltmeter. If your receiver requires two or three intermediate voltages, see that the B supply affords these. A general rule about drain is that a 35 mil rating will suffice for sets up to six tubes, but for sets having more than six, and particularly if push-pull, much larger rating is necessary. Select a B eliminator made by a reputable manufacturer of long standing in radio, so that in the event you require any replacements later on these needs will be filled.

WHEN anybody walks across the room in which my radio is, a jarring sound is heard and then the radio is dead until several seconds after the walking ceases. The sound is not microphonic, as I remember the gongy noises of years ago when using small tubes that had to have cushioned sockets or they wouldn't behave. Mine is a different ailment.—M. P.

There is an open grid, probably in the audio channel. This may be due to failure to connect a grid return, or to a grid return breaking away from its connection point, or to an open secondary of an audio transformer. When you close this circuit and apply the proper bias everything will work well again.

* * *

WHEN television comes along as a home entertainment, as everyone seems certain that it will, can the audio amplifier of a present receiver be used, or indeed, the entire receiver, by just hooking on the light-converting arrangement and motor disc? —C. G.

The audio channels of most receivers in use to-day are not suitable for television, as the picture is blurry because of distortion. This distortion is hardly noticed by the ear, but the eye is more fastidious and sharper. Whether the receiver will enable tuning in television depends on whether the receiver reaches the frequency on which television is transmitted. Probably by the time television becomes a home entertainment feature the radio amplification of receivers will be so high that no audio will be used, but the speaker will be worked right out of the detector.

* * *

ARE not receivers equipped with previous types of tubes capable of equal performance as sets embodying screen grid tubes? —C. L. B.

Yes, if the receivers embodying types of tubes previously introduced have a correspondingly greater number of tubes and are constructed effectively. Tube for tube, however, the answer to your question would be no. Greater performance, principally higher sensitivity and selectivity, using fewer tubes, is the screen grid achievement as noted up to the present, with special uses of this new tube inevitably to be worked out in years to come. The introduction of screen grid designs may render other designs of receivers obsolete from a commercial viewpoint, but not electrically.

* * *

WHY can not regeneration be used in conjunction with a multi-stage screen grid receiver? Such a diagram is almost never shown anywhere. Please state why.—C. J. S.

The amplification obtained from several stages of screen grid radio frequency amplification is so great that regeneration and its consequent extra control are not advisable.

Right or Wrong?

(Questions on page 11)

1.—Wrong. It is true that these quantities affect the oscillation, but only to a negligiby small extent. The frequency is very largely determined by the inductance and capacity in the plate voltage supply.

2.—Wrong. This is the condition that obtains between the source and the sink for maximum when the sink is connected directly to the source. For greatest undistorted output the impedance looking into the primary should be twice the impedance of the tube.

3.—Wrong. The inductance of two coils connected in series and wound on the same core is L1+2M+L2, where L1 and L2 are the inductances of the two windings and M is the mutual inductance of the two. If the coefficient of coupling between the two coils is unity, M equals the square root of the product of L1 and L2. Hence the inductance of two equal coils would be 4 times the inductance of either.

4.—Wrong. The frequency is also affected by the resistance in the tuned circuit and by that in the tube. But the dependence is small so that roughly the statement is correct.

5.—Right. The characteristics are not affected by frequency since there are no reactances, and therefore the static is the same as the dynamic characteristic.

6.—Right. This gives an easy way of determining the approximate AC resistance of the tube. Just measure the voltage applied to the plate and the resulting plate current. Divide the voltage by the current, using volts and amperes, and the ratio is the DC resistance. One half of this is the AC resistance.

7.—Right. The higher the plate resistance or impedance the higher the amplification. But this assumes that the plate voltage is high enough to take care of the high drop in the impedance.

8.—Wrong. The grid assumes a voltage depending on the type of tube, the plate voltage applied, and on the leakage between the grid and the plate. Usually the free grid voltage is negative. As a rule, the higher the plate voltage the more nearly zero is the grid voltage.

9.—Wrong. What is heard is a musical tone of 100 cycles. This is true for any three consecutive frequencies differing by 100 cycles. But the components must be accurate multiples of 100 cycles.

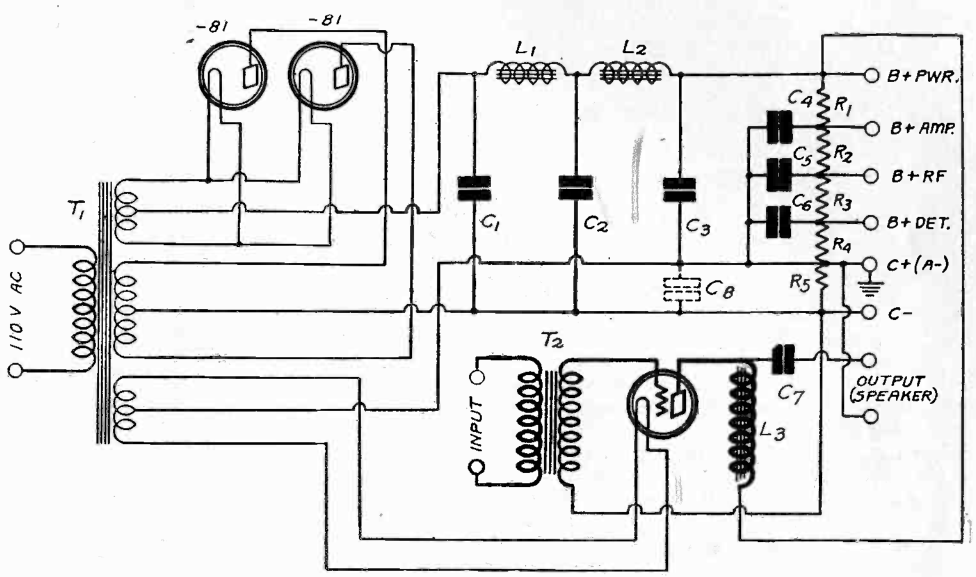
10.—Wrong. The constant in this case is not a constant at all.

BLEEDER CURRENT

It is Helpful In Four Principal Ways

By H. B. Herman

THE SUCCESS OF A POWER AMPLIFIER DEPENDS CONSIDERABLY ON THE BLEEDER CURRENT. THIS SHOULD BE ABOUT AS LARGE AS THE PLATE CURRENT OF THE POWER TUBE OR TUBES. THE FOUR PRIMARY ASSETS ARE DISCUSSED IN THE TEXT.



THE bleeder current is that current which flows independent of any plate current drawn by the tubes of a receiver. Thus any resistor across a potential difference will draw current, and this bleeder current exists whether the B supply consists of batteries or an eliminator. However, a bleeder across a battery is a sheer waste and useless. How about a bleeder across an AC B eliminator

Look at Fig. 1. The separate resistors R1, R2, R3, R4 and R5 are in series and may be considered as one, across the total output. Hence if you turn on the juice, without the B supply being connected to a receiver, the current that flows through these resistors is equal to the voltage divided by the resistance. If the total is 10,000 ohms and the voltage at B+ power is 500, then the bleeder current is 50 milliamperes.

Draws Current Independently

The first consideration therefore, is that the device draws current without any receiver load. This tends to protect the filter condensers C1, C2 and C3, since the enormous voltage strain present when no current is drawn is avoided.

Bleeder current thus is a safety factor.

Consider now the total diagram, with the audio stage included. It is clear that not only does bleeder current flow, but also plate current of the last audio tube. The grid return of this tube, through the secondary of T2, is to C—. The midtap of the lower filament winding goes to the next highest point. Therefore the bias of the last tube is negative to the extent of the voltage drop in R5. C— is the midtap of the high voltage winding feeding the rectifiers, ordinarily regarded as B—, but called C— when the bias is obtained as shown.

Current Through R5

What current now flows through R5? First of all, we know the bleeder current flows equally through the chain of resistors, say 50 ma. If the last audio tube is 250, with a required bias of about 80 volts at 420 volts plate supply, the plate current is about 50 ma. This we know from experience and from tube data sheets. So we have 500 volts over all, 420 apportioned to the plate of the last tube, the 80 additional serving as negative bias. The total current through R5 would be 100 ma. R5 in resistance value would be the voltage divided by the amperage, or 80/.1=800 ohms.

High bleeder current exists when it is approximately as great as the plate current of the last audio tube. If push-pull is used the same proportion holds, but the current values are doubled.

Produces Steadiness

Thus the plate current of the output tube or tubes, now always more than the plate current of all the other tubes in a receiver, is half of the total current. In Fig. 1 as discussed it is just half. Other conditions will make it less than half, as will appear. But the fact remains that the fluctuating plate current of the last tube is commingled with the steady bleeder current, and the effective plate voltage is more constant than otherwise.

Write down in favor of bleeder current the second valuable contribution—the steadying effect.

To view the subject of current as fully applicable to a receiver combined with Fig. 1, remember that there are the radio frequency tubes' plates, averaging 5 ma. each under ordinary circumstances, the detector, which usually draws less than 1 ma., hence scarcely can be read on a 0-120 milliammeter, and the preliminary audio tubes, often averaging 5 ma. each. The current flows to C—. So the detector plate current goes from B+ det. through R4 and R5. Add 1 ma. to the R5 current. The B+ RF current flows through R3, R4 and R5. Add 15 ma. The B+ amp. (preliminary audio) plate current flows through R2, R3, R4 and R5 to ground. Add 5 ma. Thus to the 100 ma. through R5 add the plate currents of all other tubes. Also note that the power tube's plate current flows through the filament winding to C+ to ground, via R5, so all the plate current of all the tubes flows through R5. The total in the assumed instance is 121 ma. and R5 is therefore 80/.121 or 661 ohms.

Lessened Impedance

It is obvious that the more current through R5 the smaller the resistance R5 need be to afford the desired bias for the power tube. The lower the resistance, the lower the impedance or obstruction to alternating current. As the bleeder is still substantial, 50 as compared to 121, or 41%, its effect in reducing the impedance is substantial. C6 need not be an enormous capacity to be effective as a preserver of high amplification and fine tone. It may be 4 mfd. and serve an ample purpose. The lessened impedance is a contribution to audio stability and quality. This applies also to the other resistors. The effect of the condensers across them is heightened, too.

Give the bleeder credit, therefore, for a fourth asset: reduction of common impedance.

280 RECTIFIER IS NOW RATED AT 400 VOLTS

A long series of life tests on the 280 and 380 rectifier tubes has resulted in an increased maximum transformer voltage rating at a decreased maximum drain. The old rating was 125 milliamperes at 300 volts per anode (plate). The new rating is 400 volts per plate at 110 m. a. Due to the regulation the maximum allowable current is less as the voltage is increased. The actual available output voltage, due to drop in the table and the filter system, is about 390 volts at 110 m. a., and 400 volts at 100 m. a.

The following table shows the maximum rating comparison:

280 Rectifier Tube

Constant	*Old Rating*	*New Rating*
Filament volts	5	5
Filament amperes	2	2
Maximum load current, m. a.	125	110
Maximum transformer voltage per plate	300	400

The 280 is the most popular rectifier tube in use. It is well suited to screen grid sets using a medium power tube, e. g., the 245, either singly or in push-pull.

The filament voltage is rated at 5 volts, but from 4 to 5 volts the emission changes only slightly, so a little less than 5 volts may be used. No more than 5.2 volts should be applied, however, and the transformer ratio should be such that even at maximum primary input voltage from a wavering AC line, no more than 5.2 volts could result.

Craven Prophesies More Code Channels

Washington.

By technical progress that should be made in radio within the next five years it is estimated that there will be an increase in the number of radio channels available for telegraphic use of from 2,240 to 3,922, according to Lieut. Commander Tunis A. M. Craven, naval communications expert.

A detailed estimate of the expected increase in communication channels to be brought out by more efficient operation of stations is contained in a chart submitted by Commander Craven to the Senate Committee on Interstate Commerce. The Committee requested that such a chart be inserted in the record as a part of the officer's recent testimony. A broadcast channel, it was pointed out, is 10 kilocycles wide, whereas a telegraph channel in this same band would be only two kilocycles wide. There are 475 telegraph channels or 96 broadcast channels in this band.

New Ballast Clarostat

Clarostat engineers have perfected the new line ballast. This maintains a constant voltage on the primary of the power transformer even though the line voltage may fluctuate as much as 30 per cent. The ballast clarostat is usually designed to function between the limits of 100 and 135 volts, and will hold the secondary voltages to less than 5 per cent. plus or minus. Those interested will receive full information by addressing the Clarostat Manufacturing Co., Inc., 291 North Sixth Street, Brooklyn, N. Y. Mention RADIO WORLD.—J. H. C.

Radio Enhances Interest in Study

Chicago.

The efforts of the United States Government to determine the educational value of radio have produced the preliminary finding that radio at least has a strong stimulating effect on the desire to study and on promoting an interest in study. The actual results of courses conducted over the radio have been found difficult to gauge, but a fund of $25,000 is to be raised to defray the expense of an advisory committee on education, appointed by Lyman Wilbur, Secretary of the Interior, which held its first meeting here.

The possibilities of instruction by radio are conceded to be enormous, but the definite data are scattered and unclassified. It will be the work of this committee to correlate the facts and submit a report to the Secretary of the Interior. This report ultimately will be laid before President Hoover, whose interest in the work of the committee is great.

PAPERS UNITE ON OCEAN BAND

Washington.

Representatives of the various newspapers in the country met here recently and formed a corporation to be known as the Press Wireless, Inc., to take over the twenty transoceanic frequencies which had previously been allocated to the press of the country by the Federal Radio Commission. The plan of organization of the company was approved by the Commission, Robinson, Sykes and Starbuck voting in favor. Commissioners Lafount and Saltzman were out of the city.

The new organization, incorporated under the laws of Delaware, will have its headquarters in Chicago. The capital stock will be $1,000,000, of which $116,000 has been paid in. No one paper will be allowel to buy more than $25,000 worth of stock nor less than $1,000. Thirty days will be allowed for as many papers as to desire to buy stock to do so.

Joseph Pierson of "The Chicago Tribune" was elected president of the company; R. R. Harrison of "The Christian Science Monitor," vice president; William S. Hedges of "The Chicago Daily News," secretary, and John T. Gallagher, of "The Los Angeles Times," treasurer.

Mr. Pierson said that the company would erect three stations in New York, two in Chicago, two in Washington, and one in each of the cities of Boston, Los Angeles, San Francisco.

NEW CORPORATIONS.

American Radio and Television Distributing Corp.—Atty. L. D. Schwartz, 150 Nassau St., New York.

Fitchcraft Radios—Attys. Amend & Amend, 135 William St., New York.

Hy-Watt Radio Corp.—Atty. J. Rostha, New York (no address).

General Radio Corporation, Wilmington, Del., Broadcasting—Corporation Service Co., Wilmington, Del.

Lee Electrostatic Speaker Co., New York.—Corporation Trust Co. of America.

Jamestown Radio Cabinet Corporation, Jamestown.—Atty. Cawercroft, Jamestown, New York.

Halson Radio Manufacturing Corp., Wireless apparatus.—The company, 133 West 17th St., New York.

Buckingham Radio Corp., Wilmington, Del.—Corp. Service Co., Wilmington.

Public Service Radio Co. of America, Wilmington, Del.—Delaware Registration Trust Co.

Alex Auto and Radio Company, Hempstead, L. I., N. Y.—Attys. Griffiths & Gardner, Hempstead, N. Y.

Goran Radio Music Co., Yonkers.—Attys. Kirk & Diamond, 551 5th Ave., New York, N. Y.

SETS IN HOMES WARN A STORM IS ON THE WAY

The use of the radio receiver as an instrument of weather prophecy is growing, since in many quarters of the earth the same conclusion has been drawn, that static portends a storm.

In France the subject was studied for a year. The conclusion was reached that increasing static is a sign of approaching storm, decreasing static a sign of a receding storm. While the investigation was intended for more learned purposes, nevertheless housewives read of the finding, and to their subsequent comfort were persuaded by increasing static to take the wash off the line. Came the storm, and after it the wash was rehung.

A Storm Indicator

Although electrical storms are chiefly the concern of many, the static in a receiver, used for barometric purposes, is just as good an indicator of approaching or receding wind storms. In New England numerous examples have been cited of sudden wind changes and violent blowing following the static warning.

The increase and decrease of static are principally in the rapidity of the crackling sound. The static has to be heavy, however, before the storm warning can be considered valid, because light static often is associated with a storm that never reaches the location where such static is noticed.

The total amount of static noticed in the United States in the past two years is far less than that suffered in the preceding two years.

Types of Static

There are two main types of static, or atmospheric disturbances—grinder static, resembling a long blast from a steam outlet, and intermittent static, which is of the crackling type.

Talkie is Broadcast to Byrd Expedition

Atlantic City.

During the annual sales convention of Paramount-Famous-Lasky Corporation in this city a talking motion picture program was broadcast to the Antarctic party of Commander Richard E. Byrd. This was the first time that talking and musical films had been utilized or entertainment over radio.

The program was picked up by microphones of WPG in this city and relayed to KDKA, Pittsburgh, where it was rebroadcast on short waves to Commander Byrd and his associates.

VICTOR MUSIC SERIES

A series of broadcasts sponsored by the Victor Talking Machine Company, featuring each time a different recording orchestra and vocal artists for twelve weeks throughout the Summer, began on July 18th, at 8:30 p.m., E.D.S.T., over WEAF and associated stations. The orchestra will play for one half hour. Nathaniel Shilkret conducted the opening concert of the series.

JENSEN MOVES N. Y. OFFICE

The Jensen Radio Manufacturing Company has moved its New York City office to 126 Liberty Street. The telephone number is Hitchcock 1392. Models of Jensen speakers are on display. James A. Kennedy, Eastern sales manager, is in charge of the office.

BOARD TO ASK WRIT AGAINST COURT ON WGY

Washington.

The unusual remedy of seeking an injunction against a court to restrain it from committing an illegal act will be resorted to by the Federal Radio Commission in the case of WGY, Schenectady, N. Y.

The Federal Court in the District of Columbia upheld WGY's petition for full time on the air, and now WGY and KGO, Oakland, Calif., are using the same frequency, 790 k. c. The Board maintains this upsets the reallocation and that the court exceeded its authority. Both stations are owned and operated by the General Electric Company.

Seeks Another Writ

The Supreme Court of the United States will be asked by the Commission to issue an order restraining the justices of the Court of Appeals of the District of Columbia from exceeding their jurisdiction in the appeal of the case decided by the lower court. The Commission in June 28th lodged with the clerk of the Supreme Court a motion for leave to file a petition for writ of mandamus or prohibition, along with the writ itself.

The Supreme Court now is in recess, and the motion may not be filed until the Court convenes for its October term, at which time it must be presented by counsel for the Commission in open court. The petition, it was explained, cannot be filed unless leave is granted by the Court.

The Commission recently filed with the Court a petition for a writ of certiorari, seeking to have the WGY case reviewed by the Supreme Court. This also awaits the action of the Court at its October session.

Cites Excess of Authority

The contention is made that the court should have remanded the WGY case to the Commission for hearing.

"Without power or authority under the law, said court acted in an administrative capacity, unlawfully usurped the functions of the Commission, unlawfully assessed cost against the Commission in favor of appellants in each of the three said causes, and rendered an arbitrary and capricious decision," the petition reads.

Hoover Junior Confers on Short-Wave Work

Washington.

Herbert Hoover, Jr., who had been in Washington a few days visiting his parents in the White House, conferred with Lieutenant E. K. Jett, chief short-wave engineer of the Federal Radio Commission, and G. C. Blackwell, also connected with the short-wave division of the Commission, in connection with the radio activities of the Western Air Express, Inc., Los Angeles.

The President's son is in charge of all communications of the air express company. The conference was in relation to the company's short-wave assignments, which include thirty-eight ground station licenses and many airplane licenses for communication between the ships and the ground stations.

A THOUGHT FOR THE WEEK

Any set that's a hummer in Summer will be a sprinter in Winter.

"Quality Group" to Swap Programs

The institution of a "quality group" of stations to send out the same programs simultaneously, but not to compete with nationally organized chains, is under way, with WOR, Newark, N. J.; WLS, Chicago, and WLW, Cincinnati, as the leaders. Recently these three stations sent out a "modified network" program, and all three announced it was so successful that a permanent alliance on the same basis is to be expected.

The fundamental idea is an exchange of programs that will lend variety to the presentations of the associated stations and maintain exceptional standards of program quality.

RCA ASKS O.K. ON TELEVISION

The Radio Corporation of America has filed an application with the Federal Radio Commission for a transmitting license for an experimental television station to be located at Bound Brook, N. J., according to a statement by a representative of RCA. The application requests permission to use 30 kw. for transmission on the frequency band 2,850 to 2,950 kilocycles, 105 to 101 meters.

The representative declined to say whether this proposed television plant would replace the one now in operation at 411 Fifth Ave., New York City, or whether the new station would mark the beginning of regular television service for the home. No information pertaining to the plans of this television station will be released until the license is issued, he said.

The National Broadcasting Company also has filed an application with the Commission for a construction permit and a station license for a portable transmitter to be used on boats and airplanes in the metropolitan district. The station is to be used for relaying purposes, from points inaccessible by wire, to regular broadcasting stations. Previously the NBC has cooperated with companies licensed to use portable transmitters, when reporting outstanding events on water or in the air.

Beacons on WJZ Towers

Washington.

The Radio Corporation of America will place warning beacons on the transmitting station towers of WJZ and WII, which are near Hadley Field, N. J., the Eastern terminus of the Transcontinental Air Mail Line, the company has informed the Department of Commerce.

The high steel towers of the stations have been a constant menace to air mail pilots, especially those flying at night. The towers of WJZ are 300 feet high and those of WII are more than 400 feet high.

The decision to light the towers is the result of conferences between William P. McCracken, Jr., Assistant Secretary of Commerce for Aeronautics, and officials of the Radio Corporation.

NEW WESTINGHOUSE HEAD

F. A. Merrick was elected president of the Westinghouse Electric & Manufacturing Company. He succeeds E. M. Herr, who was elected vice-chairman. Mr. Herr went on an extended vacation. Mr. Merrick was vice-president and general manager.

APPEAL IS WON BY HAZELTINE ON KENT'S SET

The appeal taken by Atwater Kent from the decision of the Federal Court in Brooklyn, N. Y., holding that a set produced by Kent infringed the Hazeltine neutralization patent, was decided by the Federal Circuit Court of Appeals in favor of the Hazeltine Corporation. The patent was applied for in 1920 and issued in 1921. It concerns neutralization by a capacity connected from the plate of a succeeding tube to a point in a preceding tube circuit. The connections are such that the equal voltages, those of feedback and counter-electromotive force, are opposite in phase, hence cancel.

Jobber Nominal Defendant

The nominal defendant was E. A. Wildermuth, Long Island jobber for Atwater Kent, but the suit was defended by the manufacturer's counsel, at no expense to Wildermuth.

Plaintiff contended the Hazeltine method was used to prevent the set from squealing. The particular model involved in the suit is one no longer in vogue, as the screen grid set uses no neutralizing devices, save the inherent properties of the screen grid tube, plus necessary shielding.

Has Something Up Sleeve

A spokesman of the Hazeltine Corporation said:

"The decision is entirely favorable and gives Professor Hazeltine the broadest possible scope in plate neutralization and holds him to be the inventor of that form of neutralization. He is not restricted to any degree of plate coupling. The patent involved in this suit has to do strictly with plate neutralization. There is a grid method, but this was in no way involved."

He intimated the Hazeltine Corporation has "something up its sleeve" regarding suits involving screen grid sets. Plate neutralization suits, he added, are now pending against RCA and Grigsby-Grunow (Majestic).

KVOO Sues to Obtain Channel It Desires

Washington.

An appeal has been filed in the District of Columbia Court of Appeals from the decision of the Federal Radio Commission denying KVOO, of Tulsa, Oklahoma, its application for the 850 kilocycle channel occupied by KWKH, of Shreveport, La., and 5,000 watts power.

KVOO is operated by Southwestern Sales Corporation, owned largely by H. G. Skelly, president of the Skelly Oil Corporation. The station is prepared to synchronize with WAPI of Birmingham, Ala., on 1,140 kc.

The corporation claims that the decision of the Radio Commission denies Oklahoma its lawful share of radio facilities, and it gave thirteen points on which it claims superiority over the station at Shreveport. One of these claims is better equipment.

ANOTHER MUCHER IN RADIO

George Mucher, of the family of Mucher Brothers, who operate in the radio field under the name of Clarostat Manufacturing Company of Brooklyn, N. Y., has just joined the Clarostat engineering staff, following his graduation from the Rensselaer Polytechnic Institute. He joins his uncle, John Mucher, Stephen Anderson Jr., and William A. Bruno on the engineering staff.

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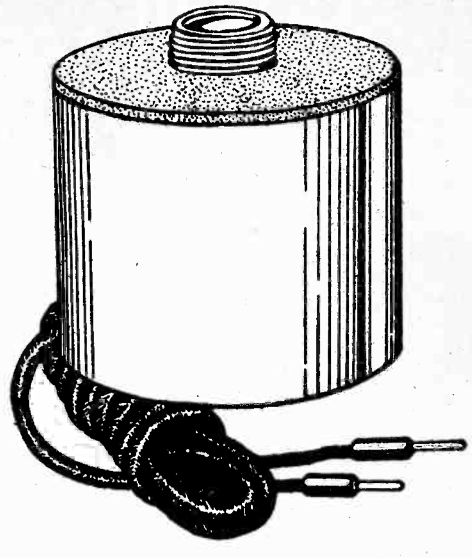
Horn Unit $2.25



This unit is pre-eminent for horn-type speakers, such as the exponential horns or other long tone-travel horns. The faintest word from a "whispering tenor" or the tumultuous shout of the crowd or highest crescendo of the band is brought out clearly, distinctly. Stands up to 450 volts without filtering. Works right out of your set's power tube, requiring no extra voltage source. Standard size nozzle and cap are die-cast aluminum, one piece, with milled platinum-like finish. The casing is full nickel, of highest possible polish. Works great from AC set, battery set or any other set, push-pull or otherwise.

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The 225 unit and 596 horn built into a ply-walnut table 33" high, 24½" wide, 17½" front to back. **Shipping weight, 50 lbs. Cat. No. 597 . . @ $20.00**

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RADIOLA 18 AC.—All-electric special $70. Radiola 100 A speaker, special $21. Act quick. Offer limited. A. S. Cooke, 1304 Pacific Street, Brooklyn, N. Y.

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If your receiver or amplifier, no matter of what kind, is not giving proper results, send it to us, prepaid. We will test it FREE and let you know what's wrong, telling you cost of repairs. Our charges are very reasonable. Six years' experience. Loudspeakers and units repaired. Burnt-out coils replaced. Jaynxon Laboratories, 57 Dey Street, New York City.

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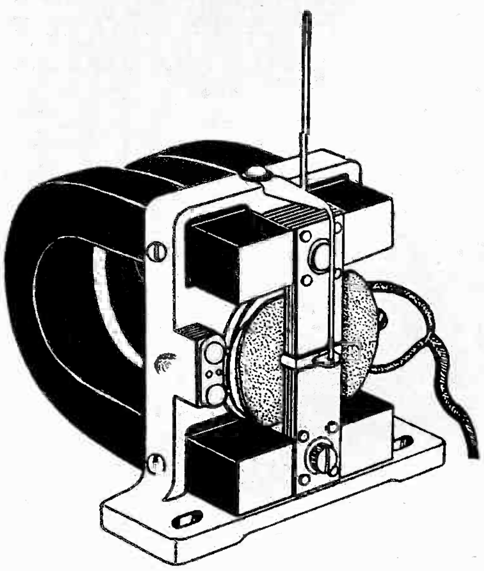
New Junior Model
POLO UNIT $4



The famous twin magnet principle for double sensitivity, large magnets for great flux, permanently adjusted armature, all are in the new junior model Polo Unit. Weight, 2¾ lbs. Stands 150 volts unfiltered. Stands up to 250 push-pull filtered. Works any output tube, power or otherwise. Supplied with 10-ft. cord. Order unit now. Five-day money-back guarantee.

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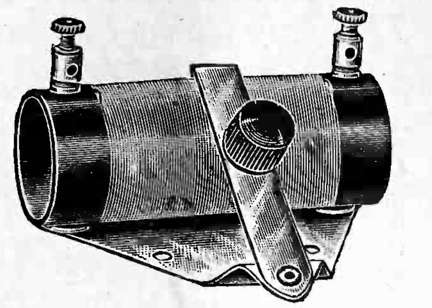
AERIAL TUNER
Improves Summer Reception



Remove aerial lead from set. Connect aerial instead to one of the binding posts of the Aerial Tuner. Connect the other binding post of the Aerial Tuner to antenna post of your set. Then move the lever of the Aerial Tuner until any weak station comes in loudest. The lever need not be moved for every different frequency tuned in. The Aerial Tuner acts as an antenna loading coil and puts the antenna's frequency at any frequency in the broadcast band that you desire to build up. It makes high wavelengths come in loud as low wavelengths. It helps separate stations and clear up reception. Makes great improvement in Summer reception. Price, $1.00.

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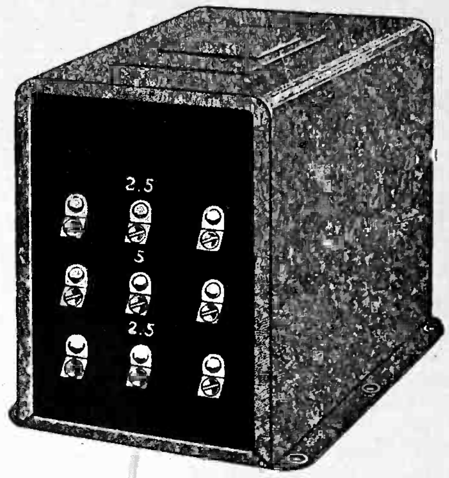

The heater type tube draws 1.75 ampere at 2.5 volts. If several such tubes are used a heavy-duty filament transformer is necessary. The top 2.5-volt winding of this filament transformer easily carries NINE AMPERES, or enough current for five heater type tubes. The bottom 2.5-volt winding stands four amperes, or enough current to heat TWO MORE such tubes, a total of SEVEN TUBES! The power tube, if of the 5-volt type, may be heated from the 5-volt central winding. 5-volt power tubes in push-pull may be heated from this winding.

All three windings are tapped at the exact electrical center. This precision location, made with the aid of an impedance bridge, accounts for absence of hum otherwise caused by the last tube when heated directly with AC. The heater type tubes are *indirectly* heated by AC, since the filament that glows is fed by AC but communicates heat to the cathode or electron emitter.

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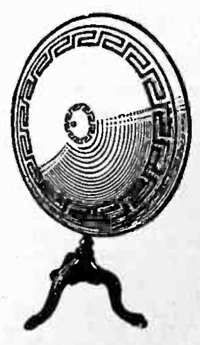

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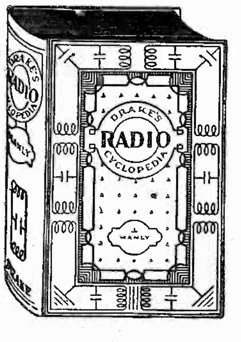

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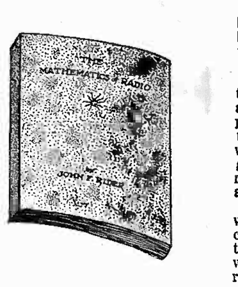

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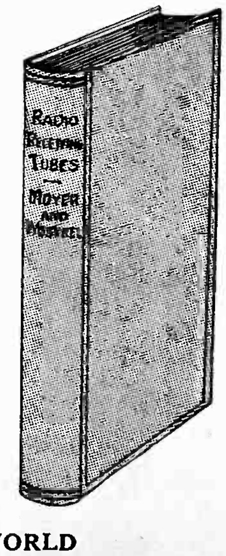

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