A 245 Push-Pull Power Amplifier—See Pages 16 and 17
"Audio Power Amplifiers,"

The First and Only Book on This Important Subject—Just Out

J. E. ANDERSON, M.A., former instructor in physics, University of Wisconsin, former Western Electric engineer, and
Herman Bernard, LL.B, management editor of "Radio World.

They have gathered together the far-furthest branches of their chosen subject, treated them judiciously and
authoritatively, and produced a volume that will clear up the mysteries that have perplexed many.

The book consists of 193 pages in type the size used in printing these words, known as 8 point, and the store a great deal of text is contained in these 193 pages, and the book is small enough to be carried conveniently in the side pocket of a sack coat. It was purposely printed that way because busy engineers and other experimenters will want to consult this precious volume while riding in conveyances, as well as when in the laboratory, and compactness was therefore desirable.

The book is strictly limited to 1,000, and the publishers recognize that the demand for distribution is necessarily limited to whom such a volume would not be without it at any price.

The device of presenting no more information or greater illustrative number of larger illustrations, but of using larger type and thinner and cheaper paper, to present a bulkier appearance, was purposely avoided. The paper is finest super stock and the size of the page is 5 x 8".

Detailed Exposition of Chapter Contents

Chapter I. General Principles, analyzes the four types of power amplifiers, AC, DC, battery-operated and composite, illustrates them in functional blocks and schematic diagrams, and the whole in clear textual exposition. The discussion is well illustrated, and the chapter is divided into sections, each section dealing with a particular class of amplifier. The discussion is exhaustive and detailed, and the chapter is a complete treatment of the subject.

Chapter II. Circuit Laws, expounds the fundamental laws of electricity and magnetism and illustrates them in functional blocks and schematic diagrams. The chapter is divided into sections, each section dealing with a particular class of amplifier. The discussion is well illustrated, and the chapter is a complete treatment of the subject.

Chapter III. Principles of Rectification, expounds the vacuum tube, both filament and plate, and illustrates them in functional blocks and schematic diagrams. The chapter is divided into sections, each section dealing with a particular class of amplifier. The discussion is well illustrated, and the chapter is a complete treatment of the subject.

Chapter IV. Practical Voltage Adjustments, gives the experimental use of the theoretical principles of rectification and explains why and how they work. The chapter is divided into sections, each section dealing with a particular class of amplifier. The discussion is well illustrated, and the chapter is a complete treatment of the subject.

Chapter V. Methods of Obtaining Grid Bias, illustrates and analyzed. Methods of connection for best results are stressed.

Chapter VI. Oscillation in Audio Amplifiers, analyses the causes and effects of oscillation and illustrates them in functional blocks and schematic diagrams. The chapter is divided into sections, each section dealing with a particular class of amplifier. The discussion is well illustrated, and the chapter is a complete treatment of the subject.

Chapter VII. Practical Voltage Adjustments, gives the experimental use of the theoretical principles of rectification and explains why and how they work. The chapter is divided into sections, each section dealing with a particular class of amplifier. The discussion is well illustrated, and the chapter is a complete treatment of the subject.

Chapter VIII. Characteristics of Tubes, illustrates and analyzed. Methods of connection for best results are stressed.

Chapter IX. Reproduction of Recordings, illustrates and analyzed. Methods of connection for best results are stressed.

Chapter X. Power Detection, illustrates and analyzed. Methods of connection for best results are stressed.

Chapter XI. Practical Power Amplification, illustrates and analyzed. Methods of connection for best results are stressed.

Chapter XII. Measurements and Testing, illustrates and analyzed. Methods of connection for best results are stressed.

The book is a complete treatment of the subject and is a valuable reference work for all engineers and experimenters interested in the field of audio amplification. It is a must for every radio engineer and experimenter.
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(9) — Illumination Tester, lamp tube.

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Power Amplifier Equipment

At left is illustrated a push-pull power amplifier, using a four-stage, resistance-coupled audio, 280 rectifier and two 28s in push-pull, as described in the November 24 issue of Radio World. Abounding volume and faithful tone reproduction are assured. The Polo Filament-Plate Supply, two Polo center-tapped audio chokes and a Multi-Tap Voltage Divider are used, with a Q-24, 2842 Merston condenser, an input push-pull audio transformer and auxiliary equipment. The total parts, including cadmium-plated steel sub-panels, come to $45.87 net, the best power amplifier for that modest amount. Provision is made for phonograph pickup plug insertion. Thirteen output voltages are provided, including 300, 150, 75, 50 and an assortment of nine different voltages under 50 available for bias. All A, B and C voltages are provided for the power amplifier and for a tuner to be used with it employing 220, 224 or 228 tubes.

The Merston condenser, 415 volts DC, for filtering circuits of B supplies, Q-24, 2-18 B has four capacities in one copper casting: two 5 and 10 mfd., and two 20 mfd. The copper case is negative. The smaller capacities are nearer the edge of the case. The vent cap should not be disturbed, and the electrolyte needs no refilling or replacement.

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If B supplies Mershons are always used "they are the rectifier tube or tubes, hence where the current is direct. They cannot be used on alternating current. Rated 485 v. DC.

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<th>Product Code</th>
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<td>P0-245-PA</td>
<td>$43.57 net. for 200 cycles, 724 volt.</td>
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Order the Diamond Pair, Cat. DPS for .00035 mfd at $1.35

[Note: These came with flexible aluminum base, but are used for AC or battery type, excepting only screen grid tube.]

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For .0005 mfd order Cat. T4 at $0.90

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Circulation Dept., Radio World, 145 W. 45th St., N. Y. City.
Practical NR Circuits
Methods to Pursue in Non-Reactive Operation
By Randolph MacNamara

A PRACTICAL non-reactive detector and one-stage audio diagram is shown in Fig. 1. It is assumed there is a tuner available for connection thereto, the connection being made to the points marked “input.” The circuit was built of parts the author had on hand. The power transformer was intended for 112A output tubes in push-pull, and in full-wave rectification afforded 150 volts direct current, at the end of the filter system, but as can be seen this was changed, so that the 280 rectifier was used in half-wave fashion instead. This doubled the voltage. It was necessary to obtain higher voltage, since the total voltage is used in series distribution. It can be seen from the diagram that the voltage drop across the total of the resistance chain is the full 300 volts. The amplifier section of the present circuit is one of the problems of this type of circuit. In other circuits the voltages are, in general, in parallel.

FAMILIAR CIRCUIT MADE TO WORK

The tuner to be connected to this detector-amplifier circuit may be fed in the usual way, from the B supply shown, but the power transformer should have the filament winding for the 224 tube and for other tubes in the tuner. Otherwise the filament transformer for the 224 and 227 or other RF tubes used would have to be provided for total AC operation. Of course battery-operated filament tubes in the tuner could be used, with the B voltages for the filament taken from the present B supply by means of suitable resistors if the 300-volt post in one instance and to the plate returns and screen grid returns in the other. However, only two or three tubes should be used in the tuner, as the B supply intended is not designed to carry high current and still retain satisfactory filtration. It is better for the present to obtain B voltages independent of this B supply.

The idea embodied in the present circuit is a familiar one, as non-reactive circuits have been under discussion for years, but certain troubles have been encountered in them. Messrs. Lofflin and White have been studiously engaged on the elimination of these troubles, and have demonstrated circuits to the satisfaction of discerning engineers.

HOW MUCH VOLUME IS OBTAINED

As to performance, the circuit as shown amplifies much the same, in quantity, as other forms of one-stage audio following a detector. Therefore local stations may be tuned in with sufficient volume, if the RF amplification consists of two stages. The quality is good.

Hum is low, and is reduced considerably as the capacity of the reservoir condenser C4 is increased. In the experimental supply 1 mfd. for C4 proved wholly inadequate, while 4 mfd. was a good value. Next to the rectifier is C3, which should be 1 mfd. Note that the voltage is twice that which would be present in a full-wave rectifier, using the same high-voltage secondary. This doubling is obtained by use of the full winding, and disuse of the midtap. The-plates of the rectifier are connected together, which improves regulation. If you intend to experiment with an existing full-wave B supply to the present use, it is necessary to have

диаграмм
Pointers for Getting Results
Last Tube Should Be Regulated First, Then Its

condensers that will stand the higher voltage. In many instances, however, the previously used filter condensers will stand 400 volts AC, so note the rating and act accordingly.

GOOD DETECTION

The 224 is worked as a high gain detector. As is well-known, a detector tube will amplify, and an amplifier tube will detect. Nevertheless, a tube must be worked primarily as a detector or as an amplifier, and its operation is on the basis of a selected point on its characteristic curve. So soon as an attempt is made to compromise between detection and amplification, so that there will be the same action of both types, there is not much of either. Nevertheless some types of tubes are better detectors than others, also provide higher gain besides better quality. The choice in the present instance is of a power detector of the high-gain type for this sort of detection. The action is all in the direction of better detection, rather than being an attempt to compromise between detection and amplification.

As was said, the problem is to obtain the correct voltages. Titote familiar with standard hookups may find it difficult to work with direct coupled amplifiers, because while the basis of reckoning is the same, the application is different. Hence an analysis of the circuit is interesting.

Bear in mind that the plate voltage is that between cathode and plate return or between filament center and plate return, each tube to be reckoned independently.

Let us start from the point of zero potential and work along toward the maximum voltage of 300.

FIRST CRITICAL RESISTOR

First we have the 224 tube. Between its cathode and ground is connected a resistor, probably the most important resistor in the circuit, and surely one which, if improperly chosen, will defeat results. Low values will insure failure of operation. High values are necessary, because the higher the value, the higher the bias, the less the plate current through R5, and the lower the bias on the last tube, since its bias is derived from the voltage drop in R5. So if the drop is too much, the plate voltage on the last tube goes 'way up, while the current is reduced to almost zero, sometimes actually zero. This also upsets all the other voltages. For R1 use 50,000 ohms (0.6 meg.).

SECOND CRITICAL RESISTOR

The bias on the first tube being the voltage drop in R1, and the screen grid voltage being adjustable, the degree of bias may be regulated by the potentiometer, since the screen current must flow through R1, and it will change according to the screen voltage. This potentiometer requires critical adjustment, since detection is attained by proper adjustment, and no signals, only a hum, will be heard otherwise. However, if you desire to feed a detector into the 224, you may convert the 224 to an amplifier by adjustment of the potentiometer R2.

The very high detecting bias being required for keeping the current low through R5, it still must be maintained low if the tube is used as an audio amplifier, and one solution in that case

How to Adjust Non-Reactive Circuits for Operation

Due to unfamiliarity with non-reactive (NR) circuits the experimenter may find difficulty in obtaining any results whatsoever. He will succeed in getting the filaments to light and the maximum voltage to register, easily enough, but that is no solution by a long shot. Hence follow these directions:

Test the output tube first. Get it to produce the rated plate current at rated plate voltage.

If the maximum voltage registers, increase the bias on the preceding tube, also increase the value of the coupling resistor. In this way plate current can be made to flow at the desired value in the last tube. Too high voltage and no current mean too low bias.

Next turn to the preceding stage and adjust the screen grid voltage or increase the bias on the tube to obtain...
From Non-Reactive Circuits
Predecessor to Obtain Detection or Amplification

is to use a lower value for R5 than 5 meg., and another is to move the end of R5, whatever value is used, even if 5 meg. is retained, to the right, to the power tube's filament center tap. This decreases the bias on the last tube and increases the plate voltage on the 224.

Regarding the effectiveness of the voltages: the full 300 volts is effective here except across the voltage divider itself. This divider consisting of the resistor units already discussed. Read on a tube tester, or other meter servicing equipment plugged into the socket, the voltage on the last tube will be lower than the applied voltage by the drop in the choke coil Ch1. On the 224 the effective voltage is too low to give a reading and so is the current.

The last tube as a detector draws very little plate current, so little that you probably have no meter sensitive enough to measure the current, unless you have a 0-1 milliammeter. The plate current would be about .6 of a milliampere and the screen current about .2 milliampere, so the total would be less than 1 milliampere if rated voltages are used, which may be done, but the rated voltages do not give the best results in this circuit in connection with the screen grid tube. If any bias experiments are to be conducted in connection with this tube, the return of R1 may be moved over to the right, being tied to the potentiometer arm, or put at the right-hand end of R2 or at the power tube's filament center. The stated values in the list of parts are practical not experimental, in connection with Fig. 1.

One thing that must be remembered in this circuit is that the screen grid voltage on the first tube is determined so as to bring about the correct adjustment. Let us see how the various resistors in Fig. 2 may be determined and how they can be adjusted for satisfactory operation. It is well to state now that any particular values of resistors are not important, but the ratio of their values is essential.

INTERRELATION OF VOLTAGES

One thing that must be remembered in this circuit is that the voltages applied to the second tube are dependent on the screen, grid, and plate voltages on the first tube, and what is more, this fact which makes it important to adjust the circuit properly. For example, suppose the screen grid voltage on the first tube is determined using the grid current and the grid and plate voltages on the first tube, and that it is

APPORTIONING VOLATGES PROPERLY

Last week were published data on the non-reactive circuits that certainly started a great deal of interest in radio circles. Here is some additional information on the fundamental circuit.

There are many variations of this circuit, depending on the type and number of tubes used and the voltages available. In Fig. 2 is shown a two tube circuit in which the tubes are supposed to be one 224 and one 245. To make a circuit of this type function satisfactorily it is essential that the voltages be distributed properly. This statement can not be made too convincing.

In ordinary circuits voltages are not critical but in this type some of them are.

Hence the drop in R5 is small and it may then be that the total effective bias on the second tube is so slow that the plate current is excessive. Indeed, the plate current may be so large that the plate of the second tube is entirely stopped. On the other hand, if the new grid bias on that tube is so great that the plate current and therefore an increased drop in the coupling resistor R5. The increased drop is equivalent to an increased grid bias of the second tube, and it may be that the new grid bias on that tube is so great that the plate current in the second tube is entirely stopped. On the other hand, if the grid voltage is too high for the plate voltage and plate load resistance used, the only thing that will make the first tube amplify but it does so with a good deal of distortion.

QUESTION OF BIAS

Suppose the plate resistance R5 in Fig. 2 is 1 meg., and that the voltages on the first tube have been adjusted so that the plate current in the tube is 100 microamperes. The drop in R5 will then be 100 volts, 50 volts more than required for the bias on the second tube. But if the low end of R5 be returned to 10 meg. the 50 volts higher than the required plate current of the power tube, the effective value of bias on the second tube will be 50 volts, the correct value. This return not only adjusts the grid bias on the second tube but it adds 50 volts to the plate voltage on the first.

A SIMPLE TUNER FOR AMPLIFIER. THIS TUNER HAS TWO EQUAL TUNED CIRCUITS COUPLED TOGETHER WITH A SMALL CONDENSER.

It is true that more current flows through R7 than through R6, but the difference is only a small current of the first tube, which is negligible in comparison with the assumed current of 10 milliamperes.

We have used 250 volts of our available supply so that we have 200 volts left. This, however, does not mean that the plate voltage on the first tube is limited to something less than 200 volts. We can use more as we shall see. Now the question may arise as to the need of a higher voltage on the plate of the screen grid tube. Readers of Radio World who have followed articles concerning screen grid tubes in resistance coupling will know that it is desirable to use much higher applied plate voltages, as the need for high voltage has been pointed out repeatedly. It is also discussed at length in "Audio Power Amplifiers" by Anderson and Bernard. It is a fact that in non-reactive circuits it is sometimes necessary to compromise regarding that need.

(Continued on page 15)
Reactance Explained

Why a Condenser is Like a Rubber Band;

By J. E.

Technical

FIVE DIFFERENT SIMPLE CIRCUITS. (A) IS A NON-REACTIVE CIRCUIT, (B) A CIRCUIT HAVING INDUCTIVE REACTANCE, (C) ONE HAVING CAPACITIVE REACTANCE, (D) A CIRCUIT HAVING BOTH INDUCTIVE AND CAPACITIVE REACTANCE, AND (E) IS A CIRCUIT HAVING BOTH TYPES OF REACTANCE BUT IN WHICH THE CONDENSER CONNECTED IN SERIES, AND (E) IS A CIRCUIT HAVING BOTH TYPES OF REACTANCE BUT IN WHICH THE CONDENSER AND THE COIL ARE CONNECTED IN PARALLEL.

THE present interest in non-reactive, direct-coupled amplifiers has brought up the question as to when a circuit is reactive and when non-reactive. We shall try to explain under what conditions a circuit is non-reactive, that is to say, when it has no reactance.

There are two types of reactance, inductive and capacitive. Inductive reactance is akin to circuit inertia. It also requires an additional electric energy to change the direction or the intensity, of the current. Capacitive reactance is akin to compressive reactance or elastic reactance and is due to electric elasticity.

These statements are scarcely explanatory since the analogous concepts may not be any better understood by some than the electrical concepts. But let us try to expatiate on the statements.

Inertia is that property of a massive body by which that body tends to remain in its present state of motion or immobility when acted on by a force of any kind. Consider, for example, a person riding on a train. The person has mass and therefore inertia. When the train is at rest, the person also is at rest and tends to remain in that state of immobility. If the train suddenly starts the person tends to remain stationary and therefore will tend to fall in the direction opposite to that in which the train started. In every case the person tends to keep him going with the same speed and only force can prevent him from continuing. Sometimes this force may be fatal to the person.

RESISTS CHANGE OF VELOCITY

Inertia does not enter only when the train starts and stops, but whenever there is any change in the speed of the train or in the direction in which the train travels. For example, when the train slows down the person lurches forward and whenever the train accelerates he lurches backward. Likewise when the direction of the train changes one way or the other the person lurches sidewise in the direction opposite to that in which the train started. In every case the person tends to remain in his original state of motion or immobility. This statement includes changes of direction as well as absolute motion.

What is true of a person is true of every other body, living or dead, that has mass, or that weights something when put on a balance.

Inductance in electricity is analogous to mass in mechanics, and electric current is analogous to velocity. If there is inductance in a circuit it requires a force, or electromotive force, to start or stop a current in that circuit. It also requires an increased electromotive force to change the direction, or the intensity, of the current. The greater the inductance (electric mass) the greater the electromotive force required to produce a given change in the intensity of the current.

If the electromotive force is alternating rapidly, that is, alternating in one direction and then in the other, and there is an inductance in the circuit, the intensity of the alternating current resulting will be small because of the electric inertia. The larger the inductance the smaller the current.

THE MECHANICAL ANALOG

We might take a mechanical analog for illustration of this effect. Suppose we take a heavy ball or other body and swing it back and forth. The force exerted by the hand in swinging the body corresponds to the alternating electromotive force and the resulting motion of the body corresponds to the electric current. The heavier the body, that is, the more massive, the more difficult it is to swing the weight. The greater the inductance in the circuit the more difficult it is to change the alternating current.

ELASTIC REACTANCE

Capacitive reactance was likened to elastic reactance. Elasticity is the property of a body by which it resists changes in shape or volume provided that after the body has been deformed by a force it returns to its original shape or volume after the deforming force has been removed. A well known example of an elastic body is a rubber band. It may be stretched to several times its normal length by exerting a force, and when the force is removed it returns to its normal length. A steel wire helix is another well known elastic body. If the turns of the helix are close, the spring may be stretched and will return to its normal form as soon as the stretching force is removed. If the spring is not wound closely it may also be compressed, and after the compressing force has been removed the spring will lengthen to its normal length.

Even a straight steel wire may be stretched by exerting a force, and as soon as the force is removed the wire will return to its original length, provided that the stretching has not been overdone. Steel and other elastic substances also resist bending, twisting, and compression. When one of these bodies has been deformed by force in any one of these ways, within limits, it will return to its original shape or volume after the deforming force has been removed.

ELECTRIC ANALOGY

Gases are well known examples of substances which resist change of volume. It takes force to put more air, for example, into a confined space, such as an automobile tire. After the compression the force and the compression force is removed the excess gas in the confined space will immediately escape so that afterwards the gas occupies the same volume as it originally did.

An electric condenser that is charged is analogous to a vessel into which electricity may be forced or compressed. It is a sort of vessel for storing electric energy, but electric charge has the property of elasticity. It requires an electrical force to charge a condenser, and once a charge is produced in the condenser it resists the removal of the charge. Electric pressure and the resulting motion of the body corresponds to the electric current. The heavier the body, that is, the more massive, the more difficult it is to swing the weight. The greater the inductance in the circuit the more difficult it is to change the alternating current.

One who has pumped up an automobile tire by hand will know that at the beginning the work is easy. There is very little reactance. But as the pumping proceeds and the pressure increases in the tire, more force is required at each stroke. The amount of air that can be pumped in depends on the volume of the tire and on the force that is exerted. The analogy between the pneumatic and the electrical cases is
very close. If electricity is regarded as a gas the two become practically identical.

FURTHER SIMILARITY

Suppose air has been pumped into a bottle and the cork is suddenly removed. There is a pop which has a more or less definite pitch. That is, a sound of a certain frequency is produced a short period. This would not be possible were the air also possessed of inertia or mass. The air rushes out of the bottle at first with the circuit reactive of this nature. When the moving air keeps the air flowing after the pressures inside and outside have become equalized. It keeps flowing outward until the pressure inside is less than the pressure outside. Then it begins to rush in again. This inward and outward motion of air keeps up for a moment, giving rise to the musical quality of the pop. This oscillation is only possible because the air possesses both plasticity and inertia.

An electrical circuit comprising capacity and inductance behaves in the same way. The current rushes in and out of the condenser for a moment after the first discharge and it keeps up for a time depending on the amount of resistance in the circuit. The greater the resistance the shorter the time of oscillation.

SIMPLE CIRCUITS

In the figure above are five different simple electrical circuits. In each there is a source of alternating electromotive force e. This electromotive force drives a current through each circuit, but in each case the current has a different intensity because the reactances of the circuit are different.

In (a) we have a non-reactive circuit because there is only pure resistance in the circuit with the electromotive force. There is no reactance in the circuit since there is neither inductance (inertia) or capacity (elasticity). The energy is all dissipated in the resistance R and for that reason a non-reactive circuit is called a dissipative circuit.

In (b) we have an inductance in series with the electromotive force. This circuit has inertia reactance, the coil and the capacity reactance. For this reason the current will be small and it will be smaller the higher the frequency and the higher the inductance. It is then the flow of current is dependent on the frequency which makes reactive circuits undesirable in audio frequency amplifiers.

In (c) we have a simple reactive circuit comprising a condenser in series with the electromotive force. Since there is elastic reactance in this circuit the current will depend on the frequency and the alternating electromotive force. The larger the frequency the larger the current will be and also the higher the frequency the higher the current. Direct current will not flow at all and currents of very high frequencies will not be in at all in this circuit. Since the current depends on the frequency a circuit having condensers, or elastic reactance, is not desirable in an audio frequency amplifier.

MIXED CIRCUITS

The circuit in (d) contains both capacity and inductance in series with the electromotive force. What the current will be in this circuit depends on the frequency, the inductance and the capacity. For low frequencies the current will be mainly determined by the condenser, since the coil will not offer much reactance compared with the reactance of the condenser. At high frequencies the current will be mainly determined by the inductance, since the condenser will offer very little reactance.

When the frequency is such that the inductive reactance is equal to the capacitive reactance resonance will obtain and the current will be determined by the electromotive force and any resistance which may exist in the circuit, especially in the coil. At resonance the circuit is non-reactive and dissipative. The current will be very large in comparison with the current at frequencies off resonance. A circuit like that in (d) is used for tuning, that is, for selecting a current of one frequency and rejecting currents of all other frequencies. It cannot be used in audio frequency circuits where all audible frequencies are to be received with the same intensity. In the ordinary tuned circuit of this kind the electromotive force is usually introduced by induction into the coil L rather than as indicated. In either case the response of the current is practically the same.

PARALLEL RESONANCE

The circuit in (e) is known as the parallel tuned circuit where the inductance and the condenser are connected in parallel with the electromotive force. This circuit is known as the parallel tuned circuit since the frequency at which a circuit motorboats or at which the current through the source of electromotive force is zero or minimum and the current in the condenser and the coil maximum. The impedance presented by the condenser and the coil to the source of electromotive force is a pure resistance of exceedingly high value. The voltage across either the condenser or the coil is very high.

The reason the currents in the coil and the condenser can be very large and the current in the source of electromotive force very small is that the currents in the coil and the condenser are out of phase. They neutralize each other as far as the current through the generator is concerned.

The circuit in (e) is used frequently in radio receivers. In fact it is used in all tuners, either in the primary of the secondary. Suppose e is the effective signal voltage in the plate circuit of an amplifier tube. Then the circuit represents the tuned plate method of coupling in receivers. If e represents the voltage developed across the secondary of a radio frequency transformer and if this condenser is connected to a grid circuit of a tube, the figure represents the ordinary tuned circuit in most receivers.

EXAMPLES OF REACTANCES

Tuning in radio receivers is done exclusively by reactances. In every case an inductive reactance is balanced against a capacitive reactance, and in most cases the capacitive reactance is varied to bring about resonance. If the receiver contains many tuners in tandem there are also many pairs of reactances that must be equalized to effect tuning. This is sometimes done by adjusting the capacitive reactances one at a time and sometimes all at once, as in gang controlled receivers.

In audio frequency amplifiers there should not be any reactances of either kind, because any reactance will introduce frequency discrimination which will mar the quality. Yet in nearly all cases some reactances must be used to make the circuits practical.

There should, for example, be a small by-pass condenser in the plate circuit of the detector. This lowers the output at the high audio frequencies to some extent. Then in many circuits, stopping condensers are inserted between the plate of one tube and the grid of the next, or between the plate of the power tube and the loudspeaker. These condensers lower the output of the low frequencies. The smaller these condensers the more do they suppress the low notes. In some circuits now being popularized most of the stopping condensers are eliminated with considerable gain of the low note output. In radio and motor boats and long distance used for coupling, additional reactances are introduced into the amplifier, both inductive and capacitive, the capacitive reactances being due to stray capacities across the windings. The coupling reactances discriminate against the low notes and the distributed capacity reactances against the high. The effect is much the same as tuning, only that the selectivity, that is to say, the discrimination, is not so great.

BY-PASS CONDENSERS

Even in the so-called non-reactive circuits by-pass condensers should be used for best results, but these introduce reactance which is discriminatory to some extent. But it is better to use them and suffer the discrimination than to omit them and have a circuit that does not amplify well. It is well to remember then the larger any condenser the lower is its reactance.

The condensers and chokes in the supply have reactance and consequently affect the frequency characteristics of any amplifier connected to it. These reactances have much to do with the frequency at which a circuit motorboats or at which it blasts in case the feedback is not sufficient to sustain oscillation.
Repeat Tuning on TRF
Amplifiers Act as Stray Detectors and Sensitive

By Neat

A RADIO FREQUENCY TUNER AND AMPLIFIER IN WHICH THE ANTENNA IS COUPLED TO THE CIRCUIT BY MEANS OF A CHOKE COIL Ch. RECEPTION OF THE SECOND HARMONIC MAY BE QUITE STRONG.

THE CAUSE OF REPEATS
What is the cause of the dual reception? Certainly we cannot ascribe it to the oscillator as is done in the Superheterodyne, because receivers which do not oscillate at all are subject to this diffusion and operators of such receivers do not expect dual or multiple response. But the fact is that many modern receivers do pick up stations at two points on the tuning dial, one point where the station is normally expected, and another point of lower wave length end of the scale. "I receive WGY at two different points. It's a common complaint. "What can be done about it?"

Of course, all do not complain to receiving WGY at two separate points. Naturally, there are many who have noticed this phenomenon before and some are likely to have come in at two different points, and any station close to the receiver is likely to come in strong at two different points.

THE EXPLANATION
As a matter of theory there are two possible explanations. The second tuning point on the ordinary receiver is usually comes on in at least two different tuning points scattered over the dial.

The lowest broadcast frequency is 550 kilocycles and the tuning range of the receiver is from 550 to 1,770 kilocycles. Therefore the station that sends out a strong wave in the first point will come in rather than a weak station at two different points, and any station close to the receiver is likely to come in strong at two different points.

Screen Grid Tubes Detect
It has been asserted that all broadcast stations are tuned in to the third harmonic of the carrier frequency of a station and double it. If the receiver is tuned to the double frequency the second harmonic is single out and amplified by the tubes just as if the receiver were tuned to the carrier. Therein lies the explanation of most of the trouble.

TRACING THE CAUSE
Suppose the input circuit of the receiver is untuned. All carrier frequencies are then doubled and the first tube with practically the same intensity that exists about the antenna. Since the first tube detects a little, besides amplifying considerably, there will be a dual of the second harmonic frequency in the plate circuit of the tube.

Now for the first time does the receiver come into play, but now it is too late, since the harmonic frequency already has been generated.

When the receiver is tuned to the second harmonic, it receives this just as if the plate circuit of the first tube were cut off. The first tube singles out the second harmonic and the second tube amplifies it. The second tube continues the selection and the third tube the amplification. And so the selection and the third tube the amplification. And so the selection and the third tube the amplification. And so the selection and the third tube the amplification.

The second harmonic of a station operating on 880 kilocycles will be received at the extreme end of the dial, since twice 880 is 1,760.

RECEPTION ON THIRD HARMONIC
It is quite possible to receive some broadcast stations on the third harmonic as well as on the second, for the third is often more intense than the second. Suppose, for example, that the tube better known as the detector, contributes to the second harmonic, the detector, contributes to the second harmonic, the detector, contributes to the second harmonic.

Moreover, the energy sent out on the second harmonic by the station is 2,340 and the broadcast stations are great enough to cause the second tuning most of the trouble, is small so that not even the most sensitive receiver made will pick it up and make it audible, except possibly when the receiver is very close to a broadcast station.

Therefore there must be another effect which gives a better explanation. And there is.

It is known that every amplifier tube, no matter how well it has been adjusted to the receiver, is likely to cause much interference unless it should happen that the output is magnified by all the succeeding radio frequency tubes.

Screen Grid Tubes Detect
It has been asserted that receivers incorporating several screen grid tubes are more subject to dual response effect than receivers having an equal number of three-element tubes and the same number of tuned circuits. That this assertion is supported is clear from the fact that screen grid tubes are normally operated as amplifiers so that the stray detection is prolific. Then, again, screen grid tubes amplify more, so that any second harmonic component that may have gotten into the circuit will attain much higher intensity than in a circuit of three-element tubes.

Just what broadcast stations may be expected on two points on the dial? The lowest broadcast frequency is 530 kilocycles and the frequency of its second harmonic is 1,100 kilocycles. Thus this should appear not far from the center of the dial, the center being on an average at about 930 kilocycles. If the receiver tunes up to 1,760 kilocycles, which it well may, the second harmonic of a station operating on 880 kilocycles will be received at the extreme end of the dial, since twice 880 is 1,760.
Receivers and Its Cures
Circuits Pick Up Odd Interference

Just as the grid bias was reduced to the second tube to a value which would put that tube in the best operating condition so the bias on the first tube may be reduced in the same manner. Hence the screen voltage should be 50 volts or somewhat less. The value of R2 in Fig. 2 can be determined approximately by assigning a desired grid bias and using the known current in the resistor. Suppose we want a bias of 1.5 volts. The drop in R2 must then be 6.65 less 1.5, or 5.15 volts. Now the current through R2 is practically the current in the plate circuit of the power tube plus the current through R6 and R7, that is, 42 milliamperes. The currents diverted by the plate and the screen of the first tube is negligible. Hence the value of R2 should be about 12 ohms.

The voltage on the screen is the sum of the drops in R2, P1 and R3 diminished by the drop in R1, or according to the figures derived and it is less by 1.5 volts than the sum of the drops in R3 and P1. We may assume a screen grid voltage one-third of the first tube is negligible.

Just as with an ordinary receiver or a Super -heterodyne, the trouble should be responsible for a screen grid voltage of 75 volts which was determined by the actual circuit in Fig. 1. Hence the value of R4 should be about 3,750 ohms. Now it is a reasonable certainty that when these resistors are put into the circuit the adjustment will not be perfect but it will fairly close and they will give a good start toward experimental adjustment. Difference in tubes will make such adjustments necessary in any case, and possibly the best two values to adjust experimentally are those of R3 and R6, that is to say, the current flowing through the resistors we can determine the values of P1 and R3. The current, as we have assumed, is 42 milliamperes. Therefore the sum of these two resistors should be 1,071 ohms, or 1,000 for simplicity. The potentiometer P1 can account for 200 volts of this resistance and R3 the rest. Hence the value of R4 should be 3,750 ohms.

Now it is a reasonable certainty that when these resistors are put into the circuit the adjustment will not be perfect but it will fairly close and they will give a good start toward experimental adjustment. Difference in tubes will make such adjustments necessary in any case, and possibly the best two values to adjust experimentally are those of R3 and R6, that is to say.

Adjustments to Make in Non-Reactive Circuits

(Continued from page 11)

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The Popular PPPA
Chassis Construction Lends Beauty

By Capt. P. E. Loftin

The height is 7 inches, the width or direction in which the sockets run, is 12 inches, and the depth is 10 inches. These are overall dimensions.

On top are the power transformer, Merson charger of two 8 mfd., and two 18 mfd., the sockets, output device and binding posts. Beneath are the filter and bypass condensers, and voltage divider.

Thus the assembly is decidedly attractive to the eye, and the tone quality will no be less attractive to the ear, provided a good push-pull input transformer is used. This transformer you are asked to select for yourself, or you may use one you have.

Five Voltages Selected

Five positive voltage binding posts are provided, and these may be used for bringing out the voltages you need, since the voltage divider provides a plentiful assortment. Of the group, 3, 6, 10, 16, 22, 50, 75, 90, 135 and 180, ten different voltages, the diagram suggests 3, 6, 50, 135 and 180 as the five, since these are most suitable for high-gain screen grid receivers.

The bias of 3 volts is really 1 to 3, being taken care of by a resistor adjustable from the top of the subpanel with a screwdriver. This resistor is a Clarostat "humdinger," one terminal connected to the low end of the voltage divider, the other Clarostat terminal to grounded B minus. This bias is used for 224 RF tubes.

Advantages Listed

The PPPA has the following features:

(1)—Filament voltage for 245's in push-pull and for 280 rectifier; heater voltage for 224's and 228's, up to six such tubes, including the 227 in the PPPA.

(2)—Plate voltage of 250 for the power tubes, with 50 volts bias to spare, total 300 volts at 80 wa., with intermediate B voltages.

(3)—All the bias voltages will you require.

(4)—Phonograph pick-up jack.

(5)—Post for detector (input) and two posts for speaker (output).

(6)—About 60 mfd. of filter and bypass capacity.

(7)—As good an audio channel as can be built in a reactive circuit, with large undistorted power output.

(8)—Good appearance.

LIST OF PARTS

C1—One .0025 mfd. mica condenser.
C2—One .01 mfd. mica fixed condenser.
C3, C4—Two 1 mfd. filter condensers, 1000 volts DC continuous working voltage rating, 550 volts AC (root means square) continuous working voltage rating.
C5, C6, C7—Four Murash condensers in one copper casing, two of 8 mfd. and two of 18 mfd., with low bracket. Cat. QZ-8, 2-18B.
C9, C10—Two 1 mfd. bypass condensers, 200 volts DC continuous working voltage rating.
T1—One Polo Filament-Plate-Choke Supply; 110 volt 50-60 cycle primary, 724 volt secondary center-tapped, 5 volt 2 amp. secondary center-tapped; 2.5 volt 3 ampere secondary center-tapped, and 25 volt 12 ampere secondary center-tapped. Cat. PFPCH. Note, for 25 cycles use Cat. PFPCH-25, for 40 cycles use PFPCH-40.
PPOC—One Polo output choke for push-pull (Cat. PPOC).
PPIT—One push-pull input transformer (select one you prefer).
SW—One AC pendant through-switch, with 12-ft. AC cable and male plug.
P—One 2 ampere fuse, with holder.
CO—One convenience outlet for dynamic speaker AC cable.
PJ, PJS—Phonograph pick-up jack with automatic switch.
R1—One Lynch metallized resistor, 0.1 meg.
R2—One Lynch metallized grid leak, 5.0 meg.
R3—One Multi-Tap Voltage Divider, 13,850 ohms, fourteen taps.
R4—One 30 ohm Clarostat Humdinger.

F—Two resistor mountings.
Six binding posts (Det., five blanks).
Speaker output jacks in bakelite assembly.
One cadmium plated steel chassis, with self-bracketing flanges, one five-prong and three four-prong sockets built in; sockets marked to identify tubes that go in them; subpanel drilled and insulated where necessary.
One base cover for chassis, with six bolts and six nuts.
Four tubes one 280, one 227, two 245.
Our New, Pretty Dress

To A, B, C, Supply for 245 Output

W. O'Rourke

Editor

(9)—Compactness, enabling installation in "tight" consoles or even in a table model receiver that has 12 inch cabinet depth (front to back) or accommodation to 10 inch cabinet depth if there is enough space to put the 12 inch stretch in the direction of the front panel.

(10)—Economy.

The filter system uses a 1 mfd. paper dielectric condenser of 1,000 volts DC continuous working voltage rating. 550 volts AC, root mean square, next to the rectifier and another at the midsection of the filter chokes PC. The first condenser has an effect on the output voltage, and only 1 mfd. is used here because the voltages are satisfactory under the circumstances and the hum is less. Anyone desiring to increase the voltage applied to the push-pull pair may put another 1 mfd. condenser in parallel with the prescribed capacity, making certain, however, that it is of the same high voltage rating. Do not put a 200 volt DC bypass condenser in this position, as it will break down at once.

Chassis Ground and Negative B

The filter chokes, two windings to be interconnected to constitute the mid-section, is inside the power transformer base.

As the chassis should be grounded, this connection is most easily made by putting a lug on the machine screw that holds down one side of the bracket of the Mershon condenser, and connecting a wire from one of the terminals of the paper condenser to the lug. The Mershon condenser provides almost all of the capacity used in the filter. This particular Mershon is the one having two anodes of 8 mfd. each and two of 18 mfd. each. The catalogue number, including bracket, is Q 2-8, 2-18 B.

The different capacities of the Mershon condenser may be distinguished easily. The smaller capacity is nearer the edge of the copper casing and the larger capacity is nearer the center. The anodes, represented by lugs on the insulated top of the casing, are positive. Attachment of the bracket to the chassis, which is of steel, takes care of grounding the Mershon properly to negative, provided negative of the B supply is connected to the chassis.

One 8 mfd. section is used as the condenser across the 1 P bias (1 to 3 volts), one 18 mfd. as the "reservoir" condenser at the filter output, the other 18 mfd. to bypass 180 volts and the remaining 8 mfd. across the 50-volt bias section.

The same voltage of 50, used negatively for biasing these particular tubes, is available as a positive screen voltage for screen grid tubes, or for plate voltage for the grid-leak-condenser detector tube. This seeming double utility arises from the fact that the heater circuits are independent of the cathode, grid and plate circuits of the 227, 224, and 228 tubes, and of course are independent of the filament circuit of the two 245s.

The intermediate voltages (other than 50) are bypassed by 1 mfd. 200 volt condensers, of which four are used. If sub- stitute intermediate voltages are preferred, move the bypass condenser over to the next section of the divider, or if additional output voltages are required, bypass each of such with 1 mfd., also, obtaining the extra condensers and binding posts additionally.

Voltage Determinations

By using a high resistance voltmeter you may determine the voltages by simple measurement, and without calculation of voltage drop on the basis of known values of resistance and the current flowing through each section of the divider. The values of current are different in each section. Through all sections flows the bleeder current, a little less than 22 milliamperes, when the power amplifier is worked with an average tuner.

If the bleeder current is measured when there is no load on the rectifier except the Multi-Tap Voltage Divider itself, the reading will be in excess of 22 milliamperes, because the voltage is higher than 300 across the divider. This is due to the load total current. The more current drawn, the lower the voltage, principally because of the regulation of the rectifier tube, the resistance of which increases with increase in current.

The plate current of the audio amplifier tube or of the audio and radio amplifier tubes and detector is drawn from the power amplifier, it is impossible to read the bleeder currents separately, as there is only one current flowing through each section of the voltage divider. This is the sum of the bleeder current and plate currents.

However, with the voltage across the two extreme terminals known, and the total resistance of the Multi-Tap Voltage Divider being 13,850 ohms, the current is calculated as 300 divided by 13,850, or about .022.

The Multi-Tap Divider consists of two enamelled wire-wound resistors, on separate cores, mounted one above the other on supporting end-brackets, and connected in series. This connection is made at the factory. The entire unit is tapped in resistance steps as follows: 3,000 ohms, 4,500, 2,000, 800, 700, 600, 550, 500, 450, 400, 200, 100, and 50. The zero lug is the fourteenth and goes to the Clarostat. The "low" end is therefore the one where the tops are closer together.
For example, suppose the total available voltage is only 250 volts. It is assumed that all the voltages and how they resulted from a special B supply unit, and there was hardly any hum. These tubes should have 250 volts on the plates and 50 on the grids. These tubes require 450 volts on the plates and 84 volts on the grids. Few B supply units give this voltage, so when the total voltage available is less than 500 volts it would pay to use a separate C supply. It should be noted that it costs practically nothing to operate a C supply, giving 84 volts or more and it costs an appreciable amount to get 84 volts from the regular high power B supply. For example, suppose the receiver contains 250 tubes, which draw a plate current of 110 milliamperes. Since the bias required is 84 volts the power consumption for the C supply alone is 9.24 watts. The same voltage could be obtained from a C supply with less than a watt.

DIVERGENCE OF OPINION

I READ RECENTLY in a book on radio that resistance coupled amplifiers are the most stable of all audio amplifiers. Also I have read on numerous occasions that the resistance coupled amplifier is the most unstable. It does not seem to me that both statements, which are diametrically opposed, can be true. What is your opinion?—V. O. S.

Possibly you read a statement that resistance coupled circuits are probably the most stable because the coupling resistors are non-reactive. The other, and opposing, statements were undoubtedly more positive and based on experimental evidence. There is scarcely a resistance coupled amplifier that does not oscillate at some frequency, unless special precautions have been taken. Transformer and impedance coupled amplifiers are quite often stable without special treatment. It is assumed that the transformers are operated by the same B supply, one at a time, in making this comparison. So the conclusion would seem to be that resistance coupled amplifiers are the most unstable. This conclusion is not based on the probable effect of a reactance but on general experience.

CAPACITY BETWEEN WINDINGS

I HAVE BEEN informed that the capacity between the primary and secondary of a radio frequency transformer reduces the amplification and that only when this capacity is negligibly small can full gain be obtained. If that is true, will you kindly tell how to reduce the capacity between the windings?—J. A. F.

It is true, as was abundantly proved by a well-known radio frequency transformer. Since the capacity depends on the dimensions of the conductors involved, one way of reducing the capacity between the windings is to make the primary, if untuned, of very fine wire. Since capacity also depends on the distance between the conductors involved, another way of reducing the capacity is to put the two windings far apart. This is limited practically by the fact that the farther the windings are apart the more is the amplification reduced by virtue of loose coupling. One way is to bunch the primary wires in a slot in such a manner that each turn is coupled inductively most effectively to the secondary, that is, putting the primary near the center of the secondary, with an appreciable distance between the turns of the two. Still another way is to put the primary turns in a flat coil, pancake form, and placing it in the middle of the secondary.

CONSTRUCTION OF C BATTERY ELIMINATOR

WOULD it be worth while to build a C battery eliminator operating on the same principle as the ordinary B supply unit for a receiver using 245 power tubes? Would it be worth while when using 250 power tubes?—W. C. K.

The only object of building a C supply would be to obtain the C potential required without robbing the plate circuits of voltage. For example, suppose the total available voltage is only 250 volts and 245 power tubes are used. These tubes should have 250 volts on the plates and 50 on the grids. Obviously, a total of 250 will not supply both. In this case it would be worth while to build a C supply, provided that the 250 volt power supply is large enough to handle the circuit. Otherwise it would be necessary to get another B supply, one which gave a total of 300 volts. With this it would not be necessary to use a separate C supply. The situation is somewhat the same with 250 power tubes. These require 450 volts on the plates and 84 volts on the grids, a total of 534 volts. Few B supply units give this voltage, so when the total voltage available is less than 500 volts it would pay to use a separate C supply. It should be noted that it costs practically nothing to operate a C supply, giving 84 volts or more and it costs an appreciable amount to get 84 volts from the regular high power B supply. For example, suppose the receiver contains 250 tubes, which draw a plate current of 110 milliamperes. Since the bias required is 84 volts the power consumption for the C supply alone is 9.24 watts. The same voltage could be obtained from a C supply with less than a watt.

REDUCING STATION INTERFERENCE

IN MY PRESENT location on Long Island I am troubled considerably by interference from a local high power station. Can you suggest how to get rid of it?—H. B. G.

If it is the station you want to get rid of, you have two courses open, move the station or move the set. If neither is practical you might try to eliminate the signal from the station. One way of doing this is to get a more selective set, or above the interfering station. One way is to tune the trap to the interfering signal. An alternative connection is to put a second winding of about 10 turns on the form and connect this small winding in series with the antenna, tuning the trap to the interfering signal. Close tuning is necessary. The trap will help a great deal. You should use about 40 turns.

EFFECT OF LONG FILAMENT LEADS

THE MEASURED voltages across the terminals of my filament transformer is slightly over the rated values but the voltages across the leads measured between the plate terminals of the tubes is much below normal, and for that reason the performance of my set is not satisfactory. What is the cause of the difference in the voltages and how can it be remedied?—N. L. W.

The difference, of course, is due to the voltage drop in the leads between the transformer and the tubes and the remedy is to reduce the resistance in these leads. This reduction may be effected either by making the leads heavier wire or by making them shorter. Making both of these changes would be desirable.

SPEAKER HUM REMOVED

RECENTLY I bought a receiver in which there was provision for the field of a 90-volt dynamic speaker. I connected a 100 volt binding post provided and the result is a terrific hum which can be heard even with loud sounds. I had used the same speaker before, taking the field current from a special B supply unit, and there was hardly any hum. What little there was could only be heard close to the speaker. What is the trouble and how can it be remedied?—H. A. D.
The field current supplied by the new receiver is not filtered well enough. It may be that the filter in the B supply becomes overloaded when the extra current is taken. The remedy is to provide additional filtering. A large by-pass condenser across the field winding may be sufficient, but it may be that you also have to use a choke coil in series with the field winding. Why not continue to use the B supply unit that did provide adequately filtered field current?

COMBINING AC AND DC

IS IT POSSIBLE to build a receiver so that DC is used on the filaments of the radio frequency amplifier and the detector and AC on the filaments of the audio frequency tubes? Would there be any advantage in arranging a circuit in this way?—A. G. C.

It is perfectly feasible to arrange a circuit that way, and many receivers are so built. Using DC up to and including the detector may make it easier to eliminate hum, but otherwise there is no advantage. It would be much simpler to use AC throughout.

POLARITY TESTS

CAN YOU SUGGEST any methods of testing the polarity of voltage sources, such as that of the DC power supply?—W. J. S.

One of the simplest polarity testers is a glass of water in which a small quantity of salt has been dissolved. Put the two terminals in the water, as far apart as practicable. Bubbles will appear around both terminals but there will be twice as many around the negative. Another simple test is one involving the use of a raw potato. Cut a potato into two and insert the two terminals into one of the cut surfaces. Around the positive terminal a green spot will form. There is also a tester available which works on the principle of the neon cell. The device has two neon cells, and it is arranged so that when the device is connected across a DC voltage source one cell lights up, indicating the polarity. If the device is connected across an AC voltage both cells light up. The radio tubes of the devices got out.

RESISTANCE-COUPLED RF

W OULD IT BE practical to use resistance coupling and screen grid tubes in the radio frequency amplifiers? I am desirous of building an amplifier of this type provided that it would be satisfactory.—E. A. B.

It would not be satisfactory. In the first place even screen grid tubes do not work efficiently in resistance coupled circuits at high frequencies and in the second there would be no selectivity. There would be a good deal of detection in the RF amplifier which would give rise to repeated tuning.

IMPEDEANCE-COUPLED AMPLIFIER

I S IT POSSIBLE to get as good quality with impedance-coupled audio as with resistance coupled circuits? Are there any advantages of impedance aside from quality over resistance couplers?—W. C. C.

There is very little difference between the quality of output of the two types of couplers provided that the impedances of the impedances are high. The quality from a resistance coupler is slightly better at the low frequencies. Impedance couplers have certain advantages. Both types of amplifiers are subject to the same disadvantages and impedance coupler must much more than resistances. They also occupy more space in the set and an impedance coupled circuit takes more plate current.

THE MORGAN AMPLIFIER

S OME TIME AGO you published a type of circuit which you call the Morgan amplifier. Have you tested this amplifier critically and is it as good as claimed? Have you had any reports on the circuit, favorable or otherwise?—J. J. R.

The circuit was developed by Prof. Morgan who knows his subject thoroughly. The circuit is correctly designed. We have had no unfavorable reports whatsoever, but we have had some very enthusiastic reports. One who built the circuit reported that before he could get satisfactory results he had to make minor changes in the voltages after he had made these changes the circuit was by far the best he had ever listened to. That changes are necessary at times is clear from the fact that tubes vary. It is necessary to make small changes in the voltages to compensate for these differences. But they are easily made.

GET A NEW B SUPPLY

I HAVE A B supply unit which I used with an old five-tube receiver. It gave good service on the old set and I am now wondering whether it will work the MB-29 tuner and an audio frequency amplifier using two 245s in the last stage. What do you say?—A. B. Q.

Since you said nothing as to what B supply unit you had we can only guess as to its adequacy in the new receiver. Our guess is that it will be sadly lacking in power and that the results with the new combination will not be as good as those with the old. By all means get a B supply which is able to handle the MB-29 and the power amplifier. Since you have the old B supply, you might try it on the new combination before you get the new B supply. Undoubtedly you will find that a substantial B supply is a good investment.
The Popular PPPA Amplier and Power Supply

The standard push-pull power amplifier using a resistance coupled first stage of audio and a transformer—coupled 245 push-pull output is shown in a new physical dress. The circuit is an A, B and C supply of well-established authenticity, and the dress is made good-looking at last.

**LIST OF PARTS**

- C1—One .0025 mfd. mica condenser.
- C2—One .01 mfd. mica fixed condenser.
- C3, C6, C7, C8—Four Mershon condensers in one copper casing, two of 8 mfd. and two of 18 mfd., with low bracket. Cat. Q2-8, 2-18B.
- C9, C10—Two 1 mfd. bypass condensers, 250 volts DC continuous working voltage rating.
- T1—One Polo Filament-Plate-Choke Supply; 110 volt 50-60 cycle primary, 224 volt secondary center-tapped, 5 volt 2 amp. secondary center-tapped; 2.5 volt 3 ampere secondary center-tapped, and 25 volt 12 ampere secondary center-tapped. Cat. PFPCH. Note, for 25 cycles use Cat. PFPCH-25, for 40 cycles use PFPCH-40.
- PPOC—One polo output choke for push-pull (Cat. PPOC).
- PPIT—One push-pull input transformer (select one you prefer).
- 5W—One AC pendant through-switch, with 12-ft. AC cable and male plug.
- F—One 2 ampere fuse, with holder.
- CO—One convenience outlet (for dynamic speaker AC cables).
- PJ, PJ—Phonograph pick-up jack with automatic switch.
- R1—One Lynch metallized resistor, 1/2 meg.
- R2—One Lynch metallized grid leak, 50 meg.
- R3—One Multi-Tap Voltage Divider, 13,850 ohms, fourteen taps.
- R4—One 30 ohm Clarostat Humdinger.
- Two resistor mountings.
- Six binding posts (Det, five blanks).
- Speaker output jacks in bakelite assembly.
- One cadmium plated steel chassis, with self-bracketing flanges, one five-prong and three four-prong sockets built in; sockets marked to identify tubes that go in them; subpanel drilled and insulated where necessary.
- One base cover for chassis, with six bolts and six nuts.
- Four tubes one 226, one 227, two 245.

**Connections Diagram of the PPPA Amplifier and Power Supply**

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**Five Voltages Selected**

- (1)—Filament voltage for 245s in push-pull and for 280 rectifier; heater voltage for 224s, 228s, up to 25 cycle primary, 50 volt secondary center-tapped, 5 volt 12 cycle primary, 724 volt secondary center-tapped, 5 volt 60 cycle primary, 135 volt secondary center-tapped, 5 volt 60 cycle primary, 180 volt secondary center-tapped, 5 volt 60 cycle primary, 180 volt secondary center-tapped. Cat. PFPCH. Note, for 25 cycles use Cat. PFPCH-25, for 40 cycles use PFPCH-40.
- (1)—One polo output choke for push-pull (Cat. PPOC).
- (1)—Filament voltage for 245s in push-pull and for 280 rectifier; heater voltage for 224s, 228s, up to 50 volt secondary center-tapped, 5 volt 12 cycle primary, 724 volt secondary center-tapped, 5 volt 60 cycle primary, 135 volt secondary center-tapped, 5 volt 60 cycle primary, 180 volt secondary center-tapped, 5 volt 60 cycle primary, 180 volt secondary center-tapped. Cat. PFPCH. Note, for 25 cycles use Cat. PFPCH-25, for 40 cycles use PFPCH-40.
- (2)—Plate voltage of 250 for the power tubes, with 50 volts bias to spare, total 300 volts at 80 wa., with intermediate B voltages.
- (3)—All the bias voltages you will require.
- (4)—Phonegraph pick-up jack (Cat. PPOC).
- (5)—Post for detector (input) and two posts for speaker (output).
- (6)—About 224 RF tubes.
- (7)—As good an audio channel as can be built in a reactive circuit, with large undistorted power output.
- (8)—Good appearance.

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**Right on**

- (1)—In the Loftin-White direct-coupled circuit the grid of the second tube is positive because it is connected to the same point as the plate of the preceding tube.
- (2)—When a screen grid tube is used in resistance coupling with a moderately high voltage on the plate the screen grid voltage should be high in order to make up for the difference.
- (3)—In a screen grid tube the voltage drop in the coupling resistor is of no practical importance, the applied voltage alone being important.
- (4)—AC hum in a receiver can be balanced out, under certain conditions, by introducing a suitable amount of hum into the grid circuit.
- (5)—A hot soldering “iron” is the best assurance of good soldered joints.
- (6)—Overheating of the soldering “iron” is one of the chief reasons why melted solder will not flow into the joint.
- (7)—Equality of all inductance coils and equality of rate of change of all condenser capacities are essential for successful ganging of several tuned circuits.
- (8)—To make ganging of several tuned circuits really effective there should be one capacity trimmer and one inductive trimmer in each circuit.
- (9)—In order to check the frequencies of broadcast stations against a standard crystal oscillator it is necessary to have one standard for each channel.

**ANSWERS**

- (1)—Wrong. The screen grid voltage must be lowered rather than raised.
- (2)—Wrong. The grid is negative by the amount of steady drop in the coupling resistor or by a less amount depending on the return of the plate of the first tube relative to the cathode of the second.
In a New, Pretty Dress

to A, B, C, Supply for 245 Output

V. O'Rourke

Editor

January 25, 1930

17

RADIO WORLD

Wrong?

Voltage Determinations

By using a high resistance voltmeter you may determine the voltages by simple measurement, and without calculation of voltage drop on the basis of known values of resistance and the current flowing through each section of the divider. The values of current are different in each section. Through all sections flows the bleeder current, a little less than 22 milliamperes, when the power amplifier is worked with an average tuner.

If the bleeder current is measured when there is no load on the rectifier except the Multi-Tap Voltage Divider itself, the reading will be in excess of 22 milliamperes, because the voltage is higher than 300 across the divider. This is due to the low total current. The more current drawn, the lower the voltage, principally because of the regulation of the rectifier tube, the resistance of which increases with increase in current.

When the plate current of the audio amplifier tubes or of the audio and radio amplifier tubes and detector is drawn from the power amplifier, it is impossible to read the bleeder current separately, as there is only one current flowing through each section of the voltage divider. This is the sum of the bleeder current and plate currents.

However, with the voltage across the two extreme terminals known, and the total resistance of the Multi-Tap Voltage Divider being 13,850 ohms, the current is calculated as 300 divided by 13,850, or about 0.02.

The Multi-Tap Divider consists of two enamelled wire-wound resistors, on separate cores, mounted one above the other on supporting end-brackets, and connected in series. This connection is made at the factory. The entire unit is tapped in resistance steps as follows: 3,000 ohms, 4,500, 2,000, 800, 700, 600, 550, 500, 450, 400, 200, 100 and 0 ohms. The zero lug is the fourteenth and goes to the Clarostat. The "low" end is therefore the one where the tops are closer together.
INDLY SHOW a circuit diagram illustrating how radio frequency chokes and by-pass condensers should be connected when it is desired to take utmost precautions in isolating the several stages with respect to feedback. The circuit in Fig. 824 illustrates a case of thorough filtering to prevent feedback both at radio and audio frequencies. This might serve as a model.

**DIVERGENCE OF OPINION**

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I HAVE BEEN informed that the capacity between the primary and secondary of a radio frequency transformer reduces the amplification and that only when this capacity is negligibly small can full gain be obtained. If that is true, will you kindly tell how to reduce the capacity between the windings?—J. A. F.

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**CONSTRUCTION OF C BATTERY ELIMINATOR**

W OULD it be worth while to build a C battery eliminator operating on the same principle as the ordinary B supply unit for a receiver using 245 power tubes? Would it be worth while when using 250 power tubes?—W. C. K.

The only object of building a C supply would be to obtain the C potential required without robbing the plate circuits of voltage. For example, suppose the total available voltage is only 250 volts and 245 power tubes are used. These tubes should have 250 volts on the plates and 50 on the grids. Obviously, a total of 250 will not supply both. In this case it would be worth while to build a C supply, provided that the 250 volt power supply is large enough to handle the circuit. Otherwise it would be necessary to get another B supply, one which gave a total of 300 volts. With this it would not be necessary to use a separate C supply. The situation is somewhat the same with 250 power tubes. These require 450 volts on the plates and 84 volts on the grids, a total of 534 volts. Few B supply units give this voltage, so when the total voltage available is less than 500 volts it would pay to use a separate C supply. It should be noted that it costs practically nothing to operate a supply giving 84 volts or more and it costs an appreciable amount to get 84 volts from the regular high power B supply. For example, suppose the receiver contains two 250 tubes, which draw a plate current of 110 milliamperes. Since the bias required is 84 volts the power consumption for the C supply alone is 9.24 watts. The same voltage could be obtained from a C supply with less than a watt.

**REDUCING STATION INTERFERENCE**

A MY PRESENT location on Long Island I am troubled considerably by interference from a local high power station. Can you suggest how to get rid of it?—J. H. A.

If it is the station you want to get rid of, you have two courses open, move the station or move the set. If neither is practical you might try to eliminate the signal from the station. One way of doing this is to get a more selective set. Above the simplest remedy in the case is to install a wavetrap in the antenna circuit. Wind some heavy magnet wire on a 2-inch bakelite tube, or other insulating tube, and connect a .005 mfd. condenser in series with the coil. Connect this in the antenna circuit and tune the trap to the interfering signal. An alternative connection is to put a second winding of about 10 turns on the form and connect this small winding in series with the antenna, tuning the trap to the interfering signal. Close tuning is necessary. The trap will help a great deal. You should use about 40 turns.

**EFFECT OF LONG FILAMENT LEADS**

T HE MEASURED voltages across the terminals of my filament transformer is slightly over the rated values but the voltages across the plate leads measure about 76 volts. This is much below normal, and for that reason the performance of my set is not satisfactory. What is the cause of the difference in the voltages and how can it be remedied?—N. L. W.

The difference, of course, is due to the voltage drop in the leads between the transformer and the tubes and the remedy is to reduce the resistance in these leads. This reduction may be effected either by making the leads of heavier wire or by making them shorter. Making both of these changes would be desirable.

**SPEAKER HUM REMOVED**

R ECENTLY I bought a receiver in which there was provision for the field of a 90-volt dynamic speaker. I connected a Jensen dynamic to the binding posts provided and the result is a terrific hum which can be heard even above loud signals. I had used the same speaker before, taking the field current from a special B supply unit, and there was hardly any hum. What little there was could only be heard close to the speaker. What is the trouble and how can it be remedied?—H. A. D.
The field current supplied by the new receiver is not filtered well enough. It may be that the filter in the B supply becomes overloaded when the extra current is taken. The remedy is to provide additional filtering. A large by-pass condenser across the B winding may be effective, but it must be sure that you also have to use a choke coil in series with the field winding. Why not continue to use the B supply unit that did provide adequately filtered field current?

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Is it possible to build a receiver so that DC is used on the filaments of the radio frequency amplifier and the detector and AC on the filaments of the audio frequency tubes? Would there be any advantage in arranging a circuit in this way? W. C. C.

It is perfectly feasible to arrange a circuit that way, and many receivers are so built. Using DC up to and including the detector may make it easier to eliminate hum, but otherwise there is no advantage. It would be much simpler to use AC throughout.

**Polarity Tests**

Can you suggest any methods of testing the polarity of voltage sources, such as that of the DC power supply?—W. J. S.

One of the simplest polarity testers is a glass of water in which a small quantity of salt has dissolved. Put the two terminals in the water, as far apart as practicable. Bubbles will appear around both terminals but there will be twice as many around the negative. Another simple test is one involving the use of a raw potato. Cut a potato in two and insert the terminals into one of the cut surfaces. Around the positive terminal a green spot will form. There is also a tester available which works on the principle of the neon cell. The device has two neon cells, and it is arranged so that when the device is connected across a DC voltage source one cell lights up, indicating the polarity. If the device is connected across an AC voltage both cells light up, indicating the possibility of devices gotten out.

**Resistance-Coupled RF**

Would it be practical to use resistance coupling and screen grid tubes in the radio frequency amplifier?—E. A. B.

It would not be satisfactory. In the first place even screen grid tubes do not work efficiently in resistance coupled circuits at high frequencies and in the second there would be no selectivity. There would be a good deal of detection in the RF amplifier which would give rise to beat tuning.

**Impedance-Coupled Amplifier**

Is it possible to get as good quality with impedance-coupled audio amplifiers as with resistance coupled circuits? Are there any advantages of impedance aside from quality over resistance couplers?—W. C. C.

There is very little difference between the quality of output of the two types of couplers provided that the impedances of the impedances are high. The quality from a resistance coupler is slightly better at the low frequencies. Impedance couplers have the disadvantage that they are subject to changes in the impedances of the devices. They also occupy more space in the set and an impedance coupled circuit takes more plate current.

**The Morgan Amplifier**

Some time ago you published a type of circuit which you call the Morgan amplifier. Have you tested this amplifier thoroughly and is it as good as claimed? Have you had any reports on the circuit, favorable or otherwise?—J. R. T.

The circuit was developed by Prof. Morgan who knows his subject thoroughly. The circuit is properly designed. We have had no unfavorable reports whatsoever, but we have had some very enthusiastic reports. One who built the circuit reported that before he could get satisfactory results he had to make minor changes but after he had made these changes the circuit was by far the best he had ever listened to. That changes are necessary at times is clear from the fact that tubes are not equal. It is necessary to make small changes in the voltages to compensate for these differences. But they are easily made.

**Get a New B Supply**

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WASHINGTON

Strict adherence to the Davis amendment to the radio law for the equal distribution of radio facilities among the zones and for the physical impossibility if satisfactory reception for all listeners is to be provided, Federal Radio Commissioner Harold A. Lafount told the Senate Committee on Interstate Commerce.

After Senator Dill (Dem.), of Washington, and co-author of the amendment, again had criticized the Commission for its failure to observe the requirements of the law, Commissioner Lafount said reception would be "ruined" if the Commission attempted to follow it to the letter.

Despite the inherent difficulties of the amendment, he said, the Commission has accomplished a virtual equality in the distribution of stations and wavelengths among the five zones into which the Nation is divided, based on population, but has been unable to do so in the case of power distribution.

**Calla Board a Violator**

Although Senator Dill admitted that the Davis amendment is not satisfactory in every detail, and that some other yardsticks of population and wavelength should be provided, he declared this does not alter the fact that the Commission has fulfilled the requirements of the law.

"The Commission has evaded the law and has not adhered to it to the letter," declared the Senator. "The Commission has taken upon itself to readjust the law when it should have followed it."

"I am not satisfied with the Davis amendment of this year. I have been told by the public that something be done about the then chaotic radio conditions, forced its enactment," Senator Dill continued. "I do not believe that both houses of Congress would agree to its repeal, but want a substitute for it first. They do not trust the Commission."

**Commission Replies**

Commissioner Lafount called attention to the fallacies of the Davis amendment. The zones are so disproportionate in size that the smallest of them, the first or eastern zone, does not cover a geographical area as large as the state of Montana, which is only about one fifteenth of the entire fifth or western zone. Yet, he declared, under the law, the geographically great fifth zone may have no more radio facilities than the compact first zone.

Moreover, he said, when the Davis amendment was put into practice, not the five western, but the middlewestern zones in which the greatest centers of population—New York and Chicago—were located naturally had the largest number of stations. It was natural, he said, that they should have had more broadcasting power, and although there has been a sweeping reallocation, this same power situation obtains today.

Commissioner Lafount said that atmospheric and other physical conditions which have the tendency either of absorbing or accentuating radio signals, which prevail in different localities, also prevent a mathematical allocation of facilities.

**Granite Plays Its Part**

For example, he declared, along the Mississippi Valley reception is excellent, while a station broadcasting with the same power and wavelengths in New England will not be heard over a range even approaching that of the transmitter in the Mississippi Valley. This, he said, is due to the granite absorption in New England.

Asked by Senator Dill what a proper system of regulating broadcasting should be, Commissioner Lafount said such a proposition should be left to the judgment of the courts. If it is a continuous problem, he said, needing almost day to day attention and revision, and should be kept fluid, without restrictive laws which do not recognize the engineering problems.

A discussion of the chain program problem, and the duplication of such programs on the listeners' dial was precipitated by Senator Brookhart (Rep.), of New Jersey. The Senator said that in his state a listener regaled that he received the same program 20 times on his dial.

**Finds Distance Appetite Wanes**

Commissioner Lafount said few complaints of duplication are received by the Commission today, he said, are content to listen to stations in close proximity to the point of reception which offer chain or other programs, and do not attempt to pick up distant stations as they formerly did when it was a novelty.

Senator Dill asked why the Commission did not limit the broadcasting of chain programs on cleared channels, used by broadcasting stations, so there would be a minimum of duplication. He suggested that the Commission might restrict the use of chain programs on certain of the cleared channels assigned to each of the five radio zones.

Questioned as to the proposal to impose limits upon broadcasting stations with a view to defraying the cost of administering radio in the United States, Commissioner Lafount said he was not definitely opposed to such a system, but that it would be extremely difficult to handle.

**Rates Under Secretary**

At the outset of the hearing, the chairman of the Commission, Ira E. Robinson, resumed his testimony, begun the preceding day. Senator Kean (Rep.), of New Jersey, interrogated the witness as to the existing conditions in the New York metropolitan area, wherein certain high-powered broadcasting stations accredited to the New York quota, have their transmitters located in New Jersey. He said these transmitters "blanket out" reception in New Jersey, and that the law should not be permitted under the law which recognizes such conditions.

Mr. J. W. Sassoon, of the Federal Radio Commission, in administering radio, looks upon it from the broad national viewpoint, and how it is done, the American public may be served to the maximum extent. He said the Commission has had the New Jersey controversy engineered in it.

Advertising rates of broadcasting stations were the basis of further examination of Commissioner Lafount by Senator Dill. Speaking of WOR, in New York, Mr. Sassoon asked why WOR, in New York, was precipitated by Senator Brookhart, of New Jersey, to broadcast "for the entire United States Daily." The Senator said that in his state a listener reported that he received the same program 20 times on his dial.

**Speaks for Pittsburgh**

After the conference, Representative Kelly (Rep.), of Pittsburgh, announced it would make an investigation of the situation through its engineers.

There were five members of the House at the conference. They were Mr. Estep, of Pennsylvania; Representative Kelly (Rep.), of Edgewood, Pa.; Porter (Rep.), of Pittsburgh, Pa.; Campbell (Rep.), of Grafton, Pa., and Sullivan (Rep.), of Pittsburgh.

**Not Given Quote**

"At the present time this zone has not yet been given its equitable portion of the national and regional channels. Three zones have been given more than the channels to which they are entitled. There is interference between WJAS and WCAE, it was stated by the delegation. The Radio Commission announced it would make an investigation of the situation through its engineers."

"Our state is under the disadvantage of having less than the quota facilities it is entitled to. The state is true, particularly, of our Zone 2, which portions of this country enjoy more than their just quota."

"The conditions have been growing worse in our zone than anywhere else since the reallocation of 1928. Our people have been hoping that the Federal Radio Commission would make the necessary readjustments in the interest of better radio reception in our zone. Ever since the 1928 reallocation we have been deprived in the Pittsburgh section of one cleared channel, the 1,020 channel."

"The Federal Radio Commission now, I believe, will make the necessary readjustments as the result of the prominence given our present unfortunate situation."

**LOOK AT YOUR WRAPPER**

You will see by the date thereon when your subscription for Radio World expires. If the subscription is about to run out, please send us renewal so that you will not miss any copies. Subscription Department, RADIO WORLD, 145 West 45th St., N. Y. City.
74 Stations Now in Northern Europe

Washington.

Broadcasting stations in northern Europe, comprising Norway, Sweden, Denmark, Iceland, Finland, Russia, Latvia, Lithuania, Danzig, and Czechoslovakia, have been increased to 74, according to an announcement of the Department of Commerce after a check-up of the stations in these countries.

Among these countries Sweden leads with 32 stations. Norway is second with 12 and Finland third with 9 stations. Denmark has 6 stations, Danzig 5, Czechoslovakia 4, Iceland and Estonia 2 each and Latvia and Lithuania 1 each.

The highest powered station listed is in Lahtis, Finland, which operates with 40,000 watts on a wavelength of 1,552.8 meters. The second strongest station is SBG in Motala, Sweden, which operates with 30,000 watts on a wavelength of 1,548 meters. The remaining 72 stations range in power from 50 to 12,500 watts.

WMAK Starts New Wave Suit

Washington.

A new appeal in the Buffalo broadcasting case, involving the Buffalo "Evening News" and WMAK, which that city was filed with the Court of Appeals of the District of Columbia by WFBF, at Syracuse.

The Syracuse station appeals from the action of the Commission removing it from half-time operation on the 900-kilocycle channel, and placing it full time on the 1490-kilocycle channel. It contends that the Commission did not act directly on its application for increased time and power on the 900-kilocycle channel.

The Commission, in its decision, issued a construction permit to the station for a station to operate full time on the 900-kilocycle channel, which now is shared by WMAK and WFBF. Previously, WMAK filed an appeal from the action.

Coincident with the filing of the new appeal, the Commission filed with the court its statement of facts and grounds for decision in the Buffalo case. Asking that the appeal of WMAK be dismissed, because the reasons cited are not specific, the Commission states it granted the Buffalo "Evening News" appeals because the Buffalo Broadcasting Corporation, controlling WMAK, has a virtual monopoly of broadcasting facilities in Buffalo.

This corporation, it states, controls the four leading broadcasting stations in Buffalo, namely, WKBW, WMAK, WKEN and WGR.

READ OUR CLASSIFIED ADS

And use this department if you have anything to sell. 10c a word, $1 minimum. Radio $6.00, 145 W. 45th St., N. Y. C.

NEW DRAKE'S ENCYCLOPEDIA

1,650 Alphabetical Readings from A-battery to Zero Best: 1,025 Illustrations, 920 Pages, 240 Combinations for Receiver Layouts. Price, $3.00. Radio World, 124 W. 45th St., N. Y. C.
Dill Asks Arrest of Air Profaner

Senator Dill (Dem.), of the State of Washington, again addressed the Senate on the use of profanity over the radio, declaring that K.W.K.H., at Shreveport, La., continues to disregard the law in this respect, its owner should be arrested and the station discontinued.

Mr. Dill, co-author of the radio act, took the floor to explain that, in objecting to the use of obscene language over the Shreveport station, which is owned by W. K. Henderson, he did not wish to be interpreted as objecting to Mr. Henderson’s policy of attacking chain stores. Some independent merchants have wrongly made this interpretation, he said, who, he supposed, used the use of profane language.

“As I have said before, I took this matter with the Commission, and the Commission said it had no affidavits as to the indecency and obscenity being used,” declared Senator Dill. “I think it now has some affidavits, I think many more.” Senator Walsh, (Dem., of Montana), inquired whether the matter had been referred to the Attorney General, and whether the existing law, in the opinion of Senator Dill, is adequate to meet the situation. Senator Dill said he thought existing law fully adequate to cover the case.

“I have written a letter to the Attorney General calling his attention to the statements I have made and to sections of the law, and have suggested that he refer the case to the Attorney General, and that the use of obscenity may be stopped or the owner prosecuted under the criminal provisions of the act,” concluded Senator Dill.

Two Cities Obtain Radio Police Permits

Washington.

The police departments of two cities have been granted permits by the Federal Radio Commission to use short waves for the creation of crime detection and apprehension services. The cities are Minneapolis, Minn., and Tulare, Calif.

Construction permits were also granted to these police departments for stations to use channels in the continental high frequency spectrum. Many other cities have, since he has been opposed service and many more now hold construction permits for the erection of stations of this character.

All Parts for the ABC Supply

as described by Capt. Peter V. O’Rourke

Provides filament and heater voltages for 227, 224, 245 push-pull and 280, and fourteen B voltages.

These parts are complete less push-pull input triode sets. They are already mounted on steel chassis at...

Guaranty Radio Goods Co.

143 West 45th Street,
New York, N. Y.

Just East of Broadway

$30.00

TRIAL SUBSCRIPTION, 8 WEEKS.

$1.00. Send $1 and we will send you Radio World for 8 weeks, postpaid.

RADIO WORLD, 145 West 45th St., N. Y. City.

By DR. LEE DeFOREST

Newly Elected President of Institute of Radio Engineers

The insidious influence of the aversive advertiser and his stupid insistence on direct advertising have, I regret to observe, become increasingly effective and devastating.

As the so-called “Father of Radio Broadcasting,” I wish again to raise my voice in most earnest protest against this revolting state of affairs.

In the present all too marked tendency of the broadcast chains and of many individual stations to lower their bars to the greed of direct advertising will rapidly work to the end that good and destroy the greatest usefulness of this magnificent new means of contact which we engineers have so laboriously toiled to upbuild and to perfect.

Public Flareback

In all seriousness I attribute a part of the present aversion of slackening in radio sales to the public and delay due to this pernicious advertising. The radio public is, I believe, becoming nauseated by the quality of many of the present programs. Short-sighted greed of the broadcasters, station owners and advertising agencies, is, slowly killing the broadcasting goose, layer of many golden eggs.

Long has this pernicious situation continued without earnest protest from our organization. We members of this institute must be jealous of its good name, regardful of a wise supervision of this broadcast institution.

We should, I maintain, take active steps to get rid of this stupid variance which is killing the most splendid and potent means of entertainment, culture and education which mankind has yet devised.

Foreign Relish by Domestics

If we anticipate the day of the international broadcast, when American programs are interchanged with those from Europe, you may rest assured that any foreign programs of high-class music will be relished in this country in preference to much of the stuff which American audiences are now compelled to hear.

This factor, the international broadcast, is at hand. The sterling work of radio communication engineers the world over in the fascinating art of wave transmission is rapidly bringing it to pass. And this development will eventually mean more than an acquaintanceship among people, internationalism, an end of war, and finally the blessings of one common tongue.
WABC Testing New

Station Rates

Washington, D. C.

The Interstate Commerce Commission has no authority over rates charged to advertisers by broadcasting stations and chiefs, Commissioner Joseph E. Eastman told a Senate committee, as he recorded his views in favor of a communications commission.

Broadcasting stations, the Interstate Commerce Commissioner explained, are not regarded as being engaged in the transmission of intelligence as common carriers. No control has ever been made as to broadcasting rates, he added, and only one request for an investigation, which was granted two years ago from the C. K. MacAlpine Company, 50 Church St., New York, had been received by the commission.

A THOUGHT FOR THE WEEK

PERES an idea that may appeal to a lot of listeners is: organize a "National Shiver Week" and, at one fell stroke, get rid of those strong-meat dramalets of mystery, racketeering and gang life that are now crowding the young ones from the box to bed, there to cover up their head and dream of murderous goings-on all night? If we can get these garish things off our minds in a seven-day period perhaps the country can spend fifty-one weeks in normal living and thinking again. Noise, the other name is radio melodrama!

RECEIVER FOR

KOLSTER ASKED

ON $17,000,000

A receiver for the Kolster Radio Corporation, was asked by David Schiffman of Passaic, N. J., to purchase 200 shares of common stock. Vice-Chancellor Lewis, signed an order, returnable, directing the Kolster officers to show cause why receiver should not be appointed. Meanwhile the corporation was enjoined from collecting or contracting any further debts.

Executives of the $17,000,000 corporation were in conference following filing of the receivership application, then returnable, directing the corporation to show cause why a receivership would not be granted.

Kolster radio shares were selling on the New York Stock Exchange at $5 just before the corporation application was filed and had dropped to 2 1/2. In 1929 the high was 78 1/4.

Paterson, N. J.

Sales Grow, Profits Drop

Mr. Schiffman alleged that the company in 1928 showed gains in sales, its net profits declined 75 per cent, due to increased after taxes. The same stock, according to Mr. Schiffman, was being quoted in the market at $5 a share at the time his petition was filed.

Radio Commission, is chairman of the board of the corporation, said that on advised counsel, executives of the corporation would make no statements.

Cites $916,233 Loss

Mr. Schiffman said he found the corporation sustained a loss of $916,233 in 1929, its financial statement listing assets of $7,011,758 in certain patent rights, "which your complainant alleges are fictitious and of no value.

The petition showed such facts according to the petition, was made "as part of a scheme to sell stock to the stockholders of record as of April 30th, 1928," at $22 a share. The same stock, according to Mr. Schiffman's petition, was quoted in the market at $5 a share at the time his petition was filed.

Kolster radio shares were selling on the New York Stock Exchange at 4 1/4 just before the corporation application was filed and had dropped to 2 1/2. In 1929 the high was 78 1/4.

WABC Testing New

Sit for 50 kw. Plant

WABC, key station of the Columbia Broadcasting System, which has been seeking a site for its proposed 50 kw transmitter, is testing field strength near Jenkintown Beach, L. I., twenty-five miles out of New York City.

The company telegraphed the Federal Radio Commission for permission to test for 10 days and obtained it.

The station will use the call letters W2XAN, the WABC short wave transmitter, but will operate on the WABC frequency. Granting of the license is another step in the Columbia's effort to find a suitable location for its high-powered transmitter, which it hopes to locate where it will not interfere with other stations. The original intention to locate the station at Columbia Bridge, N. J. was abandoned because of opposition in New Jersey.

STATE STATION RATES

UNRESTRICTED

Washington, D. C.

The Interstate Commerce Commission has no authority over rates charged to advertisers by broadcasting stations and chiefs, Commissioner Joseph E. Eastman told a Senate committee, as he recorded his views in favor of a communications commission.

Broadcasting stations, the Interstate Commerce Commissioner explained, are not regarded as being engaged in the transmission of intelligence as common carriers. No control has ever been made as to broadcasting rates, he added, and only one request for an investigation, which was granted two years ago from the C. K. MacAlpine Company, 50 Church St., New York, had been received by the commission.

A THOUGHT FOR THE WEEK

HERE'S an idea that may appeal to a lot of listeners: organize a "National Shiver Week" and, at one fell stroke, get rid of those strong-meat dramalets of mystery, racketeering and gang life that are now crowding the young ones from the box to bed, there to cover up their head and dream of murderous goings-on all night? If we can get these garish things off our minds in a seven-day period perhaps the country can spend fifty-one weeks in normal living and thinking again. Noise, the other name is radio melodrama!

NEW CROSLEY SALES MANAGER

Cincinnati, O.

R. H. Woodford, for the past five years general sales manager of the radio division of the Stewart-Warner corporation, has been appointed general sales manager of the Crosley Radio corporation. He succeeded Neal Newman, resigned.

WILBUR ASKS RADIOS TO HELP

THE ILLITERATE

Secretary of the Interior

Independent private institutions with sufficient funds for educational and cultural experiments could render a great service in the field of radio education that they have in all American education. We do not yet know what the beginnings are and what the limits of the radio. We do not know how to discover them except by experimentation, nor how to prevent the people from this special work except by trial.

We do not know how to best handle drama, literature, etc. We have already discovered that there is no interesting broadcasting possible in the field of political science, history and music.

Literacy Experiment

My hope is that we can continue the work that is now going forward and inaugurate under conditions of great freedom with adequate, further experimentation under the guidance of those who cannot be considered as having a commercial viewpoint.

Personally, I should like to see just what could be done for several thousand illiterate families by providing them with radio and 90 special observers for a period of months. It would be a novel experience to become literate without being able to write or read, using radio in the sense of becoming informed and able to follow what is going on in the world about one. Here is an opportunity for some one to use his interest, enthusiasm, and financial resources with some university which has a well developed department of sociology.

What People Want

I have indicated the significance of the radio and the necessity of some means of checking results as well as devising experiments in education. Private control cannot come through any individual or institution or any governmental agency alone. It must evolve from the experience of the industry and the creation of controlling ideals and principles.

There is a gratifying tendency to cleanse the air of unsavory broadcasts of all sorts. The Commonwealth Club of San Francisco recently reported a study in which over 7,000 letters and answers to 20 leading questions. Seventy-six per cent asked for educational programs, 64 per cent asked for more semiclassical music; 57 per cent reported that they listened to book reviews, and, says the report, "We found a tidal wave of indignation against jazz." It is important that the truth be presented over the radio. You have often heard individuals say, "I saw it in print," as if that were a finality.

By RAY LYMAN WILBUR

"Here's an idea that may appeal to a lot of listeners: organize a "National Shiver Week" and, at one fell stroke, get rid of those strong-meat dramalets of mystery, racketeering and gang life that are now crowding the young ones from the box to bed, there to cover up their head and dream of murderous goings-on all night? If we can get these garish things off our minds in a seven-day period perhaps the country can spend fifty-one weeks in normal living and thinking again. Noise, the other name is radio melodrama!"
### REVISED LIST OF STATIONS BY CALL LETTERS

**With Location, Power, Frequency and Wavelength**

74 ADDITIONS, DELETIONS, NEW WAVE ASSIGNMENTS, COMPARED WITH LIST PREVIOUSLY PUBLISHED

<table>
<thead>
<tr>
<th>Station</th>
<th>Transmitter</th>
<th>Power kw.</th>
<th>Frequency (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEBC</td>
<td>Cincinnati, Ohio</td>
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</tr>
<tr>
<td>WECA</td>
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</tr>
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<td>Philadelphia, Pa.</td>
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<tr>
<td>WCGN</td>
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<tr>
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**Transmitter**

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- WECA: Columbus, Ohio
- WCBS: Chicago, Ill.
- WCHS: Milwaukee, Wis.
- WCIW: Des Moines, Iowa
- WCGN: New York City
- WCHB: Boston, Mass.
- WCVF: Los Angeles, Calif.
- WCLG: Chicago, Ill.
- WCMX: New York City
- WCHM: New York City
- WCOY: Chicago, Ill.
- WCIE: Chicago, Ill.
- WCOZ: Atlanta, Ga.
- WCBS: Baltimore, Md.
- WCNH: New Haven, Conn.
- WCOX: New York City

**Power kw.**

- WEBC: 1500
- WECA: 1000
- WCBS: 1000
- WCHS: 1000
- WCIW: 1000
- WCOI: 1000
- WCGN: 1000
- WCHB: 1000
- WCVF: 1000
- WCLG: 1000
- WCMX: 1000
- WCHM: 1000
- WCOY: 1000
- WCIE: 1000
- WCOZ: 1000
- WCBS: 1000
- WCNH: 1000
- WCOX: 1000

**Frequency (M)**

- WEBC: 1000
- WECA: 500
- WCBS: 500
- WCHS: 500
- WCIW: 500
- WCOI: 500
- WCGN: 500
- WCHB: 500
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- WCOZ: 500
- WCBS: 500
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</table>

**New Corporations**


Lobovas Radio Corp., Ridgefield Park—Attw. S. Cameron, Lloyd & Morrison, Ridgefield, N. J.

United Radio Corporation, Wilmington, Del—Attw. Franklin L. Mettler, Wilmington, Del.

Electrical Transcription Broadcasting Systems—Attw. Falk & Orleans, 165 Broadway, New York, N. Y.

Homrad Sales Corp., Newark—Attw. David Bernheim, Newark, N. J.

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**Radio World**

January 25, 1930
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(a) Three stages of tuned R.F., using 224 screen grid tubes.
(b) Tuned input to 224 power detector.
(c) Audio, consisting of first stage resistance coupled, second stage 245s in push-pull.
(d) Four totally shielded R.F. coils.
(e) A chassis all drilled for necessary parts.
(f) A four gang condenser, guaranteed accurate, with equalizing condensers built in.
(g) 41 mfd. of filter and bypass capacity.
(h) Thirteen different fixed voltages available from the output.
(i) Single dial control.

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□ C5—One 01 mfd. mica condenser... 3.00
□ C6, C7, C8, C9—Four 1 mfd. 200 volt AC filter condensers... 2.50
□ C10, C11, C12—One 1.500 mfd. 150 volt AC filter condenser... 2.40
□ C13, C14—Four 1 mfd. 200 volt DC bypass condensers... 2.10
□ C15—One Electro Life 2,500 ohm, 250 volt DC leak resistor... 1.60
□ R1—One Standard 3,900 ohm resistor... 0.75
□ R2—One 5,000 ohm resistor... 0.75
□ R3—One Lynch 5,980 ohm metalized grid leak, with mounting... 1.25
□ R4—One 1,900 ohm resistor with mounting... 1.30
□ R5—One Multiple-Tap Voltage Divider, 12,600 ohms, 14 taps... 2.95
□ T1—One push-pull input transformer... 2.50
□ OPC—One center-tapped output choke... 2.25
□ T2—One Pole filament-plate supply (Cat. FF705)... 2.50
□ C1—One double filter choke coil, 30 hensry each section, 100 mva... 2.75
□ SW—One pendant AC switch with 12 ft. cable... 0.90
□ FL—One 2.5 volt pilot lamp and bracket... 0.90
□ Speaker (-1), (-2), (-3), Ant., Grid—Four binding posts with insulators... 0.90
□ One Clarostat Humdinger, 36 ohms... 0.85
□ One subpanel 1½ " x 11½", with five UV and three UX sockets... 1.50
□ One vernier dial... 0.80
□ Four National grid clips... 0.25
□ Hardware... 0.25
□ All parts (less cabinet, tubes and speaker)... $45.59
□ Tubes: four 224, one 227, two 245, one 280... 5.51
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- C3, C4, C5, C6-40 uf 50 volt electrolytic caps
- C7-50 uf 100 volt paper condenser
- R1, R2, R6-1.3 ohm filament resistors
- R3, R4-6.5 ohm filament resistors
- R5, R9-220 ohm 1% fixed resistors
- P1-Pilot lamp 6v. and bracket
- P2-Power switch and bracket
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