APRIL 15
1933

NEW AUTO SET

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RADIO WORLD
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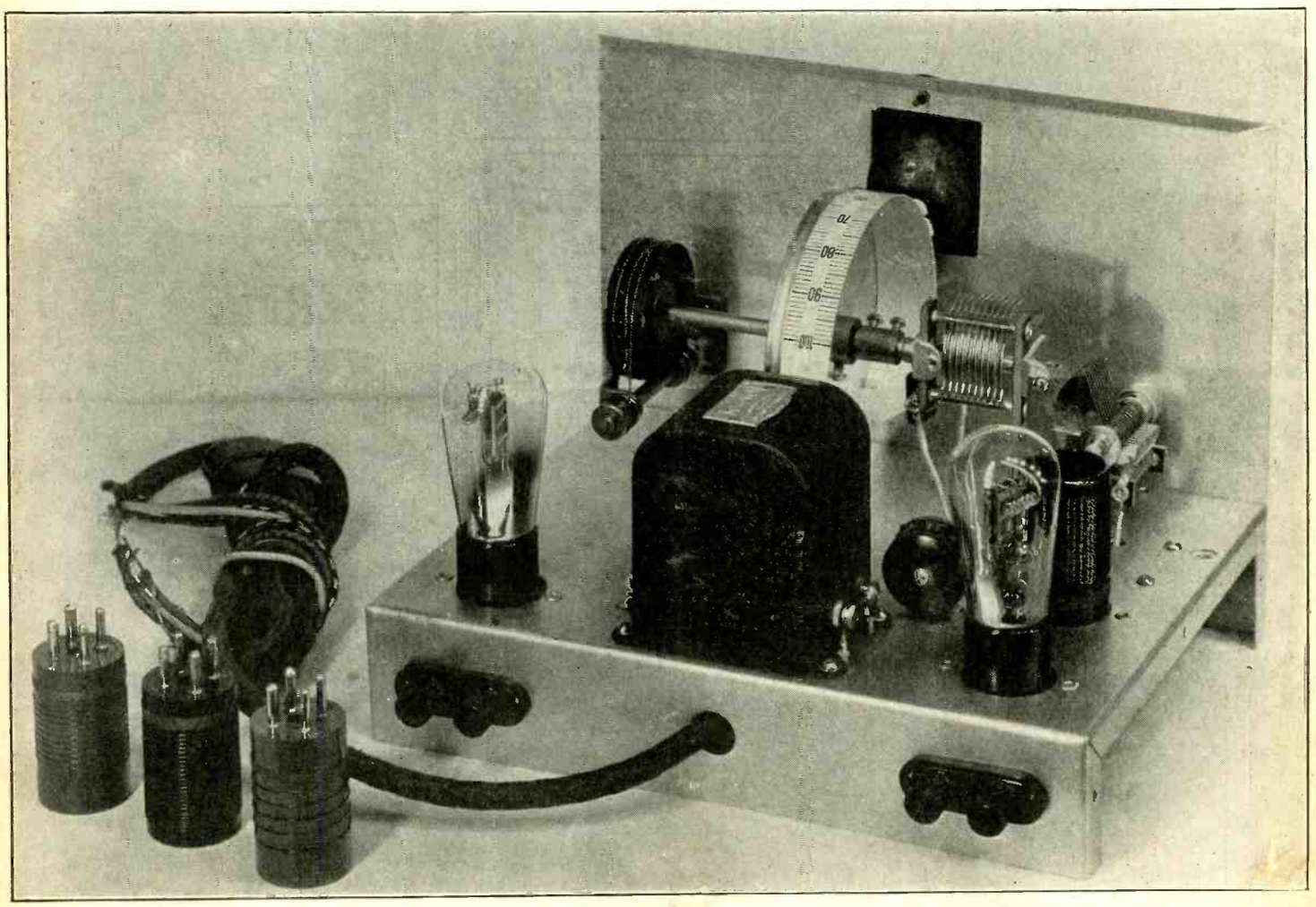
The First and Only National Radio Weekly
Twelfth Year *577th Consecutive Issue*

How to Eliminate Ignition Noise

12-TUBE DIAMOND

'GET SET, GO!' ON SHORT-WAVE COURSE!



For a starter in the realm of fascinating short-wave experiences a two-tube battery set is attractive. It costs little and does much. The Beginner's Twin, using largely Hammarlund's parts, is illustrated.
See pages 12 and 13.

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The First and Only National Radio Weekly
TWELFTH YEAR

Vol. XXIII | APRIL 15th, 1933 | No. 5 Whole No. 577

Published weekly by **Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y.**

Editorial and Executive Offices: 145 West 45th Street, New York
Telephone: BR-yant 9-0558

OFFICERS: Roland Burke Hennessy, *President and Treasurer;* M. B. Hennessy, *Vice-President;* Herman Bernard, *Secretary.*

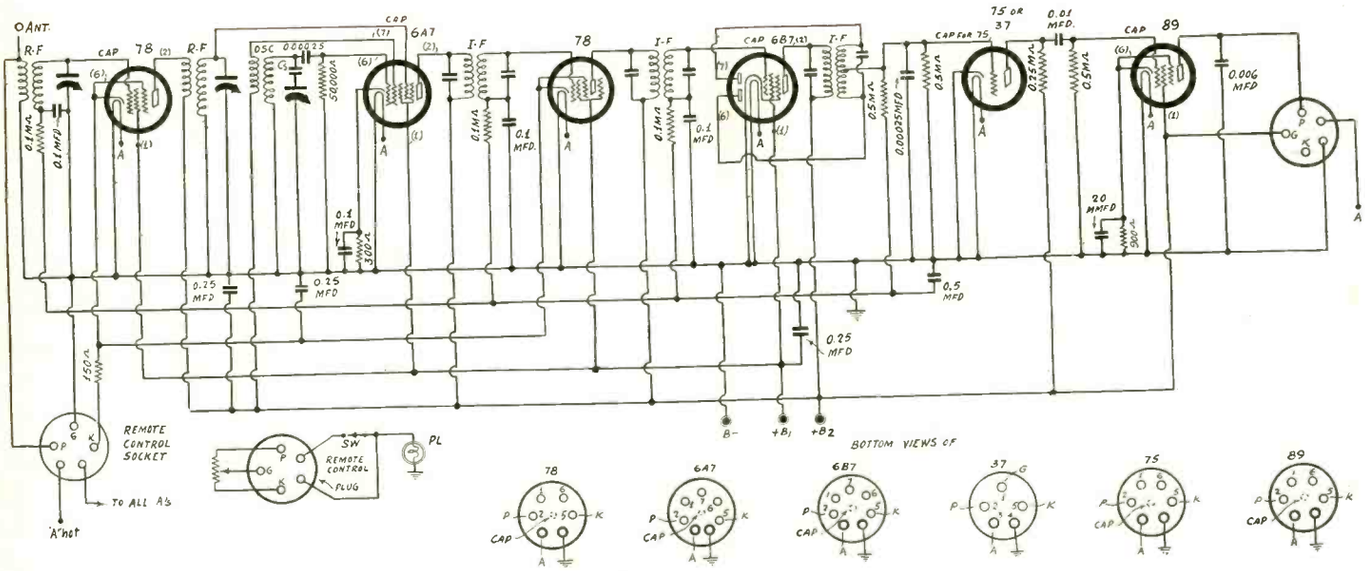
Entered as second-class matter March, 1922, at the Post Office at New York, N. Y., under Act of March 3, 1879. Title registered in U. S. Patent Office. Printed in the United States of America. We do not assume any responsibility for unsolicited manuscripts, photographs, drawings, etc., although we are careful with them.

Price, 15c per Copy; $6.00 per Year by mail. $1.00 extra per year in foreign countries. Subscribers' change of address becomes effective two weeks after receipt of notice.

A NEW AUTO SET

Latest Tubes Used in Improved Model

By J. E. Anderson



WE HAVE received numerous requests for circuit diagrams of automobile receivers incorporating the latest tubes. Most of these requests have come from professional set builders who can build a receiver from a circuit diagram alone, and who are willing to do a little experimenting to iron out kinks which usually appear in any receiver when it is first built. These builders are anxious to have the diagrams in order to be first in the field with improved circuits. The circuit shown in Fig. 1 is now in process of building and experimentation and a report on it will be published later. In the meantime it is presented for those who wish to tackle the job without the benefit of a chassis layout.

The circuit contains only six tubes. Yet it is the equivalent of one having many more. The first tube serves only one purpose, radio frequency amplification, and there is no special gain in that stage. The second tube, however, serves two purposes, oscillation and mixing. Hence we gain a tube here. The third tube serves only as an intermediate frequency amplifier. The fourth serves two purposes, intermediate frequency amplification and diode detection. Hence we gain here. The gain, however, is really

(Continued on next page)

LIST OF PARTS

Coils

Two midget type shielded r-f. transformers for 350 mmfd. condensers.
One oscillator coil 175 kc. (or other if preferred).
Three doubly tuned i-f. transformers, 175 kc. or other if preferred, the secondary of one to be centertapped.

Condensers

One gang of three 350 mmfd. tuning condensers.
One padding condenser, capacity to fit i-f. selected.
Two 0.00025 mfd. condensers.
Four 0.1 mfd. condensers.
One 0.006 mfd. condenser.
One 0.01 mfd. condenser.
Three 0.25 mfd. by-pass condensers.
One 0.5 mfd. by-pass condensers.
One 20 mfd. electrolytic condenser.

Resistors

One 150-ohm bias resistor.
Two 300-ohm bias resistors.
One 900-ohm bias resistor.
Three 0.1-megohm resistors.
One 0.25-megohm resistor.
Three 0.5-megohm resistors.
One 50,000-ohm grid leak.
One 10,000-ohm potentiometer (part of remote control unit).

Other Requirements

Two small seven-contact sockets.
Two six-contact sockets (three if a 75 is used).
Two five-contact sockets (three if 37 is used).
Five grid clips (six if 75 is used).
One six-tube chassis, with socket holes for remote control and speaker.
One remote control unit, with pilot light, tuning dial, and potentiometer.

(*Continued from preceding page*)
not one of tubes, for the 85 is also a double purpose tube, but rather in the effectiveness of the tube. The fifth tube is a diode biased audio amplifier. It may be either a 75 high mu tube, triode section only, or a 37 tube. The power tube is an 89.

The Mixer

The mixer and oscillator tube is the new 6A7. The innermost grid is used as control grid for the oscillator and the next grid for anode of the oscillator. The grid at the top of the tube is employed as input grid for the radio frequency signal derived from the output of the first tube. The screen grid, of course, is used for screening, and the plate is used for output of the modulated signal.

Following the mixer is an intermediate amplifier of two stages, with three doubly tuned transformers. The second of these feeds into the pentode section of the 6B7 and the third into the diode section of the same tube. The usual way of operating this tube is first as a diode rectifier and then as an audio amplifier.

The output of the diode rectifier is fed to the input of the first audio tube, the load resistance taking the place of the usual coupling resistor and also of the grid leak. The audio tube is therefore diode biased. While this is an unusual arrangement, there is no more reason for not operating the tube with diode bias than there is in operating the first audio tube in that manner when it is inclosed in the same envelope of the rectifier. However, operating the 37, or the 75, in that manner is permissible only when there is a high resistance in the plate circuit to limit the plate current when the signal is zero.

The by-pass condenser ordinarily used across a diode load resistance is here put between the grid and the cathode of the 37, just as it would be connected if the amplifier were in the detector tube envelope.

Automatic Bias

The voltage for the automatic bias is taken from the load resistance in the usual way by connecting a 0.5-megohm resistance from the negative end of the load resistance to the grid return leads of the controlled tubes. Three tubes are thus controlled.

A bias resistance of 300 ohms should be used in the cathode lead of the 6B7 to establish a minimum bias, and it should be shunted with a condenser of about 0.1 mfd. This resistor puts a 3-volt handicap on the diode but this is so small that it means little. However, the tube would work without the fixed bias resistance because as soon as there is any signal to amplify there will be an adequate bias on the tube from the diode load resistance.

The gain is controlled manually by means of a 10,000-ohm potentiometer in the remote control. This is so connected that the bias on the first and second 78 tubes and the 6B7 is varied. This variation is quite independent of the automatic bias, except in so far as the signal strength that reaches the diodes controls the bias. The manual control also varies the input signal for when the potentiometer is set so that the bias is maximum the antenna is connected to the chassis and there is no input to the set at all.

The Oscillator and Mixer

The oscillator is of the tuned grid type, with the tuning and padding condensers in series across the grid coil. Objections have been raised to the placing of the padding condenser on the high potential side of the tuning condenser because it makes adjustment difficult when an improper tool is used. If the adjustment is made with a screw driver with a long insulating handle there is no trouble whatsoever. However, even in this type of oscillator it is possible to place the padding condenser, Cs, on the ground side of the secondary, and thus make the oscillating circuit a mixture of a Colpitts and tuned grid circuit. When Cs is placed between the secondary coil and the chassis the grid condenser can be omitted because the padding condenser serves to block the grid.

The inner "triode" in this circuit, which serves as oscillator, can be regarded as a miniature transmitting station sending out a steady oscillation, or it can be regarded as a complex cathode in which the emission varies. When it is regarded as a transmitter, the output is transmitted to the plate circuit by electron coupling, and the output is modulated by the radio frequency signal impressed on the control grid. When it is regarded as a complex cathode with variable emission, the rest of the tube can be regarded as the elements of an amplifier. Regardless of how it is thought of, the oscillation and the radio frequency signal mix, producing a beat frequency current that is delivered to the intermediate frequency tuned transformer in the plate circuit.

There is a 300-ohm bias resistance in the cathode. This biases both the amplifier and the oscillator grids. There is in addition a 50,000-ohm grid leak between the oscillator grid and the chassis.

All the operating voltages and the various constants used in this oscillator-mixer are those recommended by the makers of the tube. They will be used until some deviation from this practice proves desirable.

Intermediate Frequency

What the intermediate frequency of a superheterodyne is matters very little. Especially is this the case when there are two radio frequency tuners in the circuit, as in this one. A frequency of 175 kc has been very popular, and still is, but higher frequencies are gaining in popularity. Previous automobile superheterodynes which we have described have used 400 kc for intermediate. That is a good frequency, but 465 kc is all right, too, and that frequency in particular is coming into vogue. If the intermediate transformers used are nominally tuned to 450 kc, they can usually be tuned to either 400 or 465 kc. At any rate, they can be tuned to some frequency between those limits that is just as good as either.

The fact that almost any intermediate frequency can be used successfully does not indicate equal flexibility with the oscillator, once the coil for that circuit has been obtained. The oscillator coil will have been designed for some particular intermediate frequency, and once it is selected there is very little choice left in the intermediate frequency. If the oscillator coil has been designed for an intermediate frequency of 400 kc, it may be permissible to change the frequency between 390 and 410 kc, but a wider digression would result in poor tracking and consequent low sensitivity and much squealing. Therefore the oscillator coil and the intermediate transformer should be selected to match. There are oscillator coils available for many different intermediate frequencies, 175, 400, 450 and 465 kc.

The Padding Condenser

The padding condenser should also be obtained to match the intermediate frequency. The lower the intermediate frequency the larger the padding condenser must be. Padding condensers are available in capacity ranges of 350-450, 700-1,000, and about 1,000-1,300 mfd. If other values are required they can always be obtained by using fixed condensers in parallel with the variable condenser.

The 900-ohm bias resistance for the 89 power tube is shunted by a condenser of 20 mfd., which is of the electrolytic type. The automatic voltage lead is by-passed with a 0.5 mfd. condenser and each lead is filtered with a 0.1-megohm resistor and a 0.1 mfd. condenser. The common cathode lead of the two manually controlled tubes is by-passed with a 0.25 mfd. condenser. An equal condenser is also used on each of the plate and screen supply leads,

Filtering is adequate unless, due to some faulty arrangement of critical leads, oscillation should occur either in the r-f or the i-f levels. If such oscillation arises it can usually be stopped by increasing the fixed bias resistors in the high frequency tubes.

Heater Circuit

The heater circuit is floating so that the set can be connected to the storage battery in any car regardless of which side of the battery is grounded. One side of each heater is connected to the chassis, and this side, of course, becomes connected to the car chassis as soon as the set is installed and grounded. The other side of each heater, and of the loudspeaker field, is connected to the "hot" side of the battery through the remote control device. The "hot" side is connected to the remote control socket terminal so marked. When the remote control plug is inserted the hot side is picked up by the cable and goes to the switch, Sw. When the switch is closed the pilot light goes on for the circuit is completed to ground. Also, the Hk terminal on the remote control socket becomes "hot," and since this is connected to all the heater terminals not grounded, the heater current is on.

New Tubes Recommended

The new tubes are recommended because of their improved performance. The 78 is superior to a 39, the single 6A7 is vastly superior to one 236 and one 237, the 6B7 is superior to an 85, or to a 75, and the 89 is much better than a 38. Whether a 37 or a 75 is used for the audio amplifier depends on how much sensitivity is required. The 37 has an amplification factor of 9 and the 75 one of 100. A voltage gain of about 8.5 can be expected from the 37 and a gain of 70 from the 75.

With a tube such as the 75 there would ordinarily be danger of motorboating. In this circuit there is little danger because there are only two plate circuits in the audio amplifier, and that combination is stable. However, the stability does not include possible overloading of the amplifier, and troubles similar to motorboating may develop as a result of overloading. If that occurs it is only necessary to manipulate the manual volume control until the overloading ceases.

Plate Current Requirements

When the plate voltage is 180 volts, the maximum current drawn from the B supply by this set will be about 50 milliamperes. If the voltage is less, there will be a proportionate reduction. It is likely that a voltage higher than 135 volts will not be used, and this is quite adequate for a car. Of course, the sensitivity will be greater with the higher voltage.

There are many B supply devices now on the market. Some are of the vibrating type and others are dynamotors. Many of them are rated at a voltage of 180 volts and a current of about 40 milliamperes. If a greater current is drawn the voltage falls. Moreover, the quality suffers. It is advisable to select a B supply that is conservatively rated.

When batteries are used, it should be kept in mind that they gradually decrease their strength. When they near exhaustion there is a high internal re-

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IGNITION NOISES

Eliminated from Auto Sets by Floating Heaters

By J. E. Anderson

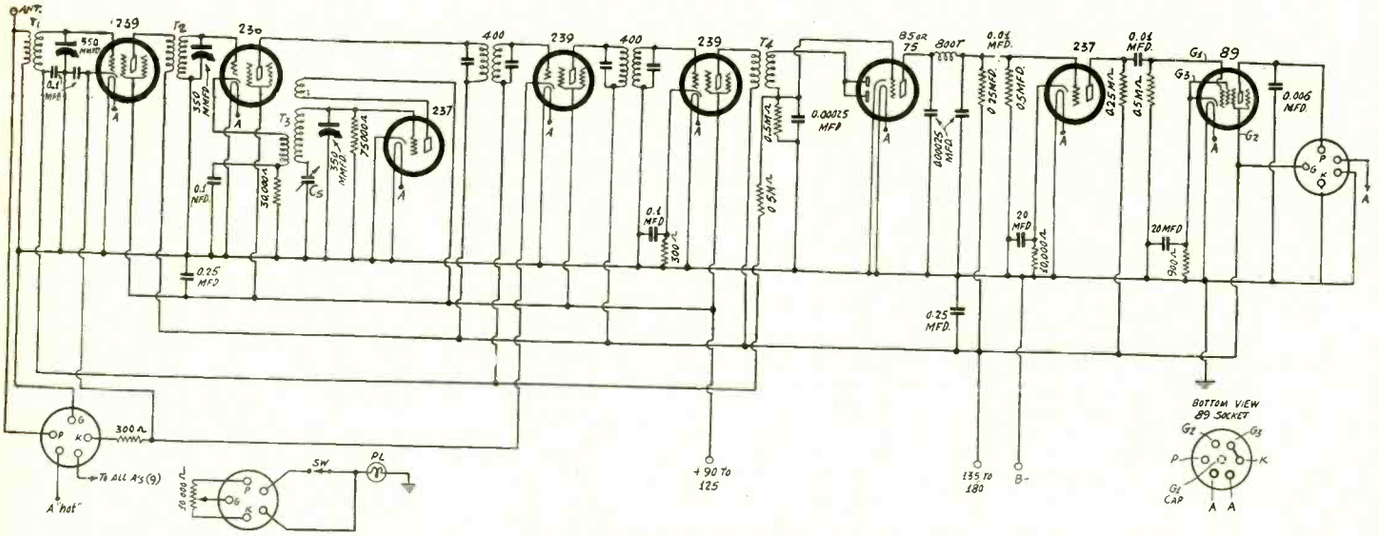

FIG. 1

The circuit of the 898 automobile superheterodyne as it appears after it has been changed to floating filaments. Elimination of ignition noise is the object of the change.

THE eight-tube automobile receiver described in the December 3rd, 1932, issue has established records for long distance reception, it is believed. A man riding around in Nova Scotia picked up English and Algerian stations, together with a large number of Canadian and United States stations. It is hardly necessary to have a more sensitive receiver in a car.

However, when the set is installed in some cars great difficulty is experienced with ignition noises. This difficulty can be overcome with a few easily-made changes in the circuit.

In the original circuit, part of the grid bias for the power tube and all bias for the 37 and the 85 triode are obtained from the storage battery. If there is any ignition noise in the battery, this will be impressed on the grids of these three tubes as a signal, and, naturally, it will be amplified. There is plenty of noise in the battery.

Bad Medicine

Some might think that the original connection was an outright blunder, but that is not so, because the resistance of the battery is nearly nil, and the noise cannot build up on the grids unless there is some resistance in the battery. As far as the noise is concerned the battery is a short circuit. Nevertheless, when the ignition noise currents are very strong, even a minute resistance might be sufficient to produce a noise in the output of the receiver, especially as the noise is amplified by three tubes.

The storage battery voltage was used for bias in the original circuit because several worthwhile advantages were gained thereby. But it appears that in some instances this is "bad medicine," for the cure gives rise to a worse condition than the original ailment, in some cars.

By a few simple changes in the receiver, which can be applied to a receiver that already has been built, correction might be made if the noises from the particular car are excessive. The wiring of the circuit with these changes incorporated is shown in Fig. 1.

First of all note that the heater circuit is floating, except that one side of it is permanently connected to the chassis. It makes no difference whether the chassis is positive or negative, for in either case the grid bias voltages will be the same, and also the plate and screen voltages. In some cars the positive side of the storage battery is connected to the car chassis. In such cases the chassis of the set will be positive. In other cars the negative of the battery is connected to the car chassis, and then then set chassis will be negative. It is not necessary to know which side of the battery is grounded.

Providing Bias

But bias must be provided for all the tubes. In the power tube it is done by connecting a 900-ohm resistor between cathode and the chassis. This resistor provides a bias that is slightly higher than the recommended value, but this does not affect the quality adversely and it does make the circuit draw less current from the B supply. The resistor should be shunted with a large condenser to prevent reverse feedback. If this condenser be made 20 mfd. the feedback on all essential low notes will be practically as low as if the bias were taken in part from the storage battery. Suitable by-pass condensers are available in the electrolytic type, about 3 inches long, 1 inch diameter.

The bias for the audio stage is obtained in the same manner, but in this stage a 10,000-ohm resistor is connected between the cathode and the chassis. This resistor is also shunted with a 20 mfd. electrolytic condenser.

R-F Bias

The triode section of the 85 is diode biased. This fact eliminates two components in the input circuit, the grid stopping condenser and the grid leak. Since the triode is diode biased, the cathode is connected to the chassis. The cap of the tube is connected to the negative end of the load resistance on the diode, and the load resistance is connected between the secondary of the untuned transformer and the load resistance remains as before, the value being 0.00025 mfd. The filter in the output of the triode also remains the same, consisting of two 0.00025 mfd. con-

(*Continued on next page*)

Socket Connections Illustrated and Explained

(*Continued from preceding page*)

sistance which will cause a deterioration in the quality. A large condenser should be connected across the battery when this occurs. If an electrolytic condenser is used it should be kept in mind that that draws a little current. Therefore it should be connected so that it does not remain across the battery when the set is not in use.

For convenience the connections to the sockets of the various tubes are shown by a sketch for each type of tube. Each of these represents the under side of the socket, just as it would be seen by a man wiring the set. The terminals are numbered in a counter clockwise direction. The fourth terminal is always connected to the chassis. No. 3 is the live side of the heater circuit. No. 2 is always the plate and No. 5 is always the cathode. No. 1 is the screen whenever the control grid is at the top of the tube, and also excepting the 75, for in this No. 1 is one of the diodes. This would not be used in this circuit if a 75 were used.

The numbers in parentheses near the elements of the tubes refer to the numbers on the socket sketches. In the 89, No. 6 is the suppressor grid and it is connected to No. 5, the cathode.

There are two seven-contact sockets. Both are of the small type.

DOUBLE PUSH-PULL in 12-Tube Super Diamond

By Herman Bernard

THE Push-Pull Diamond has advanced to a twelve-tube dual-range receiver, which is the definitive a-c model. The series started with a six-tube superheterodyne, which was increased to seven tubes, then to nine, then to eleven, and now to twelve.

There is, of course, an ample reason for the various models, as those with the greater number of tubes perform better than those with fewer tubes, and while a constructor can not always have just the receiver he desires, for reasons that need no discussion, he does enjoy a choice that permits him to select a design within his capabilities.

So soon as a receiver embodies a large number of tubes, the parts necessarily become rather expensive, although in the light of prices to-day, one can purchase the parts for a twelve-tube a-c receiver for about one-third the cost of parts for a nine-tube superheterodyne for battery operation as sold four years ago.

Speaking of battery operation, by the way, there will be a series of battery-operated Super Diamonds, using the 2-volt tubes, and also a Auto Diamond for car use, so those patient readers who want such models finally will have their desires met.

Limit Reached

Every tube in the 12-tube a-c model fulfills a definite and valuable purpose, and the combined uses evoke a receiver that reaches the limits of performance. For instance, the sensitivity is as great as it is practical to use, the power output is as great as it would be practical to use in any home. The selectivity is great enough to blot out a local 10 kc removed from a distant station. The tone quality is excellent, and one reason for the great power of 15 watts for output for home use is the very preservation of tone quality during those exacting moments when an orchestra delivers a musical crash or a speaker becomes suddenly loudly energetic. Such moments put extra-heavy drains on an output, and the great power takes care of these drains as if they were nothing.

One of the engineers who wired up the 12-tube model, on finishing his first set of this series, exclaimed:

"What power!"

Then he turned to a test engineer beside him and remarked:

"Nail down the roof!"

Of course, the volume control may be adjusted, so that the quantity of sound is anything for virtually zero to full-on, a variation of 400,000. Moreover, the tuning is readily done, just as in a tuned radio frequency receiver, without any inter-channel noise.

Inter-Channel Noise Suppression

Although the set has two stages of intermediate frequency amplification, both automatic volume controlled, there can be no inter-channel noise due to high too-high amplification and consequent regeneration because of the inter-channel noise suppression inherent in the 55 used as a diode-biased triode. That is, the diode load resistor is connected directly to the grid, so there is non-reactive direct coupling, and as the signal increases, the bias on the tube increases, for the two are one and the same. Thus, at no signal there is no bias, and the triode unit, as circuited, will not amplify at zero bias. Hence, as in all noise-suppression devices, the noise is there, all right, but it is not heard.

The circuit, using twelve tubes, differs principally from the eleven-tube model in that the second audio stage is also push-pull. The power in the primary of the power transformer is a little more than 100 watts, with such an outstanding receiver, and the heater secondary alone has to carry 10 amperes, the power tubes' secondary filament 6 amperes, while the total plate current is about 130 milliamperes. The conservative rating of the high-voltage secondary at the voltage used is 150 milliamperes, and the transformer consequently is extra-large and heavy, and one is spared the usual experience of a transformer getting quite hot on any multi-tube receiver in this class.

No Squeals

The modulator tube is separate, and has two stages of t-r-f ahead of it. The two stages are advisable, as then an aerial of almost any effective height may be used, and still there will be no squealing due to insufficient selectivity ahead of the modulator. In a sense, this is the sole cause of such squealing, since by increasing the selection the squeals may be eliminated. The intermediate channel must not be oscillating, and the padding must be correct, otherwise the remark does not hold.

In some instances it is conceivable that with only one stage of t-r-f there would be cross-modulation, as was experienced by a few who built the nine-tube model, but the remedy lies in increasing the value of the biasing resistor on the r-f tube, and not using too long an aerial. In the present design the remedy of heightened bias is introduced, but due to the extra tuned stage the aerial length (or really effective height) may be greater, and no experience with the receiver contradicts the assumption there is hardly any limit to the effective height of aerial to be used.

In connection with the cause of squeals, insufficient selectivity ahead of the modulator, of course, the degree of coupling be-

Power Supply for Auto Receiver

(*Continued from preceding page*)

densers and a choke coil of about 8 millihenries.

The bias on the second intermediate frequency amplifier remains the same as before, being provided by a 300-ohm resistor in the cathode lead, which is shunted with a condenser of 0.1 mfd.

The bias on the r-f and first i-f amplifiers remains as before but there has been a change in the wiring. The slider on the volume control potentiometer and the low side of the primary of the input transformer are now connected to the chassis. This change has been made possible by the change in the 85-tube circuit.

The bias on the two manually controlled amplifiers is obtained from a 300-ohm resistor in the common cathode lead when the sensitivity is maximum and from a part of the resistance in the potentiometer when the sensitivity is less than maximum.

Volume Control

This automobile receiver has been described in two ways previously, once with the manual volume control in the grid circuit of the 85 and once with it placed as in the present circuit. When there is an automatic volume control the logical place for the manual control seems to be in the audio amplifier, but many of those who have tried both methods in connection with this auto set have expressed strong preference for the method here used. The control in the audio circuit might be preferable if there were a noise suppression tube in the circuit. Noises that would be suppressed by this device can be suppressed by means of the manual control when this is placed in the r-f circuit.

The automatic control has not been changed at all. The gain in the r-f and the first i-f amplifiers is controlled automatically by the signal controlled d-c voltage drop in the diode load resistance.

The Power Supply

The connections of the batteries are the same as before, except for slight modification. The "hot" side of the filament battery is connected to the contact of the remote control socket marked "A 'hot'." and it makes no difference whether the "hot" side is positive or negative. The other filament contact on this socket is permanently connected to the various terminals marked "A," that is, all those heater terminals not previously connected to the chassis. This applies to the speaker socket as well as to the tube sockets.

The negative of the plate supply is connected to the chassis. There are only two leads for the positive, one for the high plate voltage and another for the screen voltage.

The B supply may be a dry cell battery or any of the automobile B supply units now available, provided that the unit has the necessary current capacity. The maximum current required with 180 volts on the plates will be about 44 milliamperes. On strong signals it will be considerably less because of the high bias on the automatically controlled tubes.

Reduction of Hiss

On weak signals when the set is working at maximum sensitivity there is considerable hiss. There are two ways in which this noise can be reduced greatly. The first is to use loose coupling between the two windings of the untuned transformer ahead of the detector. Reducing this coupling, however, also reduces the sensitivity, but the reduction in the noise is more rapid than the reduction in the sensitivity, and most of the noise can be eliminated even before there is any appreciable change in the sensitivity. Moreover, there is sensitivity to spare.

The other way of reducing the hiss is to connect a 0.006 mfd. condenser across the output of the power tube. While this reduces also the high frequency response, most people would rather miss the noise, which they can hear when it comes through, than have the high frequencies, which they can not hear even though they be present. When anyone connects the 0.006 mfd. condenser across the output he always leaves it there because of the sensible improvement in the output.

tween modulator and oscillator falls in the same classification, as the looser the coupling the greater the selectivity. However, the coupling has been apportioned correctly, on the basis of an oscillation amplitude of 80 volts. It is the oscillation that is impressed on the screen of the modulator, and in this manner electron coupling effectuated. The coupling is about one-third as great as if the application were made in the plate circuit, instead of the screen circuit, and the condition can not be described as tight coupling, but is rather loose coupling. The degree of coupling at 1,000 kc is equal to that established by a capacity of 1 mmfd. between grid of oscillator and grid of modulator.

The r-f stages are standard, except that a switch is used for moving the stator of the tuning condenser from one extreme of the secondary to a tap that is 20 turns above the grounded end. This applies to the modulator input which is, of course, at the r-f level of frequencies. The same general principle is applied in the oscillator circuit, except that instead of the switch simply picking up a tap, it picks up one side of a padding condenser the other side of which goes to the tap. Therefore the switch is connected to stator of the main tuning condenser, as in the t-r-f stages, but is switched from one padding condenser to another. The padding condenser for the broadcast band is critical, and an incorrect adjustment virtually blots out all reception below 1100 kc, but the padding condenser for the short-wave band (70-200 meters) is not so critical, and if accurate, may be a fixed condenser of 0.00047 mfd.

Frequency-Stabilized Oscillator

The oscillator is frequency-stabilized, and is the first one of that type ever to be introduced into a broadcast receiver, marking the introduction of precision methods in this class of production. Since it is new and hence not subject to much prior experimentation by the general run of constructors, it is to be expected that trouble will be experienced in this circuit. This trouble is divided into two classes: (a) grid current, (b), audio modulation.

There is one fact about an oscillator using the triode of the 55 that is at once apparent. The tube will oscillate at the slightest provocation. It is one of the most violent oscillators among the small tubes, as it will oscillate at 540 kc if the feedback winding consists of 8 turns, although the 56, also a good oscillator, will not oscillate at that frequency unless there are 17 turns. In fact, the triode of the 55 and the 85 tubes, being similar, is the most readily oscillatory tube we have, for receiver use.

This readiness is not an unmixed blessing. Any tube that will oscillate violently may draw grid current, and grid current is inimical to frequency stability at the higher frequencies. Therefore a grid suppressor of 10,000 ohms is shown. But this acts to advantage only when the grid current is made very small originally, and it may be large at the start. It would be large enough to give at least some deflection on a 0-1 milliammeter put in series with the grid and coil, or across the grid suppressor.

Very High Bias

Since the oscillation amplitude will be high, the plate current will be high. With 2,700 ohms as biasing resistor the voltage reading, in a given test, was 101 volts, or there were about 40 milliamperes of plate current. Yet a bias of around 100 volts is not astounding, since not only did the r-f oscillation itself increase the plate current, but the rectified component of the oscillation also flows through the biasing resistor, as the tube (triode) is a plate bend rectifier, intentionally or unintentionally.

If there is any grid current the voltage drop in the 100,00 ohms due to this current will augment the steady bias by the amount that such voltage exceeds the steady bias. If it does not exceed the steady bias it adds nothing to the negative effective bias.

An audio note may result from the connection of a relatively large condenser across

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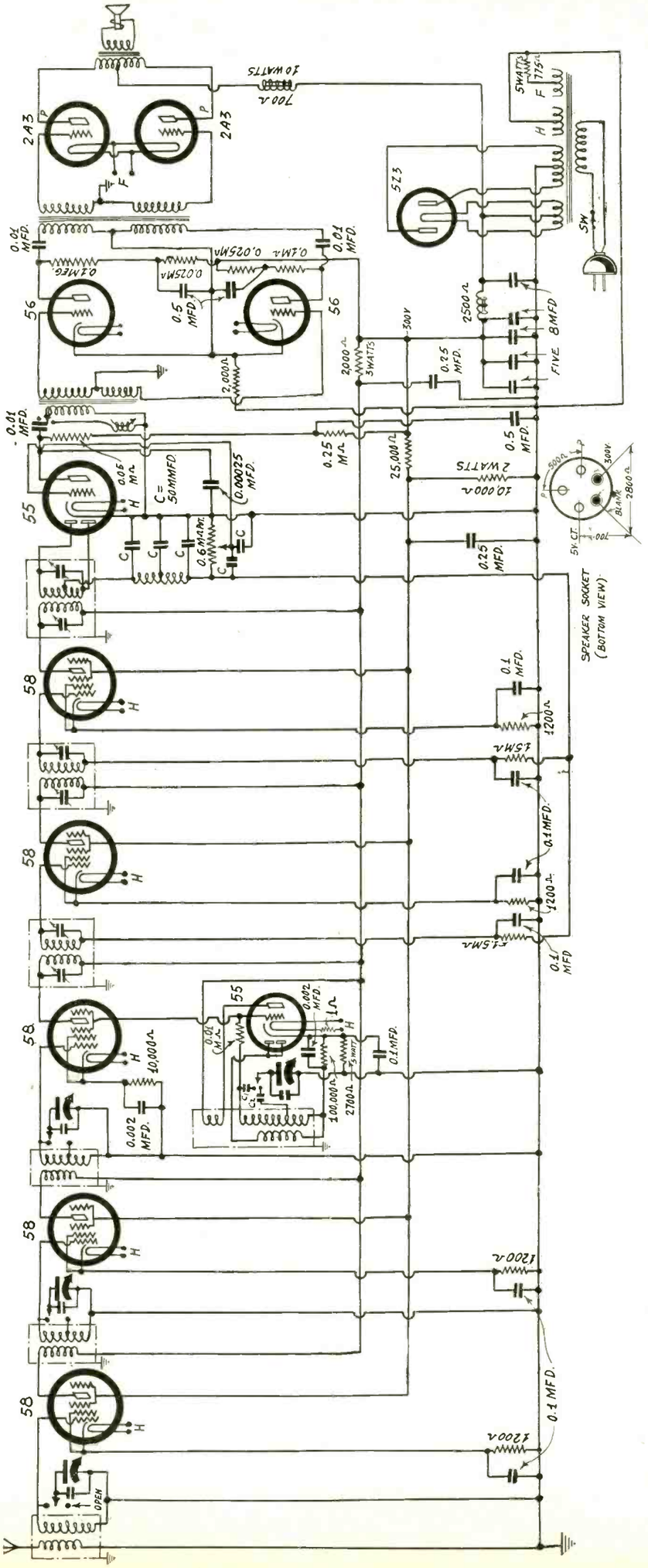
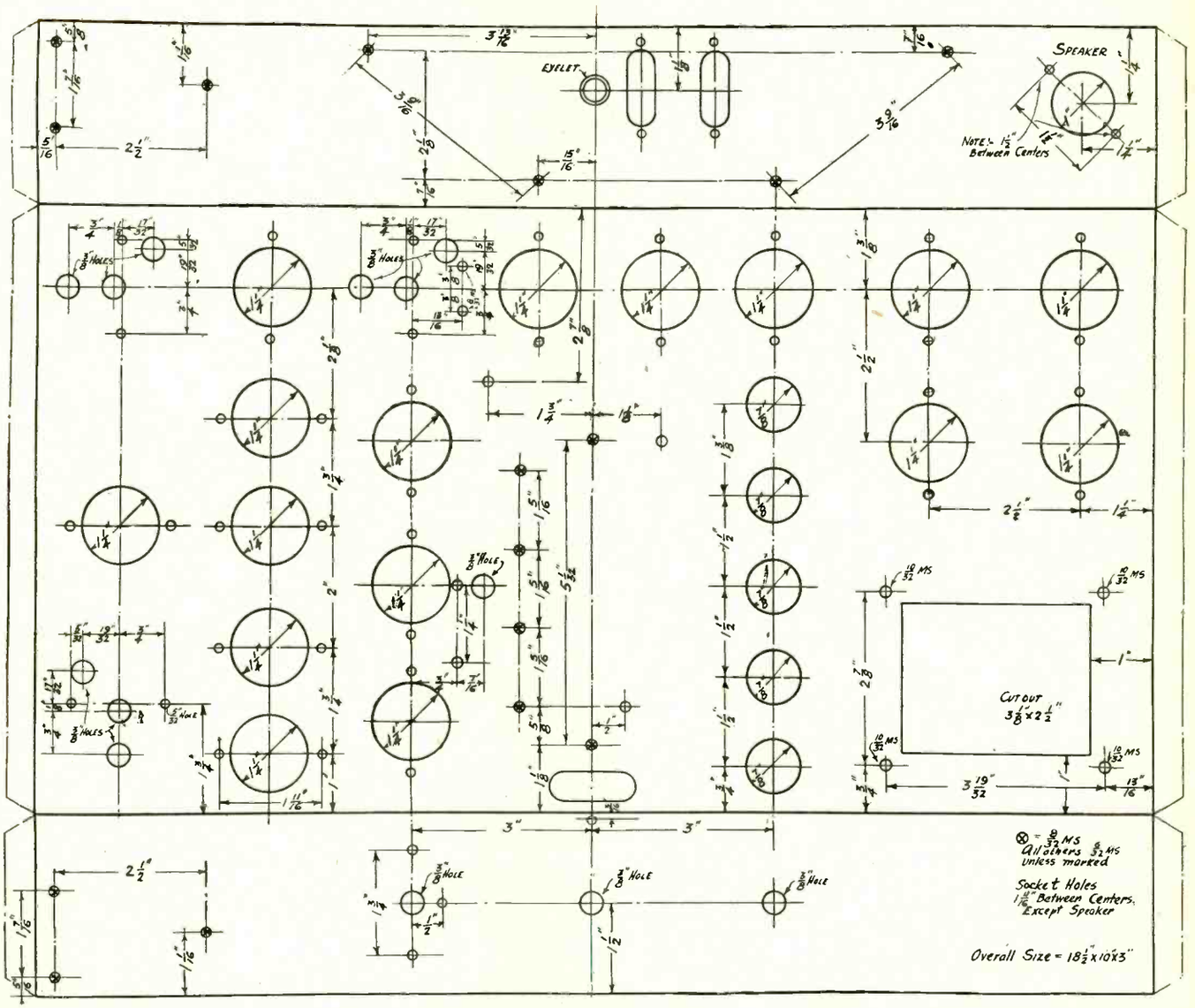


One of the finest receivers ever produced, possessing excellent tone, all the selectivity that such tone permits, and a sensitivity of better than 0.1 microvolt per meter, the 12-Tube Push-Pull Diamond is the most outstanding powerful circuit we have ever published.

Chassis for 12-Tube Diamond Is Only 18½x13x3 Inches



Layout of the chassis for the Twelve-Tube Push-Pull Diamond of the Air. The top of the chassis is 18½ inches wide and 10 inches front to back. The height of the front and rear flaps is 3 inches.

The identifications are as follows: Extreme left, front flap, three holes for a by-pass condenser block; immediately above, on top of chassis, three large holes and two small ones, for first intermediate transformer; directly above, first i-f tube; considerable distance to second i-f transformer to prevent feedback; rear flap, three holes for optional use, including another by-pass condenser block, not in diagram, however. Second Row from left, bottom to top: oscillator tube, modulator tube, second r-f tube, first r-f tube, second i-f tube. Third Row from Left, bottom to top: oscillator coil, modulator coil, second i-f coil, third intermediate coil, for which all leads go through bottom of chassis. The tuning condenser goes at center front, adjustable padding condenser to left thereof; tube to left rear of condenser is second detector, large hole to right of it is antenna coil. The five ⅞-inch holes in a row are for electrolytic condensers, large hole in same line at upper is for one of the 56 second audio tubes, next to right is for other 56 tube; to right of that 2A3 tube, and below the 56 other 2A3 tube; rectifier at right nearer transformer, which fits in cutout at right front. The front flap has three main holes, left to right, for wave switch, volume control-a-c switch and phonograph switch. The rear flap has diagonally-placed holes for the two audio transformers (marked 3 9/16 inches), eyelet for a-c cable exit; two cutouts, one for antenna-ground post assembly, other for phono assembly. The speaker socket hole is at right rear and is far enough down to avoid danger of shorting to top panel socket.

(Continued from preceding page)

a high resistance in an oscillating circuit, as experienced with grid leak oscillators, and while the resistance shown (100,000 ohms) is large, it may be reduced to such value as stops the audio howl. The condenser across the resistance has to be relatively large, for it is in series with the tuning condenser, and indeed if the padding capacity is not too large to permit operation without the howl, it might be located in that position, and for the short-wave tuning add the extra capacity in parallel. If the series capacity for broadcasts is 355 mmfd., then 120 mmfd. would be added in parallel, the switch operation controlling this, instead of the switching method and separate individual padding capacities diagrammed.

Since the oscillator is relatively new, much has yet to be learned about it, although the statement must be made that it may be worked without the rectifier component, as a preliminary test, and the rectification attended to later. The object of this rectification, in the diode unit, is to have the oscillation voltage augment the bias voltage, to maintain the plate impedance constant. The tube should operate as if it were a pure resistance.

Remedies for troubles enumerated include the following:

(1)—Use as high a value of biasing resistor as is consistent with oscillation all over the dial. In this position, cathode to ground, 2,700 ohms are shown, but this is not an adamant specification. No hesitancy need be felt about increasing this value very considerably, high up in the tens of thousands of ohms.

(2)—The plate impedance may be increased greatly, and the saturation point of the tube operation brought within the negative bias part of the characteristic, by reducing the heater voltage. This method was suggested by J. E. Anderson. The value of resistance to accomplish this can not be given definitely, as tubes may differ slightly, and operation must be at such a point that the tube will start oscillating without requiring separate excitation.

For instance, when 2 ohms were used, the tube would not oscillate until a wet finger was applied to the grid several times. Thus the tube had to be "tickled" until it worked,

so the resistance must not be so high as to deprive the tube of its self-starting advantage. A value of 1 ohm is suggested. Just what the resistance value is you need not even know, as you may coil on a pencil some resistance wire until you reduce the heater resistance voltage sufficiently to curtail the emission.

(3)—The number of turns on the feedback winding (plate circuit) may be adjusted to the desired amount of oscillation, but this is usually difficult, or harassing, especially if factory-made coils are used, and one doesn't relish the risk of possibly ruining them.

More Intimate Details Later

The oscillator may be worked with only plate and grid windings used, in the usual manner, and the same performance will obtain as from standard circuits. Hooking up the rectifier winding may be undertaken later, and in view of the special considerations, which have been merely sketched in this article, the subject will be treated at length in a subsequent article, including methods of making measurements.

Also the full 2.5 volts may be used on the heater at first. The padding and the tuning of the first intermediate, and trimming of oscillator and modulator, will have to be redone when the series resistor subsequently is put in the heater circuit of the oscillator.

Some filter circuits, shown in previous models, have been omitted, as they are not strictly necessary, due to the additional t-r-f tuning (extra stage).

Due to double push-pull, no bypass condenser is needed across the biasing resistor of the second audio stage, just as none is used on the third stage. It should be remembered that the first audio stage is in the 55 tube.

Very Large Filter Capacities

The reason for omission of the capacity is that there is no signal current to bypass, and putting a condenser across the resistor introduces a lack of symmetry, or at least results in less symmetry than does exclusion.

Hum is something to consider in any three-stage audio channel, and about the best provision that can be included is adequate filter capacity. It can be seen that there are five condensers of 8 mfd. each, one next to the rectifier, probably sufficient, the rest at the other end of the 2,500-ohm choke (which is also part of the speaker field). If desired, the capacity at the output may be doubled by using condensers that have two 8 mfd. in each can, or 64 mfd. here, with 8 mfd. remaining next to the rectifier. The reason for not increasing the capacity next to the rectifier is that the starting drain on that tube might be too high, and also the voltage would be raised somewhat, whereas now it is just about right, with a given transformer. Now, at 90 milliamperes drawn by the push-pull 2A3 output tubes, the bias on those tubes is 62 volts negative, due to the drop in the 775 ohms, and the total d-c voltage is about 420 volts, of which 56 volts are dropped in the 700-ohm choke (also part of the field), so the applied plate voltage is 420 — (62 + 56), or 312 volts.

Additional filtration is provided by hum filters, consisting of 0.5 mfd. condensers across 25,000-ohm resistors in the plate leads of the 55 and 56 tubes.

Considerable protection against hum is provided by having the screen voltage on the intermediate and other tubes low enough, which is also a provision against oscillation. Any presence of r-f or i-f oscillation tends to increase the hum, because a condition is developed that lends itself readily to modulation by the static and magnetic fields of the audio transformers, power transformer and associated parts. The audio transformers are mounted on the rear wall of the chassis, approximately at right angles. Also they are far enough from the power transformer to prevent hum introduction by magnetic coupling.

Features Listed

The connections for the speaker socket are on the diagram. Only four connections really are necessary externally, as one is made inside the speaker, nevertheless it is customary to supply a UY plug on the speaker cable. Looking at the bottom of the socket, with heater holes toward you, the left-hand heater hole is not connected externally, being the one taken care of inside the speaker; the right-hand heater hole goes to the 300-volt connection, which is the feed after the high resistance field; the hole next to right-hand heater goes to one plate; the equivalent grid connection to other plate, and the hole next to left-hand heater to the center tap of the 5-volt winding of the power transformer.

Two Speaker Types

There are two types of speakers for the circuit. One type has a 12-inch cone and has a split field, of 2,500 and 700 ohms, or 2,100 and 700 ohms, it makes small difference which. This is the lower-powered model, and the speaker itself will stand about 6 watts or a little more, before overloading. Of course the circuit is ahead of the speaker in this respect. The other model speaker is of the auditorium type, with 9-inch cone, weighs 31 pounds, will stand as much output as four 250 type tubes in push-pull parallel would deliver, and is conservatively rated at 25 watts, which is more than you will ever put into it. This exceptional speaker has an almost flat characteristic curve, the only departure from flatness being at around 1,500 cycles, due to the voice coil impedance. It is the finest speaker Rola makes.

The circuit has the following advantages:

Two stages of t-r-f and tuned modulator (three tuned stages at r-f level).

Frequency-stabilized oscillator, which means elimination of frequency shifting.

Electron coupling between oscillator and separate modulator.

Three of Hammerlund's 465 intermediate coils with air-dielectric condensers.

Push-pull 15 watts undistorted output, the great power serving as a reserve that avoids distortion on strong low notes of orchestras.

Push-pull 56's to drive the output tubes.

New tubes. The heavy-duty 5Z3 full-wave rectifier and the 2A3 output tubes are used. The power stage is a cross between Class A and Class B, but of the no-grid-current type.

Full wave duplex diode linear second detector. Stands up to 60 volts signal on second detector.

Both stages of intermediate frequency amplification subject to full automatic volume control.

Noise suppression control without an extra tube. This means no inter-channel hiss or "hash" without elimination of which a.v.c. is a nuisance.

Selectivity affording non-interfered reception from a distant station though a local 10 kc. away delivers 1,000 times as much antenna voltage.

Sensitivity of better than 0.1 microvolt per meter.

Volume control can completely eliminate signal, and has sound volume range from bare audibility to 400,000 times bare audibility.

Dual range. Broadcast and police bands by throwing a front-panel switch. Some amateurs, short-wave music and television can be received.

Short-wave band as accurately treated as broadcast band, for unusually effective results on police signals.

Band-shifting by positive-contact, low resistance switch that improves with use.

No cross-modulation or inter-modulation on either band.

Despite 130 ma B drain, and other high current supplies, husky power transformer is worked well below its standard rating.

CROSBY IN HOLLYWOOD

Bing Crosby has gone to Hollywood to make his next feature film, "College Humor," and a batch of shorts.

Women Write 85% of 'Show Boat' Fan Mail

Eighty-five per cent of the fan mail received by the sponsors of "Captain Henry's Show Boat" is written by women, ranging from twenty-one to sixty or older, an analysis of audience-reaction to the popular NBC musical romance reveals. Children comprise the majority of the remaining fifteen per cent, with men constituting less than three per cent of the letter-writing public.

Lanny Ross, the star tenor of the hour, receives more mail than any other artist on the program, with the character of Mary Lou, his fictitious radio sweetheart, played by Muriel Wilson, a close second. Annette Hanshaw, the Show Boat's blues singer, is third, and Charley (Captain Henry) Winninger, fourth.

Ardent love letters from girls who visualize him as their sweetheart and friendly letters of advice from middle-aged women who picture themselves as his mother feature Lanny Ross' mail. Annette Hanshaw has a youthful clientele, much of which is composed of college boys, some just writing to let her know they like her, and others asking for her help in breaking into radio.

Old folks by the scores write to Charley Winninger, particularly those who used to know him in his old trouping days in the Middle West. Molasses 'n' January are frequently asked if they're really colored. Children write them a lot, asking for jokes to use in plays.

Westinghouse Offers Frequency Monitor

Since the early days of broadcasting, there always have been ways and means of checking frequencies but none more precise or more positive than the new frequency measuring service now offered by Westinghouse.

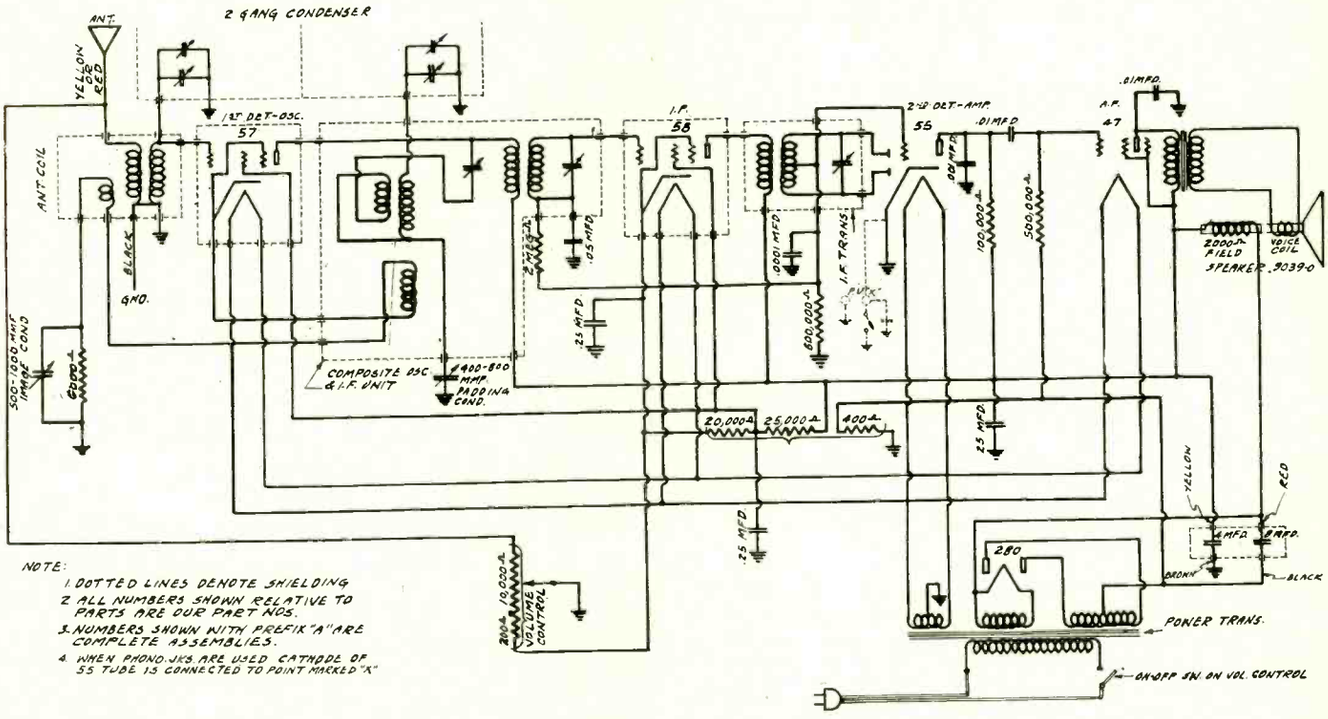
With equipment that duplicates the efficiency of official apparatus, with a primary frequency standard which is checked twice daily against Arlington's time signals and the standard frequency transmissions from WWV, Westinghouse offers to the nation's broadcasting stations a measuring service of unsurpassed accuracy.

Whether a one-time check is desired, or weekly reports over a period of months, this new Westinghouse service is available.—From Westinghouse Electric & Mfg. Co.

PAIGE RETURNS

Raymond Paige's Orchestra will back him in his Chesterfield airings over Columbia, which will originate at KHJ, Los Angeles.

SERVICING
5-Tube and 6-Tube 85-550-Meter Sets



Circuit diagram of the wiring of the five-tube 85-550 meter superheterodyne.

THE circuit diagrams of two 85-550 meter receivers manufactured for various private brand distributors, for one a 5-tube, another a 6-tube receiver are printed herewith, as are the chassis views. The service data follow, first for the 5-tube set, then for the 6-tube one:

Five-Tube Set

VOLUME CONTROL: The volume control is located on the lefthand side of the chassis. It is a 10,000 ohm potentiometer and attenuates by controlling the bias on the 258 intermediate frequency tube and also attenuates in the antenna circuit, by shunting the input. The "off and on" switch is controlled by the volume control knob. When the volume control is turned to the maximum counter clockwise position, the receiver is turned off and is placed in operation by the reversed action, which will be indicated by the pilot light being lit.

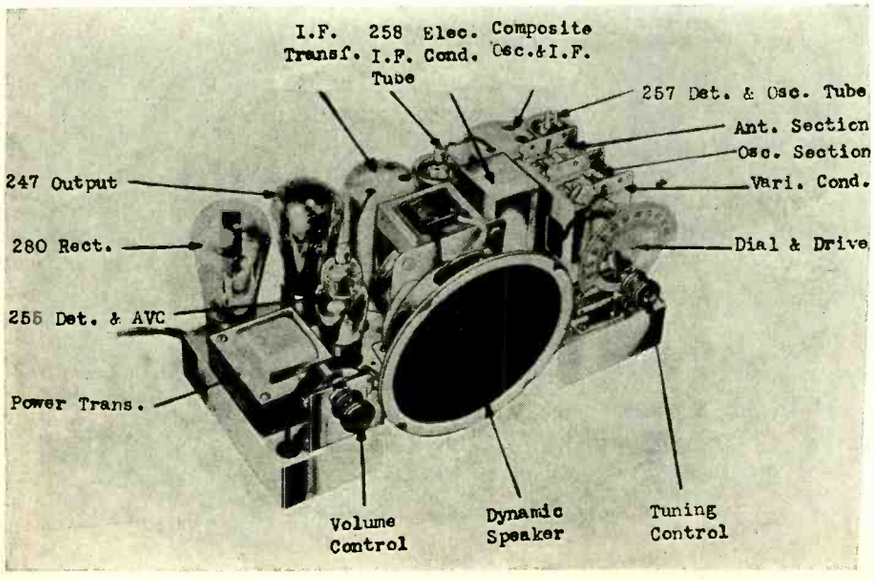
VARIABLE CONDENSER: The rugged two gang condenser is mounted on resilient rubber, insuring permanent alignment and elimination of microphonic howls. The design and construction of the smooth position action friction drive is such that there is nothing to get out of order, and no adjustments should be necessary.

DIAL: The first models of this receiver used a dial which was calibrated from 0 to 100. In the current models the dial is calibrated in kilocycles; the last cipher on the dial being omitted. Adding a 0 to the number on the dial gives the correct reading in kilocycles; i.e.: 55 refers to 550 kilocycles and 150 to 1500 kilocycles. The dial is made visible by a miniature 2½ volt pilot light. The pilot light is held in position by the pilot light bracket which slips over the end shield of the variable condenser. To remove the pilot light, simply pull upward on the pilot light socket which will permit removal of the pilot light, as the pilot light socket will then be readily accessible.

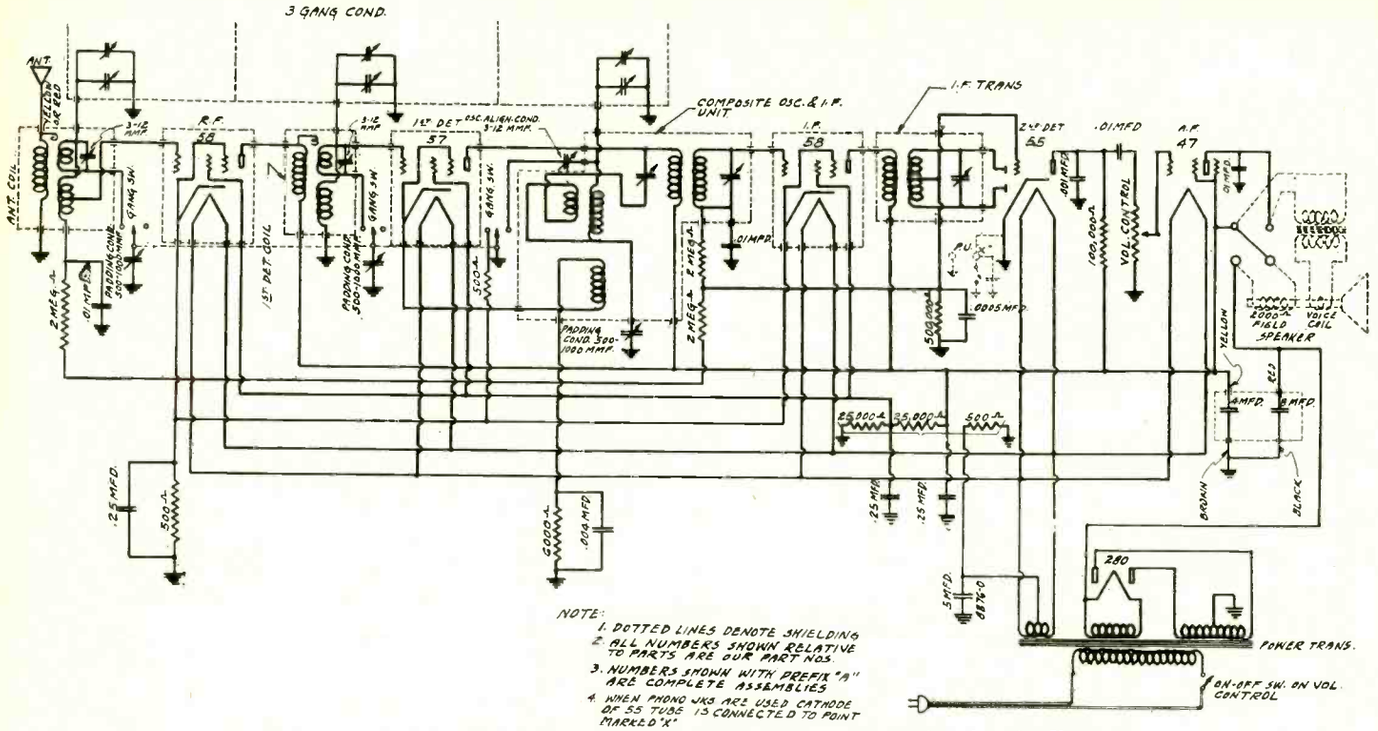
INTERMEDIATE TRANSFORMERS: The intermediate transformers are tuned to 262 kilocycles. The intermediate frequency transformer trimmers are rigidly mounted and the transformers are so constructed that the transformer rarely becomes detuned. FOR THIS REASON IT SHOULD NEVER BE NECESSARY TO RETRACK THE INTERMEDIATE TRANSFORMER UNLESS ONE OF THE TRANSFORMERS BECOME DEFECTIVE AND REQUIRE REPLACEMENT. The first and second intermediate transformers have two trimmers, each, which are accessible through the small holes on the top of the shield cans.

ELECTRO DYNAMIC SPEAKER: The dynamic speaker has a D.C. field resistance of 2000 ohms and is used as a choke in the filter circuit.

OSCILLATOR: The 57 tube is used as the modulator (first detector) and oscillator by a method which sacrifices none of the qualities of either function. The combined circuit is such that it is not supercritical and the special selection of 57 tubes is not required. Any good 57 tube, with correct characteristics, will work satisfactorily in this stage. If the receiver only operates over a portion of the broadcast band (long wave length) the trouble may be due to a tube which does not have proper characteristics.



Chassis view of the 5-tube set.



The six-tube model of the same series of receivers shown in circuit diagram.

The remedy is, of course, to replace the 57 tube.

ANTENNA: To obtain best results, a proper antenna installation is imperative. On most installations, outside antennas, not exceeding 35 feet including lead-in, will prove most satisfactory and in all, except buildings which are constructed with a large amount of steel, an inside aerial, of this length will give good results. In steel constructed buildings, only an outside antenna should be used. The higher the outside antenna, and the further away it is from surrounding objects, the more efficient it will be.

A good ground is as essential as an efficient antenna. Ground should be attached, by means of an approved ground clamp, to a cold water pipe which has been carefully cleaned, either by sand papering or filing. Generally, a steam radiator makes a satisfactory ground, but occasionally, due to poor connections in the pipes, may be inefficient; therefore, as a general rule, water pipes are preferable.

IMAGE SUPPRESSION: Occasionally, in some locations, interference in the form of whistles or stations which are tuned in on dial settings, other than the station's frequency, may be encountered. This is a rare occurrence and is called an image, caused by two signals whose frequencies differ by twice the intermediate frequency. This should not be confused with heterodyne whistles, which are caused by two stations being received, whose frequencies are the same, nor by local stations whose frequencies are close to some out-of-town station's frequency, which might result in reception from both stations. To overcome any possibility of image interference, an image suppression circuit is incorporated in this receiver. If image interference is encountered, adjusting the image suppression condenser, as described, will eliminate this annoyance. UNLESS THERE IS AN ACTUAL IMAGE INTERFERENCE, DO NOT ATTEMPT TO ADJUST THE IMAGE SUPPRESSION CIRCUIT.

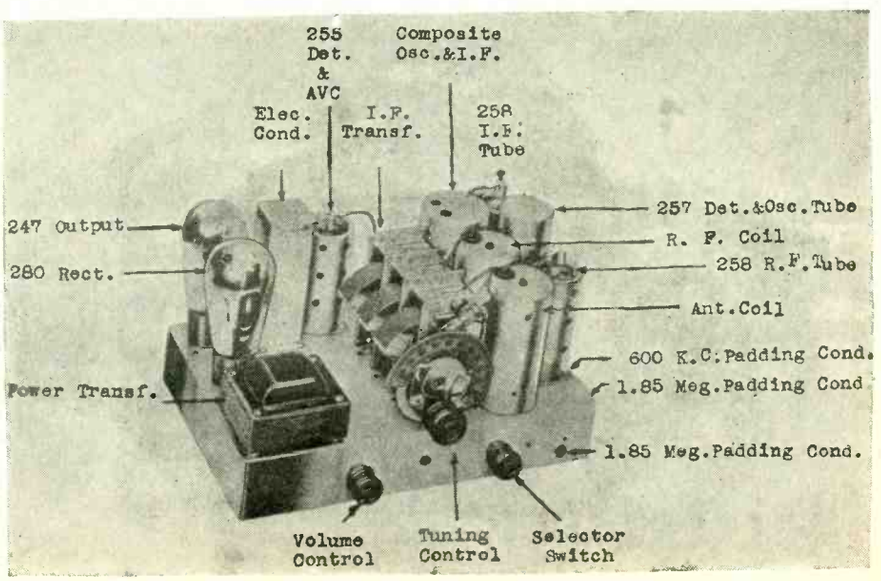
TUBES: The receiver utilizes the following tubes: One (1) Type 57 as a composite oscillator and modulator tube; One (1) Type 58 intermediate frequency amplifier tube; One (1) Type 55 duplex diode and triode tube (Detector, AVC, first audio); One (1) Type 47 output tube; One (1) Type 80 rectifier tube.

VOLTAGE TABLE: Never check voltages until all tubes are fully warmed up to proper operating condition. The voltage table, given below, is taken at 115 volts line with volume control in the full on position. It must be remembered that the voltage readings vary directly as the line voltage and also with the accuracy of the meters used. A variation of 10 percent plus, or minus, is permissible.

IMAGE ADJUSTMENT: On the early models which used dials that were not calibrated in kilocycles, the location of the image and padding condensers were different than on the later models which have dials calibrated in kilocycles. On the first models the image condenser is located on the under side of the chassis (one end being connected to the terminal lug) and the padding condenser is on the back of, and accessible through the hole in the chassis. The image suppression condenser on the current models is located on the back of the chassis and the padding condenser on the right hand side of the chassis, both being accessible through the holes in the chassis. On either model the alignment procedure is the same. If an interfering station or whistle is noticed, tune the receiver to this interference and adjust the image suppression condenser until the interference disappears, or until the interference is at the minimum point.

INTERMEDIATE FREQUENCY ALIGNMENT: Only when an intermediate coil has become defective, due to an open or burned out winding, should it be necessary to readjust the intermediate stages. Should this occur, it is necessary that an oscillator be used with some type of output measuring device. To align the intermediate stage, connect the high side of the oscillator output to the control grid of the No. 57 oscillator modulator tube, leaving the grid cap disconnected from the tube. The ground side of the test oscillator should be connected to either the ground lead of the set or to the chassis. Set the oscillator at 262 kilocycles (this must be accurate) and adjust the output of the oscillator so that a convenient reading is obtained on the output meter. If, during the alignment, the meter goes off scale, reduce the output of the oscillator or adjust the receiver volume control. It is always best to realign the set with tubes that are to be used with the receiver. Align the first intermediate transformer by turning the intermediate fre-

(*Continued on page* 15)



Appearance of the chassis of the six-tube receiver.

THE BEGIN

A Short-wave Receiver

By F.

Try-Mo Rad

BEGINNERS as well as veterans have reported splendid results with the Beginner's Twin battery-operated short-wave receiver. There must be something about the circuit that accounts for this situation. Examination of the circuit and of the receiver itself shows that there are many reasons for the sensitivity.

First of all, one reason is the extreme simplicity of the circuit. One great radio authority stated that, as a general rule, the simpler the circuit the more efficient it was likely to be, because there are fewer places where losses may occur. This simple circuit confirms the opinion of this authority.

Another reason for the sensitivity is found in the high grade parts employed. The coils, which are of the plug-in type, are wound on low-loss material with heavy wire, where heavy wire is of importance. Moreover, the turns are spaced in the tuned windings, so that capacity losses will be low.

More Reasons

Still another reason is the high grade of condensers used in the tuner and in the regeneration control. They are the Hammarlund juniors with low loss insulators between the stator and rotor elements.

Again, the dial contributes a great deal to the effectiveness. While the dial will in no sense increase or decrease efficiency of the circuit, it does permit taking full advantage of the sensitivity there is. Anyone who has tuned a short-wave set realizes the importance of having a tuning control that permits hair line adjustment, free of sudden jumps and all lost motion. Without such a control the most sensitive receiver will be practically useless. The dial used is also of Hammarlund make, which is an assurance of mechanical excellence.

Yet another reason is that the condenser in the tuned circuit has a low capacity, which compels the use of a comparatively large coil. Any receiver in which the ratio L/C is large will be more sensitive than a receiver in which this ratio is small. The L in this case is the inductance of the coil and the C is the capacity across it.

Tubes Used

Two small battery type tubes are used in the circuit, both of the 230 specifications. One of these is used as a regenerative detector and the other as an audio frequency amplifier. These tubes are especially suitable for a receiver of this type because they are economical of filament current. The rated current is only 60 milliamperes, so that the receiver takes only 120 milliamperes. And that is the maximum, unless the operator becomes extravagantly foolish. The current will be less on strong signals for the volume control is a rheostat that cuts the current down.

A current of 120 milliamperes can be supplied by a No. 6 dry cell for a long time, because such a cell is rated at 250 milliamperes. Two of these cells are required in series, for each cell gives a voltage of 1.5 volts and the tubes required

LIST OF PARTS

One Try-Mo foundation kit, consisting of 10¾x8 inch panel and subpanel of the same dimensions.
Two Hammarlund 150 (140) mmfd. midget tuning condensers.
One Hammarlund vernier drum dial.
One trimmer condenser for antenna circuit.
One 10-ohm rheostat with built-in filament switch.
One 100 mmfd. grid condenser, with 3-megohm grid leak.
One audio transformer (any ratio between 3/1 and 6/1).
One set of Powertest plug-in coils (four in set).
Three four-prong sockets (two for tubes and one for coil).
One fused battery cable.
Two twin binding post strips.
One short-wave r-f choke.
Assorted hardware.
Required accessories.
Two type 30 tubes.
Two No. 4 or No. 6 dry cells (preferably the larger).
Two small 45-volt "B" batteries.
One pair of earphones.

voltage. Therefore the use of two cells is recommended.

If there is a special reason for operating the tubes on smaller cells than the No. 6, it can be done, but not so economically, for the smaller cells cost more proportionally, and they run down more quickly.

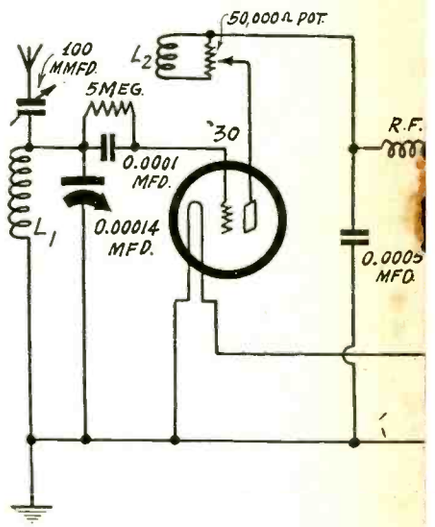
Plate Voltage

The plate voltage required on the regenerative detector is either 22.5 or 45, whichever is desired or whichever works the better. The difference is mainly one of control of regeneration. It is less critical when the lower voltage is used, and lack of criticalness is important in pulling in weak stations for which much regeneration is required.

The voltage on the plate of the audio amplifier is 98 volts, the highest that should be used on a 230 tube. It is permissible to use only 45 volts on the tube because that will be sufficient for the operation of a headset. The tube will last longer with the lower voltage on it, and the B battery will last longer, too. As far as difference in DX reception is concerned there will be no noticeable difference.

Control of Regeneration

The regenerations is obtained by means of a tickler in the plate circuit, coupled inductively to the tuned winding on the coil. The control of the regeneration is by means of a small variable condenser, of the same size as the tuning condenser, connected between the B plus end of the tickler and ground. Since one side of the tickler control condenser is grounded, and this side is connected to the metal front panel, body capacity effects will be absent. This is important when weak stations are 2 volts. The circuit will work on a single cell provided that cell is in good condition, but it will work much better with the rated



With a simple circuit like this exc obta

Radiated Code O

Ever since garage doors were first used, automobile owners have wished there might be some easy way of opening and closing them. The delay and inconvenience of having to stop the car and get out has always been a chore, and in stormy weather is especially unpleasant.

Now, thanks to modern ingenuity and the power of radio, combined with the force of electricity and suitable mechanisms, the trouble and inconvenience of this task can be forgotten. Garage doors can be opened and closed at will from inside the automobile; garage lights can be turned on and off in the same way. The radio controlled electric door operator for residence garages, commonly known as the Radio Door, brings this convenience within the means of everyone who owns a car, and it will be one of the exhibits at the Century of Progress Exposition in Chicago this year.

In a Real House

As the sole manufacturers of the original Radio Door, Barber-Colman Company, Rockford, Illinois, is sponsoring a full working exhibit of it in the house which is being erected by the United Lumber Industries. This house is designed to show the many ways in which wood can be adapted to modern residence requirements. One of these uses is the sectional upward-acting garage door, which has special wood sections designed by the architect to match the general style of the house.

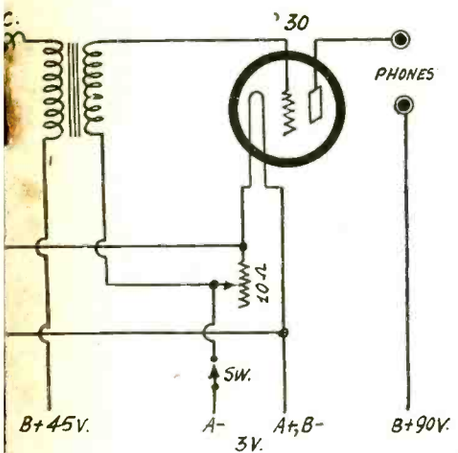
The garage will be complete, with an

NER'S TWIN

for Earphone Reception

Grimes

io Corporation



ellent results in foreign reception are nable.

pens Garage Door

attendant to demonstrate and explain exactly how the radio control works. The door, incidentally, is also a Barber-Colman product, being well known in the trade under the name of the Barcol Overdoor.

Contrary to what most pepole think, the Radio Door makes no use of the "electric eye" or photoelectric cell, or of any devices which respond to a toot of the horn or other noise. Instead, a small automatic radio transmitter in the car broadcasts a code signal which is picked up by an automatic analyzing receiver in the garage. There is a special code for each garage so that no one can get into anyone else's garage, and also so that a single electric impulse, such as a flash of lightning, cannot open the door. By pulling a knob on the instrument board of the car while approaching the garage, the driver sends the signal and the doors open. When the knob is pulled again, the doors close.

Light Control

An added feature is the light control by which the lights in the garage (and along the driveway or on the porch, if desired) are turned on automatically when the doors are opened at night. This, also, does not use an "electric eye" but is accomplished by an extra impulse in the code, which is transmitted only when the lights of the car are turned on, and actuates a special relay in the receiver. Auxiliary hand control switches may be placed wherever desired. The Radio Door mechanism can be adapted to any make of car and to almost any kind of garage door.

capacity of the A source when DX is to be pulled in. The regeneration condenser is controlled by a knob on the panel, which is entirely satisfactory.

To make the tickler condenser effective a radio frequency choke coil is connected between the stator of the condenser and the plate side of the audio coupling transformer. Without the choke the condenser could have no control over the regeneration because the self capacity of the transformer winding would be large enough to insure oscillation all the time.

The tickler winding is small and placed so that its coupling to the tuned coil is loose. Yet is it close enough to insure regeneration at all settings of the variable condensers on all the coils in the set of four. Of course, the tickler is varied from coil to coil to bring about this result.

As a further means of controlling the regeneration, and the selectivity of the circuit, a small adjustable condenser is put in the antenna circuit between the antenna and the high potential side of the tuned circuit. This condenser provides a means for adjusting the circuits to different lengths of antenna. This condenser is of the postage stamp type and is adjustable by means of a screw easily accessible from the top of the subpanel.

Filament Control

As an auxiliary means of controlling the sensitivity and the regeneration, a 10-ohm rheostat is provided in the filament circuit. This is used also to take up the excess filament battery voltage. If the supply voltage is 3 volts, as obtained from two dry cells in series, at least 8 ohms should be left in the circuit when the set is adjusted to maximum sensitivity. This leaves only a play of two ohms, but that is considerable. A fixed resistance of six ohms might be put in series with the rheostat as a check on the temptation of operating the tubes at excessive filament voltage.

Design of Coils

The coils are wound on plug-in forms 1.25 inches in diameter and 2.125 inches long, exclusive of the prongs. The largest coil contains 58¾ turns of No. 26 enameled wire, spread out over a length of 1.25 inches. The tickler on this coil contains 13 turns of No. 28 double silk covered wire.

The next largest coil contains 22¾ turns of No. 26 enameled wire, spread out over a length of 1⅛ inches. The tickler of this coil contains 10 turns of No. 26 double silk covered wire. The third coil contains 10¾ turns of No. 26 enameled wire, spread out over a length of one inch. The tickler of this coil consists of 8 turns of No. 26 double silk covered wire. The smallest coil is wound with 4¼ turns of No. 25 enameled wire, spread out over a length of ¾ inch. The tickler contains seven turns of No. 26 double silk covered wire.

The forms of the coils are colored so that the wave range can be identified by colors. The largest coil is blue, the next black, the next red, and the smallest green.

Other Parts

A large audio frequency transformer is used between the detector and the output tube. It is of a size consistent with good quality.

There are two binding post "twins." One pair is for the antenna and ground connections and the other for the head phones.

For the battery connections a five-lead cable is provided. One is for A plus, another for A minus, a third for B minus, a fourth for 22 or 45 volts, and the fifth for 45 or 90 volts. There is a line fuse built into the cable, which is protected by a moulded bakelite cover, but easily accessible.

The front panel of the circuit is laid out symmetrically. Of the two end knobs, the left is the regeneration control, the right the tuning control. The dial escutcheon is placed at the center top and the rheostat knob directly below it near the bottom.

The parts on the subpanel are also laid out symmetrically, in so far as this is practical and consistent with good electrical design. The dial and the tuning condenser occupy the larger part of the space, fully half. The regeneration control condenser is tucked away in one corner near the coil socket, where it belongs. The tubes occupy the rear corners of the subpanel and the audio transformer is placed between them. The antenna condenser is mounted on the subpanel near the regeneration condenser, with the adjusting screw on top and the condenser itself below.

Below the subpanel are only the rheostat, the antenna condensers, three sockets, and about two feet of wire.

The grid leak and the stopping condenser have been selected so that the highest possible sensitivity will result, consistent with stable operation on all the coils. While a smaller condenser might work better on the higher frequencies it might offer too high impedance to the lower and in that manner reduce the voltage impressed on the grid. A higher resistance might work better at some parts of the tuning range of each coil but it might produce blocking at other points.

It will be noticed that the grid leak is returned to the positive side of the filament. This is consistent with highest detecting efficiency with tubes of this type.

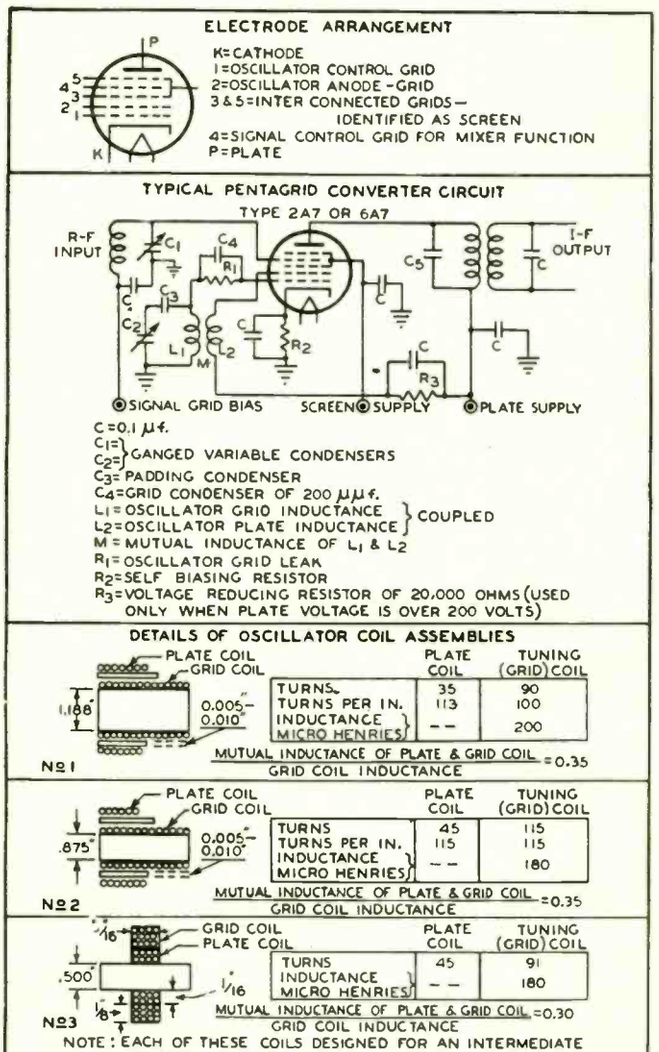
STUDIO NOTES

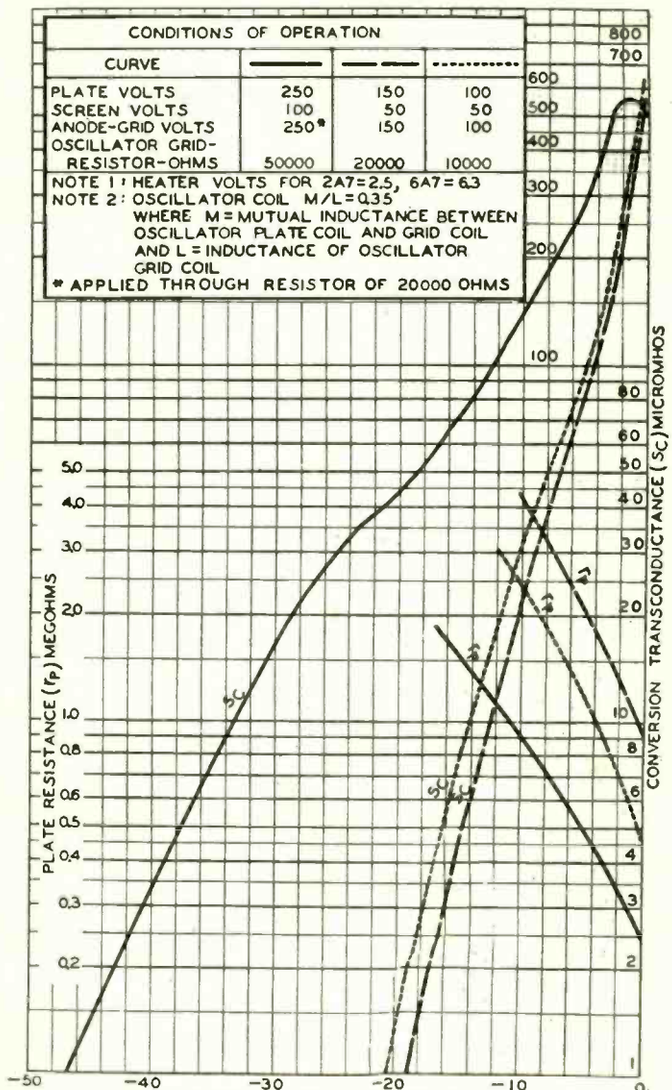
Burton Holmes, the famous globe-trotter and lecturer, was recently engaged in a serious business conversation in one of the executive offices at the National Broadcasting Company when the voice of Bill Hay came through the office loudspeaker announcing Amos 'n' Andy. Raising his hand for silence, Holmes refused to continue the conversation until the program had ended. For years, he revealed, he has been an ardent fan of the black-face comedians and never misses a broadcast if he can help it.

* * *

Irving Kaufman, veteran stage and radio minstrel, who is heard every Sunday at 1:30 p.m., E.S.T., as "Lazy Dan, the Minstrel Man," has also been added as a vocalist to the Abe Lyman Orchestra-Hollywood Newsboy presentations.

Directions for Using Two New Tubes
THE 2A7 AND THE 6A7





Tube geometry is illustrated at upper left for the 2A7 and 6A7, with typical circuit below and details of oscillator coil assemblies. At right are performance curves on the tubes.

The following "Application Note on the Use and Operation of the 2A7 and 6A7 as Pentagrid Converters" was released by RCA Radiotron Co., Inc., and E. T. Cunningham, Inc.:

The first question which will naturally occur to the engineer contemplating the use of the 2A7 or the 6A7 in a new design is "What advantages and improvements in performance can be expected from the use of these tubes?" The answer to this question is the demonstrable fact that either of these tubes, used as combined oscillator and first detector in a superheterodyne receiver, possesses certain operating advantages. These are: Greater operating stability; higher and more uniform translation gain; volume control effectiveness comparable with that of a super-control type in an i-f stage; reduction or elimination of intercoupling troubles between the signal and oscillator circuits; almost entire elimination of radiation from local oscillator; simplicity of oscillator circuit adjustment; saving of space in set.

While the operation of the 2A7 and 6A7 is by no means complicated, a review of the functional features will clarify the discussion of their application.

The electrode arrangement of the 2A7 and 6A7 is shown on the diagram. These tubes differ chiefly in their heater voltages. The cathode is at K. Grid No. 1 is the control grid for the oscillator portion of the tube. Grid No. 2 is the anode for the oscillator. Grids No. 3 and No. 5, connected together within the tube, are used to accelerate the electron stream from the cathode. Furthermore, grids No. 3 and No. 5 electrostatically shield the signal control grid (No. 4) from the other electrodes, and increase the output impedance of the tube—a desirable characteristic from a gain standpoint. The electron stream is controlled by grid No. 4 in a conventional manner. The plate, at P, is of usual structure and is the anode for the mixer function of the tube.

In operation, the cathode, grid No. 1, and grid No. 2 form the oscillator portion of the tube. Electrons emitted from the cathode can be controlled in their flow to the oscillator anode (grid No. 2), by grid No. 1. The oscillator grid circuit, therefore, can be made to oscillate at any desired frequency; so that the electron stream, in flowing through the No. 1 grid, will be modulated at this frequency.

The modulated electron stream comes under the influence of grid No. 3 which is operated at a positive potential with respect to the cathode. As a result, the electron stream is accelerated toward the plate by this grid.

The incoming radio-frequency signal, applied to grid No. 4, further modulates the electron stream (already modulated at the oscillator frequency), thus producing components of plate current, the frequencies of which are the various combinations of the oscillator and signal frequencies. Since the primary circuit of the first i-f stage is designed for resonance at the intermediate frequency (equal to the difference between the oscillator and signal frequencies), only the desired intermediate frequency will be present in the secondary of the i-f transformer.

The circuit diagram shows a desirable arrangement for the 2A7 or 6A7. An explanation of the various circuit components is included.

There are no particularly novel or unusual features to be taken into consideration in designing a superheterodyne receiver to use the 2A7 or 6A7. The design of the r-f input coil, the i-f transformers, and the gang-tuning condensers is conventional. No data are given in this note on the design of these parts, since they will vary greatly with the intermediate frequency used and with the frequency

the response is maximum, by needle deflection or listening.

In designing oscillator coils for the 2A7 or 6A7, the coupling between the grid and the oscillator anode coil should be a little greater than that commonly used with triode oscillators. In general, for the 2A7 and 6A7 the ratio of M/L [the mutual inductance (M) between oscillator anode coil and grid (tuning) coil to the inductance (L) of the grid (tuning)] coil should be from 0.25 to 0.40.

Higher values of coupling than those obtained with the above ratios may cause difficulty in tracking the oscillator frequency to the signal frequency, while lower values of coupling will result in reduced translation gain. However, the 2A7 and 6A7 will oscillate with ratios of M/L as low as 0.1.

The diagrams show three oscillator coils designed to give good results with the 2A7 or 6A7. There are no unusual features involved in the design and construction of these coils. Two constructions are shown to enable the designer to choose the coil form better suited to his space requirements. Each of these coils has an M/L ratio within the limits specified, 0.25—0.40. The coils shown are suitable for use with an intermediate frequency of 175 kc in a broadcast-band receiver. The use of other intermediate frequencies will necessitate changes in inductance of the coils.

What the Curves Show

The curve sheet shows curves of conversion transconductance versus signal control grid volts. These curves, together with those of plate resistance, were taken at representative voltages available for plate supply in typical sets. The volume control capabilities of the tubes are clearly indicated by these curves.

The translation gain obtainable with the 2A7 or 6A7 is:

$$aS_cZr_p/(Z + r_p)$$

Where:

a = Voltage ratio of the i-f transformer
S_c = Conversion transconductance
Z = Effective impedance of the i-f transformer across the input terminals.
r_p = Plate resistance of the 2A7 or 6A7

With transformers ordinarily used the translation gain obtainable with the 2A7 or 6A7 is around 60. With special high-impedance transformers, a gain of about 100 can be readily obtained.

These are typical operating conditions for the 2A7 and 6A7, but they do not necessarily provide the best results obtainable. The voltages, resistors and coils may be varied within fairly wide limits to fit the conditions of a particular application.

In general, increasing the screen supply voltage (E_{c_3} and $_5$) will increase the gain until an optimum value is reached, but this voltage should never exceed a maximum of 100 volts. The optimum value is dependent on other electrode voltages and on circuit constants. All currents will increase with increasing voltage on the screen (E_{c_3} and $_5$). A reduction of the oscillator grid leak (R_1) increases the gain and, at the same time, the currents. An increase in the ratio M/L operates in the same way.

These typical operating conditions for the 2A7 and 6A7 have given very satisfactory results in our laboratory. It will be noted that, with the plate supply voltage at 100 volts, apparently better operation was obtained than at 150 volts plate supply. This difference in performance was brought about by choice of circuit constants. An increase in screen voltage (E_{c_3} and $_5$) will raise the conversion transconductance at this plate supply voltage.

In designing circuits and selecting constants for the 2A7 and 6A7, it must be remembered that there is an unusually large number of variable factors to be taken into consideration. The tubes are quite flexible in their voltage requirements, so that reasonable care in the selection of supply voltages and circuit constants will insure improved operation over combined oscillator - first - detector circuits using types not especially designed for this dual function.

TYPICAL OPERATING CONDITIONS FOR THE 2A7 AND 6A7

Plate Supply Voltage (E_b)—volts	100	150	250
Oscillator Grid Leak (R_1)—ohms	10,000	20,000	50,000
Oscillator Grid Condenser (C_4)—uuf	200	200	200
Oscillator Anode-Grid Supply Volts (E_{c_2})	100	150	250*
Screen Supply Volts (E_{c_3} and $_5$)	50	50	100
Signal Control Grid Volts (E_{c_4})—Min.	—1.5**	—1.5**	—3
Signal Control Grid Volts (E_{c_4})—Cut Off	—20	—20	—45
Oscillator Control Grid Milliamp. (I_{c_1})	1.2	1.5	0.7
Oscillator Anode-Grid Milliamp. (I_{c_2})	3.3	4.9	4.0
Screen Milliamp. (I_{c_3} and $_5$)	2.5	2.8	2.2
Plate Milliamp. (I_b)	1.3	1.0	3.5
Cathode Milliamp. (I_k)	8.3	10.2	10.4
Self-Biasing Resistor (R_2)—ohms	150	150	300
Oscillator Coil M/L Ratio	0.35	0.35	0.35
# Conversion Transconductance (S_c)—micromhos	350	300	520
Plate Resistance (r_p)—ohms	600,000	1,000,000	360,000

**When plate supply voltage is over 200 volts, the oscillator anode voltage is applied through a voltage-reducing resistor of 20,000 ohms.*

***If signals in excess of 0.5 volts RMS are to be applied to the No. 4 grid, proportionally higher grid bias must be used.*

 # Conversion transconductance may be defined as the ratio of the i-f current in the primary of the i-f transformer to the applied r-f voltage producing it (or more precisely, it is the limiting value of this ratio as the r-f voltage approaches zero). In determining the performance of a frequency converter, S_c is used in the same way as g_m (mutual conductance) is used in single-frequency amplifier computations.

Servicing Superheterodynes

(*Continued from page* 11)

quency trimmer screw up and down until maximum reading is obtained on the output meter. Both the primary and secondary trimmer screws should be adjusted in this manner. It is always best to recheck the grid side of the intermediate frequency transformer adjustment to make certain the alignment of the secondary has not been changed by adjustment of the primary. The same procedure is followed in aligning the second intermediate transformer. After both intermediate transformers are adjusted the alignment of the intermediate stage is complete and they should not be further disturbed, and the grid cap should be connected to the grid of the No. 57 tube.

ANTENNA AND OSCILLATOR ALIGNMENT: If an antenna or oscillator coil requires replacement, it will be necessary to realign the variable condenser. The front section of the variable condenser (looking at the front of the receiver) is the oscillator section and the second section tunes the antenna stage. Tune the receiver to 1,400 kilocycles and set the oscillator at this frequency and adjust the trimmer screws of the antenna and oscillator stages, which are mounted on top of the variable condenser, so as to obtain maximum output reading; then tune the receiver to approximately 600 kilocycles and set oscillator at this frequency; next, adjust the padding condenser, which is located at the right hand side of the chassis, and which is easily accessible.

Six-Tube Set

VARIABLE CONDENSER: The three gang condenser is exceptionally rugged and is mounted on resilient rubber at three points, insuring permanent alignment and elimination of microphonic howls. A smooth positive action, friction drive, is used to drive the variable condenser. The design and construction is such as to make operation positive and smooth and as there is nothing to get out of order no adjustment should be necessary.

DIAL: The dial is divided into two sections. The upper section being calibrated in kilocycles from 1500 kilocycles to 550 kilocycles. The lower section in megacycles from 1.5 meg. to 4 meg. (one megacycle equals 1000 kilocycles). The dial is made visible day or night by a miniature 2½ volt pilot light. This pilot light is readily accessible for removal, if necessary, by unscrewing it from the pilot light socket which is mounted directly above the dial.

VOLUME CONTROL: The volume control is a 500,000 ohm potentiometer and varies the input to the No. 247 tube output. The "off and on" switch is controlled by the volume control knob. When the volume control is turned to the maximum counter clockwise position the receiver is turned off and is placed in operation by the reversed action which will be indicated by the pilot light being lit.

INTERMEDIATE TRANSFORMERS: The intermediate transformers are tuned to 175 kilocycles. The intermediate frequency transformer trimmers are rigidly mounted and are so constructed to prevent the transformer from becoming detuned due to trimmer warping or the coils absorbing moisture. FOR THIS REASON IT SHOULD NEVER BE NECESSARY TO RETRACK THE INTERMEDIATE FREQUENCY TRANSFORMERS UNLESS ONE OF THE TRANSFORMERS HAS BECOME DEFECTIVE AND REQUIRES REPLACEMENT.

The first intermediate frequency transformer has two trimmers which are accessible through the small holes in top of the shield cans. The second transformer has but one trimmer and is also accessible at the top of the shield can.

BAND SELECTOR SWITCH: The band selector switch has two positions. It is well constructed and the contacts are of the wiping type. Turning the knob to the maximum clockwise position places the receiver in operation on the broadcast band (1500 KC-500 KC). With the selector switch knob turned to counter clockwise position the receiver operates on the high frequency band (1.6 meg. to 4. meg.) Police calls, air craft and amateurs may be tuned in on this band.

ELECTRO DYNAMIC SPEAKER: The dynamic speaker has a D.C. field resistance of 2000 ohms and is utilized as a choke in the filter circuit.

RADIO FREQUENCY AMPLIFIER: The antenna circuit is tuned and is followed by a tuned radio frequency stage. Padding condensers are used in both stages to correctly align the receiver on the high frequency band.

(*Concluded next week*)

MORE SELECTIVITY
Eliminates Superheterodyne Squeals

By Murray Wall

THE principal reason for squeals in a superheterodyne is the presence of unwanted carrier frequencies in the modulator circuit. The modulator and oscillator are coupled, and therefore the presence of these undesired frequencies in the modulator accounts also for their presence in the oscillator. So the more loosely the oscillator is coupled to the modulator the greater the reduction of the effect of the stray frequencies. It is simply a question of selectivity.

In large centers of population, where there are numerous broadcasting stations, squeals will be present in all superheterodynes where the aerial circuit is realtively close-coupled to the oscillator. Thus if there were no stage of t-r-f amplification, so-called, but simply antenna coupled to the modulator through a tuned transformer, about the only solution would be to use very few turns of wire on the primary or, if the more usual medium-sized primary is present, to use a very small series antenna condenser, say, 20 to 50 mmfd. Loose coupling improves selectivity, and the method of loose coupling (between aerial and oscillator) is immaterial.

Atonement for Reduced Sensitivity

But suppose that sensitivity is to be maintained high. Then there would have to be compensation for the small input taken through the skinny-primary transformer. This might be accomplished by extra audio gain, not necessarily by using extra tubes, but by including highly sensitive tubes, like the 2B7 duo-diode pentode, and the 2A5 output tube.

The sensitivity declines at about the rate that the selectivity increases by means of loose coupling. However, another form of loose coupling, in that it removes the modulator farther from the aerial, is to have more tuned stages. And that is why the conventional three-gang condenser is being replaced with four-gang and five-gang condensers in the most up-to-date superheterodynes, for both increased selectivity and increased sensitivity are achieved. That is the motivating purpose of the four-gang condenser in such circuits as the twelve-tube Push-Pull Diamond.

The intensity of oscillation in the oscillator is far greater than most experimenters imagine. An oscillation voltage of 100 volts is not high at all, and since the oscillator and the modulator are coupled, and the figure of merit for detection may be considered, the resultant voltage in the modulator is the sum of the introduced oscillation and signal voltages. The introduced oscillation voltage will not be the total oscillation voltage by any means, for there never is unity coupling, but let us assume that 9 per cent. of the oscillation voltage is delivered to the modulator, or 9 volts, and that the wanted signal delivers a voltage of 0.25 volts. We have a resultant intermediate frequency voltage of 2.25 volts, not considering any gain.

Image Interference

If the intermediate frequency is 175 kc, and we have the r-f tuned to 1,000 kc, the oscillator is tuned to 1,175 kc. But 1,175 kc is the low frequency oscillator setting for 1,350 kc, and if there is insufficient selection at the r-f level there will be a squeal due to the same oscillation frequency causing a 175 kc output frequency from the modulator, due to the presence of 1,000 kc and 1,350 kc in the modulator. No matter if the 1,350 kc frequency is of an intensity only 1 per cent. of the 1,000 kc frequency, the squeal will be heard plainly. This type of trouble is called image interference.

By analyzing this image interference the intermediate frequency may be measured indirectly, since it is equal to one-half the frequency difference between the causes of the beat. Hence in 175 kc superheterodynes the relationship may appear at different apparent signal frequencies, for instance the common one of 1,500 and 1,150 kc, the difference being twice the intermediate frequency.

In common with this trouble is the different but confusing one of cross-modulation. This has no particular relationship to frequency, but rather to radiation from strong local stations, which causes the same station to come in at two or possibly more points on the dial, or both heard at two places, due to the carrier of one modulating the carrier of the other.

The stronger station may predominate at either setting, thus confirming that the selectivity is not high enough.

The same remedy applies. The coupling should be looser, either by fewer primary turns or by added tuned stages, or both, and also the bias may be heightened on super-control r-f amplifier tubes, for this has proved an excellent cure. In the face of cross-modulation the standard bias recommendations can not be followed but may be exceeded 100 per cent. or more.

Mystery Solved

It is therefore possible to build a superheterodyne that does not produce any squeals due to insufficient selectivity ahead of the mixer, and at the same time a set that does not give any cross-modulation. Special trap circuits for the suppression of image frequency interference have been devised, but it is hard to see how they would be effective except at one particular frequency, and moreover the additional-selectivity method is superior because infallible and because it covers all the frequencies to which the receiver will respond.

There has been some mystery about image interference, and perhaps it has not been a fully-understood subject, but in the light of results from extra selectivity it is plain that, aside from an oscillating r-f or i-f channel, or misalignment, too large a voltage of off-resonant frequencies is the principal cause.

When a four-gang condenser is used the adjustment of the superheterodyne is much more difficult than in the case of the three-gang condenser. When the set is completed it is quite possible that nothing will be heard, and more than likely so if besides there are two intermediate stages (three i-f coils). The reason is that the circuits are not lined up. With the four-gang condenser the r-f level has to be established, preferably at some high frequency, say, 1,450 kc, because the signal will not come through for any frequency unless the adjustment is at least approximately correct. The movement of a screwdriver for one-tenth of a turn on the compression type of compensators will make the difference between reception and non-reception. And the oscillator trimming condenser is even more critical.

Series Effect on Parallel Capacity

However, assuming that the r-f and oscillator sections are compensated, the circuit has to be padded for the intermediate frequency used, and this is usually done at an r-f of 600 kc. If the padding is incorrect the circuit will be almost dead except for squeals, beginning at around 1,100 or 1,200 kc, to lower frequencies, but when it is correctly padded there will be the expected fine results at all settings. Particularly if the intermediate frequency is high (465 kc, for instance), the padding condenser adjustment has an effect on the oscillator trimmer, because the series condenser (padper) is small, around 350 mmfd. That means that the slight physical changes in the padder account for large changes in effective capacity in the tuned circuit, and after padding the oscillator trimmer may have to be relined.

Certainly the intermediate level has to be accurately established, and this is true particularly if the i-f is high, for then slight adjustments of the condensers introduce large changes in intermediate frequency. If nothing comes through it may be due to misaligned i-f, so the first circuit to line up is the intermediate frequency channel.

Use of Test Oscillator

The easiest way to do this is to put a test oscillator, adjusted to the correct frequency (by use of fundamental or harmonic), with oscillator output to the plate of the i-f tube ahead of the second detector. This i-f tube may be removed from the socket. Align the coil. Then put back the tube, remove the one ahead of it and repeat the tuning process. If there are two i-f stages there is one more coil to adjust similarly.

When the coil looking out of the first detector is adjusted the rest of the i-f coils should be readjusted for maximum needle deflection, if an output meter is used, or for maximum quantity of sound, if the aural method is used. Then, after the circuit is lined up at the r-f and padded frequencies, tune in a strong local and try for a weak distant station 10 kc removed from that local. Then readjust the intermediate frequency for the last time, so that the interference, if any, from the strong local station is eliminated in favor of the weak distant station.

Oscillator Must Oscillate

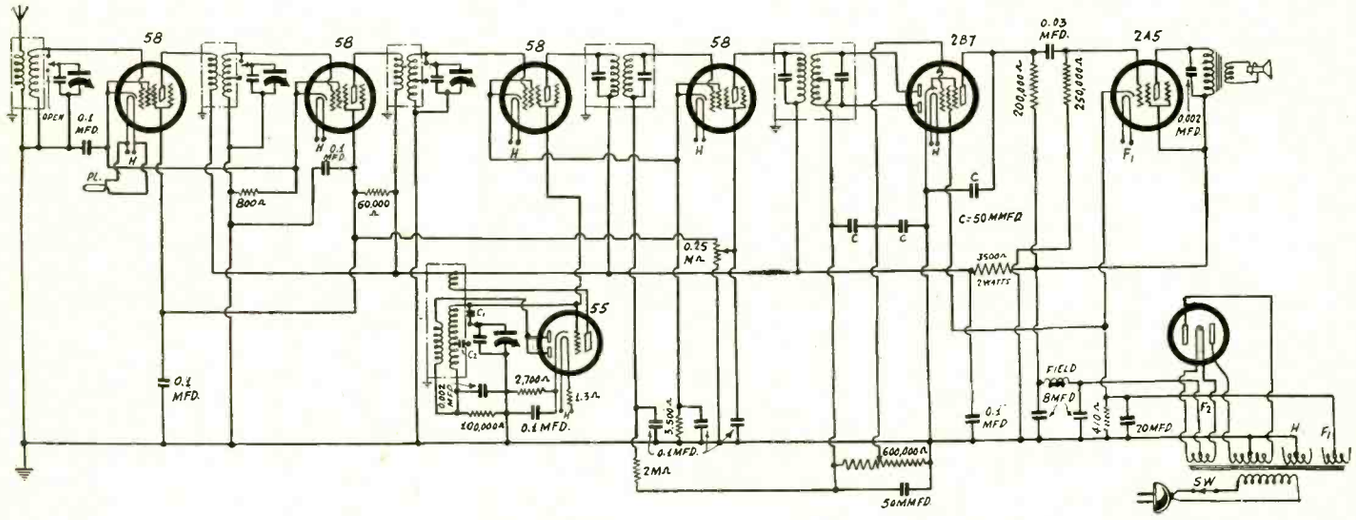
The chief trouble in superheterodynes, so far as getting them to work at all is concerned, is failure of the oscillator to oscillate, due either to defective tube or to an open or short circuit.

When no results at all are obtained, be sure to suspect the oscillator, and an easy test for oscillation is to remove the grid connection and restore it quickly, to determine if there is a plop. If there is none, the oscillator probably is not oscillating, or if it is, there may be a defect in the modulator or subsequent circuits. However, the test oscillator will enable check on the i-f channel, and the trouble is thus narrowed down more or less to modulator or oscillator.

OPERATION OF THE 2B7

in the Anderson-Bernard Bandspread System

Here Is a Most Remarkable Receiver, Having as Great a Sensitivity as the 12-tube Double Push-Pull Diamond, but One-Fifth the Power Output



Circuit of the 70-560-meter receiver to be used in the Anderson-Bernard system of bandspread tuning. The 2B7 is the detector-pentode amplifier, and the 2A5 is the output tube, both new. In fact, the 2B7 is so new it is not yet purchasable in the open market. There have been a few changes, detailed in the text, and to be diagramed next week.

THE gain from the 2B7 is so great that the eight-tube receiver shown here in diagram form is as sensitive as the twelve-tube Push-Pull Super Diamond, although of course will not handle anything like the power output of the larger set. Nevertheless it will surprise many to learn that the sensitivity of a receiver can be raised so readily by inclusion of this remarkable tube, especially those who seem to think that sensitivity has to do only with amplification at radio and intermediate frequencies. The audio has as much to do with sensitivity as the audio gain indicates, compared to the gain at higher frequencies.

The circuit is made as simple as possible, and while it might be constructed at once, some delay has been purposely introduced, because those who would like to build so sensitive a set at small cost would not be able to get the 2B7 tube and its special socket. While the tube has seven pins, it will not fit into the medium-sized seven-pin socket, as does the 59, but requires the new small-sized model. To date only one manufacturer of sockets has been found who is making this size, and not until some of the others follow suit will the socket be generally available, although it should be only a matter of a few weeks.

For the Bandspread Circuit

This is the circuit intended for use as the broadcast-band receiver in conjunction with a converter to introduce a special method of tuning, including a stepped-tuned oscillator. The broadcast range could be tuned for each step of the oscillator to give 1,000 kc bandspread, for it is just as well (or better) to tune the equivalent intermediate amplifier, leaving the oscillator fixed, as it is to tune the oscillator and leave the i-f fixed. However, the term "fixed oscillator" is purely relative. In fact the oscillator is tuned, not with constant variety, but in steps equals to the oscillator frequency equivalent of the bandspread.

The receiver as shown does not cover merely the broadcast band but the 70-200-meter band as well, and that raises the question whether it would be better to depend on that part of the system exclusively for the 70-560-meter coverage, and omit the lowest frequency short-wave band from the converter adjunct, and the further question of whether the 70-200-meter band would not be preferable for bandspread (about 3,000 kc), requiring fewer steps in the short-wave oscillator.

That Voltage Difficulty

However, the receiver for the 70-560-meter coverage has been completed, and it is a satisfaction to report that it is so sensitive that a finger placed one-eighth inch from the antenna post (not touching) develops enough pickup to bring in six local stations at adequate speaker volume in New York City.

The circuit consists of two stages of t-r-f, tuned modulator, separate frequency-stabilized oscillator, electron coupling between oscillator and modulator, one intermediate stage (two coils) feeding a full-wave diode detector, with the pentode unit as first audio amplifier, in the 2B7, and the 2A5 as the output tube.

The 2B7 will be found troublesome by some, as to preliminary adjustment of the screen voltage, or effective plate voltage, as mentioned in last week's discussion. The voltage used is 20 volts, approximately, or the negative bias on the power tube applied backward, so to speak.

Operation at 20 volts is entirely satisfactory, and the adjustment may be made in the plate circuit, by proper choice of load resistor there. The value recommended by the tube manufacturers is 200,000 ohms, and this has been retained. although the standard specifications call for 50 volts on the screen. It is quite easy to block signals out entirely by misvoltaging the screen or plate, but the fundamental consideration is to have the screen voltage considerably less than the effective plate voltage.

Check-up On Screen Voltage

Here the plate voltage will change considerably with the signal, due to direct coupling, and probably for this reason a mean value is less readily obtained than by following the formal voltaging specifications. If anything, the plate resistor may be increased in value above 200,000 ohms, so 250,000 ohms, 300,000 ohms or thereabouts may be used, although the author tested the circuit as shown and it was satisfactory.

Moreover, another laboratory had a

(Continued on next page)

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Distortion in Amplifiers

FIRST-RATE quality is a weakness of mine. I have built resistance-coupled circuits and most of them give good quality. It has been my impression that the larger the stopping condenser and the higher the grid leak, the better should be the amplification on the low notes. I have found, however, that if I reduce the stopping condenser the quality is improved and the distortion is much less. How can this be explained? I should like an explanation because if I don't get one I must give up cherished notions about coupling and quality.—W. E. A., Springfield, Mass.

It is true that the higher the grid leak resistance and the larger the stopping condenser the better is the amplification on the low notes, without being any worse on the high frequencies. However, if the grid leak resistance is high there will probably be blocking on strong signals, and this blocking will first occur on low notes because the amplitudes are greater, and are larger than the grid bias. If the condenser is reduced the amplification on the low notes will be reduced to a point where the signal cannot force the grid positive. There is an improvement in quality as a result. A high grid leak resistance will increase the amplification on all frequencies. A small condenser will reduce it only on the low. Due to much grid current in modern tubes, a very high grid leak resistance cannot be used without running into blocking and consequent distortion of the signal on strong passages rich in low notes.

* * *

Placement of Volume Control

IN A receiver provided with automatic volume control where should the manual control be placed? I have seen receivers in which the control in the grid circuit of the output tube and other receivers in which it was placed at the detector. Which is likely to give the better result?—R. E. F., Newark, N. J.

It may be stated as a general rule that the volume control should be placed as far forward as possible. If it is placed in the r-f amplifier it should be in the antenna; if it is placed in the intermediate amplifier, it should be in the grid circuit of the first tube in the amplifier; and if it is put in the audio amplifier it should be put in the grid circuit of the input tube. The reason for this is that if it is placed in any other place there will be no control of the amplification in the tubes ahead of it. For example, if it is placed in the output tube grid circuit, the signal might be so strong as to overload seriously the tube ahead, and there is no means of preventing this overloading. The output can be controlled, yes, but what is the use of controlling something that has already been badly distorted? The manual control is placed in the audio only when there is an automatic volume control to limit the amplification in the r-f and i-f amplifiers. In such cases the best position of the manual control is in the input circuit of the first audio amplifier. If the detector is of the diode triode or diode pentode type, the control should be in the grid circuit of that tube, if it is used as an audio amplifier.

* * *

Necessity for Matching Impedances

JUST WHY is it necessary to match impedances to get the best results in a radio receiver? Could you give any mechanical analogies of matching which would show the effect of mismatching?—G. E. P., Rochester.

Perhaps one analogy is the teeter board in children's playgrounds. If a heavy child sits at one end and a light one at the other there will be no balance unless the length of the board, measured from the fulcrum to each child, is made in the right proportion to the weights. The lighter child must be given the longer end. Perhaps another application of the lever is better. If a man is to lift a heavy weight with a crowbar, for example, he must proportion the lengths to suit the dead weight and his own. The lever is a mechanical transformer, and if the fulcrum rests on a solid foundation, it is a perfect transformer, one in which the coefficient of coupling is unity.

* * *

Transmission Line Characteristics

WHAT DETERMINES the characteristic impedance of a transmission line such as is used for leading signals in from an antenna to the radio receiver? What determines the natural wavelength of the transmission line?—G. B., New Rochelle, N. Y.

The characteristic impedance is the square root of L/C, in which L is the inductance per unit length of the line and C is the capacity per unit length. L in turn depends on the permeability of the medium around the conductor, which for radio lines is unity, and also on the size of the inside conductor and its distance away from the outside. C depends on the dielectric constant of the material, which is unity for air and may be many times higher for other materials. The capacity also depends on the distance between the two conductors. The natural wavelength also is determined by L and C. However, for a transmission line that is to conduct power the natural wavelength has no significance because the line is terminated at both ends so that there can be no standing waves. If it had a natural wavelength it would have to be tuned if it were to be any good for broadcast reception, and that would be a rather cumbersome process.

* * *

Noise in Rebroadcast Signals

WHEN signals originating in far distant countries are rebroadcast in this country there is invariably a hissing noise accompanying the signals, and this noise rises and falls in intensity. What is the cause of this noise, and is there any way of overcoming it?—J. H., Larchmont, N. Y.

The noise is due to amplifying tubes, of which there is a very large number between the first oscillator at the transmitting station and the power tube in your receiver. The variation in the intensity of the noise is due to automatic volume control, mainly at the receiver used by the rebroadcast station. The signals fade, rising and falling in intensity, and the receiver endeavors to maintain them at a constant level, but this is accompanied by a corresponding variation in the noise. As a signal fades out the noise rises because the amplification in the tubes increases. The level of the desired signal remains nearly constant but the relative values of noise and signal vary.

Squealless Super

(*Continued from preceding page*)

2B7 under experimentation and reported good results with voltages from 17 to 40 on the screen, depending on the type of hookup used to feed the detector. The plate voltage was 250, the resistor 250,000 ohms.

This meant merely that one hookup delivered more signal voltage than the other, and the mean value of screen voltage had to be changed accordingly, although it is perhaps simpler to alter the plate load to accomplish the same end.

It was feared that the author's sample 2B7 might not be quite like what the standard will be, but the experience of the other laboratory confirmed the voltaging as shown and recommended for this circuit. Finding a higher screen voltage, and affording proper bypass capacity (high units of microfarads) is more difficult and expensive than proportioning the plate load resistor properly.

The oscillator, of the frequency-stabilized type used in the large Diamond, requires some special treatment. If the 1-ohm heater resistor is omitted the 2,700-ohm biasing resistor should be at least 3 watts, and preferably 5 watts, because the actual dissipation would be 4 watts. With the 1-ohm in circuit the oscillation amplitude is greatly diminished, due to the increased plate impedance, and the bias arising from 2,700 ohms is around 9 volts, instead of around 100 volts, hence a 1-watt resistor then would suffice. It is a matter of choice which method to pursue, but if the reduced heater voltage method is used, the reduction should not be so great as to make the oscillation fitful and uncertain.

The 2A5 as output tube is excellent, having tonal capabilities superior to that of the 247 which it replaces, although in so replacing it, with a cathode independent of heater, instead of a filamentary cathode, the mu is incidentally enlarged (220 compared to 150) and the bass-note reproduction better, or high-audio frequency accentuation no greater than in the triode type of output tubes, which is saying approximately the same thing. The 2A5 tubes are now available, but, as suggested, it will be some time next month before the 2B7 will be obtainable from supply houses and stores.

The circuit does not produce a single squeal, even if a long aerial is used. However, there is not much use for a long aerial, because the amplification is so great ahead of the 2B7 pentode that the voltage on that pentode's control grid (equal to the rectified voltage in the diode unit) easily becomes so great that the equivalent negative bias on the 2B7 pentode stops the amplification. That is not a vice at all, since when 9 volts stop the amplification, what would happen if they did not? Some 100 volts or so on the grid of a power tube biased for around 20 volts (16.5 volts is standard for this tube).

So the 2B7 is worked as a relay that largely prevents overload of the last tube, which is a bit overloaded even before the amplification of the 2B7 is cut off. This circuit will prove a delight to those who desire excellent tone quality at medium sound level. The output is 3 watts.

PERSONALITIES

When Florenz Ziegfeld saw Fannie Brice in a burlesque theatre in 1910 it meant her success as a Follies star. Fannie, now starring over NBC networks with the Royal Vagabonds as one of radio's best-known comediennes, played in rapid succession with Ziegfeld's shows in 1911, in 1914 and then without a break through 1924. Miss Brice went to England in 1913 and then starred in the Music Box Revue in 1925-1926. But the show that stands out with the public is "My Man," which still identifies her with her nationwide radio audience.

* * *

Jeannie Lang, baby-voiced singer heard over NBC networks during the Musical Grocery Store program, receives a piece of cake each week just before her broadcast from an unidentified woman in Brooklyn. The message in the box always reads, "This cake is better than you can buy in a grocery store."

The messenger boys who delivered the cake one night said it was left at the Western Union office in Borough Hall, Brooklyn, by a woman, who paid the charges and left in an automobile. He says the same woman does this every week.

* * *

Harold Stokes, NBC orchestra director, learned to play the accordion when he was a student at University of Missouri.

* * *

Everett Mitchell, Chicago NBC announcer, is spending his odd moments these days in cooking up meals and writing air mail special delivery letters. Mrs. Mitchell is in New York for a short vacation. This is the first time in twelve years that they have been separated.

* * *

The Commercial-Technical Group of the New York Special Libraries Association visited the New York NBC studios recently to attend an informal meeting and tea given by Miss Frances Sprague, NBC librarian. The forty-five guests, consisting of librarians from leading New York and New Jersey laboratories, utility corporations, technical schools and advertising agencies, were escorted through the studios following the tea.

* * *

"Prehistoric Symphony" is NBC studio terminology for a chorus of wild animal sound effects.

* * *

Eddie Lane opened at the Roosevelt with his orchestra. He took over the task from Guy Lombardo's Royal Canadians, now on a tour including southern colleges, e.g., University of Virginia, Virginia Military Institution, Wake Forest College and Duke University. The Robert Burns Panatella programs will include the Lombardos over the Columbia network from the various cities the musicians happen to be in.

* * *

Jack Denny refuses to let anyone else finish what he has started. He played the last Tuesday Lucky Strike program. He was one of the first orchestras to be picked up from Montreal when Lucky Strike started their "Magic Carpet" idea. Lucky Strike is cutting down to only one program a week for the summer.

* * *

Emerson Gill, an old favorite with the patrons of Norumbega Park in Auburndale, Mass., has been engaged for a part of the summer season there. He is the first of a series of other orchestras arranged for through Music Corporation of America. This will be his third season at Norumbega.

* * *

Jack Dempsey, who started his first radio series on March 27th in the new WABC-Columbia script act, "Jack Dempsey Gymnasium," plans to bring luminaries of the prize ring and other personalities of the sporting world to the microphone for guest appearances from time to time during the series. His own participation in the programs will be made to conform with his schedule of engagements for personal appearances on the stage with Max Schmeling. He will be out of the script at such times as he has engagements to fill outside of New York.

* * *

Ozzie Nelson's engagement at the Hotel New Yorker has been extended. He will now remain through Thursday, May 10th. WOR has been added in addition to the regular broadcasts made over the Columbia chain.

* * *

Ethel Shutta is trying to decide just which of the many contracts she is being besieged with are best suited to her own particular style and character! George Olsen is doing his Royal Gelatin program without the lovely Ethel, his wife.

* * *

When beer began to flow again within the law Columbia microphones in midwest cities carried a 90-minute program to the network's listeners, in observance of the occasion.

Starting at 12:30 a.m., E.S.T., the network switched its originating point to Chicago, whence a description was aired from centers of night life. Then Columbia switched to St. Louis, where CBS microphones and announcers were stationed atop the Anheuser-Busch brewery. Three planes, each carrying a case of beer, one for President Roosevelt, one for Vice-President Garner, and one for New York's former governor, Alfred E. Smith, took off from that point, where a description of the event and a short talk by August Busch, proprietor of the brewery, was broadcast. At 1:15 a.m. the scene shifted to Milwaukee, at the Schlitz plant, where "the beer that made Milwaukee famous" is brewed. The clamor of loading the first trucks and their departure to fill orders, short talks by Erwin and Robert Uihlein, owners of the brewery, and musical selections by a German band were broadcast. At 1:30 a.m. Columbia switched back to Chicago, to the Prima Brewery, for an informal program of German drinking songs. Then until 2 a.m. there was another flying tour of Chicago restaurants, hotels and night clubs, to report the revelry and merriment prevailing after the legal opening of the spigots.

* * *

Salvatore Massaro died recently from throat hemorrhage. To the fans and in the studios he was known as Eddie Lang, having changed his name. He was generally regarded as the greatest guitar player in the country. He accompanied many of the leading artists of the air, including Ruth Etting, Bing Crosby and the Boswell Sisters, and his services were in demand by Paul Whiteman, Roger Wolfe Kahn, Nat Shilkret, Lennie Hayton and others.

* * *

"Roses and Drums," the series of American historical radio dramas sponsored by the Union Central Life Insurance Co., which finished its first year on the air, has been renewed for 42 more broadcasts, carrying it to mid-April, 1934, with a summer break from the middle of June to September. The broadcasts are heard at 5:30 p.m., E.S.T., each Sunday, over the WABC-Columbia network, with one or more headliners from the legitimate stage in the cast of each script.

* * *

The WABC-Columbia network will broadcast the first radio program from Oberammergau, Bavaria, from 12:30 to 1:00 p.m., E.S.T., Easter Sunday, April 16th, when Anton Lang, famous Passion Play Christus, will speak to America and C. Hooper Trask will describe the picturesque village. The Passion Play Chorus and Orchestra will conclude the program with a program of sacred music.

* * *

Among the interesting items on the WABC-Columbia network program schedule for the near future are the following events:

Ben Pollack, Columbia maestro, first "got rhythm" playing drums in Chicago cabarets. He learned the essence of syncopation as drummer with the New Orleans Rhythm Kings. Family wishes prevailed for a brief interlude when Ben joined his father in the wholesale fur business, but he was like a fish out of water and he was allowed to return to his drums. He went to California, where he made his bow clashing cymbals in the Bon Ton Ballroom and later in the Venice Ballroom. Harry Basden, leader of the band, succumbed to a nervous breakdown and the boys chose Ben to wield the baton. He developed the outfit into one of the coast's outstanding bands, took Chicago by storm, and repeated his triumphs in New York. During all this he played for dancers at the Black Hawk Restaurant and the Southmore Hotel, Chicago; the Park Central Hotel, New York; Summit Inn, Baltimore; Hollywood Restaurant, Cleveland; Blossom Heath Inn, Detroit; Club Forest, New Orleans; and Lowry Hotel, St. Paul. His melodies now are generated at Chez Paris, Chicago.

* * *

Kate Smith, who has visited so many hospitals to sing for patients, visited one recently as a patient, suffering from blood poisoning in both feet. Too much stage dancing did it and she can't wear shoes for a month. When she returned to the air, broadcasting from a wheel chair, Ruth Etting, fellow Columbia "moon" singer, greeted her with a huge armful of American Beauty roses, and the next night Jack Dempsey dropped in on Miss Smith's program to swap greetings.

* * *

From "Captain Henry's Show Boat": Muriel Wilson's roadster has an accordion-pleated fender, sustained in an auto accident. . . . The N. B. C. drug store in the Fifth Avenue air castle now serves a "Tiny Ruffner Special," consisting of five scoops of coffee ice cream, some whipped cream and milk all shaken up and served to those who can stand it. . . . A poetic lad from Atlanta writes Annette Hanshaw to tell her that her voice "stirs the innermost fibres of my being into indefinable longing," adding that "somewhere in the soul of you is a call, a challenge, that somehow makes itself heard in your song" . . . Pat Padgett has a cold . . . Charley Winninger will have an announcement of importance for the radio world within a fortnight . . . Sally Belle Cox, who sells tears to the networks, is back on the Show Boat again, now that the Show Boat baby is crying again . . . When Captain Henry's Show Boat rebroadcasts from 1 to 2 a.m. for the Rocky Mountain and Pacific Coast stations with the advent of daylight-saving time, it will be the only thing alive in the NBC Fifth Avenue studios. The red and blue networks will have closed for the night. The rebroadcast will also make one of the longest working days imaginable for the show boat cast. It will mean a six to seven-hour musical rehearsal as usual, two dramatic rehearsals of three hours each, all topped off with two one-hour shows. The rebroadcast is essential, otherwise Captain Henry's Show Boat would be sailing into the Far West at 5 o'clock in the afternoon . . . A fan letter has been received, addressed to "Miss Annette Voorhees" of Captain Henry's Show Boat.

STATION SPARKS

By Alice Remsen

A Muted String

FOR RUTH ETTING

WABC—MONDAYS and THURSDAYS
9:00 P.M.

Once in the dusk of twilight,
The moon came over a hill.
As shadows lengthened slowly,
The world seemed standing still,
Holding its breath for a moment
In the sudden hush which spread
Over the lonesome valley
As the timid daylight fled.

Floating across the water,
Out of a fragile boat,
There came a sigh of rapture,
Torn from a lover's throat.
Slowly a white hand lifted
Striking a muted string,
Then to my ears there drifted
A voice—softly murmuring.

A voice which stirred my pulses,
There in the scented night,
That filled my breast with longing
For a moment's sweet delight.
I listened; my heart beat madly
And throbbed with ecstatic pain;
But only one song was whispered—
And that drifted back again.

—A. R.

* * *

The voice of Ruth Etting reminds one of the muted string at times, particularly when she sings those plaintive little ballads she does so well. I'm sure it is not necessary to tell you to listen in to Miss Etting, because you must have done so many times, and I know that you enjoyed her. I always do. I never miss her if I can possibly help it.

* * *

The Radio Rialto

WHEN DAYLIGHT SAVING TIME COMES

There will be a great many changes in air programs as soon as Daylight Saving Time comes along again. Some will go off and a few will come on; others will take later time. . . . Jack Dempsey began a series of broadcasts over the Columbia network on March 26th. The show is called "Jack Dempsey's Gymnasium" and is a dramatic script program with the action taking place in a gymnasium. The plot centers around Pop Davis, famous Scotland Yard investigator, who is put in the gymnasium by Dempsey at the request of high government officials to work under cover on a big case. The sponsor is the Wyeth Chemical Company, makers of Jad Salts, and the program can be heard Monday, Tuesday and Wednesday nights at 6:30 p.m. . . . Irving Kaufman is another old-timer, a radio and recording favorite, who has a new program this season over WABC, 1:30 p.m., Sundays. It is the Old English program, and Irving does well as Lazy Dan, the Minstrel Man. It's a briskly moving and amusing air period. . . . Tony Wons is vaudevilling these days, presenting "Shylock"—of all things. . . . Lennie Hayton is all set to play a few theatres as soon as the Chesterfield series fades from the air. . . .

GOINGS, COMINGS AND CUTS

CBS has grabbed Frances Langford from NBC. This youngster is the blues singer discovered by Rudy Vallee when on a Southern trip two years ago. The kid is being fought over and doesn't even realize what it's all about. She's a cute looking little trick, besides having a nice ether voice. . . . And now it appears that NBC will allow its talent to appear on CBS, providing they use other names, which is not much of a disguise, because you can't change an air personality. The fans always discover their favorites. . . . Mrs. Anna Roosevelt Dall goes on the air very shortly for Best and Company of New York, for $900 per program. It will be a thirteen-week series. Counting out commissions, Mrs. Dall will probably receive in the neighborhood of $650 for her end, which is not so bad for a few minutes chatter. . . . Ed Wynn's ether web is getting along okay; the latest news is that the chain will consist of one hundred station, with Wynn as president and Ota Gygi, vice-president. I still cannot get it through my head that a comedian and a violinist will be able to make a go of a radio network, especially with such altruistic advertising ideas. I certainly admire Mr. Wynn's determination and wish him the best of success. . . . NBC still cutting salaries. . . . CBS firing instead of cutting. . . . The men responsible for the songs sung by crooners and others, will be heard on the air themselves this summer, if NBC plans really materialize. . . . We'll have plenty of beer-airings soon. Ben Bernie will continue for the Blue Ribbon people but will advertise Pabst's beer instead of malt. . . .

EDDIE WOLFE DID IT

The Three X Sisters, who are now working for NBC, have Eddie Wolfe, the man who made The Street Singer, to thank for their radio success. These three girls were a standard American vaudeville act. They spent quite a few years in England, and upon their return to this country they found that vaudeville was a back number. They tried radio but got the run-around, as do so many good performers. Then Eddie found them—and he did the trick. The girls have been going ever since, first on CBS and now NBC. They should be a good bet for personal appearances, as they really have something to offer for stage presentation. Listen to them each Monday, Wednesday and Friday over WJZ, at 6:30 p.m. . . . Radio advertising must be a great business-getter for motor cars, judging by the renewal of the Hudson Motor Car Company. This concern has extended its time agreement until February 25th, 1934, and will spend around five hundred thousand dollars for its Saturday night forty-two-station hook-up during that period. Such great faith in radio displayed by this company should be an incentive to other advertisers, making them realize radio value, and inducing them to climb aboard the bandwagon. . . .

A LITTLE RUN TO DETROIT

I took a run over to Detroit last week-end and visited that swell little station, WJR; appeared as guest artist on two programs and enjoyed the experience. This station is an NBC outlet, but maintains a very good studio staff of its own. Billy Repaid, heard on the Saturday night Hudson program, is a WJR product. . . . Almost forgot to tell you that Phil Cook has returned to the air with two broadcasts a week and a fresh assortment of voices. The one-man show will be accompanied by the one-man band, Andy Sanella. The show will be known as the Ingram Shavers, and may be heard each Monday and Wednesday at 8:45 p.m., over WJZ and an NBC network. . . . Expect to leave for New York in a few days. Commercial auditions are calling me. Hope to have good news for you soon. Cheerio till next week.

Biographical Brevities

ABOUT VINCENT LOPEZ

Vincent Joseph Lopez was born in Brooklyn, N. Y. Both his parents were musicians; his father was a bandmaster in the U. S. Navy. During his boyhood days in Brooklyn Vincent studied piano, mandolin and guitar, but even though his parents were willing to give him a good schooling in the fundamentals of music, their ambition was to see their son in the robes of a priest, and so Vincent dutifully consented to attend a seminary at Dunkirk, N. Y., and ate his heart out there because he had no opportunity to study his beloved music. Finally the director of the seminary became convinced that the boy's future did not lie in holy orders, and he relieved Vincent of further religious study. His father, however, was not willing to trust the boy to make a livelihood from music, so he sent him to a business school, where Vincent soon became an expert stenographer.

During this time Vincent took a side-line job as piano player in a roadhouse. That was the climax; his father did not approve, so Vincent left home and took all the musical jobs that offered. At length he organized his first orchestra, a five-man band, and got a trial at the old Pekin restaurant on Broadway. This job brought him the magnificent sum of thirty-five dollars a week for himself. Then Pat Rooney heard him and decided to spot him in his show. It ran a year in New York and on tour, and Vincent was made.

His next job was at the Pennsylvania Hotel grill. Then he added the Greenwich Village Follies to his already overflowing date book. He has been doing radio since 1922, which makes him one of the pioneers. "Lopez speaking" is a phrase known all over the world now wherever radio is heard.

Studio Flashes

Immediately after the broadcast of the Charlie Chan drama in the Five Star Theatre program over NBC networks recently, the entire cast and D. Thomas Curtin, who has adapted the stories for the air, sent a long telegram of best wishes to Earl Derr Biggers, author of the Charlie Chan stories. Biggers, who was Curtin's classmate at Harvard, was in a Pasadena, Cal., hospital, dangerously ill. He has since passed away.

* * *

Although Howard Claney, NBC announcer, is noted for the dignity that he lends to many radio programs, he particularly enjoys a hilarious role. For example, Claney revels in the chance of crashing through the solemnity of Jack Benny's learned discussions each Friday night. Although "it is all in the continuity" Claney takes particular delight in confusing Benny with his commercial announcements.

* * *

Frank Parker, featured tenor heard with the A & P Gypsies, is planning to go to Chicago for a three months engagement in connection with the World's Fair.

* * *

Tom Howard, comedian heard over networks with the Musical Grocery Store, gets a letter each week from a hospital in Middletown, Mass., asking him for an autographed picture. Each week the letter is in a different handwriting.

A THOUGHT FOR THE WEEK

WE'VE mentioned it before—and here goes again: give people what they want and they'll buy, even in these times. For instance, the subscription orders for RADIO WORLD *are coming along in a way that indicates our little old paper continues to hit the mark. Keep it up, radio folks. We'll do our share!*

PAM ON BUSES A DOUBLE HELP

The problem of the barker on sight-seeing buses who has to shout too lustily for the comfort of passengers in the front seats and, on the other hand, the problem of the bus driver or conductor who does not shout loud enough to make his street announcement audible except to passengers in the front seats has been solved by the perfection of an electrical announcing system specially designed for use in motor buses.

This electrical announcer makes available on a smaller scale the same principles of sound amplification used in standard Western Electric public address systems.

The bus announcing system is designed to amplify the voice of the driver, conductor or barker so that it can be easily heard by passengers seated anywhere in the bus without being uncomfortably loud for any of them. It has special features of rugged construction to withstand continual vibration.

To pick up the voice the system uses a carbon microphone energized by a six-volt battery and works through an induction coil into a loudspeaker. The induction coil and the connecting blocks covered by a metal housing may be located under the dashboard or in any out-of-the-way spot. A foot switch is used for operating the system.

To distribute its sound effectively, the horn is normally located at the rear of the bus. On double deck buses it is placed on the upper level. This enables passengers on that level and those at the rear of the lower deck to hear it while passengers near the driver hear his voice directly.

In designing the system, Bell Telephone Laboratories provided several different set-ups for the microphone. In the one-man bus a collapsible bracket attached to the roof above the driver's head holds the microphone in talking position without interfering with his movements or vision and when not in use can be pushed up out of the way.

In two-man buses a microphone which the conductor can hold in his hand is provided. He operates the system by means of a switch in the handle. This type is particularly adapted to sight-seeing buses. It does away with the traditional megaphone of the barker, permits him to give his talk without shouting and yet be heard with uniform ease by all the passengers.

—From Western Electric Co.

CORPORATE ACTIVITIES

CORPORATION REPORTS

Acme Wire Company and subsidiaries—Report net loss for the year 1932, after depreciation and other charges, $167,982. In 1931 the net loss was $198,797.

Stromberg Carlson Telephone Mfg. Co.—Net loss for year 1932, after taxes, depreciation and other deductions, $772,592. For year 1931 the net loss was $598,402. On Dec. 31, 1932, current liabilities, $186,961, and current assets, including $831,731 cash, $2,856,287.

Weston Electrical Instrument Corp.—Net loss for 1932, after taxes and charges, $143,353, compared with a net profit in 1931 of $122,264. Cash $360,775 and certificate of deposit, $100,362, compared with $249,891 in 1931, notes and accounts receivable, $231,977 compared with $343,555 in 1931; inventories $975,757 compared with $1,166,690; total current liabilities, 1932, $103,317; 1931, $107,634.

CORPORATIONS REPORTS

Utah Radio Products Company and Subsidiaries—Loss for year 1932, after depreciation, losses in experimental and development activities, also on fixed assets scrapped and other charges, but before Caswell-Runyan Company preferred dividends, $312,948; compared with $386,938 loss in 1931.

RCA Victor Goes After the Summer Business

With the announcement of a campaign to create new radio sales during the summer months, the RCA Victor Company has introduced a complete line of new instruments especially designed to meet summer requirements.

The new line, especially the handy little models and the new automobile set, offers a powerful incentive to both the dealer and consumer for maintaining interest in radio during the hot season. These models are ideally suited to the season and the times so that there is now a low-cost radio for every summertime requirement whether it be at the seashore, on the sun porch, the summer cottage or in the automobile. According to the announcement, the new merchandise opens up a practically untapped market of sales, at prices that will attract buyers. This year, more than ever before, the dealer will be enabled to go after "plus" business, by reaching out into an entirely new market with merchandise especially designed for it, in addition to the higher priced home radio market; and the consumer may now purchase merchandise which represents the most economical, convenient and adaptable form of radio ever available to him, which he can take with him everywhere he goes. There are strong indications that this summer the handy little radios are destined to play an important role in the entertainment and recreation of the vacationist at the summer resorts and on the automobile highways.

—From RCA Victor Company.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

LITERATURE WANTED

Richmond Robertson, Jr., 600 Lincoln Place, Brooklyn, N. Y.

John J. Stoika, Jr., No. 29, Nettleton, Pa.

Ar. J. Hughes, Electric Radio Service, 553 Thoreau Ter., Union, N. J.

John Gullett, 1526 Central Ave., Hot Springs, Kans.

Alex Budnik, Allied Radio Service, 616 So. 20th St., Newark, N. J.

Herbert L. Johnson, 88 W. Sixth St., So. Boston, Mass.

Lloyd Babb, S. 311-C Jefferson St., Spokane, Wash.

Comet Radio Service, W. H. Laidley, 113 B. W. Seventh Ave., Amarillo, Texas.

J. E. Thomas, R. F. D. No. 1, Bremerton, Wash.

Robert Bachman, 110 Easy Watauga Ave., Johnson City, Tenn.

John Layton, Box 251, Deer Park, Wash.

George L. Clark, Radio Supplies, 52 Walnut St., Seymour, Conn.

H. W. Anderson, 1763 Stanford Ave., St. Paul, Minn.

Sidney L. Gilbert, 338 W. Onondaga St., Syracuse, N. Y.

Griffiths Electric Co., Inc., W. H. Hartman, Mgr., 120 East Broad St., Tamaqua, Pa.

Theodore R. Spangler, R. F. D. No. 5, York, Pa.

Harry L. Walker, 335 Dunning St., San Antonio, Texas.

Alfred Hardman, Box No. 5, Daytona Beach, Fla.

John Girling, Jr., 1725 Chelsea Road, San Marino, Calif.

Ralph W. Selkirk, Heart Bar L Ranch, Fishtail, Mont.

H. C. Rydholm, 321 Main St., Sauk Centre, Minn.

Geunaro Santora, 85 Waverly Ave., Brooklyn, N.Y.

Wilson B. Fryar, Lorena, Texas.

E. M. Williams, K. of P. Bldg., Oskaloosa, Iowa.

Wilson Chastain, 1917 Russell St., Nashville, Tenn.

Radio Public Address Service, Mr. Herman Phillips, Box 13, Roscoe, Texas.

Floyd A. Inman, 1424 W. 30th St., Erie, Pa.

Thomas B. Briccetti, 139 Hamilton Ave., White Plains, N. Y.

Moore Engineering Co., 203 E. Main St., El Dorado, Ark.

Omer & Summers, Anadarko, Okla.

TRADIOGRAMS

By J. Murray Barron

The Cut Rate Radio Stores will make their opening bow to the public this week at 79½ Cortlandt Street, N. Y. City. They will carry parts and replacement parts for the amateur, serviceman and experimenter. Public address systems, transmitting apparatus and short-wave kits and sets will be featured, and competent radio consultants will be on hand to advise customers. The stock of merchandise is large and no distress or back numbers will be offered.

* * *

Already large numbers are having radio receivers installed in their automobiles. Judging from the early start this year indications point to much larger sales to the car owner. This may be ascribed to possibly two definite reasons: the great improvements and refinements that have taken place in automobile radio since last Summer and the better appreciation by the public of the convenience and pleasure of having the car so equipped. It is only a matter of time when such installations will be taken as a matter of course, like steam heat, electric lights and the electric refrigerator at home. These modern conveniences help one to forget the cares of the day and add to the comforts of life.

* * *

Like the ever changing of tubes with the added numbers, the universal a-c battery radio receivers are appearing in large numbers. All types and sizes to suit every place, whether automobile, home, camp or boat, are on the market in a large range of prices. It's a question of what you want, either four, five or six tube, and if you prefer a t-r-f or a superheterodyne. These are all factory-built receivers. So far only one manufacturer sells a kit. For those who would like to build their own, a detailed diagram of this type receiver, that will likewise work on 6-volt or 32-volt Delco Systems, will be sent free by addressing Postal Radio Corp., 135-137 Liberty Street, N. Y. City.

* * *

There is still considerable inquiry and sales for small short-wave receivers, especially the 2-volt type. It is one of the most active items in radio. With a well-designed circuit, a few-tube set will more than gratify the experimenter, as some marvelous results have been obtained. As great as has been the progress in modern inventions and science, not to speak of the gigantic progress of radio as one of the greatest accomplishments both educationally and commercially during the past ten years, even greater things are to be expected in a shorter impending period. The possibilities are so large that one hesitates to even express an opinion, lest in his wildest imagination he fall short of divining the progress that is to come about in the industry. Today many are preparing themselves for a groundwork to aid and assist in the educating of the folk who will fall heir to these marvelous opportunities. Records on these items of progress are difficult to obtain and it is only through inquiry that information comes to hand. It is learned in one instance, through the courtesy of the R.C.A. Institute, 75 Varick Street, N. Y. City, a subsidiary of R.C.A., that ten persons from the N. Y. City Board of Education and fifteen from the N. Y. State Department of Labor are with other vocational directors, taking the course "Radio from the Viewpoint of Vocational Guidance."

If it is essential to prepare oneself to know how to guide others in this great industry, the young man of the day should have little difficulty in see-

TRADIOGRAMS

ing in the near future the great use he can make of his knowledge of radio. There can be no better or more opportune time for the fellow with forethought and some foresight than the present, when so many are inclined to drift and wait for something, they do not know what, to happen, instead of taking advantage of the leisure that is theirs and grasping the many unusual opportunities to enroll in courses under circumstances that may never again be so generous and advantageous. This spirit of preparedness likewise applies to those who may be already equipped, but even that should urge them to seek greater knowledge for the bigger things that are sure to come about in the industry.

* * *

Moore Radio Company announces removal from Cortlandt Street to 1322 Sixth Avenue, N. Y. City. The new quarters will provide for large show and demonstration rooms, with a fully equipped servicing laboratory in the rear. The organization now occupies the entire third floor and extends an invitation to old friends and others to call. There are some new developments of the famous "De-Lite-R" tuner to take care of the new tubes. Out-of-town friends are invited to correspond.

* * *

Amperite Corporation, 561 Broadway, N. Y. City, is now in production with the new Amperite with the standard electrical flat prong connection. This can be used in connection with all commercial and public address installations. These Amperite automatic regulators are a new series. New and recent improved regulating characteristics are obtained with this ballast. Those interested should write the manufacturer direct for additional information.

* * *

Pierce-Airo, Inc., 520 Sixth Avenue, N. Y. City, announces an up-to-the-minute radio receiver in the DeWald line. Two models in particular, 551 and 550, give every indication of being leaders in the line as sales acceptance has been large with a steady trade. Model 551 is a superheterodyne circuit, covering the entire broadcast range and police signals. It is equipped with the new tubes, 25Z5, 77, 78, 44 and 43, is universal ac-dc with heatless chassis and weighs only 7½ pounds. It is housed in a fine quality hand-rubbed walnut cabinet. The 550 is practically the same set, except for a few minor refinements. Detailed information may be obtained direct from the manufacturer or through this column.

* * *

D. F. Goldman, of North American Radio Corp., 1845 Broadway, New York City local distributors for Zenith, tells of the introduction of an automobile radio receiver, distinctly new in design. The compactness makes for easy installation and totally eliminates the necessity of mutilating the car to install a radio. It is a superheterodyne circuit and is all-electric. The dial is calibrated in kilocycles. Further information may be had direct.

TROUBLE SHOOTER'S MANUAL, Nos. I and II

Having assembled 2,000 diagrams of commercial receivers, power amplifiers, converters, etc., in 1,200 pages of Volume No. 1 of his Perpetual Trouble Shooter's Manual, John F. Rider, noted radio engineer, has prepared Volume No. 2 on an even more detailed scale, covering all the latest receivers. Volume No. 2 does not duplicate diagrams in Volume No. 1, but contains only new, additional diagrams, and a new all-inclusive information on the circuits covered.

Volume No. 2—Perpetual Trouble Shooter's Manual, by John F. Rider, Shipping weight 6 lbs. Order Cat. RM-VT @.....$5.00

Volume No. 1 (8 lbs.). Order Cat. RM-VO @ $5.00

We pay postage in United States on receipt of purchase price with order. Canadian, Mexican and other foreign remittances must be in funds payable in New York.

RADIO WORLD

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115 Circuit Diagrams of Commercial Receivers and Power Supplies supplementing the diagrams in John F. Rider's "Trouble Shooter's Manual." These schematic diagrams of factory-made receivers, giving the manufacturer's name and model number on each diagram, include the MOST IMPORTANT SCREEN GRID RECEIVERS.

The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual," to make the manual complete

Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A.C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

Subscribe for Radio World for 3 months at the regular subscription rate of $1.50, and have these diagrams delivered to you FREE!

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Radio World, 145 West 45th St., New York, N. Y.

CHARACTERISTICS CHART

All the receiver tubes, and some others, under the following groups: Detectors and Amplifiers, Power Amplifiers, Rectifiers, Phototubes. Regulators. Two full pages, also page of descriptive text. In Radio World of April 1, 1933. 15c a copy, or send $1.00 for trial subscription of 8 weeks, including April 1. Radio World, 145 W. 45th St., New York City.

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CAPACITY MULTIPLIER, over eighty different values obtainable using standard, inexpensive parts. Schematic, $1.00. MICRO-INSTRUMENTS, 514—5th St., N.W., Washington, D. C.

URUGUAY STAMPS—100 different stamps, $1.00. 200 different stamps, $3.50. Stamps will be shipped direct from Uruguay. Heriberto Meyer, care Radio World, 145 West 45th St., New York City.

"THE FORD V-EIGHT—'B'-FOUR—'BB'-TRUCK," by C. B. Manly. A New and Practical Book for Everyone Interested in the Construction, Adjustment, Upkeep and Repair of The New Fords. Over 250 pages, 125 illustrations. Complete cross index. Pocket size, flexible leatherette cover. Price $2.00. Radio World, 145 W 45th St., New York, N. Y.

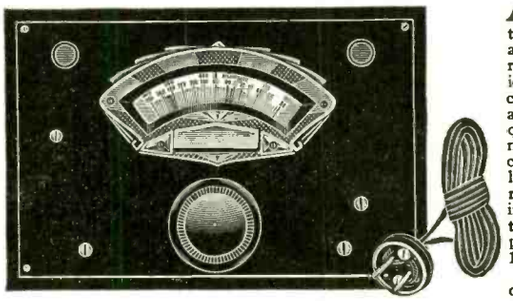
"SOUND PICTURES," by Cameron & Rider. Over 1,100 pages, 500 illustrations. The whole question of Sound Motion Pictures treated from a new angle. A Complete Guide for Trouble Shooting. Explains in detail the construction, operation and care of sound recording and reproducing equipment. Price $7.50. Radio World, 145 W. 45th St., New York City.

1-WATT PIGTAIL RESISTORS @ 8c EACH in following ohmages: 350; 800; 1,200; 20,000; 50,000; 100,000; 250,000; 2,000,000; 5,000,0000. Direct Radio Co., 145 W. 45 St., N. Y. City.

RADIO WORLD AND POPULAR MECHANICS MAGAZINE—Radio World is $6.00 a year, and Popular Mechanics Magazine is $2.50 a year. Popular Mechanics Magazine does not cut rates, but Radio World will send both publications to you for one year for $7.00. Radio World, 145 West 45th St., New York City.

"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Pagé, author of "Modern Gasoline Automobile," "Ford Model A Car and AA Truck," etc., etc. 450 pages, price $2.00. Radio World, 145 W. 45th St., N. Y. City.

All-Frequency Service from a Test Oscillator



The test oscillator has a frequency-calibrated dial, registering 50 to 150 kc, while above this tier of frequencies are registered all the popular commercial intermediate frequencies. So just consult the dial scale.

A COMPLETELY self-operated a-c test oscillator, fundamental frequencies from 50 to 150 kc, with the line frequency, 60-cycle hum, used as modulation but not heard except at resonance, affords all-frequency service, from 50 kc up. This is true because the fundamental may be used as registered on the exclusively frequency-calibrated dial, and harmonics may be used for any higher frequencies, almost without limit. All oscillators are tested up to the 28th harmonic, but response of sufficient intensity may be obtained even beyond the 50th harmonic, and there are proven cases of good results up to the 150th harmonic.

Therefore when fundamental frequencies are low, as here, you may set down the lowest, 50 kc, as one extreme, while the harmonic orders give almost unlimited service to line up short-wave receivers, converters and broadcast receivers that respond to police frequencies.

Average Accuracy 1% or Better

The a-c test oscillator, 105-120 v., 50-60 c., uses a 56 tube, a frequency-stabilized grid circuit, Hartley oscillator and a-c on the plate. Special pains have been taken to assure accuracy, and the test oscillator is guaranteed to be accurate to within 2 per cent. However, at some settings the accuracy is almost perfect, while the average accuracy is 1 per cent. or better. The 2 per cent. rating is the extreme deviation, present in only a few instances.

Therefore in possessing one of these oscillators one knows that he has an instrument of a degree of accuracy more than sufficient for the purposes to which the oscillator will be put, i.e., lining up intermediate amplifiers and padding, in superheterodynes, or lining up condenser gangs in t-r-f systems.

The oscillator will yield sharp zero beats with carriers, and the accuracy may thus be checked at any time against broadcast carriers, using the tenth harmonic (500 to 1,500 kc). This harmonic is used for all broadcast frequencies.

If any particular frequency setting that is a multiple of 50 is ascertained for a receiver or other tested device, frequencies separated therefrom in steps of 50 kc may be registered by setting the test oscillator at 50 kc and tuning the tested device. This is particularly handy in frequency calibration, and for finding frequency extremes in receivers that cover some of the police frequencies.

Get One of These Test Oscillators *Free!*

The oscillator is self-powered as an a-c device, but may be obtained also in battery model. The circuits used are simplifications of the Hartley oscillator and the construction of all oscillators is under the supervision of graduates of the Massachusetts Institute of Technology, who test each oscillator to verify its accuracy.

The a-c model is constantly modulated and yields zero beats at all times. The battery model has a switch at left for modulated-unmodulated service, and yields zero beats on unmodulated but not on modulated service.

The a-c test oscillator parts may be obtained free with a one-year subscription for RADIO WORLD, 52 issues, one each week, at $6.00, the regular subscription price, while the cost is $1.50 extra for wiring and calibrating. The $1.50 is turned over by us to an outside laboratory. Order Cat. PRE-ACOW and remit $7.50 with order. The 56 tube is 72c extra.

The battery model requires a 230 tube, a 22.5-volt small B battery, and a 1.5-volt dry cell. Order Cat. PRE-BATOW and remit $7.50 with order. The 230 tube is 78c extra. Batteries not supplied.

The main scale of the frequency-calibrated dial reads from 50 to 150. The bars are 1 kc apart from 50 to 80 kc and 2 kc apart from 80 to 150 kc. Thus for broadcast work, using the 10th harmonic, the separation as registered by the bars is 10 kc from 500 to 800 kc and 20 kc from 800 to 1,500 kc. On an upper tier the intermediate frequencies are printed: 175, 260, 400 and 450 kc, with a bar to the left of 175, representing 177.5, and a bar to the right of 175, representing 172.5. These, with 130 on the fundamental, represent all the popular commercial intermediate frequencies. Any other intermediate frequency may be obtained either directly from the fundamental, or by dividing a higher desired frequency by the nearest whole number to yield a frequency represented on the fundamental.

SHIELDED OSCILLATORS, $1 EXTRA

DIRECTIONS FOR USE

Remove the four corner screws and the cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service at broadcast frequencies. No other coupling is necessary, as radiation is strong enough. Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired frequency. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the bared end of a wire to the output post of the test oscillator, other bared end of this wire to plate of the first detector socket. The first detector tube may be removed and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way, except that output lead may have to be wrapped around the aerial near set for a few turns to effectuate coupling at broadcast frequencies. The modulation is a high-pitched note, instead of hum.

RADIO WORLD, 145 West 45th Street, New York, N. Y.

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Either capacity, **50c**

A HIGH-CLASS padding condenser is required for a superheterodyne's oscillator, one that will hold its capacity setting and will not introduce losses in the circuit, for losses create frequency instability. The Hammarlund padding condensers are of single-condenser construction on Isolantite base, with set-screw easily accessible, and non-stripping thread. For 175 kc. intermediate frequency use the 850-1350 mmfd. model. For i.-f. from 460 to 365 kc., use the 350-450 mmfd.

0.0005 HAMMARLUND S. F. L. at 98c.

A sturdy, precision straight frequency line condenser, no end stops. The removable shaft protrudes front and rear and permits ganging with coupling device, also use of clockwise or anti-clockwise dials, or two either side of drum dial. Front panel and chassis-top mounting facilities. True straight line. This rugged condenser has Hammarlund's high quality workmanship and is suitable for precision work. It is a most excellent condenser for calibrated radio frequency test oscillators, any frequency region, 100 to 60,000 kc., short-wave converters and adapters and TRF or Superheterodyne broadcast receivers. Lowest loss construction, rigidity; Hammarlund's perfection throughout.

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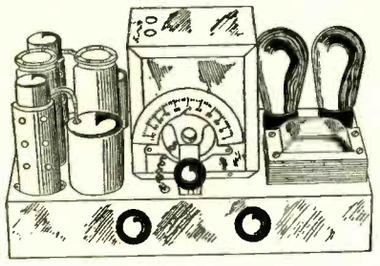
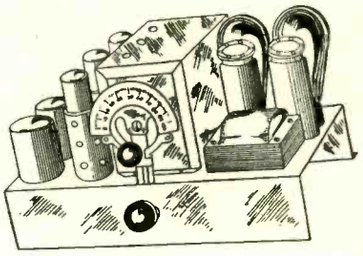


BLUEPRINTS, COILS and CHASSIS FOR THE DIAMOND OF THE AIR



FOUR-TUBE DIAMOND

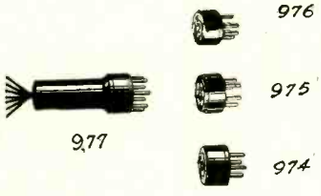
Extremely fine performance, including fetching tone quality, marks the Four-Tube A-C 1933 Diamond of the Air, blueprint of which is now available (half-scale). Many have been surprised that so much can be accomplished on a t-r-f set that costs so little to build. The circuit uses a two-gang 0.00035 mfd. condenser. Special coils are required. The chassis is metal, 13.75 x 6.75 x 2.5 inches.

Send $3.00 for six months subscription (26 issues) and get the blueprint, two official shielded coils and the drilled metal chassis free. Order PRE-D-4-COMB.

FIVE-TUBE DIAMOND

The Five-Tube A-C 1933 Diamond of the Air provides greater sensitivity than the four-tube model, also somewhat more selectivity, as a three-gang condenser is used. An infallible method of permanently suppressing oscillation is introduced, so that besides having a sensitive and selective set one will have a stable receiver. The tone is most excellent. Send $4.00 for 34 weeks subscription (34 issues) and get the blueprint, three shielded coils and drilled metal chassis free. Chassis is 13.75 x 9 x 3 inches. Order Cat. PRE-D-5-COMB.

Analyzer Plug and Adapters



For constructing a set analyzer, an analyzer plug, to go into a receiver socket, is necessary. We offer the exclusive seven-pin analyzer plug, plain long handle as illustrated, and three adapters that enable putting the plug connections into UX, UY and six-pin receiver sockets. The plug has 5-foot 7-lead cable. All four parts sent free on receipt of $6.00 for one-year's subscription (52 issues). Order Cat. PRE-ANPLAD.

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A 0-10,000-ohm ohmmeter and continuity tester. A rheostat is built in for correct zero resistance adjustment. The unit contains a three-cell flashlight battery. Supplied with two 5-foot-long wire leads with tip plugs. Case is 4-inch diameter baked enamel. Sent you for an order for one year's subscription for RADIO WORLD (52 weeks) at the regular rate of $6. Order Cat. PRE-500.

We do not pay postage on resistance meter. Average postage 17c.

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To Canadian and other Foreign subscribers the combination price offer is at $8.50 for these two magazines. Order Cat. PRE-FOR-RWRN.

RIDER'S MANUAL

The standby of the service man is John F. Rider's "Perpetual Trouble Shooter's Manual," of which Vols. 1 and 2 have been published.

Vol. 1 consists of 2,000 diagrams of commercial receivers, power amplifiers, converters, etc. Total pages, 1200.

Vol. 2 contains additional diagrams on the same basis as above, but in Vol. 2 there is no duplication of any of the diagrams printed in Vol. 1.

To get Vol. 1 free, send $9.00 for 1½-year subscription (78 weeks) and order Cat. PRE-RM-1.

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Allen-Hough synchronous phonograph motor, 78 revolutions per minute; takes up to 12-inch records. Works from a-c line, 50-60 cycles, 105-120 volts. Equipped with felt-covered turntable. To start the motor give it a slight impetus. Fits into 3-inch depth, hence handy for compact installations. Given free with 34-weeks subscription at $4.00. Order Cat. PRE-PHOMO.

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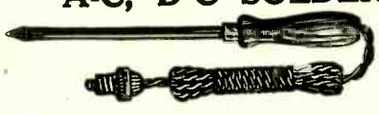

A serviceable iron that works on a-c (any frequency) and d-c, 105-120 volts. Sent free on receipt of $1.50 for three-months subscription (13 issues). Order Cat. PRE-SOLIN.

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R-F CHOKE COILS

These coils have 50, 100, 200, 400 and 800 turns, diameter 1 inch, and are suitable for detector plate filtering, screen filtering, grid and plate loads, etc. The 50 is for short waves, 100 for television band, 200 for broadcast band, 400 for high intermediate frequencies (450 to 300) and 800 for lower intermediate frequencies. Any four, or four of a kind, or combinations not exceeding total of four, sent free on receipt of $1.00 for 8 weeks trial subscription. Order Cat. PRE-4-CH and state chokes desired, by quantity and number of turns.

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"The Superheterodyne," by J. E. Anderson and Herman Bernard. A treatise on the theory and practice of the outstanding circuit of the day. Special problems of superheterodynes treated authoritatively.

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