SERVICE

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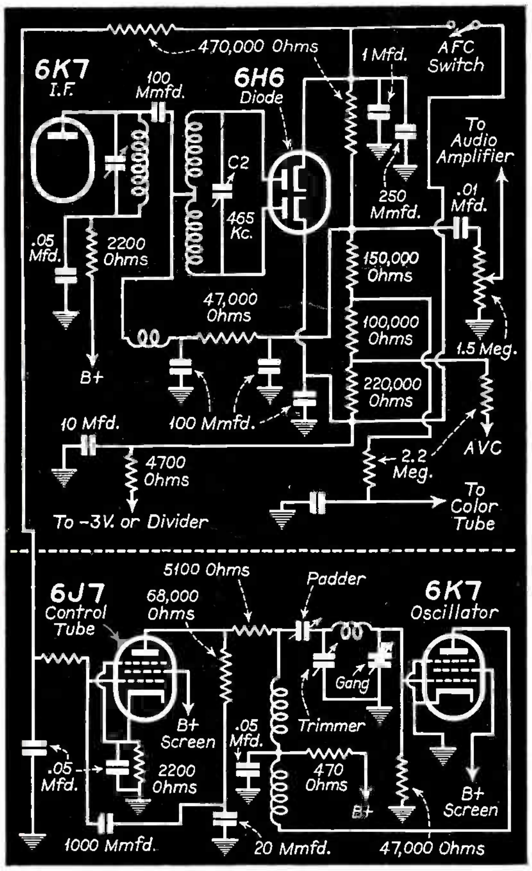
RADIO
AND ALLIED MAINTENANCE



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Automatic Frequency Control
(*See Page* 471)

OCTOBER
1936

Patent applied for

Perfect Smooth Taper.

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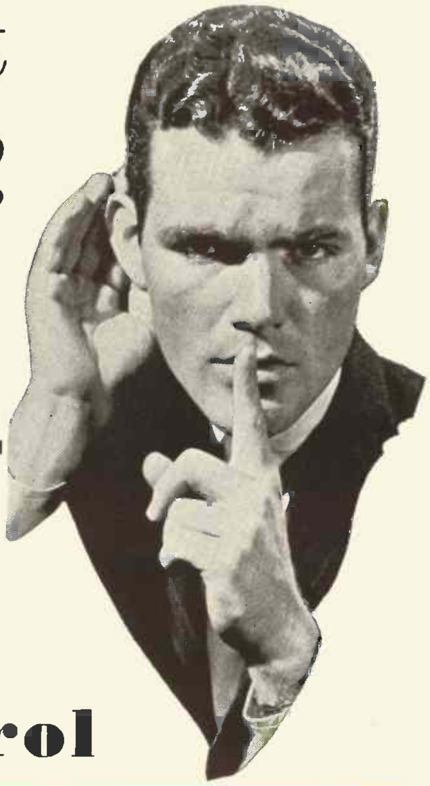

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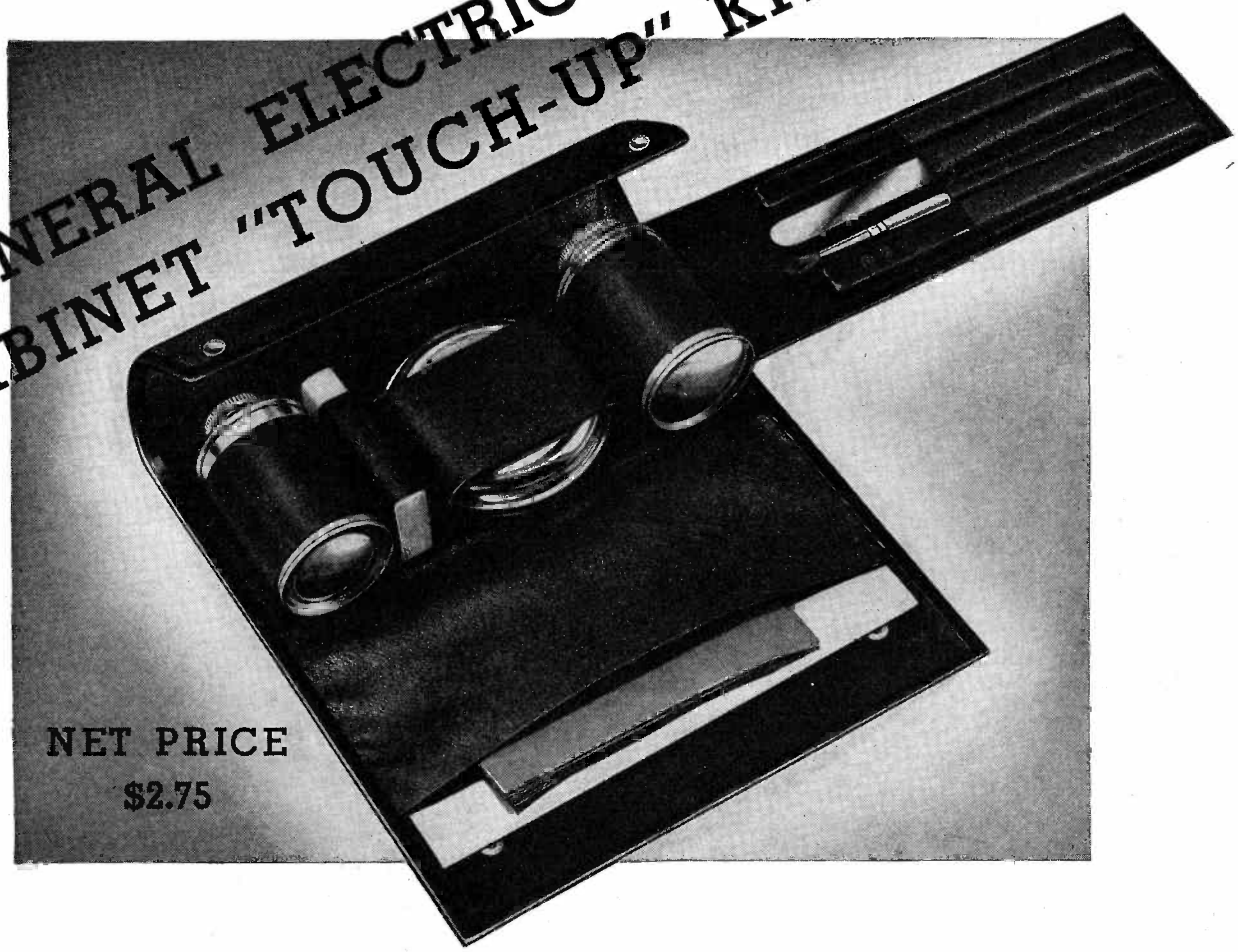

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Only those materials which are difficult for the dealer or service man to secure are included in the kit. Alcohol lamp for heating spatula is not included. This lamp is easily obtainable elsewhere.

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

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EDITORIAL CONTENTS

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OUR INQUISITIVE PHOTOGRAPHER

THE QUESTION:
What are your thoughts on the use of quality replacement condensers as compared with the use of inferior, though cheaper condensers?

THE PLACE: **IRSM Show, Hotel Pennsylvania, New York.**

Ralph E. Roe, Serviceman, Roe Radio, Inc., Roselle Park, N. J.: There can be no question as to the folly of using inferior parts. The serviceman who follows such a practice is inviting disaster—the eventual loss of his business and reputation. Everything depends on customer satisfaction. I use and recommend Cornell-Dubilier condensers.

Neal Bear, Serviceman, 8806 Harkness Rd,, Cleveland, Ohio: In this enlightened day and age I would no more think of using inferior condensers than I would of cutting off my right arm. I have found from long experience that Cornell-Dubilier Condensers keep going longer, which keeps my customers longer.

A. Davis, Jobber, Mac Radio, 50 East Third St., Mt. Vernon, N. Y.: Westchester County radio owners are insistent upon the highest quality of replacement parts. The hundreds of servicemen who are my customers have tried and tested every condenser in the field and from these wholesale tests has been born the conviction that Cornell-Dubilier condensers stand up where all others fall down. We standardize on Cornell-Dubilier condensers and recommend them highly.

Chester J. Chmeil, Serviceman, Colchester, Conn.: Any serviceman who has any pride in workmanship will never compromise with quality. I have learned that it is foolish economy to try to save a few pennies by using inferior parts. When it comes to condensers, I standardize absolutely on Cornell-Dubilier's. They are fine.

THE ANTENNA . . .

NOISELESS RECEPTION

IN THE EDITORIAL FOR the March issue of SERVICE the problem of noise interference was discussed. The Service Man's relation to this problem was also discussed.

It has been a much debated question as to the public utilities share of the responsibility regarding the general interference problem. It has been estimated that the total revenue derived by the utilities from radio is in the neighborhood of from $135,000,000 to $150,000,000 per year. This is based upon the average individual rate of about $9.00 per year for current for the radio receiver. In addition to the direct revenue, radio without question is responsible for further increased lighting revenue. To estimate the total revenue, it would be about $15.00 per year per consumer.

The utility companies have been unfairly criticized because of radio interference from electrical appliances attached to the power line. This interference feeds back into the line and is radiated from there to the radio receiver. The layman unfamiliar with the problem, and often the Service Man himself, will blame the utility. Power companies can increase their revenue by further assisting in the elimination of radio interference in so far as attempting to locate a disturbance which is primarily out of their control. We can only hope that the utilities will continue this good work and instruct the buyers of electrical equipment regarding the ever present possibility of apparatus creating radio disturbance and that they will offer the public the opportunity of purchasing equipment which can be guaranteed to create no radio interference. There still remains a large market for new radios (estimated at 40 percent) as well as the possibility of increased number of listening hours with the possibility of noiseless short-wave reception. The public is becoming more familiar with various improvements and the utilities must accept their share of the responsibility.

But where does the Service Man fit into the picture? If Mr. Smith's radio reception is full of static he may complain to the landlord, the local power company, or even the Federal Communications Commission. If he has just purchased the receiver he may bother the dealer who sold him the "lemon." It will never occur to him that the noise may come from the near-by oil burner or a set of electric trains—it may occur to him, however, that the fellow who can help him most is his radio Service Man. In such cases he is often given alibis instead of help. "It is that tree next to the high-power lines that causes the noise you hear on GSB," he is told by the man who is supposed to make a living from giving aid (not alibis) on just such problems—the Service Man.

No doubt there are thousands of radio listeners who would gladly pay a fair sum to have some local interference stilled. Of course if the source turns out to be some neighbor's vacuum cleaner, it is probable that the owner won't pay for the installation of the filter. But, one such noisy machine located in an apartment can ruin reception in a flock of receivers, and it seems reasonable that the owners of the receivers would be willing to chip in to pay for the filter. The cost per person certainly would be low on this basis.

The best way for the Service Man to obtain this type of business is to go after it. Statistics show that more than half of all radio interference arises in the home. The Service Man should let the public know that he is equipped to function as a noise detective. Contact all the local sources where interference complaints may be made—the power companies, the landlords—make arrangements with them to turn over complaints of radio noise interference.

The complainant himself should also prove a good customer for noise interference filters. It should not be difficult to persuade him to clear interference from his own home in order that appeals to his neighbors in behalf of noiseless radio reception may be given the attention they deserve.

The Service Man should make a complete study of the noise suppression problem both from a standpoint of source and elimination. Mr. Tobe Deutschman has undertaken a complete study of the noise interference suppression problem and is prepared to lend assistance to Service Men on any individual or general problem.


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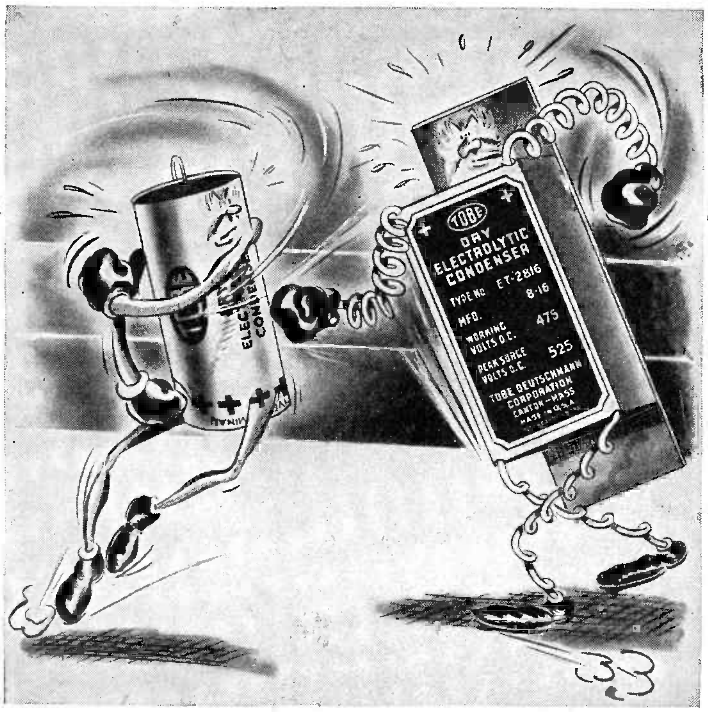
Can You Pick the Winner in this

BIG CONDENSER FIGHT?

TOBE TUBIDON

SAYS:

"Watch me win this one . . . why, TOBE FLEXIDON will run second to me anytime. I've got everything . . . I'm self-supporting by leads, easier to install, and I'm not afraid of competition—I'LL WORK FOR LESS MONEY! Some folks say I'm too cocky, but facts are facts. Just look at my specifications!"



TOBE FLEXIDON

SAYS:

"My record does all my talking for me, and I'll mix it up with TOBE TUBIDON or *any* condenser, for that matter. I'm not saying who'll win, but I've got a good idea. How can they beat my big feature of being *flexible* . . . if one section breaks down due to overload, that doesn't mean I'm finished by a long shot."

"TOBE" TUBIDON vs "TOBE" FLEXIDON

We consider TOBE TUBIDON and TOBE FLEXIDON such ultra-fine condensers that we just can't imagine how either can lose in this big fight for condenser supremacy. But the answer is up to you . . . compare their advantages: TOBE TUBIDON is tubular-shaped, up to 525 volts, self-supporting, easier to install, and *lower in cost*. TOBE FLEXIDON is rectangular-shaped, up to 525 volts, space-saving design . . . with the big feature of *flexibility* (the fact that if one section breaks down, it is necessary to replace *only* the broken section.)

Which do you favor in this big battle? Note how they shape up . . . read the exact specifications. *Remember that both are topnotchers* . . . thoroughly moisture-proof, double-jacketed, asphalt impregnation and heavy wax seal, added protection against developing open circuit or high resistance contact . . . all the features born of skillful manufacture and long experience.

SEE THE CONTESTANTS IN PERSON AT ALL GOOD RADIO JOBBERS

Ask for them by their nicknames, TOBE TUBIDON and TOBE FLEXIDON. And, if you wish to receive our complete illustrated TOBE CATALOG fill in the coupon below, and mail today.

HOW THEY SHAPE UP . . .

	TUBIDON	FLEXIDON
VOLTS	35-50-200-525	200-525
MFD.	35v.—5 to 50 50v.—5 to 25 200-525v.-1 to 16	1 to 16 (single) (multiples up to triple eight)
MAXIMUM SIZE	2-¼" x 1"	3-¼"x1⅝"x1$\frac{5}{16}$"
MINIMUM SIZE	2-¼" x ½"	2-⅛"x⅞"x⅞"
TYPE LEADS	solid bare tinned copper wire	insulated tinned copper wire
LEAD LENGTHS	2-½"	6"
MOUNTING	self supporting by leads	metal eyeletted tabs
PRICE (typical 8 mfd.-475v.)	$.75	$.95

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-the new Roto Ranger TUBE TESTER and SET SERVICER

$57.00

DEALERS' NET PRICE

IN two months, what a welcome! Simpson Radio Instruments, with the ingenious Roto-Ranger* scales were unquestionably the sensation of the I-R-S-M Show, and in the sixty crowded days since their announcement they have been hailed by service men everywhere as the one big development in recent years.

The latest addition to the Simpson line is illustrated here—the new Simpson Model 220 Tube Tester and Set Servicer—an A. C. operated tube tester and a point to point set servicer combined in one versatile instrument. As in other Simpson Roto-Ranger equipment, the new Tube Tester is equipped with independent scales synchronized with the circuit selector as described below.

The Roto-Ranger feature permits the use of three distinct English reading scales with the correct load resistances to facilitate close reading of the three classes of tubes—battery types, cathode types and diodes. Tubes are tested hot so as to locate shorts due to thermal expansion. Any possible pin arrangement, including the location of both filament terminals is provided for by the filament return selector and flexible unit switching arrangement. A spare socket provides for any radical changes in tubes that may develop. A switch in the lower right hand corner enables you to check voltage at any time without disturbing the circuit selector—a real time saver.

Testing for shorts is a simple matter of turning the circuit selector to "short check" and manipulating the toggle switches at the bottom of the panel. Two "Good and Bad" dials cover condenser testing—one indicates the condition of paper and mica condensers; the other shows the allowable leakage for electrolytic condensers at various capacities. Both indicate *exact* leakage in Megohms instead of merely detecting the general condition as in conventional instruments.

There are three very practical resistance ranges: The 0-100 ohms range (15 ohms center) measures resistance of coils and even detects poor soldering, and there is also an 0-100,000 ohm range (3500 ohms at center) and an 0-100 megohm scale with 1 megohm at center—a complete range from .2 ohms to 100 megohms. Voltage ranges include D. C. 0-8-300-1000 volts. All voltage ranges are furnished with resistance of 2500 ohms per volt—a practical combination of ranges for all test work.

See the finer workmanship of this and other Simpson Instruments—the unmistakable signs of greater precision—the clear, independent scales. Then consider the fact that these instruments actually cost less than equipment which cannot match their design, beauty or utility. This will be your final reason for using Roto-Ranger servicing instruments.

Another plus-quality Simpson "Roto-Ranger" achievement — the Roto-Ranger Volt-Ohm-Milliammeter.

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*What is Roto Ranger?

"Roto-Ranger" is the appropriate designation of the basic unit which is incorporated in the Simpson Set Servicer, Tube Tester, Volt-Ohm-Milliammeter and similar instruments. This ingenious unit consists of a selector switch which is perfectly synchronized through a precisely built bevel-gearing with a drum containing the twelve scales corresponding to the twelve selector circuits. As the selector switch is moved through its twelve positions, the drum is automatically rotated by means of the gearing so that the proper scale for the particular circuit appears in the aperture of the panel. Here is *truly* direct reading. This unit, which marks the greatest advance in recent years, is a patented and exclusive feature of Simpson Instruments. There is only one "Roto-Ranger—Simpson!"

Simpson Electric Company, 5218 W. Kinzie St., Chicago, Ill.
Please send facts covering Simpson Instruments Checked:
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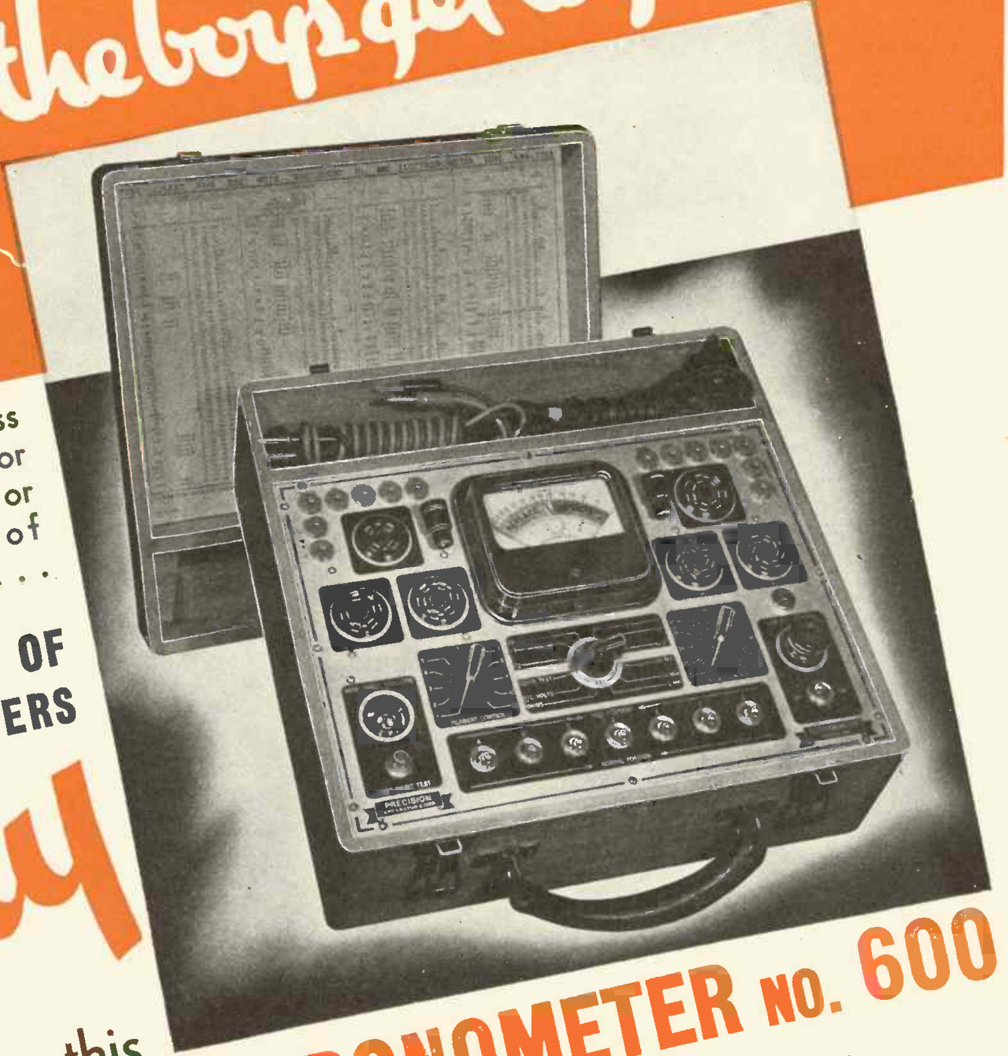
why

he's sold on this



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A combination test instrument of **COMPACT SIZE** (12¾ x 11½ x 6) for complete modern tube analyzing and point to point set analyzing . . . built to withstand "rough" usage . . . housed in an attractive hardwood case . . . approximate weight, 15 lbs. . . . designed to eliminate the inconvenience of carrying or the expense of purchasing several test units.

- **TUBE ANALYSES** with Hot neon cathode leakage test. . . Hot neon inter-element short test . . . properly rated loads applied. . . Free point systems for extreme flexibility for future releases. . . Individual tests applied to full wave rectifiers and multi-element tubes. . . Tests for all octal and non-octal tubes. . . Large meter of modern square design. . . Simple to operate . . . other many important features for accurate tube analyzing. . .

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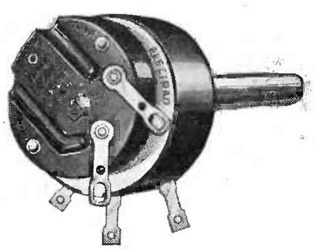

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Only *one* moving unit rides in *direct* friction contact with the carbon resistance element.

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR OCTOBER, 1936

AUTOMATIC FREQUENCY CONTROL

(See Front Cover)

By HUBERT R. SHAW*

In the May issue of SERVICE the general theory of automatic frequency control was discussed by D. E. Foster and S. W. Seeley. The article below attempts to explain that theory in terms more easily understood by the average Service Man. Additional articles on this subject will be published in future issues of SERVICE.

The importance of obtaining a working knowledge of the fundamentals of afc cannot be overstressed. The Service Man who does not understand the discussion presented below is urged to reread it several times referring to the diagrams wherever necessary.

THE circuit shown on the front cover is a schematic of the whole afc system as used in the General Electric receiver model E-126. Here is the oscillator circuit with the grid coil tuned as usual by a section of the gang condenser. Connected across this tuned circuit is a tube which has an effect upon this tuned circuit; that is, upon the frequency of the oscillations. This effect is controlled by varying its grid bias to cause either an increase or decrease in oscillator frequency. The voltage for controlling this tube is developed by special circuit arrangements of the last i-f stage and second detector.

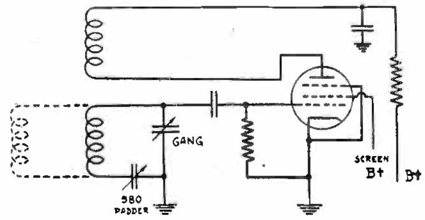

Fig. 2. Conventional oscillator circuit.

In some respects this circuit is similar to the usual avc system, but the afc voltage used for control is either positive or negative with respect to ground, depending upon to which side of resonance the receiver is tuned.

The Conventional Oscillator

Fig. 2 shows a perfectly conventional oscillator circuit found in the majority of superheterodynes on the market today. Of course, there are a number of variations, but for the purposes of this discussion we will consider this circuit only.

The frequency of oscillations in this circuit are determined by the value of the inductance and capacitance. The frequency of oscillations would be increased by making either the inductance or the capacity smaller, and conversely, the frequency could be lowered by making the inductance or the capacity larger.

The inductance could easily consist of two coils in parallel with each other and the inductance would then be something less than either one of the parallel coils alone. Placing two coils in shunt with each other is similar to placing two resistors in parallel with each other; the combined impedance or resistance will always be less than the smaller one. Where one is much larger than the other, the total resistance or impedance will be practically equal to that of the smaller. So then, if we used two coils in parallel with each other instead of a single coil, we could make the total inductance larger or smaller by making one of the coils larger or smaller. The smaller the total inductance became, the higher the frequency of oscillations and the larger it became, the lower the frequency.

The AFC Oscillator

In an afc circuit, in order to provide some means of either increasing or decreasing the oscillator frequency from its normal frequency without changing the gang-capacitor setting, we are going to connect an *apparent* inductance across the oscillator coil and provide some means of making that apparent inductance either larger or smaller. In

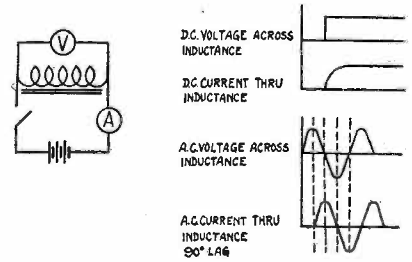

Fig. 3. The current lags the voltage in an inductance.

*Field Technical Section, Radio Division, General Electric Co., Bridgeport, Conn.

this case, the apparent inductance is going to be a vacuum tube. Just how a vacuum tube can be made to work like an inductance requires some explanation.

Let us first consider the properties of any inductance. If a circuit is arranged as shown in Fig. 3, with a real inductance across a voltage source in series with a switch, neither current nor voltage will be indicated until the switch is closed. However, when the switch *is* closed, an interesting thing happens; voltage appears across the inductance immediately but the current increases slowly and may not reach a maximum for several seconds, indicating that the current *lags* behind the voltage. If the battery is replaced by an a-c generator and the alternating voltage is applied in the same manner, and we provide some means of indicating both voltage and current, we will find that the current wave will lag behind the applied voltage wave by nearly one-quarter cycle or 90°. This is one of the properties of an inductance; whether connected across an a-c source or a d-c source, the current will always lag behind the voltage.

If we make a special arrangement of a vacuum tube so that it will have this property of drawing a lagging current, we will have a device which will act like an inductance. If we place this device across the coil in the oscillator circuit, we will have essentially two inductances in parallel. Then as we vary the apparent inductance of this tube, we will vary the total inductance in the circuit and consequently the frequently of the oscillations.

The Control Tube

Fig. 4 shows the oscillator with the control tube connected accross it. Certain changes have been made in the oscillator circuit in order to allow the connection of the control tube. The plate feedback coil has been removed to the bottom end of the grid coil and connected to it. The 580 kc padder has been moved to the top end of the coil and the comparatively large capacitor of 0.05 mfd connected between the lower end of the coil and ground. This isolates the oscillator coil so that plate voltage for the control tube as well as for the oscillator plate may be applied through the coil. The fact that the plate voltage is applied in this manner has no effect whatever upon the oscillatory circuit; the bottom end of the coil being at ground potential to r-f the same as before, since the 0.05-mfd capacitator is so large as to be practically a short circuit to radio-frequency currents. Also, the gang capacitor is across the coil in series with the 580 kc padder as before.

The control tube is in parallel with the oscillator coil. Although the d-c

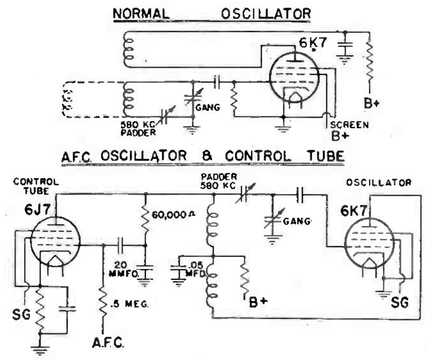

Fig. 4. The afc oscillator circuit.

plate supply of the control tube is constant, there is an r-f voltage present across the grid coil, due to the fact that it is part of the oscillatory circuit, so that the control tube is looking into an a-c source. Here, as in many tube circuits, we can forget about the d-c and consider the a-c circuit only. As stated before, it is necessary that the control tube cause a lagging current to flow from the grid coil in order for it to appear like an inductance. In accomplishing this action, the key to the whole situation is the excitation on the grid of the control tube.

First of all, let us consider what would be the effect of this control tube upon the oscillator circuit if there were no a-c excitation of any kind on its grid. The control tube circuit would simply have a finite resistance or impedance from plate to ground. Obviously, this tube impedance is directly across the oscillator tank and so would draw current from the tank circuit. However, since the tube simply works like a resistance, it would be in-phase current or in other words the current drawn from the ocillator coil by the tube would neither lag nor lead the voltage causing it. Therefore, there would be no effect upon the frequency of the oscillator. Now if the grid bias were raised or lowered, the control tube would simply draw more or less current from the oscillator circuit but this current would still be in-phase and therefore there would still be no effect on the oscillator frequency. It is probable that in an actual demonstration of the statements just made, that a slight change in frequency would result as the control tube was made to draw more or less current because of slight changes in the oscillator plate current as more or less power was drawn from the oscillator tank. These changes, however, would *not* be directly caused by the control tube.

The Proper Phase

However, if we excite the grid of the control tube with an a-c voltage which has a lagging phase with respect to the voltage across the oscillator grid coil, we will get the desired effect of a lagging current flowing in the control tube plate circuit.

The network consisting of R and C constitutes an a-c voltage divider across the oscillator coil and the voltage developed across C is applied to the grid of the control tube. This voltage applied to the grid is, however, out-of-phase with the voltage across the oscillator coil. Let us see why this is so. Although this voltage divider consists of both capacity and resistance, the resistance is considerably greater than the reactance of the capacitor, and the network therefore, looks nearly like a pure resistance to the source voltage which is across the oscillator grid coil. However, a phase difference between *current* and *voltage* always does exist when current is passed through either a capacity or an inductance. We found that in an inductance, the current lags behind the voltage; or to say the same thing in another way, the voltage *leads* the current. Conversely then, the voltage *lags* the current in a capacity, and so the voltage across the 20-mmfd capacitor *lags* the current through it. However, we know this current is practically in phase with the source voltage across the oscillator coil and so the voltage across the capacitor lags the oscillator voltage.

Since this voltage is coupled to the grid of the control tube through a capacitor, this means that the grid is excited with an a-c voltage which lags the a-c voltage in its external plate circuit by nearly 90°. This lagging excitation of the grid of the control tube causes it to draw a lagging current from the oscillator grid coil across which it is connected.

By way of a brief explanation, refer to Fig. 5. The control tube may be replaced with a generator and resistance. The generator voltage will be equal to the amplification factor of the tube multiplied by the a-c grid excitation and will be 180° out-of-phase with the grid excitation. The resistance will be equal to the internal plate resistance

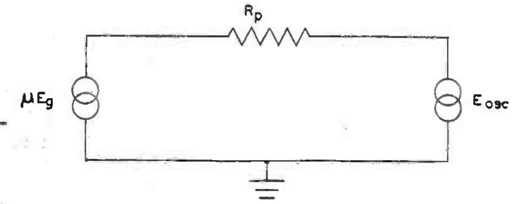

Fig. 5. An a-c analogy.

of the tube. The voltage across the oscillator coil may also be replaced with an equivalent generator of the proper phase. This gives us two generators with a definite phase relation between them in series with a resistance. The exact phase of the current which will flow is dependent upon several factors; the degree of grid excitation, the amount of fixed grid bias and the a-c voltage across the oscillator coil. However, with this circuit arrangement, the current which flows will always be a lagging current.

Tube Acts Like Inductance

Here then, we have the device we need; one which draws a lagging current from an a-c potential across it and behaves, therefore, like an inductance.

We can also control the amount of lagging current the tube will draw by varying its grid bias. Consequently, we can vary the amount of its apparent inductance and shift the oscillator frequency either up or down.

As the control tube receives a more negative grid voltage, it draws less lagging current and accordingly looks like a larger inductance since a larger inductance would have a higher reactance resulting in less current flow. A larger inductance would increase the total inductance in the circuit and lower the oscillator frequency. Conversely, as the control tube receives a less negative voltage, it draws *more* lagging current and so looks like a smaller inductance since a smaller inductance would have less reactance, resulting in greater current flow. A smaller inductance would decrease the total inductance in the circuit and raise the oscillator frequency.

The Control Voltage

As previously stated, this change in grid bias is furnished from another specialized circuit which delivers either a positive or negative voltage, depending upon which side of resonance the receiver is tuned. The voltage either adds on or subtracts from the initial bias obtained by use of a cathode resistor. Thus, as soon as an off-resonance condition exists in tuning, a control voltage is generated and the control tube functions to either increase or decrease the oscillator frequency to the point where the local oscillator beating against the incoming signal produces the correct i-f frequency.

We now come to the afc voltage generating circuit which controls the tube across the oscillator tank circuit. Referring to the top part of Fig. 8, this part of the circuit consists of a special i-f transformer, tuned to the regular i-f frequency of 465 kc; two individual diode rectifier circuits and associated apparatus.

The Voltage Generator

Briefly the action of this circuit is as follows: *At resonance*, the a-c voltages applied to each diode plate are equal. Each diode circuit has its individual load resistor and when equal voltages are applied to the diode plates, the voltage developed across each individual diode load resistance is equal. These two load resistors are connected in series so that while as much as fifty volts d-c may appear across each load resistance, the voltage measured across the opposite ends is zero. Since one end is grounded, the voltage from the top end to ground is zero. This is the condition existing at resonance.

Off resonance the a-c voltage delivered to one diode plate is higher than the voltage delivered to the other and consequently the voltage across one diode load is higher than the voltage across the other. Across the ends or from the high end to ground, a voltage will appear, equal to the difference in the voltages produced across the load resistances. Said voltage will be either positive or negative with respect to ground, depending upon which load resistor has the higher voltage across it.

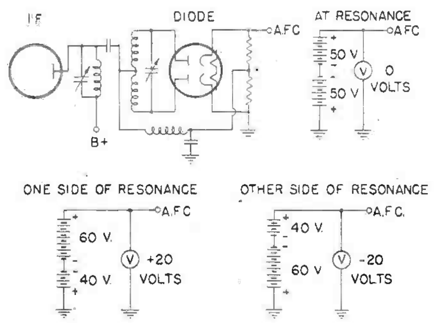

Fig. 6. The afc discriminator circuit.

This net voltage, either positive or negative with respect to ground, is then the control bias on the grid of the control tube across the oscillator.

Fig. 6 will perhaps make this point a little more clear. It is apparent that each half secondary supplies voltage to the diode plate connected to it and that each diode has its individual load resistor. There will, therefore, be a d-c voltage set up across each load resistor independently of the other, and that voltage will be dependent entirely upon the a-c applied to each individual diode plate; the usual rectifier action taking place as in any normal diode circuit. Since the voltage developed across each load is d-c, we may represent each one by a battery.

When the incoming signal is equal to the resonant period of the secondary, the voltage applied to each diode is equal and, therefore, the d-c voltages set up across each load resistor are equal. This case is represented by the first figure. If two batteries of equal voltage are connected negative-to-negative, as shown, no voltage would be measured across the opposite ends or from positive-to-positive since the difference between the two battery voltages is zero.

When the incoming signal is more or less than the i-f resonant frequency, the secondary is no longer in resonance with the signal. Under these conditions, the voltages applied to the diodes are no longer equal and the d-c voltage developed across the load resistors are unequal. The second figure shows this condition on one side of resonance. The batteries representing the d-c voltages developed, as before. They are connected negative to negative as before, but this time a voltage will be measured across the opposite ends since the difference is now a finite value. This voltage would be negative with respect to ground since the battery with its negative end away from ground is larger.

In the last case, the signal is off resonance in the other direction. Once again we have unequal a-c voltages applied to the diode plates and unequal d-c voltages developed across the loads. This time, however, the greater a-c voltage is applied to the other half of the double diode and the d-c voltage developed across its load resistor is now greater. The difference voltage is now positive with respect to ground since the battery with its positive end away from ground is larger.

A Complete Cycle

Referring to the front cover again, when the local oscillator is generating the correct signal to produce an i-f signal of 465 k-c, there is no need of any further adjustment. The differential voltage is zero and there is, therefore, no effect upon the control tube and oscillator circuit. Either side of resonance, a voltage, either positive or negative, with respect to ground, is generated, and this in turn affects the control tube and the oscillator circuit. The oscillator frequency is thus either increased or decreased until it is correct to produce an i-f signal of 465 k-c. As this condition is approached, the differential voltage becomes less and less and the action finally stops with about one volt as the differential voltage actually remaining. This action is quite rapid, however, taking place in less than a second of time.

All along we have stated that unequal voltages are applied to the separate diodes as the incoming i-f signal departs from 465 kc. In a future issue of Service we shall attempt to account for these unequal voltages.

CONVERTING A-C, D-C RECEIVERS FOR THE 25B5

By ROBERT J. E. WHITTIER*

THE 25B5 and the 25N6G can be used in a-c, d-c receivers and amplifiers to replace the 43 output tube. It will provide about twice the power output at the same distortion level. The 25B5 is another "dynamic coupling" type of output tube similar to the 6B5, but designed for operation at the voltages available in a-c, d-c receivers.

The 25B5 contains two triodes connected together internally, and operates under class A triode conditions. The low plate resistance of this tube (typical of all triodes) produces good audio quality when driving a dynamic speaker with its abrupt changes in impedance at different frequencies. Fig. 1 shows the change of distortion and power output with plate load resistance. This curve shows that the distortion does not become excessive when the plate load resistance fluctuates between 1,000 and 3,500 ohms and that the power output, with rated signal voltage on the grid, is essentially constant throughout these same limits. In this way, the effects of loudspeaker resonant peaks at different frequencies are minimized.

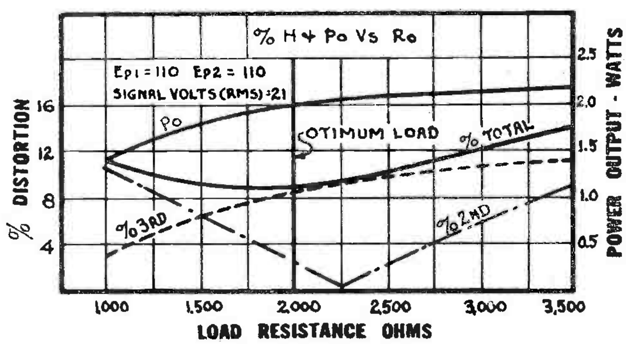

Fig. 1.

PROFITS IN CONVERSIONS

The new tube can be readily interchanged with the type 43 in receivers and power amplifiers. Of course, the initial value of the set must warrant such change in order to assure the Service Man a profit for the job.

Since the higher powered tube draws more plate current than the 43, a few parts in the set must be changed in order to provide the proper operating conditions for the 25B5 or 25N6G. The 25B5 is rated at zero grid bias and 110 volts on both input and output plates. This value is the sum of the 15 volts rated grid bias and the 95 volts rated plate voltage of the 43 type tube.

SPEAKERS

Because of the higher current of the 25B5, the type 25Z5 rectifier will not give sufficient d-c output to supply 110 volts plus a series speaker field voltage, as is done in a few a-c, d-c sets using the type 43 power tube. Therefore, it is necessary that a set designed for the 25B5 use the more conventional shunt speaker field of 3,000 ohms d-c resistance.

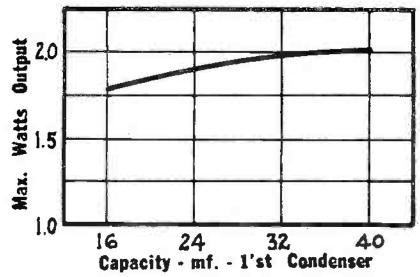

Fig. 2.

If, in any application, it is necessary to use two type 25B5's and a speaker field, two type 25Z5 rectifiers should be used. However, in an application such as this it would probably be better to use a permanent magnet type of dynamic speaker, since a single 25Z5 will supply sufficient voltage for two type 25B5's without a speaker field.

In many cases it will be necessary to use a different speaker to handle the increased power of the 25B5. A 6″ dynamic speaker will handle the 2 watts satisfactorily, but some 5″ speakers are liable to be overloaded. With 5″ speakers which tend to overload, it is sometimes possible to provide a more solid mounting for the speaker and to mount the cone directly on to the baffle to correct this difficulty.

In deciding what loudspeaker to use it should be remembered that the 25B5 is capable of producing quality comparable to a-c sets and that, with the 25B5, differences in the loudspeaker quality are noticeable.

FILTER CONDENSER

The first electrolytic condenser of the filter section should be increased to at least 32 or even to 40 mfd, since the total d-c load of the 25Z5 is about 90 ma. Life tests and measurements of peak currents of the 25Z5, under these conditions, indicate that these values do not affect the life of the 25Z5. Fig. 2 shows how the power output of the 25B5 is affected by changing the capacity of the first electrolytic condenser of the filter circuit from 16 to 40 mfd. For this curve, the resistance of the filter choke and output transformer was 200

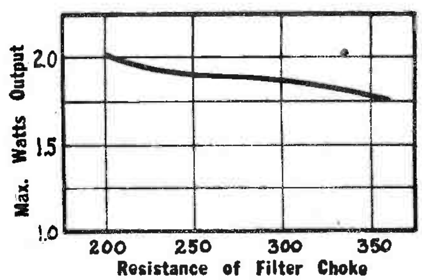

Fig. 3.

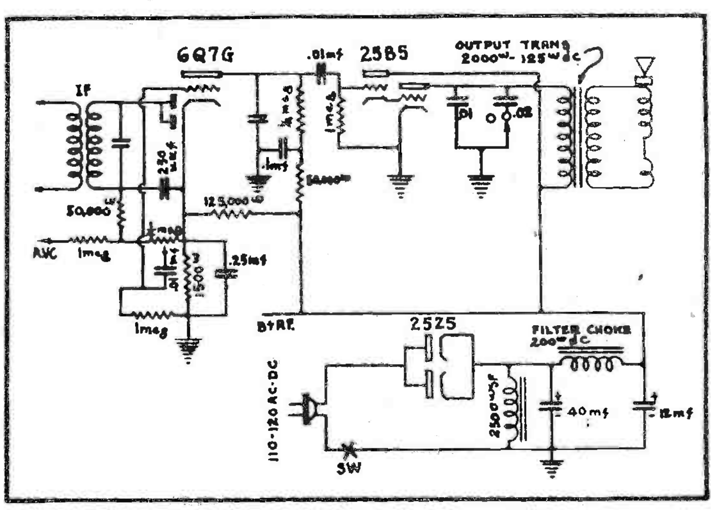

Fig. 4. Schematic diagram of audio amplifier and power supply for set "A" converted for 25B5.

*Engineering Dept., Triad Mfg. Co., Inc.

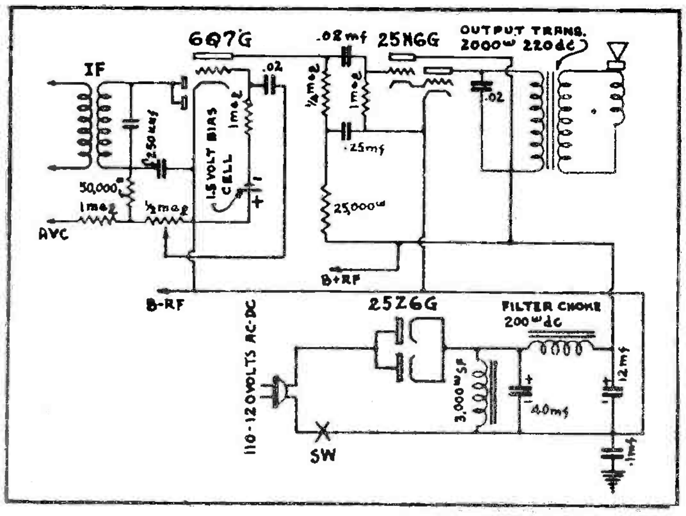

Fig. 5. Schematic diagram of audio amplifier and power supply of set "B" converted for 25B5.

and 125 ohms, respectively, as recommended in the following paragraph and a resistance of 7,000 ohms was connected across the output of the filter corresponding to an r-f amplifier plate supply load of 15 ma.

Filter Choke

Since the plate currents of the 25B5 are about 20 ma higher than the plate and screen currents of the 43 (or about 50 ma) it is necessary that the filter choke have a d-c resistance of not more than 200 ohms in order to keep the d-c drop across the choke below 12 volts. Fig. 3 shows how the power output is affected by the filter choke resistance. For this curve the first filter condenser was 40 mfd and the output transformer was 125 ohms.

Output Transformer

The output transformer for the 25B5 should have a primary impedance of 2,000 ohms. This is half the value for the 43 and, therefore, the output transformer will have less primary turns and less d-c resistance than one designed for the 43. A d-c resistance of 125 to 150 ohms is attainable and will give the best results.

It should be kept in mind that even though these parts specifications may differ slightly from previous practice, and even though the cost may be increased a few cents, these changes result directly in increased output. Each one of these three suggested changes—increased filter condenser, lower resistance filter choke, and lower resistance output transformer—increase the power output of the set.

Detectors and Voltage Amplifiers

The 25B5 requires a greater signal voltage on its grid than the type 43. The high-mu triode type 75 has been used successfully in most a-c, d-c sets as a voltage amplifier for the 43, but an investigation of the undistorted voltage output of the type 75, with 100-volts plate supply, has shown that it has just barely enough output to drive a 43.

The type 6Q7 has greater undistorted voltage output and in most cases is the best tube to use to supply the signal to the 25B5. The actual voltage gain of the 6Q7 when driving a 25B5 is slightly greater than the gain of a 75 driving a 43 because a 1-meg grid resistor can be used with the 25B5, whereas the maximum safe grid resistor for a 43 is ½-meg. This increased gain of the 6Q7 results in an amplifier giving 2 watts output. For this 100-volt operation, the 6Q7 should have a plate resistor of ¼ meg and a grid bias of 1.05 to 1.4 volts. If the tube is to be self-biased, the cathode resistor should be 6,000 to 7,000 ohms. The 1.05 volts or 6,000-ohm cathode resistor is the minimum grid bias that can be used on the 6Q7 without having contact potential difficulties. Bias cells have been used successfully with the 6Q7. No changes are necessary in the diode circuit or the avc circuit to use the 6Q7 instead of the 75.

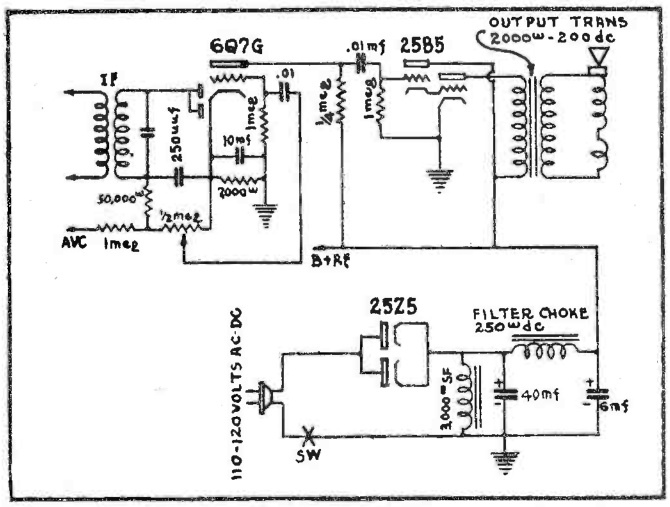

Fig. 7. Schematic diagram of audio amplifier and power supply of set "D" converted for 25B5.

The 6B7 also can be used as a voltage amplifier for the 25B5 and has slightly more gain, but because the cost of this tube is slightly greater than the cost of a 6Q7G, and the extra by-pass condenser and 2 resistors for the screen circuit increases the cost still more, it is not usually practical to use this tube.

The 6R7 is another diode-triode which can be used to supply the signal to the 25B5, and this tube has the greatest undistorted voltage output. The 6R7 can best be used with an interstage transformer to drive 25B5's in a push-pull circuit.

Conversions

Fig. 4 shows the circuit of one of the leading manufacturer's a-c, d-c sets, sim-

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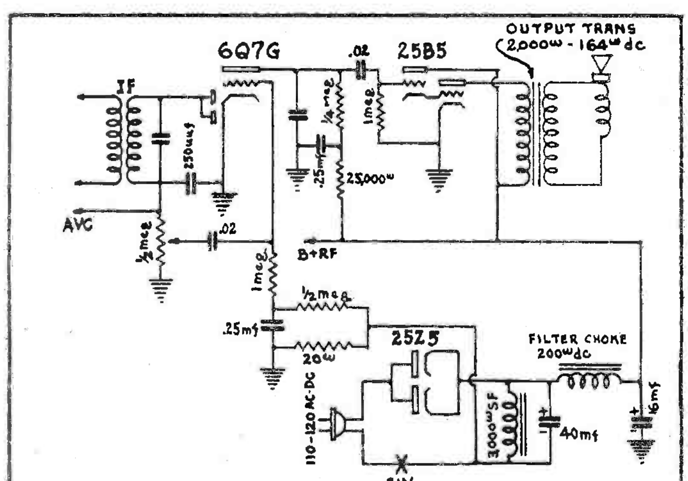


Fig. 6. Schematic diagram of audio amplifier and power supply of set "C" converted for 25B5.

HEATING OF VOLTAGE DIVIDERS

By R. ADRIN KAY

IN the August issue of SERVICE an article on "Voltage Dividers" by John F. Rider gives a general discussion on their use and calculation. The author has read this article by Mr. Rider and feels that the discussion will be quite generally welcomed by Service Men. However, there is the additional question of heat dissipation in the divider—or, in other words, "How hot can the voltage divider become without burning out?"

The experienced Service Man can usually judge by the feel of a divider, after it has been in operation for about an hour, whether it will take the load. For the man less sure of his intuition the heating of the divider presents a serious problem. A divider which will overheat under operating conditions cannot last—this results in a come-back and consequent loss of time, money and prestige. Too large a divider, on the other hand, presents the problem of greater cost as well as increased space requirements. It is possible with rather simple arithmetic, plus the information given by Mr. Rider, to determine the wattage requirements of the voltage divider.

THE CALCULATIONS

First let us remember that the divider gets hottest at the B + or high-voltage end. It is this portion that we must protect from overloading. Now for the calculations:

1. Using Mr. Rider's method, determine the maximum current drawn through the top section of the divider; e.g., add the bleeder current and the current that is to be drawn from the divider, at the lower voltage taps, by each tube connected to it: change this current, now expressed in milliamperes, to amperes by dividing it by 1,000.

2. Multiply this current (in amperes) by itself.

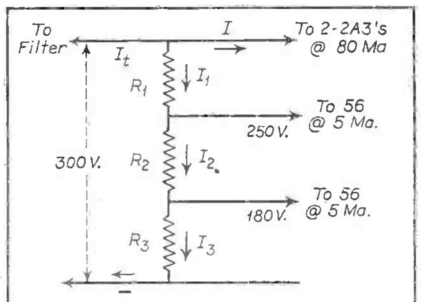
3. Multiply this answer by the total resistance of the divider and the result will be the wattage dissipated by the voltage divider. Depending upon the location of the divider the power rating in practice *must* be from 1½ to 2 times that value. If the divider is mounted on the top of the chassis where the air around it is free to circulate the nearest commercially available value about 1½ times that obtained by the aforementioned calculation can be used. If it is mounted under the chassis, where the circulation is confined, a higher wattage rating must be used. The necessity for this larger rating arises from the fact that the advertised rating of commercial voltage dividers is obtained in free space.

A HANDY CHART

The chart given in Fig. 1 gives the resistances of commonly used voltage dividers in ohms and the wattages of commercially available dividers. In the chart are the currents obtained (to the nearest whole number) by the calculations previously described. A close approximation of the wattage dissipation in the divider may be obtained directly from the chart. This is accomplished by reading across the column indicated by the nearest (higher) value of resistance used as a divider, to the nearest (higher) value of current found by Mr. Rider's method as previously mentioned. The wattage indicated at the top of this column will be slightly larger than the actual dissipation but will be a close approximation of the size necessary. The actual value of watts dissipated in the divider can be determined by proper interpolation between the values given on the chart.

Total Resistance	1.5 Watts	10 Watts	20 Watts	25 Watts	40 Watts	50 Watts	75 Watts	100 Watts	200 Watts
100	122	315	446	545	634	740	865	1000	1400
1000	38	100	142	173	200	234	274	315	447
2500	24	63	89	109	127	148	173	200	283
5000	17	45	63	71	89	100	122	141	200
7500	14	36	52	63	72	85	100	116	164
10,000	12	32	45	50	63	71	86	100	141
15,000	10	26	36	41	51	58	71	82	115
20,000	8.6	22	32	35	45	50	61	71	100
25,000	7.7	20	28	32	40	45	55	63	90
30,000	7	18	26	29	36	41	50	58	82
40,000	6.1	16	22	25	32	35	43	50	71
50,000	5.5	14	20	22	28	32	39	44	63
100,000	3.8	10	14	16	20	22	27	32	45
	Milliamperes								

Fig. 1. Wattage dissipation of dividers.



Assume bleeder current = 9 Ma. (Approx 10% of total current)

I_t = 9 Ma. + 4 Ma. + 5 Ma. + 80 Ma. = 98 Ma.

I_1 = 9 Ma. + 4 Ma. + 5 Ma. = 18 Ma.
Maximum current through divider.

I_2 = 9+4 = 13 Ma. I_3 = 9 Ma. bleeder current

$$R_1 = \frac{300 - 250}{18} = 2780 \text{ Ohms}$$

$$R_2 = \frac{250 - 180}{13} = 5380 \text{ Ohms}$$

$$R_3 = \frac{180}{9} = 20,000 \text{ Ohms}$$

Total voltage divider resistance = 20,000 + 5380 + 2780 = 28,160 Ohms

Wattage dissipated in divider = 0.018 X 0.018 X 28,160 = 9.1 Watts

Hence, a divider of at least 15 watts should be used.

Fig. 2.

A TYPICAL PROBLEM

In Fig. 2 a typical divider used in a p-a amplifier is given together with the mathematics used in calculating the various resistance values and power ratings. A similar result can be secured by reference to the chart. Reading across the line next to 30,000 ohms, the value 18 ma is found under the column labeled 10 watts; this is a close approximation to the 9.1-watt value obtained in Fig. 2.

THE PROOF

The heat developed in any resistance depends upon the amount of current flowing through the resistance. The heat is a function of the square of this current. This means that if we double the current four times as much heat is developed. If we increase the current three times the heat produced is increased nine times.

Voltage dividers are made in such a way that they will throw off as much heat as possible, that is they will radiate the heat produced in them by the current passing through them. The ability to throw off heat depends upon the amount of surface of the wire, the kind of insulating material upon which the wire is wound, the space between the turns, etc.

On the other hand, the voltage divider

(*Continued on page* 498)

General Data . . .

Wells Gardner 6G

The Wells Gardner 6G is a radio designed to operate from a battery power supply. The tubes used are of the 2-volt type and provide an undistorted power output of 400 milliwatts. Two bands are covered, the B range from 528 kc to 1730 kc and the D range from 5650 kc to 16,000 kc. Two-band coverage is accomplished by means of two sets of antenna and oscillator coils and a single-section double-throw switch.

The Circuit

Referring to the schematic circuit diagram, Fig. 1, T1 and T2 are the antenna transformer and oscillator-coil assemblies and T3 is the image-rejector coil assembly. The standard-wave and short-wave coils are indicated by the letters B and D, respectively.

The band switch completes connections to the antenna transformer secondary and oscillator grid coil in use. It also disconnects the antenna transformer secondary and oscillator grid coil not in use.

The antenna transformer with tuned secondary feeds into a type 1C6 pentagrid converter tube which functions as the oscillator and first detector. The image rejector pickup coil which is connected to the antenna B range transformer, is effective in bucking out the image frequencies on the standard-wave band.

The oscillator potential on the oscillator control grid of this tube modulates the electron stream from the cathode in such a manner as to impress on it the oscillator frequency which is always 456 kc above the frequency to which the r-f amplifier is tuned. The electron stream is also modulated at the signal frequency by the detector control grid. As a result of the beating of the two frequencies, the intermediate or beat frequency of 456 kc is present in the plate circuit of this tube.

One stage of i-f amplification is employed using a 34 tube. The primaries and secondaries of the first and second i-f transformers are tuned by small trimmer condensers.

A type 1B5 duo-diode triode tube functions as the second detector and a one-stage audio amplifier. The two diode plates are connected together. Avc voltage is applied through isolating resistors to the control grid circuits of the first detector and i-f tubes. The audio voltage developed across volume control resistor R5 is applied through the movable arm to the control grid of the 1B5 tube.

Resistance coupling is used between the first tube and the second audio stage which employs a 30 tube. The latter is transformer coupled to the output stage which uses two type 30 tubes in a stage of class B amplification. A magnetic reproducer is used.

C voltages are obtained from the 6-volt C battery connection and from a potentiometer consisting of resistors R9, R10 and R11 connected between the 6-volt C connection and ground.

Models with the filament rheostat are connected as shown in Fig. 1. This rheostat permits the use of a 3-volt A battery. As shown in Fig. 1, there are two separate variable resistors one of which controls the filament voltage and the other the pilot lamp voltage. In models which do not have the filament rheostat the +A connection is made directly to the +A line and the pilot lamp.

Alignment Procedure

Correct alignment is extremely important in connection with all-wave receivers. The receivers are all properly aligned at the factory with precision instruments and re-alignment should not be attempted unless all other possible causes of the faulty operation have first been investigated and unless the service technician has the proper equipment.

A signal generator that will provide an accurately calibrated signal at 456, 1730, 1500, 600, 16,000, 15,000 and 6000 kc and an output indicating meter are required. It will be practically impossible to align the receiver if unsatisfactory apparatus is used.

Use a non-metallic screwdriver for the adjustments. The complete procedure is as follows:

I-F Alignment

Set the signal generator for a signal of 456 kc.

Connect the output of the signal gen-

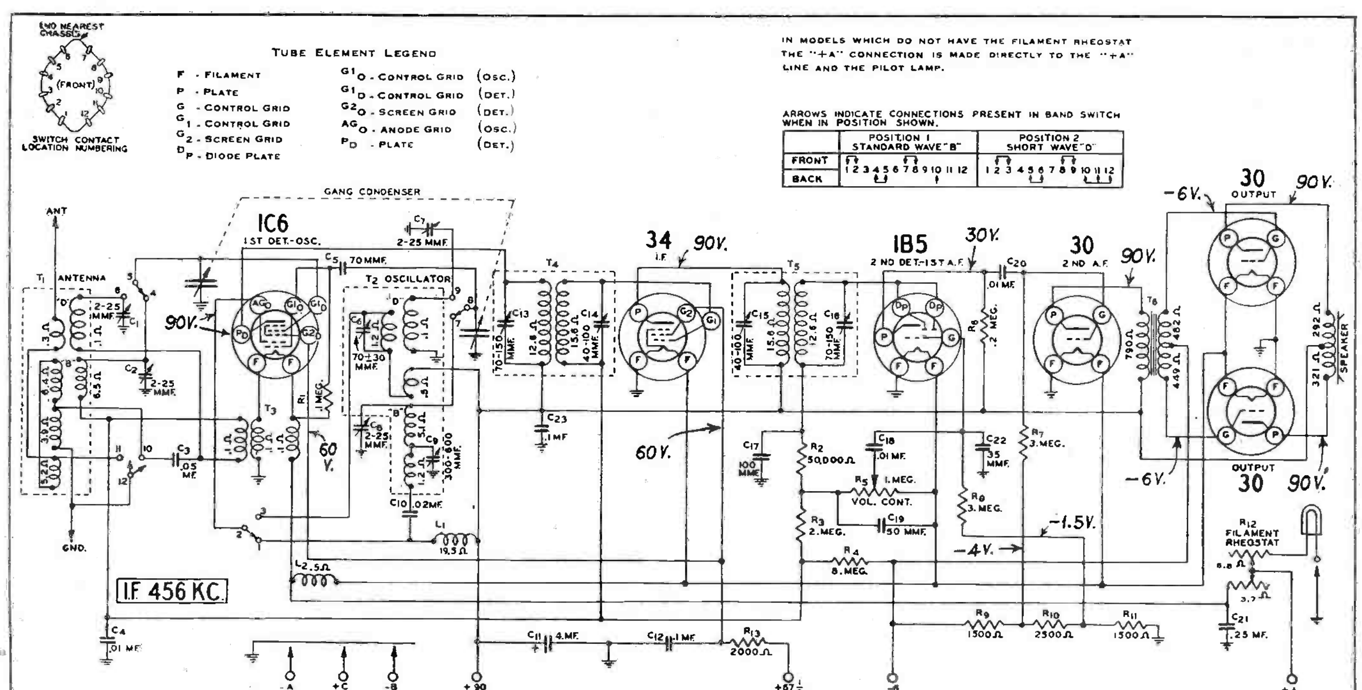


Fig. 1. Wells Gardner 6G circuit diagram.

erator through a 0.1-mfd condenser to the grid of the first detector.

Connect the ground lead of the radio to the ground post of the signal generator.

Turn the band switch to the range B position (standard-wave band).

Turn the volume control to the maximum position.

Attenuate the signal from the signal generator to prevent the levelling-off action of the avc.

Then adjust the four i-f trimmers until maximum output is obtained. The adjusting screws for these condensers are reached from the top of the chassis, and the location is shown in Fig. 2.

RANGE B ALIGNMENT

After the procedure for the alignment of each range is completed it is advisable to repeat the procedure as a final check.

1730-kc adjustment:

Set the signal generator for 1730 kc.

Turn the rotor of the tuning condenser to the full open position.

Keep the band switch in the standard-wave position.

Connect the antenna lead of the radio through a 200-mfd condenser to the output of the signal generator.

For this and all subsequent adjustments keep the volume control at the maximum position and attenuate the signal from the signal generator to prevent avc action.

Adjust the oscillator range B trimmer (C8) until maximum output is obtained. The location of this trimmer is shown in Fig. 2.

1500-kc adjustment:

Set the signal generator for 1500 kc.

Turn the rotor of the tuning condenser carefully until maximum output is obtained.

Loosen the pointer screw and set the pointer at the 1500-kc mark on the standard waveband scale. Retighten the screw.

Adjust the antenna range B trimmer (C2) to maximum.

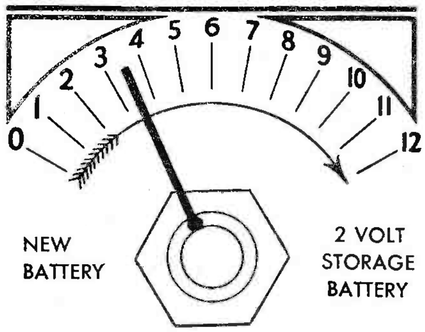


Fig. 3. Battery adjustment.

Do not change the setting of the oscillator range B trimmer.

600-kc adjustment:

Set the signal generator for 600 kc.

Turn the tuning condenser rotor until maximum output is obtained.

Turn the rotor slowly back and forth at the same time adjusting the 600-kc trimmer (C9) until the peak of greatest intensity is obtained. See Fig. 2 for location of this trimmer.

RANGE D ALIGNMENT

Caution. When aligning the short-wave band be sure *not* to adjust at the image frequency. This can be checked as follows: Let us say the signal generator is set for 15,000 kc. The signal will then be heard at 15,000 on the dial of the radio. The image signal, which is much weaker, will be heard at 15,000 less 912 kc, or 14,088 kc. It may be necessary to increase the input signal to hear the image.

16,000-kc adjustment:

Set the signal generator for 16,000 kc.

Connect the antenna lead of the radio through a 400-ohm resistor to the output of the signal generator.

Turn the rotor of the tuning condenser to the full open position.

Turn the band switch to the range D position (short-wave band).

Adjust the oscillator range D trimmer (C7) until maximum output is obtained. See Fig. 2 for location of this trimmer.

15,000-kc adjustment:

Set the signal generator for 15,000 kc.

Turn the rotor of the tuning condenser carefully until maximum output is obtained.

Adjust the antenna range D trimmer (C1) to maximum. When adjusting this trimmer, it will be necessary at the same time to turn the tuning condenser rotor slowly back and forth until the peak of greatest intensity is obtained.

Do not change the setting of the oscillator range D trimmer.

6000-kc adjustment:

Set the signal generator for 6000 kc.

Turn the tuning condenser rotor until maximum output is obtained.

Turn the rotor slowly back and forth at the same time adjusting the 6000-kc (C6) trimmer until the peak of greatest intensity is obtained. See Fig. 2 for location of this trimmer.

VOLTAGES

Check the voltages at the sockets to see if correct values are being delivered to the tubes. The antenna and ground should be disconnected and the antenna and ground leads from the set connected together. The volume control should be turned to the right or maximum position.

All of the voltage readings as shown in the diagram are read with a 1,000 ohm-per-volt meter. As high a range as possible should be used. In general, the higher the resistance of the meter, the more accurate the reading will be.

The voltage indicated on the diagram gives the voltages with all tubes in, the speaker connected and the set in operating condition. These voltages are typical of the sets, but will vary slightly with variations in individual receivers, tubes, test equipment used and battery voltages.

Stewart Warner R-144AS

The Stewart Warner chassis model 144 includes a speaker that is mounted directly on the chassis. The receiver uses a superheterodyne circuit which employs 5 glass tubes. The i-f peak is 456 kc. The tuning range of this chassis, in addition to the standard broadcast band, includes the two police-radio bands.

THE CIRCUIT

A complete circuit diagram of the receiver is shown in Fig. 1 with the tubes used, their functions and the voltages encountered on the socket prongs lettered on the diagram. These voltages were measured with a 1000-ohm-per-

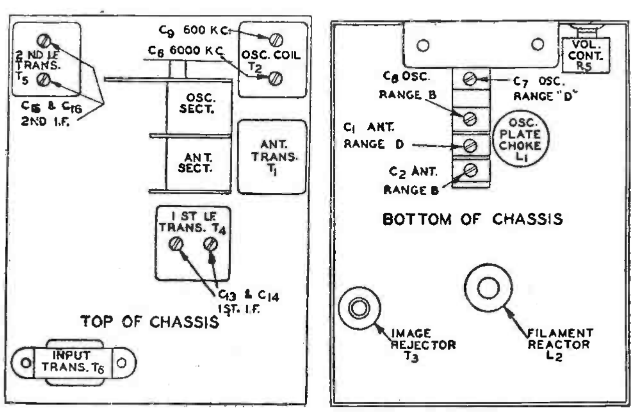


Fig. 2. Chassis views showing trimmer locations.

volt voltmeter with the antenna shorted to the chassis and the volume control turned on full. Actual readings may vary as much as 15 percent from those given. The bias for the 6F6 is —14 volts and is measured across the flexible wire-wound resistor (320 ohms) connected to the high-voltage center tap. The cathode voltage of the 6D6 i-f stage varies with the position of the volume control, from +3 volts for maximum volume to +30 volts for minimum volume.

The signal picked up by the antenna is impressed on the primary of the antenna transformer, which has connected across it a wave trap for the purpose of eliminating 456-kc interference. The signal is then tuned and impressed on the control grid of the 6D6 oscillator and first detector. The suppressor, or No. 3 grid of the 6D6, is used as the oscillator grid. The 456-kc output of the first detector is amplified in the i-f stage, using a 6D6 tube.

The second detector is of the grid leak-grid condenser type, and uses a 6C6 tube. The 6C6 is resistance coupled to the 41 pentode power amplifier. Bias for the output tube is obtained by grid-return connection to the negative end of a resistor connected between the center tap of the power transformer high-voltage winding and ground. The bias potential so obtained is filtered by a resistance-capacity filter.

The volume control is double acting. It simultaneously changes the antenna signal input and the i-f stage bias. Because of the sensitivity of this receiver, and due to the fact that it does not have

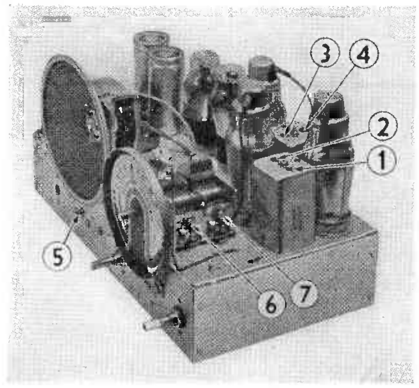


Fig. 2. Trimmer locations.

avc, it requires an antenna that is shorter than usual. The short antenna is particularly necessary where interference from powerful local stations is encountered, and where difficulty is experienced in properly controlling the volume.

When tuning on the short-wave band, local broadcast stations can be heard in the background at their regular positions on the dial. This is a normal condition, and is due to the tapped coil method of tuning the antenna coil secondary to the short-wave band. No aligning adjustments are required on the short-wave band.

Alignment Procedure

For proper alignment of this receiver, an output meter and a high-grade modulated service oscillator are essential. The oscillator should be capable of generating the frequencies of 456 kc, 600 kc and 1400 kc. The test oscillator calibration should be checked, using broadcast station signals as standards. For trimmer adjustment it is advisable to use an all-bakelite screwdriver, although one with a small metal tip may be used.

The following step-by-step routine should be carefully followed. The trimmer numbers referred to are shown in Fig. 2.

I-F Alignment

1. Connect the output meter in series with a 0.25-mfd condenser between the plate of the 41 tube and ground, or across the voice coil, depending on the type of meter.
2. Turn the volume control to the maximum volume position. (Note: The volume control should be kept in this position throughout the entire alignment procedure.) Ground the antenna lead to the chassis.
3. Turn the range switch to the right (clockwise) to the broadcast position.
4. Adjust the test oscillator to exactly 456 kc and connect its output in series with a 0.1-mfd condenser to the control grid of the 6D6 first-detector tube and the chassis.
5. Align i-f trimmers Nos. 1, 2, 3 and 4 for maximum output as indicated on the output meter. No inward or sideward pressure should be applied to the alignment tool, or the condenser may spring back to a different setting as soon as the tool is removed.
6. Repeat all i-f trimmer adjustments since the changing of each trimmer will affect the others to a certain extent.

456-Kc Wave Trap Adjustment

1. Disconnect the antenna lead from ground.
2. Connect the test oscillator output

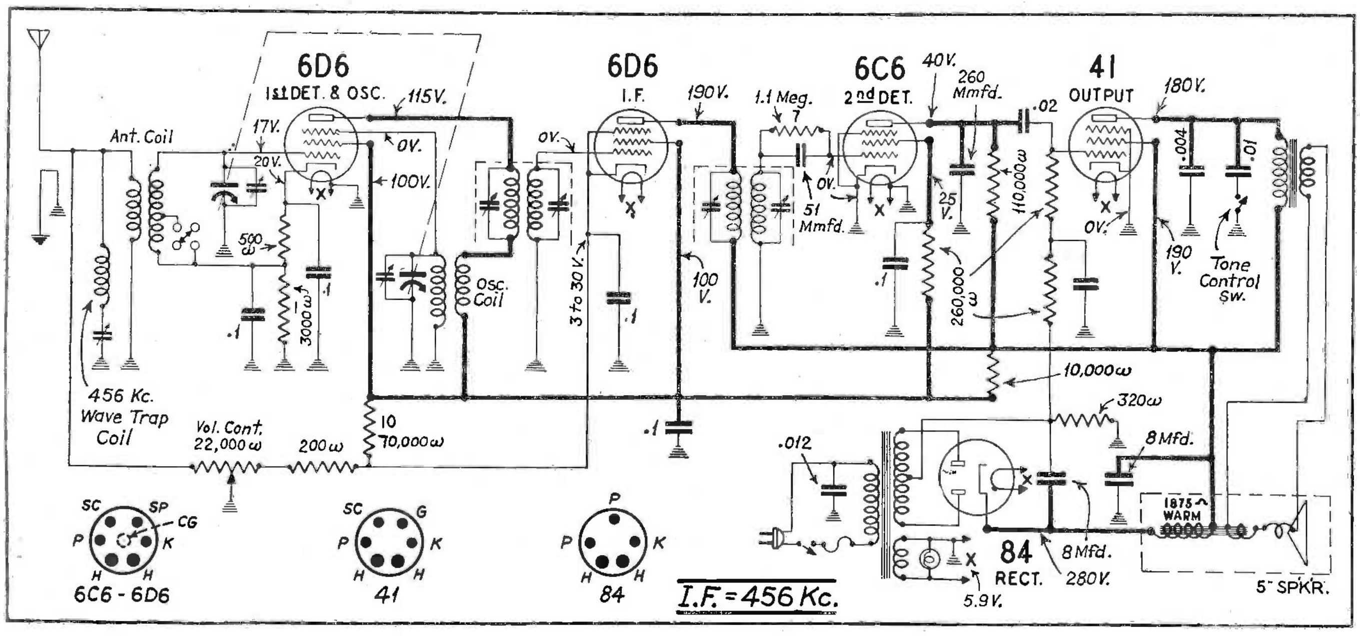


Fig. 1. Stewart Warner R-144AS circuit diagrams.

in series with a 0.00025-mfd condenser to the antenna lead, and connect the test oscillator ground lead to the receiver chassis. Ground the chassis.

3. Without changing the test oscillator from the frequency setting used in aligning the i-f stage, adjust trimmer No. 5 for *minimum* output. Increase the test oscillator output as a minimum is reached, in order to obtain a clearly defined setting of the trimmer. *Note:* If code interference transmitted on a frequency in the neighborhood of 456 kc is troublesome, the wave trap should be adjusted for *minimum* output with the test oscillator set to the same frequency as the signal that is causing interference.

Dial Calibration

If the receiver should require calibration, proceed as follows:

1. Turn the gang condenser to full mesh and check to see that the dial pointer indicates 530 kc. If it does not, remove the dial knob and turn the pointer to the correct position by means of a sharp tool inserted in the pointer slots which may be reached through the dial glass. Replace the dial knob.

2. Adjust the test oscillator to 1400 kc.

3. Turn the condenser gang until the dial pointer indicates 1400 kc.

4. Adjust trimmer No. 6 (oscillator shunt trimmer) for maximum output without changing the setting of the gang condenser.

R-F Alignment

1. Set the test oscillator to 1400 kc and apply the signal to the receiver antenna lead through a 0.00025-mfd condenser.

2. Tune the receiver to the signal for maximum output.

3. Adjust trimmer No. 7 (detector shunt trimmer) for maximum output.

4. Repeat the r-f adjustments.

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Grunow 12A

The Grunow 12A is a 12-tube, 115-volt, 60-cycle, four-band, high-fidelity receiver with tone control, band-spread dial and signal beacon. The frequency range is divided into four bands or divisions, one covering the range from 550 to 1750 kc (green); one the range from 1700 to 5500 kc (orange); one the range from 5.4 to 18 mc (amber), and one the weather band covering the range from 150 to 410 kc (red).

Continuity and voltage readings should be taken from the underside of the chassis. The values given on the schematic diagram are average and allow the Service Man to make a quick check of the chassis constants. The socket layouts given on the schematic show each socket from the underside.

Alignment Procedure

Before aligning the 12A, turn the dial until the condensers are fully meshed. The dial pointer (hour hand) should be on the horizontal line of the dial, pointing to 9 and 3 o'clock. The minute hand should be at 12 o'clock or in a vertical position.

Before any adjustment of circuit constants is attempted, allow the chassis to heat up to normal operating temperature. This heating period should take from 20 to 30 minutes and is necessary to allow all coils and condensers to reach their normal temperatures so that when alignment is completed, there will be no inductance or capacity changes due to thermal expansion or contraction.

It is good to remember this heating condition when logging a station—that is, do not attempt to log or tune in a station previously logged on a cold chassis, as the station being tuned in would drift and the calibration on the previously logged station would be incorrect.

I-F Alignment

(A) Connect signal lead of test oscillator to grid of 6A8 (first-detector tube) through 0.25-mfd condenser. Connect the ground lead to the chassis.

(B) Set dial pointer to 1400 kc and range switch on green (No. 2) position.

(C) Place test oscillator in operation at 455 kc. Turn receiver volume control to maximum and high-fidelity control to position No. 1, which is the maximum selectivity position.

(D) Attenuate test oscillator output to lowest value, consistent with obtaining a readable indication on output meter.

(E) Adjust six i-f trimmers, A1, A2, A3, A4, A5, A6, located on the i-f transformers on top of chassis (Fig. 3) until maximum output is obtained. During alignment, maintain as low a value of signal as will allow obtaining of accurate adjustment.

(F) Turn the on and off switch clockwise to the signal beacon position.

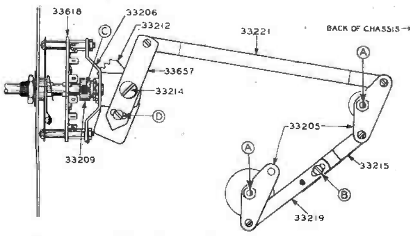


Fig. 2. Mechanical adjustments for i-f transformers.

(G) Adjust signal beacon trimmer (A7) Fig 3, which is located on side of i-f transformer (near dial) to zero beat with the 455 kc incoming signal.

R-F Alignment

175-kc alignment:

(A) Connect signal lead of test oscillator through 200-mmfd condenser to antenna binding post on chassis.

(B) Connect the test oscillator ground lead to the ground post of chassis.

(C) Place test oscillator in operation at 175 kc.

(D) Place high-fidelity control in position No. 2.

(E) Turn range switch to red (No. 1) position.

(F) Tune in signal to maximum (this point does not have to be exactly at 175-kc dial setting).

(G) Adjust the 175-kc padding condenser (A8) Fig. 4 (which is on rear of chassis) in direction of signal increase. At same time rock the tuning condenser back and forth through resonance while adjusting padding condenser until maximum output is obtained.

350-kc alignment:

(A) Place test oscillator in operation at 350 kc.

(B) Turn dial pointer to 350 kc.

(C) Turn range switch to red (No. 1) position.

(D) Place high-fidelity control in position No. 2.

(E) Adjust weather band oscillator trimmer (A9), Fig. 4, to maximum output.

(F) Adjust detector trimmer (A10) Fig. 4, to maximum output.

(G) Adjust antenna trimmer (A11), Fig. 4, to maximum output.

Recheck 175-kc padder condenser.

1400-kc alignment:

(A) Place test oscillator in operation at 1400 kc.

(B) Turn dial pointer to 1400 kc.

(C) Turn range switch to green (No. 2) position.

(D) High-fidelity control remains in No. 2 position.

(E) Adjust broadcast oscillator trimmer (A12), Fig. 4, to maximum output.

(F) Adjust first detector trimmer (A13), Fig. 4, to maximum output.

(G) Adjust antenna trimmer (A14), Fig. 4, to maximum output.

600-kc alignment:

(A) Place test oscillator in operation at 600 kc.

(B) Tune in signal to maximum (this point does not have to be exactly at 600-kc dial setting).

(C) Adjust the 600-kc padding con-

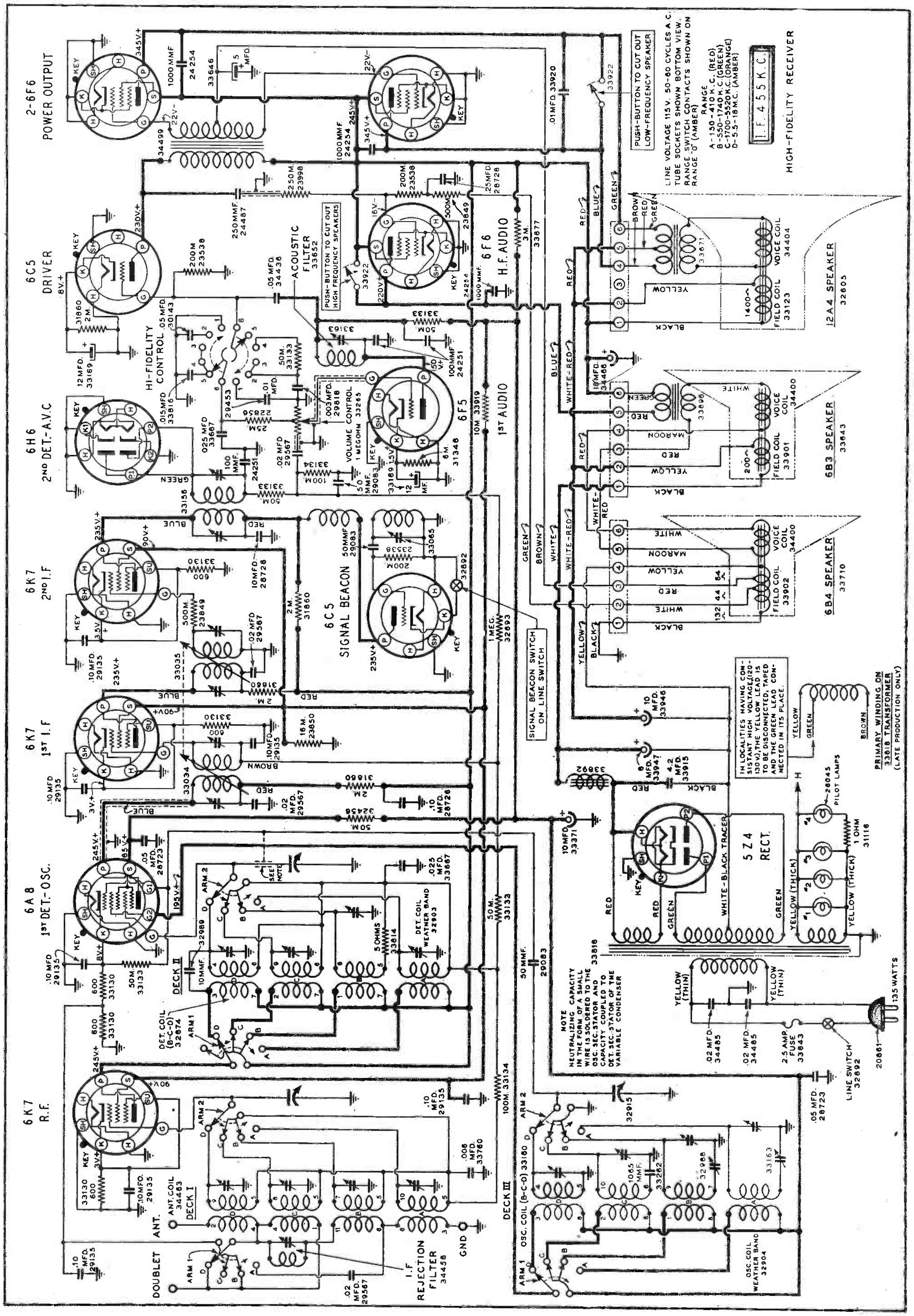
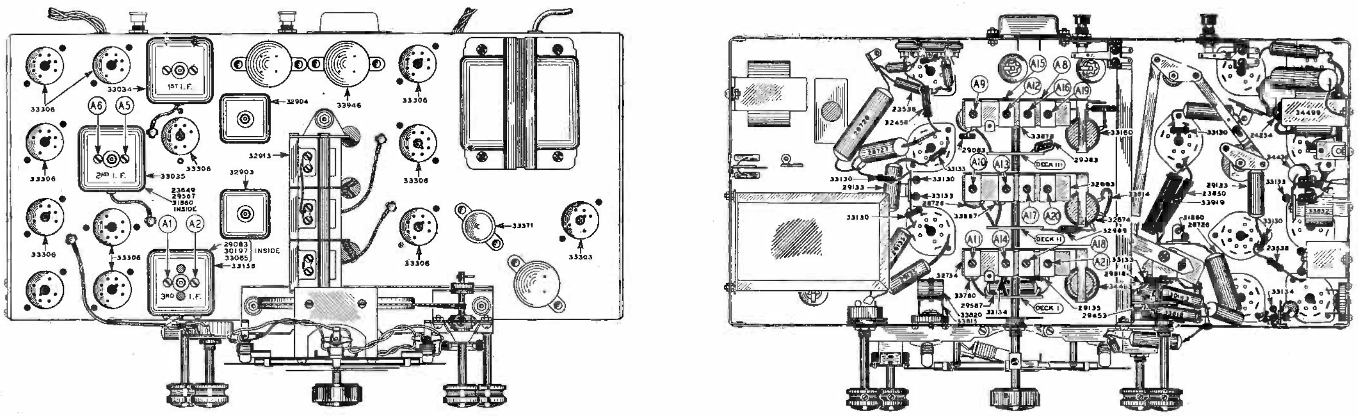


Fig. 1. Grunow 12A circuit diagram.



Figs. 3 and 4. Tube and trimmer locations.

denser (A15), Fig. 4, which is on rear of chassis, in direction of signal increase. At same time rock the tuning condenser back and forth through resonance while adjusting padding condenser until maximum output is obtained.

Recheck 1400-kc alignment.

5000 *kc alignment:*

(A) Set range switch to orange (No. 3) position.

(B) Place test oscillator in operation at 5000 kc.

(C) Turn dial pointer to 5000 kc.

(D) Adjust set oscillator trimmer (A16), Fig. 4, to maximum output.

(E) Adjust detector trimmer (A17), Fig. 4, to maximum output.

(F) Adjust antenna trimmer (A18), Fig. 4, to maximum output.

18-*mc alignment:*

(A) Connect signal lead of test oscillator through 400-ohm resistor to antenna binding post of chassis.

(B) Connect the ground lead to ground terminal of chassis.

(C) Set range switch to amber (No. 4) position and turn dial pointer to 18 mc.

(D) Place test oscillator in operation at 18 mc.

(E) Adjust set oscillator trimmer (A19), Fig. 4, to maximum output.

(F) Adjust detector trimmer (A20), Fig. 4, to maximum output.

(G) Adjust antenna trimmer (A21), Fig. 4, to maximum output.

(H) On the 18-mc oscillator alignment will be noted that there are two settings at which the signal will be received. Use the lower of the images for alignment point, that is, the setting giving most capacity or the point at which the trimmer screw is farthest in.

Alignment of i-f rejector filter circuit:

Due to interference caused by commercial code stations operating on wave lengths near the frequency at which the i-f amplifiers of this receiver are aligned, an i-f filter has been incorporated in the antenna circuit to act as a rejector system, thereby lessening the possibility of this form of interference entering the receiver.

The filter should be tuned to the same frequency as the i-f transformers, and this operation should be performed after the set has been completely aligned.

(A) Connect signal lead of test oscillator to antenna binding post through a 200-mmfd condenser.

(B) Connect ground lead to ground terminal of chassis.

(C) Set dial pointer to 1400 kc and range switch on green (No. 2) position.

(D) Place test oscillator in operation at 455 kc—turn receiver volume control to maximum and high-fidelity control to No. 2 position.

(E) Attenuate test oscillator output so that a fairly strong signal is applied, and tune filter condenser (A22) Fig. 3, so that the output meter indicates a minimum reading.

Tuning acoustic filter:

The i-f system of a high-fidelity receiver is expanded or broadened so that audio frequencies of the higher musical range will be passed through the selective circuits. It is desirous to pass audio frequencies only up to a value of 10,000 cycles, so that the entire musical range may be reproduced, at the same time frequencies above this value must be cut off—so that station noises and atmospheric disturbances are not admitted to the speaker system.

An acoustic filter is incorporated in this chassis, that may be tuned so that frequencies above 10,000 cycles are excluded. This filter is tuned as follows:

(A) After all other adjustments are completed, apply a 10,000 cycle note, produced by an audio oscillator or phonograph frequency record, connecting one of the signal leads to the grid of the 6F5 (first a-f tube) and the ground lead to the chassis.

(B) Set high-fidelity control to maximum (No. 6) position.

(C) Attenuate audio signal so as to obtain a good reading on the output meter.

(D) Tune acoustic filter condenser (A23), Fig. 3, until a *minimum* output is indicated on the output meter.

Speaker System

The 12A chassis is designed to work into a triple speaker system. This complete system consists of a dual audio arrangement wherein a two-channel audio amplifier is used—one channel, comprising a 6F6 tube coupled to two small speakers, reproduces the high notes of the musical range and the other channel, comprising two types 6F6 tubes in push-pull coupled to a large speaker, reproduces the low and middle register of the musical range. If it becomes necessary to replace or change any part of the speaker system, care should be taken to see that the polarity of all transformers, voice coils and tube connections remain as originally connected, otherwise there is a possibility of the speakers working out of phase, causing one of the speakers to cancel out certain frequency responses of the other.

To determine whether the speakers are in phase—short out the voice coil on the large speaker and reverse the voice coil leads on one of the small speakers, connecting the lead on the small speaker in the position of strongest and best response. Then with the large speaker working with the two small speakers, change the polarity of the large speaker voice coil, connecting it in the position of strongest and best response.

When making this test is a good idea to have the receiver tuned to a good musical broadcast program.

Technical Features of 1937 RCA Radio Receivers••

Model No.‡	4X	4X3	4X4	5X	5X3	5X4	7X	4T	5T	6T	6K	6T2	6K2	7U*	7T	7K	8T	8K	9T	9K2	9U*	9U2*	9K	10T	10K	15K	D22-A†	6BT	6BK	6BT6	6BK6	8BT	8BK	8BT6	8BK6
Cabinet	T	T	T	T	T	T	T	T	T	T	Ce	T	Ce	Ce	T	Ce	T	Ce	T	Ce	Ce	Ce	Ce	T	Ce	Ce	Ce	T	Ce	T	Ce	T	Ce	T	Ce
Line Supply	110V. AC/DC			110V. AC/DC			110V. AC/DC	110V. A.C.	110V. A.C.	110V. A.C.		110V. A.C.			110V. A.C.				110V. A.C.				110V. A.C.	110V. A.C.		110V. A.C.		Battery				Battery			
Phono. Terminals							Yes		Yes	Yes		Yes			Yes				Yes				Yes	Yes		Yes		Yes				Yes			
Range (Kc.)	540-1720			540-1800 1800-6500			530-1800 1800-6400 6400-22,000	540-1720	540-1800 1800-6600	540-1800 1800-6600		540-1625 1625-5700 5700-18,000			530-1800 1800-6400 6400-22,000				150-60,000				150-22,000	150-60,000		150-60,000	140-60,000	520-1900 5600-22,000				530-22,000			
Dual Speed Dial							Yes					Yes			Yes				Yes				Yes	Yes		Yes		Yes				Yes			
Line Watts	55			60			50	50	80	80		85	85	95	80				120				95	120		165	—	—				—			
Undistorted Output Watts	0.3			0.4			0.6	1.75	2	2		2			2				5				2	5		20		1.2				1.2			
I.F. Peak (Kc.)	460			460			460	460	460	460		460			460				460				460	460		460		460				460			
Dynamic Sp'k'r	5"			5"			8"	6"	8"	8"	12"	8"	12"	12"	8"	12"	8"	12"	8"	12"	12"	12"	12"	8"	12"	12"	(2) 12"	8"	12"	8"	12"	8"	12"	8"	12"
Tone Control							2 Point		2 Point	Continuous		Continuous			Continuous				Continuous				Cont.	Cont.		Cont.		Continuous				Continuous			
Selectivity-Fidelity Switch																								Yes		Yes									
Magic Eye												6E5					6E5		6E5				6E5	6E5		6E5									
Magic Voice																			Yes						Yes	Yes	—								
Variable Condensers	2			2			2	2	2	2		2			2				3				3	3		3		2				2			
Number of Tuned Circuits	5			5			6	5	6	6		6			6				7				7	9		9		6				8			
Doublet Terminal Board							Yes								Yes				Yes				Yes	Yes		Yes		Yes				Yes			
Magic Brain																			Yes				Yes	Yes		Yes									
R.F.																			6K7				6K7	6K7		6K7									
1st. Det.	6A7			6A7			6L7	6A7	6A7	6A8		6A8			6L7				6L7				6L7	6L7		6L7		1C6				1A6			
Oscillator							6J7								6J7				6J7				6J7	6J7		6J7						1B4			
Intermediate Frequency	6F7			78			6K7		6D6	6K7		6K7			6K7				6K7				6K7	(2) 6K7		(2) 6K7		1A4				(2) 1A4			
2nd. Det.							6H6	6B7	75	6H6		6H6			6H6				6H6				6H6	6H6		6H6	6H6 & 6K7								
A.V.C.				75																								1F6				1F6			
1st. Audio							6J7			6F5		6F5			6F5				6F5				6F5	6F5		6C5	6C5								
2nd. Audio																										6C5		30				30			
Output	43			43			25A6	41	42	6F6		6F6			6F6				6L6				6F6	6L6		(2) 6L6	(4) 2A3	(2) 49				(2) 49			
Rectifier	25Z5			25Z5			25Z6	1V	80	5Z4		5Z4			5Z4				5Z4				5Z4	5Z4		(2) 5Z4	(2) 5Z3								
A F C																										6K7 6H6									

* Phono. combination † Volume expander ‡ T = Table Ce = Console NOTE: All 110 V. A.C. sets available for 220 V. or for 25 cycle operation

Bosch 605-605C

These models are five-tube, two-band superheterodyne receivers employing a type 6A8 tube as a combination first detector-oscillator, a type 6K7 as a first i-f amplifier, a type 75 as a combination second detector—avc—first audio amplifier, a type 6F6 as an output amplifier and a type 5Y3 as a rectifier. They are designed to operate over two bands on frequencies from 545 to 1725 kc and 2100 to 7200 kc.

The model 605 is a table model, while the model 605C is a console model using a larger speaker.

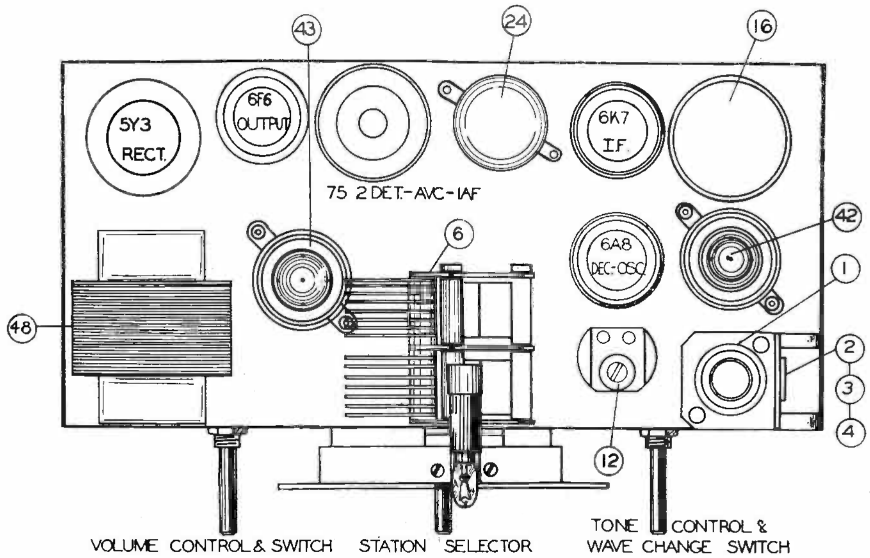


Fig. 2. Tube and trimmer locations.

Alignment Procedure

To align the circuits of this receiver it is essential to use a high-grade modulated test oscillator, the output of which can be continuously varied with absence from overload when the individual circuits of the receiver are brought into alignment.

A conventional output meter can be connected across the terminals of the speaker voice coil to indicate when the circuits are aligned. The sensitivity of the output meter must be sufficient to give satisfactory reading with a low input signal.

Before attempting to align the receiver, the Service Man should familiarize himself with the general layout of the chassis, the location of the tubes and various alignment condensers. Top and bottom views of the chassis are shown in Figs. 2 and 3 and should be carefully

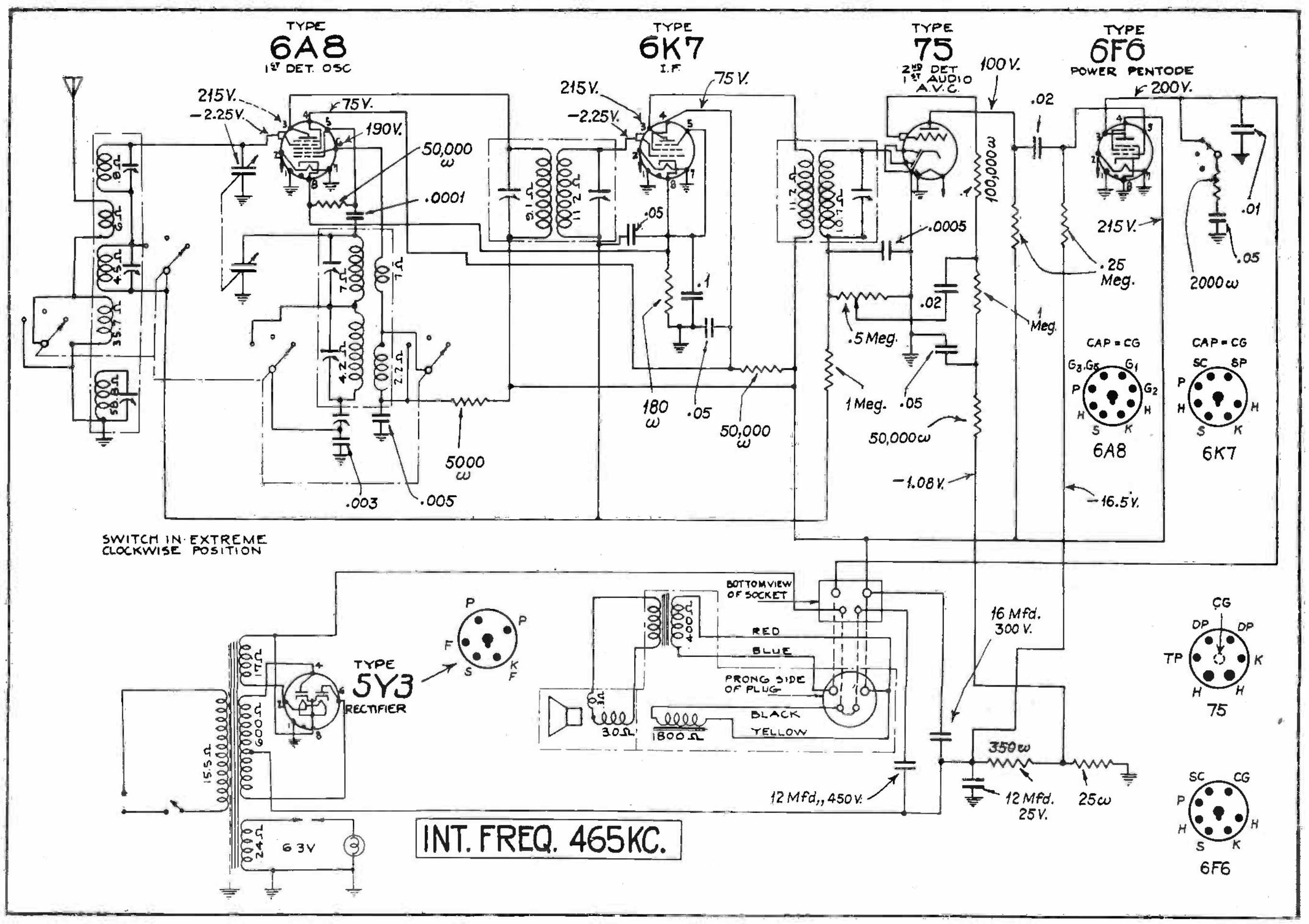


Fig. 1. Bosch 605-605C circuit diagram.

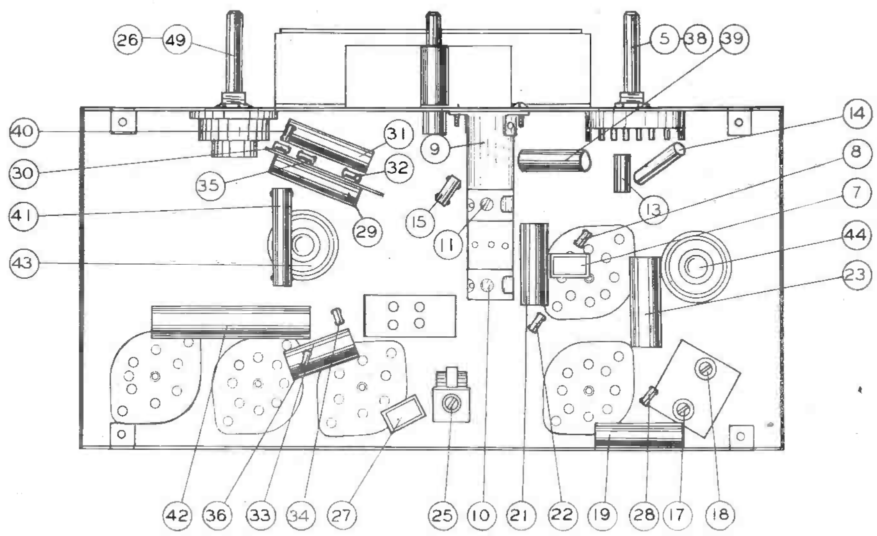


Fig. 3. Bosch 605-605C trimmer locations.

studied before the actual work is started.

I-F Alignment

1. Connect the output meter to the terminals of the speaker voice coil.
2. Set the volume control to maximum position and tone control to treble.
3. Apply the test signal to the grid of the type 6K7 i-f tube through a 0.1-mfd. blocking condenser.
4. Adjust trimmer condenser 25 to maximum output.
5. Apply the test signal to the grid of the type 6A8 first detector-oscillator tube and adjust trimmer condensers 17 and 18 to maximum output.

Broadcast-Band Alignment

1. Apply test signal to antenna lead and with a strong input signal adjust wave trap trimmer condenser 4 to minimum output.
2. Apply test signal to the antenna lead through a 0.0002-mfd condenser.
3. Set test oscillator and dial indicator to 1,700 kc and adjust oscillator trimmer condenser 11 until the signal is received.
4. Adjust preselector trimmer 3 to maximum output.
5. Set test oscillator and dial indicator to 600 kc and adjust oscillator series condenser 12 to maximum output.
6. Return both test oscillator and dial indicator to 1,700 kc and check adjustment of oscillator and preselector trimmer condensers.

Short-Wave Alignment

1. Turn the wave-change switch to the short-wave position.
2. Set the test oscillator and dial indicator to 6000 kc, and adjust oscillator trimmer condenser 10 until the signal is received.
3. Adjust the preselector trimmer condenser 2 to maximum output.
4. Check the receiver over scale for sensitivity and calibration.

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G. E. E-71, E-72 and E-76

Models E-71, E-72 and E-76 employ 7 metal envelope tubes to perform the functions indicated in Fig. 1 in a superheterodyne circuit, giving the selectivity and sensitivity inherent in this type circuit. The "B" and "C" band coils are wound on a common form, while the "D" band coils have individual forms. Two watts of undistorted output is obtained through diode detection and 2 audio amplifier stages.

The complete range from 540 to 18,000 kc is covered in three bands. A circuit diagram is given in Fig. 1 with the tubes used and their functions lettered on the diagram. The voltages given in Fig. 2 were measured with a 1,000-ohm-per-volt voltmeter with the antenna shorted to the ground and the volume control turned on full. Actual values may vary as much as 20 percent from those given.

The Circuit

The signal from the antenna is applied to the control grid of the 6A8 converter tube through the antenna coil, the secondary of which is tuned to the incoming signal by the rear section of the main tuning condenser. The secondary of the coil for the band next lower in frequency to the one in use is short-circuited through a capacitor to prevent absorption of energy at its resonant frequency which falls in the next higher band. (Note: On the schematic diagram, Fig. 1, the center portion of the waveband switch supporting the two shorting lugs rotates simultaneously with the four contact pins.) In the 6A8 tube the incoming signal is combined with the local oscillator signal which is 465 kc different in frequency. The local signal is generated by the oscillator elements of this tube and the proper frequency difference is maintained throughout the tuning range by the front section of the main tuning condenser in conjunction with the oscillator coil and padding capacitors.

The combination of the signal frequency with the local oscillator frequency in the converter tube produces

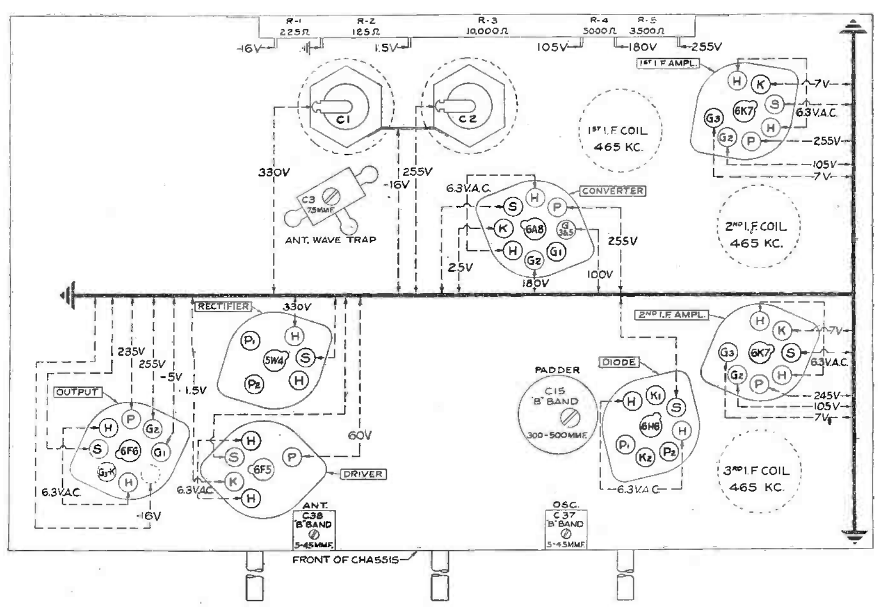


Fig. 2. G. E. E-71, E-72 and E-76 tube and trimmer locations.

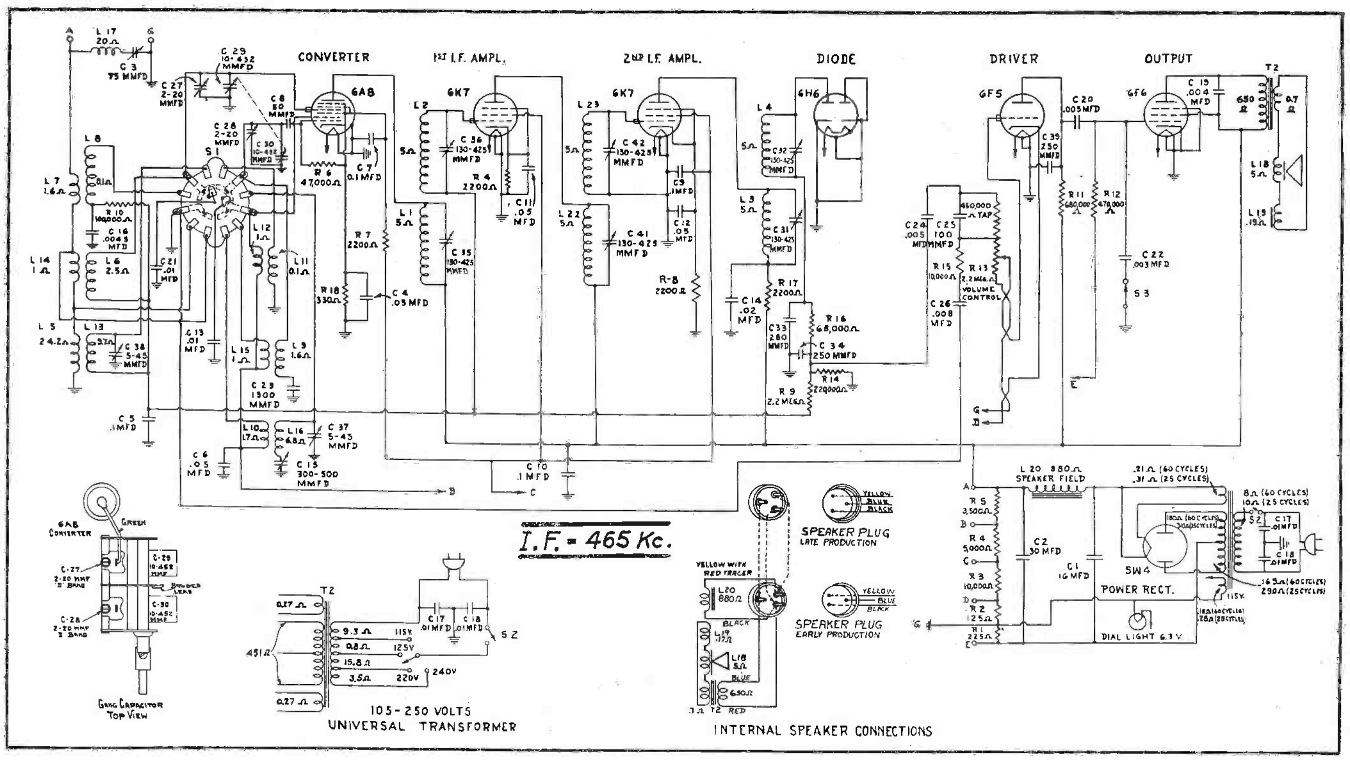


Fig. 1. General Electric E-71, E-72 and E-76 circuit diagram.

the intermediate frequency of 465 kc. This particular intermediate frequency is chosen to reduce image response and improve short-wave performance. The intermediate-frequency amplifier consists of two 6K7 tubes and three transformers, each with two tuned circuits.

The output of the i-f amplifier is applied to the 6H6 diode rectifier, which is a combined detector and automatic volume control tube. The direct current component of the rectified signal produces a voltage drop across R-14. This voltage drop provides automatic bias for the r-f and i-f amplifier and converter tubes and so gives automatic volume control action. Full automatic bias voltage is applied to the pentagrid converter tube and to the first i-f amplifier tube. The second i-f tube is operated on self-bias, obtained by the drop through R-8. This enables the second i-f tube to provide maximum power to the 6H6 diode rectifier.

The manual volume control, R-13, selects the amount of audio signal applied to the grid of the 6F5 audio amplifier tube and this regulates the output of the receiver. The output of the 6F5 tube is resistance coupled to the grid of the 6F6 power amplifier pentode. The plate circuit of the 6F6 is suitably matched to the loudspeaker by means of a step-down output transformer.

The tone control circuit consists of a 0.003-mfd capacitor connected in series with a grounding switch S-3 in the grid circuit of the 6F6 output tube. When it is desired to reduce the high-frequency output of this receiver the switch S-3 is closed to ground.

Plate and grid voltages for all tubes are supplied by the power supply system employing a 5W4 full-wave rectifier tube which, together with a suitable network of resistors and capacitors, supplies the required voltages and filtering action.

Alignment Procedure

The receiver should first be allowed to run for fifteen minutes in order to reach its approximate normal operating temperature. Before making any adjustments, it is wise to determine the correctness of the existing alignment.

The location of all trimmer capacitors, as well as socket voltages to chassis, is shown in Fig. 2.

I-F Alignment

Set the frequency band switch of the receiver to band "B," short-circuit the antenna and ground terminals and tune the receiver at some point above 1500 kc so that no signal is heard. Set the volume control at its maximum position and ground the chassis.

The i-f amplifier is tuned to 465 kc; set the test oscillator dial at this frequency. Connect the test oscillator output between the converter tube (6A8) control grid and chassis. Connect the output meter across the cone coil of the speaker and adjust the test oscillator output control so that, with the receiver volume control at maximum, a small deflection is observed on the output meter. During both i-f and r-f alignment, the test oscillator signal should be maintained at the lowest level that will give a good readable output indication.

Adjust the secondary trimmer of the third i-f transformer until a maximum output reading is obtained. Maintain a small deflection on the output meter throughout alignment by adjusting the test oscillator output. Next, adjust the primary trimmer of the third i-f transformer for maximum output. Continue this procedure, adjusting the secondary and primary trimmers, respectively, of the second i-f transformer. The secondary trimmer of the first i-f transformer may then be adjusted and, lastly, the primary trimmer of the first i-f transformer. After completing this procedure, repeat it a second time for final alignment. The i-f alignment will then be complete.

Wave-trap alignment: After completion of the i-f alignment, with the test oscillator still set on 465 kc, apply this frequency to the antenna post of the receiver through a dummy antenna. This dummy antenna consists of a 400-ohm resistor in series with a 250-mmfd capacitor and should be connected in series between the test oscillator output and the receiver antenna post. With the 465-kc signal applied to the receiver antenna post, adjust the i-f wave-trap trimmer for *minimum* output indication.

R-F Alignment

First of all, check the position of the dial pointer. To do this, rotate the gang condenser to the maximum capacity position, i. e., plates fully meshed. While in this position, align the pointer with the last black line on the scale by loosening the dial drum set screws and rotating the drum on the gang shaft. Make sure the antenna and ground terminals of the receiver are not short-circuited and connect to them the output of the test oscillator, preferably using the dummy antenna described above between the test oscillator and the receiver antenna terminal. Connect the output indicator across the speaker cone coil.

"D" band (5.6-18.0 *mc*): Because of the r-f circuit used in this receiver, the "D" band must be aligned first. Set the frequency band switch to the "D" band position by rotating it to its most clockwise position. Tune the test oscillator to 18,000 kc (18 mc) and set the dial pointer on the receiver at this frequency. Adjust the "D" oscillator trimmer, located on the front section of the gang condenser, for maximum output. (Note: The oscillator operates on the *low-frequency* side of the incoming signal; therefore adjust the trimmer until the second oscillator peak is reached as the trimmer is *increased* in capacity. A check for the correctness of this adjustment may be made by rotating the gang to the 17,070 kc calibration mark. If, with increased input from the test oscillator, no signal is detected, the correct oscillator peak has been used.) Keep the receiver volume control at its extreme clockwise position and adjust the test oscillator output to maintain a small reading on the output indicator. When the optimum adjustment on the oscillator trimmer has been obtained, adjust the "D" band antenna trimmer on the rear section of the gang for maximum output while rocking the tuning condenser through the signal.

"C" band (1.56-5.80 *mc*): No separate trimmers are provided for adjustment of this band. The correct adjustment of the "D" band and "B" band automatically aligns the "C" band. The adjustment procedure for the "B" band follows immediately.

"B" band (540-1600 *kc*): Set the frequency band switch to the broadcast position. Rotate the gang condenser until the dial pointer indicates the 1500-kc calibration point, and adjust the test oscillator to this frequency. The "B" band trimmers are located underneath the chassis. (See Fig. 2.) Adjust the broadcast oscillator trimmer for maximum output. This trimmer is the one nearest the volume control. When the oscillator has been peaked, adjust the antenna trimmer for maximum output. Here again, as pointed out previously, it is necessary to maintain a small r-f input from the test oscillator to avoid erratic action of the output indicator due to automatic volume control action.

Now set the test oscillator at 580 kc and tune the receiver to that frequency. Slowly rocking the tuning condenser back and forth through the signal, adjust the 580-kc padding capacitor for maximum output. When this has been done, return to 1500 kc on the receiver and test oscillator and recheck the alignment at that frequency for maximum output. The broadcast band should now be in alignment.

•

Sound-projecting System

One of the largest and most powerful sound-projecting system ever constructed was installed at Roosevelt Raceway at Mineola, L. I., New York, where Roosevelt Airport No. 1 used to be. The equipment is intended to be used for announcements of automobile racing events and to provide music and entertainment originated by artists in the studio on the premises.

This new Western Electric sound system is designed to cover the entire one-half square mile expanse from a single source. The system is a development of Bell Telephone Laboratories, and the equipment is being furnished and installed by the Guided Radio Corporation, as agent for the Graybar Electric Co.

•

CONVERTING A-C, D-C RECEIVERS FOR THE 25B5

(*Continued from page* 475)

ply identified as set "A," as converted by the Triad engineering department for the 25B5. Before being converted, this set used a 43 with a self-bias of 650 ohms. A tap on the 650-ohm resistor provided the bias for the 75 voltage amplifier. There was no separate filter on the 75 bias voltage, but a plate filter of 50,000 ohms and 0.1 mfd was used. To prevent using an extra electrolytic by-pass condenser for the 6Q7G bias in the conversion, this plate filter was retained and a fixed grid bias for the 6Q7 of 1.4 volts was obtained by the 125,000-ohm and 1500-ohm resistors, with only a 0.25-mfd paper condenser as shown in the circuit. A 40-mfd filter condenser, a 200-ohm filter choke and an output transformer whose primary had a resistance of 125 ohms were used.

Fig. 5 shows the circuit of another leading manufacturer's a-c, d-c set, identified as set B, as converted for the 25N6G. This set used a bias cell for the 6Q7 grid bias voltage. This set, as converted, also used a 200-ohm filter choke, but had an output transformer whose primary had a resistance of 220 ohms. Because of this primary resistance set B had higher distortion than set A. The power output of both sets was about the same because set A had a speaker field resistance of 2,500 ohms while set B had a speaker field resistance of 3,000 ohms, and this higher field resistance increased the voltage output from the 25Z6G enough to make up for the increased output transformer resistance.

Fig. 6 shows the circuit of another set, identified as set C, converted for the 25B5. In this circuit a fixed bias was supplied for the 6Q7 by the drop across a 20-ohm resistor in the negative lead of the plate supply. A ½-meg resistor and a 0.25-mfd condenser filter this voltage drop enough for the 6Q7. Measurements taken on this set with a 6Q7 cathode resistor of 6,000 ohms shunted by a 1.0 mfd condenser, instead of the 20-ohm bias resistor, gave the same results. The output transformer in this set had a resistance of 164 ohms.

Fig. 7 shows the circuit used on another set, designated as set D, which was converted for the 25B5. For this conversion, the manufacturer did not want to use very special parts, so a choke of 250 ohms and an output transformer of 200 ohms were used. Even with these compromises, the set delivers over twice the power of the 43 at the same distortion.

•

Screwdrivers

Service Men have trouble adjusting all-wave radio receivers due to the fact that their adjusting screwdriver is magnetic. Many of the tools on the market today, used for this purpose, contain iron.

By making their own screwdriver, using a piece of phosphor-bronze (a piece of a battery clip) and fastening it in the bakelite rod with a brass pin, you have a tool that will not detune the coil when inserted to adjust the condenser. *RCA Service Tip File.*

ON THE JOB . . .

Replacing Speaker Cones

Three methods have been used in the past to fasten the speaker cone to the cone frame. 1. Screws through the rim of the cone; 2. A rim clamp; 3. Cementing the cone to the cone frame.

When replacing a cone that has been fastened with screws, use the screws if screw holes are provided in the replacement cone. If there are no holes in the rim of the replacement cone, cement the cone rim to the cone frame, using quick drying household cement.

When replacing the cone in the rim clamp type speaker, re-use the rim clamp

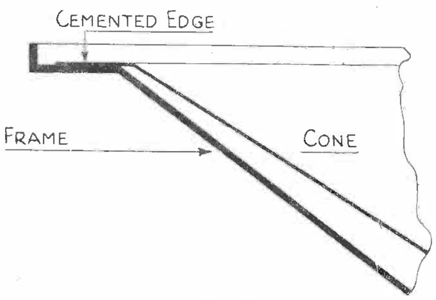


Fig. 1.

whenever possible. If the clamp or any of the clamping ears have been damaged cement the cone in place.

When replacing a cone that has been cemented to the cone frame, all traces of the cone and cement must be cleaned from the surface of the frame before cementing in the new one. Replacement cones are usually made with a heavy cardboard or fiber reinforcing ring around the rim of the cone. This protects them while handling and helps them retain their proper shape.

Figs. 1 and 2 show, in a general way, how the replacement cones should be applied. Fig. 3 shows how the voice coil should be centered in the armature gap.

Make three spacers from regular bond letterhead paper. The spacers should be approximately ten inches long and one-eighth inch wide. Fold each one sharply in the middle. This will then make the spacers approximately five inches long and .008-inch thick. Fold the spacers again to make them "L" shaped, so that they can be placed in the armature gap without falling in. The paper spacers must be placed approximately 120 degrees apart.

When cementing in a replacement cone, spread an even coat of household cement over the face of the speaker frame. Set the cone in place with the voice coil in the armature gap. The paper spacers will insure proper clearance for the voice coil on all sides. Tighten the centering screw and firmly press down the edges of the cone, so that they will be cemented securely. Allow the cement to dry thoroughly and remove the paper spacers.

In case the openings in the back of the speaker cone frame are covered with black crinoline to keep out dirt and other foreign matter, it is not necessary to remove the crinoline in order to remove the paper spacers.

With a razor blade or a sharp penknife, slit the crinoline just enough to permit the paper spacers to pass through the crinoline. Use long spacers and thread them through these slits. One end of the spacers should be in the armature gap, as shown in Fig. 3, the other end should protrude through the crinoline far enough so that the paper spacers can be withdrawn after the cone is secured in place.

Philco Transitone Service Broadcast

•

Making Electrical Contact With Aluminum

In making connection to aluminum some difficulty is involved because of

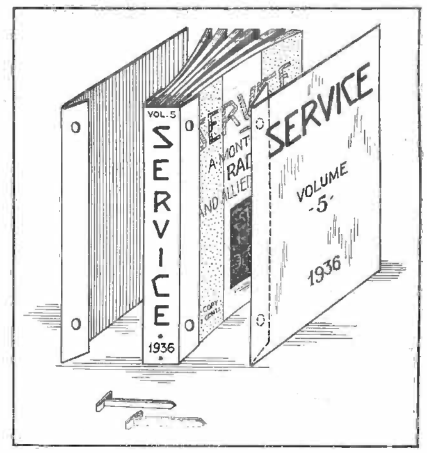
the high-resistance oxide that forms on the surface almost immediately upon exposure to the atmosphere. It is usually advisable to run a length of bus bar from one end of the chassis to the other and ground each end. A self-tapping screw, similar to the one shown in the accompanying illustration, can be used to fasten a loop or lug on the ends of the bus bar. The holes used should be slightly smaller than the screw used to assure a tight fit.

The surface between the threads and the hole is never exposed to the air and hence forms an uncorroded contact.

•

Binder for SERVICE

A simple cover for binding the individual issues of SERVICE into one vol-



ume may be made in the manner indicated in the accompanying illustration. Two hard covers slightly larger than the magazine are cut from cardboard, fibre or some similar material. On one end of each a narrow strip, about ½ inch wide, with holes as indicated, is attached using a flexible binding tape. A third section, wide enough to cover the twelve issues, also has two narrow strips attached.

When the covers are completed holes should be punched in the individual issues of SERVICE, their position matching those in the covers. The volume can be assembled as shown by means of two large paper clips. The name, SERVICE, and the volume number can then be lettered on the outside and end of the binder.

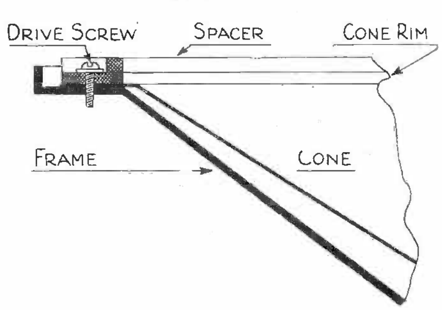
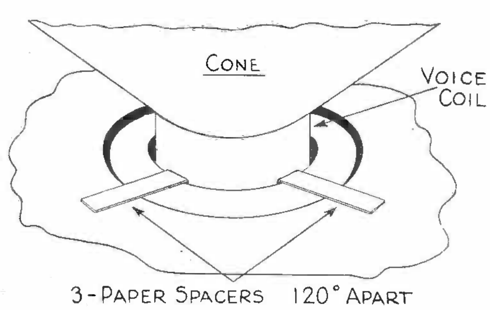


Fig. 2 (left) shows how the replacement cone should be applied.

Fig. 3 (right) shows how the voice coil should be centered in the armature gap.



Forget Temperature Troubles

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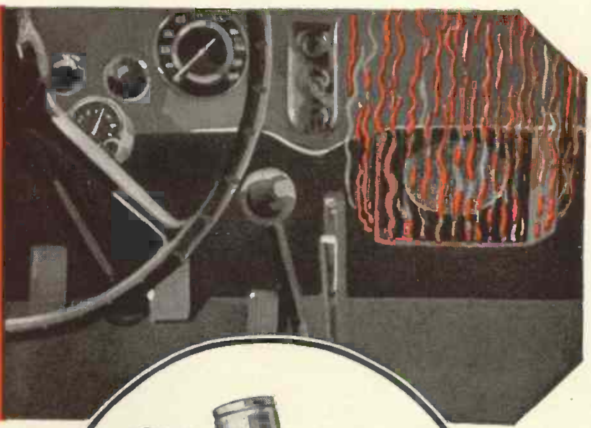

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Twelve pages of The Mallory Replacement Condenser Manual (reading time; 20 minutes) tell you how to do those tough jobs with simple, easy effectiveness—Show you how to use the Mallory Universal Application method to gain profits and save time. If you haven't received a copy, write us today and we'll send you one by return mail. You cannot afford to be without it.

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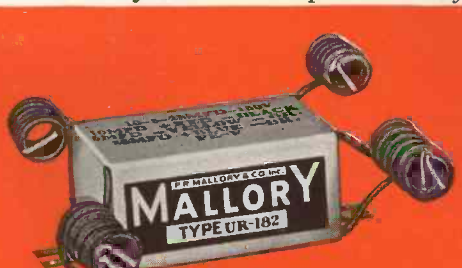
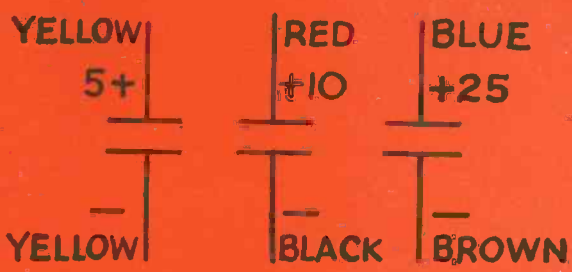


UR 182



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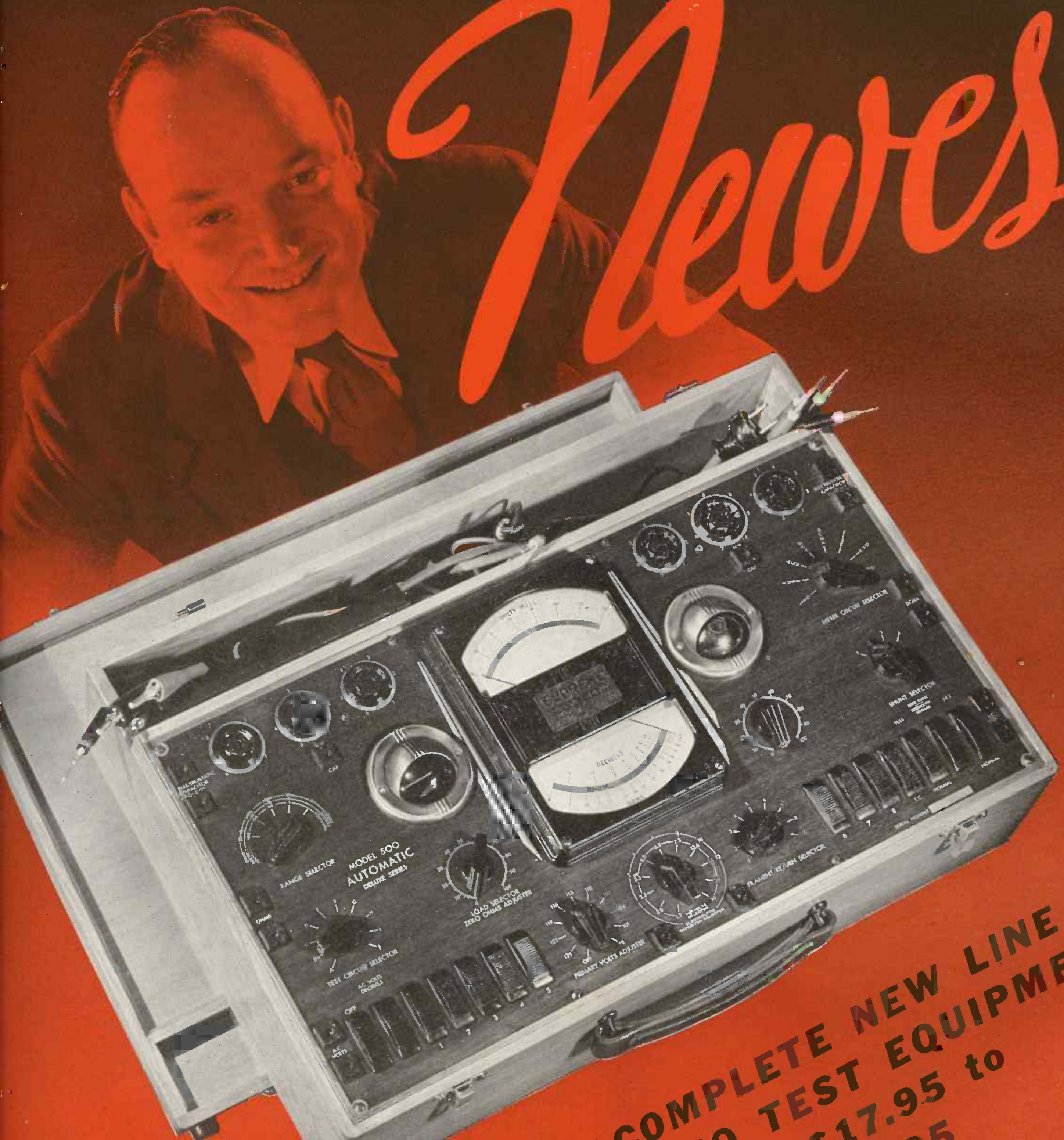

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Auto-Radio . . .

Zenith 6-M-92

The Zenith model 6-M-92 is a 6-tube auto-radio receiver employing a superheterodyne circuit and metal or metal-glass tubes. A circuit diagram is given in Fig. 1 showing the tubes used, their functions and the various voltages encountered on the socket prongs. These voltages were measured with a 1000-ohm-per-volt voltmeter with the input battery voltage at 6 volts. The volume control was on maximum and the antenna shorted to the chassis. The total current consumption at 6 volts is 6 amperes. The receiver is designed to cover the broadcast band from 535 to 1600 kc and is capable of delivering 1 watt of audio power with a signal input of only 4 microvolts. The maximum undistorted power output is 4 watts.

Alignment Procedure

Connect the output meter across the primary terminals of the speaker transformer. The volume control should be in the maximum position throughout the alignment procedure. See Fig. 2 for location of trimmers.

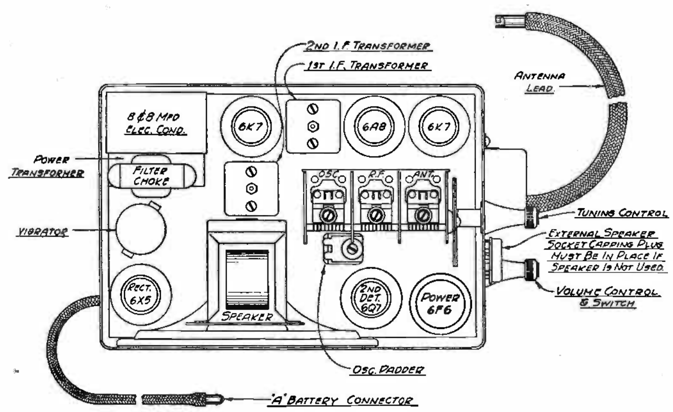


Fig. 1. Chassis view showing tube and trimmer locations.

I-F Alignment

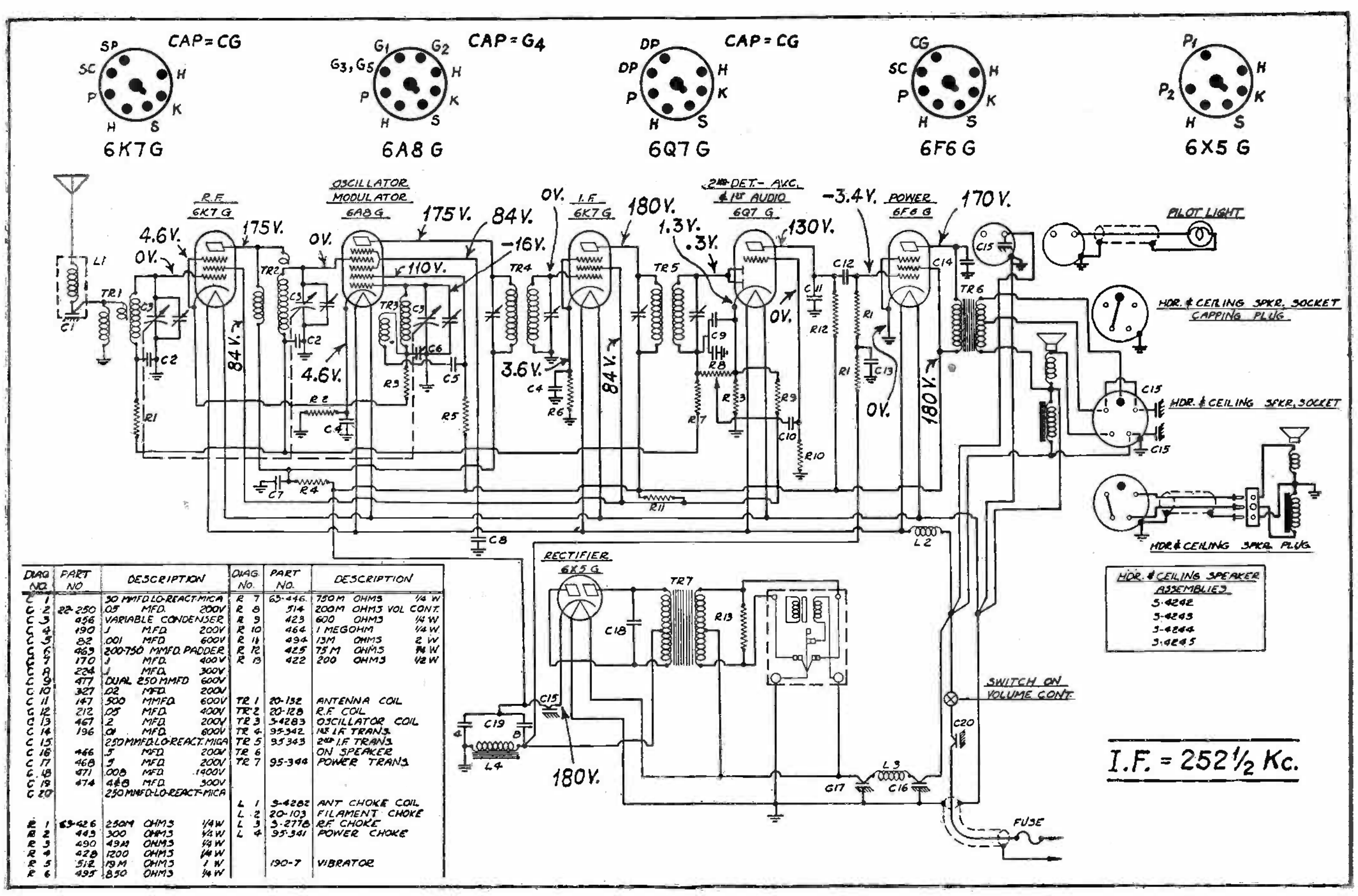
Connect the service oscillator to the control grid of the 6A8 tube and to the chassis. Set the service oscillator to 252.5 kc. Adjust the i-f transformer trimmers, starting with the secondary trimmer on the second i-f transformer and working towards the primary trimmer on the first i-f transformer, for maximum output, keeping the signal just readable by means of the attenuator on the service oscillator. These adjustments should be repeated several times to assure greater accuracy.

R-F Alignment

1400-*kc adjustment:* Change the service oscillator lead from the grid of the 6A8 to the antenna connection. A male Delco Remy connector may be used in making a connection to the antenna lead. Set the service oscillator at 1400 kc. Rotate the gang condenser one and one-fourth turns from the minimum setting. At the proper position eight teeth on the tuning gear will be visible past the gear bracket.

Adjust the oscillator, r-f and antenna trimmers in that order to the point giving the greatest output.

600-*kc adjustment:* Set the service



DIAG. NO.	PART NO.	DESCRIPTION
C 1		30 MMFD LO-REACT MICA
C 2	22-250	.05 MFD. 200V
C 3	456	VARIABLE CONDENSER
C 4	190	.1 MFD. 200V
C 5	82	.001 MFD. 600V
C 6	463	200-750 MMFD. PADDER
C 7	170	.1 MFD. 400V
C 8	224	.1 MFD. 300V
C 9	477	DUAL 250 MMFD 600V
C 10	327	.02 MFD. 200V
C 11	147	500 MMFD. 600V
C 12	212	.05 MFD. 400V
C 13	467	2 MFD. 200V
C 14	196	.01 MFD. 600V
C 15		250 MMFD LO-REACT. MICA
C 16	466	.5 MFD. 200V
C 17	468	.5 MFD. 200V
C 18	471	.008 MFD. 1400V
C 19	474	4-8 MFD. 300V
C 20		250 MMFD LO-REACT MICA
R 1	63-426	250M OHMS 1/4 W
R 2	443	300 OHMS 1/4 W
R 3	490	49M OHMS 1/4 W
R 4	428	1200 OHMS 1/4 W
R 5	512	19 M OHMS 1 W
R 6	495	850 OHMS 1/4 W

DIAG. NO.	PART NO.	DESCRIPTION
R 7	63-446	750 M OHMS 1/4 W
R 8	514	200M OHMS VOL CONT.
R 9	423	600 OHMS 1/4 W
R 10	464	1 MEGOHM 1/4 W
R 11	494	13M OHMS 2 W
R 12	425	75 M OHMS 1/4 W
R 13	422	200 OHMS 1/2 W
TR 1	20-132	ANTENNA COIL
TR 2	20-128	R.F. COIL
TR 3	S-4283	OSCILLATOR COIL
TR 4	95-342	1ST I.F. TRANS.
TR 5	95-343	2ND I.F. TRANS.
TR 6		ON SPEAKER
TR 7	95-344	POWER TRANS.
L 1	S-4282	ANT CHOKE COIL
L 2	20-103	FILAMENT CHOKE
L 3	S-2778	R.F. CHOKE
L 4	95-341	POWER CHOKE
	190-7	VIBRATOR

Fig. 1. Zenith 6-M-92 circuit diagram.

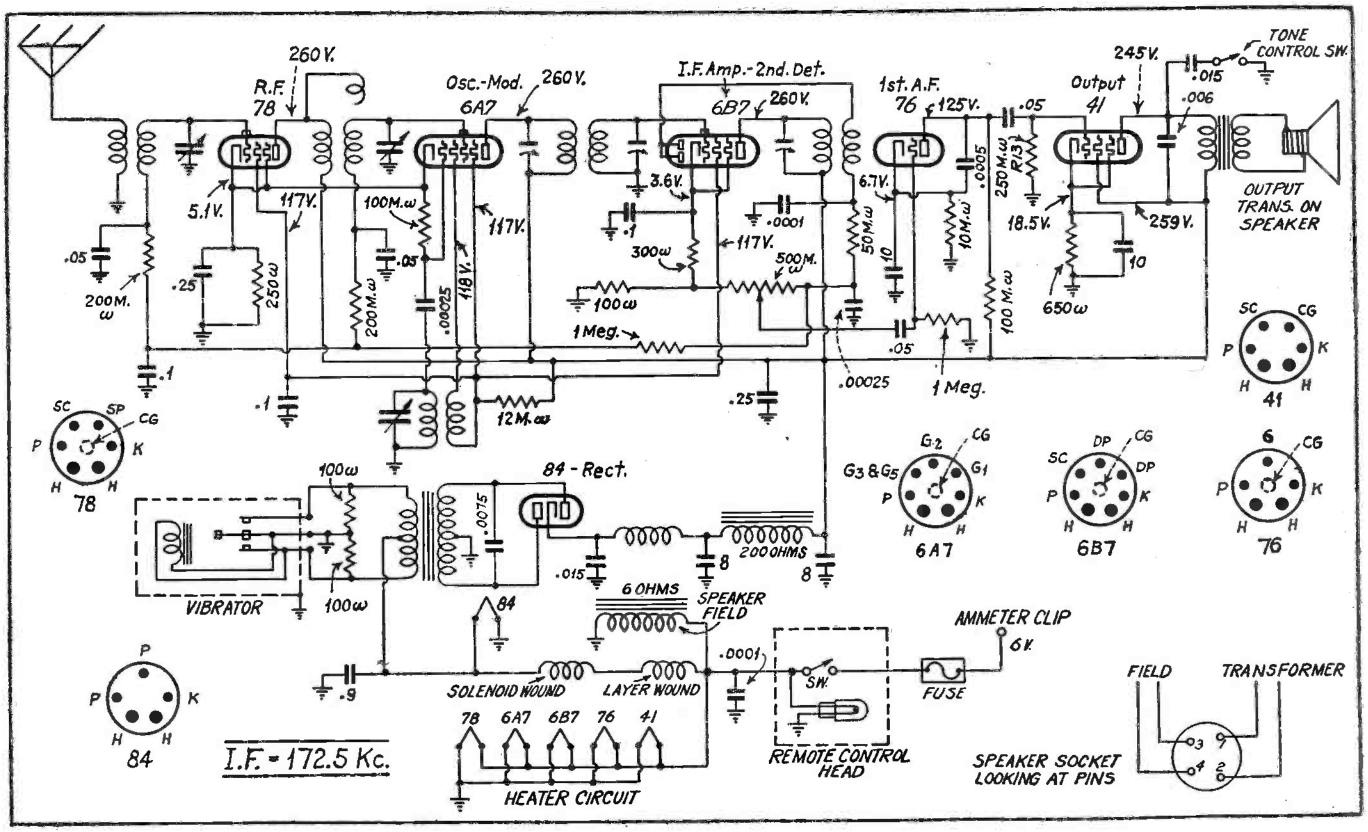


Fig. 1. Emerson E-128 auto-radio circuit.

oscillator at 600 kc and rotate the gang condenser to tune in this signal. Rotate the gang condenser to and fro past the signal, meanwhile adjusting the oscillator padder condenser until the combination of adjustments giving the greatest reading on the output meter is obtained.

Note: The 600-kc adjustment may be accomplished more simply by using the "Impact Excitation Generator." Both the generator and its uses were completely described in the September issue of SERVICE.

Repeat the 1400-kc adjustment.

•

Emerson E-128

The Emerson E-128 is a 6-tube auto-radio receiver using glass tubes in a superheterodyne circuit. A complete circuit diagram is given in Fig. 1 with the tubes used, their functions and the various voltages encountered on the socket prongs shown on the diagram. The voltages were measured with a 1000-ohm-per-volt voltmeter from the points indicated to the chassis. The volume control was on full and the antenna shorted to the chassis. The battery voltage was 6.3.

ALIGNMENT PROCEDURE

Before removing the chassis from the case pull the speaker plug out of its socket. The speaker plug should be replaced before the receiver is turned on. Before removing the chassis from the case note the locations and positions of the bonding clamps and braid. These must be replaced in their original positions when the chassis and case are reassembled.

In some instances sensitivity may be improved by readjusting the antenna (rear) trimmer on the variable condenser. This adjustment must be made using the car antenna.

It should be noted that one side of the speaker field is grounded to the speaker frame.

A 10-amp fuse is located in a small tubular holder in the battery lead. To replace the fuse, remove the cap, insert the fuse and replace the cap. The fuse is intended to protect the receiver and in no case should one larger than 10 amp be used.

The receiver was carefully adjusted and tested by experts at the factory, and should reach the customer in perfect condition. Under no circumstances should these adjustments be disturbed unless it is absolutely necessary, as in the repairing of a damaged set.

I-F ALIGNMENT

To align the intermediate-frequency transformers, use a good modulated oscillator set for 172.5 kc. Rotate the variable condenser to the position of minimum capacity, turn the volume control on full and ground the antenna.

Connect the test oscillator output between the grid of the 6A7 tube and ground. Connect an output meter across the primary of the speaker transformer, or across the voice coil. Using the smallest output from the test oscillator that will give a definite reading on the meter, adjust the two i-f transformers for maximum response. Use a non-metallic screwdriver if possible.

Repeat the i-f adjustment to assure greater accuracy.

R-F ALIGNMENT

Couple the test oscillator through a standard dummy antenna (a 0.0002-mfd condenser may be substituted) to the antenna lead and ground of the receiver, with the variable condenser in the *minimum* capacity position. Feed 1530 kc and adjust the oscillator trimmer (center) on the variable condenser for maximum response. Set the test oscillator to some frequency near 1400 kc and swing the variable until this signal is heard. Adjust the antenna and r-f trimmers (front and rear) on the variable condenser for maximum response. Reduce the output of the test oscillator and repeat.

TWO PRECISION TESTERS FOR THE PRICE OF ONE

Each Ranger-Examiner Combination puts together in one case two (2) units of test equipment every serviceman needs in his everyday work. The savings effected in design and in using this exclusive Ranger-Examiner grouping permits offering these combinations of two Precision Testers at prices you would normally expect to pay for one.

Each item is precision built throughout by the oldest company in the service equipment field. Their past contacts with the trade as well as with every advancement in the field of radio make them fully acquainted with the needs of the service profession. From the standpoint of sheer merit Ranger-Examiner testers are becoming popular favorites with radio servicemen.

RANGER EXAMINER

COMBINATION FREE POINT TESTER AND VOLT-OHM-MILLIAMMETER—MODEL 640-740

Model 640—Free Point Tester has five (5) sockets. Panel includes automatic switch type and single action jacks.

Model 740—Volt-Ohm-Milliammeter Unit has a 3" Triplett Precision instrument with scale reading 10 - 50 - 250 - 500 - 1000 A.C. and D.C. volts at 1000 ohms per volt. 1 - 10 - 50 - 250 D.C.M.A.; low ohms 0-300; high ohms to 250,000 at 1.5 volts. Rheostat adjustment.

Model 640-740 is contained in the standard size metal carrying case above described.

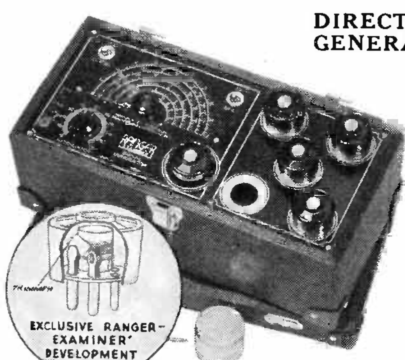
Dealer Price....$27.00

ADDITIONAL COMBINATIONS

Using the same standard size metal carrying case the following additional combinations may be had; the testers in all cases being identical with foregoing descriptions and complete with necessary accessories.

Model 540-740—Signal Generator and Volt-Ohm-Milliammeter.....Dealer Price $36.00
Model 440-740—Tube Tester and Volt-Ohm-Milliammeter.........Dealer Price $37.50

DIRECT READING SIGNAL GENERATOR — MODEL 557



Model 557 has the same features as described for Signal Generator Model 540 except that it is installed in a black leatherette carrying case and is an integral part of the case. The five individually calibrated coils are nested on the side as shown, handy for instant use. The attractive panel is silver and black.

Dealer Price....$18.00

COMBINATION TUBE TESTER AND SIGNAL GENERATOR—MODEL 440-540

Model 440-540 has the two separate testers installed in a sturdy metal carrying case for shop or field use.

COMPLETE DEALER PRICE $33.60

Model 440 Tube Tester checks all type tubes. Condition of tubes is read directly on GOOD-BAD Triplett instrument scale while load values are applied. Circuit designed to indicate inter element shorts and leakages. Illuminated dial A.C. instrument for line volts adjustment, also shows when tester is connected to power supply.

Model 540 Signal Generator uses plug-in type coils. Five frequency bands cover 110-20,000 K.C. All readings are direct and fundamentals. Each coil is individually calibrated by peaking with trimmer condensers. Accuracy within one per cent (1%) from 110-3000 K.C.—2% for higher frequencies. Completely shielded. Attenuation and stability are outstanding features. Complete with coils, two type 30 tubes, batteries and necessary accessories.

Model 440-540 consists of these two instruments installed in a sturdy metal case with built-in compartment having "snap-on" cover for accessories, finished in electro black baked enamel, panels in silver and black. Every essential feature is incorporated in these outstanding instruments. No extravagance. No added unnecessary cost. To see one—to use one—means you will be glad to own one.

D.C. POCKET VOLT-OHM-MILLIAMMETER MODEL 735

Contained in sturdy black molded case with silver and black panel, rounded corners. Ranges are 15-150-750 volts; 1.5-15-150 M.A.; ½-1000 low ohms; 0-100,000 high ohms at 1.5 volts. Provision for external batteries to be used for higher resistance measurements.

Has Triplett D'Arsonval precision instrument accurate within 2 per cent. Selector switch for all ranges. Provides for all essential D.C. measurement requirements in servicing.

Size is 3 1/16" x 5⅞" x 2⅛" deep—is easily carried in the pocket. Handy for the laboratory. Complete with battery, test leads and alligator clips.

Dealer Price $10.80

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The Stancor Ace

An amplifier, to serve present-day requirements, should be flexible as to use, as simple and compact as possible, sturdy and rigid in construction, and have high gain. The input circuit should accommodate two individual channels and provide a wide combination of input connection, each channel to operate directly from a crystal, dynamic, or velocity microphone. A low-gain input circuit for use with line operations such as radio or phonograph is also necessary. The circuit should be simple to avoid difficulties that would arise from a complicated circuit. An inexpensive, reliable output indicator would be advantageous.

The chassis should be rigid to avoid erratic operation, particularly in amplifiers of the portable type. It should be made adaptable for rack-and-panel installation or encasing if for portable use. The power supply unit should deliver enough energy to supply the field current for one or two large speakers of the dynamic type, in addition to the power required by the amplifier circuit itself. Approximately 18 watts is enough output to fulfill average requirements.

The accompanying schematic diagram shows an amplifier that has dual-channel input with accommodations for input devices that require either high- or low-gain circuits; a built-in power supply using the latest types of metal tubes, that meets the requirements as set forth in the foregoing paragraphs.

Following is a description of the amplifier and a discussion of its characteristics.

Frequency Response

Frequency discrimination and phase shift become negligible as a result of using resistance coupling and triodes in a pre-amplifier. The transformers are mounted at such an angle that chassis currents and stray fields are cancelled out. In the grid circuit of the 6F6 driver, a tuned circuit is used to raise low-frequency response without sacrificing the high-frequency response of the amplifier. Fixed bias is accomplished by using part of the high voltage to a 6X5 in a voltage doubler circuit and is filtered with two condensers and a high impedance choke, and it is then fed to the grids of the power tubes through the input transformer. The 6F6 tubes draw very little grid current so that the direct current flowing in the output transformer is negligible. The output transformer has a proper plate-to-plate impedance when the correct load is applied to the secondary. The secondary winding has 500-ohms a-c impedance at 400 cycles and is tapped at 15, 8, and 4 ohms to accommodate a wide range of speakers or for a transmission line. It is large enough that it will carry the plate current without saturation and handle the necessary peak power without overloading. The output indicator uses a 6E5 as a vacuum-tube voltmeter connected across a 4-ohm tap of the output transformer.

Power Supply

The hum problem has been solved by using a large power supply unit mounted so that it induces the least possible amount of chassis current. Adequate filtering minimizes the hum output, and tests have shown the hum level to be as much as minus 13 db from zero. Such regulation insures stable, dependable, high-quality output.

Metal tubes make it possible to build a high-gain amplifier including the power supply unit on a compact rigid chassis. The 6F6 tubes are far more capable of handling larger amounts of

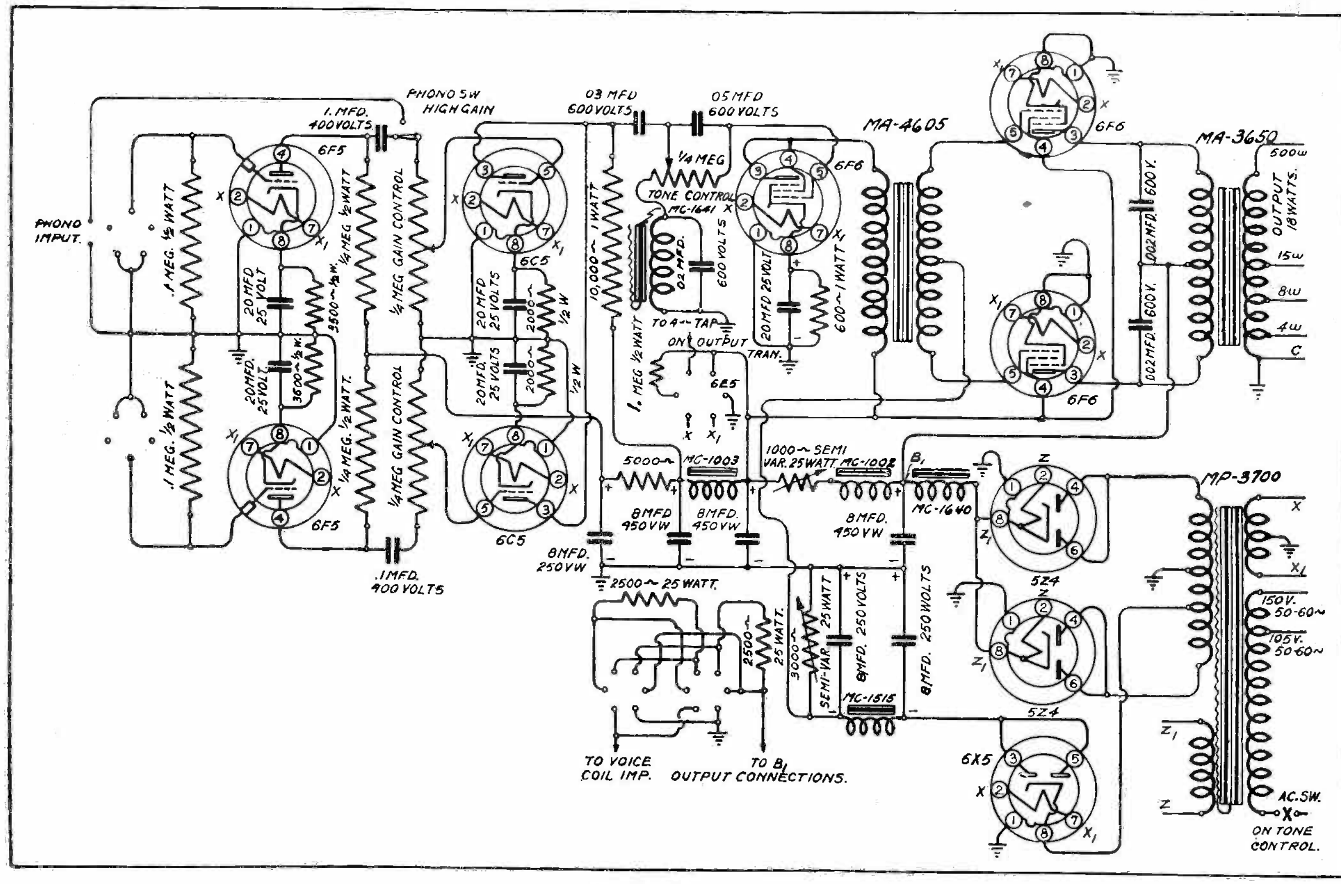


Fig. 1. The Stancor Ace.

power with minimum distortion than their predecessors, the 42's. At the present time, however, there are no suitable rectifiers of the metal-tube type to supply the large amount of plate current, so two type 5Z4's are used. The two 5Z4's deliver enough rectified current to provide ample reserve for peak powers, and for the field supply of 375 volts at 75 mils to take care of one large 5000-ohm speaker or two large speakers of 2,500 ohms each. It is possible to use a-c speakers because suitable resistors are provided to act as bleeders, thus keeping the voltage in the amplifier correct.

THE TUBE LINE-UP

A 6F5 high-impedance, high-gain triode in the input circuit feeds into a 6C5 with the gain control in the grid of the 6C5, the low-impedance or high-impedance phonograph pickup is fed directly to this stage. The electronic mixing of two metal tubes is accomplished more readily because of a complete isolation of the grid circuit brought about by the complete shielding in metal tubes. The output of the 6C5 is fed to the grid of the 6F6 driver through a resistance-coupled network.

The low-frequency booster circuit consists of a high-impedance choke tuned by a condenser, and a tone control circuit which controls the amount of low-frequency voltage that is applied to the grid. The high frequencies are controlled by the same tone control and condenser combination; the output of the 6F6 driver is transformer-coupled to the grids of the 6F6's in the class AB pentode circuit.

The "Bullet" Microphone

The "Bullet" Microphone is a new addition to the electrodynamic microphone field. It was designed especially to provide a high sensitivity in speech pickup, and an idea of its directional characteristic, frequency response, size and appearance may be gained from the accompanying illustrations.

From the frequency-response curve it is evident that this unit has been purposely designed with a rapid attenuation in response below 200 cycles. Since the lower frequencies are not predominant in speech they have been eliminated in this microphone to prevent "boominess." This means that it is suitable for close talking purposes. The characteristics of this unit also eliminate the necessity for employing wind screens, of obvious advantage in outdoor pickups.

The "Bullet" has a broadly directional characteristic for the region in front of the microphone, which means that there will be no discrimination in this area. An attenuation present in the rear part of the unit reduces the effective reverberation encountered in auditoriums and similar locations. This results in a reduction of feedback and other undesirable interferences that handicap sound reinforcement installations. Directional characteristics, however, are not a limitation, according to the Transducer Corporation, as this microphone, when placed with its mouth toward the ceiling, has uniform nondirectional characteristics over 360° in the horizontal plane.

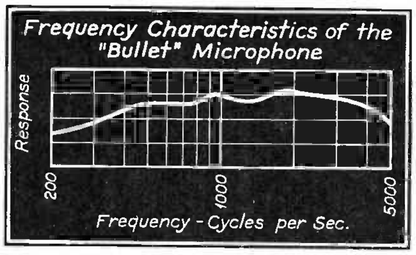


Fig. 1.

Fig. 2. The bullet microphone.

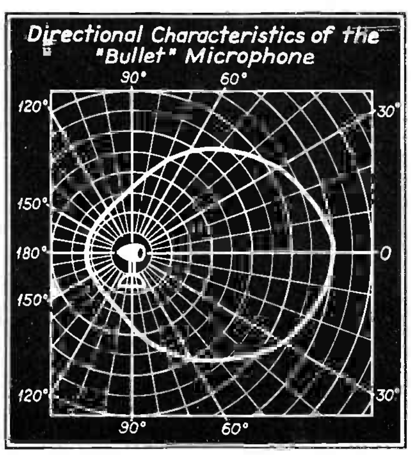


Fig. 3.

This microphone has a sensitivity equal to that of a high-quality carbon unit. No batteries or preamplifiers are required and it can be used at considerable distances from its associated amplifier. Due to the relative small amplification required, shielded cables are not essential except in locations where strong magnetic fields are encountered.

HEATING OF VOLTAGE DIVIDERS

(*Continued from page* 476)

must have suitable resistance. The resistance of wire increases as the cross sectional area is decreased and is increased as the length is increased. The heat dissipating ability of the wire, however, decreases (more or less) as the cross-section is decreased, but increases as the length is increased. (*Note*: The heat dissipating ability of the wire decreases as the surface is decreased, rather than as the cross-section is decreased.—EDITOR.) To give the divider the desired resistance and at the same time without making a divider that is too bulky to be placed in the receiver, manufacturers must compromise in design and use a wire small in diameter to provide sufficient resistance but having rather limited current-carrying capacity.

TAPERED DIVIDERS

Many manufacturers taper the resistance wire used, using larger diameter in the high-voltage section of the divider where the high currents are encountered and smaller wire in the sections passing less current. This procedure is satisfactory but presents a caution in installation to prevent a reversal of the divider. Reversal would cause immediate burn out.

Many radio Service Men have the mistaken idea that as long as the total power taken from the taps of the voltage divider does not exceed the rated wattage of the divider there is no danger of excessive heating. The error of this belief can be seen when it is shown that this reasoning would permit the drawing of a 5-ampere current out of the 1 ohm of resistance at the high-voltage end of a 25-watt divider. That is considering an I^2R value of 25 watts, when $R = 1$ ohm $I^2 = 25$ or $I = 5$ amperes.

Therefore, as a conclusion we see that the amount of power dissipated in a continuous voltage divider is determined by the maximum current allowable in any section of the wire. This current can be determined as indicated earlier in this discussion.

TEST EQUIPMENT . . .

Precision Series 600 Electronometer

The series 600 Electronometer provides complete tube testing facilities as well as adequate radio set analyses, i.e., measurements of volts, ohms, current and condenser leakages.

THE CIRCUIT

The complete circuit diagram of the series 600 is shown in Fig. 1. A single d'Arsonval type meter is used for emission indications, line measurement and set analyses. Three individual scales are provided on the scale plate. Two scales with large numerals are employed for reading of volts, ohms and milliamperes. A wide three-colored sector divided into markings of "Replace," "Weak" and "Good" is used for tube merit indication.

A G-10, candelabra base, 1-watt neon lamp is used for both tube and condenser leakage tests. The instrument employs individual 4, 5, 6, combination 7 and two octal-prong sockets. All tube analyses, i.e., hot cathode leakage, hot neon short and tube merit tests are obtained from any one of the required sockets. A tube need not be shifted to complete the tests.

There are two caps (connected with flexible wires) which will accomodate the top caps of both octal and non-octal type tubes. Either of these connector caps is attached to tubes requiring same while tests are made.

The filament control is used to obtain the correct filament voltage for the tube under test. This control may be set to any one of eleven positions (numbered from 1 to 11). These correspond to filament voltages ranging from 1.5 to 30 volts with No. 11 open. Proper filament setting for each tube is indicated on a chart supplied with each instrument.

TUBE ANALYZING FEATURES

A summary of the tube testing features provided in the 600 Electronometer follows: hot cathode leakage test; hot (neon) inter-element short test; rated load for each tube test; complete free point tube analyses, providing for future tube releases; individual tests for each section of multi-sectional tubes without changing the socket; a pilot light on-off indicator.

PINJACKS

Fourteen pinjacks are incorporated on the instrument panel. Five of these are used to obtain all voltage measurements on d-c circuits. For these readings the "Ext" control should be at the position marked "D-C Volts." Five pinjacks are used for obtaining resistance readings with the "Ext" control in the "Ohms" position. Two polarized pinjacks marked "Ma" make three direct-current ranges available with the "Ext" control in the respective positions. Through the use of these pinjacks and the current ranges mentioned measurement of current leakage in electrolytic condensers can be obtained. The voltage necessary to accomplish this measurement is taken from the radio receiver whose condensers are under test. Two additional pinjacks marked "Cond Test" are for use in measuring the leakage of paper condensers and for continuity testing.

INSTRUMENT PANEL CONTROLS

The control marked "Load-Ext" is divided into two sections. The upper (Load) section is used for tube analyses and the lower (Ext) section is used for set analyses.

The "Load" section, divided into six contact positions, is used to select the proper load for each group of tubes, thus assuring that damage to the tube will not occur by drawing excessive emission from the filament. At the same time sufficient current is delivered by the power tubes to show up poor cathode structure under heavy load conditions. This method of load selection also eliminates the necessity of a multiplicity of switches. Proper load setting for each tube is indicated on a chart supplied with each instrument.

The "Ext" section of this control switch is also divided into six contact positions. Three positions are used to select the 1, 10 and 100 ranges obtainable through two polarized pinjacks. The "ohms" position completes the circuit for four voltage ranges available at terminal pinjacks. The "Cond Test" position enables the checking of leakages in paper condensers through the use of two terminal pinjacks marked accordingly.

The "Shunt Control" is a dual potentiometer. When tube analyses are taken this control functions as a variable meter shunt enabling the setting of calibration limits for all tubes as noted on the tube chart. When ohmmeter ranges are employed, it also functions as a vari-

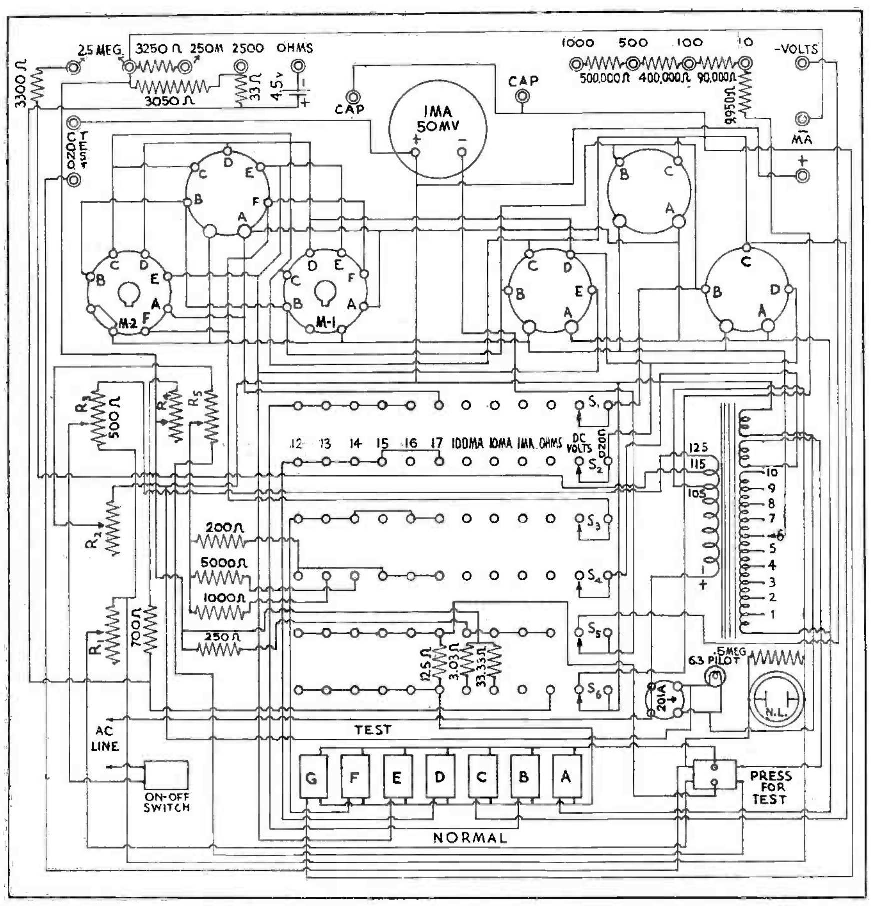
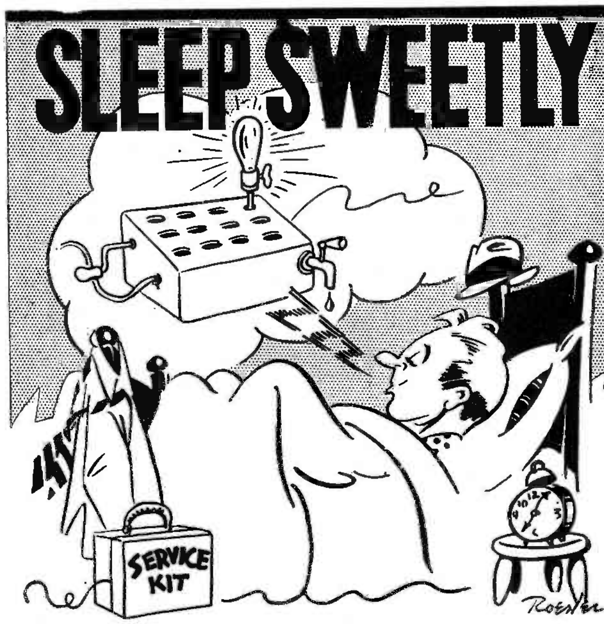


Fig. 1. Precision series 600 Electronometer circuit.



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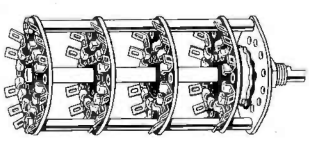

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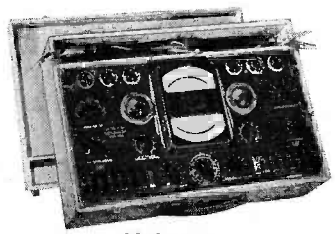

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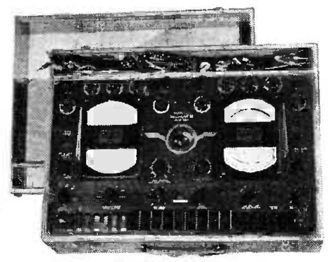

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able meter shunt for "ohms adjustment."

The "Line Adjustment" control is used to adjust the line voltage by bringing the meter pointer to the center of the scale plate marked "Line Check." This control is the heavy-duty wire-wound potentiometer.

The switches lettered "A-B-C-D-E-F-G" are employed to give a complete free point tube analyses system. Each of these switches is connected to corresponding prong positions of the sockets permitting an arrangement whereby any combination of electrodes desired may be connected into the circuit to obtain complete tests of various tube element arrangements regardless of electrode pin positions. This method affords a means of flexibility for future tube releases.

The manipulation of these lettered switches serves a three-fold purpose: to obtain hot cathode leakage tests; hot inter-electrode neon short tests and to obtain tube merit indications.

The tube merit test button, when depressed, completes the circuit for an indication on the meter.

Set Analyses Features

In addition to the tube testing features the series 600 Electronometer has the following set analyses features: four voltmeter ranges for d-c measurements, at 1000-ohms-per-volt, with full-scale readings of 10, 100, 500 and 1000 volts; three ohmmeter ranges are available with a self-contained supply and full-scale readings of 2500, 250,000 and 2,500,000 ohms, allowing measurements as small as ½ ohm; three direct-current ranges with full-scale readings 1, 10, and 100 ma; provision for measuring electrolytic condenser leakage and additional neon tube condenser and continuity tests.

If difficulty is experienced in regard to the proper operation of the instrument the 01A type tube found on the underside of the tester panel should be replaced. This tube is used to rectify the a-c in making line voltage measurements. A defective 01A tube will prevent the obtaining of a proper line voltage indication or adjustment.

•

Weston 665 Selective Analyzer

Of importance to every Service Man is the low obsolescence of the model 665 which lies in the fact that its readings are all in terms of fundamentals—volts, milliamperes and ohms. When used with the model 666 selector the combination becomes a complete selective analyzer. When new tube bases are developed the 665 requires only an inexpensive addition to the selector set and the selective analyzer is right up to the minute.

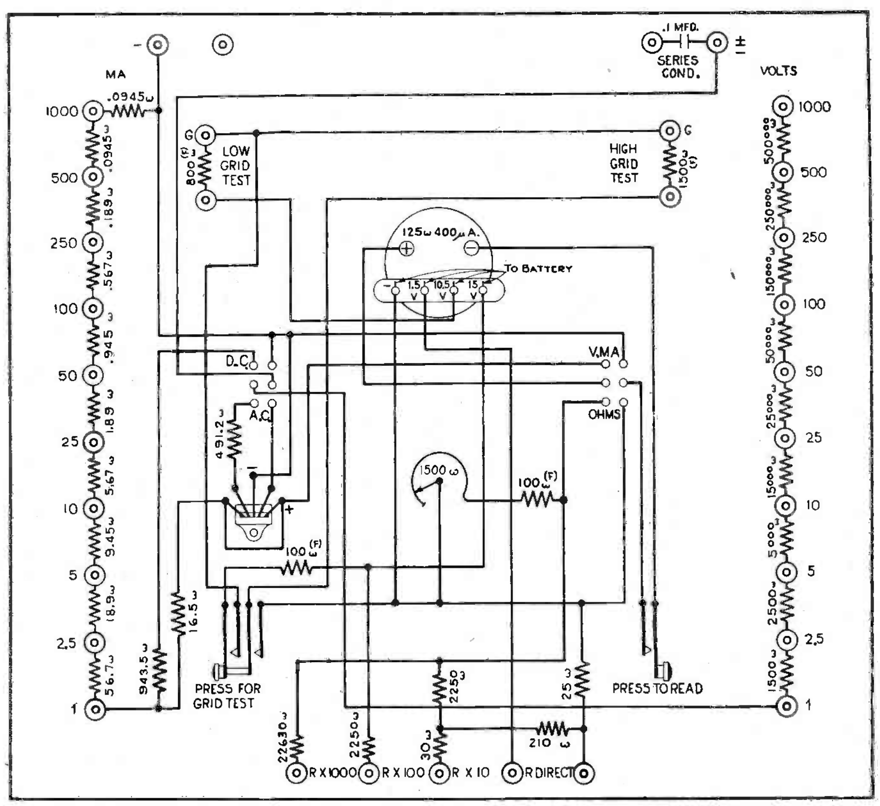


Fig. 1. Weston 665 Analyzer circuit.

Fig. 2. Weston 665 Analyzer.

In the circuit diagram shown, called type 2, the ranges are brought out to separate pinjacks. Another instrument, called type 1, is available wherein a rotary switch is used for range selection.

Voltage and Current Ranges

The Weston 665 analyzer is built around a standard d'Arsonval movement type 301 meter with an internal resistance of 125 ohms and an initial sensitivity of 400 microamperes. Ten voltage ranges are provided both for a-c and d-c at 1000-ohms-per-volt. These are from 0 to 1, 2.5, 5, 10, 25, 50, 100, 250, 500 and 1000 volts. Resistances from 1 ohm to 1 megohm can be conveniently measured on the four scales provided. Direct-current readings can be made on ten ranges which provide full-scale readings of from 1 to 1000 ma.

Features

A grid shift test can be made, through the use of the selective analyzer, on tubes requiring either a low- or high-bias. Through the use of the model 666, type 2, capacity unit, microfarads can be read directly on the 665 scale. A bridge type copper-oxide rectifier is used to obtain the a-c readings. All resistance spools have an accuracy within ½ of 1 percent. Three separate scales are provided to improve the accuracy of low-range a-c measurements.

•

Fixed Crystal Tester

A fixed crystal in series with one lead of a pair of headphones and a pair of test prods enables hearing of the signal, if it is getting as far as the circuit tested. The test prods should be connected from grid to filament or from grid to cathode of the particular stage tested. *RCA Service Tip File.*

RECEIVER CASE HISTORIES

Brunswick 15

Oscillation: Oscillation often results from poor contacts on the tuning condenser rotor. Since these are practically inaccessible on this model it is advisable to drill a hole large enough to accommodate the end of a screw-driver through the chassis and condenser drum in line with the screws holding the wiper contacts. Clean, tighten or replace.

H. H. Schock

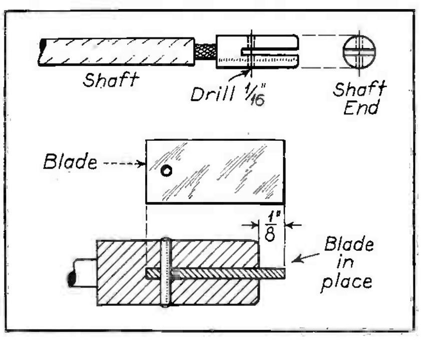
Edison R-7

Plate voltages low or missing; bleeder charred: This is caused by leaky or shorted r-f by-pass condensers located in one of the oblong cans to the rear of the chassis. A good quality tubular may be used to replace the defective unit which must be disconnected from the circuit; value, 0.25 mfd.

E. J. Bancroft

Ford Philco Auto Set

Installation: To install these models in cars other than the Ford. When in-



stalling on the fire-wall of other makes of cars, the volume control and switch cable will usually be found too short, while the dial drive shaft is almost always sufficiently long. Obtain a Philco part number 288354 flexible shaft, which is the same as the drive shaft in the original set. The new shaft is prepared as shown in the sketch, by drilling a 1/16-inch hole through the brass ferrule, and inserting a piece of 16 gauge steel in the slot. A nail cut to the proper length is used for a rivet for fastening the blade just made.

E. M. Prentke

Grunow 5 G

Distortion: This applies to any radio chassis using coupling capacitor between 75 and 42 or similar tubes. I find these go out on even fairly new sets. Avoid further trouble by using a good quality high-voltage capacitor.

E. J. Bancroft

Grunow 700-800 Series

Frying noise: There is a wide range of this trouble in these models which have been in constant service. The frying noise may be due to bad resistors, capacitors and last the frying and crackling may be caused from the secondary windings of the power transformer which may have a slight leakage between the windings.

E. J. Bancroft

Kolster K60

Distortion: Distortion in this model is frequently caused by a leaky or defective coupling condenser (C9) in the 47 grid circuit. Since a very high quality condenser is required for this position in the receiver, it is advisable to replace it if its terminal resistance shows any visable reading (should read over 100 megohms). Sometimes a leaky grid filter by-pass (BC7) causes distortion.

H. H. Schock

Kolster K90

Slow avc action: The avc action on this model has a long time constant. The time condenser (BC5) connected between the cathode and the secondary of the first i-f can be decreased from its present value (0.1 mfd) to 0.02 mfd to remedy the difficulty.

H. H. Schock

Kolster K130, K140

Neon beacon inoperative: This is often caused by insufficient plate voltage due to the deterioration of the electrolytic condensers. It is advisable to replace all the filter condensers in these cases.

H. H. Schock

Lyric A-65

Shift in screen voltage: The large 2-watt 15,000-ohm resistor (color coded) and the 10,000-ohm blue resistors usually drop to 5,000 ohms or less. Replacement with high-grade units is indicated.

These receivers have low audio gain and are critical to align.

Francis C. Wolven

Majestic 20

Inoperative: Check oscillator plate voltage. The absence of this voltage is caused by an open plate winding on the oscillator coil. Replace entire coil.

J. E. Steoger

NOTE: This was incorrectly listed as Majestic 70 in the August issue.—EDITOR.

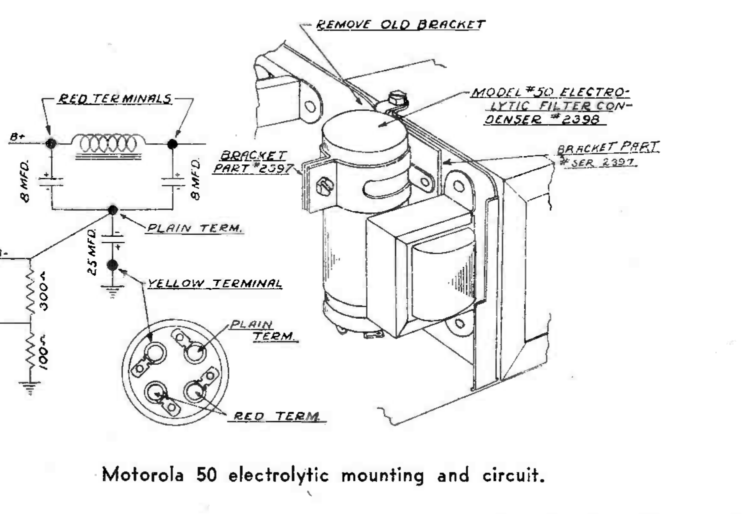
Motorola 50

Service change: A change in the mounting of the electrolytic condenser has been made in this model.

Previous to this change the electrolytic condenser was equipped with a stud in the bottom of its can and was mounted with this stud to the chassis plate adjacent to the power transformer. In the new electrolytic this stud is eliminated and the condenser is mounted as shown in the accompanying illustration. In the future all orders for replacement electrolytics for the model 50 will be filled with the new type, part No. 2398. These will be equipped with the special bracket, part No. 2397, for your convenience in replacing the previous type unit. Therefore, when replacing condenser, part No. 2317, with the later type, part No. 2398, remove the old mounting bracket and install the new unit as shown.

Electrical connections should be made as shown in the schematic diagram.

Galvin Mfg. Co.



Motorola 50 electrolytic mounting and circuit.

YOU'LL NEED THIS BOOK!

The New 1936-37 Edition of the Sylvania Service Booklet Can Bring You New Profits!

There will be more automobile radios installed this winter ***than ever before.*** More cars will come from the factories equipped with radios ***than ever before.*** A new source of business and profits is opening up before your eyes! Will you be prepared to meet it?

You can be prepared with this new Sylvania Service Booklet! Here are just a few of the features:

Elimination of motor interference for every make of 1936 car . . . Tube complement chart for practically all models of automobile radio sets, with I.F. peak frequencies . . . Set and Antenna installation hints . . . Power supply hints, etc. These and hundreds of other problems you will meet in auto-radio installation and servicing are covered in this amazing book.

And this book is absolutely free! Just fill out the coupon below and mail it NOW. You will receive your free copy of this valuable book within a few days.

Hygrade Sylvania Corporation, makers of Sylvania Radio Tubes and Hygrade Lamps. Factories at Emporium, Pa.; Salem, Mass.; and St. Mary's, Pa.

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The Set-Tested Radio Tube

HYGRADE SYLVANIA CORPORATION S-106
Emporium, Pa.

Please send without obligation your new service book, "Auto-Radio Installation and Servicing."

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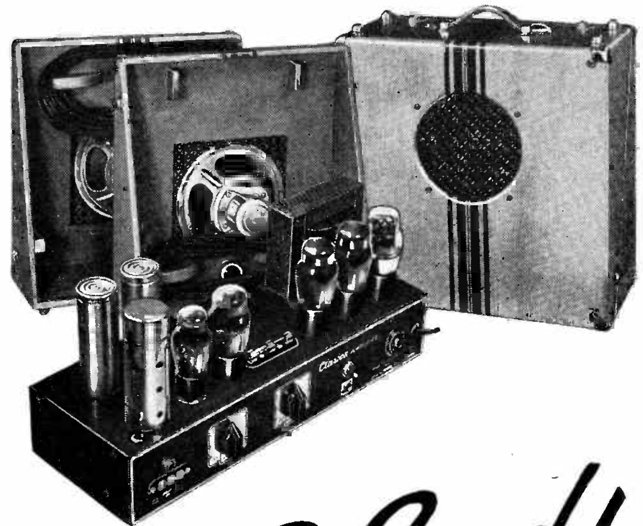
IT LOOKS Good



IT IS Good!

We have entirely discarded the idea that a Public Address system must be built for PERFORMANCE *ONLY*. The 1937 CLARION line is a full year ahead in engineering features — and, in addition, it is STYLED to SELL.

The layman who buys a Public Address System from you will be influenced by the APPEARANCE of the CLARION job you show him—he will be SOLD on its superior performance. He will STAY SOLD because of the finest engineering features in any P. A. line available today.

And remember — CLARION policy protects the Sound Engineer! Only franchised jobbers handle CLARION equipment—list prices are rigidly maintained for your protection. See your jobber. Take a look at the CLARION line. Hear it perform and you'll know why CLARION merchandise is sure to make MORE MONEY for you than ever before!

Write to Dept. K-15 for complete information.

TRANSFORMER CORPORATION OF AMERICA

69 WOOSTER ST., NEW YORK, N. Y.

Clarion AMPLIFIERS

Patterson 8-Tube Model

Distortion: Distortion in this model is often caused by a defective resistor in the cathode of the 27 detector tube.

E. J. Bancroft

Patterson 7-Tube Model

Low volume: The i-f transformers in this model contribute largely to the gradual loss of volume. Replacement with new i-f's of high quality will restore the original pep. Realignment is necessary, of course.

E. J. Bancroft

Philco 60, 610

Distortion: Distortion in this and other models is often caused by a defective coupling condenser between the 75 detector plate and the grid of the 42 tubes. The condenser used in this position should have a terminal resistance of over 100 megohms when tested on a voltage of not less than 400. Replace if its reading is less; value 0.015 mfd.

G. W. Hester

Philco 89

Fading: Fading in this model is sometimes caused by a defective oscillator coil. Check both the overall resistance of each winding as well as the resistance between windings.

E. J. Bancroft

Philco 118

Low volume: This is often caused by a high resistance leak across the trimmer of the r-f tuning section. Replacement is indicated.

G. W. Hester

RCA-Victor 121

Set dead but some static coming through: Every indication of oscillator not working. No plate voltage on oscillator section of oscillator-first detector. R-6, a 30,000-ohm, 1-watt unit near the oscillator padding condenser, is very hot. C-22, a 4-mfd section in the filter pack, is shorted.

Francis C. Wolven

RCA 140, 141, 141E, 240

Fuzzy tone: If the tone is fuzzy try changing the 53 tube; a tube tester will not show the defect. A defective 2A7 will cause lack of sensitivity and possibly some hum.

E. J. Bancroft

RCA 211

Distortion: Tone starting to distort often times just a squawk coming from the speaker. Check electrolytic C-26 for partial or complete short.

E. J. Bancroft

RCA 224

Low 80 filament voltage, low plate voltage: Check for high resistance 80 filament winding. Replace power transformer in these cases.

Temporary distortion: During the distortion period a high milliampere drain will be noted for the output tube. Voltages not affected materially. This is caused by a partial short of condenser C-40.

E. J. Bancroft

RCA Metal-Tube Chassis

Power transformer overheats: Test shows a definite voltage (d-c) between the 6.3-volt filament and the chassis. This is caused by a short between the high-voltage and filament windings. Replacement is indicated.

E. J. Bancroft

RCA-Victor T-8-18 (Magic Eye)

Noise, low volume or set dead: If power stage clicks when tube is removed and the first a-f stage (6F5) appears dead, check plate voltage on same. Trouble is probably a leaky or shorted by-pass condenser. Use a mica condenser capable of handling the voltage, some will not.

Francis C. Wolven

Stewart Warner

Oscillation: Check r-f and i-f cathode by-pass condensers and replace if necessary. Realign.

Poor tone: Replace audio coupling condenser with one of high quality and high terminal resistance.

Poor tone at low volume setting: Replace limiting resistor connected between the volume control and B+ with a 100,000-ohm resistor. This should improve control.

William Sollis

Stewart Warner with Short Wave Converter

Weak: Replace the 25,000-ohm resistor connected from B+ to the 2-mfd condenser with a good 2-watt resistor of the same value. Check the 2-mfd condenser for leakage replacing if necessary.

William Sollis

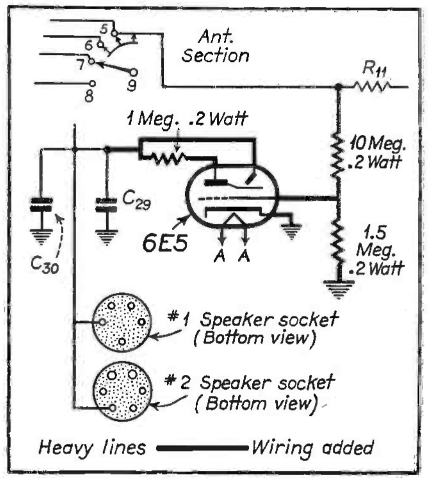
Stewart Warner 950

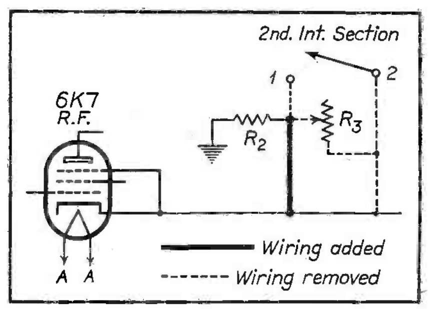
Deftctive volume control: The screen voltage which is controlled by the volume control is bled through a 20,000-ohm, 2-watt resistor. The resistor may gradually drop in value and cause the control to burn out. When replacing the control check the resistor as well.

RCA Service Tip File

Wells Gardner 2CM

Adding 6E5 to the 2CM series: A 6E5 may be added to these models as indicated in the accompanying diagrams.





The added resistors are indicated with their values and power rating.

When the 6E5 is used in conjunction with the 2CM receiver the receiver becomes a series 3A by virtue of the addition of one more tube.

Zenith 62

Low volume: Set often goes entirely out of alignment all over the band due to warping of die castings in the tuning condenser. It is generally impossible to obtain perfect alignment again, so try for best general results. Oscillation around lower end of dial is normal and should cause no concern as long as it may be checked with the volume control.

Francis C. Wolven

ASSOCIATION NEWS . . .

INSTITUTE OF RADIO SERVICE MEN REPORTS

New York Trade Show

The radio industry show sponsored by the Institute of Radio Service Men, at the Hotel Pennsylvania, New York City, September 18 to 20, attained a new high in attendance, number of exhibitors and interest.

The Pennsylvania offered space only for the seventy-four exhibition booths occupied. Not an inch of space was wasted. Apparatus and parts sales were brisk and in substantial amounts.

The industry attraction brought men from Canada and from the west coast. Service Men, engineers, jobbers, manufacturers, as well as Leslie Muter of Chicago, president of the Radio Manufacturers Association, attended the Show. Bond Geddes, RMA's executive vice-president and several directors were also present for some of the show sessions.

Every effort is being expended by the IRSM to make the Cleveland Trade Show, to be held November 1 and 2 at the Hotel Cleveland, as great a success.

Arrangements for the next big show, to be held in Chicago in the spring of 1937, are already being made and the event promises to be "greater than ever."

•

The 1937 Trade Show

The 1937 National Radio Industry Trade Show will be held at the Hotel Sherman in Chicago, April 2-3-4. As in all past events of this kind, conducted by the IRSM, everyone connected with or interested in radio in any manner will be cordially invited, and those who have participated in the trade shows during the past four years are already making preparations for the affair.

An announcement sent to the trade recently brought forth advance reservations for space, which coupled with those that had been made as early as the last Chicago Show, already indicates that the 1937 Industry Trade Show may surpass those of other years.

Arrangements are being made to expand upon the activities at the Show and during the Convention held at the same time.

Preliminary arrangements have been made for at least two other organizations in the radio industry to hold their national conventions concurrently with the events next April. There is a possibility that a third may join the list.

If such is the case, there will be assembled at the Hotel Sherman at that time the representatives of all the units who manifest interest in the service and sale of radio parts, accessories and other electronic devices.

There is plenty of time now to lay plans to be among those present at the 1937 National Radio Industry Trade Show.

Ken Hathaway, Exec. Sec.

•

Cleveland Chapter

Two important meetings were held by the Cleveland Chapter of the IRSM during September.

On September 9, we were favored with the presence of Mr. Wilson, factory service manager for Zenith. He covered the complete service data for the Zenith 1937 line.

Winteradio, Inc., one of our local distributors in conjunction with Hygrade Sylvania arranged a grand get-together at which Mr. Walter Jones, radio engineer extraordinary, spent two hours on the subject of tubes and oscillators. Two hundred and sixty-five Service Men and amateurs turned out for the meeting.

Right now we're in the midst of plans for the Fourth Annual Cleveland IRSM Radio Trade Show. At this writing the show is completely sold out—not one of the 39 booths is available. Mr. Clark Quinn of the technical committee has worked out a number of trick displays which will undoubtedly please the gang. The show is scheduled for Sunday and Monday, November 1 and 2 at the Hotel Cleveland. Don't miss it!

L. Vangunten, Secretary.

•

Cleveland Trade Show

The visitors to the Cleveland Trade Show, to be held Sunday and Monday, November 1 and 2, at the Hotel Cleveland, will be amply repaid for their time by the many featured attractions. Outstanding among these are the Wirephoto Demonstration (both transmission and reception) given by the Acme News Service through the courtesy of N.E.A. Service; the RCA Victor Service School fall series; body capacity controlled drinking fountain and the automatic attendance counter. During the Trade Show the following program will be presented:

Sunday, November 1

11:00 A.M.-1:30 P.M.

Registration.

1:30 P.M.

"Noise Reducing Antennas," by Robert G. Herzog, editor of SERVICE Magazine, New York City.

3:00 P.M.

"Test Instruments," by Floyd Wenger, chief engineer of Triplett Electrical Instrument Co., Bluffton, Ohio.

4:30 P.M.

"Super-sensitive Instruments for Service Work," by O. J. Morelock, Weston Electrical Instrument Co., Newark, N. J.

6:00 P.M.

Annual Radio Banquet.

7:00 P.M.

Convention Address by Chairman A. J. Theriault, Cleveland IRSM.

7:15 P.M.

Wirephoto Demonstration by Acme News Service.

9:30 P.M.

Speaker and subject to be announced.

Monday, November 2

11:00 A.M.-1:00 P.M.

Registration.

1:00 P.M.-5:00 P.M.

Subjects and speakers to be announced.

6:00 P.M.

Wirephoto Demonstration by Acme News Service.

7:15 P.M.

"Trouble Shooting with Cathode-Ray Equipment," by Walter Weiss, engineer, Hickok Electrical Instrument Co., Cleveland, Ohio.

9:30 P.M.

RCA Service School, second of the fall series, by P. U. Smith, special engineering representative, RCA Victor Co., Camden, N. J., through the courtesy of the Moock Electric Co., Cleveland, Ohio.

11:45 P.M.

Show closes.

•

Newark Chapter

Meetings of the Newark Chapter of the IRSM take place regularly the second and fourth Tuesday of each month at the Hotel Douglas in Newark, N. J.

It is aim of the chairman, N. V. Rotolo, and of the program committee to present an interesting speaker for each meeting.

•

RADIO TECHNICIANS GUILD

The last time we saw Jimmie Stine he looked as though he needed medical assistance. Has she set the date, Jim?

Wonder why Mr. Hodgdon didn't show up at the last meeting. We think that you would have enjoyed the talk Bob Herzog of SERVICE magazine gave at that meeting, Hodge, ole kid.

Sh, sh! Here's some real dirt: Nick Baratta has to get the wife's permission to go to the R.T.G. meetings. (Who doesn't?—EDITOR.) After the outing we don't blame her.

Don't forget the October meeting, boys. The time has come for the nomination of new candidates for office. (Election in November, installation in December.)

We have been wondering why Jim Ryan of Fall River has been so quiet lately. We'll pay the postage, Jim, ole sock.

Bliss Corless seemed to be enrapt in Mr. Herzog's discussion, but the competition from the rear was too much for him.

The nominations for offices take place at the coming meeting and 100 percent turnout is expected.

George W. Feldman, Secy.

•

RADIO SERVICEMEN'S ASSN. OF PITTSBURGH

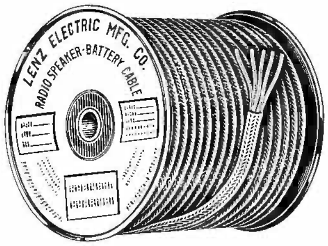
The Radio Servicemen's Association of Pittsburgh, Pa., are making a drive for members. Service Men in the neighborhood who may be interested in joining the organization may communicate with Mr. William Irlam, 514 Station St., Wilmerding, Pa.

LENZ RADIO WIRE PRODUCTS

LENZ

1936 LENZ QUALITY AND SERVICE SHALL PREVAIL!

A complete line of wires and cables for radio installation and replacement purposes. Conveniently packed in attractive packages and on spools.



A Partial List of LENZ PRODUCTS

- Auto radio cable.
- Microphone cable.
- Short Wave lead-in.
- Shielded wires and cables.
- Speaker and head set cords.
- Battery and speaker extension cable.
- Flexible rubber covered lead-in wire.
- Ground wire.
- Shielded low capacity cable.
- Crystal microphone cable.
- Transmission lines.
- Push-back wire.
- Indoor aerial.

Write for latest illustrated catalog No. 23

LENZ ELECTRIC MFG. COMPANY

1751 North Western Avenue, Chicago, Ill.
Since 1904

BRUSH *Spherical* MICROPHONE

A specially designed, general purpose microphone for remote pickup, "P. A." and commercial interstation transmission work. Low in price ... but built to Brush's traditionally high mechanical and electrical standards. Wide frequency response. Non-directional. No diaphragms. No distortion from close speaking. Trouble-free operation. No button current and no input transformer to cause hum. Beautifully finished in dull chromium. Size only 2⅛ inches in diameter. Weight 5 oz. Output level minus 66 D. B. Locking type plug and socket connector for either suspension or stand mounting furnished at no extra cost. Full details, Data Sheet No. 13. Free. Send for one.

BRUSH *Lapel* MICROPHONE

For after dinner and convention speakers, lecturers, etc. Gives great mobility—the smallest, lightest microphone on the market. Size 1½ x 1¼ x ⅜. Weight with coat attachment less than 1 oz. Special internal construction and rubber jacketed outer case insures quiet operation. No interference from breathing noises, etc. Typical Brush sound cell response and trouble-free operation. Details on request.

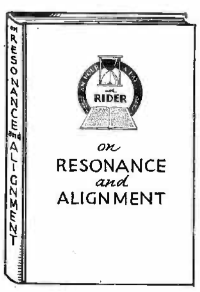
The **BRUSH** DEVELOPMENT COMPANY
PIEZO ELECTRIC
1882 E. 40th St. CLEVELAND, O.

MICROPHONES • MIKE STANDS • TWEETERS • HEAD PHONES • LOUD SPEAKERS

SPEND AN HOUR A DAY WITH RIDER

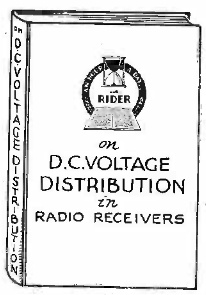
AN HOUR A DAY WITH RIDER on **RESONANCE** and **ALIGNMENT**

Do you know what happens when you tune a circuit to resonance? Are you familiar with all the various alignment operations? Can you align the oscillator, r-f and detector circuits — single, double, or triple tuned systems—of any set and KNOW why you do certain things? This book gives the answers.



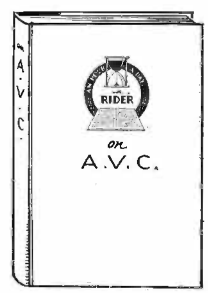
AN HOUR A DAY WITH RIDER on **D.C. VOLTAGE** in **RADIO RECEIVERS**

You should know thoroughly how the value of resistance and wattage rating of each resistor in any receiver is calculated—and why. The d-c distribution networks of 1937 sets are more complicated than ever! Get these facts at your command. Let Rider guide you through all d-c distributing systems. He makes it easy.



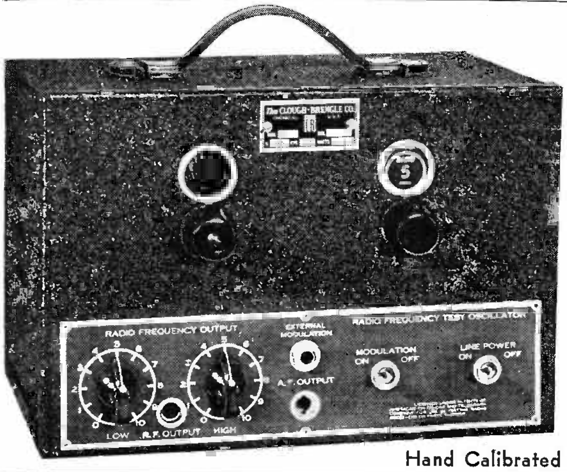
AN HOUR A DAY WITH RIDER on **AUTOMATIC VOLUME CONTROL**

A. V. C. is now a standard feature in practically every receiver. Can you recognize one system from another when you examine the schematic? Do you know how the circuits operate in the different receivers? Here is the source of information that will answer every one of your questions — and the data will serve you for years.



Pocket Size — Profusely Illustrated — Hard Covers — 96 Pages — 60 cents each.

Buy Them from Your Jobber



Hand Calibrated

A finer Oscillator—at a lower price!

CLOUGH-BRENGLE—MODEL OC

only $29.95 cash :: $4.50 down

The world's most popular radio test instrument now offered in a new 1937 version, designed especially for work in short-waves.

25-INCH TUNING DIAL—plus hand calibration against crystal standards allows a guaranteed accuracy within ½ of 1% AT EVERY FREQUENCY from 100 kc to 30 mc.

STEPLESS DUAL ATTENUATOR—Provides smooth variation of output voltage from maximum to less than ½ microvolt.

NEW ISOLATED LINE-FILTER — Triple shielding plus elaborate radio frequency filters is employed to eliminate any trace of line feedback, once impossible to eliminate.

BATTERY OR LINE OPERATED MODELS—The MODEL OC-A for 110 volt 50-60 cycle line (25 cycle and 220 volt models available), the MODEL OC-B for 110 volt ac-dc, and MODEL OD-A from self-contained batteries. Write for new descriptive bulletin.

Mail Coupon for 1937 Catalog

The CLOUGH-BRENGLE CO.
2817 W. 19th St., Chicago, U. S. A.

Name ....

Address ....





Personalities Seen at the IRSM Convention

Hotel Pennsylvania, New York City

September 18-19-20, 1936





Top Panel—Left to right

Bill Garstang	Electronics Laboratories, Inc.
Bob Coburn	National Union Radio Corp.
Gordon Peck	P. R. Mallory & Co., Inc.
Dick Purinton	Raytheon Production Corp.
Otto Paschkes	Solar Manufacturing Corp.
Frank Sprayberry	F. L. Sprayberry, Inc.
Henry L. Crowley	Henry L. Crowley & Co., Inc.
Art Moss	Electrad, Inc.

Left

Ed. Tyler, Micamold Radio Corp.

Sam Baraf and I. A. Mitchell
United Transformer Corp.

Ken (IRSM) Hathaway and
Vic Mucher
Clarostat Manufacturing Co.

Bottom Panel—Left to right

Paul Ellison	Hygrade Sylvania Corp.
Charlie Golenpaul	Aerovox Corp.
John Erwood	Webster-Chicago
Jack Geartner	Arcturus Radio Tube Co.
Ralph Hill	Ohmite Manufacturing Co.
Ray Simpson	Simpson Electric Co.
Dan O'Brien	Cinaudagraph Corp.

Right

Adolph Schwartz
Ward Products Corp.
Zeh Bouck and
Tobe Deutschman
Tobe Deutschman Corp.
Ed. Jenkins and Hal Oleson
Weston Electrical Instrument
Corp.

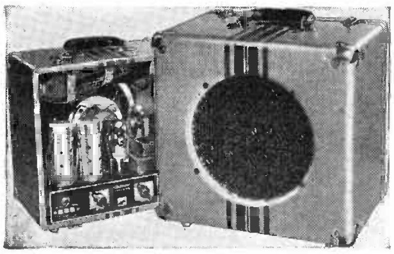




THE MANUFACTURERS . . .

CLARION PORTABLE P-A SYSTEM

The Clarion model C-45 is a portable 5-watt system including speaker, amplifier,



microphone and desk stand housed in a modern luggage case which forms the baffle for the speaker during operation. The C-45 is manufactured by the Transformer Corporation of America, 69 Wooster St., New York City.

•

G.E. POCKET-SIZE INSTRUMENTS

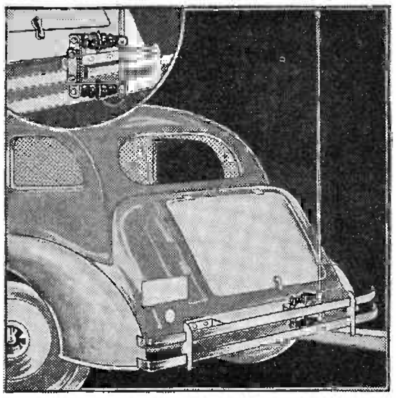
A complete line of pocket-size voltmeters, ammeters, and milliammeters, designated Type AS-5 to supersede the Type AS-3, has been announced by the General Electric Co. The new instruments incorporate a new type of element with higher torque and improved characteristics. The overall dimensions of the standard unit are 5½ in. by 3½ in. by 2 in., and the weight is only 12 ounces. All the instruments have an accuracy of one percent of full-scale value.

The instruments have magnetic damping, a Permalloy moving vane, and are shielded from stray magnetic fields. All have a knife-edge pointer and a mirror scale for accurate reading. On the double- and triple-scale instruments, a convenient switch on the face makes it possible to change ratings without removing or rewiring terminal connections. The case is of Textolite.

•

WARD PRODUCTS FISH-POLE ANTENNA

Among the features of the fish-pole antenna recently introduced by the Ward Products Corp., Ward Bldg., Cleveland, Ohio, are its durability and flexibility. No drilling is necessary in its installation and the fish-pole is mounted on Ward's power-house type insulators. It is finished in black and extends to eight feet. Other

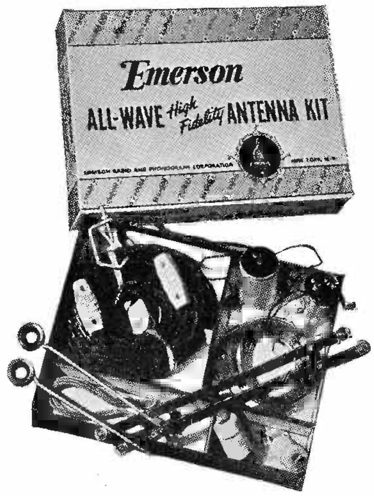


Ward products are the buggy whip aerial, running-board aerials, sound systems, microphone stands and auto-radio aids.

EMERSON ANTENNA KIT

Emerson engineers have designed an "all-wave high-fidelity antenna kit" with a three-fold purpose: To provide for increased pickup and clearer reception of both standard broadcast and short-wave stations; to prevent noise pickup on the lead-in wire; and to provide automatic antenna tuning through the use of a special set transformer. The designers claim to have accomplished their aim.

Additional information on the antenna kit may be obtained from the Emerson



Radio and Phonograph Corp., 111 Eighth Ave., New York City.

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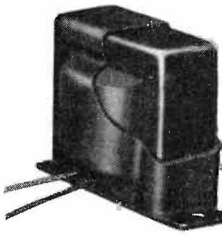
PLASTIC SEALED TRANSFORMERS

Jefferson Electric Co., Bellwood, Ill., announce their line of plastic sealed audio and output transformer and chokes. Transformers of this type have been furnished



for the export field for some time and are now available to the domestic trade.

The construction is similar to Jefferson's standard line but the complete assembly is enclosed in a special molded plastic of high melting point instead of in the usual metal case.

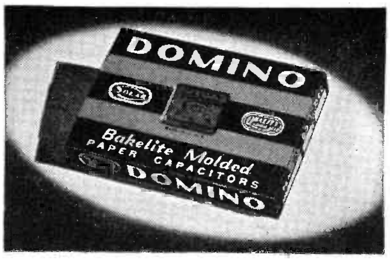
•

TOBE AUTO-POLE ANTENNA

Designed for turret-top cars the Tobe Auto-Pole antenna can be used on any model automobile. The antenna can be attached in one minute to the rear bumper frame. Length extended, eight feet; telescoped, three feet. The auto-pole is tunable and can be used for transmitting as well as receiving. It is said to be effective on the five meter band. Manufactured by the Tobe Deutschmann Corp., Canton, Mass.

SOLAR DOMINO CONDENSERS

A feature of the bakelite-molded paper capacitor recently introduced by Solar Mfg.



Corp., 599 Broadway, New York City, is its mode of packaging. A standard carton of 10, finished in red and black, is the unit.

Domino, as the new capacitor is called, resists heat and moisture, gives permanent capacity and full voltage protection. Small, flat, easy to use. Samples and capacity ratings may be had by writing the manufacturer directly.

•

ALIGN-AIRE I-F TRANSFORMERS

"Align-Aire" i-f transformers, recently announced by Meissner, are available in all frequencies from 170 kc to 3100 kc, both in the "Ferrocart" (iron-core) and standard air-core construction. They are supplied in either input, interstage, output, center-tapped output, beat-frequency oscillator, noise silencer and band-expanding units. Align-Aire i-f transformers are doubly tuned, with top tuning and use the new Meissner "Perma-Strut" construction.

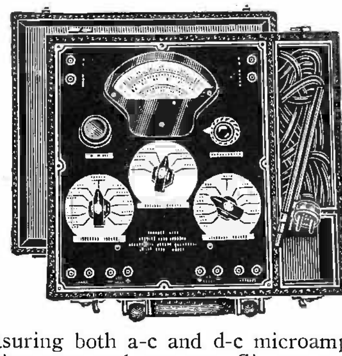
Write to the Meissner Manufacturing Co., Mt. Carmel, Ill., for additional information.

•

RADIO CITY MULTITESTER

A new design in a multiple metering system is embodied in the new Master Multitester Model 410, manufactured by Radio City Products Co., 88 Park Place, New York City.

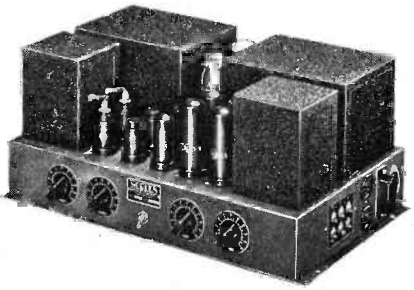
The instrument serves as 41 different individual instruments and measures resistance from a fraction of an ohm to 40 megohms in 6 ranges. Capacity is measured from .0001 mfd to 300 mfd in 5 ranges. Both a-c and d-c are measured in 5 ranges each, from a fraction of a volt to 1000 volts. An advantage is offered in



measuring both a-c and d-c microamperes, milliamperes and amperes. Six ranges each are available indicating from 10 microamperes to 2.5 amperes in both a-c and d-c.

MORLEN BEAM POWER AMPLIFIERS

The Morlen Electric Co., 60 W. 15th St., New York City, announce the MC60 and



MC120 amplifiers using the 6L6 beam-power tubes.

The MC60 and MC120 amplifiers incorporate universal, dual channel input, with full mixer control, a main gain control, and tone control. The output is a dual winding transformer having 500 ohms impedance across one winding and 8 ohms tapped at 4 and 2 ohms across the second winding. Practically any combination of speakers or other load devices can be operated from the MC output. All MC amplifiers are complete on one chassis, from input to output and in power ranges from 19 to 120 watts.

Additional information can be obtained from the manufacturer.

•

THE VELOTRON MICROPHONES

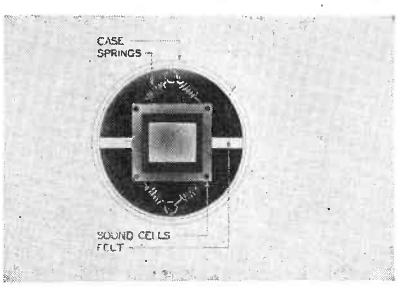
The Bruno Laboratories, Inc., 20 West 22nd St., New York City, announce the arrival of a new product, the Velotron Microphone.

This is a new velocity microphone which is said to incorporate entirely new principles of construction, employing a static rather than a magnetic field. The output is higher than that of the conventional magnetic velocity microphone being on the order of —50 db. It is a high-impedance microphone but may be employed with cable lengths up to 500 feet, without detriment to the quality of the output, it is stated.

•

BRUSH INTERNAL SPRING MOUNTING

A recent development in microphone construction tending toward quietness in use is the newly developed spring mounting in the BR2S microphone manufactured by The Brush Development Co. This



mounting makes unnecessary any external mounting ring or rubber stand shock absorber.

This device enables anyone using the microphone to pick it up and move it when in use. It is formed by fastening springs to two opposite sides of the unit of sound cells and pieces of felt on the other two sides. This makes the instrument unresponsive to jarring or other rough handling.

Because of this feature the BR2S can be used for public address work in which the microphone is likely to receive particularly hard treatment.

•

NEW AMPERITE BOOM STAND

By a slight pressure of the hand, the Amperite boom stand is adjustable in either its vertical or its horizontal position. The

microphone can therefore be placed at any height and at any angle desired. No adjusting screws are required. This action is obtained by using a ball clutch for the vertical adjustment. Such a stand is useful in placing microphones in unusual positions such as for soloists playing at the piano, or whenever quick change in the microphone position is required. Obtainable in chrome or gunmetal finish.

•

METER ENCLOSURES

Circular enclosures, for covering single indicating instruments on all types of trans-

mitters, are now being added to the standard line of Remco meter enclosures.

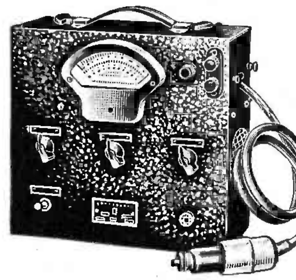
The types now available are for use with small Weston 301, flush and surface-type meters, and Weston switchboard meters of types 260, 252, etc.

A revised bulletin is available, and lists over 15 standard enclosures for innumerable applications, which may be obtained in any special finish desired to match properly the existing equipment.

For further information write to Radio Engineering and Mfg. Co., Jersey City, New Jersey.

CLOUGH-BRENGLE PEAK VOLTMETER

The Clough-Brengle Co., 2815 W. 19th St., Chicago, announce their model 88 com-



bination vacuum-tube voltmeter and peak voltage indicator.

As a vacuum-tube voltmeter, a range of 0-1.2 volts rms is covered by direct connection to the tube (type 6F5 metal) grid without any shunts. Thus, a large deflection is secured by potentials as low as 0.1 volt on the 4½″ fan-type meter. The voltmeter tube is placed at the end of a 30″ extension cable, making possible direct connection of the tube grid-cap in the circuit, the potential of which it is desired to measure, and thus eliminating all capacity effects. For work in lower frequency circuits, the tube may be placed in the instrument case and connections made through front panel binding posts.

As a peak voltmeter, ranges of 0-10 and 0-100 are provided without the necessity of external power supply. These find wide usage in measuring avc, c-bias, and other potentials where no current drain is permissible, and where the wave shape is other than sinusoidal with the resultant lack of fixed relationship between rms and peak potentials.

•

OPERADIO SOUND SYSTEM

The Operadio Manufacturing Co., St. Charles, Ill., are introducing two sound systems, the DuKane and the St. Charles, designed for use in hotel, school and similar sound distribution installations.

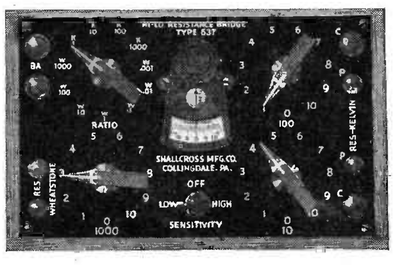
A descriptive brochure can be obtained directly from the Operadio Co.

•

SHALLCROSS RESISTANCE BRIDGE

The newly developed Shallcross 637 Hi-Lo Resistance Bridge consists of a standard Kelvin bridge for measuring from 0.00001 ohm to 11 ohms and a Wheatstone bridge for measuring from 1 ohm to 11 megohms.

The resistors employed are of Shall-



cross construction. Any further information regarding this instrument can be obtained by writing to the Shallcross Mfg. Co., Collingdale, Pa.

(*Continued on page* 518)

HIGHLIGHTS . . .

PERPETUAL CATALOG

A perpetual catalog on transformers for Service Men has been issued by the General Transformer Corp., 500 S. Throop St., Chicago.

Upon request the above organization will mail directly any additions or changes to this catalog as issued . . . or send additional forms. These supplementary forms may be easily inserted in the same binding.

Complete technical information on the GTC line of transformers is contained in this catalog. The price is twenty cents.

•

VOLUME CONTROL LIST

As a supplement to its 80-page "Volume Control Replacement Guide" issued several months ago, Clarostat now offers a reference list of exact duplicate volume control replacements arranged by type numbers. The units are listed numerically, together with the sets they service. The same 8-page bulletin also covers metal tube type resistor replacements and tapped controls. This data will be incorporated in the next edition of the Clarostat Volume Control Replacement Guide, but for the present is issued as a supplement. A copy of this supplement, as well as the Guide, may be obtained by addressing Clarostat Mfg. Co., Inc., 285 N. 6th St., Brooklyn, N. Y.

•

RADIO RECEPTOR SOUND MANUAL

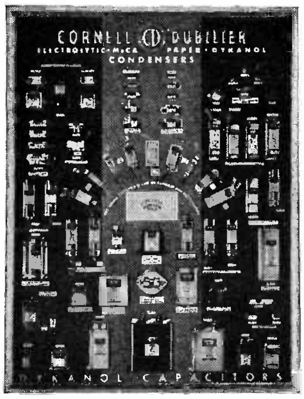
The Radio Receptor Co., Inc., New York City, publish a loose-leaf manual describing and illustrating their line of microphones, amplifiers, sound and centralized radio systems.

The 32-page book contains numerous interesting charts and circuit diagrams.

•

JOBBER HELPS BY C-D

In line with a definite policy to assist jobbers and dealers in securing business, Cornell-Dubilier Corp. has planned a



series of "dealer help" displays and other forms of "point of sale" advertising.

Now available for distribution is the display pictured herewith. It measures 35" x 45", is executed in blue, yellow and silver and is mounted in a distinctive silver frame.

This display shows the complete Cornell-Dubilier line of condensers, and may be utilized either for permanent wall display or as the background for a window display. This display is furnished free to all Cornell-Dubilier distributors.

COBURN APPOINTED SALES CHIEF

R. M. Coburn has been appointed General Sales Manager of National Union Radio Corp., New York City, according to an official announcement by S. W. Muldowny, National Union's Chairman of the Board.

During the several years of his association with the National Union organization, Mr. Coburn has served in the capacities of Sales Statistician, Office Manager, and more recently, Assistant Sales Manager.

•

NEW EDITION OF FIELD SERVICE DATA

Radio and Technical Publishing Company announce publication on October 15, of a second edition of Ghirardi's "Radio Field Service Data." This reference book for the use of Service Men out on the job or in the shop has been rewritten from cover to cover, enlarging and bringing right up to the minute the various types of data contained. For example, the intermediate peak frequencies are given for over 4,000 models of receivers. They include all 1937 sets as well as a large proportion of the older sets.

A convenient feature of the new edition is its loose-leaf arrangement, allowing for the insertion of supplements that will be issued periodically to keep the book up to date at all times. This edition is nearly twice the first one, containing over 400 pages.

Further details from Radio and Technical Publishing Co., 45-S Astor Place, New York, New York.

•

KEN-RAD 6L6 BULLETIN

An engineering bulletin entitled, "6L6 Operation Data Showing Effects of Power Supply Regulation" has been released by the Ken-Rad Tube and Lamp Corp., Owensboro, Ky. It contains information valuable to radio engineers, technicians and Service Men. It is available on request.

•

MEYERSON LEAVES MORLEN

L. A. Meyerson resigned as president of the Morlen Electric Company, Inc., and had since organized the Electric Amplifier Corp. at 135 West 25th Street, New York City. Catalogs of the Electric Amplifier Corp. are available when requested on a business letterhead.

•

ELECTRONIC BROADSIDE

The Electronic Laboratories, Inc., Indianapolis, Ind., are mailing to Service Men, upon request, an 8-page broadside describing their complete line of d-c to a-c converters. The Electronic Labs also manufacture a complete line of vibrators and vibrator replacements.

•

TURNER REPRESENTATIVE

The Turner Co., Cedar Rapids, Ia., announces the appointment of the L. G. Cushing Company, 540 North Michigan Avenue, Chicago, Illinois, as their new Illinois representative.

WHOLESALE RADIO 1937 CATALOG

The announcement by Wholesale Radio Service Co., Inc., that the 1937 catalog was ready for distribution, brought so great a response that it has been necessary to increase the mailing staff and order a second run from the printers.

The "Blue Ribbon Catalog" has more

than 150 pages, contains more than 2,500 illustrations, and lists about 50,000 items.

Readers of this magazine may receive a copy of this catalog by writing to Wholesale Radio Service Co., Inc., 100 Sixth Avenue, New York.

•

CURTIS SCHOOL MOVES

The Samuel Curtis Radio School have taken over the entire second floor at 181 Massachusetts Ave., Boston. In addition to the customary radio service instruction a course in radio telegraphy and touch typing by T. R. McElroy and one in broadcasting and television by Hollis Baird will be offered.

•

BOOK REVIEW

OFFICIAL RADIO SERVICE HANDBOOK, by J. T. Bernsley, published by Gernsbach Publications, Inc., 99 *Hudson Street, New York City,* 1008 *pages,* 5½ *by* 8¼ *inches, hard covers, price* $4.00.

This book was prepared for the use of the Service Man as a reference and text. It is the purpose of the book to supplement the service tools as an aid to everyday repairs—made more difficult by the ever advancing improvement in receiver design.

Some of the important subjects covered in this book are: circuit fundamentals; intricate tuning circuits and aligning data; volume control, tone control, avc and resonance-indicator circuits; receiver a-f amplifier systems; receiver power supplies; loudspeakers, pickups and electric phonograph equipment; fundamentals of meter and test instruments; commercial types of test equipment; the cathode-ray oscilloscope and supplementary equipment; noise interference elimination; improving knowledge and technique and operating notes.

1937 SUPREME INSTRUMENTS

The Supreme Instruments Corp., Greenwood, Miss., have published an illustrative and descriptive booklet of their 1937 line of test equipment. Supreme instruments can now be purchased on S.I.C. easy payment plan.

Copies of the booklet may be obtained directly from the manufacturer.

BRACH FORMS LYNCH DIVISION

In order to take advantage of the rapidly growing market for antenna systems the corporation headed by Arthur H. Lynch has found it desirable to consolidate with the L. S. Brach Mfg. Co., which has been supplying antenna kits to receiver manufacturers under their own names.

The L. S. Brach Manufacturing Co. and its subsidiary, Radio Wire and Cable Co., are anything but newcomers in the radio business. They have been recognized as the manufacturers of lightning arrestors, antenna systems, wire and cable, and all kinds of fire-alarm devices for over 30 years..

Mr. Lynch will join the Brach organization in an advisory capacity and the sale of all Lynch products will continue as usual. In addition, a group of new products, now being developed by Mr. Lynch will be merchandised through the Lynch Division of the L. S. Brach Manufacturing Corp.

SIMPSON ELECTRIC CO. FORMED

Following the purchase of a manufacturing plant at 5216 W. Kinzie Street, Chicago, the Simpson Electric Co. has announced a new line of radio instruments, service equipment and other electrical measuring devices. The president of the Simpson Electric Co., Ray R. Simpson, was formerly president of the Jewell Electrical Instrument Co., and in charge of all design and manufacturing of Jewell instruments during the long and successful career of that company prior to its merger with the Weston Electric Instrument Corporation.

The engineering and sales organization of the Simpson Electric Co. is largely composed of men who were formerly associated with Mr. Simpson in equivalent capacities when designing and manufacturing similar types of equipment.

Among the new devices that are being built by the Simpson organization are the Simpson "Roto-Ranger"—a radio analyzer, a complete line of panel instruments, and an all-wave signal generator.

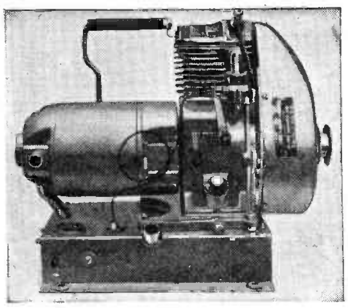
ALLIED CATALOG

The 1937 Allied Radio Catalog has been published and is ready for distribution. It contains 152 pages, featuring 10,000 exact duplicate and replacement parts; complete lines of amateur gear, p-a equipment, service instruments; all-wave kits and sets; books, tools, etc. A free copy may be obtained by writing to Allied Radio Corp., 833 W. Jackson Blvd., Chicago, Ill.

MANUFACTURERS—continued

KATOLIGHT, JR.

Fully portable, 50-pound power and lighting plants, which furnish standard 110-



volt, 60-cycle, a-c, have been placed on the market by the Kato Engineering Co., Mankato, Minnesota.

Katolight, Jr. plants are single, self-contained units; equipped with handle for convenient carrying. Generator is directly connected to, and mounted on engine block. Fuel tank is contained in base. Operates without being bolted down; quickly hooked to a-c line or appliance.

These a-c models of the Katolight, Jr. can also be used for charging 6-volt batteries. The Model JRA3 has a low capacity d-c winding which will charge a 6-volt battery at the rate of about 3 amperes under full a-c load, and has a maximum charging rate of about 10 amperes, at 6-volts, under no load.

ASTATIC MICROPHONE

The Astatic Microphone Laboratory, Inc., of Youngstown, Ohio, has developed a single diaphragm crystal microphone, Model 218, designed for pickup where the microphone is to be concealed or hidden. The interior assembly is cushion mounted, permitting use under adverse conditions of vibration. It is so designed that a long cable may be used without serious loss of output. It has a wide angle uni-directional pickup with an output level of approximately —56 db using a 5.0 meg. load. Net weight is 3½ ounces—is 2⅛" in diameter by ⅞" thick—with flat back, domed screen front and provided with spring clip for attachment.

PUBLIC-ADDRESS MICROPHONE

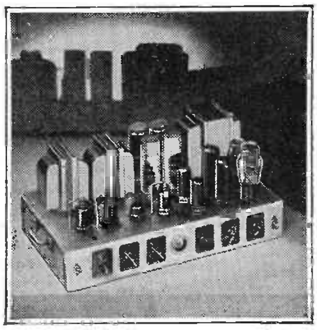
A new public-address microphone, known as the B-1, has been placed on the market by The Brush Development Company. It offers at a lower price, though somewhat lower output, many of the operating features found in the Brush sound-cell microphones.

Internal spring mounting, eliminating external shock absorbers and permitting the stand or even the microphone itself to be handled while it is in use . . . non-directional pickup . . . and the ability to run long leads with only slight loss . . . are some of the features built into this model.

The Brush B-1 microphone is 3½ inches long, 1⅞ inches wide, 3¾ inches thick. Weight, complete with the locking-type plug and socket, is 11 ounces. Output level, minus 72 db. Full details, prices, etc., can be secured from The Brush Development Company, Cleveland, Ohio.

ANTI-HOWL 6L6 AMPLIFIER

The Amplifier Company of America, 37 W. 20th St., New York City, offers a new development in high-fidelity audio amplifier design. This amplifier features such facilities as howl suppression, cathode-ray indication for howl suppression action or degree of level expansion, automatic constant output for reproduction of speech, volume level expansion for reproduction of recorded programs, tone compensated volume control and high- and low-frequency gain control. Reverse phase degeneration is optional for special applications requiring less than 1 percent total harmonic content. Provisions are available for operating one or two crystal, ribbon, dynamic



or electrostatic microphones.

Write to the manufacturer for a free brochure illustrating and describing in detail the complete line of Citation Series Gold Medal Amplifiers.

WEBSTER-CHICAGO SOUND SYSTEM

The Webster-Chicago sound system Model PA-417C consists of a 17-watt amplifier, crystal microphone in combination floor and banquet stand, and two 12" permanent magnet speakers in bias cut case. All equipment is assembled in two carrying cases.

The crystal microphone is the new directional type with 25 ft. of rubber covered shielded cable. The microphone floor stand is the full size. When demounted it packs in same case with amplifier and microphone. The weight is 41 pounds.

System is equipped with permanent-magnet speakers mounted in acoustically correct bias cut carrying case. Speakers can be placed on platform or hooked on wall. Total weight is 21½ lbs.

System PA-417C is furnished complete with all tubes, cable and other necessary accessories.

INDEX TO ADVERTISERS

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of SERVICE—A Monthly Digest of Radio and Allied maintenance published monthly at New York, N. Y., for Oct. 1, 1936.

State of New York, }
County of New York, } ss.:

Before me, a Notary Public, in and for the State and County aforesaid, personally appeared Bryan S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the SERVICE—A Monthly Digest of Radio and Allied Maintenance, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York, N. Y.; Editor, Robert G. Herzog, New York, N. Y.; Managing Editor, None; Business Manager, Bryan S. Davis, Ghent, N. Y.

2. That the owners are: Bryan Davis Publishing Co., Inc., 19 E. 47th St., New York; B. S. Davis, Ghent, N. Y.; J. C. Munn, Union City, Pa.; J. A. Walker, Richmond Hill, L. I., N. Y.; A. B. Goodenough, New Rochelle, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock, and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the......months preceding the date shown above is....................(This information is required from daily publications only.) BRYAN S. DAVIS, Business Manager.

Sworn to and subscribed before me, this 26th day of September, 1936. (Seal) J. A. WALKER, Notary Public.
Queens Co. Clk's No. 3149: Reg. No. 7476. New York Co. Clk's No. 831, Reg. No. 7-W-514. My commission expires March 30, 1937.

PLAY *Safe* with

MOLDED IN BAKELITE; resistant to heat and moisture. Small, flat, easy to use. Permanent capacity and full voltage protection. . . . In appearance and performance, far superior to ordinary paper tubulars. Investigate.

RATINGS

CATALOG NUMBER	CAPACITY MFD.	VOLTS WORKING	SIZE	LIST PRICE
MP-4101	.001	1000	A	$.25
MP-4103	.002	1000	A	.25
MP-4105	.003	1000	A	.25
MP-4107	.004	1000	B	.25
MP-4109	.005	1000	B	.25
MP-4111	.006	1000	B	.30
MP-4113	.008	1000	C	.30
MP-4115	.01	1000	C	.35
MP-4121	.001	600	A	.20
MP-4123	.002	600	A	.20
MP-4125	.003	600	A	.20
MP-4127	.004	600	A	.20
MP-4129	.005	600	A	.20
MP-4131	.006	600	A	.20
MP-4133	.008	600	B	.20
MP-4135	.01	600	B	.25
MP-4137	.02	600	B	.30
MP-4139	.05	600	C	.30
MP-4141	.01	400	A	.20
MP-4143	.02	400	B	.25
MP-4145	.05	400	B	.25
MP-4147	.1	400	C	.25
MP-4151	.01	200	A	.18
MP-4153	.02	200	A	.20
MP-4155	.05	200	B	.20
MP-4157	.1	200	C	.20
MP-4159	.15	200	C	.25
MP-4161	.2	200	C	.30
MP-4162	.25	200	C	.30

SIZE A = 1 5/32" x 5/8" x 1/4"
SIZE B = 1 13/32" x 3/4" x 5/16"
SIZE C = 1 13/32" x 3/4" x 3/8"

SOLAR MFG. CORP.

599-601 BROADWAY, NEW YORK CITY

SOLD BY LEADING JOBBERS EVERYWHERE

RCA Viscoloid Damped Pickups AND Suspension Arms

THE FINEST AVAILABLE

Priced within the reach of all!

These high quality products are unquestioned leaders! Impedance range from 4.6 to 8500 ohms! Wide variety of fine finishes

The world's finest Pickups and Suspension Arms come from RCA! This undisputed leadership, plus the modest cost of these products, are two powerful reasons why you'll find it pays to use them!

High quality and brilliant performance are the outstanding characteristics of RCA's Pickups and other phonograph accessories. Born of RCA sound engineering, they are excellent not only for replacement use on all RCA instruments, but give ace-high performance on public address systems and other sound amplification work.

RCA Pickups cover a wide impedance range — values available from 4.6 ohms to 8500! Viscoloid damping and chromium steel magnets give long and carefree service, utmost fidelity. A large variety of finishes, including walnut, grey and black, makes these Pickups ideal for use on all types of instruments.

Some of this splendid RCA equipment is shown on this page. You can obtain full details about the entire line from your RCA Parts Distributor or by writing us. Remember — when you want the best at low cost — think of RCA!

Listen to "The Magic Key" every Sunday, 2 to 3 P. M., E. S. T., on NBC Blue Network

RCA *Parts for* PROFIT

RCA MANUFACTURING CO., INC., Camden, N. J.

A service of the Radio Corporation of America

RCA PICKUPS

De Luxe Type

Viscoloid Damping—Chromium Magnets

Wide impedance range, 4.6 to 8500 ohms, precise mechanical construction and high output voltage make these Pickups matchless for finest record reproduction. List prices from $5.50 to $7.50.

RCA SUSPENSION ARMS

Inertia Type

Ideal for use with RCA de luxe type Pickups. Suspension arms include a plain escutcheon and plug with shielded leads for connection to magnetic pickup. Designed for and used on RCA's finest combinations. List prices from $6 to $6.50.

RCA PICKUP AND ARM

Junior Type

Where the de luxe type Pickup is not necessary, this type is best. Takes up little room, gives highly satisfactory performance. Impedance ranges — 80 ohms to 2400. Bronze finish. List prices from $5 to $8.15 complete.

RCA PHONOGRAPH MODERNIZATION KITS

and other high grade accessories

RCA Phonograph Modernization Kits are designed to convert old-style mechanical phonographs into modern electrical instruments. Variety of finishes. Output impedances available for all applications.

Other RCA Modernization accessories include Magic Eye Kits, Motors, Antenna Kits.