SERVICE

A MONTHLY DIGEST OF
RADIO
AND ALLIED MAINTENANCE

-"he helped produce nice, fat sparks"

(see page 42)

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PUBLIC ADDRESS

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The Antenna . . . editorially speaking -

Respectability

FOR several years past, perhaps ever since its inception, radio service work and the personnel necessary for such operations have been classed as necessary evils. The reasons for this attitude as set forth by sales organizations are items of the past. Today, the radio service man represents one of the most powerful forces present in the entire radio industry. By number and function, the radio service man can make or break. A shoemaker is understood to repair old shoes, but the service man is not a repair man. Whether or not the engineering fraternity admit the following, the service man can keep a receiver sold or ruin the possibilities of a new product or a new name.

The radio service man who calls upon a customer is a technician and salesman. No salesman employed as such by a radio dealer can ever hope to achieve as propitious a time of entry into the home of a prospect as the radio service man. The reason for this is quite evident. The service man calls when the receiver is defective. The customer may not be interested in the purchase of a radio receiver, but can be convinced, if he really needs a new receiver, that it would be best if he purchased one. The salesman in the store must wait until the customer decides for himself and decides to visit that particular radio dealer.

Every radio dealer who employs a service man should cultivate that individual as a salesman. He should be instructed as a salesman. In turn every independent radio service man should make some contact with some dealer organization so as to enable him to carry out the sale of a receiver or accessory in proper fashion. Some such arrangement upon a suitable commission basis is necessary because many receiver sales must be properly financed.

Radio servicing despite the many labor and time saving devices developed and sold is daily progressing towards the engineering stage. Not that it will ever become a problem of engineering, but a modern receiver incorporates such features of design as to require definite knowledge upon the part of the man who is to keep that receiver sold by restoring it to its original degree of efficiency. In brief these few words denote the function of the radio service man who is gradually becoming a radio service technician.

Recognition in this direction is in the hands of the service fraternity—in the hands of the men themselves; their appearance, their mode of speech, their actions. Confidence has been lacking in service ability.—Confidence is greatly influenced by appearance—by approach. Your first contact with the dealer when you seek employment or the customer when you enter his home, is personal. Ability is necessary—vital—but appearance is equally important, because after all you are a salesman as well as a technician. You must be received as a technician and not as a repair man. This is not an attempt to sugar a name. It is a fact which means success or failure in the future.

Cut Rate Service

CUT rate advertising has its lure, but cut rate service does not pay. The sale of cut rate service is something which cannot be controlled by either legislation or by the grouping of opposing forces. Legislation is in effect to prevent the stabilization of price but there is no law and there can be no law, if the constitution of this country is to be maintained which will force a man to sell his services and time at a certain price. Grouping of men in the form of associations is one way to force stabilization of prices, providing that Mr. John Public is educated to buy from no one but members of the association. However, the formation of an association with the sole idea of maintaining a price is again prevented by legislation. Furthermore education of the public is expensive. Hence some other means must be considered.

In the first place it is impossible to do away with cut rate radio service just as it is impossible to eliminate cut rate prices upon any other commodities. And the primary reason for this condition is that there are to be found cut rate customers who will not buy anywhere else. Just as long as there are cut rate customers, there will be cut rate stores.

The remedy must come from the inside. The cut rate radio service man or organization must cease functioning as such. In the first place it does not pay. No one can call and examine a radio receiver for a total fee of fifty cents. It's not in the cards and is a sure sign of racketeering. If the customer refuses to be convinced that he does not need all the items usually recommended, the call is a loss. And if he does fall for the line, he invariably is a one time customer because sooner or later he learns the truth. Barnum may have been right, but even the circuses have ceased using the tactics employed in his time. It does not pay.

There is another very important fact which must be considered by organizations who go in for cut rate radio service work. It is true that radio service work is in a chaotic state and that the public as a whole are not yet fully aware of what is or is not an equitable price for service work. However, there have been numerous instances where the tactics which usually accompany cut rate service, such as withholding a receiver until the charge demanded has been paid, have reached the law courts and been

(Continued on Page 42)

The Facts About Air-Cell Receiver Conversion

By G. M. Reed

Part 1

CHARGING wet type storage batteries is admittedly a nuisance. The exploitation of the air-cell battery and the development of the 2 volt tubes has created a great deal of interest in the possibility of converting storage battery type radio receivers into what has become known as the air-cell receiver.

This brief resume is intended to accomplish two ends. In the first place it is aimed to persuade against the practice of converting storage battery receivers into air-cell battery receivers. The second is to set forth the various pitfalls accompanying such conversion, so that if after reading about the trials and tribulation accompanying such conversion, you still insist upon making the change, you will know what problems confront you.

The idea behind the statement advising against conversion is not to limit service activity. Instead, it is to avert future troubles, which if due directly to the conversion, will require remedies without compensation or return. There is no money in repeat service calls. Neither is there any money in making replacements without charging for them or in the creation of ill will, if these requested replacements are refused.

We hasten to explain one thought which may have occurred to you as a reader of these lines. The statements made are not based upon the condition that the 2 volt tubes are not satisfactory or that the air-cell battery is not satisfactory. Both of these units are perfect when utilized in proper fashion. Such utilization requires complete designing of the system, identical in every respect to the operations required when a commercial radio receiver manufacturer intends to produce an air-cell battery receiver. Just why this is so, will be explained in a subsequent paragraph.

The Air-Cell Battery

In the first place the life of the air-cell battery is limited. It is a primary battery and non-rechargeable. Once its useful charge has been exhausted, it must be discarded. Second, the discharge rate is very definitely limited. This rate is approximately 650 milliamperes or .65 ampere. The ampere hour rating is about 600 ampere hours. While it is true that a higher rate of discharge is possible, the stipulation that its charging rate is limited is made because a certain operating life is naturally required. Under normal discharge of about .6 ampere or 600 milliamperes, the life of the battery is about 1000 hours. At lower values of current load the operating life is proportionately greater. Thus at a current load of about 300 milliamperes, the normal span of life would be about 2000 hours.

The initial voltage rating of a fresh battery is about 2.53 volts and in contrast to the usual discharge characteristics of a conventional storage battery, the voltage of an air-cell battery during its normal span of life is about 2.48 volts, perhaps even approaching 2.49 or 5. volts. The battery will supply this voltage at various reasonable rates of discharge within its ampere hour capacity. Of course very heavy loads are not to be considered.

With these details in mind let us consider some of the difficulties to be experienced in conversion.

The Difficulties of Conversion

The first difficulty, one which strikes at home because it hits the pocketbook, is that the manufacturers of this battery guarantee the life of the battery only when it is used with an air-cell battery receiver of commercial manufacture which has their approval. This means that the guarantee covering the battery is voided when it is used with a converted receiver. Thus in the event of any trouble, justifiable or otherwise, if the battery is used with some set other than an approved commercial receiver, the guarantee is void. The reason for this is that commercial receivers are being strictly designed for use with this new type of "A" battery.

The second difficulty is that associated with the 2 volt tubes. These tubes while not strictly critical in their filament voltage ratings, have an ideal operating voltage range. The upper safe limit is 2.2 volts and the lower satisfactory limit is 1.9 volts. The ideal operating voltage range extends from about 2.0 to 2.1 volts. It is true that a new tube will operate with filament voltages less than 1.9 volts. For that matter, the tubes will operate at values as low as 1.5 volts and have been found to be useful as oscillators at filament voltages as low as 1.2 volts. However the life of operation at these subnormal values is limited to the new period. After some time, it becomes necessary to increase the voltage. After several hundred hours, the lower satisfactory limit is 1.9 volts.

Because of this limitation in operating voltages, the filament circuit must be designed for use with the air-cell. At first thought one would imagine that it is a fairly simple matter. Theoretically it is.

But not so in practice. Two items are involved. First the attainment of full operating life of the tubes and second the attainment of full operating life of the battery. If either is not obtained, the customer will raise his voice of disapproval, and it certainly will not benefit the service man.

The filament current rating of .06 ampere (60 milliamperes) is based upon a rated filament voltage of 2.0 volts for the '30 and '32 tubes. The rating of .130 ampere (130 milliamperes) for the '31 is also based upon a rated filament voltage of 2.2 volts. However tests show that this value of filament current flows through the filament when the filament voltage is about 2.1 volts. Actually this is the value considered during the design of a commercial receiver of this type.

Now, when the process of conversion is being considered, attention must be paid to the fact that two values of filament voltage and battery voltage are existent. The substantially uniform output voltage of the air-cell battery obviates the need for a variable resistance in the filament circuit. Actually the use of such a resistance would be a hazard as was found to be the case when storage battery receivers were in vogue. Invariably the owner of a receiver, in the effort to secure greater volume or greater sensitivity advances the filament rheostat and the actual voltage applied to the filament is far in excess of the rating.

Recognizing that the initial voltage of the air-cell battery is 2.53 volts, the value of the filament current resistance must be such as to limit the initial voltage upon the tubes to 2.2 volts. This means that it is necessary to first determine the filament current per tube at 2.2 volts. Experience has shown what when the voltage to be dropped is set at .33 volt, the voltage applied to the filaments when the battery voltage falls to its normal steady value of about 2.49 volts, is about 2.1 volts, or at least within the most advantageous operating range and that the maximum operating life is secured from the filament battery.

If the value of the filament control resistance is based upon the 2 volt .06 ampere rating, the filament voltage applied to the tubes when the battery has reached its normal value of slightly less than 2.5 volts, will be less than actually required for most advantageous operation, both as the tubes and the battery life. The reason for this is that the filament control resistance will be higher than actually required. On the other hand if the current is approximated and the value of resistance is lower than actually required, the filament voltage will be excessive and tube life will be reduced.

The Filament Circuit

The selection of the proper filament circuit resistance, that is, its numerical value is a matter of a few measurements and the application of Ohm's law for resistance. However the practical selection of the unit, is something else. Consider the following. A receiver employs seven of the 2 volts tubes. Six of these tubes require .06 ampere each and the seventh requires .13 ampere, thus totaling .49 ampere. Based upon an initial voltage of 2.53 at the battery and a required voltage of 2.2 volts, the voltage to be dropped is .33 volts at say .49 ampere. In actual practice, the current consumption considered in the calculation would be in excess of .49 ampere.

According to the figures quoted, the value of the filament control resistance would be approximately .673 ohm. To secure a resistance of this value is not very difficult, but another item must be considered a total resistance of .673 ohm is required. This value must be divided between the control resistance and the total resistance of the filament circuit leads, contacts, switch connections, etc. It is therefore necessary that the resistance of the entire filament circuit be known before deciding upon what should be the value of the filament control resistance. If this is not done, the total resistance in the circuit will be so great that the voltage upon the tube filament will be much lower than actually required and the receiver will perform poorly.

In the old type receivers of the battery type, the resistance of the filament circuit was neglected. In a normal receiver, this resistance amounts to some value between .1 and .2 ohm. In an old receiver wherein very little attention was paid to circuit resistance and wherein the control switch and sockets are quite old, the corrosion at the surfaces may be sufficiently great to produce a total resistance as high as .3 ohm. Obviously, the circuit resistance may be from 16 to perhaps 50 percent of the total resistance required, hence cannot be ignored. In fact it must be measured and measured accurately at that. When known, this figure is deducted from the calculated value and the proper resistance is used.

As a point of information, many receiver manufacturers consider the accuracy of the filament circuit resistance to be so important that the required resistor is used without being coiled. The proper resistance value is determined in terms of length of a resistance wire. The wire uncoiled is placed between two blocks and cut to length. A length of spaghetti is slipped over this wire and lugs are soldered to the two ends and the completed unit is used in this fashion.

Referring once more to conversion, it is easy to understand that the measurement of the filament circuit resistance presents a problem, primarily so because of the low resistance involved and because the general run of resistance measuring equipment available as part of service test devices do not readily allow measurement of resistance less than 1. ohm.

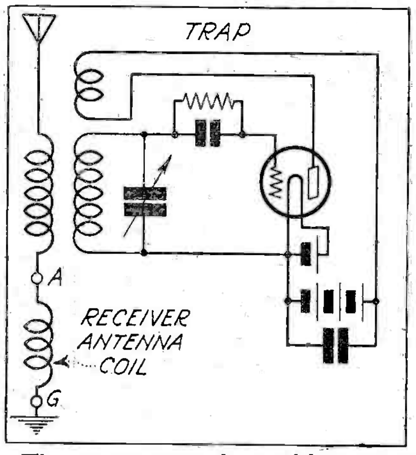
(To be concluded in next issue)

General Data . . .

Power detection has operating characteristics which often cause confusion. The impression gleaned is that the volume control is defective. Quite a few receivers employ this type of detection, particularly t-r-f systems. The condition created by over-loading of the power detector is that there occurs an increase in volume as the volume control is advanced up to a certain point. Still further advancement of the volume control and the volume does not increase. Instead, it flattens out and then starts to decrease. If the receiver is now detuned by manipulation of the tuning control, the volume increases both sides of the exact resonance point. When such a condition occurs, there is nothing wrong with the volume control. It is purely a sign of tube overloading and the only remedy is to reduce the setting of the volume control. Changing volume controls will not help.

◆

Wave traps are not yet of fashion. There are many instances where such devices are still required. The greatest trouble experienced with these devices has been the difficulty of securing fairly satisfactory operation upon the wave desired without interfering with other stations within 10 or 20 kc of the station to be eliminated. A wave trap which accomplishes the desired



The wave trap is nothing more than a simple regenerative receiver. Do not allow it to oscillate.

end is shown herewith. In reality it is nothing more than a simple regenerative detector, which when adjusted to possess a fair degree of regeneration will eliminate stations with very little overlap. It consists of a primary, secondary and plate winding. The primary winding, connected into the aerial circuit need not have more than perhaps three or four turns and must be loosely coupled to the secondary. The entire system is contained in a shielded cabinet and is dry cell, operated. A type '31 tube is excellent as a detector. The plate voltage need not exceed 22.5 volts and can be supplied from a small battery. The grid leak and condenser are of conventional values, consequently do not need special mention. The B battery bypass condenser is 1 mfd.

The resonance curve of the trap system is dependent upon the degree of regeneration available in the circuit. Because of this regeneration and the inductive coupling between the primary and secondary circuits, care must be exercised to avoid excessive regeneration and radiation of an interfering signal. A fair amount of regeneration is possible before the system becomes a radiator of signals and with this amount of feedback, the selectivity curve is sufficiently sharp to make possible the elimination of an interfering signal even at the high frequency end of the regular broadcast spectrum, —and with very little if any overlap. Practice makes perfect and 10 kc separation has been achieved. This is something worthwhile playing with. If only one station is to be eliminated, the variable condenser used need not be any larger than a trimmer. The coil too can be small and the entire unit can be mounted into a metal case of very small proportions. Once again, this unit is not a pipe dream. It has been used and really works.

◆

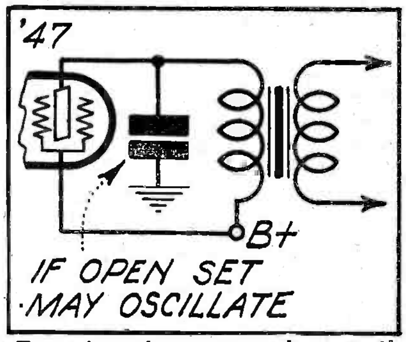
Hum in a radio receiver may be due to a reversed connection of the field coil. In many radio receivers, the field coil is connected into the power pack filter by means of a two pole plug. Where the plug can be inserted only one way, it may be a good idea to unsolder the field coil connections and reverse them. Of course the change should be made only when all other possible reasons for hum have been checked. In some Sears Roebuck and Colonial receivers a hum neutralizing system is used. In such receivers it is important that the field coil be connected in proper fashion.

◆

Balancing of radio receivers requires that certain precautions be exercised. Exclusive of the indicating system used, it is imperative that the balancing tube used be in perfect condition with the exception of the state created in order that the tube heater or filament should not be incandescent. Adapters should not be used during this work. When balancing the receiver, the shield normally placed over the tube in the receiver must be in place over the balancing tube. This shield adds capacity to the circuit and this additional capacity must be present in order that satisfactory balance be obtained. If the shield is lacking, balance will not be secured.

◆

Oscillation in a pentode receiver is often due to something which is seldom suspected and never considered. As a matter of fact is not determinable



Examine the connections to the condenser and also to the ground or chassis.

with a set analyzer. The diagram above shows the location of a bypass condenser usually connected between the output tube pentode plate and ground. (This is not the tone control). If this condenser is open circuited or if the ground connection is poor, oscillator troubles may result. The usual value of this capacity ranges from .002 mfd to about .006mfd. Take particular note of the fact that one terminal is ground and not the tube screen. (Ed. It may be a good idea to try the addition of such a condenser if one is lacking in the receiver.)

◆

Line voltage regulators serve several purposes. One of these, although seldom realized is the function as a preventitive against power transformer primary burnout. By virtue of its operating characteristic the variable resistance automatic line voltage regulator tends to maintain a limited potential across the primary of the power transformer. This characteristic is utilized when an accidental short circuit occurs across one of the secondary circuits of the power transformer. The short circuit tends to increase the primary current. Without an automatic limiting device, the current can rise to such proportions as to cause burnout of the primary winding. With an automatic voltage regulator in the primary circuit, the increased current causes an increased drop across the control device, and the voltage across the transformer primary is kept at substantially the normal value. The total effect is discovery of the defect in the secondary system before sufficient heat is developed to cause appreciable damage. Experiments have shown that power systems equipped with such devices are practically free from burnout troubles in the primary winding. In addition, the use of the device obviates the troubles due to radical fluctuations in line voltage.

◆

An electrolysis action upon the insulation of the wire between the filter choke and one of the electrolytic condensers in the Philco models 70 and 90 has been reported during damp weather. The action which takes place causes the insulation to break down. A direct short circuit is not produced. Instead leakage occurs and of sufficient amount to cause abnormally low operating voltages. Wherever this condition is found, the wire should be unsoldered, covered with spaghetti insulation and reconnected. Later production Philco 70 and 90 receivers have heavy rubber insulated wire on this connection.

Similar conditions may be encountered with other receivers. The remedy quoted is applicable, unless rubber insulated wire is used to replace the original connecting lead.

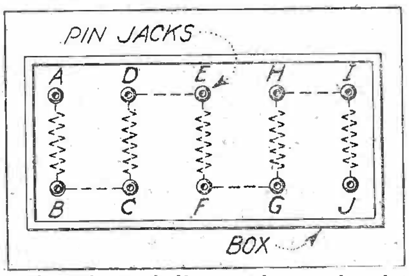
◆

The oscillator tube in the Philco 51 will stop oscillating if the rotor plate of the tuning condenser is touched. The same condition will result if the condenser is adjusted to the low frequency limit of the dial and the metal spacer on the rotor plates is allowed to touch the ends of the stator plates. If this occurs, snap the power switch off and then on again. Normal operation may again be secured by adjusting the oscillator tuning condenser, that is, rotating the tuning control to the high frequency limit. An insulated wire is placed around the metal spacer on one set of rotor plates to prevent them from making contact with the stator. Later model 51 receivers have a small fibre insulator of special design to replace the wire.

◆

A multi-range resistance box is a very handy unit for use in every service shop. It serves many purposes, one of which is a means of rapidly securing a number of resistors of different value for checking supposedly defective units and for comparison purposes. The illustration below shows five such resistors mounted within a box. The terminals upon the cover are of the pin jack variety. Each resistor has two such pin jack terminals and the five resistors are joined in series, as shown by the dotted lines. By interconnecting the various pin jacks, various values of resistance are available. Thus if each resistor is rated at 50,000 ohms, a range of from 10,000 to 250,000 ohms is available.

When the connecting leads are placed into pin jacks A and J, the five resistors are in series and the total resistance, is 250,000 ohms. When the connecting leads are placed into

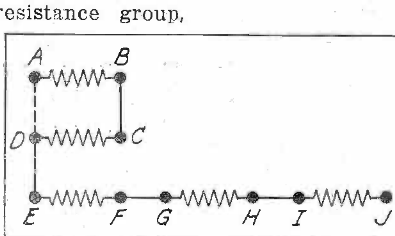


The dotted lines show the internal series connections between the individual resistances.

pin jacks A and B, the resistance in the circuit is 50,000 ohms; into A and D, the resistance in the circuit is 100,000 ohms; into A and F, the resistance in the circuit is 150,000 ohms.

By suitable parallel and series-parallel connections various intermediate values may be secured. Thus when pin jacks A and D are joined by an external wire and the connecting leads to the circuit are plugged into pin jacks A and B, the first two resistors are in parallel and the resistance in the circuit is 25,000 ohms. If the junction between A and D remains undisturbed and the external circuit is connected to B and F, the total resistance in the circuit is 75,000 ohms; between B and H, it is 125,000 ohms and between B and J, it is 175,000 ohms. If A is joined to D, and C is joined to F, the total resistance between A and F is 16,666 ohms. In similar fashion it is possible to place all five resistors in parallel.

By suitable choice of values for each set of such five resistances, a fairly great range of values is available. The mention of 50,000 ohm units in this note is an arbitrary choice, decided upon after a checkup which showed that the majority of resistances utilized in a radio receiver, at least of the carbon type are to be found within the 10,000 to 250,000 ohm range. Five resistors of about 1,000 ohms each would cover the voltage divider resistance group.

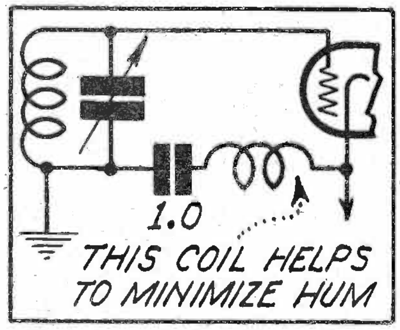


Here two resistances are connected in parallel by joining jacks A and D. With F and C joined, three are in parallel.

Two speakers are used in the Majestic 35 chassis. This chassis is employed in the Collingwood and Abbeywood models. The two speakers used in the Collingwood model are the G-10-C and the G-14. The speakers used in the Abbeywood, model 353 are the G-13-B and G-14-B. The Collingwood model receiver is designated as 351. In both of the receivers named, the two field coils are in series, connected into the positive leg of the power pack circuit. The plate current of the two push-pull pentode output tubes flows through but one of the two output transformers used. The other output transformer primary is shunted around the one connected into the output tube plate system, with a series condenser of .002 mfd. in one leg. Thus if a current meter is connected into this primary circuit, there will be no indication of plate current. Both of these receivers are of the superheterodyne type and the i-f systems are peaked at 175 kc.

◆

If you are working upon Silvertone 1152, 1174, 1252 or the later models of 1260 receivers, also upon some Colonial receivers and cannot find the cause of an unaccountable hum, check the hum balancing or minimizing circuit to be found between the cathode and ground connection to the tuning condenser in the detector grid circuit. See illustration below. In the event



This hum balancing circuit is to be found in Silvertone and Colonial receivers.

of damage to the condenser used in this system, a bad hum and low detector control grid bias will result. An open hum balancing coil will have no effect upon operating voltages, but it will increase the hum. Even with such systems, it may be worthwhile to try reversing the connections to the speaker field, that is, if a mysterious and unaccountable hum is present.

◆

The i-f systems in the RCA Radiola 62 and 64 receivers are peaked at 180 kc. In the model 66 made by the same organization, the i-f system is peaked at 175kc.

◆

Power transformer primaries range in resistance from about 3.5 to about 15 ohms. The majority are within the 3.5 to 10 ohms range.

Power consumption of radio receivers has received much attention for more reasons than one. Knowledge of this type is required when a line voltage regulator or control device is to be installed, such as of the automatic type. Then again the customer may be curious enough to ask about the operating cost of his receiver. It is possible that there may be need for power transformer replacement, etc. At any rate such a table will find utility for a long time to come.

As an aid in the event that some receiver other than that listed herein must be considered, experience and investigation of a large number of receivers shows that the average wattage consumption of a radio receiver or similar device is about 10 watts per tube. Of course there are exceptions, but speaking in generalities, what we stated will be found true in the majority of instances. A specific computation is impossible because of the various tolerances and electrical efficiency factors which enter into the power consumption rating of every receiver.

To determine the operating cost of a receiver when the power consumption per hour is known, divide the known cost per kilowatt-hour by 1000, then multiply the quotient by the wattage rating of the receiver. The result will be the cost of operating the receiver upon an hourly basis. Thus if the power company charge is 7.5 cents per kilowatt hour, (a kilowatt-hour is 1000 watts for an hour), the cost per watt per hour is .0075 cents. If the receiver is rated at 90 watts, the cost of operating it per hour is .675 cent. If the receiver is used for 10 hours per day, the operating cost is 6.75 cents per day. Upon a 30 day month basis and 10 hour operation each day, the cost per month is about $2.025.

The following table of power consumption of receivers has been compiled from various sources of information considered to be reliable. Some of the ratings are those quoted by the receiver manufacturers, some are from a table of measured values prepared by the Amperite Corporation and the balance are values determined by measurement in different localities. As a rule, the power consumption quotations exist with line voltages between 115-120 volts.

ATWATER-KENT

Receiver	Power Consumption
55	80 Watts
60	85 Watts
61	75 Watts
67	70 Watts
80	65 Watts
82	80 Watts
83	65 Watts
85	80 Watts
87	110 Watts
89	115 Watts
96	90 Watts
90	70 Watts
99	110 Watts

AMRAD

AC 9	50 Watts
Duet	90* Watts
Serenata	90 Watts
Symphony	90 Watts
Minuet	90 Watts

* Radio receiver only.

BRUNSWICK

11	85 Watts
12	85 Watts
15	75 Watts
16	85 Watts
17	95 Watts
22AC	75 Watts
S31	90 Watts
32A	70 Watts
33	95 Watts
42A	75 Watts

COLONIAL

25 AC	100 Watts
26 DC	120 Watts
31	90 Watts
32 AC	90 Watts
44	70* Watts
47	80* Watts
48	80* Watts
50	100* Watts
37	70* Watts

* All models are 60 cycles. Add 5 watts additional for 25 cycle receivers.

CROSLEY

48	65 Watts
53	80 Watts
54	80 Watts
57	80 Watts
58	80 Watts
59	80 Watts
63	95 Watts
65	80 Watts
73	100 Watts
77	100 Watts
84	105 Watts
120	110 Watts
121	110 Watts
122	80 Watts
124	100 Watts
21	10-15 Watts
22	10-15 Watts
31	60-70 Watts
32	60-70 Watts
41	60-70 Watts
41A	60-70 Watts
42	60-70 Watts
40-S	85-110 Watts
41-S	85-110 Watts
42-S	85-110 Watts
82-S	85-110 Watts

EDISON

R-1	90 Watts
R-2	90 Watts
R-4	100 Watts
R-5	100 Watts
C-1	185 Watts
C-2	130 Watts
C-4	140 Watts

FADA

16 (No speaker)	73 Watts
17 (No speaker)	73 Watts
25-M	100 Watts
32 (With speaker)	73 Watts
35 (K chassis)	90 Watts
35-B (Rev. K chassis)	110 Watts
40 (P chassis)	98 Watts
41 (KA chassis)	100 Watts
41 (KA chassis)	100 Watts
42 (KA chassis)	100 Watts
43 (KF and KG)	75 Watts
44 (KA chassis)	100 Watts
45 (KU chassis)	100 Watts
46 (KA chassis)	100 Watts
47 (KA chassis)	100 Watts
48 (KW chassis)	120 Watts
49 (KW chassis)	120 Watts
50 (E-180 SPU)	63* Watts
50 (E-420 SPU)	105* Watts
51 (KO-KOC chassis)	75 Watts
53 (KO-KOC chassis)	75 Watts
57 (KO-KOC chassis)	75 Watts
65 (KW chassis)	120 Watts
70 (E-180 SPU)	63* Watts
70 (E-420 SPU)	105* Watts
71 (E-420 SPU)	105* Watts
72 (E-420 SPU)	105* Watts
75 (Revised E)	105* Watts
77 (Revised E)	105* Watts
761 (KF and KG)	75 Watts
762 (KF and KG)	75 Watts
763 (KF and KG)	75 Watts
764 (KF and KG)	75 Watts

* Add 20 watts for 14-B speaker.

FREED-EISMANN

NRII	150 Watts
NR 55	50 Watts
NR 56	50 Watts
NR 78	70 Watts
NR 79	85 Watts
NR 95	90 Watts

FRESHMAN (EARL)

21	50 Watts
22	50 Watts
31	85 Watts
32	85 Watts
41	85 Watts

GRAYBAR

311	60 Watts
340	115 Watts
500	50 Watts
550	50 Watts
700	110 Watts
770	110 Watts
900	110 Watts
G-4	55 Watts
G-8	95 Watts

GENERAL MOTORS

A	105 Watts
B	108 Watts
MA	65 Watts
MB	69 Watts
130	110 Watts
201	71 Watts
216	71 Watts
217 b	71 Watts
218	71 Watts
251	90 Watts
252	103 Watts
253	103 Watts
254	103 Watts
255	103 Watts
256	103 Watts
257	103 Watts
258	103 Watts
259	103 Watts
290	127 Watts
291	127 Watts

GRIGSBY-GRUNOW

15	60 Watts

RECEIVER	Power Consumption
15B	60 Watts
60 (60 cycle)	110 Watts
60 (25 cycle)	125 Watts
25	120 Watts
20 (21, 22, 23)	110 Watts
25B	120 Watts
35	150 Watts
71	95 Watts
72	95 Watts
150 (With motor)	90 Watts
181	220* Watts
160 (60 cycle)	150* Watts
160 (25 cycle)	160* Watts
150	90* Watts

* Includes phonograph motor

A. H. GREBE

21950-A	130 Watts
270-A	125 Watts
270-B (D.C.)	210 Watts
270-C	125 Watts
285-A	125 Watts
285-B (D.C.)	210 Watts
450-A	125 Watts
450-B (D.C.)	210 Watts
AH1	85 Watts
HS-4	81 Watts
HS-4	115 Watts
SK-4	128 Watts

HOWARD

GD-171	80 Watts
GD-245	105 Watts
SG-A	95 Watts
SG-B	80 Watts
SG-F	95 Watts
"O"	80 Watts
"H"	105 Watts
"T"	50 Watts

KELLOG

523	115 Watts
524	195 Watts
525	225 Watts
526	115 Watts
527	195 Watts
528	225 Watts
533	110 Watts
534	110 Watts
535	110 Watts
536	110 Watts

KOLSTER

K-38	160 Watts
K-42	100 Watts
K-44	140 Watts
K-45	240 Watts
K-60	95 Watts
K-62	95 Watts
K-70	95 Watts
K-72	95 Watts
K-80	95 Watts
K-82	95 Watts
K-90	95 Watts
K-92	95 Watts

GENERAL ELECTRIC

S-22	95 Watts
T-12	55 Watts
T-41	115 Watts
H-31	110 Watts
H-32	110 Watts
H-51	110 Watts
H-71 (Radio only)	110* Watts
H-72	115 Watts
H-91	100 Watts
S-22	95 Watts
S-42	95 Watts
K-62	100 Watts
K-82	100 Watts

PHILCO

20	75 Watts
40 DC	210 Watts
41 DC	210 Watts
41-E DC	420 Watts
42	210 Watts
42-E DC	420 Watts
46 DC	42 Watts
46-E DC	85 Watts
65	95 Watts
70	80 Watts
76	95 Watts
77	95 Watts
86	90 Watts
87	95 Watts
90	95 Watts
95	105 Watts
96	105 Watts
111	105 Watts
112	105 Watts
211	135 Watts
212	135 Watts
220	100 Watts
270	100 Watts
296	145 Watts
511	75 Watts

PIERCE-AIRO (DEWALD)

547-A	55 Watts
535	55 Watts
637	45 Watts
735	70 Watts
746	70 Watts

RCA-VICTOR

44	100 Watts
46	100 Watts
47 (Radio only)	100 Watts
47 (Phonograph)	135 Watts
66	110 Watts
80	120 Watts
82	120 Watts
86	120 Watts
R-4	95 Watts
R-5	56 Watts
R-6	95 Watts
R-7	90 Watts
R-7A	90 Watts
R-8	100 Watts
R-9	90 Watts
R-11	120 Watts
R-12	100 Watts
R-21	140 Watts
RE-18A	165 Watts
RE-19	135 Watts
RE-20	145 Watts
RO-23	120 Watts
RAE-26	120 Watts
R-50	126 Watts
R-55	126 Watts
RAE-79	222 Watts
PT-32	33 Watts
C-12	115 Watts
SWA-2	20 Watts

SEARS ROEBUCK

Dominion	65 Watts
Fantasy	60 Watts
Ministrel	110 Watts
Recital	95 Watts
Solo	60 Watts
Titania	65 Watts
J	75 Watts
92	75 Watts
93	75 Watts
93-T	75 Watts
94	90 Watts
95	90 Watts
100	90 Watts
108	70 Watts
109	90 Watts
110-A	90 Watts
111-A	90 Watts
111-B	90 Watts
112	90' Watts
132	90 Watts
138	55 Watts
139	55 Watts
140	55 Watts
1040	90 Watts
1150	85 Watts
1152	75 Watts
1170	85 Watts
1174	75 Watts
1250	55 Watts
1260	85 Watts
1370	56 Watts

SILVER MARSHALL

A	77 Watts
D	95 Watts
E	92 Watts
F	81 Watts
G	110 Watts
726 SW	109 Watts

SPARKS-WITHINGTON

10	105 Watts
15	105 Watts
25	125 Watts
30	135 Watts
35	275 Watts
470	55 Watts
740	143 Watts

STEWART-WARNER

R 100-A	135 Watts
R 100-A	54 Watts
R 102-A	88 Watts
RA-102 (With converter)	100 Watts

STROMBERG-CARLSON

10	125 Watts
11	125 Watts
12	155 Watts
14	155 Watts
19	135 Watts
20	135 Watts
22	140 Watts
25	130 Watts
26	130 Watts
27	155 Watts

U. S. RADIO AND TELEVISION

8 series	95 Watts
7 series	95 Watts
10 series	110 Watts
26-P	65 Watts
99 series	65 Watts

ZENITH

90	90 Watts
92	130 Watts

◆

Resistances intended for use as voltage reducing units in AC filament circuits should be arranged in each leg of the filament system. Thus if one filament circuit requires a resistor of 1.5 ohms so as to reduce the voltage at the filament terminals from 5 to 2.5

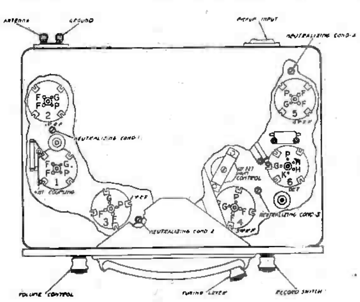
volts, a resistor of .75 ohms should be inserted in each leg. This is particularly true in the case of circuits wherein the filament shunt resistance has a fixed centre tap.

◆

To neutralize the radio frequency amplifier utilized in the R-32, RE-45, R59, RE-75, RE-154 and RE-156 receivers, proceed as follows:

There are five r-f tubes, four untuned circuits which must be neutralized. The antenna coupling stage is untuned and does not require neutralizing. A dummy tube or an adaptor must be provided. A good '26 tube with one filament prong cut off or insulated or a UX adaptor with one open filament prong may be used. The latter method is preferred as the receiver can be neutralized with the individual tubes to be used. By doing this the actual grid-plate capacity is balanced out in-instead of the average capacity. In no case use a dummy plug.

A strong local station or a modulated signal from an oscillator should be tuned in at about 1200 kc. With the signal tuned in and the dummy tube in the first r-f tube socket, (not antenna coupling tube) adjust the trimmer condenser for a minimum signal. Increase the strength of the input signal until a minimum signal point can be determined. Unless this is done, a 'no signal' position may be reached due to low input but the stage



will not be neutralized. Proceed in like manner wtih the second, third and fourth r-f stages.

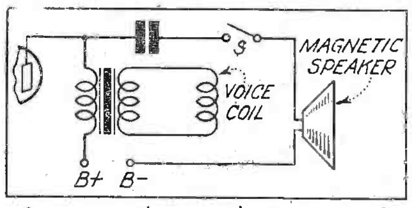
After completion, number 4 trimmer should be turned back (to the left) about one quarter turn. This one quarter turn will increase the output signal by a great amount and the tube will not spill over.

The receiver should be neutralized first and then aligned; after which it may be a good idea to repeat the process for greater accuracy. The efficiency of the radio frequency amplifier used in the receivers named, at the same time, of the compelte receivers depends to a very great measure upon the accuracy of the neutralization and alignment. The aforementioned method of neutralization has been taught to several hundred service men in the RCA-Victor shops and has been tried and tested. The top view of the chassis showing the position of the various neutralizing condenser adjusting screws is shown upon this page.

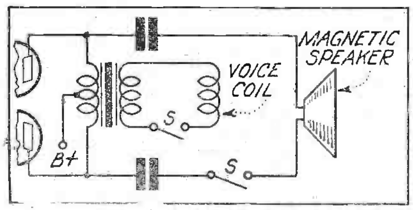
The above is a communication from V. A. Barbee of the Test Eengineering Division of the RCA-Victor Company at Camden, N. J.

◆

Multi-speaker systems are in vogue. Usually the demand is for the addition of a magnetic speaker to a receiver



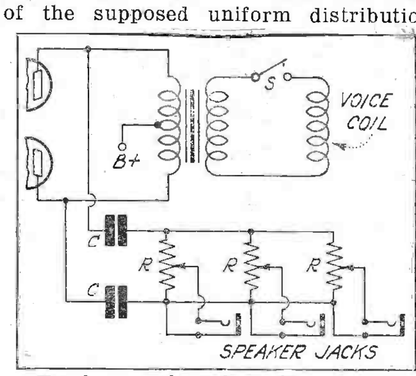
A magnetic speaker connected to a single tube output circuit.



A magnetic speaker connected to a push-pull output circuit. The switches control the additional speakers.

now equipped with a dynamic reproducer. The method of connecting a magnetic speaker to a reciever which utilizes a single output tube and dynamic speaker is shown below. The condenser is a 2. mfd unit. The switch allows opening the extra speaker circuit, when that unit is not in use. If desired, a switch can be inserted into the voice coil system so as to allow a choice of speakers. Of course the use of the supplementary switch in the voice coil circuit is possible only when the voice coil and secondary winding upon the output transformer are separate and individual windings. Several dynamic reproducers produced several years ago were of the single solid copper bar type. Naturally a switch is impossible in such systems.

The addition of another output condenser is required to adapt the system to push-pull output circuits. In view of the supposed uniform distribution



Each speaker has its own volume control. The switch disconnects the voice coil.

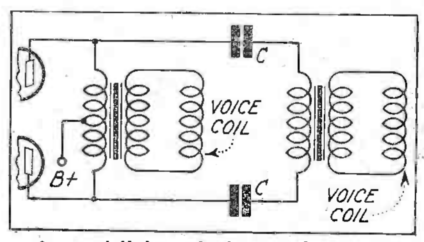
of the D.C. voltages across the two halves of a push-pull transformer primary, it is possible to connect the magnetic speaker directly across the primary winding without inserting the two blocking condensers. However, it is best that they be included. The value of the additional condenser required for the push-pull output system is 2. mfd. The switch in the voice coil circuit and in the magnetic speaker circuit enables a choice of either or both or neither speakers.

In the event that several magnetic speakers are required, several volume control, potentiometers and speaker jacks can be connected across the output circuit. As is evident the speakers are in parallel, the volume input to each being controlled by its associated control resistance R. In each case R is equal to 100,000 ohms maximum.

◆

Two dynamic speakers are usually arranged in the following manner. One of the speakers and its associated output transformer are connected in normal fashion. The second dynamic requires its own output transformer. The latter is connected in series with a fixed condenser of about 1. mfd. and shunted around the first output transformer primary. The field coil for this speaker can be connected in series with the first, providing that the design of the power pack is such as to be able to supply the required power.

If sufficient current is available through one of the voltage reducing resistances and the ohmic value of the speaker field is the equivalent of the voltage reducing resistance, it may replace the resistance and function as a



An additional dynamic speaker is connected across the primary of the output transformer. If desired, only one condenser C, can be used. A good supplementary speaker is a permanent magnet dynamic which does not require field excitation.

voltage reducing unit. If its resistance is less, but the current flow is correct, a supplementary resistance may be added in series with the field coil so as to total the required value.

If the power pack utilized in the receiver cannot supply the required power for the second speaker field, a separate power supply must be used. If desired two condensers may be utilized in series with the leads of the second speaker primary.

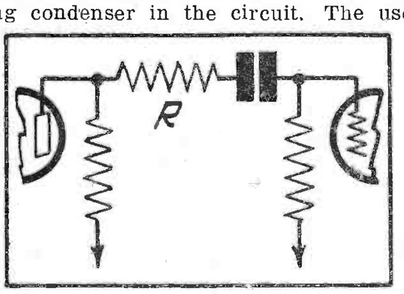
"Suddenly cutting off" is a frequent phrase mentioned in radio service correspondence to denote intermittent operation. Perhaps you too, as you read this note have experienced the same trouble. The usual remedy suggested is an examination of possible intermittent short circuits between the condenser rotors, grounding of bias resistances, grounded bypass condensers, etc. Invariably the complaint is accompanied by the statement that a set analyzer check shows all circuits to be perfect, yet the trouble persists. This is true even when the test is made immediately after the receiver ceased operation.

Here is an example of where a simple fault creates a major effect. In a large number of instances where such defects were reported the trouble was finally located as being a poor contact between one prong of one of the tubes and the associated socket.

Where such a condition exists in the output tube, it may be determined by placing a current meter into the plate system of the rectifier. Jiggling the plate tube in its socket in the effort to improve the contact will show a variation in plate current when the circuit is completed. Under such conditions the fault, although not specifically indicated, is localized. If such a test does not show any effect, it is a good idea to improve the various tube and socket contacts. A set analyzer or set tester check does not indicate the fault because the tube at fault is removed from its socket and the tester or analyzer plug usually makes good contact with the tube socket.

◆

An intermittent contact in the resistance connected in series with the blocking condenser used in some resistance coupled audio amplifiers, between the detector and first audio or output stage will cause much trouble which will be difficult to locate. This resistance is designated as R in the illustration. One characteristic will be a sudden decrease in volume output if not total lack of operation. A point to point check from the plate to the grid of the succeeding tube will give very little information because of the blocking condenser in the circuit. The use of such a resistor is somewhat out of the ordinary and one will seldom seek this unit unless warned to do so.

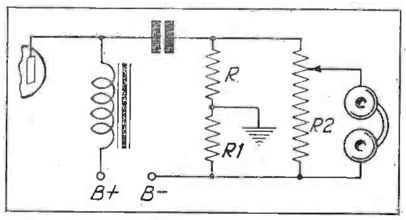


Not many receivers use a resistance in this position, but it is worth the trouble to find it, when used.

If the resistor is not perfect, a great deal of noise will develop during operation of the system. If short circuited across its terminals there will be no change in operating voltages but regeneration in the audio amplifier may reach annoying proportions.

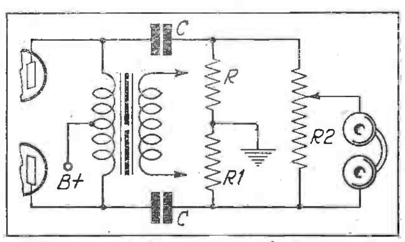
◆

Headphones can be added to single and push-pull output systems by utilizing the circuits shown herewith. In single tube output systems the coupling condenser is of 2 mfd. and is joined to the plate of the output tube. This con-



The coupling condenser is joined to the plate of the tube.

nection can be made to the plate terminal of the output transformer primary or to the plate end of the output choke, if a choke-condenser output system is employed. If desired, a wafer type adapter can be used to make contact with the plate of the output tube. As to the B- connection, it can be the chassis of the receiver of the C- terminal, in as much as this point usually is the B- in the receiver. R and R1 are 1 megohm units, with the mid-junction grounded. The potentiometer R2 can be of 250,000 or 500,000 ohms total. Precaution must be exercised



The coupling condensers are connected across the primary of the output transformer.

with respect to the junction of the B- end of the headphone circuit. It should not be connected to the B plus end of the output choke or output transformer primary. If this is done, one side of the headphone circuit is at high potential and an accidental grounding of the wearer of headphones is apt to prove injurious.

The application of the same headphone system to a push-pull output circuit differs in but two respects. Another blocking or coupling capacity is added. This too should be of 2. mfd. The same condition results if the tube is gassy.

The other difference is that the complete circuit is connected across the plate ends of the output transformer primary or choke, which ever is used. Once again, wafer type adapters can be used in each of the output tubes if contact with the plates of these tubes is desired. The resistance rating of R and R1 is as previously quoted and the wattage ratings need not exceed 2 watts. R2 should be of the 5 watt type. Of course it is highly advantageous to select a potentiometer which will allow variation with minimum noise. If desired, R2 may be joined to R and R1 with a length of twisted cable so as to allow latitude for the listener. Since this circuit is of high impedance, the suggestion is made to used shielded cable. As it happens headphone cords are available with a shield surrounding the leads within the outer braiding. This shield may be grounded by means of the contact provided for that purpose.

◆

When a 60 cycle receiver is to be used upon a 25 cycle line and the required power transformer change has been made, the parallel resonant condenser in the filter system (if one is used in shunt with the filter choke) should be twice the size previously used for 60 cycle power systems. You should remember that the major hum frequency in full wave rectifiers employed on 60 cycle lines is 120 cycles and 50 cycles in 25 cycle systems. In half wave rectifier circuits, the major hum frequency is equal to the line frequency.

◆

Philco receivers equipped with automatic volume control must be adjusted in a certain manner during the alignment procedure. Usually the AVC tube interferes with the proper application of the output meter. When aligning the r-f or i-f systems of these receivers, set the supplementary volume control (manual) to MAXIMUM. When this adjustment is made, alignment changes can be made using the output meter as the indicator.

◆

All automatic volume control tubes of any type do not operate with equal efficiency. In many instances where difficulty is experienced during the operation of the receiver and automatic control of the volume, the remedy is nothing more than a change of tubes. A tube with low emission will not vary the output volume, whereas a tube with excessive emission, although perfectly satisfactory for use in some other part of the receiver, is unfit for use as an AVC tube. It will cause an excessive increase in control grid bias and thus reduce the sensitivity of the receiver to an abnormal degree. The same condition results if the tube is gassy.

Public Address . .

IF we're going to talk about public address systems, it might be well to start at the beginning. When all is well, there is nothing to talk about because there are no complaints. When something goes wrong, we have something to discuss.

One of the most frequent complaints is that the system installed is unsatisfactory, that is to say, the output is insufficient. In some cases, the radio input is satisfactory, but the microphone input is just no good.

There is no doubt about the fact that public address installation offers a field of activity for the service man. Now, if you are interested in such work, start off with the right foot. Don't attempt to make a public address system out of a radio receiver. We all know that the average radio receiver can make a lot of noise when connected to a phono. pickup and that a few of the receivers are equipped with amplifiers which contain enough tubes to represent a fairly powerful audio amplifying system. A few of these receivers can be revamped by additions of one kind or another to act as public address systems, but the balance are not suitable. A two-stage amplifier, consisting of the detector tube with an amplifying bias, and a pair of '45s or '47s, does not make a public address system.

In the first place the pickup from a microphone is very much less than that secured from a phono. pickup. This means that an audio amplifier which provides satisfactory output to fill a certain space when the original source of the sound is a record-pickup combination may not be satisfactory for microphone pickup. Without a doubt one or two additional stages of amplification will have to be added. That is not all.

A phonograph pickup can be added to a system without very much trouble. A high-impedance pickup is suitable practically any place in the input system of an amplifying vacuum tube. A low-impedance pickup can be arranged with any one of a number of so-called "matching" transformers and a fair quality of reproduction will be available. Not so with microphones. You can't connect a microphone into an amplifier circuit in any haphazard fashion. Proper coupling is required for several reasons.

In the first place, because of the low sound input and naturally low sound output. Incorrect coupling may cause sufficient loss to prevent any pickup by means of the microphone unless the speaker places his mouth up against the face of the mike. When in this position, there is every chance of poor quality. In the second place poor coupling of the microphone to the amplifier can ruin the quality of speech. As a rule the usual result of such operation is a great predominance of of the high notes and a great lack of the lower audio frequency register. Every effort must be made to include the lower audio frequencies if good quality is to be secured.

Practically every succesful public address system of the low output power type, say from 10 to perhaps 25 watts, employs at least one separate stage which is utilized solely as the microphone amplifier. In the majority of instances two stages are used. At least two stages are standard in commercial microphone amplifiers. The need for this additional amplification is imperative in systems where the microphone is located at a distance from the main amplifier. The greater this distance, the greater is the need for the additional amplifier. Perhaps, as you read these lines, you may be thinking about some so-called public address system used in some concession at a summer resort, which consists of nothing more than a two stage audio amplifier, a part of a receiver and a microphone. Sure it works, but it is not of the kind which would tempt a listener to ask the name of the man who made the installation.

Microphone amplifiers should consist of about two stages. If resistance coupled, using the ordinary run of '12A or '27 type tubes, plate coupling resistances should be of the order of about 300,000 ohms to 500,000 ohms. The grid leaks should be of between 200,000 ohms and 250,000 ohms. Naturally the input and output are transformer coupled so as to most easily secure the proper impedance for the microphone and for the system to be connected to the output of the mike amplifier. If the amplifier is transformer coupled, use low turn ratio units. A ratio of between 1.5:1 and 2:1 is sufficient. If screen grid tubes are used, the plate coupling resistances should not be in excess of 100,000 ohms in the case of a two stage system with grid leaks of from 250,000 ohms to 500,000 ohms. In single stage amplifiers, the plate coupling resistance can be about 250,000 ohms. These values represent a fair average of the units used in commercial systems and since these have been quite successful in their sale, it stands to reason that they are pretty much right.

The function of the microphone amplifier is not to produce a great amount of amplification. The more sensitive the microphone, the less need be the gain in this pre-amplifier, if we may call it that. At all times it must produce sufficient gain consistent with stability. The last named item is of tremendous importance. The presence of an appreciable amount of regeneration will nullify every advantage gained by using high quality audio frequency transformers or the use of constants in resistance coupled systems which will allow good frequency transfer. Feedback in the systems will change the operating characteristic of audio frequency transformers, so much so, that what can be called flat under normal operating conditions, becomes quite peaked when regenerative effects are introduced. Whether the lows or highs will predominate depends entirely upon the effects present.

Proper filtering of the grid and plate circuits in a-c operated microphone amplifiers is the best means of minimizing regeneration. At the same time it is necessary to employ good design in the power pack filter system. You must remember to consider the placement of the various coupling units in the system and the relative position of the respective leads. This is more important in screen grid pre-amplifiers than in systems which use the conventional three element tubes of the a-c or d-c type. Grid filter resistances can be of from 250,000 ohms to 500,000 ohms in value. Plate filter resistances need not exceed 25,000 to 50,000 ohms. When the latter are used, it is necessary to bear in mind that a voltage drop occurs across this unit, which naturally reduces the effective voltage at the plate. Accordingly, consider well the available plate voltage and select a filter resistance which when used with a suitable bypass condenser will provide filtering, without undue voltage drop. The higher the value of the filter resistance, the lower can be the value of the associated bypass condenser. The important consideration is the proper by-passing at the low frequencies, say between 40 and 300 cycles. The higher frequencies will take care of themselves if the condenser used is satisfactory for the lower register. Filter resistances of 25,000 ohms or higher do not require bypass condensers in excess of 0.5 mfd. Considering the other resistance in series with the filter resistor before a point of common coupling is reached, values as low as 0.2 mfd. have been found successful.

(To be continued in April SERVICE, when we shall also show several typical microphone amplifier circuits and also consider the main amplifier.)

Auto-Radio . . .

Philco has a new Transitone auto radio receiver. It is the model 7. The schematic and chassis diagrams are shown below. The various numerical designations shown upon chassis layout correspond with the numbers shown upon the wiring diagram.

There are certain peculiarities to be found in this receiver. Two pentode tubes are used, one as the 2nd detector or demodulator and another as the output tube. The 1st detector and oscillator functions are performed by one tube. Obviously the receiver is a superheterodyne. The oscillator system and the input to the i-f system both emanate from the plate circuit of the autodyne tube. The peak frequency of the i-f system is 175 kc.

Adjusting the R.F. Padding Condensers

In order to obtain the maximum results from the radio installation, the first and second R.F. padders should be adjusted after the installation is completed.

It will be necessary to remove the front cover plate and to set up a good oscillator capable of generating a signal of approximately 1400 K.C. Connect a six foot lead to the oscillator output terminal, simply dropping it over the back of the seat, and turn on the oscillator. Turn on the receiver and tune to approximately 140 on the receiver scale. Adjust the oscillator frequency to 1400 kc. When using an i-f oscillator, set it for the 175 kc. range and use the eighth harmonic. Turn on full volume on the receiver and adjust the output of the oscillator until the signal is barely audible. Tune the receiver sharply to the signal and then adjust the first r-f padder. This is the one mounted to the extreme right on the condenser housing. Adjust this for maximum signal and then proceed with the second padder, the one in the center. Use only the standard fibre padding wrench. Replace the front panel and the adjustment is completed.

Servicing

A great number of the demands for service made by the car owners will be imaginary and can be traced largely to ignorance of what is to be expected from automobile radio.

When the installation is turned over to the customer, certain things should be pointed out. Interference from street cars and power lines, lack of signal under bridges and tunnels and in some cities, apparent fading at street crossings due to shielding by overhead cables and wires, are easy to explain to the customer and will not be construed as alibis which is likely to happen if the customer is told only after registering a complaint.

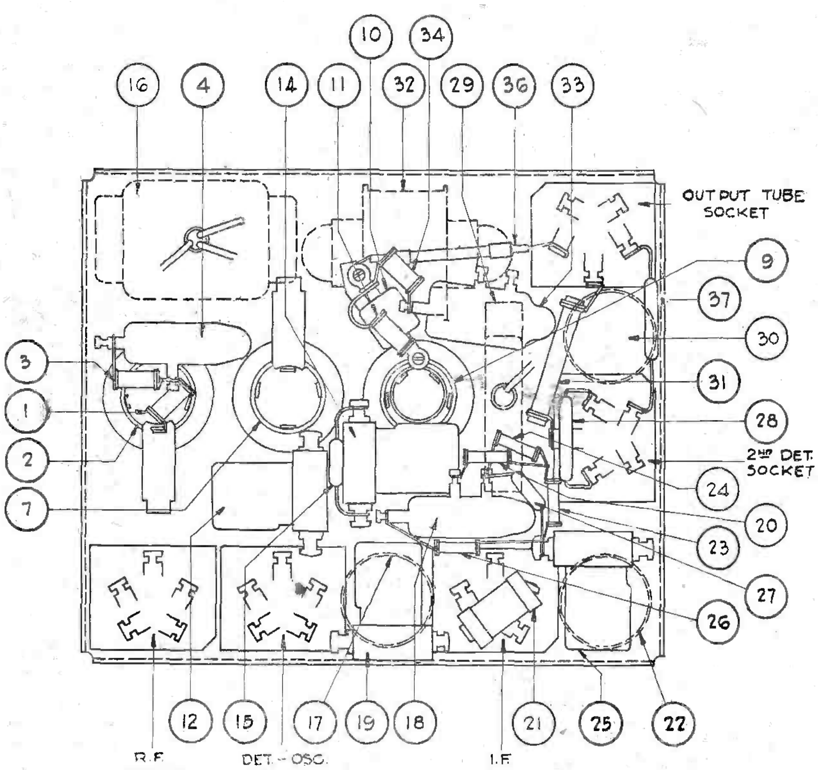
Condenser Data

Numbers on Figs. 1 and 2	Capacity Mfd.	Color
27	0.00025	Yellow
10, 15	0.0007	White and Golden Yellow
28, 37	0.002	Blue
33	0.015	Black Bakelite
4, 18	0.05	Black Bakelite
29	0.25	Metal
16	0.25; 0.5; 1.0	Metal

Tube Socket Readings

Tube	Filament Volts	Plate Volts	Cathode Volts	Screen Grid Volts	Plate Current
R.F.	6.0	129	0.0	61	2.8 ma.
Det-Osc.	6.0	129	6.0	61	0.8 ma.
I.F.	6.0	129	0.5	61	2.0 ma.
2nd Det.	6.0	115	0.0	50	6.0 ma.
Output	6.0	125	11.0	129	6.0 ma.

All voltages taken to chassis with A plus grounded. Detector-oscillator cathode readings taken with receiver tuned to 550 kc.



Model 7—Chassis

Adjusting Intermediate Frequency Stages

Remove the grid clip from the detector oscillator tube and connect the output of the oscillator to the control grid. The detector oscillator is the second tube from the right.

With the receiver and oscillator turned "on", set the oscillator for 175 kc. Adjust the oscillator attenuator so that the signal is barely audible with the receiver volume control turned on full. If the oscillator is equipped with an output meter, connect the meter and adjust the attenuator so that a half scale reading is obtained. Using a Philco No. 3164 fibre wrench, adjust the second i-f condenser. This is numbered twenty-five on the schematic and chassis view. The correct adjustment is obtained when the strongest signal is heard in the speaker or the maximum reading is secured on the meter.

Next adjust the secondary and primary i-f condensers, nineteen and twelve respectively. Disconnect the oscillator and reconnect the clip to the control grid.

High Frequency Compensator

Connect the output of the oscillator to the antenna lead and the housing of the receiver. With the receiver turned on and the oscillator set for 175 kc., tune the receiver to 1400 kc., the eighth harmonic of 175 kc., and adjust the third padder on the tuning condenser for maximum signal. This is the one on the extreme left of the housing. The purpose of this adjustment is to line up the condenser so that 1400 kc., is tuned in at 140 on the scale when the scale is set properly.

It may be necessary to adjust the first two compensators on the tuning condensers at 1400 kc., in order to get a strong enough signal through.

R.F. Compensators

After the detector oscillator has been padded at 1400 kc., adjust the first and second R.F. Condensers on tuning condenser at 1400 kc.

Low Frequency Condenser

Now tune the receiver to 700 kc. and adjust the condenser fourteen. During this operation the tuning condenser must be shifted and the compensators must be adjusted to bring in the maximum signal.

After this has been done, check the adjustment of the high frequency condenser at 1400 kc again.

Resistor Data

Numbers on Figs. 1 and 2.	Resistance*** Ohms
38	7*
21	225*
36	1,250**
1, 11	5,000
31, 34	50,000
3, 23, 24	99,000
20, 26	490,000

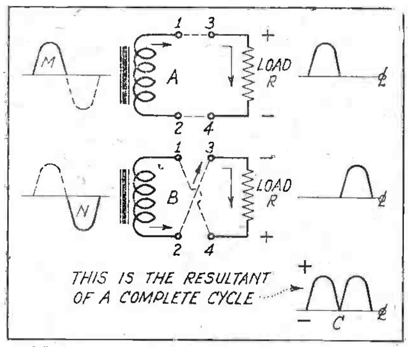
* Flat type.
** Insulated covering.
*** Philco utilizes the RMA color coding.

The synchronous commutator is something new for the service man to think about. These devices are used in the power supply systems designed for auto-radio installations.

The function of the device is to mechanically rectify alternating current so as to provide pulsating direct current. Basically, it is a rotating switch, whereby the polarity of the current supply is always maintained the same with respect to the load.

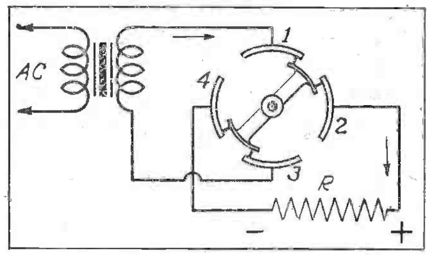
Consider A in the figure shown below. Only the secondary of the transformer is shown. During one half cycle, say the alternation above the zero line, the direction of the current is as shown by the arrow and abitrarily speaking, point 3 upon the load R is positive with respect to point 4. Consequently the potential difference between points 3 and 4 along R has the polarity named.

Now, if the points 3 and 4 along R were connected to a switch which



would be mechanically rotated so that points 3 and 4 would be connected as in A, during alternation M and then when the current reversed, as in B, during alternation N, the polarity of the voltage developed across R would remain unchanged. There would then be present across R a pulsating voltage of varying amplitude but of unidirection. Naturally the current flow through R would also be pulsating as shown in C.

The switching of the load connec-

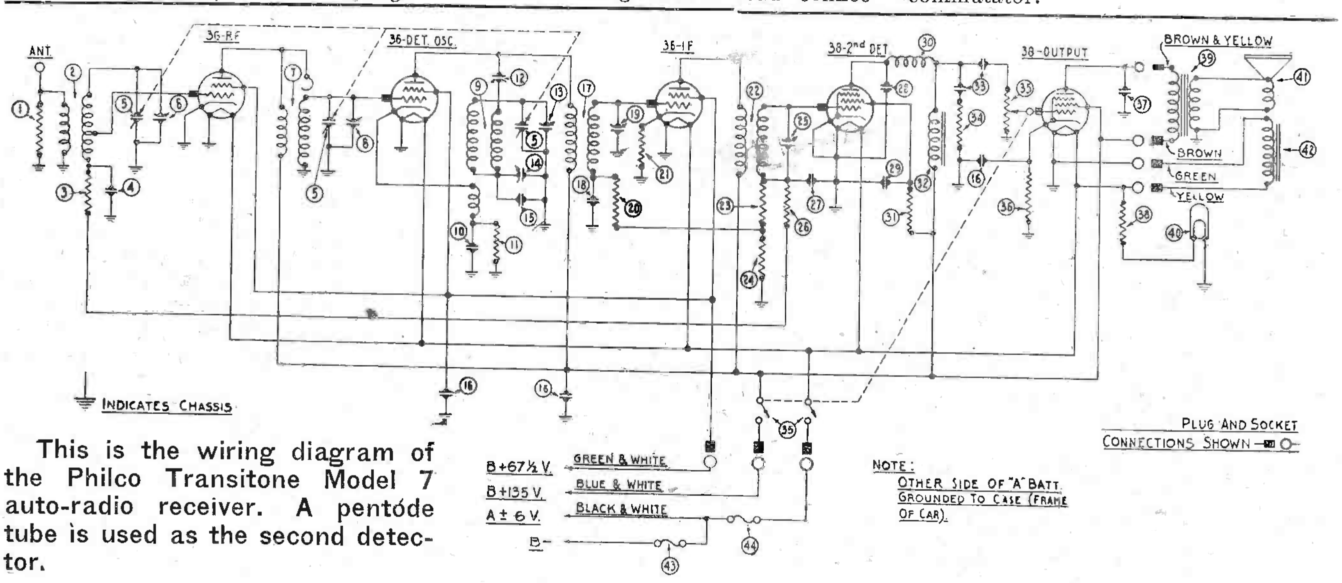


tions to the transformer must of course be in synchrony with the reversal of the current through the transformer. An idea of the mechanical arrangement of a synchronous commutator is shown below. The segments 1, 2, 3, and 4 are stationary. The segments 5 and 6 rotate at a speed in synchrony with the alternating current reversals through the transformer. Of course, there usually exists some slight deviation from exact synchrony, but in view of the small deviation and the small potentials and currents involved no complications result.

Consider one cycle of current. During the time that one alternation of current is in progress, the rotating segments link stationary segments 1 and 2 and the current flows in the direction shown. Then when the current reverses in polarity the rotating segments also change position and the current again flows out through stationary segment 2, which now is connected to stationary segment 3. Stationary segment 1 is in turn connected to segment 4. The final result is as shown in figure C above.

The filter employed smoothes out the pulsations, just as in the conventional power pack.

At the present time, there are two auto radio "B" eliminators which employ synchronous commutators. One of these is that made by the Pines Winterfront Co. and the other is made by Howard Radio Co. The device which generates the A. C. for the transformer also actuates the commutator.



This is the wiring diagram of the Philco Transitone Model 7 auto-radio receiver. A pentode tube is used as the second detector.

Short Waves . . .

When is fading not fading? In many cases where short wave converters are used with broadcast receivers. Variation in the operating potential applied to the oscillator in the converter is frequently the reason for actions very similar to fading and also productive of distortion. The cause for the action is a shift or change in the beating frequency produced by the oscillator in the converter. When this changes, the resultant intermediate changes. With a fixed intermediate adjustment, that is, tuning adjustment of the broadcast receiver, the variation of the i.f. output of the converter results in decreased signal output and distortion. The extent of the decrease depends upon the extent of the shift and the resonance curve of the broadcast receiver at the tuning adjustment utilized for the reception and passage of the intermediate frequency output of the converter.

A few figures may be of interest. Fortunately the range of line voltage variation mentioned herein is not prevalent in large metropolitan centers, but the data will no doubt be of aid when the trouble is experienced in outlying sections. With a line voltage variation of from about 105 to 125 volts, a frequency shift as great as 4kc has been noted with the simple tickler coil type of oscillators. With a variation of about 15 volts, that is from a normal of 125 volts down to about 110 volts, a change of as great as 1.5 kc has been observed. Such variations are particularly true in the case of converters which utilize the plate voltage developed in the broadcast receiver and employ a separate transformer and power circuit for the heaters in the converter.

The shift in oscillator frequency does not follow rapid line voltage variation; that is, when the oscillator is of the cathode type, due to the thermal lag of the cathode electron emitter. Thus rapid fluctuations of line voltage will cause fluctuations of the heater brilliancy, but will have very little effect upon the operation of the complete system. However a slow but definite decrease of line voltage or a similar increase of line voltage, of the range previously mentioned with a period of stability at the lower or higher value, will cause the condition stated.

Two remedies are possible, one of which is an absolute necessity. The first is the use of a line voltage regulator to control the filament or heater voltage fed to converter. (Ed. The average converter consumes 25 to 30 watts.) The second remedy and necessity if tone quality and signal strength is to be obtained, is to change the tuning adjustment of the BROADCAST RECEIVER so as to resonate the supposed intermediate frequency amplifier with the i.f. signal output of the converter.

When the frequency shift is small, say less than 1 kc, it is possible to operate the system without any such jiggling of the broadcast tuning, but tone quality may suffer and the volume will be reduced. However, under certain conditions the shift is so great as to cause total loss of the signal. Then retuning is imperative.

Retuning of the converter does not help, because the RF and mixer systems are not affected by the change in operating potentials and the frequency of the incoming short wave carrier is not changed. The variable control for changing the i.f. output of the converter should not be changed. The frequency shift should be followed by changing the broadcast receiver adjustment. Not only is this method simpler, but it does not involve tedius realignment of the converter system.

(Ed. The effect of varying operating potentials upon oscillator frequency has been receiving much attention of late. See abstract "Constant frequency oscillators" elsewhere in this issue.)

◆

Changing the intermediate frequency adjustment of the broadcast receiver used with a short wave converter helps selectivity and offers an additional means of tuning. Instructing the owner of a short wave converter combination of various tricks possible with such systems, will preclude repeat service calls.

The ability to change the intermediate frequency setting of the broadcast receiver and still accomplish reception of signals is based upon the fact that the selectivity available with the modern short wave converter is dependent not only upon the converter, but also upon the broadcast receiver utilized with the converter. Furthermore, upon the fact that many of the converter circuits are arranged in such fashion that more than one short wave carrier finds its way into the mixer circuit.

Since the signal passed into the broadcast receiver is the frequency difference between the incoming short wave carrier and the locally generated signal (produced by the oscillator in the converter), the broadcast receiver must be tuned to resonance with the output signal of the converter. Thus if receiver short wave carrier has a frequency of 2400 kc and the converter oscillator is adjusted to produce an output intermediate frequency signal of 1050 kc, the local oscillator is tuned to 3450 kc and the broadcast receiver is tuned to 1050 kc. Now, the converter circuits are arranged to track, which means that the tuning adjustment of the oscillator in the converter is always such as to produce the required 1050 kc difference. When the broadcast receiver is resonated with this frequency, the signal is passed through in normal manner.

However, if the broadcast receiver is adjusted to 1075 kc it will no longer pass the 2400 kc signal when the oscillator is set for 3450 kc, but if there is to be found in the converter mixer circuit, a signal of 2375 kc, when the converter oscillator is adjusted to 3450 kc, the frequency difference is 1075 kc and the 2375 kc signal will be passed through the receiver and properly amplified.

Since the frequency difference remains the same when the oscillator frequency is higher or lower than the incoming carrier, a signal would be passed through the receiver if the converter mixer contained a short wave carrier of 4525 kc and the oscillator were adjusted to 3450 kc. Such a wide divergence is not experienced in practice, because the 2375 kc and 4525 kc signals are upon different bands. However with the 3450 kc converter oscillator adjustment, tuning the broadcast receiver to 1025 kc instead of 1075 kc changes the response of the converter, providing that with the fixed oscillator adjustment of 3450 kc, there is present in the converter mixer system a short wave carrier of 2425 kc. Assuming that the last named condition is true, the 1025 kc signal is the result of mixing the 2425 kc carrier with the 3450 kc output of the oscillator in the converter.

It is imperative when such instruction is given to state that shifting the receiver tuning adjustment will not always result in a signal, because it is possible that only one carrier, the one to which the converter circuit is tuned, is present in the mixer system.

Aiding Selectivity

Simultaneous shifting of the short wave converter tuning dial and the broadcast tuning dial, namely the intermediate frequency tuning of the broadcast receiver may help achieve greater selectivity. This is particularly true when one of the desired stations is much stronger than the other, but the carrier of the latter heterodynes the former. Thus if two stations of say 2410 kc (124.5 meters) are present when the converter is tuned to 2410 kc, if may be possible to select the stronger of these stations, possibly both, one at a time, by slightly changing the tuning of the converter and following the change by readjustment of the broadcast receiver. Such separation is possible in the following manner. A 2410 kc carrier is of 124.5 meters. For an output signal of say 1075 kc, the converter oscillator is normally adjusted to 3485 kc. Suppose that the converter tuning is shifted to 2416 kc and the 2410 kc signal is still present in the converter mixer system. At this dial setting the converter oscillator is tuned to 3491 kc. However the short wave carrier is 2410 kc. The other weak carrier of this frequency is not present when the converter is tuned to 2416. With the converter oscillator adjustment at 3491 kc, the frequency difference between the desired carrier and the converter oscillator is 1081 kc. By adjusting the broadcast receiver to 1081 kc, the 2410 kc signal will be passed through the receiver and properly amplified.

Broadcast Station Interference

In many cases it may be necessary to shift the oscillator frequency of the converter. This is due to the presence of a local broadcasting station upon the intermediate frequency adjustment of the broadcast receiver. If such is the case, the normal output frequency of the converter is changed and the original statement of the converter manufacturer, relative to this frequency must be ignored. Thus if the manufacturer states that the converter is so adjusted as to require a broadcast receiver tuning adjustment of 1050 kc and if a local broadcast station operates upon this frequency, it may be necessary to select some nearby frequency, say within 20 or 30 kc either side of the original 1050 kc. If possible an odd multiple of 5 rather than 10 should be selected. This means some frequency ending with the numeral 5, as for example 1035 kc, 1065 kc, 1075 kc, etc.

It should be understood that the aforementioned frequencies are those related to systems which were originally quoted as being adjusted to 1050 kc. If the original adjustment is 1000 kc and some such change is required, because of broadcast station interference, the frequency selected should be one determined by a simple reception experiment. Select a frequency near 1000 kc by tuning the broadcast receiver and noting a spot where around 1000 kc, where no local station is received and where "full" volume control adjustment results in weak response, if any.

The change made upon the converter oscillator system should not be greater than perhaps 45 or 50 kc. Do not attempt to change the operating frequency of a system intended for use at 550 or 650 kc, to 1000 kc or thereabouts. Such great frequency changes are beset with difficulties.

In order to minimize broadcast station interference, the leads between the converter and the broadcast receiver should be shielded. At any rate these leads must be as short as possible. At the same time you must avoid inductive coupling between the converter leads and the speaker cable or other parts of the broadcast receiver. If this precaution is not exercised, howling will result.

◆

Intermediate frequencies used in short wave converters are not the same in all instances. This has been found to be true in short wave converters manufactured by any one organization. No doubt it is the result of experiment and the effort to eliminate some of the troubles experienced with the earlier models. The following i.f. frequencies are recorded as of this date.

RCA Short Wave Converter	1000 kc.
RCA SWA-2 ***	1075 kc.
National NC-5	550 kc.
Kennedy 53	1000 kc.
Kennedy 54**	1525 kc.
Kennedy 54-A	1000 kc.
Pilot "All-Wave"	550 kc.
Philco 4	1000 kc.
Silver-Marshall 726	650 kc.
U.S. Radio and Television 300	1000 kc.

** Provision is made for adjustment of the system to operate at 1500 kc. Such is necessary in view of the fact that it may be difficult to adjust the broadcast receiver for operation at 1525 kc.

*** Provision is made for operation at intermediate frequencies between 1050 and 1100 kc. Such is necessary because there exists the possibility of local station interference at 1075 kc, despite the fact that this frequency is a multiple of 5 and consequently midway between broadcast station allocations.

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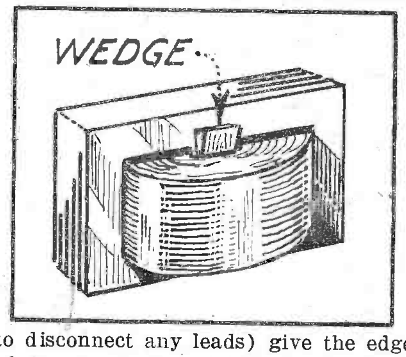
Loose Laminations in, or a loose winding upon a power transformer core may cause a pronounced hum and frequently cause an audible sound. Replacement is necessary only after an examination shows that the cover of the transformer cannot be removed. If it is possible to remove the power transformer case, (Ed. In most cases, this is possible and it is not necessary to disconnect any leads) give the edges of the laminations a good coating of shellac and tighten them by winding twine or tape around the core where it is loose. In some cases a U shaped bracket will be found within the case. Remove this bracket, bend the sides in a bit more and replace. If the winding is loose, insert a small wood wedge as shown. Be careful to insert the wedge between the winding and the core and not between the layers of insulation close to the core.



R-f chokes are frequently the cause of lack of oscillation in home made tube signal generators. Nothing visible gives evidence of the location of the trouble. All voltages are correct and circuit continuity is complete, yet the system refuses to oscillate. When you experience any such troubles, try replacing the r-f choke with another of different design. The exact value of inductance is not of particular interest, just so long as the design of the unit differs from that previously employed.

All r-f chokes should be as small as possible consistent with satisfactory oscillation. The current flowing through these units causes the radiation of a field. Then again there may be coupling between the choke and the oscillating system, which will defeat the purpose of the choke.

◆

An audio howl is frequently caused by hardening of the rubber mountings used as floats for the chassis. These harden and convey the vibration from the cabinet to the tubes. The only remedy is to replace them with sponge rubber supports or new live rubber washers. At no time during the operation of the receiver should the chassis supporting screw be tightened sufficiently to compress the rubber chassis float.

◆

A crystal controlled oscillator is provided by Philco for adjustment of their converters. This crystal is tuned to 3600 kc and the adjustment frequencies are 1.6 megacycles; 3.6 megacycles; 7.2 megacycles; 8.8 megacycles and 18 megacycles. A megacyle is equal to 1,000,000 cycles. Thus 3.6 megacycles equals 3,600,000 cycles.

◆

The automatic volume control tube must be considered when making alignments upon the i-f system of a superheterodyne. We refer to the system wherein the AVC tube is not used as a detector. If this tube is allowed to remain in the socket during the alignment it will nullify the advantages obtained by means of the output meter. However, if it is removed, the capacity taken out of the circuit will influence the alignment. Accordingly, the only remedy is to use a "dummy" tube in its stead. Such a tube is a duplicate of the type used for the AVC position, but has one of the heater prongs cut off at the base of the tube.

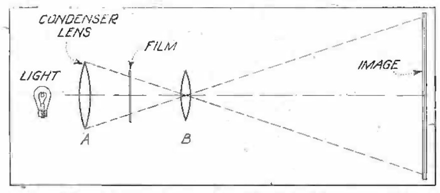
◆

Writes One Service Man . . .

I have so many books which have been written for service men that I am a book worm and have no time to work. I am afraid to get a job for fear that as soon as I do someone will announce another book "for the service man".

Home Talkies . .

Motion pictures are based upon an optical illusion. The eye is fooled by the fact that a number of still pictures are passed before the eye during vision at a certain rate of speed. A reel of so called motion pictures consists of a number of 'still' pictures, that is, regular photographs. These are taken at a certain speed and each still shows the animated object in a different position. When the finished picture is projected, the eye sees a series of stills, but at such speed that the image appears to be in motion.



This is an elementary projector. Lens B is the objective lens.

If the still pictures are projected at a rate of less than 16 individual pictures per second, the eye notes a flicker representing the fact that what is actually viewed is a number of individual phtographs. However, at higher speeds, the flicker disappears and continuous motion is imagined. The usual rate of projecting the stills which constitute home movies is 24 pictures per second.

A reel of film is divided into 'frames'. Each frame is a single picture of the series constituting the film. When one 'frames' a picture it is the equivalent of adjusting the aperture so that it is in correct position adjacent to the picture so that the light passes to the film. In home talking movie devices an incorrectly framed picture results in a partial blocking off of the picture upon the screen because the light does not strike the entire frame.

During the projection of so called motion pictures, each picture or frame remains momentarily stationary in front of the light aperture. During the time that the frames move, a shutter blocks the light so that there is no blur due to the picture in the motion. The pictures are guided by means of the sprocket holes. These holes are square and are located on the two side edges of the picture. (Ed. See holes shown in illustration used to describe mending of film.)

The general structure of the optical system of a motion picture projection is shown upon this page. Essentially it consists of a source of light, usually known as the projection lamp. The light from this source passes through a 'condenser' lens (A) where it is concentrated and focused upon the film. (The various apertures and mechanical control devices are omitted during this description.) The light passes through the film into the objective lens system (B). Only one lens is shown in the illustration. As a rule several lenses and in some cases combination lenses are used in this system.)

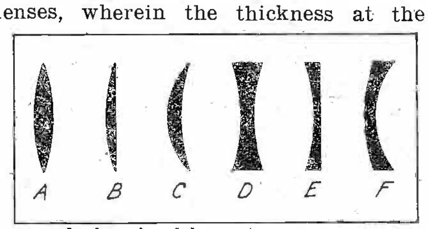
The objective lens system serves to focus the image projected upon the screen. Accordingly it is so arranged that its position may be varied. The selection of the lenses used in this system is based upon the size image desired and the distance of the screen from the projector. If the objective lens is not properly focused, the picture upon the screen will not be sharp and clear. One adjustment is sufficient if the distance between the projector and screen is always the same. If this distance is changed, the focus must be changed.

The intensity of the picture depends upon its size and distance from the projector. With any one objective lens, the greater the separation between the projector and the screen, the larger is the image and the less the intensity of light upon the screen. (See "Inverse Square Law", pp 10, **Service** for February, 1932.) The less the distance between the projector and the screen, assuming proper focusing, the greater is the brilliancy of the light upon the screen, consequently the detail of the image.

◆

Lenses are of different type. Six kinds of lenses are shown elsewhere upon this page. They represent basic types. Various combinations of such lenses are arranged to produce certain effects. A combinations of lenses is known as a compound lens.

The lenses A, B and C are known as convergent or convex lenses. All such lenses are thicker in the centre than at the edges. On the other hand, D, E and F represent divergent or concave lenses, wherein the thickness at the edges is always greater than at the centre. The primary difference between types of lenses is their action upon a parallel beam of light. If a parallel beam of light is incident upon a convergent lense, the rays leaving the lens tend to converge to a point called the principle focus. Such lenses are A, B and C.



A is double convex.
B is plano convex.
C is concavo convex.
D is double concave.
E is plano concave.
F is convexo concave.

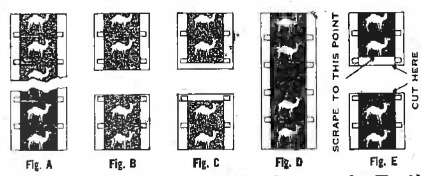
When a parallel beam of light is incident upon a divergent lens, D, E or F, the effect of the lens is to cause the beams to diverge or spread.

◆

Mending film will be a frequent job. So much so that a small mending kit will eventually become a part of the regular service kit. This is true despite the fact that most of the film which shall be used in the early stages of home movies will be rentals. However sufficient people will buy films to justify such calls.

Figure A illustrates a few frames of broken 16 millimeter film. Broken film is prepared for mending, by cutting the film about one-eighth of an inch from the frame line on both pieces. (The frame line separates the different frames.) The removal of the torn edges is shown in figure B.

If you will examine the film you will notice that one side is glossy and the other side has a dull finish. The latter side has the emulsion on it. After having cut off the torn edges, moisten the space between the edge of the film and the nearest frame line upon the emulsion side of the film. Use ordinary water. Apply with a toothpick and allow it to remain wet for about one half minute. Then, with a sharp instrument scrape off emulsion up to the nearest frame line. The emulsion will come off easily. Remove all dampness with a cloth. The cleaned surface is shown in figure C.



Figures A, B, C, D and E illustrate various steps during the mending of a break in motion picture film.

The scraped parts of the film are then smeared with an even and thin coating of film cement. Then an amount of blank film equal to the amount cut out plus the overlap, is laid over the cement so that the sprocket holes match. It is very important that the sprocket holes match accurately in order to avoid binding when the film is passed through the machine. Mending kits have regular mountings for lining up the sprocket holes. Make sure that you have an overlap of one-eighth inch as stated in order to provide sufficient strength to the patch. After the patch has been placed upon the cemented surfaces, press it flat with the fingers or a dry smooth surface for about one half minute. If possible the patch should be made with black leader film. This is shown in figure D.

In synchronized film, it is imperative that the amount of film removed because of a break be replaced with the patch. If five frames are removed, the equivalent of five frames must be replaced.

The afore mentioned method of patching is equally applicable to non-synchronized or silent film. However, a more convenient method is available when desired. In the case of silent film, it is not necessary to replace the frames removed. Simple cut off the torn edges to about one-eighth inch from the frame lines. Now moisten the emulsion side as stated and scrape clean. Place the glossy side of the other section of the film over the scraped portion. Be certain that the sprocket holes line up. Keeping the film in position, raise the section of the film located above the scraped part so that a thin even coating of cement can be applied to the scraped portion. Now press the other film firmly to the cemented portion for about one half minute. Wipe clean and the patch is completed. The two sections of non-synchronized or silent film are shown in figure E.

The period of time required to project a picture can be approximated if the length of the film is known. As a rule, 16 millimeter film, the kind used in home talking movie installations runs at an approximate speed of about 20 feet per minute. This means that a reel of 100 feet of film will require about 5 minutes. Naturally a reel with 400 feet of film will require about 20 minutes for the complete showing.

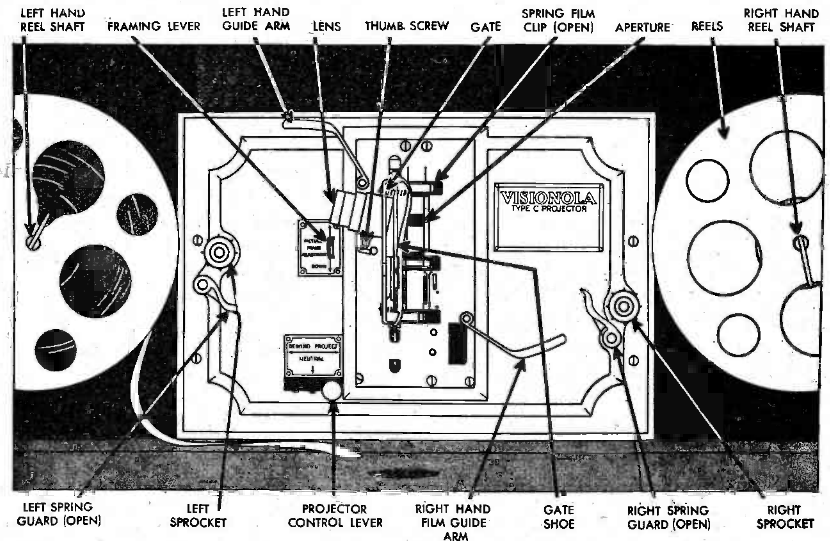
Film must not be allowed to become dry and brittle. This means that a certain amount of moisture must be contained in the can housing the film. Cans available for the housing of 400 feet reels usually have a compartment containing a porous material which is kept moist by periodic applications of a small amount of water. While it is true that moisture is necessary, water should not be applied to the film itself.

Film which is synchronized with speech or sounds must be properly threaded, that is started. This means that the frame marked with an "X" or bearing the word "Start" must be properly located at the aperture. By the same token, the synchronized record must be set properly. The phonograph needle must be placed at the point marked "Start".

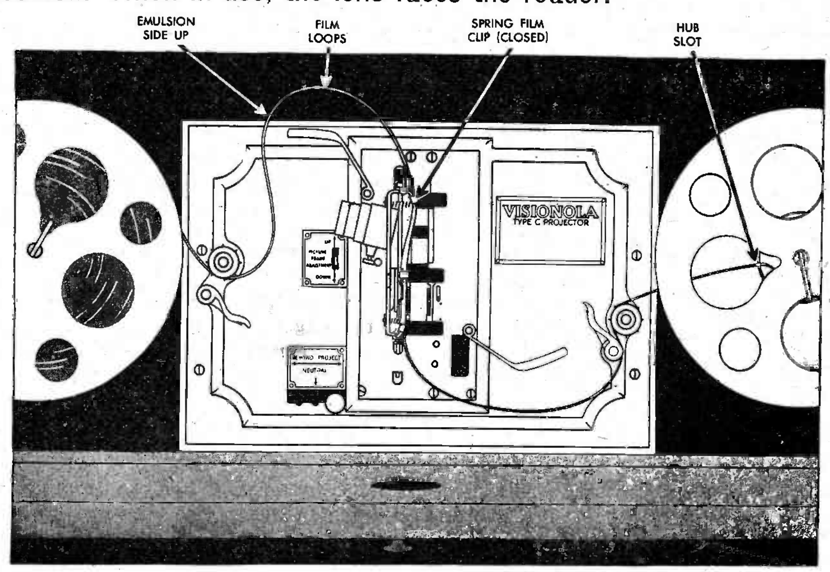
The 16 inch Motion picture sound records are cut differently than the regular records. The starting point is closest to the centre of the record and the needle moves towards the outer edge of the disc. Excessive speed of the record tends to raise the pitch of the speech, whereas slow speed tends to reduce the pitch and create a drawling effect. If for some reason, the phonograph needle jumps a grove, it is best to secure another record otherwise such an action will thrown a synchronized talkie out of kilter.

The weight and free motion of the tone arm are quite important factors. Excessive weight will not only wear away the recording but it will slow down the speed of the disc and thus interfere with synchronization as well as the character of the sounds being produced. If the tone arm does not move freely, the record will be worn away with undue haste and the character of the speech will be destroyed. Avoid applying any physical shocks to the mechanism during the time that the record is revolving and playing.

Picture Mechanism of Sparton Visionola



The above illustration shows the various and units found upon the projector mechanism of the Sparton Visionola home projector. The lens and film gates are shown at right angles to their normal position. When in use, the lens faces the reader.



SECOND STAGE IN OPERATION OF VISIONOLA SHOWING FILM LACED IN APERTURE GATE AND ON SPROCKETS

This illustration shows the film threaded through the various parts of the projector. The projection lamp can be considered as being behind the centre plate and directly behind the projection lens when that part is in its normal position. The film is threaded with the emulsion side up.

Abstracts . . .

Constant frequency output of an oscillator is as important to a service man as it is to the engineer of a broadcasting station. An r-f or i-f oscillator which does not afford an output signal of constant frequency is of very little utility either in testing or during alignment. The following abstract is that of a paper devoted to the subject of constant frequency oscillators utilized for transmission purposes. Fortunately, some of the examples illustrated employ tubes of the type utilized in radio service work, so that the actual meat of the paper is of vital service interest. There is no doubt about the fact that constant frequency will be one of the major sales features of oscillators which shall be produced in the very near future.

(Ed. In abstracting this article, we selected the items of interest to radio service men. The remainder of interest to engineers allied with transmitters receives mention.)

There are two basic reasons for possible variations of the frequency output of an oscillator. These two reasons are changes in the external circuit and variations in the internal constants of the tube. The changes in the external circuit represent the constant of the oscillator and associated circuits. These variations may be caused by vibration of the elements of the circuit such as the condenser plates, nonrigid structure whereby a definite change takes place over a period of time, a change of temperature which may cause a change in the separation between the plates of a fixed condenser or the turns of an inductance, shrinkage of winding forms or variation of the diameter of winding forms, etc.

The variations in the internal constants of the tube are attributable primarily to variations of the operating potentials, such as filament, plate or grid voltage. The major tube constant which undergoes a change and causes a frequency variation, which at times may be instantaneous is that of the plate resistance.

By suitable rugged structure of the external elements of an oscillating circuit such as the tuning condenser, fixed condensers, leads and inductances, the items to be considered simmer down to the tube operating potentials and constants.

Experiment has shown that the frequency of a vacuum tube oscillator while largely determined by the constants of the oscillating circuit, is however also affected by variations in plate and filament voltages because of the effect of these variations upon the plate impedance of the tube. While it is true that the magnitude of this variation is small when compared to the fundamental frequency adjustment of the oscillator, it nevertheless, is sufficiently great to cause unreliable service and interfere with the absolute utility of the tube generator. (Ed. Tests have shown that a variation of from 1 kc. to as high as 8 kc. is possible by suitable variation of the filament voltage. The variation for a like percentage change in plate voltage is not equally great.)

Stabilization of oscillators may be accomplished in devious ways, but one system is that employing a resistance at one of several points in an oscillator. While a degree of stabilization is accomplished, absolute stabilization is impossible, but that secured is sufficient for ordinary practices.

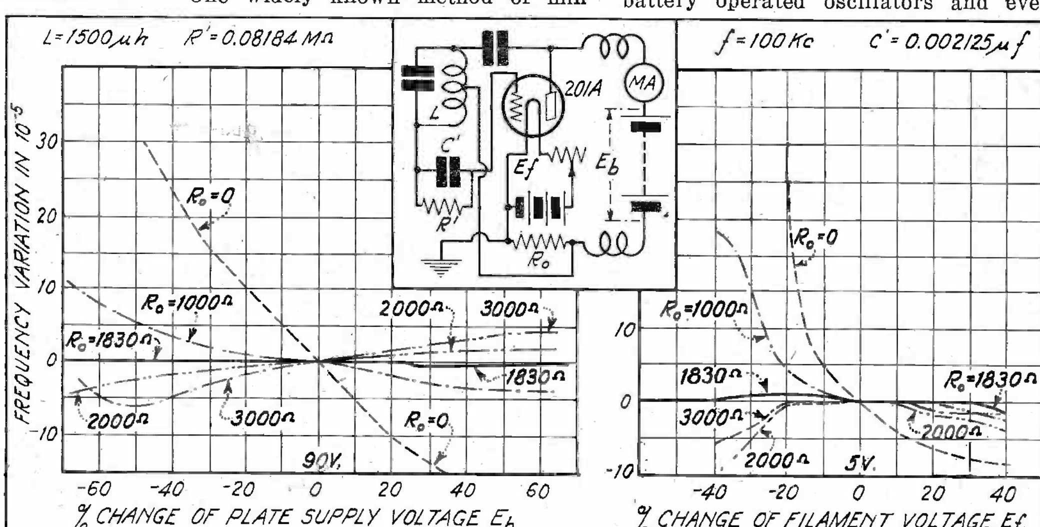
One widely known method of minimizing frequency variation is to introduce an external high resistance in the plate circuit, in series with the oscillating circuit so that the frequency of oscillation is less influenced by the variation in the tube plate impedance.

Another method is to employ a grid leak of high resistance so as to provide the dynamic bias. The bias voltage then applied to the grid is dependent upon the strength of the oscillations and tends to automatically diminish the variation in plate resistance when the operating voltages, namely the filament and plate, are changed.

A system devised by the authors employs a fixed resistance of suitable value located in such manner that it acts not only as a resistance in the oscillating plate circuit, but also tends to produce a part of the grid bias. Also grid excitation by virtue of the voltage drop produced by the direct current and the oscillating components of the plate current flowing through it. Thus this resistance produces a state of stabilization greater than that which may be achieved by the application of either of the two individual resistances previously referred to.

The two graphs and wiring diagram illustrate the effect of various values of resistance starting at zero, utilized in this position in the oscillating circuit shown. This oscillator finds very extensive utility in the radio service field and it is for this reason that these graphs are of particular interest. The fundamental frequency of the oscillator is 100 kc. As is evident a radical change in output frequency occurs when the plate voltage is changed from a normal value of 90 volts. The same is true when the filament voltage is varied from its normal value of 5. volts. Closer examination of the two curves shows that there is an optimum value of stabilizing resistance, which when used produces a fairly stable output despite plate and filament voltage changes. (Ed. This information is of particular value in connection with battery operated oscillators and even

The wiring diagram illustrates the test oscillator circuit. With proper operating potentials, the tube used can be a '30 and Ro should be determined by experiment. The graphs illustrate the effect of varying Ro with varying operating potentials applied to the 201A tube.



(Courtesy Institute of Radio Engineers)

a-c operated oscillators where plate and filament or heater voltage variations are encountered.)

In the instance shown, utilizing a UX 201A tube with 90 volts applied to the plate and 5 volts to the filament, the correct value of stabilizing resistance is of the order of 1830 ohms. It is significant to note the frequency change when no stabilizing resistance is used.

The author describes several instances where a different value of stabilizing resistance is required to compensate for plate voltage variations and for filament voltage variations. In the case of a Hartley oscillator, the suggestion is made to use a low value of inductance and a high value of capacity so as to cause minimum variation due to plate resistance changes.

The optimum methods of stabilizing Colpitts as well as Hartley oscillators are shown with representative values mentioned. The authors illustrate quartz, mechanical and vacuum tube methods of stabilizing tube oscillators.

(Ed. As far as the service man is concerned, the first part of this paper is of the greatest value. The authors have a method of presenting this data which is easily understood and applicable. Several tests have been made by the writer of these lines in connection with the stabilization of conventional service test oscillators utilizing the '30 tube. While the tests were not carried out to completion at the time of this writing, they illustrated the successful application of this method of resistance stabilization and a combination r-f and i-f oscillator stabilized in this fashion will be described in the very near future.)

Present owners of service test oscillators can try such forms of stabilization by experimenting with different values of resistance incorporated at the position shown, providing that the oscillators are of similar type. Fortunately, the majority of oscillators recommended for construction and sold commercially are of the Hartley type.)

Kusonose and Ishikawa, Proc. I.R.E. February 1932.

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Electrolytic condensers are judged upon the basis of four important factors. These are in the order of their importance, the capacity, the leakage, the resistance and the power factor. All four of these figures may be tested with a high degree of accuracy. The equipment required varies from fairly simple circuits to fairly complex systems suitable primarily for laboratory application.

A simple means of determining the capacity of an electrolytic condenser is shown herewith. The measurement of capacity is carried out with a circuit which resembles very closely the regular "B" eliminator filter system. Furthermore, the test as shown is made with a composite current, that is, direct current with superimposed alternating current.

In the circuit shown, it is important that the d-c voltage exceed the peak a-c voltage. With this stipluation observed, there are no rigid requirements relative to the exact voltages employed. Of course the voltages involved should not exceed the operating voltage rating of the condenser being measured. The formula used in connection with the test is as follows:

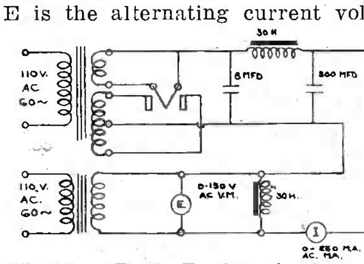
$$Cx = \frac{I}{2 \; 3.1416 \; F \; E}$$

where

Cx is the capacity in farads

I is the alternating current in amperes

E is the alternating current voltage



(Courtesy Radio Engineering)

This is the circuit used to test the capacity of electrolytic condensers. It is quite simple to construct.

(A safe margin for adjusting the d-c voltage is to use a value which is at least 1.5 times as great as the a-c voltage at E.)

An example of the application of the circuit is as follows: Suppose that the test circuit is assembled and applied to a 60 cycle supply line and E is equal to 50 volts. The condenser to be tested is rated at 8. mfd. The current indicated upon the a-c milliameter is .15 ampere or 150 milliamperes. Then the formula becomes

$$Cx = \frac{.150}{2 \times 3.1416 \times 60 \times 50}$$

$$= \frac{.150}{18850}$$

$$= .0000079 \text{ farad}$$

Since 1. farad equals 1,000,000 microfarads, multiplying the above quantity by 1,000,000 gives the product 7.9 microfarads.

(Ed. The aforementioned capacity test should be of interest to a large number of service men in view of the fact that the test equipment is of simple type and utilizes apparatus which may be found in any well equipped service station. Such a circuit because of its great simplicity has been desired for a very long time and there is no doubt that its application will be very frequent.)

The balance of the system is quite conventional and the average '80 type power pack capable of supplying between 100 and 150 volts d-c will be satisfactory. We make specific reference to the 500 mfds. indicated as the output capacity of the filter. We are communicating with the author of the article as named at the conclusion of this abstract and shall make further comment in the April issue of **Service.**

The leakage current of electrolytic condensers varies with the type and the type and conditions of operation. However certain conditions create certain effects irrespective of type. Thus, if a condenser has been out of use for a prolonged period of time, there is an apparent deterioration of the film upon the anode which is the equivalent of a reduction of the resistance of the film. The result is an increase in leakage current. When this condenser is returned to active surface, the film is improved and the leakage current returns to normal.

(Ed. In some instances as for example in the case of electrolytic filter condensers which have been inactive for several months, several hours are required for what may be termed reactivation of the film. During this period the hum output of the receiver or amplifier is quite appreciable. Little by little it decreases, until when the condenser film is again normal, the hum too reaches its normal level.)

Temperature influences the leakage current and the maximum operating temperature should be considered as 50 degrees Centigrade (122 degrees Fahrenheit). The circuit recommended for the measurement of leakage current is a power pack designed to supply a variable output voltage sufficiently high to allow testing at the d-c voltage rating of the condenser. The unit to be tested is connected in series which a d-c milliammeter equipped with suitable shunts with 100 milliamperes as the maximum. The series combination of the current meter and the condenser is connected across the voltage divider of the power pack. The divider is adjusted to supply the desired d-c voltage. Such a divider can be a 100 watt, 50,000 ohm potentiometer. The meter recommended is a standard 0-1 milliammeter, with a 10 mil and a 100 mil shunt.

The average resistance of an 8 mfd electrolytic condenser is about 8 ohms, although the resistance value varies with type of electrolyte, frequency and temperature. The resistance value is important in connection with the efficiency of the unit when used in a filter system. The effectiveness is directly proportional to the impedance of the unit at any given frequency. The author shows a simple and convenient method of determining the impedance by the comparison method. A vacuum tube voltmeter is used to measure the a-c voltage across the condenser and then across a variable resistance inserted into the circuit in place of the condenser. This resistance is varied until the voltage across the vacuum tube voltmeter is equal to that measured across the condenser. The impedance of the condenser then is equal to the amount of resistance required to produce the condition named.

The author describes a bridge system for measuring the resistance of such condensers and also the capacity.

Gerstang, Radio Engineering March. 1932

The Man on the Cover

LEON A. CHARBONNIER

("Charb" to the radio trade). Service Manager of the Atwater Kent Manufacturing Company of Philadelphia.

Since 1916 he cultivated and helped produce nice fat sparks at the spark plugs of A-K ignition systems. Ignition interference didn't bother him very much at that time. Now it is a major problem. In the past he maintained sales engineering contact with automotive and motor boat ignition users.

Soon after 1922, when his organization produced their first radio receiver, "Charb" was transferred to the radio service branch where he has been ever since. He is credited with having started the first service school for members of a manfacturing organization and for its dealers and their service men. As far as we know this school is still in existence and has turned out very worthwhile service men.

He has joined the ranks of authors (involuntarily), having produced the very comprehensive A-K service manual, which at the present time numbers about 300 pages. This is distributed among the dealers and distributors who sell the receivers produced by his organization. Reports have it that he has a mole plumb in the middle of his back, but he refuses to affirm or deny the statement.

Too busy to travel much.—However seems to find time to show himself at the various conventions where a reasonably good time is assured.

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The Antenna

(Continued from Page 24)

decided adversely against the service organization. Furthermore these decisions and the things which lead up to them have received notice in the public press. This means that the handwriting is on the wall.

Every local newspaper carrying cut rate service advertising when advised of any such condition will immediately refuse to carry advertising of this nature. Its general reader public demands protection from fraudulent advertising and if any such condition is reported, the results as a rule are very unpleasant.

In order to accomplish the end, cut rate radio service advertising must be ambiguous and in its ambiguosity it is dishonest. It must be ambiguous because if it is honest, the work shows no financial return. If the cut rate is a price war, the public benefits and the dealer or service man loses. A service call from a reliable service organization is worth $2.00 per hour. This charge is entirely equitable because it includes the traveling time and in reality should be the minimum service fee. If you charge less, not with any intention of gouging during the service call, you are making a mistake, as a tabulation at the end of a month or six months will show.

Cutting prices in a legitimate fashion is legitimate but you are the loser because the cut price does not enable you to service a receiver any faster, and you receive less for your services. And bear in mind that if you are careless during a service job on the grounds that you are working at a cut rate, a dissatisfied customer can cause great havoc among your prospective customers. That fact that you charge cut rate prices is of no consequence. It means nothing if the job is poorly done.

In large towns you may have an opportunity to last because your advertising will pull new suckers, but in small communities, you might just as well quit.

Cut rate radio service just does not pay. The sooner the cut rate service man realizes this fact the better for him and the industry at large. The same applies to price wars.—Get your price. If your work is good you'll last and be there to see the cut rate shop take in its shingle.

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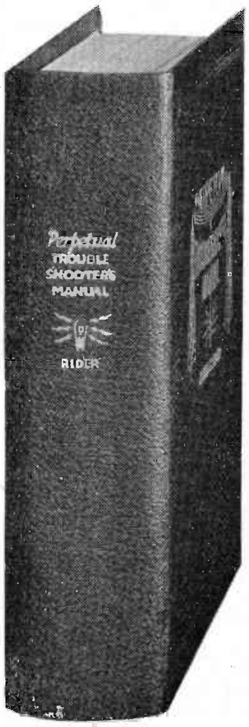

of more than 1000 pages is the standard among serious minded radio service men. . . . . . why it is used in the most famous radio schools and in laboratories and educational organizations.

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Index of Monthly Literature

**Item marked with two asterisks is abstracted in this issue.

IRC Service . . .

TIME AND MONEY SAVERS

With this issue of "Service", we are starting a series of talks on the subject of resistors, and the resistor helps that are available to make your radio work easier for you.

There is no more important part of the radio set than the resistor. And the man who has at his elbow the proper guides and data to solve resistor trouble adds greatly to the volume of his business and his yearly profits.

In this first page we are giving you a general idea of the various items we offer. In each later issue we shall discuss but one or two problems of major importance to the repair man.

The Handy Certified Kit of twenty Metallized Resistors, which you see here pictured, is new this year. We had no idea when we offered it, what a ten-strike it would make with men in the field—and the hundreds of letters we would receive thanking us for the assistance it has proved to be.

Then, too, we want you to become acquainted with the I.R.C. Resistor Guide, if you do not already own one. It has simplified the replacement problems of Servicemen in every State in the Union.

There are nearly 16,000,000 receiving sets now in operation in America. The field of the repair man is becoming more important with each passing month. By the same token, his problems are multiplying, and to assist him in every way to meet these situations at minimum trouble and cost to himself, our engineers are constantly at work.

As time goes on, we shall give you the news of these developments on this page. And we want you to feel free to write us at any time on any special question that puzzles you in your work. Our service department is at your disposal.

This summer, for instance, you may wish to construct test equipment to use when the days get busier again in the fall. A postal card will bring you, without charge, a set of charts showing how to do this. Why pay out hundreds of dollars for expensive equipment when you can so easily make it yourself?

Type MF4

Here's the one-Watt Metallized Resistor, most used by Servicemen. It is made up in ranges from 100 ohms to 100 megohms. New low prices this year enable you to obtain these units at the same price paid for ordinary resistors. The cost to you is eighteen cents. The list is thirty cents.

This is the famous I.R.C. Resistor Replacement Guide. It gives all the resistor data you need to know about any popular receiver. An order for twenty Metallized Resistors will bring you this Guide free—or it may be bought singly for one dollar. And then we keep sending you new sheets without charge, which keep it constantly up to date.

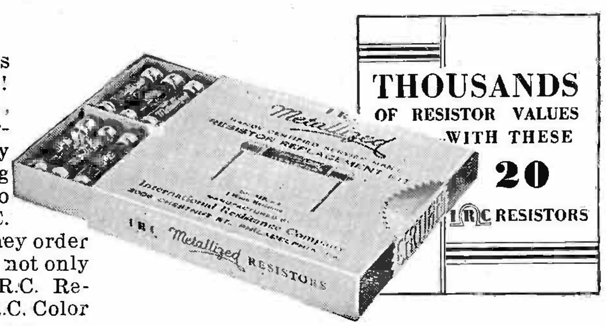
Say you got a job tomorrow to put a radio set in a car. Wouldn't you like to have a clear picture of the electrical system of an automobile so you could go right ahead? With this kit, we furnish a folder giving a complete wiring diagram. Dozens of Servicemen have written us their appreciation of this help.

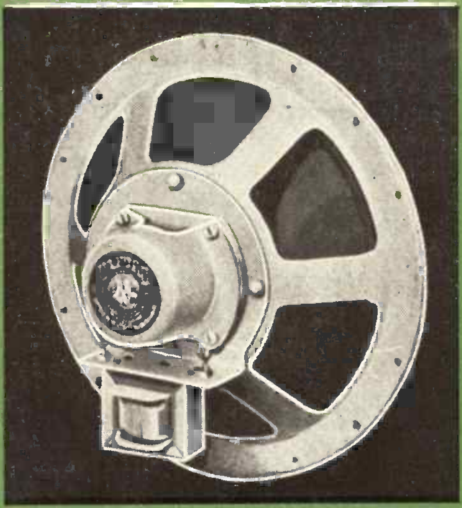
Has it ever occurred to you the uses you can put Wire Wound Resistors to in making for yourself valuable test equipment? When thinking of buying new meters, real money can be saved by converting your old ones. (Write for the I.R.C. charts and see how easily it is done.)

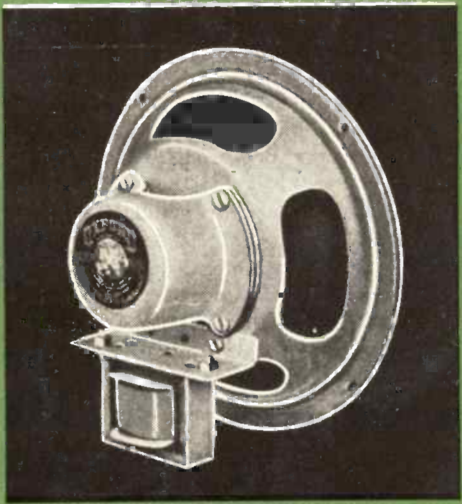
WW 2

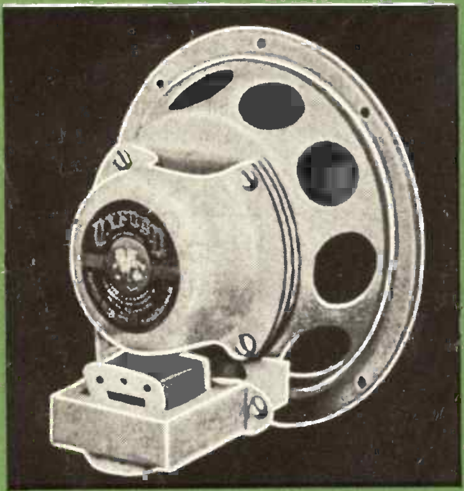
Additional Service Helps not shown here, can be obtained by dropping a line to the Service Department of the International Resistance Company.

Thousands of values from these twenty units! Sounds impossible, doesn't it? Yet any Serviceman can obtain any value he wishes by using the formulas that go with this Handy I.R.C. Kit. Your check or money order for $3.50 will bring you not only the kit, but also the I.R.C. Resistor Guide and the I.R.C. Color Code Chart without charge.









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