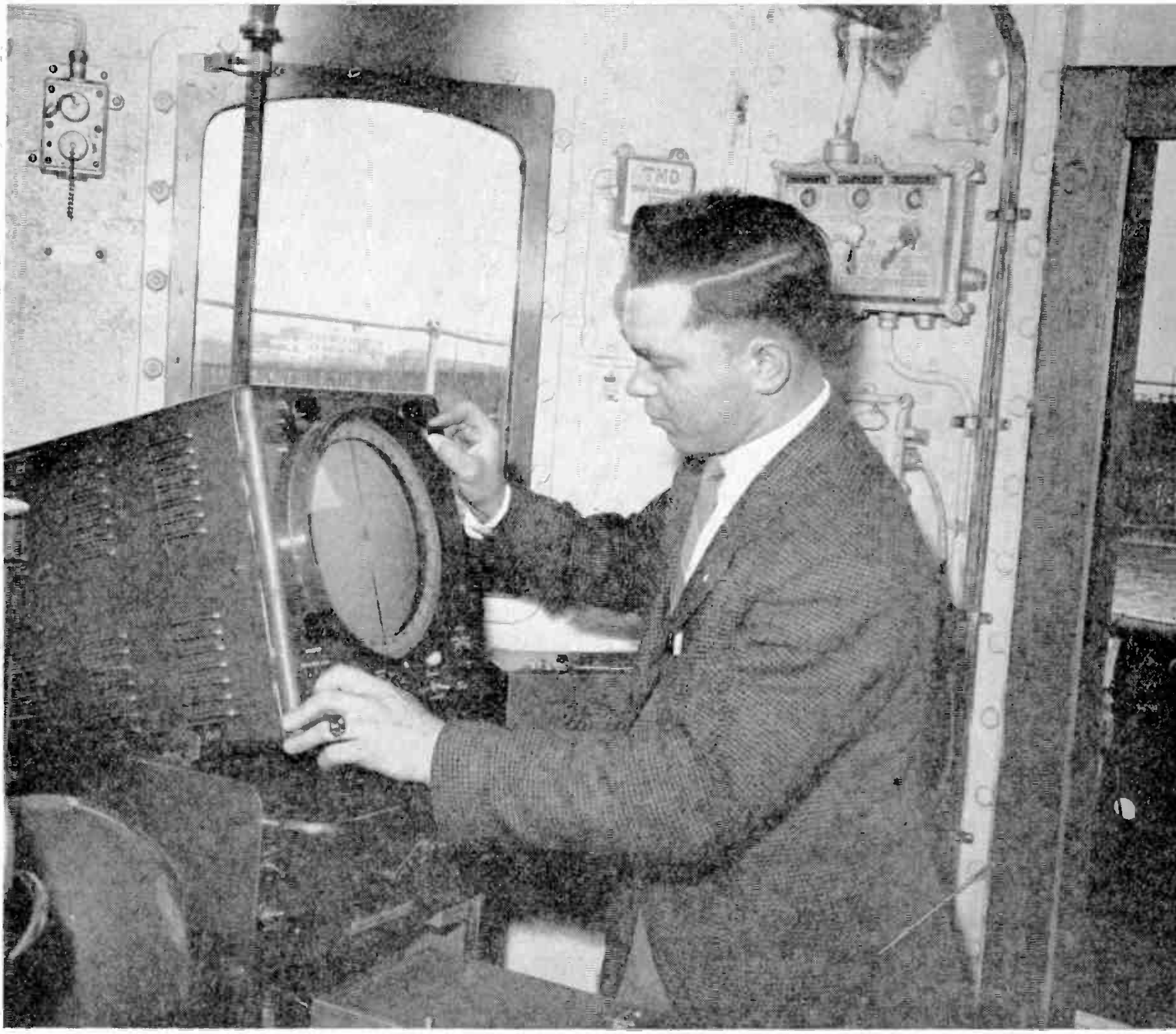
National RADIO-TV NEWS



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Hi-Fi at a Minimum Cost

Servicing Oscillators

NRI Alumni Association News

Oct.-Nov. 1956

VOL. 17 No. 5

DFTP

Most of us react to a problem, first, by *resisting* it, resenting its being thrust upon us. Examined carefully, this resistance turns out to be merely an attempt to evade the problem instead of accepting and doing something about it.

An instructor in a World War II officers' candidate school found it necessary to caution his students against this resistance so often that he adopted the warning "Don't Fight The Problem." Eventually he shortened this to "D.F.T.P." It was his way of saying "Don't waste time and energy bemoaning the fact that you have a problem. Devote that time and energy to its solution."

An ancient wise man declared that we are never given a problem until we're ready for it—until we possess the ability and means for solving it—and that we should welcome our problems because it is in solving them that we achieve growth and progress.

Look back on the obstacles and difficulties in your own life. Recall the satisfaction, encouragement and increased self-confidence you acquired from those that you overcame.

In time of trouble or when hindrances of one sort or another loom up in our path and threaten to thwart us, let us all remember "D.F.T.P."

J. E. SMITH, *Founder*

NATIONAL RADIO-TV NEWS

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Published every other month by the National Radio Institute, 16th and U Sts., N. W., Washington 9, D. C. Subscription, $1.00 a year. Printed in U. S. A. Second-class mail privileges authorized at Washington, D. C.

The Chevrolet Corvette Transistorized Car Radio with Transistor Push-Pull Audio and Blocking-Oscillator B Supply

by FRANK HUGHES

Director of Field Service, Delco Radio Div., General Motors Corp.

High-Power Transistors have now reached a stage of development where it is possible to use them not only as audio amplifiers, but as a source of B power in auto radio receivers.

A circuit, into which pairs of these semi-conductors (2N173 and 2N174) have been engineered, is shown in Fig. 1 (next page).

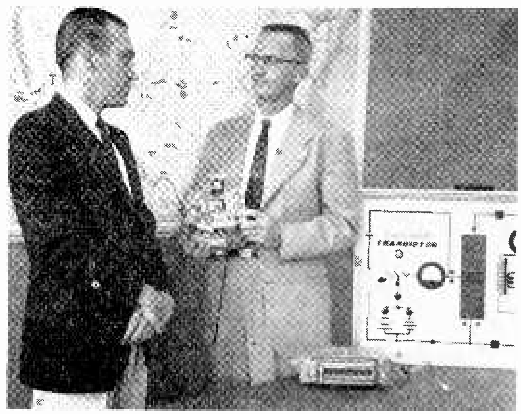
The transistors, alloy-junction pnp type, designed for general use with auto-battery power supplies of 12 and 28 v, respectively, are characterized by high-current carrying capacity at these voltages; the 2N173 also amplifies with particularly low distortion.

The large signal-current amplification is high and relatively constant for collector currents up to 7 amperes. The distortion is low, even in the common emitter configuration. To insure maximum ruggedness and reliability, they are enclosed in a hermetically sealed case.

The receiver consists basically of the conventional Delco Wonder Bar circuit using a combination of tubes and transistors. The tube line-up includes a 12BA6 rf amp, 12BE6 oscillator modulator, 12BA6 if amp, 12BE6 oscillator modulator, 12BA6 if amp, 12BF6 detector first audio, 12AU7 trigger tube and a 12X4 rectifier.

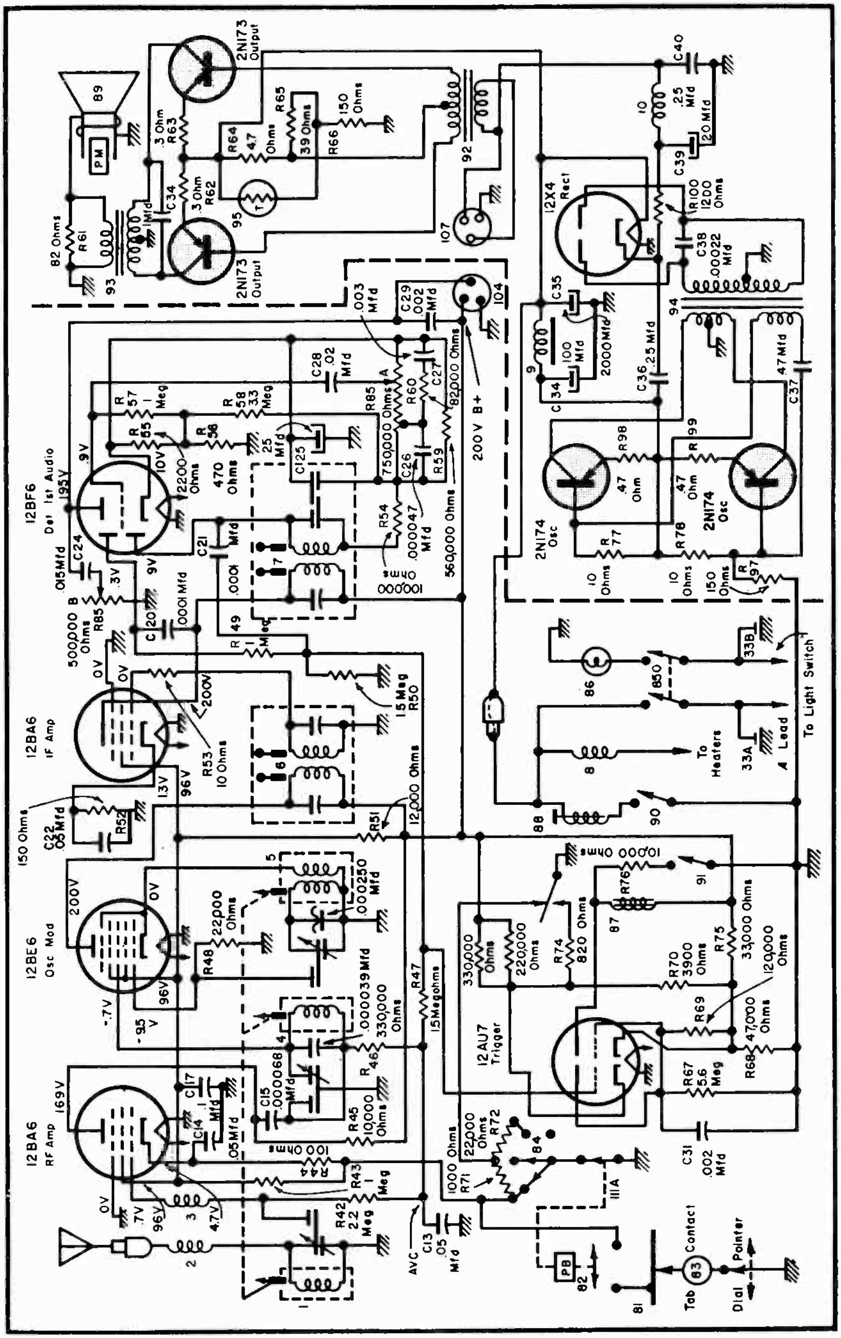
The output power amplifier stage utilizes two 2N173 transistors connected in push-pull; in common-emitter type circuits to take advantage of the tremendous power gain potential of the units.

The emitter-base circuits of each of these transistors are biased in the forward direction by the action of the positive 12-v from the car battery being applied directly to the two emitters. A



A. N. Johnson (right), Delco service mgr. and Frank L. Hughes discussing transistorized audio-amp/power-supply unit used in Corvette car receiver. Display at right is used to illustrate operation of a power transistor and its circuitry. Demonstration board is used in G-M center classes and one-night distributor-sponsored sales clinics.

bleeder-resistance network is present between the emitters and ground, consisting of 4.7-ohm, 39-ohm and 150-ohm resistors (R64, 65, 66). The base of each transistor is connected back to its emitter through one-half of the input transformer secondary winding and the 4.7-ohm resistor (R64). Approximately .3 of a volt is dropped across the 4.7-ohm resistor, which biases the base .3 volt negative, with respect to the emitter. Under static conditions a small amount (about 45 ma) of base-emitter current will flow. The collector circuits are connected in reverse



12BA6
RF Amp
12BE6
Osc Mod
12BA6
IF Amp
12BF6
Det 1st Audio
2N173
Output
2N174
Osc
12X4
Rect
12AU7
Trigger
200V B+
To Heaters
To Light Switch
A Lead
AVC

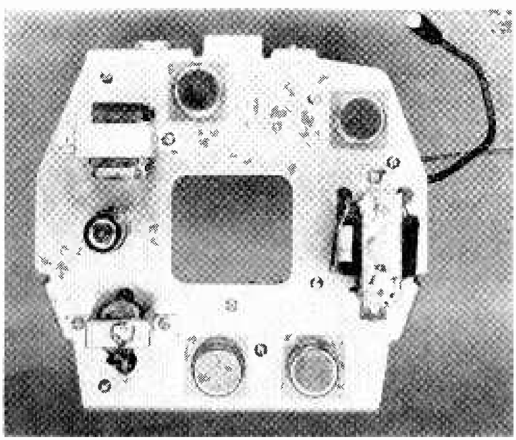
FIG. 1

bias, since the collectors are connected to ground through one-half of the output transformer primary winding. The collectors are negative, with respect to the emitter, by the battery voltage.

The audio signal from the first audio amplifier (12BF6) is coupled into the output stage through an input transformer. As the base of one transistor is driven positive, the other base is being driven negative. The base that is being driven negative will cause an increase in forward bias and an increase in current through the emitter and collector circuits. The base that is driven positive will receive a decrease in forward bias, and the emitter and collector current of that transistor will naturally decrease. On the other half cycle of the audio signal, the operation is reversed and the transistor that was lying dormant will now amplify the signal, while the other transistor will be driven toward cutoff. This results in push-pull operation, very similar to the conventional push-pull circuit using tubes. The input signal will be reproduced in the primary of the output transformer, but will be greatly increased in power. The output transformer transfers this audio power to the speaker.

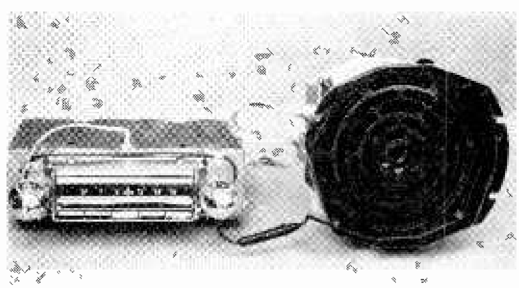
A thermistor (95) is used in parallel with the 4.7 and 39-ohm resistors in the emitter-bleeder network. The thermistor is bolted directly to the chassis and will vary the bleeder resistance as the temperature of the chassis varies. This serves to compensate automatically the forward bias of the base-emitter circuit to counteract conductivity changes that come about due to chassis temperature changes.

In the power supply, the vibrator is replaced by two 2N174 transistors, connected in a blocking-oscillator type circuit. The power transformer used in this unit is quite different than that found in most auto radios. Since the B+ current drain of the radio is very small, a small



transformer, but one-inch square, is required. The winding is on a small ferrite core. This transformer consists of center-tapped secondary windings, and a third winding, untapped, which we will refer to as the induction winding. This induction winding is shown just below the primary winding on the schematic.

The emitters of the two transistors are tied together and returned to the A+ voltage through an on-off switch. The collectors of the two transistors are connected to ground through one-half of the power transformer primary winding. This applies a reverse bias on the collector as compared to the emitter. A bleeder-resistance network is present between the emitters (—12v) and ground. This network consists of 10-ohm and 150-ohm resistors (R28 and R97). As the on-off switch is turned on, the +12 volts of the car's battery is connected to the two emitters and to the bleeder network. Due to the bleeder action, approximately .75 of a volt will be dropped across the 10-ohm resistor. The forward bias on the base-emitter circuit of the lower transistor at this instant is .75v. The bias on the upper transistor will be zero since there is no current flow through a 10-ohm resistor (R77). The forward bias on the lower transistor will cause that unit to conduct. The collector current flows through the lower half of the power-transformer primary winding and induces a voltage in the primary induction winding. This induced voltage will cause a .47-mfd capacitor (C37) in this circuit to charge. The charge current for this capacitor will flow through R78 in a direction that causes an increased voltage drop across the resistor and increases the forward bias of the base-emitter circuit for the lower transistor at this instant is .75v. The bias on the upper transistor will be zero since there is no current flow through a 10-ohm resistor (R77). The forward bias on the lower transistor will cause that unit to conduct. The collector current flows through the lower half of the power-transformer primary winding and induces a voltage in the primary induction winding. This induced voltage will cause a .47-mfd capacitor (C37) in



Closeup of transistorized power and audio supply chassis, left, and complete tuning unit connected to speaker-power-amp chassis, above.

this circuit to charge. The charge current for this capacitor will flow through R78 in a direction that causes an increased voltage drop across the resistor and increases the forward bias of the base-emitter circuit for the lower transistor. Increasing the forward bias causes a corresponding increase in collector current and an increase in the induced voltage in the induction winding. In a very short part of the cycle, the transistor resistance between emitter and collector falls to a very low value. The collector current increases at a more leisurely rate, being limited chiefly by the inductance in the collector circuit.

This action takes place until the collector current equals beta of the transistor times the base current. When this point is reached, the collector current cannot increase further and with no further increase in collector current, the induced voltage in the induction winding will disappear. With the disappearance of the induced voltage, the forward bias of the lower transistor will immediately return to .75 v, causing that transistor to offer more resistance to collector current flow. The current through the lower half of the primary winding will now start to decay, inducing a voltage of opposite polarity in the induction winding. The .47-mfd capacitor (C37) will discharge and attempt to charge again with the opposite polarity.

The discharging and charging current for this capacitor will flow through the two 10-ohm resistors (R77 and R78), driving the base of the lower transistor positive with respect to its emitter and the base of the upper transistor negative with respect to its emitter. This biases the lower transistor in the reverse direction, cutting off its collector current completely. The upper transistor is now biased in the forward direction and collector current will start flowing through the upper primary winding of the power transformer. The voltage induced in the induction winding again appears but in the opposite polarity as before, causing a forward bias on the upper transistor. Again the collector current will arise to beta times the base current of the upper transistor, at which time it will collapse and the cycle starts over again.

The frequency of oscillation is 20,000 cps, which is above the audio range, and thus no hum or buzz can be heard in the radio.

A .00022-mfd capacitor (C38) is used to absorb the inductive kick of the transformer, as one transistor starts conducting and the other is cutoff. This inductive kick could place very high inverse voltages on the components for very short intervals which could be destructive.

The .47-ohm resistors in the emitter circuits of the 2N174 transistors and the .3-ohm resistors in the emitter circuits of the 2N173 transistors are dc degenerating resistors that adjust the forward bias applied to the transistors to prevent thermal runaway.

Information in this report is based on transistor circuitry studies, presented as a part of the Delco Radio electronic school conducted in thirty General Motors training centers located throughout the country.

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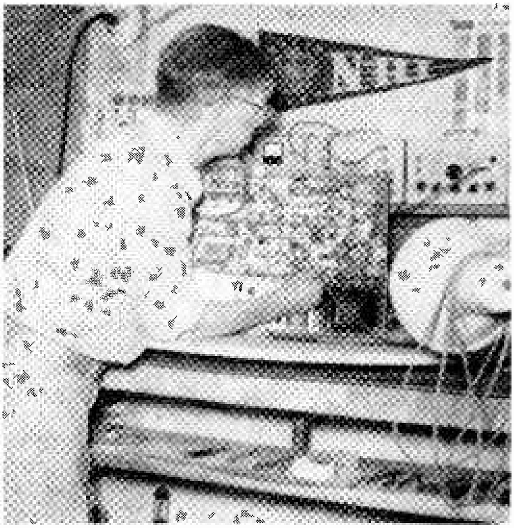
"Lazy Susan" Aids in TV Servicing



Graduate Magnus Johansen, Linthicum Heights, Md., has adapted the principle of the "lazy susan" rotating food tray to make his TV work easier. He is shown, above, at the rotating table he built to eliminate lifting and turning the chassis while servicing. A gentle tug and the chassis swings into position. The three foot top is ¾" plywood supported on four rollers and pivots on a 1½" pipe.

n r i

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James J. Kelly

HI-FI At a Minimum Cost

by

JAMES J. KELLY,

NRI Consultant

One of the most up and coming phases of the electrical industry is high-fidelity. Virtually every technical magazine that you look at today has at least one article devoted to this new and growing field. If you have had the opportunity to listen to a good high-fidelity system and you appreciate music, whether it is classical or jazz, you undoubtedly decided that you would like to have a similar system of your own. However, at the same time you found that such systems are extremely costly (the most modest of true high-fidelity systems costs in the neighborhood of $150 retail). This raises the question, why can't you get your system considerably cheaper since you are in the radio business yourself? Also, you may have been approached by prospective customers who want you to install a high-fidelity system for them, and here also the emphasis is on economy. In view of this, let us discuss the various factors involved in selecting the components in a high-fidelity system, and in doing so, see what corners can be cut and how equipment cost can be kept at a minimum and yet still keep the system in the category of true high fidelity.

First, let us see exactly what is meant by the term "high-fidelity." The basic high-fidelity system is simply an electrical system used to play phonograph records. Looking at the familiar table model phonograph that has been in use for a number of decades, you find a turntable, pickup arm, electrical amplifier, and loudspeaker. These are the same components you find in a high-fidelity system. There is no radically new and different device employed. Instead, high-fidelity is accomplished simply by using components in the system that are extremely high in quality of performance. For example, in the familiar phonograph, the amplifier is a very simple circuit which can usually be purchased from a wholesale distributor for $6 or $8. In a Hi-Fi system, the amplifier costs from $40 to $300. This expensive equipment does its work far better than ordinary sound reproducing equipment. First, it keeps distortion at a minimum. After working with high fidelity for a time, you will be amazed at the amount of distortion the sound in the familiar radio or phonograph undergoes. Second, the high-fidelity amplifier has a wide frequency range. Theoretically, the human ear can hear sounds in the frequency range from 20 to 20,000 cycles per second. The ordinary radio or phonograph only reproduces a very small segment of this frequency range. Enlarging the frequency range of the equipment is one of the major factors contributing to the difference between high-fidelity and other systems. This, also, is the aspect of high-fidelity equipment that is most widely advertised.

The reason for the importance of wide frequency range lies in the complex nature of sound. For example, the fundamental frequency of middle C on the piano can easily be reproduced. It might at first appear that extremely high and low frequencies would not be involved. However, when this note is struck on the piano, not only is the fundamental frequency present, but there are also overtones and undertones of very high and very low frequency. It is the loss of these overtones in the ordinary sound reproducing system that results in the sound being considerably different than what you would hear if the actual piano were present. The timbre of the sound is lost when it passes through ordinary reproducing systems.

The next phase of sound reproduction in which the high-fidelity system far outshines the ordinary system is tone balance. Most reproducing systems tend to have a greater output at one range of frequencies than at another. For example, the little table radios and portable radios have a tendency to be screechy because their small loudspeakers produce high frequencies far better than low frequencies. At the same time, the older console type radios with their very large loudspeakers have a tendency to boom because their large loudspeakers reproduce the low notes quite well but the high frequencies are inadequate. In a good Hi-Fi system, all of these tones are kept balanced.

Finally, the true high-fidelity system adds no additional noise. If you carefully listen to a conventional phonograph or radio, you will notice that there is a considerable amount of hum and static in the background. Although this may not be noticeable unless you carefully listen for it, it detracts from the quality of the sound produced. Moreover, noise and distortion increase listening fatigue. Listening to a poor sound reproducing system for a prolonged period will result in your simply becoming tired of listening, and you turn the set off. The same program material can be listened to over a good high-fidelity system for a far longer period before you get the same desire to turn it off. This situation is known as listening fatigue.

All of this may sound somewhat complex and technical. However, a full understanding of this can be gained simply by going to one of the high-fidelity sales rooms that are to be found in virtually all major cities and towns and listening to the various pieces of equipment that are on display. Doing this is essential before you attempt to assemble your own high-fidelity system, since in this way you will become familiar with the qualifications and prices of various items of equipment that are available.

An important point to keep in mind is that the term high-fidelity has been greatly exploited in the past year or two. Many radio phonograph combinations put on the market by reputable and well known manufacturers are referred to as high-fidelity by the manufacturers. Although these pieces of equipment are far better than their predecessors, they fall short of meeting the minimum requirements of a true high-fidelity system. Many of these devices cost more than better sounding high-fidelity systems. When going to dealers to look at equipment, be sure you go to one who specializes in true high-fidelity equipment and not just a retail outlet that is selling phonographs that are erroneously called high-fidelity by their manufacturers. At the same time, beware of the bargains in high-fidelity equipment. Before purchasing parts sold at far reduced prices, find out specifically what parts they are by means of the manufacturer's model number, and find out all you can about these particular pieces of equipment from a reputable source.

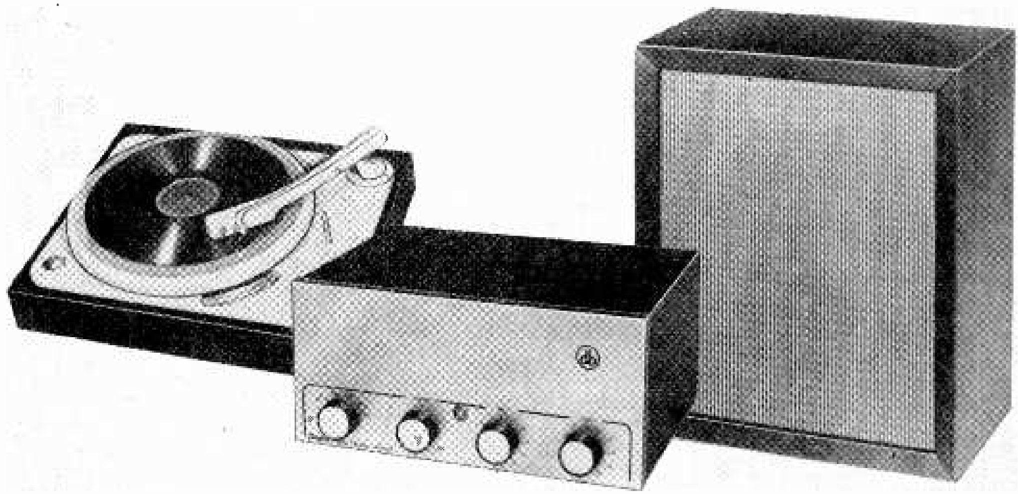
You can recognize the sales room handling true high-fidelity equipment by the fact that the amplifiers, loudspeakers, record players, and other items will all be separate. Today's high-fidelity equipment does not come completely installed in a cabinet ready for use. Only after the customer selects the various components in the system will the sales organization install them in a cabinet of the customer's choice. In many cases, high-fidelity equipment is not installed in cabinets. Instead, the separate components are placed on bookcases or tables.

Now, let us get down to the more detailed facts concerning the selection of the necessary equipment at a minimum cost. The basic system must contain four essential parts. They are: the record player, which consists of the turntable, pickup arm and cartridge, the amplifier, the loudspeaker, and the loudspeaker enclosure.

Eventually you may want to add to this basic system an FM tuner, tape recorder, and the sound segment of the TV receiver. FM is far more desirable in a high-fidelity system than AM. This will be explained later.

The fact that you are in the Radio business and buy at wholesale will not enable you to obtain your equipment at a substantially lower price. Only in a very few instances will the usual 40% discount be available. Most items sell at a 10% discount or less. However, you can build some of the components in the system yourself and make a considerable saving. What is more important, by using your knowledge of radio to carefully select the equipment you buy, it is possible to get far better value for your money.

Let us start at the point at which the sound is picked up, that is, the cartridge. In a high-fidelity system the pickup cartridge is usually purchased as a separate item and is installed in the record player you select. There are a number of factors that must be considered in the selection of a cartridge. First, what type of records will you play with the system? The old 78 rpm records require a stylus (needle) that is three times wider than the small stylus used for the new micro-groove records. Therefore, if you have both 78 rpm and the new micro-groove records in your collection, you must have a means available for changing from one stylus to another. Some cartridges have provisions for doing this, and others do not. If you plan to use both type records, you must select a cartridge that has provisions for changing from one stylus to the other.



Courtesy: *David Bogen Company*

A complete basic hi-fi system.

There are two basic types of phonograph pickups in use today. They are the crystal type and the magnetic type. Virtually all of the pickups used in the conventional phonograph systems in the past decade have been the crystal type which is considerably cheaper than the magnetic. However, the magnetic type is generally superior when sound quality must be taken into account which is the situation in high-fidelity. Nevertheless, there are some crystal (ceramic) cartridges that are true high-fidelity units such as those made by Electrovoice, Sonotone, and Ronette.

One of the most popular of cartridges in use today is the General Electric RPX, a variable reluctance cartridge. Of course, there are more expensive cartridges that are better in some ways. However, the GE RPX cartridge combines economy, durability, and high quality. If you intend to use only the micro-groove records, you can obtain this cartridge for approximately $6. If you intend to use both micro-groove and 78 rpm records which necessitates interchangeable styli, you can obtain the triple play cartridge for less than $9.

The next consideration is the stylus itself. In the past decade, there have been many so-called permanent needles on the market. There is definitely no such thing as a permanent needle. The best record stylus, which has a diamond tip, can be played approximately 500 hours. After this much use it must be replaced. It is very important to keep in mind that when a stylus becomes worn and out of shape, it will very seriously harm records. This is not very noticeable in conventional systems. However, when you use a good Hi-Fi system, you will readily notice the deterioration in music quality when a record has been played a number of times with a worn stylus. When you consider the cost of records, you can see that using a worn out needle will actually cost you money since it will seriously damage expensive records. This points out the necessity of changing needles as soon as necessary.

Osmium and steel needles are so poor in their lasting qualities, that they need not even be considered. Needles such as this are not even manufactured for use in cartridges made for high-fidelity systems. This leaves two general types of stylus in popular use. They are the sapphire and the diamond. The price of the sapphire is approximately $2.50. The price of the diamond stylus is approximately $15. These prices, of course, vary depending upon the cartridge in which the stylus is to be used. In the beginning you will probably want to use a sapphire stylus, because it will be desirable to keep the initial cost of equipment as low as possible. Remember, keep track of how much the stylus is used, and be sure to replace it after fifty hours of use. If possible, a low power microscope can be used to check the condition of the stylus point. Eventually, it will be to your advantage to purchase a diamond stylus. Actually, it is cheaper to use the diamond stylus. Although the diamond stylus will cost approximately six times as much as the sapphire, it will last at least ten times longer. As a result, over a period of time you will actually save money by using a diamond stylus.

Many persons have both micro-groove and 78 rpm records in their collection, but they play the 78 rpm records only on rare occasions. In this case, it is foolish to purchase two diamond styli. Instead, they purchase a diamond stylus for the micro-groove records, and a sapphire stylus for the 78 rpm records.

The next item to consider is the record player itself. In purchasing a record player, you must first decide between a manual single play unit or a record changer. The record changer has the obvious convenience of changing records automatically. It is, of course, more expensive. However, because of the use of the long playing records, an automatic changer is no longer as desirable as it was before the advent of these records.

There are a number of qualities in a record player that you must look for before purchasing. First, it must have the necessary speeds. In most instances, it will be desirable to have a record player that has three speeds: 78 rpm, 45 rpm, and 33-1/3 rpm. These are the speeds of the records in use today. Some record players have only 45 rpm and 33-1/3 rpm. If you have no 78 rpm records, a record player such as this will be completely satisfactory. Also, some units have, in addition to the three previously mentioned speeds, a speed of 16 rpm. There are some records of dialogue that use this speed.

The next characteristic of the record player that you must check for is reliability of speed. It is essential that the turntable rotate at exactly the correct speed. If it turns either too fast or too slow, distortion of the sound will result. You can check this by simply listening to a demonstration in the sales room, or to be more exact, check it with a stroboscope. This is a disk placed on the turntable. The speed of the turntable is ascertained by the particular row of dots that appears to stand still when the turntable is rotating. In addition to reliable speed, the speed of the record player must also be uniform. That is, the turntable must not speed up and slow down periodically. This results in what is known as flutter and wow which are very disagreeable types of distortion. This, too, can be checked simply by means of a demonstration of the record player.

The final quality to look for is durability. This information is very difficult to obtain unless you can talk to some persons who have owned a similar record player. They can tell you whether or not they have had any trouble with mechanical breakdown.

Record changers usually cost between $35 and $60. However, in recent months wholesale houses have sold satisfactory record changers at prices ranging between $15 and $30. As I said before, you must be cautious when buying equipment at a bargain price. Be sure to get a demonstration of the equipment first.

Another way to keep the price down and yet get high quality is to purchase a manual player rather than a changer. Examples are the Garrard Model T manual player for approximately $32, and the Audiogersh manual player Model XM-110 for approximately $37. Although these units do not have the advantage and convenience of a record changer, they are quality products that can be depended upon. Be sure the record player you purchase has a four-pole rather than a two-pole motor. The four-pole motor indicates higher all-around quality. Moreover, the four-pole motor will cause a turntable to rotate more uniformly.

In the very large and elaborate high-fidelity systems, record changers are not used. Instead, large studio type turntables are employed, because they have the most uniform speed. However, in a modest high-fidelity system the difference between these very expensive turntables and the moderately priced record player is not noticeable.

The next major item to look for is the amplifier. Here you can have an appreciable financial savings by building it yourself.

First, let us see what makes up a high-fidelity amplifier. There are a number of factors that must be considered before you choose the amplifier that you will use in your system. The first major consideration is power. When we speak of power in an audio amplifier, we are referring to the audio power that the amplifier can deliver to the loudspeaker. High-fidelity amplifiers range from 8 watts up. Of course, the very elaborate loudspeaker systems require more power than simpler loudspeaker systems. Also, if you wish to operate a number of different reproducers from the same amplifier more power will be needed.

The next factor to be considered in selecting a high-fidelity amplifier is the controls. However, this is of minor importance since virtually all high-fidelity amplifiers on the market today have more than enough controls. The basic controls are a bass control, treble control, volume control, and selector. Most conventional radio equipment, if it has a tone control at all, has only one. This is usually in the form of a variable low pass filter. As a result, all that can actually be done with the control is to eliminate various amounts of the high frequency portion of the audio signal. A very limited control such as this is undesirable in a high-fidelity system. You will find that it definitely adds to your enjoyment if you control the bass portion and treble portion of the audio signal separately. In a high-fidelity system, no frequency attenuation will take place when the two selector knobs are in their mid position. Advancing either of the knobs will cause either the bass or the treble to increase. Conversely, retarding either of the knobs will cause the respective frequencies to diminish.

In many high-fidelity amplifiers, you will find numerous control knobs in addition to these basic controls which I have mentioned. The majority of these controls will simply be frequency controls that actually do the same job as the two basic tone controls. The manipulation of the controls will allow some predetermined frequency attenuation characteristic to be imposed on the signal. There has been a great lack of standardization in the record industry. Phonograph records are not made with a flat frequency response. For various reasons, the frequency response of the record is altered from the desirable flat characteristic in the manufacturing stage. Your amplifier must then alter the frequency response so that the output will be uniformly flat across the audio spectrum. Although separate controls are frequently incorporated to do this, this frequency alteration in the audio amplifier can be accomplished by use of the treble and bass controls.

It is also desirable to have a number of different inputs on your amplifier and a means of switching from one to the other. This is because you will eventually want to apply other signals from a number of different sources to your system. The most common are the record player, FM tuner, and perhaps television sound or an AM tuner.

There are also important technical specifications that the amplifier must meet. First, it should be capable of passing virtually all of the audio frequencies from 20 to 20,000 cycles. The drop-off at either end of the audio spectrum should not be more than 1 decibel. Also, the second harmonic and intermodulation distortion should be less than 3 per cent. The noise and hum level should be at least 50 decibels below the rated output.

The magnetic type of phonograph cartridge that I spoke of earlier has a considerably lower output than the familiar crystal cartridge. Therefore, if you are to use a magnetic cartridge in your system, your amplifier must have an additional stage of low level amplification.

Perhaps you have wondered why some systems incorporate a device known as a preamp or pre-

Courtesy: David Bogen Company

An inexpensive low power amplifier.

amplifier and others do not. Actually, the reason is quite simple. A high fidelity amplifier consists of a number of low level voltage amplifier stages, in which the various tone and volume controls are found, and a power output stage. The power output stage and the power supply in an audio amplifier with a relatively high power rating are extremely bulky. Therefore, for convenience in installation it is frequently desirable to have the power supply and power output stage on one chassis that can be mounted in some inconspicuous place, and the low level voltage amplifiers and the controls that are in them on a smaller chassis that can be placed in some accessible position so that the controls can be reached. When this is done, the chassis containing the low level amplifiers and the controls is known as a preamp and the other chassis is known as the power amplifier. So you see, there is actually no difference between a system using a power amplifier and a preamp and a system using one single amplifier with all of the controls mounted on it. It is just that in one case two separate chassis are used and cabled together simply as a matter of convenience in mounting.

Unlike the record player, you can build your own high-fidelity amplifier at a considerable savings. One of the most convenient ways of doing this is to purchase the amplifier in kit form. There are many high-fidelity amplifier kits on the market today. You will find in their advertisements a listing of all of the technical specifications that I have mentioned. In selecting an amplifier, compare the power level, frequency response, distortion level, and noise level of the various amplifiers to determine which is the most desirable.

You may wish to build your own copy of one of the factory made amplifiers that are on the market. This can be done by using the manufacturer's service manual as a guide. Of course, if you do this you should only do it for your own personal amplifier. If you sell such an amplifier, you will be infringing on patent rights. Building an amplifier in this manner will usually be somewhat more expensive than purchasing an amplifier factory-produced in kit form.

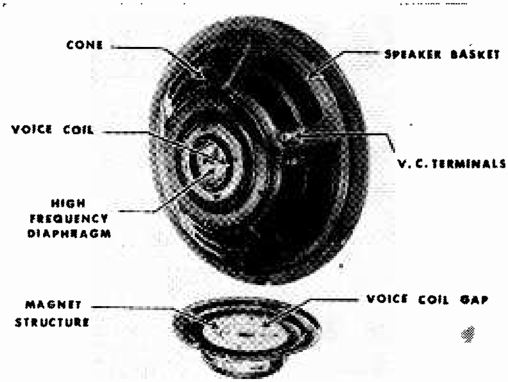
It may appear that another approach to the problem of building an inexpensive amplifier is to obtain the diagram of an amplifier sold in kit form, and purchase your own parts to build it. Actually, you will be surprised to find that it would be more expensive to do this than to purchase a kit from the manufacturer. The kit manufacturers buy their parts by the carload from the parts manufacturer. As a result, they get these parts at a price far below the usual wholesale price. They can in this way prepare the kits and put them on the market at a price that is actually below the total wholesale price of the parts used in the kit.

To sum up the amplifier situation, the most economical way of obtaining an amplifier is to build it yourself. The amplifier should have a power rating between 8 and 15 watts. Unless you plan a very elaborate system, a power rating greater than this will not be necessary. It should meet the minimum technical specifications described earlier.

The next major item to consider is the loudspeaker. The performance of your high-fidelity system depends to a great extent upon the performance of the loudspeaker. Therefore, the selection of a loudspeaker is one of the most important steps in the assembly of your high-fidelity system. Of course, quality is of the essence. There is a very pronounced distinction between high-fidelity loudspeakers, which must be far superior in quality of design and workmanship, and run-of-the-mill replacement speakers.

The most noticeable characteristic of a loudspeaker is its physical size. Good loudspeakers come in sizes of 8, 12 and 15 inches. There are also a few loudspeakers made in sizes of 10 and 18 inches. The diameter of the loudspeaker determines to a great degree how well it will reproduce low frequencies. As the diameter of a loudspeaker is increased, its ability to reproduce the very low frequencies is increased. Of course, there will always be some instances where a loudspeaker, because of its superior quality, will outperform another loudspeaker that is actually larger. However, as a general rule, increasing the diameter of a loudspeaker will increase its ability to reproduce low notes.

The power rating indicates essentially how loud a sound can be produced by the unit before it begins to distort the sound or even becomes damaged. Power ratings of loudspeakers vary



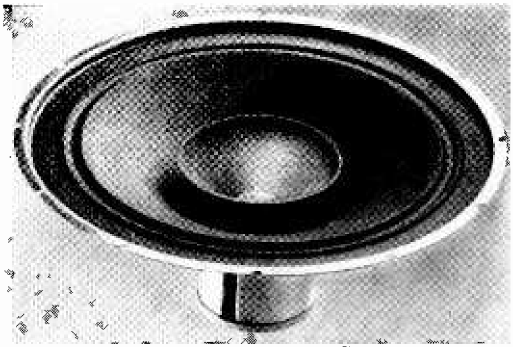
Courtesy: University Loudspeakers Inc.

Structure of a high quality loudspeaker.

from 4 to 6 watts in small 8-inch loudspeakers to as high as 30 or more watts in the large low frequency reproducers known as woofers. Actually, an average power level of 3 watts in the average room is uncomfortable. The principal argument in favor of high power rating is that even though the average power level of sound will be quite low, there will be occasional pulses of sound that must be quite strong if faithful reproduction is to be secured. If the system is not capable of reproducing these brief pulses of sound, distortion will result. However, this type of distortion is of minor importance and it can be overlooked in favor of the more economical low power system.

The next characteristic of the loudspeaker to consider is its frequency response. Some loudspeakers are designed so that they can be used by themselves, and are capable of reproducing the entire audio spectrum. Other loudspeakers are designed so that they will reproduce only a portion of the frequencies in the audio spectrum. These loudspeakers are to be used in conjunction with other loudspeakers that are designed to reproduce the remaining audio frequencies. The coaxial type of loudspeaker, about which you frequently hear, is simply two separate loudspeakers with the small high frequency unit mounted in the center of the large low frequency unit. The reason for the dual speaker system is that the very large loudspeakers that are best for reproducing the very low frequencies are relatively poor reproducers of high frequencies and vice versa. Therefore, if finances permit, it is desirable to use two separate speakers each of them reproducing the frequencies which it best handles. A filter circuit known as a cross-over network applies, to each speaker, the signals at its particular range of frequencies.

As you can see, all of these factors that contribute to increasing the quality of the speaker



Courtesy: Narelco

A good quality 8-inch speaker priced below $10.00.

system are quite expensive. Since we are concerned with assembling a high-fidelity system at a minimum cost, we must consider what compromises can be made that will still allow us to obtain a good speaker system. The expense of the speaker system and enclosure increases by a tremendous amount as the size of the speaker is increased. Therefore, we must first limit ourselves to a small speaker. Using a small speaker will limit the low frequency response of the system as explained earlier. However, this is unavoidable. Since the small speaker is somewhat limited in its ability to reproduce bass notes, there is no need to use a dual speaker system. A good 8-inch speaker will produce the mid range and high frequencies quite well, and, therefore, there is no necessity to supplement it with an additional high frequency reproducer. Power handling capacity is also of minor importance. Four watts will be completely adequate in a small system.

There have been a number of so-called bargain speakers, and in some cases dual coaxial speakers, put on the market that are considerably larger than the speaker that we are considering. However, you must keep in mind that the prime criterion of a Hi-Fi loudspeaker is its quality. Many of these so-called bargain speakers fall quite short of the minimum quality requirements, and even though they are large and in some cases dual systems, they will not work as well as a well designed 8-inch speaker.

Most good 8-inch Hi-Fi loudspeakers are sold at prices ranging from $20 to $25. However, an 8-inch speaker produced by Narelco selling for only $10 gives excellent results; its performance is only slightly inferior to that of speakers selling for $25.

When selecting a loudspeaker, it is best to go to a Hi-Fi sales room where you can hear various loudspeakers demonstrated. Check the manufacturer's specifications for low frequency response. The principal limiting factor in the small loudspeakers is inability to reproduce low frequencies. Therefore, you should check to see which of the speakers you are considering will reproduce the lowest frequencies.

Also check the physical appearance of the loudspeaker. It is a good guide to quality. The metal frame, or basket, of a good quality speaker should look substantially stronger than the basket of the replacement type loudspeaker which is just stamped out of a thin piece of sheet metal. The size of the magnet is very important. Also, look for a seam on the paper cone. A good high-fidelity loudspeaker has a cone that is molded in one piece. Low quality loudspeakers will have a seam running from the rim to the center of the cone where the cone is glued together. This characteristic is undesirable. By comparing a replacement type loudspeaker that is used in ordinary receivers to a group of Hi-Fi loudspeakers, you will readily see the difference in their physical appearance.

So you see, when economy is the prime consideration a good 8-inch loudspeaker is generally considered the best selection. You will find a few good 12-inch loudspeakers at prices that are similar to those of the 8-inch units. However, even if you obtain a good 12-inch speaker, you will still be faced with the problem of obtaining a larger speaker enclosure which will result in greater cost.

After selecting a loudspeaker, the next item on the agenda is the loudspeaker enclosure. This is one of the facets of sound reproduction that had been given little thought prior to the advent of high fidelity. The usual method was simply to hang a loudspeaker any place that was convenient. This is particularly obvious in most modern Television receivers in which the sound reproducer is usually a 4-inch speaker. It is hung anywhere in the cabinet where space can be found; on the top, bottom or rear.

Actually, the enclosure in which the loudspeaker is placed is as important as the loudspeaker itself. The best speaker made will sound exceedingly poor in a bad enclosure. Correspondingly, a relatively inexpensive speaker will sound fine in the proper enclosure.

The necessity for a good enclosure basically stems from the fact that sound waves are created both at the front and rear of the cone. These two sound waves are out of phase with each other and if allowed to come together while out of phase, will cancel each other. The job of the loudspeaker enclosure is two-fold. It prevents this undesirable cancelling of out-of-phase sound waves, and it also improves the loudspeaker's ability to reproduce low frequencies which, as you know, is the principal limitation of the smaller loudspeakers.

There are four basic types of enclosures. The first is the infinite baffle. Here the loudspeaker is mounted either in a wall or an enclosed box in such a way that the sound coming from one side can never mix with the sound coming from the other side of the loudspeaker. Therefore, the undesirable mixing of out-of-phase sound is eliminated. However, this type of enclosure does nothing to increase the strength of the low frequencies. This is a fault since low frequencies are difficult to reproduce and usually need strengthening.

One of the most common types of enclosures in use today is the bass reflex. This consists of a box which has, in addition to the hole over which the loudspeaker is mounted, another port. This port allows the sound waves coming from the rear of the cone to escape. The size of the port and the dimensions of the box are so designed that the sound that escapes from the port will no longer be out of phase with the sound wave coming from the front surface of the loudspeaker. Instead, the sound waves will be in phase with the sound emanating from the front of the loudspeaker, thus giving increased power at lower frequencies.

All loudspeakers have a resonant frequency at which they vibrate. This frequency is determined by the size and shape of the cone. At resonance, the sound is louder than at other frequencies, causing distortion. The bass reflex cabinet tends to flatten out this undesirable resonant peak.

Another popular loudspeaker enclosure is the folded horn. In this type of enclosure, the sound wave coming from the rear of the loudspeaker passes through a horn which is simply a chamber that gradually grows larger and larger. The effect of this horn is to enhance the bass frequencies and put them in phase with those coming from the front of the cone. Since this horn is physically very large, the cabinet is so designed that the horn is folded. That is, the horn is not built in a straight line but curves back and forth so that it can be fitted into a small space. The folded horn type of enclosure is usually placed in the corner of a room so that the walls of the room themselves serve as an extension of the horn thereby increasing its bass response.

The fourth group of enclosures are those that are generally known as special enclosures. Many of the relatively small enclosures for use with 8-inch speakers are of this type. These units give surprisingly good results for their size. The RJ enclosure and the Karlson enclosure are two exceedingly good units in this category.

Each type of enclosure has a particular quality of sound that is all its own. Therefore, it is again desirable to go to a good Hi-Fi sales room and listen to demonstrations of various types of enclosures to determine which you prefer. Listen for the low frequency sound. Be sure a record containing considerable bass is used in the demonstration. Enclosures have little effect on the high frequency sounds because they are radiated directly from the front of the loudspeaker. How it produces low frequencies is the important thing.

There are numerous ways to get the enclosure that you want. I have listed them in the order of their cost. The most inexpensive way is to obtain the plans and build it yourself. To do this, you must have the necessary wood working tools available, and you must be relatively proficient in their use. If you do not have the skill or the inclination to build the enclosure yourself, you can purchase loudspeaker enclosures in kit form from various manufacturers. In this case, the parts are precut and it is a simple matter to assemble them. Another possibility is to obtain the plans and have a carpenter or cabinet maker build the enclosure for you. Finally, you can purchase the enclosure factory-built either in unfinished wood or in an expensive furniture finish.

Some of the books listed in the bibliography at the end of this article contain plans for building your own speaker enclosure.

With the selection and installation of the speaker and enclosure, the basic Hi-Fi system is complete. Later, you may wish to add an FM or AM tuner to the system. This will enable it to pick up Radio broadcasts also. When doing this, keep in mind that the signal transmitted by an AM station is limited both in its frequency and in its dynamic range. Therefore, music received through an AM tuner will fall short of the minimum quality expected in a high-fidelity system. FM stations on the other hand are not compelled by Federal law to limit the frequency and dynamic range of the audio signal that they transmit. Therefore, better results can be expected from an FM tuner. There are a large variety of tuners in various price ranges available. The most inexpensive source of an FM tuner is to build your own from one of the many kits that are available.

Considering what we have discussed, let us see what the approximate minimum price would be for a true Hi-Fi system; by this I mean a sound reproducing system that has the minimum requirements of true high-fidelity and not simply an unusually good phonograph. A good record player can be purchased for a price as low as $25. This includes a good ceramic cartridge and sapphire stylus. Amplifiers are available in kit form at prices as low as $17. There are one or two excellent loudspeakers available at prices as low as $10. The author had an RJ type of speaker enclosure built by a cabinet maker for only $5. The total cost of this basic Hi-Fi system is about $60. If you can afford to invest slightly more, get a better amplifier. Most audiophiles who start their Hi-Fi system on a very limited budget eventually reach the point at which they wish to improve them by obtaining a better loudspeaker and enclosure. Of course, this is exceedingly expensive and it will be some time before this point is reached. The amplifier obtained at a price of only $15 or $18 will be found to be inadequate when a vastly improved speaker system is contemplated, and it will therefore be necessary to obtain a new amplifier if the speaker system is to be enlarged. This problem can be avoided by spending only a few dollars more on a better amplifier at the beginning. When you then reach the point when you can afford a far more expensive speaker system, there will be no need to change amplifiers. The amplifier that you obtain at the beginning will be adequate. So you see, even though you can get little discount on the purchase of Hi-Fi equipment, because you are in the radio business you will be able to capitalize on your knowledge of electronics and your ability to build some of the components in the system and thereby save a considerable amount of money in the assembly of a good high-fidelity system. By being familiar with the technical aspect of Hi-Fi, you will be able to purchase the least expensive components that will do the job. Using the basic ideas set forth here, the author has obtained, at a cost of approximately $130, a high-fidelity system that would have cost well over $200 had all the components in the system been purchased indiscriminately.

There are numerous books available that will give you additional information on high-fidelity. Paramount among them are catalogs made available by sales organizations which list the various pieces of equipment that are available. These catalogs include the technical specifications of all pieces of equipment that are essential to your system.

If there are no high-fidelity sales rooms located conveniently nearby, write the Allied Radio Corporation, at 100 North Western Avenue, Chicago 80, Illinois. At your request, they will supply you with a free high-fidelity catalog. This same organization has another book entitled "This is High Fidelity" available at a price of ten cents. For a layman's guide to purchasing and assembling a high-fidelity system, "Home Music Systems" is recommended. This book, by Edward Canby, is published by Harper & Brothers. For a very detailed technical analysis of high-fidelity, "Recording and Reproduction of Sound" by Dr. Oliver Reed is recommended. This book is published by Howard W. Sams.

———*n r i*———

If everyone stopped striving for success because there was a chance that he might fail—no one would succeed.

Some Suggestions Regarding Long Distance Telephone Calls To NRI

Occasionally we receive a long distance telephone call from an NRI student or graduate—for something that he needs in a hurry, or to discuss an urgent problem.

Because such calls cost the student or graduate quite a bit, we feel that they should be made only when absolutely necessary. And—particularly where a consultation problem is involved, our reply by letter will be more complete, and therefore more satisfactory than an answer given in a hurry over the phone. That's why we suggest that it may be better to write us Air Mail rather than telephone, except where an immediate reply is required.

If you do find it is necessary to call, we shall of course, be glad to help you in any way we can. In that case, please keep in mind the following because it will enable us to handle your call most efficiently and save you money on the cost:

1. Tell *our* switchboard operator—the one who answers "National Radio Institute"—your name, address, student number, and that you are calling long distance. The way the Telephone Company handles calls nowadays, she won't *know* that it is long distance unless you tell her.

2. Explain the purpose of your call. The operator won't be able to give you the information or handle your problem herself, but she must know its nature so as to refer you to the proper individual or department.

3. Remember that the Institute is open from 8:15 AM to 5:00 PM, Monday through Friday —closed completely Saturday and Sunday. Outside of these office hours, the switchboard is also closed, and there will not be anyone here to handle your call.

———*n r i*———

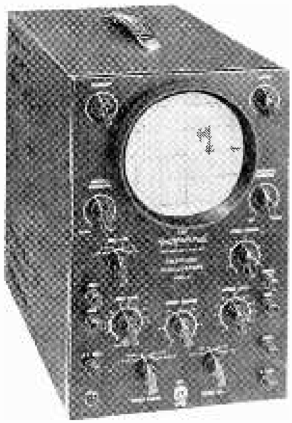
New Roll Chart for NRI Model 69 Tube Tester Available

A new Roll Chart (copyright 1956) for the NRI Model 69 Tube Tester is now available from NRI. Price, $1.25 postpaid.

To order, send your remittance and request for the Model 69 Roll Chart to the National Radio Institute, Supply Division. If you live in Washington, D. C., please add three cents for the D. C. sales tax.

It's Not Too Early To Think About Christmas

This issue and the December-January issue of NR-TV News will give a complete catalog of the items offered by the NRI Supply Division. Further information about any items will gladly be given upon request. Monthly time payments can be arranged for all test instruments. All NRI test instruments are covered by the standard RETMA warranty. It's not too soon to begin dropping hints to your wife or girl friend about your Christmas hopes. Be sure to place orders early!



Model 56 NRI Professional TV Oscilloscope

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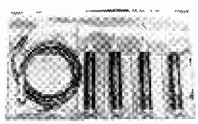

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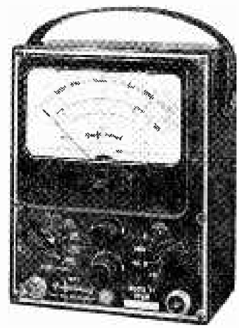

Model 11 NRI Professional Vacuum Tube Voltmeter

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Optional Accessories—30,000 volt High Voltage TV probe, $8.00. Crystal Detector HF Probe, $6.65. Leather case, $9.50.

Actual weight 4 lbs. Shipping weight: 6 lbs. Shipped express collect. Requires 50-60 cycle, 110-120 volts ac. Size: 7⅛" x 5½" x 3".

Drake Model 400 Soldering Iron $4.50

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The series "766" Speedex "Speed-O-Matic" wire stripper is fully automatic with "delayed return action" to prevent crushing of fine stranded wires. For #10, 12, 14, 16, 18, 20, and 22 wire. These are the common sizes used in Radio and Television. Sturdy construction. Narrow, easy grip handles. A real time-saver.

Model 89 NRI Professional AM-FM-TV Signal Generator and Marker Only $45.00

One of NRI's most popular instruments. Wide range: 170 Kc. to 60 Mc. on fundamentals. Guaranteed accuracy ± 1% on all six bands. Special calibration points for FM and TV alignment. Strong harmonics give accurate coverage up to 120 Mc.

Uses stable Hartley Electron-Coupled r.f. oscillator circuit with cathode follower output. Colpitts audio oscillator gives 400 cycle pure sine wave. Single output jack with detachable coaxial output cable. Detailed instructions included.

Maroon crackle finish case with etched aluminum panel. Size: 12" x 8¼" x 10¼". Actual weight: 12 lbs. Shipping weight: 15 lbs. Shipped express charges collect. Requires 50-60 cycle, 110-120 volts ac.

The Famous Model 260 Simpson AC-DC VOMA, Only $38.95

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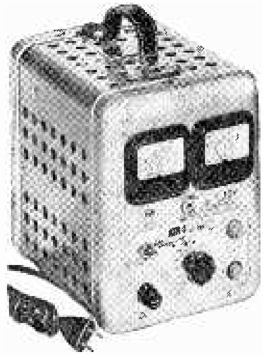
Optional Accessories — 25,000-volt Television Probe, $9.95. Eveready Neolite Carrying Case, $8.75.

Actual Weight: 3½ lbs. Shipping weight: 6 lbs.

USE ORDER BLANK AT RIGHT

All test instruments are shipped by Railway Express, charges collect. All other items are shipped by parcel post, prepaid.



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NRI Consultant

A fairly common complaint in servicing Radios is a serious loss of sensitivity and selectivity. Frequently, this is caused by improper operation of the local oscillator circuit. Since the intermediate frequency is produced by combining the Radio signal and the output of the oscillator circuit, an incorrect intermediate frequency will be produced when the oscillator does not operate normally.

Standard servicing techniques for normal trouble-shooting in the oscillator circuit are familiar to all Radio-TV servicemen. However, since the operation of these circuits is sometimes quite critical, more attention must be paid to the voltages on the oscillator tube. A slight reduction of plate or filament voltage would probably have little effect on an i-f amplifier stage, but it might cause the oscillator to go dead.

When the oscillator circuit of a receiver is believed to be at fault, a simple test can usually be made to determine whether or not this is the cause of the trouble. When touching the ungrounded side of the oscillator tuning condenser with your moistened finger, a definite click or thump should be heard in the loudspeaker. This noise should be heard both when touching the condenser with your finger and removing your finger. Usually, if only one click is heard, the oscillator is not functioning normally. If the results of this simple test are not conclusive, a measurement of the oscillator grid voltage must be made. A definite negative voltage of between 5-15 volts should be obtained if the circuit is oscillating. This indicates that grid current is flowing, a condition that exists when normal operation is obtained.

In Fig. 1, a simplified diagram is illustrated to show how the combination of the Radio and oscillator signals produces the 455-kc intermediate frequency. As an example, signal "A" from the broadcast station is 1000-kc. Therefore, the local oscillator frequency must be 455-kc higher, giving it a frequency of 1455-kc. These two signals are combined in the mixer stage, and the difference is the intermediate frequency, 455-kc.

Fig. 2 shows a typical AC-DC circuit. You will notice that a single tube is employed as both mixer and oscillator. This type of tube is known as a pentagrid converter. A common cathode is used, but separate grids are necessary for each of the two circuits. Pin 7 is the control grid for the mixer portion of the tube, and Pin 1 is the oscillator control grid. Pin 6, the screen grid, also serves as the oscillator plate. Since we are dealing only with oscillator action at this time, this circuit has been simplified in Fig.

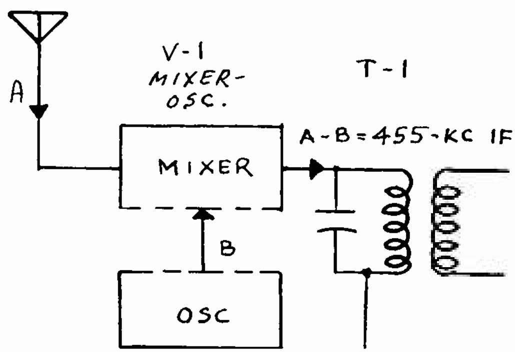
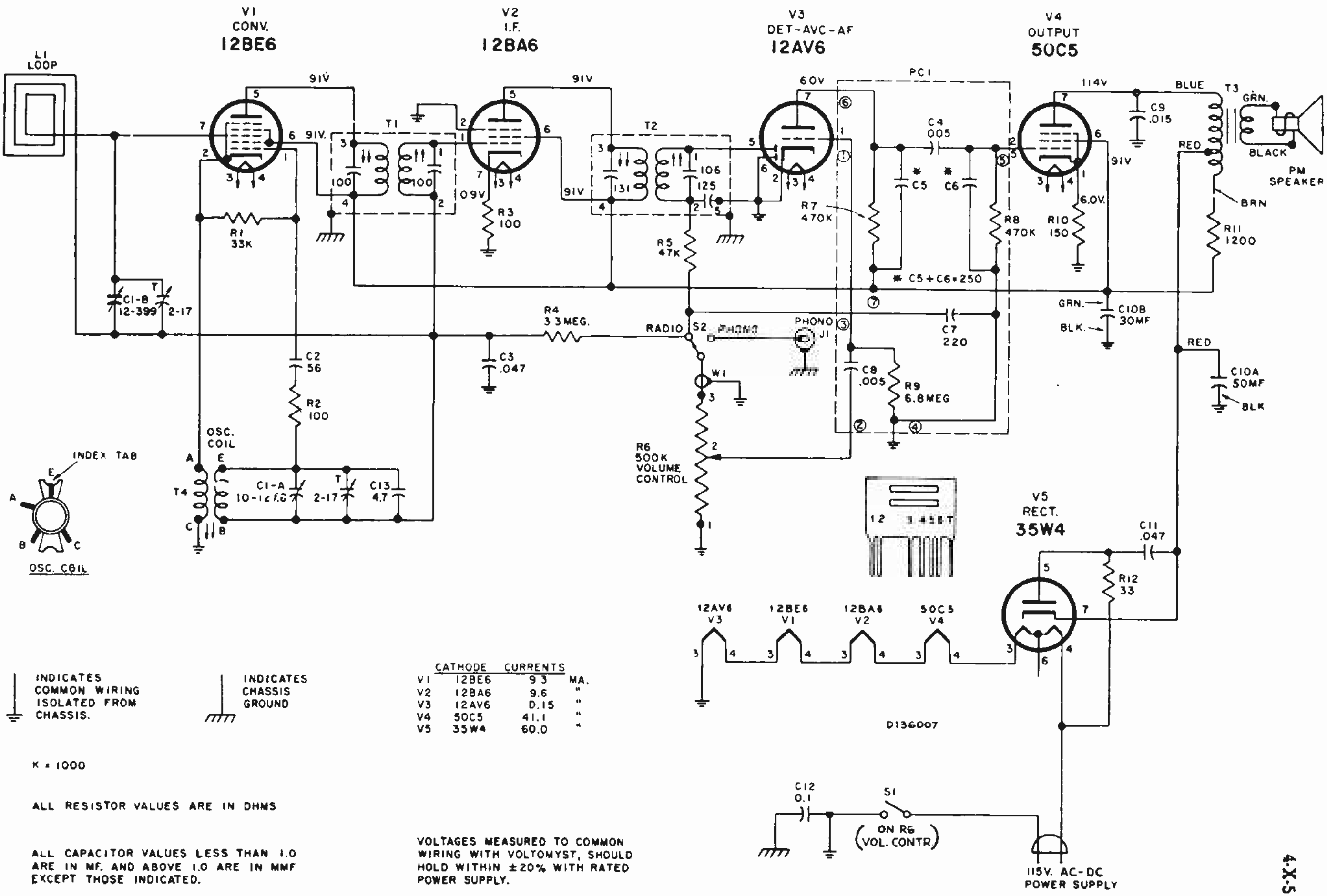


Fig. 1. Notice that when RF signal "A" is combined with oscillator signal "B" in the mixer tube, the difference is always 455-kc.



Schematic Circuit Diagram

Fig. 2. RCA Victor 4-X-551 series AC-DC receiver.

3. With all other circuits operating normally, failure of the local oscillator could be caused by a below-normal B+ voltage, a defective tube, a bad oscillator coil assembly, a change in value of R1 or C2, or any of the other common defects usually associated with rf circuits. The values of R1 and C2 are quite critical. In fact, you will frequently find that R1 has changed in value, resulting in eventual loss of oscillator action.

As stated before, a definite test of oscillator grid voltage will indicate whether or not the circuit is operating normally. On Pin 1, the oscillator grid, this negative voltage shows that the grid is drawing current. This current flow takes place during a portion of each cycle of operation. Therefore, a substantial increase in the resistance of R1 could easily cause swamping of the grid circuit, causing unsatisfactory operation.

In a circuit of this type, very little trouble is had with below normal filament voltages. However, if a set of this type is employed in an area that has low AC line voltage, it will sometimes be necessary to provide a method of boosting the AC line voltage with an auto transformer. With below normal cathode emission in the oscillator circuit, the output of the oscillator may be seriously reduced.

In the servicing of an oscillator circuit, it is always best to try temporary substitution of another tube, rather than rely on the results shown by your tube tester. The slight change in tube characteristics may not be indicated by the tube tester, but it may be sufficient to cause improper operation of the oscillator.

A common cause of improper operation of an oscillator circuit of this type is a change in the characteristics of the oscillator coil assembly. In other words, excessive moisture may have collected in the coil windings, resulting in a loss of Q or efficiency. Naturally, if the efficiency of this coil drops below a certain point, the overall efficiency of the circuit is reduced. Even though the coil may check satisfactory with your ohmmeter, this is definitely no indication of the condition of the coil. Actual substitution of a replacement component would be the only definite test.

A slight reduction in B+ voltage would probably have little effect on any other circuit in this receiver. However, a very pronounced effect would be produced in the oscillator. That is why it is extremely important to carefully and accurately check this voltage if this type of trouble is suspected. A loss of capacity of the input filter condenser, or an increase in the size of R11 are quite common. The loss of capacity in the output filter condenser would probably have little effect on the voltage.

Further examination of the circuit in Fig. 2

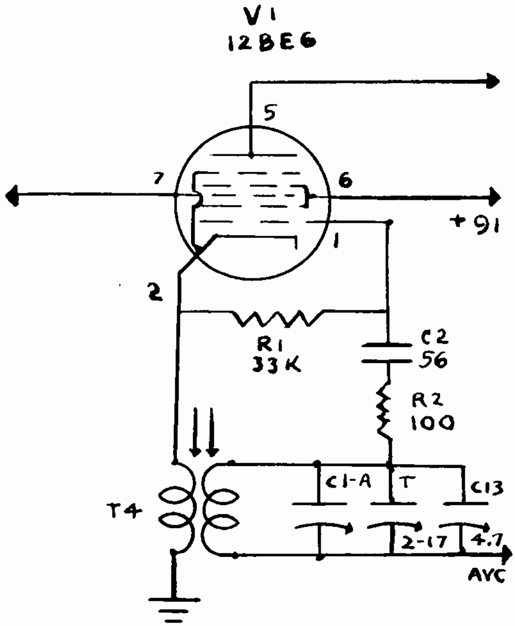


Fig. 3. Oscillator circuit of RCA receiver. For simplicity, other portions of the diagram have been omitted.

shows that a printed circuit assembly is employed between the 12AV6 and 50C5 tubes. At a casual glance, you would normally not associate this component in any way with the oscillator circuit. However, a small amount of leakage in C4, the coupling condenser, would place a positive voltage on the control grid of the 50C5. This would cause excessive current flow through the tube, probably resulting in a serious drop in B+ voltage. If this voltage drop is sufficient, complete inoperation of the oscillator would result.

In Fig. 5, another type of diagram is shown that employs slightly different oscillator circuits. Also, this is a portable type receiver that employs battery type tubes. You will usually find that the voltages applied to this type of oscillator tube are quite critical. This is particularly true of the filament voltage. With this receiver you may find that normal operation can be obtained when the set is used on batteries, but it does not operate when used on the AC-DC line. Even though all voltages may appear to be normal after a casual examination is made, you would probably find that one of the filament resistors or filter condensers has changed in value. In addition, a weak selenium rectifier is quite often found to be the source of trouble.

Although the same type troubles may be experienced in this oscillator circuit as compared to

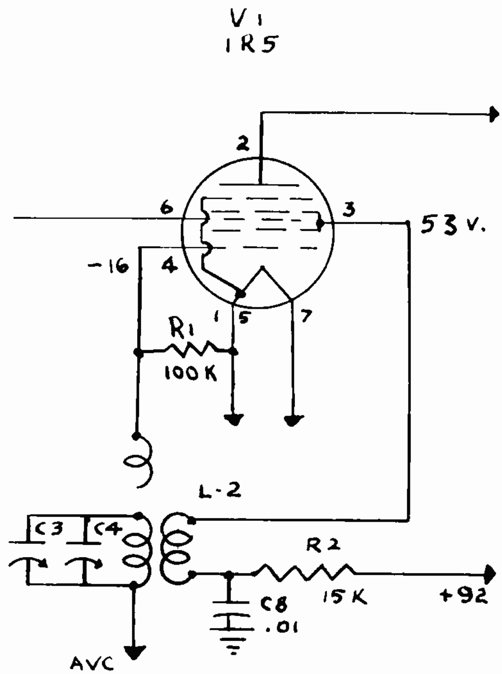


Fig. 5. Oscillator circuit of Emerson receiver.

the one previously discussed, there are several other factors that must be taken into consideration. In addition to the rather critical filament voltage, an additional decoupling resistor and condenser are employed. This combination consists of R2 and C8. A frequent cause of trouble is an increase in the value of R2, sometimes caused by a small amount of leakage in C8. It is good practice to replace these two components whenever any trouble in this circuit is encountered.

Examination of this diagram shows that an additional winding on the oscillator coil is used to couple this assembly to the control grid circuit. You will usually find that the universal type replacement oscillator coils do not have this winding in place. Instead, a separate coupling condenser must be used between the oscillator grid circuit and the coil winding. Normally, a capacity of about 50-mmf is satisfactory.

By examining the B+ power supply circuit, you will notice that a 1500-ohm resistor, R13, is employed as the filter resistor for the B+ circuit. If excessive current is drawn in any of these circuits, the voltage drop across R13 will be substantially increased. This could be caused by a gassy tube, leakage through the coupling condenser C16, or any other common defects of this type. Only a small increase in current flow through R13 would result in a substantial reduction of B+ voltage.

The alignment of any local oscillator circuit is extremely important. If it is improperly aligned, you will probably find it impossible to receive signals at the correct points on the tuning dial. In addition, there may be dead spots and a loss of sensitivity and selectivity. In the alignment procedure, most servicemen will first check the alignment of the i-f amplifier stages. After this is done, a signal of known frequency is injected into the control grid of the mixer stage. The tuning dial should then be set at the corresponding point and the oscillator trimmer adjusted for maximum signal strength. This can usually be done by simply tuning in one of the local radio stations where the operating frequency is known.

In commercial receivers of these types, you will sometimes find that the oscillator will not function satisfactorily after replacement of the coil has been made. In cases such as this, by changing the size of the oscillator grid resistor, normal operation can be restored. In some cases, it may be necessary to change this resistance size by as much as 25%. Both larger and smaller values of resistance should be tried, using the value which gives most satisfactory results. By keeping this fact in mind, you may be able to avoid time consuming trouble-shooting.

In the circuit shown in Fig. 4, let's trace through the filament and plate circuits, looking for possible defects that would cause loss of operation of the oscillator. Starting at the selenium rectifier, V5, the B+ voltage goes through R15, R13, the transfer switch, R2, and L2. Therefore, an increase in size of any of these resistors, a loss of capacity of C23, leakage in C18 or C8, or a defect in the oscillator coil itself, could cause a reduction or loss of oscillator plate voltage on Pin 3 of VI.

In the filament circuit, R14 is employed to reduce the B+ voltage to a potential of 6.8 volts. From this point, this voltage goes through the transfer switch to the filament string. Since the 1R5 oscillator-mixer tube is at the ground end of this string, leakage in C22, C21, or C20 would cause a reduction of filament voltage applied to the 1R5. Particular attention should be paid to these components as well as the selenium rectifier if below-normal filament voltages appear to be present. Sometimes oscillation can be restored by increasing the value of the oscillator grid resistor. If too large a resistor is used, blocking of the oscillator which gives a motor-boating effect will result.

In many of the older Radios, an exact duplicate oscillator coil is impossible to obtain. You will then find it necessary to install a universal type of coil as a replacement, making any circuit

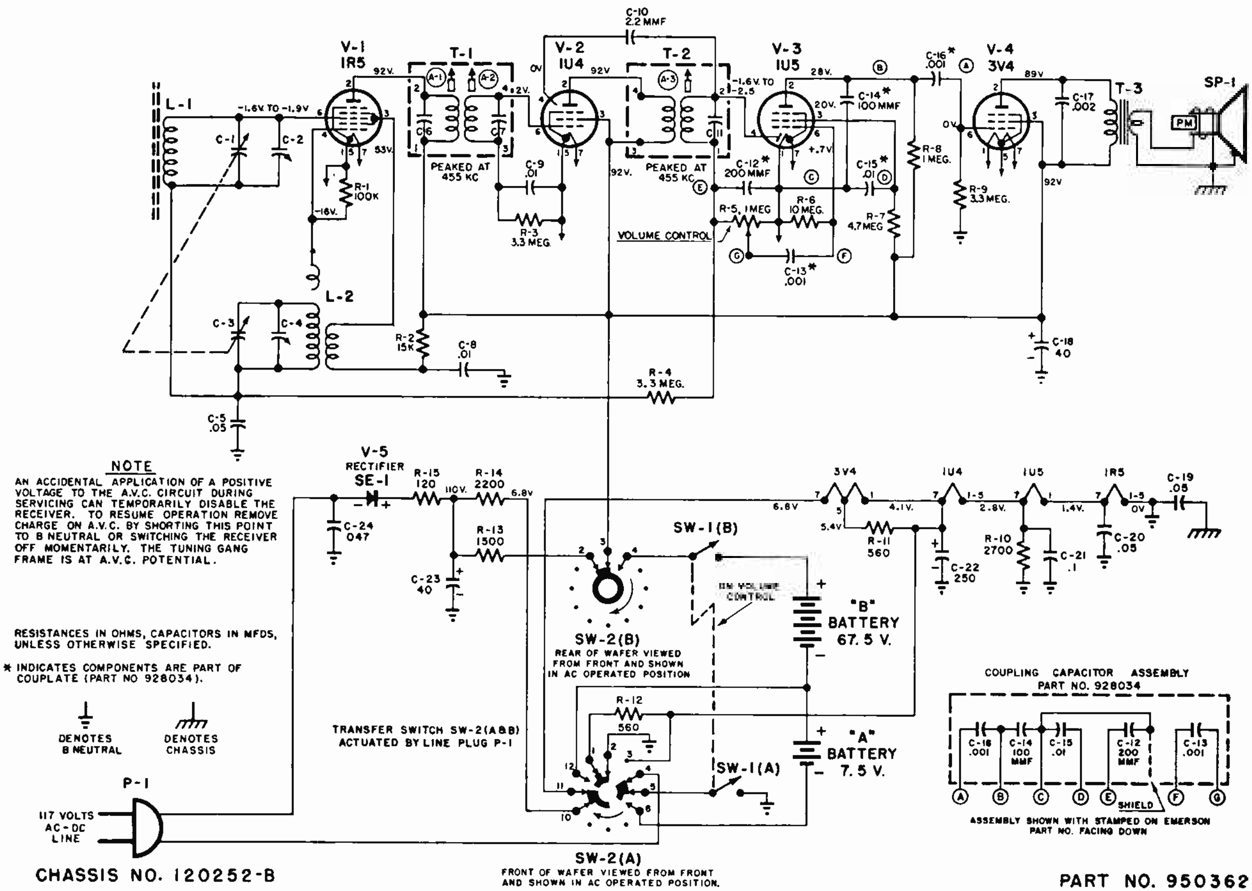


Fig. 4. Emerson Model 830B three-way portable.

modifications that are necessary. However, this should not be too difficult, as wiring instructions are usually included with replacement parts of this type. Of course, you must choose the type of coil that provides the necessary frequency range in order to obtain the correct intermediate frequency.

Although the tests and procedures outlined for trouble-shooting are rather general, they will usually enable you to quickly locate any defect in local oscillator circuits. By keeping a few simple facts in mind, a great deal of unnecessary trouble-shooting can usually be avoided. First, you should determine whether or not the oscillator is functioning satisfactorily by checking the oscillator grid voltage. A very definite negative voltage should be obtained. If this voltage is not present, test the oscillator plate voltage. If this appears below normal, look for either a leaky condenser or a resistor that is increased in size. Also, a careful check of the rectifier must be made if it is an AC operated receiver.

If the negative grid voltage appears to be normal, in all probability you will find that the coil is defective. The oscillator may be operating satisfactorily, but the frequency may have changed due to a change in coil characteristics. If the voltage is so low you are not sure it is due to the oscillator driving the grid, short the oscillator tuning condenser with your finger. If this causes a drop in the measured voltage the oscillator was working. If there is no change in voltage the oscillator is dead.

Particular attention should be paid to the AC line voltage if a set appears to operate normally in the shop but will not operate satisfactorily in the customer's home. This condition is quite common, particularly in suburban and rural areas. If this is the case, the line voltage in the shop should be adjusted by means of a tapped auto transformer so that it will be the same as that employed where the set will be used. This will avoid extra service calls, and insure more satisfactory operation of the receiver.

In servicing horizontal and vertical oscillator circuits in TV receivers, the same general procedures can be followed. On the control grid of the oscillator circuit, a definite negative DC voltage should be obtained. Also, a careful check of all plate voltages must be made. In these circuits, you will frequently find that the frequency of the oscillator is controlled by the plate voltage. In addition, adjustment of this plate voltage. In addition, the picture size and linearity may be controlled by this method.

Fig. 6 illustrates a typical vertical blocking oscillator circuit. Basically, this is the type of vertical deflection oscillator that is used in the majority of modern TV receivers. An in-phase

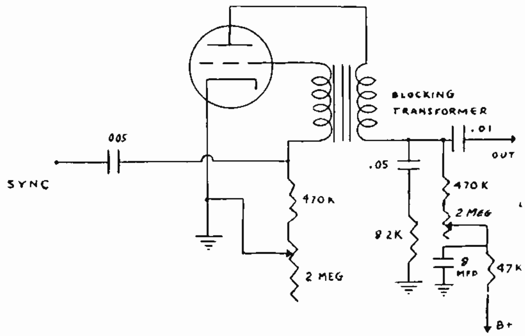


Fig. 6. Typical vertical oscillator circuit.

voltage is fed back to the control grid through the blocking oscillator transformer, resulting in a free-running condition. The 2-megohm control between ground and the 470K-ohm grid return resistor controls the rate of oscillation. The other 2-megohm control is actually a form of output amplitude control, and acts as a vertical size control for the picture. The sync pulses are applied to the oscillator grid control circuit through the .005 coupling condenser. Under normal conditions, the operating frequency of this circuit would not be constant without the application of these sync pulses.

A common complaint in modern TV receivers is in connection with this blocking oscillator stage. This is the inability of the TV receiver to lock in the picture vertically. However, this would normally be associated with the sync circuit, since it would be possible to roll the picture vertically in either direction by turning the vertical hold control.

If the picture can be locked in for a few minutes before it begins rolling again, you would normally assume that a defect exists in the oscillator circuit. If the vertical hold control has to be constantly changed in order to maintain vertical sync, the first thing that should be tried would be a new tube. If the condition does not appear to be improved, either of the 470K-ohm resistors should be suspected. Due to the comparatively high operating temperature present under most TV chassis, these resistors will have a tendency to increase in value, sometimes resulting in the complete inability to lock-in the picture vertically, even at the extreme range of the vertical hold control. Since these resistors have a tendency to increase in value as the temperature rises, it is always best to disconnect the suspected component from the circuit and temporarily try a new resistor that is definitely known to be of the correct value.

Another component that often changes in characteristics is the transformer itself. This type of transformer can seldom be accurately checked in the service shop except by substitution. The Q and mutual inductance of the transformer may change over wide ranges, even though the oscillator may still block at an incorrect frequency. A defect of this type could not be located by means of an ohmmeter.

If the picture appears to maintain vertical stability, but you are unable to obtain sufficient size, you should first suspect the fixed resistors in the B+ line and the 8-mfd filter condenser. Of course, a new tube would be the first component to be checked by substitution. A defect in this circuit would usually be associated with an increase in the size of one of these resistors, resulting in a picture that appears to be compressed vertically. When the vertical size control is turned to its minimum resistance position, maximum vertical size should be obtained. Of course, a small amount of leakage in the 8-mfd filter condenser would substantially reduce this voltage. However, if the condenser has decreased in capacity, it is difficult to say exactly what the result would be. In some circuits, complete loss of vertical deflection would result. In others, it may continue to operate in a slightly unstable condition.

A complete loss of vertical deflection could be caused by defects in several associated circuits. However, since only oscillators are under discussion, let's see what some of the common defects of this type would be in this stage. Of course, a defective tube would be the first suspected part. Next, the plate voltage of the oscillator should be carefully checked with the vertical size control at both extremes of its range. A very pronounced change in plate voltage would result when this control is varied. If this appears normal, a test for a negative dc voltage on the control grid must be made to determine whether or not the stage has actually stopped operating. If this voltage is absent, and the plate voltage appears to be within tolerance, you would again suspect the blocking oscillator transformer or the discharge network formed by the .05-mfd condenser and the 8.2K-ohm resistor. If a definite dc voltage is obtained on the control grid, and the plate voltage appears normal, a defective .01-mfd coupling condenser at the output of the circuit should be suspected.

It must be remembered that there are many other causes for loss of vertical deflection beside the ones listed here. Since only the oscillator circuit is being analyzed, these will not be discussed in this article.

The operation of the circuit in Fig. 7 is not the same as that of the vertical blocking oscillator. Rather, this is known as a cathode-coupled multivibrator. The cathodes of both sections of the twin triode tube are coupled directly together, and receive their bias through the common 2.2K-ohm resistor. However, in analyzing defects in this circuit, similar service methods to those previously described may be used. If you are able to momentarily hold the picture horizontally and this point seems to be near the mid range of the horizontal hold control, you would look for a defect at some point ahead of the horizontal oscillator. In the adjustment of the horizontal hold control, the 50K pot between ground and one of the control grids of the twin triode, should be set at its mid-range. The ringing coil would then be adjusted so that the picture locks in without moving the horizontal hold control.

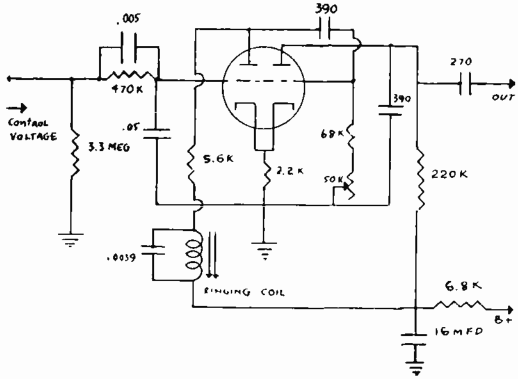


Fig. 7. Typical horizontal oscillator circuit.

An important point to remember is that when the horizontal oscillator ceases to operate, a complete loss of high voltage will result in modern TV circuits. If you find it impossible to obtain a raster on the face of the picture tube, this is one of the first circuits to be checked if all other conditions appear to be normal. Again, before disturbing any circuit components, try a new tube. When this has been done, a quick check of both plate voltages must be made. If both of these voltages appear to be low, you would immediately suspect either the 16-mfd filter condenser or the 6.8K-ohm plate supply resistor. Of course, this is assuming that the normal B+ voltage is being applied to the point marked on the diagram. If an excessive voltage drop is taking place across the 6.8K-ohm resistor, one side of the 16-mfd condenser should be disconnected and this voltage again checked. If it rises to normal, the condenser is obviously defective and should be replaced.

If only one plate on the tube appears to have a low voltage, this does not necessarily mean that one of the plate resistors has seriously increased in size. You will often find that a small amount of leakage in the 390-mmf condenser will place a positive voltage on the grid of one section of the tube, effectively reducing the bias.

This will result in a substantial increase of cathode-plate current, producing a larger voltage drop across the 220K-ohm output plate load resistor.

If both plate voltages appear to be normal, test for a negative grid voltage at the junction of the control grid and the 68K-ohm grid resistor. This is the same type of test that was conducted with the other oscillators. If this negative voltage is not present, but does not go in a positive direction, check the value of the 2.2K-ohm cathode bias resistor. When, for some reason the tube stopped oscillating, the cathode-plate current through the output section of the tube will substantially increase, raising the current flowing through this 2.2K-ohm resistor. Frequently, the temperature will be increased to the point where the 2.2K ohm resistance will rise, eventually causing a cut-off condition.

A complete loss of either plate voltage would indicate an open plate load resistor in either circuit, or an open ringing coil in the other plate circuit. These ringing coils do not go bad too often, but you will sometimes find a defect in these components. A complete loss of plate voltage on one section could mean that the coil is open and must be replaced.

Only the most commonly encountered defects have been discussed in the horizontal oscillator stage. However, here are some others that you will sometimes come across. These include—shorted turns in the ringing coil, resulting in horizontal loss of control; a leaky 270-mmf output coupling condenser that could cause a complete loss of high voltage or serious overheating of the horizontal output tube; a change in value of the .05-mfd input grid filter condenser, which may result in loss of horizontal sync or high voltage, and substantial changes in values of the other components employed in this circuit.

Another simple test will quickly indicate if the horizontal oscillator is the source of trouble if a loss of high voltage takes place. Short the input grid of the tube to ground. If high voltage immediately appears, even though the picture is out of sync, this would normally indicate a defective component in the grid circuit such as an open resistor, or an incorrect voltage being applied from the horizontal AFC circuit.

In both the vertical and horizontal oscillators, several factors should be remembered. If it is possible to momentarily obtain a stable picture near the mid-range of the hold controls, but it is impossible to hold the picture in place, you would usually discount any defect in these stages. Rather, you would look for a fault in the preceding stages. If you can obtain a stable picture, but are unable to hold it so for more than a few minutes, a resistor is probably increasing in value as the temperature is raised. Or perhaps one of the condensers has a serious change in capacity due to the increase in operating temperature. In addition, the Q of either the blocking oscillator transformer or the ringing coil may be changing. A consideration of all these conditions will provide an accurate, substantial basis from which to work in the servicing of these circuits in modern TV receivers.

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RCA Needs Television Technicians

The RCA Television Division, located in Bloomington, Indiana, needs trained television technicians to aid in its manufacturing of both color and black and white television receivers.

Starting salaries range from $3890 per year for the day shift to $4264 per year for the evening shift. There is a 10% bonus for evening work plus many other company benefits which include a company paid life insurance program, accident and sickness insurance program, paid vacation, eight paid holidays and other benefits.

Additional information may be obtained by contacting Mr. R. E. Dunn, Employment Manager, RCA Victor Television Division, Bloomington, Indiana.

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Use Your Right

His right hand is the fighter's best weapon. His right to vote is the citizen's best weapon against bad government, the infringement of his liberties. It guarantees, in this free country, that he governs himself and is not governed. Vote as you like. That, too, is your right. Use it November 6.

——*n r i*——

If a child annoys you, quiet him by brushing his hair, is the latest advice. If this doesn't work, use the other side of the brush and the other end of the child.

——*n r i*——

How You Can Help NRI Give Faster Service

When you write to NRI—whenever you send a payment, lesson or order, please be sure to give your full name, complete address and your NRI Student Number. If you are a graduate, write "Grad" after your name or "G" after your student number. If you will remember always to do this we will be able to give you quicker service.

Technical Ramblings

By B. VAN SUTPHIN

NRI Consultant

Subject: Oscillation

Oscillation causes symptoms ranging from a shrill whistle down to a steady, low frequency "putt, putt, putt" sound like the exhaust of a motor boat. No matter what the pitch (frequency) it is all oscillation, and always has the same basic cause: feedback of energy from one circuit into another circuit where it is not supposed to be.

Almost all oscillation troubles encountered in service work are caused by capacitor failures. The rest are divided among other causes, such as wires moved too close to the wrong circuits, etc. Oscillation, incidentally, is always caused by open capacitors, never by shorted ones, which would stop the set from playing entirely. Therefore, when you begin hunting for the cause of oscillations, the main weapon is a substitute capacitor which you can bridge across the suspected units. An open capacitor cannot be located with either a voltmeter or an ohmmeter in most cases.

The compact radio sets of today use many capacitors as "multiple bypasses." In other words, a given capacitor may be bypassing more than one stage or more than one circuit for economy reasons. The problem, in avoiding oscillation, is to prevent a signal voltage from one stage from being fed into another. Inasmuch as all of these stages are supplied from a common voltage source, our first problem is to keep this source from furnishing common coupling between the stages.

For instance, in the common AC-DC set, shown in Fig. 1, there is generally no B+ bypass capacitor as such. (This refers to a paper capacitor, about .05 mfd to .1 mfd which was used for this purpose in some of the older sets.) Instead, the output filter, C-16, is the only bypass used in the return circuits of the rf, i-f, and audio stages. In addition to its function as a filter it is really a common by-pass, to every circuit in the set. Therefore, you can easily see that even a small change in the capacity or in the power factor of this capacitor will have a great effect upon the performance of the set.

In commercial radios it is rather rare for these capacitors to become defective suddenly. As these capacitors age, their ability to serve as a bypass often falls off much more rapidly than their ability to serve as a filter. Consequently, a defective output filter may cause oscillation long before there is any noticeable increase in the hum level. This gradual change is often almost unnoticed by the set owner as it "creeps into" the tone of the set. One day it gets so bad that it does become noticeable and then he takes it to the shop. You, not having listened to the set constantly, can spot these symptoms immediately when trying the radio.

Here are the symptoms that indicate trouble of this kind: hum, possibly not very loud, but still just a wee bit above normal, along with a squealing as the set is tuned from station to station. This often takes the form of a zero beat whistle beginning high in pitch, gradually going lower as you tune toward the station then increasing on the other side as you go away from the station.

This can be detected at a very early stage, once you gain the experience to recognize it. It will not be a whistle or a squeal, but rather a sharp hissing sound, decreasing as the station is tuned in, and almost stopping when the center frequency of the station is reached. Watch out for this symptom; it may mean that the filter is on the verge of going out. In some cases you may be able to replace it right then, saving the customer a call back. In any case, it might be wise to mention the fact to the set owner, leaving it up to him whether to replace the capacitor or not. Incidentally, if he decides not to replace it, tell him what will happen: The set will gradually squeal worse and worse, and the hum will increase. When the inevitable occurs, your reputation as a prophet will be considerably enhanced.

This complaint is quite easy to check, by the way. Take the set out of the cabinet, and tune in a station. Then "rock" the tuner back and forth across the station and notice the level of

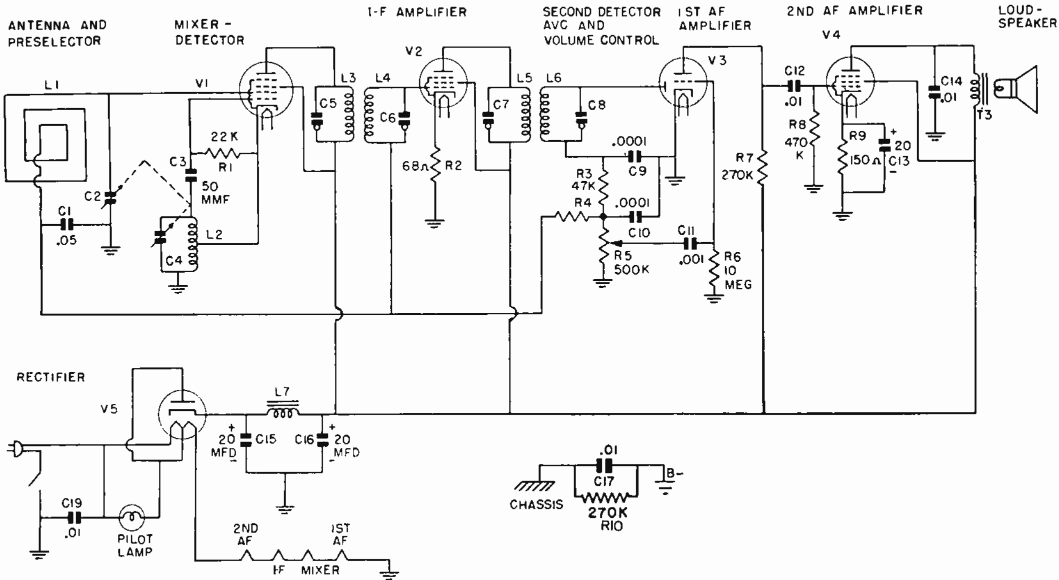

FIG. 1. Typical ac-dc receiver schematic.

the hiss. Compare it with your shop receiver, and with your memory of other sets in good operating condition to see if the hiss is within limits. If you think there is too much, bridge a good capacitor across the output filter. Then tune the set to a station; then tune it just slightly "off tune" to one side, so you can plainly hear the hiss. If the hiss is sharply reduced when the good filter is bridged across the old one, and the tone is perceptibly better, then the original capacitor should be replaced.

If the old filter has gone so far that the set is actually howling (audio oscillation), or squealing when tuned (rf oscillation), then the improvement will be drastic. Always remember when hunting oscillation that you are not looking for a shorted capacitor, but an open one. Therefore, take a good capacitor and shunt the suspected ones in turn until you find which one is bad. When you hit the right one, the oscillation may stop entirely. If it does not, there will be such an obvious improvement in tone that it will be no trouble to make a decision. For a sure check, disconnect one end of the old capacitor and connect a good one in its place. Then check the set.

These same symptoms will also be found in ac sets, battery sets (especially the straight battery operated home receivers which use a single 10 mfd electrolytic as a common rf and audio bypass) and even in auto radios and portables. If the oscillation does not respond to bridging the filters, try bridging all the screen grid, rf plate, and avc rf bypass, using a paper capacitor around .05-.1 mfd.

In the "typical ac-dc schematic", Fig. 1, capacitor C1 is the avc bypass. It prevents audio variations in the avc voltage and prevents signal voltages from being fed from the oscillator-mixer circuit to the i-f amplifier circuit. If this capacitor opens the set may oscillate. In some cases, however, the set will seem to operate normally until it is tuned to the low frequency end of the broadcast band; then the set will oscillate. This problem is rather rare but should be kept in mind.

Another peculiarity, encountered only in ac-dc sets is the capacitor used as a "common B—" bypass. If the negative side of the power supply is not grounded to the chassis but is "floating," this B— circuit is returned to the chassis through an RC filter, consisting of a .05-mfd capacitor and a 470K-ohm resistor. Capacitor C17 and resistor R10 make up this filter in Fig. 1. If this capacitor opens, you may have rf feedback due to the complexity of the circuit. Although it looks very simple, this capacitor serves as a ground return for many circuits. One authority said, when discussing it, that it contained a mixture of frequencies, amplitudes, and phases impossible to predict. So, if you can't stop the oscillation with any of the more common cures, try bridging the capacitor. Better still, try installing one of the specially wound capacitors made for this circuit only.

These look like standard bypasses, but they are specially wound so that the capacitor itself forms a series resonant circuit at 455 kc which is the popular i-f. Thus, this capacitor forms a series trap for any currents at that frequency, and is much more efficient at bypassing them to ground than the common capacitor. These can be obtained from your regular parts supply houses and are known simply as "resonant capacitors." They are made in popular sizes, .02-mfd., .05-mfd., and .1-mfd.

One peculiarity found in smaller sets is oscillation seeming to originate in the i-f amplifier stage. While the tube, or tubes, test good, and there are no bypasses open still the stage wants to oscillate. In this case, try replacing the i-f amplifier tube. If the set happens to have the same tube type in both rf and i-f stages, exchange them and see if this stops the oscillation. Many times, it will.

If you have replaced a tube in the i-f amplifier, and it still oscillates, try another new tube. This trouble may be due to tubes which are just a little above the average in mutual conductance, although some of them test the same as the others. In any case, if everything else fails, and the set still oscillates, try changing the tube itself, no matter how good it checks.

Missing tube shields are a frequent cause of oscillation, especially in the older sets. The modern tubes have a shield built in the structure of the tube itself. Most of the older tubes did not have this feature, but required extra shields. Many home mechanics remove these shields, thinking they are merely for decoration and consequently the set oscillates. When you get one of these sets for service, check for missing tube shields. This can be easily spotted. The tubes which had shields originally will have a small ring, clamp, or series of clips around the socket for grounding the shield. Replace the shields, and then proceed with your service work.

These are general hints for curing oscillation in ac-dc receivers. In that type of set, the most frequent cause for trouble is a defective output filter. Always check that filter capacitor first when you encounter oscillation in one of these receivers. In most cases, you will find that the output filter is defective and is causing the oscillation.

n r i

Our Cover Photo

Graduate John J. Janega is shown checking the performance of an LN27 Canadian Marconi marine radar aboard the SS Cabot Strait. As an Electronics Technician representing the Canadian Marconi Company in Sydney, N.S., Canada, he services Loran, echo sounders, radio telephones, W/T direction finders, fish scopes and radar. In this responsible position he is his own boss, travels extensively making service calls, and also goes to sea to check and service equipment. While traveling by car, he has time to do some hunting and fishing. He keeps up on new electronic advancements through active membership in I.R.E. This interesting, and often exciting, work gives him "much above average" earnings.

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The Callahan living room had been exceedingly dark and comparatively quiet for more than an hour. Mrs. Callahan could stand the suspense no longer and finally called down:
"Lizzie, are you entertaining that young man down there?"
"No mother," Lizzie replied, "we're just talking."

n r i

Middle Age: When you feel on Saturday night the way you used to feel on Monday morning.

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N.R.I. ALUMNI NEWS

Louis E. Grossman .... President
F. Earl Oliver .... Vice Pres.
Howard B. Smith .... Vice Pres.
William Fox .... Vice Pres.
Herbert Garvin .... Vice Pres.
Theodore E. Rose .... Executive Secretary

Elmer E. Shue and Howard B. Smith Nominated Candidates for President of NRI A.A. in 1957

The candidates for the office of President of the Alumni Association are Elmer Shue of Baltimore and Howard Smith of Springfield, Mass.

As mentioned in the previous issue, Mr. Shue was a strong runner-up for President last year against Mr. Grossman of New Orleans, who was elected. But Mr. Shue has come back strong this year. He has been a member of the NRI Alumni Association ever since he enrolled with NRI twelve years ago. He is an active and enthusiastic member of the Baltimore Chapter, has held every important office in that chapter. His long record of service, his loyalty to the Alumni Association, his character and ability, all qualify him for the office of President.

Howard Smith of Springfield, Mass., would also make a good President. He was one of the charter members and leaders in the formation of the Springfield Chapter. He is a former Chairman of the Springfield chapter and is at present its Vice-Chairman.

Of the eight candidates nominated for the office of Vice-President, four will be elected. The eight candidates are F. Earl Oliver of Detroit, William Fox of New York, Jules Cohen of Philadelphia, Joseph Dolivka of Baltimore, Frank Sholnik of Pittsburgh, John Babcock of Minneapolis, Edwin Kemp of Hagerstown, and Joseph E. Stocker of Los Angeles. Notice that this list omits the names of two of our present Vice-Presidents: Howard Smith because this time he is running for office as President and Herbert Garvin because of his retirement from Radio-TV activities this year. Therefore, two Vice-Presidents will be elected for 1957 who have not previously served as National Officers.

Oliver is a real old-timer in the Alumni Association, is a past President and has held the office of Vice-President for a number of years. Fox is very active in the New York Chapter and is one of its many speakers. Jules Cohen is the high-spirited Secretary of the Philadelphia-Camden Chapter. Joseph Dolivka is the very able Chairman of the Baltimore Chapter.

Frank Sholnik is the former (1956) hard-working Chairman of the Pittsburgh Chapter. Edwin Kemp of Hagerstown has served well and faithfully as Chairman of the Cumberland Valley Chapter. Joseph E. Stocker of Los Angeles, California, is not a member of a local chapter, there being no local chapter in his area.

Vote for **one** candidate for President and **four** candidates for Vice-President.

Polls close at mid-night October 25, 1956. Results will be announced in the December-January issue of the NATIONAL RADIO-TV NEWS.

To vote, fill in the ballot on page 30 and mail it in time to reach Washington by October 25.

All members of the NRI Alumni Association are eligible to cast a vote and are earnestly requested to do so. It is the duty and privilege of every member to help choose the officers of his Alumni Association.

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Chapter Chatter

SAINT PAUL-MINNEAPOLIS (Twin City) Chapter welcomed the opportunity to view a twenty-minute film on "Safety Precautions for Electronic Personnel." The film was loaned by the U. S. Naval Air Station, Minneapolis.

Following the film there was a discussion of the

(Continued next page)

Election Ballot

All NRI Alumni members are urged to fill in this ballot carefully. Mail your ballot to National Headquarters immediately.

FOR PRESIDENT (Vote for one man)

- ☐ Elmer E. Shue, Baltimore, Md.
- ☐ Howard B. Smith, Springfield, Mass.

FOR VICE PRESIDENT (Vote for four men)

- ☐ F. Earl Oliver, Detroit, Mich.
- ☐ Willy Fox, New York, N. Y.
- ☐ John Babcock, Minneapolis, Minn.
- ☐ Jules Cohen, Philadelphia, Pa.
- ☐ Frank Skolnik, Pittsburgh, Pa.
- ☐ Edwin Kemp, Hagerstown, Md.
- ☐ Joseph Dolivka, Baltimore, Md.
- ☐ Joseph E. Stocker, Los Angeles, Calif.

SIGN HERE:

Your Name ....

Your Address ....

City ....State ....

Polls close October 25, 1956. Mail your completed Ballot to:

T. E. ROSE, *Executive Secretary*
NRI ALUMNI ASSOCIATION
16th & U Streets, N.W.
WASHINGTON 9, D. C.

problems of retailing Hi-Fi equipment. The main part of this program was devoted to John Babcock's and Charles Goodell's comparison and discussion of the equipment itself—Heathkit donated by Babcock, Sylvania loaned by the Northland Electric Company of Minneapolis, and a Mitchell loaned by Goodell. The members concluded that the Mitchell and the Heathkit amplifiers were about on a par, but that the Sylvania turntable was superior to either the Mitchell or the Heathkit.

Guest speakers were Mr. Marv Kirkbe and Mr. Daton Johnson from Electro Voice, who delivered a talk and showed a film on the new point needles for phonographs.

The chapter has quite a program planned for 1956-1957, including dog nights, picnics for members and their families, guest speakers, films, a Christmas Party, and other features.

Meetings are held on the second Thursday of each month at the Saint Paul Midway YMCA at 8:00 P.M. The Secretary is Charles K. Goodell, 19 West 38th St., Minneapolis 9, Minnesota.

PHILADELPHIA-CAMDEN Chapter is getting back into full swing following the summer letdown. In spite of weather, vacations and other summer-time problems, the chapter held its customary Service Night Meeting. These meetings are important because members bring in their dogs to work on and get the opportunity to use the chapter equipment.

The chapter has signed up four potential new members whose application will have been voted on by the time this is published. It is good to know that this chapter is not neglecting getting new members.

Any other NRI students or graduates interested in joining the Chapter should get in touch with Secretary Jules Cohen, 7124 Souder St., Philadelphia 24, Pennsylvania. The chapter meets on the second and fourth Mondays of each month at the Knights of Columbus Hall, Tulip and Tyson Sts., Philadelphia.

BALTIMORE CHAPTER was pleasantly surprised at an incident which occurred at one of its meetings. Mr. Harp and Mr. Shue reported encountering some unusual conditions in their TV repair work. At the conclusion of the regular business, they were given the floor to explain in detail what steps they took to locate and remedy the defects they had found. Everyone present agreed that Mr. Harp's and Mr. Shue's discussion made the meeting the most productive one of the year from a professional servicing standpoint. Their talks were so interesting that hardly anyone noticed how much time they took. Later

(Continued next page)

it was found that the rest of the program would have to be delayed until the next meeting.

The members were so enthusiastic about Mr. Harp's and Mr. Shue's discussion that at the conclusion of the meeting they agreed to include, as a regular part of the program for future meetings, a report of the most unusual or most perplexing repairs made by members during the month. Members also began making plans for a banquet to be held soon.

Students and graduates in the Baltimore area who wish to join the Baltimore Chapter or would like to attend one of its meetings should get in touch with Secretary Joseph M. Nardi, 4157 Eierman Ave., Baltimore. The Chapter meets on the second Tuesday of each month at 100 N. Paca St., Baltimore.

MILWAUKEE CHAPTER examined a used Heathkit oscilloscope to determine whether to buy it. But as the soldering was inferior and there were many mistakes in assembly and wiring, it was rejected. The chapter will continue to use Treasurer Sponer's scope until another satisfactory one can be bought.

The "open forum" part of the meeting was devoted to a discussion of the use of the oscilloscope in servicing and to work on members' sets. Bill Smith donated an AM Signal Generator ranging from 220 to 275-megacycles.

The chapter is busy laying plans to celebrate its third anniversary with a party and banquet in November. Chairman Bettencourt and Vice Chairman Petrich and Committee members will announce definite plans for the event at the October meeting. Cards will be sent members asking how many want to attend. The price will probably be about $2.50 each for members, wives, and friends. This celebration will certainly deserve the support of all members, as it is certain to be one that will be thoroughly enjoyed by all who attend.

All students and graduates in the Milwaukee area are welcome to attend meetings of the chapter and to apply for membership. Meetings are held at 8:00 P. M., on the third Monday of each month at Petrich's Radio and Television Shop, 5901 West Vliet St., Milwaukee.

Chairman Ernest V. Bettencourt, 3407-A North First St., Milwaukee 12, or Secretary Robert Krauss, 2467 North 29th St., Milwaukee. will be glad to give further information about the chapter.

NEW ORLEANS CHAPTER members recently cut short their regular meeting to visit the factory of the Standard Television Tube Corporation in New Orleans where they were shown how a picture tube is made from start to finish. All agreed that it was a very interesting evening.

But the chapter regretfully announces that Anthony Buckley can no longer serve as Secretary due to a promotion that will require him to undertake a good bit of traveling. "Buck" has served the chapter well and faithfully. His interest and enthusiasm will be sorely missed. Herman H. Blackford has been elected Secretary in his place. Congratulations, Mr. Blackford, and all good wishes!

The New Orleans Chapter extends a cordial invitation to all students and graduates in the area who would like, to attend meetings or to apply for membership. Meeings are held in the recreation room of National President Louis E. Grossman, 2229 Napoleon Ave. For further information write or telephone Chairman Alfred Francis, 1928 Louisa St., New Orleans 17, La., or Secretary Herman H. Blackford, 937 Joliet St., New Orleans 18, La.

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Here and There Among Alumni Members

JOSEPH W. SENIA, Bridgeport., Conn., is an electrical instructor in the service school of Sikorsky Helicopters Division, United Aircraft.

Graduates and partners LIONEL VERBLE of Vanduser, Missouri and HAROLD CUNNINGHAM of Sikeston, Missouri, are now doing the Television service work for six dealers in their area. They have all the work they can do and recently hired an NRI student to help them part-time.

Graduate JIMMIE L. BROWN of Charleston, South Carolina, is now an Electrician Mate 1C in the Navy. His NRI training helped him to pass the examination for Chief Electrician. We were glad to see him on his recent visit to NRI.

ALFONSO ARMENTA of Ontario, Calif., is now a Class "A" Radio Technician for Lockheed Aircraft Service. He is also keeping up his part-time service shop at home, doing well.

WILSON F. SOEHLIG of Oran, Missouri, is employed by the Radio Supply Company there. He recently laid out the plans for built-in hi-fi in a new furniture store.

Graduate RAYMOND V. BARNETT of Bismarck, N. Dak., is the chief engineer at Station KBOM. He is directing the modernization of the station facilities there.

NATIONAL RADIO-TV NEWS
16th & U Sts., N.W. Washington 9, D. C.

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