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Editorial

ENVY—"Discontent at the excellence or good fortune of another." That's partly the way the dictionary defines this word—a word with enough meaning to have caused the downfall of countless men and nations. But startling as it may seem, did you know that ENVY actually has a good side?

A lot of people envied for what they have would gladly be willing to trade places. You have worries, fears, disappointments—so do they—we all do. A person envied has his sleep-banishing problems, character weaknesses, personal inadequacies. If you only knew—if you could compare others troubles with your own—there's a good chance your envy would turn into sympathy.

Use envy constructively. Make it fire your ambition, strengthen your resolution, sharpen your sense of values. Instead of envy for the success of others, try to turn envy to admiration and duplicate their success.

Just admire another for what he *is* . . . not for what he has.

J. E. Smith, Founder

A Thinking Man's Thinker

IBM recently introduced its transistorized Model 7090 computer described as the "most powerful" available. This computer can simultaneously read and write electronically at the rate of *3 million* bits of information per second or find stored data in *2.18 millionths* of a second. Industrial applications include inventory control, production control, and accounting. A typical system sells for $2,750,000—or if you're a little short on cash, it rents for $65,000 per month!

It is the peculiarity of knowledge that those who really thirst for it always get it.
Richard Jefferies

G.E. Announces Program In Profitable Service Management

A NEW TECHNIQUE for helping local independent radio and television servicemen improve their business methods now is being offered by General Electric.

A long-playing record entitled "Sounds of Success" features actual interviews with 30 of the most successful servicemen in the country.

The interviews reveal the selling secrets of these successful independent businessmen in their own words. The aural presentation is supplemented by two texts. Tailored to meet the needs of these small business establishments, the course is available throughout the country through authorized wholesale distributors of General Electric receiving tubes and other electronic components.

In offering the course, the company "continues its traditional assistance to independent servicemen," said Henry B. Nelson, trade relations manager for G. E.'s multi-million dollar electronic components distribution operation. He said G. E. relies almost exclusively upon independent servicemen to provide service for G-E radios and television sets, and added:

"A principal reason for offering this course is to help radio and television servicemen help themselves attain the professional business stature they deserve in their communities. As electronics seeps deeper into everyday activities, it is imperative that each manufacturer unite with distributors in coordinated and concentrated efforts to expand service facilities. G.E. has pioneered in offering technical assistance in developing what now rates as a highly competent and

(Continued page two)

Profitable Service Management—*from page one*

efficient electronics service industry. We hope that our new course in business management methods will provide the basis for an even stronger and broader service industry.

He said the new course was prepared under the direction of Dr. John K. Pfahl, associate professor of business organization at Ohio State University, and produced by the McGraw-Hill Publishing Company under G-E sponsorship.

In addition to the LP record entitled "Sounds of Success," the course includes a 104-page book on "Sound Business Practices" and a 64-page text on "Selling Electronic Service."

The text on business practices covers methods of planning expansion, shop operations, overhead costs, pricing, service call cost analysis, inventory, credit organization, various forms of organization, record-keeping, taxation and cash planning.

Successful selling techniques feature the second volume and cover such subjects as special offers, seasonal planning, customer relations, use of basic market research information in selling, customer grievances, guarantee policies, customer contacts, and advertising campaigns.

Satisfactory completion of the course earns the service dealer a certificate of achievement attesting to a comprehensive understanding of and training in efficient, modern business methods.

The course is being offered through authorized General Electric electronic parts distributors. These wholesalers are being encouraged to work closely in assisting dealers with business problems—and, in some cases, to sponsor group seminars in business management for dealers.

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—*n r i*—

HOW TO CHANGE A NEEDLE*

Phonograph Service Requires Diverse Needle Replacement Techniques

In the past decade high fidelity has become as commonplace in the American home as the gramophone was a generation ago, placing increased responsibilities and demands on the sound technician.

Today, the ability to change any of the many kinds of phonograph needles quickly and efficiently is an indispensable skill. In addition, the service technician must be able to locate the source of trouble in the needle-cartridge area, and come up with a fair estimate of how often a needle needs changing.

Popularization of stereo is making the job even more complex. Consequently, what once was a simple chore performed by almost anyone in the home, is rapidly becoming a more complicated task.

For example, in changing almost any needle, the technician is faced with two problems. He must know how to remove and replace needles in all kinds and makes of cartridges, and he must get the correct needle in the proper cartridge. Fortunately, there are only about eight ways in which needles are held in the cartridge of playing arms of either monophonic or stereo turntables and record changers. These include snap-on, plug-in, screw-mounted, slide-in, snap-in knurled knob, crank type and friction hold.

The illustrations presented here show the principal needles used with typical cartridges. When called on to replace what often appears to be a faulty or worn needle, the alert serviceman must be able to tell whether the difficulty is in the needle or in the cartridge.

In such cases, always make sure that friction-fit needles are firmly seated so that all movements of the stylus tip are transmitted to the cartridge elements. When the needle becomes loose, an intermittent garble sound often is produced.

Needles of the screw-in and snap-in type present a distinct problem. The forward part of the needle must be engaged in the yoke-type coupling which is attached directly to the cartridge element. If these needles are not properly secured to the yoke, intermittent garble or no sound at all will result.

In reluctance type cartridges, such as the GE, the technician should make sure

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The NRI Model 290 Portable Transistor Receiver

By J. B. Straughn
Chief, NRI Consultation Service

This receiver, now available through the NRI Supply Division, (see page 30), is one of the most remarkable we have ever seen. The sensitivity and selectivity are more than adequate for local stations and at night I have even been able to pick up some distant stations. Unlike more miniaturized transistor receivers the tone is surprisingly good due to the relatively large 4-inch speaker. Most of the "pocket sized" transistor sets use a 2-inch speaker. These small speakers produce rather tinny sound quality and are quite insensitive, requiring considerable audio power to produce a reasonably loud sound.

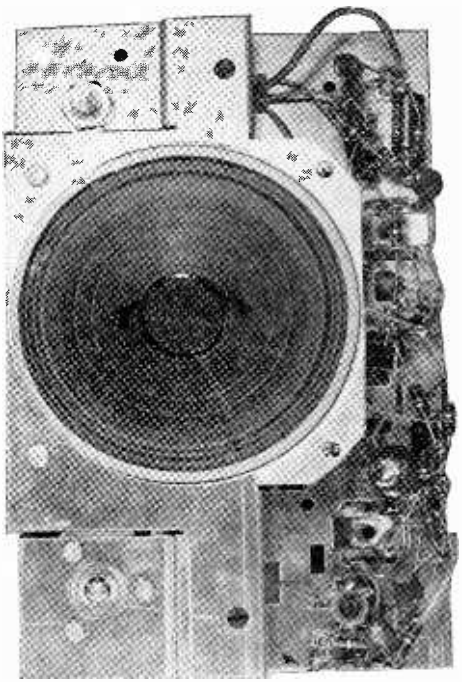

Figure 1A. (Photo). This is the top of the Model 290 chassis.

The chassis of this neat appearing Transistor Portable is shown in Fig. 1A and Fig. 1B page four. While the bottom of the chassis might appear crowded, there is actually plenty of room and if the receiver is built according to instructions no trouble will be encountered.

Partly because of the "large" 4-inch speaker fewer stages are necessary as can be seen in the complete schematic in Fig. 2. Transistor Q_1 is used as a combination mixer oscillator, Q_2 as the IF—1st AF amplifier and Q_3 is used as the audio output amplifier. Q_4 is also a transistor, but with its base and emitter tied together, it acts as a crystal diode and functions as the second detector.

Actually then, this is a three transistor type circuit. With only three transistors how it is possible to get such good results? This is due in part to the use of high quality transistors, matched coils and to the large physical size of the loop antenna. Just as important are the optimum operating voltages used and reflexing of the IF

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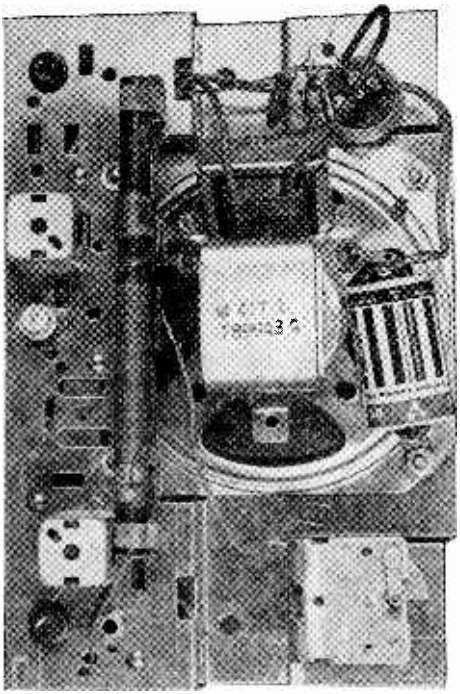


Figure 1B (Photo). Here are the parts located on the bottom of the chassis.

stage so that it acts simultaneously as an IF amplifier and as a first AF amplifier.

This "reflex" is actually an old type circuit used 30 years and more ago in the early tube receivers when a tube might easily cost a day's wages. These circuits were dropped as soon as tube prices came down because they were tricky to get working right and were subject to very serious crosstalk. With today's transistor circuit, operation is quite straightforward. The only noticeable difference from conventional operation is that the volume can only be reduced to a whisper (not cut off entirely) on very strong local stations. The reason for this will be explained later when the operation of the stage is discussed.

A transistor like a tube must he biased for correct operation. Q_1, Q_2, and Q_3 use a common emitter circuit which corresponds circuit-wise to the grounded cathode tube circuit, where signals are applied between the control grid and cathode. Here the signals are applied between the base and the emitter. Do not however attempt to carry the comparison further as it will only lead to confusion. In the tube, electrons are emitted by the cathode and in their flow to the plate are controlled by the grid to plate voltage. In these transistors, which are of the PNP type, electrons flow from the negative side of the battery to the collectors and leave by way of the emitters. This is exactly opposite to electron flow in a tube so you can see why we cannot use tube circuitry explanations when discussing transistors.

Now, of course, the emitters emit but, in the case of the PNP transistor, holes rather than electrons are emitted into the base region. This permits the flow of electrons in the external circuits. I have found it easier and better to simply speak of current flow in the circuits, disregarding entirely the direction of electron flow, except when electron flow direction is needed to determine the polarity of dc voltage drops in the circuit. The emitters do emit so we will just talk about the current flow, ignoring its direction when possible. With NPN transistors, the emitters actually emit electrons and with them electron flow can be considered. However there are so many sets using both NPN and PNP transistors that it becomes easier to always think in terms of "current" flow, moving from the chassis, to the emitter, into the collector and to the ungrounded side of the power supply. This requires some revision in thinking for those used to tracing electron flow through tubes but it's not too hard—try it.

In a transistor we have three important voltages. These are the base, the emitter, and the collector voltage. With PNP transistors the voltages are negative with respect to the chassis. The opposite is true in the case of NPN transistors. The forward emitter bias is quite important as this determines the stage gain and the amount of collector current. If this bias is excessive, too much collector current will flow and the transistor will be damaged. If the emitter bias is too low, stage gain will fall off. Either too little or too much bias will cause distortion.

The emitter bias is the difference between the emitter and base voltage. In the PNP transistor the base will be slightly more negative than the emitter. In other words the emitter is positive with respect to the base. There are a number of ways of obtaining this bias. In the three transistors in the Model 290, a combination of fixed and self bias is used. Look at the circuitry of Q_1. Note the voltage divider formed by R_3 and R_2. This sets the base to chassis voltage. Electrons flowing from the emitter to chassis produce a voltage drop across R_4, which also makes the emitter negative with respect to the chassis. The difference in these two voltages is the emitter forward bias.

In the same way the voltage drop across

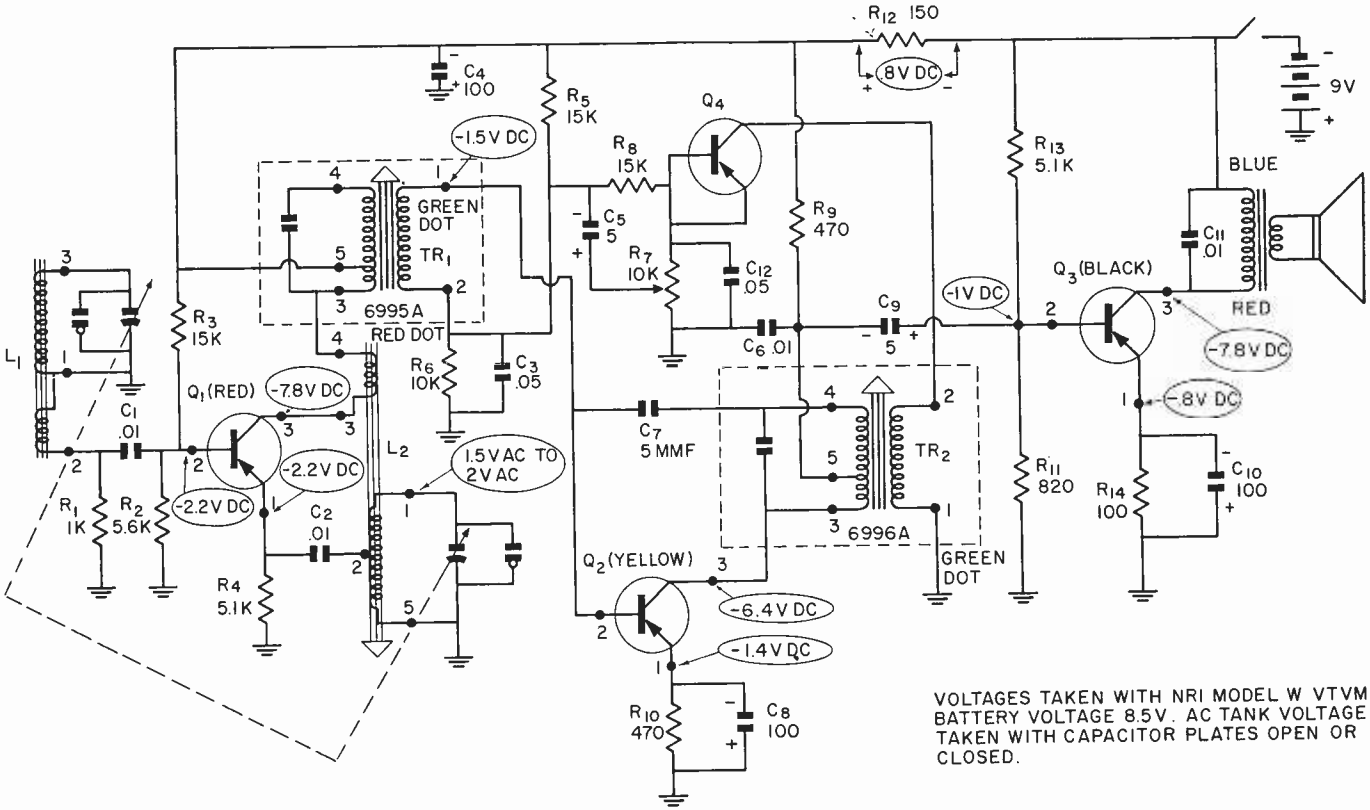


Figure 2. Schematic diagram and operating voltages of the Model 290 transistor receiver.

R_6, controlled by R_5 and the series R_8 and R_7 in parallel with R_6, sets the base voltage for Q_2. Self bias is produced by the drop across emitter resistor R_{10}. R_{13} and R_{11} produce the base voltage for Q_3 while R_{14} determines the emitter voltage.

Now let's trace the signals through the set and see just how it works. As in any receiver, passing Radio waves will induce voltages into the loop antenna and at the resonant frequency a large current flows in the resonant circuit. An rf voltage at the resonant frequency is induced into the secondary of L_1. This is applied across R_1 and also C_1-R_2. Variations in voltage across R_2 will change the forward emitter bias of Q_1 with resultant changes in collector current.

Variations in collector current through the primary of L_2 will induce a voltage into the tuned oscillator tank which will be shock excited into oscillation at its resonant frequency. A portion of this voltage is tapped off the oscillator coil and fed to the emitter of Q_1 through C_2. The resulting variation in the emitter voltage causes further variations in collector current at the oscillator frequency and the voltage in the oscillator tank is further reinforced and the transistor continues to oscillate.

The two signals being fed into Q_1 (the incoming Radio signal and oscillator signal) are mixed in Q_1 which is biased to act as a detector.

The difference frequency (455-kc) is the i-f signal and carries the original station modulation. This signal in 3-5 of the primary of the first i-f transformer sets up a large circulatory current in the entire primary which is tuned to 455-kc.

The 455-kc i-f signal in the primary induces a voltage at this same frequency into the secondary of TR_1. This is applied between the base and emitter of Q_2, the path to the emitter being through C_3 and C_8. The signal is amplified by Q_2 and appears across the primary of TR_2 which is also tuned to the if frequency. The operation of Q_2 is not absolutely linear and some detection on very strong signals takes place. This happens in most i-f amplifiers whether of the tube or transistor type. It is usually unnoticed because the impedance of the output circuit at audio signals is low and because an audio signal cannot be transferred from the primary to the secondary of an i-f transformer. However, if you trace out the collector circuit of Q_2 you will see that the collector current flows through 3-5 of the TR_2 primary and through R_9 and R_{12} to the battery. R12 is bypassed to ground by C_4 but R_9 has considerable audio voltage developed across it. There is no i-f voltage across R_9 because of the bypass action of C_6. The audio across R_9 is fed to the base of Q_3 through C_9 without going through the second detector and volume control. The signal at the loud speaker will be at a very low level but cannot be lowered to zero by the volume control. The effect is unusual but actually causes no trouble.

Now let's see why we have an audio collector load in the i-f amplifier stage. The i-f signals in the primary of TR_2 induce a voltage into the secondary. This i-f signal is applied to the diode rectifier Q_4 and the resulting audio signal is developed across the volume control R_7. By adjusting the volume control the signal between the movable arm and ground is applied through C_5 and the secondary of TR_1 to the base of Q_2 and through the chassis and C_8 to the emitter. Q_2 amplifies this audio signal in the unusual manner and it appears across R_9. Thus Q_2 acts both as an i-f amplifier and first AF amplifier. The signal across R_9 is coupled to the base of Q_3 through C_9 and to the emitter through C_4 and C_{10}.

Again the signal is amplified and the audio current in the collector circuit passes through the primary of the output transformer. This induces a voltage into the secondary and the signal current flowing through the voice coil actuates the voice coil and cone into motion reproducing the audio sounds just as they were picked up by the microphone at the broadcast station.

You will note in examining the schematic that the values of bypass and coupling capacitors seem to be abnormally large by comparison to those used in tube receivers. The difference is due to the impedances in the transistor receiver.

Take coupling capacitor C_5 for example. In a tube type set the audio coupling capacitor following the volume control might have a value as low as .001-mfd. and certainly would not be greater than .01-mfd. Here, however, we are using a 5-mfd elec-

IF - - -

"Well, friend," said the psychiatrist, "I think we have your kleptomania under control now."

The patient smiled gratefully and got up to leave.

"However," said the doctor, "if you do have a relapse, will you pick up one of those little transistor radios for me?"

trolytic for coupling purposes. The size of the coupling capacitor must be such that most of the signal will appear across the following load and very little across the coupling capacitor itself. In a tube circuit as shown in Fig. 3 the coupling capacitor feeds a 10-megohm resistor and even a .001-mfd capacitor has a low reactance compared to 10 megohms. Therefore practically all of the signal in this voltage divider consisting of C_3, R_3 will be dropped across R_3 where we want it.

In Fig. 2 the load into which C_5 feeds is a 10K-ohm resistor (R_6) shunted by a .05-mfd capacitor. It is obvious that if C_5 had a value of .001 that practically all of the audio signal would be dropped across it and almost none would appear across R_6 for application to the base of Q_2.

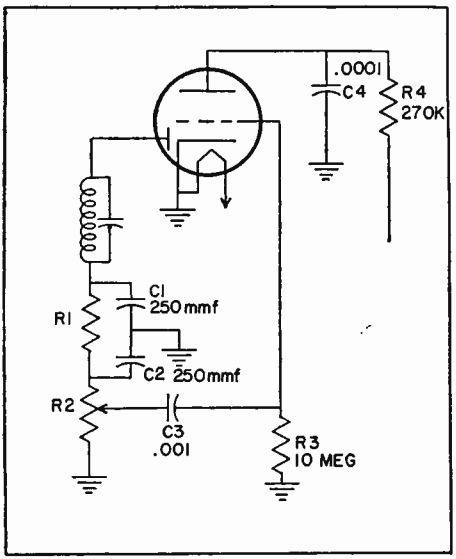


Figure 3. Typical R-C Coupling for a triode tube. Note the values of C3 and R3 as compared to C5 and R6 in Fig. 2.

Also notice that R_7, the volume control, is shunted by a .05-mfd capacitor. Such a capacitor across the volume control in Fig. 3 would practically act as a short circuit due to the large value of R_2. In Fig. 2 however, the reactance of C_{12} is high at audio frequencies compared to R_7 so it does not act as an AF bypass. At the i-f value however, it makes a good bypass and that is its purpose in the circuit.

The seemingly odd values of the other capacitors can be explained in the same manner.

Notice the one capacitor in the receiver which has a familiar value, considering its use. This is C_{11}, across the primary of the output transformer. The value of C_{11} tells us that the output transformer has a primary impedance in the neighborhood of that found in tube receivers.

There is only one really small capacitor in the receiver and this is C_7 which connects from the primary of TR_2 to the base of Q_2. The signal at terminal 4 of TR_2 is 180° out of phase with signals at the base of Q_2. Therefore some energy is being fed back from the output of Q_2 to the input, phased to cancel out any fed from the collector to the base through the transistor. Thus C_7 is a neutralizing capacitor and prevents Q_2 from going into oscillation at the intermediate frequency. The capacity of C_7 is not too critical.

Building this receiver is an enjoyable project and when you are finished you will have a portable which will give years of satisfactory operation.

Transistor Replacement

In theory transistors do not go bad. In practice however failures do occur, just as tubes sometimes fail.

Low power transistors such as the ones in this set sometimes open at the base connection internally. Also they may develop leakage between the emitter and collector. A transistor tester will show up these troubles and with experience they can be located with an ohmmeter. (We hope to have an article on this in a future issue of the News).

High power transistors of the type used in auto sets seldom fail but when they do a short between emitter and collector results.

All transistors in the Model 290 are checked 100% before we purchase them. However, if replacements are required the following RCA transistors are recommended:

Q_1 (red) = RCA 2N411
Q_2 (yellow) = RCA 2N409
Q_3 (black) = RCA 2N407

Q_4 may most easily be replaced by a 1N60 germanium diode with its cathode soldered to the junction of R_8, R_7 and C_{12}. Its anode (unmarked end) connects to 2 of TR2.

"The Congressional committee investigating TV has plowed only a couple of rows in a large field. It is not enough to establish that quiz shows were rigged. In the Westerns, do they use real bullets?"

Burlington Iowa Gazette

Hi-Fi Corner

by John G. Dodgson

EQUIPMENT EVALUATION: THE PICKERING GYROPOISE 800 TURNTABLE

Although this Pickering table has been out for some time I've never bothered to investigate it—partly because there are so many tables on the market but also because I suspected their "bearing of air" might be just another gimmick. Pickering claims that vertical rumble has been effectively suppressed by using a magnetic suspension, a "bearing of air" instead of the usual mechanical linkage. In fact, they call it their "Airborne Stereotable."

When the Gyropoise arrived from Pickering I carefully inspected it. The platter (or tray) is cast aluminum with a steel spindle. Around the spindle, mounted directly on the platter, is a powerful ring magnet. The baseplate is quite rigid, about 3/16 inch thick, and appears to be made of some steel alloy. Right in the center is the spindle well and around it another heavy ring magnet. Now normally the spindle well contains the main bearing—a steel or nylon ball seated at the bottom and covered with lubricant. The Gyropoise well doesn't contain a bearing—in fact, there's an open bottom and when the platter is in its position the platter spindle projects below the well. The platter, of course, is held in position by the opposing fields of the ring magnets. These magnets are strong enough to provide over ⅛ inch "bearing of air." Does the air bearing work? It has to — there's no other bearing!

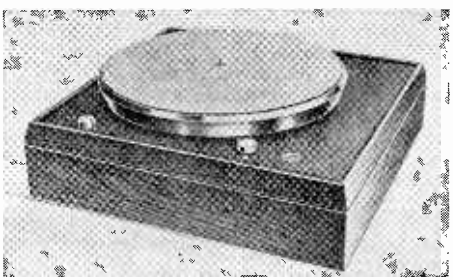
Of course the spindle and well assembly is still needed to hold the table laterally so it can be rotated.

The Gyropoise is loaded with those extra little features that justify its price range. To me one of the most valuable is the spring suspension of the entire baseplate. With the rigid mounting of most tables it's practically impossible to track below 3 grams since any vibrations in the house will unseat the stylus from the groove. With three boys running around the house, this gets to be nerve-racking! Besides the vibration problem it's not possible to operate a rigidly mounted table close to a speaker because of the acoustic feedback.

Another valuable feature of the Gyropoise is its built-in spirit level. With stereo the turntable must be level for proper tracking of both grooves. The built-in level works in conjunction with the spring-mounting screws. A slight rotation of the screws will raise or lower any corner of the table, I had no difficulty leveling the table with either the lightest or heaviest tone arms.

The on-off control is clever. A long lever projects from outside the platter to the idler assembly. Near the middle of the lever there is a hole with a slide switch projecting through it so movement of the lever will actuate both the slide switch and the idler wheel. The idler, incidentally, is a large live-rubber type—completely rubber instead of just a metal wheel with a thin rubber tire.

Performance. In a system with amplifiers flat to 5 cps and speakers capable of substantial output at 30 cps any rumble or noise from the Gyropoise is below record surface noise and therefore inaudible. Special rumble bands on test records showed it to be a minimum of 60 db down, the lowest limit I can detect. (The NARTB requires only —44 db.)



The Pickering Gyropoise 800 Stereotable.

Wow and flutter are undetectable to my ears. A check with a stroboscope showed very constant speed—no doubt due to the heavy synchronous motor.

Criticism. Although no difficulty was encountered in mounting the turntable on its base (excellent base, by the way) considerable trouble was met in mounting the tone arm. This trouble was due to the fact that the baseplate is provided with a hole for the Pickering Unipose arm. If a Unipose is used it will mount in a few seconds with no trouble. However, if the Unipose is not used, the mounting hole will most likely be in the wrong place and be the wrong size. No one can blame Pickering for trying to sell their Unipose arm but perhaps two types of baseplates could be offered. At any rate it isn't impossible to mount another arm—it's just a nasty job.

My only other complaint, and it is minor, is the lack of a pilot lamp. It would help to remind to turn it off.

In conclusion then, the Pickering Gyropoise easily meets its advertised specifications. The "bearing of air" works well and effectively suppresses vertical rumble. It's performance, extra features, and rugged contsruction make it a worthwhile investment for a high quality stereo system.

Converting to Stereo

JOHN D. DODGSON
NRI Editorial Staff

Although the following information is written specifically for the conversion of a component type monophonic high-fidelity system to stereophonic operation, much of it is also applicable to the conversion of package type systems. In addition, some special problems encountered in "package" conversions are described at the end of this article.

Methods. The most obvious method of converting a monophonic high-fidelity system to stero is complete replacement of the present system with a new one specifically designed for stereo reproduction.

The old system can often be traded in. Most dealers will allow 20% to 40% trade-in allowance on equipment of equal or higher price. The trade-in procedure works just about the same as it does for automobiles. That is, the allowance depends on not only the price of the new equipment purchased but the demand, condition, and the age of the equipment traded in. If the dealer will not take the equipment on a trade it is often possible to sell it personally by word-of-mouth or through a small classified ad in a local paper.

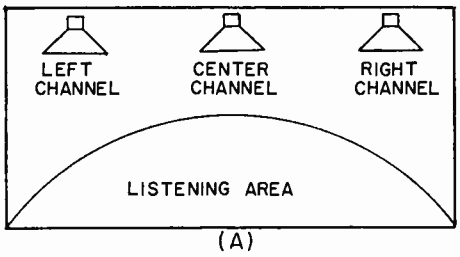
Another method of disposing of the equipment is to deal with some of the larger mail-order houses which will take trade-ins. These are usually advertised in the electronics and high fidelity magazines.

Although the simplest method of converting to stereo is to replace the present system with a stereo system, the best method is to use the present system as a center channel and to purchase a new stereophonic system to be used as the right and left channels. This method is obviously the most expensive, although almost all who do it claim it's worth the expense.

Finally, the least expensive, and thus the most popular method of converting to stereo, is to use as many components as possible in the present high-fidelity system to convert to stereo operation. Although the least expensive method, this is obviously the most troublesome method.

WIDE STAGE STEREO

Before getting into the problems of converting to stereo by the last method mentioned above, let's look at the best method: using the present system as a center channel. This method of stereophonic reproduction using the normal right and left stereo channels plus a center (full-range) channel was first devised by Paul Klipsch and was named "wide stage stereo" by him. Many (including the author) maintain that this is the best possible stereophonic reproduction. It should be pointed out, however, that it is likewise the most expensive method. Moreover, it is also obvious that the developer of wide stage stereo, Paul Klipsch, was in the corner horn speaker-enclosure business and it is normally not possible to use corner horns in a stereo system without a center "fill" or there will be an excessive "hole in the middle."



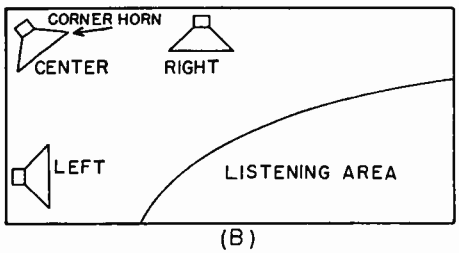


Fig. 1. (a) Normal speaker placement for 3-channel "wide stage stereo."

(b) Using a corner horn for the center channel.

To use the present high-fidelity system as a center channel, only the amplifier and present speaker are used, as shown in Fig. 1A. The speaker cannot normally be used in the center if it is a corner horn type. However, it is possible in some room configurations to use a corner of the room as the center of the speaker spread, as shown in Fig. 1B.

It is most important to note that this wide stage stereo system, utilizing a center channel, is not the same as so-called three-channel systems of package high fidelity or the 3-channel "satellite" components. That is, the center channel of the wide stage stereo system is a full-range system. The signal fed to the center channel is a combination of the information fed to both the right and left-hand channels (A+B). The satellite and the package high-fidelity, 3-channel systems utilize the woofer only in the center channel and the right and left-hand channels contain mid-range and high-frequency reproducers. This method of stereophonic reproduction is based on the premise that low-frequency sounds are not directive and the stereophonic reproduction is thus not enchanced by directivity separation of the lower frequencies. This assumption is based on a series of tests carried out some time ago. However, these original tests were carried out with sine waves only, and recent tests by CBS Laboratories with music seems to conclusively show that low-frequency musical sounds are directive.

Besides the placement of the loudspeakers the only problem encountered in wide stage stereo is the method of combining the right and left channel signals to feed the center channel amplifier. There are many methods of doing this but since we do not have the space here to go into all of them, only the simplest (and most likely the best) method will be investigated.

This method is illustrated in Fig 2. Notice that two resistors and a potentiometer are required. The isolating resistors R_1 and R_2 are connected from one of the taps of each amplifier channel to the outer terminals of the potentiometer R_3. These isolating resistors can be practically any value between 100 ohms and 100,000 ohms. Further, any tap of the right and left channel amplifiers can be used, although best results are usually obtained by connecting to the tap that is also used for the right and left channel speakers.

The potentiometer R_3 can also be any value, although I have found that 50,000 ohms to 100,000 ohms generally works best. This potentiometer R_3 is a "mixer" control. That is, as the slider is moved up toward resistor R_1 most of the signals fed to the center channel amplifier will be from the left channel, while when the slider is moved toward resistor R_2 most of the signal fed to the center channel will be from the right channel. Thus, the center channel speaker need not be placed exactly in the center between the right and left channel speakers. The center terminal or slider of the "mixer" control R_3 should be connected to one of the high-level inputs of the center channel (monophonic) amplifier such as the crystal, tuner, auxiliary, etc.

Notice that it is important to connect the

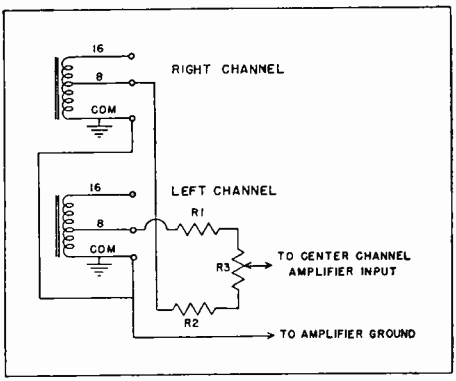


Fig. 2. One method of obtaining a mixed (A+B) signal for the center channel.

common terminals of both the right and left channel amplifiers together, then to run this lead to a ground terminal on the center amplifier. Shielded leads need not be used for any of these connections if they are kept short. However, it is best to use a shielded lead from the center terminal of the mixer control to the center channel amplifier (and ground the shield at that point).

By plugging the center channel amplifier into the main amplifier's switched outlet, it will not be necessary to turn it on and off in addition to the main amplifier.

This method of obtaining a center channel generally does not require continual adjustment of the volume or tone controls of the center channel amplifier. Normally the center channel is kept from 3 db to 6 db down in relation to the outer channels. This reduction of the center channel will effectively fill in the middle and yet preserve the stereo separation and directivity.

This wide stage stereo system has a further advantage in that increasing the center channel volume will reduce the effec-

Fig. 3. A typical Stereo Adapter, the Knight.

tive stereo separation. This, unfortunately, is too often necessary on many discs recorded with unnatural separation.

Conversion Problems. We will now consider some of the problems encountered by trying to use as many components as possible from the present high-fidelity monophonic system. The first problem that will generally be considered will be the amplifier.

Amplifier Problems. The main prerequisite of high quality stereo reproduction is that both channels be of equal quality. Naturally, the exact same components need not be used in both channels providing the components in each channel are of equal quality. Without doubt, however, it is best to use the same components in each channel.

Therefore, the most natural method of using the present amplifier in a stereo system is to obtain another of the same type and use it in the other channel. Even if the amplifier is a high quality unit you may find that it is no longer possible to obtain the same type because either the company stopped making it or has gone out of business. If the amplifier is of high quality and is not more than five or six years old, it would be worthwhile to advertise for one or to contact all of the audio dealers in your area, to help you to obtain one. However, if the amplifier is over six years old, it would be best to purchase one of the newer stereo amplifiers. Amplifier quality has substantially improved in the last few years.

Two monophonic amplifiers can be successfully used for stereo reproduction, but you will find that it is quite inconvenient to use them because it will be necessary to manipulate two on-off switches, two gain controls, and two sets of tone controls every time the system is used. To minimize this difficulty most manufacturers produce a stereo adapter unit similar to the one shown in Fig. 3. This unit either plugs directly into, or easily wires into the monophonic amplifiers to give you centralized control of the gain and balance. The addition of such an adapter to such a system is very worthwhile.

Probably the best method of using a pair of monophonic amplifiers for stereo operation is to use the power amplifier sections only of these amplifiers, and to obtain one of the newer stereo pre-amplifiers for control. The output of the stereo preamplifier can be plugged into the high-level jacks of the monophonic amplifiers, and the tone controls should be set to the "flat" positions.

The volume or gain controls of the monophonic amplifiers can be used as level controls when first setting up the system and then can be ignored.

Because of power transformer leakage and the many interconnections, hum problems often arise in any of the above methods. These hum problems can usually be eliminated by running heavy ground wire between each of the chassis and then to the power line ground of the house. If this does not eliminate the hum, try different positions of the line cord plugs in the power outlets.

THE STEREO CARTRIDGE AND RECORD PLAYER

Without question, if trouble is encountered in the conversion it will be with the record-playing device.

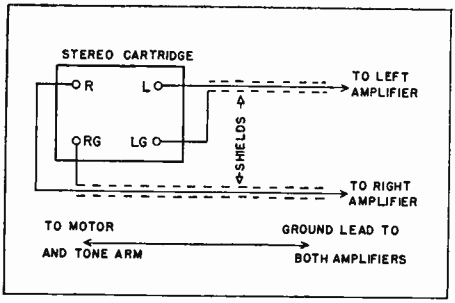


Fig. 4. The 4-wire stereo cartridge wiring method.

Naturally, the first step is to remove the monophonic cartridge, install a stereophonic cartridge and then change the wiring accordingly. That is, one or two more wires will need to be added to carry the second channel information. This is strictly a mechanical operation but generally does not cause too much trouble. However, you might have difficulty in obtaining wires sufficiently thin enough to fit through the tone arm, and particularly down through the base of the tone arm to underneath the turntable or changer. Flexible wire should be used for this and most flexible hookup wire is simply too large. If you cannot obtain flexible wire sufficiently thin for this purpose you'll find that the wire used in inter-com type multi-conductor cables is just about right. If at all possible, shielded wire should be used, but this is almost always physically too large. If the manufacturer of the record player offers a stereo conversion kit, it is by far the best method, even though it may seem to be excessively expensive.

There are actually two different ways of wiring the stereophonic cartridge (and record player). These are known as the three-wire and four-wire systems. Actually, an additional ground wire is needed in both systems which would correctly make it four-wire and five-wire.

Fig. 4 illustrates the five-wire system. Notice that each channel is kept separate: a shielded lead is used for each channel and another separate ground is used.

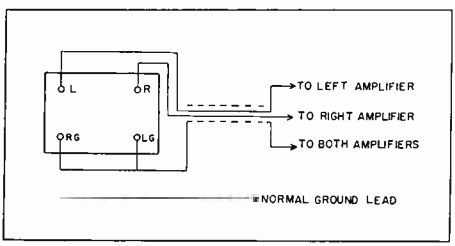


Fig. 5. The 3-wire stereo cartridge wiring method.

Naturally, the center conductor of one shielded cable is connected to the "hot" terminal of either channel of the stereophonic cartridge. The shield of the cable is connected to the corresponding ground terminal of the cartridge. The other shielded conductor cable is connected in the same manner to the other channel hot and ground terminals. The other end of the shielded cable should, of course, be appropriately terminated with a phono plug.

A separate ground lead must be run from the chassis of the amplifier to the record player whether it be a changer or a turntable. This ground lead should be connected to the motor, tone arm, and sometimes even the main mounting plate of the unit. Very often a solder lug will be provided on the motor (or one can be easily attached). Sometimes the motor is mounted on a metal motor plate and if the tone arm is also mounted on the plate, it is then only necessary to connect the ground lead from some point on this plate to the amplifier. It is not unusual to find that even when the sections of the record player are apparently physically connected together, hum can be reduced by connecting links of heavy wire between the sections. This is strictly a "cut and try" procedure.

The other end of this ground lead should be connected to the amplifier, as mentioned above. If a stereo preamplifier is used, only one connection is necessary. However, if a pair of monophonic amplifiers are used, it is necessary to connect the ground lead to one of the amplifiers, then run another heavy piece of wire from this point to a ground connection on the other amplifier. Just where on the amplifier the ground lead is connected depends on the individual unit. Sometimes it is convenient to use a solder lug under one of the screws on the chassis. I have found one of the simplest methods is to solder the ground wire to the outer portion of an ordinary phono pin plug and plug it into one of the unused input jacks. It is sometimes possible to reduce the hum level by connecting to certain grounds on the amplifier and this should be tried if hum is encountered.

The so-called three-wire system is shown in Fig. 5. Notice in this illustration that a single length of two-conductor shielded cable is used to couple the stereo cartridge to the amplifier system. The ground terminals of both the right and left channels are connected together and to the shield of the two-conductor shielded cable. Each of the inner conductors are connected to the right and left "hot" terminals of the cartridge.

(Continued page eighteen)

How To Change a Needle—

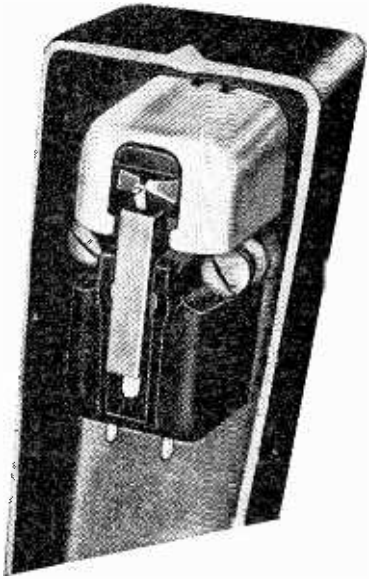
continued from page two

that the magnetic vein is equally spaced between the pole pieces and that it does not touch the pole pieces. Static sounds will result if the vein comes in contact with the pole pieces. Also, the serviceman must make sure the needle is not bent and that it does protrude out beyond the guard.

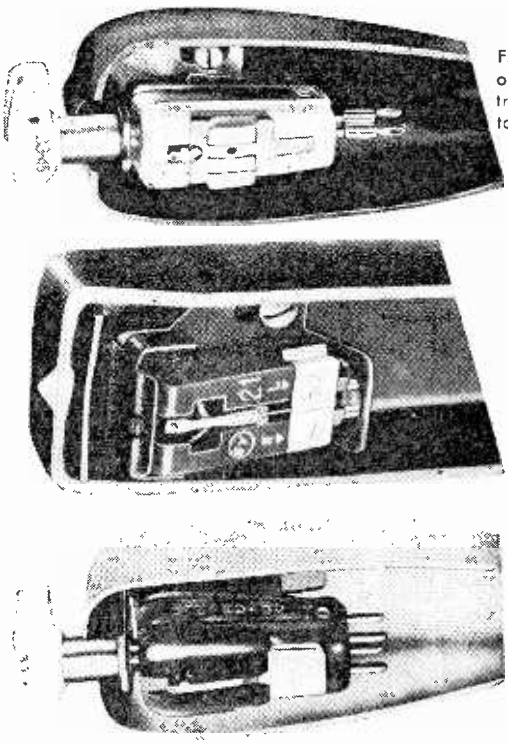
However, if there is any reason to suspect that poor reproduction is being caused by a worn needle, an examination under a microscope is in order. A worn needle soon will make itself heard. Unfortunately, when this point is reached, the needle is already harming records.

As a needle wears, it becomes flat along the sides. This creates a grinding effect on the inside of the record's sound

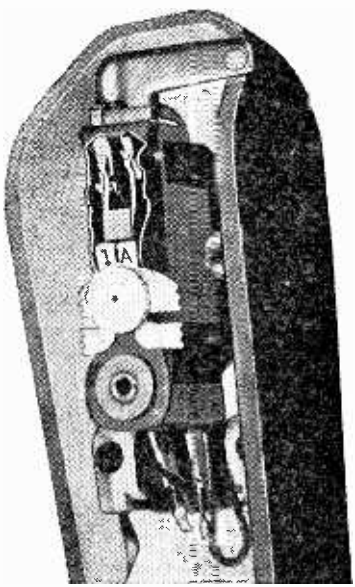
(Continued page fifteen)



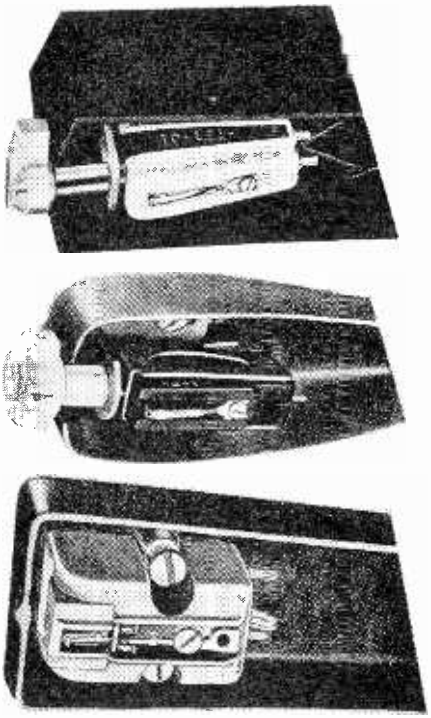
FRICTION-HELD—On G-E's VR-22 Stereo, take out the two mounting screws, and remove cartridge. Run a small wire through hole in the top of cartridge, pushing out needle assembly.



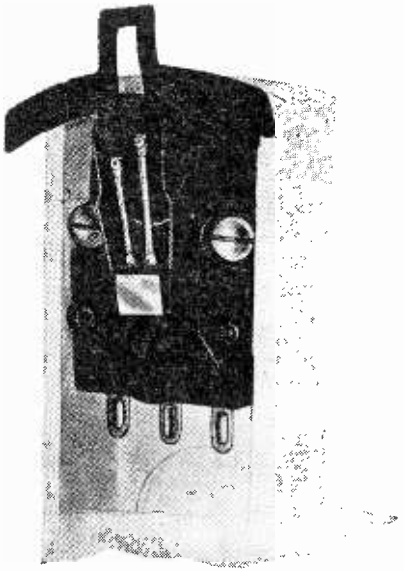
SNAP-ON—To remove needle from the Ronette monophonic (above), Electro-Voice Stereo (center) or the Ronette Stereo (below), grasp the wide metal clip and pull down. With the needle assembly out, a replacement is installed by simply snapping one in place. Make sure front part of the needle is properly engaged in the yoke.



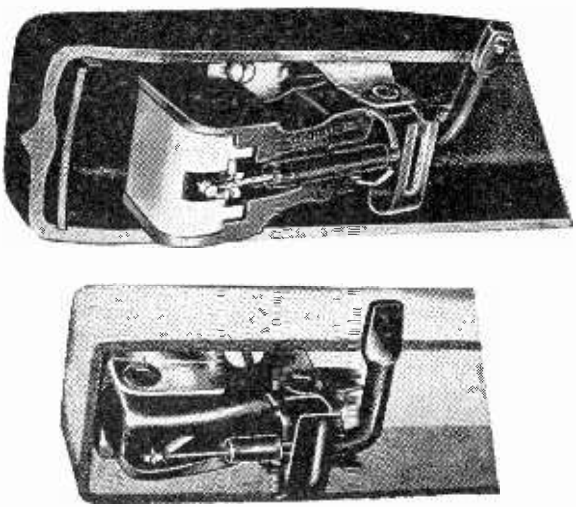
KNURLED-KNOB—Shure's Mono unit holds the needle by a knurled knob. To remove, unscrew knob and pull entire assembly forward. Needle is changed by sliding in place and tightening knob.



SCREW-MOUNTED—The needle assembly can be removed from the Ronette Mono (top) and the Columbia Stereo (below) by removing the needle in place and tightening the screw. The Astatic Mono (center) screw does not come out and the needle is shaped like a horse-shoe. The needle slides into the screw's body. Advantage is: screw can't be lost.



SNAP-IN—The needle is removed from this RCA Stereo cartridge by prying up from the rear of the copper needle clip with thumb nail and pulling down with the other hand. Assembly then drops out. New needle snaps in place.

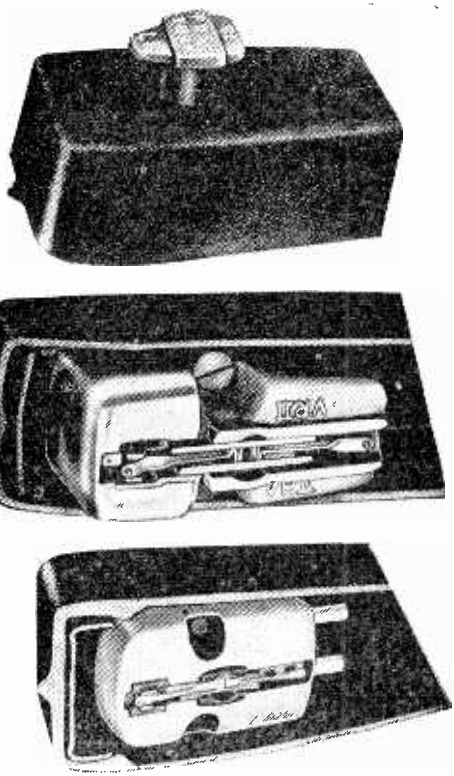


CRANK-TYPE—(left) The needle arm is snapped out of the cartridge sideways—to the right of tone arm—by pressing down on the spring clip, allowing it to discharge the needle assembly from both the Sonotone Stereo (above) and Mono (below). When snapping needle back in cartridge, be certain fore part is well engaged in metal fork.

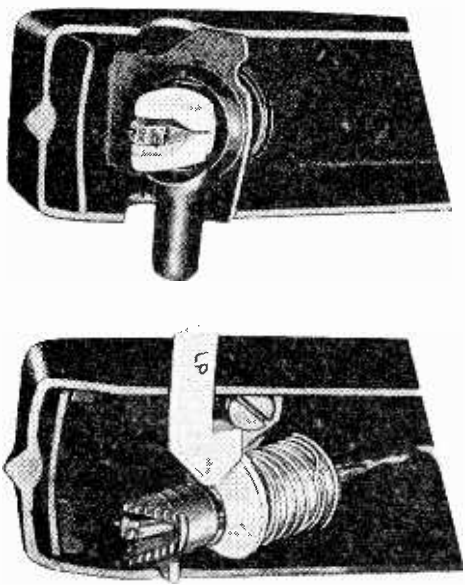
grooves, shearing off the tiny corners which produce the high notes and distorting the character of the sound.

A good way for the service technician to check on this is to find out how many hours the customer has played his machine since changing needles. For example, a diamond-tipped needle may be played about 750 to 1500 hours. The person who owns a sapphire tipped needle can usually play it safely up to 60 hours. This assumes using the correct tracking pressure indicated by the manufacturer.

A good rule of thumb can be applied to the average phonograph owner, who probably does not keep any record of the hours he plays his machine is this: under normal use a sapphire needle should be changed every two or three months, and a diamond tip every one or two years. This generalized rule is naturally subject to needle pressure, record cleanliness, handling and other variable considerations.



SLIDE-IN—To remove G-E's VR11 needle (center) or RPX (below) press down on the spring-loaded knob (shown above) to push needle assembly out of the recess. Then, grasp needle and pull it forward and out. To replace needle, slide it in, and release the spring-loaded knob. Check to see that needle is centered between the two poles. Old-type needle change required removing knob and then the entire assembly.



PLUG-IN—Needle assemblies can be removed from either Webcor (top) or the Electro-Voice by grasping front of the needle and pulling plastic cap forward. The entire housing, including needle & cartridge comes out. New assembly is just plugged-in.

LIFE

You may bring to your shop, and put in a frame, a motto as fine as its paint, But if you're a crook when you're playing the game, the motto won't make you a saint. You can stick up the placards all over the wall, but here's a word I announce: It's not the motto that hangs on the wall, but the motto you live that counts.
If the motto says, "Smile," and you carry a frown, "Do it now," and you linger and wait; if the motto says "Help," and you trample men down, if the motto says "Love," and you hate—You won't get away with the mottos you stall, for truth will come forth with a bounce.
It is not the motto you hang on the wall, but the motto you live—that counts.

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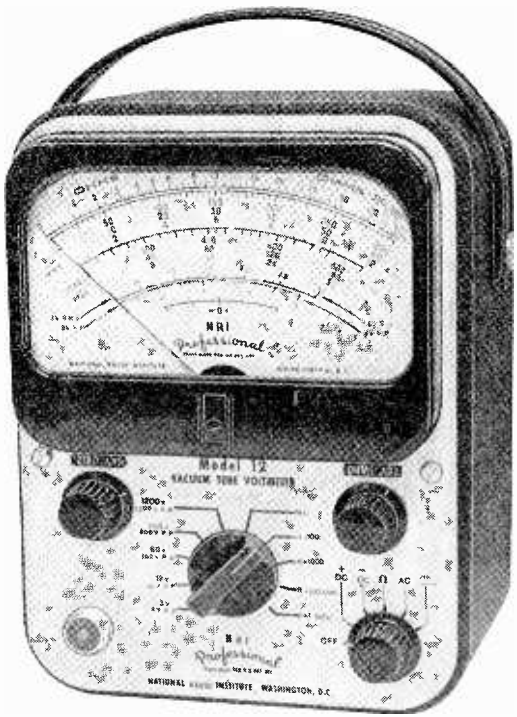


SPECIFICATIONS

1. DC Volts—Five ranges, 0-1200 volts, provide for all basic dc measurements in Radio and Television. With High Voltage TV Probe (included during this sale), dc range is extended to 30,000 volts. Voltmeter polarity switch eliminates reversing leads. For correct polarity just change polarity switch.

2. AC Volts—Five ranges, 0-1200 volts, cover power frequencies, and supersonic frequencies.

3. Peak-to-Peak AC Volts measure up to 3200 volts in five ranges. Maximum shunt capacity of input cable 67 mmfd.

4. Ohmmeter Measurements—Up to 1000 megohms in five overlapping ranges. This permits measurements of extremely small and large resistances. Tests condensers for leakage and opens. Low ohms scale for checking coil windings. One zero adjustment serves all five ranges.

5. Zero Center Scale—Shifts electrical zero of the dc voltmeter from left end of scale to center of scale in a jiffy. A very important type of measurement in balancing FM and TV discriminator circuits, or in making measurements of unknown polarity. Five ranges 0 to ± 600 volts.

Output Measurements in connection with alignment. High dc sensitivity makes the Model 12 ideal for avc output measurements. DC blocking condenser on ac ranges permits measuring audio signal at plate of output tube.

Twenty-Five Separate Ranges

DC Volts	AC Volts	Ohms
0-3	0-3	0-1000 (10 ohms center scale)
0-12	0-12	100K (1,000 ohms center scale)
0-60	0-60	0-1 Megs (10,000 ohms center scale)
0-300	0-300	0-100 Megs (1 Meg center scale)
0-1200	0-1200	0-1000 Megs (10 Megs center scale)

PANEL: Brushed aluminum field, contrasting black deep-etched characters.

CASE: Metal, black ripple finish, with perspiration proof plastic handle, over-all size: 7¾" x 5⅞" x 3½".

METER: 400 microampere, double-jeweled D'Arsonval construction, ± 2%. Large 5½-inch meter—easy to read.

ACTUAL WEIGHT: 5¼ lbs. SHIPPING WEIGHT: 7 lbs. INCLUDES: Operating instructions and schematic diagram, AC-DC-Ohms probe, two 1½ volt flashlight cells.

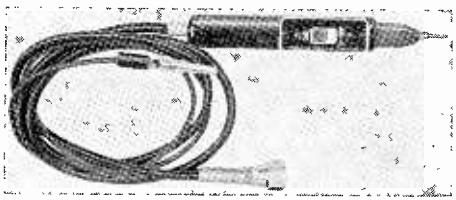
TUBES: One 12AU7; two 6AL5 tubes.

POWER REQUIRED: Operates only on 50-60 cycles, 110-120 volts ac.

WARRANTY: Standard 90-day EIA warranty.

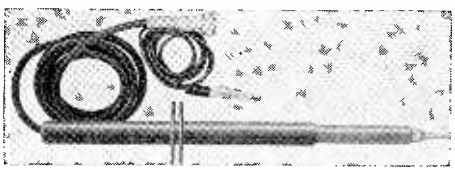
Compare the NRI Professional VTVM with other instruments of this type. For quality and price you will find yourself coming back to the NRI VTVM as your best buy. We sincerely believe this instrument is unsurpassed in quality at this low price.

Universal Test Probe Included



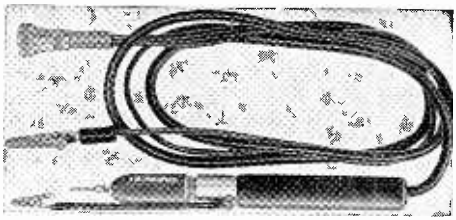
Universal test probe (above) included at no extra charge. Handy switch in handle. Throw in one direction for all AC volts, PEAK-TO-PEAK AC volts and Ohm measurements; in opposite direction for all DC volts measurements.

Included During This Sale



High Voltage TV Multiplier Probe

Illustrated above. Extends DC volts range to 30,000 volts for SAFE high-voltage TV measurements. Heavy-duty bakelite handle with two-inch high voltage barrier. Helical film-type cartridge multiplier resistor. Regular price, $6.50.



Optional Accessory
Crystal Detector High Frequency Probe

Illustrated above. Gives positive peak voltage values for sine-wave voltage up to a maximum peak value of 120 volts. Frequency range up to 250 mcs. Well-made probe, shielded lead and connector. Price $9.50. This probe not included in 60-day special sale.

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One NRI Professional Vacuum Tube Voltmeter, Model 12, including Universal test leads, insulated alligator clip, detachable isolating probe for *dc* measurements and High-Voltage TV Multiplier Probe	$45.00	
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Converting to Stereo

(from page twelve)

Should a pair of monophonic amplifiers be used with this wiring system some difficulty will be encountered with the physical manipulation of the two-conductor shielded cable. It will be necessary to add a length of single-conductor shielded cable at one of the amplifier inputs in order to route the other "hot" conductor to the second amplifier. The wire connected to either hot terminal of the cartridge must be shielded at all times or it will pick up hum. As shown, a separate ground wire must also be used with the three-wire system for the motor, tone arm, etc.

When a stereo preamplifier is used in a system it is obvious that the three-wire system is probably the easiest to use. Should a pair of monophonic amplifiers be used in a system it is less awkward to use the four-wire system. However, ground loops, causing hum, are often encountered when using the three-wire system. It is best to use the four-wire system whenever possible, particularly if a pair of monophonic amplifiers are used, if the stereophonic cartridge is a magnetic type, or if the system is of such quality (particularly the speakers) that good low-frequency response is obtained.

Some of the less expensive ceramic type stereophonic cartridges are provided with only three terminals—a common ground terminal for both channels. Obviously, if such a cartridge is used in the system then only the three-wire system can be used.

"Hear that 30 inch woofer?"

Other than rewiring the tone arm, turntables generally do not provide any other problems.

When a record changer is used in the system some difficulty may be encountered with the muting switch. This particular switch is used in many record changers to short the hot and ground leads together during the change cycle to prevent the noise from being transmitted through the system. Most record changers that were wired and designed for monophonic operation use a single-pole muting switch since, of course, there was only one channel to contend with. Obviously then when going to two channels this type of muting switch will have one pole too few. The only solution here is to obtain a double-pole muting switch from the manufacturer if it is available, or simply not to use muting on one channel. You may find that the noise is so excessive that the changer cannot be used for stereo. Incidentally, you may find that a muting switch is not used at all!

As mentioned above, the problems of installing the cartridge and wiring it are simple mechanical problems. The main problem encountered is whether or not the record player is of sufficient quality. Since the modulation in the stereo groove is applied at 45° planes to the record groove, the stereo cartridge is susceptible to vertical as well as horizontal interference. Thus, although the record player may have been of sufficient, or even extremely high, quality for monophonic reproduction it may have excessive vertical rumble and noise and thus be of poor quality, or even useless for stereo reproduction. Unfortunately, there is no way of determining this factor until the unit is tried. Moreover, most stereo cartridges have less output than the monophonic cartridges, and thus the record player noise must be even lower to provide the same signal-to-noise ratio. Again, the only possible method of determining whether or not the signal-to-noise ratio is satisfactory is to "try it out." However, if the changer is over five years old it would probably be best to replace it. Some of the newer turntable kits provide quality far beyond their nominal price.

In addition to the above problems, it is particularly important to properly mount the stereophonic cartridge. The stylus of the cartridge must be perpendicular to the record surface when viewing the cartridge, both from the front and the side. In order to obtain this mounting it is often necessary to shim one side of the car-

tridge. Although small pieces of cardboard can be used for such shimming, a more permanent type shim should be used. I have found that thin plastic is best for this purpose. One inexpensive source of thin plastic is the wallet-type card and photograph holders made for men's wallets which are obtainable at most variety stores. These plastic folders will provide sufficient plastic for thousands of shims, and can be cut to any size with scissors.

After the tone arm is wired and the cartridge mounted properly as indicated above, the tracking pressure will probably need to be re-set according to the manufacturer's instructions. However, in addition to being somewhat optimistic about the necessary tracking pressure, most manufacturers determine the pressure under ideal conditions with the best of equipment (that is, turntable and tone arm). Therefore, after setting the pressure to what the manufacturers recommended, the record player should be tested by playing a record containing very heavily modulated pasages (loud, low frequencies) in the inner bands. Listen to the reproduced sound with the recommended pressure and with one or two additional grams of pressure. You may find that the additional pressure improves the sound quality and should therefore be used. If a record changer is used in the system, repeat this test when one record is played and when the test record is on the full stack of records. Of course, try to use as low a pressure as possible, since the low pressure will reduce record and stylus wear.

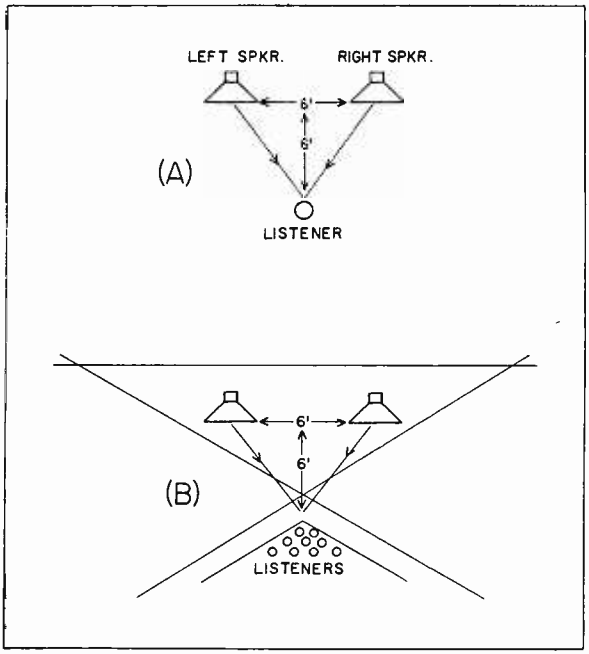

Fig. 6. Stereo speaker placement for one listener.

LOUD SPEAKERS

As pointed out in the beginning, the best method of stereo conversion is to use the present loudspeaker in the center channel. If this is not possible, the most economical method is to purchase another loudspeaker and enclosure of the same type to be used as the other channel reproducer. As with the amplifier, pains should be taken to obtain the same type of loudspeaker if it is of sufficiently high quality. However, even more applicable than it was with amplifiers, tremendous strides have been made in recent years in loudspeaker (and enclosure) development. It is now possible to obtain reproducers of much higher quality than those of just a few years ago, at a fraction of the price. This is particularly true in reference to the bookshelf type speakers now available—few of these, by the way, will actually fit in a normal bookshelf. However, do not confuse the bass response of these new units with over-all natural musical reproduction.

It is particularly important to match loudspeaker quality in the mid and high ranges, since this is where stereo separation is most obvious. Even if you cannot obtain the same type of woofer for your second channel, by all means duplicate the mid-range and tweeter units. Go out of your way to obtain the same type units.

The placement of the loudspeakers in a stereophonic system depends largely on the shape of the room and its decor.

The ideal listening position for stereophonic reproduction is shown in Fig. 6. Notice that it is necessary to sit the same distance from the speaker "line" as the speakers are separated. This ideal listening position is obviously limited by the fact that only one person can listen at a time.

Fortunately things are not quite as bad as they seem from this illustration. Al-

though, unless one sits exactly in the center between both speakers, he does not hear equal sound from both speakers, the stereo illusion can still be obtained by sitting off-center. This is similar to sitting in other than front row center at a concert, or standing directly in the center of a dance band. It is only important that one does not sit so close to one speaker that he cannot hear any sound from the other.

Therefore, when setting up the speakers in the listening room it is best to plan that no one will sit closer to either of the speakers than they are separated, as shown in Fig. 7. People sitting in the center of the room can actually sit a little closer to the speakers than they

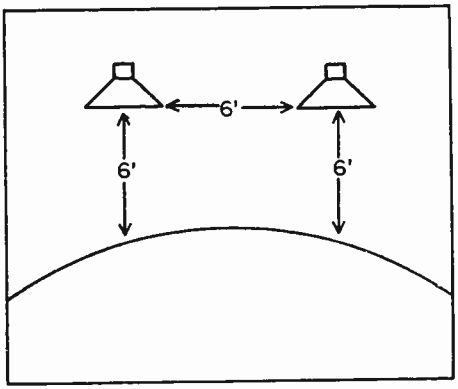

Fig. 7. Normal speaker placement and listening area.

are separated, although some excessive separation will be noted on some pieces of music. Although the speaker set-up in Fig. 7 seems to show very little listening area the seating area in most rooms is against the wall, so trouble is actually not encountered. If the seating area is out from the wall, or if the room is shallower, then it is necessary to place the speakers a little closer together. Generally four to six feet of separation is best.

There is no correct formula for setting up the speakers in a stereo system—experimentation is necessary. In addition to moving the speakers closer together and farther apart, it is important that the angle of the speakers be varied. That is, it is sometimes possible to point the speakers toward each other or away from each other to provide for a "best" listening area. If it is necessary to place one of the speakers closer to the listening area than the other because of other furniture in the room, satisfactory stereophonic reproduction might be possible simply by unbalancing the speakers. That is, less signal would be fed to the closer speaker.

SOME PACKAGE SYSTEM PROBLEMS

It is generally more difficult to convert a package high-fidelity system to stereo. In fact, this is one of the prime advantages of the component-type system—it is easier to take advantage of developments in the field.

Although the record playing unit in a package high-fidelity system will permit its conversion to stereo (in most cases) it is almost always impossible to find room for another amplifier. Thus, the second channel amplifier will either need to be placed on top or in another cabinet. Probably the best way to convert a package system to stereo is to replace the monophonic amplifier in the system with a stereophonic unit (if there is room). Naturally, the speaker system in the package unit can be used for one channel and another speaker system could be purchased for the other channel. However, it will probably be impossible to duplicate the original system.

If a sufficient number of speakers are provided in the original system it might be possible to break them up. That is, if say, two 12" speakers and two 5" speakers came with the unit, it would be possible to remove one of the 12" speakers and one of the 5" speakers and place it in a separate cabinet for the other channel.

Some difficulty, however, will generally be encountered in trying to match impedances since package amplifiers are not designed (nor need) to be versatile. Before any such stereo conversion is attempted, all manufacturers' information, including schematic diagrams, should be obtained. It might also be possible to get some advice from the manufacturer—it's worth trying a letter, anyway.

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ONLY THE BEGINNING

Education is a part of man's evolution. The accumulation of knowledge, however, is of little value itself. It must be regarded as no more than a means to an end. The true end of all learning is not merely to know, but to understand.

The proper aim of every student, whether young or old, teenager or title man, is not just to be learned, but to be wise. And wisdom does not come from education as such, but from the intelligent application of knowledge obtained.

Understanding Capacitor Action

by Ken Harlan

(Reprinted with permission of Sylvania Electric Products Inc., February 1960, Sylvania Service Digest)

Of all the components used in electronic circuits, it appears that one of the most common of all, the capacitor, is the least understood. During meetings and clinics held in the past several years, I have had technicians tell me that they could not understand how signal bias voltages were developed thru capacitor action or why capacitors would apparently pass AC current but not DC, and some were even surprised to learn that a signal was not inverted 180 degrees when passed thru a capacitor. All these comments and questions point to the fact that many technicians do no really understand basic capacitor theory. While it is true that volumes have been written on this subject it is also true that the average person has his hands full just trying to keep abreast of changes and new developments. Actually he has little time to sit

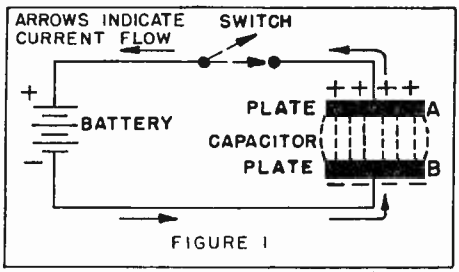

FIGURE 1

down and wade thru highly technical explanations, so he just takes it for granted that a capacitor will perform certain functions, and lets it go at that. However, I believe we will all agree that if we understand how something works . . . it makes the job of trouble-shooting a lot simpler.

Before explaining capacitor action, however, it is important that we understand the difference between a conductor and a non-conductor, insofar as electron movement (current flow) is concerned. To start with, we know that a molecule of any known substance is the smallest particle to which this substance can be reduced, and still retain its physical and chemical properties. A molecule is made up of atoms held together within the molecule by electron bonding. The atom, in turn, consists of a nucleus (mainly protons and neutrons) around which are layers or shells of electrons. In some substances, the nuclear binding forces are so weak that some of the electrons in the outer shell will break away and wander thru the molecular structure as free electrons. These free electrons are then available to provide current flow thru the substance with the proper application of voltage. Such substances are generally classified as conductors, and include copper and silver, as well as other metals, compounds and liquids. It should be remembered that when electrons are removed from one end of a conductor, an equal number of electrons must enter the other end of the conductor. Current flow through a conductor, then, really amounts to a progressive movement of electrons from one atom to an adjacent atom. Other substances, whose nuclear structures are bound by stronger forces, do not contain normally free electrons, and therefore will

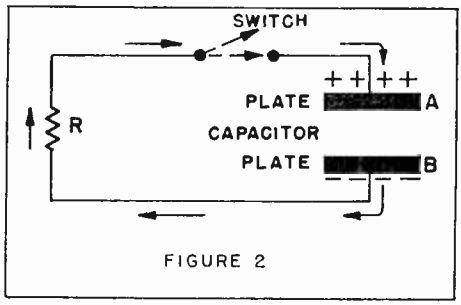

FIGURE 2

not conduct an electric current under normal conditions when a voltage is applied. Such substances are classified as insulators, or non-conductors, or, in discussing capacitors, as dielectrics.

We all know that a capacitor, simply, is made up of two conductors separated by a non-conducting material termed a "dielectric." This dielectric may be air, oil, mica, paper, chemical solutions, a vacuum, or any material which will not permit the flow of electric current. In Figure 1, we have two conducting plates separated by air and connected to a battery through a switch. It we close the switch, two things happen simultaneously. The positive pole of the battery, being deficient in electrons will pull electrons from plate "A" of the capacitor, leaving that plate positively charged. The negative pole of the battery, now having an excess

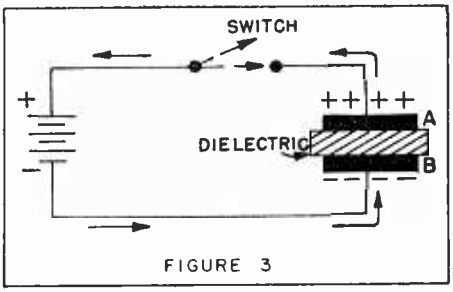

FIGURE 3

of electrons will force electrons onto plate "B", causing it to become negatively charged. The opposing charges thus created at the plates of our capacitor, set up an electrostatic (dielectric) field between them as indicated by the dotted lines. Current (electrons) will continue to flow until the electrostatic field reaches saturation. When this condition is reached, we have "charged" our capacitor and will discover that the electron charge or electromotive force contained in our electrostatic field is equal and opposite to the electromotive force (voltage) of the battery. Obviously then, no further current will flow as we have reached a state of electrical balance.

Let us now substitute a resistor for our battery, as shown in Figure 2. As long as the switch remains open, no current will flow, and the capacitor will remain charged. If we close the switch, we will find that current will flow in the opposite direction thru the circuit, i.e. from plate "B", which has an excess of electrons to plate "A", which has a deficiency of electrons. This current flow will continue until an electron balance is restored, whereupon, our capacitor will be considered as "discharged."

The amount of electrical energy that a capacitor is capable of storing depends on the area of the conducting plates, the spacing between them, and the dielectric used. If we take the capacitor, shown in Figure 1, and substitute a different dielectric material between the plates, Figure 3, we will find that we can store more electrical energy than before. Since the electromotive force of the battery remained the same, where did this increased storage ability come from? If we review our previous mention of molecular structure, you will remember that a dielectric was defined as a non-conducting material, or in other words, a material whose electrons were firmly held within the nuclear structure. If we place such a material between the two plates of our capacitor and close the switch, a charge or potential will be placed on each

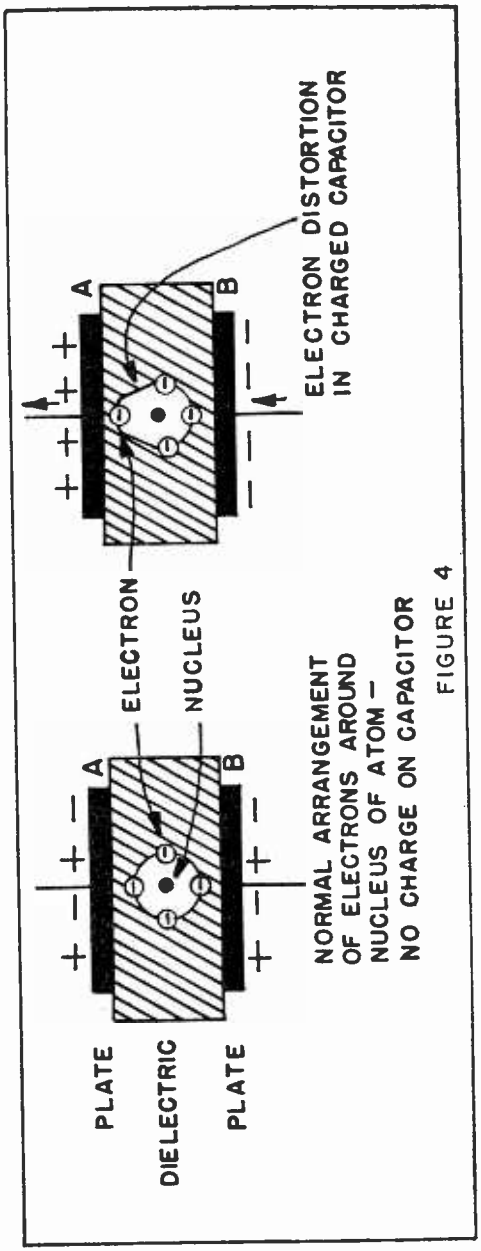

FIGURE 4

side by the battery, creating an electrostatic field. The effect of this field on our dielectric will cause the atoms in contact with the positive plate to lose some of their electrons to this plate, which, as explained earlier, will create an excess of electrons at the negative plate. The atoms which have lost electrons to the positive plate are now in a state of unbalance and thus have a high affinity to electrons of neighboring atoms deeper within the dielectric material. Because of the strong nuclear binding forces of these deeper atoms, the electrons are not torn loose, but move in a distorted orbit toward the positive plate, Figure 4. As we move deeper into the material we would eventually reach a state of balance between the positive and negatively charged plates of our capacitor. As we progressed further toward the negative plate, we would discover that the nuclear electrons near this plate were again in a distorted orbit due to the repelling charge created by the excess of free electrons. The distortion of these orbits causes a change in the nuclear field of the atoms of our dielectric material and tends to neutralize the field created by the charge on the capacitor plates. The total dielectric field, therefore, consists of not only the electrostatic field created by the capacitor plates, but also the fields around the atoms in the dielectric material. Thus, more electrons are allowed to flow out of plate "A" with a corresponding increase of electrons at plate "B."

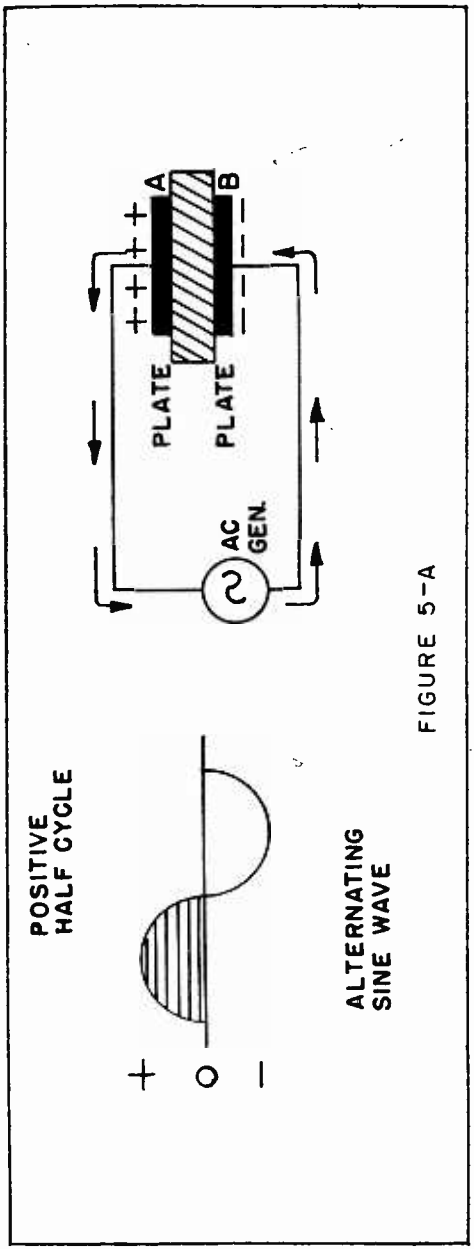

FIGURE 5-A

From the foregoing, we can see that while Direct Current cannot actually flow though a capacitor, there is current flow at the instant of applied voltage to the cicuit, at which time current flow ceases. In the case of Alternating Current the action is essentially the same, except that here we have an applied voltage that is constantly changing, as well as reversing polarity. Our capacitor no sooner becomes charged on one polarity of an AC cycle, Figure 5A, than the voltage reverses, the capacitor discharges, and then charges to an opposite polarity on the other half of the cycle, Figure 5B. We, therefore, have current flowing in such a circuit at all times, and we can see that instead of flowing through the capacitor, the current actually flows in and out.

From the foregoing, it should also be quite evident why we will not have phase reversal in a normal capacity-coupled circuit. Further, we should now be able to understand how signal bias is achieved.

In Figure 6, we have a triode tube operating as a separator, which illustrates one typical operation of a capacitor. Into the grid of this tube, we are capacity-coupling

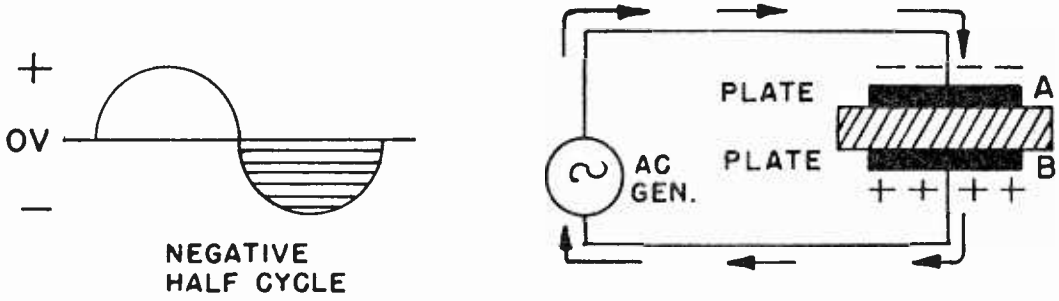

FIGURE 5-B

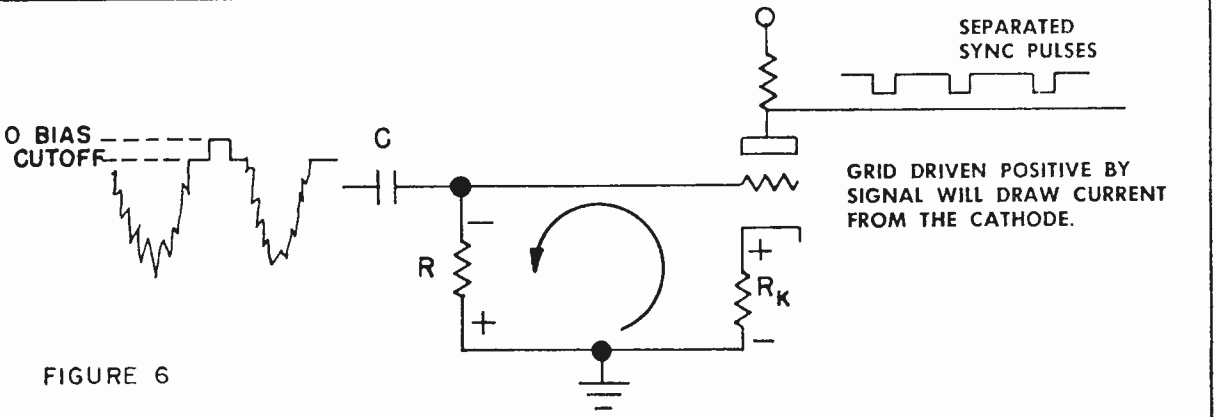

FIGURE 6

a positive going composite video signal. The function of our circuit in this particular instance is basically sync-pulse separation. In other words, we want to separate the sync-pulses from the blanking and video. In order to accomplish this, we must place a negative bias or voltage on the grid which will cause the tube to cut-off everything below the sync-pulse level and allow conduction only during the more positive excursion of the sync-pulse itself. One means of obtaining such a negative voltage is by "signal bias," which is explained as follows:

When we apply the positive composite signal to the grid by means of capacitor "C," the grid will be driven positive to the peak value (voltage) of the signal. The grid now being positive will start to draw grid current. This current will flow from ground to cathode to grid, and back to ground through the grid return resistor, thereby creating a negative DC charge on the grid side of the capacitor. (See Figure 6). When the sync-pulse ends and the signal drops toward a less positive level, capacitor "C" will commence discharging through resistor "R." By properly choosing the values for "C" and "R," so as to set the charge and discharge time of "C," we can create a relatively constant negative DC bias on the grid of the tube of whatever voltage we desire.

This circuit will always "clamp" at the same level. If the applied signal decreases, no grid current will flow for a few cycles, and there will be no charge applied to "C." At some point as "C" discharges, the reduced signal will again drive the grid positive, and the tube will then clamp at this new level. You will find that the tip of sync, regardless of signal amplitude, will always drive the grid slightly positive. The cut-off level of course will be determined by the amount of signal applied (overdriven) and the characteristics of the tube itself. This is determined by the design of the circuit.

This current will flow from ground to cathode to grid. (There is always an external return path in the grid circuit connected between the left-hand side of C and ground in Fig. 6.) This grid current charges C so that it's right hand plate is negative with respect to it's left-hand plate. When the input signal goes in a negative direction, grid current will cease and capacitor C will discharge through R. The discharge current through R now produces a bias voltage that is applied to the grid of the tube.

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Judge For Yourself

We know this sounds like an old joke but according to Bill Gold of the Washington Post, it actually happened in a nearby County Circuit Court.

The judge was hearing a domestic relations case and the issue was the amount of money a husband should pay for the support of his wife and children.

After listening to the evidence and pondering his decision for awhile, the judge turned to the woman and said: "I'm going to give you $30 a week."

The husband's face brightened. "Thanks, your honor," he said, "and I'm going to try to chip in a little from time to time myself."

This was probably the same judge who asked the defendent on the stand: "Have you ever been up before me?" The reply was: "I don't know judge. What time do you get up?"

In a Sunday School class discussion of temperance, one mother related that she learned how well she had taught her children the evils of liquor when her youngest, a TV cowboy fan, brought her a picture he had drawn of a cowboy in a saloon.

"But don't worry Mother," he quickly assured her. "He isn't going to drink anything. He just went in there to shoot a man."

JET AGE

A fellow told us he boarded a Boston-to-Los Angeles jet airliner a short time ago. After the plane took off, he overheard the stewardess approach a woman passenger and ask of she would like to remove her coat.

"No thanks," the woman said. "I'm getting off at Chicago."

A bride of a few days noticed that her husband was feeling rather blue.

"Darling," she pleaded, "I know something is bothering you and I want you to tell me what it is. After all, your worries are not just your worries now—they're *our* worries."

"Well," sighed the husband, "We've just had a letter from a girl in Chicago—and she's suing us for breach of promise."

NRI ALUMNI NEWS

Chapter Chatter

LOS ANGELES CHAPTER'S Chairman Eugene DeCaussin appointed new member Ralph Clements as Chairman of a newly-formed Entertainment Committee. Ralph Clements selected Kenneth Williams and Earl Dycus to assist him in fulfilling the duties of this committee. There followed a discussion on the proposal that the Chapter show more films on Electronics at its meetings. Ralph Clements stated that he can get all the films on Electronics offered by RCA, by whom Ralph is employed. Earl Dycus said he would try to get similar films from the Pacific Telephone Company, indicating that this company offers to loan films devoted to Electronics and the application of Electronics to the telephone industry. These films are available to clubs and similar organizations simply for the asking.

Lee Chavez resigned as Treasurer but has remained and will remain a member of the Chapter. The members voted to have Secretary Earle Allen take over the Treasurer's duties temporarily.

The Chapter has been making plans for a big party to be held in June. All members, active or inactive, are cordially invited.

SAN FRANCISCO CHAPTER members were shown two films on transistors by Sidney Mahler on his movie projector. The films were brought in by Anderson Royal. Booklets entitled "Transistor Fundamentals and Applications" were also brought to this meeting by George Law for distribution to all the members.

San Francisco Chapter celebrating its first anniversary.

At the next meeting Chairman Arthur Ragsdale and Anderson Royal led a discussion on the subject matter treated in these booklets. At each meeting a number of pages of these booklets are assigned to the members for home study and the information contained in these pages is discussed at the next meeting.

Charles Kilgore has been admitted to membership. Welcome to the Chapter, Charles.

SPRINGFIELD (MASS.) CHAPTER held a special meeting at Blake's Restaurant in Springfield. The meeting was addressed by Chairman Rupert McLellan, Secretary Howard Smith and the Chapter's former Technical Advisor, Lyman Brown. After the meeting refreshments were served and a social period was held, during which door prizes were given out.

At the previous meeting, a shop meeting, a member brought in an NRI scope which was part of a course he is taking. The complaint was compression of waveforms on the right side of the screen. After examination of the patterns shown in the text it was decided that this was normal. Another member brought in a set that was giving him a difficult time; his troubles were soon cleared up, too.

The latest members admitted to membership are George Desnoyers and Joseph Rufo. Our congratulations to these new members. Incidentally, the last-named was one of the signers of the petition for the Chapter's charter.

NEW ORLEANS CHAPTER for sometime now has featured talks and demonstrations on TV servicing by Mr. Gaston Galjour at its meetings. These talks and demonstrations have proved very popular with the members.

DETROIT CHAPTER welcomed Mr. Dean Fessenden of the Bell Telephone Company, who gave a very good demonstration on

how micro waves work. At the following meeting Mr. Ferrington, also of Bell Telephone, spoke on "Tomorrow's Magic."

Members are still working on the Chapter's TV demonstration board. This is a big job and takes a lot of time, but the results should make the effort well worthwhile.

SOUTHEASTERN MASSACHUSETTS CHAPTER'S Walter Adamiec led a discussion on series and parallel arrangements of resistors and condensers, also multivibrators. The members rehashed long forgotten formulas, determined voltage drops and relative power handling capacities of various component arrangements. The discussion then turned to practical circuits, and a typical multivibrator was analyzed, as well as a diode detector.

John Alves demonstrated his CRT Rejuvenator and charged the tube in a receiver loaned to the Chapter by Walter Adamiec.

The Chapter sometime ago obtained a TV chassis in good condition but minus the pix tube. A new tube was purchased by the Chapter and Walter Adamiec demonstrated the correct handling and installation procedures. The receiver will be available for demonstrations from now on.

FLINT (SAGINAW VALLEY) CHAPTER reports its officers for the current year as follows: George Rashead, Chairman; Andrew Jobbagy, Vice-Chairman; Arthur Clapp, Secretary; Aaron Triplett, Treasurer; H. A. Gillean, Sergeant at Arms; Andrew Jobbagy, Jr., Publicity Director. (This is not the first time that George Rashead has been elected as Chairman, having served the Chapter in that capacity in 1952 and 1954). Our congratulations and best wishes to these officers!

Following the election, Andrew Jobbagy, Sr., gave a report on his recent visit to England, Scotland and Ireland. The members found his talk so interesting and entertaining that he was scheduled to tell more about his journey at a future meeting.

The next meeting featured movies on Exploring Satellites and a Muscle Beach cartoon.

ANNOUNCEMENT

IT HAD TO COME

Higher NRI Alumni Association Dues

Present membership dues were adopted long ago—before World War II, in fact. Despite inflation and sharply rising costs that have raised prices of some things 100% and more, National Headquarters has valiantly held the line. It can't do it any longer. Operating costs are exceeding income.

This forced the Board of Trustees of the NRI Alumni Association to vote higher dues effective July 1, 1960. The new rates are $3 for one year or $5 for a two-year membership.

PHILADELPHIA-CAMDEN CHAPTER reports still more new members—this time John W. Davis, Andrey Juszciewicz and William R. Wells. The last-named is the brother of the Chapter's Librarian, Charles W. Wells. Our welcome to these new members!

Bill Kuyken, Field Engineer of the Philco Corp., and Bill Graw, Service Manager of the J. M. Otter Co., attended a meeting to give a talk on transistors. This was one of the best meetings devoted to transistors that the Chapter has had. With the help of a 33 m/m film strip projector and a tape recorder, Mr. Kuyken went through the transistor with such ease that when he was finished, the sixty-five members present knew what the transistor was about. Schematics were distributed to the members and some were left over for those members who were unable to make it to the meeting. Mr. Kuyken's very thorough talk on trouble-shooting the transistor set made it seem very simple.

The next meeting consisted of a visit to the WCAU Transmitting Studio for which fifty - five members showed up. Secretary Jules Cohen visited the studio about four years ago but says that he was as much impressed with this second visit as he was with the first one.

The Chapter is overjoyed with the large attendance at its meetings. It seems that the members cannot wait until the next meeting to get together again. These Chapter meetings have made it possible for some of the members to make real friends and there are cases where members have become partners with other members and some who have been employed by other members. The Chapter rightly takes pride in this.

PITTSBURGH CHAPTER has purchased a transistor Radio kit and a supply of transistors, to serve as the main project for the next several meetings. Vice-Chairman Howard Tate is in charge of this project. At this meeting, however, Chairman Tom Schnader explained the theory and discussed the operation of transistors.

Due to an increase in his business activities, former Secretary Ray Bender was forced to resign his office. The Chapter fully appreciates the valuable services

Directory of Local Chapters

Local chapters of the NRI Alumni Association cordially welcome visits from all NRI students and graduates as guests or prospective members. For more information contact the Chairman of the chapter you would like to visit or consider joining.

CHICAGO CHAPTER meets 8:00 P.M., second and fourth Wednesday of each month, 666 Lakeshore Dr., West Entrance, 33rd Floor, Chicago. Chairman: Charles Teresi, 3001 N. Norica, Chicago, Ill.

DETROIT CHAPTER meets 8:00 P.M., second and fourth Friday of each month, St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 P.M., second Saturday of each month, 3149 Richfield, Flint. Chairman: George Rashead, 338 E. Marengo Ave., Flint, Mich.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P.M., second Thursday of each month, North Hagerstown Senior High School, Hagerstown, Md. Chairman: J. Howard Sheeler, 300 Walnut St., Shippensburg, Pa.

LOS ANGELES CHAPTER meets 8:00 P.M., second Friday and last Saturday of each month, 11523½ S. Broadway, Los Angeles. Chairman: Eugene DeCaussin, 5870 Franklin Ave., Apt. 407, Hollywood, Calif.

MILWAUKEE CHAPTER meets 8:00 P.M., third Monday of each month, Radio-TV Store & Shop of S. J. Petrich, 5901 W. Vliet St., Milwaukee. Chairman: Philip Rinke, RFD 3, Box 356, Pewaukee, Wis.

MINNEAPOLIS-ST. PAUL (TWIN CITY) CHAPTER meets 8:00 P.M., second Thursday of each month, Walt Berbee's Radio-TV Shop, 915 St. Clair St., St. Paul. Chairman: Kermit Olson, 5705 36th Ave., S., Minneapolis, Minn.

NEW ORLEANS CHAPTER meets 8:00 P.M., second Tuesday of each month, home of Louis Grossman, 2229 Napoleon Ave., New Orleans. Chairman: Herman Blackford, 5301 Tchoupitoulas St., New Orleans, La.

NEW YORK CITY CHAPTER meets 8:30 P.M., first and third Thursday of each month, St. Marks Community Center, 12 St. Marks Pl., New York City. Chairman: David Spitzer, 2052 81st St., Brooklyn, N. Y.

PHILADELPHIA-CAMDEN CHAPTER meets 8:00 P.M., second and fourth Monday of each month, Knights of Columbus Hall, Tulip & Tyson Sts., Philadelphia. Chairman: Herbert Emrich, 2826 Garden Lane, Cornwell Heights, Pa.

PITTSBURGH CHAPTER meets 8:00 P.M., first Thursday of each month, 134 Market Pl., Pittsburgh. Chairman: Thomas D. Schnader, R.D. 3, Irwin, Pa.

SAN FRANCISCO CHAPTER meets 8:00 P.M., first Wednesday of each month, Palm Ave. & Geary St., San Francisco. Chairman: J. Arthur Ragsdale, 1526 27th Ave., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P.M., last Wednesday of each month, home of John Alves, 57 Allen Blvd., Swansea, Mass. Chairman: Arthur Hubert, 1566 Pleasant St., Fall River, Mass.

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P.M. first Friday of each month, U. S. Army Hdqts. Building, 50 East St., Springfield, and on Saturday following the third Friday of each month at a member's shop. Chairman: Rupert McLellan, 233 Grove St., Chicopee Falls, Mass.

that Ray has rendered to his fellow members. Jim Wheeler is the new Secretary of the Chapter.

NEW YORK CITY CHAPTER'S Tom Hull has continued with his educational series of lectures on "basic fundamentals" and has also begun a new series of lectures on transistor circuits.

Frank Zimmer (fifth from left) demonstrating his hi-fi equipment to members of the New York City Chapter.

Jim Eaddy, the Chapter's expert transistor trouble-shooter, is keeping the members well informed on how to check for the various troubles encountered in transistor Radios.

Frank Zimmer brought his Hi-Fi equipment to a meeting and demonstrated how a good Hi-Fi set-up could make any kind of recording sound good. Frank played many records, from the one-sided records dating back to the 1920's to the later shellac-covered cardboard records, and then some present-day recordings. The members agreed that this was a very educational and entertaining evening and expressed the hope that there would be more on Hi-Fi in the near future.

CHICAGO CHAPTER used up almost an entire meeting in a discussion of transistors. Secretary Frank Dominski displayed two instruments he had assembled from kits. One was a simple transistor tester and the other one a signal injector used for signal tracing.

Ted Rose, Executive Secretary of the NRI Alumni Association, was a guest at the next meeting. He demonstrated the new NRI Portable Transistor Receiver and passed it among the members, who were obviously quite impressed with it. The remainder of the evening was devoted to an informal discussion and to working on a small receiver brought in by Robert Kirtley.

The latest member of the Chapter is Bolivar Santiago. Glad to number you among the members, Bolivar!

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER'S John Pearl undertook a discussion on measuring peak-to-peak voltages with the oscilloscope. John is an instructor in Radio and Television in the North Hagerstown High School. At the same meeting Harry Straub conducted a stereophonic tape recorder demonstration.

MILWAUKEE CHAPTER at recent meetings has continued with general discussions on TV receivers, including how the resistor circuit works in TV sets.

The latest member to be admitted to membership is Halvor Wolfe. Welcome to the Chapter, Halvor.

MINNEAPOLIS-ST. PAUL (TWIN CITY) CHAPTER customarily elects its officers each spring to serve until the following spring. The officers to serve for the current year are: Kermit Olson, Chairman; John Babcock, Secretary; M. C. Lundgren, Vice-Chairman; Paul Donatell, Treasurer; and R. Thompson, Sergeant-at-Arms. Our congratulations to these officers.

The Chapter has been giving some thought and study to the problem of charges made for Radio-TV service work, and also to plans for the summer sessions.

Twin City Chapter's Chairman Kermit Olson, Secretary John Babcock and Treasurer Paul Donatell being sworn into office by Ted Rose, Executive Secretary of the NRIAA.

Secretary John Babcock's daughter Karen Ann won a four-year university scholarship awarded by the Ford Motor Company Fund to children of Ford employees. Mr. and Mrs. Babcock are naturally very happy and proud of their daughter's achievement.

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SUCCESS

Outside of the Fountain of Youth, the thing most searched for is the formula for living a successful life. Maybe you've found yours—if you haven't, maybe this will do it for you . . . .

He has achieved success who has lived well, laughed often and loved sincerely; who has gained the respect of men and women and the love of children; who has filled his niche and accomplished his task; who has looked for the best in others and given his best in return; who has left the world a better place than he found it, whether by growing a rose, writing a poem, or rescuing a soul; who has never lacked appreciation of earth's beauty or failed to express it; whose life was an inspiration . . . . . and whose memory is of his great friendship with God . . . . . .

Douglas MacCrae

NEW———easy-to-build———NRI Kit

Portable Transistor Receiver

Outstanding Features

Lots of power . . .

Excellent tone . . .

Plenty of volume . . .

Compact, convenient size and shape . . .

Good looking . . .

Four transistors. Superhet circuit. Long battery life. Directions for assembling are clear, easy to follow. No technical knowledge is needed.

HIGH SENSITIVITY

A four transistor receiver with sensitivity equal to many larger, more-expensive portables. Uses matched, pre-aligned i-f transformers; high Q loop; matched oscillator coil; high quality transistors. Circuitry includes a mixer oscillator, i-f stage which through reflexing also serves as the first af amplifier, a transistorized second detector, and power output stage.

EXCELLENT TONE

Big 4-inch speaker with full size output transformer delivers excellent tone quality—free of the "tinny" sound common to so many transistor portables. Top-notch performance indoors or out.

LONG BATTERY LIFE

Total current drain of this receiver is only 15 ma. Nine volt transistor battery provides hours and hours of pleasant listening—even gives satisfactory results after battery voltage drops to half value. No problem getting replacements. A stock battery size for Radio-TV wholesalers. Changing battery takes half a minute.

EASY TO BUILD

The most easily assembled receiver of its size we've seen yet. Build it in one evening. You need only a soldering iron, long-nose pliers, and side-cutting pliers. Instructions tell you exactly what to do. Construction is clear and straightforward. Most hardware is pre-mounted for your convenience on punched metal chassis. Built to be handled like a portable—no delicate printed circuits in this receiver. **Also available fully assembled at slight additional cost.**

ATTRACTIVE STYLING

Housed in flexible, unbreakable, rugged, yet good looking case—the closest thing to brown cowhide—both in texture and strength. Over-all measurements are just 5⅜"high, 8¼"wide, 2¼" deep. Comfortable, flexible, strong carrying handle. Weight—including case and battery—two pounds. Two controls — On/Off/Volume and Tuning.

Hundreds of uses . . . You'll find hundreds of uses for this low-cost transistor radio —it's perfect for baseball and football games, picnics, hikes, cycling jaunts, and many other outdoor activities as well as private listening indoors. Also, civil defense authorities suggest every family keep a portable radio handy for use in case of emergency. CD stations are clearly marked on tuning dial.

Kit Contains:

pre-punched aluminum chassis
4-inch speaker with output transformer
ferrite rod antenna
two matched I.F. transformers
two section tuning capacitor
three transistor sockets
four matched transistors
volume control and on-off switch
9-volt battery with mounting clips
fourteen resistors
seven ceramic capacitors
five electrolytic capacitors
hookup wire, solder, hardware
carrying case with handle
two dial knobs
detailed instructions

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