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Graduate Receives Special Citation

Our heartiest congratulations go to Graduate Andrew C. Clark, Miami Springs, Florida, who recently was awarded a special citation by the General Electric Co. Mr. Clark, amateur radio station W41YT, has devoted a considerable amount of time participating in the Florida weather network civil defense, Red Cross, and youth training activities.

Need Service Manuals on 1959 GE TV's?

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Editorial

RAGS TO RICHES

All of us at some time or other have read stories—seen TV plays or movies—about a youngster born on the wrong side of the tracks and raised in a poverty-stricken family but who through his own ambitions and perseverance rose to fame and fortune. It may be a true story or simply fiction and the plot generally follows the same pattern.

Many of us in considering the probability of the "rags to riches" formula for success may feel that when you've read one, you've read them all. Similarity seems to give them an artificial air and many of them seem exaggerated.

Such doubt was perhaps justified in the days before home-study became widespread and started its profound effect upon the lives of millions of Americans in all walks of life. Here at NRI are files filled to capacity with letters from "our boys," scores of which could give us the plot for a rags to riches type story. Sure, the similarity is there but in reading over these short autobiographies—written in the student's

(*Page thirty please*)

Servicing Signal-Seeking Tuners

By DALE STAFFORD
NRI Consultant

The modern automobile hasn't quite reached the point where it will drive itself but certainly the developments of the past few years have done much to reduce the time and effort the driver must devote to the task. Automatic transmissions, power brakes, power steering, power-operated windows, automatic headlight dimmers, and many, many other devices are all stepping stones toward the ultimate goal of the truly automatic car. Surrounded by all these modern conveniences, it is not surprising that today's driver should demand, and get, a car radio that requires the minimum in time and trouble to operate. Such a receiver is the signal-seeking radio developed during the last few years.

It may seem that a receiver which can search for, and tune itself to, a broadcast signal would have to be a very elaborate piece of gear. Actually, there is nothing very complicated about signal-seeking tuners. However, they didn't get that way without a lot of work by the engineers who developed them. The fact that the

Servicing Signal-Seeking Tuners

(*From page one*)

signal-seeking tuner is relatively simple and easy to service is a tribute to these men.

The first step in understanding search tuners is to find out what is required of them. First, some method of tuning over the broadcast band is needed. Since car radios use permeability-tuned tuning coils, this means that we must find a way of moving the cores. It is a simple matter to design an arrangement of levers or gears which will move the cores together. Look at Fig. 1A. The cores are connected to the core bar and this, in turn, connects to the planetary arm. The planetary arm is pivoted and, of course, when it moves, the cores must move into or out of the coils. A similar arrangement is shown, although not quite so plainly, in Fig. 1B.

However, some method of moving the planetary arm must be found. One way is to use a motor, connecting it to the planetary arm through a gear train. When the mechanism reaches the limit of its travel in one direction, a switch may be used to reverse the motor connections, sending the tuner searching back over the band in the opposite direction.

Another method of driving the planetary arm is shown in Figs. 1A and 1B. This type of tuner searches in one direction only, from the low end to the high end of the band, snapping back to start a new sweep when it reaches the high end. In this case, the driving power is supplied by the driving spring (shown in Fig. 1A). When the tuner reaches the end of the sweep, the cam on the planetary arm actuates the limit switch which, in turn, energizes the solenoid. The solenoid core is pulled into the coil and, by means of the solenoid linkage, the tuner is snapped back to the opposite end of its travel, stretching the driving spring. The spring now pulls the tuner through another sweep. Without some means of controlling the speed of the sweep, the power spring would pull the mechanism through the sweep far too rapidly. For this reason, a nylon paddle-wheel (shown in Fig. 1), spinning at about 2400 rpm, is used as an air-vane governor.

Since we have succeeded in moving the cores of the tuning coils so that the receiver tunes over the entire band, all we

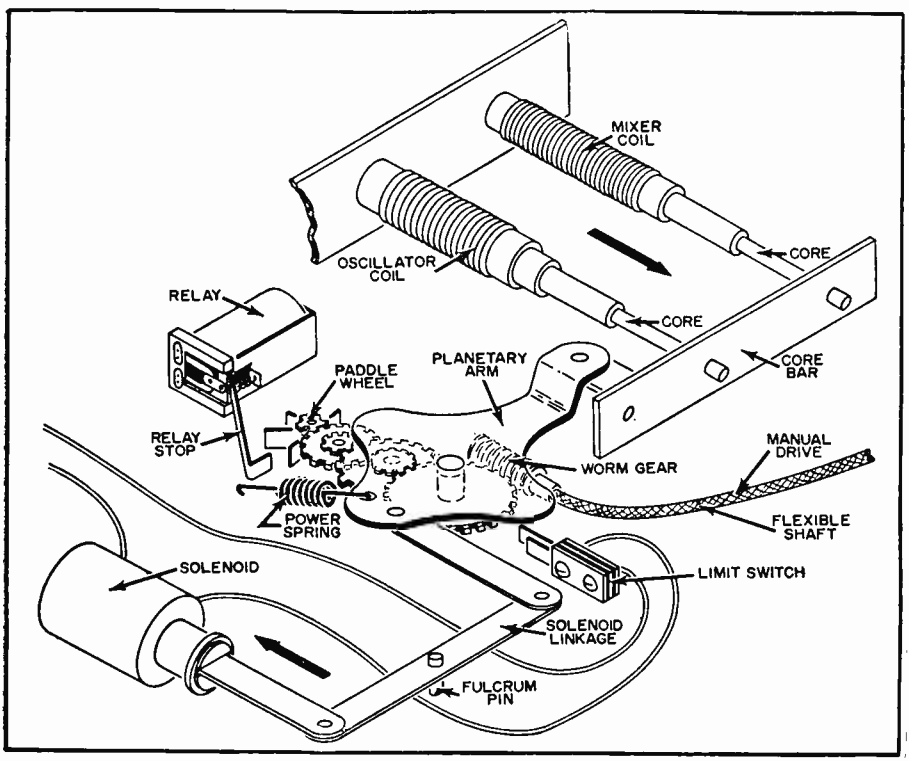

FIG. 1A Search tuners-mechanical arrangement.

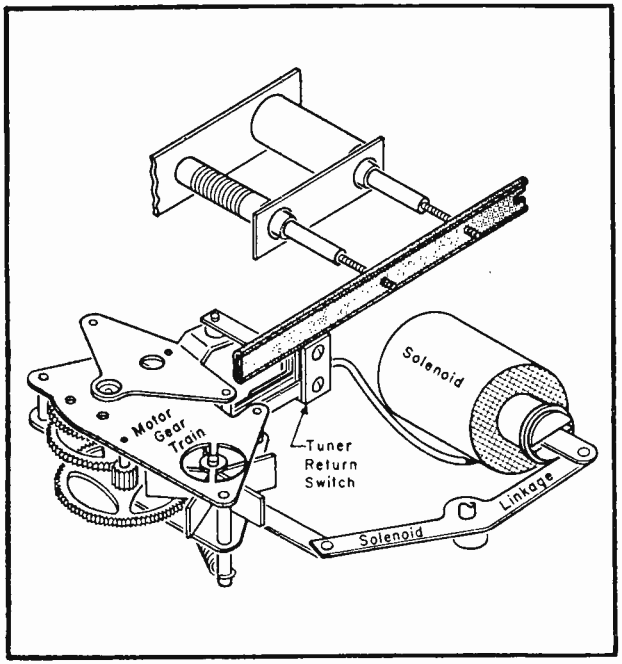

Figure 1B. Search tuners mechanical arrangement.

need now is some way to start the tuner searching, a method of keeping it operating until a station is found, and a way to stop the sweep at the proper place. Mechanically, this is simple. Look at the relay shown in Fig. 1A. The armature or relay stop has a hook at the end which slips between two of the blades on the paddle-wheel preventing it from turning so the tuner cannot search. If we energize the relay, the relay stop will be drawn clear of the paddle-wheel and the tuner starts searching. As long as we keep the relay energized, the relay stop is held clear of the paddle-wheel and the tuner continues to search. If we de-energize the relay, the relay stop moves into the path of the paddle-wheel blade and the tuner stops searching. Nothing very complicated so far, is there? Now, let's put these things together and see how they work.

OPERATION OF SEARCH TUNER CIRCUITS

Looking at Fig. 2, notice that the relay coil has been connected in the plate circuit of the relay tube and any current flowing through the tube must flow through the relay coil. However, simply turning on the power to the set will not energize the relay since the 47K cathode resistor limits the current to a value insufficient to operate the relay. For this reason, the starting circuit, consisting of the 12K resistor and the bar switch is included. The switch is of the momentary contact type which is returned to the open position by a spring when the bar is released.

When the bar is pressed, another path from B+ to ground is completed and the increased current flow operates the relay. The relay stop is normally held in the path of the paddle-wheel by a spring, but, when the relay operates, the stop is drawn clear and the tuner starts searching. A holding circuit is also completed which keeps the relay energized. Notice that, when the relay stop is drawn down by the relay coil, the stop grounds one end of a 1K resistor. This resistor is in series with a 6.8K resistor connected to the relay tube cathode, so, in this position, these two series-connected resistors are effectively in parallel with the 47K cathode resistor. Thus, enough current will flow to keep the relay energized and allow the tuner to search until the current through the relay tube is reduced by a signal from the trigger tube. The 120K plate resistor of the trigger tube is also used as the grid resistor for the relay tube. Thus, current flow through this resistor will develop a voltage drop across it, biasing the relay tube grid negative with respect to its cathode. If the bias is sufficient, the current through the relay tube will be reduced to the point where the relay "drops out," the relay stop moves into the path of the paddle-wheel and the tuner stops searching.

Plate current flows in the trigger tube only when the tuner swings into a station.

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The grid is connected through a capacitor to the second i-f transformer. As the tuner sweeps into a broadcast signal, the positive portion of the i-f signal drives the trigger tube grid positive and the tube conducts. A current flows through the 120K resistor and the bias on the relay tube swings toward the plate current cut-off value, the relay drops out and the tuner stops.

The sidebands of strong stations will develop sufficient voltage to trigger the circuit before the tuner has time to swing into the center of the signal if some method of delaying the triggering action is not provided. Therefore, a negative dc voltage from the AVC line is coupled to the trigger tube grid. This partially cancels the signal being fed to the grid from the i-f transformer and delays the action until the station is properly tuned in.

cathode circuits to form a holding circuit, somewhat as in Fig. 2. Voltages from the second i-f transformer and the AVC line are fed to the grid of the trigger tube. A pulse of current flowing in the plate circuit of the trigger tube develops a voltage drop across resistor R2, biasing the grid of the relay tube negative with respect to its cathode. The current flowing through the relay tube is reduced and the relay "drops out." The sensitivity switch is much like that shown in Fig. 2.

A slightly different circuit used in another popular make of car radio is shown in Fig. 4. Again note the resemblance to the circuits of Figs. 2 and 3. Again, we have a starting circuit, a holding circuit, and a trigger circuit. Here, the sensitivity switch and the actuator switch have been combined so that pressing a search selector button either opens or closes the sensitivity switch and also momentarily closes the actuator (or starting) switch.

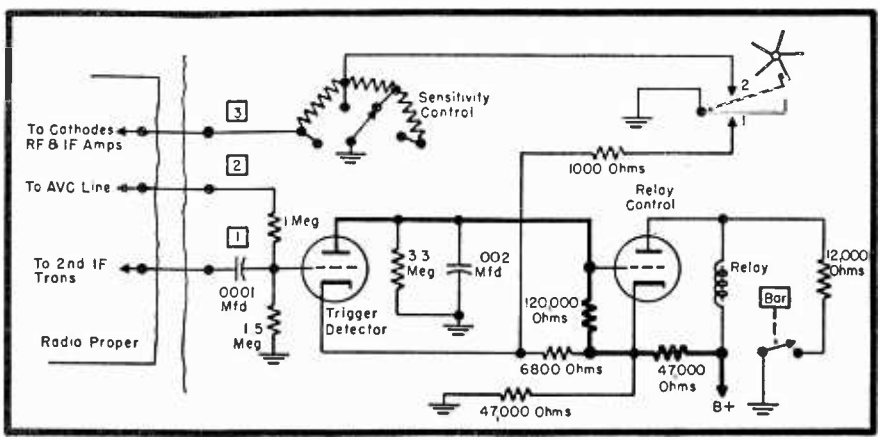


FIG. 2. Signal-seeking tuning circuit.

The sensitivity control connects the cathodes of the rf and i-f amplifier tubes to ground through different values of resistance. It can be set so the receiver will select only the strongest stations received or more sensitive settings may be used. As shown on the diagram, a connection through the relay stop shorts out the two right-hand resistors when the receiver is playing.

While separate trigger and relay tubes could be used, a commercial circuit would probably use a single dual-triode, such as a 12AU7.

Fig. 3, page 19, is the circuit for the receiver in a popular make of car. It resembles, in many ways, the circuit shown in Fig. 2. When the relay coil is energized by operating the actuator switch, one end of resistor R1 is grounded by the relay contacts, reducing the resistance in the

The dual-section tube is one of the new types which operates with only 12 volts on the plate, and plate voltage is supplied by the car battery. This means that the tuner will not operate if the battery is connected with the wrong polarity.

In the "Normal" position of the sensitivity switch, the cathode of the first i-f amplifier is connected to ground through a variable resistor. In the "Town" position, an additional variable resistor is connected in parallel with the cathode resistor, reducing the resistance in the cathode circuit.

Momentarily closing the actuator switch completes a path from A+ to ground through the relay coil, energizing the relay

(*Continued on page* 19)

Synthetic Stereo

By JOHN G. DODGSON
NRI Consultant

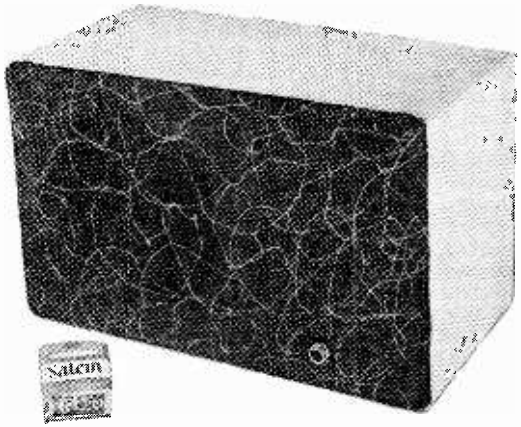


Fig. 1 Front view of the complete Synthetic Stereo unit. Note size comparison.

Although they may argue about almost everything else, Hi Fi enthusiasts all agree on one thing—Hi Fi spoils you! The longer you have it, the more difficult it becomes to enjoy a regular phonograph.

The same applies to stereophonic sound; and, whether we like it or not, "Stereo" is here. With all the big name manufacturers behind it there's no turning back!

Incidentally, a number of people have heard stereo and didn't like it—so have I! But I've also heard some that were good—so good that it made monaural (one channel) high fidelity sound like an old juke box. Seems like stereo is like the little girl in Mother Goose—"When she's good, she's very good, and when she's bad, she's horrid!"

The transition period from monaural to stereo is similar to the older transition period from 78 rpm to 33-1/3 records. The old records may contain some wonderful music and they may have sounded pretty good, but compared with the new, they sound flat! The big problem here is that even a moderately sized stack of LP records represents a good deal of money.

The purpose of the Synthetic Stereo shown in Figs. 1 and 2 is to improve monaural sound—not to substitute for stereo sound. In my opinion, no monaural (one channel) sound can replace a stereophonic (two channel) sound. Most who have heard the Synthetic Stereo feel that at times, depending on the type of music, it equals true stereo. All feel that it is a definite improvement.

The Syntehtic Stereo unit contains a special amplifier and an inexpensive wide-range speaker. The enclosure is simply a box large enough to hold the speaker and amplifier; its size is not critical. There is some acoustic padding in the box to reduce standing waves—this will be discussed later. Of course, the first requirement to use the Synthetic Stereo unit is an ordinary (monaural) high fidelity system. The type or cost doesn't matter. It has been successfully used with systems ranging from a little over $100 to well over $1000! No matter what system is used, the output signal of the system is the input signal of the Synthetic Stereo unit. That is, the main system amplifier output that is normally connected to the speaker (or speakers) should also be connected to the input of the Synthetic Stereo unit.

This input signal to the Synthetic Stereo is applied to four special pre-amplifier stages consisting of two dual-triode tubes. The output of this pre-ampifier drives an ordinary single-ended power amplifier, which in turn feeds the wide range speaker.

The special pre-amplifier affects the input signal in three ways. First, it causes a

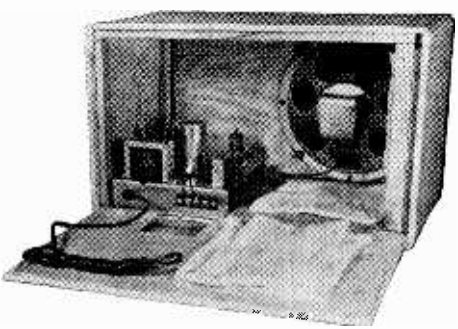


Fig. 2 Back view of the unit with the back cover removed.

minute but detectable time difference; second, it causes a slight amount of reverberation; and last, it shifts the phase of the middle and high frequency harmonics from the fundamental and from each other.

Thus, the Synthetic Stereo unit takes the regular Hi Fi sound and changes it slightly. By placing the unit from 8 to 10 feet on either side of the regular Hi Fi speaker, the sound will spread between the speakers—the wall will become the orchestra! This is not the same as simply placing two speakers some distance apart and feeding them the same signal. Because of the different signals, the synthetic stereo produces the effect of not only a widened sound source but a definite "depth." This, incidentally, is the real value of true stereo—a width and depth to the music—rather that of the effect of sounds issuing forth from the right and left. Such "right and left" effects are fine for demonstration, but frankly I don't think much of listening to trains or sports cars rumbling through my living room!

The synthetic stereo amplifier, shown schematically in Fig. 3, contains 5 stages, as previously mentioned. The pre-amplifier (first four stages) is the "heart" of the unit. Several of these have been built and used in conjunction with different power amplifiers. Some were used with both commercial and home-built standard high fidelity push-pull power amplifiers, and some were used with single-ended power amplifiers as shown here. The only advantage of the push-pull units was the higher power output (which wasn't needed) and lower distortion. It was felt that the additional cost and complexity was simply not worth it and, therefore, plans were not prepared for a push-pull unit.

Amplifier Construction

Fig. 3 is the schematic diagram of the unit, and Fig. 4 shows a sketch of the layout used by the author for the units shown in Figs. 1 and 2. This is a view of the bottom of the chassis. *It is not necessary to use this layout.* The layout you use is not critical, providing you follow these suggestions:

1. The power transformer must be mounted at minimum distances of one inch from V3, 3 inches from V2, and 4 inches from V1.
2. The power and output transformers must be at least 1½ inches apart with their iron cores turned at right angles to each other.
3. The filter capacitor (C9) should be at least 1½ inches away from V1.
4. A shielded type tube socket must be used for V1.

Of course, normal precautions must be used in wiring. Keep the grid and plate leads and components apart, cut the hookup wire and parts leads as short as possible, tin or clean all component leads

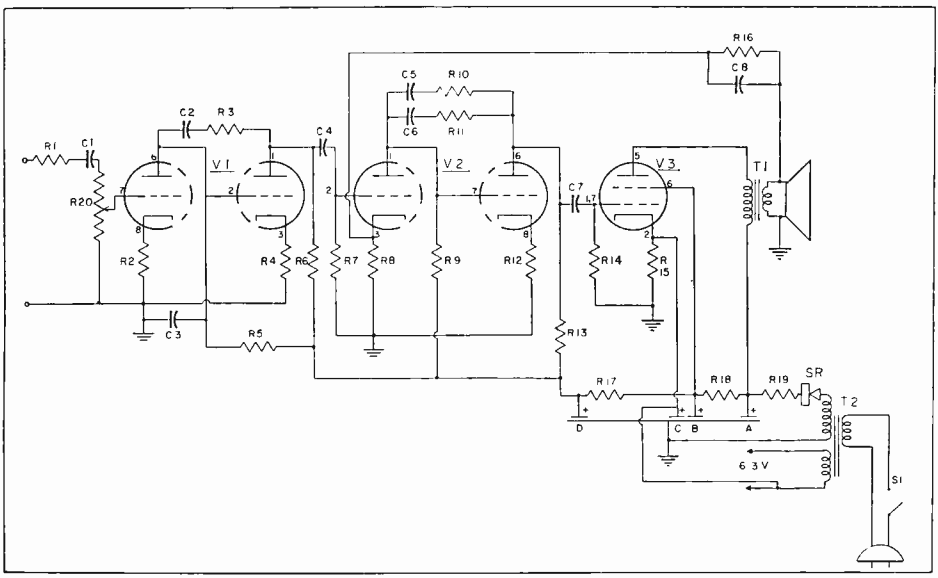


Fig. 3 Schematic diagram of the Synthetic Stereo amplifier.

Fig. 4—Parts List

All resistors ½ watt, 10%

All capacitors 400 volt discs, except where noted

R1, R18	4.7K
R2	3.3K
R3, R10	47K
R4, R5, R6	470K
R9, R12, R13	470K
R7	560K
R8	2.2K
R11	220K
R14	390K
R15	220
R16, R17	10K
R19	10
R20	1 MEG (see text)

C1, C7	.005 MFD
C2	.001MFD
C3	270 MMF ceramic tubular
C4, C5	.01 MFD
C6	.1 MFD, tubular
C8	200 MMF
C9	80-40-40/150V, 100/25V, see text

V1 12AU7 tube
V2 12AT7 tube
V3 6AQ5 tube

T1 Output transformer } see text
T2 Power Transformer }

S1 Part of R20 (see text)

before soldering, keep the soldering iron tip clean and tinned, etc.

It is also advisable to connect all grounded connections in any one stage to one point. For example, in stage V2, one side of resistors R7, R8, and R12, should all be connected to the same ground point. This reduces the possibility of hum being caused by ground loops.

Notice in the schematic diagram that one of the input connections and one of the output connections are grounded. Because of this I used only 3 terminals for the input-output connections, one being a common ground connection. This terminal strip, a 3-terminal screw type strip, is shown as ST1 in Fig. 5. The 5-lug terminal strip (one lug grounded) ST2 was used for C1 and R1 of the input network and C8 and R16 of the feedback network Terminal strip ST3 served for most of the parts in stage V1, while strips ST4 and ST5 were used for the parts in stages V2 and V3. Terminal strip ST3 had four insulated lugs, ST4 had one, and ST5 had five. The 4-lug terminal strip ST6 (3 lugs insulated) served for connections of the power cord, on-off switch and power transformer primary. The power transformer itself was mounted on the "ST6" side of the chassis, while the output transformer was mounted on the "ST2" side. Since both were mounted on top of the chassis, the underneath sketch of Fig. 5 does not show them.

Remember it is not necessary to use this particular layout. Of the many units built it seemed to be the easiest to use.

The chassis itself was made out of sheet aluminum and measured 6 inches square and 2 inches deep. However, if this isn't available, standard chassis bases of similar or slightly larger size can be obtained from your local parts jobber or a mail order house. Don't try to use a smaller chassis. Incidentally, since the unit will be "hidden" in the cabinet and appearances don't much matter, the chassis problem can be solved by using an aluminum baking tin! The type called a "loaf tin" (ask your wife or girl friend) is especially suitable. This is very thin aluminum and can be cut with ease.

A number of the components in the parts list are followed with the note "see text." This is because these units are flexible—that is, substitute parts can be used. Comments on these parts follow.

Volume Control and On-Off Switch. The volume, or gain, control must have an audio taper, and the ohmic resistance can be either 500K ohms or 1 megohm. The on-off switch in the author's unit was attached to the volume control, just as most are on radios, except that it was the push-pull type. That is, pulling the shaft forward, turned on the switch, and pushing it in turned it off. This type control eliminates the neccessity of adjusting the gain every time the unit is turned on, since turning it off by simply pushing it does not change the gain control position. If this type control is not available, a separate on-off switch is recommended.

Many high fidelity amplifiers provide "switched" power outlets. That is, any equipment plugged into the outlet will be turned on and off with the amplifier. In this case, the on-off switch can be omitted and the Synthetic Stereo can be plugged into the amplifier's on-off switch-controlled outlet.

The Output Transformer. A standard "bargain" type transformer was used in all of the units built. These can usually be purchased for 49c to $1 at most parts jobbers or mail-order houses. The primary impedance should be from 5000 to 10,000 ohms, and the secondary from 3.2 to 8 ohms. It, as you can see, is not critical.

The Power Transformer. The primary winding, of course, is rated at the standard 117 volts, 60cps. There are two secondary windings—one to supply B+ voltage and the other for the tube heaters. The heaters require 6.3 volts at 1.05 amp and 120 volts at 25 ma are required for B+—these are minimum requirements. The filament winding must supply 6.3 volts, but the current rating can be 1.05 amperes or higher.

The B+ requires 120 volts, but any value up to 150 volts (the filter capacitor maximum rating) is satisfactory. Since B+ current is only 25 ma, a transformer rated at this, or higher (say 40 or 50 ma) is OK. The author used a Crest PF61. Another suitable transformer is the Merit P-3045.

The Filter Capacitor. This unit has four separate sections, as shown in the schematic diagram of Fig. 3. They are: a. 40 mfd at 150 volts; a b. 80 mfd at 150 volts; a c. 40 mfd at 150 volts; and a d. 100 mfd at 25 volts. The author used a Sangamo, type PLQ 80502. Similar types are available from other manufacturers. Of course it's perfectly all right to use two, three, or even four separate capacitors, but remember when planning your layout that they will require more mounting space.

Gather all the parts before purchasing the chassis or planning the layout. Then place the parts on a blank piece of paper to see how to lay out the chassis best, keeping the foregoing suggestions in mind. Make sure you know how and where you're going to place all parts before purchasing or cutting the chassis—it'll be too late then! The piece of paper will show you just how large the chassis should be.

When building the unit, follow the previous general suggestions. In addition, tightly twist the heater wires together and install them first, dressed down to the chassis, so all other wires and components will be "over" them.

When the unit is completed, check from B+ to ground with an ohmmeter for shorts before turning it on. Then connect a speaker to the output terminals, plug the power cord in a wall outlet, and turn it on. With the gain control turned full "on" you will probably get hum—this is normal. To reduce it, connect one side of the heater to the cathode of the output tube. This places a positive voltage on the heater and reduces hum leakage from heater to cathode in all of the tubes. Sometimes connecting one side of the heater to the cathode will reduce the hum more than connecting the other side. Because of this, try connecting both sides, one at a time, and use the connection that produces least hum. If the heater winding of your power transformer has a center tap, try it also. Once you determine the connection producing minimum hum, you can go ahead with the cabinet construction. Don't worry at this time if the hum seems excessive. All amplifiers produce some hum when the gain controls are turned fully on. It is only important that the hum is not objectionable at the normal listening level.

Cabinet Construction

As previously mentioned, the enclosure size is not important. This is because the stereo effect is not noticeable below 300 cps. This is also true of real stereo and is due to the long wavelength of the lower frequencies. Since output below 300 cps is not needed, the large enclosure, heavy construction, and other such complications associated with bass reproduction are eliminated.

The enclosure illustrated in Figs. 1 and 2 measures 10 inches high, 16 inches long, and 8½ inches deep. It is made of ¼ inch plywood, but is liberally braced in all corners with ½ inch square wood. That is, wherever two pieces of wood meet, the entire joint is reinforced with a ½ inch square of wood. All joints are glued and nailed (with ½ inch wire brads). Although Weldwood glue was used, any casein type glue is recommended. Elmer's Glue-All is excellent, generally available and easy to use.

Remember that the enclosure size given above is only an example. Use a larger one if you wish, but one much smaller isn't recommended. No matter what size you use, be sure the speaker and amplifier will fit in it. Naturally, you can use heavier wood if desired.

Part of the inside of the cabinet is covered which acoustic padding to absorb the mid- and high-frequency signals coming off the back of the speaker cone. The amount is

not critical—I covered the back, one side, and top. The type material is not too important. Glass wool, available in most hardware stores, is excellent but should be covered with cheesecloth. Burlap, flannel, or old towels also do a good job.

The cabinet was covered with a plastic material called "Contact" which is usually obtainable from hardware stores, building suppliers, Montgomery Ward or Sears, Roebuck. A variety of colors or wood grains are offered. The grill cloth should naturally be chosen to match the "Contact," or however you finish the cabinet.

The front grill effect of the cabinet was obtained by simply covering the top, bottom, and both sides of the cabinet with Contact as one unit. The front was covered with grill cloth and pulled tightly around all edges (to the back of the front panel) and stapled in place. The front was nailed to the remaining assembly with headless nails which were countersunk and thus were concealed by the grill cloth. The speaker and amplifier were installed from the back which was held in place with wood screws. The speaker itself is held in place with wood screws. The amplifier chassis is held by self-tapping metal screws inserted through the bottom of the cabinet into previously drilled holes in the chassis.

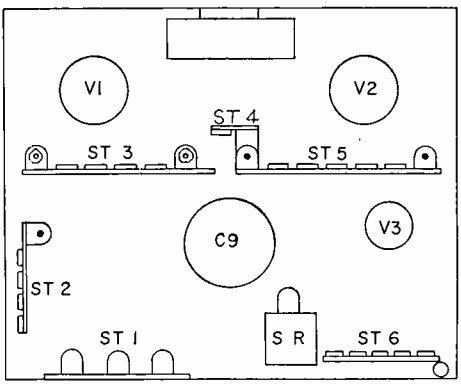


Fig. 5. Sketch of the amplifier layout used by the author.

Notice in Fig. 2 that a portion of the back cover is cut away directly behind the input-output terminals on the amplifier chassis. This is to facilitate connecting the main Hi Fi system to the amplifier. In addition, it provides ventilation for the amplifier.

Loudspeaker

Since the Synthetic Stereo unit does not utilize low frequencies, the speaker need only to reproduce mid- and high-frequencies. Of all the speakers tried with the unit, the 8" Norelco 9770M was best. This speaker, selling for a little less than $10, is perfectly adequate in the mid-range, and high frequency response extends out to 19 kc. Purchasing a speaker with better bass response for this unit is actually a waste of money, since the amplifier is specifically designed not to reproduce low frequences.

The frequency response of the amplifier is within ± 1 db from 100 cps. to 15 kc. At 20 kc the response rises to + 1.2 db. Below 100 cps the response falls off at a rate of about 14 db per octave—Specifically it is—13.8 db at 50 cps.

Testing and Adjusting

After you install the Synthetic Stereo amplifier and speaker in the cabinet, connect the speaker to the output terminals of the amplifier. Put the back in place, using at least six wood screws. Then connect the input of the stereo amplifier to the output terminals of the Hi Fi system's amplifier or main speaker voice coil with 8 to 10 feet of wire. Two wires, of course, are needed. They can be plain hook-up wire, TV twin-lead,

(*Page ten please*)

Radio-TV Business Opportunity in Ogden, Utah

Students and Graduates living in and around Ogden may be interested in this business participation or partnership opportunity with Graduate John E. Perkins who writes:

"I have a going TV and Radio business with more work than I can take care of because I can only work at it part time. I am an engineer for the Southern Pacific Railroad. I have a complete tube stock and all instruments necessary to take care of a first class shop. Business is in a good location and will gross from $500 to $700 a month on a part time basis.

I believe the right man could build himself a full time profitable business and I would be willing to turn it over to him without any investment until he tried it out and saw for himself what it would be. It would take a good technician and a good mixer; a man easy to get along with. I would be willing to donate my time to help him get acquainted and give him a good send off."

Those living in the area who would like to discuss this opportunity with Graduate Perkins should contact him at 211 Porter Ave., Ogden, Utah.

coaxial cable, or whatever you have. Place the synthetic stereo unit 6 to 8 feet on either side of the main Hi Fi speaker. Choose one of your favorite records, preferably full orchestra or chorus. Turn on both your Hi Fi and the stereo unit, but turn the stereo gain control down (so you can't hear it). It is advisable at this point to get someone to help you so you can position yourself between the units while they adjust the stereo gain control for correct "balance." With the speakers 8 to 10 feet apart along a wall, the best listening position is midway between the speakers, 8 to 10 feet out from the wall.

Turn on the music and then slowly advance the gain of the stereo unit. The music should tend to move across the wall from the main speaker to the stereo speaker. Most of the music appears to come from the wall between the speakers. Sometimes it helps to close your eyes for the final adjustment.

When you reach the balanced condition you may not see much of an improvement over your regular Hi Fi. If so, just listen to it for a few minutes, then turn off the stereo, and listen again. The normal reaction is "flat and dull!"

Since nothing man makes is perfect, you may run into trouble. If you have excessive hum with the stereo volume control set to the correct "balanced" position, the hum may be in the amplifier, or it may be picked up on the line from the main speaker. To test for this, disconnect the line from the main amplifier at the stereo amplifier—do not change the gain control position. If the hum is satisfactorily reduced, you'll have to use shielded wire between the units. Shielded single conductor wire like coaxial cable or shielded microphone wire can be used. Connect the center conductor of the shielded cable to the input terminal of the stereo unit and the shield to the common terminal. Connect the other end of the cable to the main amplifier in a similar manner—the shield to common and the center conductor to the terminal connected to the main speaker. Also try reversing these connections at the main amplifier and use the one giving the best results. To further reduce any hum try reversing the line plug of the stereo unit in the wall outlet.

If disconnecting the connecting line at the stereo amplifier does not reduce the hum, it is being produced internally. The usual cause is cathode-to-heater leakage in the tubes—particularly V1. Try new tubes, one at a time. Then troubleshoot in the normal fashion—be sure to look for poorly soldered ground connections. Remember also that a new part does not necessarily mean a good part. Substitute whenever you suspect a defective component.

Other troubles, such as a dead amplifier, motorboating, distortion, etc. can be due to defective parts or incorrect wiring.

The quality of the sound from the Synthetic Stero unit, except at the low-frequency end, depends on the input signal quality. In general, the unit "improves" a high quality system more than it does a less expensive system. If you feel that the stereo amplifier does not "put out" enough highs, you can try reducing the 270 mmf capacitor C3 about 50 mmf at a time. Improving the low frequency response will not improve the stereo effect and, in fact, will just increase distortion.

None of the parts used for the Synthetic Stereo unit are available from NRI. They are all standard components and can be obtained at your local parts jobber, mail order houses, and at other places mentioned in this article.

Editor's note: We would like to ask a favor of our readers. If you have built or are building the synthetic stereo unit described in the foregoing article, won't you drop us a line and let us know about it? This will help us in planning future "build it yourself" articles for Radio-TV servicemen, experimenters, and hobbyists.

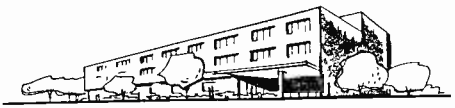
We'd like to know: Was the stereo unit constructed for yourself or someone else? Did you build or are you planning to build more than one unit? Do you intend to sell or have you sold one or more of the units? If so, for how much? And finally —give us your own impression of the stereo effect the unit provides.

Address your letter to: Editor, NRI News, National Radio Institute, 3939 Wisconsin Ave., N.W., Washington 16, D. C. Thanks!

The greatest thrill is achievement. To have done something worthwhile is much more satisfying than the thoughts of what you hoped to do. The more you attempt, the greater will be the prize. The more you fail, the greater the opportunity you have to climb even higher next time. The harder the problem you have to tackle now, the easier will be the greater problems that come along. Having tackled something big, the better you feel when you have mastered it. The best things in life are the most difficult to obtain.

Gerald Findler in Efficiency

NRI ALUMNI NEWS



Chapter Chatter

NRIAA Welcomes Another New Local Chapter

Last summer NRIAA Member J. Arthur Ragsdale of San Francisco, having noted the formation of a local chapter in Los Angeles the previous year, conceived the idea of establishing one in the San Francisco Bay area. He wrote National Headquarters about it. National Headquarters, after determining that there were a sufficient number of Alumni Association members in the vicinity to justify the attempt, appointed Mr . Ragsdale as Temporary Chairman to handle the details of forming the chapter. Through much hard work on the part of Mr. Ragsdale and the valuable help of those who aided him, enough charter members were lined up to establish the chapter.

Thereupon the new chapter was chartered as the San Francisco Chapter on January 7, 1959. Executive Secretary Ted Rose flew to San Francisco to attend the organizational meeting and to present the Charter to the new Chapter. The main business transacted at this organizational meeting was the election of permanent officers, the selection of a meeting night and a meeting place, and the fixing of dues for membership in the Chapter.

The officers elected to serve during 1959 were: J. Arthur Ragsdale, Chairman; Roland Tomlinson, Vice-Chairman; Phil Stearns, Secretary; George Chessen, Treasurer; and Isaiah Randolf and Edward Persau, Financial Committee.

It was decided that meetings would be held on the first Wednesday of each month, 8:00 p.m., at the home of Chapter Member Pete Salvotti, 2534 Great Highway, San Francisco. Pete's comfortable and attractive recreation room is almost ideally suitable for this purpose. Of equal importance is the fact that there is ample parking space in the streets close to Pete's home.

Dues were fixed at 50¢ per month or, when paid in advance, $5 per year.

In addition to the original charter members present, four new members joined the chapter at the organizational meeting. At the very next meeting—the first regular meeting—held on February 4, ten new members were admitted to membership. It looks like the San Francisco Chapter is off to a flying start!

The feature of the first regular meeting was the showing of two RCA films "The Sound and The Story" depicting the step-by-step production of hi-fi records, and "The Story of TV," tracing the development of TV from an inspiration to the present-day color TV. The chapter is indebted to Sidney Mahler for securing these films, providing the projector and showing the films to the members.

The chapter would like it known that all NRI graduates and students in the San Francisco Bay area will be cordially welcome at the meetings. For more information, contact Chairman J. Arthur Ragsdale, 1526 27th Ave., San Francisco 22, or Secretary Phil Stearns, 1650 45th Ave., San Francisco 22.

PITTSBURGH CHAPTER was pleased to welcome Mr. Balenger and Mr. Goznel of Sylvania Electric Products Company as guest speakers at one of its recent meetings. Mr. Balenger spoke on the physics of transistors and Mr. Goznel on how to beat the drug store tube checkers. Members found both talks to be interesting and informative.

Plans are expected to be made for more such practical talks by representatives of other Radio-TV manufacturers and distributors.

Plans are also under way for visiting Channel 4. This should prove very interesting indeed.

The Chapter has undertaken a new and important project: the establishment of a

"service bench" to which members can bring their problem sets to have them analyzed and explained. Plans were formulated for this project months ago. The service bench is probably in actual operation by now and should prove to be a valuable source of help for members' Radio-TV service problems.

Any NRI students or graduates in the Pittsburgh area who have not taken advantage of the Chapter's invitation to attend its meetings should do so without further delay. The meetings are held at 8:00 P.M. on the first Thursday of each month at 134 Market Place, Pittsburgh. The Chairman is Tom Schnader, R.D. 3, Irwin; the Secretary is Ray Bender, 2626 Norwood St., Pittsburgh.

DETROIT CHAPTER has continued to devote the major part of its attention to work on the Chapter's TV panel board, although at one meeting a short session was given over to Chairman Nagy's Radio problem.

The Chapter would like all its members to know that they may have the use of its meeting place from 6:00 P.M. on meeting nights, but that anyone wishing to come early should contact the Chairman or the Secretary so that an officer of the Chapter can be present to render what help he can with the problem to be solved.

The Chapter extends a warm invitation to all NRI students and graduates to come to its meetings, which are held at 8:00 P.M. on the second and fourth Friday of each month at St. Andrew's Hall, 431 E. Congress St., Detroit. If you would like to find out more about the Chapter, contact Chairman John Nagy, 1406 Euclid, Lincoln Park, or Secretary Ellsworth Umbreit, 12523 Racine Ave., Detroit.

MINNEAPOLIS-ST. PAUL (TWIN CITY) CHAPTER has been enjoying talks by two of its most prominent members, Chairman John Berka and John Babcock, who is National President of the NRIAA for the current year.

John Babcock addressed a meeting on the legal aspects of TV servicing. Chairman Berka gave a talk on two subjects, one on video amplifiers and the defects commonly encountered in them and how to recognize them, and the other on TV and Radio parts replacement. He discussed the tolerances of resistors and capacitors and how to choose the proper replacement parts for other components.

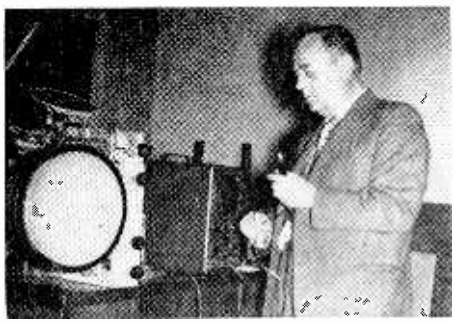
Another talk by Chairman Berka on video detectors and amplifiers at a subsequent meeting was postponed due to the large number of "dog" Radio and TV sets which members had brought to work on. Also at this meeting the members present devoted considerable time to helping an NRI student analyze some difficulty he was having with his scope.

This is a good example of how valuable membership in the Chapter can be. Any NRI student and graduate in the area will be welcome at the meetings and will find the members only too glad and willing to help you with any Radio-TV problems you may have. This is the most important advantage of membership in a local chapter of the NRI Alumni Association.

The Chapter meets at 8 P.M. on the second Thursday of each month at Walt Berbee's Radio-TV Shop, 915 St. Clair, St. Paul. Chairman John Berka, 2833 42nd Ave., St. Paul, will be glad to answer any inquiries about the Chapter and its activities.

BALTIMORE CHAPTER was pleased to act as host to two visitors from the National Radio Institute, J. B. Straughn, Assistant Director of the NRI Instruction Department and Chief, Consultation Service, and Ted Rose, Executive Secretary of the NRI Alumni Association.

This visit differed from previous ones in that the usual festivity was secondary to a technical talk and demonstration delivered by Mr. Straughn. Mr. Straughn took a major part in the design and development of a new NRI Model 250 Oscilloscope and appeared in person to demonstrate its many features. This was the first time the Baltimore Chapter was privileged to



J. B. Straughn demonstrating NRI Model 250 Oscilloscope at meeting of the Baltimore Chapter.

hear Mr. Straughn in the role of an instructor and, to put it mildly, there was a great deal of gratification evident.

The Chapter, never at a loss for photographers, had two members busy documenting the talk and demonstration on film. Aubrey Hooper shot a colored movie film

of the proceedings, while J. Henderson took numerous still shots.

Refreshments were served, during which there was the usual swapping of the latest jokes. Judging by the frequent and spontaneous laughter, this part of the evening was likewise quite entertaining.

This was the first meeting atended by the Chapter's newest member, Graduate William Tebo. Glad to include you in the membership, Bill.

The Chapter always has its welcome mat out for all NRI students and graduates who would like to come to the meetings. The meetings are held at 8:00 P.M. on the second Tuesday of each month at 100 N. Paca St., Baltimore. For further information contact Chairman Joseph Dolivka, 717 N. Montford Ave., or Secretary John Woolschleger, 1106 S. Lakewood Ave., Baltimore.

SOUTHEASTERN MASSACHUSETTS CHAPTER, as reported in the February-March issue of the NRI News, now holds its meetings in the basement-shop of Chairman John Alves' home, 57 Allen Blvd., Swansea, Mass.

Chairman Alves, assisted by Frank Sarro, at one meeting devoted the entire evening to the actual step-by-step use of a volt-ohmmeter, tube tester, and signal tracer in troubleshooting a "bugged" ac-dc Radio with a number of faults present, which may occur (one at a time) in actual servicing. Because of the practical nature of this discussion the members felt it was well worth the time it took.

All NRI students and graduates in the area are cordially invited to attend these meetings, either as guests or prospective members. The meetings are held at 8 P. M. on the last Wednesday of each month. For further information about the Chapter get in touch with Chairman John Alves at his home or Secretary Edward Bednarz, 184 Grinnell St., Fall River.

NEW ORLEANS CHAPTER elected to omit its February meeting due to the Mardi Gras celebration held in that month each year in New Orleans.

As announced in the February-March issue of the NRI News, the members decided to take up a detailed discussion and study of color TV at its meetings. The first such session in line with this program was conducted by Chapter Member Gaston Galjour, who brought in a color TV set and demonstrated step-by-step adjustment procedures. This was a timely demonstration. Every TV serviceman should learn all he can, now, about servicing color TV receivers.

The Chapter meets at 8 P. M. on the second Tuesday of each month at Secretary Grossman's home, 2229 Napolean Ave., New Orleans. All NRI students and graduates in the area will be cordially welcomed at the meetings as guests or prospective members.

PHILADELPHIA-CAMDEN CHAPTER continues to increase its already large membership. The latest new members reported are: Graduate Daniel Wisler, Phoenixville; Graduate Francis Newbaur, Morrisville; and Student Anthony Romanuskor, Hatboro. A cordial welcome to these new members!

The chapter recently had one of the largest meetings in its history. Seventy-three were present. Guest speaker Bernard Bycer, design engineer of RCA, delivered a very interesting lecture on hum in TV.

The feature of the following meeting was four guest speakers from the Albert Steinberg Company who gave talks on HI-FI and Stereo. The main speakers were Stan Goldenberg, Sound Engineer; Lee Wolf, Northeast Store Manager; and Harry Brown, N. Philadelphia Store Manager.

Representatives of the Albert Steinberg Company who gave talks and demonstrations on hi-fi and stereo at a meeting of the Philadelphia-Camden Chapter. L to r: Ray Wallreth, Harry Brown, Lee Wolf, and Stan Goldenberg.

Philadelphia-Camden Chapter group which visited the Philadelphia Police Communication Bureau.

Ray Wallreth, salesman, also helped to make this an interesting meeting. A Wellers soldering gun was donated by the Albert Steinberg Company as a door prize, which was won by Joseph Dilorenzo.

Secretary Jules Cohen has given a glowing report of how much the members enjoyed a visit to the Philadelphia Police Communications Bureau. Sergeant Edward Follser conducted the tour. The members were taken into the rooms and shown how the calls go through. Everything was thoroughly explained so that members could see how the police work and operate so efficiently. The members were then taken to the Fire Department Bureau and there went through the same thing. John Loughney, Supervisor of the Department, explained everything in detail. These tours will be long remembered by the members who participated in it.

Such tours are just one of the many activities of this chapter. Any NRI student or graduate in the area who has never visited the chapter is missing a great deal and should make it a point to do so. Write or telephone Secretary Jules Cohen, 7124 Souder St., Philadelphia for more information about the chapter—or simply present yourself at one of the meetings. The chapter meets at 8 P. M. on the second and fourth Monday of each month at the Knights of Columbus Hall, Tulip and Tyson Sts., Philadelphia.

FLINT (SAGINAW VALLEY) CHAPTER was so well pleased with the officers who served it during 1958 that it unanimously reelected all of them for 1959. They are: William Neumann, Chairman; Aaron Triplett, Vice-Chairman; George Hinman, Secretary; and Clyde Morrisett, Treasurer.

A motion was made and passed to the effect that any member missing three consecutive meetings would be dropped from the Chapter's mailing list. All members of the Chapter please take note.

The Chapter decided to continue its use of sound films on subjects dealing with Radio and TV, also that at each meeting some member would relate the symptoms of troubles he had encountered in servicing and that each member would give his diagnosis.

Here is another important item for all members of the chapter. Meetings were formerly held at Vice-Chairman Aaron Triplett's Repair Shop. From now on the meetings will be held regularly at 7:30 P. M. at the home of Warren Williamson, 1201 Allen St., Flint.

At the first meeting held at Warren Williamson's, Mrs. Williamson appeared about 10 P. M. to inquire whether anyone would care for a cup of coffee. No one was opposed to this suggestion, so Mrs. Williamson brought out a heaping platter of sandwiches, plenty of hot coffee and several dozen home-made doughnuts. Needless to say none of the food was wasted or returned, and all the members would like here to express their appreciation for her hospitality.

All NRI students and graduates in the area are welcome to attend these meetings. Get in touch with Chairman William Neuman, 1613 S. Kiesel, Bay City, or Secretary George Hinman, 603½ State St., Bay City.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER has made an important change which all members of the Chapter should note carefully. The Chapter formerly held its meetings on the second Wednesday of each month. The meetings are now being held on the second **Thursday** of each month, at 7:30 P.M.

The meeting place remains the same: The North Hagerstown High School.

The Chapter has been trying to arrange for a visit to WGAL-TV (Channel 8) in Lancaster but has been postponing final plans due to the weather and the distance that must be traveled by many. The trip has been planned for a Sunday, with a visit through the station in the afternoon. This trip may have been made by the time this issue of the NRI News is published, but if not, those interested in making the trip should get in touch with the Secretary.

The Chapter cordially invites all NRI students and graduates in the vicinity to at-

tend its meetings. For further information contact Secretary Edwin M. Kemp, 618 Sunset Ave., Hagerstown.

NEW YORK CITY CHAPTER has been pleased to welcome the many new members who signed up at the last few meetings and it is hoped they will remain with the Chapter for a long time to come.

The Chapter feels very fortunate in having a man like James Eaddy as a member. He is always ready to speak on any phase of Electronics. At the last few meetings he spoke on transistors in Radio, TV sets, and automobile sets. He also demonstrated how to assemble an extension cord with fuses in the cord, to prevent blowing out house fuses in case of a shorted set. He has repaired sets for other members who were at a loss to find the trouble. He has done this as a courtesy, at no charge. He has performed many other services for the Chapter, too many to enumerate.

Another valuable asset to the Chapter is Thomas Hull, who has spoken on a great many subjects covering the TV set from the tuner to the picture tube and loud speaker. Lately, Tom has been explaining the use of a scope—what each knob on the scope does and what to expect when it is connected to a certain point in a TV set.

Everett Rogers is due some bouquets, too. He often takes the members back to the days of the crystal set and transmitters aboard ships at sea, and then into a modern office building, describing the electrical systems there and how he uses a scope to locate troubles that occur.

The New York City Chapter urges all NRI students and graduates in the area to attend its meetings, either as guests or prospective members. Join the group—become a part of all these helpful activities.

The Chapter meets on the first and third Thursdays of each month, 8:30 p.m., at the St. Marks Community Center, 12 St. Marks Place, New York City. For further information get in touch with Chairman Edward McAdams, 3420 Irwin Ave., New York City, or Secretary David Spitzer, 2052 81st St., Brooklyn 14, N. Y.

SPRINGFIELD (MASS.) CHAPTER has admitted three more new members. They are John Michnovez, Springfield; Neil Nicoll and Edward Pelletier of Ludlow, Mass. Welcome to these new members!

A word about John Michnovez. He is a real old-timer, having graduated from NRI in 1938. He subsequently taught Radio and TV in evening classes in a Springfield trade school (adult education) and is now Chief Engineer of Radio Station WMAS in Springfield. He has generously voluteered to help programming of the Chapter's meetings and by giving talks on Electronics. John should therefore prove a very valuable asset to the Chapter.

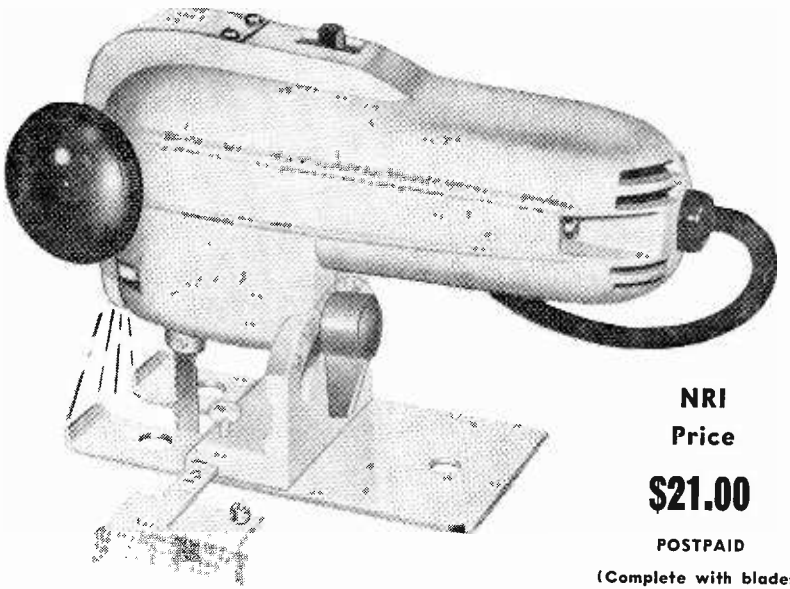
National Headquarters was sorry to learn of the passing away of Arnold Wilder's

(*Continued on page* 18)

Refreshment time at the Springfield Chapter's Saturday Night Shop Meeting held at Henry Duperre's shop.

now available to students and graduates

Shopmate Model 2100B Jig Saw



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(Complete with blades)

SPECIFICATIONS

*Motor—115 V AC-DC 1.8 Amp Rating
*Switch—Heavy Duty, Slide Type
*Overall Length 7½"
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A rugged, well-designed Jig Saw built to do a man-sized, professional cutting job. But at far less than you'd expect to pay for a saw of equal performance.

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The Shopmate is actually **eight saws in one.** Smoothly and swiftly it does the work of a rip saw, jig saw, band saw. Also operates as a coping saw, crosscut saw, hacksaw, scroll saw, and keyhole saw. Makes all type cuts—straight lines, curves, circles, intricate designs. Cuts 2" x 4" wood or ½" cold-rolled steel in seconds. Built-in light lets you see as you saw.

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Cool, streamlined, easy-grip handle and light-weight allows hours of tireless operation. Gives greater safety and control for accurate cuts. The Shopmate makes its own starting hole on inside cuts. Starts right in cutting out squares, circles, triangles. Eliminates the "drill first; saw later" operation. In Radio-TV work, the Shopmate Saw is a lifesaver for installing custom sound or hi-fi systems in homes and businesses. Handles with ease all composition boards, plastics, hard rubber—even leather. Perfect for roughing-in house wiring, extension wall plugs, switches, and sockets. Whether you own a home or shop or are just an average "do it yourself" man, you'll find hundreds of jobs are actually fun using the Shopmate.

SPECIAL LOW NRI PRICE

Regular retail price of the Shopmate Jig Saw is $29.95. (As advertised in the Saturday Evening Post.) But because NRI buys in such large quantities, we are able to offer the Shopmate at the greatly reduced price of just $21.00. A savings of $8.95.

(USE HANDY ORDER BLANK ON PAGE 17)

POPULAR NRI MODEL O FILAMENT TESTER

Only 5.50 postpaid, complete with batteries

IMPORTANT FEATURES:

- **completely self-contained, uses 2 long-life penlight cells**
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- **easy to use—complete instructions on back**
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☐ I enclose $5.50 for which send me, postpaid, one NRI Model O Series String Filament Tester.

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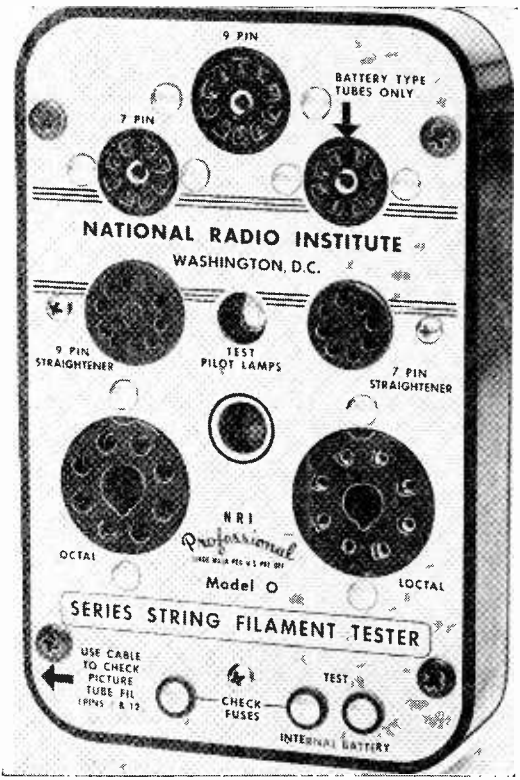
Low Price Means Worth-While Savings On This Handy Instrument

Made for NRI by a well-known manufacturer, the Model O Series String Filament Tester is a real buy at $5.50 . . . substantially below the selling price of comparable instruments.

The most frequent cause of tube failure is an open filament. With the NRI Model O, you can check the filaments of tubes in series string Radio-TV receivers FAST. Just plug tube into the socket it fits. If test lamp lights, filament is good. (7-pin battery tubes use a plainly marked socket.) To check fuses, place ends on contact points. If pilot lamp lights, fuse is good.

Convenient to use in customer's home. Carry in pocket or tool box. Speed up your service work. Order today.



NRI ALUMNI NEWS

Chapter Chatter

(Continued from Page Fifteen)

mother. Our deepest sympathy, Arnold. Because of this, the Saturday Night Shop meeting originally scheduled to be held at his home was transferred to the shop of Henry Duperre. At this shop meeting an electrodynamic speaker was added to one member's Heath amplifier; another member had an audio defect which was giving trouble, and he too went home happy. Refreshments were served by Henry and his wife, which was much appreciated by the members.

A feature at another meeting was the showing of a film "The Story of Television." The film was supplied by the Institute of Visual Training.

Orin Hayden delivered an interesting talk on automation in record keeping—the equipment used and an explanation of punch cards and how punching operates various types of machines, IBM, etc.

The Chapter holds its meetings twice a month, a regular meeting at 7:00 P.M. at the U. S. Army Headquarters Building, 50 East st., Springfield, and a "Shop" meeting in the shop of one of its members on the Saturday following the third Friday of each month. All NRI students and graduates are invited to both meetings. For more information, get in touch with Secretary Howard Smith, 53 Bangor Street, Springfield.

MILWAUKEE CHAPTER has been concentrating on TV receivers lately. At one meeting a discussion of Stanley Ward's TV receiver was undertaken by Slavko Petrich, Erwin Kapheim and Stanley Ward. At the next meeting Wallace Smith's and Ed Lamm's TV receivers were discussed by James Lasky, Slavko Petrich, Ed Lamm and Ralph Lassen.

Previous to these meetings the chapter had been analyzing the five tube radio receiver. This was interrupted in favor of analyzing TV receivers, but when this series of discussions is completed the chapter expects to return to the Radio receiver.

These talks and demonstrations are enlighting and members get a great deal of practical, useful information from them.

The chapter has a standing invitation to all NRI students and graduates in or near Milwaukee to come to its meetings, get acquainted with the members, and find out how much help is available on Radio-TV service problems. The meetings are held at 8 P.M. on the third Monday of each month at the Radio-TV Store and Shop of Slavko Petrich, 5901 W. Vliet St., Milwaukee. If you would like to know more about the chapter and its meetings, contact Secretary Erwin Kapheim, 3525 N. Fourth St., Milwaukee.

Milwaukee Chapter members Robert Krause (in left corner, back to camera—wonder what he's hiding?), Stanley Ward, Slavko Petrich, Phil Rinke, Ralph Lassen, James Lasky and Fabien Pretchowski discussing a TV receiver.

LOS ANGELES CHAPTER as a highlight at one of its meetings showed three films. The first one was on Elox electronic equipment, the second on IBM electronic computers and the third one on salesmanship —what to do and not to do in selling. The members found the films not only entertaining but also that they contained much practical information.

Executive Secretary of the NRI Alumni Association, Ted Rose, while in California to attend the organizational meeting of the San Francisco Chapter, took advantage of the opportunity to drop in for a visit at a meeting of the Los Angeles Chapter. He thoroughly enjoyed renewing acquaintance

(Continued on inside rear cover)

Some of the officers of the Los Angeles Chapter. L to r: Mike Raftis, Treasurer; Joe Stocker, former Chairman; visitor Ted Rose; Tom McMullen, Chairman; and Earle B. Allen, Secretary.

Servicing Signal Seeking Tuners

(*Continued from page 4*)

and closing all 5 sets of the relay contacts.

Closing relay contacts #5 completes a circuit from ground through the contacts, through the solenoid coil to A+. The solenoid is energized and the stop is drawn clear of the paddle wheel. At the same time, relay contacts #4 close the circuit from ground to A+ through the motor windings and the tuner starts searching. Relay contacts #3 connect the sensitivity switch to ground.

Contacts #2 short out the cathode resistor of the relay tube allowing the tube to draw enough current to keep the relay energized until a signal is found. Contacts #1 are connected across the speaker voice coil and mute the speaker while the tuner is searching.

The grid of the trigger tube is supplied (as in Fig. 2) with a signal taken from the second i-f transformer which drives the grid positive as the tuner swings into a station causing the tube to conduct. A voltage taken from the AVC line delays the triggering action allowing the tuner to stop at the proper point. When the trigger tube conducts, current flowing through the plate resistor (see Figure 4) develops a voltage drop across it with the polarity shown. The negative voltage is fed to the grid of the relay tube by the coupling capacitor and reduces the current flowing through the relay tube to a value which is no longer sufficient to keep the relay energized. The relay "drops out" and the tuner stops.

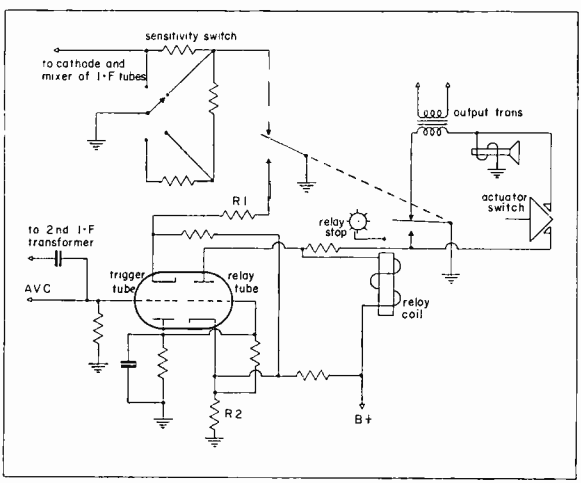


FIG. 3. Typical search tuner-spring motor.

TROUBLESHOOTING SIGNAL-SEEKING TUNERS

Troubleshooting these tuners should not present too much of a problem. Defective tubes and dirty or corroded relay contacts are the main causes of trouble and these defects should be easy to locate and correct. Mechanical defects such as broken or bent, burred, gummy, or sticking parts should be found easily.

The troubleshooting procedure will probably be easier if the various actions are divided into the main functions of starting, holding, and triggering and noting where the failure occurs.

Let's take a few typical troubles and run down some of the probable causes. Suppose the tuner fails to search when the actuator switch is pressed, indicating trouble in the starting circuit. As with any electronic circuit, the first step is to make sure power is being applied. In a circuit such as in Fig. 4, the battery must be connected with the proper polarity or the tuner will not operate. Perhaps the actuator switch is defective or the relay coil may be open. Make sure the solenoid draws the stop clear of the paddle-wheel. With the spring-operated type, the power spring may be broken or disconnected, or a defective limit switch or solenoid may be allowing the mechanism to stick at the high end of the band. With the motor type, there may be an open motor winding, the relay contacts may not be closing the motor circuit, or a defective reversing switch may be stopping the tuner at one end of its travel.

Should the tuner start to search the moment power is applied and before the search button is pressed, it means that too much current is being drawn through the relay coil or a defective solenoid is not moving the stop into the path of the paddle-wheel. Too much current may be due to a defective actuator switch, a short at the plate or cathode of the relay tube or a short to ground in the relay coil.

If the tuner sweeps only after it has warmed up a while, the relay tube is probably defective.

If the tuner sweeps only when the actuator switch is held down, the holding circuit is defective. Replace the relay tube, check for an open in the plate or cathode circuit of the relay

tube and check the relay contacts which should short out all or part of the resistance in the cathode circuit of the relay tube.

If the tuner sweeps but fails to select any stations or can't be made to stop on any except very strong stations, it may be that the proper signal is not being fed to the grid of the trigger tube. If replacing the tuner tubes and checking components in the tuner doesn't disclose the cause of the difficulty, check the antenna, the adjustment of the antenna trimmer, the rf, converter and i-f tubes, and the sensitivity control.

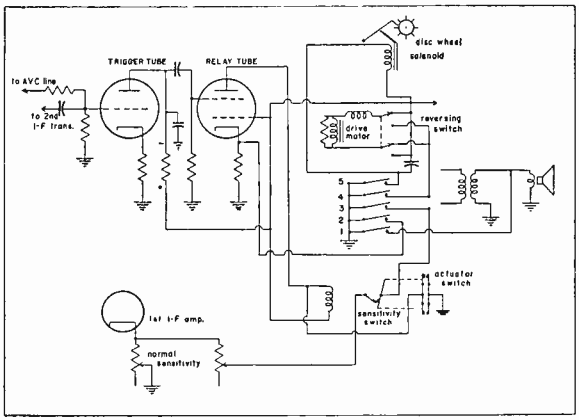


FIG. 4. Typical search tuner-motor driven.

These suggestions do not, of course, cover all the defects that may be found in search tuners. However, we have tried to present basic information which may help a technician analyze the tuners he may encounter. Knowing just how they should work when operating properly makes the search for a defect much simpler.

n r i

n r i

Notice to Test Equipment Buyers

In recent months, an increasing number of test instruments of foreign manufacture have been made available for sale in this country. Some instruments are fully assembled—others in kit form.

In many cases, the only indications the equipment may be of foreign manufacture are the name and price. If the price seems unusually low as compared to like American products, there is a good chance it is foreign.

If you are considering the purchase of one or more instruments which you believe may be of foreign manufacture, you are cautioned to:

1. Investigate fully the availability of replacement parts. In some cases parts are not obtainable from *any* source.

2. Determine whether the instrument uses standard components—that is—can American components be used as substitutes.

3. Find out if the instrument is guaranteed. If so, by whom, and where must it be sent to make the guarantee good.

4. And finally—"Let the buyer beware." Don't try to cut corners. Experienced servicemen will agree it pays to buy and use dependable, quality test equipment built by manufacturers who have earned their reputations in the field.

"No ma'am — he's not bothering me."

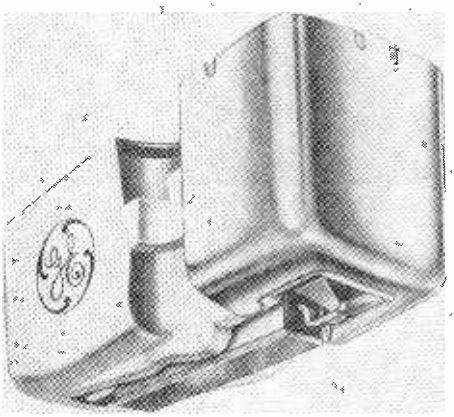
Hi Fi Corner

By JOHN G. DODGSON
NRI Consultant

This month—product reports

General Electric Stereo Cartridge: Some time ago G. E. kindly supplied me with one of their new stereo cartridges—specifically the GC-5 Golden Classic. I postponed reporting on it for two reasons. First of all, the GC-5 is the "professional" model designed for transcription tone arms and I hesitated to test it until I replaced my "monophonic" arm for one specifically designed for stereo.

The second reason is perhaps more important. Cartridges like speakers have an unmeasurable characteristic that might be called "texture." Measuring the frequency response of the cartridge and listening to a few familiar records does not tell the true story. It is necessary to live with the cartridge for a few weeks to be able to properly evaluate it.



The General Electric GC-5
Golden Classic Stereo Cartridge

After installing the GC-5 in a G.E. TM-2 tone arm I checked the frequency response on test records and compared it to previous tests on other cartridges. The low frequency response is as good as any cartridge I have seen. The output at 30 CPS is exactly the same as at 1 kc. At the high end the response gradually begins to rise at 2 kc to + 1.6 db at 10 kc. At that point it gradually drops to —2dp at 15 kc. The over-all frequency response is ± 2.0 db from 30 CPS to 15 kc—the limits of my test record. Since this figure also includes the preamp equalization which is only within ± 1.5 db the GC-5 is well within ± 2 db from 30 CPS to 15 kc. More significant than the absolute limits of response is the over-all smoothness especially in the all important mid-range.

The slight 1.6 db peak at 10 kc is very likely due to the interconnecting cable and pre-amp input capacity. At any rate it did not prove troublesome except with one cone-type tweeter which probably also peaked at 10 kc. However, a slight reduction of the pre-amp treble control removed all discoloration.

The measured frequency response of the GC-5 was not quite as good as the G.E. VR II which I previously tested. The difference though is so slight that it is not audible.

Using the GC-5 for several weeks along with some other cartridges brought out the "texture" problem. I had previously been using a very high quality magnetic cartridge for monophonic records which has superior high-frequency response to the GC-5. Yet it is not possible to determine this on listening tests! The cartridges do sound different but neither

sounds better than the other! Incidentally the price of the GC-5 is just about half that of the other cartridge.

On the stereo side the GC-5 is superb. The frequency response of one output was a remarkable copy of the other—within ±.2 db. Channel separation exceeds the claimed up to 25 db over portions of the range. I had no trouble in obtaining excellent tracking down to 1½ grams (which isn't recommended). At the suggested 3 grams and with the GC-5 cartridge's high lateral and vertical compliance the high frequencies on stereo records should be preserved a long, long time.

I found two slight troubles with the GC-5. First, the output voltage is low—6 to 8 mv. This is not exclusive to G.E.—all magnetic stereo cartridges have low output. In fact, the GC-5 has more output than most. Despite the low output no hum trouble, from this cause, was encountered in two different installations. The second objection is direct hum pickup from magnetic fields. Transformers must be kept at least one foot away from the cartridge. This induction hum problem came up while installing a GC-5 in a friend's hi-fi system. The turntable was mounted on the bottom shelf in a two-shelf cabinet, with two large amplifiers less than 10 inches above the turntable and another amplifier next to the table. The hum problem was finally solved by placing a number of sheets of galvanized iron on the top shelf under the amplifiers. Needless to say the proximity of the amplifiers was abnormal. I had no hum trouble in my own system.

In conclusion, the GC-5 is truly a "top performance" cartridge that meets, or exceeds its specifications at a very reasonable price.

G.E. TM-2G Tone Arm: This tone arm shown in the illustration is about the best I have seen to date. It looks better than its photographs and performs better than it looks! Two of these tone arms were recently installed. One with a Rek-O-Kut turntable and the other with a Weathers. No trouble was encountered in either installation—possibly due to the very complete installation instructions that came with the arm. After installation, the arm (with installed cartridge) is statically balanced simply by turning a thumbscrew at the back end which controls a large weight. Precise setting of the tracking force from zero to 6 grams is then accomplished by sliding a small lever on the top of the tone-arm.

Using the GC-5 cartridge and a Weathers turntable I was able to obtain excellent tracking with a stylus force of only 2 grams. As a matter of fact, tilting the turntable as much as 15° did not dislodge the stylus from the groove or result in any audible difference. This is not, of course, the recommended way to play records but it clearly shows the superb lateral balance of the tone-arm so necessary with stereo records. With perfect balance such as this, the stylus tip exerts an even pressure against the independently modulated groove walls of a stereophonic record.

The tone-arm is equiped with a finger lift and a built-in arm rest. It comes wired for stereo operation but can be easily changed to monaural or monophonic, as single channel is now being called. As might be expected, G.E. supplies everything you'll need to install the tone-arm—complete instructions, all necessary screws and nuts,

General Electric Stereo Classic TM-2G Tone Arm

terminal strip, two high quality coaxial cables with molded phono plugs, and even an Allen wrench for setting the height of the tone-arm.

The plug-in type head used with the arm does not require the cartridge terminals to be soldered. The pins of the cartridge simply fit against leaf springs in the tone-arm when the head is installed. Because of

(Continued on inside rear cover)

Oscilloscope Probes

By J. B. STRAUGHN

Chief, NRI Consultation Service

J. B. Straughn

In TV service work the majority of wave shapes can be viewed by connecting the scope to the circuit under test with ordinary test leads instead of with special cables and probes. However, it is often desirable and, in some cases, necessary to adapt the INPUT of the scope to the circuit under test by using one of several types of test probes.

Notice the above statement "adapt the input"—this is important. When an oscilloscope is connected into a circuit under test, the input circuit of the scope becomes part of the tested circuit. In some instances this can change the circuit appreciably, cause improper operation, and result in false waveforms. This is particularly true of high-impedance circuits or high-frequency circuits.

A typical set of oscilloscope probes is shown in Fig. 1. Although this particular set was designed for the NRI Model 250 Oscilloscope Kit, it is typical of all probe sets.

This set consists of four individually-labeled test probes, accompanied by a universal connecting cable, and supplied in a convenient plastic hang-up type of carrying case. Fig. 2 shows the schematic of each probe and identifies it.

LOW-CAPACITY PROBE

This type of probe effectively reduces the input capacity of an oscilloscope and thereby maintains a high impedance input at high frequencies.

FIG. 1. A typical set of oscilloscope probes.

It was mentioned previously that the input circuit of the scope could change the circuit under test. This loading effect of the scope depends on its input characteristics—the resistance and shunt capacity. Typical values for good quality service type scopes are 3 megohms shunted by 20 MMF. In addition to this input capacity, the shielded coaxial cable, often needed to minimize stray voltage pickup, adds its own capacity of 14 MMF to 30 MMF per foot to the input circuit. Thus, the total shunt capacity could be from 50 to well over 100 MMF. It is evident that the high resistance of 3 megohms is not going to seriously affect many circuits but the capacity might be sufficient to detune resonant circuits or seriously distort the waveforms. To reduce the input capacitance effects of the scope, a low capacity probe is used in such circuits.

As shown in Fig. 2, the low capacity probe consists of series capacitors and series and shunt resistors. The probe has been redrawn in Fig. 3 to show the function of the individual parts more clearly. Since the series .05 mfd capacitor serves only to block DC voltage when measuring at points containing AC and DC, it is not shown in Fig. 3. Because of its large capacity, its impedance is so low it appears as a short circuit to signal frequencies.

The main purpose of the low-capacity probe

is, of course, to reduce the effects of the scope input and coaxial cable shunt capacity. This is done with a capacitive voltage divider. By connecting a small capacity in series with the large scope (plus cable) input capacity, the effective capacitance will be less than the smallest capacity. For example, if the scope input capacitance is 90 MMF connecting a 10 MMF capacity in series would reduce the capacity to approximately 9 MMMF enabling the scope to be used in all but the most critical circuits.

It is evident that connecting a small capacitor in series with the scope input is going to reduce the signal applied to the scope—this is referred to as the attenuation of the probe. In our above example 9/10 of the signal will appear across the probe's 10 MMF capacitor and 1/10 will be applied to the scope input. Thus the attenuation factor of the probe is 10 to 1. Normally, this reduction in input signal is not important since the reserve sensitivity of a well-designed scope is ample to observe all waveshapes where the low capacity probe will be used.

It is desirable that the attenuation factor of the probe be constant for low frequencies as well as high frequencies. This can be accomplished by making the time constant of the probe equal to the time constant of the scope input. To do this the small input capacity of the probe (C in Fig. 3) is made variable and is connected across a large resistance (R1 in Fig. 3). This capacitor (C) is then adjusted at the factory. The shunt resistor, R2 in Fig. 3, serves to stabilize the input impedance of the scope as the vertical attenuator is varied.

TV Sync Signal Tracing is one of the most

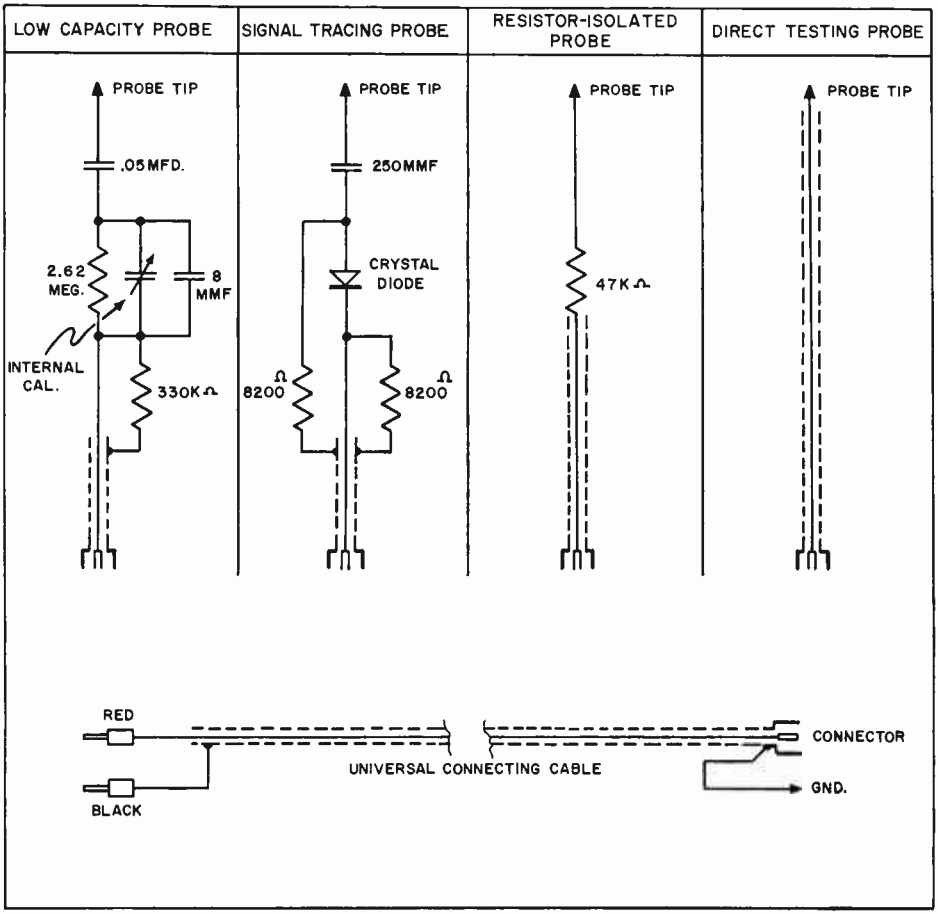


FIG. 2. Schematic diagrams of the probes shown in Fig. 1.

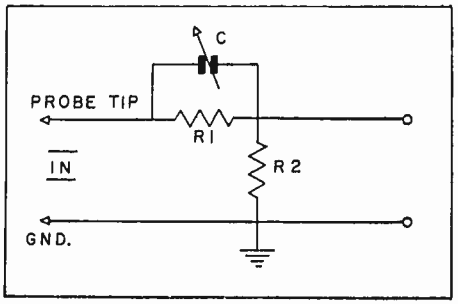


FIG. 3. A low-capacity probe.

useful applications of the low-capacity probe. The sync signal can be traced from the sync take-off point through the sync separator-amplifier without distortion of the sync pulses as shown in Fig. 4.

This ability to view the sync pulses without introducing distortion is particularly important in servicing complaints such as horizontal pulling, vertical jitter, and others that occur because of changes in the shape of the sync pulses.

The Grid of the Vertical-Blocking Oscillater is frequently a difficult test point and is a good example of the application of the low capacity probe. The grid resistor in this circuit may have a value as high as 10 megohms. Furthermore, the waveform is sharply spiked and the high-frequency content of the waveform is easily lost if a direct connection (or the direct probe) is used. However, the low capacity probe reduces the test capacitance across the circuit to a small percentage of the value imposed by a direct probe. As a result, the waveform displayed on the scope screen is essentially the true waveform since the operation of the circuit is virtually undisturbed.

The high resistance of such circuits is often another source of difficulty because the input resistance of some low-capacitance probes causes excessive DC drain-off. The low capacity probe described here, however, includes a built-in blocking capacitor which avoids circuit disturbance by preventing drain-off of DC bias voltage.

The Horizontal-Deflection Coils present a testing problem as a result of the relatively high peak-to-peak voltage which is present. Typical TV receivers develop approximately 1500 peak-to-peak volts across these deflection coils. Although such voltages exceed the input voltage rating of a service scope and will produce severe waveform distortion due to the overload of the vertical amplifier if applied directly, such difficulty can be avoided by using the low capacity probe.

General test in video, sync, and sweep circuits should usually be made with the **Low Capacity Probe,** since then the operator need not be concerned that the input capacitance of the scope might be loading the circuit under test and distorting the waveforms.

SIGNAL-TRACING PROBE

This probe is a DEMODULATOR or RECTIFIER probe, whose chief use is found in the rectification of modulated RF or IF carriers.

The frequencies of some of the signals involved in TV troubleshooting and alignment are often too high to be investigated directly with a service type scope. For example, VHF tuner alignment could involve frequencies beyond 200 MC and even the i-f frequencies found in the video i-f amplifier and detector stages are either near 21 MC or 41 MC. Since even a good service scope is useful only to about 4 or 5 MC, it is evident that these signals cannot be displayed on the CRT without some additional aid.

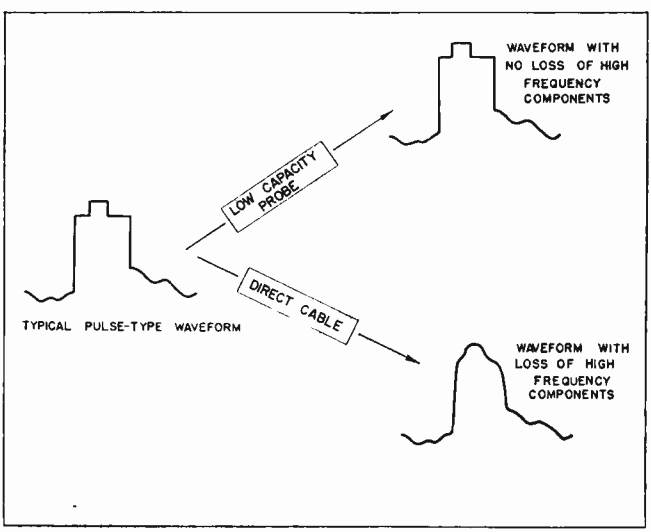


FIG. 4. Basic operation of a low-capacity probe.

When such high frequency signals are modulated, as is usually the case, it is not necessary that a complete trace of each individual cycle of the high-frequency carrier be shown on the CRT. Instead, the high-frequency signal can first be demodulated or detected and the resultant modulation voltage recovered in the process can be displayed as shown in Fig. 5. Fortunately, this "modulation envelope" happens to be the signal that is important in trouble-shooting and alignment. In short, then, the demodulator probe makes it possible to investigate waveforms that would otherwise be impossible to see with a service type scope alone.

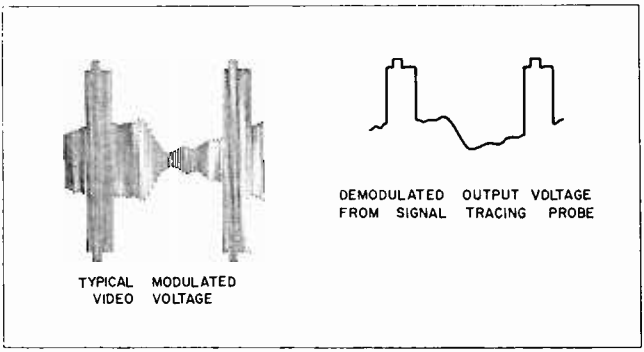


FIG. 5. The basic demodulation or detection operation of a crystal probe. Since the RF or I-F carriers are almost invariably too high in frequency for direct application to general-purpose scopes, the crystal probe rectifies the modulated carrier and transmits only the modulation information to the scope input.

Application

The signal-tracing probe has a number of very practical applications in general circuit testing. Some of these applications are as follows:

1. Signal Tracing in RF, I-F and Video amplifiers.
2. Buzz analysis in 4.5 MC amplifiers, or in the sound I-F amplifier strips (split sound TV).
3. Marker-Generator calibration.
4. Stage-by-stage alignment.
5. ANY TEST WHICH REQUIRES DEMODULATION OF THE SIGNAL as long as the test voltage does not exceed approximately 65 volts peak.

The demodulator or detector probe shown in Fig. 2 uses a simple series crystal-diode rectifier circuit. The output of the rectifier charges the capacitance of the coaxial cable, and the 8200-ohm bleeder resistor reduces the time contsant of the circuit sufficiently so that effective demodulation is obtained. The 250-MMF input capacitor serves to block DC from damaging the crystal and also prevents the medium-input impedance of the probe from upsetting bias in high-impedance circuits. The 8200-ohm resistor connected from ground to the junction of the 250-MMF blocking capacitor and the crystal diode serves as a shunting resistor for hum voltage reduction. The 250-MMF capacitor also helps reduce hum since it offers a high impedance at low hum frequencies.

This series diode type demodulator probe supplied with the NRI Probe Kit is not the only type in use although it is the most popular. Two other types are also commonly used — the shunt type and the voltage-doubler type.

The shunt type, as the name implies, utilizes a crystal diode connected in shunt with the input circuit (from "hot" to ground). Shunt probes are often low impedance type and thus deliberately detune the circuit to which they are connected. Therefore, special test and alignment procedures must be used. Although in some cases they can be superior to the higher impedance series type probe, they are generally not as useful.

The voltage-doubler type probe shown in Fig. 6 has the advantage of more sensitivity than the series or shunt probes. This probe combines the positive-peak value of the modulating waveform with the negative-peak value and thus feeds the scope a signal proportional to the peak-to-peak value. The voltage doubler feature does improve the sensitivity but the low input impedance causes high frequency distortion. Its greatest use would be in looking for a signal rather than examining a waveform for distortion.

Incidentally, remember that the voltage-doubler type probe will deliver a signal

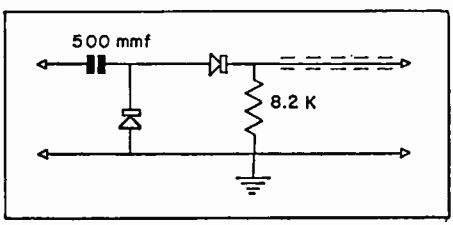


FIG. 6. A voltage-doubler type demodulator probe.

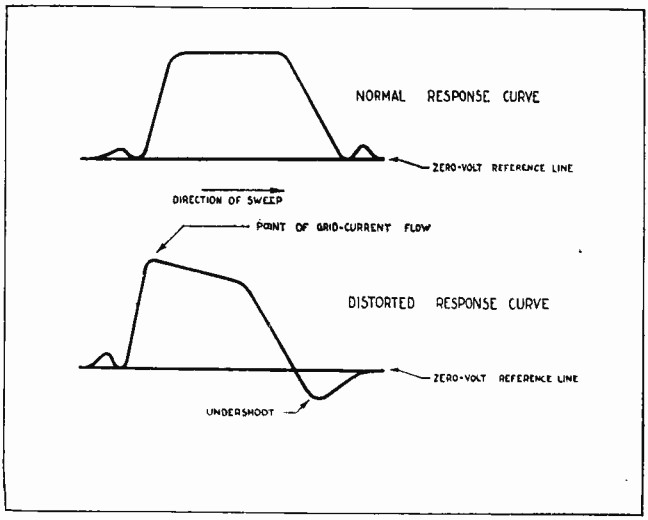


FIG. 7. Normal and distorted response curves. The undershoot distortion in the i-f curve is caused by grid-current flow in the first amplifier stage.

twice as large as that of a conventional probe only when the signal is symmetrical (equal positive and negative peaks).

Signal Tracing is a straightforward procedure, and is done in the same general manner as conventional signal-tracing in a broadcast receiver. The probe picks up the signal at any point in the video I-F amplifier and displays the waveform on the Scope screen. The technician should note that if signal tracing is necessary in TV front end circuits, it will usually be necessary to use a sweep signal rather than a TV station signal because the signal voltage may otherwise be too low for satisfactory deflection on the scope screen.

By the use of the signal-tracing technique, the technician can quickly pinpoint a dead or weak I-F stage, a regenerative, or an oscillating stage. A dead stage develops no deflection on the scope screen. A regenerative stage shows up in either of two ways, depending upon whether the technician is using a sweep signal or a TV station signal in the circuit. A sweep signal that passes through a regenerative stage will show an extremely large response at one end or in the middle, but very low response over the rest of the curve. If the regeneration is excessive, spurious markers may also appear. An oscillating stage shows up as a curve which has "gone to pieces" and also often exhibits undershoot (See Fig. 7) due to the grid overdrive and flow of grid current. Strong oscillation may paralyze the stage and cause it to be confused with a dead stage—however, the supplementary use of a VTVM at the output of the video or sound detector will distinguish between the two cases, since the oscillating stage will cause a strong deflection on the VTVM, whereas, a "dead stage" will cause little or no deflection.

Stage-by-stage alignment is recommended if the manufacturer provides stage-by-stage response curves or if severe difficulty is experienced in obtaining the proper overall response curve. The sweep signal and marker are applied at the grid of the tube in the stage under test — the crystal probe is connected to the plate of the tube following the stage under test, and a 200-ohm carbon swamping resistor is shunted across the plate-load resistor of the tube following the stage under test. (See Fig. 8).

The swamping resistor of Fig. 8 flattens out the resonant response of the following stage thereby permitting the operator to view the true single-stage response. The low impedance of the generator cable likewise flattens out the resonant response of the preceding stage so that the true single-stage response is unaffected by the preceding stage.

Although the probe could be connected to the grid of the tube following the stage under test, this procedure is less desirable because the small input capacitance of the probe tends to slightly detune the stage under test and prevents obtaining an entirely true replica of the stage response.

General Demodulation Tests such as testing for parasitic voltages in audio amplifiers, checking for standing waves on transmission lines, etc., can also be made with the signal tracing probe.

RESISTOR-ISOLATED PROBE

When direct-connection test leads or probes are connected to points in somewhat critical circuits (such as the converter grid of TV front ends), a tendency arises for a feedback loop to be established between the receiver, scope amplifier and power line, often producing oscillation.

The resistor loss introduced by the *Resistor-Isolated Probe* suppresses this tend-

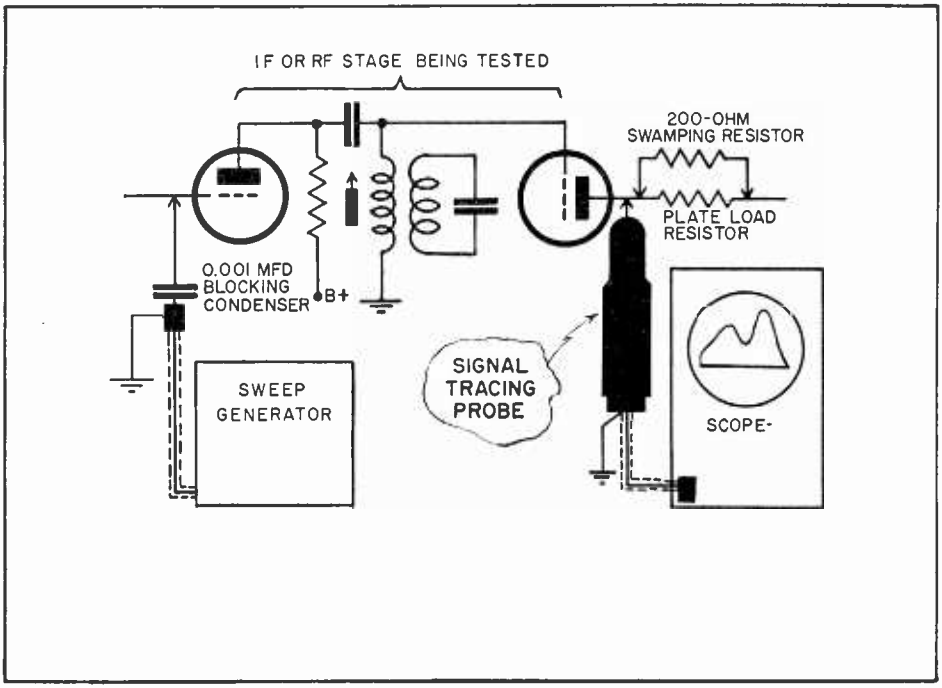


FIG. 8. Test set-up for checking single stage response using a demodulator probe.

ency, "isolating" the test circuit from the scope "feedback" circuit. In addition, the resistor isolated probe serves a second important function in alignment procedures by operating upon the beat marker as a low-pass filter, thereby filtering out the higher-frequency beat components from the marker, yielding a sharp needle-pointed marker indication on the scope screen. (See Fig. 9). The time constant of this filter arrangement is selected so that the operator will never encounter marker displacement, (which could be caused by excessive time delay in the filter), even on the steepest portions of the response curve.

DIRECT-TESTING PROBE

This probe is used in all general-purpose oscilloscope tests where the circuit under test is *LOW IMPEDANCE* and/or *LOW FREQUENCY* or where *direct scope connection* to the circuit test point is required in order to utilize the maximum sensitivity of the scope. The cable in the NRI probe set adds approximately 55 MMFD capacity to the scope's input capacity: hence its restriction to the test of low impedance and/or low-frequency circuits. Other coaxial cable capacities will be about this same value. The value of this shielded cable in avoiding stray hum pick up is shown in Fig. 10. The general procedure is to start with this probe and then substitute one of the special ones when it becomes necessary.

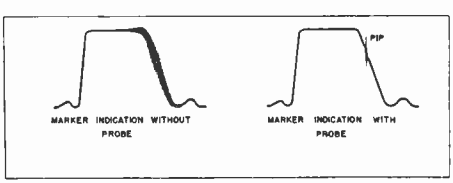


FIG. 9. The operation of a resistor-isolated probe.

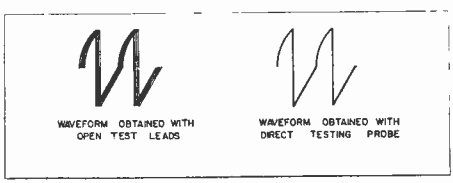


Fig. 10. The direct testing probe with its shielded coaxial cable avoids stray field pick-up.

Flash—The Model 250 Scope Contains A Built-in Flyback Checker!

by NRI Technical Department

The NRI Model 250 scope can be used by itself to check the horizontal output transformer, yoke, width coil, linearity coil or ringing coil while a TV receiver is turned off. Troubles in these parts are often difficult to spot. An open can of course be checked with an ohmmeter but a shorted turn, a shorted layer or a rosin joint present a problem which cannot be conclusively solved with an ohmmeter. The usual procedure is to install a new part which is not only expensive but time consuming, or you could use a separate Flyback Tester which sells for from $40 to $70.

If a short duration pulse is supplied to the part in question it will be shock excited into oscillation and a damped wave will be set up in the part. This may be seen with an oscilloscope. If there is a shorted turn or other defect in a coil which has continuity only a few cycles of the wave train will exist. If the part is open the scope will just pick up and exhibit a 60-cycle signal.

More service men would test, rather than blindly replace TV horizontal parts, but most owning a scope do not have a device which will produce a sharp pulse of the correct frequency to shock excite the part under test. Many do not feel that a large investment for a Fly-back yoke tester is justified.

Owners of the Model 250 scope are indeed fortunate since with a slight modification they can obtain exactly the right pulse from the Z AXIS binding post on the front panel of the scope.

The Z AXIS post must be capacity coupled, instead of wired, to the output of the blanking amplifier at terminal 11. This straight wire connection is shown by dotted lines in the scope schematic. If the circuit is wired-in, *remove the wire.* Connect four inches of insulated hookup wire to the Z AXIS solder lug and another four-inch length of insulated hookup wire to terminal 11. Twist the free insulated ends together. Clip off any excess over three or four turns. There should be no strain on these leads due to the twist connection. Do not let the bare ends touch each other. The twisted leads give the small coupling capacity required. There will be no danger of a shock if you touch the Z AXIS post and the metal scope panel.

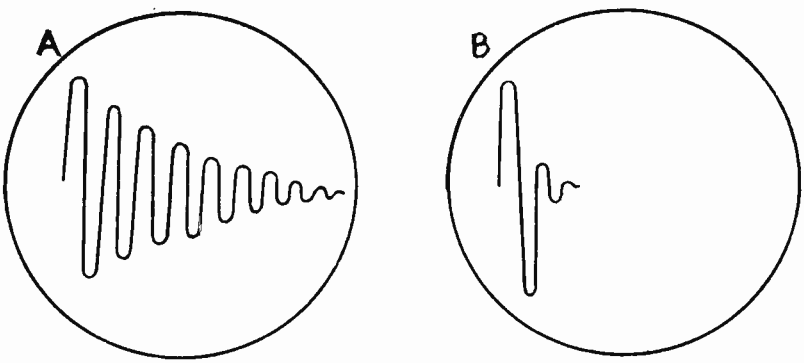


Fig. 1. Waveform produced by a good component, A; and waveform produced by a defective component, B.

To check horizontal coils, yokes and output transformers, connect a lead (a length of solder will serve) between the Z AXIS and Vertical input posts. Clip the ground lead of the scope to one end of the part and a lead from the Vertical binding post to the other end of the part. Adjust the Sweep Selector, Fine Frequency, Vertical Attenuator, and Gain controls to produce a damped wave on the screen of the CRT. If the component is good you will see a wave shape like the one in Fig. 1A. If the part is defective but not open, the wave shape will appear as shown in Fig. 1B. If the part is completely shorted there will be no vertical deflection—only a horizontal line. Adjust the horizontal sweep fre-

quency of the oscilloscope according to the following table.

COMPONENT	SWEEP RATE
Width coil	1-10 kc
Horizontal linearity coil	1-10 kc
Horizontal output transformer	100-1 kc
Deflection yoke	1-10 kc
Receiver deflection circuit with yoke connected	1-10 kc
Receiver deflection circuit with yoke disconnected	100-1 kc

The Fine Frequency will be set to show the individual cycles of the damped wave train. The Synch should be set to + or —.

The complete horizontal deflection system of a TV receiver can be checked by removing the plate cap of the horizontal output tube and connecting the oscilloscope probe (use direct probe if you own the probe set) to the cap lead of the transformer. The grounded lead of the probe is clipped to the receiver chassis (B— in AC-DC sets). One shorted turn in any of the horizontal sweep components will produce the short damped waveform in Fig. 1B which is characteristic of a defective component. The effect of a shorted turn can be seen by shorting the filament winding of the horizontal output transformer while observing the wave shape on the scope. Remember, the receiver must be turned off while making these tests.

Noise in nearby radio receivers when using the scope may be corrected by converting a 600-volt .005 mfd capacitor, or larger, from terminal 2 of the fuse holder in the scope to the scope chassis, at lug 1 of terminal strip A.

All Model 250 Scopes are now equipped with a 2 AMP rather than a 1 AMP fuse to take care of normal current surges. All scopes preassembled at NRI have these built-in changes.

Tact

Tact is a priceless quality in good human relations. Whenever you find anyone who is outstandingly successful and popular, you will find a person who is outstandingly tactful. Tact is merely doing things in the way the other person would like them done, rather than in the way you yourself would do them if you had only yourself to please. Watch your tact and watch your influence over others rise.

Dr. Donald Laird

(*Rags to Riches—From page one*)

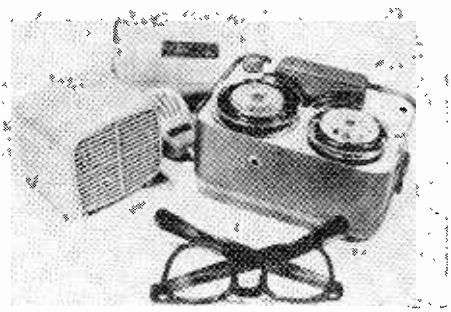
or graduate's own way — we banish all thoughts of artificiality and exaggeration. Consider this letter from A. W. Brackin of Montgomery, Alabama:

"When I decided to take the NRI course, little did I realize what it would do to me. I started off with a leading telegraph company ten years ago as an apprentice assembler and have advanced to testing and regulating technician. I did so well at our office that they decided to send me out on new installations in other cities. That's more than they have done with other technicians—generally an engineer is sent for what I am doing.

I realize my NRI training got me where I am today. It raised my standard of living from an existence to a good comfortable living. My life before I enrolled was filled with uncertainty, hard work and heartbreak. Again I will say how thankful I am that I decided to take the NRI course."

It would be inaccurate to say Graduate Brackin started out in poverty or is a wealthy man today. But what greater riches are there than the satisfaction of genuine achievement through ones own efforts? It is reading between the lines that counts. And just as important is the future which lies before so many NRI men—men who have shown the ambition and foresight to prepare themselves for better things to come.

J. E. Smith, Founder



Inexpensive miniature PHONO-TRIX battery powered tape recorder and dictation machine (pictured at right) made available by Antrex Corporation, Chicago. Uses transistors and weighs only 4 pounds. Records and plays back anywhere—Playback through its own loudspeaker. PHONO-TRIX operates at all three speeds with variable control. Uses standard 3 inch reels of tape which give 60 minutes of recording. Flashlight batteries give 50 hours of life.

NRI ALUMNI NEWS

Chapter Chatter

(*Continued from page 18*)

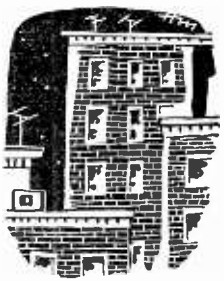
with the members and congratulated them on the progress the Los Angeles Chapter had made in the approximately sixteen months that had passed since it was founded.

Members have been considering holding meetings in new quarters where its Electronic equipment can be permanently stored. An important part of this plan is to establish a workshop to which members can bring Radio and Television receivers and other electronic equipment for analysis and repair, also so that more suitable facilities will be available for demonstrations of Electronic equipment.

The Los Angeles Chapter seems to be vying with the Philadelphia-Camden Chapter for pulling in new members. Since last report, the Los Angeles Chapter has admitted eight new members. They are the B. J. Whittington, Jerome Tracey, James Keenan, John Prokop, George Schweitzer, Frank Garcia, Lee Chavez, and Nibaldo Figueroa. The Chapter is only too glad to number these gentlemen among its members.

The Chapter will be equally glad to welcome any other NRI students and graduates in the area to its meetings, either as guests or prospective members. The Chapter meets at 8:00 P.M. on the second Friday of each month. For the present, the meetings will continue to be held at St. Joseph's Catholic School Hall, 1220 S. Los Angeles St., Los Angeles, Calif. The Chairman is Thomas McMullen, 1002 W. 187th Place, Gardena; the Secretary is Earle B. Allen, Jr., 11523 S. Broadway St., Los Angeles, Calif.

CHICAGO CHAPTER has had a complete change of officers. Both former Chairman Walter Nicely and former Secretary Charlie Mead have served the Chapter long and faithfully. In the case of Walter Nicely, his increased responsibilities with his employer, Delta Airlines, in connection with the company's acquiring new jet-powered equipment, necessitate his making frequent journeys out of town, which would handicap him in fulfilling the duties of Chairman of the Chapter. Walter himself therefore recommended that new talent volunteer to serve as officers for the current year.



Accordingly, after some discussion and a bit of cooperative persuasion, the following officers were unanimously elected: Charles Teresi, Chairman; Frank Dominski, Secretary, and Morris Lerner, Treasurer.

Our best wishes to the new officers!

The Chapter meets at 8 P.M. on the second and fourth Wednesdays of each month at 666 Lakeshore Drive, West Entrance, 33rd Floor. All NRI students and graduates in the area are welcome to attend the meetings. For more information about the Chapter get in touch with Chairman Charles Teresi, 3001 N. Nordica Ave., Chicago, or Secretary Frank Dominski, 2646 W. Potomac, Chicago.

———*n r i*———

Hi-Fi Corner

(*Continued from page 22*)

this arrangement the arm will accept only G.E. cartridges—the VR-II or new stereo types.

The only slight objection I could find to the TM-2G was the arm rest and even this is trivial. Although the rest does firmly hold the arm it can easily be accidentally knocked off the rest. Actually, in proper use with the phonograph unit installed in a cabinet this is a rather remote possibility, but if the phonograph is to be moved it would be best to remove the head from the arm, thereby avoiding damage to the cartridge.

———*n r i*———

Civilization is a system under which a man pays a quarter to park his car so he won't be fined a dollar while spending a dime for a nickel cup of coffee.

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