Theodore E. Rose
Editor
J. F. Thompson
Associate Editor
J. B. Straughn
Technical Editor
L. L. Menne
Editor Emeritus

NRI NEWS

Vol. 18, No. 9 June-July, 1959

Published every other month by the National Radio Institute, 3939 Wisconsin Ave., N.W. Washington 16, D. C. Subscription $1.00 a year. Printed in U.S.A. Second class postage paid at Washington, D. C.

1959 Predicted as Electronic "Boom" Year

The year end report of the Federal Communications Commission reveals that 1958 was a surpassing year for all phases of the Radio-TV industry. New records were established everywhere from the number of sets in use to the number of stations on the air.

Government experts now predict that this year—1959—will be an electronic boom year. The U. S. Department of Commerce in their annual projection review said 1959 will be healthiest on record for electronics. It estimated home-type Radio-TV receiver and related product output would reach a top of **$1.5 billion** and other electronic components would rise to the same new high.

World's Largest Military Closed Circuit TV System Now In Operation At U. S. Army Signal School, Ft. Monmouth, N. J.

The world's largest military closed-circuit military educational TV system has been placed in operation by the U.S. Army Signal School.

The expanded seven channel system with cameras for both live and film programming uses 468 receivers bringing instruction courses and other training material to a student body of 6,000 men. A pioneering force in the field of educational TV, the Signal School started in 1951 with a single TV camera which had served as part of a touring military exhibit.

Editor's Note:

BEGINNING ON PAGE twelve of this issue, we feature an article on "How To Service the Common AC-DC Radio Receiver." This article has been reprinted from a back issue of NRI News and we've added a practical trouble-shooting chart listing the probable causes of frequently encountered troubles in AC-DC sets. We feel sure our "old-timers" will go along with us in reprinting this timely article for the benefit of "new-comers" who have requested it. We're equally sure many experienced servicemen will find it a welcom and perhaps a needed?) refresher.

How Much Is Your Time Worth?

If you were handed $2.00 for every hour you devoted to your NRI lessons, wouldn't it be worth it to study a good deal more?

The odd thing about this is that you have every chance to make your study time pay you far more than $2.00 an hour. This fact was brought out in a conversation with an NRI man who visited the Institute. He told me his company had raised his salary by $70.00 a month or $840 a year when he had completed about 40 lessons on a schedule calling for 10 hours study a week (two hours per night, five nights a week).

J. E. Smith

When he visited the Institute, it was less than a year since he had received that raise. Thus, up to then, he had already been paid $2.00 an hour for the time he had studied and would continue to receive $2.00 an hour for that time so that at the end of another year, he would have received a cumulative total of $4.00 an hour, at the end of the third year $6.00 an hour, and so on.

(*Continued on page thirty-one*)

Thomas Carswell

Building and Using an Electronic Switch and Square-Wave Generator

By Tom Carswell
NRI Consultant

It was recently brought to my attention the relatively large number of Radio-TV-high-fidelity technicians who have never used an electronic switch in conjunction with their oscilloscope. The majority of these technicians, although they had heard of the versitilty and use of such an instrument, had never given serious thought to its wide variety of functions. This is particularly true of those who specialize in high fidelity amplifier repair and design. The cost of such an auxiliary instrument is relatively small when compared to the innumerable man-hours it will save in locating many unusual defects in various types of circuits.

Basically, the electronic switch consists of a means of rapidly switching the input of a mixer stage from one circuit to another, combining the outputs into a single source, then feeding this combined output into an oscilloscope. By having two independently controlled input circuits in the switch, you are able to make simultaneous observations of both of these signals on the face of the cathode ray tube. Although this switching could be accomplished by mechanical means, this certainly would not be practical due to the high rate of switching required and the undesirable transients that would be produced.

Perhaps the most popular use of the electronic switch in service work involves checking the frequency response of high fidelity amplifier circuits by using a square-wave generator of variable frequency and an oscilloscope. The amplifier to be tested would have the output of the square wave generator connected to the amplifier input, while the output of the amplifier would connect to either its loudspeaker system or an external non-inductive load. The electronic switch dual inputs would have one connected to the input of the amplifier under test, the other input connected to the amplifier output, with the output of the switching circuit connected to the vertical deflection input of the oscilloscope. With the oscilloscope set up for normal operation, an extremely accurate examination could be made of the input and output wave forms and a direct comparison made as they would be superimposed upon each other. However, such a simple system is not practical in most cases, as it is extremely inflexible. There must be a means of varying the switching rate of the electronic switch, together with complete control over positioning the simultaneous wave forms on the face of the CRT. That is, you should be able to separate them from each other or superimpose them for a more accurate determination of possible distortion.

The complete constructional and operational data of a flexible instrument of this type will be described in this article. All of the components are standard and the values are not at all critical. With the exception of the panel and cabinet, they can all be obtained from your Radio-TV parts jobber. After you have completed the assembly of the instrument and used it a few times, you quite probably will wonder how you could have done without it for such a long time.

In Fig. 1 page 4, you will find a photograph of the completed electronic switch ready for mounting in its portable cabinet. As you can easily see, all terminals and controls are readily accessible on the front panel and a carrying handle is provided for complete portability. The instrument

(Page four please)

Please Help Us Identify!

American Express Company Money Order Number MF-10,396,525 for $6 received in a plain white envelope, postmarked "Army Air Force Postal Service, March 29, 1959." There was no name or return address on the envelope, or identification inside; the purchaser failed to write his name and address in the spaces provided on the money order. This is undoubtedly a tuition payment. If we knew who sent it, we could credit it to his account.

Report on Experiments 51-60, Radio Demonstration Kit 6RK, received in a plain white envelope post-marked "Montreal, P. Q., Canada, March 19, 1959." There was no name, address, student number on either the envelope or report.

Please write and tell us if either of these items is yours.

Reminder to all NRI students and graduates: Whenever you write us—whenever you send a payment, lesson or order, please **be sure** to give your full name, complete address and your NRI student number. If you are a graduate, write "G" after your student number. That way, you can be sure everything you send us will be properly identified and handled as promptly and efficiently as is possible.

Listen Americans!

by

Dr. George S. Benson

Director—National Educational Program

John Jones works in an industry. He operates one of the small but amazingly productive machines in a plant that turns out a widely used electrical appliance. He is on an hourly wage rate. But the pay is good and his income is a little above the average for skilled workers in American industry. John made out his federal income tax return for 1958 and he did some thinking and figuring. And then, for the first time in his life he wrote a letter to his Congressman.

John, on his tax return, attached a slip that showed he had already paid more than a month's income in withheld income taxes; and yet he owed an additional sum for whch he had to send Uncle Sam a check. He noted too the amount of taxes he'd paid through the year on purchases of merchandise. And he set about figuring how much indirect, or hidden taxes he'd paid during the year. When he totaled the whole thing up and then added his state and local taxes, John had a better understanding of why he didn't have a bank balance and was "just making ends meet."

He wrote his Congressman and his two Senators. "I'm just a little guy," he told them, "and I know the government performs some mighty valuable services for me and my family. But I've been doing some figuring and thinking. In spite of the services, government has become a heavy burden on me. It's costing too much. Even in defense spending I suspect a lot could be saved. And since we're in a cold war we ought to be cutting expenses and not increasing them in all the other services. Please use your influence to cut government spending everywhere."

This is one of the most effective letters that could be written to Congress. It is sincere and moderate. If just half of the American workers would take careful stock of how much tax they are paying and do what John has done, the pruning knife would begin to work on government spending.

It is no exaggeration to say that the average American family could own and operate an automobile, or send a child through college, with the amount of money that could be cut from their tax bill if every possible measure of thrift were applied in government and if, for the duration of the cold war at least, plans for new projects and all unnecessary spending were set aside.

Index

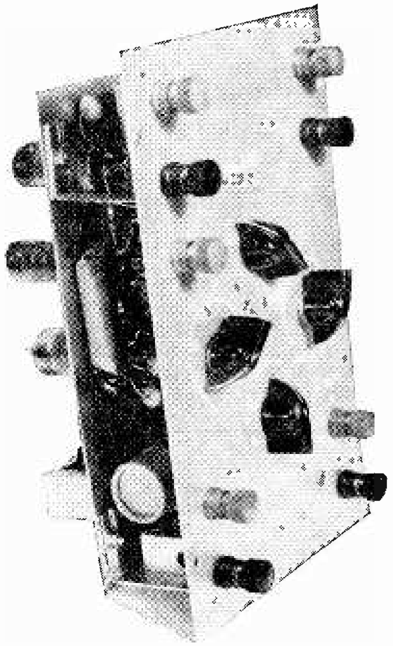


Figure 1. Electronic switch ready for mounting in portable cabinet.

is extremely light and can easily be carried to any point of your bench and be set up ready for use in a matter of seconds.

There is a rather unique feature of this electronic switch which is worth mentioning at this time. In addition to the amplifier, mixing, and switching circuits, a separate twin-channel amplifier is provided that can be used for a multitude of purposes. Primarily the twin outputs from this amplifier are employed to provide external sync to the oscilloscope from either of the input channels. If input signals of different frequences are to be observed simultaneously, the oscilloscope can be set up for external sync and the sweep rate can be synchronized with either of these signals by simply choosing the correct output terminal on the electronic switch. This twin-channel amplifier can be either a 12AU7, 12AT7, 12AX7, or 12BH7 tube. Certain types of these tubes will give more output than others, although the output for standard sync purposes would be more than sufficient for average use.

To gain a better understanding of this instrument, carefully examine the overall block diagram in Fig. 2. You will notice that the input signals are fed into the input signal amplifier after which they are transferred to a mixing stage. The mixing stage is triggered by means of a free-running multivibrator whose switching rates are variable in several steps. This is necessary due to the wide frequency ranges of the signals that will be observed on the oscilloscope. Alternately, each section of the mixer tube will be triggered to cut-off by the output of the multivibrator. As a result, the output on the plates of the mixing tube will alternate from input to input as each section of the tube conducts.

Now that the signals have been switched so that they can be simultaneously applied to the oscilloscope, a refinement should be added to isolate the plate circuits from the output of the switch. This is very effectively done by inserting a low-loss cathode follower which presents an output whose impedance is practically constant, regardless of the output frequency.

To those of you who are unfamiliar with this theory, the schematic diagram shown in Fig. 3 will most certainly appear to be somewhat confusing at first glance. However, by rereading the basic theory of operation just described, you should have no difficulty in gaining a complete and accurate understanding of this theory of operation.

The parts placement and wiring are not at all critical. The layout shown in Fig. 4 can be changed in any manner to suit the size of your parts and your ideas for component layout. This particular method was chosen simply because it requred no bending of chassis edges and four simple brackets can be mounted under the chassis to provide a very solid means of chassis support back of the panel. Any other method of chassis support would be satisfac-

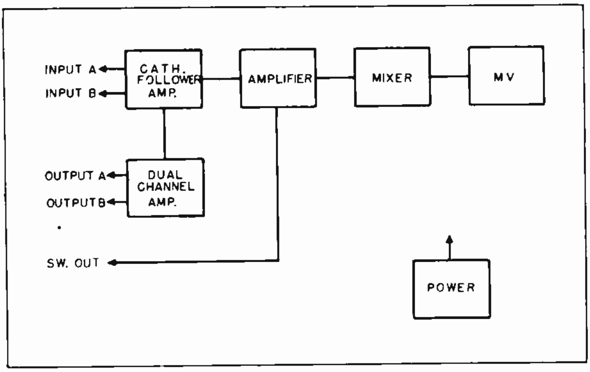


Figure 2. Block diagram of electronic switch.

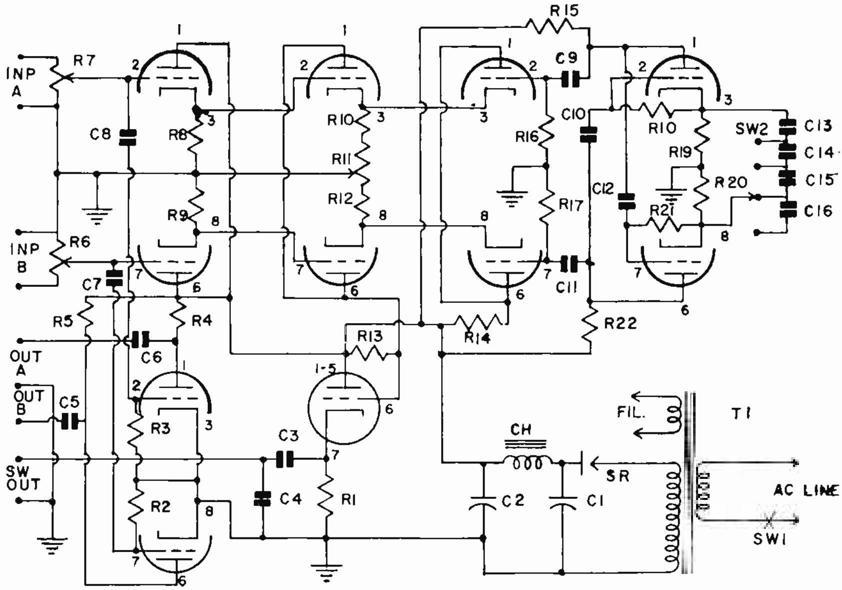


Figure 3. Schematic diagram of electronic switch.

tory, as long as you leave sufficient chassis area for the tubes and the components.

You might find it more convenient to move the tubes somewhat closer together so that the filter choke can be mounted on the opposite side of the chassis plate. It is not necessary that this be mounted exactly as shown and you may find the assembly and wiring somewhat easier if the choke is moved as described.

You will notice by the diagram in Fig. 3 that the chassis and panel are connected in no way to the heater circut. This was deliberately done in order to avaid the possibility of hum being introduced into the grid and cathode circuits of the tubes. However, after completion of the instrument, it was found that grounding either side of the heater string to the chassis had little or no effect on the wave form that was produced on the oscilloscope. It probably would be perfectly satisfactory if one side of these heaters were grounded as they normally would be in many circuits of this type. This would simplify the wiring somewhat by eliminating these extra leads to the tube sockets.

Here is a word of caution in the initial wiring of the chassis. It definitely would be a good idea to do this before any attempt to mount the chassis on the panel is made. Otherwise, it will be rather difficult to reach some of the tube pin connections and you possibly would burn some of the wiring and components with your soldering iron. About 90% of all wiring can be done, including the panel terminals and controls, before interconnecting the chassis and the panel circuits.

As is typical in the assembly of most circuits, it is advisable to wire in all ground leads on the chassis before making any other connections. After this is done, the filament circuit should be completed with the interconnecting filament leads placed flat against the chassis to reduce the possibility of hum pickup. Then, determine the exact points where you wish to make any possible mounting holes for the insulated or ground lugs to which various terminals of the components will be made. In the initial assembly here at NRI, these holes were located and drilled after this preliminary wiring was completed. Of course, if you prefer, they could be drilled at any time before this point. It would not be a good idea to attempt to drill these holes after any further steps in the assembly have been made due to the possible damage of the components and wiring by the drill.

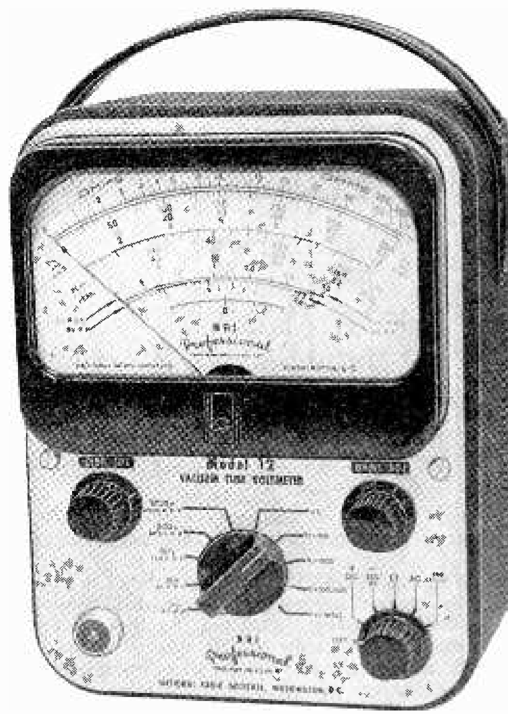
Continue with the basic wiring on the chassis, mounting all resistors and capacitors securely and whenever all leads are in place on a certain terminal, it should be carefully soldered. Be sure to hold the tip of the iron in place long enough so that any excess flux that remains will be boiled out. Also, tilt the chassis in such a position so that the excess solder will

(Page eight please)

NRI Professional Model 12 Vacuum Tube Voltmeter

Best Quality at Its Price

This VTVM is a top performer among low-priced Vacuum Tube Voltmeters. It's accurate, good looking, easy to operate. It has a wide selection of ranges, is stable and dependable, light in weight, small and compact. Only because we buy these VTVM's in large quantities direct from a well-known instrument maker, are we able to offer this fine instrument at this low price.



The Advantages of A Vacuum Tube Voltmeter

Essentially, a VTVM uses the amplifying ability of vacuum tubes to increase greatly the sensitivity of the basic voltmeter. The NRI Professional VTVM, Model 12, uses a sensitive 400 microampere meter movement in a balanced dual triode bridge vacuum tube circuit, which results in a constant input impedance of 13 1/3 megohms on all dc voltmeter ranges. This means that you can ignore the loading effects of the dc voltmeter even when making measurements in critical radio and television circuits. Peak-to-Peak or AC rms volts and resistance are also measured with the sensitive circuit. The meter movement is electronically protected against reasonable overloads.

Provides Five Basic Types of Measurements

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

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

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

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

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

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

Twenty-Five Separate Ranges

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

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

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

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

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

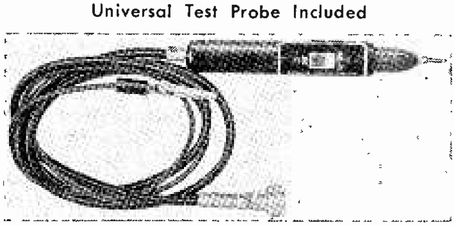
TUBES: One 12AU7; two 6AL5 tubes.

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

WARRANTY: Standard 90-day EIA warranty.

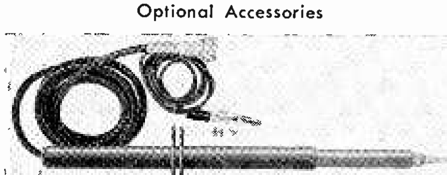
Compare the NRI Professional VTVM with other instruments of this type. For quality and price you will find yourself coming back to the NRI VTVM as your best buy. We sincerely believe this instrument is unsurpassed in quality at this low price.

Universal Test Probe Included



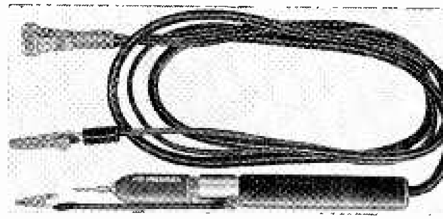
Universal test probe (above) included at no extra charge. Handy switch in handle. Throw in one direction for all AC volts, PEAK-TO-PEAK AC volts and Ohm measurements; in opposite direction for all DC volts measurements.

Optional Accessories



High Voltage TV Multiplier Probe

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



Crystal Detector High Frequency Probe

Illustrated above. Gives positive peak voltage values for sine-wave voltage up to a maximum peak value of 120 volts. Frequency range up to 250 mcs. Well-made probe, shielded lead and connector. Price $9.50.

Sent express collect. Please use order blank below. (Personal checks should be certified to avoid 10 to 15 days' delay in shipment waiting for checks to clear.)

--------- cut here ---------

USE THIS BLANK TO ORDER YOUR VTVM

NATIONAL RADIO INSTITUTE ITE
3939 Wisconsin Ave., NW
Washington 16, D. C.

I enclose $........... (certified check, money order or bank draft) for which send me, by Railway Express, charges collect, the items I have indicated in the box on the right.

	Price	Write price here and add this column
One NRI Professional Vacuum Tube Voltmeter, Model 12, including Universal test leads, insulated alligator clip, and detachable isolating probe for dc measurements	$45.00	
One Crystal Detector High Frequency Probe	6.50	
One High Voltage TV Multiplier Probe	9.50	
(If you live in Washington, D. C., add 2% D. C. Sales Tax)		
Total amount enclosed		

☐ Tell me how I can buy this instrument on monthly terms.

Name ....Student No. ....

Address ....

City ....State ....

Express Office ....

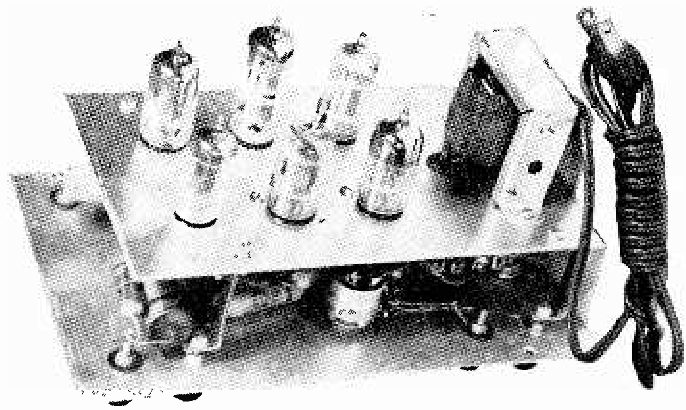


Figure 4. General tube and parts layout.

(*Continued from page five*)

flow back on the tip of the iron, reducing the possibility of a short between adjacent terminals.

After the chassis wiring has been completed, follow the same procedure with the panel controls. Connect the leads on the panel and chassis terminals that will be interconnected in the final step of assembly. Leave these wires about three inches long and any excess can be cut off when the panel and chassis circuits are interconnected.

In the final step of assembly, it is only necessary that you begin connecting these wires between chassis and panel. Use a given sequence and check off each connection on the schematic diagram as it is made. This will avoid the chance of a minor error that could upset the operation of the entire instrument. The length of these wres is not particularly significant, although they should be cut as short as conveniently possible. After all the connections have been completed, bolt the mounting brackets on the chassis so that it is rigidly supported behind the panel. Since these brackets are metal, they also will provide a secure electrical bond between these two units. This completes the assembly of your electronic switch.

Your next step is to check out the entire assembly. Insert all the tubes in their respective sockets, making sure to have the tube pins accurately lined up with the socket holes to avoid possible bending of these pins. After all tubes are in place, make sure the on-off switch on the channel B gain control is turned to the off position. With the instrument lying on its side, so that the tubes are in a horizontal position, insert the power plug into an AC wall outlet. Keep your hand on the plug in case there is a short circuit at some point in the wiring. If nothing happens, turn the power switch on, keeping a close watch on the chassis for possible signs of sparking or smoking. If any such overloading appears, you will almost always find it is a result of excess solder or an accidental short between tube socket terminals.

If everything seems to be satisfactory, make sure that all tubes are lighting. Remember, there are two filaments in all of the twin triodes and you should be able to observe a pair of brightly lighted spots near the inside top of the glass envelope. If the tubes appear to light in a normal fashion and nothing appears to be smoking or overloading, it is ready for a final checkout with your oscilloscope and any associated signal source such as a 60-cycle sine wave or any regular square-wave generator. If a square-wave generator is not available, simply connect inputs A and B to any 6-volt AC source. In fact if you can conveniently reach one of these points on your electronic switch chassis, this could be used for this purpose. The output of the instrument must connect to the vertical input of the oscilloscope. In additon, connect a short jumper between the insulated terminals of the dual inputs. This places the 60-cycle signal simultaneously to both of these channels.

Set up the oscilloscope for any convenient low frequency sweep rate and turn the input gain controls, R6 and R7, on the switch up to about mid-position. Turn the gain of the oscilloscope up to a point where a trace of about 1-inch is obtained. You probably will be able to observe a pair of sine wave traces unless the vertical positioning control, R11, on this switch is exactly centered. Turn this control first in one direction and then the other. The traces on the face of the scope should separate in opposite directions. That is, they can be either superimposed, or separated in either direction.

Next, let's check the operation of the electronic switch for each of the four switching speeds provided. These speeds will normally be approximately 200, 500, 2000, and 5000 alternations per second. The actual switching rate or speed is determined by the size of the capacitors employed in conjunction with the rate-change rotary switch, SW2. However, these particular rates were chosen as they would cover practically all of those ranges required for normal testing in electronic circuits. Set the rate switch to its fully counter clockwise position, the point where you'll have the lowest switching speed. Wth the 60-cycle sine waves still imposed on the face of the CRT, you will notice that rather pronounced breaks in the continuity of the waveform or trace can be observed. Then, switch to the next highest position and the rates in the sweep trace will be smaller and more numerous. By continuing up to the highest switchng rate, these interruptions in the trace will become progressively smaller, indicating a higher switching speed that is produced by the triggering action of the multivibrator.

If everything appears to be satisfactory up to this point, you can be reasonably sure the switch is operating normally. However, there are several other tests that can be made to illustrate the many uses to which the instrument can be put.

Disconnect the jumper wire between inputs A and B. Also, disconnect the 6.3-volt 60-cycle wire that connects to one of these terminals from the filament circuit. Turn both gain controls, R6 and R7, fully counter clockwise to the point where the

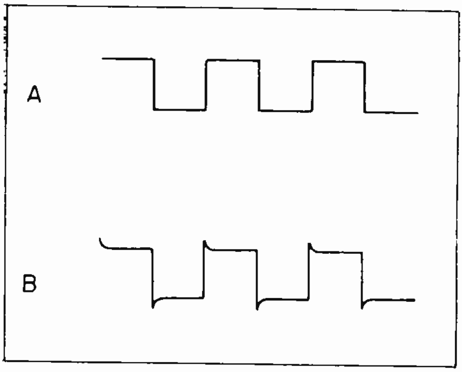


Figure 5. Typical input and output square-wave signals in a high-fidelity amplifier.

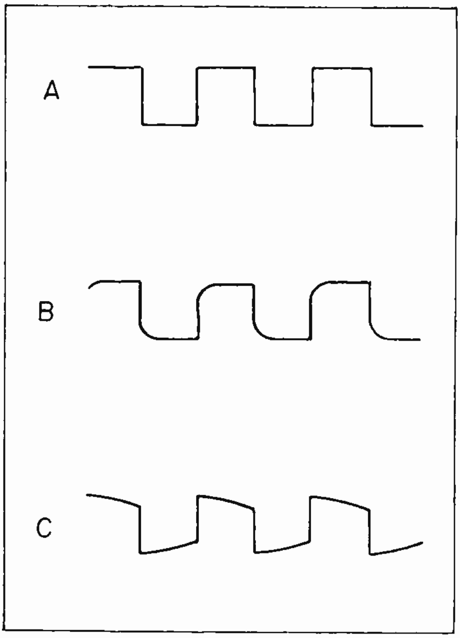


Figure 6. (A) Ideal square wave. (B) Loss of high-frequency response. (C) Loss of low-frequency response.

gain control for input B has the movable contact against the switch stop but the switch is not turned off. Turn the vertical positioning control, R11, first in one direction, then in the other. You will notice that a square wave is presented on the face of the CRT. Check this in each position of the speed rate selector switch, SW2, and four spearate and distinct frequencies can be observed. It may be necessary that you change the sweep rate of the oscilloscope itself in order to obtain a more definite pattern. Notice the symmetry of the square wave and the relatively steep leading and trailing edges. By employing this square wave output in conjunction with a high fidelity amplifier under test, a very accurate determination of its overall frequency response can be made. This is due to the fact that, although the basic upper and lower frequency limits of this output may appear to be rather limited, you must remember that when a clean reproduction is obtained, you can be sure the amplifier under the test will reproduce complex waveforms at frequencies that are 10% of the lowest square wave frequency and ten times the highest square wave frequency. If this output were fed directly into a test amplifier and a clean trace was obtained at the output of the amplifier on all ranges, the amplifier would have a frequency response range with negligible distortion of between 20-cycles and 50,000-cycles. This is one of the unique features about this type of electronic switch that makes it so valuable in testing amplifier circuits.

There is one more series of tests to be made to demonstrate the use of the additional dual-channel amplifier that is primarily employed for producing a sync signal to the oscilloscope. If a square-wave generator is available, connect its output to either of the input termnals on the electronic switch. Also, replace the jumper between these input terminals so

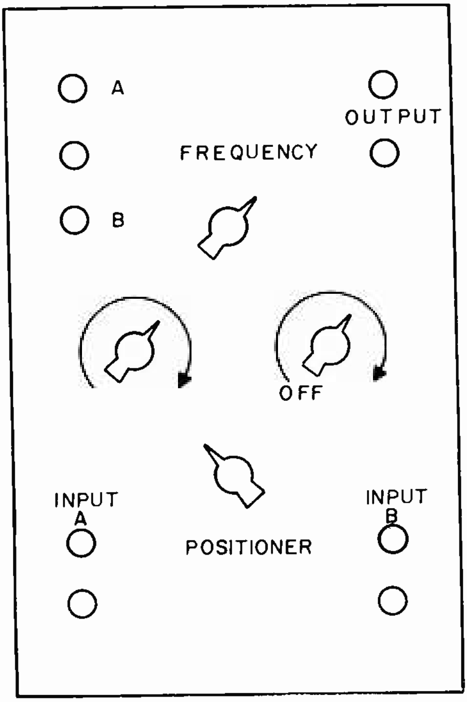


Figure 7. Front panel layout of switch.

that the signal is fed into both channels. Connect a lead between either of the outputs of the dual-channel amplifier to the external sync terminal on the oscilloscope and set the scope up for external sync. Turn up the gain of the instruments being used so that a satisfactory trace is produced on the CRT. Now, advance slowly the external sync gain control on the oscilloscope and you should find that the trace observed is considerably stabilized. This is due to the fact that you are syncing the oscilloscope to the amplified output pulses of the electronic switch and extreme sync stability should be obtained.

Continuing with the testing and demonstrating of the versility of this additional dual channel amplifier, disconnect the output of the amplifier from the external sync terminal on the oscilloscope. Leave all other connections in place for the moment. Connect your vtvm test leads across either the output terminals of the dual-channel amplifier and reduce the gain of both input controls to zero. Set up the vtvm for its lowest ac voltage range and gradually increase either of the gain controls on the switch until the meter pointer moves to about midscale. Make a note of this reading. Do not touch the setting of the square wave generator as we wish to make a comparison of the deflection obtained directly from the square wave generator output and the output of the dual channel amplifier. Connect the vtvm directly across the generator output and if all controls were set for normal operation, only a slight meter deflection should be noticed, indicating that this amplifier provides an ideal method of measuring extremely low ac voltages with a standard vtvm. In fact, when using a frequency test record, you can actually measure the outputs of many different types of phonograph cartridges and, if a record is kept of these measurements that are made during your routine service work, you can quickly determine whether or not the pickup cartridge is below acceptable standards.

There is a rather unique case to which this same amplfier can be put. By connecting a pair of headphones across the output, it makes an excellent audio signal tracer if a shielded probe and lead is used on the input. If an rf type probe is substituted, you will be able to trace the signals through the i-f stages and possibly even the rf stages in a radio receiver. It is recommended that for most of these uses, a standard shielded pair of test leads be used in order to reduce the possibility of external noise or serious hum pickup.

By referring to the illustrations, you will notice that the overall operating frequency response of the switch is more than sufficient for all audio amplifier work. In addition, the square-wave output is quite clean and is equal to that obtained with many square-wave generators that serve only one major function. Duplicate some of these other waveforms by connecting your 60-cycle ac signal into one channel and any other random frequency from the square wave generator into the other. Notice that you can accurately observe different shapes of waveforms and even widely separated frequencies at the same time. They may be super-imposed for a careful comparison of amplitudes and then separated for an even closer examination of each individual wave trace for possible distortion and even phase displacement. In fact, as you gain experience in using this instrument, you will find that its applications are practically unlimited around the radio-TV-high fidelity service establishment.

Some other typical uses of the instrument in such an establishment would be to observe simultaneously sync pulses at the input and output circuits of the sync separator or amplifier stage of a TV receiver. Since the amplitude of either one can be varied independently of the other, careful super-imposition of the traces will instantly show you any distortion, however small, that is present. Also, by careful calibration of the individual gain controls, the exact amplitudes can be compared and the gain of the stage can readily be computed by simply dividing the output voltage by the input voltage.

If reasonable care is taken in the assembly of this neat little unit, you will have a service instrument that should give you years of satisfactory trouble-free service and will probably become one of the most frequently used auxiliary instruments in the shop. Mechanically, the construction is straight-forward and once the socket holes have been punched and all other mounting holes located and drilled, you should be able to complete the assembly in a few hours time.

Incidentally, the assembly constructed here at the Institute employed the same cabinet that is used for the NRI Model 2W vtvm. Besides making an extremely pleasing appearance due to their identical sizes, they will easily fit into a small rectangular space on the shelf you may use for your service instruments. These cabinets, complete with the handle and panel mountng screws, can be obtained from NRI for $4.00 postpaid. The aluminum panel can be cut from any standard medium gauge aluminum that you find convenient to work with. It is advisable that you choose a gauge that is not too heavy to be cut by ordinary hand shears.

If you have only a one-quarter-inch drill on hand and find that making the mounting holes for the panel controls is rather objectionable, why not purchase one of the small one-quarter inch-three-eighths inch hand reamers that can be obtained from almost any large Radio-TV parts dealer for a dollar or so? Such a tool will pay for itself many times over in the time saved and the reduction in the number of callouses developed on your hands.

Electronic Switch Parts List

C1	**50 mfd—150 volt**	**R8**	**10K**
C2	**30 mfd—150 volt**	**R9**	**10K**
C3	**.25 mfd**	**R10**	**1K**
C4	**.001 mfd**	**R11**	**1K**
C5	**.25 mfd**	**R12**	**1K**
C6	**.25 mfd**	**R13**	**22K**
C7	**.05 mfd**	**R14**	**4.7K**
C8	**.05 mfd**	**R15**	**10K**
C9	**.1 mfd**	**R16**	**10M**
C10	**.001 mfd**	**R17**	**10M**
C11	**.1 mfd**	**R18**	**10M**
C12	**.001 mfd**	**R19**	**100K**
C13	**.1 mfd**	**R20**	**100K**
C14	**.05 mfd**	**R21**	**10M**
C15	**.02 mfd**	**CH**	**40 ma choke**
C16	**.005 mfd**	**T1**	**6.3V—2A, 150v —25 ma**
R1	**47K**	**SW1**	**On-off switch on R6**
R2	**10 meg**	**SW2**	**Single pole — 4th row rotary sw.**
R3	**10 meg**	**9**	**Standard insul. binding posts**
R4	**220K**	**4**	**Dial knobs**
R5	**220K**		**Panel, chassis, line cord, cabinet**
R6	**500K**		**Misc. hardware, etc.**
R7	**500K**	**5**	**12AX7 tubes**
R8	**10K**	**1**	**6C4 tube**

—*n r i*—

Westinghouse Engineers Say "Leave the driving to IT"

Radar Device Will Automatically Drive Cars Coast-to-Coast

Motorists of the future will be able to travel from coast to coast fully relaxed while radar equipment in their cars makes all the driving decisions according to two Westinghouse engineers. They predicted the program will be in experimental use in two years and may be in general use within five years.

Automobiles could follow a strip of foil or special paint down highways while all control functions—including steering, determination of speed and stopping—could be handled automatically. The radar guidance system would be simpler, more reliable and more practical than any suggested so far, they said.

This radar system could give a panoramic display of the roadway ahead for a distance of up to one mile and effective for day or night driving in any weather in which cars could travel with reasonable safety. It could indicate the distance to

(*Continued on page nineteen*)

HOW TO SERVICE THE COMMON AC-DC RADIO RECEIVER

IN SPITE of numerous developments in the field, it still holds true that most of the radios the service technician encounters are ac-dc sets. The circuits used in most of these sets are basically the same. This article will help you to understand ac-dc sets and service them faster and more efficiently.

The composite ac-dc receiver diagram (Fig. 1) and the diagrams of the more common circuit variations form a basic service manual for ac-dc sets. The diagram has been placed in the center of this magazine, on pages sixteen and seventeen, so that you can easily remove it. After you finish reading the article, you may wish to mount the diagram over your service bench for easy reference.

Tubes Used in Typical AC-DC Circuits

The modern 5-tube ac-dc receiver uses the following tubes or their equivalents: 12BE6 oscillator-mixer; 12BA6 i-f amplifier; 12AT6 second detector-avc-first audio; 50B5 audio output; and 35W4 rectifier. Fig. 2 lists the tubes you are most likely to find in ac-dc sets.

In many cases, a manufacturer specifies a certain tube in the first run of a receiver, but substitutes a different tube later. The manufacturer can, by changing the tube socket and the socket wiring, substitute a 50L6 for a 50B5, a 12SK7 for a 14A7, or a 35W4 for a 35Z5. When such tube substitutions are made by the manufacturer, there is seldom any change in the receiver circuit. The tubes are almost identical; consequently, a new tube socket and slight rewiring allow tubes to be substituted.

This is a very important point, because you will frequently find such substitutions in commercial ac-dc receivers. There is no reason for such a substitution to bother you if you have a tube manual. Simply look at the base diagram of the substitute tube, and determine which pin is connected to which element of the tube. Then check the voltages and compare them with the voltages listed for that particular element of the tube.

Tracing the Filament Circuit

Let's look at Fig. 1, particularly at the filament connection of the various tubes. This basic order of connection is used in almost all ac-dc receivers. The rectifier tube filament connects to the "hot" side of the power line, and the audio output tube is next. Then, comes the i-f amplifier tube, the oscillator-mixer, and finally the second detector-avc-first audio tube. The second detector-avc-first audio tube filament is usually connected at **the B—end** of the filament string so that one side of the filament is at B—potential. This helps prevent excessive hum pickup by the high-gain first audio amplifier stage.

This information enables you to determine where the various tubes should be placed in the receiver even when you receive a set that has had the tubes removed. Locate the socket that has one of its filament pins connected to the hot side of the power line, and install the rectifier tube in that socket. Next, locate the tube socket that has one of its filament pins connected to one of the filament pins of the rectifier tube socket, and install the audio output tube in that socket. Next, install the i-f amplifier tube, then the oscillator-mixer tube, and finally the second detector-avc-first audio tube. (Of course you can start at the B— point for the receiver and trace the circuit in the other direction).

Filament Circuit Defects

The most frequent defect in the filament circuit of an ac-dc receiver is an open tube filament. The simplest way to locate such a defect is to remove each tube from the set and then check across the filament pins of the tube with an ohmmeter. If any tube filament is open, replace that tube.

There is one more point that must be mentioned in connection with open tube filaments. Notice that the pilot lamp (PL1) is in parallel with a portion of the rectifier tube filament. Also notice that the rectifier plate connects to the tap of the filament. This means that the B— supply current for the entire set must flow through the parallel combination of a portion of the rectifier tube filament and the pilot light. When you find an open rectifier tube filament, you should always check the possibility of a short in the power supply circuit before you install a new tube. This is particularly true when you also find that the pilot light has burned out.

To check the possibility of a short, unplug the receiver, short the two prongs of the power plug, and turn the set's switch on. Then connect one lead of your ohmmeter to the shorted prongs of the power plug, and connect the other ohmmeter lead to the cathode pin of the rectifier tube socket. Note the reading and then reverse the ohmmeter leads and again observe the reading. The highest reading is the one to use. Both readings are suggested because electrolytic condensers are involved and you must observe the polarity of your ohmmeter test leads. Only one reading, with the positive ohmmeter probe connected to the rectifier cathode, is required if you know your ohmmeter polarity. A low-resistance reading (10,000 ohms or less) indicates a short. Locate the shorted component and replace it before you install a new rectifier tube. Particularly, check the filter condensers and the audio by-pass condenser connected between the plate and the cathode of the audio output tube, or between the plate of the audio output tube and B—. These condensers frequently short.

Occasionally, you will encounter a set that "blinks." That is, the set will start to heat up, and the tube filaments will light; suddenly they will go out. After a minute or so, the filaments will come on again; then go out again. This symptom is the result of a thermal open in a tube filament. Since the tube filaments are in series, an open at any point will cause all of the filaments to "go out." When the circuit opens, the entire line voltage will appear across the "break" and there will be no voltage drop across the rest of the tube filaments. This makes it easy to find the defective tube. Connect an ac voltmeter, set to measure the line voltage, across each tube filament in turn. Leave the meter connected until the set "blinks." If the tube is good, the voltage across the filament will drop to zero. If it increases, the tube should be replaced since it has a thermal open in its filament.

Another common filament defect prevents one or more of the tubes in the set from lighting. The schematic shows that the filament of the second detector-avc-first audio is the only tube filament that connects directly to B—. Now suppose a heater-cathode short existed in the i-f amplifier tube—what would happen? Of course, the heater-cathode short would connect the filament of the i-f amplifier to B—. Consequently, the full line voltage would be applied to the rectified tube filament, the audio output tube filament, and possibly the i-f amplifier tube filament. The oscillator-mixer tube filament and the second detector-avc-first audio tube filament would receive no voltage. Consequently, they would not light.

When you encounter this unusual condition, it is sometimes difficult to decide just which tubes are receiving filament voltage. The metal tubes used in many ac-dc receivers do not have visible filaments; and although a tube which feels cold would indicate a lack of filament current, you should always use your voltmeter to check the filament voltages. In this way, you can decide exactly which filaments are receiving voltage, and then decide which tube is most likely to have a heater-cathode short.

The Five-Tube AC-DC Circuit

As mentioned previously, Fig. 1 is a composite circuit. That is, it represents the type of circuit you are most likely to find in commercial receivers. Few sets will be exactly like this diagram, but the general design will be the same. In this discussion, we will consider each part in the receiver, its function, its approximate value, and the effect of failure—either an open or short. The parts will be considered separately starting at the loop antenna and moving through the set. The parts are listed in Fig. 3.

The loop antenna picks up the electromagnetic radiation from the air and supplies the resultant rf voltage to the input of the receiver. The loop antenna and the mixer section of the tuning condenser form a tuned circuit that helps pick out the desired signal and exclude undesired signals.

Loop antennas occasionally open, and cause decreased sensitivity and, in some cases, a tendency for the set to block or to motorboat. Simply check for continuity between the two terminals of the loop. An open circuit reading indicates an open loop. Incidentally, be sure that you use the correct pair of terminals on the loop. Some receivers have an extra winding for use with an external antenna and these leads are usally brought out to their own terminals. Loop antennas rarely short.

Another possible loop antenna defect is absorption of moisture. (This is particularly true of loops wound on porous cardboard). This condition will show up as decreased sensitivity and abnormally broad adjustment of the loop trimmer. The simplest way to correct this trouble is to replace the loop. In fact, that is the simplest way to correct any defect in the loop antenna, except an open loop connection or a poor solder joint at one of the terminals.

The dual-section variable condenser tunes both the input circuit of the set and the oscillator circuit. If you need a replacement condenser, purchase a "superhet condenser" designed for use with a 455-KC i-f system. Dust often collects in tuning condensers and prevents proper contact between the rotor and the condenser frame. Cleaning the rotor contacts with carbon tet and applying a few drops of oil will generally clear up this problem.

Occasionally you will find a tuning condenser with bent plates. The set will generally be noisy at one point on the dial and dead below that point. If you can determine which plate is bent and can straighten it, do so. If all the plates are bent, purchase a new condenser.

L-2 is the oscillator coil. The coil is subject to opens, shorts, and possible absorption of moisture. If the coil opens, the oscillator will stop and the set will be dead. If the section of the coil that is between the cathode of the oscillator-mixer tube and B— opens, the oscillator will stop and a higher-than-normal voltage will appear between the cathode of the tube and B—. If the other section of the oscillator coil opens, you will have no real indication except lack of oscillation. Of course, a quick ohmmeter test would disclose that the coil is open.

Particularly notice the open circuit winding shown immediately above coil L2. This winding provides capacity coupling between the grid of the oscillator tube and oscillator tank coil. Though no connection exists between these two coils, there is sufficient capacity to provide the necessary feed-back. In some cases, this special winding is not used. Instead, a 50-mmf condenser or a 100-mmf condenser is connected between the grid of the oscillator tube and the ungrounded side of the oscillator coil. The effect is the same.

There is no way to check the capacity winding except by temporarily connecting a condenser between the ungrounded side of the oscillator coil and the grid of the oscillator tube. However, the winding rarely fails, and consequently a testing procedure is not particularly necessary.

The oscillator circuit shown in Fig 4 is used in some ac-dc sets. Notice that the oscillator coil has two separate windings. If a tapped oscillator coil like the one shown in Fig. 1 is not available for replacement purposes, rewire the circuit so that it is like the one shown in Fig. 4.

In both oscillator circuits R1 is the grid resistor for the oscillator stage; the bias for the stage is developed across this part. This resistor is usually 22K ohms for the mixer tubes listed in Fig. 2. If this resistor shorts or opens the oscillator will stop. The resistor will sometimes increase in value and prevent the oscillator from operating at one end of the dial.

T1, the first i-f transformer, couples the output of the oscillator-mixer to the grid of the i-f amplifier. If the primary of the transformer opens, there will be no plate voltage on the oscillator-mixer tube. Of course, the set will be dead. If the secondary of the i-f transformer opens, a higher-than-normal negative voltage will appear at the grid of the i-f amplifier tube. Sometimes you will find that connecting a meter between the grid of the i-f amplifier tube and ground will cause the set to start playing. This usually indicates that the secondary of the i-f transformer is open. An ohmmeter test will verify this. (This is a relatively rare complaint, and one that you are not likely to encounter). Of course, the i-f transformer can absorb moisture. When this happens, both the selectivity and the sensitivity of the receiver will decrease. Replacement is the only practical solution for i-f transformer defects. Use a standard replacement 455-kc i-f transformer. The above considerations also apply to the second i-f transformer, T2.

R3 is the volume control and, at the same time, the load resistor for the second detector stage. The control is generally a 1-megohm unit, but values between 250K ohms and 2 megohms are sometimes used. If the control opens, the set may oscillate at certain settings of the volume control and operate normally at certain other settings, but the set is more likely to be dead. To check the control, connect one of your ohmmeter leads to the B— terminal of the volume control, and the other to the hot terminal. Read total resistance of the control on your meter. Next, move one ohmmeter probe to the center terminal of the control. Then vary the control over its range. The resistance should vary smoothly without any abrupt changes. If an open circuit reading is obtained at some particular setting of the volume control, the control is open and should be replaced. It is highly unlikely that the volume control will ever short; the internal construction makes that virtually impossible.

Another common volume control defect is noisiness. Many servicemen use carbon tet to clean volume controls. However, you will be able to do a much better job if you will mix ten drops of machine oil with one or two fluid ounces of carbon tet. Shake the mixture so that the oil will dissolve in the carbon tet. This mixture does a much better job than carbon tet alone. Also, commercial preparations for cleaning volume controls are available.

Three voltages appear across resistor R3: The dc voltage developed by the detector action, the rf signal voltage, and the audio signal voltage obtained from the modulated rf carrier. The dc voltage is desirable for avc purposes, and the audio voltage is, of course, desirable to operate the first audio amplifier tube in the receiver. The rf signal is not desirable and must be by-passed for good detector action. Condenser C3 is the rf by-pass. Generally, this condenser is connected directly across the two outside terminal of the volume control. This condenser is usually a 250-mmf. mica condenser or a small ceramic condenser. If the condenser opens, the receiver may oscillate. To check the condenser, temporarily substitute a new one.

Resistor R2 and condenser C2 are the filter network for the avc system. Resistor R2 is generally a 1-meg. or 2-meg. unit and condenser C2 is usually between .02-mfd. and .1-mfd. If condenser C2 opens, the avc voltage will vary at an audio rate. At the same time, rf energy probably will be fed from the grid circuit of the oscillator mixer tube to the grid circuit of the i-f amplifier. This feedback will probably cause oscillation. If condenser C2 shorts, no avc voltage will be applied to either tube, and the set will more than likely distort on strong signals.

If resistor R2 opens—as it frequently does —the receiver may have any one of a number of symptoms. The set may be dead, it may overload on strong signals, or it may oscillate. If resistor R2 is completely open, the grid circuit of the i-f amplifier tube and the grid circuit of the oscillator-

(Page twenty-five please)

"Irregular employment and lower wages face the uneducated in the economy today."
—U. S. Chamber of Commerce.

Fig. 5. Voltage Table

	1	2	3	4	5
Plate	100	100	60	115	120AC
Screen	100	100	—	100	—
Cathode	—	—	—	6-9	120
Control Grid	*—1	*—1	0	0	—
Osc. Grid	—9	—	—	—	—

*Note: Voltages measured with set tuned to a weak station. These voltages will vary with signal strength.

Fig. 2. Tube List

V1—Osc.-Mixer
12SA7
12BE6
14Q7

V3—2nd. Det.—1st. A.F.
12SQ7
12AT6
12AV6
14B6

V2—I.F. Amp.
12SK7
12BA6
14A7

V4—Audio Output
50L6
35L6
50B5
50C5
50A5
35A5

V5—Rectifier
35Z5
35Y4
35W4

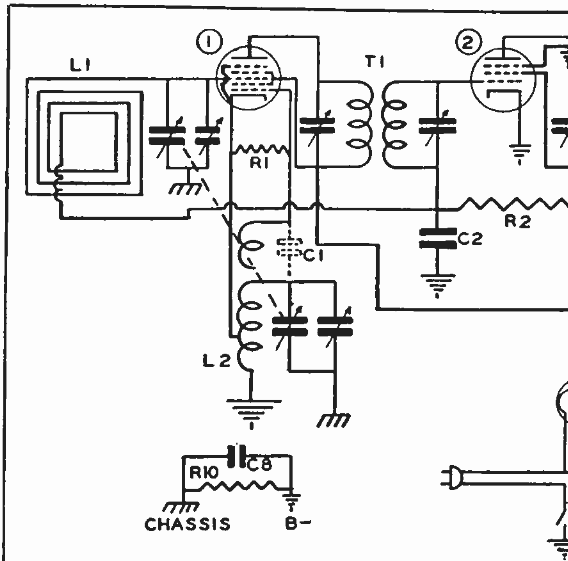


Fig. 1. Basic A

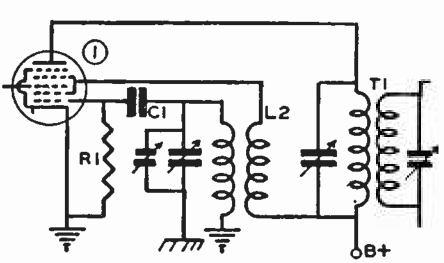


Fig. 4. Oscillator circuit with 2-winding oscillator coil.

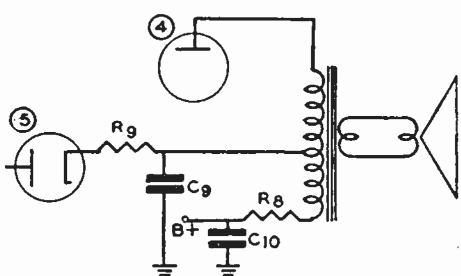
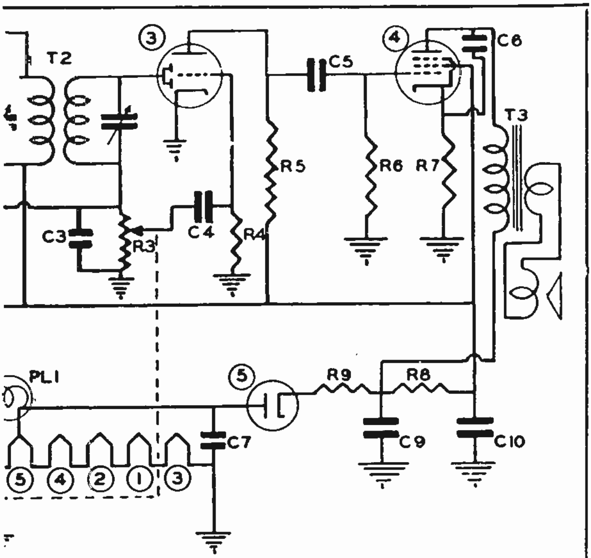


Fig. 7. Tapped output transformer as part of filter network.

Fig. 6. Alignment Table

Step	Signal Generator Coupling	Signal Generator Frequency	Receiver Dial Setting	Adjust
1	High side to stator of oscillator tuning condenser. Low side to B—	455kc	Low end of dial	Trimmers of 1st and 2nd i-f transformers
2	To loop of wire placed near loop antenna	1400kc (see note)	1400kc (see note)	Oscillator trimmer
3	Same as in Step 2	1400kc (see note)	1400kc (see note)	Mixer trimmer

Note: To avoid interference in steps 2 and 3, you can use any frequency between 1400kc and 1500kc; just be sure that you set the receiver dial and the signal generator dial to the same frequency.



C-DC Schematic.

Fig. 3. Parts List and Values

R1 —22K-ohm, ½ watt
R2 —2 megohm, ½ watt
R3 —1 megohm potentiometer
R4 —10 megohm, ½ watt
R5 —470K-ohm, ½ watt
R6 —470K-ohm, ½ watt
R7 —150-ohm, 1 watt
R8 —1200-ohm, 2 watt
R9 —33-ohm, ½ watt
R10—470K-ohm, ½ watt
C1 —50 mmfd mica or ceramic
C2 —.1mfd.
C3 —250 mmfd
C4 —.01 mfd.
C5 —.01 mfd.
C6 —.005 mfd.
C7 —.1 mfd.
C8 —.1 mfd.
C9 —30 mfd./150 V } may be a dual
C10—50 mfd./150 V } condenser
PL1—#47 pilot light

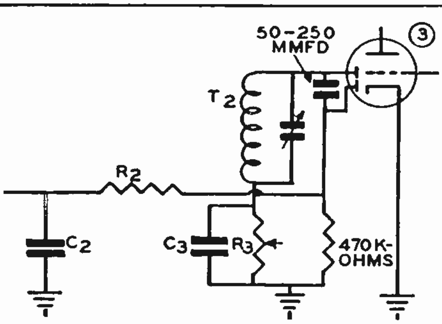


Fig. 8. Separate avc system.

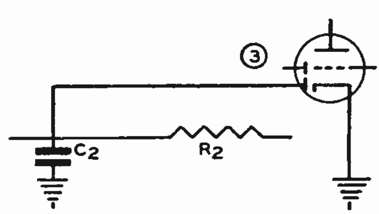
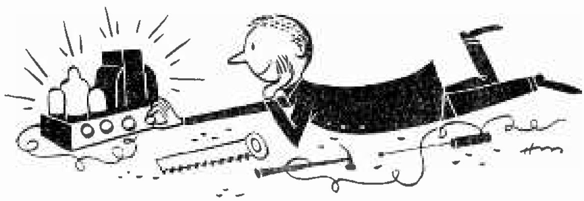


Fig. 9. Gas gate.



Hi-Fi Corner

by John G. Dodgson

Product Report: Weathers KL-1 Turntable Kit

In every industry there are certain unwritten but nevertheless iron-clad rules for doing things. Usually there are good reasons for such rules; often though it leads to stagnation.

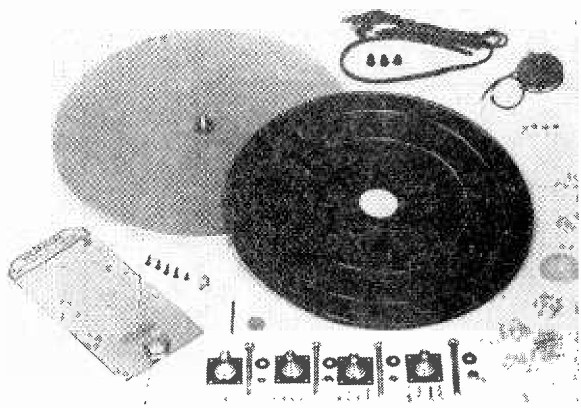
In the turntable field there are many rules such as; the motor must be a powerful synchronous type; the motor must be loosely suspended by springs and/or rubber from the rest of the system; the turntable must be weighted very heavily to give flywheel action; the drive system must consist of idlers or belts isolating the motor from the turntable; the idlers must be disengaged from each other when not in use to prevent flats; etc.

One look at the new Weathers turntable will show you that the Weathers engineers didn't know about these rules— fortunately.

The Weathers motor is a very small 12 pole synchronous type —a glorified clock motor— driving a very light drawn aluminum platter. The turntable sits on a small ⅛ inch shaft supported by teflon bearings. The drive system consists of a small thin disc of pure gum rubber mounted on the motor shaft driving the inside (outer) edge of the turntable. The motor and turntable well are mounted on a light thin piece of steel about four inches wide and seven inches long. This assembly then mounts on what Weathers calls a seismic platform mounted in turn on the base with foam-plastic damped springs.

Turntable speed is controlled by the exact distance from the motor shaft to the turntable shaft and not the relationship between the diameters of the various shafts and idler wheels as found in most other tables. This is the reason for the metal plate—the distance is set at the factory when installing the turntable shaft bearing well. The idler wheel then need only turn the table with no worry about its exact diameter. In fact the gum rubber idler thins out at its edge and actually bends over where it contacts the table. It never disengages from the table even when turned off simply because there is no need for it to do so.

The motor at first seems ridiculously small and it is small. But, its job is to rotate the turntable and this it does with no effort. Weathers claims that it will bring the table from a complete stop to 33-1/3 rpm in ¾ of one revolution with up to 10 grams tracking force. I don't know what it will do with 10 grams—anyone using that much pressure has no need for turntable anyway—but with four grams force my Weathers will come up to speed in less than ½ of one revolution.



Weathers KL-1 Turntable Kit.

Speed regulation couldn't be better. My unit runs at exactly 33-1/3 r.p.m.—when first turned on and also after about 10 hours of continuous running (I accidently left it on over night). By means of a Variac I shifted the line voltage from its normal 117 volts down to 90V and up to 130V—the turntable speed did not vary.

The "puny" looking motor wasn't puny in operation. After all its job is to rotate the table at certain speed and not change that speed with shifts in line voltage. It does this as well or better than any professional table. In addition this 12 pole synchronous motor has a hidden virtue—its basic rumble frequency is 10 cps instead of the usual 30 cps. Thus the motor rumble isn't audible for the simple reason that no speaker system will put out any sound as low as 10 cps. The turntable rumble problem is perhaps more important than speed regulation, particularly in stereo where the vertical as well as the lateral vibrations are picked up by the cartridge. In a stereo setup my Weathers is completely silent—no rumble at any volume level.

Wow and flutter are indicated by Weathers as being .04% and .01% respectively. I have no way of measuring this but I do have a few records containing sustained tones that in the past always showed up wow and flutter in a table. On the Weathers absolutely no variation in tone could be heard definitely indicating that the wow and flutter percentage is below the acceptable level.

As previously mentioned the tone arm and the motor mounting plate holding the motor and turntable are all mounted on what Weathers terms a Seismic platform. On the factory built unit this is a drawn aluminum sheet (which is not supplied in the kit). The kit instructions suggest using plywood which I tried and it works well. For better appearance though, I used aluminum. This platform is mounted on the base with four very resilient conical springs that are damped with small pieces of foam plastic. The whole object of this system is to provide isolation from vibrations in the room or acoustic feedback from the speaker system. This is particularly important when light tone arms and/or light tracking pressure is used. Using a GE TM-2 tone arm with a GE GC-5 stereo cartridge I have no trouble tracking at 2 grams.

The KL-1 kit shown in the photograph requires that the purchaser build a platform and a base—for which complete instructions are provided. Everything else is supplied including the nails for the spring assemblies and lubricant for the turntable shaft.

It is difficult to find some feature of the KL-1 to criticize. Perhaps the only improvement possible would be in the instructions. They are complete and well written but I had the feeling when reading them that they were written by a man experienced in building turntables and bases for another experienced man instead of being written for the novice. I would also suggest more explicit instructions for wiring and mounting an on-off switch including a network for suppressing the switch noise. Instructions for installing a pilot-lamp might also be helpful—especially since the table is so quiet it might accidentally be left on for days.

I think Weathers is going to lose a lot of sales simply because their turntable does not follow the iron-clad rules—and this is unfortunate. True, the table is not built like a battleship—rather, it is built like a fine watch. The Weathers maintains precise speed, no audible rumble and no perceptible wow and flutter—it's difficult to argue with results. If the consumer can ignore the old rules he can end up with a turntable as good or better than any on the market at about one-third the price.

n r i

"Leave the Driving to IT"

(*Continued from page eleven*)

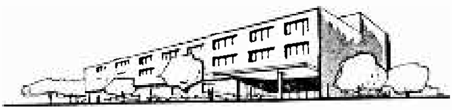
other automobiles, the closing rate and give a collision signal if such a situation appears possible. Another important potential is the capability of reading code guidance signals from the foil or paint strip on the road.

The inventors calculate a complete system for one car could be mass produced for about $250. It would weigh only 40 pounds and would fit either under the hood or behind the grill of an average-sized automobile. The only visible component would be a small radar antenna mounted in the center of the grill.

The material to reflect radar energy back to the car could be installed either in the form of adhesive-backed metal foil or a metallic paint sprayed on the road with the same equipment that now sprays center lines and lane markers. When signals are reflected by the metallic guidance strip back to the antenna, they would be fed through a device sensing the degree of error in steering and calling for instantaneous correction automatically directed to the cars power steering mechanism. Even with the system in operation, the driver would be able to assume complete manual control simply by turning the steering wheel, they added.

Slowing, stopping, and speed control could be made automatic by a uniform system of code symbols which the radar would recognize. These symbols would take the form of smaller, parallel areas of the guidance strip.

NRI ALUMNI NEWS



Chapter Chatter

MILWAUKEE CHAPTER has devoted several meetings to the analysis and general discussion of TV circuits and models. These discussions were led by Slavko Petrich, Ralph Lassen, Stanley Ward and Chairman Philip Rinke.

Chairman Rinke also gave chapter members an excellent briefing on the new NRI Model 240 Volt-Ohmmeter Kit donated to the chapter by National Headquarters. A member was scheduled to be chosen at the May meeting to assemble the instrument. When completed it will be auctioned off to the highest bidder, the proceeds to be added to the chapter's treasury.

SAN FRANCISCO CHAPTER—the newest of the NRIAA local chapters—thoroughly enjoyed a talk by Charles F. Humphreys, representative for Weston Instruments, on the permanent-magnet moving-coil mechanism, the moving-iron vane mechanism, the electro-dynamometer mechanism, and the volt-ohmmeter. Much valuable information was contained in this talk.

At a previous meeting Sidney Mahler showed two Bell Telephone Company color films, one on transistors for amplifiers and the other entitled "Charlie's Haunt" on safety in the shop, at home, and on the street.

After considerable discussion the chapter members decided to hold a dog session every other month, following a short business meeting. This should prove to be very helpful to the members; a great deal can be learned from such dog sessions.

The most recent new member to be admitted to the chapter is Carl L. Thomas. Welcome, Mr. Thomas.

The chapter wants special attention drawn to the fact that it has changed its meeting place. This is understandable since the chapter was only recently organized and is in still somewhat formative stages. The chapter now holds its meetings at 147 Albion St., San Francisco, and will continue to do so for at least the next several months. Should the chapter again make a change in its meeting place, it will be announced in the NRI News.

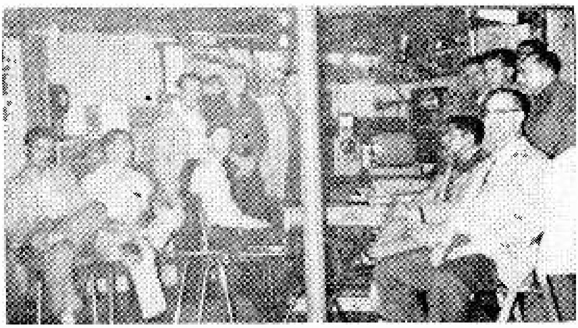
HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER has decided that the Model 240 Volt-Ohmmeter donated to the Chapter by National Headquarters will be used as a door prize at the Chapter's Annual Banquet. The winner will be selected from among members present at all meetings up to that time.

The chapter would like it known that it draws its members from such nearby towns as Waynesboro, Shippensburg, Carlisle, Greencastle, Mercersburg, Boonsboro, Clear Spring, Hancock, Middletown, Frederick, Williamsport, Keedysville, Smithsburg, Cavetown, Chambersburg, Martinsburg, and Shepherdstown. The Chapter will welcome visits from any other students and graduates in these areas who may be interested in joining the Chapter. See the Directory of Local Chapters.

PITTSBURGH CHAPTER member Dave Benes and Mr. Clement McKelvey, instructor at the Allegheny Technical School in Pittsburgh, undertook a discussion on servicing TV tuners and ac-dc radio receivers. Chapter members are indebted to Mr. McKelvey for the valuable help he has contributed on Radio-TV problems.

The chapter has been planning on arranging for future lectures by the representatives of receiver manufacturers—possibly one by Motorola on servicing techniques, probably on transistors—although no definite decisions have been reached on this yet. The chapter has also been considering the possibility of a group visit to Channel 4.

The chapter has been pleased to admit the following new members: Jack E. Fox, A. Robertson, John M. McDermott, Stanley Martin, and John W. Staab. A cordial welcome to these new members!



A meeting of the Flint Chapter. Officers at left: Clyde Morrisett, Treasurer; H. A. Gillean; Aaron Triplett, Vice-Chairman; George Hinman, Secretary; and William Neumann, Chairman.

FLINT (SAGINAW VALLEY) CHAPTER has resumed the popular practice of showing motion pictures on technical subjects at each meeting. Recent ones were Oscillators and How They Work, Series and Parallel Circuits, and Capacitors and Capacitance and Capacitive Reactance. These films were borrowed from the Bell Telephone educational library and the members thoroughly enjoyed them.

Former chairman Warren Williamson demonstrated the use of a scope in trouble shooting sync trouble on a set brought to his shop for repair. He also told about his membership in the Associated Radio and Television Servicemen, an organization devoted to the interests of the independent serviceman, and distributed the latest bulletin from them.

The chapter decided to raffle off at its annual banquet in June the new NRI Model 240 Volt-Ohmmeter donated by National Headquarters.

The newest members to be admitted to membership in the chapter are Arthur Clapp, Morris Clapp, Odes Powers, and Harvey Chase. A cordial welcome to these new members!

Vice-Chairman Triplett in partnership with Odes Powers has opened a new Radio-TV Sales and Service at 3149 Richfield, at which the chapter will hold its meetings hereafter.

NEW YORK CITY CHAPTER Secretary Dave Spitzer brought in his 16-mm sound projector and showed some excellent films from the New York Telephone Company and other sources, on How TV Works, Micro-Wave Demonstrations, TV Transistor, Coaxial and Micro-Wave Miracles and Echos in War and Peace.

Tom Hull is continuing his TV and scope demonstrations, explaining every point the technician should know about the scope and showing those green pictures of wave shapes at different points of pick-up from the chapter's TV receiver. At the conclusion of these demonstrattions, the members will find it easier to use the scope. Tom calls on members from the floor to help with these demonstrations, thus giving all a chance to operate the scope.

James Eaddy is still at it with his lectures and demonstrations on how to repair transistor sets as well as AC-DC Radio receivers. Cres Gomez presented Jim with a personal gift in recognition and appreciation of his outstanding efforts to help his fellow-members. Daniel Perugini demonstrated his electronic switch, which turned a large light on and off by flashing a small flashlight onto a light-sensitive tube.

A highlight of this season was the meeting taken over and conducted by three factory-trained General Electronic representatives. They gave the members many service hints and explained the operations of their new U-3 chassis with the electronic tuning. With the aid of slides and a projector, they showed how to take apart the electronic tuning device and make any necessary adjustments. They also used a test set with switches to show certain defects and how to find these defects with test instruments. On the screen was a diagram with voltages marked off. The members traced out the circuit until the defective part was located. The representatives showed many more features about their set, too numerous to mention. Incidentally, they were gratified at the turnout and reception they received; there were fifty-four members present at this meeting.

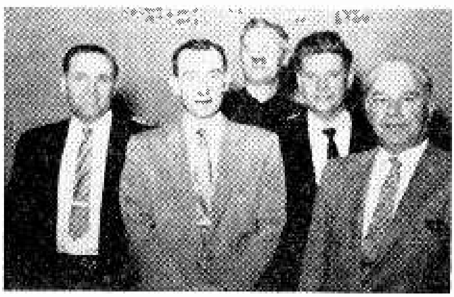
SPRINGFIELD (MASS.) CHAPTER had one of the most fruitful meetings of any in recent months due to the presence of Motorola representatives John Palughi, Regional Service Manager; Ed Beaulieau, District Sales Manager, and Joseph Zorro and Paul Cregan of Grabell-Lyons Motorola Service and Parts Distributors of Hartford, Conn. Incidentally, Mr. Zorro, who is Service Manager of Grabell-Lyons, is an NRI Graduate of 1935.

The feature of the evening was a film by Motorola demonstrating the servicing of the Motorola "Placir Board." This is a much more rugged board than the usual printed or plated circuit and is considerably easier to service. Mr. Palughi was so impressed with the reception given this presentation by the members that he has promised to try to arrange a similar meeting for some time this coming Fall.

At this meeting Samuel Infanto of Fitchburg was admitted to membership. A hearty welcome to you, Sam!

Westinghouse has also proposed that they send representatives to a meeting to demonstrate their Radio-TV products. As of the time we go to press, no date has been set for this program.

Another meeting featured the motion pictures "TV Haliday Depth Sounder" and "TV Story of Sound."



Chairman Rupert McLellan and Motorola representatives at Springfield Chapter meeting. L to R: John Palughi, Chairman McLellan, Joseph Zorro, Paul Cregan and Ed Beaulieau.

The chapter hopes to have a representative from Ampex to explain video tape procedures at a meeting this fall when a tape machine will be installed at WWLP-TV.

Members are becoming more and more enthusiastic about the shop meetings at which they get so much down-to-earth help on practical problems in Radio-TV Servicing. These meetings are held in the shop of one of its members on the Saturday following the third Friday of each month.

NEW ORLEANS CHAPTER continues to feature talks and demonstrations by chapter member Gaston Galjour at its meetings. Some of these meetings are devoted almost entirely to question-and-answer periods—questions by the members and answers by Mr. Galjour. The members derive a great deal of help and benefit from these sessions, thanks to Mr. Galjour.

CHICAGO CHAPTER reports that attendance at its meetings has been on the increase and that this is expected to continue into the future.

On the same trip on which they visited the

(*Page twenty-three*)

Directory of Local Chapters

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

BALTIMORE CHAPTER meets 8:00 P.M., second Tuesday of each month, 100 N. Paca St., Baltimore. Chairman: Joseph Dolivka, 717 N. Montford Ave., Baltimore, Md.

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

DETROIT CHAPTER meets 8:00 P.M., second and fourth Friday of each month, St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: John Nagy, 1406 Euclid, Lincoln Park, Mich.

FLINT (SAGINAW VALLEY) CHAPTER meets 7:30 P.M., second Saturday of each month, 3149 Richfield, Flint. Chairman: William Neuman, 1613 S. Kiesel, Bay City, Mich.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P.M., second Thursday of each month, North Hagerstown Senior High School, Hagerstown, Md. Chairman: Reginald Ankeney, 138 Main St., Clear Spring, Md.

LOS ANGELES CHAPTER meets 8:00 P.M., second Friday of each month, St. Joseph's Catholic School Hall, 1220 S. Los Angeles St., Los Angeles. Chairman: Thomas McMullen, 1002 W. 187th Pl., Gardena, Calif.

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

MINNEAPOLIS-ST. PAUL (TWIN CITY) CHAPTER meets 8:00 P.M., second Thursday of each month, Walt Berbee's Radio-TV Shop, 915 St. Clair St., St. Paul. Chairman: Walter Berbee, 328 E. Co. Rd., A-2, St. Paul, Minn.

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

NEW YORK CITY CHAPTER meets 8:30 P.M., first and third Thursday of each month, St. Marks Community Center, 12 St. Marks Pl., New York City. Chairman: Edward McAdams, 3430 Irwin Ave., New York 63, N. Y.

PHILADELPHIA-CAMDEN CHAPTER meets 8:00 P.M., second and fourth Monday of each month, Knights of Columbus Hall, Tulip & Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Ave., Philadelphia, Pa.

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

SAN FRANCISCO CHAPTER meets 8:00 P.M., first Wednesday of each month, 147 Albion St., San Francisco. Chairman: J. Arthur Ragsdale, 1526 27th Ave., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P.M., last Wednesday of each month, home of Chairman John Alves, 57 Allen Blvd., Swansea, Mass.

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

J. B. Straughn (back to camera) demonstrating the NRI Model 250 Oscilloscope at meeting of the Chicago Chapter. Assisting him are, to his right, Charles Teresi, Chairman; to his left, Walter Nicely, past Chairman. In foreground, standing, back to camera: Frank Dominski, Secretary.

Minneapolis-St. Paul Chapter, NRIAA Executive Secretary Ted Rose and J. B. Straughn of the NRI Instruction Staff were also guests at a meeting of the Chicago Chapter. J. B. Straughn took up almost the entire evening with a demonstration of the oscilloscope in TV Servicing, in which he used the NRI Model 250 oscilloscope. At the conclusion of this demonstration a question-and-answer period began. At first there were only a few questions asked, but once the ice was broken the questions came thick and fast. The members present were enthusiastic about this meeting, felt that the time was indeed well spent.

Herman Velasco was the lucky door-prize winner of the NRI Model 240 Volt-Ohmmeter which was donated to the Chapter in kit form by National Headquarters and was assembled by the members.

The Chapter has planned a program under which members will go through the alignment procedure of the Television receiver, also a program designed to familiarize all the members with different types of test equipment.

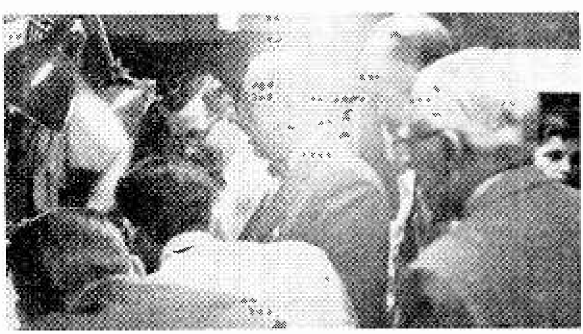
PHILADELPHIA - CAMDEN CHAPTER was enthusiastic about an excellent talk on hi-fi and stereo delivered by one of its own members, Joseph Donnelly. To demonstrate his talk he brought some of his own equipment which he builds and sells. He explained the proper way to install hi-fi and stereo and gave a good many short cuts and hints. The members not only got plenty of useful information but also enjoyed the excellent music that was demonstrated.

At a previous meeting Bill Heath, Service Supervisor of the Westinghouse Corporation, brought with him a wall size schematic of the Westinghouse portables, also service bulletins which he distributed to the members. He demonstrated the portables and, using a slide projector, went through the set and explained all the details of operation and what to look for when there is trouble. He also brought a hi-fi and TV combination which he demonstrated. Mr. Heath is an honorary member of the Chapter and the members always look forward to his talks.

New members are continuing to flock to the Chapter—so many since the last issue of the NRI News that space does not permit listing them by name. In fact, the membership has grown so and attendance at meetings is such that the Chapter may soon have to give serious consideration to getting a larger meeting hall.

MINNEAPOLIS-ST. PAUL (TWIN CITY) CHAPTER was pleased to welcome a visit from Ted Rose, Executive Secretary of the NRI Alumni Association, and J. B. Straughn of the NRI Instruction Staff. Ted Rose administered the oath of office to the officers elected to serve for the current year. They are: Walter Berbee, Chairman; Kermit Olson, Vice-Chairman; Harold Lindquist, Secretary; Paul Donatell, Treasurer, and Adelbert Charles, Sergeant-at-Arms.

Mr. Straughn then delivered a talk on and a demonstration of the NRI Model 250 Oscilloscope, in which he was ably assisted by Chairman Walter Berbee.



A group of Minneapolis-St. Paul Chapter members questioning J. B. Straughn on the features of the NRI Model 250 Oscilloscope following his demonstration of the instrument. To his right: Walt Berbee, Chapter Chairman.

Like the other local chapters, the Twin City Chapter was the recipient of a Model 240 Volt-Ohmmeter Kit as a gift from National Headquarters. The chapter elected to give the kit away at its June meeting: the names of all paid-up members will be put into a box for the drawing of the name of the lucky winner.

LOS ANGELES CHAPTER enjoyed a talk by guest speaker Milton M. Leventhal, manufacturer's representative for Doss Electric Research, who discussed and gave a complete demonstration of the Doss line of test instruments. Former Chairman Joseph Stoker also delivered a fine talk on the sharp practices of unethical Radio-TV wholesalers.

Two films were shown by chapter member Earle Dycus. One was on guided missiles. The subject of the other one was the wiring of buildings with a new type tubing and the part played by electronics in the manufacture of this tubing. Members found both of these films fascinating.

The members were particularly pleased to have as a guest speaker Mr. Victor L. Bangle, President of the Radio and Television Technicians Association, who spoke on the integrity and honesty of certified Radio-TV technicians in the Los Angeles area and exposed the gimmicks employed by the get-rich-quick service man.

One of the newer members of the chapter, Robert Belov, offered to act as host for the next meeting to be held in his boathouse in one of the city parks.

The most recent new member to be admitted to membership in the chapter is Harry Matsukane. Congratulations, Harry!

SOUTHEASTERN MASSACHUSETTS CHAPTER member Walter Adamiec gave an excellent blackboard demonstration on the basic fundamentals and circuits used in Radio-TV. He took his material from the latest Rider's radio books as used by the Armed Forces in learning as quickly as possible. The next few meetings were scheduled to be used for this blackboard review.

At another meeting Mr. John Duarte, proprietor of a Radio-TV shop in New Bedford, delivered a talk on the use of the oscilloscope in servicing a TV receiver that has horizontal sync trouble, and a demonstration on an actual TV set.

Members are looking forward to a visit to the new local Radio Station WSAR which has been under construction. The chapter has been promised a special tour through the station. It should prove very interesting, especially a demonstration of how the station is put on the air.

The chapter has admitted new members John Augusta, Jr., and John Nery. A warm welcome to these gentlemen!

DETROIT CHAPTER has still been plugging away at its TV Demonstration Board. Two panel boards are now finished. The chapter is anxious to complete the panel board and so has spent all available time on the project.

Secretary Ellsworth Umbreit has built the synthetic stereo unit, the construction plans for which appeared in the April-May, 1959, issue of the NRI News. Stanley Szafran, another member of the chapter, built the cabinet for the unit. Secretary Umbreit reports that he is very happy with the performance of the unit and will demonstrate it at a chapter meeting. He also reports that he is going to build another one, as he thinks he has a good chance to sell some, and that several other chapter members have indicated that they are planning on building one.

———n r i———

SINCERITY

Sincerity is the mother of integrity. Each of us can make an important contribution to human progress simply by being sincere.

A large part of the world's woes come about because people are *not* sincere. Most of us share this blame. Little pink deceptions—often born out of politeness—have a way of developing tiny spots or dry rot on our character. We don't intend to lie, we just *pretend* a little. We say things we really don't mean—to impress people, to be agreeable, to obtain small advantages. We tell fibs almost without realizing it. And without realizing what it is doing to us and our reputation.

Intellectual honesty is easier to preach than it is to practice. But it is worth the effort. It earns us self-respect as well as the respect of others. It puts starch in our backbone!

The Little Gazette
Judd & Detweiler Inc.
Washington, D. C.

How To Service The Common AC-DC Radio Receiver

(*Continued from page fifteen*)

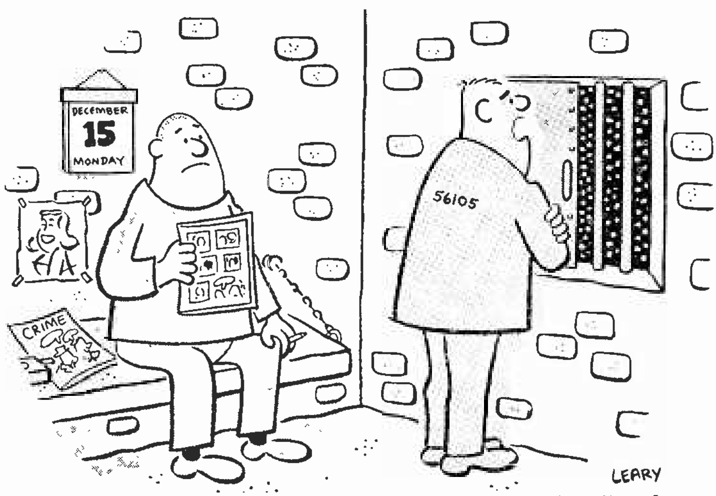
mixer tube will be "floating." Consequently, the grids will slowly assume a negative charge that will be sufficient to cut off all plate current. Therefore, the set will be dead. If the resistor has increased in value so much that the avc voltage across resistor R3 is not transferred to the grid circuit of the two tubes, the set will overload on strong signals and produce distortion. If the resistor increases in value so much that insufficient avc voltage is supplied to the two tubes, the i-f amplifier stage may oscillate. Check the resistor with an ohmmeter; check the condenser by temporary substitution. C4 transfers the audio signal from the volume control to the grid of the first audio amplifier tube. It is generally a .01 mfd. unit. If this condenser shorts, the dc voltage across resistor R3 will be applied to the grid of the first audio amplifier tube. The set will probably distort on weak signals and be dead on strong signals. If the condenser opens, the set will be dead.

R4 is the bias resistor for the first audio amplifier tube. It is usually a 10-megohm unit, but higher values—up to 20 megohms—are sometimes used. If this resistor increases in value, the bias voltage on the first audio amplifier tube will also increase. If the bias increases too much, the tube will be cut off and the set will be dead. If it increases only slightly, the sound will probably be distorted. If the resistor is shorted, the set will be dead.

Resistor R5 is the plate resistor for the first audio amplifier stage. It is generally a 470K-ohm unit. If this resistor decreases in value, the plate voltage applied to the first audio amplifier will increase, and the gain will decrease. If the resistor increases in value, the plate voltage applied to the first audio amplifier tube will decrease, and the set will indicate one of two troubles. Either the sound will be distorted, or the set will be quite weak.

C5 is the coupling condenser between the plate of the first audio amplifier tube and the grid of the audio output tube. It is generally a .01-mfd. unit. If this condenser shorts, the positive voltage at the plate of the first audio amplifier tube will be applied to the grid of the audio output tube; distortion will result. If the positive voltage at the audio output tube grid is sufficient to overcome the bias, excessive current will flow through both the audio output tube and the resistor in series with the cathode. The cathode resistor will probably be damaged, and the tube may become gassy. If condenser C5 opens, the set will be dead.

TUNED FOR LAUGHS



"Was a day just like this when I battled my way through 25 miles of snow to make that service call. Then this guy came to the door laughing, told me he had forgot to plug in the set."

Reprinted by permission of Sylvania News, published by Sylvania Electric Products Inc.

R6, generally a 470K-ohm unit, is the grid resistor for the output stage. If resistor R6 shorts, the set will be dead as the grid of the audio output tube will be shorted to ground. This is highly unlikely. If the resistor increases in value, you will probably notice a decrease in the sound output, and, at the same time, some distortion.

R7 is the cathode resistor for the audio output tube; the value is usually 150 ohms. If the resistor increases in value, the bias applied to the audio output tube will also increase, and the set will probably distort. Of course, if resistor R7 increases enough, the negative voltage will reduce the plate current to the point where the set will be dead. More about R7 in a moment.

C6 is the audio by-pass that keeps the undesired high-level, high-frequency audio components out of the plate circuit of the audio output tube. It is generally a .005-mfd unit. If the C6 opens, the volume will probably increase slightly and the set may oscillate. In addition, you will notice a distinct change in tone. (Many servicemen refer to this condenser as a "tone-control condenser." The term, though incorrect, gives you a rough idea of its effect.) If C6 shorts, the plate voltage for the audio output tube will be applied across resistor R7. Consequently, resistor R7 will be severely damaged. In fact, the resistor will probably burn in two. The primary of T3 may also be damaged or open.

T3 is the audio output transformer for the receiver. The load required by most of the tubes used in the output circuits of ac-dc sets is between 2000 and 4000 ohms. Therefore, the output transformer should match a 2000-4000 ohm plate circuit to a 4-8 ohm voice coil. If the primary of this transformer shorts, the set will be dead but plate voltage will still be available for the audio output tube. In fact, the plate voltage will be slightly higher than normal. If the primary opens, no plate voltage will be available for the audio output tube, and with screen voltage applied but no plate voltage, the screen if visible, will be red hot. The tube will probably be damaged. If the secondary of the audio transformer opens, the set will be dead. This is highly unlikely.

The speaker changes the voltage variations into sound variations. A PM speaker with a 4-8 ohm voice coil is generally used in ac-dc sets. If the voice coil opens, the set will be dead; if the voice coil shorts, the set will also be dead. The resistance of the voice coil is usually between 4 ohms and 8 ohms. You can therefore check the voice coil with the lowest range of your ohmmeter. It is seldom practical to repair a defective speaker. Replacement is always the best solution.

Other defects occur in speakers. The voice coil will sometimes open intermittently. When this happens, the sound output of the speaker will disappear, and then suddenly return with a loud crash. Usually, the sound will come back when loud bass notes are being transmitted, and immediately disappear again. Speaker cones sometimes warp and cause the voice coil to drag on the pole piece of the speaker. When this happens, the receiver will distort. If the dragging is slight, the distortion will occur only at low volume.

R8 is the filter resistor of the receiver. It is usually between 1000 and 2000 ohms. If the resistor shorts, the set will hum; if it opens, the set will be dead. In either case, you can check the resistor with an ohmmeter.

If you find the filter resistor badly burned, be sure to check the output filter condenser and the plate by-pass condenser for the audio output stage before you install a new resistor. If either of these condensers is shorted, the new filter resistor will overheat.

C9 and C10 are the filter condensers. C9 is usually 30 mfd. and C10 is generally 50 mfd. (They are usually combined in a dual-section condenser). If either of them opens, the set will hum. If either of them shorts, excessive current will flow through the rectifier and the tube will probably be damaged. A 30-mfd./150 volt input filter condenser and a 50-mfd./150 volt output filter condenser are satisfactory for replacement purposes. (Use the 30-mfd. condenser as an input filter and the 50-mfd. condenser as an output filter. Connecting the condensers in this manner gives a very low hum level.)

R9 is the current limiting resistor used to prevent excessive current flow through the rectifier tube and the pilot light while the input filter condenser is charging. The resistor is usually 22 ohms or 33 ohms. If the resistor opens, the set will be dead; if it shorts, turning the set off and back on immediately may burn out the pilot light.

The current-limiting resistor can be connected between the cathode of the rectifier tube and the input filter condenser, or it can be connected between the pilot light and the plate of the rectifier. In either position, the resistor limits the current flow when the set is turned on.

C7, generally between .01 mfd. and .1 mfd., is the noise by-pass condenser for the set. The only purpose of this condenser is to prevent noise pulses in the power line from entering the receiver. If this condenser shorts, the house fuse may blow. Notice that the condenser is connected almost directly across the ac line. In other cases, if this condenser shorts it will burn out the pilot light and a portion of the rectifier tube filament. The condenser may be connected from the plate of the rectifier tube to B—, from the cathode of the rectifier to B—, or directly across the power line. The purpose of the condenser is the same in each case.

C8 couples the B— lead of the receiver to the chassis itself. It is generally a .1-mfd unit. Notice that one side of the oscillator coil is connected to B—, but one side of the oscillator tuning condenser is connected to the receiver chassis. Condenser C8 completes the circuit so that the oscillator coil and the tuning condenser are in parallel. If C8 opens, the set will probably be dead, or the receiver will tune the wrong range. (Notice that if condenser C8 opens, the oscillator frequency will increase). The simplest way to check the condenser is by temporary substitution. If condenser C8 shorts, the B-line of the set (one side of the power line) will be connected directly to the receiver chassis. In that case, the set will be dangerous.

Resistor R10 is connected across condenser C8 to prevent C8 from assuming a charge equal to the line voltage. Notice that if resistor R10 opens, condenser C8 can assume a charge equal to the line voltage. Therefore, 110 volts can exist between B— and the receiver chassis. However, this will not produce any particular effect on the receiver performance, but the set would be dangerous.

Representative voltage readings are given at the upper left (Fig. 5) of the diagram. These readings are approximately what you should expect in an ac-dc receiver, with a half-wave rectifier circuit, that is operating properly. Alignment information is given at the upper right of the diagram (Fig. 6). Before you align the receiver, you must connect an output meter to the set. If you are using a volt-ohm-milliameter, use the OUTPUT jack of the instrument and the COMMON jack. Connect the COMMON lead to B— in the set and connect the OUTPUT lead to the plate of the audio output tube. Set the test instrument to an ac range that will read voltages up to 100 volts. If your test instrument does not have an OUTPUT jack, connect a .01 mfd., 600-volt condenser in series with one of the test leads. Then connect one of the test leads to the B— point for the set and connect the other one to the plate of the output tube. Set the instrument to an ac range that will read voltages up to 100 volts. (Most vacuum tube voltmeters have a dc blocking condenser built in, but it is well to use the .01-mfd unit just in case.)

In Step 1 of the alignment procedure, be sure that you connect the high side of the signal generator output to the stator of the oscillator section of the tuning condenser, and set the receiver dial to the low end of the range. These two precautions will prevent the receiver oscillator from beating with the output of the signal generator and giving you misleading results. If a tunable beat or squeal is heard, short the oscillator section of the tuning condenser gang and connect the signal generator output to the oscillator grid (grid #1) of the oscillator-mixer tube. This stops the oscillator and any squeals now heard are due to oscillation in the i-f amplifier.

In Steps 2 and 3 of the alignment procedure, connect the output of the signal generator to a 2- or 3-turn loop of wire (4 or 5 inches in diameter) placed near the loop antenna. This will provide sufficient coupling for alignment purposes, and prevent the signal generator from detuning the receiver circuits.

Circuit Variations

As mentioned previously, commercial receivers will seldom be exactly like the one shown in Fig. 1. There will be circuit variations. For the most part, these will

Graduate Tries His Hand At Poetry—With Success!

The following poem, submitted and written by Graduate Robert Werner of Allentown, Pa., is dedicated to his son Donald who is presently in Electronics training with the Air Force. We liked it; hope you will too!

Technician

No flyer, he,
moving with lightning thrust
through cloudbank, fog, and cosmic dust.
But rather, busily,
with meter and pliers
deftly shaping magic wires;
through which such currents flow
as make the fastest plane seem slow.

No unimportant work indeed,
but always great the need.
For in the end
men, machines all depend
on his effort to guide their speed.

No; no flyer he
but pilots unfaltering guide
his handiwork by their side.
And each plane that mountains skim
flies safe and true—because of him.

be substitutions of different part values, etc. That type of circuit variation should not give you any trouble. There are, however, some variations that require further discussion and explanation.

In Fig. 1, condenser C6 is connected between the plate and the cathode of the output tube. The cathode is not bypassed. Therefore, a portion of output signal appears across the cathode resistor. If you replace the condenser, be sure to connect it as it was originally, and be sure to use the correct valve. In some receivers, C6 is simply a plate bypass used to keep the high-level high frequency audio signals out of the plate circuit. In these sets, the condenser is connected across the output transformer primary or between the tube plate and ground.

Some receivers use a triple-section filter condenser including a high capacity-low voltage section as cathode bypass for the audio output stage. Use of a cathode bypass condenser increases the audio output. In commercial receivers that do not use the condenser, you can often increase the audio output of the set by connecting a 20-mfd./25-volt condenser across the cathode resistor. (Use of a cathode bypass will increase the low-frequency response by removing degeneration at the lower frequencies.)

Some manufacturers use printed circuits in their receivers. The printed circuit usually replaces resistor R5, condenser C5, and resistor R6. When you encounter a printed circuit in an AC-DC receiver, trace the leads and try to determine just what the printed circuit replaces. Not all of them are coupling networks between the first audio amplifier stage and the output stage. If you cannot obtain a duplicate printed circuit for use in a certain receiver, you can always use individual components of the proper value.

Some receivers use a tapped output transformer as part of the filter network. Let's look at Fig. 7 for a moment. Notice that electrons from the plate of the audio output tube flow down through the primary of transformer T3 to the tap and back to the rectifier. Also notice that electrons from the remainder of the receiver flow up through the primary of transformer T3 to the tap. Therefore, the hum currents buck each other. In addition, the lower portion of the transformer primary acts as a filter choke in the B supply circuit. If a tapped output transformer is not available for replacement, change the circuit to the one shown in the basic AC-DC schematic (Fig. 1).

Some manufacturers use a choke in the power supply instead of the 1200-ohm filter resistor. As these sets generally use lower values of filter capacity it is best to purchase a small ac-dc choke for replacement purposes. If you cannot obtain a replacement choke and you must use a 1200-ohm filter resistor, be sure to increase the capacity of the filter condensers so that you have the normal 50-30 mfd. network.

A permeability tuning system is used in a few ac-dc sets. In this system, the inductance of the coils is varied while the circuit capacity remains constant. Special alignment procedures are often necessary for circuits using this tuning spstem; you should, therefore, try to obtain the correct service information for the set.

Manufacturers have found uses for the extra diode plate in the duo-diode triode tube generally used as a second detector, avc, first audio. One of the popular circuits is the separate avc system as shown in Fig. 8. Notice that the rf signal is transferred to the extra diode plate through the small mica condenser (between 50-mmfd. and 250-mmfd.) and is rectified by the diode circuit. This rectification produces a dc voltage drop across the 470K-ohm resistor. This voltage—after filtering —is used as avc voltage.

When a tube is gassy, the grid of the tube becomes positive. If the grid of the tube is connected to the avc line, the avc line will also become positive and the positive voltage will be fed to all other grids connected to the avc. Therefore, a gassy tube can cause all the other tubes on the avc line to draw excessive current.
To prevent the above sequence of events, some manufacturers use the extra diode as a "gas gate." When the extra diode plate is connected as shown in Fig. 9, the avc line cannot become positive because a positive voltage on the avc line makes the diode plate of the "gas gate" positive and thereby allows the tube to conduct. When the tube conducts, the avc line is shorted to B— through the diode plate-cathode path in the tube. When the avc line is negative, the "gas gate" has no effect on the circuit operation.

Approximately 9 volts dc is developed across the oscillator grid resistor, R1. In some receivers, this voltage is used for bias in other circuits. A 15-megohm resistor between the grid of the oscillator and the avc line will feed a certain initial bias to the avc line. This bias prevents excessive current flow through the oscillator-mixer tube and the i-f amplifier tube when no signal is applied to the input circuit of the set.

Also, the voltage across R1 is sometimes used as bias for the audio output stage. In that case, the "cold" end of resistor R6 (in Fig. 1) is disconnected from B— and then connected to the oscillator grid with a 270K-ohm resistor. The ac circuit is completed to B— through a .1-mfd. condenser connected between the "cold" end of resistor R6, and B—.

In some circuits, protective bias for the i-f amplifier stage is obtained by using a small value—generally less than 200 ohms —cathode resistor. The cathode bias developed prevents excessive current through the i-f amplifier tube under "no signal" conditions. Some manufacturers increase the sensitivity of their sets by using an rf amplifier stage. In that case, an audio output tube with a 35-volt filament is used, and another 12-volt tube for use as an rf stage is added to the filament string. (The tube is usually the same type used in the i-f amplifier circuit) An rf amplifier stage in an AC-DC set is likely to be a very simple circuit. In fact, an extra tube and an extra tuned circuit is generally the limit. These circuits are so simple that they are not likely to give any trouble.

The rung of a ladder was never made to rest upon; but only to hold a man's foot long enough to enable him to put the other somewhat higher.

Some manufacturers use slug-tuned i-f transformers. Again, the change is so slight that it is not likely to give you any trouble. When a replacement transformer is needed, however, use a slug-tuned transformer. Generally, those units have a much higher Q than the more common i-f transformers, and therefore give better selectivity.

Some ac-dc sets use a selenium rectifier instead of a tube rectifier. When such a substitution is made, the selenium simply replaces the diode rectifier tube, and a filament resistor is added to drop the voltage to the correct value for the various tube filaments.

Certain other receivers use voltage doublers in the power supply. It is impossible to say just how the voltage doubler is likely to be connected, as it may be a half-wave unit, or a full-wave unit. For that reason, you should try to obtain the service information for the receiver whenever you encounter a set with a voltage doubler.

The circuit variations discussed are not all of the possible variations. However, the other circuit variations that you encounter in service work are likely to be so slight that they give you no difficulty whatsoever.

The causes and cures of typical troubles in AC-DC sets are given below.

Dead Receiver

No Tubes Light. Check for one tube with a burned-out filament. If the rectifier filament is open, check for leaky filter capacitors, leakage in coupling capacitor C5, cathode-to-heater leakage in the power output tube or gas in the power output tube. Any of these conditions will cause excess cathode current and may burn out the tap on the rectifier filament. If you can find nothing wrong or if some other tube is at fault, install a new tube and try the set out. Also look for a break in the power cord or a defective on-off switch—test with your ohmmeter.

Some Tubes Light. This indicates a cathode-to-heater short in either the last tube in the filament string which lights or in the first tube in the group not lighted. Installation of a good tube will clear up the trouble.

All Tubes Light.
Defective tube: Test all tubes in a tube tester.

Incorrect Operating Voltage: check all DC voltages on each tube. Look for open or shorted capacitors, open resistors, an open loop, open output transformer primary, open in the loudspeaker voice coil, and an open in the oscillator coil.

Dead Oscillator: Measure the dc voltage across R1; the grid end should be 5 to 15 volts negative. If the grid is positive or has a value less than 5 volts, try a new tube, check for a short in the tuning capacitor, and then try a new oscillator coil.

Set Is Distorted

Defective Out Stage: Try a new output tube and a new coupling capacitor in place of C5. Check the cathode bias resistor value and the cathode bypass capacitor if used. The plate bypass should also be checked for leakage.

Distorted When Volume Is Advanced: Replace C4, try a new 1st AF tube, and check its plate load resistor for size with ohmmeter.

Distorted On Strong Stations: Check AVC bypass C2 for leakage or a short. Try new AVC-controlled tubes.

Distortion With Hum: Check for an open in the Loop L1, check for leakage from B— to the chassis. If tubular electrolytic with mounting strap is used, slide the capacitor forward or backward so the portion which was under the strap can be examined. If there are any green spots, replace the entire capacitor. Check for an open in grid resistor R4 and try new tubes throughout, starting with numbers 4 and 3.

Set Hums: Check C9 and C10 by shunting one at a time with other capacitors of about the same capacity and with at least the same working voltage. If any improvement is noted remove both C9 and C10 and install replacements.

Check all tubes for cathode-to-heater leakage. Measure the resistance of all control grid circuits to chassis and compare measured values to diagram. Make certain that negative leads of electrolytics are connected as shown in schematic. It is easy to connect them to the chassis when the chassis is not B— and this will cause hum and weak reception.

If everything seems to be all right, remove original electrolytics and install replacements. Sometimes leakage may develop between the positive plates of C9 and C10. Then complete removal of the originals and their replacement is the only way to check their condition.

Oscillation: Check i-f alignment with a signal generator. If the screws of the i-f trimmers have been loosened, the i-f transformers may be tuned in the broadcast band and the mixer section of tube #1 will go into oscillation.

Check paper capacitors for opens by shunting one at a time with others of about the same size known to be in good condition. Try shunting C10 with a .1-mfd capacitor. If this stops the oscillation, leave the .1-mfd in the circuit permanently and consider replacement of C10. The installation of glass tubes where metal tubes were originally used will cause oscillation in some cases. If shields were originally used, they must be in place.

Try connecting a small capacitor (.001 mfd or less) from the plate to the cathode of tube #3. Also check to see if C6 is open.

Weak Reception

Test all tubes. Check dc operating voltages —if low, try new electrolytics, check the plate bypass of the output tube, try another output tube and a new coupling capacitor in place of C5. With an ohmmeter check the values of all resistors and the resistance of the i-f transformer windings. Check all paper capacitors for leakage and opens paying particular attention to C2, C3, C4 and C5. Realign the receiver using a signal generator. If any trimmers adjust more broadly than you have found to be the case in similar receivers, new inductances should be tried in the circuit. In the case of the i-f trimmers, try new i-f transformers. Remember that the trimmer across the secondary of the last i-f transformer will normally have a broader adjustment than the others.

Intermittent Reception

Try new tubes regardless of how the originals test. Replace C4 and C5 and if the volume control is noisy, replace it. If the trouble still continues, try to localize the trouble. Connect a VTVM across R3 to measure the AVC voltage. If the voltage remains constant when the set fades or cuts out, the trouble is in the AF section—otherwise it is in the mixer—i-f or in the power supply. Be particularly on the lookout for a break in the loop near its ends. Check the resistance of the i-f transformer windings. If one is considerably higher than the others or if its resistance varies, install a new i-f transformer.

How Much Is Your Time Worth?

(*From page* 1)

As a matter of fact, the picture was even rosier for this particular student. The reason he happened to be in Washington was he had been appointed manager for his company's branch in Richmond and was passing through on the way to his new job.

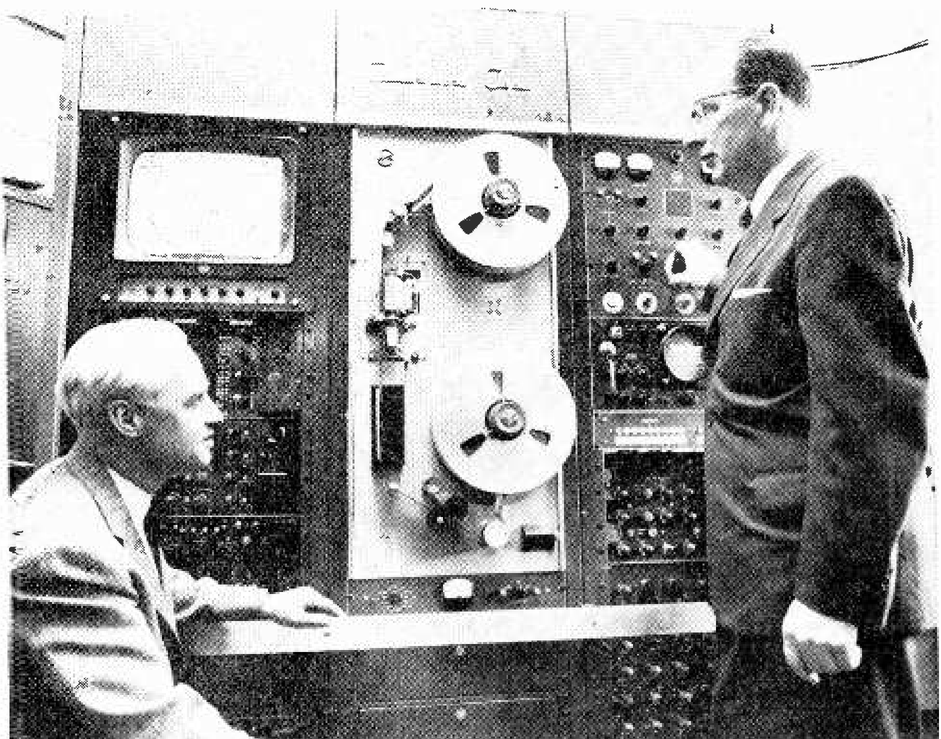
His experience is not unusual. I mention it only because he is the only student with whom I have come in contact who had figured out, on an actual dollars-and-cents basis how much his study time was worth. On such a basis, I can recall some NRI men whose study time has paid them as much as $10.00, $15.00, and even $20.00 an hour!

Every NRI man can make his study time pay just as good a dividend and can probably find more spare time for which to collect. True, you won't be paid right away. But after all, it's the future you are working for and it's the future for which you'll be paid **if you earn it now!**

J. E. Smith
Founder

———*n r i*———

RCA DEMONSTRATES TELEVISION TAPE RECORDER



This production model of RCA's television tape recorder was demonstrated at the National Association of Broadcasters convention modates up to 96 minutes of recorded black-and-white or color television programming. At the control panel (right) is C. H. Colledge, General Manager, RCA Broadcast and Television Equipment Division; watching at left is E. C. Tracy, Manager, Broadcast Equipment Marketing Department.

NRI NEWS
3939 Wisconsin Ave.
Washington, D. C.

Second-class mail
privileges authorized
at Washington, D. C.

Mr. George A. Storms, Jr. F237-A622-G 4A
410 Smith St.
York, Penna.