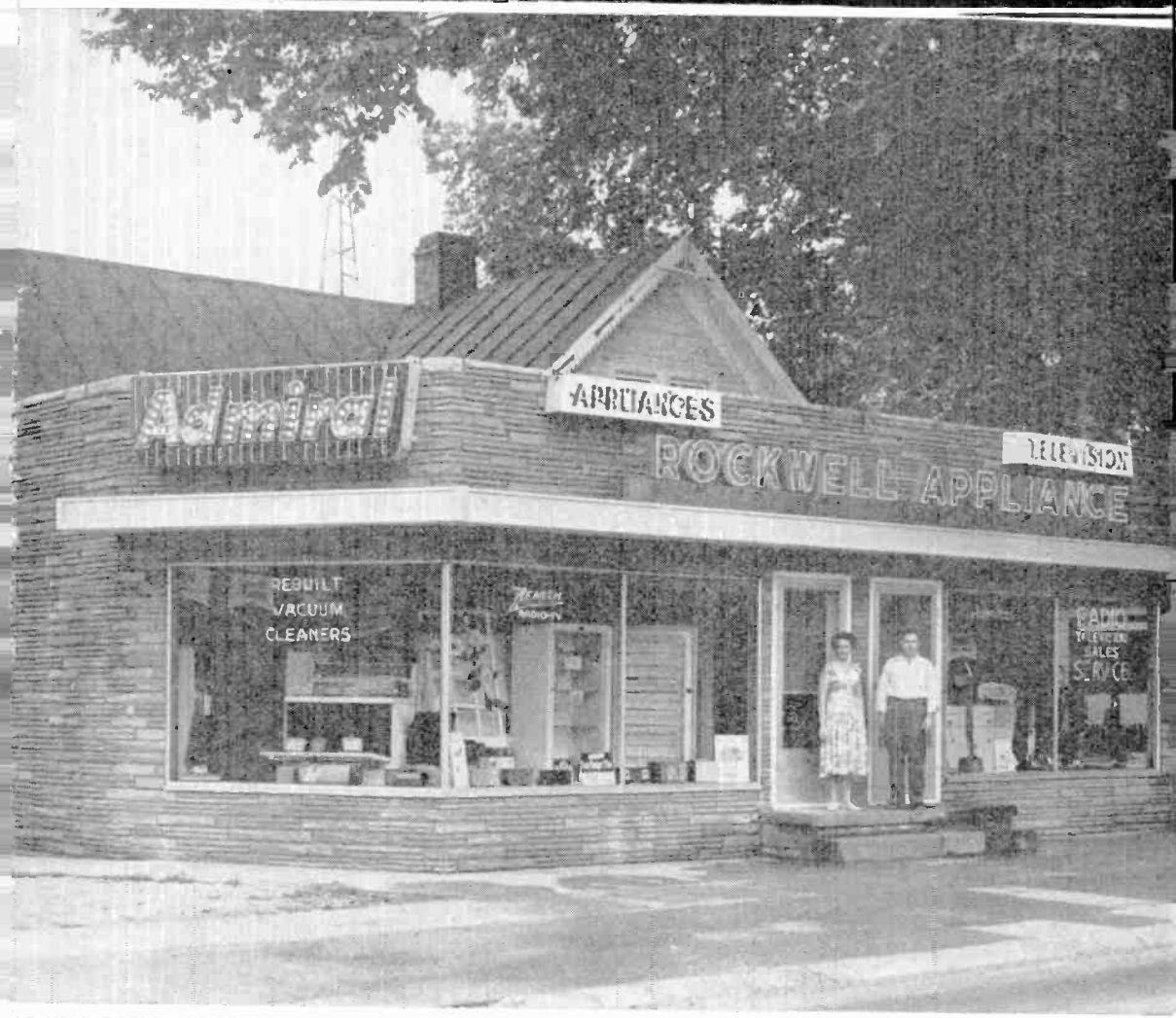
National RADIO-TV NEWS



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Analyzing the Modern TV Receiver

Servicing Hi-Fidelity Equipment

NRI Alumni Association News

Feb.-Mar. 1956

VOL. 17 No. 1

Give a Little More Than is Expected

"He profits most who serves best."

That old adage is as true today as ever. No one can gain promotion or build a successful business unless he constantly tries to give *a little more* than his employer or his customers expect. The fellow who grabs an extra dollar here and there without giving full value for the charge can never be a success. Why! Because a man who cheats on petty things is tearing down his moral fibre. He may fool his employer for a while, or a few customers now and then, but he can't fool himself. He eventually loses that spark, that vitality possessed by men who have nothing to hide—nothing to fear.

When scales are balanced evenly, a little bit of extra weight on one side will over-balance the scale in that direction just as effectively as would a ton of extra weight.

In the same way, a little better value, a little extra effort makes a man or a business stand out above the average. It pays to give a little more value than seems necessary—to work a bit harder than is expected.

We are proud of the reputation of NRI students and graduates. For forty-two years we have been advocating truth and honestly in all business dealings. Our records are definite proof that a great many of our students and graduates have profited by his counsel. Let every NRI man uphold these standards, and, by so doing, bring genuine rewards to himself.

J. E. SMITH,
Founder.

NATIONAL RADIO-TV NEWS

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ANALYZING THE MODERN TV RECEIVER

By TOM CARSWELL
NRI Consultant

Tom Carswell

A BASIC understanding of the operation and function of each individual section of a TV receiver is essential to the modern TV technician. This article is presented with this thought in mind. However, even to those who have no TV background, it should prove interesting in that much of the mystery of such expressions as "sync pulse," "blocking oscillator," "pulse clipping," etc. will be explained in every day language. A brief explanation of the video and sound stages will be covered. The radio technician will see that the operation of the video i-f and sound i-f stages is similar to the operation of the i-f stages in a radio receiver. In addition, the video amplifier and sound amplifier in a TV are similar to the audio stages in a radio. Since one of the least understood portions of the TV circuit is the vertical and horizontal synchronizing systems, these will be discussed in more detail.

By examination of the block diagram shown in Fig. 1, you will notice that signal paths are indicated by small arrow heads. This will provide an easy method of following the various signals from one section to the next. At the same time, the block diagram shows how signals from one circuit control the operation of other sections of the receiver. It is a good idea to refer to this diagram frequently while reading the discussions of the various circuits. The block diagram is that of an intercarrier type of TV receiver. In this receiver the sound and video signals are amplified together and fed to the video detector. The two signals are separated at the output of the video detector. This type of circuit was chosen since it is the system most frequently employed in the modern TV receiver.

The signal is received on an antenna which is tuned to the desired TV channels. The TV signals are fed from the antenna through a balanced transmission line or a coaxial cable to the input of the receiver. At the comparatively high frequencies employed in TV transmissions, the antenna and lead-in are quite critical in design and construction. As a result, great care must be given to the installation and repair of these units. A tuned input circuit selects the desired signal and feeds it to the rf amplifier grid. An-

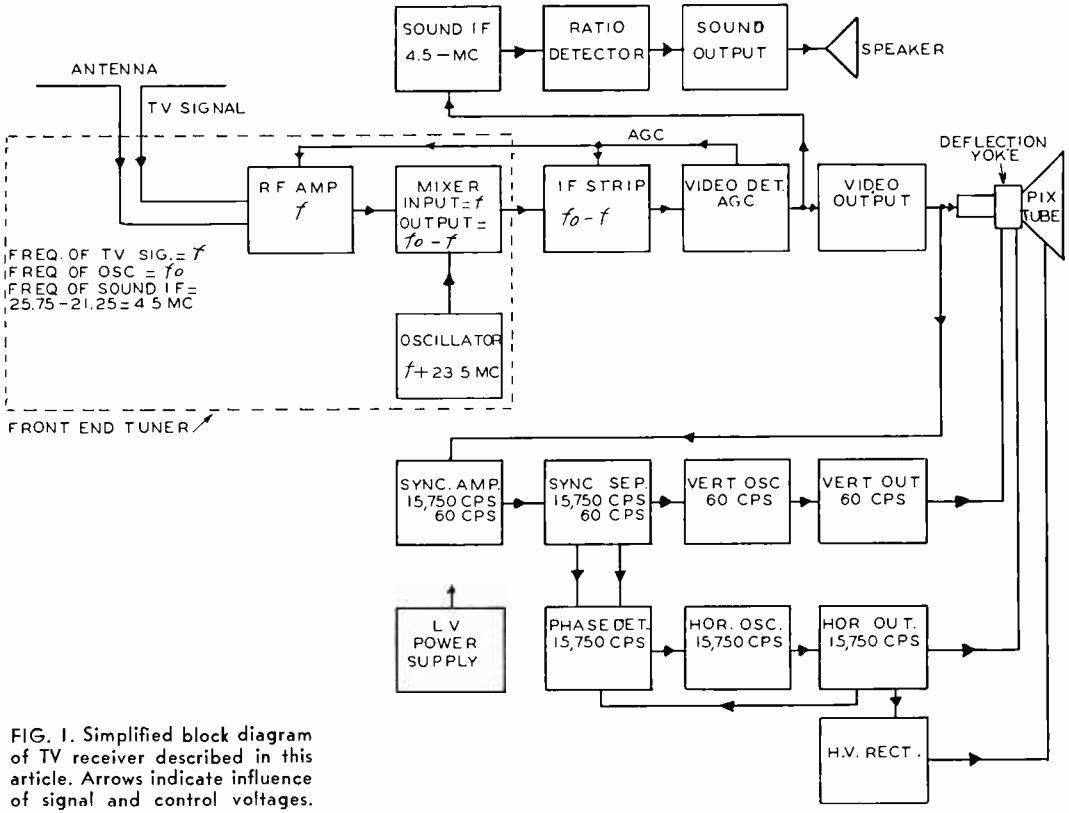

FIG. 1. Simplified block diagram of TV receiver described in this article. Arrows indicate influence of signal and control voltages.

other tuned circuit couples the output of the rf amplifier to the mixer. The signal at the mixer input is still at the same frequency and contains the same information as the original TV signal.

The mixer stage is known as such because a second radio frequency signal is introduced, and is combined or mixed with the TV signal to produce two new frequencies. One of these new frequencies is the sum of the signal from the local oscillator and the original TV signal. The other new frequency consists of the difference between the two frequencies. This signal is used in the i-f stages. Regardless of which TV channel is used, the difference between these two frequencies is always the same because the oscillator frequency is automatically changed when the set is switched to another channel.

Now that we have obtained an i-f signal, let's see just what information it contains. In the original TV signal, there are actually two separate carriers. One is known as the video carrier, and the other as the sound carrier. These two carriers are exactly 4.5-mc apart. In the i-f amplifier they are still separated by the same frequency and still contain all of the original signals, namely the synchronizing signals, the video signals, and the audio signals.

The i-f amplifier in a TV chassis, usually referred to as the video i-f strip, performs the same functions as those of the standard radio receiver. However, the alignment procedure is not the same. Some TV sets employ what are known as stagger-tuned i-f stages. In this case, the individual i-f transformers are tuned to slightly different frequencies in order to provide the wide frequency response necessary. Another type of i-f amplifier employs over-coupled i-f transformers. Due to the overcoupling, the response characteristics are broad. Regardless of which type of i-f strip is employed, the same results are produced at the output.

As previously mentioned, the frequency of the i-f amplifiers is determined by the difference between the oscillator frequency and the frequency

of the TV signal. You will find, in most cases, that this will be either 23.5-mc or 45.75-mc. Since the composite TV signal is approximately 5-mc wide, the overall response of the i-f strip must be able to pass all frequencies between 21-mc and 26-mc, or between 42 and 47-mc. You will usually find that at least three i-f stages are employed.

After this composite signal has been increased many times in the i-f strip, it is coupled to the video detector stage. In this stage, three separate signals are produced. One of course is the video signal. The sound i-f signal is formed by mixing or beating the audio and video carriers and is the difference between them (4.5-mc.) The third signal produced is the dc voltage known as agc (automatic gain control.) This is a varying voltage that is proportional to the strength of the received signal. In other words, for a strong TV signal, the agc voltage will be high. This agc voltage is applied to the grid return of one or more of the i-f amplifier stages. It may also be connected to the grid return of the rf amplifier in the front end tuner. The agc voltage is negative with respect to the chassis. A strong TV signal will cause an increased negative bias on the grids of the amplifiers, and the sensitivity of the receiver is reduced. Conversely, when a comparatively weak TV signal is received, the negative agc voltage is lower, allowing much higher gain in the controled stages. This action results in nearly equal outputs at the video detector from weak and strong signals.

The sound i-f operates at 4.5-mc. A tuned circuit coupled to the video detector output removes the 4.5-mc signal from the video and applies it to the first audio i-f tube. This 4.5-mc signal would cause a fine line interference pattern on the face of the picture tube if it were not removed from the video. This tuned circuit then performs two duties: It eliminates 4.5-mc interference in the video, and extracts the 4.5-mc sound carrier.

The sound which accompanies the television picture is frequency modulated on the audio carrier. The sound is recovered in special detector circuits which do not respond to amplitude modulation. Since static and the noise resulting from automobile ignition and electrical appliances are AM, they are not heard on a TV receiver. The circuits used for sound detection in a TV receiver are the same as those used in an FM broadcast receiver.

At the output of the sound detector, we have an audio signal exactly the same as that from the detector of the broadcast receiver. This is fed into one or more ordinary audio amplifier stages, and then to the loudspeaker.

The video output from the detector is fed to the video amplifier through a broad-band coupling network. This network must pass all frequencies from dc to 4-mc. This broad band is obtained by using low values of load resistance in series with small inductances as the load impedance for each stage. These inductances are called peaking coils. The low values of load resistance reduce the gain of the stage at low frequencies. The peaking coils raise the gain at the higher frequencies. In this way a stage is made to amplify equally all the signals in a broad band. Many sets use the detector peaking coil as an untuned primary for the sound take-off transformer.

Most modern sets use a variable cathode resistor in the video amplifier to control the picture level. A few of the older sets which did not use agc, controled the picture by varying the gain of the i-f amplifier strip. The video amplifier output is coupled to the picture tube through a resisitive-inductive broad-band network.

By referring to the block diagram in Fig. 1, you will see that another connection is made to the video output stage. This lead is coupled to a tube usually referred to as the sync separator-amplifier or sync separator- clipper. In either case, the function of this stage is the same. That is, it separates the synchronizing pulses from the video signal. These pulses are used to keep

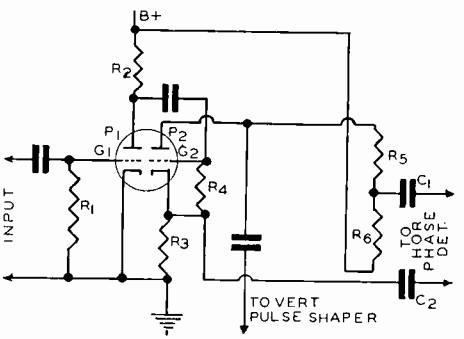

FIG. 2. Basic sync separator-amplifier circuit.

the beam of the picture tube in step with the beam of the camera tube.

In Fig. 2, a basic diagram of a sync amplifier-separator circuit is shown. Although you will find many types of circuits, used in commercial TV sets, the principle of operation is similar. Both triode sections are operated without fixed bias. The amplitude of the sync pulses applied to the first section is great enough to cause the tube to draw grid current. The IR drop due to the flow of grid current through resistor R1 is great enough to bias the tube at or near plate current cut-off. The signal at the input of the sync-clipper is shown in Fig. 3. The video information is negative-going at this grid so it is

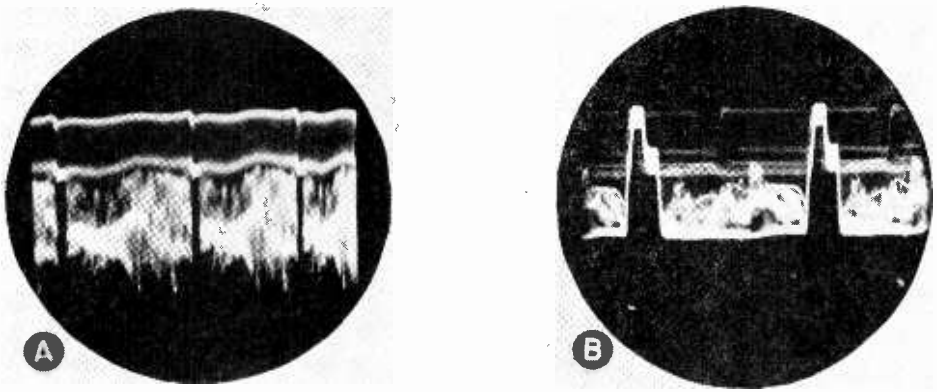

FIG. 3. Waveform at input of sync separator: A. Field rate, B. Line rate.

cut-off and only sync pulses appear at the plate.

The signal from the plate of the first section overdrives the grid of the second section. The signal was reversed in phase while passing through the first section, so the second section clips off the sync tips. This clipping makes all sync pulses the same height and removes any noise bursts on the sync tips. The output of the second section is shown in Fig. 5. In two stages the video information and noise have been removed from the sync, and the sync pulses have been amplified. There are two sets of sync pulses in the output. One set at 60-cycles controls the vertical movement of the picture tube beam. The other set at 15,750-cycles controls the horizontal movement of the beam.

Two outputs are taken from the second triode. One output is used to control the vertical sweep oscillator; the other controls the horizontal oscillator. Each output has a filter and shaping circuit to separate the vertical and horizontal pulses.

Before showing the exact circuits used to shape the pulses for the sweep generators, it would be well to review the principle used to separate the two sets of pulses.

In Fig. 6, a square wave is applied to two resistive-capacitive filters. The filter composed of R1 and C1 is a high-pass filter. C1 is made small to block low frequencies and R1 is chosen so that the time constant of the circuit is small compared to the period of the square wave. By making the time constant small, C becomes fully charged in a very short time and ceases to con-

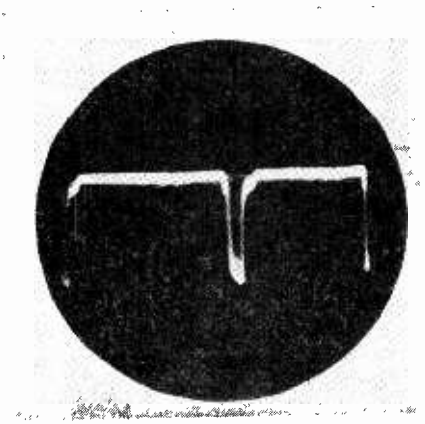

FIG. 4. Line waveform at plate of sync separator.

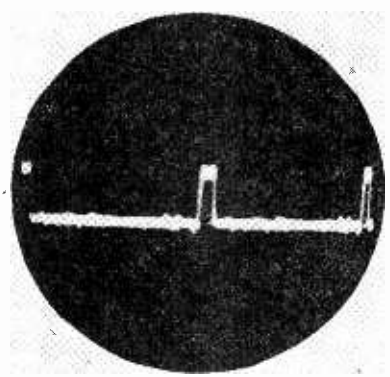

FIG. 5. Line waveform at output of sync amplifier.

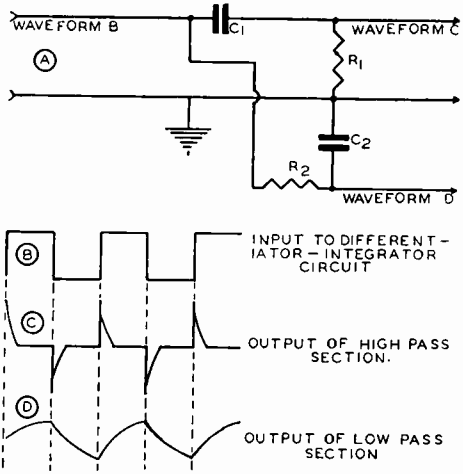

FIG. 6. Diagram of simple sync segregation circuit with associated waveforms.

duct. This results in waveform C.

R2 and C2 are a low pass filter; C2 is made large and R2 is chosen so that the time constant of this circuit is long compared with the period of the square wave. By making C2 and R2 large, the condenser can never become fully charged when the square wave is fed to the circuit. The output is shown in waveform D. Since C2 was connected across the output, high frequencies are bypassed to ground.

The vertical oscillator in a TV receiver operates at a frequency of 60-cycles per second. The output of this oscillator must be exactly in phase with the vertical sweeps of the TV camera and follow every change in the camera sweep frequency. Any deviation, no matter how slight, will cause the picture to move up or down on the tube face. Therefore, a means of synchronizing the oscillator with the camera tube oscillator must be provided. The vertical sync pulses are obtained from the timing generator which controls the TV camera. These pulses are used to lock in the vertical oscillator of the receiver at the same frequency. When this is done, excellent vertical stability is obtained.

In the TV circuit used for this article, the vertical sweep oscillator was triggered by positive-going pulses. These pulses were taken from the sync-clipper and fed through the integrating network shown in Fig. 7. The action of this network in filtering out the horizontal pulses and shaping the vertical pulses can best be seen by viewing the waveforms at the output of each section. These waveforms are shown in Figures 8A, B, and C. The letters on Fig. 7 correspond to the waveforms of Fig. 8.

(Page eight, please)

LISTEN AMERICANS!

By DR. GEORGE S. BENSON

Director, National Education Program—Searcy, Ark.

IN the comedy cartoon movies, a frequently used gag shows a dog named Fido accidentally becoming entangled in a huge mysterious-looking machine, and disappearing inside it. Automatically, out the other end of the machine comes a long string of link-sausages, or "hot dogs," with the lead sausage still barking—just like Fido had barked. This is fictional "automation." In the comedy cartoon it isn't real, of course. It isn't real in a 1956 packing house where "hot dogs" are made. Automation hasn't progressed quite that far.

There are many bugaboos about automation. It is well to be reminded that it isn't a new idea—that, indeed, "Fido" has been going through the "hot dog" sequence for 30 years at least. Some American industries have been using what's now called "automation" for at least 30 years. Important production jobs in the petroleum, auto and other industries have been handled automatically through machine control for many years. Automation is an evolutionary development—a logical outgrowth of the competitive market and the ingenuity of free men.

When blacksmith shops began to go out of business as the automobile replaced the horse and buggy early in this century, there were moans of alarm from many quarters. The prevailing thought among alarmists was that there would be no jobs for the people temporarily displaced in the wagon and buggy industry and this meant disaster.

Some of today's economics textbooks state that it is questionable whether inventions are good for the nation, particularly new industrial production machines which cut down on human labor. All this seems to be rather short-sighted or even blind reasoning. The facts about the development of the automobile are available. The development made 10,000 jobs for every one which it eliminated in the wagon and buggy industry. The same is true as regards the other steps in America's technological progress.

The fact that Americans enjoy a living standard five times better today than a century ago can be traced to the growth of "automation" which has increased man-day production. The fact that nearly 65,000,000 Americans are employed today is a commendation for advances in "automation" during the last 20 years.

Harnessing the machine has opened almost limitless opportunities for the production of new products. Nylon would have been virtually

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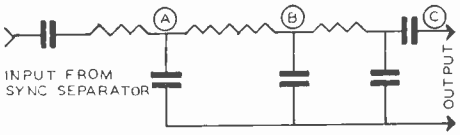

FIG. 7. Typical pulse shaping network used to produce trigger pulse to synchronize vertical oscillator.

(Continued from page seven)

Although the vertical oscillator operates at a frequency of 60-cycles per second, there are only thirty complete pictures a second. This is due to the fact that only every other line of the picture is scanned each time the beam moves down the tube. The next time down the alternate lines are formed. This is called line-interlace scanning. If a complete picture was scanned sixty times a second, a band width of 10-mc would be necessary instead of the 5-mc used today.

Since the output of the vertical oscillator is insufficient to provide adequate vertical deflection of the beam, an amplifier stage must be provided. This amplifier stage operates the same as any other low frequency amplifier. The sawtooth current wave is obtained at the output of the amplifier and applied to the deflection yoke on the neck of the picture tube. This sawtooth current passes through the vertical section of the deflection yoke, producing a magnetic field which moves the electron beam of the picture tube from top to bottom of the tube face. This current wave must be linear in order to move the beam at a constant speed. You will usually find a control known as a linearity control which is used to adjust the shape of the wave.

A somewhat different system is employed to obtain horizontal sync. As can be seen in Fig. 2, a balanced output is obtained by putting half of the plate load resistor in the cathode return of a standard triode amplifier. By making resistors R3 and R6 equal, output voltages at C1 and C2 will be equal in magnitude but opposite in polarity. These are the same two condensers shown in Fig. 9, which is a simplified diagram of a typical phase detector. A sample of the pulses produced by the horizontal oscillator is taken from the horizontal output stage. These pulses should be the same frequency as those synchronizing pulses obtained from the TV signal (15,750-cycles per second).

When the pulse is being sampled and the sync pulses are occurring at exactly the same time, voltage cancellation will take place, causing zero voltage to appear at the junction of R1 and R2. However, if the sample pulses are slightly displaced in time (phase), the output voltage

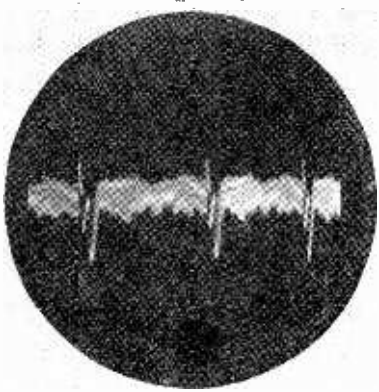

FIG. 8. A. Output first section.

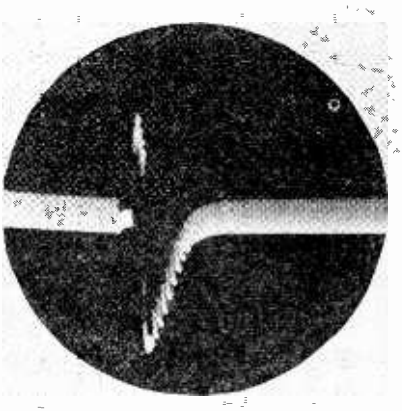

Fig. 8. B. Output second section.

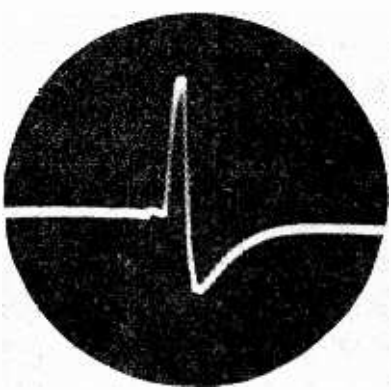

Fig. 8. C. Output third section.

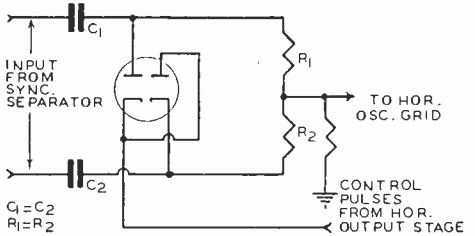

FIG. 9. Simplified phase detector circuit employed to stabilize the horizontal oscillator tube in order to maintain a "locked-in" condition with the sync pluse signal.

will either increase or decrease, depending on whether the sync pulse arrives before the horizontal pulse or the other way around. This type of circuit is also sometimes called a phase comparator. The wave shapes of the horizontal sync pulses applied to the phase detector are shown in Fig. 10.

The output voltage of the phase detector is used to correct the phase of the horizontal oscillator. This is usually a multivibrator circuit, so designed that any change in dc voltage on one of its grids will cause the frequency of the oscillator to change. This grid is connected to the junction point between R1 and R2 of Fig. 9. By applying a voltage that changes when the receiver horizontal oscillator drifts, this oscillator can be kept in step with the camera tube.

No details will be given on the operation of the horizontal oscillator, since this is unnecessary for this discussion. However, remember that it must operate at exactly 15,750-cycles per second, and its pulses must be exactly in phase with those of the horizontal synchronizing pulses taken from the TV signal.

The output of the horizontal oscillator is fed to a beam power amplifier. The output of the amplifier is coupled to the yoke through a step-down output transformer. This stage provides the necessary current through the yoke to move the beam from left to right. As in the vertical circuit, some means will be provided to adjust the circuit for constant speed beam movement. A simplified circuit diagram of the horizontal output is shown in Fig. 12.

A further use of the horizontal output stage is to provide the high voltage for the accelerating anode of the picture tube. Most modern receivers employ what is called a flyback transformer. The primary of this transformer usually consists of an autotransformer winding with the smaller portion of the coil being used as the plate load for the horizontal output tube. When the magnetic field of the deflection yoke collapses during the retrace portion of the sweep, a high voltage pulse is produced. The pulse is coupled back to the primary of the transformer, and stepped up to produce an outut pulse that is usually between 12,000 and 15,000-volts. Since this is an ac voltage, it is unsatisfactory for use until rectified. A high voltage halfwave rectifier is employed, the output of which is filtered and then applied to the accelerator anode connection on the picture tube envelope. This rectifier tube obtains its filament voltage from the same transformer. If the filament voltage were taken from the power transformer of the set, the transformer would have to be insulated for at least 15,000-volts. This high voltage is necessary in order to boost the speed of the electron beam to provide a bright picture on the face of the tube.

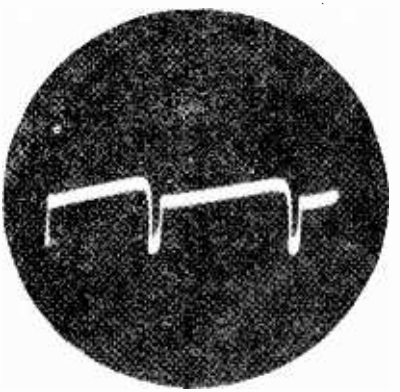

FIG. 10. Input on one side of the phase detector. The other input is the same but the pulses are reversed in polarity.

FIG. 11. Input to Horizontal Output stage. The frequency of these pulses is controlled by the varying grid voltage applied from the phase detector.

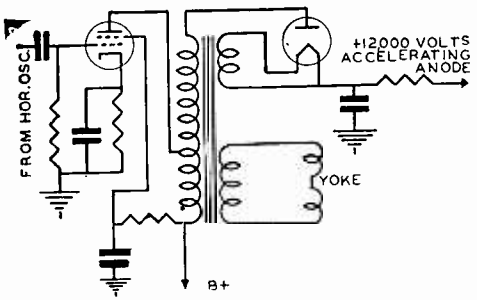

FIG. 12. Simplified horizontal output and high voltage rectifier circuit.

The picture tube is focused by making the electron beam and the spot of light it produces as small as possible. This is done by controlling either electric or magnetic fields in the small portion of the picture tube. One method employed is known as electromagnetic focusing. In this case, a circular coil assembly is placed around the neck of the picure tube behind the deflection yoke. A variable direct current is passed through this coil. The magnetic field of the coil controls the size of the beam. In other cases a permanent magnet is moved on the neck of the tube to accomplish the same purpose. Another type of focusing which is becoming popular is known as electro-static focusing. This requires no external component except a focus control. In many modern receivers, a special focusing anode is built directly in the tube, and no focus control is necessary.

You have probably noticed a small magnet that is placed on a metal band on the neck of the picture tube. This is known as an ion trap. The high voltages used in the picture tube are able to dislodge heavy ions as well as electrons from the cathode. These ions have the same charge as the electrons and are attracted to the face of the tube. If the heavy ions were not removed from the electron beam which strikes the face of the picture tube, they would damage the fluorescent coating of the screen. Therefore, they must be deflected in order to prevent this happening. Since these heavy ions are formed at the cathode of the tube, the ion trap is placed near the base. If the ion trap is improperly adjusted, it is possible that no beam will be formed and the raster will disappear from the face of the picture tube.

Editors note: The ions travel out from the gun as a compact beam which does not follow the electron beam path. The forces sweeping the electron beam have no effect on the ions. If nothing is done the ion beam will always strike the same spot on the screen, burning the fluorescent material and causing a brown spot to appear. The ion trap deflects the ions so they do not reach the screen.

As you can see, this article did not cover many other important functions of the components in a TV receiver. However, it will provide you with a working knowledge of the major circuits involved. Remember, taken as a whole, the TV receiver will appear to be a terribly complex piece of equipment. However, by having a working knowledge of the major sections and breaking the set down as has been done in this article, a thorough understanding of its operation will be easily obtained.

———n r i———

Western Electric Company has Openings for Electronic Technicians in Winston-Salem, North Carolina

The North Carolina Works of the Western Electric Company is engaged in the manufacture of radar equipment for the Armed Forces. Electronic Technicians, for which openings now exist, have the responsibility of testing and calibrating this equipment. Specific duties include the following:

1. Interpret wiring and assembly drawings, manufacturer's specifications, test set data, schematics, engineering information, and sketches.

2. Analyze and locate causes of improper operation of test and control equipment.

3. Test, calibrate, and adjust equipment.

4. Collaborate in the modification of equipment and make recommendations for changes and improvements.

Qualified NRI graduates or students should write directly to Mr. C. A. Mannfeld, Employment Manager, Western Electric Company, North Carolina Works, Lexington Road, Winston-Salem, North Carolina.

———n r i———

A bachelor left in charge of his infant niece was faced with a crisis. He frantically called a young acquaintance who was a parent and who solved the problem in man-to-man fashion.

"First thing to do," said the friend, "is to place the diaper in the position of a baseball diamond with you at bat. Fold second base over home plate. Place the baby on the pitcher's mound and then pin first and third to home plate."

———n r i———

Judge: "Who was driving when you had the accident?"
Drunk (triumphantly): **"None of us. We were all in the back seat!"**

Technical Ramblings

By ROBERT BOARDWAY

NRI Consultant

Current Measurements in Radio-TV Circuits

IN Radio and Television servicing, it is often helpful to know how much current is flowing in a circuit. However, many of the vtvm's on the market do not have provisions for measuring current directly. Even if we have a volt-ohm-milliammeter with the required scales and internal shunts, it is a very time consuming process to break the circuit and insert the meter. In Fig. 1 for example, we could break the plate circuit at X and install a milliammeter to measure the plate current. If we then wanted to know the screen current, we would have to remove the meter from the plate circuit and install it in the screen circuit. We would do this by breaking the circuit at Y. Finally, to measure the cathode current, we could break the circuit at Z and install the meter.

A much simpler and faster approach to current measurements is through the use of Ohm's Law. We usually know the value of the resistors in a circuit and we can very easily measure the voltage drops across these resistors. Applying Ohm's Law, we can then divide the voltage drop by the resistance and calculate the current flow in the circuit.

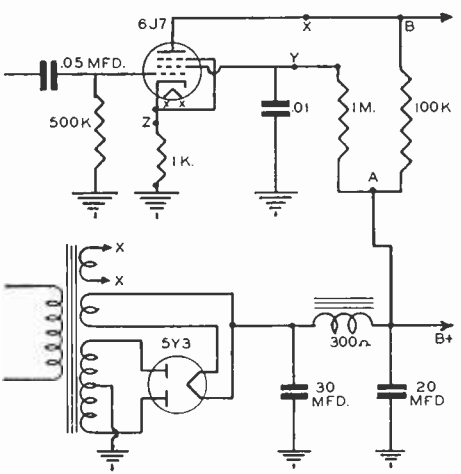

Fig. 1. R-C coupled pentode amplifier stage and power supply.

For example, in the circuit shown in Fig. 1, we may wish to measure the plate current of the 6J7. To do this, we could connect our volt-meter across the 100K-ohm plate load resistor. Let us assume that we obtain a voltage reading of 200 volts. The plate current could then be calculated as follows:

$$\text{Plate current} = \frac{200}{100{,}000} = 2 \text{ ma.}$$

In a similar manner we could measure the voltage across the 1-megohm screen resistor. If we obtained a voltage reading of 250 volts, the screen current of the 6J7 could be calculated as follows:

$$\text{Screen Current} = \frac{250}{1{,}000{,}000} = 0.25 \text{ ma.}$$

If the voltage drop across the 1000-ohm cathode bias resistor were measured as 2.25 volts, the cathode current of the 6J7 could be calculated as follows:

$$\text{Cathode Current} = \frac{2.25}{1000} = 2.25 \text{ ma.}$$

You will notice that when the resistance is 1000 ohms, the current in milliamperes is equal numerically to the voltage drop across the resistor. This is a useful fact to remember since it will sometimes make the calculation of the current very simple.

After measuring the plate, screen and cathode currents, we could compare our results with the maximum allowable values as listed in a tube manual, or the normal values as listed in the manufacturer's service information. If the values were not correct, we would know that the stage was not operating properly. For instance, if the plate and screen currents were lower than normal and the operating voltages were correct, the tube would probably be weak. If the currents were all too high, the tube would probably be gassy or the coupling condenser in

(Page twenty-four, please)

Radio-TV-Electronics Field Provides Interesting Careers

Had No Experience— Now Busy With Spare-Time Servicing

"I have enjoyed the NRI course. Every new lesson seemed to come at just the right time to keep my interest at a peak. The basic fundamentals in the first lessons were so clearly brought out that a good many of the later lessons followed logically from the first.

"I had never touched a radio in any way as far as servicing goes. Now I am operating a spare time business. I do no advertising. If I did I woud have no spare time for other things.

"I am so tickled with the course and the fair business principles taught and practiced by NRI that I cannot help talking about it."

Walter L. Gearing
Box 743
Loma Linda, Calif.

Chief Inspector Of Quality Control

"At the present time I am Chief Inspector of Quality Control with the Technical Appliance Corporation of Sherburne, N. Y. It would be very hard for me to describe just how much your course has done towards securing this position.

"As far as I am concerned your course is responsible for my entire future. I hope that many others will avail themselves of the wonderful opportunity and follow through with your course. It can be measured in terms of profit, respect, happiness, and the satisfaction of knowing that you are aiding the great future of electronics."

Thomas Favaloro
10 Terrace St.
Norwich, New York

nri

Partner in Radio-TV Servicing Business

"I am proud to announce that I am in partnership in a successful Radio and TV servicing business known as Myers and Woodrum Radio and TV Clinic. We are doing service and installation for Spartanburg Refrigeration Co., who handle and sell RCA television.

"I consider it one of the greatest honors in my life to have the privilege of joining the NRI Alumni Association."

R. C. Myers
743 N. Vernon St.
Spartanburg, S. C.

Owns And Operates Successful Service Business

"Thank you for the excellent training you have given me. I now own and operate the Florien Radio Service of Florien, La. Have all the work in Radio and TV I can possibly do.

"I also service irons, tape recorders, wire recorders, and practically anything connected with electronics. It should never be said that a person cannot learn if he wants to. I had only an eighth grade education."

C. H. Mitchell
Route 3
Florien, Louisiana

Radio-TV Serviceman For Western Auto

"Since I completed your course in Radio and TV I have been an employee at the Western Auto Store. We sell and repair radios and television sets. My chief responsibility is to take care of all the radio and TV business.

"Taking the course offered by NRI has proved a forward step to my success as a radio and TV repairman. I am indeed grateful to NRI for aiding me to attain success."

Carriger Williams
808 Walker Street
Elizabethton, Tenn.

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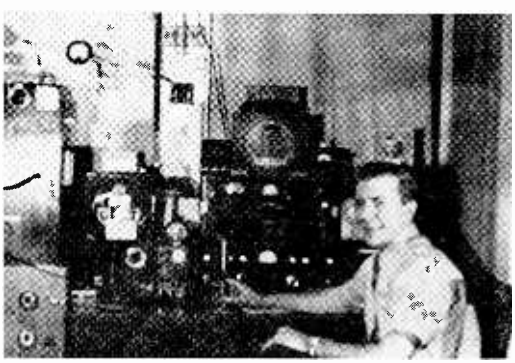
Senior Electronic Laboratory Technician



"Thank you for the fine job you did in helping me to achieve success. Your course in Radio and Television is well written and clearly outlined. I gained very much from it.

"I am a senior electronic technician with Tracer Lab Inc. and am doing very well in their engineering division. I am also an amateur radio operator, advanced class, and have made amateur Radio contacts using the NRI transmitter.

"I had many interruptions during my course. Many times I felt like quitting. I read the advice which Mr. Smith gave on the back of each lesson and, believe it or not, it was a challenge to me to continue and finish—or be a quitter. If it hadn't been for that little encouragement I guess I would have given up. There is nothing I can be more proud of than my NRI diploma."

Edward Holmes
386 N. Main St.
Randolph, Mass.

As space permits, from time to time, we like to devote a page or two in NR-TV News to short success stories such as above. They are taken from testimonial letters we have on file. Photographs and letters of this kind are always greatly appreciated by us. We feel we should pass them on to our readers for the inspiration to be gained from a reading of them.

Servicing High-Fidelity Equipment

By JOHN G. DODGSON

NRI Consultant

John G. Dodgson

HIGH fidelity is now a booming business and there is no reason the radio and TV serviceman should not "hop on the band wagon" and cash in on the profits from repair and installations.

No great difficulties are presented in servicing high fidelity equipment; and more important to the serviceman, you will not need to invest a great deal of money in test equipment, tools, and stock—although a few "extras" are necessary in addition to your normal Radio-TV equipment. But back to this later.

First of all, just what is this *high fidelity* business? You will be hit by this question, along with its sequels: How does it work; how good is it; how much does it cost; is it worth the price; etc.

Now let's take one question at a time. High fidelity is the attempt to reproduce music with such a high degree of faithfulness that it will sound like the original. As far as the quality of reproduction is concerned, it can be unbelievably good compared to the average radio receiver, but then the engineers twenty-five years ago felt the same way about their early attempts at high fidelity reproduction.

The cost of a good high fidelity system may vary from slightly over $100 to several thousand dollars depending on the customer's pocketbook and whether he is trying to satisfy his ears or to "keep up with the Joneses." As far as "is it worth it" is concerned, I think YES. It is worth spending extra dollars to hear music as it should be heard, if you like music.

How to Start

This may be easier than you think—just add "Servicing and Installation of High Fidelity Systems" to your advertising, name cards, stickers, etc. If you have a shop, set up a small but good Hi-Fi system in the front of the shop and keep it running at a medium-high level so that it doesn't prevent conversation but loud enough so that customer can't miss it. One serviceman I know does just this. He keeps a small system in the front of his shop and uses an FM tuner as the source. When customers inquire about the system, he places a specially chosen high fidelity record on a turntable and runs it through the system after increasing the volume to a suitable level. Needless to say, the customer is impressed. However, his clincher is to place the same record on an ordinary table model phonograph set up next to the system and play it. The demonstration leaves no doubt of the superiority of high fidelity reproduction, and this few minutes' work will often sell the idea of high fidelity and perhaps sell a great deal of equipment and future servicing.

Servicing the Individual Components

First of all, this article cannot possibly provide a complete rundown on the servicing of all high fidelity equipment. Several volumes would be necessary to cover every possible angle. However, some of the more common servicing problems which I have encountered will be discussed.

Some methods of Radio and Television Servicing can be carried over to the servicing of high-fidelity equipment. However, other methods are sometimes necessary and in all cases good quality high-fidelity equipment demands high quality servicing.

You will find that most high-fidelity manufacturers are quite exacting and produce only first class equipment. After poking around in the

jumbled jungle of parts and wires in commercial receivers, I was amazed the first time I turned over a Leak Model TL-10 amplifier and observed the "schematic-diagram" type of layout, terminal boards for mounting parts, and cabled wiring with color-coded leads.

Not only the appearance and construction of Hi-Fi equipment, but the performance also is excellent and this feature naturally affects the servicing. For example, the normal hum level in commercial Radio and TV receivers cannot be tolerated in high-fidelity equipment. These facts should be kept in mind at all times when servicing to make satisfactory repairs and to reduce comebacks.

An important point is that Hi-Fi customers are usually more critical and demanding than the average Radio-TV customer because of the nature of the equipment itself. It may be helpful to mention that there are possibly three different groups of high-fidelity equipment owners. First of all, you will find a group that are strictly sound maniacs, who care little for music, but spend all their time listening to bass drums and triangles. This species is gradually becoming extinct or rather evolving into the second type, the average owner who enjoys music and has a pretty good ear for sound. The third type is the fellow who purchased the equipment to impress his neighbors or friends and wouldn't know distortion if "it slapped him in the face." The latter type causes little trouble to the serviceman.

The serviceman who intends to go into the Hi-Fi field is confronted with a number of problems. Fortunately, a large investment is not necessary to get started. Most of the equipment necessary for high-fidelity servicing is used in Radio-TV servicing. Of great importance is a good voltmeter having a sensitivity of at least 20,000 ohms per volt or preferably a Vacuum Tube Voltmeter. Next, you will need an oscilloscope with good low frequency response. The high frequency response characteristics of the scope need not concern you since most scopes designed for Radio-TV servicing have sufficient high frequency response for audio work. For servicing AM-FM tuners you will need a signal generator but again, this instrument is also needed in your service work.

In addition to these major pieces of test equipment, you will need an audio generator—preferably one that will provide either a sine wave or a square wave output depending on the setting of the instrument controls. No additional hand tools are necessary for high-fidelity servicing although you may find a few special ones on the market which can be of extra help to you. Little additional stock is necessary either, although a few tubes will be used in amplifiers that are not found in the average radio and TV receivers, such as the following power output tubes: 6L6, 5881, KT66, 6550, 1614, and the low noise dual-triode voltage amplifier type 12AY7. Other tubes commonly used in both Radio-TV receivers and high-fidelity amplifiers are: 12AT7, 12AU7, 12AX7, 6SN7, 6SL7, 6SC7, 6AU6, 6V6, 6AQ5, 5Y3, 5U4, and 6X4.

In addition to the equipment, hand tools, and stock, "Hi-Fi know-how" is of great importance to the serviceman. It is essential that he be familiar with the various high-fidelity components. Probably the best way to gain this familiarity is by visits to sound studios and careful examination of the available equipment. Also he should write to the manufacturers of high-fidelity equipment for catalogs and technical data. He should also read all articles on high fidelity appearing in the leading electronic magazines. Of course, there are books available on high-fidelity servicing and techniques and the purchase of one of these is a good investment.

It will be of great help to the serviceman if he has a high-fidelity system of his own in the shop. Many times the customer will have a complaint regarding only one specific component in his complete system and only that specific component need be taken to the shop. For example, if the customer's complaint is improper operation of a record changer, then only the changer should be removed to the shop for repair. After the mechanism is repaired, it should be checked.

Of course, normal changer operation can be checked by just placing a record on the table and turning it on. The rumble and hum of the changer, however, cannot possible be checked without a high quality amplifier and speaker system. You can easily see that servicing the individual components of a complete system would require the remaining components in order that a complete check be made.

A great deal of money need not be invested in this high-fidelity system for use in the shop. It is difficult to recommend a low-cost system without injecting prejudice for some manufacturers or against others. However, I will mention the small system I started with and used for servicing—in fact, I still do use this system. The turntable is a Garrad Model T ($32) employing a General Electric variable reluctance cartridge ($6); the amplifier a home-made model (under $20); the speaker is a Stromberg-Carlson Model RF-460 ($12) installed in an R-J bookshelf type enclosure ($24). (Incidentally, from time to time you will find construction articles in the electronic magazines for these R-J type enclosures which provide excellent sound and are small and light. I know of several shops that use them for bench test units. The 8-inch bookshelf type, which I have, can be built with $4 or $5 worth of plywood.)

Also the serviceman should have a few high-

fidelity records for testing and demonstration purposes. Most of the large recording companies sell special test records. These are available in most record stores. If they do not have them on hand, they will gladly order them for you. One company, Cook Laboratories, sells a record which can be used to check the over-all distortion from cartridge to speaker.

In addition to the special test records, a few high quality musical records should be obtained for testing and demonstration. Stick to either the music with which you are familiar or your favorite composers or orchestras. Be sure that the record you purchase is of the "high-fidelity" variety or it will be useless to you no matter how much you may like the music.

Cartridges-Turntables-Record Changers

Records provide the most popular source of music for high-fidelity systems. To change the information contained in the microscopic grooves of a record to an electrical signal that can be amplified and reproduced, a cartridge is used. The cartridge converts the mechanical motion of the stylus to an audio signal with frequencies ranging from 30 to 15,000 cycles. This is a tremendous job for such a little device and as you can imagine the cartridge is a most important part of the system.

The most popular type of cartridge on the market today is the magnetic, such as General Electric, Fairchild, and Pickering. Very few high-fidelity cartridges employ crystal elements. There are also a few, such as the Electro-Voice Model 84 and Sonotone, that use ceramic elements.

The usual troubles encountered with cartridges, turntables, and record changers are strictly mechanical. The greatest difficulty with cartridges is the stylus or needle itself—it wears and breaks. Stylii should always be checked; and unless the point is a diamond, you will frequently find need of replacement. Metal stylii, whether they be old-fashioned steel or the newer osmium, are out of the picture as far as high fidelity is concerned.

Synthetic jewels, such as sapphires, last a good deal longer than metal stylii but even they wear out rapidly. Remember that no stylus is permanent and all should be checked whenever a turntable is serviced. Diamonds last longer than any other type but they wear out eventually. Because diamond is an extremely hard, brittle substance it can be chipped easily if the tone arm is accidentally dropped on a hard surface.

Replacing a stylus is usually an easy job since manufacturers usually provide stylus replacement instructions with their cartridges. Even if you do not have the instructions, an examination of the structure will usually reveal just how the needle should be replaced. About the only other common difficulty encountered with cartridges is poor contacts at the output terminals; these can be cleaned and re-soldered. Sometimes a customer will drop a cartridge (when used in a plug-in head) and break it.

Cartridges that have been dropped generally cannot be repaired by servicemen. They will either have to be returned to the factory for servicing or replaced. The latter solution is preferable.

Turntables and record changers are mechanical devices and repairing them requires little or no electronic skill or know-how. There are generally only two controls on a turntable of the non-changer variety: an on-off switch, and a method of changing to the three commonly used speeds of 33 1/3 rpm, 45 rpm, and 78 rpm.

A simple turntable merely rotates the record at the proper speed for reproduction. Record changers have the additional jobs of dropping records one at a time, lowering the tone arm at the proper place on the record, raising the tone arm when the record is finished, and moving it out of the way so the next record can drop. Of course, the changer also has an on-off switch and a method of selecting speeds. Some changers are quite simple, but most look like "Rube Goldberg devices" from underneath. A few are strictly mechanical monsters. I personally avoid working on them when I can, although they are part of a high-fidelity system and the technician should be able to repair them.

Courtesy Fairchild Recording Equipment Corp.

FIG. 1. The Fairchild moving coil cartridge. A modern high fidelity pickup.

Fortunately, most manufacturers put out detailed information on their changers and turntables which includes not only exploded views of the different sections but trouble-shooting hints and remedies that cover almost everything that could ever happen to a changer. This service information is quite valuable and in many cases is absolutely necessary in order to locate the various points of the changer that should be oiled or greased and also to obtain the part number of an oddly shaped piece of metal that

has been broken and must be ordered from the factory.

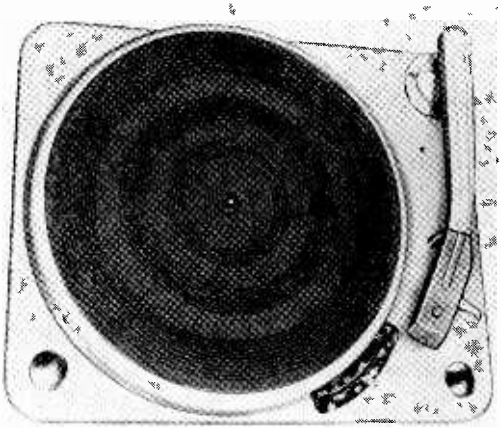
Three common troubles that occur in turntables and changers are hum, rumble, and wow. All turntables have a certain amount of hum and rumble, but most high quality units have reduced this to an insignificant figure.

Hum is caused by the motor, its type, its location in relation to the cartridge and the sensitivity of the cartridge to hum. Magnetic cartridges (which are the most popular) are particularly susceptible to hum, while the crystal and ceramic type are generally unaffected by hum. In inexpensive changers it is sometimes impossible to sufficiently reduce hum because of the motor location, and in those cases the only solution is to replace a magnetic cartridge with a good ceramic unit. Incidentally, while on this subject of cartridge hum, the lower the impedance of the magnetic cartridge and the higher the output, the less annoying the hum. Some low impedance cartridges, such as the Fairchild, use an input transformer and it is important that this transformer not be mounted near the motor of any other transformer fed by 60-cycle current. Electrostatic or electromagnetic fields from these parts will induce hum in the input transformer.

Hum is probably more often picked up by the cable between the cartridge and the preamplifier than by the cartridge itself. Make certain that a shielded cable is always used and that the shield is securely grounded. Also be sure to route the cable away from the motor in the turntable and the power transformer in the preamplifier.

Rumble is caused by motor vibrations reaching the cartridge by way of the turntable. The normal rumble of a turntable is determined by the design. As you might expect, high quality expensive tables have very little rumble. Turntables that have inherently high rumble cannot be improved. However, there are several things that should be checked—especially the rubber mounts between the motor and the changer frame. Climatic conditions and age harden these rubber mounts and destroys their usefulness. The solution, of course, is to replace them. Also be sure that the turntable and other portions of the changer that are suspended on springs are properly mounted. Many times the bolts are tightened down to such an extent that the cushioning effect of the springs is nullified.

Wow is due to very low frequency changes in the turntable speed. It is easily detected on steady tones, such as the bowing of a violin. because wow will cause the pitch of the tone to rise and fall.



Courtesy David Bogen Co., Inc.

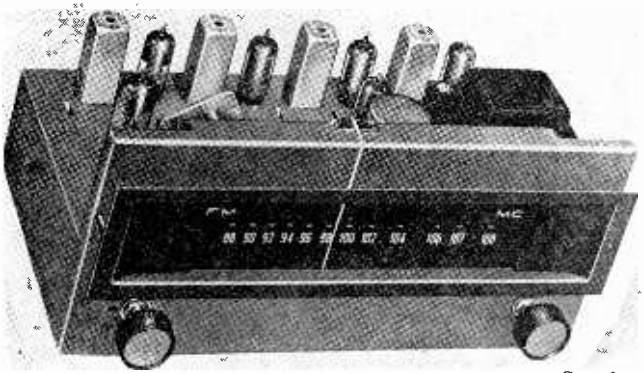
FIG. 2. The Bogen B50 Turntable with plug-in head.

Almost all of the modern high-fidelity turntables are driven by a rubber idler wheel which revolves in contact with the inside of the outer rim of the turntable. Any defect of this rubber idler will cause wow. Most changers today use a system by which the rubber idler is disengaged from the turntable when the instrument is turned off. This prevents the idler from being in constant contact with the turntable and developing a "flat." Always check this rubber idler carefully and be sure to clean it. Any grease and oil on the idler can cause slippage and result in wow. One method of checking the idler is to touch the edge of the turntable with the table revolving. When you do this the pressure will slow it down, but the drag should remain constant and smooth. If the drag the finger feels is reduced in some portions of the turntable's revolution but not in others, then the idler is slipping at these points. As mentioned above, slipping is usually caused by oil or grease on the rubber. A good idler should last at least a year or more, although frequent checking is recommended.

The idler is usually held in position against the turntable rim with a spring in a slotted mounting. Be sure to check the spring to be sure it is "alive."

Unfortunately, many troubles happen to changers and turntables. You will usually find that the more money you pay for the device, the longer it will last before needing servicing. On the other hand, sometimes the additional money is tacked on to pay for accessories that may make convenient operation for the customer but will add to the complications of servicing.

Very often you will find a small metal part in a phonograph to have been bent either by constant use or misuse. By consulting the service



Courtesy David Bogen Co., Inc.

FIG. 3. The usual type FM tuner found in home Hi-Fi systems—the Bogen FM400

information, you will find just which piece of metal causes a certain trouble, and how to bend it to cure it. One important common trouble is the collection of grit and grime which changes turntable speed, clogs up the changer mechanisms, and causes considerable rumble and hum. A rare changer indeed is the one that does not need cleaning, oiling, and greasing. Often just cleaning a changer will clear up the trouble completely.

Incidentally, you should always check the stylus pressure when servicing turntables and changers to be sure that it is as the cartridge manufacturer recommended. Stylus pressure gauges are necessary for this and can be obtained from most wholesalers at a reasonable price.

One other point in this changer servicing business—you can often determine how a changer works or is supposed to work by supporting it up in the air some way and observing it from underneath. The trick is to find the way to support it up in the air while you watch it and have two hands free to work on it. There are some special record changer stands available for this work, but most servicemen support the changer on two blocks of wood at the edge of the workbench and then stoop down and look up. Actually, with a little mechanical aptitude servicing changers and turntables is not so difficult as I am implying. The fact is—I just don't like to work on them, but I know servicemen who enjoy the work. Besides, they provide an excellent source of income.

Before leaving this subject of changers and turntables it might be well to mention the "care and feeding of records." I always carry a well-cared for disc with me on a service call just to be sure that the customer's trouble is not due to the record he is trying to play rather than the equipment on which he is playing it. Most people mishandle their records causing them to wear out rapidly and even sound poorly before they wear out.

The most important rules in caring for records are to keep them clean and to keep the stylus brushed free of lint and dirt. Whenever I purchase a new record I clean it thoroughly with lukewarm water and a mild soap. After drying it with a lint-free towel it is ready to play. Dirt in the grooves of a record acts as an abrasive and quickly wears out both the grooves of the record and the stylus.

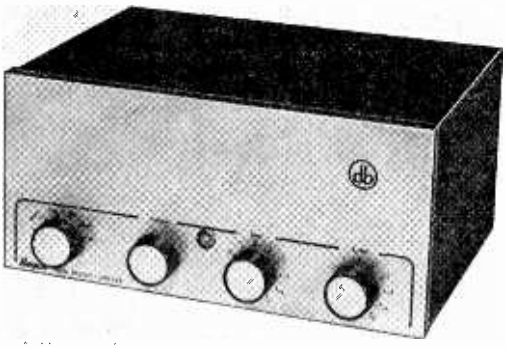
There is another important factor in record care called "static." The record itself picks up a static electrical charge by any rubbing that may occur both by sliding in and out of the record jacket and by the stylus itself moving around through the grooves. A record that has such a static charge attracts lint and dust just as a magnet attracts iron filings. There are several anti-static compounds available which reduce this undesirable trait and, by the way, I use them constantly.

Warped records can cause considerable trouble. A record with a slight warp causes the same effect as a turntable with considerable wow—another good reason to carry a good record with you. Finally, keep in mind that record quality today is excellent, but there are still many records which are rather poor. Quality varies from company to company and even from record to record (of the same company).

Tuners

Tuners provide the next important source for high-fidelity systems. There are several types of tuners—AM only, AM-FM, and FM only. In addition to this, some tuners have built-in preamplifiers while others include a complete preamplifier-amplifier.

You might say a tuner is merely the front end of the radio comprised of an rf-if section and a detector. Most high-fidelity tuners employ a tuned rf stage and at least one stage of audio which is usually a cathode follower stage in order to provide low impedance output so that the cable from the tuner can be run some distance to the amplifier without a loss of high frequencies. The more expensive tuners will contain afc and perhaps two or three stages of audio as well. One of the latest improvements is a cascode type rf amplifier which provides excellent signal-to-noise ratio. Most small and medium size tuners contain from six to nine



Courtesy David Bogen Co., Inc.

FIG. 4. A typical modern high fidelity amplifier—the Bogen DB110. This is a 12-watt unit capable of excellent performance.

tubes, such as the Bell Model 2255 or the Bogen FM 400 (which is shown in Fig. 3). On the other hand, some custom type tuners contain many more, such as the REL Precident which uses over thirty tubes.

The usual difficulties encountered in the rf-if detector stages of a radio are also encountered in high-fidelity tuners. The greatest difficulty, of course, is due to defective tubes and probably the next is alignment drift.

Amplifiers

Amplifiers, the so-called heart of the system, come in all sizes, shapes, and breeds. There are two general kinds of amplifiers: Those with controls and those without. The amplifiers without controls consist of only one or two voltage amplifier stages, a phase inverter stage, and the power output stages. Those with controls generally include a preamplifier along with the usual tone and volume controls. The latter is the most common type. A few high-class amplifiers come in two separate sections and sometimes three consisting of preamplifier, amplifier, and power supply. There is no difference in problems encountered in servicing techniques except that the two and three chassis type units sometimes develop cable troubles.

One amplifier trouble often encountered is excessive hum. As with other servicing, a common culprit is the tube. In servicing high-fidelity amplifiers it is essential that you have tubes that are known to be good (by checking them in another high-fidelity amplifier). A tube tester cannot show you how much hum a tube is causing and that goes for the high-priced laboratory type mutual conductance tube testers as well. Furthermore, unless the hum level is extremely high the tube cannot be checked in a Radio or Television receiver because of its inherently high hum level compared to Hi-Fi equipment.

Amplifiers that are completely dead are the easiest to service since the trouble is usually due to an open resistor, a shorted condenser or a defective tube. The old NRI method of circuit disturbance is by far the best way to service these amplifiers. Signal tracing can also be employed by running a record or audio generator through the amplifier, and then checking from stage to stage with a pair of high-fidelity earphones or using a cable connected to another high-fidelity amplifier.

As you might imagine, the usual servicing techniques you have been using in Radio and TV receivers can be applied to servicing amplifiers. Be sure, however, to keep in mind that much higher quality is to be expected. The hum and noise that might be labeled "normal" in a Radio or TV receiver can very well be excessive and the major complaint in a high-fidelity amplifier. This slight degree of hum and noise can be caused by defects that would be ordinarily overlooked in Radio-TV chassis.

The circuit disturbance procedure and the signal tracing method as mentioned above can be of the greatest help in servicing any complaint in an amplifier. Probably the most efficient method of trouble-shooting a distorting amplifier is to

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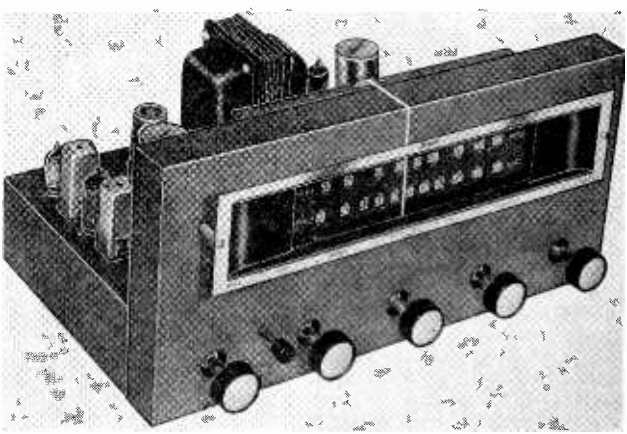

Courtesy David Bogen Co., Inc.

FIG. 5. A more complex type of tuner (Bogen R750) incorporates facilities for both AM and FM reception and includes a preamplifier.

A PREVIEW OF 1956

By Dr. W. R. G. Baker, Vice-President, General Electric Company, and
General Manager, G-E Electronics Division, Syracuse, New York.

IN looking forward in the year 1956, we have every confidence that the electronics industry will more than equal 1955's record activity. Aided by a continuation of the current high national economic level, the rapid rate of advancement peculiar to the electronics business may carry us to new all-time peaks in total industry volume.

Contributing to the general outlook for the electronics field for the next 12 months are the following factors:

1. There will be a growth of television broadcasting in smaller market areas. Sixty-five new television stations are expected to go on the air in 1956, bringing the total to 535. More than half of these will be able to transmit color. The swing to color transmission will proceed steadily.
2. New advances will be made in color reception. Industry retail sales of color television receivers should total approximately 150,000 in 1956.
3. Sales of monochrome television sets are expected to total 7,100,000.
4. The steady impact of clock and portable radios will help offset a regressive movement in the table-model market. We expect that the industry will sell 7,000,000 home and portable radios in 1956.
5. The thriving industrial radio market will continue to move upward. Total industry sales of mobile communications equipment in 1956 will show a 15 per cent increase.
6. Electronics will become a more vital link in the overall weapons concept of modern defense. Greater emphasis will be placed on equipment capable of control, guidance and navigation of airborne weapons systems with extreme accuracy and reliability.
7. More efficient production of both military and civilian goods will be achieved through the use of more flexible automatic machinery.
8. As the age of automation progresses, there will be a dramatic increase in the use of printed wire boards in electronic circuitry.
9. The new year will see transistors make a major break-through in devices for entertainment and industrial purposes as well as for military use. For the first time, transistors will be available which will reduce the size and complexity of computing machines and make them smaller and more efficient.
10. The increased use of electronic controls in industrial and military equipment will provide steady growth in the demand for electron tubes of all types.
11. New research will be carried on which will have tremendous impact on the industry not only in 1956 but for many years to come.

Television Receiver Outlook

The year 1956 will see General Electric in pilot production of its post-acceleration type color television picture tube. This new tube will have the phosphor on the face-plate and will offer greatly improved brightness. Because of further progress desired on the picture tube itself, it is not likely that General Electric color receivers will be marketed before the second half of 1956. For the long-run future, however, color television will occupy a dominant place in G-E's television plans.

Television receiver industry volume soared to a record level of 7,800,000 units during 1955, increasing eight per cent over the previous high of 1954. During 1956, it is anticipated that the television industry will go through a moderate transitional period due to rapid saturation in set ownership. This probably will not be offset by the rise in replacement and second set sales but it may be countered in some respects by the growing interest of many broadcasters in small-market television transmission equipment. Industry receiver sales of both monochrome and color sets should total 7,250,000 in 1956.

Broadcast and Industrial TV

Low-initial equipment investment combined with low operating and programming costs will stimulate television station growth in the smaller market areas during 1956. This will contribute to overall industry and General Electric dollar volume.

Despite UHF problems, the number of television stations in the United States continues to increase. Sixty-five new stations will be added next year. There were 470 in operation during 1955.

Currently, 250 stations possess network color facilities. Eighty have color film and slide equipment. Twenty-five have live color equipment. It is anticipated that this growth will continue during the coming year.

A review of the industrial television equipment market indicates increased activity for 1956. The period of experimentation has come to a close.

Communication Equipment

The use of two-way mobile communication equipment has continued to expand at a rapid rate. More diversified applications are proving the worth of this tool as a saver of labor, time and money in government, commerce and industry, large and small.

The anticipated increase of 15 per cent in industry sales of mobile radio communication equipment will come from greater use in established fields and substantial expansion in relatively new areas such as materials handling, trucking and delivery service.

Sales of carrier-current equipment, which provide telemetering, protective relaying and telephone communications for electric utilities, are expected to run between 10 and 15 per cent higher than in 1955.

Installation of microwave equipment for point-to-point radio communications by governmental and private organizations is increasing steadily and General Electric is becoming a major supplier of this type of equipment.

New interest is expected in 1956 in radio traffic control systems of the type installed by General Electric in Chicago late in 1955. This system permits almost instantaneous corrections of signaling cycles to meet changing traffic demands.

Applications of new components such as transistors, miniaturized parts and printed circuits will continue the trend toward smaller equipment with even greater reliability than present high standards.

Home Radios

The radio receiver industry, after a period of decline, made a comeback in 1955, particularly in the portable radio category. Industry retail sales for 1955 totaled 6,800,000 compared to 6,431,000 for 1954. The increase was attributed to the clock and portable category. There will be a slight increase in clock radio sales in 1956 with a heavy increase in portables, bringing the total to slightly more than 7,000,000.

Semiconductor Products

A line of transistors which will permit the effective transistorization of radio sets is now being supplied in mass production quantities. We now have production capacity to meet the heavy demand expected in 1956. The use of transistors in the military field is increasing rapidly. Production quantities have been ordered for 1956 delivery to handle many of the aircraft communication requirements. Military development support of this program is being continued into 1956. This will help make available more quickly the higher frequency and higher temperature types of transistors which are needed to more completely transistorize military equipment. Many new versions of higher frequency and higher power transistors will be released to expand applications many-fold over currently planned projects.

Silicon rectifiers for both low power and high power applications will be available for mass production in 1956. This will open many fields of military and industrial applications requiring high temperature operation and will reduce the bulk and weight of power equipment as well as improve efficiency and operating life.

(Page twenty-six, please)

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New Roll Charts Available for Owners of Model 70 NRI Professional Tube Testers

The year of 1955 saw the introduction of a large number of new receiving type tubes for Radio and Television. Although a new Roll Chart was made available in March of 1955, quite a number of new tubes have been introduced since that date. Another new Roll Chart was prepared in December, 1955. Men who have purchased Model 70 Tube Testers having a serial number of 6000 or higher should not purchase these new Roll Charts. All men who own tube testers having a serial number lower than 6000, can benefit by purchasing this new chart.

The new charts are available from the NRI Supply Division for $1.25, postpaid. Please use the coupon below.

ORDER BLANK FOR MODEL 70 ROLL CHART

Supply Division
National Radio Institute
16th and U Street, N.W.
Washington 9, D. C.

Enclosed is my remittance for $1.25. Please send me a new Roll Chart for my Model 70 Tube Tester. This chart was printed in December, 1955.

Name .....

Address .....

City..... Zone..... State.....

Student No. .....

If you live in Washington, D. C., please include an additional three cents to cover D.C. sales tax.

Our Cover Photograph

A Fascinating Story of How NRI Graduate R. L. Rockwell, of Bath, Ohio, Developed His Part-Time Business into a Successful Sales and Service Organization.

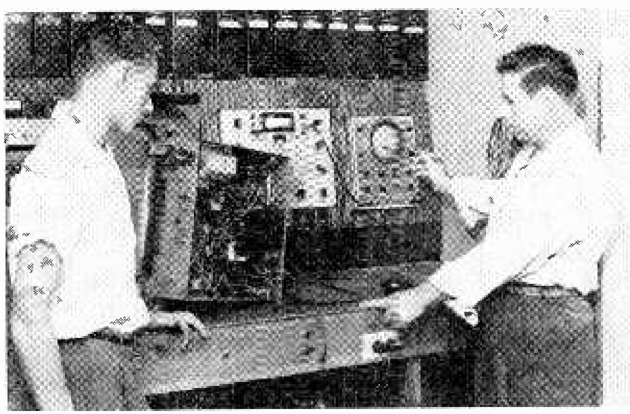
OUR cover photograph and the additional photographs on this and the following page tell an inspiring story of proper technical training, hard work, and careful business planning. Looking back to the year of 1948, Graduate Rockwell wrote to NRI at that time as follows:

Mrs. Rockwell and Roy Rockwell in the television and vacuum cleaner department of their store.

"About five or six years ago I was looking for something to read to occupy my spare time. I read about NRI. I had often wondered what made a radio operate, so I figured this would give me plenty of reading material. I knew only what the average fellow does about electricity. So, I started your course.

"I started servicing long before finishing the course and received enough money from my NRI Tester to buy a complete set of new test equipment. This new test equipment has paid enough to set me up in the appliance business. This past year I did better than $10,000 worth of business in a front room of our home. We carry washers, sweepers, Admiral radios, refrigerators, and small appliances. We purchased a new truck, new office equipment, and we have all of our appliances paid for and about $2,000 to operate on.

"I also work in a local factory which pays $300 a month, but some months I make more at home than I do in the shop. Every dime from the first service job has been turned back in to make this little business expand. We usually have fifteen to twenty service jobs on hand at all times. When I get my new store built, I will quit the shop and I hope that day will be soon."



Russell Rockwell and his father Roy Rockwell checking an Admiral television receiver on the service bench of Rockwell Appliance Company.

It is interesting to note that in 1948, Graduate Rockwell was still developing his business on a part-time basis. He was reinvesting all of his part time earnings and living on his salary from a regular job. Now let us see what Graduate Rockwell was doing in 1949:

"Your NRI Course has changed things that make life worth living. I worked in the factory until last October. Now I work at my business full time and have a salesman with me, and last week we started another serviceman for radio service. We did an $18,000 business in appliance and radio servicing for 1948. All this in a store that we built in the front of our house."

And so, from year to year, Graduate Rockwell's business has grown. The story in 1955 includes the name of Russell Rockwell, Graduate Rockwell's son. Russell has enrolled for NRI training and is following in his father's footsteps, getting ready to take over the major respon-

sibility for the growing business in years to come.

Here's what Graduate Rockwell wrote recently:

"We have one of the largest and most modern appliance stores in the county, thanks to NRI. When I started your course, I did not know a resistor from a condenser, but I was determined to be successful. Our total sales in the last year were better than $72,000 with no salesman. We did a lot of radio and television service work along with sales. Our net worth is around $40,000. It was $3,000 when I started your course, so you see I have done all right during the past few years.

"I have a son who is eighteen years old. My main interest is in my son, Russell, as I want to prepare him to take this business over in the next ten years. Now is the time for him to start, and I know of no better way than with NRI."

Isn't the success story of Graduate Rockwell inspiring? Yes, it is also unusual. It is the story of one NRI Graduate who had exceptional determination to see the realization of this dream for a successful business. We notice in the pictures appearing on these pages that the Rockwell business is a family affair. Mrs. Rockwell is interested and active in the business. Son

The entire force of Rockwell Appliances are shown in the "white goods" department of the store. On the left is Clinton Porter, then Mrs. Rockwell, son Russell, and Roy Rockwell.

Russell is also active. He is doing well in his NRI lessons. We are inclined to feel that the continued growth and success of the Rockwell enterprise is assured.

Hi-Fi

(Continued from page nineteen)

feed a signal from a signal generator to the input of the amplifier. Then trace the signal stage by stage with an oscilloscope.

Loudspeakers and Enclosures

The speaker systems are the weak link in a high-fidelity system since they are the most inefficient and the highest distortion producing unit in the chain. Hi-Fi speakers come in a variety of sizes from 8 inches to 18 inches (not including tweeters), and along with the speakers work the cross-over networks, and perhaps the most important component—the enclosure.

High-fidelity loudspeakers develop the same sort of troubles that occur in the ordinary replacement type speakers—open voice coils, rubbing voice coils, warped cones, etc. In addition to this, the coils and condensers in cross-over networks become defective and the controls become noisy.

One difficulty which is unique is the trouble caused by the enclosure itself. Many of these high-fidelity speaker enclosures are complex and costly. Here lies probably the second greatest use of your own high-fidelity system—the convenience of substituting your own speaker system for the customer's. It can be extremely difficult if not impossible to move a customer's speaker system to the shop because of size and weight. For example, my speaker enclosure (the Karlson) although only 3 feet high, 22 inches wide, and 18 inches deep, weighs some 75 pounds without the speaker! This could be termed a medium-sized enclosure and the larger ones very often weigh up to 400 pounds. Needless to say, the servicing of such speaker systems is done right in the home.

In conclusion, high fidelity can be an interesting and profitable sideline for your Radio-TV service business, besides adding a little prestige.

If you're interested in Hi-Fi and would like more articles on the subject, drop us a line. Let us know what sort of articles you would prefer —theory of operation, servicing of individual components, construction. etc.

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There is hardly anything in this world that some man cannot make a little cheaper and a little worse, and the people who buy on price alone are this man's lawful prey.

JOHN RUSKIN

Technical Ramblings

(Continued from page eleven)

the grid circuit would be leaky. We would then check the tube by temporarily substituting a new one. We would check the coupling condenser by measuring the grid voltage with the tube out of its socket. If the reading was positive, the coupling condenser would be leaky and we would replace it.

As another example, in the circuit shown in Fig. 1, we may wish to determine the total current supplied by the conventional B+ supply. To do this, we could measure the voltage across the filter choke and divide this value by the 300-ohm dc resistance of the choke. If the voltage drop was 30 volts, the current flow could be determined as follows:

$$\text{Current} = \frac{30}{300} = 100 \text{ ma.}$$

If we found that the current flow through the choke was too high, we would check the 20-mfd output filter condenser. Leakage in this condenser might cause hum in the loudspeaker. It would also result in excessive current flow through the choke and low B+ voltage.

If we found that we had no B+ voltage and the choke was good, we would check the 5Y3 rectifier tube. However, since a short in the 30-mfd input filter condenser could cause the 5Y3 tube to fail, we would check this condenser before replacing the tube.

In the service business, time is money. Therefore, we try to develop the fastest possible methods of servicing. When measuring voltages and currents, we can save time by clipping the "common" lead of our meter to the chasis or the B— point and leaving it there. We can then use the probe or positive lead to make most of our measurements. To measure the voltage across the 100K-ohm plate load resistor in Fig. 1, we would measure the voltages at points A and B. Subtracting the voltage at terminal B from the voltage at terminal A would give the voltage drop across the resistor. With a little practice, this subtraction can be done in your head.

In many cases, we just want to know whether a tube is conducting or not. To find out if the 6J7 tube in Fig. 1 is conducting, we can measure the voltage at each end of the plate load resistor. If our readings are different, there must be a current flow through the resistor and the tube must be passing current.

If we find that the 6J6 tube is not passing current, we would check the tube by temporarily substituting a new one. If the tube was good we would check the 1000-ohm cathode resistor, the 1-megohm screen resistor, and the 100K-ohm plate load resistor. An open in any of these resistors would cause the tube to stop conducting.

If we found that the screen resistor was open we would check the .01-mfd. screen bypass condenser before replacing the screen resistor. A short in this condenser could very easily cause the resistor to overheat and burn out.

If we found that the tube was good and the plate, screen, and cathode resistors were good, we would then logically proceed to the grid circuit. What defect in the grid circuit would cause the tube to stop conducting? If the 500K-ohm grid resistor were open, the grid would become increasingly negative until the tube was cut off. Therefore, we would check this resistor also.

One word of caution is necessary when using this method of measuring current. If the meter resistance is less than 10 times the resistance of the resistor in the circuit, the voltages in the circuit will be upset. Therefore, we should use a meter having a high internal resistance. A vtvm is ideal because its internal resistance is usually 10 megohms or more.

As you can see, it is very easy to determine the current flow through a resistor of known value by measuring the voltage drop across the resistor and dividing it by the resistance. With a little practice, this procedure can be done very rapidly saving considerable time in your service work.

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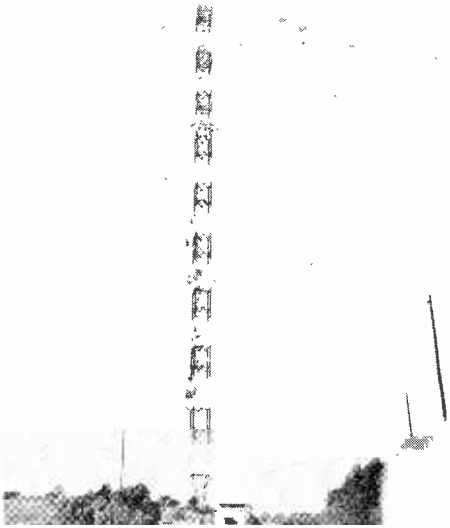
(Continued from page seven)

worthless in the spinning-wheel era. Today it accounts for perhaps 100,000 good-paying jobs. Air-conditioning plants could be sold only to Sultans and Kings—if automation didn't produce units at a price within the reach of millions of home owners. Hundreds of such examples could be cited. The new products to make living more pleasurable also make jobs more plentiful. Automation, then, could be said to be merely a new word for progress!

THANKS

To the many students and graduates who remembered us during the Holiday Season with Christmas cards and other messages of good will, we wish to express sincere thanks.
It is very gratifying to us here at NRI to be remembered in this friendly way. Along with our thanks go our best wishes for good health, contentment and much progress during 1956.

ELECTRONICS' JACK-IN-THE-BEANSTALK



The 800 Foot Vertical transmitting antenna, NRS (T), Annapolis, Md. All wiring on the project was supervised by Electronics Division, PW Department personnel.

E. A. Merryman and J. W. Anderson, Electronics Field Engineers, inspect base and insulator mountings of the 800 foot tower.

Editor's Note—The following article, taken from *The Log,* a publication of the U. S. Naval Gun Factory, speaks of the activities of Mr. Earl A. Merryman. Mr. Merryman was the first Secretary of the NRI Alumni Association, elected at the organization meeting in November, 1929.

Tourists on their way to Annapolis, Md., now have a new landmark guiding them to town. For rising up majestically into the sky is an 800 foot tower, located at the Annapolis Naval Transmitter station, destined to be one of the most powerful in the United States when it is completed.

When the tourist gets closer to the huge tower, he will rub his eyes and take a double look when he sees this Jack-in-the-beanstalk apparatus resting on a single base insulator as shown in the photo.

The entire electronics installation was supervised by personnel of the Naval Gun Factory Electronics Division, Public Works Department.

Earl A. Merryman, NGF electronics field engineer who worked on the project told a *Log* reporter that the largest transmitter in the new building can hold a five room house within its walls.

The Safest

Measures have been taken to make the new 50 KW transmitter one of the safest in the world. For example, to insure absolute safety of operation of this equipment, the operating personnel must use six keys in sequence to open any one of the big transmitter's doors. This is to make sure that no operator can get close enough to be in danger of electrocution from the tremendously high voltages used in the equipment. Each of the many doors to the transmitters must be locked with the same six keys before the operating personnel leaves the inside of the transmitter and only then will the transmitter operate.

Another, perhaps more drastic, safety measure concerns the grounding extension line for the transmitter which hangs above, and in front of, each door. If the operating personnel should happen to forget to remove the line and hold it in his hand, the door, when it was opened would pull the line from the hook and it would fall and tap them on the noggin to remind them of their omission.

The Electronics Division field engineer assigned to all problems at the Annapolis Transmitter station is Mr. Earl A. Merryman. Mr. Merryman has been working with radio since 1911, and is a retired Navy Chief Radioman, having served in three wars.

A Preview of 1956

(Continued from page twenty-one)

The germanium and semiconductor rectifier markets will more than double in 1956 over 1955.

Components

The year 1956 will see an expansion in the use of encapsulated assemblies of resistors and capacitors in electronic circuits. Such devices will contribute materially to improvements in assembly techniques.

There will be a sharp uptrend during the year in the use of printed wiring. Not only will it be used in radio and television sets but every type of electronic equipment where a compact circuit is required. In addition it is expected that printed circuits will find uses in many home appliances and generally in the electrical industry.

Electronic Tubes

Difficult environmental conditions encountered in military applications, particularly guided missiles, will give stimulus next year to the introduction by General Electric Company of several new versions of micro-miniature ceramic tubes.

A new mercury arc rectifier, with greater power handling capability and with operating characteristics that will make possible economies not previously obtainable, will provide substantial impetus to railroad electrification.

Magnetrons for cooking units in the home and in restaurants will be produced in quantity and other types will be introduced and manufactured for electronic heating and industrial processing.

Of extreme importance to industrial automation programs will be production early in the year of new power thyratons with longer life, more stable characteristics, and excellent overload capabilities.

Special purpose cathode-ray display tubes for military and industrial use will provide their own memory and will display information until it is no longer needed. Other special cathode-ray tubes will present multi-colored radar pictures.

Military Electronics

Increased emphasis by the military services on electronics systems in aircraft and missiles continues. Continuing advancements in aircraft performance and capability of nuclear weapons places increasing demands on components.

A new type of test equipment is now employed in Light Military factory areas to perform complicated component and systems tests. Extension of this equipment for use by military customers in the field is being pursued. Such usage will be of importance because it will permit the military to make rigorous factory-type tests in the field shortly before an actual military mission.

The Company continued to produce quantities of powerful ground and shipbased radars for air defense in 1955. Intensification of effort is expected in 1956 to provide defense and offensive capabilities in keeping with potential weapon threats. With aircraft speeds and altitudes increasing, radar systems providing early warning at greater ranges and higher altitudes than ever before will become increasingly important. In the missile field, additional emphasis is being placed on electronic guidance and control.

Electronic Research

The increased application of electronic technology in consumer, industrial and defense products will necessitate even greater emphasis in 1956 in applied electronics research and advance engineering.

During the year, prototype systems will be completed permitting demonstration of new accomplishments in radar and infra-red. In addition, a system permitting accurate navigation of aircraft, the first model of which was flown in 1955, will be made available for service evaluation in 1956.

The growth of our General Electric Microwave Laboratory at Stanford, Palo Alto, California, will continue in 1956.

We expect substantial progress in the coming year in development of high-power pulse and CW traveling wave amplifiers, high-power and super high-power klystrons, backward wave oscillators and amplifiers and low-noise traveling wave tubes which will be used for radar, communications, and counter-measures service.

During 1956, a new Industrial Electronics Laboratory will begin operation within the General Electric Electronics Division. This laboratory will be devoted to applied research and advance engineering in various phases of industrial electronics.

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TV Service Man Needed, Macomb, Ill.

J. H. Naber, Store Manager for the Montgomery Ward Store in Macomb, Ill., writes that they will have an opening within 60 days for a qualified TV service man. Address inquiries to Mr. Naber, at above address.

N.R.I. ALUMNI NEWS

Chapter Chatter

New York Chapter Program Committee Members announced the beginning of a series of special lectures on TV with Tom Hull at the microphone. Diagrams have been made available for these lectures.

At one meeting Dave Spitzer spoke on Condenser Checkers. Frank Catalano spoke on TV experiences.

Ferdinand and Fox gave a demonstration of TV trouble shooting. Al Ferrito spoke on auto radio troubles. Crez Gomez spoke on field experiences and Phil Spampinato had as his subject High Fidelity Audio. Spampinato, by the way, has just been promoted to a senior engineer in his firm.

At another meeting Frank Zimmer spoke on Hi-fi Twin Trax Tape Recorder. David Spitzer again spoke on the Condenser Checker and related some of his TV experiences as did also Frank Catalano.

Bill Gardner of Westbury, Long Island, is our newest member.

Meetings of New York Chapter are held on the first and third Thursday of each month at St. Mark's Community Center, 12 St. Mark's Place, between Second and Third Aves., in New York.

Philadelphia-Camden Chapter, through the cooperation of Mr. Lubrano, Service Manager of the Pierce Phelps Co., Distributors of Admiral TV, heard a very interesting talk on Printed Circuits by Mr. Nunamacher of the Admiral organization. Mr. Nunamacher had a late Admiral chassis and very thoroughly explained the process of making printed circuit strips and how to service them. Service bulletins were distributed among the members from which many useful hints were obtained. This was an excellent meeting.

At another meeting Mr. George Methlie and Mr. Albert L. Barnshaw, through the courtesy of the Bell Telephone Company, gave a talk on the Microwave Relay and the Mobile Telephone.

Arrangements have been made for representatives from Zenith and Motorola to speak to our members.

The following officers were elected to serve during 1956.

Chairman, John Pirrung
Vice Chairman, Ken Smith
Rec. Sec'y, Jules Cohen
Fin. Sec'y, Joseph Burke
Treasurer, Chas. J. Fehn
Librarian, Carlton Bennett
Sgt. at Arms, John Krepol

New members are William J. Hawryluk and Nicholas Zam. These men were given a hearty welcome.

Meetings are held on the second and fourth Monday of each month in the Knights of Columbus Hall, Tulip and Tyson, in Philadelphia. If you would like to receive notices regarding meetings send a postcard to Secretary Jules Cohen, 7124 Souder Street, Philadelphia 49, Penna., or telephone Fidelity 28094.

Pittsburgh Chapter announces the following officers elected for 1956.

Chairman, William Lundy
Vice Chairman, Frank Skolnik
Secretary, Peter Kenny
Treasurer, Earl Uhl
Executive Committee, L. Steyer
S. Steyer
D. Benes

Bert Bregenzer, President of SFRTRA of Penna., spoke on current events in TV industry. Clement McKelvey, TV authority, spoke on TV Alignment.

Excellent technical programs and interesting

Springfield, Mass. chapter just before their Christmas party.

lectures and demonstrations are on the schedule for the next several meetings. We are rapidly acquiring the newest and finest in test equipment. Meetings are held on the first Thursday of each month at 8 P.M. at 134 Market Place, Second Floor.

Springfield, Mass., Chapter is experimenting with a new idea. A committee was appointed to find a suitable meeting place for an occasional Saturday night meeting. The purpose is to give those members who are unable to attend meetings on the first and third Friday of each month, which is the regular meeting night, an opportunity to get the benefit of these nice sessions. Further announcement will be made to the members by the Secretary.

Mr. Conner and Mr. Mason of the New England Telephone and Telegraph Company gave an excellent talk on the Microwave Transmission.

Officers for 1956 are:
Chairman, Raymond Nystrom
Vice Chairman, Howard B. Smith
Secretary, Marcellus Reed
Treasurer, Arnold L. Wilder
Executive Committee: Lyman Brown
Stanley Malec
Leo Martin

Our Christmas party was outstanding. $25 was contributed by our members to the "Toy for Joy Fund" to provide toys at Christmas time for children who might otherwise be overlooked. In addition, a considerable number of Springfield Chapter members met on Sunday at the Reserve Headquarters Building to repair Radios, TV and Phonograph equipment for needy and shut-in people. All of our local newspapers gave proper credit to our members for this fine community spirit. *(The officers and members of Springfield chapter are to be commended for their participation in these projects. Editor)*

Microwave demonstration by a representative of New England Tel. and Tel. Co. at Springfield Chapter.

Regular meetings are held on the first and third Friday of each month, beginning at 7 P.M., at the U. S. Army Headquarters Bldg., 50 East Street in Springfield.

Baltimore Chapter announces the following officers elected for 1956:
Chairman, Joseph B. Dolivka
Vice Chairman: Elmer E. Shue
Treasurer: John E. Harp
Secretary: Joseph M. Nardi
Librarian: Aubrey G. Hooper
Sgt. at Arms: James E. Hurka
Auditor & Technical Consultant: H. J. Rathbun

The semi-annual banquet was held at Munder's

Some of the Springfield, Mass. chapter members restoring Radio and TV sets to good use for the needy and shut-ins. That's Lyman Brown in the center apparently giving a bit of information to an interested member.

Restaurant on Thursday, December 15, 1955. We were very pleased to have as our guests L. L. Menne, J. B. Straughn and Ted Rose from Headquarters. This was strictly a social meeting confined to wholesome entertainment. Chairman Dolivka probably earned first place among the entertainers for his very interesting stories.

Another social meeting is planned for February or March. We hope to have some of the members from Philadelphia, Hagerstown and perhaps some other chapters join with us and exchange greetings and ideas.

Regular meetings are held on the second Tuesday of each month at 100 N. Paca Street in Baltimore.

Detroit Chapter members made a tour through Radio-TV station CKLW, Windsor, Ont., Canada. Mr. Gene Sanders explained the operation of the TV camera, movie projectors, slide projectors, the monitors and the TV-FM transmitters. He gave a very excellent demonstration and description of the TV camera and parts.

Officers for 1956 will be elected at our next meeting. Students and graduates in the Detroit area who would like to join the chapter are invited to get in touch with Stanley Szafran, 2660 Holmes, Hamtramck, Michigan, or Jack Shupak, 4075 Tuxedo, Detroit 4, Michigan.

Chicago Chapter members continue with color TV lectures that are both informative and fascinating. NRI students and graduates in the Chicago area should take advantage of this opportunity to get the fundamentals of color Television through these illustrated lectures. Each meeting is topped off by working out the solution to the "tough dog" problems of members. A good way to get some real help on some of the hard ones.

Meetings are held on the second and fourth Wednesday of each month in the Tower Space in the American Furniture Mart Building, 666 Lake Shore Drive. Use West door for most convenient entrance.

New Orleans Chapter members are very happy over the election of their former chairman, Louis E. Grossman, as National President of the NRI Alumni Association. They look forward to the next meeting, a social in celebration of this honor which has come to the New Orleans Chapter. Mr. L. L. Menne and Mr. T. E. Rose of NRI Alumni Headquarters are scheduled to be guests at this social.

At one meeting Mr. Ed Schwartz, an expert on oscilloscopes, gave a very interesting talk on How to Locate Defects in TV Sets. Two defective TV sets were used in these demonstrations. Members were asked for their opinion as to the cause of the trouble and what they thought would be the remedy. Mr. Swartz then demonstrated the proper approach to the problem.

Officers elected for 1956 are as follows:
Chairman: Alfred Francis
Vice Chairman: Oscar Hilding
Treasurer: Octave Jumonville
Secretary: Anthony H. Buckley

The address of Chairman Alfred Francis is 1928 Louisa St., New Orleans 17, La. The address of Secretary Anthony H. Buckley is 305 Serpas Drive, Arabi, La.

Hagerstown Chapter, better known as the Cumberland Valley Chapter, meets regularly at the Hagerstown YMCA on the first Thursday of each month.

Election of officers for 1956 was held with the following result:
Chairman: Edwin M. Kemp
Vice Chairman: Melbourn A. Foreman
Secretary: John H. Pearl
Treasurer: Robert J. Saum

Chairman Kemp gave a very fine talk on In-Circuit Capacitor Leakage Tester.

Students and graduates in the Cumberland Valley area are cordially invited to meet with us.

St. Paul-Minneapolis Chapter heard Mr. W. C. Soderlund, Service Manager, George Spencer Company, who spoke on servicing the 1956 Admiral TV. At the same meeting Mr. J. R. Isnogle, Field Engineer, Admiral Corporation, spoke on the acceptance of color TV. Mr. Isnogle is a

progressive NRI graduate of 1930.

Mr. Bill MacIntosh of Starks Radio Supply Co., will be our speaker at a forthcoming meeting. He will demonstrate the use of testing equipment. Our members recall Mr. MacIntosh very well as our first guest speaker when our Chapter was organized.

Meetings are held on the second Thursday of each month at the St. Paul-Midway YMCA. Secretary John I. Babcock, 3157 32nd Ave., South, Minneapolis 6, Minnesota, will be glad to hear from any students or graduates of NRI who would like to receive notices regarding meetings.

A group of Milwaukee Chapter members. Note the badges which make it easy to identify members by name. Plenty of good fellowship in this chapter.

Milwaukee Chapter has elected the following officers for 1956.

Chairman: Ernie Bettencourt
Vice Chairman: S. J. Petrich
Secretary: Robert Krauss
Treasurer: Louis Sponer
Executive Committee: John P. Edgerton
Gunter Opperman
Philip Rinke

An expression of appreciation was extended to the nominating committee who conducted the election, namely Robert H. Weiging and Louis Sponer.

A vote of thanks was extended to Chairman Bettencourt for his excellent work with the Milwaukee Chapter News.

On motion by Ernie Kapheim a blackboard will be provided. The chapter is grateful to Mr. Petrich, at whose quarters the chapter meets, for suspending payment of rent until the chapter becomes stronger financially.

Mr. Rinke, Mr. Keller, assisted by Mr. Petrich gave a practical demonstration in the repair of television receivers. Films showing "The Transistor" and "Stepping Along with TV" were shown. Refreshments were served after the meeting.

The address of Secretary Robert Krauss is 2467 North 29th Street, Milwaukee, Wisconsin.

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TV Serviceman Needed

Powell's Furniture Store, in Mountain Home, Arkansas, is in need of a competent TV Serviceman capable of conducting a TV service department. Qualified students or graduates should contact Mr. A. C. Wolf, Powell's Furniture Store, Mountain Home, Ark.

Communications Technician Needed

The Lorain County Radio Corporation, 203 W. Ninth St., Lorain, Ohio, has an opening for a technician to service and install electronic equipment aboard Great Lakes vessels. Work includes AM, FM, Radar, and RDF. 2nd class radiotelephone license is required. Inquiries should be directed to P. E. Romoser, Chief of Development Engineering and Service, at the above address.

———*n r i*———

Broadcast Station Opporunities

Operators holding first-class radiotelephone licenses are needed by the following stations:
Station KWOC, Poplar Bluff, Iowa.
(D. M. Lidenton, Chief Engineer)
Station WAGR, Lumberton, N. C.
Inquiries should be sent directly to the above addresses.

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Here and There Among Alumni Members

John Costack of Regina, Sask., Canada, is employed as bench serviceman for Richie's Radio and TV. Mr. Frank Richie is an NRI graduate of some 25 years ago.

———n r i———

Graduate Andrew W. Hutnik, of Trenton, N. J., is employed with one of the Overseas Radio Stations of A.T. & T., at Lawrenceville, N. J. His station operates 30 transmitters, mostly single sideband with rhombic antennas, and power up to 80 KW.

———n r i———

Congratulations to Graduate M. H. Slone, of Ulysses, Ky. Five months after graduation from NRI he set up his own shop and is now very happy in full-time servicing.

———n r i———

Alexander Kish, of Carteret, N. J., recently sent an excellent photograph of himself at his Radio-TV Bench. He's doing fine in his own full-time shop.

———n r i———

Charles Free, of Idabel, Okla., is manager for the Idabel Music Co. and also operates his own Radio and TV Shop. Doing very nicely.

———n r i———

John P. Raposa of Fall River, Mass. has been elected 2nd Vice President of the Radio Television Technicians Guild of Greater Fall River. He is employed as Radio-TV Serviceman by Mason's Furniture Co., in Fall River.

———n r i———

Joe K. Duckworth, of Fort Worth, Texas, is doing teletype, transmitter, receiver, and relay station installation for the C.A.A. in the 2nd region.

———n r i———

Benny Collins of New Orleans Chapter was married recently. Says he has a solemn promise from his wife that he will be able to attend chapter meetings regularly.

———n r i———

Graduate Samuel C. Minetti, of Madison, N. J., now has amateur call K2QCY. He is also a Radioman first class in his Naval Reserve Electronics Division, and expects to take the exam for "Chief" Radioman soon.

———n r i———

Robert H. McKinney, former secretary of Detroit Chapter of NRIAA, reports more work than he can possibly do in spare time.

Amateur call for Alfred Younger, of Anderson, Indiana, is KN9ABA.

———n r i———

The owners of Marks Parts Co., 508 East Ohio Street, NS., Pittsburgh, Penna., with a branch at 313 Braddock Ave., Braddock, Penna., frequently attend meetings of Pittsburgh chapter. These people solicit the business of the members of our chapter who are doing Radio-TV servicing and are glad to give the customary discounts. They are open evenings, too.

———n r i———

John L. Baer, of Hilton, N. Y., has retired from the U. S. Navy and is now employed with Eastman Kodak.

———n r i———

John E. Harp, in his quiet unassuming way, is doing a bangup job as Treasurer of Baltimore Chapter. Very popular with the members u[illegible] know John is a good man on finances.

———n r i———

Richard S. Haynes, of Elizabethtown, Tenn., is doing what he describes as "most interesting" work in missile systems testing with Sperry-Farragut Co.

———n r i———

Johnnie Gallegos, of Los Alamos, N. Mexico, happily reports that he has received his 2nd Class Radiotelephone license from the FCC.

———n r i———

Norman E. Nolte, of Dayton, Ohio, is at present an Electronic Laboratory Technician at the Standard Electrical Products Co. He builds experimental models of electronic and electrical equipment for their Engineering Department.

———n r i———

Wm. C. Buecken, of Chicago, Ill., is pleased to report that he is an Inspector in the Government Inspection Laboratory of Motorola Corporation.

———n r i———

Edward Davidson of Morrisonville, N. Y., is another NRI graduate who started Radio and TV Servicing in his spare time and now has grown to a full time shop.

———n r i———

Claude W. Scott of Vallejo, Calif., earned enough money doing Radio-TV servicing in his spare time to pay for his course and to purchase tools and equipment. He is mighty proud of his NRI diploma.

———n r i———

Edgar A. dePool of Garden City, New York, is a professional musician who finds his Radio-TV work a pleasant hobby.

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