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Editorial: Technician—and Citizen

To increase **your** earning power was probably one of several reasons why you decided to enroll with NRI. You are willing to devote your time to the study of Radio, TV, Communications and Electronics because you like it; because you know that increasing your knowledge can mean better living for you and your family, better education for your children, and a host of other desirable things. Thus, increasing your earning power benefits you directly.

But what about things money can't buy—**freedom, religious liberty, your right to open your business wherever and whenever you please**—blessings which we enjoy as American Citizens? Will concentrating your efforts on building security for yourself and your family help preserve these precious things? I feel it will. A citizen who doesn't want to be dominated by his government should be financially independent of his government. Thus, the self-sufficiency gained through technical training is a big step helping to preserve American ideals. But is it enough?

Being an American Citizen means owing allegiance to your country at all times. Millions of us have learned the meaning of this in times of war. But more important, what can we contribute in times of peace? Because the United States has a government resting "on the people," you and I, as citizens, must keep informed about political trends of our government to do our part in **safeguarding** and **improving** principles which benefit each of us, every day. This is a challenge. It calls for the expression of **your own** carefully formed opinions—at the polls, in your lodge or church, or in letters to your Congressmen. Strive every day toward becoming a better citizen as well as a better technician.

J. E. Smith
Founder

In 1959. Americans spent a total of $2,890,000,000 for Radio-TV receiver repairs and maintenance. Average—$11.08 for every set in use.

Alumni Officer Nominations for 1961

See page 24

THE THYRATRON

"How the Thyratron Works"—an article beginning on page six of this issue, is taken from lesson material in NRI's new Electronics course.

This course, stressing Electronic principles, practices and maintenance, is designed to train men for career level jobs as Electronic Technicians in Government and industry. A few of the many subjects covered are: computers, servo-mechanisms, automation, ultrasonics, telemetering, radiation detection. This program answers a long-felt need in a technical field offering almost unlimited opportunity.

We believe students and graduates will find this article timely and interesting. Similar articles are scheduled for future issues of the News in keeping with our editorial policy to give NRI men the kind of reading they want most.

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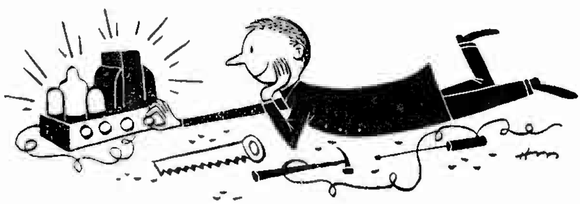


Hi-Fi Corner

by
John G. Dodgson

This Month—Product Evaluation: The Eico HF-87 Dual 35 watt stereo power amplifier

High Power Vs. Low Power. Not too many years ago, 10 to 12 watt power amplifiers were the standard in home music systems and a 20 watt unit was really high-powered. Then, for no apparent reason other than the striving for bigger and better (mostly bigger), amplifier power began climbing first to 30, then 35, and even 50 watts.

Now we have the HF-87 (and it's not alone): 70 watts of power for a home music system in a small listening room. Why,—when obviously only a small fraction of this power is necessary—and, for example, one of the larger theatres in this area used only 10 watts for decades? Does this high power capability really make any audible difference?

Frankly, I was of the opinion that any increase of power in my system would make no difference and the present dual 14 amplifier was more than sufficient. So I experimented with the lower power (?) 28 watt amplifier and the high power 70 watt Eico HF-87 amplifier by hooking them both through a switching system to a medium-high efficiency speaker system. Both amplifiers were thoroughly checked out and are quite similar in sine-wave frequency and square-wave response although the HF-87 has an edge in both departments. The input level controls of both amps were set to produce equal loudness from the speakers at 1000 cps.

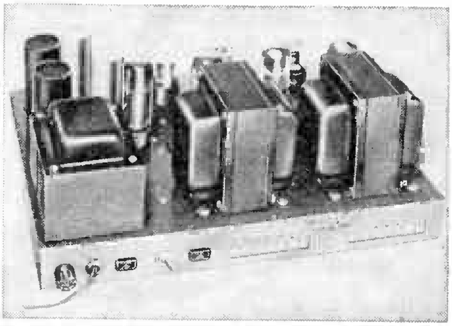


Fig. 1. The Eico HF-87 dual 35 watt stereo power amplifier.

Finally listening tests were run over several days with all types of music.

The results surprised me. The HF-87 was unquestionably superior for all but background level listening. The superiority was particularly evident on any loud passages, the beginning notes from practically any instrument, and the low bass and high treble sounds.

Previously, it was my opinion that it didn't make much difference which amplifier was used in a system providing it was fairly good. The HF-87 changed my mind. To me, using the HF-87 finely focused the sound—like opening a dusty window. The lucid clarity on loud passages and transients was often astounding. Of course this difference is not due to the power itself but to the fact that even when the amplifier is called on to produce peaks it is still "coasting" where a smaller unit would be strained and distorting.

The EICO HF-87 was obtained in kit form and constructed in less than 10 hours including checking parts, etc. No trouble was encountered and there were no errors in the assembly manual. Physically the HF-87 is somewhat unhandy to work on because of its size, 15" x 11" x 6", and weight, 32 lbs.

Performance. Square-wave response was remarkably good from 20 cps to 20 Kc. In fact, it was as good as any amplifier at any price that I've yet seen and I've seen most of them. Tilt at 30 cps was almost unmeasurable. At 5 Kc, where it is best seen, ringing was negligible.

The sine-wave frequency response was so flat it wasn't worth plotting on graph paper. Some of the figures obtained are shown in Fig. 2. Notice that at 1 watt output there is no variation from 20 cps to 20 Kc. Not shown in the table is that the output at 5 cps rose to +1.9 DB and

(Continued page four)

From the Mailbag:

These Graduates Show How NRI Training Has Paid Off

"My NRI training has put me in a position where my earning power has increased about 40%. I truly want to thank NRI for a well prepared course which I think needs no improving. I operate my own business in my spare time which is evenings after work and on Saturdays and last year I increased my earnings about $1200 above the year before. I would like to say the money that I spent for the NRI course had really paid off for me."

Robert L. Young
8199A Wiebel
St. Louis 40, Mo.

"The NRI course had helped me obtain a good position at Hamilton Standard, United Aircraft Corporation in the electronic division. I am receiving $2.07 per hour to start and a good chance for advancement. I can truthfully say that anyone who is contemplating taking the course will not have any regrets. Many thanks to NRI for a wonderful course."

Roger E. Vallerand
455 Granby St.
Hartford 12, Conn.

"Since I graduated in 1958, things began to happen for me. Presently I am employed with RCA as an Electronic Technician doing work on Television cameras and related equipment. I am 19 years old and earn $120 weekly at RCA. Your course has done a lot for me—my best investment. NRI is interested in men who are willing to study and work to attain their goal."

J. T. Szumowski
1702 Frankford Ave.
Philadelphia 25, Pa.

"I am proud to have selected NRI as my school. You have a very fine and constructive course which is well balanced and tailored for home study. Not only did I learn Radio-TV servicing but mathematics, physics, business accounting, precision tools, and most of all self confidence just to name a few. Nowhere can a man buy so much education for so little money. Let me say "thanks" again for everything NRI has done for me."

Earl A. Hudson
1109 Clarendon St.
Durham, N. C.

Long Distance Phone Calls To NRI

Students who call us long distance AND WHO USE DIRECT DIALING may save themselves money on their phone bill if they tell our operator. "This is a long distance call from (name of place)." Unless the student tells our operator, she cannot know.

When we know, we give the incoming long-distance call preference over other local calls and all other delaying factors.

The student should, of course, give his name promptly, and be ready with his student number. If we have to look up the number for him, his phone bill is running up while we are looking.

But whether he has his student number or not, he should tell us when the call is long distance.

Edward L. Degener Retires After Forty-One Years Service

NRI's General Manager Edward L. Degener was honored at a farewell dinner on June 29, 1960 following his decision to retire from active duty after 41½ years of faithful service as a top executive with the Institute.

"Ed" Degener started to work with NRI in 1918 as the *only* office employee at that time. He was made Advertising Manager in 1927 and rose to General Manager in April, 1944, the position held at his retirement.

Mr. Degener and his wife Sallie reside in Bethesda, Maryland. He intends to spend much of his time at his favorite pursuits —golf, traveling and gin rummy with fellow-golfers. All of their friends at NRI extend to them every wish for continued success in the new life before them.

at 100 Kc it dropped to only —2.3 DB. At the full 35 watts output there is only a —.4 DB drop at 20 cps and 20 Kc with, of course, 0 DB between these points. Both channels were within .45 DB of each other with one slightly better than the other. The above figures as well as those in Fig. 2 are from the worse channel!

Hum and Noise. What's that? Seriously the total hum and noise was so low I couldn't measure it. Connected to a high efficiency speaker system the HF-87 is totally silent 3 feet away from the speaker with both input controls wide open.

Features. The use of silicon diodes instead of a vacuum tube rectifier provides excellent power supply regulation. The diodes and tubes are protected from surges when first turned on by a surgistor. Two power outlets are provided on the chassis in addition to a toggle-type ON-OFF switch. The output transformers provide 32 ohm taps to permit monophonic operation with a 16 ohm speaker.

Complaints. Frankly, I haven't as yet found or thought of any. I would like to see all of the input and output on one side of the chassis but this is a moot point.

Conclusion. Considering the previous remarks, a summary is hardly necessary. To misquote Eico's own words the HF-87 is, without doubt, one of the finest amplifiers available but happily at a lower cost than others in its class.

Odds and Ends. There isn't space for another complete product report. However, some short comments on other products recently checked might be helpful to anyone in the market for that item. Most products mentioned were only "quick-checked"; some were thoroughly tested and full reports are in the works.

Frequency	0 DB=1 Watt	0 DB=35 watts
20 cps	0 DB	—0.4 DB
50 cps	0 DB	0 DB
20 Kc.	0 DB	—0.4 DB
50 Kc.	—0.8 DB	—2.2 DB

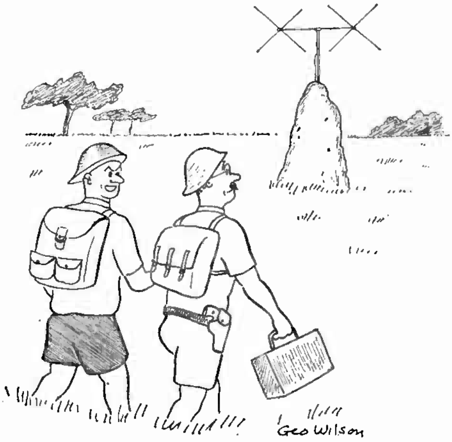
Fig. 2. Frequency response of the Eico HF-87. The first column is the test frequency; the second, the variation in DB at the 1 watt level; and the third shows the variation in DB at the full 35 watt output. See text.

Low Cost Amplifier. The task of locating a satisfactory inexpensive factory built stereo preamp-amplifier for a friend's low cost stereo system proved interesting. At least it turned up the *Grommes 20LJ*—a remarkable buy. This 20 watt stereo amp-preamp, at only $69.95, proved better than several others priced up to $100. The frequency response dropped off at the low end but could be brought up with the bass control. The high end response was excellent. Don't expect it, of course, to equal higher priced units in performance or features. Last, but not least, here is one you won't have to hide in the house—very stylish design.

Bookshelf Speakers. Anything smaller than a bathtub is called a bookshelf speaker—none will fit in a bookshelf (and some would be better off converted into bookshelves). But once in a while a "winner" comes along—like the *Fisher XP-1.* This is a 3-way system, 12 inch woofer, 5 inch mid-range, plus a super-tweeter. I must admit I was quite surprised with the XP-1; it has a big sound uncommon in a small system. Most tend to sound like the music is coming from a hole in the wall. The bass is excellent—substantial harmonic free output at 30 cps; the mid-range seemed a little ragged (not enough to worry about) and the highs quite smooth and bright. Although it is a high compliance system, necessary for low-bass response in a small enclosure, the Fisher XP-1 is a high efficiency unit. I had no trouble driving it with a 10 watt amplifier although it did sound better on peaks with higher power.

All things considered, the Fisher XP-1 must be classed as one of the better "bookshelf" systems. Don't fail to listen to it if you're in the market for one.

Fairchild. Their SM-1 moving magnet stereo cartridge proved to have excellent frequency response—within ±2.8 DB from



"You'll say these ants are almost human, Professor."

30 cps to 15KC. A slight rise from 2KC to 10KC gives it a bright sound suitable for many of the popular high compliance speaker systems. Unfortunately I found some break-up on high level glide tones with under 5 grams pressure. A note to the factory brought two more cartridges that tracked without difficulty at 3 grams.

More impressive from Fairchild is their 212 turntable. It is quite large and impressive. Powered by a synchronous motor and an ingenious double-belt drive, it has proved remarkably smooth in operation and free from any noise, rumble, wow or flutter.

Shure M3D Stereo Cartridge. This is not a new cartridge nor is it an inexpensive one at $45. To go further it isn't even impressive looking. However, of 16 stereo cartridges checked so far, the Shure M3D is, in my opinion, the very best. Besides its very flat frequency response it is remarkable for its superb transient response and excellent tracking ability. I have yet to find any recorded music it can't perfectly track at 3 grams. At $45 it is, of course, aimed at the better systems—and the better the system the more one appreciates the M3D.

(Note that all the stereo cartridges have not yet been checked, particularly the newer ones—Empire 108 or Pickering 381, to name a few.)

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The Luckless Legion

Millions of column inches of valuable space are contributed by American newspapers and magazines every year in the never-ending battle to halt the bloody carnage taking place on our highways. It seems incredible that drivers continue to act as they do behind the wheel of an automobile despite the avalanche of grim facts and warnings.

But it is a matter of record; record that is slightly over 50 years old yet already stands as one of the more sordid indictments against our society.

A recent report by The Travelers Insurance Companies states that since the advent of the automobile, **more than 62,000,000** men, women and children have been killed or injured on our highways. **More Americans have died on our highways than in all the wars this country has fought. More have been injured in U. S. traffic accidents than in all the world wars combined!**

The cause of this slaughter screams for attention. More than 85 per cent of all fatal accidents last year was blamed on human error!

More than 85 per cent of the 37,600 deaths in 1959 occurred because somebody behind the wheel had shrugged off the countless highway safety news stories and editorials printed each year. "It can't happen to me," he thought.

Perhaps he didn't consciously think that. Maybe the fact that it could happen to him didn't get past his subconscious. Perhaps it never did happen to him. Perhaps he was the survivor in a horrible crash that maimed and killed those he loved most.

Inattention is the overwhelming factor which figures in 85 per cent of our death crashes. A lapse of attention to the road ahead, a heavy foot on the gas pedal, an unnecessary gamble to save a few seconds that cost an eternity—these are the ways in which the human behind the wheel failed. The supreme penalty was the result for those who erred once too often.

It is safe to predict that as drivers we will be exposed to countless news stories describing what happened because the human behind the wheel made a mistake. Read them carefully. They can help us all to avoid that same mistake—and pay the supreme penalty.

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HOW YOU CAN HELP NRI GIVE FASTER SERVICE

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

Intelligence is like a river—the deeper it is, the less noise it makes.

How The Thyratron Works

By

A. Widmann
NRI Editorial Staff

An increasing number of radio-TV service shops are supplementing their income by servicing industrial electronic equipment. This large growing field is a natural for the local service shop. The radio-TV technician has a wealth of basic electronic know-how that makes it easy for him to learn to service industrial equipment. Many of the circuits and parts are similar to those used in Radio and Television receivers. Often the industrial circuits are less complicated. However the technician can get stumped if the circuit uses a component part that is new to him. The thyratron tube is one example. Many circuits are built around this tube and the circuit operation depends upon the characteristics of the tube.

The grid-controlled gas-filled thyratron tube comes in sizes ranging from miniatures with standard 7-pin bases to heavy industrial types nearly two feet long. The thyratron shown in Fig. 1 illustrates the rugged construction of some industrial types. Many of the smaller thyratrons look just like ordinary receiving tubes. Regardless of their size or shape, they all work on the same basic principle of passing large amounts of current when the gas in the tube ionizes. This large current-carrying capacity makes a thyratron the choice for industrial electronic circuits such as relay circuits, motor control circuits, and regulated power supplies.

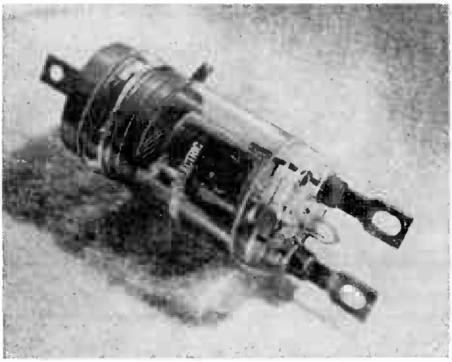


FIG. 1. A large industrial type gas-filled thyratron.

Art Widmann

To intelligently troubleshoot circuits using thyratron tubes, it is necessary to thoroughly understand what goes on inside of the tube. The tube's special characteristics result from the gas in the tube. Gas is used in gas-filled diode rectifiers as well as thyratrons and since the gas diode is simpler than the thyratron, let's study the gas diode first to learn how the gas acts. Then we can apply what we learn about gas diodes to the thyratron.

The Gas Filled Diode

An inert gas, such as mercury vapor, argon, or Xenon, increases the current carrying capacity of a tube. You know that whenever the cathode of a vacuum tube is heated, it emits electrons. These electrons form a negatively charged cloud of electrons called a space charge, around the cathode. It is from this space charge that the plate draws electrons to produce plate current. The negative charge of the electron cloud opposes the emission of electrons from the cathode. This action accounts for the relatively high internal resistance of the vacuum tube. In effect the space charge limits the amount of current that the tube can conduct.

If we put a small amount of inert gas in the tube, we can eliminate the space charge and increase the current-carrying capacity of the tube. When heat is applied to the cathode, some of the emitted electrons are attracted towards the plate just as they are in a vacuum tube. The positive voltage on the plate accelerates the electrons. As an electron moves toward the plate, it may collide with one of the gas molecules. If the electron strikes the gas molecule hard enough, it will knock electrons loose from the gas. This leaves the gas molecule deficient in electrons and the molecule becomes a positive ion. The positive ion will attract another electron from the space charge to balance its positive and negative charge. However, when many collisions take place there is a rapid interchange of electrons because the electrons emitted from the cathode are continuously striking gas molecules. At the same time, the positive potential at the plate is attracting the free electrons and accelerating them toward the plate. The area between the plate and the cathode becomes filled with electrons, positive ions, and non-ionized gas molecules. The tube is said to be ionized and the swirling mass of electrons, positive ions, and non-ionized gas molecules is called "plasma." This plasma

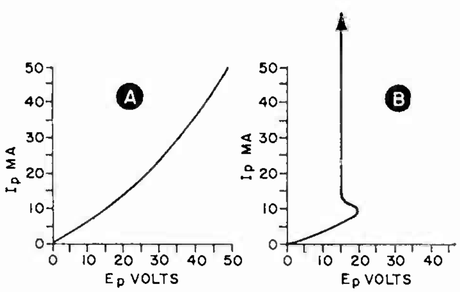


FIG. 2. The Ep-Ip curve for a vacuum diode (A), and the curve for a gas-filled diode (B).

is an excellent conductor of electricity. As the plate draws current from the plasma, the positive ions in the plasma draw electrons from the area close to the cathode. The electrons are attracted away from the cathode as fast as they are emitted so no space charge builds up. Therefore, the internal resistance of the tube is decreased and the current carrying capacity is greatly increased.

Once the gas in the tube ionizes, the voltage drop across the tube becomes almost constant regardless of the current flowing through the tube. Fig. 2 compares the EP-IP curve for a vacuum diode and a mercury-vapor diode. Notice that for the vacuum diode (Fig. 2A), the plate current IP varies almost directly with the plate voltage EP. As plate voltage is increased, plate current will continue to increase until the tube reaches saturation.

Fig. 2B shows a different curve for a gas-filled diode. When the cathode of a gas filled tube is heated, electrons are emitted and form a space charge just the same as in the vacuum tube. As the plate voltage is gradually increased from zero, some of the electrons leave the space charge and travel to the plate. When the plate voltage is low the electrons move quite slowly and do not have enough velocity to knock electrons loose from the gas molecules. Therefore the gas is not ionized and the plate current curve is much the same as it is for the vacuum tube when the plate voltage is low.

However, as the plate voltage is increased from zero the electron velocity increases. At some specific value of plate voltage, the electrons velocity will be great enough to knock electrons loose from the gas molecules. The gas ionizes and the positive ions quickly eliminate the space charge. The internal resistance of the tube drops to a low value and the current flow jumps to a high value. The voltage across the tube drops to the minimum value required to keep the tube ionized. Then the plate voltage stays almost constant as the plate current rises in almost a straight line.

The specific value of the ionization potential depends mainly on the type of gas used. After the tube ionizes, the plate voltage will remain almost constant no matter how much current is flowing or how high the available supply voltage may be.

In Fig. 2B the plate current curve is shown rising toward a maximum value but it does not give an indication of what the final value will be. We must know more about the circuit to determine the actual current flow when the tube ionizes or fires. The action of a gas tube closely resembles the action of a switch. Before the tube fires, little or no current flows through it and we can compare it to an open switch. Once the tube ionizes, it acts as if we had shorted the plate and cathode together—just as if we were closing the switch. As in the case of a switch, the amount of current flow through it depends on the impedance of the external circuit.

There is one other condition that limits the current in a gas-filled tube. This is the maximum number of electrons that can be emitted by the cathode. However, a gas filled tube will usually destroy itself by overheating before this limit is reached. From this you can see that a gas tube must never be operated without a load to limit its current to an amount that can be safely handled by the tube. This is an important factor that must be considered when dealing with all kinds of gas filled tubes.

Grid Controlled Thyratron

When a third element or grid is placed between the cathode and plate of a gas filled tube, the tube is called a thyratron. A comparatively small control signal applied to the grid can control the large currents that a gas tube conducts. However the control characteristics of the thyratron are entirely different from those of a vacuum tube.

A vacuum tube triode can act as an amplifier because its grid can control the plate current at all times. When a varying potential is applied to the grid, the plate current will vary directly with the grid voltage. In a thyratron, the grid can prevent the tube from conducting current, but it cannot stop conduction or make any changes in the plate current once conduction has started. As soon as the gas ionizes and the tube conducts, the grid loses all control.

Fig. 3 shows a thyratron tube connected

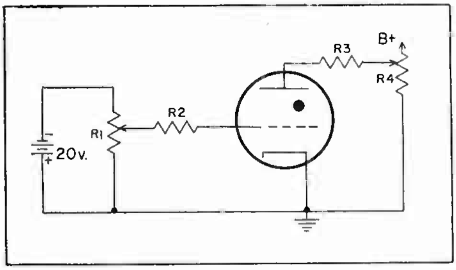


FIG. 3. Circuit arrangement used to study the conduction characteristics of a thyratron.

in a test circuit to illustrate the conduction characteristics of the tube. The black dot next to the grid in the tube envelope is the symbol to indicate gas in the tube. The grid is connected through R2 to potentiometer R1 and a battery in such a way that we can vary the grid voltage from zero volts to —20 volts. The plate is connected through R3 to the arm of potentiometer R4 so we can vary the plate voltage of the tube.

If we put a high enough negative potential on the grid of the thyratron, the plate potential will have little or no effect on the electrons emitted by the cathode. The negative voltage on the grid will repel the emitted electrons back toward the cathode. The electrons will not obtain a high enough velocity to ionize the gas in the tubes. In this way, we can prevent the tube from firing and from passing current as long as we maintain a sufficiently negative grid potential. So far, the action is the same as it is for a vacuum tube triode in which the grid is biased beyond cut off. However, once we reduce the negative grid potential in a gas filled tube below cut off, the comparison ceases. As soon as the negative grid voltage is reduced enough to allow the gas to ionize, the tube conducts and the grid loses all control of current flow. The positive ions in the plasma are attracted to the negative grid and surround it. The positive ions form a sheath around the grid that prevents the grid potential from having any effect on the tube current. As the positive ions come in contact with the grid they take an electron from the grid and are neutralized. However another positive ion immediately moves in to take the neutralized gas molecule's place. Thus there is a steady movement of positive ions to the grid and a steady flow of electrons from the grid circuit into the grid. This grid current flow makes it necessary to place a series grid resistor, such as R2 (Fig. 3), in the grid circuit of thyratrons. If a grid resistor is not used, enough grid current can flow to damage the tube. These grid resistors are usually a large value from 470K to several megohms.

Once the gas ionizes, the thyratron acts very much like a gas diode. The space charge is neutralized and internal resistance of the tube becomes very small. The voltage across the tube drops to a low value and current rises to a high value. For this reason the plate circuit resistance must be high enough to limit the tube current to a safe value. Compared to vacuum tubes, thyratrons can safely conduct much larger current. However, there is a limit and the limit is different for each thyratron tube type. Since thyratrons have such a small internal resistance, it is easy to exceed their ratings. Thus, if the plate load resistance is shorted even momentarily it is possible to ruin the tube.

The only way to stop conduction of a thyratron tube is to lower the plate potential below the ionization potential. Once the tube fires the grid loses all control and the current through the tube is limited by the resistance in the plate circuit. In Fig. 3 we show the plate resistance made up of R3 and the part of R4 from the slider to B+. As we move the slider closer to the ground end of R4, the available plate supply to the tube gets smaller and smaller. This causes the tube to conduct less and less current. When the plate voltage is lowered below the ionization potential of the tube, the gas in the tube de-ionizes. The electrons

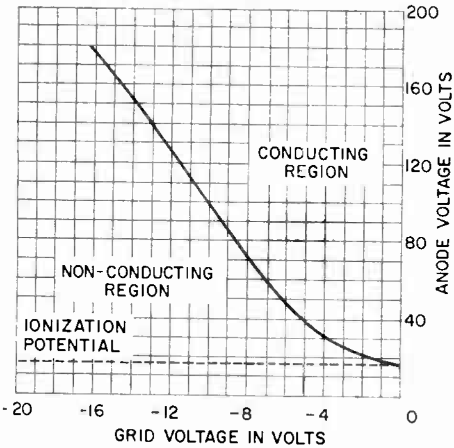


FIG. 4. Grid-voltage, plate voltage conduction curve for a small thyratron.

leaving the cathode are no longer accelerated enough to knock electrons loose from the gas molecules. The positive ions all capture electrons and are neutralized. Soon the entire gas is neutralized and the plate current drops practically to zero. The length of time required for the gas to de-ionize varies with different thyratron tube types. In some, the gas will deionize in 100 microseconds while in others it takes as long as 1000 microseconds.

After the gas in the tube de-ionizes the grid regains control. The negative potential on the grid is no longer shielded by positive ions. If the plate voltage is increased above ionization potential the negative grid potential repels the electrons that are emitted from the cathode and the tube is prevented from ionizing.

The grid potential necessary to keep the thyratron from firing varies with the plate voltage. Fig. 4 shows a plot of the grid potential necessary to prevent the tube from firing at different plate voltages The tube will not conduct for any combination of grid and plate voltages to the left or below the curve. To the right and above the curve is the conducting region. Any combination of grid volts and plate volts in this region will result in the tube ionizing. For example, with a plate potential of 100 volts, the grid potential must be less than —10 volts for the tube to fire. Also, if the grid is held at —10 volts, the plate voltage must be raised above 100 volts before the tube will conduct. The dotted line in Fig. 4 shows that the tube will never fire unless the plate voltage is greater than the ionizing ionization potential, regardless of the grid voltage. Another thing about the graph—the curve applies only to the firing potential of the tube. Once it has fired, a change in grid potential cannot cut it off again. The plate potential must be lowered below the ionization potential to stop the tube from conducting.

To control the current in a thyratron we must control both the grid voltage and the plate voltage. One way to control the plate voltage is to use AC for the plate supply voltage. During the negative half of the AC cycle, the plate voltage will drop below the ionization potential of the tube and give the grid a chance to regain control. With AC on the plate, we can then use a control voltage upon the grid. The two common methods of grid control are phase shift control and bias control. Let's look at bias control first.

Bias Control. The method of controlling the output of a thyratron by setting the dc bias on the grid is called bias or amplitude control. Fig. 5 shows a grid controlled rectifier that we can use to illustrate the grid bias control principle. This circuit is a grid-controlled half-wave rectifier and is one that is sometimes used in industrial circuits.

The circuit in Fig. 5 is much like any half-wave rectifier except for the adjustable bias arrangement in the grid circuit of the thyratron. AC is supplied through the isolation transformer T1 to the plate of the tube. The rectified current produces a dc output potential across resistor R3 which represents the rectifier load. In the grid circuit, variable resistor R1 allows us to vary the grid to cathode bias from zero to —15 volts. Resistor R2 is a grid current limiting resistor.

Now let's see how the grid circuit is able to control the dc output of the rectifier circuit. If we move the slider of R1 all the way to the top, the full —15 volts will be applied to the grid of the thyratron. From

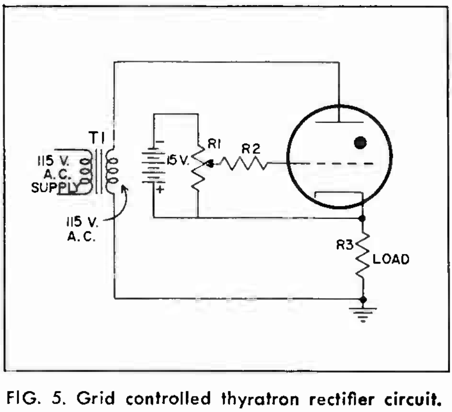


FIG. 5. Grid controlled thyratron rectifier circuit.

the EG-EP curve in Fig. 4 we can see that this voltage is sufficiently negative to prevent the tube from ionizing. The tube is held cut off and there is no dc output from our circuit.

When the grid to cathode voltage is zero the dc output of the circuit will be maximum. Moving the slider of R1 in Fig. 5 to the cathode end of R1 reduces the grid to cathode potential to zero. The tube will conduct each time the AC plate voltage goes positive and the circuit will function as an ordinary half-wave rectifier. Fig. 6 shows the plate voltage and current curve for the circuit in Fig. 5 with grid voltage at zero. The plate voltage curve shows the positive alternation of one cycle of 115 volt AC. An RMS voltage of 115 volts produces a peak voltage of 161 volts as shown. When the AC voltage cycle rises above the ionization potential marked ET in Fig. 6, the tube fires. The curve for the plate current jumps to a value determined by the plate voltage and the load resistance R3. As plate voltage increases to 161 volt, the plate current increases up to a maximum of 100 milliamps. Then plate current falls as plate voltage decreases. When plate voltage drops below the ionization potential, plate current drops to zero because the tube de-ionizes. During the negative half cycle of plate voltage no plate current flows. Thus the tube rectifies the AC on the plate and produces a dc output. Notice that the average current is 31.8 milliamps. This is the maximum amount of output of our power supply and it is maximum when grid bias is zero.

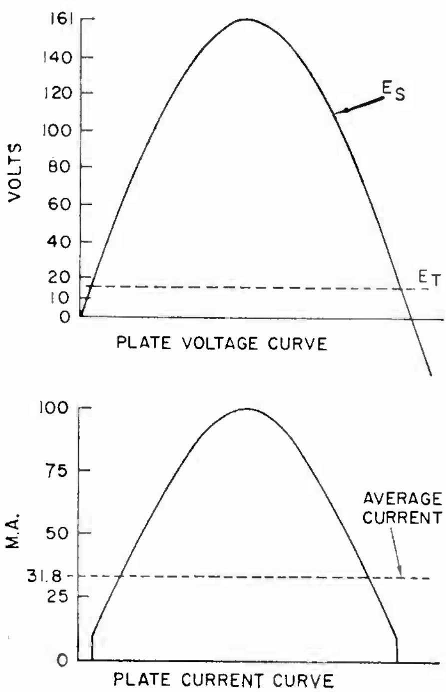


FIG. 6. Plate current with zero grid volts.

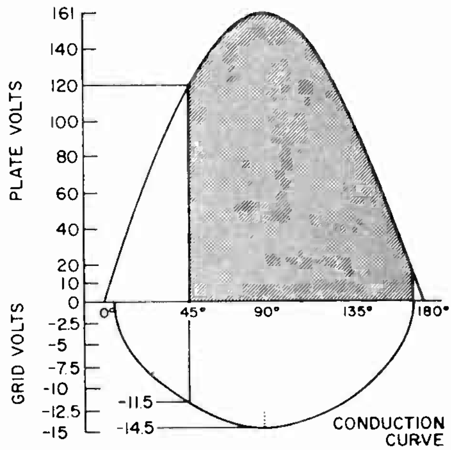


FIG. 7. Typical thyratron conduction curve with 115V AC plate supply.

Now let's examine the conduction of the tube with grid bias voltage between zero and cut off. Fig. 7 shows the conduction curve for a typical thyratron with 115 volts AC plate supply. By comparing this conduction curve with the one in Fig. 4 you can see that they are for the same tube. In Fig. 7, the same information has been plotted against the positive alternation of a sine wave cycle on the plate. It shows the grid potential required to cause ionization at the different values of plate voltage. For example plate voltage rises to 120 volts during the first 45° of the plate voltage cycle. By projecting the line from the 120 volt point through 45°, the line intersects the conduction curve at —11.5 grid volts. This tells us that a grid voltage more negative than —11.5 volts will prevent conduction at 45° while a grid voltage less than —11.5 volts will allow the tube to fire.

The condition shown in Fig. 7 is with the grid bias voltage held at —11.5 volts. This bias is sufficiently negative to prevent the tube from conducting until the plate voltage rises to 120 volts. When the plate voltage reaches 120 volts the tube fires and passes current for the remainder of the half cycle. The tube did not conduct until the plate voltage had passed through 45° of its cycle. This is called the firing angle of the tube.

We can change the firing angle by adjusting the grid bias. Setting the grid bias at —5 volts will cause the tube to fire earlier in the plate voltage cycle. The tube will conduct for a longer time during each half cycle and the average current for the tube will be increased. Setting the grid bias more negative will decrease the average current. With —14.5 volts on the grid the tube will not conduct until the plate voltage rises to 161 volts. This is the peak plate voltage and since it occurs half way through the positive half cycle, we have increased the firing angle to 90°. The tube conducts for only half of the positive alternation and the average current has been decreased.

The average current was 31.8 milliamps at 0° firing angle (zero volts bias) when the tube conuducted for the entire half cycle. With a 90° firing angle (—14.5 volts bias) the tube conducts only half as long for each positive alternation so the average current to 15.9 milliamps. This is the full extent that we can control the current with dc bias control. If we try to increase the firing angle above 90° by making the grid more negative than —14.5 the tube will never fire and the output current would be zero.

While bias control is limited to controlling the current over the first 90° of the cycle, it is still useful. In Fig. 5 we showed a small thyratron controlling 100 milliamperes of current. A larger thyratron will work exactly the same but would pass much more current. It could be used to control the dc level of the power supply or the speed of a dc motor. The circuit enables us to control a large amount of current by simply adjusting the dc bias control.

While the bias control method is widely used because of its simplicity, it has several disadvantages. The most obvious is, of course, that we cannot control the firing angle during the last half of the positive alternation. Another big disadvantage is that variation in the tube characteristics occur with temperature changes. While the variations are usually small, the conduction curves for most tubes are quite flat. This means that even small variations in characteristics will have quite an effect on the firing angle of the tube. If we require better control of the firing point we can use phase shift control.

Phase Shift Control. By using an AC control voltage on the grid we can get precise control of the firing point over the entire positive alternation. The AC control voltage is phase shifted to control the firing point. This method of control is called phase shift control. To see how it works let's look at Fig. 8. It shows one positive alternation of the plate supply voltage, the conduction curve for the tube, and two possible AC control signals. The solid line shows an AC grid control voltage 180° out of phase with the plate voltage. When this signal is applied to the grid of the thyratron, the tube will not fire. As the plate voltage rises toward maximum, the grid voltage increases toward maximum in a negative direction. The grid voltage never crosses the conduction curve and so the tube does not fire.

The dotted curve shows the operation of the tube with an AC grid control voltage that has been shifted so it is 162° out of phase with the plate voltage. This means that the grid voltage will cross the zero line 18° before the plate voltage reaches zero. As shown in Fig. 8, this causes the grid voltage to intersect the conduction curve at about 135°. With a firing angle of 135°, the tube conducts for the remaining 45° of the positive alternation and passes a small amount of current.

From this you can see that by shifting the phase of the AC control voltage different amounts, we can control the tube over the entire positive alternation. The negative swing of the AC control voltage holds the grid below the conduction curve during part of each cycle. This allows the grid voltage to start conduction even after the plate voltage has passed its peak. The control limits are not quite a full 180° because the tube can never fire until the plate voltage reaches the ionization

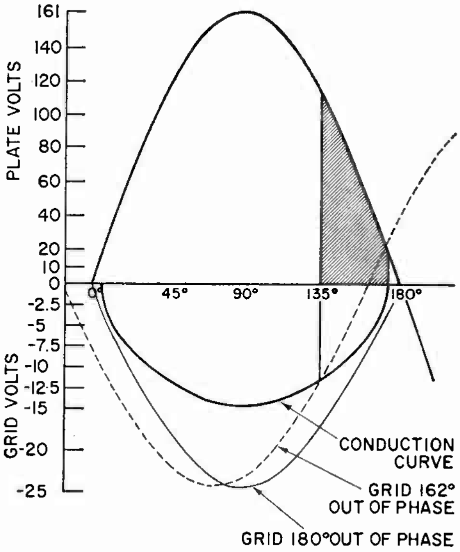


FIG. 8. Thyratron operation with AC on grid and plate.

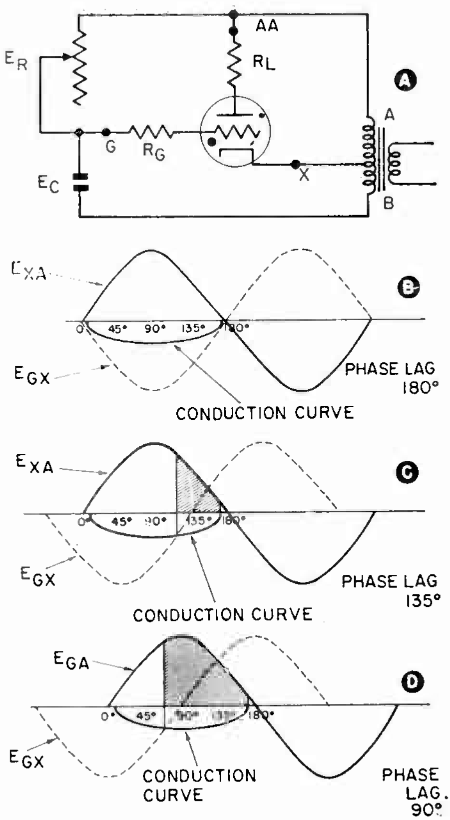


FIG. 9. RC phase shift used to control thyratron.

potential. Also it will stop firing slightly before the end of the alternation when the plate supply drops below the ionization potential. Since the ionization and de-ionization potentials are so small compared to the maximum plate supply, these two factors can be ignored for most practical purposes.

In addition to wider control of the firing angle, phase shift control gives greater precision. As you can see in Fig. 8, the rapid change of the grid voltage sine wave causes it to intersect the conduction curve at a sharp angle. Therefore, small variations in tube characteristics will have little effect on the firing point of the tube. Thus the two disadvantages of bias control are overcome by using phase shift control.

Phase Shift Controlled Thyratron

Fig. 9A shows a thyratron circuit with a simple RC network in the grid circuit to provide phase shift control. The secondary of the power transformer is arranged to provide both plate voltage for the tube and an AC signal for the grid circuit. The grid circuit has a capacitor and a variable resistor for shifting the phase of the AC signal from the transformer. With the slider of the variable resistor moved all the way to the top the grid of the tube will get the same voltage at the plate. Point A of the secondary of the transformer will be connected directly to point G in the grid circuit. Thus the grid voltage will go positive the same time as the plate voltage goes positive. The firing angle is 0° and the tube conducts for the entire positive alternation of plate voltage.

With the slider of the variable resistor moved all the way down, the slider moves off the resistance and opens the circuit. The voltage supplied to the grid now comes from the X-B section of the transformer. End B of the transformer is 180° out of phase with end A which is the plate supply voltage. The voltage at B is coupled through the capacitor EC to point G and the grid of the tube. Thus the grid is supplied an AC voltage that is 180° out of phase with the plate voltage as shown in Fig. 9B. The grid voltage Egx, never crosses the conduction curve for the tube and the tube never fires.

By moving the slider arm up we can phase shift the signal and produce the condition shown in Fig. 9C. With resistance in the circuit, some current will flow through the EC-ER circuit. The voltage across the capacitor lags the current through the circuit. The AC signal that appears on the grid will now be the vector sum of the voltage across EC and the voltage across the X-B section of the transformer. The voltage across XB would make our grid 180° out of phase with plate voltage. However, the voltage across EC changes the 180° phase angle. The amount of voltage across EC depends upon the amount of current flowing through the EC-ER circuit. In Fig. 9C, the resistance has been adjusted so the total phase shift of the grid voltage is 135°. This causes the grid voltage Egx to cross the conduction curve and current flows for part of each cycle.

Decreasing the resistance of ER will produce the condition shown in Fig. 9D. With less resistance in ER, more current will flow through the EC-ER circuit and there will be larger voltage across EC. This shifts the resultant grid voltage Egx more nearly in phase. As shown, Egx is 90° out of phase with the plate voltage. The grid voltage crosses the conduction curve early in the cycle and current flows for a greater portion of each cycle. From this you can see that by adjusting the slider of the resistor ER we can smoothly vary the current through the thyratron tube and load RL from zero to maximum.

A Thyratron Motor Control Circuit

Fig. 10 shows a schematic of a full-wave grid-controlled rectifier used as a motor control circuit. The circuit controls the amount of current flow through the armature of a DC motor. The field of the motor is separately excited by a dc supply voltage. The speed of the motor is controlled by adjusting the amount of current that the thyratrons pass. The plates of the thyratrons are connected to opposite ends of the secondary of the power transformer T1. Therefore the tubes provide full wave rectification of the AC supply. The center tap on the transformer provides the DC return path through the armature.

The firing angle of the thyratron is controlled by a phase shift circuit. The grid of V1 is connected to one end of the secondary winding of T2 while the grid of V2 is connected to the other end. Thus the grids are supplied an AC signal that is 180° out of phase. The phase shift circuit that supplies the AC signal to the grids is in the primary circuit of T2. Variable resistor R1 and the choke L1 make up the phase shift network.

The AC voltage is supplied to the phase shift network through L2. Winding L2 is a separate secondary winding on the core of transformer T1. An AC voltage develops across L2 which is in phase with the plate supply winding of T1. Secondary winding L2 is connected in the phase shift circuit between the center tap of T2 primary and the junction of R1 and L1. The phase shift network shifts the phase of the current flowing through the primary of T2. Therefore, the voltage induced in the secondary of T2 is phase shifted by the same amount.

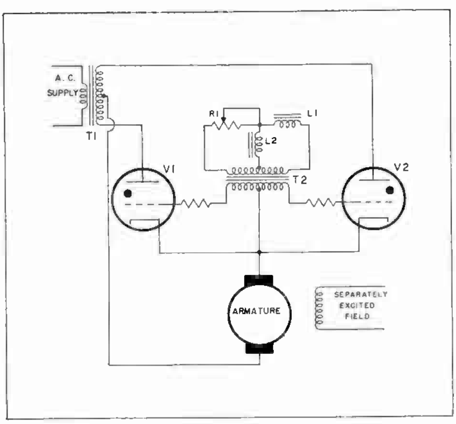


FIG. 10. Full-wave grid-controlled rectifier used as a motor control circuit.

The transformer windings of T2 are properly phased to provide a suitable grid signal for both thyratrons. When the plate voltage of V1 is on the positive alternation, the grid signal for V1 will be on a negative alternation. The next half cycle will cause the plate of V2 to go positive and its grid will be on the negative alternation. When R1 is adjusted to shift the phase of the grid control signal, both tubes will be affected the same amount. Thus for a given setting of R1, both tubes will pass the same amount of current on alternate half cycles of plate voltage.

When the slider of R1 is positioned so the resistance is completely shorted out, the grids are supplied signals 180° out of phase with their plate voltage. The thyratrons do not conduct and no current flows through the motor armatures so the motor is stopped. As R1 is adjusted to increase the resistance, the signals to the grids are shifted more nearly in phase with the plate voltage. The firing angle of the tubes is made smaller and the tubes conduct for a portion of each cycle. The rectified current flows through the motor armature causing the motor to rotate. In this way the motor speed can be smoothly varied through its entire operating range by adjusting R1.

The Thyratron Relay Circuit

Fig. 11 illustrates the use of a thyratron for operating a relay. This circuit uses a 2D21 thyratron which is a popular tube for relay circuits. The tube is the size of an ordinary peanut receiving tube and uses a standard 7-pin socket. You will notice the schematic shows a screen grid and the tube is actually a tetrode. In this circuit the screen is tied to the cathode and serves no control function. However, in some applications of the 2D21 a control signal is fed to both the control grid and screen grid. If either grid is held sufficiently negative the tube will not fire.

The circuit in Fig. 11 is a sound operated switch. A circuit of this type has been used to start the timer and camera for determining the winner of horse races. The sound of the starting gun is picked up by the dynamic microphone. The dynamic microphone generates an electrical signal that fires the thyratron. Current flow through the thyratron also flows through the coil of the relay causing the relay contacts to close. The contacts complete the circuit to the clock timer and the photo-finish camera. This arrangement insures that the clock is started at the start of the race so it will record the actual running time of the race.

Batteries are provided for both the plate supply and the filament circuit because the unit is portable. The unit is placed near the starting gate so the time it takes for the sound to travel to the microphone will not cause any appreciable timing error. A long cable connects the relay contacts to the timer and camera.

Let's go through a cycle of operation to see how the circuit works. Shortly before starting time, switch S1 is closed. You will notice that this is a two section switch. S1A completes the circuit of the 6 volt battery which provides filament current for the tube and bias voltage across R3. The S1B section of the switch completes the circuit to the 90 volt battery which provides plate voltage through R4 and the coil of the relay. C2 charges to the 90 volt battery potential through R4.

After the filament warms up, the circuit is ready to operate. The 2D21 is held cut off by the negative voltage picked off from R3. Trace the filament circuit and you will see that the switch end of R3 is also connected to the cathode of the tube. The other end of R3 is connected to the negative terminal of the 6 volt battery. Thus we can adjust the bias between zero and —6 volts by setting R3. The bias is set sufficiently negative so that ordinary sounds will not generate enough signal to overcome the bias. The sharp report of the starting gun causes the microphone to generate a large signal. The signal is developed across R1 and coupled through C1 to the grid of the thyratron. The signal overcomes the grid bias and the tube ionizes. Current flows through the tube and relay coil. The magnetic field of the relay coil attracts the relay arm closing the relay contacts.

Capacitor C2 speeds the action of the relay while R4 limits the relay holding current. The relay coil requires much more current to pick it up than to hold it closed. When the tube fires a sudden rush of current flows through the tube and relay coil to C2. This provides a large amount of current to close the relay quickly. This current partially discharges C2 after which the current through the circuit is limited by R4. This arrangement insures quick operation of the relay and keeps the current drain low on the battery.

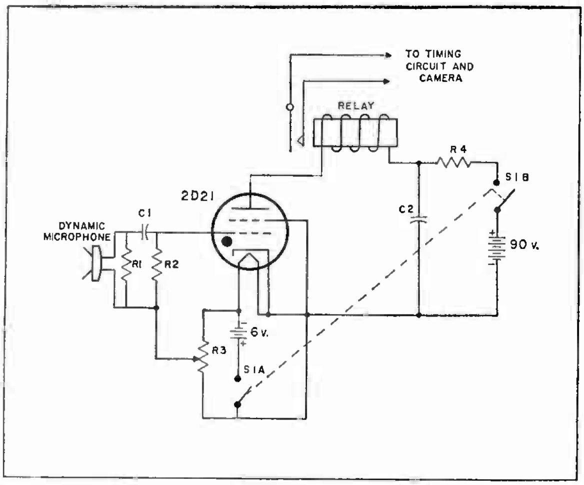


FIG. 11. The sound of the starting gun actuates this thyratron operated relay.

After the race is over the relay is released by opening the switch. Since the grid loses control when the tube fires, plate voltage must be removed to de-ionize the tube and allow the grid to regain control. The switch has to be opened only momentarily and then the circuit is ready for another cycle.

———nri———

ALL-AMERICAN HEADACHE

It's a tough world for the American businessman. Every time he comes up with something new, the Russians invent it a week later and the Japanese make it cheaper.

Twilight Sentinel Automatic Light Switch

Courtesy Guide Lamp Division, General Motors Corporation

INTRODUCTION

The Guide "Twilight Sentinel" is an electronic device which automatically controls the "on-off" operation of the headlights, tail lights, and instrument lights of the car on which it is installed. This operation is in response to the amount of light striking a light-sensitive cell. The complete system consists of three units—photocell, amplifier, and "manual-automatic" switch. (See Fig. 1).

The photocell is a photo-conductive type and is mounted face up, behind the windshield, so it is exposed to direct sky light. The photocell converts the sky light into an electrical signal which is used by the amplifier unit. (See Fig. 2, page 17).

The amplifier unit applies voltage to the photocell and switches the car lights on or off in response to a signal from the photocell. The amplifier unit consists of a transistor amplifier, sensitive relay, and power relay. It is mounted on the right-front door post behind the kick pad. (See Fig. 7, page 20).

The "manual-automatic" switch is a push-pull type switch and is mounted above and to the left of the manual light switch.

FUNCTIONAL OPERATION

With the "manual-automatic" switch in "automatic" position and the ignition on, the "Twilight Sentinel" provides completely automatic operation which turns the car lights on or off according to the light level. As evening approaches and daylight is reduced to the point where lights are needed for safe driving, the "Twilight Sentinel" will turn the car lights on. A built-in ratio prevents the lights turning off

(Continued page seventeen)

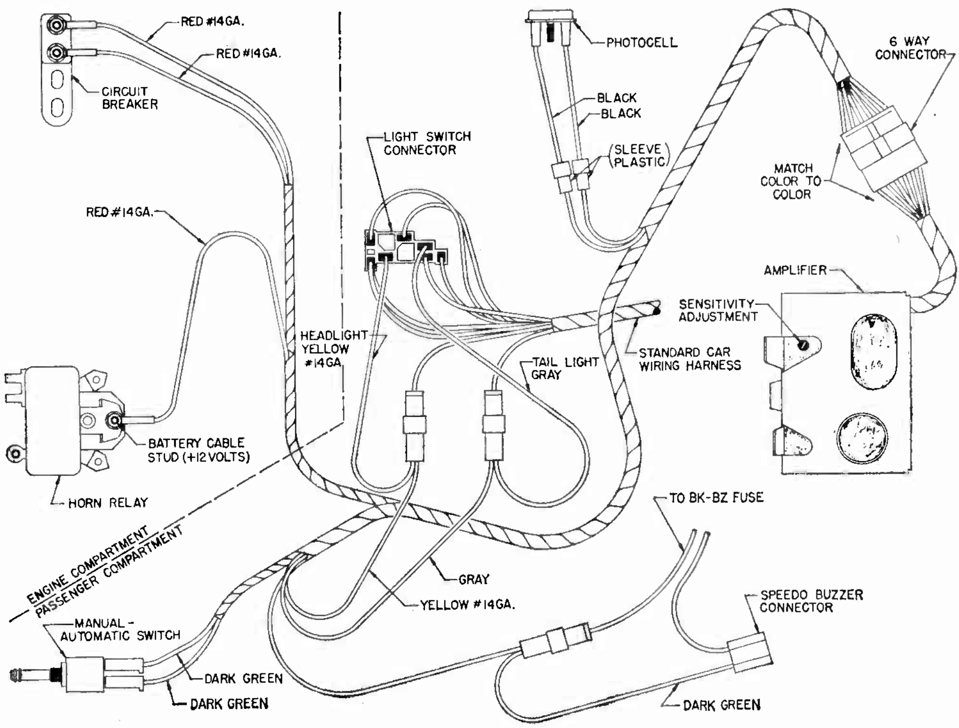


Fig. 1.

For Black-White and Color TV, Radios, Hi-Fi, Industrial Electronics

NRI Professional Model 250 Oscilloscope

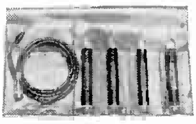
USE ORDER COUPON—PAGE 17

Specifications

Vertical sensitivity: .023 VRMS after internal calibration is adjusted.
Frequency response: Flat from 13 CPS to 2.5 mc. Down .05DB at 11 CPS. Down 1.5 DB at 3.58 mc. Down 3.5 DB at 4.5 mc.
Horizontal sensitivity: 1.0 VRS.
Frequency response: Flat from 20 CPS to 90 kc. Down .8 DB at 12CPS. Down 3 DB at 250 kc.
Uses 11 tubes including dual types giving equivalent of 19. 5-inch CRT.
Rise time: .05 ms.
Sweep frequency: 10 CPS or less to 500 kc.
Push-pull on-off switch.
Operates from 110-1120 volts. 60 cycle only.

IMPRESSIVE CABINET AND PANEL

Sturdy aluminum cabinet finished in handsome black wrinkle. Dimensions 9⅜" x 13¾" x 15½". Brushed aluminum panel with deep etched black lettering. Red and black control knobs. "5-way" binding posts. Strong carrying handle and rubber feet on bottom of cabinet to prevent marring. Added features that give you professional appearance and operation. Overall shipping weight, 23 lbs.



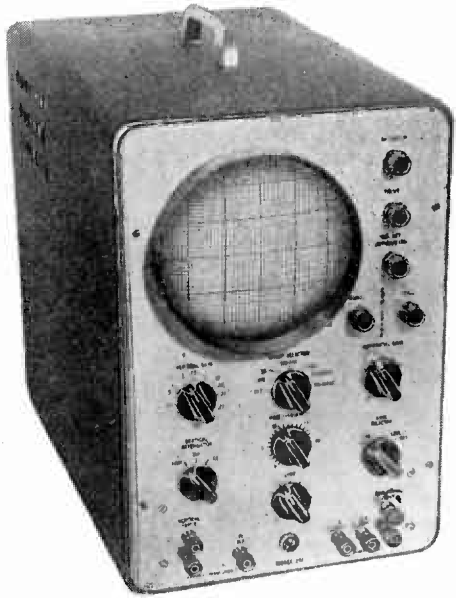
PROFESSIONAL PROBE SET AVAILABLE AT EXTRA COST

Even though most scope observations and tests can be made with ordinary test leads, special probes are necessary to get maximum use from this instrument.

This DeLuxe Probe Set, designed exclusively for use with the Model 250, includes complete instructions, sturdy roll-up carrying case, shielded cable and these probes. 1. High impedance, low capacity probe. 2. Crystal demodulator probe. 3. Resistive isolating probe and 4. Shielded direct probe. Price complete—only $14.95.

ADDED FEATURE OF THE MODEL 250

The NRI Model 250 can be used, by itself, to accurately check the horizontal output transformer, yoke, width coil, linearity coil, or ringing coil while a TV receiver is turned off. Eliminates the need for a separate Flyback Tester costing between $40 and $70.



Kit—$89.50
Assembled—$139.50

NRI DESIGNED for your complete satisfaction. For color, black-white TV servicing; AM-FM and transistor radios; high fidelity; industrial Electronics.

HIGH SENSITIVITY—.023 (RMS) volts per inch; but not noisy.

READ PEAK-TO-PEAK VOLTAGES directly. No calculations required.

RUGGED CONSTRUCTION; built to last. Truly professional appearance.

WIDE BAND RESPONSE. No wave distortion transients. Actually shows 3.58 color burst.

USES PHASE INVERTER TUBES in horizontal and vertical push-pull output stages.

SYNCS AND LOCKS EASILY—with positive action—on any TV receiver signal. Traces TV signals; locates defective sync circuits.

ACCURATELY MEASURES RIPPLE OUTPUT of any power supply. Check auto radio vibrators dynamically.

VERTICAL AMP RESPONSE—flat 13 cps to 2.5 mc down 1.5 db at 3.58 mc.

SWEEP RANGE—10 cycles to 500kc. Uses special NRI linearity circuit.

PLENTY OF BRIGHTNESS. No need to turn off or dim lights to see trace. 2400 volts on CRT.

PERFECT FOR SQUARE WAVE ANALYSIS and FM-TV alignment with a sweep generator.

QUALITY COMPONENTS THROUGHOUT. Standard 90-day EIA parts and labor warranty.

AVAILABLE ON LOW MONTHLY TERMS.
Uses two printed circuits, clear instructions, easy to build.

Twilight Sentinel—*continued*

when passing under bright street lighting. During daylight hours while car lights are not required, the "Twilight Sentinel" will keep the lights turned off. A time-delay feature is incorporated to prevent the car lights turning on immediately if the light level is reduced suddenly while the car is passing under trees, short overpass, etc. When the ignition is turned off, the "Twilight Sentinel" is inoperative and the lights will be off. This will prevent leaving the car with lights on and returning to find a "Dead" Battery.

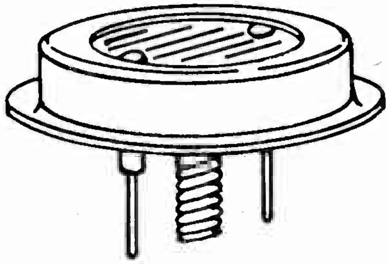


Fig. 2

When the car is started in a garage, the lights may turn on because of the low light level. However, as soon as the car is driven into the direct daylight, the lights will be turned off by the "Twilight Sentinel."

If the driver desires to turn his lights on during the daylight hours, he may do so by operating the standard light switch in the normal manner. This bypasses the "Twilight Sentinel" and the lights must be turned off at the standard switch before the "Twilight Sentinel" can again control the lights.

In "manual" position of the "manual-automatic" switch, the "Twilight Sentinel" does not function. While switch is in this position, the car lights must be manually operated by the standard light switch. In some states the law requires that the car lights remain off in certain tunnels. If the light level is low enough so that the "Twilight Sentinel" turns the light on, the "manual-automatic" switch must be placed in "manual" position in order to comply with the law. The "Twilight Sentinel" needs no warm-up time and it will provide immediate automatic control whenever the switch is returned to "automatic" position.

CIRCUIT DESCRIPTION

PHOTOCELL CIRCUIT (See Fig. 3, page 18). The voltage for the photocell (1) is supplied through the ignition switch, a fuse, and the "manual-automatic" switch so that both must be on for the "Twilight Sentinel" to operate. The cell is connected in series with resistors (3) and (4) to ground. With a bright light on the photocell (1) its internal resistance is low (approximately 300 ohms). As the amount of light striking the photocell (1) decreases, the internal resistance increases. This causes the current flow to decrease and lowers the voltage at the base of the transistor (11).

AMPLIFIER CIRCUIT (See Fig. 4, page 18). Voltage for the base of the transistor (11) is supplied by the series network of the photocell circuit. Voltage for the emitter is supplied by the series-parallel network of the sensitivity adjustment (2), resistor (5) and resistor (6) to ground. The collector is connected in series to ground with the coil of the sensitive relay (9) and resistor (7).

With a high light level on the photocell

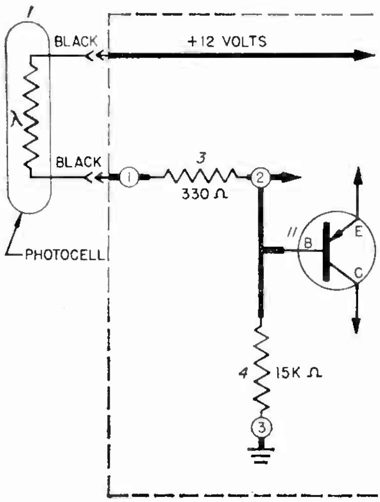


Fig. 3

(1) the transistor base voltage is higher than the emitter voltage and the transistor is not conducting. As light is reduced on the photocell (1) the base voltage drops and the collector current increases.

RELAY CIRCUIT (See Fig. 5). The armature of the sensitive relay (9) is connected to one end of the power relay (10) coil.

The armature of the power relay (10) is connected to 12 volts. The other end of the power relay (10) is connected to 12 volts through the "manual-automatic" and ignition switches. One contact connects to the headlight wire and the other to the tail light wire. Both of these contacts are parallel to the standard light switch.

As light is reduced further on the photocell (1) the collector current increases to actuate the sensitive relay (9). This grounds one end of the power relay coil and actuates it, thus turning on the headlights and tail lights.

When the sensitive relay (9) is actuated, resistor (6) is disconnected from ground causing the emitter voltage to rise. This results in the photocell (1) having to decrease in resistance a greater amount to shut off the transistor. This action provides the ratio of light levels needed to turn the lights "on" at one light level and "off" at a higher level.

MISCELLANEOUS: (See Fig. 4)
Resistor (3) provides protection for the transistor (11) and capacitor (12) in the event a lead of the photocell (1) is grounded. The capacitor (12) provides the time-delay feature of the circuit. In the event light is suddenly removed from the photocell (1) the capacitor (12) maintains the base voltage high enough to prevent the lights from turning on. After about one to three seconds the capacitor (12) will discharge enough to allow the transistor (11) to conduct.

The sensitivity adjustment (2) provides the correct emitter voltage to allow the transistor to conduct when a predetermined light level is on the photocell.

Resistor (7) is used to limit the current through the sensitive relay coil.

Resistor (8), Fig. 5, is used to protect the sensitive relay points by reducing the amount of inductive kick-back when the power relay (10) is actuated.

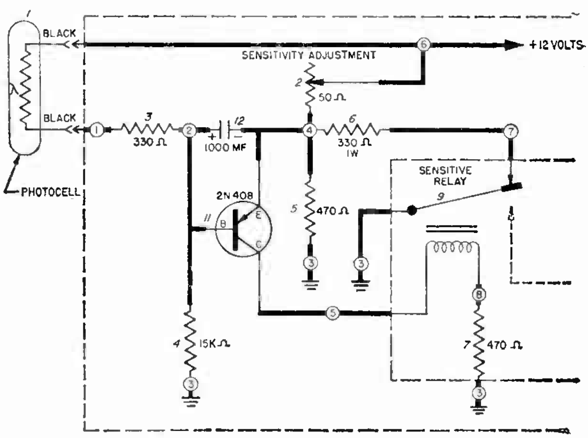


Fig. 4

PRELIMINARY CHECKS BEFORE ADJUSTMENT

The "Twilight Sentinel" is adjusted at the factory and will maintain its adjustment. Of course, there may be occasions when the adjustment is questioned. Like any other electrical device, a misunderstanding of the operation of the unit may lead one to believe that an adjustment is necessary. The following trouble may be reported:

1. Lights turn on too late in evening.
2. Lights turn on too soon in evening.
3. Lights remain on during day.

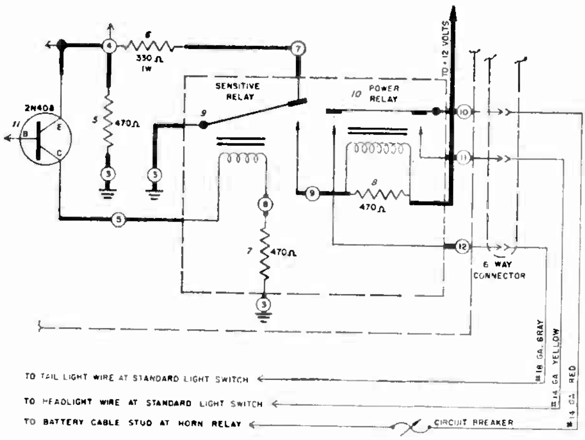


Fig. 5

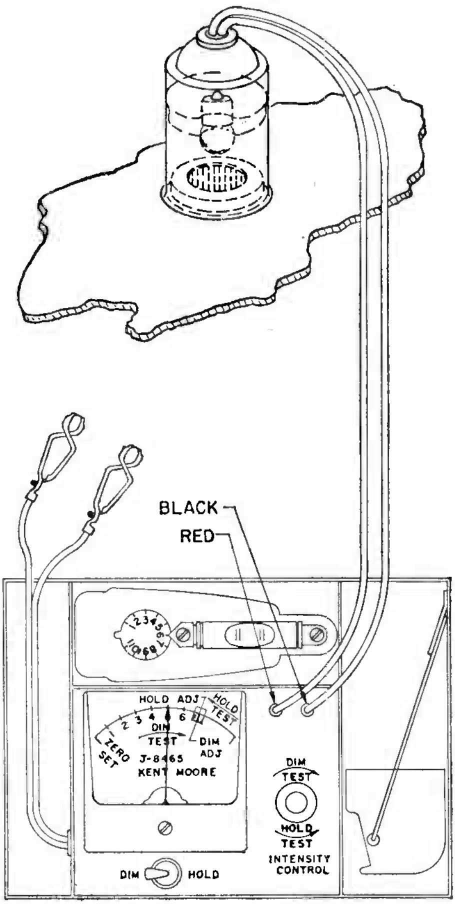


Fig. 6

4. Lights fail to come on.

While the above complaints may be corrected by simple sensitivity adjustment in most cases, a few on-car checks should be made to determine if the difficulty can be corrected by adjustment.

CHECKING PROCEDURE

(Because of the high light levels needed to operate the "Twilight Sentinel," a flashlight or field tester should be held close to the photocell whenever light is needed.)

Place "manual - automatic" switch in "automatic" position. Place manual light switch in "off" position, turn ignition on, and hold a black cloth over photocell. Lights should be on. Remove cloth. Lights may or may not turn off. If not, shine flashlight into cell. Lights should now turn off.

If the "Twilight Sentinel" performs as stated above, it will perform satisfactorily after the proper adjustments are made.

SENSITIVITY TEST AND ADJUSTMENT ON CAR

The sensitivity test and sensitivity adjustment are made using the "Guide-Matic" Tester, Model J-8465, manufactured by Kent-Moore Organization, Inc., in conjunction with the "Twilight Sentinel" Test Head, Model J-8627. (See Fig. 6).

PRELIMINARY SETUP

1. Insert red and black plugs of "Twilight Sentinel" Test Head into the respective jacks of the "Guide-Matic" Tester.
2. Check "Zero Set" of meter.
3. Place "Twilight Sentinel" Test Head on photocell. IMPORTANT: Test Head must be firmly seated on photocell or sensitivity readings will be in error.
4. Connect red power lead of "Guide-Matic" Tester to +12 volts and black lead to ground.
5. "Dim-Hold" switch of "Guide-Matic" Tester should be in "Dim" position for all tests and adjustments of "Twilight Sentinel."
6. Place "manual-automatic" switch of "Twilight Sentinel" in "automatic" position.
7. Turn on ignition and proceed with test.

SENSITIVITY TEST ON CAR

1. Rotate "Intensity Control" completely clockwise. Lights should be off. If not,

proceed to "Sensitivity Adjustment on Car."

2. Turn "Intensity Control" slowly counterclockwise until lights turn on. (IMPORTANT: Because of the time delay feature, the "Intensity Control" must be rotated slowly to give the correct sensitivity reading.) The meter pointer must be on "5." If reading is incorrect, proceed to "Sensitivity Adjustment on Car."
3. Turn control clockwise until lights turn off. Meter reading should be between "6" and "Dim Adj." line. If the "Twilight Sentinel" is out of adjustment, proceed to "Sensitivity Adjustment on Car."

SENSITIVITY ADJUSTMENT ON CAR

Follow steps in "Preliminary Set-up" and remove right kick pad to allow access to "Twilight Sentinel" "Sensitivity Adjustment" control: (See Fig. 7).

1. Turn "Sensitivity Adjustment" control clockwise and "Intensity Control" clockwise. Lights should be off.
2. Rotate "Intensity Control" counterclockwise until meter pointer is on "5."
3. Rotate "Sensitivity Adjustment" control slowly counterclockwise until lights turn on. IMPORTANT: Because of the time delay feature, the "Sensitivity Adjustment" control must be rotated slowly to obtain correct adjustment.
4. Re-check sensitivity as shown in Steps 1 through 4 under "Sensitivity Tests on Car."

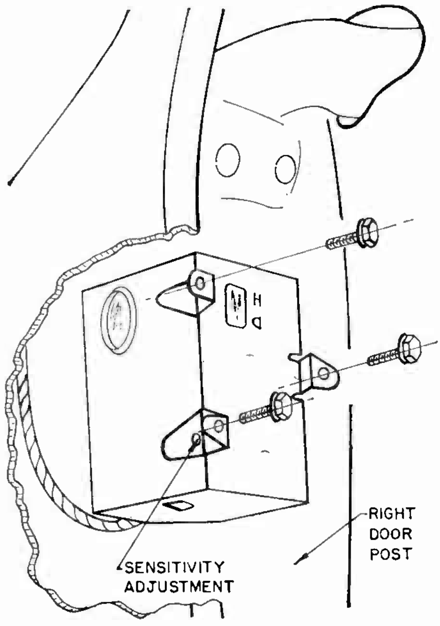


Fig. 7

TROUBLE ISOLATION

FAILURE OF LIGHTS TO TURN ON

1. Place "manual-automatic" switch in "automatic" position. Place manual light switch in "off" position. Turn ignition on and place a black cloth over photocell. Lights should turn on. If not, remove one of black wires to photocell. If lights go on, trouble is in photocell and it should be replaced. If lights remain off, go to Step 2.

2. Disconnect six-way connector near amplifier. Place a jumper between #14 gage yellow wire of car harness. If headlights turn on, trouble is in amplifier and it should be removed from car for further testing. If not, trouble is in wiring harness of circuit breaker.

FAILURE OF LIGHTS TO TURN OFF

1. Place "manual-automatic" switch in "automatic" position. Place manual light switch in "off" position and turn ignition on. Shine flashlight into cell — lights should be off. If not, remove the two black wires from photocell and short them together. If lights go off, trouble is in photocell and it should be replaced. If not, proceed to Step 2.
2. Disconnect the six-way plug near amplifier. If lights go off, trouble is in amplifier and it should be removed for further testing. If lights remain on, trouble is in car harness.

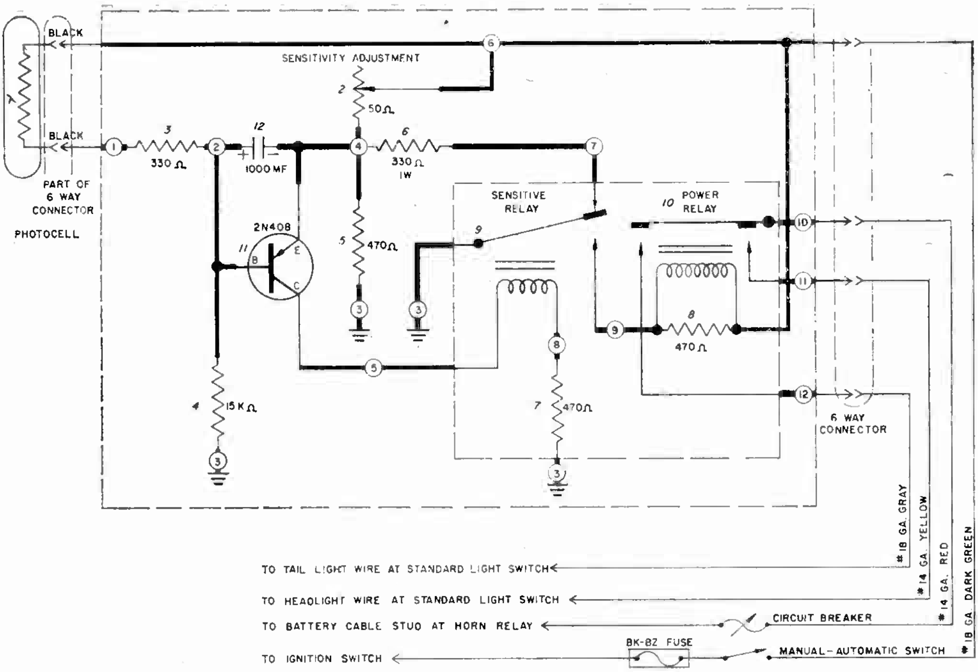
PROCEDURE FOR REMOVAL FROM CAR

IMPORTANT—Before proceeding with removal procedures, remove battery ground strap from battery.
NOTE: Car lights will function properly by using the regular car light switch after the removal of any component if the following instructions are observed:

Amplifier Removal
1. Remove the right-hand kick pad and disconnect the six-way connector.
2. Remove three screws from door post and remove amplifier.

Photocell Removal
1. Disconnect the two black leads of photocell from harness.
2. Remove seven screws from upper dash panel and remove panel.
3. Remove photocell and replace dash.

"Manual-Automatic" Switch Removal
1. Remove knob and disconnect two wires from rear of switch.
2. Tape exposed terminals to prevent grounding.



CHECK POINTS	1	2	3	4	5	6	7	8	9	10	11	12
LIGHTS ON	10.0 12.0	9.8 11.8	0	10.0 12.0	3.5 11.8	12.0	10.0 12.0	1.75 6.25	0	12.0	12.0	12.0
LIGHTS OFF	9.25 12.0	12.0	0	9.25 12.0	0 6.0	12.0	0	0 3.0	12.0	12.0	0	0

12.0 VOLTS INPUT. ALL VOLTAGES MEASURED WITH V.T.V.M.

Fig. 8

3. Remove switch.

Circuit Breaker Removal

1. Remove #14 gage red wire from battery cable stud of horn relay.
2. Remove two #14 gage red wires from circuit breaker and remove circuit breaker from starter relay mounting bolts.
3. Replace nuts on starter relay mounting bolts.
4. Do not replace #14 gage red wire on horn relay battery stud until circuit breaker is replaced.

TROUBLE SHOOTING TESTS

Photocell: The photocell is to be replaced if it was found faulty under "Trouble Isolation."

Amplifier:

I. Lights Fail to Turn On

A. Initial Tests and Preparations (See Fig. 11)

1. Remove amplifier cover.
2. Check circuit board for open conductors or solder shorts.
3. Check the two black wires of amplifier harness to make sure they are not shorted together.
4. Place "Sensitivity Adjustment" control in approximate center of rotation.
5. Connect a small 12-volt bulb between the yellow wire of amplifier harness and ground. (Bulb "On" indicates lights are "On" and bulb "off" indicates lights are "off.")
6. Connect the positive (+) side of a 12-volt battery or Well Filtered power supply to the red and green wires of the amplifier harness. (Adjust voltage to 12 VDC as measured with a vacuum tube voltmeter.)

B. Follow the tests progressively until the amplifier does not function as indicated.

1. Measure voltage at 6 and 10. If they do not measure 12 volts, check for open wire in amplifier harness.
2. Place jumper between 3 and 9. If light comes on, proceed to Step 3. If

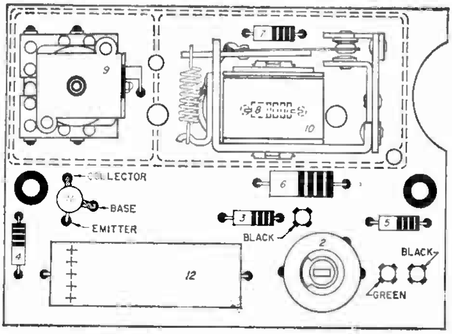


Fig. 9

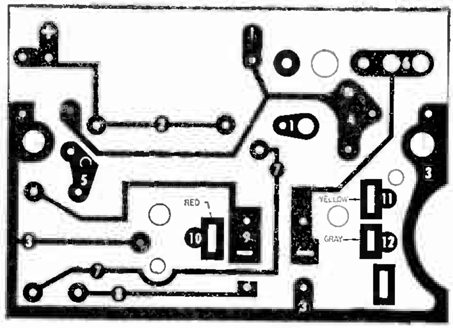


Fig. 10

not, trouble is in power relay (10), and it should be replaced.

3. a. Remove jumper between 3 and 9.
   b. Remove voltage from amplifier.
   c. Unsolder collector lead of transistor (11).
   (Caution: Use heat sink.)
   d. Place a jumper between 5 and 10.
   e. Put 12 volts to amplifier.
   f. If light comes on, proceed to Step 4. If not, check coil of sensitive relay armature ground connection 3.
4. a. Remove voltage from amplifier.
   b. Unsolder emitter of transistor (11).
   c. Check for shorted capacitor. If shorted, replace it.
5. Check for open resistor 4. Should measure 15K ohms.
6. Check for short between 4 and ground 3. Should measure 190 ohms.
7. Measure resistance between 4 and 6 while rotating "Sensitivity Adjustment" control (2). Should be continuously variable between 0 and 50 ohms. If not, replace control (2).
8. If one of the above checks located the trouble, replace collector, and emitter leads to circuit board. If not, replace transistor. (Use Heat Sink)

II. Lights Fail to Turn Off

1. Remove amplifier cover.
2. Check circuit board for open conductors or solder shorts.
3. Check amplifier harness for shorts.
4. Check continuity between 10 and 11 and between 10 and 12. If both checks indicate an open circuit, proceed to Step 5. If either or both indicate a short, replace power relay (10).
5. Check continuity between 3 and 9. If open or shorted, replace sensitive relay (9). Before replacing sensitive relay (9), check for open resistor (8).
6. Measure resistance between 1 and 2. Should measure 330 ohms. If open or shorted, replace resistor (3).
7. Unsolder collector and emitter of transistor. Caution: Use a heat sink to prevent damage to the transistor.
8. Measure resistance between 2 and 3. Should measure 15K ohms. If not, replace resistor (4).
9. Measure resistance between 4 and 6. Should be variable between 0 and 50 ohms by rotating the "Sensitivity Adjustment" control.
10. If the above tests do not locate the trouble, replace the transistor.

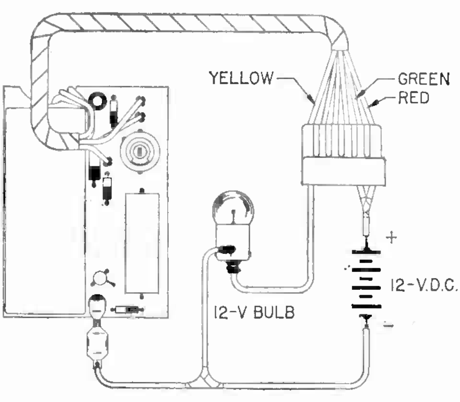


Fig. 11

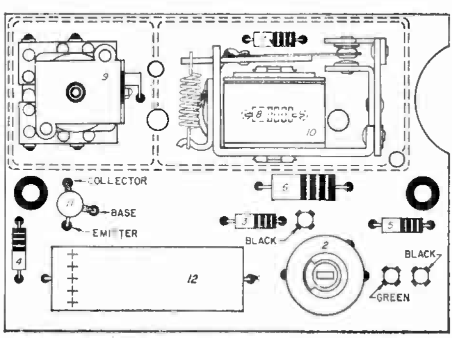


Fig. 12

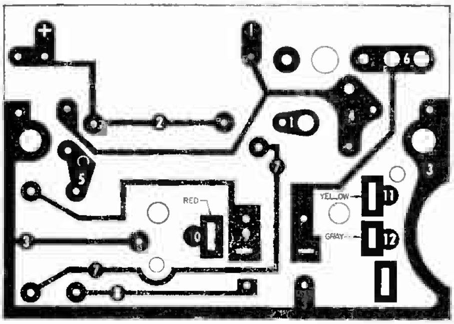


Fig. 13.

11. If the above tests locate the trouble, resolder the transistor connections. Caution: Use a heat sink to prevent damage to the transistor.

III. Miscellaneous Troubles
1. If there is no time delay when light is suddenly removed from the cell, replace capacitor (12).
2. If fluttering occurs, check for open resistor (5).
3. If there is no ratio, check for open resistor (6).

Foreign Tube Substitution Guide

A handy up-to-date wall chart listing interchangeability information for American and foreign receiving tubes now is available through authorized General Electric distributors.

The easy-to-read chart (ETR-1916B) 11 inches wide and about 28 inches long, lists approximately 300 American tube types which are interchangeable with approximately 100 foreign tube types.

The chart is offered as an aid to service and maintenance technicians who may not have an exact replacement on hand when immediate service is required. General Electric states that the indicated interchangeable types will give satisfactory performance in most instances. However, it is possible that due to unusual circuit design or critical applications, unequal operation may be noticed in some equipment.

The Company recommends that replacement with the same type be made whenever possible.

All NRI Alumni Members Should Vote

Let's do our part to help the staff handling the elections by submitting ballots early. Polls for nomination close *August 25, 1960.*

See pages 25-26 for list of nominees.

Nomination Ballot

T. E. Rose, *Executive Secretary*
NRI Alumni Association,
3939 Wisconsin Ave.,
Washington 16, D. C.

I am submitting this Nomination Ballot for my choice of candidates for the coming election. The men below are those whom I would like to see elected officers for the year 1961.

(Polls close August 25, 1960)

MY CHOICE FOR PRESIDENT IS

....

City ....State ......

MY CHOICE FOR FOUR VICE-PRESIDENTS IS

1. ....

City ....State ......

2. ....

City ....State ......

3. ....

City ....State ......

4. ....

City ....State ......

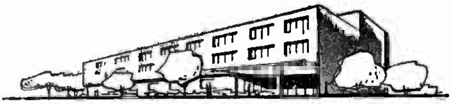
Your Signature ....

Address ....

City ....State ......

Student Number ....

NRI ALUMNI NEWS



NOMINATIONS FOR 1961

Election campaigns are very much in the news these days. The Republican and Democratic parties have held their conventions and selected their candidates for the White House. As customary in all presidential elections, we can expect a deluge of campaign speeches, publicity releases, TV programs about the candidates, and other political activities by both parties, until November.

In keeping with the times, your NRI Alumni Association is also holding its annual election campaign for its President and four Vice-Presidents to serve the Association for the ensuing year.

As with all such campaigns, ours will begin with the nomination of candidates. The two members who receive the greatest number of votes for the Presidency will become the candidates for that office. The eight members given the largest number of votes for a Vice-Presidency will be the candidates for Vice-Presidents.

August 25, 1960, is the deadline for nominations. Mail your ballot well in advance of that date to make sure it reaches National Headquarters on or before the deadline. **Ballot is on page 23.**

National Headquarters will count the nominating votes received by August 25. The names of the candidates nominated will appear in the October-November issue of the NRI News. Our members will then vote for the candidates they wish to serve as President and Vice-Presidents for 1961. The necessary ballots will be supplied in the October-November issue.

The present NRI Alumni Association Constitution and By-Laws were adopted on January 8, 1958. It has been proposed that Article VI, Section 2, be amended so as to place restrictions on the re-election of National Officers who have already served one or two terms. The proposed amendment has been submitted to the members for action. At the time we go to press, the final results of this proposal were not yet known—ballots were still coming in to National Headquarters. This election is therefore being held in accordance with the provisions of the January 8, 1958, Constitution and By-Laws, Article VI:

1. The election of the President and the Vice-Presidents shall be by ballot.

2. The President shall be eligible for re-election only after expiration of at least one year following his existing term of office, and when not a candidate for President, may be a candidate for any other office. Other officers may be candidates to succeed themselves, or for any other, but not more than one, elective office in the Association.

3. The election of officers shall be held in October of each year, on the day designated by the Executive Secretary, but not later than the twenty-fifth of the said Month.

4. The Executive Secretary shall advise Members by letter or through the columns of the NRI News, on or before August first of each year that names of all nominees shall be filed in his office not later than August twenty-fifth following.

5. Each Member shall be entitled to submit, in writing, one nomination for each office, and the two nominees receiving the highest number of votes shall be the nominees for the office for which nominated.

6. The Executive Secretary, before placing any name on the ballot, shall communicate with each nominee, to ascertain his acceptance of the office, if elected. If such tentative acceptance is withheld, the eligible nominee having the next highest number of votes shall be the nominee for that office.

7. The Executive Secretary, on or before October first of each year shall furnish Members a ballot listing the names of the nominees for each office.

8. No member shall be entitled to vote if he is in arrears in the payment of dues.

9. Ballots, properly executed and valid ac-

cording to the instructions plainly printed thereon, shall be returned to the Executive Secretary on or before midnight of October twenty-fifth of each year.

10. The Executive Secretary shall designate three Election Tellers from the staff of the Institute, who shall count the ballots and certify the results, together with the return of the ballots, to the Executive Secretary.

11. *In the event of a tie vote for any office, the Executive Secretary shall cast the deciding ballot.*

12. The nominee receiving the greater number of votes for the office for which nominated shall be declared by the Executive Secretary to be elected to that office, and notice of such election be forwarded in sufficient time, prior to January one, to permit such elected officer to enter upon the duties of said office on that date.

The incumbent President, the popular and much-respected Thomas Hull of the New York City Chapter, will end his term of office on December 31. The successful candidate for the Presidency for 1961 will then take office on the following day, January 1.

Hull's opponent in last year's election was Jules Cohen of Philadelphia. Considering Hull's popularity and his strength as a candidate, Cohen made an excellent showing in the election last year. Since Hull is not eligible for re-election—our Constitution does not permit the President to succeed himself—this makes Cohen the outstanding candidate in this year's election.

Officially Cohen has been Secretary of the Philadelphia-Camden Chapter for a good many years. Members have been heard to refer to him as the "main wheel" of the Chapter. He gives the impression of a human dynamo because of his enthusiasm and seemingly inexhaustible store of energy, much of which he generously devotes to the activities and interests of his Chapter. Due largely to its excellent programs, the Philadelphia-Camden Chapter has become the biggest of all the local Chapters. Cohen is the chief organizer and guiding spirit behind these fine programs. He was elected a National Vice-President for 1958 and again for 1959. This could be his year to win the highest office.

Although under our present Constitution the President may not succeed himself, the Vice-Presidents may. The incumbent Vice-Presidents are therefore eligible for re-election. They are John Babcock of Minneapolis, F. Earl Oliver of Detroit, Howard Smith of Springfield, Mass., and Roland Tomlinson of San Francisco.

See "Nomination Suggestions" for the names of other members, selected geographically, that you may want to consider as possible candidates. It is the right of each member to vote for whomever he wants but in considering any other than those mentioned, make sure that they are members of the Alumni Association; if they are not, they are not eligible to hold office.

All members should exercise their privilege of taking part in the choice of the Associations' officers. Fill in the Nomination Ballot and mail it well before August 25.

Nomination Suggestions—use ballot on page 23

James E. Howard, Bessemer, Ala.
Byron M. Brumback, Huntsville, Ala.
Ernest L. Blake, Phoenix, Ariz.
Lewis Chastain, Tucson, Ariz.
Dwight L. Hatcher, Jr., Fayetteville, Ark.
Edmond D. Tyler, Morrilton, Ark.
Eugene De Caussin, Hollywood, Calif.
Nibaldo Figueroa, Los Angeles, Calif.
Kenneth Williams, Glendale, Calif.
J. Arthur Ragsdale, San Francisco, Calif.
Roland Tomlinson, San Francisco, Calif.
Reginald Selby, San Francisco, Calif.
Robert K. Winter, Colorado Springs, Colo.
Roy White, Eckley, Colo.
Fred S. Rossetti, Branford, Conn.
James B. Shields, Fairfield, Conn.
Albert J. Kent, Claymont, Del.
John E. Tarburton, Wyoming, Del.
George R. Brooke, Washington, D. C.
Cecil Swann, Washington, D. C.
William H. Lloyd, Hialeah, Fla.
John H. Warnick, Melbourne, Fla.
H. S. Tullis, Buford, Ga.
Hansel N. Self, Rome, Ga.
Carl Moore, Cascade, Idaho
Peter L. Welch, Moscow, Idaho
Edwin Wick, Chicago, Ill.
Andrew Johnson, Chicago, Ill.
Alex Michaels, Chicago, Ill.
Frank Dominski, Chicago, Ill.
Sidney Bennett, Chicago, Ill.
Alex Michaels, Chicago, Ill.
Jack W. Frazier, Charlestown, Ind.
Charles R. Rhodes, Indianapolis, Ind.
John Fay, Cedar Rapids, Iowa
Dean Knight, Robins, Iowa
A. M. Dickerson, Hope, Kans.
Mack Hocker, Plainville, Kans.
Stanley Grimes, Covington, Ky.
Jerry Bartley, Pikesville, Ky.
Patrick Boudreaux, New Orleans, La.
John Conrad, New Orleans, La.
Robert Clancy, Camden, Maine
Everett A. Fogg, Winn, Maine

ballot appears on page 23

Reginald Ankeney, Clear Spring, Md.
Lewis R. Knox, Easton, Md.
George M. Butcher, Baltimore, Md.
David B. Spangenberg, Takoma Park, Md.
Howard Smith, Springfield, Mass.
Arnold Wilder, Springfield, Mass.
Walter Adamiec, Middleboro, Mass.
Edward Bednarz, Fall River, Mass.
John Berka, Minneapolis, Minn.
Walter Berbee, St. Paul, Minn.
F. Earl Oliver, East Detroit, Mich.
Charles Mills, Detroit, Mich.
Andrew Jobbagy, Flint, Mich.
David Nagel, Mount Morris, Mich.
Brady Whitmire, Macon, Miss.
Eugene D. Anton, Walls, Miss.
Lee Waller, Excello, Mo.
Verdie Davis, Springfield, Mo.
Raymond H. Berreth, Eureka, Mont.
Irvin A. Renz, Missoula, Mont.
William L. Nash, Fullerton, Nebr.
Charles F. Harrington, Western, Nebr.
L. R. Carey, Elko, Nev.
Robert W. Spainhower, Sparks, Nev.
Lloyd C. Lawrie, Concord, N. H.
Leo E. Lamy, Manchester, N. H.
Michael Schlotz, Atlantic City, N. J.
John R. Smith, Paramus, N. J.
Edward H. Nenno, Deming, N. Mex.
Lawrence C. Ham, Roswell, N. Mex.
Frank Catalano, New York City
James Eaddy, Brooklyn, N. Y.
William Fox, New York City
Harry W. Gerdts, Jackson Hgts, N. Y.
Frank Zimmer, Long Island City, N. Y.
Thomas F. Manning, Buffalo, N. Y.
Mark L. Willis, Draper, N. C.
William Royster, Oxford, N. C.
Oliver Usher, Bismarck, N. Dak.
Walter H. Liebelt, Minot, N. Dak.
Jerome Silvati, Cincinnati, Ohio
Tansy Ward, Lima, Ohio
D. L. Smith, Buffalo, Okla.
Virgil I. Turner, Oklahoma City, Okla.
Warren E. Bacon, Oswego, Oreg.
E. Breese, Prineville, Oreg.
J. Howard Sheeler, Shippensburg, Pa.
Thomas Schnader, Irwin, Pa.
Frank Skolnik, Pittsburgh, Pa.
William Lundy, Pittsburgh, Pa.
John Pirrung, Philadelphia, Pa.
Harvey Morris, Philadelphia, Pa.
George A. Sherman, Jr., Newport, R. I.
Walter H. Tierney, Warwick R. I.
Ira C. Crocker, Belton, S. C.
John M. Ligon, Rock Hill, S. C.
W. Monroe Arne, Carpenter, S. Dak.
William J. Morkert, Rapid City, S. Dak.
Thomas Mitchell, Columbia, Tenn.
Chester B. Chadwick, Tullahoma, Tenn.
Winfred R. Campbell, Big Spring, Texas
J. C. Buntyn, Temple, Texas.
Clarence L. Morriss, Ogden, Utah
Wayne E. Bryant, Tooele, Utah
Charlie R. Gilbert, Bristol, Va.
Harold C. Morris, Shenandoah, Va.
Arthur N. Olson, Bennington, Vermont
Joseph Martin, Newfane, Vermont
Horace D. Jerald, Clarkston, Wash.
Cecil R. Thompson, Vancouver, Wash.
Dempsey Sherwood, Dunbar, W. Va.
Homer G. Hickman, Parkersburg, W. Va.
Erwin Kapheim, Milwaukee, Wis.
Marvin Winter, Waukesha, Wis.
John B. Dingman, Grass Creek, Wyo.
Harold P. Brown, Laramie, Wyo.
Gerald R. Brown, Windsor, Nfld., Canada
G. L. O'Blenis, Salisbury, N. B., Canada
Abram Burke, Spryfield, N. S., Canada
Clifford Gould, Essex, Ont., Canada
George B. Newman, Knowlton, Que., Can.
Henry Rosa, Glenside, Sask., Canada
D. J. Rankin, Ninette, Man., Canada
Sam Popoff, Castlegar, B. C., Canada

Chaper Chatter

CHICAGO CHAPTER has been concentrating on transistors. Mr. Oakley suggested a general discussion on replacement of transistors—that is, to make a study of the transistor chart, the different types of transistors, their ratings and characteristics. He himself purchased a transistor checker kit and reports that he finds it very useful. He agreed to bring it with him to the next service meeting, also a transistor radio with plug-in type transistors so that the members can give the checker a try-out. Mr. Oakley further suggested that after the members had studied the transistor checker and seen it in action, the chapter should purchase the same type of checker. This was agreed upon.

Secretary Dominski passed out literature on servicing transistor equipment: How to Test Transistors; How to Build a Transistorized Power Supply and Transformer Design for Transistor Power Supplies, etc. After the members had looked over this literature, they held a round table discussion that proved very interesting.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER'S George Fulks played host to members at a meeting held at his home. This meeting was devoted to the alignment of AM and FM Radios, during which use was made of the host's equipment and facilities.

Instead of a regular meeting in June, members of the Chapter held a picnic at the Rouserville Hunt Club in the mountains near Mont Alto.

Following the same plan as in former years, the members voted not to hold meetings in July and August. The next regular meeting will therefore be held on September 8.

PITTSBURGH CHAPTER CHAIRMAN Tom Schnader led a discussion on the defects occurring in TV receivers. For this meeting the Chapter's TV receiver was rigged up with six defects to show the members what different things will cause the picture to be off. These defects were hooked up with switches which could be put in or taken out at any time. The members were so well pleased with this type of discussion and demonstration that they made a request for more of the same.

Vice-Chairman Tate delivered a talk on the use of the oscilloscope in servicing auto radio power supplies. William Lundy discussed the use of the oscilloscope in observing TV wave forms.

All members and all interested NRI students and graduates in the Pittsburgh area should note this particularly: the Chapter has been meeting at 134 Market Place, but this building has been torn down.

Meetings are now being held at 436 Forbes St., which the members like even better than the old hall.

NEW YORK CITY CHAPTER members are being kept well informed on transistor and transistor circuits by Tom Hull's and Jim Eaddy's fine lectures and demonstrations. Tom Hull covers the theory and Jim Eaddy takes care of the trouble-shooting portion.

For the past few meeting nights, before the regular scheduled meetings commenced, Ralph Pincus officiated at "ham sessions." Many members arrive early to attend these sessions and learn how to send and receive code, also the regulations covering ham operations. This program promises to be a regular feature for future meetings.

Chairman Dave Spitzer ran off a GE color film on tube manufacturing. At another meeting he gave a demonstration on how to convert an automobile radio to home use.

The last meeting of the season was an "open forum" to which members invited their friends and relatives for an evening of "music appreciation," with Frank Zimmer at the controls of his Hi-Fi equipment. Both members and their guests thoroughly enjoyed the evening.

The Chapter has suspended meetings for July and August. The next regular meeting will be held on September 15.

It is with sincere regret that the Chapter announces the decease of Mark Anthony. He was an active and loyal member who will be missed.

SPRINGFIELD (MASS.) CHAPTER still enjoys a good turn-out of its members at its shop meetings. Two of these meetings were recently held at the home of Arnold Wilder. At these meetings several TV's and Radio receivers were repaired, also a Hi-Fi amplifier and a tuner, which made the owners very happy. At the conclusion of the meeting refreshments were served by Hugo Walpurgis.

It is the Chapter's practice at the end of each season to elect its officers for the following season, so that each slate of officers can serve a full season without interruption. The Chapter reports that the officers elected to serve for the 1960-1961 season are: Norman Charest, Chairman; Raymond Sauers, Vice-Chairman; John Park, Secretary; Sam Infantino, Treasurer, and Orin Hayden, Augusto Lorenzatti and Hugo Walpurgis, Executive Committee. Our congratulations to these gentlemen!

PHILADELPHIA - CAMDEN CHAPTER celebrated its 26th anniversary with a stag party. The members entered into the party with their customary heartiness and enthusiasm. Seventeen lucky members won door prizes donated by Albert Steinberg and Company, General Electric, Almo, and Radio Electric Service Company. The Chapter wishes to express here its appreciation to these companies for their contributions.

Besides an over-abundance of jokes (many of which would not bear repetition in polite company) the feature of the evening was a technical film on the new Philco Portables. After the showing of the film, the members' attention was directed to the delicious food that had been provided

Part of the group of Philadelphia-Camden Chapter members that toured the WCAU Transmitting Studio, as reported in last issue of the NRI News.

for the party. John Pirrung did the honors of distributing the hot dogs and they were truly good. It is difficult to see how only sixty-five men could consume such a mountain of food. About the only thing left over was some napkins and the only reason for these is that they were inedible. Everyone present seemed to feel that the Chapters' 26th Anniversary had been properly celebrated.

At a previous meeting Harvey Morris continued his talks on scope troubleshooting. Harvey is very popular among the members and is constantly sought after as a speaker. He has such an easy way of putting over his talks that even beginners can follow him.

Since the last issue of the NRI News the Chapter reports the admission of eleven more new members. Space does not permit listing them individually but our congratulations to these new members. The Chapter now boasts a membership of 170, the largest of the NRIAA local Chapters.

The members voted to hold only one meeting in July and August. The regular twice-a-month meetings will be resumed in September.

Philadelphia-Camden Chapter's Harvey Morris demonstrating his trouble-shooting routine to members of the Chapter.

MINNEAPOLIS-ST. PAUL (TWIN CITY) CHAPTER thoroughly enjoyed a demonstration of the B & K Television Analyst by Ray Thompson.

The newest member to be admitted to membership in the Chapter is Paul Lehman of Minneapolis. Congratulations, Paul!

Due to so many members planning their vacation in July, the Chapter voted to eliminate the meeting for that month. The next meeting is therefore to be held on August 11, at which time the Chapter will

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Directory of Local Chapters

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

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

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

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

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

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

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

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

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

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

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

PITTSBURGH CHAPTER meets 8:00 P.M., first Thursday of each month, 436 Forbes St., Pittsburgh. Chairman: Thomas D. Schnader, R.D. 3, Irwin, Pa.

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

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

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P.M., first Friday of each month, U. S. Army Hdqts Building, 50 East St., Springfield, and on Saturday following the third Friday of each month at a member's shop. Chairman: Norman Charest, 43 Granville St., Springfield, Mass.

take up the scheduling of programs for the ensuing months. All members should make it a point to attend this meeting to take part in choosing the kind of programs they'd like to see the Chapter put on in the coming season.

FLINT (SAGINAW VALLEY) CHAPTER, as we go to press, had decided to hold its annual banquet at Hungarian Hall, 405 South Dort Highway. The menu was to feature chicken, family style. It is hoped the members will have recovered from the results of their over-enthusiastic appetites by the time this appears in print.

NEW ORLEANS CHAPTER members were guests of the Standard Television Tube Corporation. The group was conducted through the factory and was shown how a Television tube is made from start to finish.

LOS ANGELES CHAPTER devoted the major part of a meeting to a general discussion of the Radio and Television troubles that the serviceman runs into when he is called upon for repair service. This discussion emphasized the problems created for the Radio-TV serviceman when he finds that he must correct the poor work previously done by untrained and unqualified servicemen.

The Chapter makes a practice of showing a good many films at its meetings. Some of these films are educational, like the one Eugene DeCaussin exhibited on the Motorola Television Receiver. The film began with an engineer drawing a TV antenna on a blackboard, then tracing the signal through the receiver, showing how it travelled to the picture tube; the agc and sound system were analyzed in the same manner.

Another type of film, exhibited by Earl Dycus, was called the "Biggest Bridge in Action," dealt with the hiring of handicapped people—the blind, the deaf, the crippled, etc.—and the jobs that they can learn to do.

Other films are merely on entertaining. But, regardless of the type of the film, the Chapter members find all of them interesting and that they add a great deal to the chapter's programs.

SOUTHEASTERN MASSACHUSETTS CHAPTER members were intrigued by a test prod constructed by Walter Adamiec from two clips connected through a .01 600V capacitor. With the aid of various members the audio and vertical circuits of the Chapter's set were analyzed. John Alves demonstrated a similar unit of commercial manufacture.

At the next meeting the same two members, Walter Adamiec and John Alves, demonstrated basic oscilloscope wave forms. This was the first of a series designed to acquaint members with the scope, so that they can become familiar enough with it to use it on the Chapter's set. As soon as the members attain a working knowledge of wave forms, the program will return to trouble-shooting the Chapter's receiver.

John Alves generously offered to reproduce schematic diagrams of the Chapter's receiver so that members can more easily follow along with experiments in the future.

The Chapter has recently admitted Graduates Raymond Morin, East Taunton, Mass., and Manuel Sousa, No. Tiverton, R. I. Welcome to the Chapter, gentlemen!

SAN FRANCISCO CHAPTER has been devoting part of its recent meetings to a study of transistor fundamentals and applications, led by Chairman Art Ragsdale and Anderson Royal, Chairman of the Program Committee.

Anderson Royal also gave a highly practical and informative talk on power supplies. As a result of this talk and the discussion which followed, it was decided by the members that the chapter would undertake a new program of study, starting with power supplies, their circuits and the possible defects which may occur. This study will be accompanied by actual practice on power supplies which members will bring in or construct.

The chapter has admitted Bill Flynn as the newest member to join the chapter. Glad to number you among the members of the chapter, Bill!

DETROIT CHAPTER made a tour of the Bell Telephone Building under the supervision of Mr. John Gruber. The members saw where messages from ship to shore are monitored, also went through the room where all TV screns are installed for monitoring TV programs from out of town. They were particularly impressed with the receivers and transmitters that Bell uses for microwaves, and with how these receivers and transmitters are checked for trouble. The Chapter found this tour exceedingly interesting and educational.

A recent meeting was held at the home of Vice-Chairman Ellsworth Umbreit. Ellsworth, assisted by Earl Oliver, gave an

(Continued page thirty-one)

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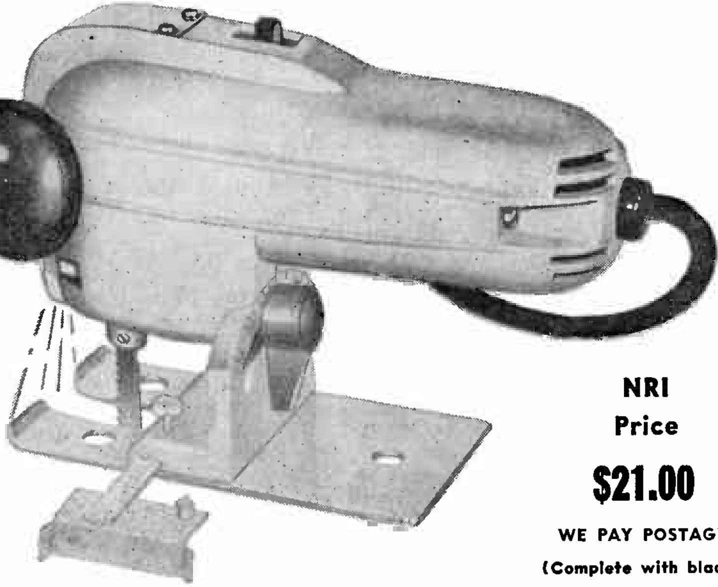

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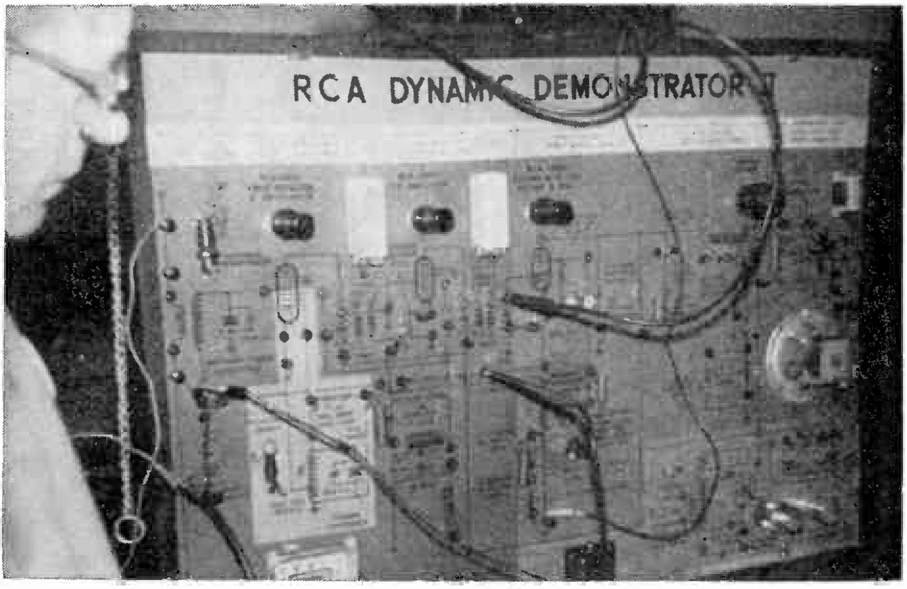

Detroit Chapter's Dynamic Radio Panel Board. That's Earl Oliver peeking around the corner.

(from page twenty-nine)
excellent demonstration of the B & K Television Analyst. This meeting gave the members a chance to see Ellsworth's workmanlike shop and to enjoy his high fidelity set-up, which Ellsworth changed over to stereo. Following this, Ellsworth and Earl Oliver gave a very interesting demonstration on the Chapter's dynamic Radio panel board.

Stanley Szafran was elected Chapter Photographer and got right to work on his new job.

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