# National RADIO-TV NEWS


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# WALK IN THE OTHER FELLOW'S MOCCASINS

There's one problem that every member of the human race has in common. It is probably the most important problem of all: how to get along with the other fellow.

Maybe you've heard the story about the feeble-minded boy who found a lost horse by imagining where he would go if he were a lost horse. While amusing, this story nevertheless contains a principle that we would all do well to follow. In our relations with others, we would get along a lot better—be better liked ourselves—if, before we acted, we stopped to think how we would react if we were the other fellow.

A wise old Indian proverb tells us to walk a mile in the other man's moccasins before we judge him. It is good advice. If you want to find out *how* good, try it. For just one week put yourself in the other fellow's shoes—and see how things look from where *he* stands.

But here's a warning: your life may never be the same after the week is up.

J. E. Smith
*Founder*

# NATIONAL RADIO-TV NEWS

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# Trouble Shooting In The Vertical Deflection Circuits

By JOSEPH SCHEK
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Joseph Schek

The vertical deflection section in all Television receivers is arranged to amplify the 60-cycle saw-tooth signal, generated in the vertical oscillator stage. By means of an impedance matching output transformer, the signal from the vertical output stage is then inductively coupled to the vertical deflection coils mounted in the yoke. A typical vertical sweep system is shown in Fig. 1.

It is the job of this section to deflect or sweep the electron beam from the top of the picture tube screen to the bottom in a linear manner. Then in the shortest possible time the beam is returned to the top of the screen to again begin the downward deflection. This vertical scanning process continually repeats itself at the predetermined rate of 60-cps.

This rate is required because the picture is transmitted at the rate of 30 frames per second and each frame contains two interlocked fields for a total of 60 fields per second.

Electronic oscillators by themselves cannot maintain their pre-adjusted frequency setting and will continually drift. The fact that the sweep oscillator frequency may drift is of no consequence. The important thing is that the sweep oscillator always be in step with the sweep oscillator at the transmitter. When the set oscillator and the transmitter oscillator operate at exactly the same frequency the two are said to be in synchronization or synchronized. Fortunately, the oscillator can be controlled by an externally supplied synchronizing signal. This causes the sweep oscillator to operate at the proper sweep frequency at all times. This vertical sync pulse as the synchronizing signal is called in the signal transmitted by the TV station and is produced by the sweep oscillator at the station.

In the clipper or separator circuits, the sync pulse is separated from the composite signal; stripped of any video information and then applied to the vertical oscillator to keep it exactly

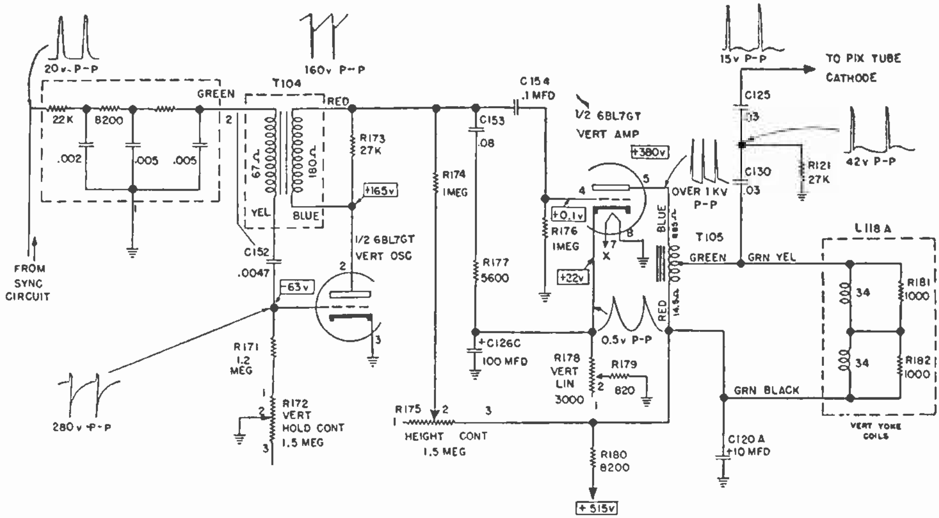


FIG. 1. Typical Vertical Sweep Circuit.

in synchronization with the vertical scanning rate of the transmitted signal.

The vertical oscillator signal is coupled to the vertical output stage where the plate signal produces a linear sweep on the screen of the picture tube. A departure from normal circuit operation in the vertical sweep section is usually made plainly visible by its effect on the test pattern or picture appearance. This situation lends itself particularly well to localizing the defects by analysis of the visible symptoms. When you are faced with a complaint indicating vertical sweep trouble, the particular picture deflect provides the clues you will use in effect-to-cause reasoning to quickly locate the faulty part.

The effectiveness of this approach is almost entirely determined by your knowledge of the vertical and associated circuits and the basic purpose of each part in producing the normal vertical sweep. As you check the circuits and locate the faulty part compare your original trouble analysis with the actual defect. This will help develop your ability to use effect-to-cause reasoning.

Some of the more common visible symptoms are listed as follows:

1. Loss of vertical deflection.
2. Insufficient height.
3. Poor linearity.
4. Vertical rolling.
5. Vertical sync troubles.

Each of these symptoms will be discussed separately; and wherever possible a photographed reproduction will be used to illustrate the effect on the picture. A normal test pattern is shown in Fig. 2.

## General Discussion

Before considering individual trouble symptoms, let us review typical types of vertical oscillator and output stages now in general use. Returning to Fig. 1, a blocking oscillator is shown capacitively coupled to the triode output stage. Notice an auto-transformer without separate primary and secondary windings couples the vertical amplifier to the yoke coils. The single transformer winding connects between plate and B+, with a tap brought out close to the B+ lead. With this arrangement, the continuous winding is effectively split into two sections. The high impedance portion using approximately 98% of the windings serves both to match the ac plate resistance of the amplifier section in the 6BL7

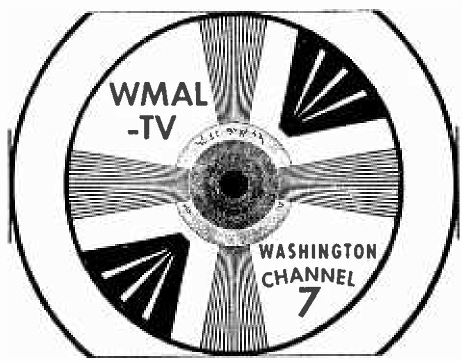


FIG. 2. Normal Test Pattern.

vertical sweep tube and to induce a sawtooth signal in the remaining turns of the winding. The low impedance of the deflection yoke is in this way provided with sweep power from a signal source of correct impedance.

When installing a replacement unit, uncertainty may exist concerning the positions of the auto-transformer leads. An ohmmeter check will quickly reveal the total resistance as well as the low and high impedance sections.

Incidentally, a three lead auto transformer can be improvised from a two-winding output transformer by bringing together one lead of each winding and forming the yoke tap. Should the picture appear completely upside-down, then reverse the leads of the vertical yoke winding to obtain the correct phase relationship.

The plate circuit of the vertical oscillator and output stages are powered by the B+ boost voltage. This is indicated by the diagram voltage value of 380 volts at the 6BL7 vertical amplifier plate. Remember that a fault in the horizontal deflection stages could reduce this voltage and prevent height as well as full horizontal width.

The vertical retrace blanking signal is available from the network made up of C130, C125 and R121. The height control R175 is located in the plate circuit of the oscillator tube and is part of the network which consists of R174, R177 and C153. Varying the 1.5 megohm height control changes the RC time constant of the network and causes capacitor 153 to change to a higher or lower level during the time that the oscillator tube does not conduct. This varies the amplitude of the output signal in the plate circuit of the oscillator stage.

In practically all cases, the vertical linearity control R178 is found as a variable cathode resistor in the output stage. Varying the linearity control changes the bias on the output stage so that the rise of the sawtooth signal will be as linear as possible with respect to its time base.

In the deflection yoke, the vertical winding can always be identified by the presence of two 560-ohm or 1000-ohm resistors connected directly across the terminals. Each of the two resistors, designated in Fig. 1 as R181 and R182, provide a load to damp those transient oscillations that would occur during retrace time. The cathode of the output tube is by-passed with a 100-mfd capacitor C126C so that degeneration of the signal will not take place and normal gain can be achieved.

A multivibrator type oscillator coupled to a typical output stage similar to that previously described is illustrated in Fig. 3. Extra damping for the vertical output stage is obtained from the 150K resistor, R58, that is connected across the upper section of the vertical output auto-transformer.

The height control circuit arrangement consists of using the potentiometer as a variable grid resistor. The amplitude of the input signal is controlled in this way and the total vertical scan will be determined by the setting of this control. Coupling between the multivibrator oscillator sections necessary to initiate and sustain feedback is obtained by directly connecting both

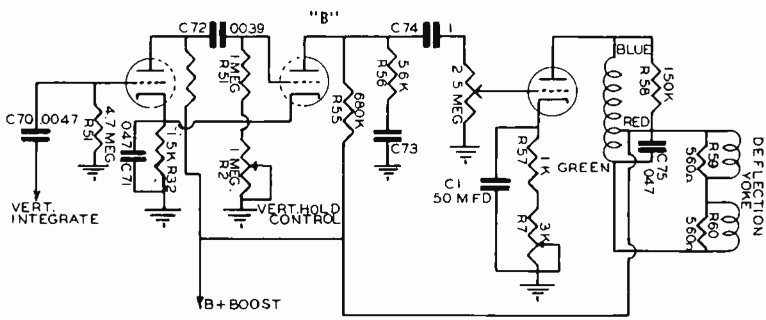


FIG. 3. Multivibrator and a Triode Output stage.

cathodes and returning to B— through a common resistor R32. The plate circuit of the section marked B (in Fig. 3) of the multivibrator forms the vertical sawtooth across the RC network of R56 and C73. The operating frequency of the vertical oscillator is determined by the setting of R2. Adjustment of this control charges the RC time constant of the grid circuit in Section B of the multivibrator.

The vertical deflection section shown in Fig. 4 consists of a modified multivibrator which drives the output vertical amplifier stage. For reasons of manufacturing economy, this circuit uses only a minimum number of tubes and does not require a blocking transformer in the single section oscillator stage. V1 and V2 may be in a single envelope. Feedback to sustain oscillation is obtained from the plate circuit of the output stage. The feedback network is made up of C2, C3, C4, R6, R7 and R8.

These components are used to reduce the amplitude of the feedback signal to the proper level and to shape the signal before it is applied to the control grid of the oscillator.

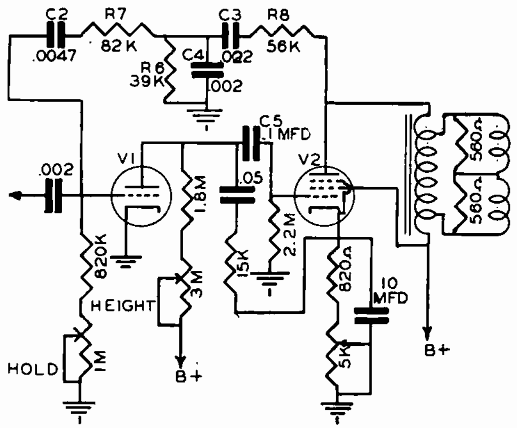


FIG. 4. The Pentode Section of a Multivibrator (V2) also serves as a Vertical Output Stage.

The sawtooth forming circuit consists of capacitor C1 which charges through R1 and the height control R2. Resistor R3 serves as the peaking element to form the sawtooth wave form used to excite the control grid of output tube.

In the circuit shown in Fig. 5, the cathode of the vertical output tube is returned directly to ground instead of passing through the usual linearity control. In this case, the linearity control is located in the grid circuit, and varying this control will shift the operating point of the output tube to provide good linearity. The resistors R77, R6 and R78 are connected in series and are in parallel with the grid resistor of the horizontal output stage (not shown in Fig. 5). This means the dc voltage present at the hori-

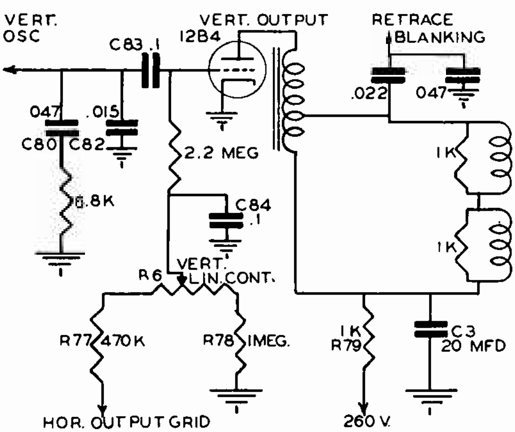


FIG. 5. How Bias can be obtained and adjusted from Horizontal Section for Vertical Output Linearity.

zontal output grid because of the signal from the horizontal oscillator, also appears as a negative voltage at the lower end of R77. Adjustment of R6 places more or less of this voltage on the grid of vertical output stage so that the tube will operate on the proper point of its operating plate voltage (EP) plate current (IP) curve. C84 is a relatively high capacity paper condenser serving to remove the vertical and horizontal signal components and establish a pure dc bias voltage for the vertical output tube.

A single dual-triode 12BH7 tube is used as a multivibrator oscillator and output tube in the circuit shown in Fig. 6. This vertical sweep system is being used in some of the more recent TV models because its relative simplicity results in manufacturing economies. The feedback network consists of C77, R77, and R78 and uses the integrator network to accomplish the remainder of the wave shaping necessary to provide the proper signal to initiate and sustain oscillation.

### General Isolating and Trouble-Shooting Procedure

To produce a vertically linear picture on the face of the picture tube, the vertical sweep must appear as a signal that rises evenly in voltage with respect to its time base. In other words, the sawtooth current flowing through the deflection coils must increase at a constant rate as shown in Fig. 7. If the sawtooth current flowing through the vertical deflection coils is distorted as shown in Fig. 8, the vertical linearity will be poor, and a picture similar to Fig. 9 will be obtained. Notice that the top of the picture is flattened somewhat and the bottom of the picture is stretched. The flattening at the top is due to the fact that the current did not increase as fast as it should have, and the stretching at the bottom is due to the fact that the current flowing through the deflection coil increased at too rapid a rate.

In many cases it is impossible to obtain a completely linear picture, but if the receiver is in good operating condition, by carefully adjusting the controls you should be able to obtain satisfactory linearity. Excessive nonlinearity that cannot be corrected by adjusting the controls usually indicates a defect in the sweep system.

### Isolating the Defects

Naturally, it is assumed that the first step in any trouble shooting procedure, after confirming the customer's complaint, is a thorough test of all tubes within the suspected section. This is accomplished either by direct substitution with good tubes or checking with a tester known to be reliable.

The operation of the height, linearity and hold controls should next be checked. The actions of

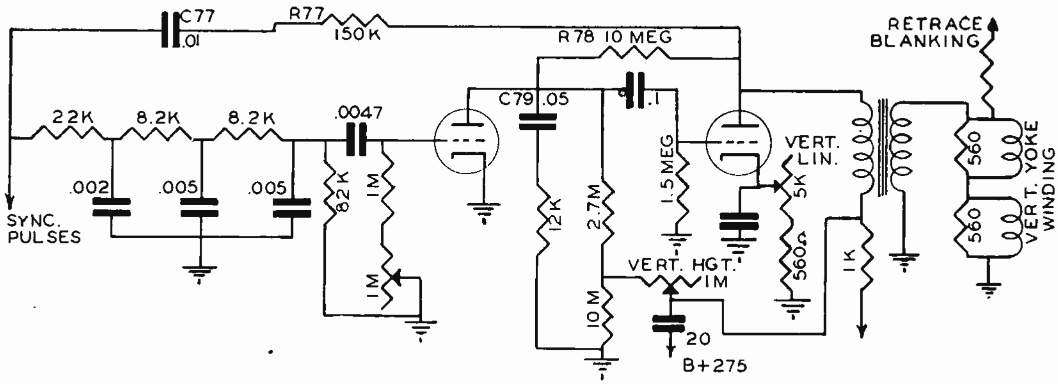


FIG. 6. Single dual triode used as a combined Multivibrator and Output Stage.

the controls can often provide those clues that can lead to a correct diagnosis of the trouble If the height control would cause the bottom of the picture to spread but the linearity control could not expand the top of the picture, it would then be known that the operating voltages of the output stage were not correct.

Referring to Fig. 1, we see a number of components, any one of which can break down and be held responsible for poor height and linearity. Normally, considerable current passes through the plate decoupling resistor, R180, heating this component which in due time will most likely fail. The resistance value will probably increase and in reducing the vertical sweep circuit operating voltage, cause unsatisfactory height and linearity.

Similarly, leakage in C120A will increase the voltage drop across R180 and then deprive the plate circuits of sufficient operating voltage. This 10-mfd decoupler condenser will cause serious trouble not only when in a shorted condition but where its capacity has greatly decreased. Loss in capacity would permit a portion of the vertical output sweep pulse to enter the common B+ and both affect the audio and horizontal sync circuits. The sound may contain an unusually high amount of buzz and a horizontal pull will appear in the picture. The remedy for this would be to carefully trace out the location of this electrolytic bypass and install a replacement. When tubes and the operating voltages closely approximate the circuit data but you still are unable to obtain satisfactory vertical deflection, the difficulty would very likely be due to a defective vertical output transformer. Often the vertical output transformer develops an internal short. Some of the turns of the transformer may be shorted out which may affect the linearity of the circuit through the deflection coils without changing the wave shape of the plate of the output tube appreciably. Where the break-down in the vertical output transformer is due to a bad internal connection, then a loud buzz will be audible and unstable vertical retrace lines will appear.

This is by way of emphasizing that you may not

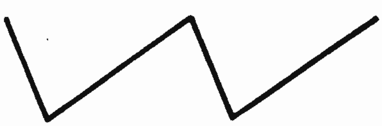

FIG. 7. Current through the Deflection Coils must be a Linear Sawtooth.

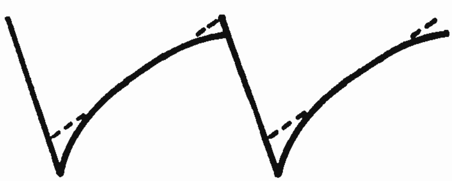

FIG 8. A Distorted Sawtooth Wave Shape.

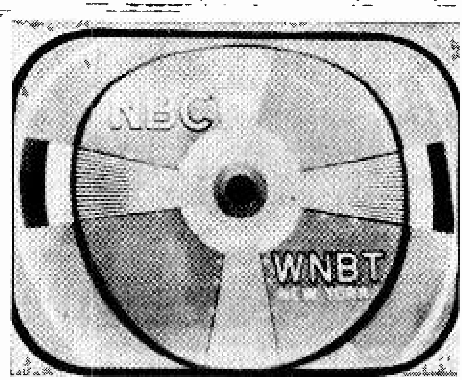


FIG. 9. Vertical Non-Linearity in Picture.

be able to measure or otherwise identify the precise nature of the transformer defect, because the break-down will occur only during actual operation. In seeking a replacement, you may for reasons of economy and convenience install a transformer that you happen to have on hand and may obtain satisfactory results. But frequently the plate circuit tolerances will not permit a general replacement and insufficient height or poor linearity will be the result of installing

FIG. 10. Vertical Keystone Effect when Deflection Coil Shorts.

a transformer with different characteristics. By consulting the service data or transformer manufacturer's reference catalog, the correct type number can be obtained.

Shorted turns in the vertical winding of the deflection yoke may also cause poor vertical scanning. Some turns on one half of the yoke may be shorted and produce the characteristic "keystone" effect. The visual result is illustrated in Fig. 10. Frequently a defect of this type cannot be detected by checking the resistance of the deflection yoke with an ohmmeter.

### Common Trouble Symptoms

1. **Complete loss of vertical sweep.** Disappearance of vertical sweep is indicated in Fig. 11. This trouble symptom appears when there is no vertical signal applied to the yoke winding or the signal cannot deflect the beam vertically due to a faulty yoke. Analyzing the symptom and using effect-to-cause reasoning, the appearance of the horizontal line is a positive indication that at least both the horizontal deflection and high voltage circuits are operating normally.

Possible causes of a loss of vertical sweep are:

A. Defective oscillator or oscillator-output tube.

B. Open coupling capacitor (See C154 in Fig. 1) C72 and C74 in Fig. 3; C2, C3 and C5 in Fig. 4; C83, in Fig. 5; or C77 and C78 of Fig. 6.

C. Open linearity control.

D. Open height control.

E. Open output transformer.

F. A defect in the blocking oscillator transformer.

G. Open vertical yoke winding.

H. Open plate load resistor.

If substitution of tubes has failed to restore the sweep, then the plate, screen and cathode voltages should be checked to make sure that the trouble is not caused by an open resistor in the circuits. The relatively heavy current passing through the vertical output cathode components consisting of the linearity control and fixed bias resistor frequently causes a loss of signal. The quickest test for this trouble would be to measure the resistance of these components.

An interesting symptom where the cathode resistance has changed to a relatively high value is the blinking effect of the raster showing the charge and discharge of the cathode bypass electrolytic condenser.

2. **Insufficient Height.**

Insufficient height is the condition that exists when a linear picture cannot be made to fill the screen. The illustration in Fig. 12 shows a picture that fails to fill the screen at the top or bottom.

Possible causes of insufficient vertical sweep are:

A. Improper adjustment of the height and linearity controls.

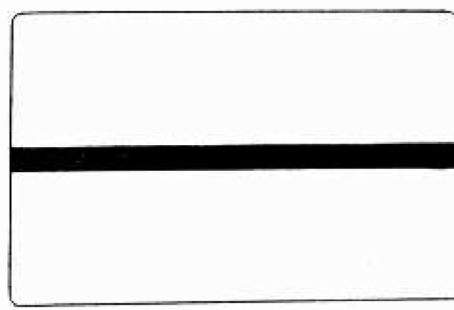

FIG. 11. Appearance of Screen when Vertical Sweep has Failed.

B. Weak oscillator or output tube.

C. Low B+ voltage.

D. Defective decoupling network in a plate circuit.

E. Low boosted B+ voltage.

F. Loss of capacitance in electrolytic bypass.

G. Weak damper tubes have been known to cause insufficient sweep because they do not furnish enough boost voltage.

In most cases of this type, the horizontal sweep

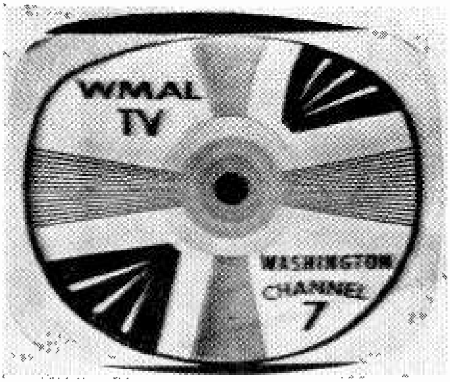

FIG. 12. Short Picture resulting from Insufficient Vertical Height.

may have also decreased; though this particular symptom will depend upon individual deflection circuit tolerances.

Low power supply dc output caused by weak rectifiers or filter condensers would most likely be responsible for insufficient B+ voltage.

**3. Poor Linearity.**

Unsatisfactory linearity is the condition that exists when the picture appears elongated. There are various degrees of non-linearity as determined by the nature and severity of the component break-down. The types of non-linearity as determined by the nature and severity of the component break-down. The types of non-linearity are: compression at the top or bottom and fold-over.

The illustration in Fig. 9 shows a picture compressed at the top. Possible causes for compression at the top of the picture are:

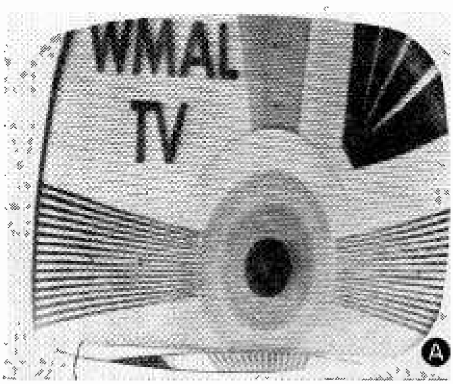

FIG. 13. Vertical Fold-over caused by Leaky Coupling Capacitor.

A. Improperly adjusted controls.
B. Insufficient bias voltage in the circuit in which self bias is not used (See Fig. 5).
C. Defective output tube.
D. Open grid resistor in output stage.
E. Changed value of resistor in the cathode of the output stage.
F. Heater-to-cathode leakage.

The illustrations in Figures 13 and 14 are two examples of picture fold-over caused by troubles in the vertical sweep section. The picture in Fig. 13 is the result of leakage in the coupling capacitor between the oscillator and output stages. The degree of fold-over will be determined by the amount of leakage in the capacitor. The trouble symptom appearing visually in the picture of Fig. 14 was caused by heater-to-cathode leakage in the output tube. The severity of fold-over will depend upon the degree of leakage between the elements in the tube.

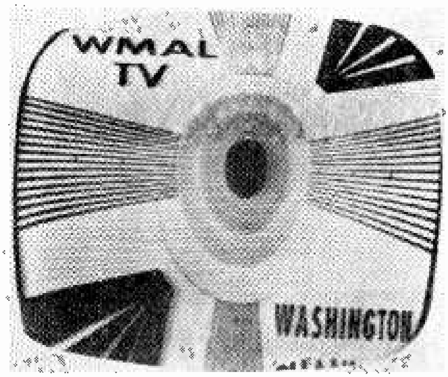

FIG. 14. Vertical Fold-over caused by Heater-to-Cathode leakage in the output tube.

To sum up possible causes of fold-over:
A. Defective output tube.
B. Leakage in coupling capacity to output stage.
C. Leakage in discharge capacitor (See C153 in Fig. 1, C73 in Fig. 3, C1 of Fig. 4, C80 and C182 of Fig 5 and C79 of Fig. 6).
D. Heater-to-cathode leakage in vertical amplifier tubes.

### Vertical Rolling

When the vertical sweep oscillator in the receiver operates at exactly the same frequency as the vertical sweep oscillator in the television station transmitter, the picture will be stationary and its condition is described as "locked-in."

However, if the vertical oscillator operates on any frequency other than the correct one, the picture will move up or down. This is usually called, "Vertical Rolling." If the oscillator fre-

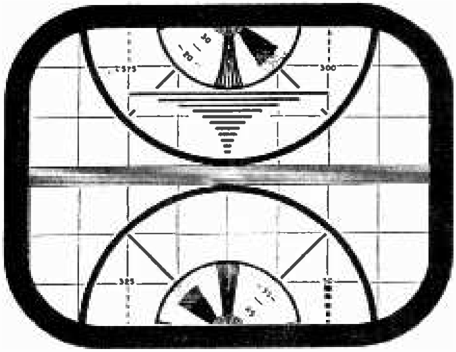

FIG. 15. Slow Vertical Rolling.

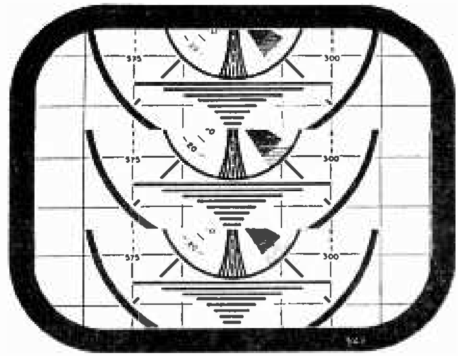

FIG. 16. Rapid Vertical Rolling.

quency differs only slightly from the correct frequency, the picture will move slowly as in Fig. 15. On the other hand, if the oscillator frequency is far from the correct frequency of 60-cps, the vertical movement will be rapid and there will appear to be a number of picture segments moving as shown in Fig. 16. Both defects can be quickly demonstrated by rotating the Vertical Hold control on any TV receiver.

When the picture will not "lock in" vertically, effect-to-cause reasoning quickly establishes that the trouble is in the vertical oscillator circuit or sync circuit. Either a defect has occurred so that the synchronizing pulses are not reaching the vertical oscillator, or there is a defect in the vertical oscillator so that it does not operate at the correct frequency even though it is receiving the proper synchronizing pulses.

Let us see if we can isolate the defect any further by effect-to-cause reasoning. The vertical oscillator frequency is adjusted by the Hold control in the typical circuit shown in Fig. 1, the vertical Hold control is located in the grid circuit of the oscillator stage. If you are able to adjust the Hold control and bring the oscillator to the correct frequency, it indicates that the oscillator will work at the correct frequency. Oscillators of this type, however, are not stable, and if no synchronizing pulses are applied to the oscillator, the frequency will drift rapidly and the oscillator will not remain exactly in step with the vertical sweep oscillator in the TV transmitter.

From this we can conclude that if we can adjust the oscillator to the correct frequency, by carefully rotating the vertical Hold control, the oscillator itself must be working properly. Therefore, the slow vertical rolling is due to the fact that the vertical sync pulses from the composite input signal are not controlling the oscillator. This might be due to a defect in the sync circuit that has removed the sync pulses completely or there may be some defect that is distorting the vertical sync pulses.

On the other hand, if you find that regardless of the settings of the vertical Hold control, you cannot stop the vertical rolling, a breakdown is indicated in one or more of the frequency determining components. If your tests have isolated the defect to the vertical oscillator, you should check the resistors and condensers that comprise the frequency determining components in the vertical oscillator circuit.

In Fig. 1, the following resistors will affect, in varying degrees, the frequency at which the vertical oscillator operates: R171, R172, R174, R175, and R177. These resistors can be checked with an ohmmeter. Any resistor that measures beyond the rated tolerance should be replaced Capacitor C152 and the output .005 mfd unit in the integrator network also affect the oscillator frequency. If the resistors prove good, check the capacitors either by checking them on an R-C Tester or by substitution. In the case of the .005 mfd a new printed integrator should be tried.

If the resistors and capacitors used in the oscillator circuit all check good, the trouble may be due to a defective blocking oscillator transformer. In Fig. 1 this is designated as T104.

Sometimes the picture may lock when you adjust the vertical Hold control but in a short while the picture will start slowly rolling.

This might indicate that the tube or some part in the vertical oscillator circuit is slowly changing in value. Resistors will frequently change value and cause this type of trouble. It is of interest to note that some receivers will use special negative temperature coefficient resistors to compensate for the normal resistance rise of other resistors in the vertical oscillator circuit. Consult the service data as to the type of resistor used to prevent incorrect parts replacement that

(Continued on page 22)

# CONSTANT VOLTAGE SOUND SYSTEMS

By J. DODGSON, NRI Consultant

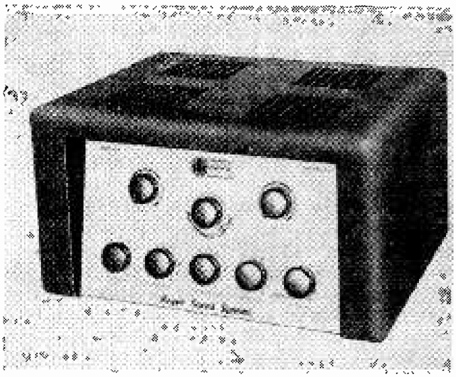

Fig. 1. A modern PA amplifier designed for both constant voltage and constant impedance distribution systems.

All public address systems are custom installations since almost all public buildings employing PA systems are different from each other. This is especially true with the output end of the system—the loudspeakers or horns, and transmission lines.

This "custom" feature of PA systems presents to the sound man different problems for each installation. Although there may be many similar jobs, each one is sufficiently different to require different components, methods and planning.

The planning of the installation is probably just as important as the actual installing of the component parts. Since all permanent installations require that the speaker lines be run in the walls or ceilings, it is difficult and expensive to change a system once it is installed.

Until a few years ago, planning the transmission line and speaker installation was extremely complicated. These older systems used what is commonly known as a constant impedance system to match the speakers to the amplifier. The modern constant voltage system was designed to simplify the planning and installation.

Except in unusual situations low impedance lines are not used in permanent PA installations because of the power loss. Separate matching transformers are therefore required for each loudspeaker. Of course it's possible to save on transformers by connecting the speakers in series or in series-parallel arrangements but this is unwise. An open anywhere in the series-system would completely disable the system while an open in a branch of the series-parallel system would throw full power on the other branch and likely damage the speakers. With matching transformers on each speaker, an open in any transformer or speaker voice-coil would not disable the system.

Thus, the typical PA system will require a number of loudspeakers, each with its own matching transformer, and each properly connected (in parallel) to an appropriate amplifier capable of handling the power requirements of the speakers and of properly matching the speaker transformers.

These, then, are some of the problems to be solved:

1. The number of speakers
2. The power requirement of each speaker
3. The specifications of each matching transformer to provide the proper impedance match and power.
4. The specifications of the amplifier capable of supplying enough power to all speakers and of matching the transformers.

Naturally there are a great many other problems like wire size; where and how to run the wire; speaker size and quality; speaker location, baffles, and installation, etc. Of course, in this ar-

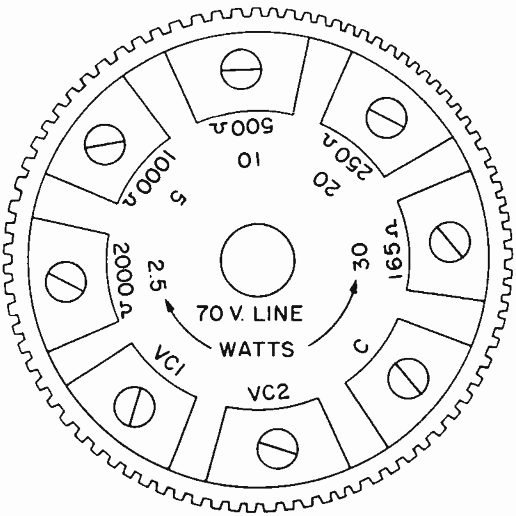


Fig. 2. A driver terminal board capable of being used for both distribution systems.

ticle we are concerned only with the impedance problems.

Before going farther, a few basic requirements should be examined. First: a high impedance (over 50 ohms) should be used to keep line losses low. Second: since all the matching transformers are in parallel, their combined impedance must equal the chosen amplifier output impedance in the constant impedance system. Finally: should all the speakers be the same in required power output then all the matching transformers will be the same, but, if the power requirements of the speakers are different then the transformer impedances (turns ratios) will be different—in both the constant impedance and constant voltage systems.

According to the above first and second requirements, both the amplifier and matching transformers are rated in various impedances for use in constant impedance systems. Impedances of 4, 8, 16, 125 and 500 ohms are common for the amplifier. The transformers normally are available with primary impedances of 500, 1K, 1.5K, 2K, 4K, 8K, 16K, etc.

For use in constant voltage systems the amplifier output provides not only the regular impedances but also taps indicated as 70 volts and sometimes also 140 volts. The matching transformer, instead of being rated in impedance, however, is rated in power. Taps on the transformer indicate the various connections to be used to provide the speaker with input powers of from .62 to 25 or 50 watts depending on the maximum power rating of the transformer. Fig. 2, for example, shows the terminal board of a driver unit rated in both impedance and watts for use in both constant voltage or constant impedance systems.

Evidently then, to use a constant impedance distribution system, it is necessary to calculate each matching transformer impedance according to the required power of the speaker and then to match all of the transformer combined impedances to the amplifier output impedance. In the constant voltage system the amplifier and transformer manufacturer has, in effect, already done this and it is only necessary to determine the required speaker power and use the appropriate tap on the transformer.

To illustrate the advantages of the constant voltage system let us examine a small hotel installation requiring loudspeakers in the ballroom, dining room, and in fifteen individual rooms.

By experience and/or sound level meter readings, the installer has found that the ballroom would require two 25 watt loudspeakers, four 5-watt loudspeakers would be sufficient in the dining room, and two watt loudspeakers would be satisfactory for the fifteen individual rooms. The loudspeaker groups therefore take respectively:

$$2 \times 25 = 50 \text{ watts}$$
$$4 \times 5 = 20 \text{ watts}$$
$$15 \times 2 = 30 \text{ watts}$$

This gives us a total as 100 watts. To determine the impedances of the loudspeaker matching transformers it is necessary to obtain the power ratio for each loudspeaker by dividing the total power of the system (100 watts) by the power consumed by the individual loudspeaker.

This power ratio is then multiplied by the amplifier output impedance to obtain the impedance of the primary winding of the loudspeaker matching transformer. The power ratio for the 25 watt loudspeaker is 4 (100 divided by 25). For the 5 watt loudspeakers it is 20 (100 divided by 5) and for the 2 watt loudspeakers it is 50 (100 divided by 2).

With an amplifier termination of 500 ohms, the primary impedance for the 25 watt loudspeakers should be 2000 ohms (500 x 4); for the 5 watt loudspeakers it should be 10,000 ohms (500 x 20); and for the 2 watt loudspeakers it should be 25,000 ohms (500 x 50). Of course, it would be difficult, if not impossible, to obtain transformers for the 2 watt loudspeakers since they are rarely made to match impedances of 25,000 ohms. Thus, it would be wiser to use some lower value of source impedance so that the correct primary impedance of the 2 watt loudspeaker transformers would be more reasonable. If we use the source impedance of 125 ohms, it will be necessary to again repeat the computations of dividing the power by the loudspeaker requirement to obtain the power ratio and then multiplying the power ratio by the terminating impedance to obtain the matching transformer primary impedance. By doing this we will find that the 25 watt loudspeakers require a primary impedance of 500 ohms; the 5 watt speakers will require 2500 ohms; and the 2 watt loudspeakers will require 6250 ohms. Since these transformers are readily available, it would be better to use a line impedance of 125 ohms.

A simplified diagram of this installation is shown in Fig. 3. After the amplifier is installed with its accompanying microphones, turntable, tuners, etc. and the transmission lines are run to the various sections of the hotel, the speakers would need to be installed with the matching transformers. The main system could then be considered completed except for some additional accessories. For example, it is almost always necessary to provide some method of switching the individual room speakers in and out or perhaps even providing a volume level control However, in the constant impedance system, it is not possible to switch speakers in and out without providing some method of keeping the

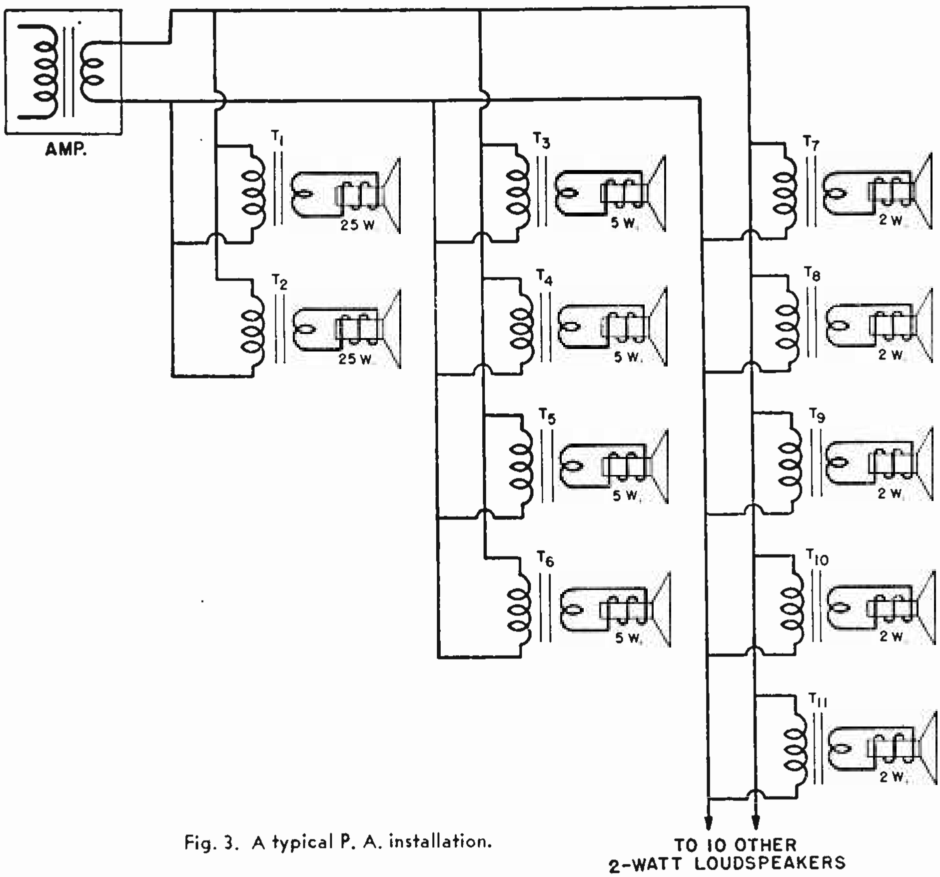


Fig. 3. A typical P. A. installation.

total impedance constant or the sound level will be changed in each of the speakers. Therefore, one of the two switch systems shown in Fig. 4 would need to be installed. Since individual matching transformers are used in each of the small room speakers, it would be necessary to use the system shown in Fig. 4B. Should a continually adjustable volume level control be needed, it would be necessary to install either an L or T pad as shown in Fig. 5.

In addition to these complications should it happen that the hotel expands and the additional rooms require loudspeakers, it would then be necessary to go back and completely re-calculate the transformer impedances. In most instances this would require replacing all of the matching transformers on the speakers.

Now let us consider the same public address system installation using the constant voltage system. The same preliminary planning would be necessary. That is, it is always necessary to determine the sound levels needed in the various rooms in which speakers are installed. Thus, we would start out with the same information of two 25 watt speakers in the ballroom, four 5 watt speakers in the dining room, and 2 watt speakers in the fifteen individual rooms. In addition to the loudspeakers it would also be necessary, again, to obtain matching transformers for each loudspeaker. However, these matching transformers would be of the constant voltage type which, instead of being rated in impedance, are rated in power.

These transformers are installed as shown in Fig. 6 which shows the connections to one of the 25 watt units. Notice that no calculations at all are necessary. The loudspeaker is merely connected to the proper impedance tap shown on the transformer and the line from the amplifier is connected to the appropriate wattage tap shown on the primary of the transformer.

Should it be necessary to install an on-off

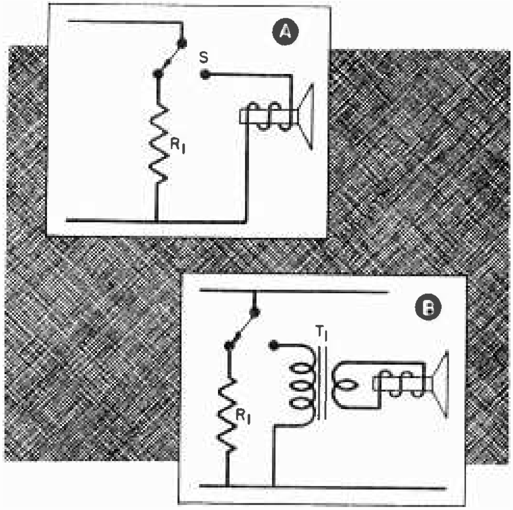


Fig. 4. Two ways of keeping the line impedance constant when switching loudspeakers in or out.

switch on the speakers in the individual rooms, it would not be necessary to switch a resistor into the circuit. Removing or adding the speakers to a constant voltage system does not upset the sound level of the other speakers. Thus, should the hotel expand and require speakers in additional rooms, only these speakers need to be connected to the main line and none of the other speakers or speaker matching transformers would need to be changed. Of course, the amplifier would need to be replaced with a more powerful unit to supply the additional power requirements or more likely a booster amplifier could be easily added to the present system.

Notice that the constant voltage system eliminates the troublesome problems of impedance matching. Remember that this impedance matching serves only one purpose: to get maximum power from the system. If we have a system where impedance mismatch does not upset the power relationship, then there is no problem about impedance matching. This is what we do with the constant voltage type system where the power delivered to the load is simply a function of the load impedance and not the impedance match. This, we can throw away our problem of load matching. The loudspeaker itself is always across the secondary of the transformer but the primary is tapped so that when the 70 volt line is connected to a given section of the primary winding, the amplifier will see a given impedance and will deliver to that tap a corresponding electrical power. If the full primary is put across the line, the voltage to the secondary is stepped down to maximum amount giving a lower power input to the speaker. As the line is connected to smaller sections of the primary in the transformer, the voltage stepdown is decreased, developing more voltage on the primary and consequently delivering more power to the loudspeaker.

An interesting feature of this system is the method of adjusting the gain or volume control of the constant voltage amplifier when its full rated power is not utilized. For instance, one might think it economical to turn down the gain of an amplifier which may be rated at 100 watts when only 35 watts are drawn from it.

This, however, is not true. The constant voltage system is similar to your home light and power system. If all your appliances were turned off, your wattmeter would stand still, but the line voltage would still remain at 117 volts. This same thing holds true in the 70 volt system. Even though the gain control may be set at maximum to provide 70 volts, if there is no load tied to the amplifier, the amplifier will deliver no power. The power it will take from the line and the power it will deliver to the load will be completely dependent upon the actual load itself. In addition it is not possible to overdrive the units on the system even if the full power rating of the amplifier is used, since it is voltage which overdrives the unit and not power. Since the voltage is maintained constant by the amplifier irrespective of load, then even one unit (for example 2½ watts) may be put across a wide open 100 watt system with complete safety. Turning down the gain of the amplifier will naturally reduce the power input to all speakers, if one desires to do so, but at the expense of up-setting the sound power distribution as a whole.

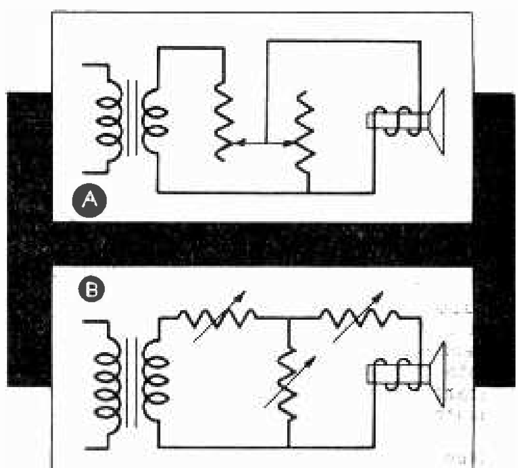


Fig. 5. Typical L pad (Part A) and T pad (part B).

If the system is set up after a legitmate sound survey has been made and the power ratings of individual units of this system are set properly, there should be no reason to play with the gain controls of the amplifier. If variations are required in certain areas due to changes in noise conditions, then these changes should be made by tapping at the transformer of the unit in that particular location to achieve the proper sound output at that station without upsetting the sound level of the remaining speakers. This is just another advantage of the 70 volt constant voltage system.

In summary then, here are a few advantages offered by the constant voltage sound system. For multi-speaker systems, impedance matching is completely eliminated. It is not necessary to

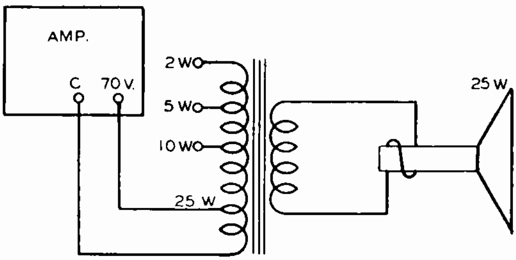


Fig. 6. Method of connecting a constant voltage matching transformer and speaker to the amplifier.

arrange a network of speakers or series-parallel combinations to obtain the proper impedance match to the amplifier. In the constant voltage system, the impedance match is already taken care of by the manufacturer of the matching transformer by fixing the wattage ratings on the terminal board. One simply chooses the required power tap and puts it directly across the constant voltage line.

Since the 70 volt line maintains constant voltage irrespective of load, once an individual power adjustment on the speaker has been made, it continually receives the same amount of power even when other speakers are added or subtracted from the system. This results in a more constant uniform coverage.

By being able to proportion individual speaker power to immediate local and specific needs without upsetting other local adjustments of the other components, there is more efficient use of available sound power.

Maximum utilization of available audio power is made possible by the elimination of volume controls or attenuators which burn up power to make a level change, in contrast to transformers which are essentially non-power consuming devices.

It becomes relatively easy to determine the necessary amplifier power by simply counting up the actual power requirements without the necessity of allowing for uncertain attenuator losses.

More adequate overload protection is afforded each individual speaker unit on the constant voltage system. Should the unit somewhere in an installation fail, the line voltage would still remain unaltered and so this unit failure in one location does not start any chain-reaction such as rise in line voltage that might, in other distribution systems, overdrive the remaining speakers.

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# TV Receiver Development Reaches New High with 110° Picture Tube

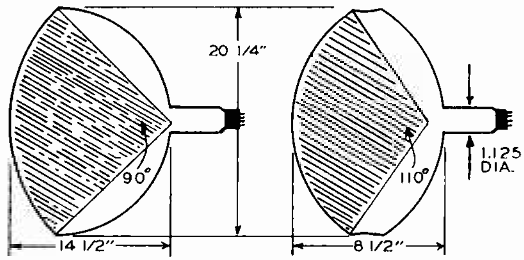


Fig. 2. Comparison of 21ATP4 (90°) Picture Tube and the new 21COQP4 (110°) model.

Taking a long and envious look at the multi-billion dollar yearly automobile replacement market, the television manufacturers have gone all out to develop and produce sets with innovations that startle the consumer in replacing his present set or using it as a spare.

This year's biggest design change-over in television receivers, that is now reaching the retail level, is found in sets incorporating the newly developed 110° deflection tube. These wide-angle tubes, the subject of intensive engineering research for over a year, are now firmly out of the blueprint stage.

Three types, 14-17- and 21 inch sizes are now available and a 24 inch type will be on the market this fall. The new 21 inch tubes are nearly six inches shorter than the 90° models and are 20 per cent lighter.

To further emphasize the difference in size, use of the 17 inch type (17BVP4) has permitted a 50 per cent reduction in the overall dimension of the 17 inch set. Figure 1 shows how the picture tube bell becomes shorter as the deflection angle increases.

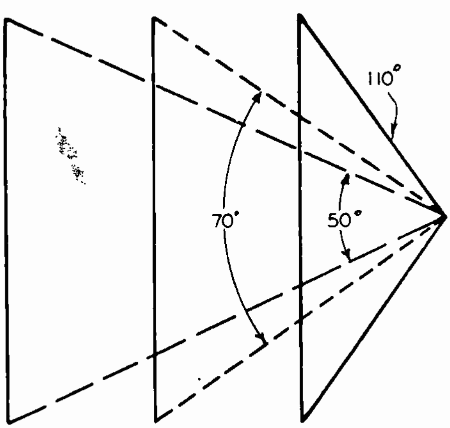


Fig. 1. How the Picture Tube Decreases in Length as the Deflection Angle is made wider.

In achieving the 110° deflection the picture tubes will employ a slimmer tube neck, 1⅛" in diameter, compared with 1-7/10" for most present 90° types. This small neck diameter not only makes possible the use of a deflecting yoke having high deflection sensitivity, but also permits deflection of the beam through the wide deflection angle with only slightly more power (when used with high efficiency sweep components) than is required to scan a tube with 90° deflection.

A comparison of the standard 21AP4 picture tube and the 21CP4 110° picture tube appears in Fig. 2. It will be noted that the diagonal measurement on the face of the picture tubes is exactly the same. This shows that there has been no decrease in the amount of square inches on the face of the picture tube, but the shorter depth of the new picture tube is quite evident from the dimensions shown. The tube itself is aluminized and is of the non-ion trap type. Therefore, the only components on the neck of the picture tube is the deflection yoke. Centering is accomplished by moving metal tabs mounted at the rear of the yoke. Cross sectional views of the new 110° and the old 70° yoke appear in Fig. 3. It will be noted that the winding of the 110° yoke is flared onto the bell of the picture tube and that the core material of the yoke itself is flared in a similar manner. Because of this the center of the deflection angle is now forward into the hell of the picture tube.

This design enables engineers to get 110° diagonal scan without corner cutting. Of course, as with any deflection yoke, the yoke itself must be fully forward against the bell of the picture tube for proper operation.

The basic design idea was to develop 110° sweep with 17,000 volts by using conventional and well known horizontal output or driver tubes. For example, in one popular model the horizontal output tube type 12DQ6 drives a new, small-sized but very efficient output (high-voltage) transformer. Efficiency of this transformer is dependent upon cancellation of magnetic flux.

Servicemen are familiar with the core material

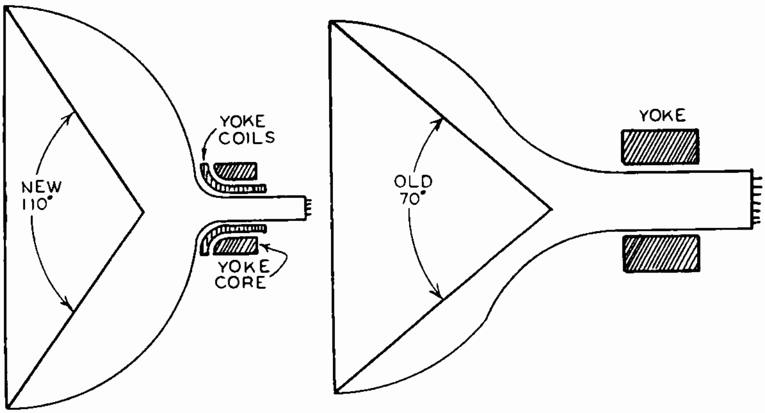


Fig. 3. Cross Sectional View of the New Flared 110°. Yoke and the old 70° yoke.

used in a horizontal scan transformer. But what they may not be aware of, is that with all electromagnets, whether they be ac or dc, the core will saturate if the amount of power put into the windings is greater than the core material can handle.

This point is illustrated in Fig. 4A where an electromagnet is shown. If dc is caused to flow through the winding a point will be reached where no increase in flux will be developed with an increase of applied electrical power. At this point the core of the transformer is considered saturated. In 4B, we see the same electromagnet, except that an additional winding has been added. By following the current flowing through the winding it can be observed that current is flowing in opposite direction through the two windings; therefore, the magnetic field being developed by the two windings will cancel.

In conventional-sweep transformers the core is partially saturated by the dc flowing in the windings. This dc is the B+ for the plate of the horizontal output tube. This means that only a limited amount of rf power can be handled by the core material. To be conventional, simply enlarging the size of the core material would overcome this problem. But this solution would lead to other serious problems in transformer design. Instead it was felt that the portion of the core material that was being lost due to the dc flowing in the horizontal scan transformer, should be eliminated. To do this, an additional winding was placed on the horizontal sweep transformer in the same direction as the main winding. By proper circuit connection the B+ current for the horizontal output tube is made to flow in one direction through the additional winding, and in the other direction through the main winding. In other words, the B+ is flowing in one direction for one winding and in the opposite direction for the other winding. This opposite dc flow will cause field cancellation of the dc. Therefore, all the core material can be used to handle the rf energy. The electrical arrangement of the windings is shown in Fig. 5. This means that a much smaller core material can be used as compared with conventional transformers. This increased efficiency in conjunction with the high sensitivity yoke eliminated the sweep problem that was anticipated.

New receiving tubes have also been designed for the 110° picture tubes. One line includes

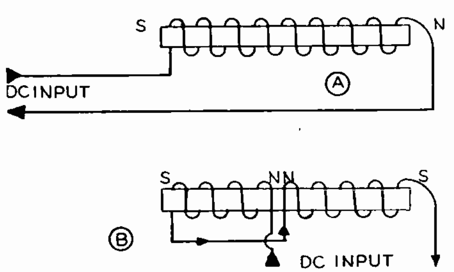


Fig. 4. Flux Cancellation principle is illustrated in this schematic.

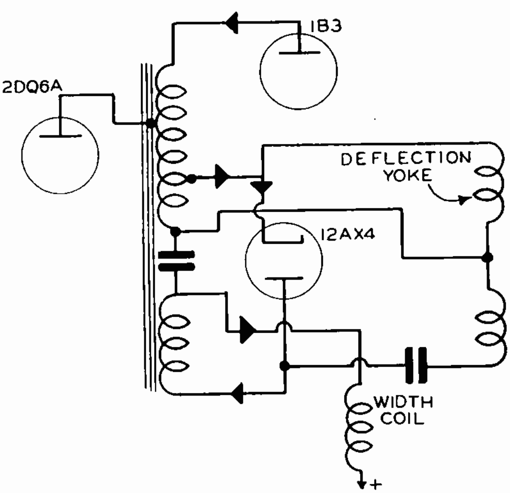


Fig. 5. Simplified Horizontal output circuit showing direction of current flow.

9-pin miniature beam power pentrodes, electrically similar to the 6W6, (6DB5 and 12DB5) that can be used as vertical deflection or audio amplifiers. The 6DB5 and 12DB5 are identical except for heater characteristics; the 12DB5 incorporates a 600 ma heater for use in series string chassis.

For 110° vertical deflection use, a new duo-triode 9 pin miniature type (10DE7) has been developed and is now in use. This tube contains two dissimilar triode sections. The smaller section is used as the vertical oscillator. The output section is rated at 80 ma and a maximum plate dissipation of 7 watts. In addition to the 10DE7, a type 13DE7 is available for 450 ma series string applications; a 6DE7 has been designed for standard transformer-supplied filament power.

At this time all of the television set manufacturers are featuring most if not all of their new models as using the 110° picture tubes. The outstanding advantage from both the manufacturers and users viewpoint is that the 110° tubes combined with compact chassis construction permits up to a 50% reduction in the overall dimensions of the cabinet.

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NATIONAL RADIO INSTITUTE
E. L. Degener, General Manager

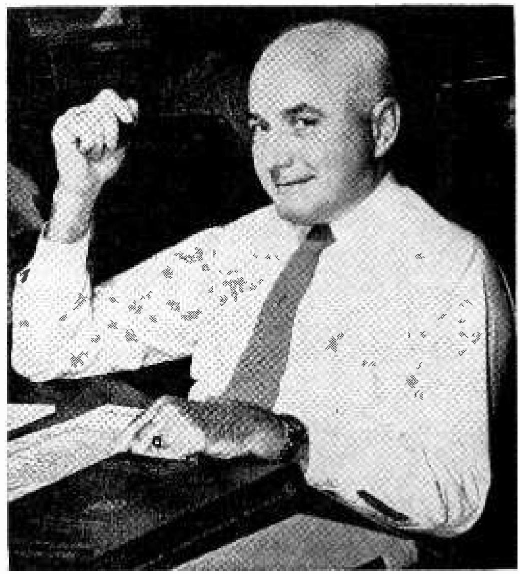
Sworn to and subscribed before me this 1st day of October, 1957.

Charles Alexander
Notary Public

(My commission expires January 14, 1959.)

# Building An Armature Tester

By LEO M. CONNER,
NRI Consultant



Leo M. Conner

Many radio service shops are beginning to service small appliances in order to give better all-around customer service and to build up greater income.

Because of the electrical simplicity of most small appliances, the experienced radio-TV serviceman has little difficulty in finding defective cords, heater elements and thermostats. It is possible to find open or grounded field coils in small motors with the average vom or vtvm. However, shorted armature coils cannot be found with a vom or vtvm and a tool, called a "growler," is used.

For some reason, many servicemen and electricians feel that this device is very mysterious and complicated. They do not understand how it operates and seem to think that the construction of a growler would be very difficult.

The purpose of this article is to show how a growler operates and how to build one in a few minutes from materials usually found around a service shop.

*How a Growler Works:*

Most servicemen know that when the primary of a power transformer is connected to the ac line with no load on the secondary, the primary current flow will be limited to that caused by core and copper losses. As the secondary is loaded, the primary current increases and reaches maximum when the secondary is short-circuited.

A growler has a laminated iron core similar to a power transformer except that the core has an air gap in it. Only one winding is on this core and it corresponds to the primary winding on a power transformer when the growler is in use.

The construction of the growler core is such that the armature windings to be tested are in the magnetic field of the growler when placed in the air gap. The armature windings then serve as secondary windings for the transformer.

If none of the armature windings is short-cir-

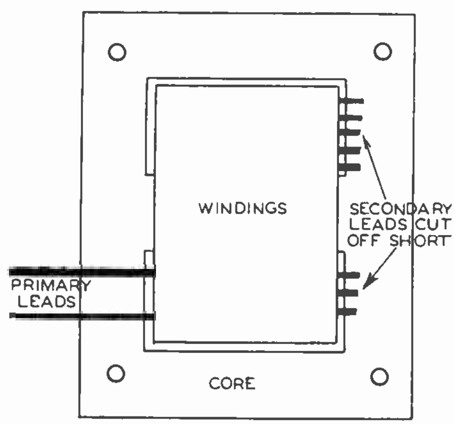



Fig. 1. Transformer after removing case and cutting secondary leads.

cuited, only a small current will flow in the primary and very few magnetic flux lines will be set up in the core. In testing an armature, the armature is turned until all of the coils have crossed through the air gap in the core.

Should one of the armature coils be short-circuited, a heavy primary current will flow and a large number of magnetic lines of force will be set up through the core. This will cause the armature to vibrate which makes a loud buzzing sound. Hence, the name "growler."

If an armature has shorted turns, it must be rewound and this job is one for a shop specializing in armature winding. Most shops which offer rewinding service also have exchange armatures available which makes for faster service.

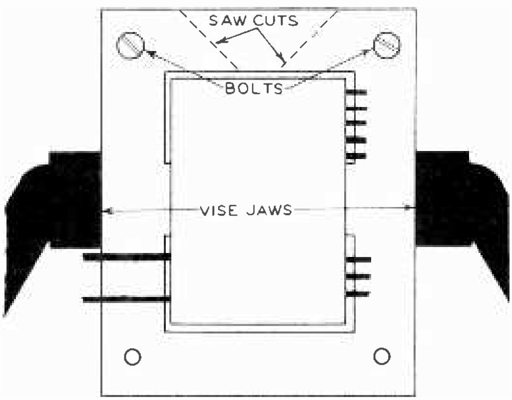



Fig. 2. How to clamp core in a vase and notch the core.

*Building a Growler:*

Because of the similarity to a power transformer, an old transformer can be used to make a growler. A large transformer, such as a TV power transformer, is best because larger armatures can be tested. However, any transformer can be used.

The transformer selected should have a good primary winding and none of the secondary windings should be short-circuited. In fact, if any secondary winding is shorted, the transformer cannot be used.

After the transformer has been selected, the case should be removed and discarded. All leads, except the primary leads, should then be cut off as close to the winding as possible. Fig. 1 shows how a suitable transformer might appear after the case has been removed and the secondary leads cut off.

When this much has been done, you are ready to cut the air gap. To do this, clamp the core in a vise so that all of the "squeeze" is on the section that goes through the windings. This should put one end of the core up. Put bolts through the holes in the top corners of the core and then place nuts on the bolts and pull them up tight. Fig. 2 shows a suggested method of clamping the core.

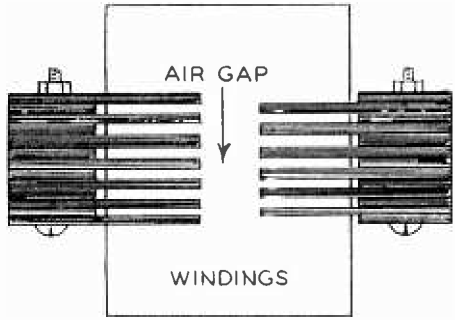



Fig. 3. The core may appear like this after notching.

Note the dashed lines through the core at the top. This "V" cut is the air gap. The cut is "V" shaped so that a round armature will fit down into the core for a short distance. The cuts are made with a hacksaw. Be sure you do not cut into the windings. If enough space is available between the core and the winding, slip a thin piece of metal between the two and this will protect the winding.

When the cuts are finished, you will most likely find that short pieces of the core drop out, giving an appearance similar to Fig. 3. This will not affect the operation and is due to the fact that some laminations on each side do not go clear across the core. Do not worry if the edges of the cut are not exactly straight. Filing should not be necessary.

After the core is notched, it may be mounted on a board by using "L" shaped brackets. Some technicians prefer to have a switch in the primary line but it is not necessary. In wiring the circuit either connect a cord to the primary leads directly or through a switch, whichever you prefer.

*How to use the Growler:*

You should suspect shorted turns in an armature whenever excessive sparking occurs at the commutator. The armature should be removed from the motor and placed in the notch in the growler. The power should then be applied to the growler winding. If you hear a loud buzzing noise, a shorted turn is between the edges of the gap. If you hear no noise, rotate the armature in the gap. If there are no shorted turns on the entire winding, there will be no buzzing as you turn the armature.

Open armature coils can be found with an ohmmeter. To do this, touch one ohmmeter probe to one segment on the commutator. Then move the other lead around to other segments until you find the one which shows continuity to the first segment. Then move the first lead to the next segment and find the second segment which shows continuity. There should be continuity between each segment and one other segment. Should you find one segment which does not show continuity to any other segment, that coil is open and, unless the open is right at the commutator, the armature will have to be rewound.

From this information you can see that the growler is a simple, easily made tool which is very valuable in small motor checking. Its use is not limited to small armatures, however, because it can be used to check automobile starting motor and generator armatures as well as the larger fractional horsepower motors.

One of these growlers has proven to be a valuable addition to the building maintenance shop here at the Institute. If you do any motor work, you will find it a valuable addition to your shop equipment.

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# Troubleshooting in the Vertical Deflection Circuits

(Continued from page 10)

can only add to the circuit troubles instead of correcting them.

The trouble might also be due to a distorted sync pulse that loses control of the oscillator when the i-f or video amplifiers exhibit poor low frequency response. The vertical sync signal as you know, has a 60-cycle square wave pulse. If the low frequency response is poor in any stage handling the sync pulse, the pulse may be wiped out completely, reduced in amplitude or distorted. If this happens, the vertical oscillator will not remain in synchronization very long. In such a case, adjust the Hold control until the picture stands still and then carefully examine the picture.

If you notice that the pattern is smeared or blurred as shown in Fig. 17, it is quite likely that the low frequency response of the video amplifier is poor. Poor low frequency response in the video amplifier is often the cause of slow vertical rolling. Common causes of circuit trouble in video amplifier stages other than tubes are faulty video coupling condensers or decreased resistance value of the plate load resistors.

**4. Vertical Sync Circuit Troubles.**

A component break-down in the sync circuits could lead to general instability of the vertical oscillator.

In order to properly use the sync signals, they must first be separated from the video information and then the horizontal and vertical sync pulses must be separated from each other. Fig. 18 shows a typical sync separator amplifier circuit. The sync information is separated from the picture information in the two triodes V1 and V2. The horizontal and vertical sync pulses are separated from each other in wave-shaping networks.

The resistance-capacity network composed of R1, R2, and R3 together with C1, C2, and C3 pass the vertical sync pulses but block the horizontal pulses. On the other hand, the vertical pulses are eliminated and the horizontal pulses pass in the network comprising C4-R4.

FIG. 17. Smeared Picture showing Pool Low Frequency (Vertical Pulse) Response.

As in all electronic equipment, the most common failure is tube break-down. If the cathode emission of either tube becomes low, the separator or clipping action will be incomplete and part of the video information will reach the sweep oscillators. This video information can sync the oscillator at the wrong time and cause vertical rolling.

If the composite (video and sync information) signal arriving at the grid of V1 through C6 is either weak or distorted, it will make the clipping action incomplete. A fairly common trouble in the sync circuit is the failure of the first sync coupling capacitor C6. The nature of the break-down may be in the form of an open or shorted condition. A shorted capacitor will place a positive charge upon the grid of V1 because the other end is connected to the video amplifier plate load resistor network.

You can readily detect a capacitor short by measuring the voltage at the grid of V1. A positive reading will indicate the component failure. The service technique of checking for voltage on the "cold" or grid side when the "hot" lead of the coupling capacitor is connected to a plate circuit is a reliable and quick check for possible shorted capacitors. Coupling capacitor C7 and C5 can be tested in this way. An "open" capacitor condition or partial loss of its original capacity may cause the vertical to roll without having any great effect on horizontal stability. The exact defect will depend largely upon the particular receiver and the condition of its tubes and other components.

If any of the three capacitors C1, C2, or C3 become shorted to ground then the vertical sync pulses will no longer arrive at the oscillator and the vertical oscillator will not lock-in. A reduction in the value of these condensers would

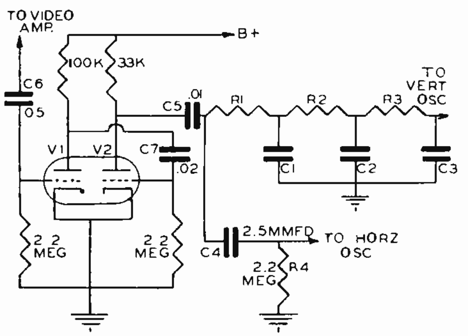


FIG. 18. Sync Separator-Amplifier Circuit showing Vertical and Horizontal Sync Networks.

tend to make the vertical oscillator unstable. Because of the relatively large total number of tubes used in the tuner, video i-f and amplifier stages, a fairly common circuit fault is heater-to-cathode leakage in one or more of the tubes used in these sections. The 60-cycle sine-wave superimposes itself upon the signal through the cathode circuit and overrides the vertical sync pulse. The result is vertical rolling. Because of the sine-wave form only its peaks may disrupt the sync and the symptoms will be for the picture to roll—then stop—then roll again, continually repeating this cycle. The remedy for the trouble would be to replace the faulty tube that can be located by substituting, one at a time, the tubes in the tuner, video i-f and amplifier stages.

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*The ability to see through an idea is good—seeing an idea through is much better.*

## High-Voltage Probe Now Available For W VTVM

For some time, the NRI Supply Division has received inquiries from Students who would like to buy a high-voltage probe to use with the Model W VTVM. The Model W VTVM is built with parts supplied in the second kit of the present Radio & Television Servicing course. Kits in this course are known as "W" kits.

A high-voltage probe for the Model W VTVM is now available through the NRI Supply Division for $5.50 postpaid. This probe uses a helical film-type cartridge multiplier resistor to extend the top range of the VTVM to 30,000 volts.

To use the high voltage probe merely insert the probe of your VTVM into the hollow handle of the high voltage probe so the VTVM probe tip is fully engaged. Attach the VTVM ground clip to the negative side of the receiver circuit. Set the function switch to +DC and the range switch to 1200 volts. Holding the high voltage probe so the round flanges are between your hand and the red tip, touch the tip of the probe to the voltage source.

Read the voltage on the 0-3 black scale and multiply your reading by 10,000. A reading of 3 is 30,000 volts, the maximum voltage which can be measured. A reading of 1.25 is 12,500 volts. A meter indication two divisions to the right of 1 is 1.1 or 11,000 volts. The high voltage probe provides a multiplying factor of 25 (30,000 ÷ 1200). Thus the probe can actually be used on any range since it extends each range. The following ranges can be obtained with the probe.

*(Continued on page 31)*

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## New Roll Charts Still Available for Model 70 NRI Professional Tube Tester

A new, up-to-date roll chart is still available for Model 70 owners. This chart, printed in 1957, gives tube test data on hundreds of newly-introduced tubes plus data on the most used older tubes.

If you purchased your Model 70 within the last few months, it may already have this later chart. To check this, roll your chart to the "top." If it reads Form NRI-70-7-57, you have one of the older charts. The new charts are available for immediate delivery. Price is $1.50 postpaid.

To order, write directly to the NRI Supply Division, 3939 Wisconsin Ave., Washington, D. C. Be sure to enclose your remittance—check or Money Order. If you live in Washington, D. C., please add three cents sales tax.

# NRI Graduates Increase Their Incomes—Have Greater Independence

## Had No Experience—Course Opened Complete New Field

"The NRI Radio and Television Servicing course has opened a complete new field for me. I knew nothing at all about Radio or Television before taking your course.

"I now have a spare time shop in my home and more business than I can take care of. Also planning a full time shop. The only advertising I have done was to hang my NRI diplomas up in my shop and let my reputation as a trained serviceman take care of the rest. The results have been wonderful. I have recommended NRI to all my friends."

James C. Weddle
Box 923
Roderville, West Virginia

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## Profitable Part-Time Business

"I am now doing spare time Radio and Television work and making plans to go into a full time business. During a twelve month period, I can report "extra" earnings of about $1,500 from work on a spare time basis.

I have had the opportunity to see Radio and Television courses offered by other schools and feel fortunate to have chosen NRI.

Clifford Stroud
Cliff's Radio & TV
Carthage, South Dakota

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## Started Servicing Soon After Enrolling

"I started doing part time Radio and TV work soon after enrolling in your NRI course. I am now doing spare time Radio and TV work and earning from $25 to $35 per week.

"I am well pleased with the course and recommend it highly."

Joseph D. Patterson
903 Buffalo Street
Birmingham 8, Alabama

## Our Cover Photo


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## Earned More Than Twice The Cost of Course Before Graduating

Before I finished the NRI course, I made more than twice its cost in spare time radio jobs. After graduating, I started servicing radios full time, localizing defects that stumped men who had been in the field much longer.

I am now getting plenty of TV experience as my employer does about 90% of the servicing in this area. I never hesitate to highly recommend NRI to anyone interested in Radio, TV or Electronics. The only regret I have is that I did not enroll sooner.

Robert C. Harvey
Cody's
N. B., Canada

## Proof That "Know-How" Pays Off

Graduate Floyd W. Cox sends us this excellent photo of his well-equipped service truck and writes:

"I am pleased to let you know how my business has progressed since I last wrote you.

"I have been doing full-time Radio and TV servicing for two and one half years now and enjoying every minute of it. I have two NRI Graduates with me as partners plus two NRI Students working part time. I am franchised with four major TV companies.

"If any prospective NRI Student should read this letter—is really sincere about wanting a good business of his own—will follow the advice given him by the NRI Staff—he is sure to be successful. I am living proof of that and gladly invite anyone to drop by my place of business and see for himself.

"The Know-How plus Honesty and Sincerity is really paying off."

Floyd W. Cox
745 No. Huntley Dr.
Los Angeles 46, Calif.

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## Proud To Be A Graduate

For the past 2 and one-half years, I have been operating a spare-time Radio-TV service shop.

I gross from $100 to $200 per month and also hold a second class Radiotelephone license. I rate the NRI course very high—best bargain of my life. Course has paid for itself many times over and returning me more every day.

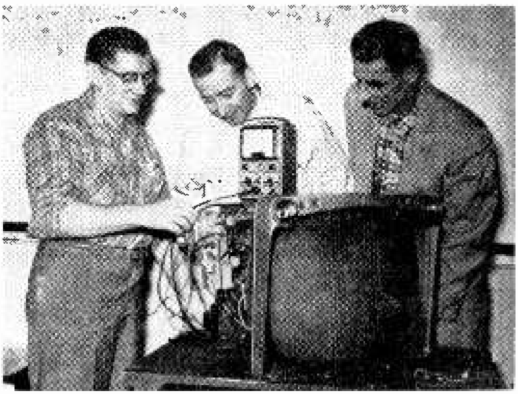
I am proud to be an NRI Graduate and have nothing but admiration and respect for such an organization.

Charles D. Howard
Box 611
Bardwell, Texas

# N.R.I. ALUMNI NEWS

Howard Smith ........ President
F. Earl Oliver ........ Vice Pres.
Jules Cohen ........ Vice Pres.
William Fox ........ Vice Pres.
Joseph Stocker ........ Vice Pres.
Theodore E. Rose ........ Executive Secretary

# Chapter Chatter

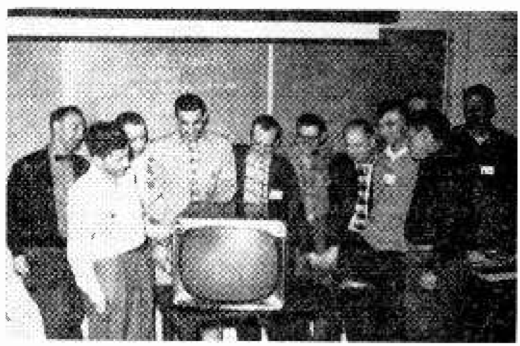


Springfield Chapter—Repair of Christmas Joy Clinic TV at meeting Dec. 6th. Left to right Walter Ceszewski, Rupert Mehellan, Augusto Lorenzatti.

**Springfield (Mass.) Chapter** held its Yuletide celebration on December 20 at its regular meeting place, 50 East St., Springfield. This was the Chapter's Christmas Party. By popular demand it was also Ladies Night, was attended by members' ladies. Each member and his lady deposited a donation in the Chapter's Santa's Pack to be turned over to the city's Toy For Joy Fund. Entertainment was under the direction of Ed Kazunas with Joseph Spezeski and Hugo Walpurgis assisting; Arnold Wilder and Frank Piatek were in charge of refreshments. A highlight of the evening was the installation of officers for 1958: Rupert McLellan, Chairman; Walter Ciszewski, Vice-Chairman; Howard Smith, Secretary; Harlon Barrett, Treasurer; Lyman Brown, Marcellus Reed and Arnold Wilder, Executive Committee, of which Lyman Brown is Chairman.

The Chapter's Christmas Joy Clinic—during which members repair radio and TV receivers free for the needy—was the most successful of any year to date. The Chapter repaired over fifty radio receivers and a few TV sets. The Chapter's Technical Director, Lyman Brown, organized the Clinic and in recognition of his efforts has been named as candidate for one of the GE All-American Awards for public service. Lyman Brown and the members who participated in the Clinic are to be complimented on a worthy task well done! Aside from the satisfaction members get from performing such a worthwhile public service, the Clinic gives them a wonderful opportunity to get practical experience in the repairing and servicing of radio receivers and TV sets under the direction of thoroughly experienced and skillful supervisors.

A previous meeting featured the presentation of two films. One was on the Bell Solar Battery, showing how energy from the sun can be used to operate radio receivers, etc. The other, "Driving 90 Horses" dealt with the three "C's"—courtesy, concentration, and control—of automobile driving.



Springfield Chapter—Group check Christmas Joy Clinic TV to see what is wrong

The Springfield Chapter always has a variety of programs under way. Most of them are designed to help the Chapter members improve their knowledge and skill in the actual servicing and repair of radio and TV receivers. All NRI students and graduates in the area are cordially invited to attend the Chapter meetings and are assured that they will profit by doing so.

The Chapter meets at 7 P.M. on the first and third Friday of each month at U. S. Army Headquarters Building, 50 East St., Springfield. For further information about the meetings, get in touch with Mr. Howard Smith, 53 Bangor St., Springfield, Mass.

**Hagerstown (Cumberland Valley Chapter)** wants all NRI men in the Cumberland Valley to know of an important change in the time and place of its meetings. The chapter formerly met at 8 P.M. on the second Thursday of each month at the YMCA in Hagerstown. Meetings are now held at 7 P.M. on the second Wednesday of each month at the North Hagerstown High School on Potomac Ave.

Note particularly the starting time of 7 P.M. No one should skip a meeting just because he will be late. Even if you are an hour late you can pick up when you arrive and will not miss much of the entire program. The starting time of 7 P.M. was adopted in order to permit a more comprehensive program and still finish by 10 P.M.

These changes mean that the Chapter is now able to have even more interesting meetings. The chapter will now have available an electronics laboratory for lectures and other uses, as well as a blackboard for drawing circuits, etc.

The programs have also been changed. At a recent meeting each member was asked the type of program that he would like to have. As a result the color TV course was dropped and an entirely new program adopted. John Pearl, electronics instructor at the North Hagerstown High School, is in charge of the programs, which are excellent. For variation there will be programs on Hi-Fi and similar electronic subjects in which all radio TV men are interested. Plans for several social events are also under way.

All NRI students and graduates in the Cumberland Valley are cordially invited to attend the meetings—and you will be missing a valuable opportunity to improve your knowledge of Radio and TV if you don't. Those interested in attending the meetings either as a guest or prospective member should get in touch with Edwin Kemp, 618 Sunset Avenue, Hagerstown, Md.

**Baltimore Chapter** had another one of its high spirited meetings, caused by the following sequence of events: (1) one of its members, upon moving to a distant city, donated his collection of technical magazines to the chapter; (2) Treasurer John Harper, together with several other members, collected the books in three large cartons and brought them to the meeting, deposited them by the Chairman's desk; (3) five members whose chief aim in life seems to be to accumulate all the back numbers of technical magazines they possibly can, all pounced on the books at the same time. Chairman Dolivka finally restored order and the serious business of the meeting was undertaken.

In addition to the regular program, a feature of the evening was Elmer Shue's entertaining the members with selections on his electronic banjo.

The Baltimore Chapter holds meetings at 8:00 P.M. on the second Tuesday of each month at 100 N. Paca St., Baltimore. All NRI students and graduates are invited to attend its meetings. Write or telephone Chairman Joseph Dolivka, 717 N. Montford Ave., or Secretary John Woolschleger, 1106 S. Lakewood Ave., Baltimore.

**Southeastern Massachusetts Chapter**—one of the two new Alumni Association Local Chapters organized last fall—is busy formulating and carrying out plans for the benefit of its members.

At a recent meeting Mr. C. Whitaker of the Cornel-Dubilier Company delivered a very interesting and instructive talk on condensers.

The December-January issue of National Radio-TV News carried the announcement that the Chapter would hold its meetings twice a month: on the first Monday of each month at the New Bedford Hotel, New Bedford, and on the third Monday of each month alternately at Taunton or Fall River. The members have since decided to hold one meeting a month, on the first Monday of each month in the DAV Hall in Fall River.

NRI students and graduates in the Southeastern area of Massachusetts are extended a warm invitation to attend the meetings. Those interested in doing so should write or telephone Chairman Walter Adamiec, 109 Taunton Street, Middleboro, Mass., or Secretary John Walsh, 26 White Street, Taunton, Mass.

**New Orleans Chapter** has important news for all NRI men in the New Orleans area. This is the announcement that the Chapter plans to engage the services of Mr. Milton Kennedy, recently an instructor in electronics for the U. S. Army and now operating his own Television service shop, to deliver a series of lectures and practical demonstrations on television receivers. Also, the Chapter is going to reduce the monthly dues from $1 to fifty cents a month.

No NRI student or graduate in the New Orleans area should miss this opportunity to attend Mr. Kennedy's lectures. All members are of course entitled to attend. NRI students and graduates who are not members are cordially invited to the lectures, either as guests or prospective members of the Chapter.

For more information get in touch with Chairman Patrick Boudreaux, 1015 Race St., or Secretary Oscar Hilding, 6225 St. Anthony St., New Orleans. Meetings are held at the home of Louis Grossman, 2229 Napoleon Ave., New Orleans.

**Detroit Chapter** enjoyed the distinction of witnessing the swearing in of Earl Oliver as National Vice-President of the NRIAA for 1958. Old-timer Charlie Mills administered the oath of office.

Previously the chapter held a meeting at the K-L-A Sound Laboratories, whose business is PA installations. Chairman John Nagy is their outside installation man and it was through his efforts that the demonstration was held. At this meeting K-L-A salesmen Dave Wakefield, George Todorff and Earl Nurenberg gave very interesting talks on hi-fi speakers, monaural recording, and stereophonic recording. The meeting was well attended and the members were much impressed with the demonstrations and talks.

The Chapter reports that five new members have been admitted recently, that a motion to purchase a flash camera for use at chapter meetings was acted on favorably, and that the chapter has created a new office, that of Official Photographer. It looks like the chapter is getting ahead with its plans for bigger and better meetings.

At the last meeting in December Mr. Blevins delighted members with something unique and valuable in the way of education, a lesson in memory training, in which he is well versed. He held the attention of all present, said he would continue the lessons if the members wished it. From the response of the members it looks like Mr. Blevins has a job on his hands.

The chapter invites all NRI students and graduates in the Detroit area to come to its meetings, get acquainted with the members, and find out for yourself how much you can enjoy them and how you can further your knowledge of radio-TV. Write or telephone Chairman John Nagy, 1406 Euclid, Lincoln Park, or Secretary James Kelley, 1140 Livernois Ave., Detroit. Meetings are held on the second and fourth Friday of each month, 8:00 P.M., at St. Andrews Hall, 431 E. Congress St., Detroit.

**Milwaukee Chapter** has lately featured a series of exceptionally fine talks containing much helpful and valuable information for all NRI men interested in furthering their knowledge of Radio and Television.

Mr. Lasky spoke on the functions of the Color Tube. This was an up-to-date lecture on how to adjust a color CR Tube and how color is produced.

Mr. Wallace Smith spoke on horizontal sync oscillator and AVC. This circuit analysis series particularly is producing a larger array of speakers at each meeting. Mr. Smith used an article from the NRI Alumni News for his talk. A question and answer period followed the talk, in which Messrs. Bettencourt, Petrich, Lasky, and Kapheim and others took part. Mr. Petrich made an especially important point—that is, that horizontal circuit analysis need not be complicated if service work is undertaken from the TV serviceman's point of view rather than relying entirely on magazine articles, which he explained usually cite unlikely examples not often found in actual servicing.

Other talks have been on horizontal output, by Robert Krauss, and on damper, AGC and deflection yoke circuits, by Ernie Bettencourt and Slavko Petrich.

Ernie Bettencourt of the literature committee has worked hard in obtaining catalogs and technical literature for the members. He is continuing to do an excellent job as Editor of the NRI AA Milwaukee Chapter News, which is sent regularly to all members of the Milwaukee Chapter.

The officers elected to serve for 1958 are: Philip Rinke, 1st Chairman; Slavko Petrich, 2nd Chairman; Erwin Kapheim, Secretary; Louis Spooner, Treasurer; and August Piechewski, Sergeant-At-Arms. Congratulations to the new officers!

There has been considerable discussion about what the members want in the way of recreation following the regular business part of the meetings. Dartball, cards and movies have been suggested.

NRI students and graduates in the Milwaukee area should not fail to take advantage of the Chapter's invitation to attend its meetings. Get in touch with Chairman Philip Rinke, RFD 3, Box 356, Pewaukee, or Secretary, 3525 N. 4th St., Milwaukee. The chapter holds its meetings on the third Monday of each month at the Radio-TV Store and Shop of S. J. Petrich, 5901 W. Vliet St., Milwaukee.

**Pittsburgh Chapter,** instead of its regular meeting, in December gave a banquet. It was held at their regular meeting place. There was an abundance of delicious food and plenty of beer and soft drinks. All members present agreed that it was a very enjoyable evening. Anyone who did not attend missed a lot of fun.

All NRI students and graduates in the Pittsburgh area are invited to come to the meetings, either as guests or prospective members. Meetings are held at 8:00 P.M. on the first Thursday of each month at 134 Market Place, Pittsburgh. For further information, get in touch with Chairman Frank Skolnik, 932 Spring Garden Ave., Pittsburgh.

Vincent Foley and Evan Wells of IRC at a Meeting of the Philadelphia-Camden Chapter.

**Philadelphia-Camden Chapter** rang the bell again with one of those delightful banquets and an evening of entertainment at the Boulevard Ballroom in Philadelphia on December 9. There were thirty-four members present, most of whom were accompanied by their wives, and two guests, Howard Smith, Chairman of the Springfield (Mass.) Chapter and National President of the NRI Alumni Association for 1958, and executive Secretary Ted Rose from National Headquarters.

Music was furnished by the Ray Hottinger Tripletts, entertainment by the Bill Barron Entertainers, a talented group of amateur singers and dancers from the Duffy School of Dancing, who turned in really remarkable performances. This highly successful social was arranged by Chairman John Pirrung and Secretary Jules Cohen, although John generously gave Jules practically all the credit.

A feature of the evening was the administering of the oath of office to the new officers for 1958. Ted Rose officiated at this ceremony. The new officers are John Pirrung, Chairman; Fred Seganti, Vice-Chairman; Jules Cohen, Recording Secretary; Joe Burke, Financial Secretary; Adolph Striberny, Librarian; Charles Fehn, Treasurer; and John Krepol, Sergeant-At-Arms.

One of the six tables at the Philadelphia-Camden banquet.

Howard Smith was also sworn into office as National President.

At a previous meeting chapter members were glad to welcome Vincent Foley and Evan Wells of IRC as guest speakers.

The chapter reports six new members: Charles Wells, George Wetzell, Stanley Wolk, Philip Walsh, all of Philadelphia; John Lehman, Paulsboro, N. J., and Wallace Crossman, Associate Member, Cornwells Heights, Penna. A warm welcome to all these new members! You're going to learn a lot and have a lot of fun from your membership in the chapter.

All other NRI students and graduates in the Philadelphia-Camden area interested in joining the chapter or attending its meetings should get in touch with Secretary Jules Cohen, 7124 Souder Street, Philadelphia. The chapter meets at the Knights of Columbus Hall, Tulip and Tyson Streets, Philadelphia.

**New York City Chapter** is continuing with its

Officers of the Philadelphia-Camden Chapter for 1953 being sworn in by Executive Secretary Ted Rose at the Chapter's banquet.

customarily heavy program of lectures and demonstrations, all of them highly interesting and instructive to the Radio-TV man.

At recent meetings Dave Spitzer told about interesting experiences he has had in repairing TV sets. Emil Ruocco explained the construction of a transistor radio kit that he built. Tom Hull concluded his series of talks on the vertical output section of the chapter's TV set.

Talks and demonstrations are continuously being given by other members, all of whom are effective speakers and know their business. Talks are accompanied by discussions, questions and suggestions by members present, so it is a real loss when any member fails to attend a meeting.

During the past year the chapter was plagued with illness or accidents to quite a few of its members. Fortunately this seems to have come to an end. All the members now seem to be enjoying good health.

Emil Paul, who was the chapter's secretary for so long, has been forced to give up the office because of the working hours on his regular job. Emil has the sincere appreciation of his fellow chapter members and of National Headquarters for the duties he performed so well and so faithfully as Secretary.

Officers elected to serve during 1958 are: Ed McAdams, Chairman; Tom Hull, Exec. Chairman; Frank Zimmer, 1st Vice-Chairman; Emil Ruocco, 2nd Vice-Chairman; David Spitzer, Secretary; and Frank Catalano, Treasurer.

The chapter urges all NRI students and graduates in the New York City area to attend its meetings as guests or prospective members. Contact Chairman Edward McAdams, 3430 Irwin Ave., New York 63, or Secretary David Spitzer, 2052 81st St., Brooklyn, N. Y. The chapter meets on the first and third Thursday of each month at St. Mark's Community Center, 12 St. Mark's Place, New York City.

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## White's Radio Log

The 35-year-old publication, "White's Radio Log," a directory of AM, FM, TV and short-wave broadcasting stations, has been acquired by Science and Mechanics Publishing Company, a subsidiary of The Curtis Publishing Company. In making this announcement, V. D. Angerman, Editor and Publisher of SCIENCE AND MECHANICS, said that Vol. 35, No. 1, of "White's Radio Log" appears as a special supplement to the RADIO-TV EXPERIMENTER, a 192-page handbook released on newsstands December 31, 1957.

Long accepted as the authoritative guide to the broadcasting industry, "White's Radio Log" was founded by Charles DeWitt White in the pioneer days of radio in 1924. Nation-wide newsstand distribution was established in 1927, and during the golden years of radio White published other, related, volumes as well, such as: "Sponsored Radio Programs," "Short-wave Schedule Guide" and the "Radio Announcers' Guide."

The Log itself reached a circulation of over 1,000,000 copies at one time. In 1923-31 it was distributed as the "Enna Jettick Radio Log" to promote the sale of Enna Jettick shoes; in 1938 as the "General Electric Radio Log" to promote the sale of General Electric's "sensational 1939 receivers with push-button tuning."

The Fall-Winter 1927 issue of the "Log" listed 701 U.S. stations. The 1958 edition lists over 3,000 U.S. standard-broadcast (AM) stations, cross-indexed by: 1) call letter; 2) frequency; and 3) location. In addition, the "Log" includes all U.S. frequency-modulation (FM) and television stations, a complete directory of Canadian broadcasting, and a comprehensive, world-wide listing of short-wave stations. Over 1,000 substantive changes have been made in the 1958 edition, the first since Mr. White's death on April 6, 1957.

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Our hats off to Graduate Cres Gomez of Union City, N. J., recently nominated for a national public service award for his efforts toward better understanding between non-Spanish and Spanish-speaking people. Mr. Gomez teaches Spanish to police of three towns, translates in court cases, and teaches Radio to Boy Scouts. He is also Chairman of Union City's Puerto Rican League; owns and operates Acme Modern Radio and TV Shop located at 1415 Summit Ave. Such worthwhile services deserve recognition. You have our vote, Mr. Gomez!

### Thanks

To the many students and graduates who remembered us during the Holiday Season with Christmas cards and other messages of good will. It is very gratifying for all of us here at NRI to be remembered in this sincere and friendly way.

Along with our thanks go best wishes for progress, good health, and contentment during 1958.

# Could You Have Predicted These Changes in 1932?

Suppose you had sat down in 1932 and tried to predict changes to come in the next 25 years. How many of these would you have guessed? (The figures given on earnings, production, stock prices and hours worked are for 1929.)

—Cars on the road: 1932—21,000,000; 1957—55,000,000.

—Passenger car travel: 1932—200 billion miles; 1957—600 billion miles.

—Surfaced roads: 1932—700,000 miles; 1957—2,000,000 miles.

—Average workweek: 1929—44.2 hours; 1957—40.5 hours.

—Gross national production: 1929—103.8 billion dollars; 1957—424 billion dollars.

—Purchasing power of the dollar: 1929—$1; 1957—64 cents.

—Average hourly earnings in manufacturing: 1929—57 cents per hour; 1957—$2.05 per hour.

—Life expectancy (white males at birth): 1932—59 years; 1957—68 years.

—Employment: 1929—48,000,000; 1957—65,000,000.

And note these developments that affected your life during the 25-year span: splitting of the atom; commercials, black-white and color TV; drive-in movies; big-screen movies; regular transoceanic air service; helicopter flight; split-level houses; modern shopping centers; discount houses; parking meters; space satellites; nylon, Acrilan, Dacron and other synthetic fibers; streptomycin, aureomycin, many other wonder drugs; Salk vaccine; heart surgery; tranquilizing drugs; anti t.b. drugs; electronic calculators and computers; hundreds of time-saving appliances; jet airplanes, etc.

You could add many more to this list and it would be interesting to compare it with a list 25 years from now—1983. The questions of war, economic health, prosperity, will dominate the next quarter century—just as the last. But how will you fit into the picture with the revolutionary developments that are forecast? That is up to you. Chances to profit from new career fields are obvious. It will be next to impossible to ignore changes taking place. Think and plan ahead—NOW. Be prepared for the blessings the future will offer you.

*(Continued from page 23)*

| *Range Switch Position* | *Range with HV Probe* |
|---|---|
| 3V | 75V |
| 12V | 300V |
| 30V | 750V |
| 120V | 3000V |
| 300V | 7500V |
| 1200V | 30,000V |

Although the probe does provide six more ranges, it is evident that three of these ranges —75V, 750V, and 7500V—are limited in use since the calibration of the meter scales would make voltage readings different.

The 3000V range, however, would have a number of uses such as in checking Transmitter power supplies or Oscilloscope high voltage supplies.

It is important, of course, not to apply more voltage than can be measured on any range. Just as with normal use of a VTVM (or VOM) always start with the highest range (1200V) when the voltage under measurement is not known. If the voltage should be less than 3000 volts, then the range switch can be turned to the 120V position for a more accurate reading. Of course, it is seldom necessary to accurately measure high voltages. A tolerance of +30% is usually quite acceptable.

By the way, when measuring the high voltage in a transformerless type TV receiver, be sure the VTVM ground clip is attached to the common or B— point which may not be chassis. If at all possible refer to the schematic diagram to determine the B— point. If such information is not available, either of the terminals of the on-off switch of the receiver can usually be used.

If you have a Model W VTVM (*not* the Multitester built with *E* or *CK* kits) and would like to order a high-voltage probe, write directly to the NRI Supply Division. Price is $5.50, postpaid. If you live in Washington, D. C., please add $.11 for D.C. Sales Tax.

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