SYLVANIA NEWS

JANUARY 1957 VOL. 24, NO. 1

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations.

technical

SECTION

THE DECIBEL

By E. H. Boden,
Advanced Application Engineer

INTRODUCTION

The increasing use of the decibel makes it more and more important that radio and television servicemen and radio amateurs become acquainted with this unit of measurement and know how to properly use it. Catalogs and technical literature are making use of the decibel to describe the performance of amplifiers, antennas and filter networks. Radio amateurs have for sometime used decibels in giving signal strength reports.

The use of decibels provides a convenient shorthand notation for power ratios and simplifies overall communication system analysis.

BASIC DEFINITION OF THE DECIBEL

At one time or another we have all probably read or heard it said that the human ear is non-linear in response to changes in power or energy levels. For example, let's assume we have an audio amplifier that is delivering a pure tone and has an actual power output of 10 watts. Now, research has shown that for the ear to sense that the output has been doubled the actual power output of our amplifier must be increased by 10 times, 100 watts. For the ear to sense an increase of four times, the output of the amplifier must be increased by 1000 times, 10,000 watts, etc. Thus it can be seen that the ear becomes less sensitive to changes in power as the delivered power is increased.

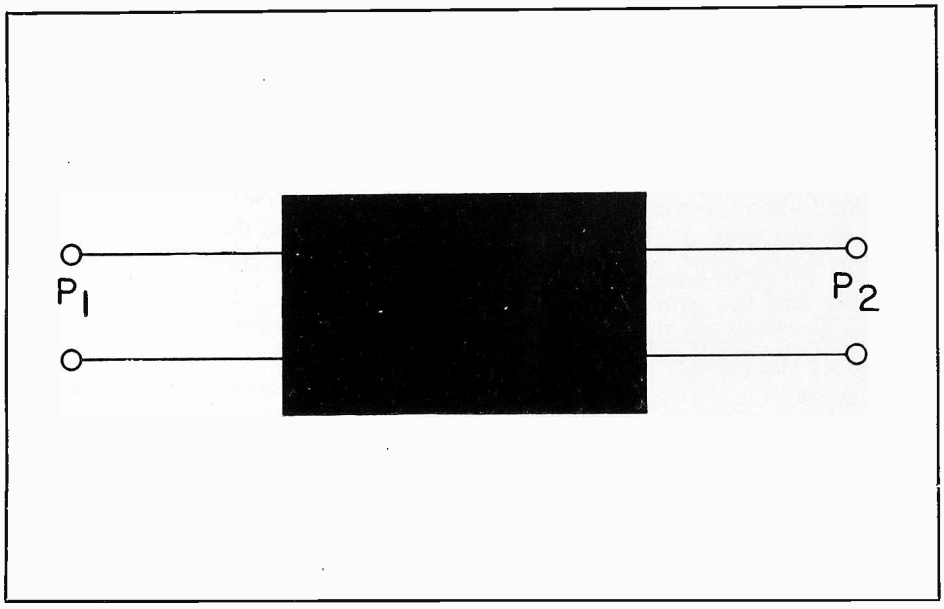


FIG. 1. Amplifier or network having an input of P_1 and output of P_2.

The decibel is simply a relative unit of measurement used to express changes in power based on the ability of the human ear to recognize these changes. As previously stated, application of the decibel as a unit of measurement is not limited to the audio frequency band and/or audio amplifiers. The ease with which the decibel enables us to express power gain and/or power loss, through elimination of the necessity of handling large numbers, has resulted in wide-spread usage.

For those who are mathematically inclined, the decibel is defined by the equation:

$$db = 10 \log_{10} \frac{P_L}{P_S} \qquad (1)$$

where P_L is always the larger power, in watts. P_S is always the smaller power, in watts.

The log function comes from the fact that the response of the ear to changes in power is actually logarithmic. Although equation (1) may be written in a few slightly different forms, the decibel is never anything more or less than equation (1).

USING A DECIBEL TABLE

To find db we can use equation (1) or, for those who prefer to eliminate as much math as possible, we can refer to a Decibel table, Table I. The use of this table is best explained with a few examples. Let's assume we have a gain of 3 decibels. Referring to Table I we find that the corresponding power ratio for a gain of 3 db is 1.99 to 1. In other words, the power output is 1.99 or approximately 2 times the power input. Referring again to Table I, we see that for a power output which is

5 times the power input the gain is 7 db, thus we can work from either direction.

Now, let's see how to handle a power gain of 26 db. First, we look opposite 6 db and find that the corresponding power ratio is 4. In the same manner we find that 20 db represents a power ratio of 100. The power gain, therefore, corresponding to 26 db is 4 x 100 or 400 times.

DB GAIN

To generalize, in Figure 1 we have a "black box." P1 is the power, in watts, that is going in or the input power. P2 is the power, in watts, that we are getting out or the output power. If our box is an amplifier with gain, then P2 will be greater than P1. Let's say by experiment it was found that when a power of 10 milliwatts was put into the amplifier we got 2000 milliwatts (2 watts) out. Let's now find the gain in db. The power gain of the amplifier is found by dividing the power output by the power input:

$$\frac{2000 \text{ mw}}{10 \text{ mw}} = 200$$

Since a power gain of 200 (power ratio of 200 to 1) cannot be read directly in db from Table I it must be broken down into 2 x 100. Referring to Table I we find that a power gain of 2 is 3 db and a power gain of 100 is 20 db. The db gain of the amplifier is simply the sum of 3 db and 20 db or 23 db.

DB LOSS

Many times we find a minus sign in front of a decibel figure. This simply means that there is more power going in than coming out. Now let's say that our "black box," Figure 1, is a network in which there is a loss, i.e., P2 is less than P1. Let's say then, that P1 = 10 mw and P2 = 2 mw. Referring to Table I we find that for a power ratio $\left(\frac{P_L}{P_S}\right)$ of 10/2 = 5. A figure of 7 db is obtained. Since the power input is greater than the power output we say the circuit has a loss of 7 db or a −7 db gain.

RELATIONSHIP TO NOISE FIGURE

Some months back[1] we talked about noise figures of amplifiers. At that time we expressed noise figures in decibels. Here again we were talking about a power ratio. The ratio then was the noise power of the circuit in question as compared to the noise power of an ideal circuit. Ten times the logarithm of this ratio gave us the noise figure in decibels.

TRANSMISSION LINES AND BOOSTERS

Since the advent of directional television antennas we have become accustomed to seeing antennas listed with 5, 6 or 9 db gain. This seems to imply that we are getting some free power in the antenna someplace. What is really happening is we are making an antenna more sensitive in one direction at the expense of sensitivity in other directions. In most cases the gain is relative to a half wave dipole while at times it is relative to a point source (antenna with equal response in all directions). A half wave dipole has a gain of 2 db over that of a point source.

A transmission line may be reduced to a simple network. For a given length, frequency and type of line,[2] there will be a power loss. By taking ten times the logarithm of the sending end power to the receiving end power we will have the db loss of the transmission line, or using Table I.

Before going on, let us see how we can use what we have learned so far. Let us suppose that we have an antenna, amplifiers and lengths of transmission line in order to bring the signal from a remotely located antenna to the receiver. Let us also assume that a satisfactory signal can be obtained at the antenna with a simple folded dipole. When using ordinary flat twin lead there is a

TABLE I

TABLE OF DECIBELS FOR POWER AND VOLTAGE RATIOS

DB	POWER RATIO	VOLTAGE* RATIO	DB	POWER RATIO	VOLTAGE* RATIO
1.0	1.26	1.12	6.0	3.98	1.99
1.2	1.32	1.15	6.2	4.17	2.04
1.4	1.38	1.17	6.4	4.36	2.09
1.6	1.44	1.20	6.6	4.57	2.14
1.8	1.51	1.23	6.8	4.79	2.19
2.0	1.58	1.26	7.0	5.01	2.24
2.2	1.66	1.29	7.2	5.25	2.29
2.4	1.74	1.32	7.4	5.50	2.34
2.6	1.82	1.35	7.6	5.75	2.40
2.8	1.91	1.38	7.8	6.03	2.46
3.0	1.99	1.41	8.0	6.31	2.51
3.2	2.09	1.44	8.2	6.61	2.57
3.4	2.19	1.48	8.4	6.92	2.63
3.6	2.29	1.51	8.6	7.24	2.69
3.8	2.40	1.55	8.8	7.59	2.75
4.0	2.51	1.58	9.0	7.94	2.81
4.2	2.63	1.62	9.2	8.32	2.88
4.4	2.75	1.66	9.4	8.71	2.95
4.6	2.88	1.70	9.6	9.12	3.02
4.8	3.02	1.74	9.8	9.55	3.09
5.0	3.16	1.78	10.0	10.00	3.16
5.2	3.31	1.82	20.0	100.00	10.00
5.4	3.47	1.86	30.0	1,000.00	31.60
5.6	3.63	1.91	40.0	10,000.00	100.00
5.8	3.80	1.95	50.0	100,000.00	316.00

*May be used only when input and output impedances are equal.

transmission line loss of 40 db for the particular length involved. To make up for this 40 db loss, two 20 db boosters may be used. If an antenna of 10 db gain and possibly a tubular twin lead with 10 db less loss is employed only one 20 db booster would be needed. What we are saying is that the db gains must add up to equal the db losses. In this way we can be certain of a good picture.

VOLTAGE AND CURRENT RELATIONSHIPS

It was said earlier that equation (1) could be rewritten in a few slightly different forms. These new forms are derived by substituting the latter two fundamental power relationships in equation (1):

$$P = IE = \frac{E^2}{R} = I^2R \qquad (2)$$

Skipping the mathematics involved our new equations are:

$$db = 20 \log \frac{E_L}{E_S} \qquad (3)$$

and

$$db = 20 \log \frac{I_L}{I_S} \qquad (4)$$

These two relationships, however, hold true only if the input and output resistances of the circuit with which we are working are equal.

Although the application of equation (3) is limited by the fact that input and output resistances must be equal it is still very handy. For example, if we have a booster with a 300 ohm input and output, the gain of the amplifier in db is simply 20 times the log of the input to output voltage ratio. Table I also includes voltage ratios for various db levels, thus eliminating the necessity of handling logarithms.

RESPONSE CURVES

Figure 2 shows the gain characteristics of a typical IF amplifier of a color receiver.[3] Note that the picture brightness carrier is −6 db. This means that the picture carrier power is one-fourth the maximum response of the amplifier. The chroma carrier is at zero db, that is, it is amplified fully, while the sound carrier is down 52 db (1/160,000 the power or 1/400 the voltage level.)

The above methods of describing the IF response curve is also used to describe the characteristics of a video amplifier, a hi-fi amplifier or even a vacuum tube voltmeter.

AMATEUR RADIO

At this point it is interesting to go back and think about some of the signal reports given out in amateur radio. "Your signal here Joe, is 10 db over S-9." This tells Joe that he may decrease his power a factor of 10. Since Joe is running 1 kw to the final, the signal report tells him that he may reduce his power to 100 watts and still have an S-9 signal with a much reduced electric bill.

DBM

Occasionally one finds the use of dbm. This means decibel relative to one milliwatt power. Plus 30 dbm would then equal one watt of power while −3 dbm equals 0.5 milliwatt.

Microphone db ratings have not been standardized. For some, the zero db reference level is one volt at a sound pressure of one dyne per square centimeter while others use one milliwatt at 0.0002 dyne per square centimeter (threshold of hearing).

CONCLUSION

With practice and frequent use one will find the decibel a very convenient tool, i.e., it saves the handling of large numbers (50 db is 100,000 times), and many times, lengthy descriptions. Where a number of amplifiers and transmission lines are involved the overall performance is obtained by a simple algebraic addition.

---

[1]Boden, E. H., Noise in Television Receivers, SYLVANIA NEWS, February 1956, Vol. 23, No. 2.

[2]Allen, J. S.: An Antenna for UHF TV Reception, SYLVANIA NEWS, March 1952, Vol. 19, No. 3.

[3]Hazeltine Staff—Principles of Color Television, John Wiley & Sons, Inc., New York, 1956, p. 346.

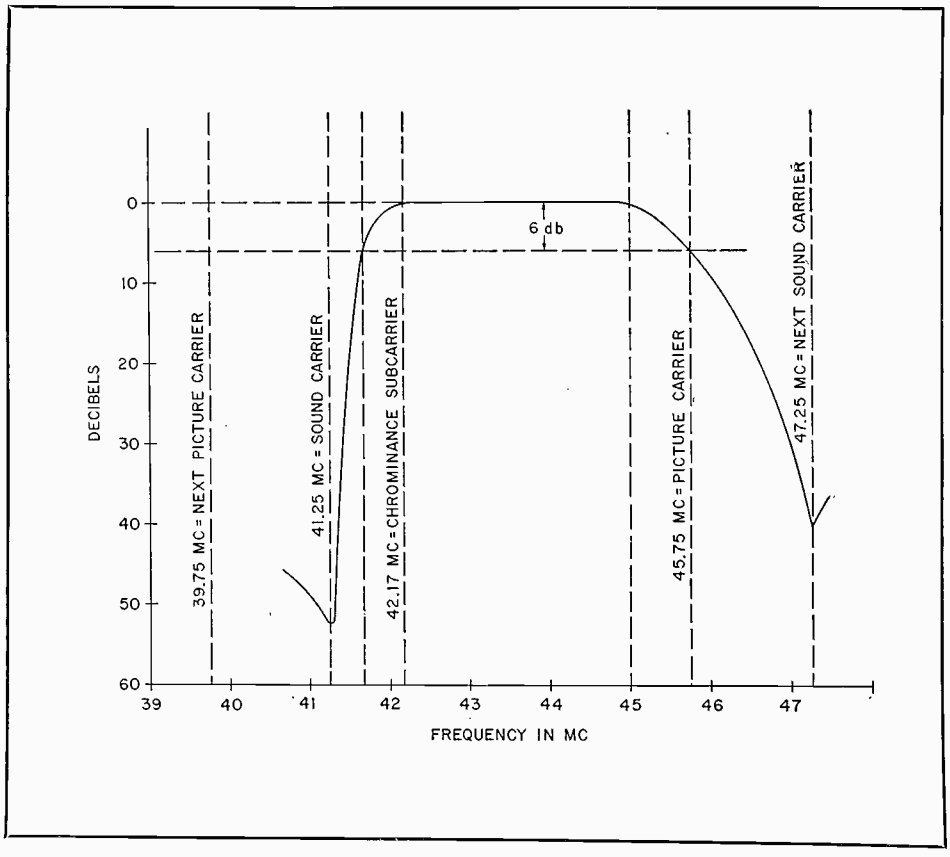


FIG. 2. Gain characteristic of color receiver IF Amplifier.

LOGARITHMS

Editor's Note:

For those who wish to go further into the basic equation for decibels, Mr. Boden has prepared the following review of logarithms.

Some people think that logarithm is a word, like calculus, used by teachers to scare little mathematicians. Fortunately, this is not so. Truly, logarithms are as simple as they are powerful. They were invented by a famous Scottish astronomer, Lord John Napier in 1614 and have been considered[1] the greatest contribution to mathematics and mathematical sciences since the invention of the very numbers we use.

To explain logs, let us first observe that if we write 10^2 we mean 100 and that 10^3 is 1000 and so on. Also $10^1 = 10$. Now let us look at $10^2 \times 10^2$. By expanding the two squares and then performing the multiplication we have $10^2 \times 10^2 = 100 \times 100 = 10{,}000$. But, 10,000 is also 10^4. Now notice what John Napier notices, that by adding the exponents of the first two 10's we get the exponent of another 10 which is the answer. For example, $2 + 2 = 4$ or $10^2 \times 10^2 = 10^4$. In the same way

$$10^1 \times 10^2 = 10^3$$
$$10^1 \times 10^3 = 10^4 \qquad (1)$$
$$10^2 \times 10^3 = 10^5$$

The point is that we performed multiplication by doing addition. If we knew to what power to which we may raise 10 to get other numbers such as 2 and 4 then we could do any kind of multiplication we wanted by simple addition. Table II is a table of just such numbers. Table II is a table of powers to which 10 may be raised in order to give a certain number.

For example, the log 2 = .3010. This then says that if ten is raised to the .3010 power it would equal 2. Now let us use logarithms to solve 2 x 4.

Referring to Table II and looking opposite 2 we see that its log is .3010. In the same way the log of 4 is found to be .6021. Since these two numbers are exponents we add them

$$\begin{aligned} \text{Log } 2 &= .3010 \\ \text{Log } 4 &= .6021 \qquad (2) \\ &\overline{\quad .9031} \end{aligned}$$

The sum is the logarithm of the number which is our answer or 8. Saying it another way, the antilog of .9031 = 8.

Let us now look at another example. Our problem now is 12 x 150. This time we have numbers for which we apparently do not have a logarithm. But, if you notice, we can rewrite both of these numbers

$$12 = 10^1 \times 1.2$$
$$150 = 10^2 \times 1.5$$

Also the log of 10 = 1 and the log $10^2 = 2$ so that from Table II

$$\begin{aligned} \log 12 &= \log 10 + \\ \log 1.2 &= 1 + .0792 = 1.0792 \\ \log 150 &= \log 10^2 + \\ \log 1.5 &= 2 + .1761 = 2.1761 \\ &\overline{\qquad\qquad 3.2553} \end{aligned}$$

Also from Table II we see that the log of 1.8 is .2553 and because our answer has a three in front of the decimal point we multiply 1.8 by 10^3 to obtain the answer of 1800.

Should it be desired to multiply several numbers together, one finds the log of each number, adds the logs of the numbers and then looks up the antilog of the total for the answer.

By the use of logs, division is also simplified. Briefly, to divide 12 by 2 one subtracts the log of 2 from the log of 12.

$$\begin{aligned} \log 12 &= 1.0792 \\ \log 2 &= -.3010 \\ &\overline{\quad .7782} \end{aligned}$$

Antilog .7782 = 6.0

Another interesting feature of logarithms is the ease with which one may raise a number to any power or take any root of a number. For example, to find the square of 3 we find the log of 3, multiply it by 2 and get the antilog.

$$2 \log 3.0 = 2 \times .4771 = .9542$$

The antilog of .9542 = 9.0

In the above we have used 10 as our number to be raised by certain powers. When we do this our system is termed "to the base 10" and is written $\log_{10}$. When used with decibels the base is always 10. When it is understood to be to the base 10 the 10 may be omitted.

---

[1]Kasner and Newman, Mathematics and the Imagination, p. 81, Simon and Schuster 1940.

TABLE II

A SHORT TABLE OF LOGARITHMS

N	I	N	I	N	I
1.0	.0000	4.1	.6128	7.2	.8573
1.1	.0414	4.2	.6232	7.3	.8633
1.2	.0792	4.3	.6335	7.4	.8692
1.3	.1139	4.4	.6435	7.5	.8751
1.4	.1461	4.5	.6532	7.6	.8808
1.5	.1761	4.6	.6628	7.7	.8865
1.6	.2041	4.7	.6721	7.8	.8921
1.7	.2304	4.8	.6812	7.9	.8976
1.8	.2553	4.9	.6902	8.0	.9031
1.9	.2788	5.0	.6990	8.1	.9085
2.0	.3010	5.1	.7076	8.2	.9138
2.1	.3222	5.2	.7160	8.3	.9191
2.2	.3424	5.3	.7243	8.4	.9243
2.3	.3617	5.4	.7324	8.5	.9294
2.4	.3802	5.5	.7404	8.6	.9345
2.5	.3979	5.6	.7482	8.7	.9395
2.6	.4150	5.7	.7559	8.8	.9445
2.7	.4314	5.8	.7634	8.9	.9494
2.8	.4472	5.9	.7709	9.0	.9542
2.9	.4624	6.0	.7782	9.1	.9590
3.0	.4771	6.1	.7853	9.2	.9638
3.1	.4914	6.2	.7924	9.3	.9685
3.2	.5051	6.3	.7993	9.4	.9731
3.3	.5185	6.4	.8062	9.5	.9777
3.4	.5315	6.5	.8129	9.6	.9823
3.5	.5441	6.6	.8195	9.7	.9868
3.6	.5563	6.7	.8261	9.8	.9912
3.7	.5682	6.8	.8325	9.9	.9956
3.8	.5798	6.9	.8388	10.0	1.0000
3.9	.5911	7.0	.8451		
4.0	.6021	7.1	.8513		

SYLVANIA NEWS

MARCH 1957 VOL. 24, NO. 3

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

COLOR-TV PICTURE-TUBE ADJUSTMENTS AND THEIR RELATION TO CHASSIS CIRCUITRY (PART II)

How to Position and Check Yoke, Purity, Static and Dynamic Convergence Controls and the Rim Magnet and Field Neutralizing Coils to Obtain Best Color Reproduction

by John T. Jans, Applications Engineer TV Picture-Tube Division, Sylvania Electric Products Inc.

Dynamic convergence is necessary to converge all three colors over the face of the tube instead of just at the center. The need for dynamic convergence is illustrated in Fig. 1. If the picture tube face and mask were spherical with a center at the deflection center, no such need would exist, but a picture tube face of that shape would be impractical.

Dynamic convergence adjustments should be made with a dot or cross-hatch pattern on the picture tube. The dynamic convergence is accomplished by passing a parabolic current wave through a coil having the same core and magnetic path as the static convergence magnet. Parabolic currents of both the horizontal and vertical frequencies are supplied, variable in amplitude to about 10-*ma* peak-to-peak and in shape from a saw tooth to a parabola. The coils should be of an impedance whereby the field they produce will move the spots about ¼".

Dynamic convergence requires adjustment of the horizontal size and shape controls for all three colors, and then the vertical size and shape

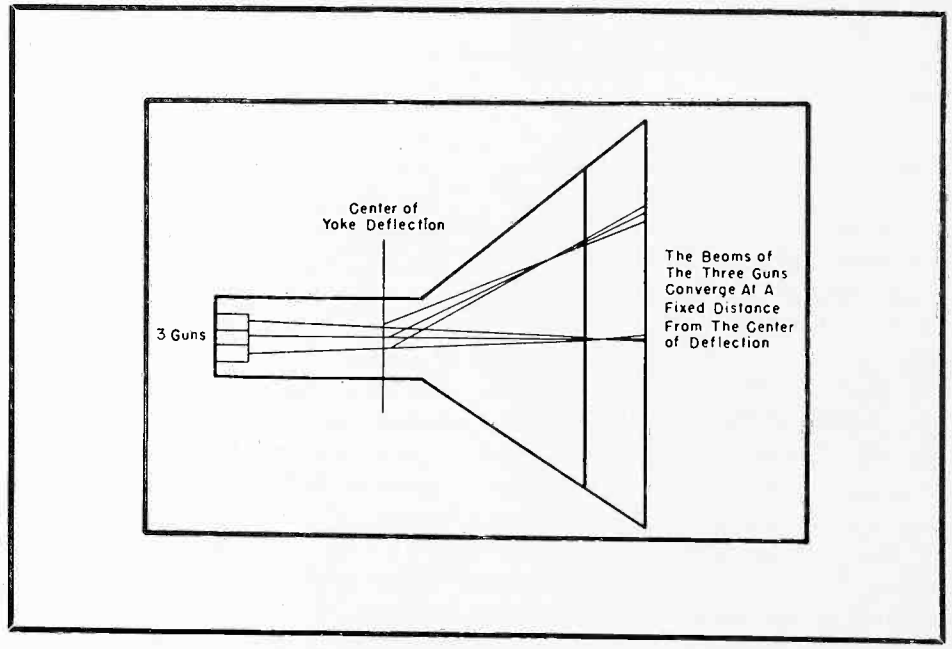


FIG. 1: NEED FOR dynamic convergence is illustrated in this drawing. Because the distance from the center of deflection to the screen is not constant, the beam convergence must vary as the beam moves over the face of the screen.

controls for all three colors. The dots need not be made to overlap each other, but only to have the same position relative to each other over the entire screen. The static convergence magnets can then be used to overlap all spots perfectly. After static and dynamic convergence correction, all colors of all the dots in the dot pattern should overlap within less than 1/16" over the entire screen face. This adjustment requires considerable practice and patience, but it can be done with the convergence components, tubes and circuits now available.*

After convergence and purity adjustments have been made, the remaining impure color patches along the edge of the picture can be improved by adjusting the rim magnets. These magnets are fastened around the face of the color tube and create a field that causes the beam to move about on the screen face in the area near the magnet. Again the adjustment is by trial and error for the best overall color purity on all three colors. A field neutralizing coil is sometimes used in place of or in conjunction with the rim magnets. This coil creates a field parallel to the axis of the tube around the edge of the tube, which causes the beams to shift on the dots in a manner shown in Fig. 2. The field-neutralizing coil is controlled by a pot. that varies the *dc* through it both in polarity and amount. On new model color receivers the field-neutralizing coil has been eliminated.

The yoke position, purity, rim magnet, and field-neutralizing coil adjustment should be checked on all three (red, green and blue) colors, so that each field is pure in itself and, when all three colors are added to make a white field, it should be a pure white. Sometimes a slight adjustment of the rim magnet can improve the white field without harming the pure primary color fields.

When all of the foregoing adjustments have been made the receiver is ready to be adjusted for white balance. Usually the G_1 and G_2 controls have been radically changed in adjustment to obtain a blank color field and a complete readjustment must be made. With a vacuum-tube

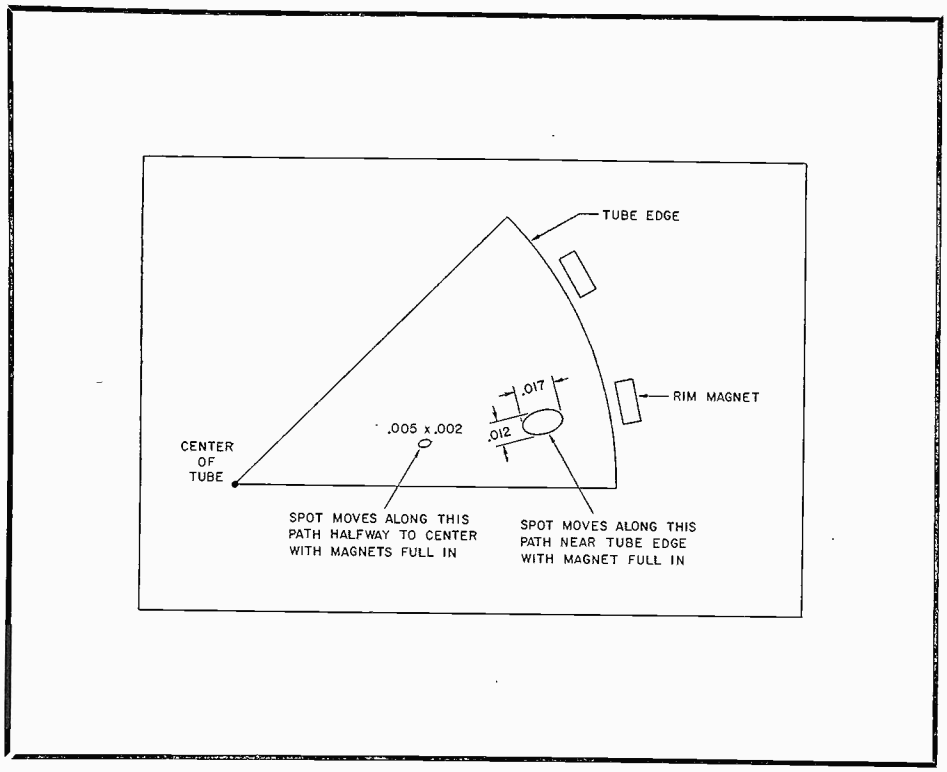


FIG. 2: REACTION of a field-neutralizing coil which creates a field parallel to axis of the tube around its edge, causing beams to shift on the dots.

voltmeter, all the G_2 voltages on all three guns should be set to some equal value of about 350 or about 200 *v* above the cathodes. The dot pattern should be removed and the receiver turned to a good monochrome signal. The contrast should be lowered to a minimum and the master brightness control turned until the raster is just blanked out. The red, green and blue-background controls, if present, should be adjusted, (often only green and blue are used) so that a very dim raster is neutral gray and not any particular color. The master brightness operation should then be checked. As the blank screen brightness is increased, the screen should always be some shade of neutral gray. If it tends to become a primary color (red, green or blue) as the brightness is increased, the G_2 voltage of that color should be increased by 40 volts; one should then readjust the backgrounds and check again. If the screen tends to become some complementary color (yellow, blue-green or purple) then the G_2 voltage of the complementary primary should be decreased by 40 v, the background readjusted and checked again. If the G_2 control of one color reaches the end of its range the other two controls may be adjusted in the opposite direction.

Now one should increase the contrast control until a normal picture appears. Both the highlights and the shadows should be a neutral gray in color. If the highlights are one color, the G_2 voltage of that color should be raised. This also requires dropping the G_1 voltage of the same color to give a neutral shade in the shadows. A monochrome receiver on the same channel is a good standard to match for white color. After the white balance has been found satisfactory, one should record the G_2 and G_1 voltages, as read with a *vtvm*. These settings should not change throughout the useful life of the color tube and can easily be reset the next time the receiver is adjusted.

ERRATUM

We regret that Figures 3 and 4 in the February issue, COLOR-TV PICTURE-TUBE ADJUSTMENTS AND THEIR RELATION TO CHASSIS CIRCUITRY, are reversed with respect to the captions.

The remaining adjustments vary with the color mixing circuitry.

The color-mixing circuitry is usually described by the level at which the decoded color or chrominance signal is added to the luminance signal. In a low-level matrix circuit the decoded *I* and *Q* signals are added to the luminance signal to produce red, green, and blue signals, all of which are individually amplified and *dc* restored before being applied to the picture tube. A high-level matrix circuit, however, decodes the chrominance signal to color difference signals (*R-Y*), (*B-Y*) and (*G-Y*), which are applied directly to the grids of the picture tube at the same time the luminance (or *Y*) signal is applied to the picture tube cathode.

If low-level matrixing is used, a b-w picture signal must be turned on and the individual red, green and blue video gains adjusted, so that the highlights are white and not a particular color. If the highlights are red, for instance, the green and blue video gains must be increased. Usually, there is a green and blue video gain with a master video gain or contrast control. To vary red, all three controls must be used. Low-level matrixing was used on the earlier color receivers.

Most new-model receivers with 21-inch picture tubes use high-level matrixing. The luminance or monochrome signal is fed identically or in some fixed ratio to all three guns; thus there is no control over the video signal voltage to each individual gun. However, the actual beam current to each color screen can be varied by adjusting the G_1 and G_2 voltages on each gun. With a high-level matrix type of receiver, the background and G_1 controls must be set to give a neutral gray on a very dim raster. Then, a monochrome video signal of average contrast must be applied. If the highlights are some primary color other than white, the G_2 voltage of that particular color should be raised, and the background of that color lowered until a dim raster is again gray. One must repeat the monochrome video signal and continue to adjust the G_2 and background controls until the monochrome picture is gray on the low brightness scenes and white on the highlights.

Thus far, all of the adjustments have been made to give a good b-w picture. With a receiver using a shadow-mask color-picture tube, a good b-w picture is the most difficult to obtain and such a picture indicates correct adjustment of the picture tube itself.

A color picture or color bar test pattern must be used to adjust the receiver color processing circuits. The fine tuning must first be adjusted until the colors are stable and the picture free of interference. Older color receivers were very critical for fine tuning, but the newer models have a fair range over which the fine tuning control gives a good color picture. The color hold control, if present, should be adjusted so there are no varying bars of color over the picture. The hue or color phase control is adjusted so the colors look correct. The best color to judge is flesh color, which can be varied with most hue controls from yellow-green to red. If flesh tones look right, all other colors will probably be correct. Chroma or color gain control adjusts the amount of color or saturation. If the control is set too low, the colors are more pastel than is natural. This control should be adjusted to suit the viewer's preference.

**See* KEN KLEIDON *convergence-adjustment report in October, 1956,* SERVICE, *which describes a step-by-step approach.*

Bring Roll Charts Up-To-Date

Note these important changes — Make sure your new Sylvania roll charts are completely accurate and up-to-date . . . transfer these important changes now.

Change three settings on the 139 and 140 charts to read:

5AT8	5.0	0	..	0	3	579	56	Y
	5.0	0	..	0	2	2	41	U
6AG5	6.3	0	4	0	4	36	56	Y
6AN8	6.3	0	..	0	1	3	25	W
	6.3	0	..	0	3	079	35	W

Change five settings on the 219 and 220 charts to read:

6AN8	6.3	4	59S	25	5	2Y	1	3
	6.3	4	35S	50	5	078Z	6	9
6BQ6	6.3	2	7	19	7	045SY	9	8
6DN6	6.3	2	7	12	7	58Z	9	3
12BR7	12.6	4	589S	46	5	2X	1	3
	12.6	4	3569	23	5	X	7*	8
	12.6	4	3579	23	5	X	6*	8
12C5	12.6	3	45	13	4	26V	7	1
	12.6	3	24	13	4	56V	7	1

Change two settings on the 620 chart to read:

6AN8	6.3	4	59R	25	5	2X	1	3
	6.3	4	35R	57	5	078Y	6	9
12C5	12.6A	3	45	13	4	26U	7	1
	12.6A	3	24	13	4	56U	7	1

Bring your tube tester up-to-date by sending for new roll charts. You'll save yourself the needless time and trouble of writing in settings by ordering these new roll charts now.

They are available for:

Catalog Number	Tube Tester Model Number
PC 15845-M	139 - 140
PC 18325-J	219 - 220
PC 25700-B	620

Write the catalog number of the new roll chart for your Sylvania Tube Tester on your letterhead. Enclose a check (for the nominal charge of $1.50 for each roll chart) made out to Sylvania Electric Products Inc. Mail it promptly to:

Tube Tester Roll Charts
Sylvania Electric Products Inc.
180 East Third Street
Williamsport, Pennsylvania

That's all you do. Your new accurate roll chart will be on its way to you as soon as your letter and check are received.

American Substitutions For European Tubes

The number of European tube types encountered by the serviceman, particularly in audio equipment, seems to be growing steadily. Although a great many European types are available in this country, an American replacement may be desired. The accompanying table shows the American equivalents for 85 European types.

The European types are listed in the left hand column. The center column shows the equivalent American types followed by the qualifying remarks DE or NE, right hand column. DE indicates "Direct Equivalent," i.e., requiring no circuit or socket changes. NE stands for "Nearest Equivalent." The majority of types listed as NE can also be considered direct replacements in most applications, but may differ slightly from the standpoint of special characteristics. The data shown are believed to be accurate; however, no responsibility can be assumed in case of error.

Please note that all types listed may not be available from SYLVANIA. Consult your current price list.

EUROPEAN TYPE NO.	AMERICAN TYPE NO.	CODE
DA90	1A3	DE
DAF91	1S5	DE
DAF92	1U5	DE
DAF96	1AH5	DE
DCC90	3A5	DE
DF91	1T4	NE
DF92	1L4	NE
DH63 (M)	6Q7GT	NE
DH77	6AT6	NE
DK91	1R5	DE
DL33	3Q5GT	DE
DL35	1C5GT	NE
DL36	1Q5GT	DE
DL92	3S4	DE
DL93	3A4	NE
DL94	3V4	DE
DL95	3Q4	DE
DP61	6AK5	DE
EAA91	6AL5	NE
EB91	6AL5	NE
EBC90	6AT6	NE
EC90	6C4	DE
EC92	6AB4	DE
ECC33	6SN7GT	NE
ECC81	12AT7	DE
ECC82	12AU7	NE
ECC83	12AX7	DE
ECC85	6AQ8	DE
ECC91	6J6	NE
ECF80	6A8GT	NE
ECF82	6U8	DE
ECH81	6AJ8	DE
ECL82	6BM8	DE
EF91	6AM6	DE
EF92	6CQ6	DE
EF93	6BA6	NE
EF94	6AU6	NE
EF95	6AK5	NE
EH90	6CS6	DE
EK90	6BE6	DE
EL37	6L6G	DE
EL90	6AQ5	DE
EL91	6AM5	DE
EL821	6CH6	NE
EM34	6CD7	DE
EM80	6BR5	DE
EQ80	6BE7	DE
EZ35	6X5	DE
EZ80	6V4	DE
EZ81	6BW4	DE
EZ90	6X4	DE
GZ32	5V4G	DE
H63	6F5	DE
HABC80	19T8	NE
HBC90	12AT6	NE
HD14	1H5GT	NE
HD30	3B4	DE
HF93	12BA6	NE
HF94	12AU6	NE
HK90	12BE6	NE
HL90	19AQ5	DE
HL92	50C5	DE
HM04	6BE6	DE
HY90	35W4	DE
L63	6J5GT	NE
L77	6C4	DE
N18	3Q4	DE
N144	6AM5	NE
PABC80	9AK8	DE
PCC84	7AN7	DE
PCC85	9AQ8	DE
PCF80	9A8	DE
PCF82	9U8	DE
PL81	21A6	DE
PM04	6BA6	NE
PM05	6AK5	NE
PM07	6AM6	NE
SP6	6AM6	NE
UF41	12AC5	DE
UBC41	14L7	DE
UCH42	14K7	DE
X17	1R5	DE

DE—Direct Equivalent
NE—Nearest Equivalent

SYLVANIA NEWS

MARCH 1957 VOL. 24, NO. 3

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

COLOR-TV PICTURE-TUBE ADJUSTMENTS AND THEIR RELATION TO CHASSIS CIRCUITRY (PART II)

How to Position and Check Yoke, Purity, Static and Dynamic Convergence Controls and the Rim Magnet and Field Neutralizing Coils to Obtain Best Color Reproduction

by John T. Jans, Applications Engineer TV Picture-Tube Division, Sylvania Electric Products Inc.

Dynamic convergence is necessary to converge all three colors over the face of the tube instead of just at the center. The need for dynamic convergence is illustrated in Fig. 1. If the picture tube face and mask were spherical with a center at the deflection center, no such need would exist, but a picture tube face of that shape would be impractical.

Dynamic convergence adjustments should be made with a dot or cross-hatch pattern on the picture tube. The dynamic convergence is accomplished by passing a parabolic current wave through a coil having the same core and magnetic path as the static convergence magnet. Parabolic currents of both the horizontal and vertical frequencies are supplied, variable in amplitude to about 10-*ma* peak-to-peak and in shape from a saw tooth to a parabola. The coils should be of an impedance whereby the field they produce will move the spots about ¼".

Dynamic convergence requires adjustment of the horizontal size and shape controls for all three colors, and then the vertical size and shape

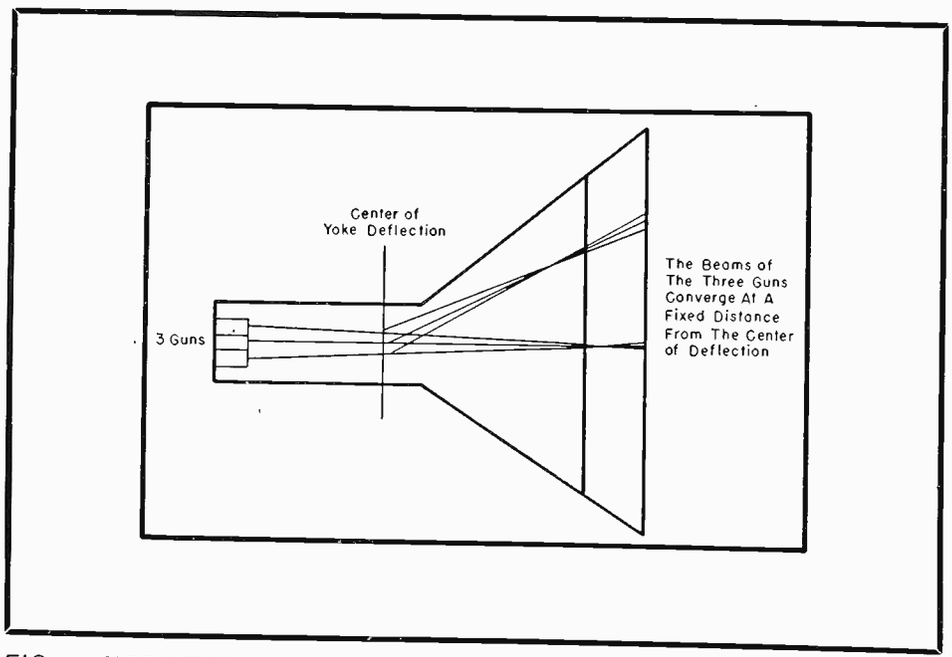


FIG. 1: NEED FOR dynamic convergence is illustrated in this drawing. Because the distance from the center of deflection to the screen is not constant, the beam convergence must vary as the beam moves over the face of the screen.

Help Yourself To More Sales . . .

PUT YOURSELF IN

By JAMES W. RITTER, Sales Training Manager, Elec

Many millions of dollars are spent each year by manufacturing organizations such as Sylvania, your independent distributor and yourself to build a solid reputation for independent service-dealers as "headquarters for complete radio and television servicing."

When a TV parts consumer enters your shop, or when you enter a customer's home, it's your opportunity to win a steady customer by giving prompt, courteous service. Only by maintaining a large active list of "satisfied customers" will your business succeed!

How do you go about winning friends and influencing customers? There are hundreds of important points that should be considered when the subject of customer relations is approached. But, there is one simple formula that usually will help create a positive impression in anyone's mind. Merely do more of what they like and less of what they dislike.

Is your attitude toward every customer who enters your shop one of helpfulness? Do you try your best to make him feel at ease and as if you are really interested in giving him good service? Greeting your customer with a friendly smile and the pleasant words "may I help you, please" doesn't cost you a cent. It may help you increase your sales volume.

Good or
principle tha
quickly. Th
pression is a
especially tr
"customer."
not only w
service count
you're visitin
consumer, t

When thre
scend upon y
politely ackn
each and qu
turn? Is yo
tively displa
benefit so tha
of this waitin

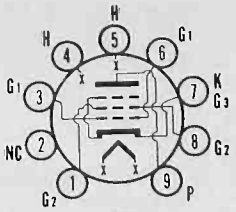
Many iten
your shop c
sales for you
reach of the

One of the
to remember
tried and tru
manship" is t
statements tha
and take." I
preference f
which you do
chances of lo
are better if y
and tone of v
product, any
courteously
temporarily o
or that you
while it's a q
the same proc
people is bett
the sale.

Never put y
with a custom
a negative rea
usually more
the reasons b
choice—then
the "better"
stock. In a p
sell up the pro
sell down com
salesmanship
salesman who

SYLVANIA TYPE 12AB5

BEAM POWER PENTODE



9EU

MECHANICAL DATA

Bulb	T-6½
Base	E9-1, Small Button 9-Pin
Outline	6-3
Basing	9EU
Cathode	Coated Unipotential
Mounting Position	Any

ELECTRICAL DATA

HEATER CHARACTERISTICS

Heater Voltage[1]	12.6 Volts
Heater Current	0.2 Ampere
Heater-Cathode Voltage (Design Center Values)	
Heater Negative with Respect to Cathode	
Total D C and Peak	200 Volts Max.
Heater Positive with Respect to Cathode	
D C	100 Volts Max.
Total D C and Peak	200 Volts Max.

DIRECT INTERELECTRODE CAPACITANCES (Unshielded)

Grid to Plate: (g1 to p)	0.7 μμf
Input: g1 to (h + k + g2 + g3)	8.0 μμf
Output: p to (h + k + g2 + g3)	8.5 μμf

RATINGS (Design Center Values)

Class A_1 Amplifier	
Plate Voltage	315 Volts Max.
Plate Dissipation	12 Watts Max.
Grid No. 2 Voltage	285 Volts Max.
Grid No. 2 Dissipation	2 Watts Max.
Grid No. 1 Circuit Resistance	
Fixed Bias	0.1 Megohm Max.
Cathode Bias	0.5 Megohm Max.

CHARACTERISTICS AND TYPICAL OPERATION

Class A_1 Amplifier (Single Tube)

Conditions:			
Plate Voltage	180	250	250 Volts
Grid No. 2 Voltage	180	200	250 Volts
Grid No. 1 Voltage	−8.5		−12.5 Volts
Cathode Bias Resistor		270	Ohms
Peak AF Grid No. 1 Voltage	8.5	10.5	12.5 Volts
Zero Signal Plate Current	29	33.5	45 Ma
Maximum Signal Plate Current	30	36.0	47 Ma
Zero Signal Grid No. 2 Current	3.0	1.6	4.5 Ma
Maximum Signal Grid No. 2 Current	4.0	3.2	7.0 Ma
Plate Resistance (approx.)	50,000		50,000 Ohms
Transconductance	3700	4000	4100 μmhos
Load Resistance	5500	6000	5000 Ohms
Maximum Signal Power Output	2.0	3.3	4.5 Watts
Total Harmonic Distortion	8	12	8 Percent

Class A_1 Push-Pull Amplifier (Values are for Two Tubes)

Conditions:	
Plate Voltage	250 Volts
Grid No. 2 Voltage	250 Volts
Grid No. 1 Voltage	−15 Volts
Peak AF Grid No. 1 to Grid No. 1 Voltage	30 Volts
Zero Signal Plate Current	70 Ma
Maximum Signal Plate Current	79 Ma
Zero Signal Grid No. 2 Current	5 Ma
Maximum Signal Grid No. 2 Current	13 Ma
Plate-to-Plate Load Resistance	10,000 Ohms
Maximum Signal Power Output	10 Watts
Total Harmonic Distortion	5 Percent

NOTE:

1. This tube is intended for use in automobile radios operated from a nominal 12 volt battery. Design of the tube is such that the heater will operate satisfactorily over the range 10.0 volts to 15.9 volts, and that the maximum ratings provide a safety factor for the wide voltage variation encountered with this type of supply.

APPLICATION

The 12AB5 is a miniature beam power pentode designed primarily for service as an audio power amplifier in auto radios having a 12 volt heater supply. Except for heater characteristics, electrically the 12AB5 is identical to the 6CM6 and the 12CM6.

SYLVANIA ELECTRONIC TUBES

Issued as a supplement to the manual in Sylvania News for March 1957

SYLVANIA TECHNICAL MANUAL

(Tenth Edition)

Supplement No. 17-10

This is the 17-10 supplement to the new Tenth Edition of the Sylvania Technical Manual. Insert it in your Manual without delay.

Since insertion in numerical alphabetical order may be impossible without splitting existing data for one or more types, it is suggested that all inserts be grouped in the appropriate section of the Manual.

KEEP YOUR SYLVANIA TECHNICAL MANUAL UP TO DATE — IT WILL BE MORE VALUABLE TO YOU. MAKE THESE INSERTIONS AT ONCE, BEFORE THE PAGES BECOME LOST OR MUTILATED. Additional inserts will be included with your Sylvania News as soon as they can be prepared. For additional information on these or other Sylvania Types, write Sylvania Electric Products Inc., Technical Publications Section, Emporium, Pennsylvania.

A Technical Publication of

SYLVANIA ELECTRIC

Emporium, Pennsylvania

17BVP4 (Cont'd)

TYPICAL OPERATING CONDITIONS

Anode Voltage	14,000 Volts d c
Grid No. 4 Voltage for Focus	−50 to +350 Volts d c
Grid No. 2 Voltage	300 Volts d c
Grid No. 1 Voltage Required for Cutoff[3]	−35 to −72 Volts d c
Ion Trap Magnet Strength	33 ± 3 Gausses Min.

CIRCUIT VALUES

Grid No. 1 Circuit Resistance	1.5 Megohms Max.

NOTES:

1. Heater warm-up time is the time required for the voltage across the heater terminals to increase to 5.0 volts in the JETEC test circuit, with E = 25 volts and series R = 31.5 ohms.
2. External conductive coating must be grounded.
3. Visual extinction of focused raster. Extinction of stationary focused spot will require that these values be about 5 volts more negative.

WARNING:

X-ray radiation shielding may be necessary to protect against possible danger of personal injury from prolonged exposure at close range if this tube is operated at higher than the manufacturer's Maximum Rated Anode Voltage or 16,000 volts, whichever is less.

SYLVANIA PICTURE TUBES

ical

ION

JBE

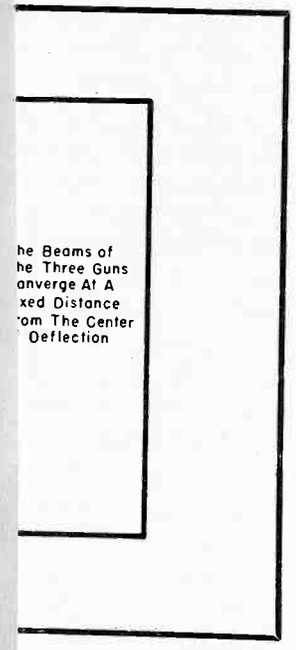
IEIR

IS

)

Products Inc.

s for all three colors, vertical size and shape



s drawing. Because the distance from the center of deflection to the screen is not constant, the beam convergence must vary as the beam moves over the face of the screen.

about ¼".

Help Yourself To More S

PUT YOURSEL F

By JAMES W. RITTER, Sales Training

Many millions of dollars are spent each year by manufacturing organizations such as Sylvania, your independent distributor and yourself to build a solid reputation for independent service-dealers as "headquarters for complete radio and television servicing."

When a TV parts consumer enters your shop, or when you enter a customer's home, it's your opportunity to win a steady customer by giving prompt, courteous service. Only by maintaining a large active list of "satisfied customers" will your business succeed!

How do you go about winning friends and influencing customers? There are hundreds of important points that should be considered when the subject of customer relations is approached. But, there is one simple formula that usually will help create a positive impression in anyone's mind. Merely do more of what they like and less of what they dislike.

Is your attitude toward every customer who enters your shop one of helpfulness? Do you try your best to make him feel at ease and as if you are really interested in giving him good service? Greeting your customer with a friendly smile and the pleasant words "may I help you, please" doesn't cost you a cent. It may help you increase your sales volume.

sell up the products you stock—never sell down competition. It's not good salesmanship and isn't it the good salesman who makes money?

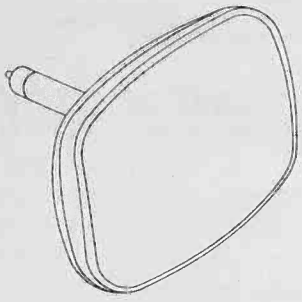
you like it, he probably will, too. And remember, customers are the only indispensable factor in our business.

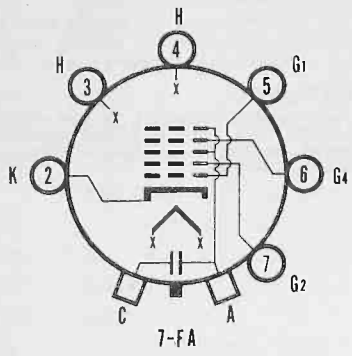
SYLVANIA TYPE 17BVP4

TELEVISION PICTURE TUBE

17" Direct Viewed	Aluminized Screen
Rectangular Glass Type	Electrostatic Focus
Lightweight Tube	110° Magnetic Deflection
Spherical Faceplate	1⅛" Neck Diameter
Gray Filter Glass	Single Field Ion Trap

External Conductive Coating





7-FA

CHARACTERISTICS

GENERAL DATA

Focusing Method	Electrostatic
Deflection Method	Magnetic
Deflection Angles (approx.)	
Horizontal	105 Degrees
Diagonal	110 Degrees
Vertical	87 Degrees
Phosphor	Aluminized P4
Fluorescence	White
Persistence	Short to Medium
Faceplate	Gray Filter Glass
Light Transmittance (approx.)	79 Percent

ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current	0.6 ± 5% Ampere
Heater Warm-up Time[1]	11 Seconds
Direct Interelectrode Capacitances (approx.)	
Cathode to All Other Electrodes	5 μμf
Grid No. 1 to All Other Electrodes	6 μμf
External Conductive Coating to Anode[2]	1500 μμf Max.
	1000 μμf Min.
Ion Trap Magnet	External, Single Field Type

MECHANICAL DATA

Overall Length	13¼ ± 5/16 Inches
Minimum Useful Screen Dimensions	14¾ x 11 1/16 Inches
Bulb	J132½ A1
Bulb Contact (Recessed Small Cavity Cap)	J1-21
Base	B6-185
Basing	7FA
Weight (approx.)	10 Pounds

RATINGS

MAXIMUM RATINGS (Absolute Maximum Values)

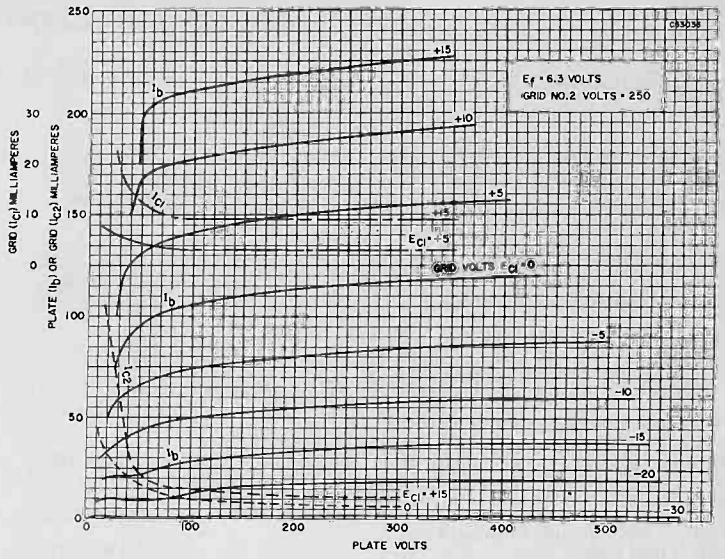
Anode Voltage	17,600 Volts d c
Grid No. 4 Voltage	-550 to +1100 Volts d c
Grid No. 2 Voltage	550 Volts d c
Grid No. 1 Voltage	
Negative Bias Value	154 Volts d c
Negative Peak Value	220 Volts
Positive Bias Value	0 Volts d c
Positive Peak Value	2 Volts
Peak Heater-Cathode Voltage	
Heater Negative with Respect to Cathode During Warm-up Period not to Exceed 15 Seconds	450 Volts
After Equipment Warm-up Period	200 Volts
Heater Positive with Respect to Cathode	200 Volts

SYLVANIA PICTURE TUBES

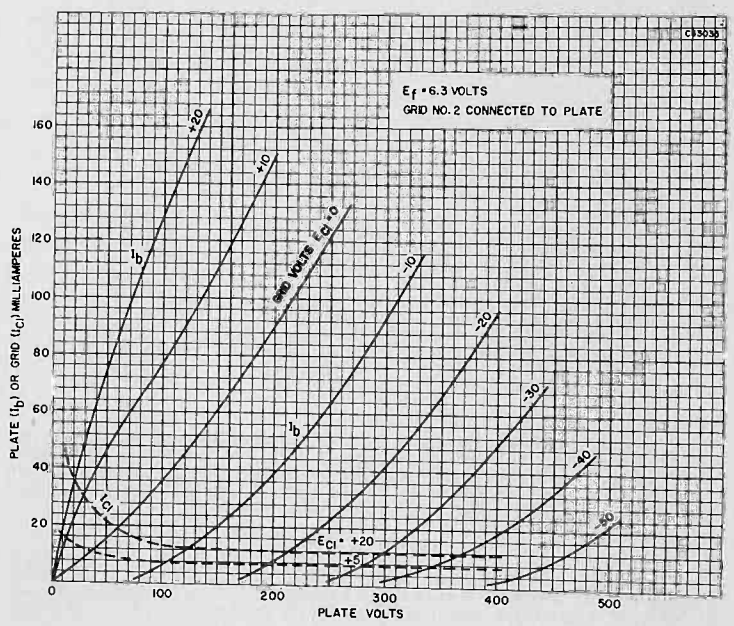
Issued as a supplement to the manual in Sylvania News for March 1957

12AB5 (Cont'd)

AVERAGE PLATE CHARACTERISTICS



AVERAGE PLATE CHARACTERISTICS
(TRIODE CONNECTED)



SYLVANIA ELECTRONIC TUBES

echnical
SECTION

RE-TUBE
ND THEIR
HASSIS
ART II)

, Static and
Magnet and
Reproduction

, Sylvania Electric Products Inc.

shape controls for all three colors, and then the vertical size and shape

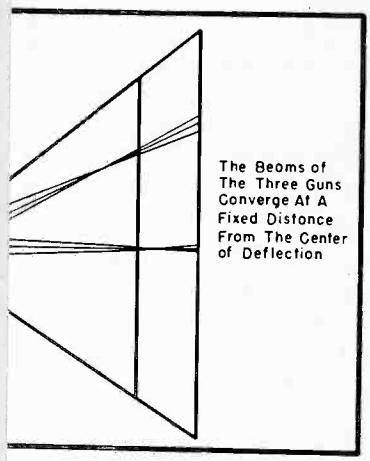


FIG. 1: NEED FOR dynamic convergence is illustrated in this drawing. Because the distance from the center of deflection to the screen is not constant, the beam convergence must vary as the beam moves over the face of the screen.

tooth to a parabola. The coils should be of an impedance whereby the field they produce will move the spots about ¼".

Help Yourself To More S

PUT YOURSEL

By JAMES W. RITTER, Sales Training

Many millions of dollars are spent each year by manufacturing organizations such as Sylvania, your independent distributor and yourself to build a solid reputation for independent service-dealers as "headquarters for complete radio and television servicing."

When a TV parts consumer enters your shop, or when you enter a customer's home, it's your opportunity to win a steady customer by giving prompt, courteous service. Only by maintaining a large active list of "satisfied customers" will your business succeed!

How do you go about winning friends and influencing customers? There are hundreds of important points that should be considered when the subject of customer relations is approached. But, there is one simple formula that usually will help create a positive impression in anyone's mind. Merely do more of what they like and less of what they dislike.

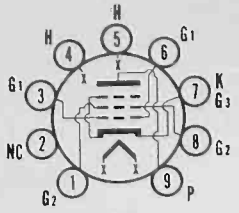
Is your attitude toward every customer who enters your shop one of helpfulness? Do you try your best to make him feel at ease and as if you are really interested in giving him good service? Greeting your customer with a friendly smile and the pleasant words "may I help you, please" doesn't cost you a cent. It may help you increase your sales volume.

sell up the products you stock—never sell down competition. It's not good salesmanship and isn't it the good salesman who makes money?

you like it, he probably will, too. And remember, customers are the only indispensable factor in our business.

SYLVANIA TYPE 12AB5

BEAM POWER PENTODE



9EU

MECHANICAL DATA

Bulb	T-6½
Base	E9-1, Small Button 9-Pin
Outline	6-3
Basing	9EU
Cathode	Coated Unipotential
Mounting Position	Any

ELECTRICAL DATA

HEATER CHARACTERISTICS

Heater Voltage[1]	12.6 Volts
Heater Current	0.2 Ampere
Heater-Cathode Voltage (Design Center Values)	
Heater Negative with Respect to Cathode	
Total D C and Peak	200 Volts Max.
Heater Positive with Respect to Cathode	
D C	100 Volts Max.
Total D C and Peak	200 Volts Max.

DIRECT INTERELECTRODE CAPACITANCES (Unshielded)

Grid to Plate: (g1 to p)	0.7 μμf
Input: g1 to (h + k + g2 + g3)	8.0 μμf
Output: p to (h + k + g2 + g3)	8.5 μμf

RATINGS (Design Center Values)

Class A_1 Amplifier	
Plate Voltage	315 Volts Max.
Plate Dissipation	12 Watts Max.
Grid No. 2 Voltage	285 Volts Max.
Grid No. 2 Dissipation	2 Watts Max.
Grid No. 1 Circuit Resistance	
Fixed Bias	0.1 Megohm Max.
Cathode Bias	0.5 Megohm Max.

CHARACTERISTICS AND TYPICAL OPERATION

Class A_1 Amplifier (Single Tube)			
Conditions:			
Plate Voltage	180	250	250 Volts
Grid No. 2 Voltage	180	200	250 Volts
Grid No. 1 Voltage	-8.5		-12.5 Volts
Cathode Bias Resistor		270	Ohms
Peak AF Grid No. 1 Voltage	8.5	10.5	12.5 Volts
Zero Signal Plate Current	29	33.5	45 Ma
Maximum Signal Plate Current	30	36.0	47 Ma
Zero Signal Grid No. 2 Current	3.0	1.6	4.5 Ma
Maximum Signal Grid No. 2 Current	4.0	3.2	7.0 Ma
Plate Resistance (approx.)	50,000		50,000 Ohms
Transconductance	3700	4000	4100 μmhos
Load Resistance	5500	6000	5000 Ohms
Maximum Signal Power Output	2.0	3.3	4.5 Watts
Total Harmonic Distortion	8	12	8 Percent

Class A_1 Push-Pull Amplifier (Values are for Two Tubes)	
Conditions:	
Plate Voltage	250 Volts
Grid No. 2 Voltage	250 Volts
Grid No. 1 Voltage	-15 Volts
Peak AF Grid No. 1 to Grid No. 1 Voltage	30 Volts
Zero Signal Plate Current	70 Ma
Maximum Signal Plate Current	79 Ma
Zero Signal Grid No. 2 Current	5 Ma
Maximum Signal Grid No. 2 Current	13 Ma
Plate-to-Plate Load Resistance	10,000 Ohms
Maximum Signal Power Output	10 Watts
Total Harmonic Distortion	5 Percent

NOTE:

1. This tube is intended for use in automobile radios operated from a nominal 12 volt battery. Design of the tube is such that the heater will operate satisfactorily over the range 10.0 volts to 15.9 volts, and that the maximum ratings provide a safety factor for the wide voltage variation encountered with this type of supply.

APPLICATION

The 12AB5 is a miniature beam power pentode designed primarily for service as an audio power amplifier in auto radios having a 12 volt heater supply. Except for heater characteristics, electrically the 12AB5 is identical to the 6CM6 and the 12CM6.

SYLVANIA ELECTRONIC TUBES

Issued as a supplement to the manual in Sylvania News for March 1957

SYLVANIA NEWS

MARCH 1957 VOL. 24, NO. 3

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

COLOR-TV PICTURE-TUBE ADJUSTMENTS AND THEIR RELATION TO CHASSIS CIRCUITRY (PART II)

How to Position and Check Yoke, Purity, Static and Dynamic Convergence Controls and the Rim Magnet and Field Neutralizing Coils to Obtain Best Color Reproduction

by John T. Jans, Applications Engineer TV Picture-Tube Division, Sylvania Electric Products Inc.

Dynamic convergence is necessary to converge all three colors over the face of the tube instead of just at the center. The need for dynamic convergence is illustrated in Fig. 1. If the picture tube face and mask were spherical with a center at the deflection center, no such need would exist, but a picture tube face of that shape would be impractical.

Dynamic convergence adjustments should be made with a dot or cross-hatch pattern on the picture tube. The dynamic convergence is accomplished by passing a parabolic current wave through a coil having the same core and magnetic path as the static convergence magnet. Parabolic currents of both the horizontal and vertical frequencies are supplied, variable in amplitude to about 10-*ma* peak-to-peak and in shape from a saw tooth to a parabola. The coils should be of an impedance whereby the field they produce will move the spots about ¼".

Dynamic convergence requires adjustment of the horizontal size and shape controls for all three colors, and then the vertical size and shape

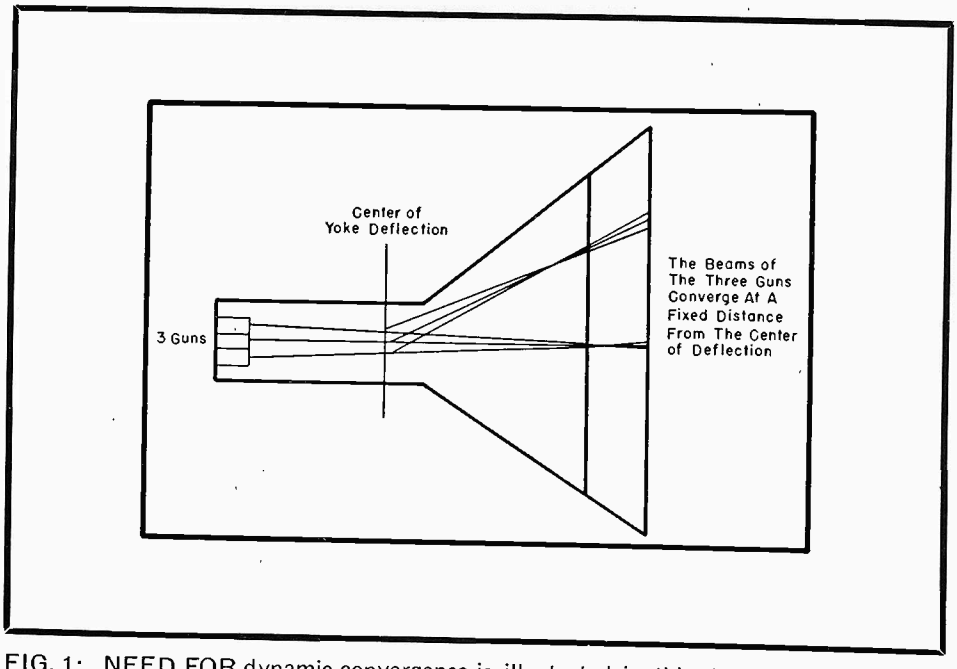


FIG. 1: NEED FOR dynamic convergence is illustrated in this drawing. Because the distance from the center of deflection to the screen is not constant, the beam convergence must vary as the beam moves over the face of the screen.

Help Yourself To More Sales . . .

PUT YOURSELF IN THE CUSTOMER'S PLACE

By JAMES W. RITTER, Sales Training

Many millions of dollars are spent each year by manufacturing organizations such as Sylvania, your independent distributor and yourself to build a solid reputation for independent service-dealers as "headquarters for complete radio and television servicing."

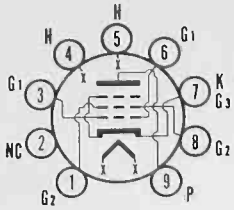
When a TV parts consumer enters your shop, or when you enter a customer's home, it's your opportunity to win a steady customer by giving prompt, courteous service. Only by maintaining a large active list of "satisfied customers" will your business succeed!

How do you go about winning friends and influencing customers? There are hundreds of important points that should be considered when the subject of customer relations is approached. But, there is one simple formula that usually will help create a positive impression in anyone's mind. Merely do more of what they like and less of what they dislike.

Is your attitude toward every customer who enters your shop one of helpfulness? Do you try your best to make him feel at ease and as if you are really interested in giving him good service? Greeting your customer with a friendly smile and the pleasant words "may I help you, please" doesn't cost you a cent. It may help you increase your sales volume.

SYLVANIA TYPE 12AB5

BEAM POWER PENTODE



9EU

MECHANICAL DATA

Bulb	T-6½
Base	E9-1, Small Button 9-Pin
Outline	6-3
Basing	9EU
Cathode	Coated Unipotential
Mounting Position	Any

ELECTRICAL DATA

HEATER CHARACTERISTICS

Heater Voltage[1]	12.6 Volts
Heater Current	0.2 Ampere
Heater-Cathode Voltage (Design Center Values)	
Heater Negative with Respect to Cathode	
Total D C and Peak	200 Volts Max.
Heater Positive with Respect to Cathode	
D C	100 Volts Max.
Total D C and Peak	200 Volts Max.

DIRECT INTERELECTRODE CAPACITANCES (Unshielded)

Grid to Plate: (g1 to p)	0.7 $\mu\mu$f
Input: g1 to (h + k + g2 + g3)	8.0 $\mu\mu$f
Output: p to (h + k + g2 + g3)	8.5 $\mu\mu$f

RATINGS (Design Center Values)

Class A_1 Amplifier	
Plate Voltage	315 Volts Max.
Plate Dissipation	12 Watts Max.
Grid No. 2 Voltage	285 Volts Max.
Grid No. 2 Dissipation	2 Watts Max.
Grid No. 1 Circuit Resistance	
Fixed Bias	0.1 Megohm Max.
Cathode Bias	0.5 Megohm Max.

CHARACTERISTICS AND TYPICAL OPERATION

Class A_1 Amplifier (Single Tube)

Conditions:			
Plate Voltage	180	250	250 Volts
Grid No. 2 Voltage	180	200	250 Volts
Grid No. 1 Voltage	−8.5		−12.5 Volts
Cathode Bias Resistor		270	Ohms
Peak AF Grid No. 1 Voltage	8.5	10.5	12.5 Volts
Zero Signal Plate Current	29	33.5	45 Ma
Maximum Signal Plate Current	30	36.0	47 Ma
Zero Signal Grid No. 2 Current	3.0	1.6	4.5 Ma
Maximum Signal Grid No. 2 Current	4.0	3.2	7.0 Ma
Plate Resistance (approx.)	50,000		50,000 Ohms
Transconductance	3700	4000	4100 μmhos
Load Resistance	5500	6000	5000 Ohms
Maximum Signal Power Output	2.0	3.3	4.5 Watts
Total Harmonic Distortion	8	12	8 Percent

Class A_1 Push-Pull Amplifier (Values are for Two Tubes)

Conditions:	
Plate Voltage	250 Volts
Grid No. 2 Voltage	250 Volts
Grid No. 1 Voltage	−15 Volts
Peak AF Grid No. 1 to Grid No. 1 Voltage	30 Volts
Zero Signal Plate Current	70 Ma
Maximum Signal Plate Current	79 Ma
Zero Signal Grid No. 2 Current	5 Ma
Maximum Signal Grid No. 2 Current	13 Ma
Plate-to-Plate Load Resistance	10,000 Ohms
Maximum Signal Power Output	10 Watts
Total Harmonic Distortion	5 Percent

NOTE:

1. This tube is intended for use in automobile radios operated from a nominal 12 volt battery. Design of the tube is such that the heater will operate satisfactorily over the range 10.0 volts to 15.9 volts, and that the maximum ratings provide a safety factor for the wide voltage variation encountered with this type of supply.

APPLICATION

The 12AB5 is a miniature beam power pentode designed primarily for service as an audio power amplifier in auto radios having a 12 volt heater supply. Except for heater characteristics, electrically the 12AB5 is identical to the 6CM6 and the 12CM6.

SYLVANIA ELECTRONIC TUBES

Issued as a supplement to the manual in Sylvania News for March 1957

SYLVANIA NEWS

MARCH 1957 VOL. 24, NO. 3

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

COLOR-TV PICTURE-TUBE ADJUSTMENTS AND THEIR RELATION TO CHASSIS CIRCUITRY (PART II)

How to Position and Check Yoke, Purity, Static and Dynamic Convergence Controls and the Rim Magnet and Field Neutralizing Coils to Obtain Best Color Reproduction

by John T. Jans, Applications Engineer TV Picture-Tube Division, Sylvania Electric Products Inc.

Dynamic convergence is necessary to converge all three colors over the face of the tube instead of just at the center. The need for dynamic convergence is illustrated in Fig. 1. If the picture tube face and mask were spherical with a center at the deflection center, no such need would exist, but a picture tube face of that shape would be impractical.

Dynamic convergence adjustments should be made with a dot or crosshatch pattern on the picture tube. The dynamic convergence is accomplished by passing a parabolic current wave through a coil having the same core and magnetic path as the static convergence magnet. Parabolic currents of both the horizontal and vertical frequencies are supplied, variable in amplitude to about 10-*ma* peak-to-peak and in shape from a saw tooth to a parabola. The coils should be of an impedance whereby the field they produce will move the spots about ¼".

Dynamic convergence requires adjustment of the horizontal size and shape controls for all three colors, and then the vertical size and shape

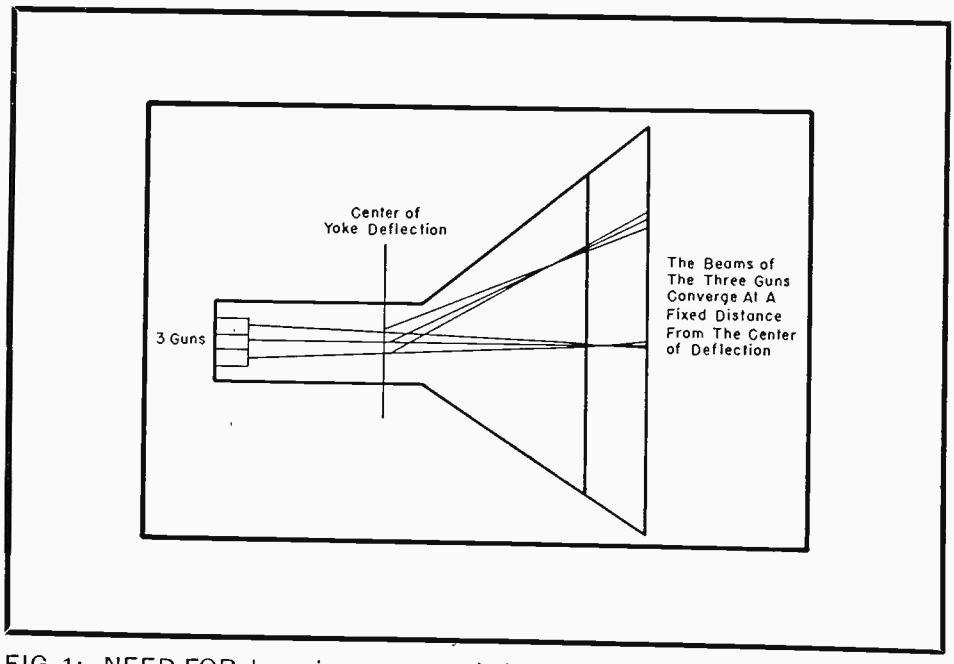


FIG. 1: NEED FOR dynamic convergence is illustrated in this drawing. Because the distance from the center of deflection to the screen is not constant, the beam convergence must vary as the beam moves over the face of the screen.

controls for all three colors. The dots need not be made to overlap each other, but only to have the same position relative to each other over the entire screen. The static convergence magnets can then be used to overlap all spots perfectly. After static and dynamic convergence correction, all colors of all the dots in the dot pattern should overlap within less than 1/16" over the entire screen face. This adjustment requires considerable practice and patience, but it can be done with the convergence components, tubes and circuits now available.*

After convergence and purity adjustments have been made, the remaining impure color patches along the edge of the picture can be improved by adjusting the rim magnets. These magnets are fastened around the face of the color tube and create a field that causes the beam to move about on the screen face in the area near the magnet. Again the adjustment is by trial and error for the best overall color purity on all three colors. A field neutralizing coil is sometimes used in place of or in conjunction with the rim magnets. This coil creates a field parallel to the axis of the tube around the edge of the tube, which causes the beams to shift on the dots in a manner shown in Fig. 2. The field-neutralizing coil is controlled by a pot. that varies the *dc* through it both in polarity and amount. On new model color receivers the field-neutralizing coil has been eliminated.

The yoke position, purity, rim magnet, and field-neutralizing coil adjustment should be checked on all three (red, green and blue) colors, so that each field is pure in itself and, when all three colors are added to make a white field, it should be a pure white. Sometimes a slight adjustment of the rim magnet can improve the white field without harming the pure primary color fields.

When all of the foregoing adjustments have been made the receiver is ready to be adjusted for white balance. Usually the G_1 and G_2 controls have been radically changed in adjustment to obtain a blank color field and a complete readjustment must be made. With a vacuum-tube voltmeter, all the G_2 voltages on all three guns should be set to some equal value of about 350 or about 200 *v* above the cathodes. The dot pattern should be removed and the receiver turned to a good monochrome signal. The contrast should be lowered to a minimum and the master brightness control turned until the raster is just blanked out. The red, green and blue-background controls, if present, should be adjusted, (often only green and blue are used) so that a very dim raster is neutral gray and not any particular color. The master brightness operation should then be checked. As the blank screen brightness is increased, the screen should always be some shade of neutral gray. If it tends to become a primary color (red, green or blue) as the brightness is increased, the G_2 voltage of that color should be increased by 40 volts; one should then readjust the backgrounds and check again. If the screen tends to become some complementary color (yellow, blue-green or purple) then the G_2 voltage of the complementary primary should be decreased by 40 v, the background readjusted and checked again. If the G_2 control of one color reaches the end of its range the other two controls may be adjusted in the opposite direction.

Now one should increase the contrast control until a normal picture appears. Both the highlights and the shadows should be a neutral gray in color. If the highlights are one color, the G_2 voltage of that color should be raised. This also requires dropping the G_1 voltage of the same color to give a neutral shade in the shadows. A monochrome receiver on the same channel is a good standard to match for white color. After the white balance has been found satisfactory, one should record the G_2 and G_1 voltages, as read with a *vtvm*. These settings should not change throughout the useful life of the color tube and can easily be reset the next time the receiver is adjusted.

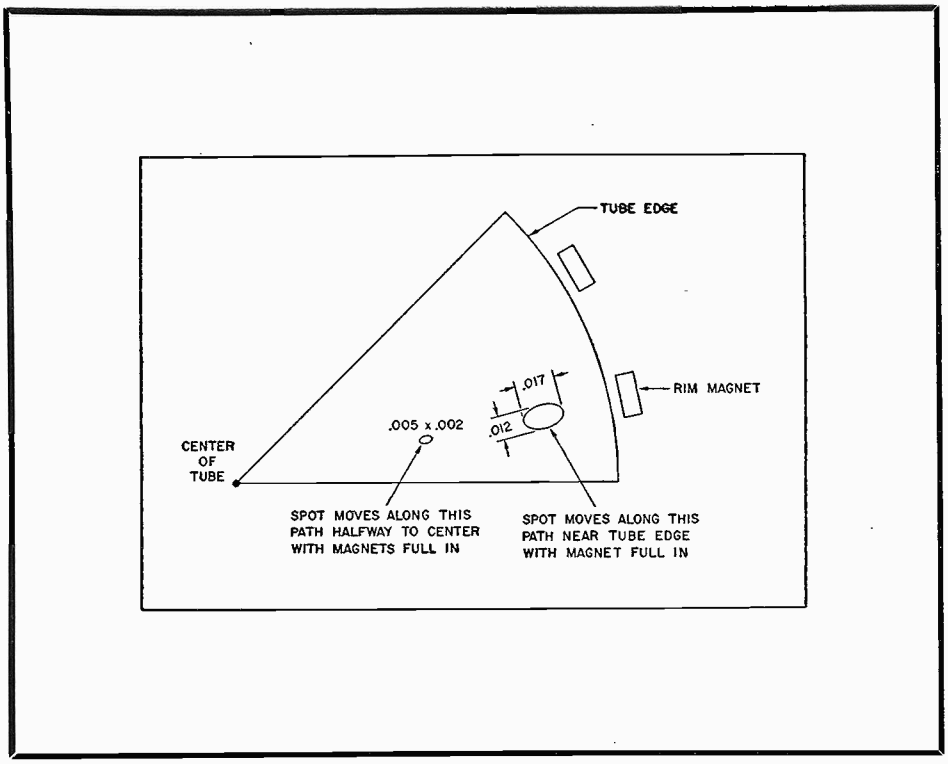


FIG: 2: REACTION of a field-neutralizing coil which creates a field parallel to axis of the tube around its edge, causing beams to shift on the dots.

ERRATUM

We regret that Figures 3 and 4 in the February issue, COLOR-TV PICTURE-TUBE ADJUSTMENTS AND THEIR RELATION TO CHASSIS CIRCUITRY, are reversed with respect to the captions.

The remaining adjustments vary with the color mixing circuitry.

The color-mixing circuitry is usually described by the level at which the decoded color or chrominance signal is added to the luminance signal. In a low-level matrix circuit the decoded *I* and *Q* signals are added to the luminance signal to produce red, green, and blue signals, all of which are individually amplified and *dc* restored before being applied to the picture tube. A high-level matrix circuit, however, decodes the chrominance signal to color difference signals (*R-Y*), (*B-Y*) and (*G-Y*), which are applied directly to the grids of the picture tube at the same time the luminance (or *Y*) signal is applied to the picture tube cathode.

If low-level matrixing is used, a b-w picture signal must be turned on and the individual red, green and blue video gains adjusted, so that the highlights are white and not a particular color. If the highlights are red, for instance, the green and blue video gains must be increased. Usually, there is a green and blue video gain with a master video gain or contrast control. To vary red, all three controls must be used. Low-level matrixing was used on the earlier color receivers.

Most new-model receivers with 21-inch picture tubes use high-level matrixing. The luminance or monochrome signal is fed identically or in some fixed ratio to all three guns; thus there is no control over the video signal voltage to each individual gun. However, the actual beam current to each color screen can be varied by adjusting the G_1 and G_2 voltages on each gun. With a high-level matrix type of receiver, the background and G_1 controls must be set to give a neutral gray on a very dim raster. Then, a monochrome video signal of average contrast must be applied. If the highlights are some primary color other than white, the G_2 voltage of that particular color should be raised, and the background of that color lowered until a dim raster is again gray. One must repeat the monochrome video signal and continue to adjust the G_2 and background controls until the monochrome picture is gray on the low brightness scenes and white on the highlights.

Thus far, all of the adjustments have been made to give a good b-w picture. With a receiver using a shadow-mask color-picture tube, a good b-w picture is the most difficult to obtain and such a picture indicates correct adjustment of the picture tube itself.

A color picture or color bar test pattern must be used to adjust the receiver color processing circuits. The fine tuning must first be adjusted until the colors are stable and the picture free of interference. Older color receivers were very critical for fine tuning, but the newer models have a fair range over which the fine tuning control gives a good color picture. The color hold control, if present, should be adjusted so there are no varying bars of color over the picture. The hue or color phase control is adjusted so the colors look correct. The best color to judge is flesh color, which can be varied with most hue controls from yellow-green to red. If flesh tones look right, all other colors will probably be correct. Chroma or color gain control adjusts the amount of color or saturation. If the control is set too low, the colors are more pastel than is natural. This control should be adjusted to suit the viewer's preference.

**See* KEN KLEIDON *convergence-adjustment report in October, 1956,* SERVICE, *which describes a step-by-step approach.*

Bring Roll Charts Up-To-Date

Note these important changes — Make sure your new Sylvania roll charts are completely accurate and up-to-date . . . transfer these important changes now.

Change three settings on the 139 and 140 charts to read:

5AT8	5.0	0	..	0	3	579	56	Y
	5.0	0	..	0	2	2	41	U
6AG5	6.3	0	4	0	4	36	56	Y
6AN8	6.3	0	..	0	1	3	25	W
	6.3	0	..	0	3	079	35	W

Change five settings on the 219 and 220 charts to read:

6AN8	6.3	4	59S	25	5	2Y	1	3
	6.3	4	35S	50	5	078Z	6	9
6BQ6	6.3	2	7	19	7	045SY	9	8
6DN6	6.3	2	7	12	7	58Z	9	3
12BR7	12.6	4	589S	46	5	2X	1	3
	12.6	4	3569	23	5	X	7*	8
	12.6	4	3579	23	5	X	6*	8
12C5	12.6	3	45	13	4	26V	7	1
	12.6	3	24	13	4	56V	7	1

Change two settings on the 620 chart to read:

6AN8	6.3	4	59R	25	5	2X	1	3
	6.3	4	35R	57	5	078Y	6	9
12C5	12.6A	3	45	13	4	26U	7	1
	12.6A	3	24	13	4	56U	7	1

Bring your tube tester up-to-date by sending for new roll charts. You'll save yourself the needless time and trouble of writing in settings by ordering these new roll charts now.

They are available for:

Catalog Number	Tube Tester Model Number
PC 15845-M	139 - 140
PC 18325-J	219 - 220
PC 25700-B	620

Write the catalog number of the new roll chart for your Sylvania Tube Tester on your letterhead. Enclose a check (for the nominal charge of $1.50 for each roll chart) made out to Sylvania Electric Products Inc. Mail it promptly to:

Tube Tester Roll Charts
Sylvania Electric Products Inc.
180 East Third Street
Williamsport, Pennsylvania

That's all you do. Your new accurate roll chart will be on its way to you as soon as your letter and check are received.

American Substitutions For European Tubes

The number of European tube types encountered by the serviceman, particularly in audio equipment, seems to be growing steadily. Although a great many European types are available in this country, an American replacement may be desired. The accompanying table shows the American equivalents for 85 European types.

The European types are listed in the left hand column. The center column shows the equivalent American types followed by the qualifying remarks DE or NE, right hand column. DE indicates "Direct Equivalent," i.e., requiring no circuit or socket changes. NE stands for "Nearest Equivalent." The majority of types listed as NE can also be considered direct replacements in most applications, but may differ slightly from the standpoint of special characteristics. The data shown are believed to be accurate, however, no responsibility can be assumed in case of error.

Please note that all types listed may not be available from SYLVANIA. Consult your current price list.

EUROPEAN TYPE NO.	AMERICAN TYPE NO.	CODE
DA90	1A3	DE
DAF91	1S5	DE
DAF92	1U5	DE
DAF96	1AH5	DE
DCC90	3A5	DE
DF91	1T4	NE
DF92	1L4	NE
DH63 (M)	6Q7GT	NE
DH77	6AT6	NE
DK91	1R5	DE
DL33	3Q5GT	DE
DL35	1C5GT	NE
DL36	1Q5GT	DE
DL92	3S4	DE
DL93	3A4	NE
DL94	3V4	DE
DL95	3Q4	DE
DP61	6AK5	DE
EAA91	6AL5	NE
EB91	6AL5	NE
EBC90	6AT6	NE
EC90	6C4	DE
EC92	6AB4	DE
ECC33	6SN7GT	NE
ECC81	12AT7	DE
ECC82	12AU7	NE
ECC83	12AX7	DE
ECC85	6AQ8	DE
ECC91	6J6	NE
ECF80	6ABGT	NE
ECF82	6U8	DE
ECH81	6AJ8	DE
ECL82	6BM8	DE
EF91	6AM6	DE
EF92	6CQ6	DE
EF93	6BA6	NE
EF94	6AU6	NE
EF95	6AK5	NE
EH90	6CS6	DE
EK90	6BE6	DE
EL37	6L6G	DE
EL90	6AQ5	DE
EL91	6AM5	DE
EL821	6CH6	NE
EM34	6CD7	DE
EM80	6BR5	DE
EQ80	6BE7	DE
EZ35	6X5	DE
EZ80	6V4	DE
EZ81	6BW4	DE
EZ90	6X4	DE
GZ32	5V4G	DE
H63	6F5	DE
HABC80	19T8	NE
HBC90	12AT6	NE
HD14	1H5GT	NE
HD30	3B4	DE
HF93	12BA6	NE
HF94	12AU6	NE
HK90	12BE6	NE
HL90	19AQ5	DE
HL92	50C5	DE
HM04	6BE6	DE
HY90	35W4	DE
L63	6J5GT	NE
L77	6C4	DE
N18	3Q4	DE
N144	6AM5	NE
PABC80	9AK8	DE
PCC84	7AN7	DE
PCC85	9AQ8	DE
PCF80	9A8	DE
PCF82	9U8	DE
PL81	21A6	DE
PM04	6BA6	NE
PM05	6AK5	NE
PM07	6AM6	NE
SP6	6AM6	NE
UF41	12AC5	DE
UBC41	14L7	DE
UCH42	14K7	DE
X17	1R5	DE

DE Direct Equivalent
NE Nearest Equivalent

merchandising SECTION

MARCH 1957 VOL. 24, NO. 3

YOUR NAME "UP IN LIGHTS"

Big, bold letters on this eye-catching outdoor illuminated sign spell out your name to television parts consumers

Whether your shop is located in a crowded shopping center or on a busy street corner, this special personalized Sylvania sign is the best way for you to advertise your business. With its big "double face," it can be seen and read easily—even by consumers who drive quickly by your shop.

FOUR BRILLIANT COLORS

Attractively lighted in four brilliant colors, the sign spotlights your name and the words "radio, television service" in bold letters.

BUILT FOR RUGGED USE

This special Sylvania sign, available only to you, the Sylvania independent service - dealer, is constructed of sturdy, weather-resistant aluminum and plastic. Put through a series of tests for safety, the sign bears the seal of approval of the Underwriter's Laboratories. It's built to withstand years of rugged outdoor use—it's the sign that will give you longer service.

MINIMUM MAINTENANCE

The special Sylvania outdoor illuminated sign is not only simple to erect, but requires practically no maintenance. The special galvanized iron handles make it easy to set up. Aluminized or galvanized nuts secure it firmly in place. The special plastic "faces," one on each side of the sign, require no painting to keep their brilliance.

ADVERTISING "YOU"— NIGHT AND DAY

The word "independent" is clearly printed on both sides of this sign, letting consumers know that your shop is a private business. You'll be attracting consumers to your shop window and into your store at all hours of the day, when you're displaying this special sign. The six, 60-watt lamps constantly keep your name "up in lights."

SEE YOUR DISTRIBUTOR, NOW

This special, multi-colored, sturdily constructed outdoor sign is available only through your authorized Sylvania distributor. Be sure you let radio and television parts consumers know that you're in business to serve them. Ask your distributor now for details on how you can own this special outdoor illuminated sign featuring the word "independent" under your name!

New Sylvania-Sponsored Color Course

Be prepared to cash in on the increased business that will be coming your way soon as a result of color television. Experts predict that in a few short years almost two million color receivers will be in use.

Only as a trained and experienced color TV technician will you get your fair share of this expanding market.

Helping you "be prepared" to better your business, Sylvania is sponsoring a complete correspondence course on color TV. It's available to you, now, through your Sylvania distributor.

Enrolling in the specially prepared color course, sponsored by Sylvania under the direction of the Radio Television Training Association, can insure the future growth of your business. It's an investment that will pay you dollar dividends!

FEATURES COLOR SURVEY

A special introductory survey of the color television market is the result of the combined efforts of RTTA and Sylvania. It's yours as soon as you are registered for the course. This unique introductory lesson will give you an overall view of the problems, and a general explanation of the expanding color television field. Printed in full color, the lesson will familiarize you with the idea of mixing colors and making picture tube adjustments.

COMPLETE 14 LESSON COURSE

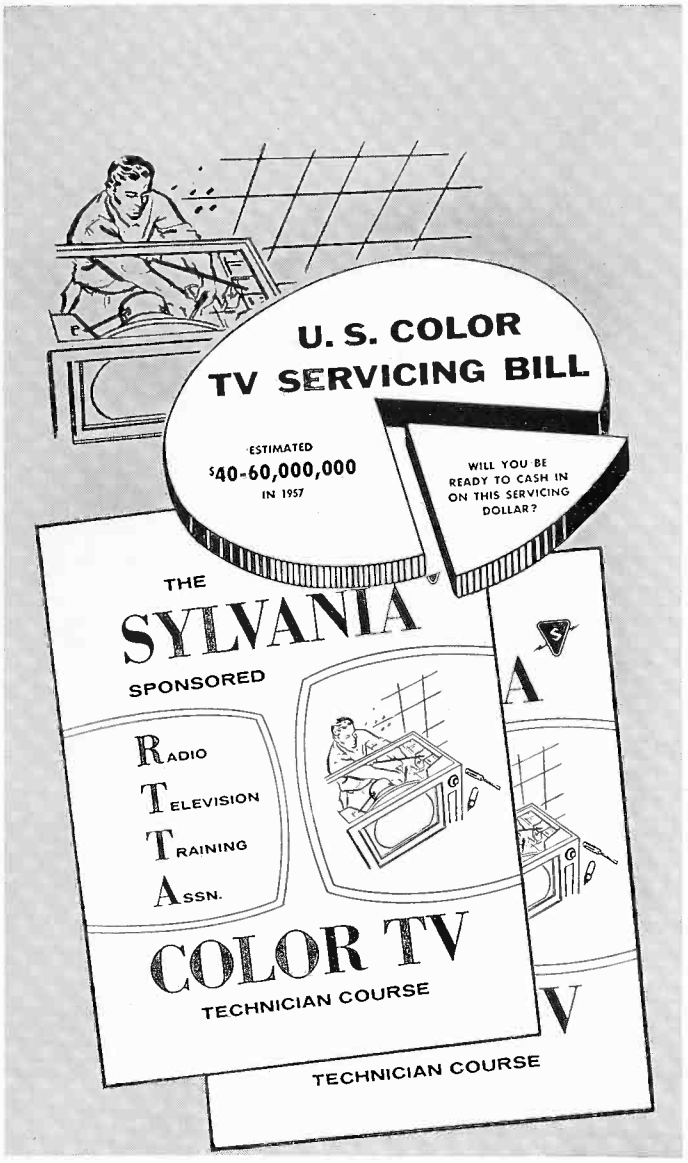
The course begins with an introduction to the Laws of Color and defines the differences between the transmission and reception of black-and-white and color television. Starting at the transmitter, you are guided through the development and transmission of the composite Color TV signal. With an over-all view of how the receiver functions, each circuit is analyzed. A knowledge of how Color TV circuits work, both as individual and as cooperative units in the receiver, prepares you for all future developments in the field of Color TV.

And of course, Color TV has its own peculiar servicing problems. To meet them, you will receive thorough training on test instruments, alignment as well as servicing.

Detailed examinations are included with the lessons and will be individually analyzed by the RTTA staff. You will receive a complete explanation of any errors you make on the self-testing exam.

COLOR COURSE MEETS PROFESSIONAL STANDARDS

The Radio Television Training Association, one of the nation's leading radio and TV schools, boasting



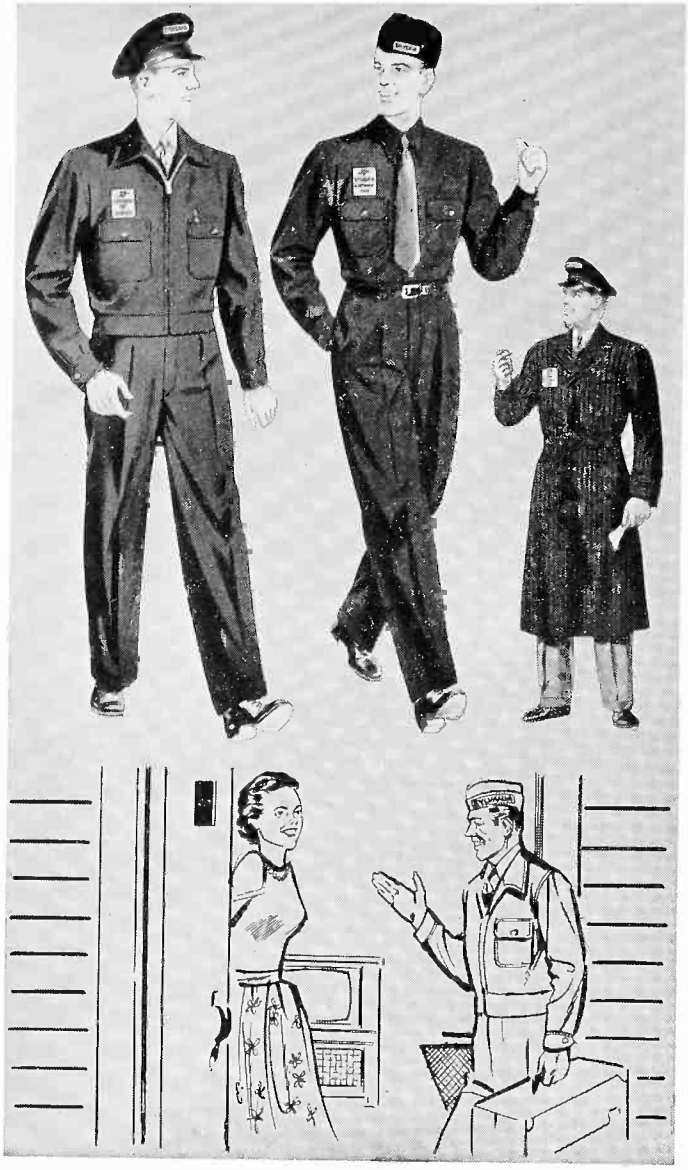
thousands of service technician graduates has prepared the course. Upon its completion, a valuable industry-acknowledged certificate of achievement is awarded. More than 15,000 of these certificates have been granted service technicians since 1949.

SEE YOUR DISTRIBUTOR, NOW!

Your local authorized Sylvania distributor will give you complete details on how you can enroll in the Sylvania-sponsored RTTA Color Course. It is available, through Sylvania, only to independent service-dealers who purchase Sylvania quality receiving tubes and "Silver Screen 85" picture tubes.

See your distributor, now. Help yourself to more profits as an expert in color TV servicing!

Look Like a Professional



If you've spent years learning the technical skills and absorbing the multitude of facts necessary for a professional radio-television technician, you're probably proud of it. And, rightly so!

But, do you "look" the part? When you enter a person's home, does he see a neatly groomed man whose trimly tailored uniform gives him that "professional look?"

As a service-dealer and an independent business man, you should always "dress right"—you can't afford not to!

Sylvania's new regulation service-dealer uniforms will help give you the business-like appearance that instills confidence in your customers. You'll be "dressed right" when you're wearing one of the handsome forest green outfits illustrated here.

DISTINCT UNIFORM COMBINATIONS

Sylvania's newly designed uniforms are available to you now from your Sylvania distributor. The tailored lines of the Eisenhower-style jacket, made of sturdy, long-wearing gabardine, will keep you looking trim. The jacket's closely woven twill construction gives it the strength to withstand even the rugged wear a busy service-technician can give it.

Designed to *be* comfortable and *look* smart, the jacket features adjustable cuffs and a zipper plus two roomy, button-down breast pockets. The jacket is protected against shrinkage by the exclusive "Sanforized" process.

The long-sleeve Sylvania shirt, in the finest dress shirt pattern, is made of popular sanforized green twill.

The trousers are also made of sturdy gabardine and feature cuffs, roomy side-pockets and pleats.

YOUR UNIFORM ADVERTISES YOU

The handsomely tailored Sylvania service-dealer uniforms feature the well-known Sylvania insignia, the "flashing S," under which the name of your shop can be embroidered in a special script.

You can use the back of your forest green shirt and jacket for your shop's name and telephone number. At a special, low cost, Sylvania will embroider the back of each garment of your choice.

HELP YOURSELF "DRESS RIGHT"

Order your official Sylvania independent service-dealer uniforms, now. There are no better values available to you at these special prices:

DESCRIPTION	STYLE	PRICE
Green Gabardine Jacket.....	3855	$8.56
Plaid Flannel Lining		1.98
Green Gabardine Pants.....	9530	6.75
Green Gabardine Cap.....	B9501	3.25
Green Gabardine Overseas Cap..	S9505	1.19
Green Twill Regular Shirt.....	4244	4.98
Grey Poplin Half-Sleeve Shirt....	4045	3.98
Green Herringbone Shop Coat...	2075	7.28

The nominal charges for embroidery are:

Special Chain Stitch Lettering on back—18 letters or less—88c plus 6c for each additional letter.

Script Name over Left Pocket—8 letters or less—10c plus 2c for each additional letter.

Help increase the confidence of your customers in you as a professional radio-television technician. Order these smart uniforms through your Sylvania distributor, or write directly to:

SYLVANIA ELECTRIC PRODUCTS INC.
1100 Main Street, Buffalo 9, New York

When ordering directly from Sylvania, be sure to include correct sizes.

Thoughts on . . .

COLOR TV SERVICING

By GEORGE ISHAM
General Merchandising Manager
Electronic Products Sales

With approximately one half of all evening network programs now available in color, and with more and more color sets being sold every day, (there probably will be over 1,000,000 color sets in use by the end of 1958), it definitely is time for independent servicemen to learn as much as possible about the maintenance of color TV.

Don't let this task scare you. Actually, color installation and servicing will not prove too difficult. The transition from black and white servicing to color servicing will be nowhere near as hard as was the transition from AM and FM radio to TV. Let me hasten to add, however, lest we become complacent, color is not simple, and does require added know-how. And, the sooner a serviceman acquires the necessary information, the better off he is going to be.

You may question the following statement, but it is accurate. Right now, not more than one serviceman in five feels confident of his ability to do a good job on a color set. This, I think you will agree, is a pretty serious situation. Why? Because if it persists, the bulk of color maintenance can gravitate to the Manufacturers' Retail Service Branches. That, you certainly do not want! That, we certainly do not want! That is the reason we think independent servicemen should learn color. That is the reason we now are sponsoring a color TV service course. That is the reason we think every serviceman who has not studied color should give serious thought to taking this course. That is why this course has been set up so that you can get it at no out-of-pocket expense, and can earn the entire cost with your purchases of our receiving tubes and picture tubes. Is it a good course? We think so. It is complete. It is comprehensive. It is well arranged. It is written in serviceman's language. Our John McCaul, whom many of you have heard talk at service meetings, says he thinks it is the best thing of its kind he has seen. If John feels that way, it's a pretty safe bet, you will too.

SYLVANIA NEWS

SYLVANIA ELECTRIC PRODUCTS INC.
1100 Main Street • Buffalo 9, N. Y.

BULK RATE
U.S. POSTAGE
PAID
Permit No. 3402
Buffalo, N.Y.

A

NOTIFIED

Printed in U.S.A.
Form 3547 Requested

VOL. 24, NO. 3 MARCH 1957

PUBLISHED BY
SYLVANIA ELECTRIC PRODUCTS INC.
MANUFACTURERS OF SYLVANIA RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES, FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, ELECTRIC LIGHT BULBS, PHOTOLAMPS, CAMERA EQUIPMENT, RADIO AND TELEVISION RECEIVERS.

Richard Kerr
For 213 Bronson Rd.
Syracuse, N. Y.

In This Issue

SYLVANIA NEWS

BILL PACE, EDITOR TWENTY-SEVENTH YEAR OF PUBLICATION • APRIL 1957 • VOL. 24, NO. 4
Published in the interest of the Independent Service Dealer on the 15th of the month, © 1957, Sylvania Electric Products Inc.

SYLVANIA and YOU, YESTERDAY and TOMORROW

Sylvania Wins Coveted NATESA Award for 6th Straight Year
Marketing Vice-President "Bart" Wickstrum Gives Some Reasons Why

Sylvania's continuing efforts to help you, the independent service-dealer, improve your business in the face of increasing competition from Manufacturers' Retail Service Branches made headlines on two separate occasions recently.

Sylvania achieves a unique distinction as the only electronic products manufacturer to be honored for six consecutive years by winning the 1956 NATESA award. The specially engraved plaque was presented to the company in New York City last month.

In Phoenix, Arizona also last month, Sylvania's top marketing official was the featured speaker at a special TV Servicemen's Seminar sponsored by the Better Electronic Service Technicians, Inc., and the Arizona Television Service Dealers Association. It was the group's first get-together and gained the support of people like Arizona's governor Ernest McFarland, who attended.

Reprinted here are some of the more important points made by Sylvania's keynote speaker for the affair, Mr. Wickstrum . . . reasons why Sylvania has always been, and will continue to be "Friends of Service Management"—title of the award presented by NATESA to Sylvania for six consecutive years.

YOUR ELECTRONICS FUTURE

BY B. K. "BART" WICKSTRUM
VICE-PRESIDENT, MARKETING
SYLVANIA ELECTRIC PRODUCTS INC.

On the program it states that my topic is "The Electronics Future." That, ladies and gentlemen, can be stated in a few words such as: Enormous, amazing, bewildering. There is no limit to the horizons of the electronics of the future. There is not an area of human activity which will not be involved with electronics including education, recreation, work, sickness, war, peace, transportation, rest, food, clothing, information, communication, banking, bookkeeping, farming, mining, manufacturing, comfort — everything, practically can and will be involved. Since this audience is essentially composed of TV Servicemen, I am going to talk about the future as related to Electronic Service.

I'm going to get myself right out on a great big limb and say that I think the biggest opportunities facing servicemen today are: one, keeping abreast of developments and, two, acquiring sufficient information to do "a number one" maintenance job. When looking at the service industry as a whole, there is, and I am sure you will agree with me, a need for some improvement, not only along technical lines but in the field of salesmanship and merchandising as well. It is because of these possible needs that a couple of situations now exist, the implications of which, and the future of which, I think we should talk about.

The first of these is Manufacturers' Retail Branch Service. Manufacturers' Retail Branch Service is a fact. And, it is going to continue to be a fact. We might as well face up to it, despite all the contradictions and explanations of policy which some companies have been issuing lately. When television broke almost like a tidal wave on the American scene, there appeared, in the minds of some manufacturers, doubts about the ability of independent servicemen to adequately install and service these machines. I say "some". We at Sylvania continued to have confidence in the independent just the same as we did when we withdrew our advertisement from a national magazine after a supposed expose' of the service racket. The magazine, as some of you may recall, printed a full retraction after this action on Sylvania's part had stimulated them to investigate the situation. And right here might be just as good a place as any to explain Sylvania's philosophy regarding *independent* operations. I have here in my hand a plaque. Let me read it to you. The plaque reads as follows:

> "Free competition is the life of trade . . . and progress;
>
> "Only independent means of distribution preserves freedom of competition;
>
> "There will always be a place at the top for independents who work together to provide an even higher standard of American living."

Right now we are in the process of reproducing this in sufficient quantities for every independent serviceman in the country—to hang up in his place of business—if he desires.

We are not in the retail service business and we are *not* going to be in the retail service business.

But to get back to what I was saying; with the advent of television, there appeared the *Factory Retail Branch Service*. With color just around the corner, threatening to really blossom

at any moment, Factory Retail Branches probably will become more firmly entrenched. We at Sylvania do not like this development. We have fought it. And, we will continue to fight it. But, we have this situation. The important thing now is, what are we, you and me, and every other independent, going to do about it?

Let me say this, in all sincerity; you and we, the independents of this industry, have a big job on our hands —a job which will call for a lot of cooperation and hard work on all our parts. Servicemen will have to investigate every possible means of acquiring information. And, the ways and means of acquiring this information is, we believe, largely the responsibility of the independent manufacturers.

With this in mind, let's review what Sylvania has done and is doing. Number 1 is *Sylvania News*. This publication has been published for Servicemen since 1926. It is the oldest trade publication in the industry. Some servicemen have even kept files of all the Technical Sections of *Sylvania News* over the entire period of 30 years. In this Technical Section we have tried to keep the service industry up to date on all developments over this entire period of time. Because we believe *Sylvania News* to be very worthwhile, we do not hesitate to spend upwards of $100,000 per year to place it in your hands.

Another part of our program has to do with Service Schools. Last year our service school engineers talked to over 13,000 servicemen in all sections of the country. Are these schools worthwhile? Well, I'll tell you one thing—I sincerely hope so—they cost enough dough. Last year even, and color wasn't exactly red hot in 1956, these schools were devoted almost 100% to color, and the problems contingent with color. This is a continuing program, it is in effect next year, and the year after that.

Because we feel that education is all important, we currently are making available to servicemen through our distributors a course on Color Television Servicing which we are told by people in the industry is the finest thing of its kind yet. We firmly believe it will help independent servicemen in all sections to become better versed in the service of color sets so they can be ready when the avalanche starts.

A problem currently confronting independent servicemen in many markets in the country, is the appearance of tube testing and tube selling in drug stores and supermarkets. This, of course, is a part of the "do-it-yourself" fad. Studies we have made indicate that somewhere around 2% of all replacement receiving tubes currently are being sold on this do-it-yourself basis. Now, 2% is nothing to get awfully excited about, but there are definite possibilities that this thing may grow. Why? Because it offers people the possibility of getting their sets back in operation on Sundays and Holidays and as such is a service.

Why have we been spending money on such survey work? Is it because we are thinking of selling these do-it-yourself operators? No. It is because we did not know for sure how this might affect independent servicemen. We wanted to learn how big this thing really is. Well we found out that "do-it-yourself" is liable to become a serious problem. As a result, we have some suggestions on what to do about it. We are inclined to believe that one good solution would be for the independent serviceman to get into the do-it-yourself business himself.

One man in Dayton, Ohio has a set-up in a nearby store. He has a sign over the checker which reads, "For the convenience of our customers." And the sign reads further: "If a new tube doesn't cure your trouble call us at"—and gives his telephone number. This suggestion might not work for you, but it is working for some.

Certainly, you should have tube testing facilities in your own store. Believing this sincerely we currently are getting out a kit of display material including counter cards, window stickers and direct mail material on "Tubes Tested Free."

How do these things fit in with the electronic future? They *are* your electronic future. Service and Know-how. That is what you have to sell.

SIXTH CONSECUTIVE AWARD was made to Sylvania recently for "Outstanding Service in Creating Better Customer Relations" by the National Alliance of Television and Electronic Service Associations at special ceremonies in the company's New York City headquarters. Accepting the award for Sylvania from NATESA president Bob Hester is general sales manager, D. W. Gunn, Electronic Products Sales. At the ceremonies were, left to right: George Isham, general merchandising manager of Electronic Products Sales; prexy Hester, Harold Rainier, distributor sales manager, Electronic Products Sales; NATESA board chairman Frank Moch, Sylvanian Gunn and Al Merriam, service manager, Sylvania's Radio and Television division.

Home Calendars Build Dealer Volume

ORDER EARLY, NOT LATE BUILD SALES IN '58

When an attractive Sylvania calendar is prominently displayed in your consumers' homes they'll be doing the same as this month's *Sylvania News* cover girl—reaching for that telephone to call *you* for service! Ordering your Home Calendars now, you'll be assured of receiving the right quantity with the picture you select. Avoiding the last minute rush around the winter holidays, you'll be giving yourself plenty of time to get these sales-building calendars into homes in your area.

CHOOSE FROM TWO DISTINCT STYLES

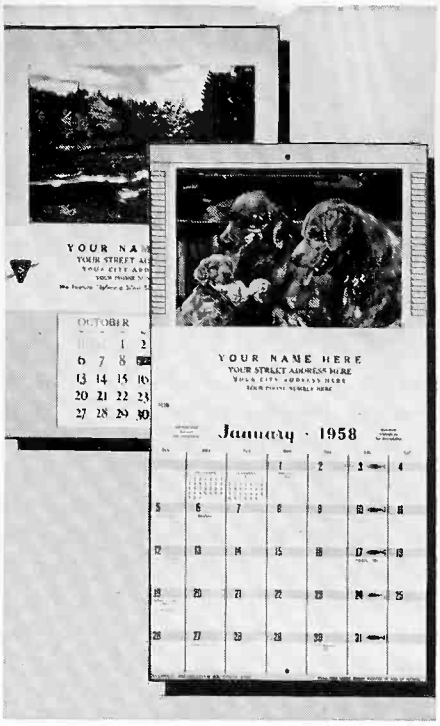
Now two different types of Home Calendars are available to service-dealers. The Deluxe Home Calendar, featuring worthwhile household information, new recipes and a large and useful calendar pad, makes an attractive holiday gift to your regular customers. This expensive-looking calendar costs you only nineteen cents each complete with picture and imprinting.

Offered to Sylvania independent service-dealers for the first time is a special Art Mount Home Calendar which makes an ideal gift to prospective customers as well as your regular customers. Complete with picture and imprinting, this calendar sells for the low price of eleven cents each.

A special two dollar discount is available to you when purchasing 100 Deluxe Home Calendars and 100 Art Mount Home Calendars in the same order.

CHOOSE FROM FOUR FULL-COLOR PRINTS

You can choose anyone of the four scenes illustrated on this page for both the Deluxe Home Calendar and the Art Mount Home Calendar. Each one makes a handsome addition to any home. The picture you select appears on the imprinted calendar in full color.



ORDER YOUR 1958 CALENDARS NOW

Be an "early bird" when it comes to the personalized Sylvania home calendars. Every calendar you order is imprinted plainly with your name, address and telephone number. It's a 365-day reminder to consumers to call you for their TV servicing problems.

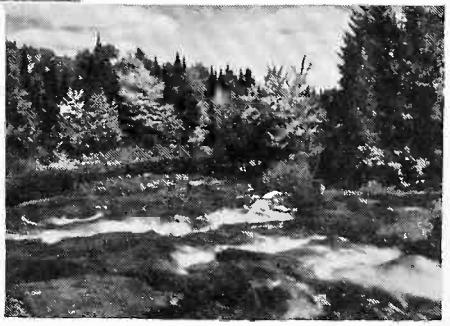
Place your order now with your Sylvania distributor. If you prefer, write for free sample and order form to: SYLVANIA ELECTRIC PRODUCTS INC., 1100 Main Street, Buffalo 9, New York.

THE GOOD OLD SUMMERTIME

A GOOD WORKOUT

RESTLESS RIVER

THAT'S RIGHT



BRANCHELL
ACCIDENT PROOF
ROYALE
DINNERWARE

merchandising
SECTION

Continued By Dealer Demand . . .

APRIL 1957 VOL. 24, NO. 4

SYLVANIA'S ALL-OCCASION DINNERWARE PREMIUM

Hundreds of independent service-dealers have asked Sylvania to continue offering one of the company's most popular premiums — Royale Dinnerware by Branchell. Service-dealers and their wives are finding Royale a practical, yet handsome addition to their dining table and their friends are complimenting them on their choice!

As a Sylvania service-dealer you can own a sixteen-piece set of this nationally known dinnerware through your purchases of Sylvania quality receiving tubes and "Silver Screen 85" picture tubes.

PERFECT SETTING FOR ANY TABLE

Informal entertaining, springtime "cook outs" or a formal dinner party, the occasions are all different but Royale's smartly decorated yet simply styled dinnerware will prove the perfect table setting. The lady in your life will thank you for bringing home a set of this practical, good-looking dinnerware. She'll find the smart "decorator" colors help brighten family meals.

IT'S A CHALLENGE TO CHILDREN

Busy mothers won't have to worry about "picking up the pieces" when they serve the youngsters' meals on Royale dinnerware. Especially molded of famous Melmac, Royale is fully guaranteed—

No Chipping, Cracking, Breaking

SERVICE FOR FOUR

Royale's popular sixteen piece "rainbow" set features equal assortments of four distinctive colors which blend smartly with any decorative room pattern.

The set is available in combinations of four eye-catching decorator colors: They are: Gardenia White, Flame Pink, Charcoal Grey and Turquoise Blue.

The special sixteen-piece set includes four cups, four saucers, four-10" dinner plates plus four bread and butter plates.

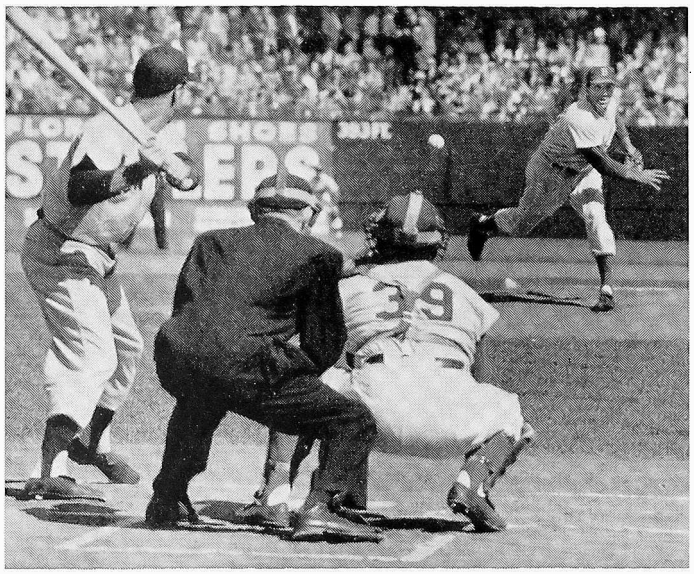
EXCLUSIVELY FOR YOU . . .

Your Sylvania distributor will give you one Buccaneer "Doubloon" or one Sylvania premium token for every 25 quality receiving tubes or every 2 Sylvania picture tubes you buy, of any type.

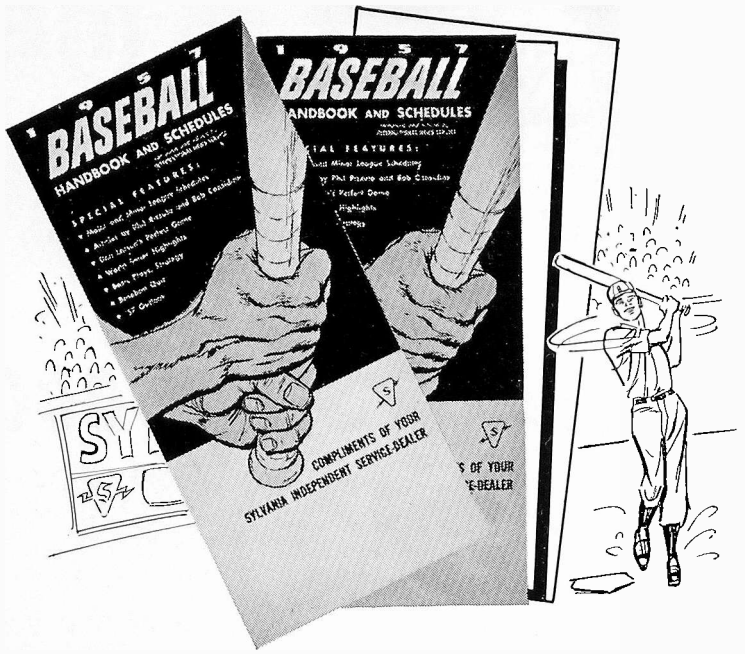
This special dinnerware premium, nationally known Royale by Branchell, is exclusively for you and your family from your Sylvania distributor with your purchases of Sylvania tubes.

It's Sylvania's Newest Customer Winner . . .

The 1957 Baseball Handbook and Schedules



First pitch of 1956 World Series as Sal Maglie pitches to Hank Bauer. Roy Campanella catching.



It's compact enough to fit into a jacket pocket, but it can be one of the biggest sales builders in your shop—the special 1957 Baseball Handbook and Schedules, made available to you from Sylvania only through authorized distributors of the company.

When you say "take one" to a customer, you'll be giving him something that every baseball fan will use until even after the World Series next fall. With your name, address and telephone number clearly imprinted on the cover of the booklet, sports-minded TV set owners will know without even looking in the telephone book where they can get "expert radio-television service."

The colorful independent service-dealer emblem which you should be displaying prominently in your shop is clearly printed on the inside back cover of the booklet. Four full pages are devoted to directly selling you and your products.

COMPLETE MAJOR AND MINOR LEAGUE SCHEDULES

The forty-eight page fact-packed booklet features complete schedules for every major league team and minor league association. A full-page is devoted to each major league team on which the names and statistics of key players are featured plus thumbnail sketches of the Club's stars and a diagram of its stadium.

Your customers probably won't get enough baseball facts out of the booklet to win the big prize on one of the TV quiz shows, but they'll be able to settle many a friendly argument by referring to the pages of this 1957 Baseball Handbook for the answers.

One of the booklet's most interesting features is a detailed account of New York Yankee pitcher Don Larsen's "perfect game" which made even the 1956 World Series outcome an anti-climax. Written by sports correspondent, Bob Considine, the article tells in detail how Larsen fanned 27 Dodgers in a row including such "game busters" as Duke Snider and the now retired, Jackie Robinson.

SPORTS EXPERTS PREDICT FOR '57

The International News-Service top sports reporters put themselves on record in the pages of this special 1957 Baseball Handbook giving their candid comments on what the history books will say about this baseball season. Your customers will enjoy out-guessing the experts and comparing their personal opinions to those who say "it's the Yankees again" this year. Of course, even the experts can't seem to make a firm prediction about the National League where they predict a real pennant race between Brooklyn, Milwaukee and Cincinnati.

ORDER YOUR BASEBALL BOOKLETS NOW

While opening game ceremonies are making sports page headlines place your order with your Sylvania distributor for copies of the 1957 Baseball Handbook and Schedules.

Your customers will thank you for giving *them* this special baseball booklet by giving *you* more sales. Be sure you have an adequate supply so that you can leave them with customers when you're making home service calls.

Only a limited quantity of these booklets is available from Sylvania through your Sylvania distributor. Contact your distributor now. Remember, there's a special place for the imprinting of your name, address and phone number on the cover of the booklet, making it a personal reminder to your customers!

SYLVANIA NEWS

APRIL 1957 VOL. 24, NO. 4

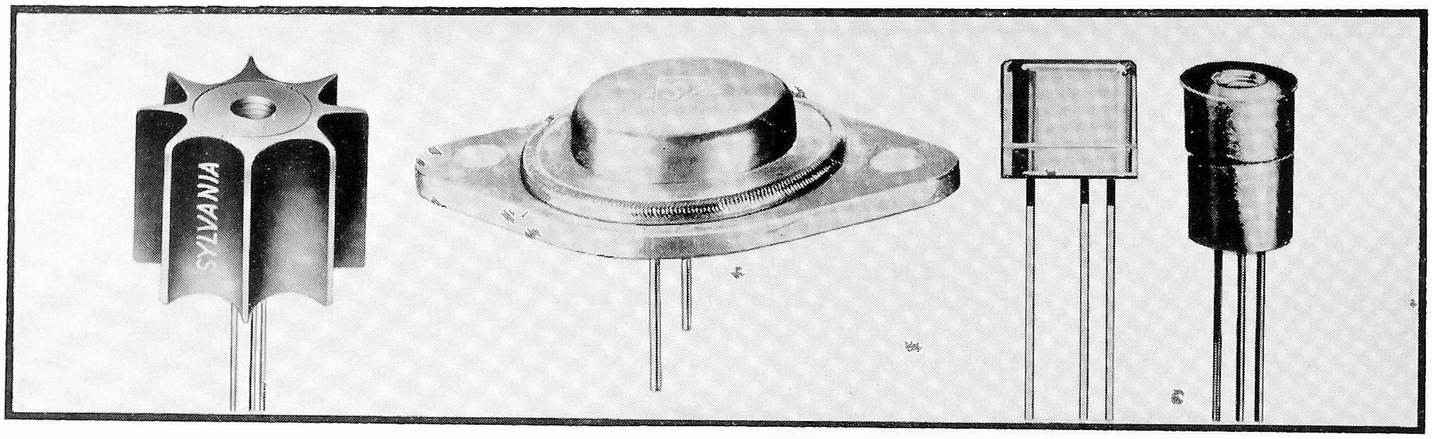
R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

TRANSISTOR FUNDAMENTALS

BY H. DEBBI



The transistor was announced in 1948, and since that time it has developed into a practical and dependable electronic device. Since the appearance of the transistor, the field of electronics has rapidly expanded to include these new solid-state components. Many new circuit concepts have evolved, and the full capabilities of the transistor have not yet been realized. In order for the electronics technician or serviceman to make efficient use of this component, a knowledge of its fundamental properties is necessary. A thorough understanding of transistors is involved with the detailed study of the physics of semi-conductors and entails considerable mathematical analysis. However, in this article the emphasis has been placed on a basic understanding of transistor properties. Consequently, theoretical discussion has been kept at a minimum.

Before getting into the discussion of transistors as such, let us list a few of the characteristics which make these devices so attractive: Having no filament and requiring low operating voltages, the transistor consumes little power. This means longer battery life and a considerable reduction in the size and weight of portable equipment. Furthermore, low power consumption is consistent with low heat radiation. The transistor's compact construction with no "floating" elements eliminates the problem of microphonism. Transistors require no preheating, functioning the instant they are excited. Finally, some transistors are light sensitive and thus lend themselves to photoelectric techniques.

Presently, there are many types of transistors, some reasonably well established and others that are strictly in the developmental stage. To mention a few: point-contact, junction, drift, tetrode, field-effect, hook, point - junction, fieldistor, surface barrier, and so forth. To be sure, each has its own unique characteristics, advantages and areas of application. The junction triode is perhaps the one type which is in most common usage from the standpoint of the serviceman. With this in mind, we will limit our discussion to this variety.

N-P-N AND P-N-P FORMS

The name "transistor" was assigned to a solid-state conduction triode which utilized the translational properties of the triode tube together with the resistor phenomena of semiconductors. The junction transistor is available in either the N-P-N or P-N-P form. The major difference between these forms is: The direction of current flow and/or required voltage polarity.

The two most commonly used symbols for the N-P-N and P-N-P transistors are shown in Figures 1A and 1B. The direction of current flow is given by the direction of the emitter arrow. A convenient method for remembering the correct voltage polarity required by each form is to refer to the middle letter of either the N-P-N or P-N-P notation. That is, for the N-P-N variety the middle letter is P, so the collector requires a positive voltage. Similarly, the middle letter of the P-N-P form is N,

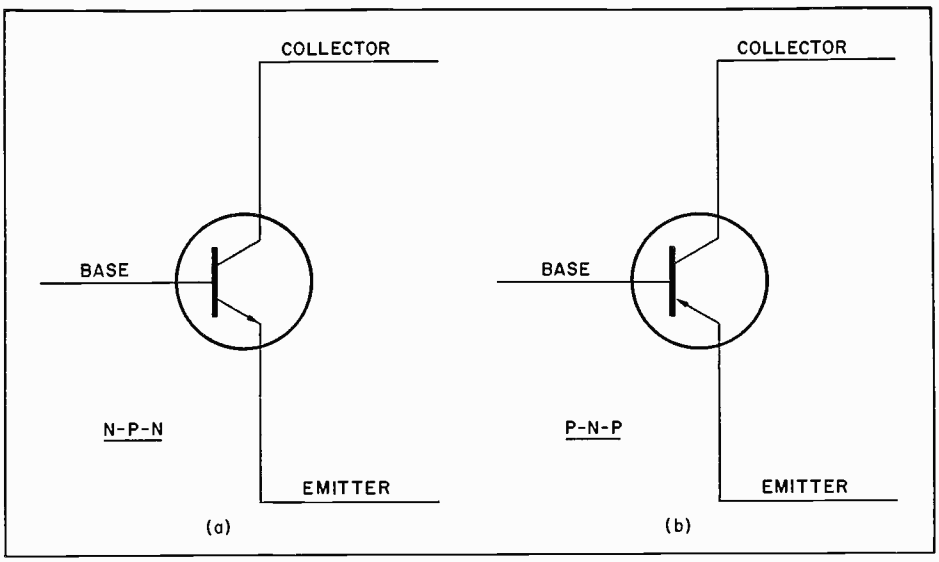


FIGURE 1—Transistor Symbols: A—N-P-N, B—P-N-P.

for negative collector voltage.

Although the N-P-N and P-N-P forms have opposite current flow and voltage polarity, their functions are symmetrical. This similar but opposite action of the N-P-N and P-N-P transistors is often referred to as "complementary smymetry". This attribute of these devices enables some rather unique circuit arrangements. One example is a single-ended, push-pull, Class B amplifier, using an N-P-N and P-N-P transistor, which requires no center-tapped input transformer, no center-tapped output transformer and no phase inverter. The important thing to remember, is that the N-P-N or P-N-P forms of a certain type of transistor are similar except for current flow and voltage polarity. The choice of either form in a particular application is usually dictated by the polarity of voltages required and availability of transistors which have characteristics suitable for the application.

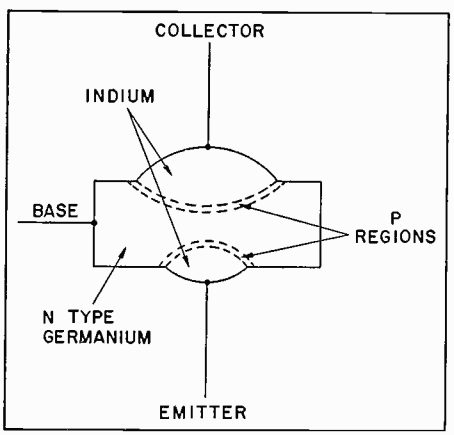


FIGURE 2—Illustration of P-N-P Junction transistor made by the alloy process.

CHARACTERISTICS OF GERMANIUM

At this point some mention should be made as to the type of material that goes into the making of transistors. At the present time germanium is the material most commonly used in transistor manufacture. Other elements such as silicon are also being used. Pure or intrinsic germanium exhibits very low conductivity; in effect it ranks as an insulator with a high dielectric constant.

Germanium in the purified form is crystalline in structure. In other words, the atoms of pure germanium are arranged in a specific pattern, and this pattern is referred to as a "lattice structure." The pattern or "lattice structure" of germanium makes for a highly stable arrangement so long as the germanium remains pure.

Germanium becomes a semiconductor only after controlled quantities of certain impurities are injected into the lattice. Transistor action is dependent upon these controlled imperfections which are purposely introduced into the crystal. The nature of the impurity used determines whether the germanium will be of the N-type or of the P-type. N-type germanium is obtained when the added impurity introduces an excess of negative charge carriers—"electrons". P-type germanium is produced by an impurity which adds an excess of positive charge carriers, termed "holes". These two types of germanium are combined so as to produce either an N-P-N or a P-N-P type transistor.

METHODS OF MANUFACTURE

Junction transistors are manufactured usually by one of two general methods. The most popular method of transistor manufacture employs an alloying process. Using this method, impurity elements are alloyed to the opposite sides of a thin wafer of either "N" or "P" type germanium. Construction of a P-N-P junction transistor made by the alloy process is shown in Figure 2. Figure 3 shows the actual construction of a Sylvania Type 2N34 transistor. The alloy junction transistor is suitably encased to protect it against contamination. All Sylvania junction triode transistors are hermetically sealed to protect them against the adverse effects of humidity, light and dirt particles.

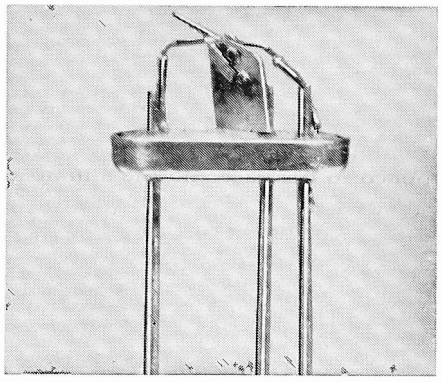


FIGURE 3—Photograph of actual transistor manufactured by the alloy process, Sylvania TYPE 2N34.

A second, although less popular, method of transistor manufacture consists of "growing" the crystal in alternate layers of "N" and "P" type germanium. This crystal is then appropriately sliced to produce the P-N-P or N-P-N transistor forms such as the one shown in Figure 4. Metallic contacts are attached to each region, and the unit is sealed and encased in metal to protect it against contamination.

JUNCTION TRANSISTOR ACTION

The junction transistor operates by virtue of the controlled flow of electric charge carriers in a solid. The P-N-P junction transistor requires a negative collector voltage and a positive emitter voltage as shown in Figure 5. With the voltage polarity

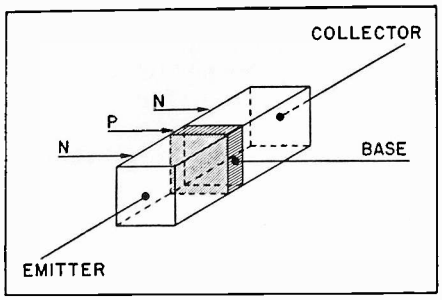


FIGURE 4—Illustration of Junction Transistor made by "Growing" the Crystal in alternate layers.

and signal change indicated, the emitter injects positive charge carriers "holes" into the N-type region of the base.

The predominant charge carriers of the N-type base region are electrons with negative charges. Consequently, some of the holes injected by the emitter combine with the electrons in the base region and are thus neutralized. However, the base layer is very thin, so that the diffusion action of the holes causes most of the holes to travel through the collector junction and cause current flow in the collector circuit. In the example of Figure 5, the transistor is common-emitter connected with the input signal applied to the base and the amplified output signal developed across a collector load resistance.

It should be pointed out that the foregoing explanation of transistor action is indeed simplified. A complete and detailed study of semiconductor phenomena is best approached in a mathematical language of solid-state physics and quantum mechanics.

TRANSISTOR CIRCUIT CONFIGURATIONS

The transistor can be connected in any one of three fundamental ways, depending upon whether the emitter, base or collector serves as the common terminal. The word "common" as it is used here means common to both input and output. The three basic circuit configurations for a P-N-P transistor are shown schematically in Figures 6A, 6B and 6C, and they are referred to as the common emitter, common base and common collector configurations, respectively. All three basic configurations are used in practical transistor amplifier circuits, each circuit having its own particular characteristics and advantages. There is a good analogy here between transistor and vacuum tube amplifiers. The common emitter, common base and common collector transistor amplifiers are respectively analogous to the grounded-cathode, grounded grid and cathode follower vacuum tube amplifiers.

The choice of transistor circuit is usually a matter of desired input and output impedances, power output and frequency response. One thing should be carefully noted at this point: transistors do not possess separate and distinct input and output circuits as do vacuum tubes. That is, the input and output impedances of the transistor are interdependent. Some representative values for input and load resistances of the three basic circuits are: 1,000 and 30,000 ohms, respectively, for common emitter; 70 and 70,000 ohms common base; 500,000 and 20,000 ohms common collector.

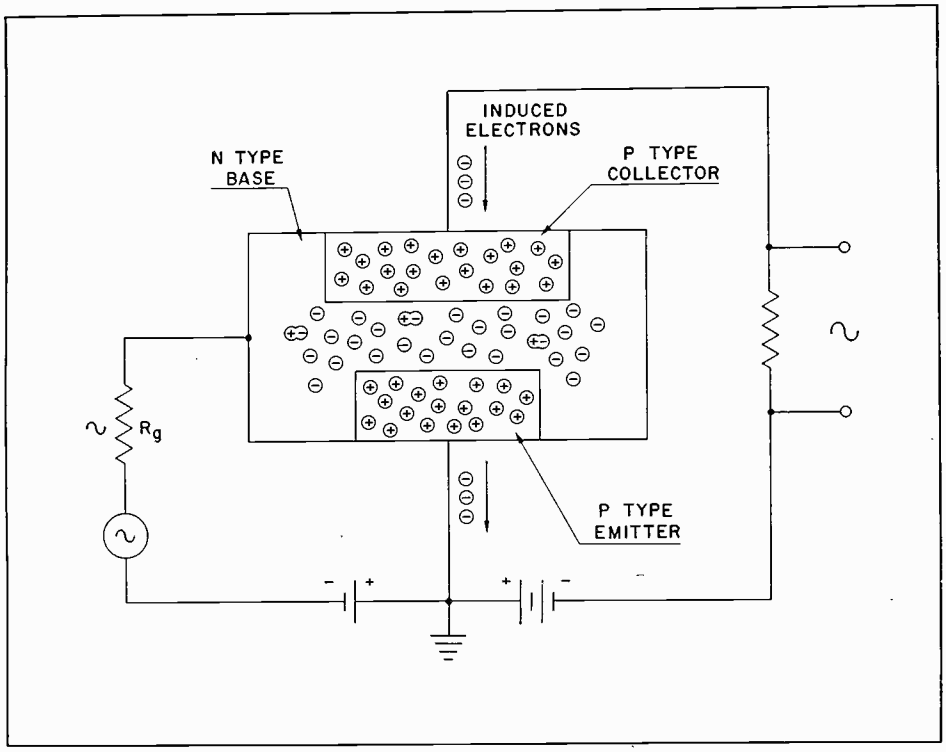


FIGURE 5—Illustration of Junction Transistor Action.

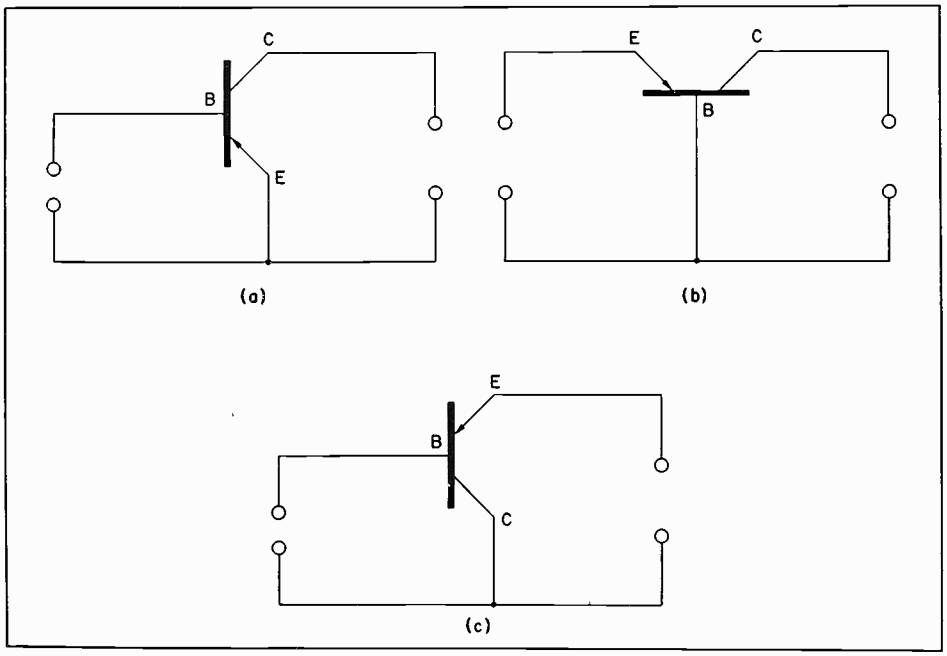


FIGURE 6—Basic Circuit Configurations: A—Common Emitter, B—Common Base, C—Common Collector.

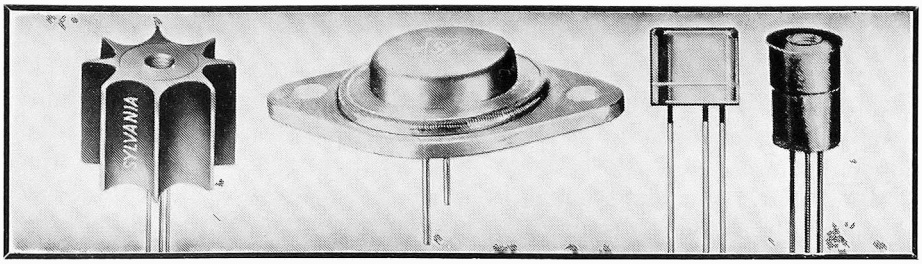


FIGURE 7—Package Construction of Sylvania Transistors.

Generally, the common-emitter amplifier is the one most commonly used today. Functioning in the common-emitter circuit, the transistor has more available power gain than in either the common base or common collector configuration. In addition, the common-emitter amplifier simultaneously amplifies both current and voltage. The common-collector circuit like the analogous vacuum tube cathode follower, always exhibits a voltage gain less than unity. Likewise, the current gain of the common - base transistor amplifier never exceeds unity. The common-emitter and common-collector amplifiers have essentially the same frequency response and current gains. The frequency response of the common-base circuit is superior to that of either the common-emitter or common-collector connections. Ordinarily, the common-base and common-collector circuits produce no phase reversal between input and output signals. A phase reversal is realized only with the common-emitter configuration.

SERVICING TIPS

Transistorized radios along with other equipment using transistors are now available and eventually will require servicing. There are a few basic practices which can save the serviceman costly mistakes and considerable time. Any previous knowledge of vacuum tube circuits is undoubtedly an asset. For example, a schematic diagram of say a transistor radio is very similar to one of a conventional vacuum tube receiver. Chances are the transistor radio is a superhet, the principles of which are identical to the vacuum tube duplicate. However, the serviceman should be cautioned against a too rigorous attempt to parallel vacuum tube and transistor circuits. It is impossible, for example, in a given circuit to replace a tube with a transistor or a transistor with a tube without first modifying the circuit.

Transistors when properly treated have exceptionally long life. Two of the most common causes of transistor failure are the application of too much heat to the transistor leads and subjecting them to improper voltages. Most transistors are provided with long flexible leads so that they can be soldered directly into a circuit. The solder connections should be made quickly and it is good practice to grasp the lead with a pair of long-nose pliers thus providing a heat sink.

The transistor can be mounted in any position, but it certainly is critical with respect to physical location in a given circuit. Transistors should not be mounted in spots where the ambient temperature will affect its operation, such as near power resistors and tubes. As the operating temperature of a transistor is increased, its amplification and life are decreased. Increased temperature also tends to increase the noise level of the transistor. In some cases where transistors are operated near their maximum ratings a permanent heat sink is necessary.

Many times if a transistor is subjected to the wrong voltage polarity, it is permanently damaged. Naturally, inserting a transistor incorrectly into a socket is the same as applying the wrong bias polarity. The serviceman should acquaint himself with the methods of identifying transistor terminals. Figures 7 and 8 and Table I are intended to help the serviceman with this problem. Figure 7 is a photograph of four Sylvania transistors, each employing a different package construction. Figure 8 shows the basing arrangement of each configuration while Table I lists individual transistor types by package construction.

Transistors are frequently damaged by transient surges. When removing or installing any component in transistor equipment, the power should be turned off. The same thing applies when replacing batteries in transistor portable devices.

Once the difficulty has been localized in a piece of transistor equipment, it is wise to first check the components of the associated circuit rather than just plug in a new transistor. Blindly substituting transistors can be costly. If a transistor is suspected, it is usually a good idea to replace it with one of the same type. The only sure way of checking a transistor is to substitute another one of the same type in the circuit. Transistor testers are not always reliable. After inserting a new transistor, it may be found that the associated circuit will have to be "peaked" for optimum operation.

TABLE I
SYLVANIA TRANSISTOR BASE CONNECTIONS
FIGURE 8 DRAWING REFERENCE

(A)	(B)	(C)	(D)
2N101	2N34	2N68	2N242
2N102	2N35	2N95	2N307
2N143	2N94/A	2N141	
2N144	2N193	2N142	
	2N194		
	2N211		
	2N212		
	2N214		
	2N216		
	2N228		
	2N229		
	2N233		

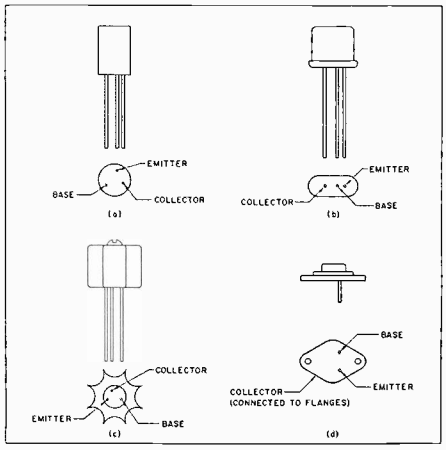


FIGURE 8—Basing Connections of the four package designs shown in Figure 7.

Cash In On Color . . .

Enroll Now in New Color TV Course

Like most independent service-dealers, you're probably not completely confident that you can handle all the color problems that are coming your way, soon. Like most good business men, you're no doubt concerned about getting your share of the expanding color market.
Sylvania, through its independent distributors, is offering you a special opportunity to increase your servicing dollars in the expanding television industry—a complete correspondence course on color TV!

COLOR BOOM COMING SOON

An estimated 500,000 color TV receivers will be in use this year. In 1958 the estimate runs to 1,500,000 color receivers. Unless you, as an independent service-dealer, are ready to service these sets, Manufacturers' Retail Service Branches will capture a larger percentage of the servicing business. Protect your business future by enrolling in the Sylvania-sponsored color course, now.

COURSE PREPARED BY COLOR EXPERTS

The Radio Television Training Association, one of the nation's leading radio and TV schools with thousands of service technician graduates, has prepared the course. Upon completion of the course, you will receive a valuable industry-acknowledged certificate of achievement issued by Sylvania and the Association.
Thousands of service technicians have already completed RTTA courses. Hundreds of applications have already been received by Sylvania from independent service-dealers throughout the country . . . dealers who know that the Sylvania-sponsored Color TV Technician Course can help them stay "up front" in their industry.

SPECIAL SURVEY OF COLOR TELEVISION

A specially prepared introductory survey of the color television market will be a valuable aid to you. It is the result of the combined efforts of RTTA's experienced staff and Sylvania's sales-service engineers—experts in TV repair work!

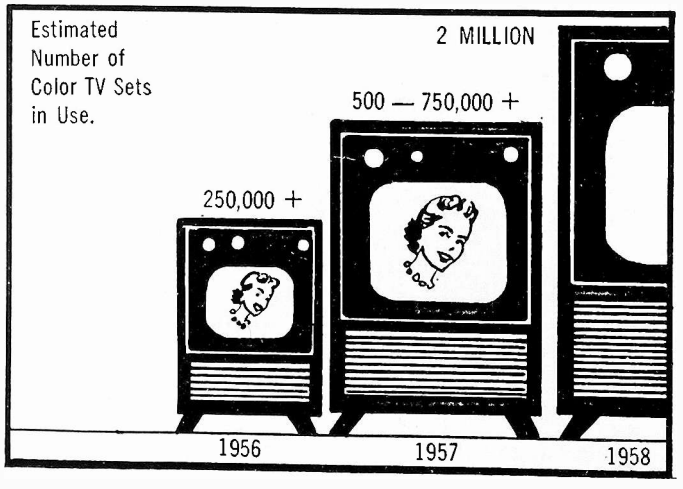
This unique lesson will be sent to you as soon as your registration application is received, giving you an overall view of the problems encountered in color servicing plus a general explanation of the expanding color television field. Printed in full color, the introductory analysis will familiarize you with the idea of mixing colors and making picture tube adjustments.

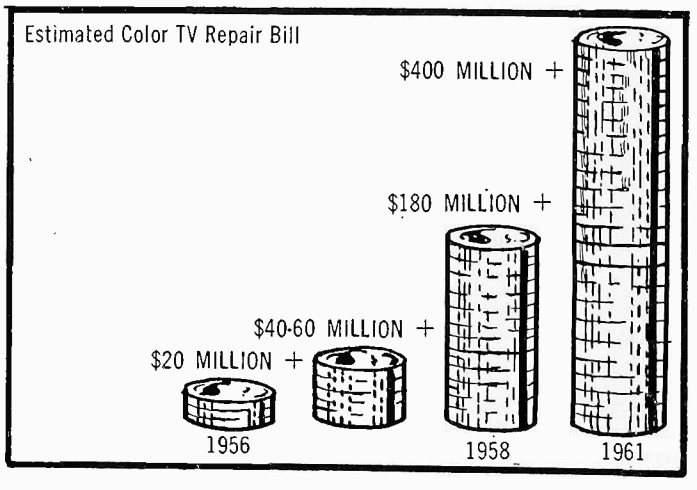
COMPLETE 14 LESSON COURSE

The course begins with an introduction to the Laws of Color and defines the differences between the transmission and reception of black-and-white and color television.
Starting at the transmitter, you are guided through the development and transmission of the composite Color TV signal.
With an over-all view of receiver function, each circuit is analyzed. A knowledge of how Color TV circuits work, both as individual and as cooperative units in the receiver, prepares you for future developments in the field of Color TV.
And of course, Color TV has its own peculiar servicing problems. To meet them, you will receive thorough training on test instruments, alignment as well as servicing. Detailed examinations are included with the lessons and will be individually analyzed by the RTTA staff. You will receive a complete explanation of any errors you make on the self-testing exams.

REGISTER WITH YOUR DISTRIBUTOR

This special Sylvania-sponsored RTTA Color TV Technician Course is available to you from your local authorized Sylvania distributor. When you buy Sylvania quality receiving tubes and "Silver Screen 85" picture tubes you are eligible to register for the course. Your Sylvania distributor will give you complete details on how you can enroll.
Don't miss this chance to build your business volume through color TV servicing!





Thought's on . . .

DO IT YOURSELF

BY GEORGE ISHAM - GENERAL MERCHANDISING MANAGER, ELECTRONIC PRODUCTS SALES

The other day I had the opportunity to call on Rex Gordon who is an outstanding Service-Dealer in Indianapolis. Indianapolis, as some of you may know, is more or less the birthplace of "Do It Yourself" tube testing. At the time of our study of "Do It Yourself" last summer, Indianapolis showed up as the market where there was more drug store super-market tube testing and selling than any other place in the country. This is mentioned because the situation existing in Indianapolis makes the Rex Gordon story that much more convincing—to me at least. The story, briefly, in Rex Gordon's words, "*My tube business has doubled.*"

Here is what Rex Gordon did. Faced with a loss of tube sales to drug stores and super-markets, he decided to join 'em as a means of fighting 'em. He bought a good tube tester—one not too hard to operate, but a much better tester than the type of unit found in most "Do It Yourself" operations. He advertised the service in the newspapers. And, he painted a permanent sign on the window beside his front door—a sign that is big enough and bold enough to catch the attention of consumers as they pass his shop.

Result: The tube checker paid for itself quickly. Tube sales increased. Many new customers were attracted to the store because of his promotional efforts. And, as can be imagined, Rex Gordon has ceased to be concerned with the drug store up the street.

What Rex Gordon is doing has been done by hundreds of service-dealers in all parts of the country. A lot of dealers even have a checker or two operating in nearby drug stores. And in almost every case, their ventures have paid off very well.

You may not agree, but as we see it, there are several factors involved in "Do It Yourself." In the first place, many people like to feel they are capable of operating an instrument like a tube checker. Also, if they do the job themselves, they feel no one is gyping them. Many feel that by doing the job themselves they are not imposing on anyone—especially if they have a lot of tubes to test.

It would seem to me it's worth a try.

SYLVANIA NEWS

SYLVANIA ELECTRIC PRODUCTS INC.
1100 Main Street • Buffalo 9, N. Y.

BULK RATE
U. S. POSTAGE
PAID
Permit No. 3402
Buffalo, N. Y.

For A
Richard Kerr
213 Bronson Rd.
Syracuse, N. Y.

Form 3547 Requested
Printed in U.S.A.

VOL. 24, NO. 4 APRIL 1957

PUBLISHED BY
SYLVANIA ELECTRIC PRODUCTS INC.
MANUFACTURERS OF SYLVANIA RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES, FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, ELECTRIC LIGHT BULBS, PHOTOLAMPS, CAMERA EQUIPMENT, RADIO AND TELEVISION RECEIVERS.

In This Issue

SYLVANIA NEWS

MAY 1957 VOL. 24, NO. 5

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical

SECTION

SUBSTITUTE PICTURE TUBE UNIT EMPLOYING THE 8XP4 90-DEGREE CHECK TUBE

by John T. Jans

Senior Applications Engineer - Television Picture Tube Division

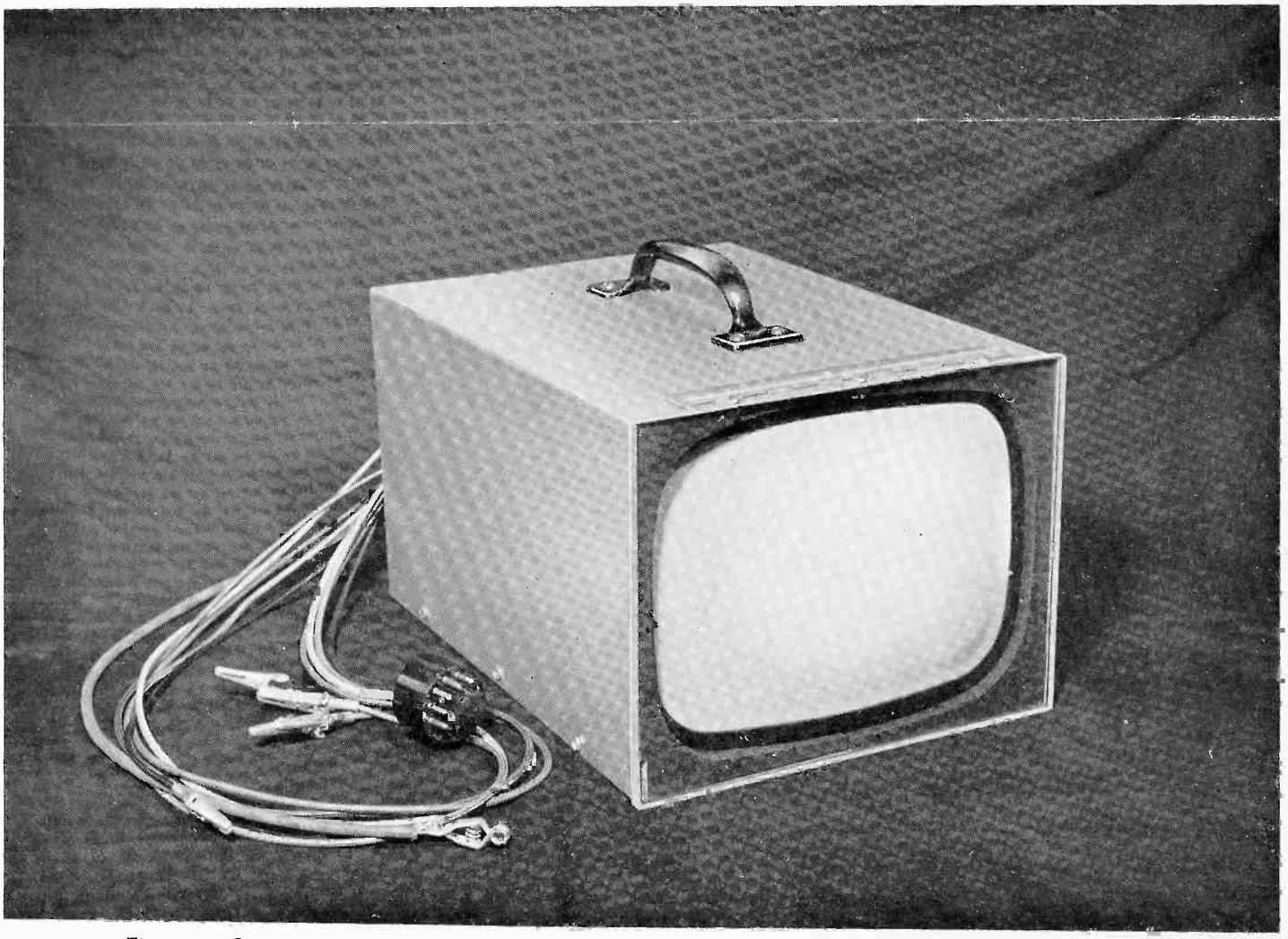


Figure 1—Complete substitute picture tube assembly. Finished unit is lightweight and convenient to carry.

In the wake of last year's successful introduction of the 5AXP4 substitution CRT, the Sylvania 8XP4 has recently made its appearance as a companion tube to provide conveniences, with some types of TV receivers, that the earlier tube does not. As was the case with its predecessor, it is a boon in situations where the service technician would otherwise be faced with such possibilities as dismantling an entire receiver or taking that receiver, cabinet and all, into the shop; especially in those cases where the picture tube is cabinet-mounted, separate from the chassis.

With the 8XP4 the service technician can provide a universal substitute for the picture-tube assembly to operate under the most stringent conditions. The 8XP4 is a 90-degree, rectangular, self-focus, non-ion-trap tube of small, handy 8-inch diagonal size. Therefore, a 90-degree receiver with narrow scan would show up narrow on the 8XP4. It would not overscan, as might be done if the tube were designed for use in 55- or 70-degree deflection circuits.

With this tube and a 90-degree yoke such as or similar to the *Merit* MDF 91, the service technician can build a substitute unit for the picture-tube assembly which will prove useful on almost every make TV receiver. Most 90-degree receivers have yokes with about the same impedance (12 millihenrys and 30 ohms in the horizontal winding, and 40 millihenrys and 50 ohms in the vertical) so this yoke will match satisfactorily nearly all makes of receivers using 90-degree picture tubes. Note the absence of a balancing capacitor in the horizontal windings of the yoke, as shown in Fig. 2. With the yoke in question, this should introduce no distortion of the picture or raster.

A large number of 70-degree receivers and many 55-degree receivers will also match this same yoke. However, on the latter types, the scan power supplied to the yoke will be low enough so the check tube will not scan fully. All that need be done is outline the limits of a picture from a 70-degree and a 55-degree receiver in good operating condition on the face of the 8XP4 tube for use as a reference. This can be done with ordinary marking crayon. Then if a receiver using a 55-degree tube scans

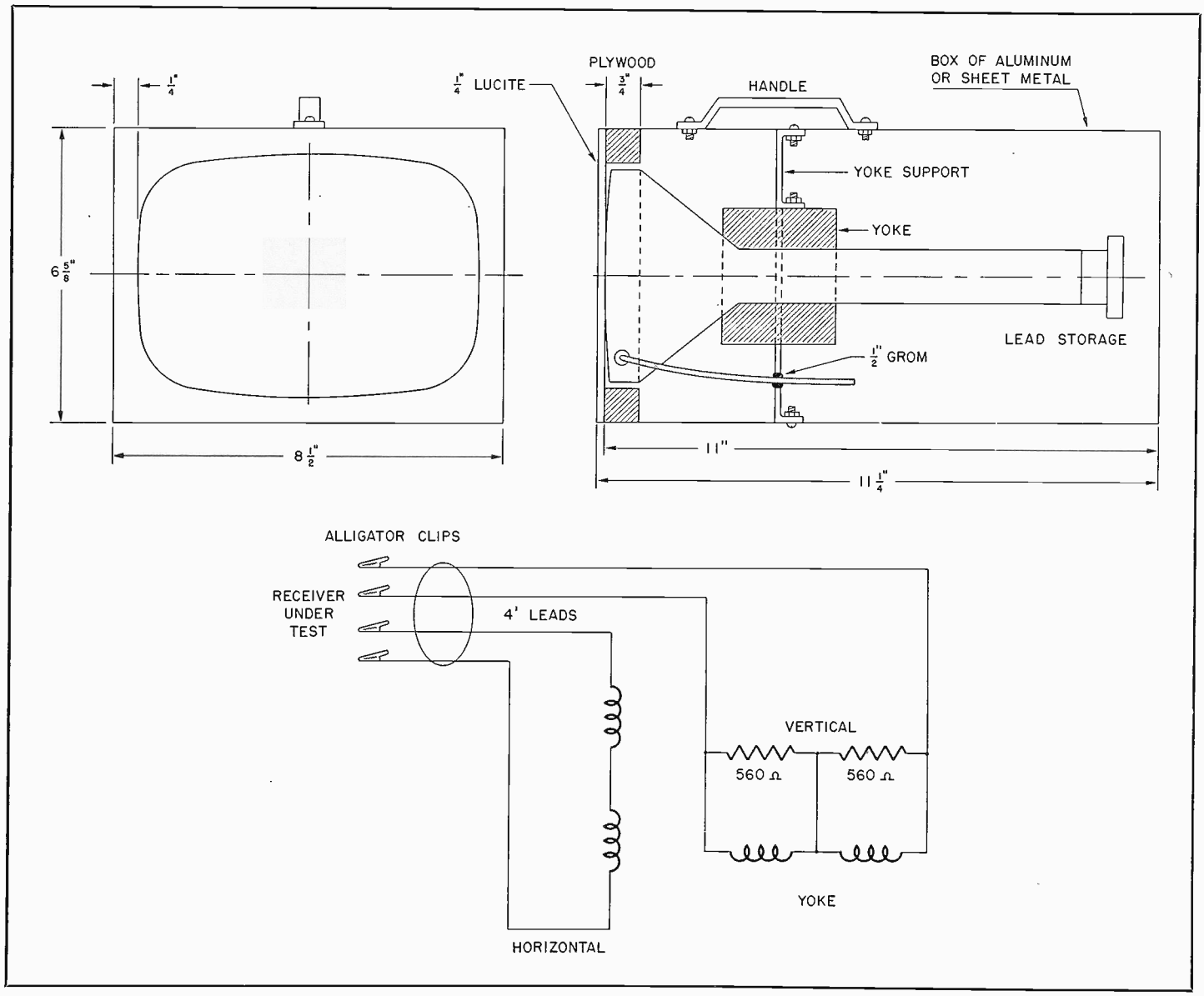


Figure 2—Details of Cabinet construction and method of mounting the 8XP4. Alligator clips connect yoke to set under test.

a picture large enough to fill the 55-degree outline, the receiver is scanning correctly.

Many receivers require a high-voltage filter capacitor to scan correctly. This capacitor is often supplied by the picture tube's external coating. The 8XP4 has no external coating, so on receivers that require the capacitor, a 500-$\mu\mu$fd., 20-kv. capacitor may be connected from the high-voltage terminal on the receiver to chassis ground.

Housing the yoke and check tube in a small cabinet or box makes a handy test unit for mounting above the service bench or carrying along on service calls. Leads with battery or alligator clips connect the yoke to the yoke terminals in the receiver. The 8XP4 tube is self-focusing and without ion trap, so the service technician need not worry about focus or ion-trap adjustments. With this unit, all parts of the receiver chassis are readily available for servicing. There is no possibility of important parts on the chassis being covered by the picture tube, as is the case with vertical chassis. Because the picture tube need not be especially supported or braced, the chassis can be tilted to any position for repair.

On a few TV sets, it is actually easier to remove the picture tube from the chassis and leave the chassis in the cabinet. For a situation like this, the 8XP4 can be inserted in the chassis and still leave room for servicing. It's a good idea, therefore, to make a door on the box holding the 8XP4 tube and yoke so the tube can be removed for direct use.

While the 8XP4 will work satisfactorily for the deflection system in nearly any receiver, it is particularly useful in 90-degree systems, especially where such deflection-circuit problems as width and linearity are under examination. In such 90-degree systems, therefore, it has broader application than its useful companion and forerunner.

Like its predecessor, however, this CRT is subject to development of a small dark area—ion burn—at the center of the faceplate. This spot will not impair the usefulness of the 8XP4 in its intended application or shorten its life. The use of low brightness settings will retard this burn.

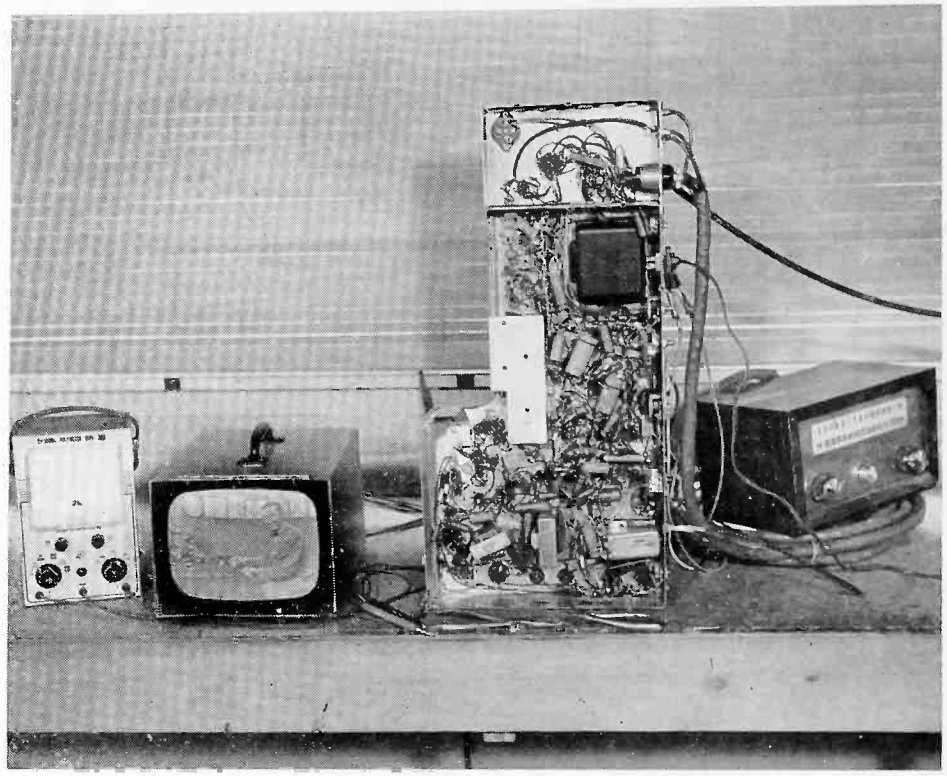


Figure 2—8XP4 check tube unit used in conjunction with set employing a cabinet mounted picture tube.

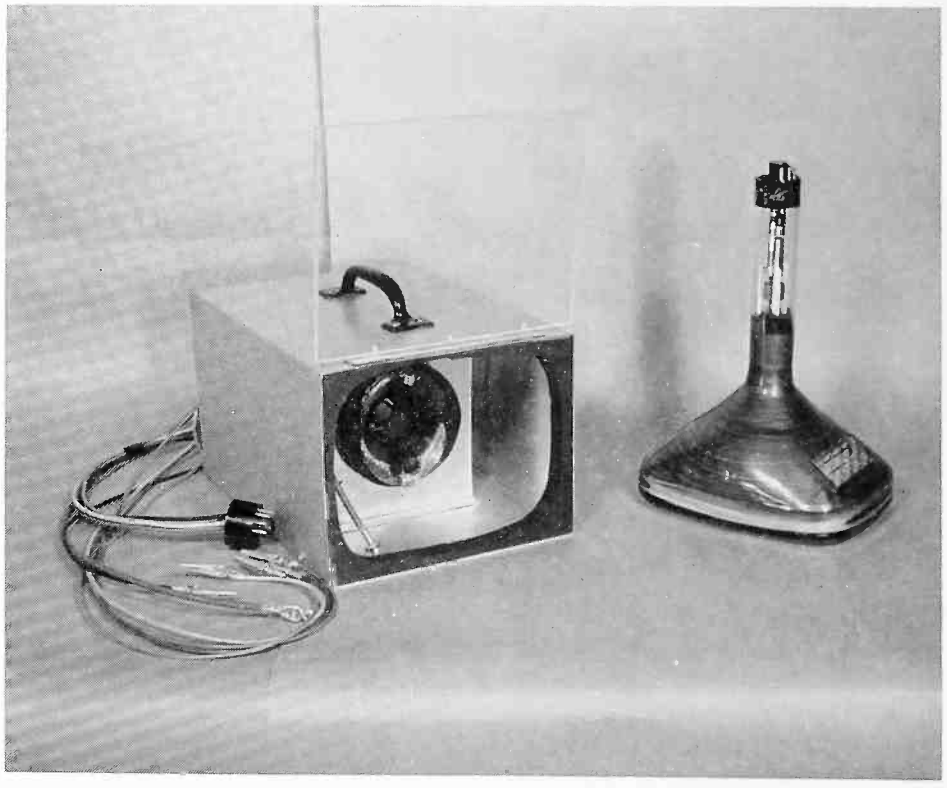


Figure 3—Finished assembly with check tube removed. Note yoke mounting bracket. Hinged plastic cover plate facilitates removal of the 8XP4 for direct substitution in a receiver.

American Replacements For European Tubes

The accompanying table shows the American equivalents for 44 more European types. *The first portion of this list appeared in the March issue.*

The European types are listed in the left hand column. The center column shows the equivalent American types followed by the qualifying remarks DE or NE, right hand column. DE indicates "Direct Equivalent," i.e., requiring no circuit or socket changes. NE stands for "Nearest Equivalent." The majority of types listed as NE can also be considered direct replacements in most applications, but may differ slightly from the standpoint of special characteristics. The data shown are believed to be accurate; however, no responsibility can be assumed in case or error.

Please note that all types listed may not be available from SYLVANIA. Consult your current price list.

EUROPEAN TYPE NO.	AMERICAN TYPE NO.	CODE	EUROPEAN TYPE NO.	AMERICAN TYPE NO.	CODE
B152	12AT7	DE	EY80	6U3	DE
B309	12AT7	DE	EZ35	6X5GT	NE
BPM04	6AQ5	DE	EZ90	6X4	NE
DAC32	1H5GT	NE	GZ34	5U4GB	NE
DAF91	1S5	NE	HBC91	12AV6	NE
DDR7	6AM5	DE	N14	1C5GT	NE
DF91	1T4	NE	N17	3S4	NE
DF92	1L4	NE	N19	3V4	NE
DH63(M)	6Q7GT	NE	N727/6AQ5	6AQ5	DE
DK32	1A7GT	NE	PY82	19Y3	NE
DK91	1R5	NE	U78	6X4	NE
DK92	1AC6	DE	U147	6X5GT	NE
DK96	1AB6	DE	V2M70	6X4	NE
DL92	3S4	NE	W17	1T4	NE
DL96	3C4	DE	X17	1R5	NE
DL98	3B4	NE	X63(M)	6A8GT	NE
EABC80	6AK8	DE	Z63	6J7G	NE
EBC81	6BD7A	DE	Z77	6AM6	NE
EBC91	6AV6	NE	ZD17	1S5	NE
EC80	6Q4	DE	1C1	1R5	NE
EC81	6R4	DE	1F2	1L4	NE
EC91	6AQ4	DE	1P11	3V4	NE

DE—Direct Equivalent NE—Nearest Equivalent

SERVICE HINTS

EDITOR'S NOTE: Sylvania offers $10.00 in Advertising Material Certificates for all technical hints that it believes useful to the service-dealer readers of SYLVANIA NEWS. Sylvania is not obligated to return any material submitted for publication, whether or not published.

SUBSTITUTE BIAS CELLS

Occasionally a set will come in which uses a small bias cell. They are sometimes very difficult to obtain. By simply taking apart a small "B" battery used in portables, any number of bias cells can be had. They can be clamped or held in place by two small pieces of plastic and a screw on each side to make contact to the cell.

BROADMAN RADIO LABORATORY
Flushing, New York

SOURCE OF HI-VOLTAGE INSULATED WIRE

Before discarding defective hi-voltage fly-back transformers, I remove the filament winding, (one or two turns around the core), and use these for making connections in the hi-voltage section. These wires are usually of the very best hi-voltage insulated wire, very suitable for this work.

BROADMAN RADIO LABORATORY
Flushing, New York

SYLVANIA NEWS

JUNE 1957 VOL. 24, NO. 6

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

SERVICING THE HORIZONTAL DEFLECTION CIRCUIT

By G. M. LANKARD

The horizontal deflection amplifier has long been recognized as one of the most critical applications in a television receiver. The human eye continually "monitors" the operation of this tube in terms of its effect on picture scan and brightness. Thus, any loss in performance is immediately evident.

Wide deflection - angle picture tubes, "off-the-line" B+ systems, and other design trends common to many late model receivers impose even more rigid requirements on the horizontal deflection amplifier.

To repair these sets efficiently, the serviceman must be aware of problems such as "snivets," which have not been encountered previously. He must also have a thorough knowledge of the factors affecting tube life.

SNIVETS

Snivets usually appear as vertical black lines near the right hand edge of the picture tube screen, Figure 1A. Depending upon the particular receiver and exact operating conditions, however, snivets may take the form of several broken, jagged lines, or as a blotch. As shown in Figure 1B, snivets are often more pronounced in the absence of a video signal. Under strong signal conditions, Figure 1C and 1D, they will sometimes appear as a white line.

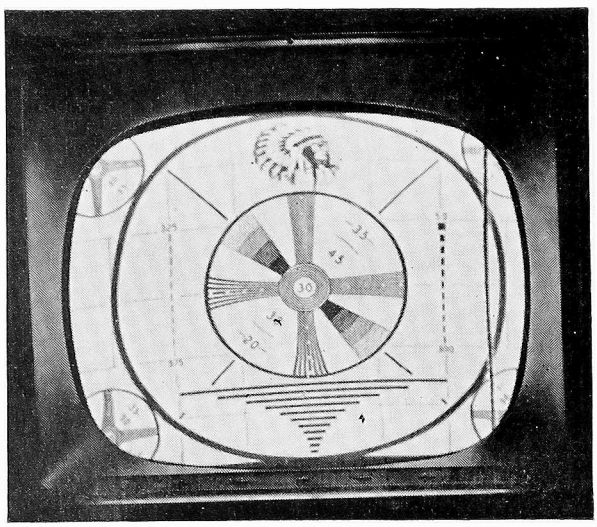
The cause of snivets can be explained quite easily with the aid of the zero bias plate characteristic curve shown in Figure 2. Although a horizontal amplifier tube is actually operated Class C, the load line is very complicated and difficult to describe under those conditions. Class A conditions serve quite well for explanatory purposes.

Referring to Figure 2, let us say that R_{L1} represents the load line of the horizontal deflection amplifier in a receiver having a relatively high B supply. We can see that the load line intersects the zero bias plate current curve well above the knee.

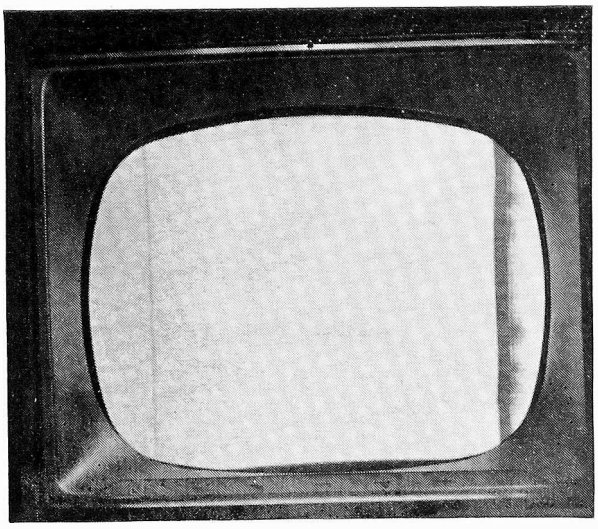
Now, let us consider the load line of the horizontal deflection amplifier in a late model receiver which has a lower B supply voltage, R_{L2}, Figure 2. As can readily be seen, R_{L2} intersects the zero bias plate current curve in the vicinity of the knee. Such operation, in itself, will not ordinarily produce snivets. However, not all tubes employed in early low B-supply receives exhibit the smoothly curved knee characteristic shown in Figure 2. Occasionally an individual tube would display discontinuities in the knee as shown in Figure 3. When this happened, there were several values of Ib between points A and B for a single value of Eb. This resulted in a region of instability and oscillations could be set up each time the tube is driven into this region. If these oscillations were of such a frequency that they could be picked up by the TV receiver tuner input, they were amplified by the receiver and appeared on the screen as black vertical lines or "snivets".

The extent of snivets is influenced by the conditions under which the tube is operated in the particular receiver. Any condition which causes the load line to fall into the region of discontinuity, found in an occasional tube, will cause snivets. Since the load line is determined by the loading effects of the yoke, high voltage circuit, linearity and width controls, as well as horizontal drive, brightness, contrast, etc., changing one or more of these conditions can cause or eliminate snivets, or change the frequency so that they will appear on fewer or more channels. Snivets are more frequently found on UHF channels than VHF, but may be present on the high VHF channels.

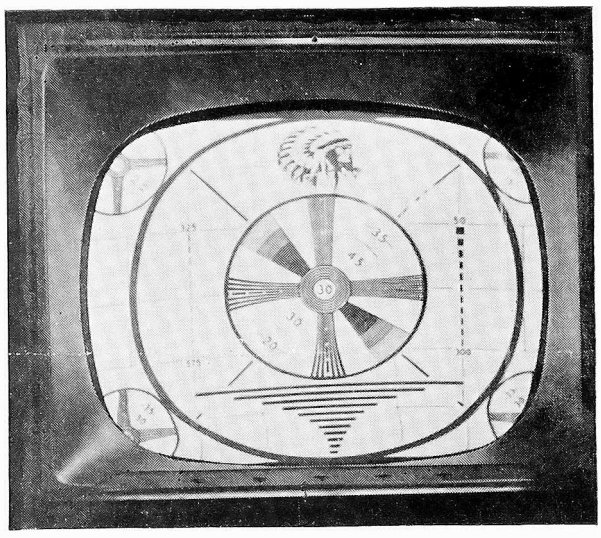
Several new tube types have been especially developed to eliminate the characteristics which cause snivets.



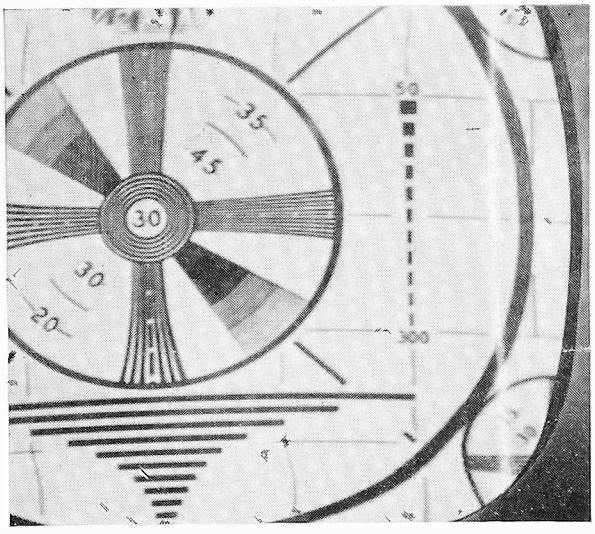
A



B



C



D

FIGURE 1 —"Snivets" as viewed under various conditions:
1A—With moderate signal strength snivets will usually appear as a vertical black line near the right hand edge of the screen.
1B—Snivets often become more pronounced in the absence of a signal.
1C and **1D**—Under strong signal conditions a white line may be evidenced.

These tubes have a considerably lower plate characteristic knee, i.e., the plate knee occurs at a lower value of B+. Even if the knee of an occasional tube exhibits minor discontinuities, snivets will not occur because the load line will be above the knee.

Sylvania has imposed rigid testing requirements to control the plate characteristic knee of horizontal amplifier tubes to assure anti-snivet tubes and design and development is continually carried on to further improve the knee characteristics while preserving all of the original desired tube characteristics.

SCREEN CURRENT AND DISSIPATION

Improving the efficiency of the horizontal deflection circuit lowers the plate dissipation of the horizontal deflection amplifier tube. However, the screen current increases in proportion to the decrease in plate dissipation. In earlier TV receivers it was not uncommon for the screen dissipation to be lower than 1 watt. In the more recent models the screen dissipations will approach 2.5 to 3.0 watts, which are the maximum tube ratings for most horizontal deflection tubes.

Excessive screen dissipation may cause failure of the horizontal deflection amplifier in two different ways. First, the screen may simply burn-up and/or become bowed and short to other elements of the tube. The second way in which excessive screen dissipation can cause failure is for the screen to become a primary emitter. When the screen grid becomes hot enough to "boil off" its coating, the bare base metal is exposed and under certain conditions will emit electrons much like the cathode. The plate voltage of the horizontal amplifier reaches its peak-positive pulse value at a time when the control grid has cut off forward-

plate current. With this high positive voltage on the plate attracting electrons, the screen grid, if sufficiently hot, will emit electrons, resulting in uncontrolled current flow in the plate circuit. This current flow, at a time when the tube is supposed to be cut off, is in opposition to the normal collapsing field in the high voltage transformer. As such, it acts as a load on the circuit, lowering the deflection transformer Q. The result is low high voltage and short scan. See Figure 4. The repetitive heating of the screen increases the "boiling off" of screen grid coating and further increases screen emission.

Measurement of the dc power input to the screen will help guard against excessive screen dissipation. The serviceman can accomplish this by simply (1) measuring the dc voltage appearing between the screen and cathode, (2) finding the screen current by measuring the voltage drop across the screen dropping resistor and then dividing this voltage by the resistance of the dropping resistor. (In sets which do not employ a dropping resistor the screen current may be found by inserting a milliammeter in series with screen circuit.) The dc power input to the screen is equal to the product of the screen current and voltage. The resultant value should not exceed the screen dissipation rating for the particular tube type, as stated in the tube manual.

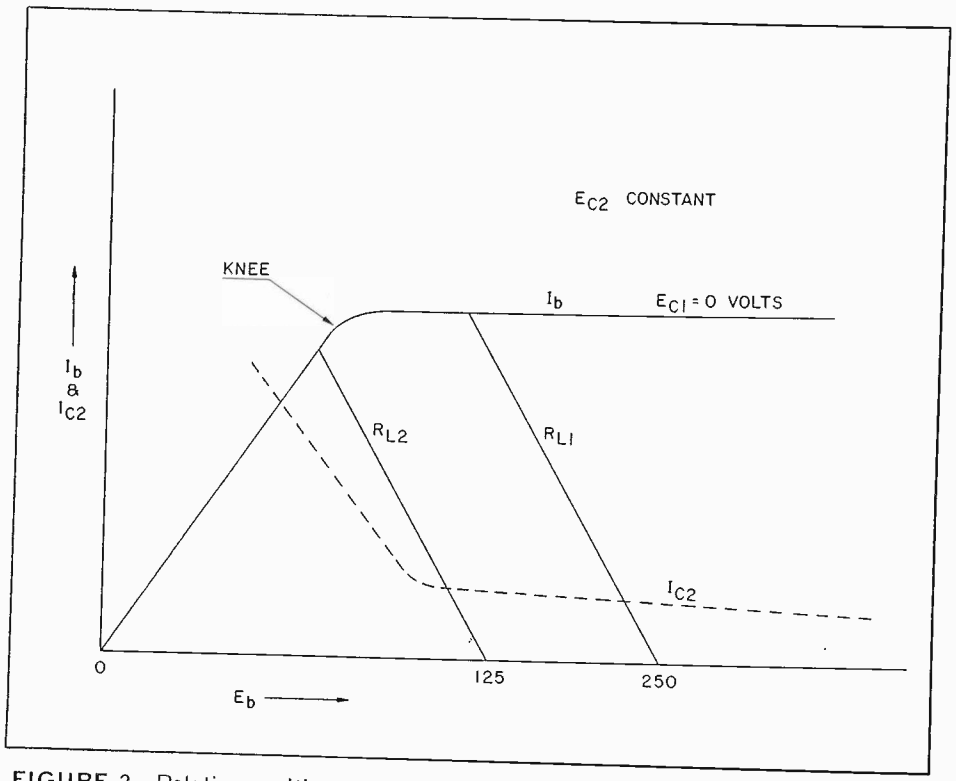


FIGURE 2—Relative position of horizontal deflection amplifier load lines for low supply and high B supply with respect to knee of plate characteristics curve.

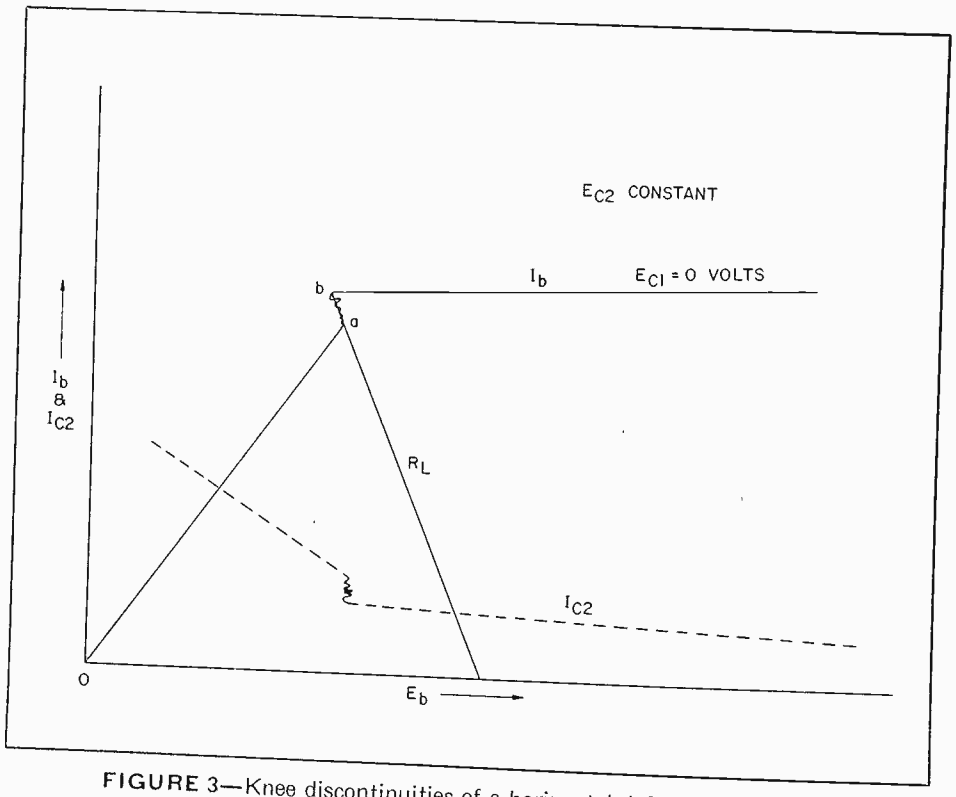


FIGURE 3—Knee discontinuities of a horizontal deflection amplifier.

EXTENSIVE TESTING INSURES PERFORMANCE

The rigid requirements imposed upon the horizontal deflection amplifier demand new testing techniques during tube manufacture.

Test methods employ a signal applied to the control grid of sufficient value to drive the tube beyond plate current cut off and to zero bias. Under these conditions, the tube is measured for its peak plate current capabilities at rated screen dissipation. Measuring peak plate current insures that the tube is capable of the peak cathode current required to provide ample high voltage and scan.

Extensive research by Sylvania engineers has shown that the ratio of plate current to screen current also

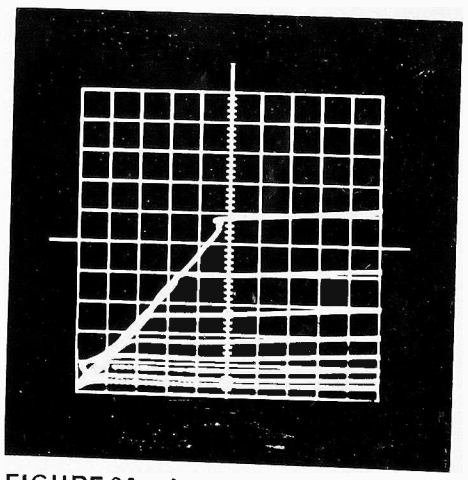


FIGURE 3A—Actual plate characteristics oscillograph showing knee discontinuity occasionally encountered.

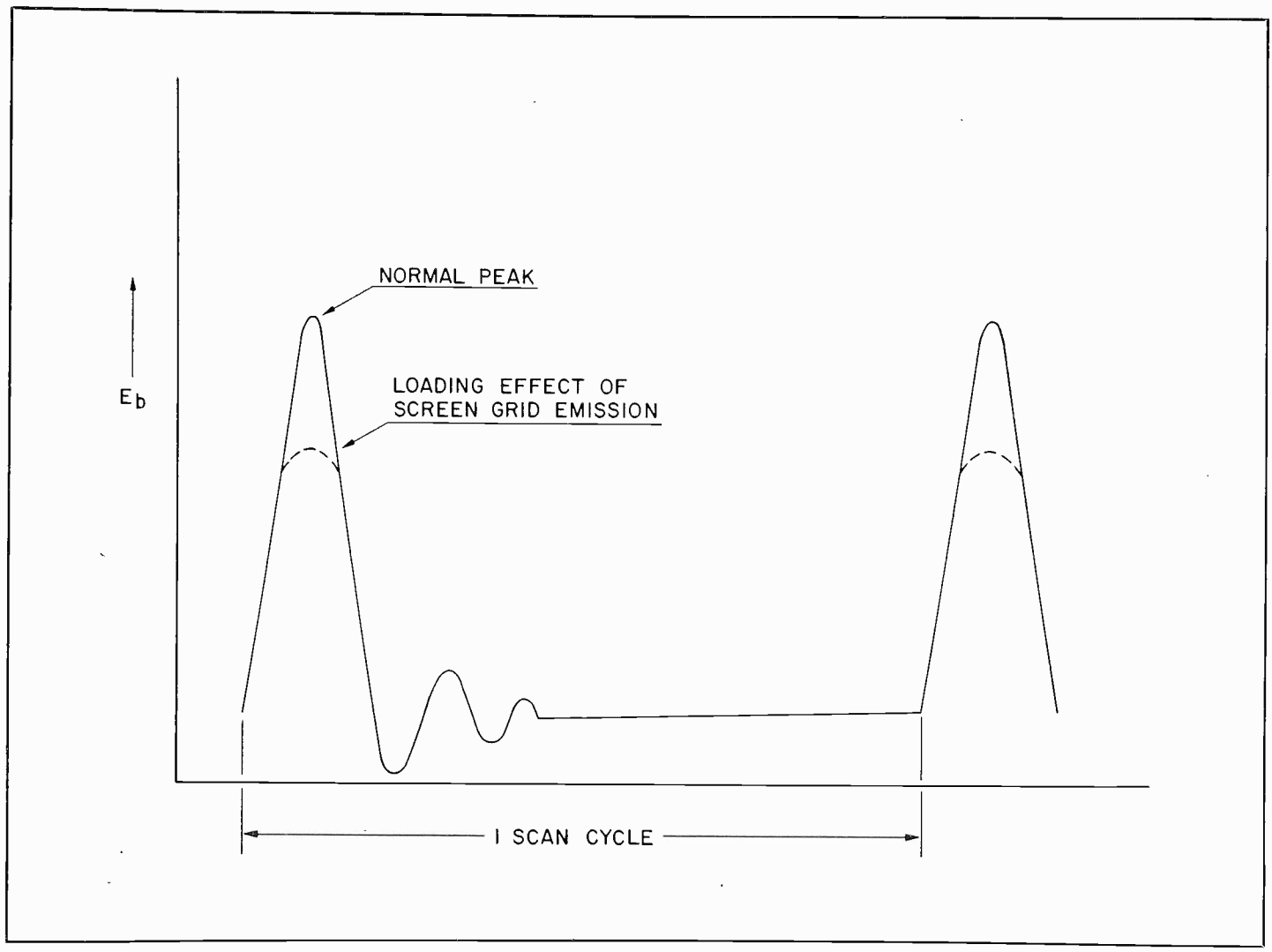


FIGURE 4—Loading caused by excessive screen dissipation lowers high voltage pulse and/or picture tube anode voltage.

plays an important role in insuring performance of the horizontal deflection amplifier. Many new TV receivers do not have horizontal drive controls. To keep the screen current of the horizontal amplifier at a relatively constant value, a high value screen dropping resistor is employed, approximately 10K ohms. If the screen current of a particular tube is high, the drop across this resistor will be excessive, resulting in low screen voltage. With insufficient drive under lower screen voltage conditions, the receiver will have short scan and low high voltage. However, if tubes with high screen current also have high plate current capabilities, the effect of the low screen voltage will be overcome. It, therefore, becomes apparent that plate current to screen current ratio is extremely important. Strict requirements for this ratio are used in production. The plate characteristic knee voltage is also controlled in production to assure "anti-snivet" tubes.

These special tests are designed to further insure the performance of Sylvania horizontal deflection tubes and are conducted in addition to an already extensive production testing, Static Life Testing, Dynamic Life Testing and TV Life Testing program.*

*Factors Affecting the life of Horizontal Deflection tubes, G. L. Quint, SYLVANIA NEWS, Vol. 23, No. 8, September, 1956.

NEW TUBE TYPES ADDED TO ROLL CHARTS

Bring your tube tester up-to-date by placing your order for these new roll charts which feature approximately one hundred new tube types.

Catalog Number	Tube Tester Model Number
PC 15845-N	139-140
PC 18325-K	219-220
PC 25700-C	620

When ordering charts, write the catalog number of the new roll chart for your Sylvania Tube Tester on your letterhead. Enclose a check for the nominal charge of $1.50 for each roll chart made out to Sylvania Electric Products Inc. Mail your request to:

Sylvania Electric Products Inc.
Tube Tester Roll Charts
1891 East 3rd Street
Williamsport, Pennsylvania

SYLVANIA NEWS

JULY-AUGUST 1957 VOL. 24, NO. 7

R. A. Humphreys, Technical Editor
This information in Sylvania News is furnished without assuming any obligations

technical SECTION

TYPE 6BU8 A NOISE IMMUNE SYNC SEPARATOR CLIPPER AND AGC TUBE

By E. F. INGE, Commercial Engineering Department

The Type 6BU8 is a twin pentode designed as a sync separator-clipper and AGC tube in television receivers. This unique tube has gained great popularity in a relatively short time and the service man may encounter it and its associated circuitry in many late model receivers. Prior to discussing the three functions of the Type 6BU8 in the television receiver let's examine the construction and electrical characteristics of this tube.

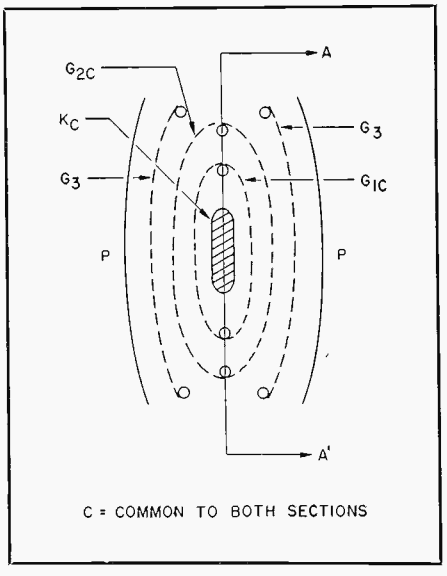


FIGURE 1—Physical Configuration of Type 6BU8 Elements.

TUBE CHARACTERISTICS

The Type 6BU8, as previously mentioned, is a twin pentode. It is unique, however, in that the cathode, grid No. 1, and grid No. 2 are common to both pentodes with separate No. 3 grids and plates for each section.

Considering only that portion of the tube to the right of section A A′ in Figure 1 as a complete pentode, the Type 6BU8 can be considered two complete pentodes with the cathodes, No. 1 grids, and No. 2 grids connected in parallel. We will see how it is possible to connect these elements in parallel after we have discussed how the tube operates in a typical circuit. To simplify the explanation of tube operation we will first consider the sections of the 6BU8 to be completely independent pentodes having identical electrical characteristics.

Each pentode of the Type 6BU8 contains two control grids, the No. 1 and No. 3 grids, each capable of controlling the plate current of the tube. These two control grids have sharp cutoff characteristics, which are required for good, clean sycn separation and for operation as an AGC tube.

SYNC SEPARATOR-CLIPPER ACTION

So much for the physical configuration and electrical characteristics of this tube. Now let's determine how it performs its required functions in a typical circuit. We will first consider the function of sync separation and clipping. A typical circuit using the Type 6BU8 as a sync separator-clipper is shown in Figure 2. In this application it is required to recover the transmitted sync signal from the composite video signal for use in syncronizing the horizontal and vertical oscillators of the receiver. The portion of the sync pulse to be recovered is shown as the shaded portion in Figure 3. To simplify the analysis of the sync separator-clipper action, the No. 1 grid will be assumed to have no signal applied. In the absence of signal, this grid will operate at approximately zero bias. This is accomplished by returning the grid resistor to a positive potential.

The signal applied to the No. 3 grid is a composite video signal having positive going sync, Figure 4. This signal is obtained from the output of the video amplifier and is approximately 30 volts peak to peak.

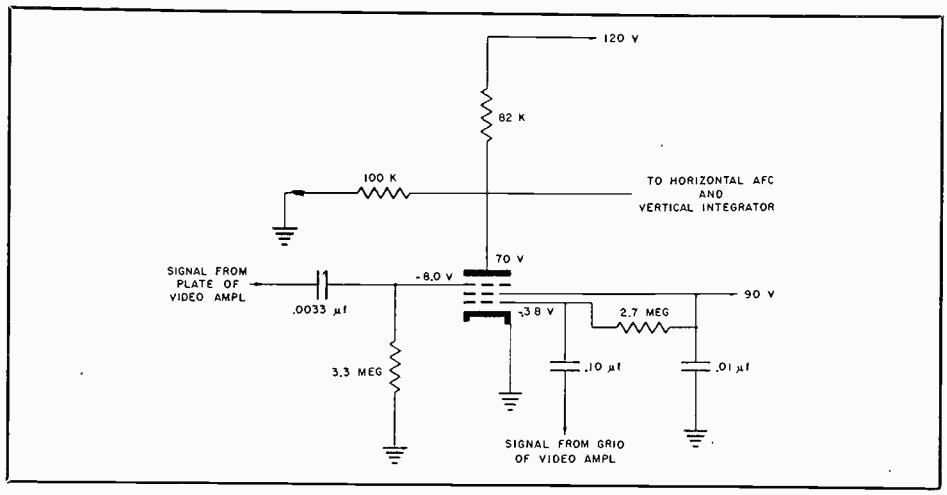


FIGURE 2—Typical Sync Separator-Clipper Circuit.

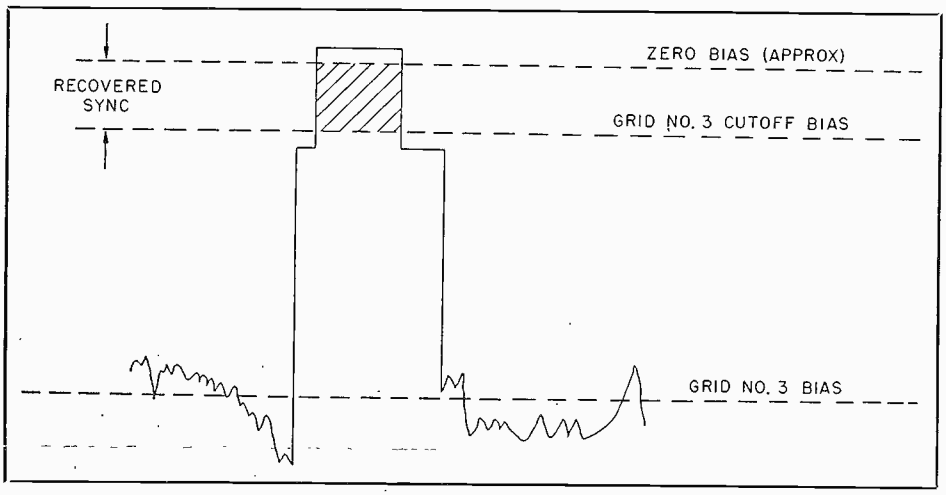


FIGURE 3—Line Representation of No. 3 Grid Signal for One Horizontal Line Illustrating Sync Separation and Clipping Action.

The No. 3 grid operates with signal bias, the magnitude of which depends on the signal amplitude. Signal bias is obtained through the diode action of the grid as the positive swing of the signal tends to drive it into the positive grid region, thereby charging the coupling condenser. This method of obtaining bias clamps the top of the sync pulse at the zero bias level, as shown in Figure 3, and also insures the clipping of small irregularities from the positive end of the sync pulse. The amplitude of the No. 3 grid signal is adjusted to a value which will insure that the tube is driven beyond cutoff except during the period of the sync pulse as shown in Figure 3. Since the tube only conducts during the sync pulse this will be the only portion of the composite video signal reproduced in the plate circuit of the sync separator-clipper, Figure 5. We now have a signal composed of the horizontal and vertical synchronizing signals. This sync signal may be applied directly to the horizontal AFC system to control the horizontal oscillator frequency. The vertical sync pulse is obtained by integrating the sync signal. The vertical oscillator may then be synchronized directly with the vertical sync pulse.

NOISE IMMUNITY

Now that we have seen how the sync separator-clipper functions let's see how noise affects circuit operation. A large amplitude noise pulse will cause a shift in the developed grid No. 3 bias as shown in Figure 6 and thereby prevent the sync pulse from driving the tube to zero bias. This results in a sync output signal consisting of low amplitude sync pulses and large amplitude noise pulses. This will cause unstable synchronization of the local sweep oscillators.

Application of a low level signal of 2 volts peak to peak, which is 180 degrees out of phase with the No. 3 grid signal, to the No. 1 grid of the sync separator-clipper tube, Figure 7 and 7A, will provide noise immunity in the following manner. The amplitude of the grid No. 1 signal is adjusted so that the sync pulse does not quite drive the No. 1 grid to cutoff, Figure 7. Noise pulses of higher amplitude than the sync pulses will now drive the No. 1 grid beyond cutoff, thereby preventing these noise spikes from appearing in the plate circuit. Thus the Type 6BU8 has performed its second function, that of providing noise immunity.

AGC TUBE

The third function of the Type 6BU8 is that of developing the AGC bias. The AGC bias controls the gain of the RF amplifier and one or more video IF stages and thereby maintains a relatively constant output from the video detector. This prevents variations in contrast with changes in signal strength and overloading of the receiver in strong signal areas. The AGC bias must be directly proportional to the signal strength yet independent of variations in screen brightness or contrast. In order to fulfill these two requirements the AGC bias developed by the 6BU8 is made proportional to the amplitude of the sync pulses, which will vary with signal strength but not with contrast or brightness.

First let's see how the AGC bias

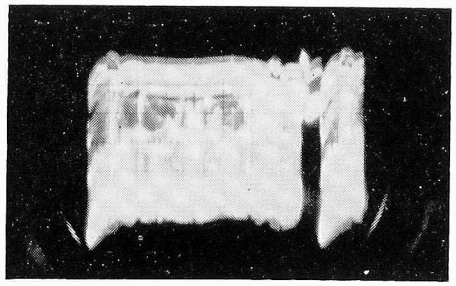


FIGURE 4—Oscillogram of Composite Video Signal Applied to Grid No. 3.

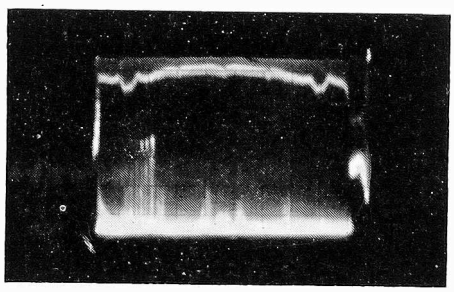


FIGURE 5—Oscillogram of Sync Output for Approximately One Field. (60V peak to peak)

is developed from the composite video signal for a constant signal strength. A typical AGC circuit using the Type 6BU8 is shown in Figure 8.

As in the discussion of the sync separator-clipper it will be assumed that no signal is applied to the No. 1 grid.

The signal applied to the No. 3 grid is obtained from the plate circuit of the video amplifier and is approximately 15 volts peak to peak with positive going sync pulses. A fixed bias is also applied to the No. 3 grid, which may be varied with the AGC control. This applied bias is adjusted so that with the strongest available signal the sync pulses will drive the tube into conduction, but will not drive the No. 3 grid to zero bias, Figure 9. Conduction of the tube during the sync pulse establishes the plate voltage of the AGC tube at an average value, which we will call E_b. The current through the AGC divider network, Figure 10, will be proportional to this voltage.

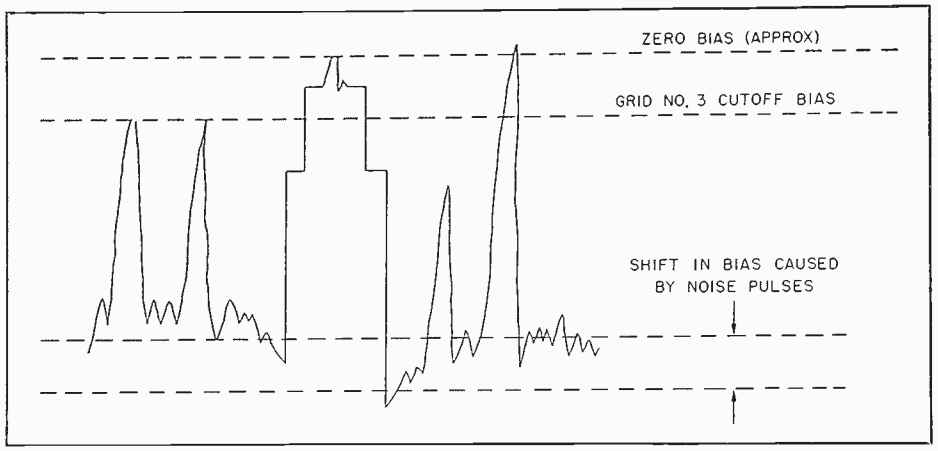


FIGURE 6—Affect of Large Amplitude Noise Pulses on Sync Separator-Clipper Action.

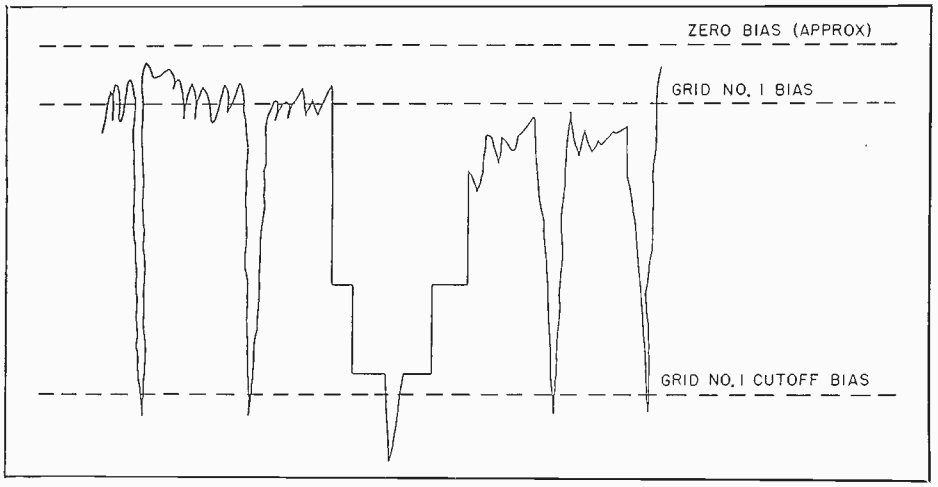


FIGURE 7—Noise Immunity Action of No. 1 Grid.

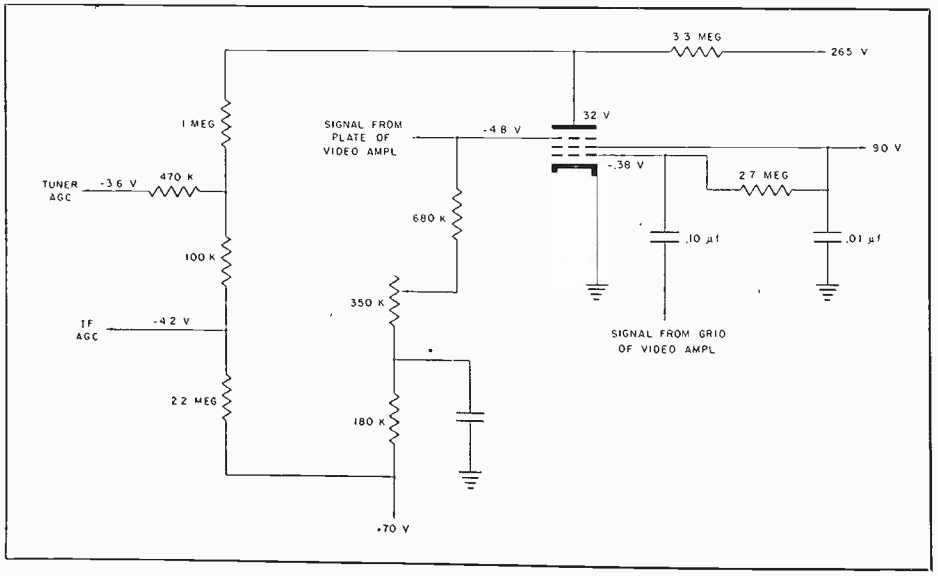


FIGURE 8—Typical AGC Tube Circuit.

The IF AGC bias, with respect to ground, will be to the sum of the reference voltage (−70V) and the voltage drop across the 2.2 Meg resistor, the tuner AGC voltage will be the sum of the reference voltage and the voltage drops across the 2.2 Meg and 0.1 Meg resistor.

Now that we have seen how an AGC bias is developed from the sync pulses, let's see how the circuit performs with variations in signal strength. As the signal increases, the sync pulses drive the No. 3 grid toward zero bias causing the tube to conduct harder, thereby lowering the average plate voltage of the AGC tube. As the average plate voltage, E_b, decreases, the IF and tuner AGC biases become more negative, thereby reducing the gain of the receiver. With a decrease in signal strength the average plate voltage of the AGC tube increases causing the AGC biases to become more positive and increase the gain of the receiver. We now have an AGC bias which is proportional to the amplitude of the sync pulses and thereby proportional to the signal strength.

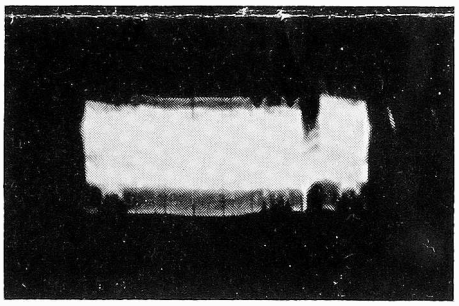


FIGURE 7A—Oscillogram of Composite Video Signal Applied to Grid No. 1.

As in the case of the sync separator-clipper, large amplitude noise pulses will affect the operation of

the circuit. Noise immunity of the AGC tube is obtained in precisely the same manner as it was obtained in the sync separator-clipper.

Inspection of the circuits for the sync separator-clipper and AGC tubes shows that the cathode, grid No. 1, and grid No. 2 of both tubes perform identical functions and that the external circuits for these 3 elements are identical. This makes it possible to connect these three elements in parallel as is done in the type 6BU8.

SERVICE NOTES

Problems encountered in servicing this type of circuit should be of little consequence once the principle of operation is understood. The essential tools include an oscilloscope and a vacuum tube voltmeter. The serviceman should be cautioned that use of any voltmeter other than a VTVM will produce erroneous readings due to the high impedence circuits involved.

The voltage waveshapes and amplitudes shown are typical for the circuits used in the discussion and will be similar for other circuits using this tube type.

The following are some of the more common troubles that may be encountered and the probable cause.

1. Unstable vertical sync:

The vertical oscillator synchronization is dependent upon the amplitude of the sync pulse, whereas the horizontal is dependent upon phase rather than amplitude. Therefore, unstable vertical sync with solid horizontal sync would be an indication of a low amplitude sync output from the sync separator-clipper.

2. Loss of both horizontal and vertical sync:

This would indicate either loss of the grid No. 3 signal or that the sync separator-clipper section of the Type 6BU8 is inoperative due to a tube or component failure.

3. Unstable vertical and horizontal sync:

Unstable sync due to a noisy signal would indicate loss of the grid No. 1 signal.

4. Horizontal pulling:

Horizontal pulling is caused by a decrease in the grid No. 3 signal, which allows a portion of the video to be present in the sync signal. This pulling appears on the screen in the vicinity of a black portion of the picture when the video in the sync signal causes an erroneous correction voltage to be produced by the AFC circuit.

5. Picture overload:

Overloading of the IF amplifiers as evidenced by a negative picture would indicate loss of the AGC bias. This would be caused by a tube failure in the AGC section of the Type 6BU8 or a component failure in this portion of the circuit.

6. Blank, snowless raster:

Although this could be an indication of many different troubles the serviceman should check the AGC section of the 6BU8. Loss of the plate voltage on the AGC tube will give a bias of −70V on the AGC bias, which biases the IF tubes beyond cutoff.

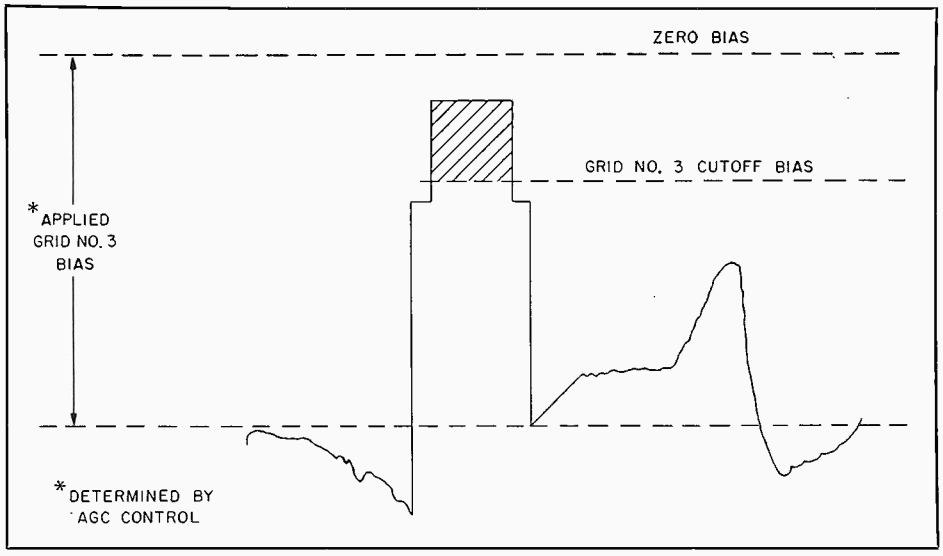


FIGURE 9—Line Presentation of Signal Applied to Grid No. 3 Showing Action of the Automatic Gain Control.

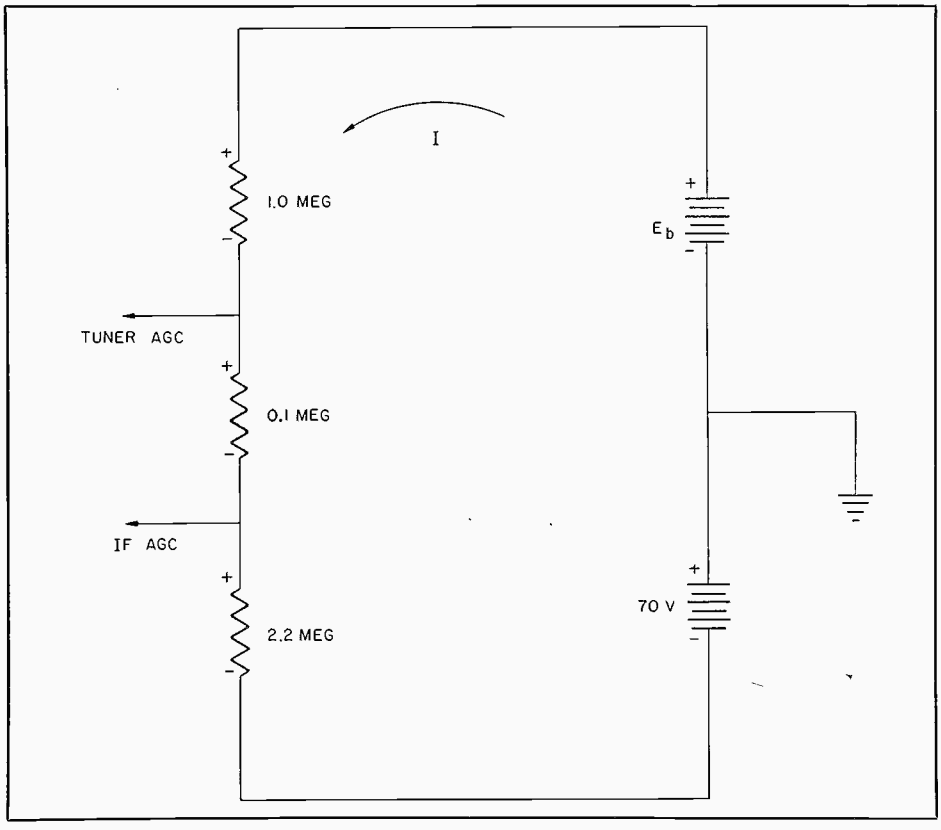


FIGURE 10—AGC Divider Network.

SYLVANIA NEWS

OCTOBER 1957 VOL. 24 NO. 9

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

THE CASE OF THE CONTINUING SPOT

by J. T. Jans

Application Engineer TV Picture Tube Division, Sylvania Electric Products Inc.

Most servicemen can recall at least one time and probably several, when a customer has asked "Why do I get a little bright spot on my television receiver after I turn it off?" Undoubtedly many servicemen have asked themselves the same question. Before we look into the causes for the spot, let us first see how the picture tube operates when the receiver is on.

PICTURE TUBE OPERATION WITH SET ON

The picture tube has a cathode, heated by a filament, which supplies electrons for the beam. A control grid, at a voltage negative with respect to the cathode, controls the flow or number of electrons in the beam. The accelerating grid (G2) acts somewhat like a screen grid in a receiving tube in that it pulls electrons from the cathode and gives them a start toward the anode.

The picture tube anode accelerates the electrons on their way to the screen. Finally the electrons go to the screen in the form of a fine beam, or stream. The electrons are attracted to the anode and screen by operating these two elements at a high positive potential, 8 to 20 KV depending on the particular receiver and/or picture tube type.

The deflection yoke on the neck of the tube moves the beam so it strikes different parts of the screen. When the scan is operating, the beam is moved over the entire face of the tube. If the yoke is not operating, the beam is not deflected and becomes a spot in the center of the screen. *There is no chance of such a spot occurring while the set is turned on* because the horizontal-scan flyback is used to develop the anode voltage and if there is no scan there is no anode voltage to pull the beam to the screen. Should the vertical scan fail, the pattern becomes a horizontal line.

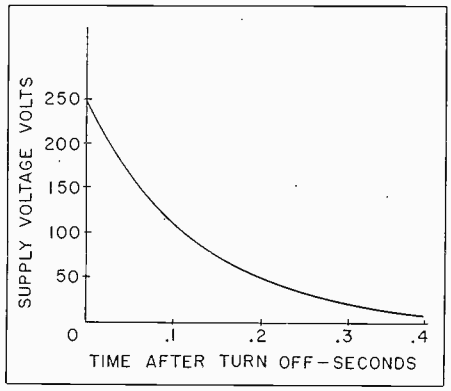


Figure 1—Curve showing the rate at which the low-voltage power supply of a Television Receiver discharges after the set is turned off.

EFFECTS WHEN RECEIVER IS TURNED OFF

Now let's see what happens when the receiver is turned off. The power being supplied to the picture tube heater goes off the instant the switch is opened; but the cathode will remain hot enough to emit electrons for two or three minutes.

The receiver power supply, which supplies the G2 and G1 voltages as well as the scan and anode voltage will receive no more power from the line. However, the filter capacitors (about 100 mfd or larger) are charged to the B+ voltage and will take a finite time to discharge. In a receiver which has a B+ of 250 volts at approximately 200 ma, the time-constant of the discharge would be about 0.125 seconds, as shown in Figure 1. This means that in less than a second the scan will be gone and G1 voltage and G2 supply voltage will be nearly zero. *The picture tube anode voltage, however, can only bleed-off thru the picture tube* since, as can be seen in Figure 2, there is no other load to discharge the high-voltage filter capacitors.

The high-voltage filter is made up of the high voltage capacitor and the capacitance formed by the external coat and mounting hardware on the picture tube. To reduce horizontal-frequency radiation the filter capacitance is usually made as large as possible. Underwriters allow up to 3000 $\mu\mu$f total capacitance and many recent receivers have about 2500 $\mu\mu$f.

With an anode voltage of 14 KV at a beam current of 200 μa, the picture tube looks like a resistance

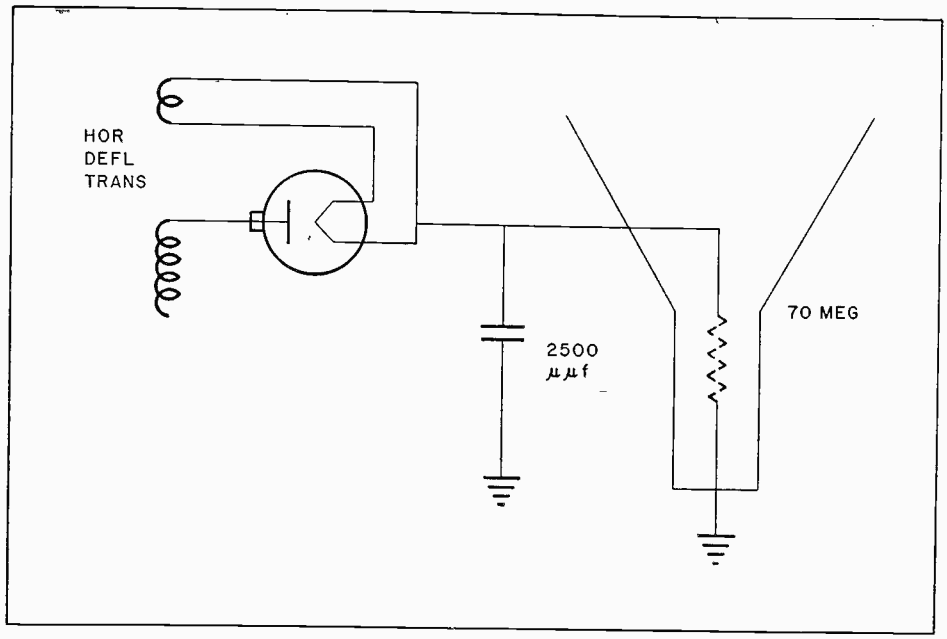


Figure 2—Typical high-voltage power supply of a Television Receiver with the picture tube shown as an equivalent resistance.

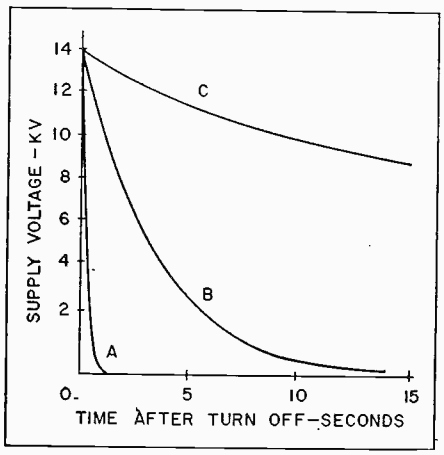


Figure 3—Curves showing discharge of high-voltage supply for different conditions of anode current—see text.

of 70 megohms and the time-constant is 0.175 seconds as shown in curve A of Figure 3. If the beam current is reduced to 10 μa, the time-constant is 3.5 seconds, as in curve B of Figure 3, and a 1.0 μa beam has a time-constant of 35 seconds, curve C. What this means is that if the beam current is high, the anode voltage will bleed off rapidly, but if it is low the voltage will hold up for several seconds and produce a bright spot on the face of the tube. A 1.0 μa beam current forms a bright distinct spot.

Until recently, nearly all picture tubes were made with ion traps, Figure 4. As shown, the beam is bent by the slash-cut between G2 and the anode. The ion-trap magnet bends the electron beam, but not the ion-beam, back thru the anode aperture. As the anode voltage drops, the slash-cut becomes less effective in bending the electron beam. The bending action of the magnet increases with decreasing anode voltage. By the time the anode voltage drops to about 50-70% the beam is bent to the point where it will no longer pass thru the aperture and so does not get to the screen. *With the aluminized screen eliminating the need for an ion-trap, the beam of a non-ion-trap tube passes straight down the center of the gun and strikes the screen no matter what the anode voltage.* This makes the spot last much longer—until the anode voltage has dropped nearly to zero.

ELIMINATING THE SPOT

The spot which appears on the face of the tube when the receiver is turned off could possibly burn the screen and certainly does cause bewilderment of the set owner. *Most receiver manufacturers have taken steps to reduce or eliminate the spot by one means or another.* Some receivers have a set of contacts on the on-off switch that places G1 at zero bias when the set is turned off. This allows a large beam current to flow which quickly bleeds off the anode voltage.

The most commonly used method of preventing the spot today appears to be the addition of a resistor and capacitor network to the G2 circuit as shown in Figure 5. Before discussing the circuit shown in Figure 5, let's see how G2 and/or the voltage applied to this element affects the anode or screen current. Let's also see what happens without this network.

First of all, G2 acts much like the screen-grid in a receiving tube in that the anode current is directly proportional to the voltage applied to G2. Now, assume that G2 is connected directly to the B+ or boost voltage. When the receiver is turned off the G1 bias drops to zero along with the power supply in about one second. With G2 tied directly to the B+ or boost, its voltage will drop too, leaving the picture tube with a high anode voltage at zero G1 and G2 voltages. Since the cathode is still hot enough to emit, a small beam

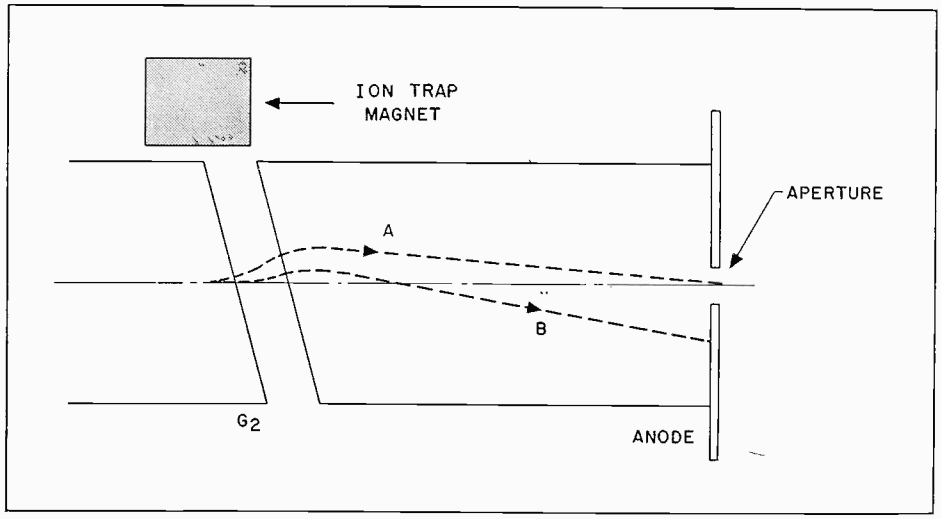


Figure 4—Action of ion-trap with correct anode voltage, beam A; and low anode voltage, beam B. At low anode voltage the ion-trap magnet bends the electron-beam so that it no longer passes through the anode aperture.

current (1 μa or less) results. *With the scan gone, the beam will be a small spot lasting a minute or more.*

With the addition of a resistor and capacitor to the G2 circuit, as shown in Figure 5, the G2 voltage holds-up for the time-constant of the R and C. The capacitor cannot discharge thru the picture tube because G2, due to the design of a picture tube, draws little or no current. If the time-constant is about 1 second (1 mfd — 1 meg) the G2 voltage allows considerable beam current to be drawn so that by the time the scan is gone the anode voltage has dropped nearly to zero.

The next time you see a receiver with a spot lasting a minute or so after the set is turned off, *check the capacitor on G2.* If it is open, it could be the cause of a "continuing spot," but usually no other trouble. At least you can ease the set owner's mind by reducing or eliminating the spot for him.

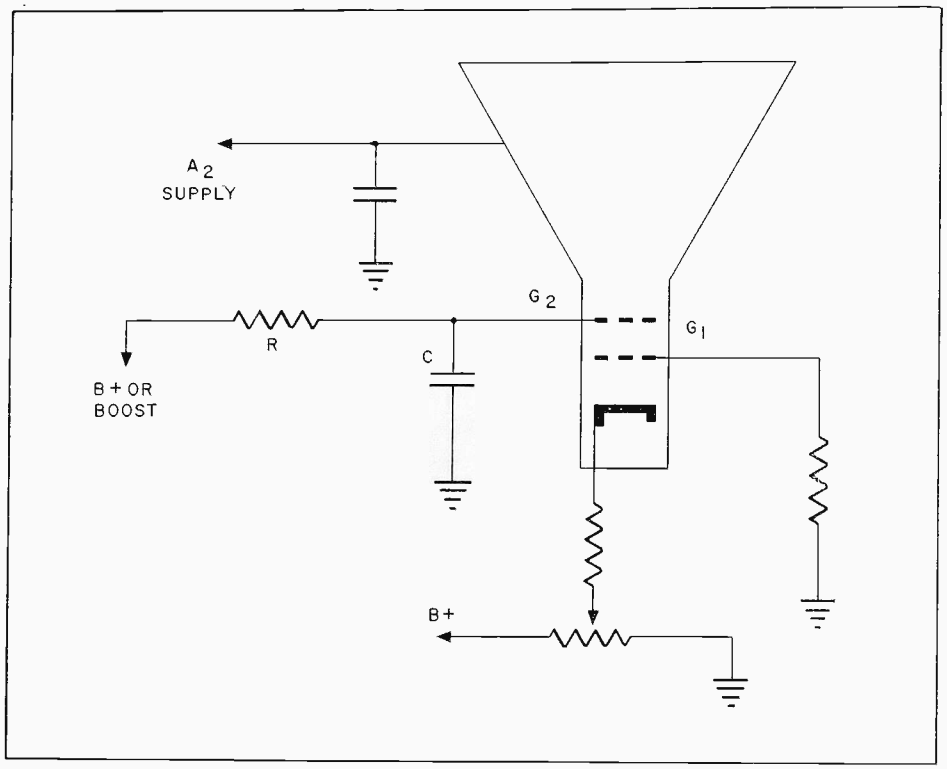


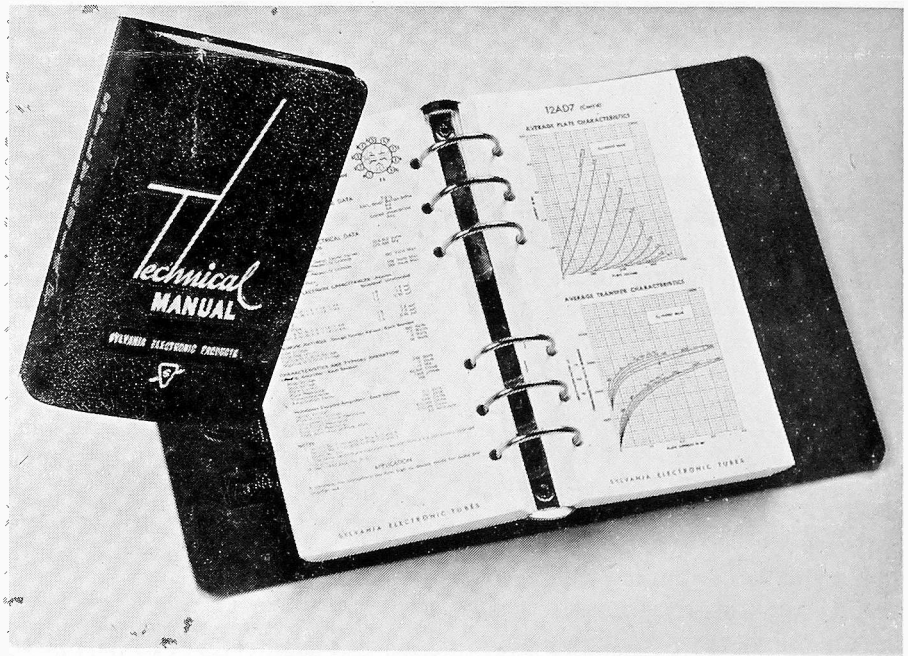
Figure 5—Schematic showing the "spot-preventing" RC network in the G2 circuit.

TECHNICAL MANUAL FEATURES LARGER, SIX-RING BINDER

The number of tube types for which servicemen must have data has increased tremendously in the past year. In fact, the increase has been such that the previously used multi-ring, Sylvania Technical Manual, binder started to overflow. To combat this problem without reducing the content, the 10th Edition, 3rd Printing is contained in a larger-ring binder. The new Technical Manual Binder has plenty of space for supplemental inserts, while maintaining the loose-leaf, lie-flat characteristics of the previous binder.

The Sylvania Technical Manual contains data on well over 1000 tube types including radio and television receiving tubes, picture tubes and special purpose tubes. In addition, your Technical Manual is automatically kept up-to-date on the *most popular new types* by a free supplement service included with SYLVANIA NEWS.

The appendix of the Technical Manual includes helpful reference material on series string television, handling of picture tubes, vacuum tube ratings, use of curves, amplifier classification, etc.



ORDER YOUR SYLVANIA TECHNICAL MANUAL NOW for only $2.50 (enclose check or money order—no C.O.D.'s please). Sylvania Electric Products Inc., 1100 Main Street, Buffalo 9, New York.

ADDITIONAL FEATURES

- Resistance coupled amplifier data.
- Characteristic curves on all important types.

Easy to Use

- Tabbed section dividers.
- Loose leaf.
- Convenient size.
- Condensed data section cross referenced in main section.

Easy to Read

- Large basing diagrams.
- Highly legible type.

AN EXPLANATION OF THE AUXILIARY BEAM ALIGNMENT MAGNET

Introduction of the non-ion trap picture tube has been highly beneficial to the television serviceman. No longer is there any need for last minute adjustments on ion trap magnets before, or after, delivery to the customer. Thus, the chance of misalignment (after delivery from the factory or when replacing a tube) has been minimized. The end result is better overall performance and a more satisfied customer.

AUXILIARY BEAM ALIGNMENT MAGNETS

However, *very infrequently*, a serviceman may find on a non-ion trap picture tube of any manufacture another magnet which may take one of several forms (a ring, a plate, etc.) It may even be similar in appearance to an ion trap magnet, but it is an *auxiliary beam alignment magnet* and should not be confused with the former, Figure 1B.

The function of this magnet is to ensure that the electron beam follows the path most conducive to highest picture quality. Sylvania has found that, generally, this auxiliary magnet is not necessary or even desirable on their non-ion trap picture tubes. Less than 1% of Sylvania's non-ion trap picture tubes require this accessory. *In short, Sylvania picture tubes, almost without exception, give the sharpest, clearest pictures without added accessories.*

MENTIONED AS A SERVICE, NOT A SERIOUS PROBLEM

However, in a continuing effort to acquaint you, the serviceman, with even the slightest possibility, this subject is brought to your attention.

If, in replacing a non-ion trap picture tube, you should find an auxiliary beam alignment magnet on the worn out tube:

1. first, and always, try the new tube without an auxiliary magnet, Figure 1C.
2. however, if objects appear to be smeared or fuzzy on the screen of the new tube, the auxiliary magnet may improve sharpness of focus; this will not hold true if a receiver component other than the picture tube is not up to snuff.
3. to experiment with the auxiliary magnet on the new tube, merely pull the socket off and slip the magnet on the neck; rotate and/or slide the magnet up and down the neck while watching the screen to determine whether smear or fuzziness (in areas where there should be a sharp transition from black to white) is cleared up.
4. *however*, better than 99% of the time, the new picture tube will not need an auxiliary magnet—and any inferior focus is due to a flaw in some other receiver component.

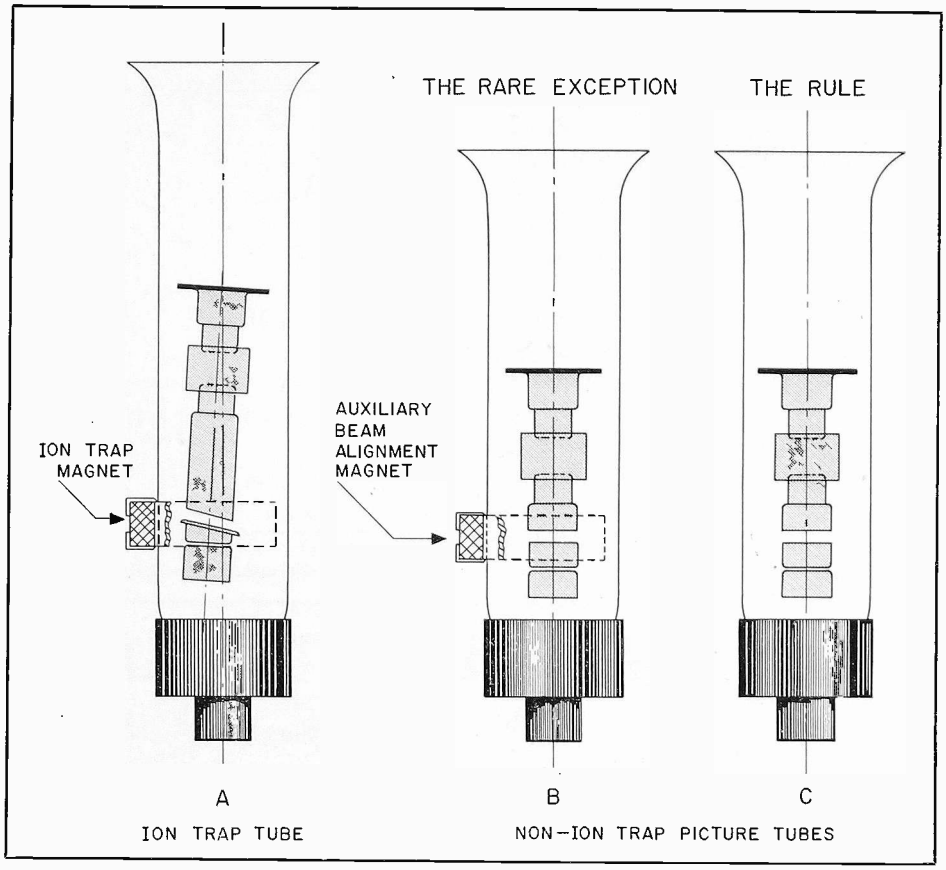


Figure 1—(A) Ion trap picture tube; (B) Non-ion trap tube with auxiliary beam alignment magnet; (C) Non-ion trap tube.

TUBE TESTER SETTINGS — ROLL CHART CHANGES

12AX7—MODELS 219/220

Change the "F" setting to read 2T on the first test.
Change the "F" setting to read 7T on the second test.
Change the "D" setting to read 36 on both tests.

12AX7—MODEL 620

Change the "F" setting to read 2S on the first test.
Change the "F" setting to read 7S on the second test.
Change the "D" setting to read 37 on both tests.

These changes will appear on future printings of the roll charts.

SYLVANIA NEWS

OCTOBER 1957 VOL. 24 NO. 9

R. A. Humphreys, Technical Editor

This information in Sylvania News is furnished without assuming any obligations

technical SECTION

THE CASE OF THE CONTINUING SPOT

by J. T. Jans

Application Engineer TV Picture Tube Division, Sylvania Electric Products Inc.

Most servicemen can recall at least one time and probably several, when a customer has asked "Why do I get a little bright spot on my television receiver after I turn it off?" Undoubtedly many servicemen have asked themselves the same question. Before we look into the causes for the spot, let us first see how the picture tube operates when the receiver is on.

PICTURE TUBE OPERATION WITH SET ON

The picture tube has a cathode, heated by a filament, which supplies electrons for the beam. A control grid, at a voltage negative with respect to the cathode, controls the flow or number of electrons in the beam. The accelerating grid (G2) acts somewhat like a screen grid in a receiving tube in that it pulls electrons from the cathode and gives them a start toward the anode.

The picture tube anode accelerates the electrons on their way to the screen. Finally the electrons go to the screen in the form of a fine beam, or stream. The electrons are attracted to the anode and screen by operating these two elements at a high positive potential, 8 to 20 KV depending on the particular receiver and/or picture tube type.

The deflection yoke on the neck of the tube moves the beam so it strikes different parts of the screen. When the scan is operating, the beam is moved over the entire face of the tube. If the yoke is not operating, the beam is not deflected and becomes a spot in the center of the screen. *There is no chance of such a spot occurring while the set is turned on* because the horizontal-scan flyback is used to develop the anode voltage and if there is no scan there is no anode voltage to pull the beam to the screen. Should the vertical scan fail, the pattern becomes a horizontal line.

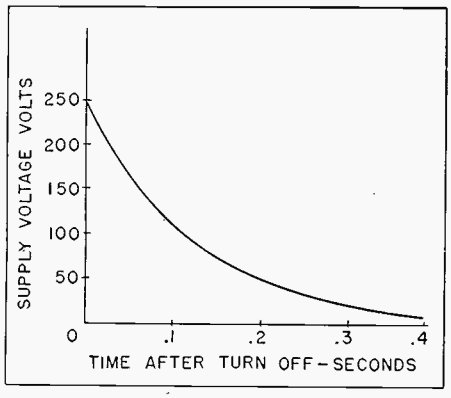


Figure 1—Curve showing the rate at which the low-voltage power supply of a Television Receiver discharges after the set is turned off.

EFFECTS WHEN RECEIVER IS TURNED OFF

Now let's see what happens when the receiver is turned off. The power being supplied to the picture tube heater goes off the instant the switch is opened; but the cathode will remain hot enough to emit electrons for two or three minutes.

The receiver power supply, which supplies the G2 and G1 voltages as well as the scan and anode voltage will receive no more power from the line. However, the filter capacitors (about 100 mfd or larger) are charged to the B+ voltage and will take a finite time to discharge. In a receiver which has a B+ of 250 volts at approximately 200 ma, the time-constant of the discharge would be about 0.125 seconds, as shown in Figure 1. This means that in less than a second the scan will be gone and G1 voltage and G2 supply voltage will be nearly zero. *The picture tube anode voltage, however, can only bleed-off thru the picture tube* since, as can be seen in Figure 2, there is no other load to discharge the high-voltage filter capacitors.

The high-voltage filter is made up of the high voltage capacitor and the capacitance formed by the external coat and mounting hardware on the picture tube. To reduce horizontal-frequency radiation the filter capacitance is usually made as large as possible. Underwriters allow up to 3000 $\mu\mu$f total capacitance and many recent receivers have about 2500 $\mu\mu$f.

With an anode voltage of 14 KV at a beam current of 200 μa, the picture tube looks like a resistance

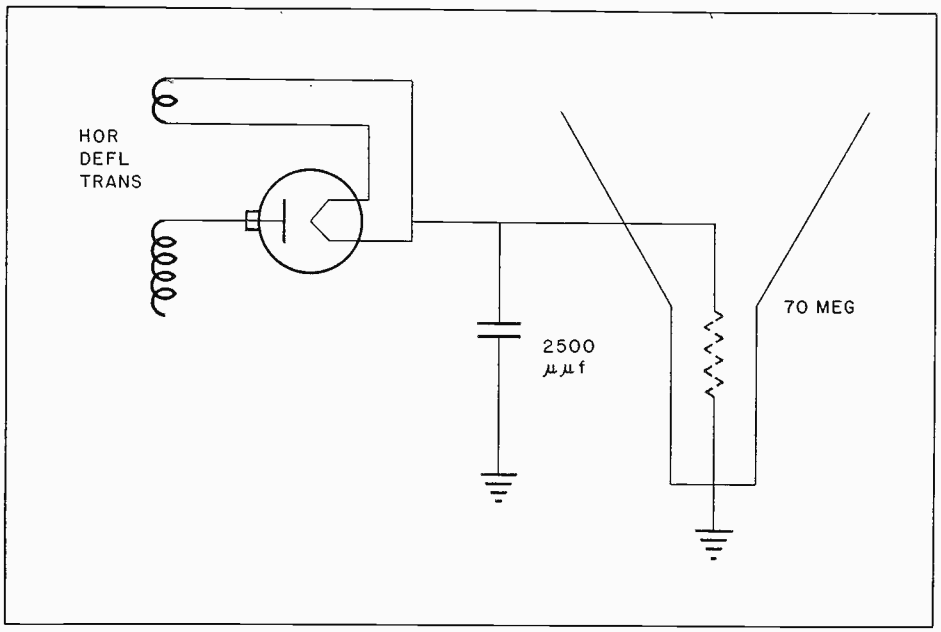


Figure 2—Typical high-voltage power supply of a Television Receiver with the picture tube shown as an equivalent resistance.

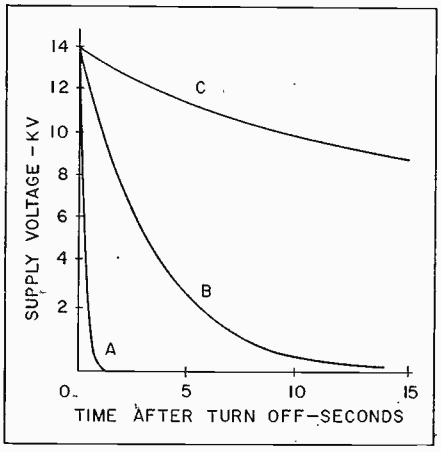


Figure 3—Curves showing discharge of high-voltage supply for different conditions of anode current—see text.

of 70 megohms and the time-constant is 0.175 seconds as shown in curve A of Figure 3. If the beam current is reduced to 10 μa, the time-constant is 3.5 seconds, as in curve B of Figure 3, and a 1.0 μa beam has a time-constant of 35 seconds, curve C. What this means is that if the beam current is high, the anode voltage will bleed off rapidly, but if it is low the voltage will hold up for several seconds and produce a bright spot on the face of the tube. A 1.0 μa beam current forms a bright distinct spot.

Until recently, nearly all picture tubes were made with ion traps, Figure 4. As shown, the beam is bent by the slash-cut between G2 and the anode. The ion-trap magnet bends the electron beam, but not the ion-beam, back thru the anode aperture. As the anode voltage drops, the slash-cut becomes less effective in bending the electron beam. The bending action of the magnet increases with decreasing anode voltage. By the time the anode voltage drops to about 50-70% the beam is bent to the point where it will no longer pass thru the aperture and so does not get to the screen. *With the aluminized screen eliminating the need for an ion-trap, the beam of a non-ion-trap tube passes straight down the center of the gun and strikes the screen no matter what the anode voltage.* This makes the spot last much longer—until the anode voltage has dropped nearly to zero.

ELIMINATING THE SPOT

The spot which appears on the face of the tube when the receiver is turned off could possibly burn the screen and certainly does cause bewilderment of the set owner. *Most receiver manufacturers have taken steps to reduce or eliminate the spot by one means or another.* Some receivers have a set of contacts on the on-off switch that places G1 at zero bias when the set is turned off. This allows a large beam current to flow which quickly bleeds off the anode voltage.

The most commonly used method of preventing the spot today appears to be the addition of a resistor and capacitor network to the G2 circuit as shown in Figure 5. Before discussing the circuit shown in Figure 5, let's see how G2 and/or the voltage applied to this element affects the anode or screen current. Let's also see what happens without this network.

First of all, G2 acts much like the screen-grid in a receiving tube in that the anode current is directly proportional to the voltage applied to G2. Now, assume that G2 is connected directly to the B+ or boost voltage. When the receiver is turned off the G1 bias drops to zero along with the power supply in about one second. With G2 tied directly to the B+ or boost, its voltage will drop too, leaving the picture tube with a high anode voltage at zero G1 and G2 voltages. Since the cathode is still hot enough to emit, a small beam

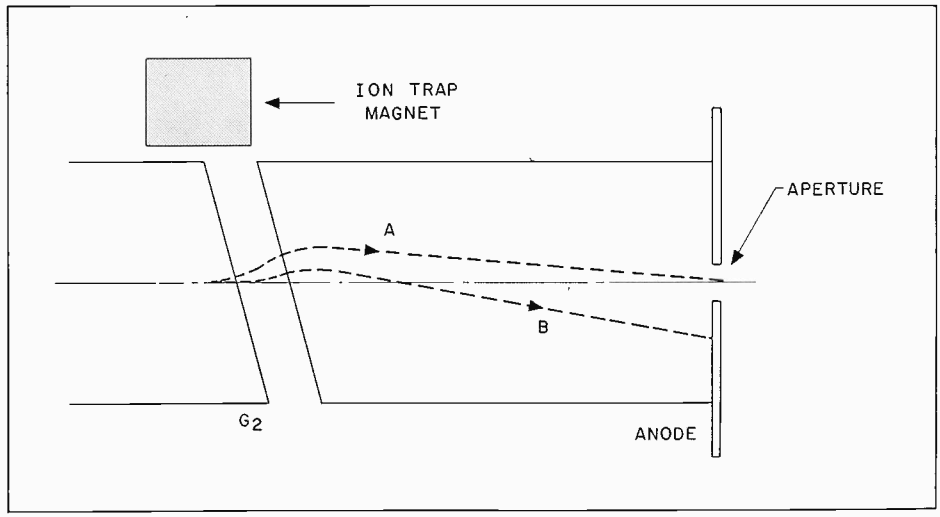


Figure 4—Action of ion-trap with correct anode voltage, beam A; and low anode voltage beam B. At low anode voltage the ion-trap magnet bends the electron-beam so that it no longer passes through the anode aperture.

current (1 μa or less) results. *With the scan gone, the beam will be a small spot lasting a minute or more.*

With the addition of a resistor and capacitor to the G2 circuit, as shown in Figure 5, the G2 voltage holds-up for the time-constant of the R and C. The capacitor cannot discharge thru the picture tube because G2, due to the design of a picture tube, draws little or no current. If the time-constant is about 1 second (1 mfd — 1 meg) the G2 voltage allows considerable beam current to be drawn so that by the time the scan is gone the anode voltage has dropped nearly to zero.

The next time you see a receiver with a spot lasting a minute or so after the set is turned off, *check the capacitor on G2.* If it is open, it could be the cause of a "continuing spot," but usually no other trouble. At least you can ease the set owner's mind by reducing or eliminating the spot for him.

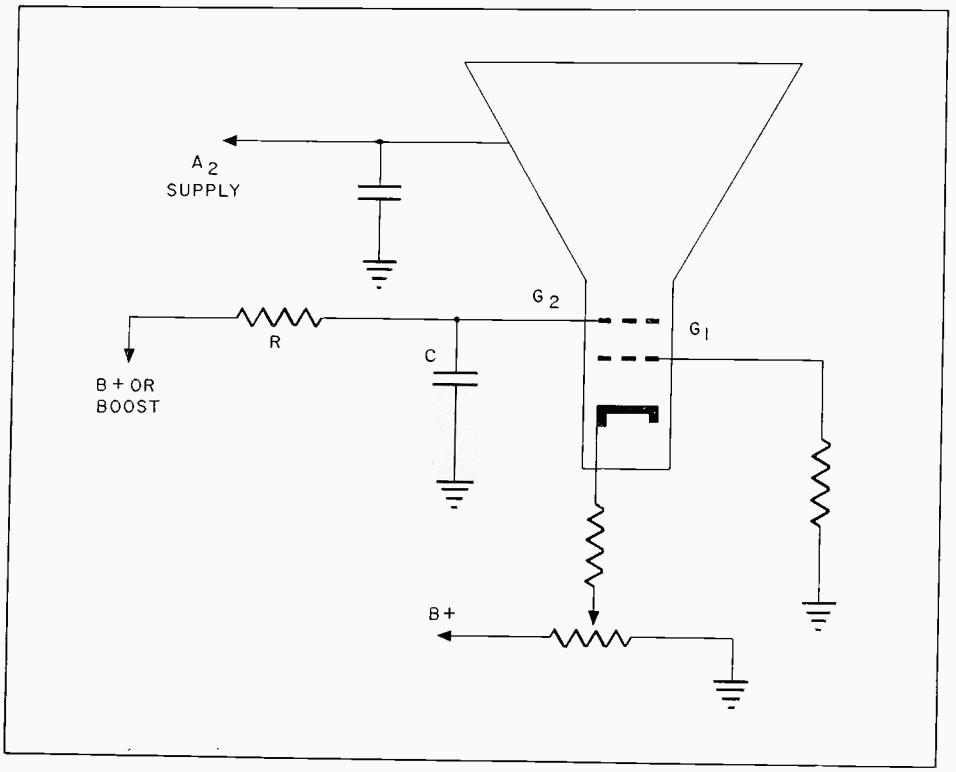


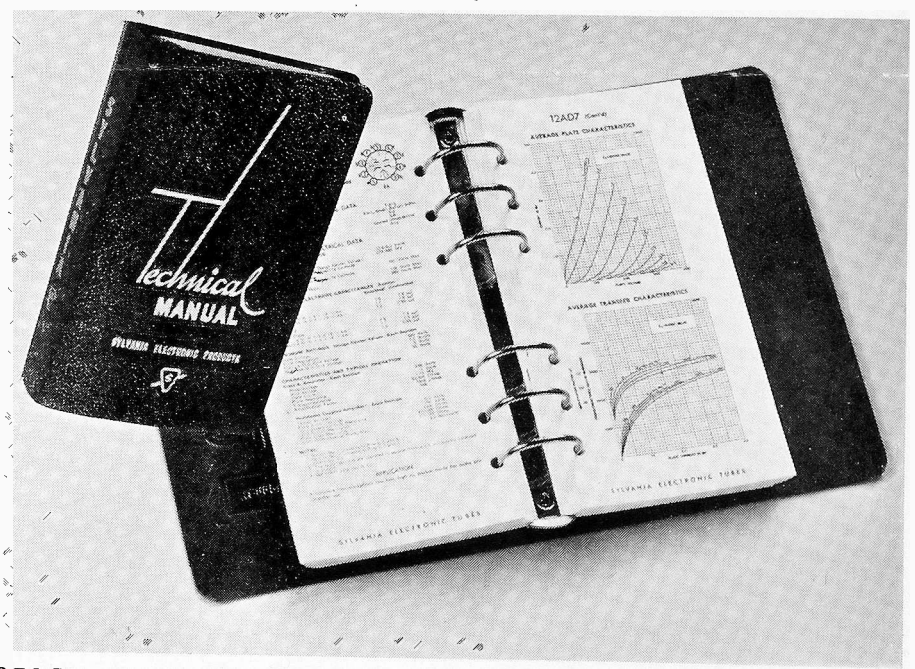
Figure 5—Schematic showing the "spot-preventing" RC network in the G2 circuit.

TECHNICAL MANUAL FEATURES LARGER, SIX-RING BINDER

The number of tube types for which servicemen must have data has increased tremendously in the past year. In fact, the increase has been such that the previously used multi-ring, Sylvania Technical Manual, binder started to overflow. To combat this problem without reducing the content, the 10th Edition, 3rd Printing is contained in a larger-ring binder. The new Technical Manual Binder has plenty of space for supplemental inserts, while maintaining the loose-leaf, lie-flat characteristics of the previous binder.

The Sylvania Technical Manual contains data on well over 1000 tube types including radio and television receiving tubes, picture tubes and special purpose tubes. In addition, your Technical Manual is automatically kept up-to-date on the *most popular new types* by a free supplement service included with SYLVANIA NEWS.

The appendix of the Technical Manual includes helpful reference material on series string television, handling of picture tubes, vacuum tube ratings, use of curves, amplifier classification, etc.



ORDER YOUR SYLVANIA TECHNICAL MANUAL NOW for only $2.50 (enclose check or money order—no C.O.D.s please). Sylvania Electric Products Inc., 1100 Main Street, Buffalo 9, New York.

ADDITIONAL FEATURES

- Resistance coupled amplifier data.
- Characteristic curves on all important types.

Easy to Use

- Tabbed section dividers.
- Loose leaf.
- Convenient size.
- Condensed data section cross referenced in main section.

Easy to Read

- Large basing diagrams.
- Highly legible type.

AN EXPLANATION OF THE AUXILIARY BEAM ALIGNMENT MAGNET

Introduction of the non-ion trap picture tube has been highly beneficial to the television serviceman. No longer is there any need for last minute adjustments on ion trap magnets before, or after, delivery to the customer. Thus, the chance of misalignment (after delivery from the factory or when replacing a tube) has been minimized. The end result is better overall performance and a more satisfied customer.

AUXILIARY BEAM ALIGNMENT MAGNETS

However, *very infrequently*, a serviceman may find on a non-ion trap picture tube of any manufacture another magnet which may take one of several forms (a ring, a plate, etc.). It may even be similar in appearance to an ion trap magnet, but it is an *auxiliary beam alignment magnet* and should not be confused with the former, Figure 1B.

The function of this magnet is to ensure that the electron beam follows the path most conducive to highest picture quality. Sylvania has found that, generally, this auxiliary magnet is not necessary or even desirable on their non-ion trap picture tubes. Less than 1% of Sylvania's non-ion trap picture tubes require this accessory. *In short, Sylvania picture tubes, almost without exception, give the sharpest, clearest pictures without added accessories.*

MENTIONED AS A SERVICE, NOT A SERIOUS PROBLEM

However, in a continuing effort to acquaint you, the serviceman, with even the slightest possibility, this subject is brought to your attention.

If, in replacing a non-ion trap picture tube, you should find an auxiliary beam alignment magnet on the worn out tube:

1. first, and always, try the new tube without an auxiliary magnet, Figure 1C.
2. however, if objects appear to be smeared or fuzzy on the screen of the new tube, the auxiliary magnet may improve sharpness of focus; this will not hold true if a receiver component other than the picture tube is not up to snuff.
3. to experiment with the auxiliary magnet on the new tube, merely pull the socket off and slip the magnet on the neck; rotate and/or slide the magnet up and down the neck while watching the screen to determine whether smear or fuzziness (in areas where there should be a sharp transition from black to white) is cleared up.
4. *however*, better than 99% of the time, the new picture tube will not need an auxiliary magnet—and any inferior focus is due to a flaw in some other receiver component.

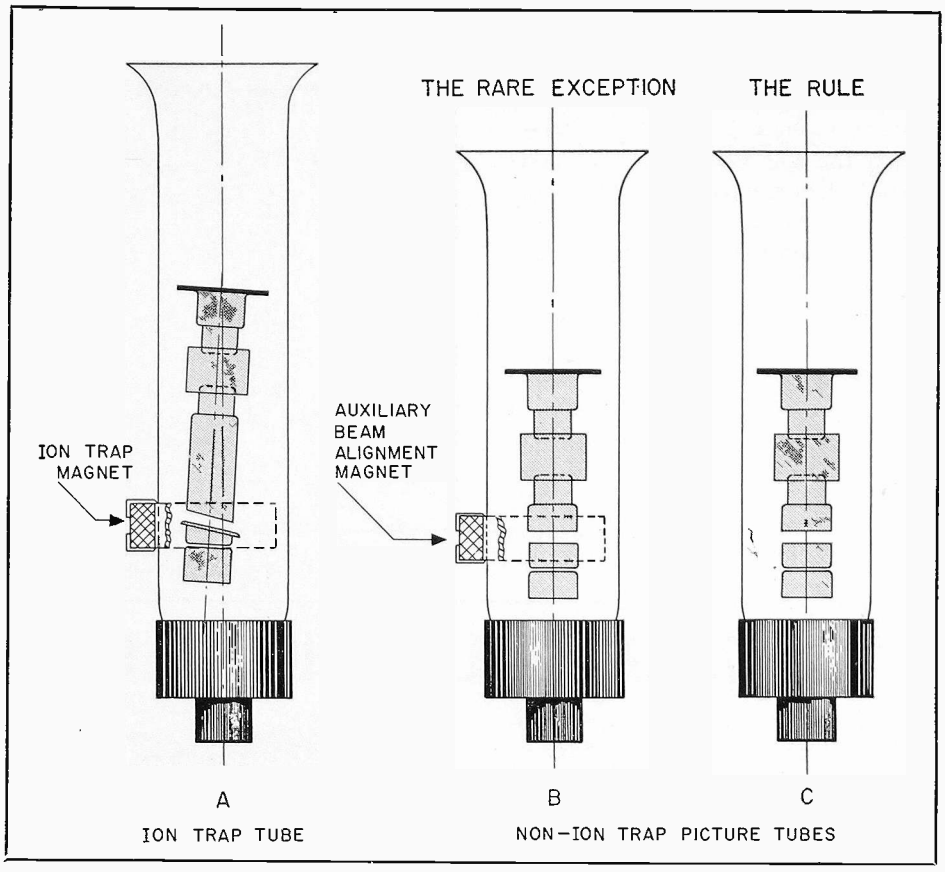


Figure 1—(A) Ion trap picture tube; (B) Non-ion trap tube with auxiliary beam alignment magnet; (C) Non-ion trap tube.

TUBE TESTER SETTINGS — ROLL CHART CHANGES

12AX7—MODELS 219/220

Change the "F" setting to read 2T on the first test.
Change the "F" setting to read 7T on the second test.
Change the "D" setting to read 36 on both tests.

12AX7—MODEL 620

Change the "F" setting to read 2S on the first test.
Change the "F" setting to read 7S on the second test.
Change the "D" setting to read 37 on both tests.

These changes will appear on future printings of the roll charts.

SYLVANIA NEWS

NOVEMBER · DECEMBER 1957 VOL. 24, NO. 10

technical SECTION

R. A. Humphreys, Technical Editor
This information in Sylvania News is furnished without assuming any obligations
D. H. Simon, Guest Editor

SPECIALIZED COUNTER TUBE CIRCUITS

By John E. Adams and David H. Simon

The Sylvania decade counter (glow transfer) tube is a gas-filled device employing 30 pin-like cathodes which surround a disc-shaped anode. The cathodes are identical physically but are electrically connected in three groups, called guide 1 buss, guide 2 buss, and output cathode buss. Conduction occurs in the tube between the anode and the most negative cathode pin, causing a glow on the tip of the pin which permits direct visual read-out, and electrical read-out in the form of voltage developing across a cathode load.

In operation, a negative input pulse is applied to the guide 1 buss, which causes the glow to move from a cathode (the quiescent position) to the nearest guide 1 pin. Near the end of the first input pulse, a second input pulse is applied to guide 2, making it the most negative pin and causing the glow to shift there. Since the guide pins are normally positive with respect to the cathodes, removal of the input pulse from guide 2 causes the glow to move to the nearest cathode, thus completing one counting cycle.

Some examples of the applications for the decade counter are visual and electrical monitoring of industrial processes for simple but accurate counting and measuring; monitoring of machine cycles; accurate measurement of time intervals (when used with an accurate frequency standard); and direct control of equipment, including welding and machine tool equipment. More common applications are in scaler devices for add and subtract processes.

Three suggested circuits for counter tube applications are presented in this issue. The circuits to be discussed are one involving a minimum number of components, a narrow pulse

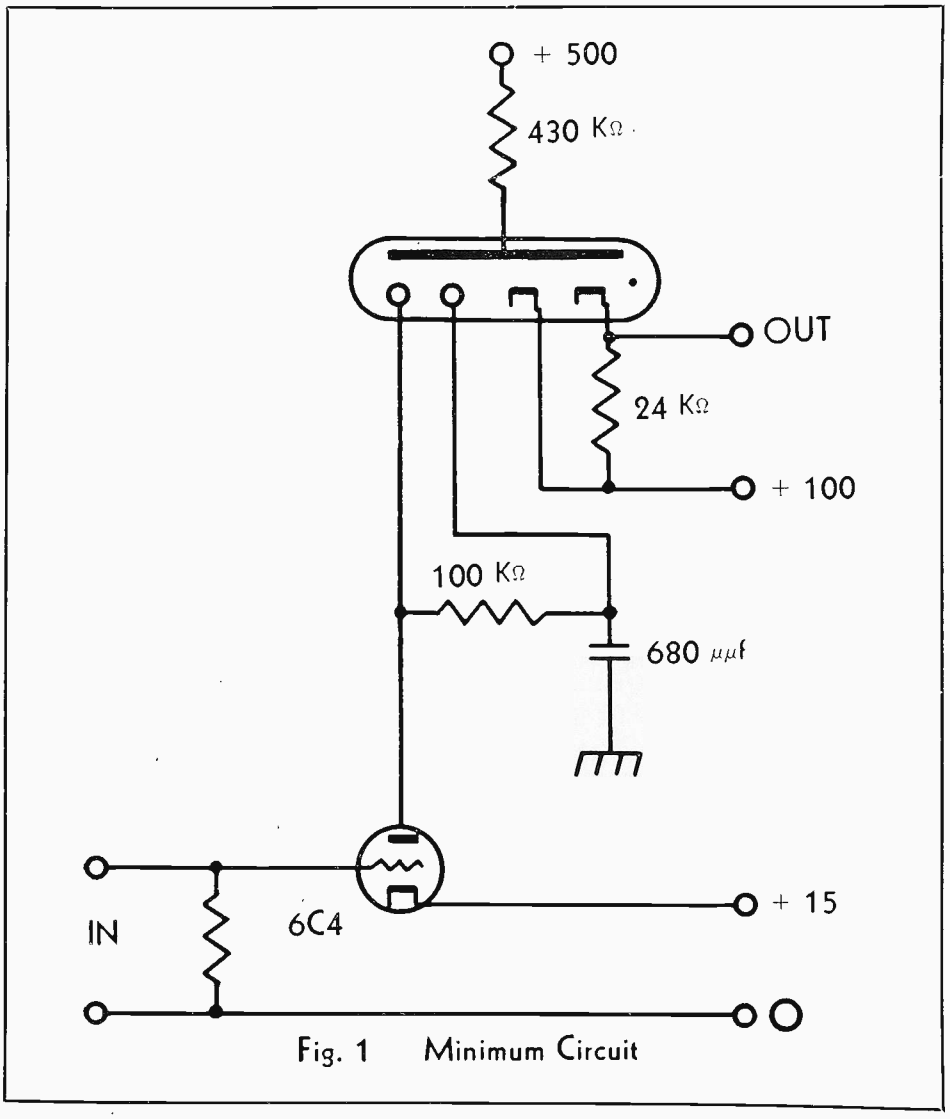


Fig. 1 Minimum Circuit

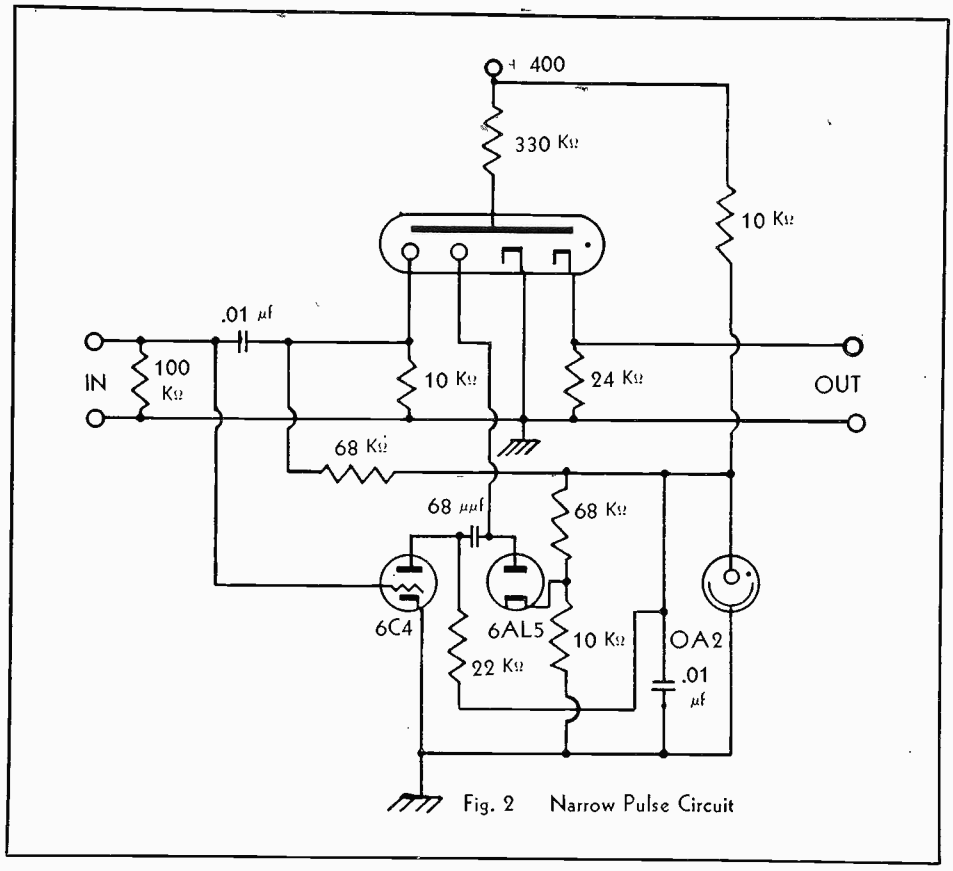


Fig. 2 Narrow Pulse Circuit

circuit, and a circuit for operating counter tubes from contactors. Optimum phase relationships for input and output waveforms are also discussed. While counter tube circuitry is not strictly a microwave subject, we have included it in the Newsletter because we have found that many microwave engineers are at times confronted with a need for laboratory and control equipment in measurements of time intervals, frequency, and random or controlled signals, and in gate reset applications.

These driving circuits offer a few basic design ideas, and exemplify the variety of driving circuits which may be used with Sylvania decade counters. The circuits as well as the values of components are typical and may be adjusted to fit the requirements of the particular application. The use of subminiature tubes in the driver stages to reduce space, weight and power consumption is an example of the type of variation possible.

MINIMUM CIRCUIT

In some applications, it is desirable for reasons of economy and space to operate a glow transfer tube with an absolute minimum of components. The "minimum circuit" (Figure 1) shows how this may be done with one vacuum triode and three small parts.

During the on time of the applied pulse, the 100 ohm and 680 μμf RC combination acts to bring guide 2 to less than 70 volts. When the trailing edge of the pulse passes, the vacuum tube is no longer a source of electrons for the glow on guide 1. For about 30 microseconds (the de-ionization time) guide 1 will draw electrons from wherever it can, and the condenser provides a source. The resistance, however, is large enough so that the voltage across it, resulting from this condenser current, is greater than the voltage difference necessary to cause transfer of the glow, so the glow shifts to guide 2, which is still more negative than any cathode. The glow now charges the condenser up to about 125 volts (the sum of the cathode, read-out[1] and transfer[2] voltages), whereupon the glow shifts to the lead cathode. For reliable operation this charging action should take long enough to assure de-ionization of guide 1 before guide 2 reaches the cathode voltage (100 volts) so that reverse transfer will be avoided. This time is 30 micro-seconds for medium frequency tubes operating in the 4 Kc range, and with the glow current and voltage change, the formula Q = CE gives a theoretical minimum capacity of approximately 400 μμf. Almost any triode will be satisfactory in this application, provided it is biased to cut-off for 125 plate volts. The input pulse then has a minimum width of 30 μsecs and a minimum height equal to the bias voltage.

In cascading a counter tube from another counting stage, it is advisable to use capacitive coupling, so that if the preceding zero cathode remains ignited (by the count being finshed on a multiple of ten) the glow of the driven tube will not be retained on a number one guide but will move on to the lead cathode. The coupling capacitor should not be too great in value, as the action of this circuit depends partly on the waveform decay rate. The 100 k ohm resistor and the 680 μμf condenser are median values, the practical extremes being 82 k ohms to 150 k ohms and 400 μμf to .01 μf, respectively.

This circuit is particularly useful where low cost, space and weight considerations outweigh the small loss in reliability, such as inexpensive geiger counters.

NARROW PULSE CIRCUIT

This "Narrow Pulse Circuit" (Figure 2) has performed quite well in tests with negative pulses which were about 130 volts in amplitude and of ten to twenty microseconds duration. It should be noted that a guide pulse which is narrow or triangular, rather than wide and/or rectangular, must be greater in amplitude to fulfill ionization requirements. (A limit is reached at about 140 volts peak, beyond which spurious ionization occurs.) Use of the circuit is not recommended where the counting rate is greater than 8 kc.

In the circuit of Figure 2, the input pulse drives guide 1 directly, and is inverted by the 6C4 to drive guide 2 by differentiation through the 68 μμf condenser. If a higher input impedance is desired, a diode may be inserted in the guide 1 connection, similar to the guide 2 diode. The

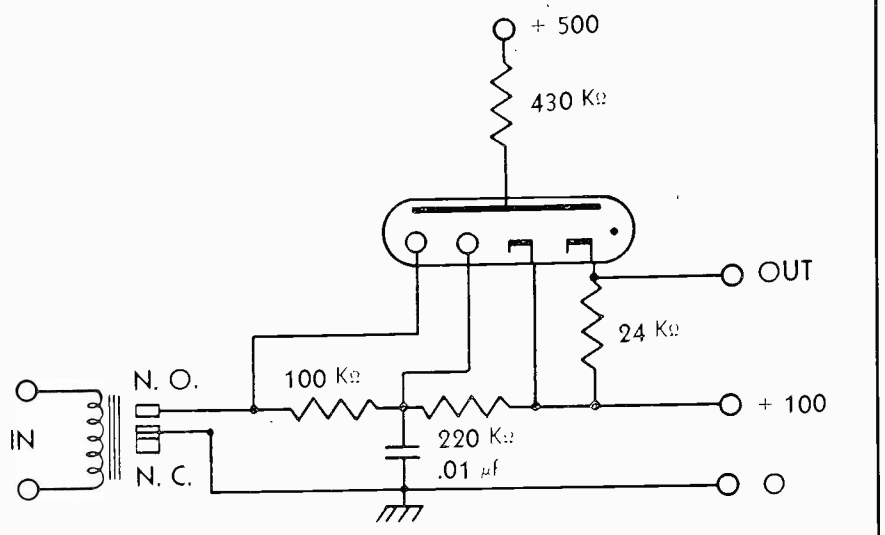


Fig. 3 Contactor Circuit

diode prevents an accumulation of positive charge on the guide as the cycling is repeated. This would occur in the absence of the diode due to the glow current when the guide is ignited. The diodes are biased to a voltage equal to the sum of the transfer and read-out voltages, which prevents the guides, when quiescent, from interfering with the action of those cathodes with load resistors for output voltage.

The narrow pulse circuit finds application where short, random pulses are likely to occur, including phases of nuclear, chemical and geophysical work, and lightning studies. The circuit should be used where only narrow pulses are available. For other applications, the standard drive circuits shown on the counter tube Engineering Data Service sheets are preferred.

CONTACTOR CIRCUIT

It is possible to operate glow transfer tubes from contactors on relays and certain types of machinery. The contact action should be that known as "momentary make", with a ratio of make to break time of less than unity.

In the circuit shown in Figure 3, the values in the guide network are median, the practical extremes being from 82 k ohms to 150 k ohms, from 1000 $\mu\mu$f to 0.1 μf and from 180 k ohms to 330 k ohms. This circuit may be cascaded from another glow transfer tube by using a relay coil of 10 k ohms or more, coupled to the 68 k ohms cathode load of the preceding stage by a 1.0 μf capacitor and a 1N34 diode in series. (The diode prevents the relay from closing on both the ignition and extinction of the preceding cathode, and the capacitor prevents the relay from being held shut if the preceding stage finishes a count on that particular cathode. If the relay is held shut, the glow of the driven tube will remain on guide 1, which is undesirable.)

The relay contacts can be expected to last quite well since they are handling very little power, with no reactance connected directly to them.

PHASE RELATIONSHIPS

Proper timing of the ignition and extinction of adjacent guides is the key to reliable operation. Four steps must occur in order: ignition of guide 1, ignition of guide 2, extinction of guide 1, and extinction of guide 2. This is shown by the voltage waves in Figure 4, the values of 4A being for medium speed tubes and those of 4B for high speed tubes. Note that in order to satisfy the basic requirement, an overlap of guide pulses is necessary. The minimum overlap is 10 microseconds for the medium speed tube and 2 microseconds for the high speed tube.

The idealized waveforms of Figure 4 are encountered only in test equipment; waveforms similar to those of Figure 5 are more common. Here, not only is the overlap time of importance, but also the time between leading edges, and the time between trailing edges. The minimum value of overlap is 10 microseconds for the medium speed tube, and 2 microseconds for the high speed. These are also the minimums for the time between leading edges, and the time between trailing edges.

RESET

Usually, it is a requirement of the equipment that counting starts from a particular initial cathode, and that upon completion of a counting period, the glow be returned to the reference, or zero cathode. This may be accomplished either by opening the negative connection of all cathodes and guides except the zero cathode, or by pulsing the zero cathode negative. In either case, the zero cathode becomes 120 volts or more negative with respect to all other pins, for 50 microseconds or longer in the medium speed tubes and for 2 microseconds or longer in the

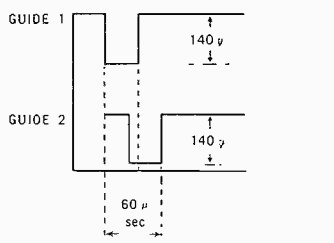


Fig. 4A Guide Pin Input Voltages Vs. Time for Medium Speed Counter Tube. Pulse Widths are 30 to 40 μs Min. Overlap is 10 μs Min.

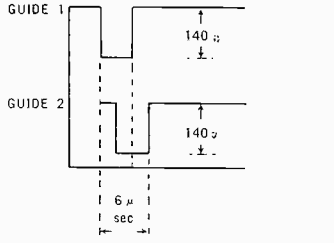


Fig. 4B Guide Pin Input Voltages Vs. Time for High Speed (100kc) Counter Tube. Pulse Widths are 4 μs Min. Overload is 2 μs Min.

1. Read out voltage is the voltage developed across an output cathode load when the cathode is conducting.
2. Transfer voltage is the voltage required to move the glow from one pin to another.

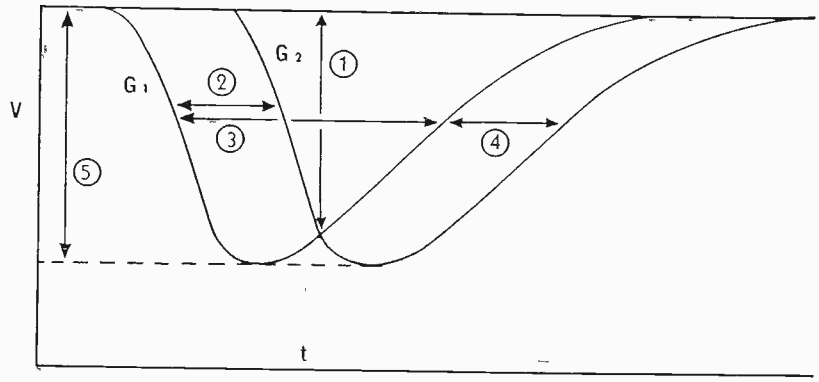


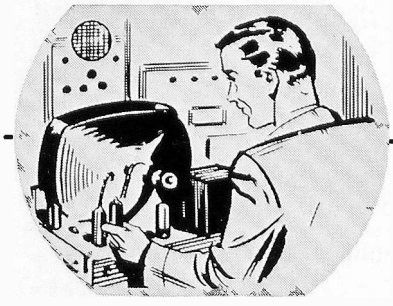
Fig. 5 Waveforms on Adjacent Guides
① Min. 50 v Optimum: 120 v
② and ④. Medium Speed Tube: 10 μs Min.
High Speed Tube: 2 μs Min.
③ Medium Speed Tube: 50 μs Min.
High Speed Tube: 4 μs Min.
⑤ 120 — 180 V
②, ③ and ④ are Measured at the Half-Voltage Point.

higher speed tubes.

The maximum pulse duration for the reset pulse is limited by the operating frequency. Commonly, the reset action is made to occur slowly, with a wide reset pulse, but in certain applications it may become necessary to reset the glow rapidly to a reference cathode to avoid loss of count during their setting operation. Therefore, the reset pulsewidth in this case should be consistent with the speed at which the counted signal is being received from the drivers.

When several tubes are cascaded, it is recommended that resetting be made to the zero cathode in the first stage, and the number 9 cathode in succeeding stages. This is to absorb the counting pulse, which is passed to the other tubes when the first tube is reset.

SERVICE HINTS



EDITOR'S NOTE: Sylvania offers $10.00 in Advertising Material Certificates for all technical hints that it believes useful to the service-dealer readers of SYLVANIA NEWS. Sylvania is not obligated to return any material submitted for publication, whether or not published.

SPEAKER REPAIR

Experience has shown that the most satisfactory solution to the problem of a defective speaker is to replace it. This holds true for the majority of speaker ailments. A defect such as that shown in the accompanying drawing can, however, be satisfactorily and permanently repaired.

Several cases have been encountered where the wire-braid, which links the voice-coil winding to the terminal strip, has been broken at the point of entry to the cone, Figure 1. The braid is bent sharply so that it will lie flush with the cone. Vibration does the rest.

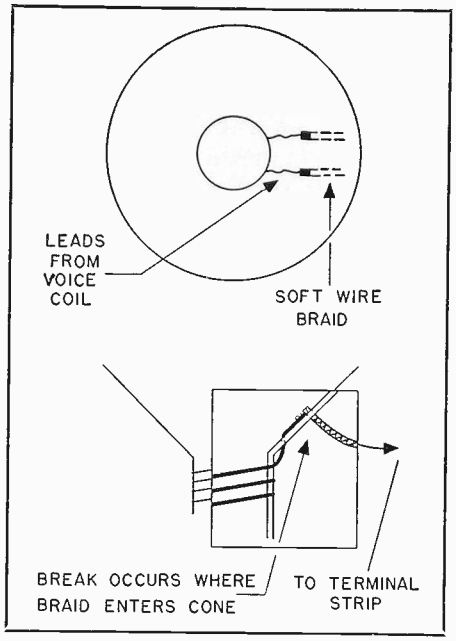


Figure 1—Break occurs at knee of bend in wire-braid (effectively point-of-entry to cone).

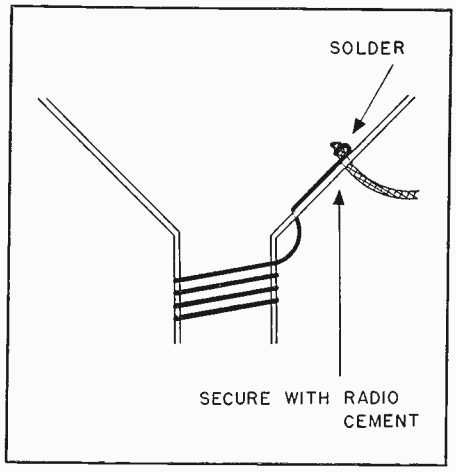


Figure 2—Method of permanently repairing speaker defect illustrated in Figure 1.

The first step in repair is to loosen the voice-coil lead from the cone with cement thinner. The remaining tab of wire-braid is next carefully unsoldered from the voice coil lead. The wire-braid leading from the terminal-strip should now be inserted so that it extends through the cone about ⅛ inch. (The braid is usually long enough to do this without replacing it). The voice-coil lead is wrapped around the protruding wire-braid next, and then soldered, Figure 2. The voice-coil lead, joint and braid are secured to the cone with radio-cement.

A little radio-cement applied to the underside of the cone at the point where the braid enters the cone will prevent this problem with the other lead.

R.A.H.