

# SERIES STRING TELEVISION

By R. A. Humphreys  
Technical Publications Section

# TECHNICAL SECTION

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William O. Hamlin, Technical Editor

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## Introduction

The term *series string*, as applied to the arrangement of the filaments and heaters of vacuum tubes, is familiar to most of us. Series heater strings have long been used in AM and FM receivers, and in recent years in a few television receivers. In the latter, however, development has been rather slow. Manufacturers of early series string television receivers were faced with several problems not encountered in the development of transformerless radio receivers. Because of variations in heater current ratings of standard receiving tubes, series parallel networks had to be used to obtain a complete complement. Such circuitry, in addition to requiring more component parts, had many drawbacks. Among these were possible short tube life, possible multiple failures and a long receiver warm-up time. These factors made it very difficult for the manufacturer to realize the economic advantages of series heater operation while still providing the customer with a set comparable to existing transformer type receivers. Consequently, the production of series string television receivers in years past has been on a more or less limited basis. To alleviate this situation, Sylvania recently provided the set manufacturer with a complete line of tubes specifically designed for series string operation in television receivers.

## Why Series String

As with radio receivers, the advantages of series heater operation include elimination of a transformer winding for the heater supply, with probable substitution of a voltage doubler rectifier circuit for the low voltage B supply winding. Thus, the power transformer can be eliminated

altogether, if desired. This represents a considerable saving in cost, weight and physical size of the chassis. Chassis layout is also simplified, since the influencing magnetic fields set up by the transformer are no longer present. All of these factors lower the initial cost of the television receiver. The importance of a more flexible chassis design and overall saving in size and weight are further emphasized by the recent trend toward miniaturization and/or portability.

## Series-Parallel Arrangements

The tubes employed in a series heater string must have equal heater current ratings or be connected in a manner that will limit the heater current of each tube to its rated value. In the past, there have not been tubes for all television receiver functions

with equal heater current ratings to make up the required complement. Therefore, parallel combinations of tubes and resistors were used to provide proper heater current and voltage distribution. Let us consider the series-parallel arrangement shown in Figure 1. The complexity of the circuit is immediately evident. The string current is determined by the tube or tubes having the highest heater current rating, in this case 600 Ma. Resistors R2 through R5, connected in shunt with associate 300 and 450 Ma tubes, divide the string current so that each of the lower heater current tubes will pass only its rated value. Parallel connection of tubes having equal heater voltage and heater current ratings are also used to balance heater currents and provide proper voltage distribution, for ex-

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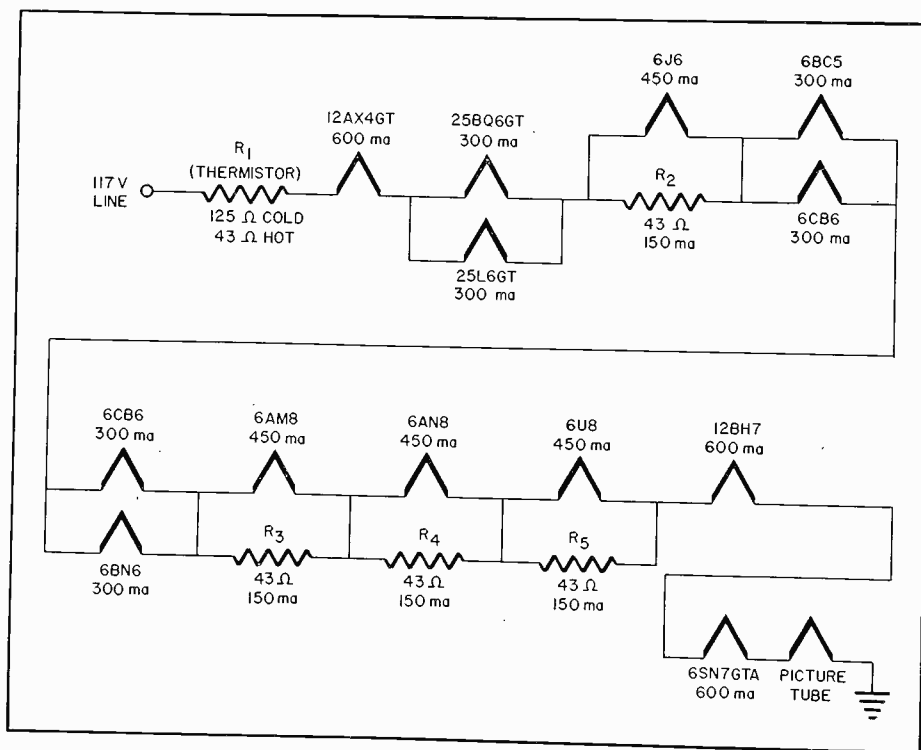
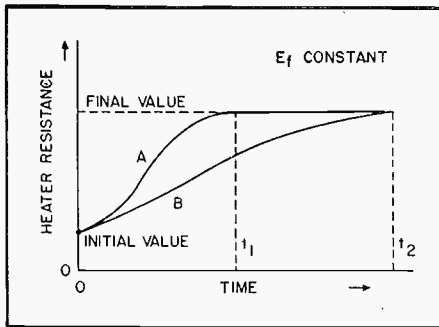


FIGURE 1—A television receiver series-parallel heater string using tubes designed for parallel connected, transformer operated receivers.



**FIGURE 2**

Heater warm-up time vs. heater resistance for two average receiving tubes with heater voltage constant.

(Continued from page 5)

ample the 6CB6 and 6BN6, Figure 1.

Although appearing to be practical, such an arrangement has certain disadvantages. If the heater in the parallel combination should open, the other is required to pass the full string current; and, since the string current is in excess of the rated current for the resistor or tube, it too will probably fail.

This brings to mind an interesting point in the servicing of such receivers. Accidental removal of one of the two tubes comprising a parallel network or removal of a tube shunted by a current equalizing resistor may cause additional damage to the set. Consequently, servicing becomes more difficult, since the receiver has to be turned off each time a tube substitution is made.

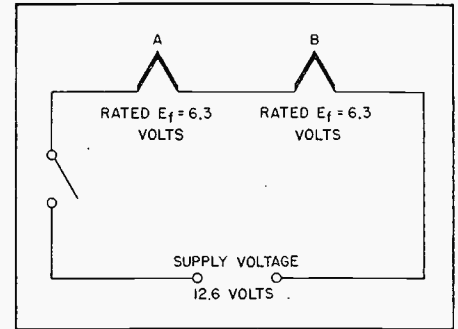
### Heater Characteristics

To thoroughly understand the problems involved in series string operation, it is essential that we know a bit more about the characteristics of a tube's heater.

The resistance of a tube's heater increases with temperature. After warm-up, the heater resistance may be several times its initial value. We also find that very few tubes have the same heater warm-up characteristics, due to the wide variations in heater and cathode construction. Figure 2 is a plot of heater resistance vs. time (constant voltage condition) for two such tubes—type A having a fast warm-up time and type B having a slow warm-up time.

In a series heater string, the voltage division is determined by heater re-

sistance. Consequently, differences in heater warm-up characteristics may cause excessive voltage surges across the heaters of the faster heating tubes until the slower heating types warm sufficiently to take their share of voltage. For the purpose of illustration, let us again consider tubes A and B, this time connected in series across a 12.6 volt supply, rated heater voltage for each tube being 6.3 volts, (Figure 3). At the time the switch is closed the division of voltage is proportional to each tube's cold heater resistance or 6.3 volts, the rated heater voltage. This is graphically illustrated in Figure 4. At time  $t_1$ , however, the voltage across tube A has risen to approximately 8 volts,



**FIGURE 3**

Two average receiving tubes (A and B) across a 12.6 volt supply.

while the heater voltage of tube B has dropped to 4 volts, because of the more rapid warm-up characteristic of tube A.

**TABLE I**

Series String Type	Heater Voltage	Heater Current in Ma	Heater Warm-up Time in Sec. (Approx.)	Prototype
2AF4	2.35	600	10	6AF4
2T4	2.35	600	10	6T4
3AL5	3.15	600	10	6AL5
3AU6	3.15	600	10	6AU6
3AV6	3.15	600	10	6AV6
3BC5	3.15	600	10	6BC5
3BE6	3.15	600	10	6BE6
3BN6	3.15	600	10	6BN6
3BZ6	3.15	600	10	6BZ6
3CB6	3.15	600	10	6CB6
3CF6	3.15	600	10	6CF6
3CS6	3.15	600	10	6CS6
4BQ7A	4.2	600	10	6BQ7A
4BZ7	4.2	600	10	6BZ7
5AM8	4.7	600	10	6AM8
5AN8	4.7	600	10	6AN8
5AQ5	4.7	600	10	6AQ5
5AT8	4.7	600	10	6AT8
5AV8	4.7	600	10	6AV8
5BK7A	4.7	600	10	6BK7A
5J6	4.7	600	10	6J6
5T8	4.7	600	10	6T8
5U8	4.7	600	10	6U8
5V6GT	4.7	600	10	6V6GT
5X8	4.7	600	10	6X8
6AW8	6.3	600	10	6AW8
6AX7	6.3	300	10*	12AX7
	3.15	600		
6S4A	6.3	600	10	6S4
6SN7GTB	6.3	600	10	6SN7GTA
12AX4GTA	12.6	600	10	12AX4GT
12B4A	12.6	300	10*	12B4
	6.3	600		
12BH7A	12.6	300	10*	12BH7
	6.3	600		
12BK5	12.6	600	10	6BK5
12BQ6GTA	12.6	600	10	6BQ6GTA
12BY7A	12.6	300	10*	12BY7
	6.3	600		
12CA5	12.6	600	10	6CA5
12CU6	12.6	600	10	6CU6
12L6GT	12.6	600	10	25L6GT
12W6GT	12.6	600	10	6W6GT
25CD6GA	25	600	10	25CD6G

\*Applies to 600 Ma connection only.

In the hypothetical case just discussed, the voltage across the faster heating tube rose to a value well above its rated heater voltage. Such a repeated condition may result in heater failure. In television receivers employing standard receiving tubes this problem becomes more pronounced since we are then dealing with a much higher supply voltage, greater numbers of tubes, different values of heater resistance and a wide range of thermal characteristics.

### Thermistors Necessary

To limit surge voltage, television receivers with series-parallel heater combinations incorporate a negative temperature coefficient device, or thermistor, in series with the heater string,  $R_1$  Figure 1. The resistance of such a unit varies in a manner opposite to that of a tube's heater. That is, its resistance decreases with increases in temperature. In application, the high cold resistance of  $R_1$  limits the string current at the time the switch is closed. Since the voltage appearing across each tube is a direct function of string current, the maximum voltage that will appear across each tube's heater during warm-up will also be reduced. As  $R_1$  warms up, its resistance gradually decreases until normal operating conditions are reached. Although a negative temperature coefficient device greatly reduces surge voltages and currents occurring in series string heater

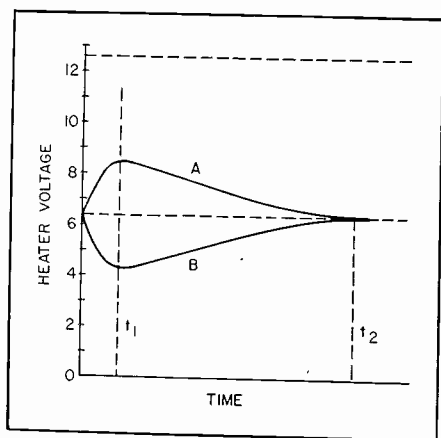


FIGURE 4

Variation of voltage across two average receiving tubes as they warm up, being connected in series across 12.6 volts.

circuits, it has its drawbacks. The expense of a thermistor is quite high, thus tending to reduce the saving secured through elimination of the transformer. A negative temperature coefficient device also increases the time required for stable receiver operation—an important factor in the eyes of the consumer.

### Steady State Conditions

Tube life and circuit performance, in addition to being influenced by power surges, are dependent upon steady state heater voltage. Operation at voltages above or below the manufacturer's recommended values may result in shortened tube life and/or poor set performance. The latter is particularly true in television receivers, due to the fact that some of the circuits are extremely critical.

The steady state division of voltage in a series heater string is determined by the hot resistance of each tube.

In production, variations in hot heater resistance are controlled by heater current limits, or tolerances. For example, a standard receiving tube having a 600 Ma rating may actually draw a heater current as low as 550 Ma or as high as 650 Ma at rated voltage. In terms of heater resistance, this means that tubes near the upper heater current limit have lower hot resistances and when placed in a string drawing 600 Ma, will have a lower than normal heater voltage. A tube near the lower heater current limit will have an abnormally high heater voltage. Tests have shown that these heater current production limits are not sufficient to insure proper heater voltage distribution in series heater circuitry.

### New Tubes for Series String Television

To facilitate the development of a practical series string television receiver, Sylvania Electric Products Inc. recently provided the equipment manufacturer with a complete line of tubes for series heater string operation. A list of these new tubes including ratings on heater voltages, heater currents, heater warm-up time and their prototypes is shown in Table 1.

All the types included in the new line incorporate 600 Ma heaters, permitting series string operation without parallel networks. Heater voltages are lower on all series string types whose prototypes have heater current ratings less than 600 Ma. For example, the 2T4 in the table, has a 2.35 volt, 600 Ma heater, whereas its prototype, the 6T4, is rated at 6.3 volts, 225 Ma. Series string types in this category also have increased heater wire size. These features tend to make the tubes more rugged from the standpoint of voltage or power surges.

To insure proper steady state operating voltages, heater current production tolerances have been reduced from  $\pm 50$  Ma for standard receiving tubes, to  $\pm 25$  Ma for all series string types. Slight variations in individual heater voltages will still be present in series strings. However, the magnitude of these variations should be relatively unimportant in properly designed circuits.

As previously discussed, one of the most difficult problems encountered in series heater circuitry is a practical method of reducing surge voltages caused by the nonuniform thermal characteristics of tubes. Surge voltages would not be present if all tubes had identical warm-up characteristics. Such a criterion is, naturally, impractical economically. However, thermal characteristics of tubes can be controlled.

At present, the generally accepted method of controlling thermal characteristics in production is by a "heater warm-up time" test. In this test, the measured time is that required for a heater, originally at room temperature, to reach 80% of its rated heater voltage after four times the rated voltage is applied to the heater in series with a fixed resistor. The fixed resistor is specified as three times the hot resistance of the tube's heater. For all types included in the new line of 600 Ma tubes, the heater warm-up time in the test described is approximately 10 seconds. This figure should not be confused with the time required for the receiver to become operative.

(Continued to page 8)

## Series String Television

(Continued from page 7)

A typical heater circuit, employing the newly introduced 600 Ma series string television tubes, is shown in Figure 5. The simplicity of the arrangement is evident by comparison with the series-parallel circuit of Figure 1. As previously stated, networks comprised of tubes and resistors are no longer required to obtain the complement. The series negative coefficient device employed in the circuit of Figure 1 has been replaced by a conventional, low cost fixed resistance. This resistance provides the voltage drop necessary for proper steady-state voltage distribution and gives additional protection against surge voltages and currents during the warm-up period.

With respect to receiver warm-up time, tests on experimental models employing new series string tubes and a fixed series resistor in place of a thermistor, have shown that a normal raster will appear 45 to 55 seconds after power is applied. This time is still somewhat longer than that required by a transformer type receiver. However, it represents approximately one third the time required for stable operation of a receiver utilizing a thermistor.

### Service Problems

In general, the techniques employed in servicing series string television receivers are much the same as those used with present transformerless radio receivers.

The most time consuming and frequently encountered service problem, in equipment utilizing series heater arrangements, is locating a tube with an open heater. With television receivers this is particularly true, because of the increased tube complement. A great deal of time can be saved by the following method, employing a minimum of equipment.

This system is based on the fact that line voltage is present across the socket pins of the bad tube. The only equipment necessary is a neon bulb, NE-45, to which probes have been connected via flexible leads. With the

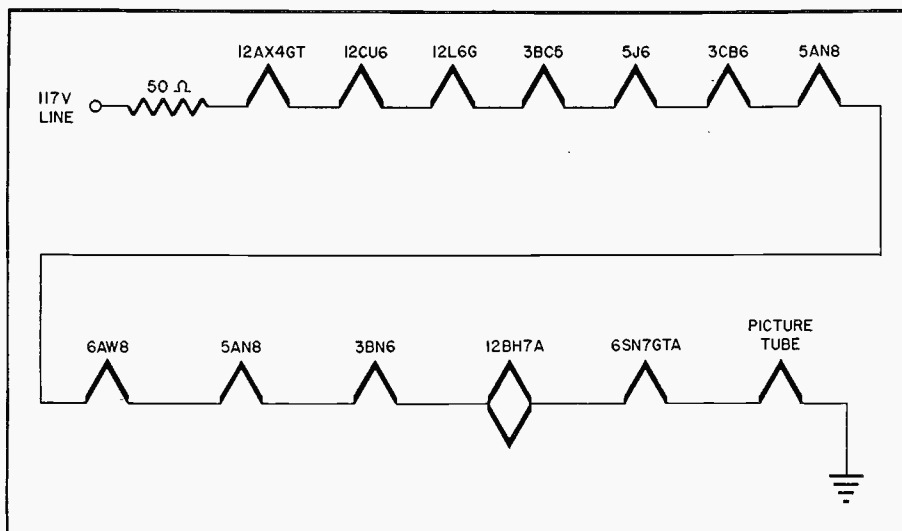


FIGURE 5—A television receiver series heater string using the new series string heater designed tubes.

receiver turned on, a tube is picked at random and removed from its socket. The neon indicator probes are then inserted in the heater pin terminals of the socket. If this happens to be the defective tube, the neon bulb will light. If not, the tube is reinstalled and the procedure repeated until the bad tube is located. (An a c voltmeter could be used in place of the neon indicator if so desired.)

Although an open heater may be speedily located by this method, it does not tell the serviceman why the tube burned out. Caution should be exercised to insure that the open heater was not caused by an earlier component failure.

Heater to cathode shorts also present a problem in series string circuits, since they are apt to be extremely misleading. For example, let us say that a tube in the string develops a heater—cathode short and that the cathode of this tube is connected to the ground end of the string.

Such a condition, depending on the tube's position in the string, may short out a large section of the string, thus, placing full line voltage across only a few tubes. As a result, the heater of one of these tubes will probably fail. Therefore, a heater-cathode short in one tube may cause heater failure in another tube. This problem is an inherent characteristic of all series heater arrangements. To minimize the occurrence of this situation, the majority of the new

series string tubes have increased heater-cathode voltage ratings. Further protection against heater-cathode failure is achieved in the receiver design by placing critical tubes near the low voltage end of the string.

Some confusion may be caused by the similarity in type numbers between series string tubes and standard receiving tubes. For example, the series string version of a 6SN7GT is 6SN7GTB, not 6SN7GTA. Strict attention should be given to the complete type number, including the suffix letter. The serviceman should be certain that defective tubes are replaced with series string types only. The prototype is not necessarily a satisfactory replacement.

### Picture Tubes

Picture tubes for series heater strings have not been introduced as a new line. Television picture tubes intended for transformer operation already incorporate a design center heater current rating of 600 ma and have relatively high heater-cathode voltage ratings. Narrowing of heater current limits, in agreement with the newly developed receiving tubes ( $600 \pm 25$  ma) and control of thermal characteristics in production, now provide the necessary protection against failure due to surge voltages or improper steady state voltage distribution. These changes have been made possible by a redesigned heater coil and closer wire weight tolerances.



# TECHNICAL SECTION

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William O. Hamlin, Technical Editor

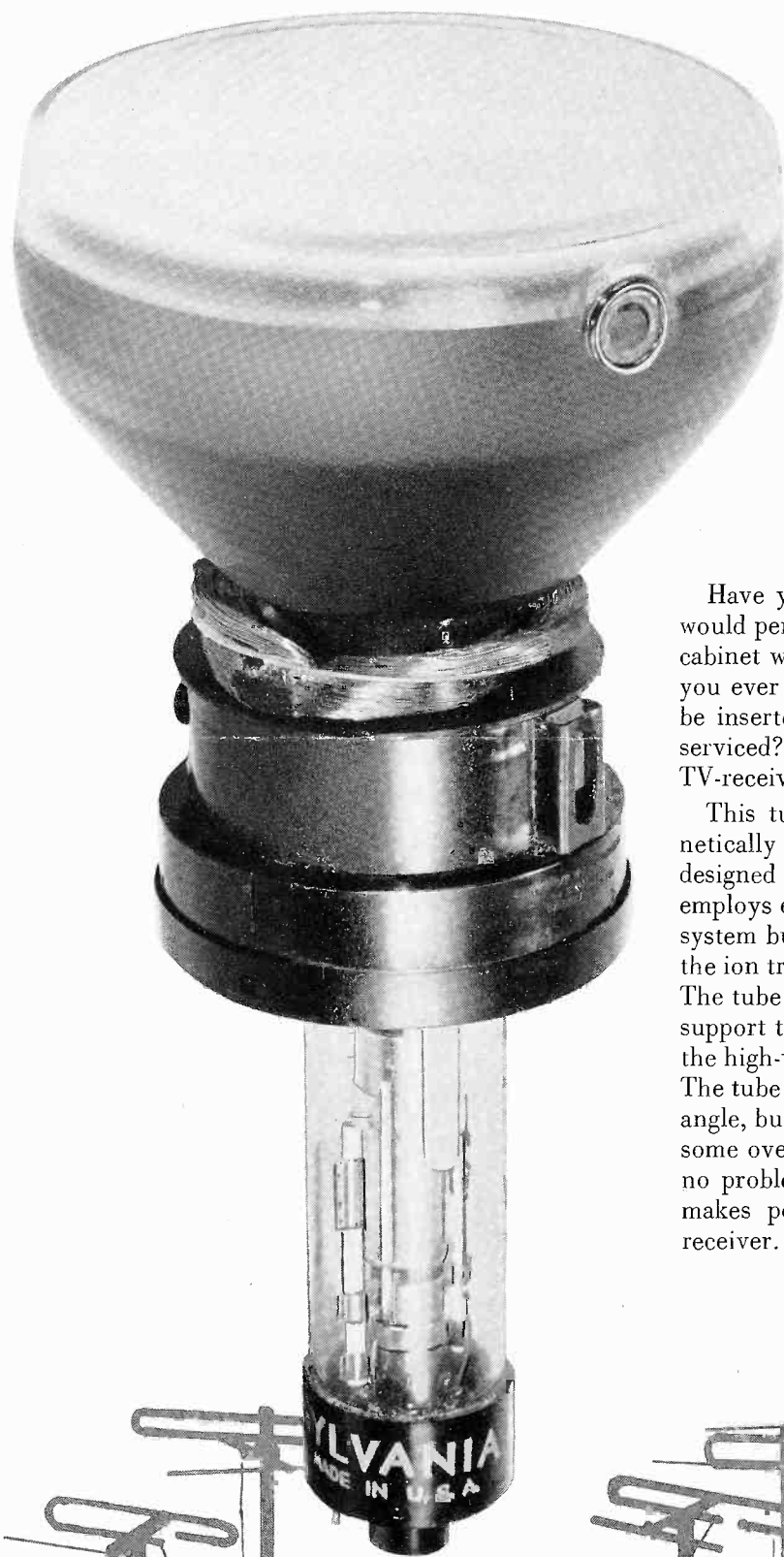
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## SYLVANIA'S NEW TELEVISION RECEIVER CHECK TUBE *Type 5AXP4*

Have you as a service dealer ever wished for a device that would permit the cabinet-mounted picture tube to be left in the cabinet while the receiver is being serviced in the shop? Have you ever wished you had a universal picture tube which could be inserted into almost any TV chassis while the set is being serviced? Realizing this need existed, Sylvania has designed a TV-receiver check tube tailor-made for these requirements.

This tube, Sylvania Type 5AXP4, is a 5-inch, round, magnetically deflected tube using electrostatic self-focusing. It is designed so that it can be inserted into any receiver which employs electromagnetic deflection. Since the tube has a focus system built into it, no focus mechanism needs to be used, and the ion trap should not be used while making tests on a receiver. The tube is so light that the yoke of the receiver will very easily support the tube. The only electrical connections required are the high-voltage lead and the picture-tube socket of the receiver. The tube may be used in any receiver regardless of the deflection angle, but when it is being used in a 90-degree deflection system, some oversweep of the tube face is experienced. This presents no problem, however, since the visible portion of the picture makes possible an accurate check on the operation of the receiver.

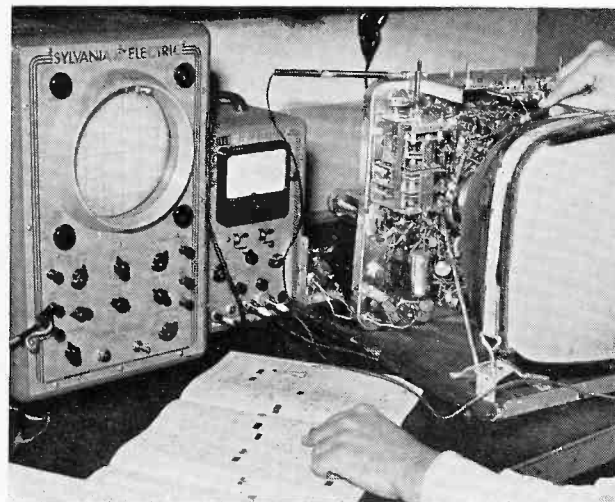
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**Figure 1**  
**Removing yoke from neck of a cabinet-mounted tube.**

There are several advantages to the service dealer afforded by the 5AXP4. To illustrate how it can be employed as a servicing tool, let us point out a few of its applications. One of the most time-consuming steps in the removal of a receiver from the cabinet is that of removing the cabinet-mounted picture tube. In many instances, several brackets are employed to hold the picture tube in the cabinet. The removal of these brackets not only takes considerable time but also exposes the tube to possible breakage. Since the Sylvania TV-receiver check tube can be used in the shop as a substitute for the original tube in the receiver, it is not necessary to remove the large tube from the cabinet. After the receiver chassis and the deflection yoke have been removed from the cabinet, they can be taken to the service shop where complete analysis of the operation of the receiver can be made. The ease with which the yoke can be removed from the picture-tube assembly is illustrated in Fig. 1.\* The focus assembly is removed



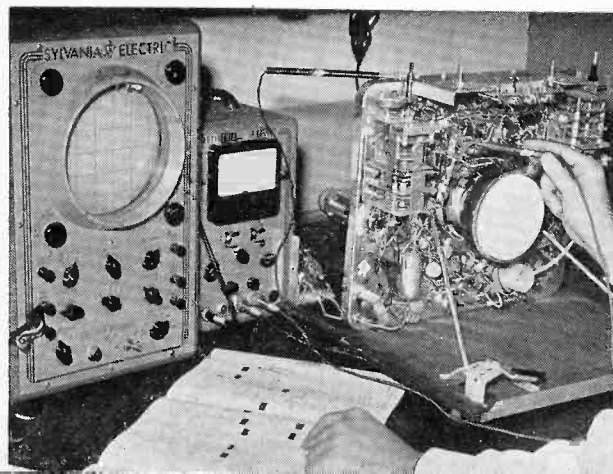
**Figure 2**  
**Measuring voltages on a vertical-chassis receiver.**

first, and the wing nut holding the deflection yoke is removed. The yoke can then be slipped off the neck of the tube, as shown in the illustration. After the receiver is placed on the bench in the service shop, the deflection yoke is slipped over the neck of the check tube and the picture-tube socket and high-voltage lead are connected. A thorough analysis of the receiver operation can then be made. This procedure of leaving the picture tube in the cabinet can be followed in almost every instance except in those cases in which the picture tube itself is suspected. If, however, the trouble in the receiver is obviously not being caused by the picture tube, there is no need for its removal.

This suggests another application for the TV-receiver check tube by service dealers. It is the use of the Sylvania 5AXP4 as a substitute for the picture tube in the receiver to determine whether or not the original tube is operating

\*Illustrations by courtesy of the Howard W. Sams & Co., Inc., Indianapolis, publishers of the PF REPORTER.

**Figure 3**  
**TV-receiver check tube mounted in a vertical-chassis receiver. Note accessibility of components.**



properly. The substitution for the picture tube presents quite a problem in many service shops, since it is not possible to stock all types of picture tubes. Thus, when a tube is suspected of being defective, there may be no real means of verifying the suspicion unless another tube can be substituted. It is true that a test of the tube on a reliable tester will indicate the condition of the tube in most cases, however, a more positive test is made through substitution. Since the installation of the 5AXP4 is a simple one, the substitution tests can be made in a minimum of time, and the results are very conclusive.

Another advantage offered by the 5AXP4 is its small size. Fig. 2 shows a receiver with a vertical chassis and its 17-inch picture tube mounted in place on the chassis. As can be seen in the photograph, the presence of the large tube causes some difficulty in making voltage measurements at the tube bases. This is particularly true of the tubes mounted near the deflection yoke and those mounted underneath the picture tube. If the 17-inch tube is removed from the chassis and the 5AXP4 tube is substituted for it, all tube sockets are readily accessible. This is illustrated in Fig. 3, which shows the same chassis with the check tube mounted in position.

Although it is possible to service the receiver with the picture tube removed from the chassis, certain symptoms which might be exhibited by the picture tube during the servicing procedure would not be present with the tube removed. Since the small check tube does present a picture, any symptoms which are exhibited while making voltage measurements or performing waveform analysis might present information that would be useful in servicing the set.

Fig. 4 shows the Sylvania TV-receiver check tube being mounted in a TV chassis. The size of the tube can be noted by comparing it with the technician's hands. After the tube is inserted in the yoke, several methods may be employed for holding it in position. Probably the simplest involves the use of a centering-magnet assembly such as that employed on many

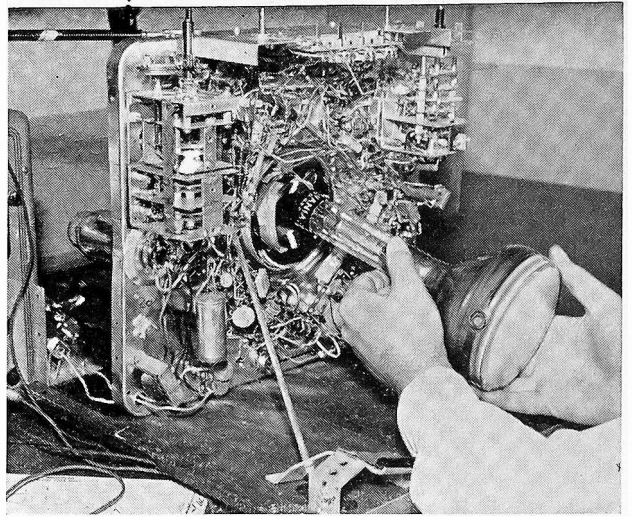


Figure 4. Installing the 5AXP4 in a TV receiver.

picture tubes. The centering magnets are removed from the assembly so that they will not affect the operation of the tube. Fig. 5 shows such an assembly after the centering magnets have been removed. These assemblies are readily available at parts distributors, and they work very satisfactorily in holding the 5AXP4 in position. To use this assembly, slide it over the neck of the tube after the tube has been inserted in the yoke and move the assembly forward on the neck of the tube until it comes in contact with either the chassis or the back of the yoke, whichever the case might be. Fig. 6 shows the assembly in position. There is sufficient tension to prevent the tube from sliding forward, and it is thus held in position.

The Sylvania 5AXP4 can be mounted permanently in a box with a deflection yoke mounted on its neck for use as a test assembly in the service shop. Such an assembly would be extremely helpful in shops that specialize in the servicing of a particular type of receiver. If such is the case, the yoke leads can be extended and terminated with the proper plug so that it can be plugged into the receiver under test. It should be pointed out that such an arrangement would not be completely universal, since the variation in the inductances in the horizontal and vertical windings of the yoke vary considerably among receivers. One means of overcoming this would be to mount the tube permanently in a box so that the neck of the tube is free from any mounting brackets. The yoke of the receiver under test can then be quite easily slipped over the neck of the tube, and the servicing can be efficiently performed. Of course, it would be necessary to provide for extension of the high-voltage lead as well as the leads to the base of the tube, but this presents no great problem.

As stated previously, the Sylvania 5AXP4 TV-receiver check tube is self-focusing and does not require any external focus assembly. In receivers

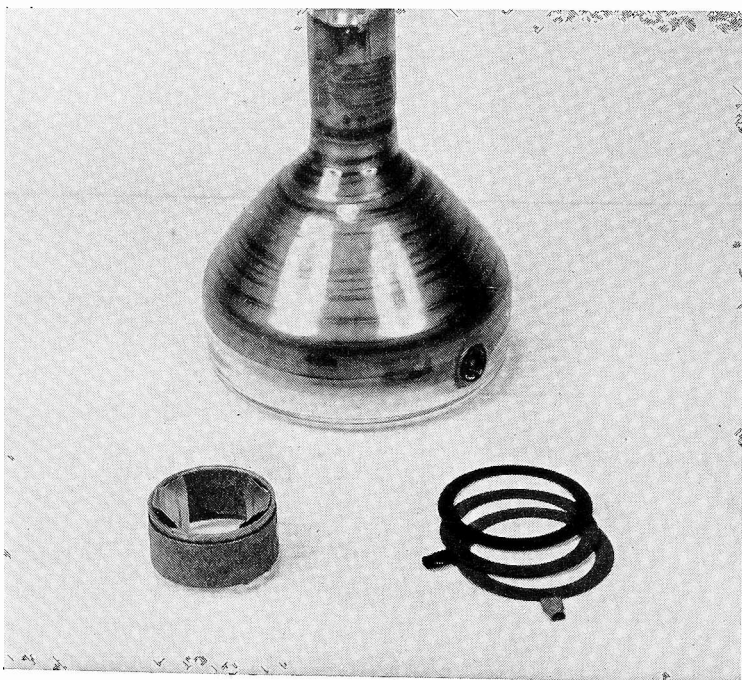


Figure 5. A centering-magnet assembly with the centering magnets removed.



which have the focus assembly mounted directly to the yoke in such a way that it cannot be removed, some defocusing of the picture will be experienced. It is usually not so severe, however, that it prevents satisfactory operation of the tube.

The characteristics and ratings of the 5AXP4 are such that it works equally well over a wide range of voltage inputs. This makes the tube a truly universal unit. The quality of picture which is obtainable through the use of a 5AXP4 is illustrated in Fig. 7. It should be pointed out at this time that final linearity adjustments should be performed on the picture tube which is installed permanently in the receiver. However, approximate adjustments can be made while the 5AXP4 is mounted in the chassis. Only slight touch-up adjustments are then required when the large tube is reinstalled.

Normally, a picture tube would not be considered as a tool; but the Sylvania 5AXP4 is just that. During certain tests, it can provide very conclusive results which heretofore have been a sort of hit-and-miss proposition. This is particularly true when the tube is used to substitute for a

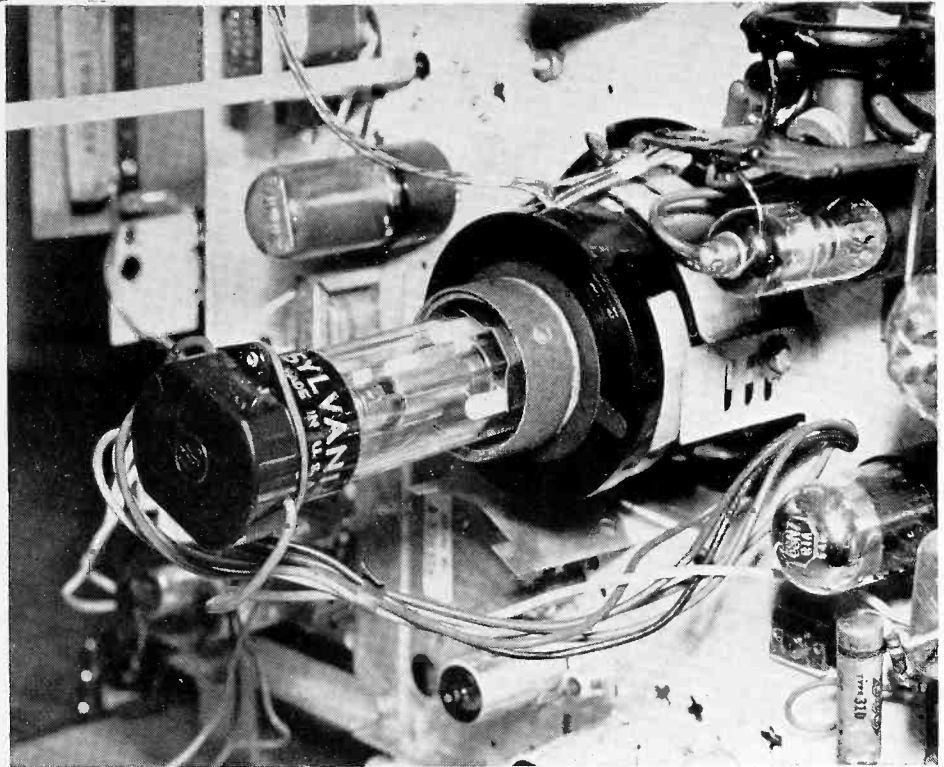


Figure 6. Modified centering assembly in place on the neck of the tube.

suspected picture tube. The use of the 5AXP4 eliminates the necessity of removing cabinet-mounted picture tubes, and thus considerable time is saved. Because of its small size and

weight, the 5AXP4 can be used in place of the large picture tube to make the receiver chassis lighter and more manageable during the servicing operation. The use of the 5AXP4 lessens the implosion hazard and eliminates any risk of damage to the customer's picture tube.

These are only a few of the many applications for the Sylvania 5AXP4 tube. Sylvania engineers have designed it with versatility in mind. Because of this versatility, the tube will be used in an even greater number of applications by service technicians.

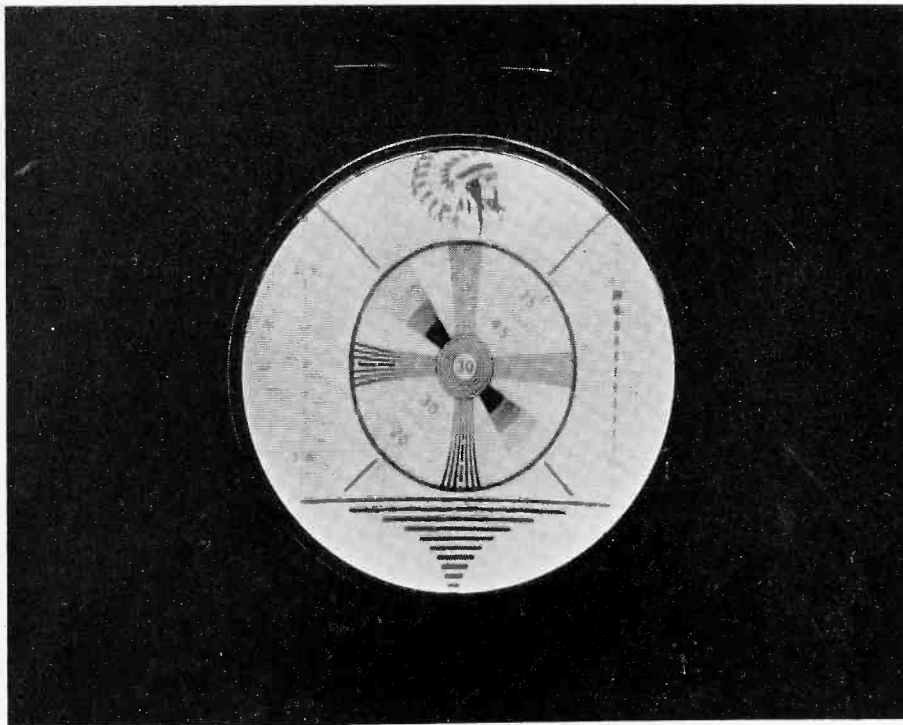


Figure 7. Test-pattern display on the 5AXP4 mounted in a receiver having 90-degree deflection.

### CORRECTION FOR SYLVANIA TUBE TESTER CHART

All owners of the Sylvania 219/220 Tube Tester should correct roll chart for Type 12AU7 and 12AU7A. In column "D" change number 35 to number 41.

# TECHNICAL SECTION

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R. A. Humphreys, Technical Editor

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## A Chat With Roger Wise

(Chief Engineer, Sylvania Products Company)

### BARIUM FEATURE OF POWER TUBES

Many precautions are taken in the manufacture of Sylvania radio tubes to free the parts completely from gas. One of these precautions is the heating of the walls of the bulb, since an absorbed layer of gas clings to these walls and is released at a very slow rate unless the temperature is raised almost to the melting point of the glass. Another precaution is the heating of the nickel parts to a red heat so that the small amount of gas which is present in the interior of the nickel will be released and pumped away.



Roger Wise

As the last step in securing a high vacuum, an active metal, such as magnesium, is vaporized in the tube and deposited on the walls of the bulb. This material, technically termed a "getter", combines with the slight remaining traces of gas and thus permanently disposes of it. While magnesium is quite satisfactory for the small tube types, it is not very rapid in action, and some need has been felt for a more satisfactory material for the larger tube types, particularly those using carbonized (blackened) plates, which have a tendency to give off larger quantities of gas than is the case with the smaller, bright nickel plates.

An ideal material for this purpose is barium, which is so active that it cannot be exposed to the air at any time, as it rapidly oxidizes and becomes inoperative. This material is now being used in all of the larger Sylvania tubes in addition to magnesium, and has proved to be exceptionally efficient for the purpose. Even when severely overheated, there is no trace of gas apparent in the bulb of such tubes, and readings of the reversed grid current which normally indicates gas, are exceptionally low. This additional protection is a form of insurance to the user that he will obtain the service he is entitled to expect from these sturdy Sylvania power amplifier and rectifier tubes.

### NEW TUBE TYPES

When a burst of enthusiasm about a new tube is heard, there is a natural temptation to forget the disadvantages which may be known or anticipated, and to mention only the merits of the device in question.

It was with interest that we examined a few "new" tubes of a type similar to some which were built experimentally here some time ago, and discarded for several reasons, one being the fact that one of the constants was unsuited to set design purposes. Measurement failed to reveal much progress in overcoming this particular defect, and we question the future of the particular model.

It is always safe to wait until the merits of a new tube are proven in service before deciding just what types will be rendered obsolete by the new comer.

### CATHODE PREPARATION

In the preparation of the cathodes for the heater type of tubes such as SY-227 and SY-224, a uniform coating of the active materials is secured by the use of a spray gun. The cathodes are placed in a frame in which only the portions to be coated are left uncovered. The cathodes are then exposed on all sides to a carefully regulated spray, care being taken to keep the time of exposure constant, in order to secure the same weight of coating material on each cathode. Individual cathodes are selected and weighed to ascertain that the proper limits are not exceeded.

After coating, all traces of the liquid are removed from the cathode surface by baking the complete pieces in a special oven for the proper length of time. The coating left on the thin nickel sleeve consists, at this stage of the process, of the carbonates of barium and strontium, together with a binder which prevents the carbonates from crumbling off while the cathode is being mounted.

Among other details which distinguish this use of the spray gun from the ordinary applications is the careful filtering of the air, which is carefully purified to prevent contamination of the cathodes by any impurity. Such precaution at every stage of the process makes it possible to maintain uniformly high quality in the finished product.

A QUARTER OF A CENTURY AGO, when SYLVANIA NEWS was a stripling, the "Technical Section" consisted of a single-column "Chat with Roger Wise."

Today's modern serviceman, vastly more experienced and learned than his father, would find many of the original technical articles too fundamental.

The things that are fundamental now were innovations then, however—and the presentation of astounding technological advances just as startling in that era as color television is today.

When SYLVANIA NEWS publishes its FIFTIETH ANNIVERSARY ISSUE, the servicemen of 1980 will undoubtedly say of the 1955 series on Color Television, "My Lord! Did they have to have such simple stuff explained to 'em!"

In 1955, however, the series SYLVANIA NEWS is doing on Color Television is the result of the most recent research developments in the industry. It encompasses discoveries and developments in the field of color right up to press time of February, 1955. And since color is the newest science in America today, the editors asked Messrs. Lankard and Allen to include one of the articles in their series in this issue to appropriately launch SYLVANIA NEWS' second 25 years.

# Color TV receiver circuitry

## COLOR TV FOR THE SERVICEMAN—PART III

By G. M. LANKARD and J. S. ALLEN

**I**N parts I and II of this series, "Color TV for the Serviceman" which appeared in previous issues of SYLVANIA NEWS, we covered the fundamental principles of the NTSC color standards and color picture tubes. We are continuing the series in this issue by comparing the familiar black-and-white television receiver with a typical color receiver, both similar in many respects. It is hoped that such a comparison will facilitate the transition from black-and-white to color for the serviceman, and simplify color television circuitry for him.

### RF SECTION

We find that the same tuner may be used for either receiver, since tuners are usually broad enough to pass all the information contained in the 6 mc channel. UHF converters, likewise, should be equally satisfactory for color or black-and-white reception, as they also have fairly broad inputs and outputs.

### IF SECTION

The if circuit design is basically the same for either color or monochrome. The frequency response for color must, however, be broader than that encountered in most black-and-white receivers. A typical color set if response curve is shown in Figure 1. Note that the picture carrier is 6db or 50% down from maximum response. The flat-top portion, however, covers a wide range of frequencies and extends closer to the sound carrier than is usually encountered in black-and-white practice. This is necessary in order that the chrominance subcarrier sidebands may be passed faithfully. The flat-top should extend to 4.1 or 4.2 mc below the picture carrier location. If the flat-top portion of the if bandpass does not extend far enough from the picture carrier, the resultant picture will suffer from degraded color, insufficient color, or complete loss of color. It then follows that if alignment in color receivers is very important

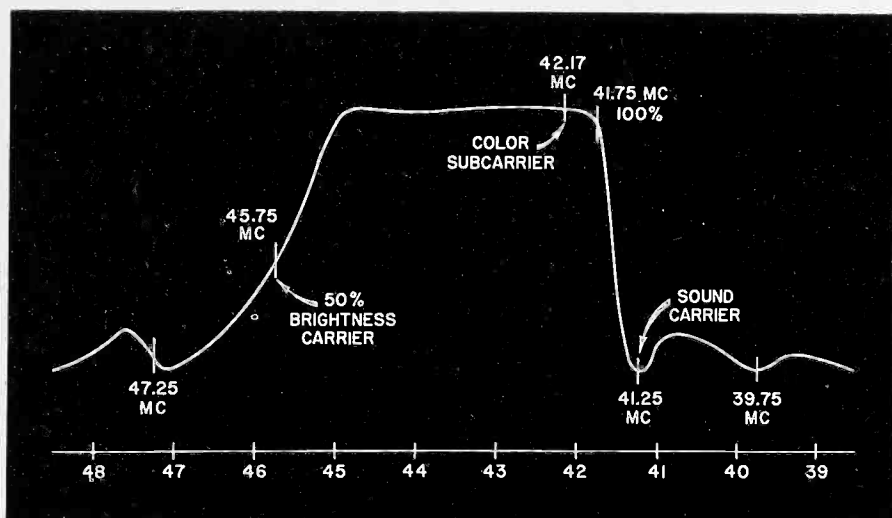


FIGURE 1.  
A typical Color Receiver IF response curve.

and more critical than in monochrome where often loose approximations of proper i f bandpass are tolerable.

Higher attenuation of the sound carrier is required in color i f amplifiers. The amount of attenuation necessary is a subject of some controversy, the figure ranging from 40 to 60 db. The exact value is not important here, but it should be noted that this high attenuation must be achieved in the space of less than half a megacycle which requires not only careful i f design, but careful and accurate alignment. Insufficient attenuation of the sound carrier in the i f will result in a 920 kc beat, which is the difference between the 4.5 mc sound carrier and the 3.58 mc color subcarrier. The effect of this 920 kc beat can be seen in Figure 2 left as compared to the proper scene shown in Figure 2 right.

Improper tuning of the station will also result in obtaining this 920 kc beat. The receiver should be tuned for a minimum visible beat which indicates proper placement of the carriers with respect to the fixed i f bandpass. Tuning too far downward on the response curve will result in loss of color and increase in sound carrier, since the i f response drops off rapidly below the color subcarrier and increases below the sound carrier. It is essential then that the sound i f carrier falls into the high attenuation notch in the i f response curve.

Although the high sound carrier attenuation is required to reduce 920 kc beat-note visibility, it poses some problems in recovery of the sound, because the 4.5 mc intercarrier beat is also of very low amplitude following the video detector. It is customary, therefore, to add a separate detector for sound recovery that obtains its signal ahead of the video detector. The usual point of connection is at the plate of the last i f amplifier. The sound is taken off at this point before the picture detector and its accompanying sound carrier trap. The sound carrier trap is necessary to minimize the 920 kc beat. It is usually necessary to add an additional stage of 4.5 mc i f amplification before the sound discriminator or ratio detector. Beyond this point, color and monochrome sound sections are identical.

FIGURE 2.



*Color Picture with 920 kc beat.*



*Proper Scene with no beat present.*



## VIDEO SECTION

The circuitry following the video detector is subject to considerable variation depending on the receiver design. One representative arrangement is illustrated in Figure 3. In our example the detector is followed by two stages of video amplification. The first is a wide-band stage employing a high gm pentode such as a Type 12BY7, which performs the following functions.

First, the color video information is obtained from the cathode and is passed to the chrominance bandpass amplifier through the color contrast control. A 4.5 mc trap is contained in this circuit to (a) further reduce the possibility of the occurrence of 920 kc beat-note in the color demodulators and (b) prevent the passage of 4.5 mc sound information to the second video amplifier.

Second, the plate circuit of the first video amplifier contains normal video peaking components as well as a coupled 3.58 mc tuned circuit. The information obtained from the 3.58 mc trap is passed to the burst amplifier and eventually utilized for color synchronization.

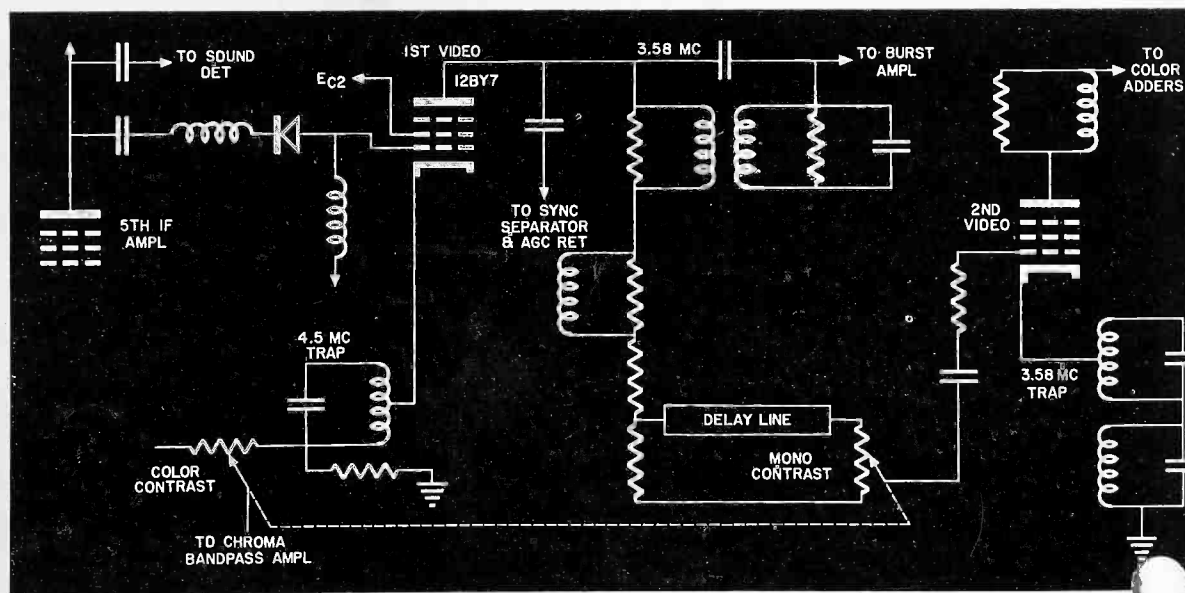
Third, the video signal from the plate is passed through a section of delay cable to the monochrome or luminance contrast control which feeds the grid of the second video amplifier. The monochrome control is ganged with the color contrast control in order that both the monochrome and color signals fed to the picture tube may be varied simultaneously and retain proper color balance. For those not acquainted with delay cable, this is a special

form of coaxial cable in which the inner conductor is a spiral of fine wire rather than a straight conductor. Such a construction produces a cable the electrical length of which is much greater than its physical length and thus provides a convenient method of delaying electrical signals. The delay cable is necessary so that both the luminance and color information which traverse different paths in the receiver will arrive at the color adders (color interpretation circuits) in step with each other. The color signals pass through circuits of narrower bandwidth than the luminance signal with the result that they are delayed more, and the cable is inserted to produce a compensating slow-up of the luminance signal.

Fourth, the sync signals and a g c are removed from the plate of this video amplifier and supplied to their respective amplifiers and control circuits. The second video amplifier supplies luminance information to the matrixing amplifiers or color adders. A 3.58 mc trap is placed in the cathode to prevent the color subcarrier component from appearing on the picture tube. Presence of 3.58 mc subcarrier on the picture tube would result in a herringbone interference pattern quite similar to that shown in Figure 2 left.

When a black-and-white transmission is received, the signal produced at the plate of the second video amplifier will result in a black-and-white picture. During a color transmission this signal, when mixed properly with the outputs of the color demodulators, will produce a color picture.

FIGURE 3.  
*Video Detector and  
Video Amplifier Circuitry  
of a Color TV Receiver.*



# COLOR TV FOR THE SERVICEMAN PART V

## Deflection, High-Voltage and Focus Circuits

By G. M. Lankard

The sync separators and a g c circuits used in color tv receivers are basically the same as those used in present black and white receivers. The sync is removed from the first luminance video amplifier which corresponds with the first video amplifier in monochrome receivers.

Keyed a g c, provided by a pulse from the horizontal output transformer, is employed and is similar to that used in some black and white receivers. This form of a g c has the advantage that it is relatively immune to the effects of noise since the noise pulses, which are greater than the sync, can be clipped off.

The horizontal oscillator is of the conventional type, either

a blocking oscillator or multivibrator.

It will be well to mention here the two types of picture tubes presently in use. The original three-gun tube which was used in earlier model color receivers was described in detail in "Tri-Color Television Picture Tubes"—July-August, 1954 SYLVANIA NEWS, and is of the flat mask type, 15GP22. A few thousand color receivers were manufactured using this type picture tube and it is possible that the tv serviceman may be called upon to service them. The 21AXP22 is a 21" three-gun picture tube of the curved mask type. The curved mask allows a simpler form of convergence to be used (to be discussed later).

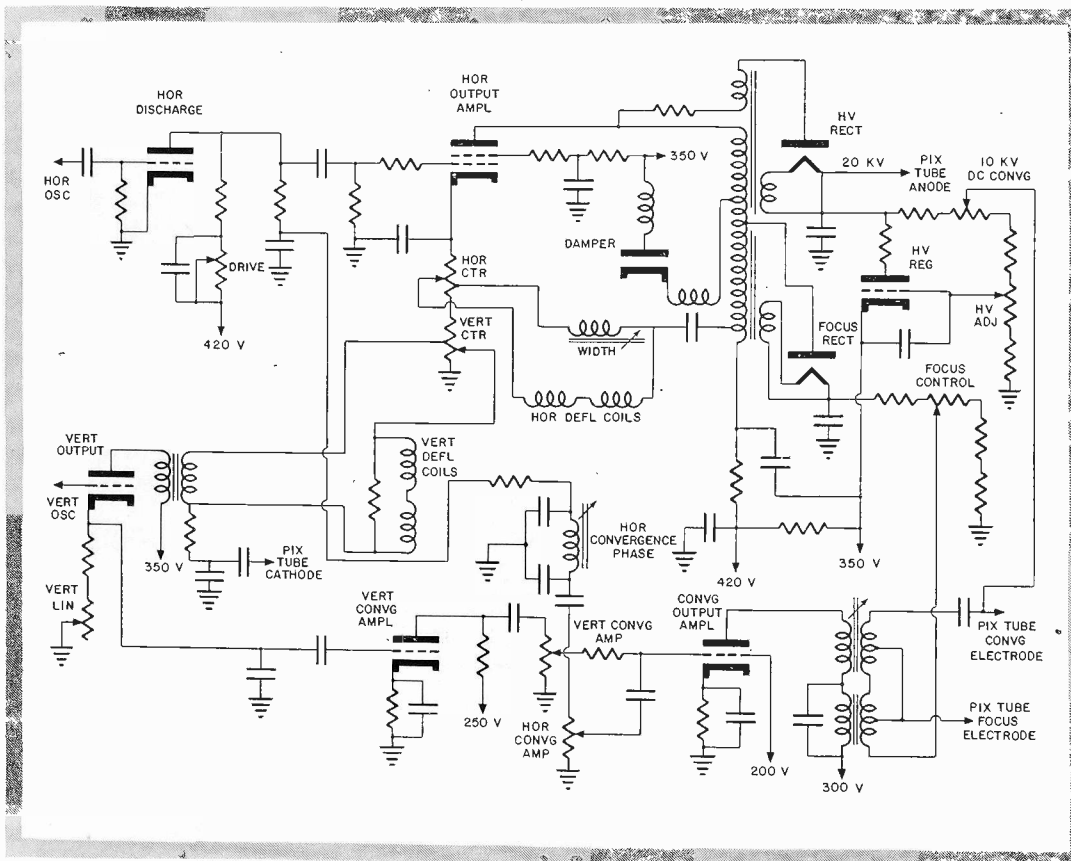
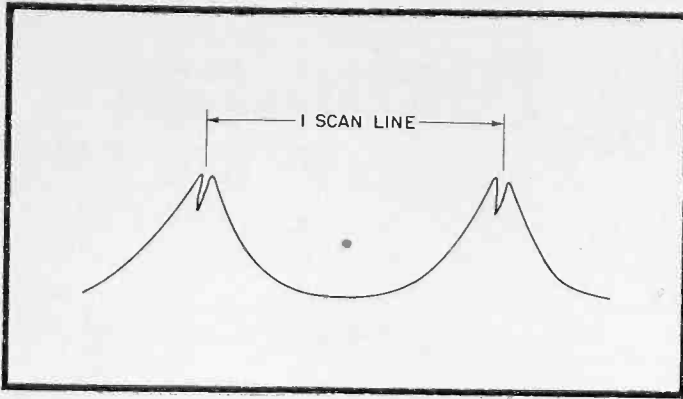


Figure 1

Schematic of deflection, convergence, H-V and focus of a color tv receiver using a 15GP22 color picture tube.



**Figure 2**

*Typical waveshape of dynamic convergence voltage required for horizontal convergence and focus.*

### **Horizontal Output Circuit**

The horizontal output circuit must produce the horizontal deflection current, picture tube anode voltage, focus voltage, and in the case of the 15GP22, static convergence voltage. Electrical centering is used instead of magnetic.

The 15GP22 requires an anode voltage of approximately 18 to 20 kilovolts. This voltage is obtained in the conventional manner; i.e., through rectification of the high voltage pulses produced across the horizontal deflection transformer (Figure 1). Static convergence voltage, approximately 10,000 volts, is obtained by a voltage divider in the high voltage circuit.

Uncommon to high voltage supplies in black and white receivers, an additional tube is employed in color receivers to regulate the picture tube anode voltage. This tube is connected, effectively, across the high voltage output circuit and operates as a shunt type triode regulator. Variations in high voltage caused by changing brightness in the televised program are absorbed by the regulator. If the high voltage were unregulated and allowed to change, the convergence and focus would likewise change with the scene brightness.

Focus voltage is obtained from a tap on the high voltage transformer and a separate rectifier.

### **Dynamic Focus and Convergence**

The necessity of convergence for a three-gun color picture tube was described in "Tri-Color Television Picture Tubes"—July-August, 1954 SYLVANIA NEWS. Dynamic focus and convergence voltages are superimposed onto the DC focus and convergence voltages to maintain constant focus and convergence over the entire picture area. The horizontal dynamic voltages may be taken from the plate circuit of the horizontal discharge tube and applied to the grid of a convergence amplifier through the horizontal dynamic convergence amplitude control (Figure 1). This voltage has a parabolic waveshape approximately that shown in Figure 2. It can be seen from Figure 2 that the waveform rises to a peak at each end of the scan cycle and is a minimum at the center. This voltage, which rises to a peak of about 1500 volts at the maximum peaks, is superimposed onto the DC static convergence and focus voltages in order that convergence can be maintained at the edges as well as in the center of the screen, since the beam of a flat mask tube travels farther to reach the edges.

The vertical dynamic focus and convergence voltage is obtained from the cathode of the vertical output tube and is

applied to the grid of the convergence amplifier tube through the vertical convergence amplitude control in the same manner as the horizontal convergence voltage. The waveshape of the vertical dynamic focus and convergence voltage is similar to that shown in Figure 2 for the horizontal.

The horizontal dynamic convergence and focus transformer primary is in series with the primary of the vertical dynamic convergence and focus transformer (Figure 1). The two secondaries are tapped to provide the proper ratio of dynamic convergence to dynamic focus voltage. The dynamic convergence voltages are then capacitively coupled to the convergence electrode of the picture tube and added to the DC convergence voltage, while the dynamic focus voltages are series coupled to the focus electrode and added to the DC focus voltage. Horizontal and vertical dynamic convergence and focus voltage waveshape is controlled by the horizontal dynamic convergence phase control and vertical dynamic convergence phase control, respectively, found in the grid circuit of the convergence amplifier.

### **Purity**

A purity coil is required for proper alignment of the three beams with respect to the phosphor-dot plate and shadow mask. (The three beams, from the red, green and blue guns, are caused to converge at the aperture mask and thereafter will fall on their respective phosphor dots on the faceplate.) This coil is mounted on the neck of the picture tube directly behind the deflection yoke (Figure 3). Purity adjustments are made by rotating the coil and at the same time varying the DC current passing through the coil. To obtain the necessary current, approximately 150 maDC, the coil is usually connected in series with a source of low DC voltage.

A field neutralizing coil is required to neutralize the effects of extraneous fields, such as transformers or other magnetic fields in the immediate area, which affect the purity of the raster. Even the earth's magnetic field has an effect on the color purity. The field neutralizing coil is located around the outside edge of the faceplate of the picture tube. Neutralization is accomplished by varying the DC current through the coil, in the order of 100 ma in either direction.

Beam positioning magnets and a neck shield are also necessary to obtain proper purity and convergence. The neck shield is clamped around the neck of the picture tube directly behind the purity coil (Figure 3). Its purpose is to shield the electron beams, in the vicinity of the guns, from stray magnetic fields such as those caused by transformers. The neck shield is extremely important since the presence of stray magnetic fields may make it impossible to obtain proper purity and convergence.

Housed within the neck shield are three beam positioning magnets, one for each electron gun. The magnets are mounted in the neck shield and positioned directly opposite the three guns. The adjustment screws protrude through the neck shield as shown in Figure 3. Adjustment of the beam positioning magnets assists in proper alignment of the three electron beams with respect to each other.

### Brightness and Screen Grid Controls

The remaining requirement in setting up a three gun color picture tube is the adjustment of the bias and screen grid voltage controls so as to produce a black and white picture in the proper shades of gray without objectionable color shifts for different brightness levels. Three brightness controls, the blue, green and master brightness controls, are provided to adjust the bias on the grids of the picture tube. They are adjusted to produce a white raster by properly proportioning the amounts of the three colors. The master brightness control is usually located on the front panel of the receiver and corresponds to the brightness control on a black and white receiver.

Three screen controls are provided to permit separate adjustment of the screen grid voltage of each gun. The voltage required for both the screen and bias controls is approximately 400 volts DC.

### Low Voltage Supply

The low voltage power supplies are of the conventional type used in black and white television receivers, except that considerably more current capacity is required by present color receivers. B+ voltages of about 400 volts are required, which is somewhat higher than in black and white receivers. Other voltages required for lower voltage circuits and negative bias voltages are removed from the same power transformer. Several filament windings are provided for isolation purposes.

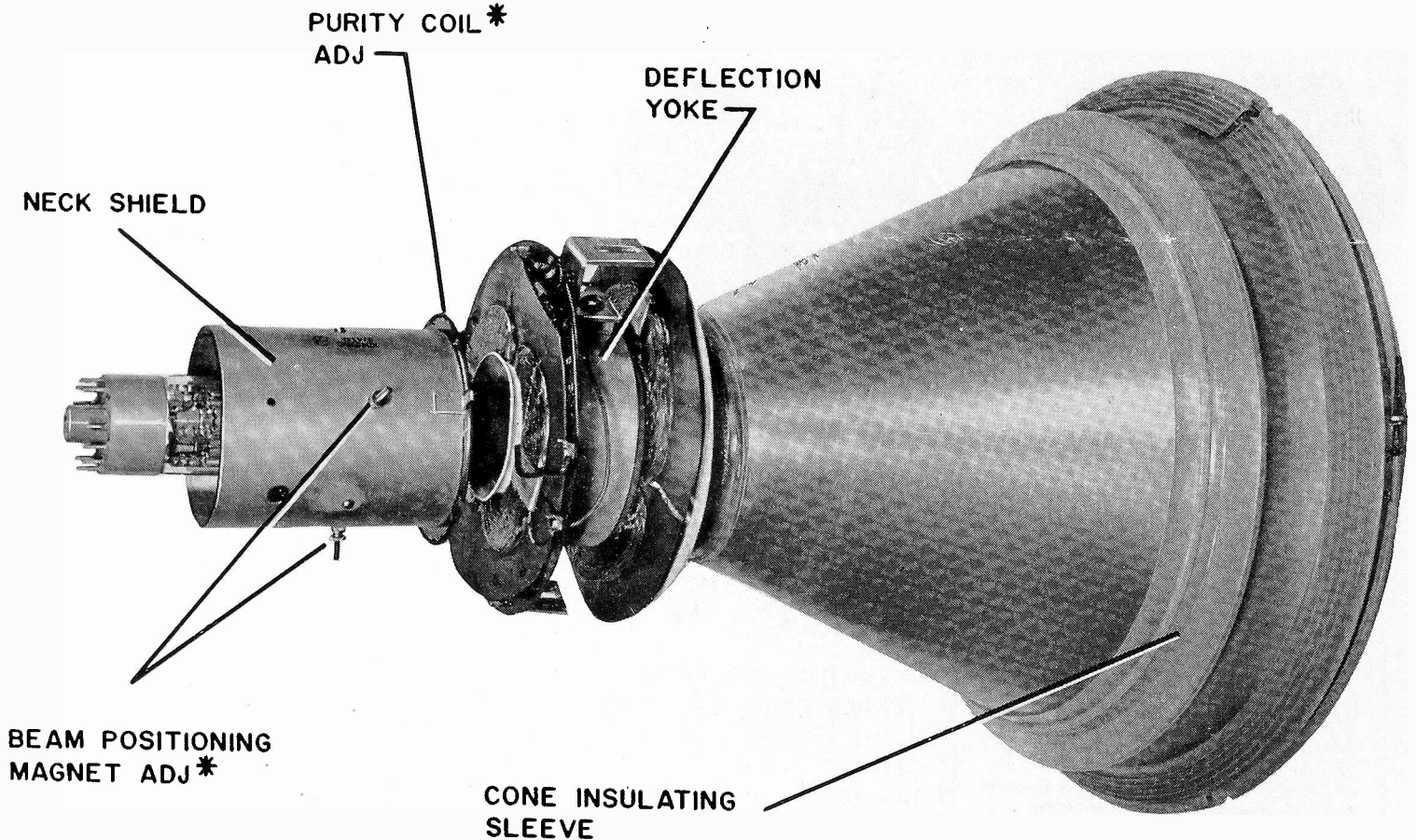


Figure 3

Photograph of 15GP22 — The cone of this tube is constructed of metal and is covered by a high voltage (20 kv) insulating sleeve. The deflection yoke is mounted on the neck of the tube at the base of the cone. The purity coil adjustment can be seen at the front edge of neck shield. The beam positioning magnet adjustments protrude from the neck shield. (\*The actual purity coil and beam positioning magnets are housed within the neck shield.) The field neutralizing coil (not shown) encircles the faceplate of the 15GP22.

# SYLVANIA POLYMER HINTS

Models 301 and 302

## 3 VAC Range Meter Deflection

The Sylvania Polymer user sometimes puzzles over the high meter deflection with open test leads on the low voltage AC range (3 volts AC). This occurs due to the instrument's extremely high sensitivity and high input resistance. However, it is not detrimental to the instrument and does not result in erroneous voltage measurements. When the test leads are connected to a circuit the meter will give a correct reading, because the polymer input does not build up a charge with a closed test lead circuit.

If the open test lead circuit condition is annoying, it may be cured by a simple modification. Connect a .01 uf 600 V capacitor from the *Common Lead* to the polymer chassis. It may be soldered permanently into the instrument, because there is no detrimental effect to meter operation.

## Accuracy of Instrument

It is often desirable to know the degree of reliability to which

an instrument reading may be considered. Sylvania Polymer accuracy is given in the table below. These are maximum tolerances allowed on the instrument so that the average instrument will be somewhat more accurate than these tolerances indicate.

D C Volts All Ranges	—±4% of full scale	
A C Volts All Ranges	—±6% of full scale	
Peak to Peak Volts All Ranges	—±6% of full scale	
Ohms	±10% All Readings Left of Half Scale	
	±15% All Readings Half to ¾ Scale	
D C Current All Milliampere Ranges	±3% of Full Scale	
	1 and 10 Ampere Ranges ±5% of Full Scale	

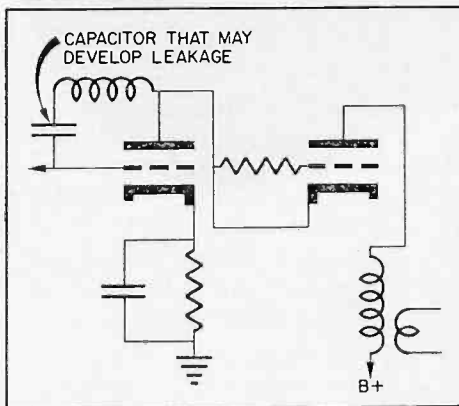
R F Volts (on 302 only)

RANGE	10 KC to 100 MC	100 MC to 300 MC
3V	6%	11%
10V	6%	11%
30V	8%	13%
100V	8%	13%
300V	11%	16%

## SERVICE HINTS



**CASCADE TUNER TUBE REPLACEMENTS** In some cascode tuners, it is sometimes necessary to repeatedly replace the tube (6BQ7A, 6BZ7 or 6BK7A). Actually, the tube is receiving a lot of unwarranted attention, because the trouble is elsewhere in the tuner.



What sometimes happens is that the neutralizing capacitor develops leakage, thereby removing bias from one section of the cascode amplifier tube

(see schematic). The lack of bias causes the new tube to be damaged in short order.

A quick check of this condition is the temperature of the tube. Too little bias or no bias will cause the tube to be excessively hot. If the condition is serious, the plates may become red.

—W. K. B.

## COMBINATION TV CHEATER CORD AND OUTLET

When servicing TV's (or radios) in the home, I find the cord shown at right handy to carry in my tool kit, especially if there is only one receptacle near the set being serviced. The sketch is self explanatory and the multiple outlet block can be purchased from a dime store. Adding the "cheater", a short extension cord and lamp completes the job.

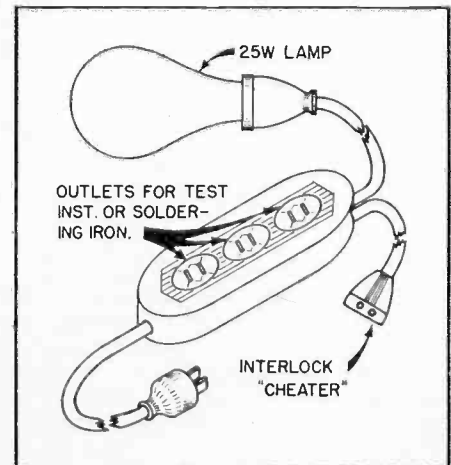
—GUY MEASLES,  
Beaumont, Texas.

**DRILLING AND SOLDERING HINTS** 1. The use of small paper "Jelly cups" will usually avoid spread-

ing steel chips from drilling operations throughout a chassis.

2. Paper tubes rolled from an 8½ x 11 sheet of paper serve very nicely when using a rat-tail file to enlarge holes for a slightly larger component.
3. Narrow strips of asbestos paper will protect delicate peaking coils and other components from accidental damage when wrapped around the soldering iron tip and even the body of the iron itself.

—DECAMILIS RADIO SERVICE,  
Inkster, Michigan.





# COLOR TV FOR THE SERVICEMAN PART VI

By G. M. Lankard

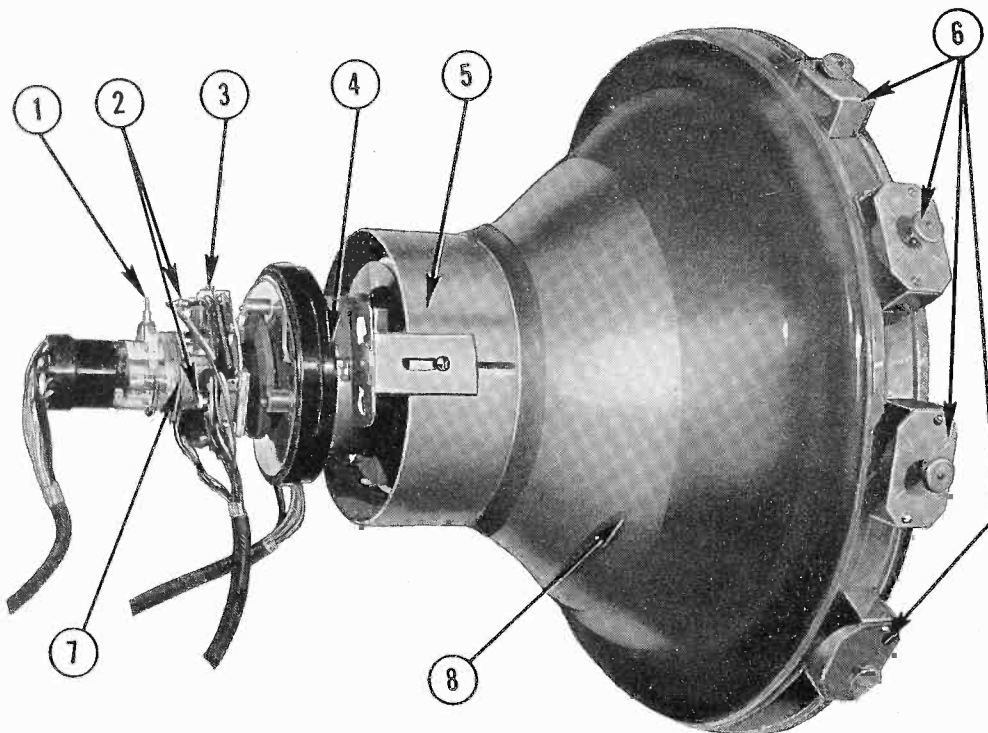
### More Recent Receivers

The more recent 21" color picture tube employs a curved shadow mask and faceplate with the three-color phosphor dots placed directly on the faceplate. You will recall that the 15GP22 employed a flat shadow mask and separate flat plate on which the phosphor dots were located. The curved shadow mask and faceplate simplify the convergence considerably in that the electron path to the edge of the screen is not much greater than to the center of the screen.

Permanent magnets are used for purity, convergence and field neutralization adjustments. Convergence magnets are applied to each gun separately. The high voltage DC convergence electrode with its parabolic shaped voltage is not present in the new 21" color tube (Type 21AXP22).

### Convergence

A small yoke which consists of three sets of permanent magnet cores and coils, one for each electron gun, is situated directly behind the deflection yoke on the neck of the picture tube. Figure 1. Each of the three convergence units consists of a horseshoe magnet type assembly. In the "U" portion of the horseshoe is located a cylindrical permanent magnet. The legs of the assembly protrude to the neck of the picture tube directly over a pair of metal strips through which the electron beam must pass. Rotation of the permanent magnet provides a DC convergence adjustment for that particular electron beam.



**Figure 1** The picture tube is mounted against a plastic ring (not shown) and supported by means of pressure against the deflection yoke shield (5). Around the periphery of the face are mounted the field neutralizing magnets (6). The deflection yoke (4) is inside the yoke shield. The convergence yoke (3) is directly behind the deflection yoke. The small thumb screws visible on two of the assemblies are the static convergence magnet adjustments (2). The small ring (7) behind the convergence yoke is the purity yoke. The blue beam-positioning magnet, which looks like an ion trap, is positioned directly over the blue gun (1). The cone of the picture tube is metal and therefore, a high voltage (25 Kv) shield is required (8).

Dynamic convergence is obtained by means of the coil assemblies. A coil is wound over each leg of the horseshoe-shaped unit and through them pass the vertical and horizontal parabolic-shaped currents necessary for producing the parabolic magnetic fields required for proper convergence beyond the center of the raster. Adjustment of the phase and amplitude of the current flowing through the coils determines the dynamic convergence for each beam.

No extra tubes are required for the dynamic convergence currents. The vertical parabolic current is obtained from the vertical output tube, through a shaping network, Figure 2. The current is taken off through the center arm of the vertical tilt controls, through a series potentiometer which acts as the amplitude control, and applied to the convergence coils. A series choke is provided to keep the horizontal signal out of the vertical circuit.

The horizontal dynamic convergence current is developed by an LC network. A pulse is taken from a separate winding on the horizontal output transformer and is applied in series with L and C, Figure 2. As a result of L, the current through the network is a "sawtooth". The sawtooth current produces a parabolic voltage across C. The horizontal dynamic convergence current is then taken off a potentiometer which is across the capacitor, and its amplitude is determined by the potentiometer adjustment. This signal is then applied to the center-tap of the convergence coil. The trimmer across each coil is used to adjust the horizontal convergence phase.

A fourth magnet is required for lateral adjustment of the

blue beam convergence. It is located directly over the blue electron gun and facilitates convergence. The purity magnet, Figure 1, located directly behind the convergence yoke assembly, is adjusted by means of circular rotation of the unit. It takes the place of the bulkier unit in earlier sets.

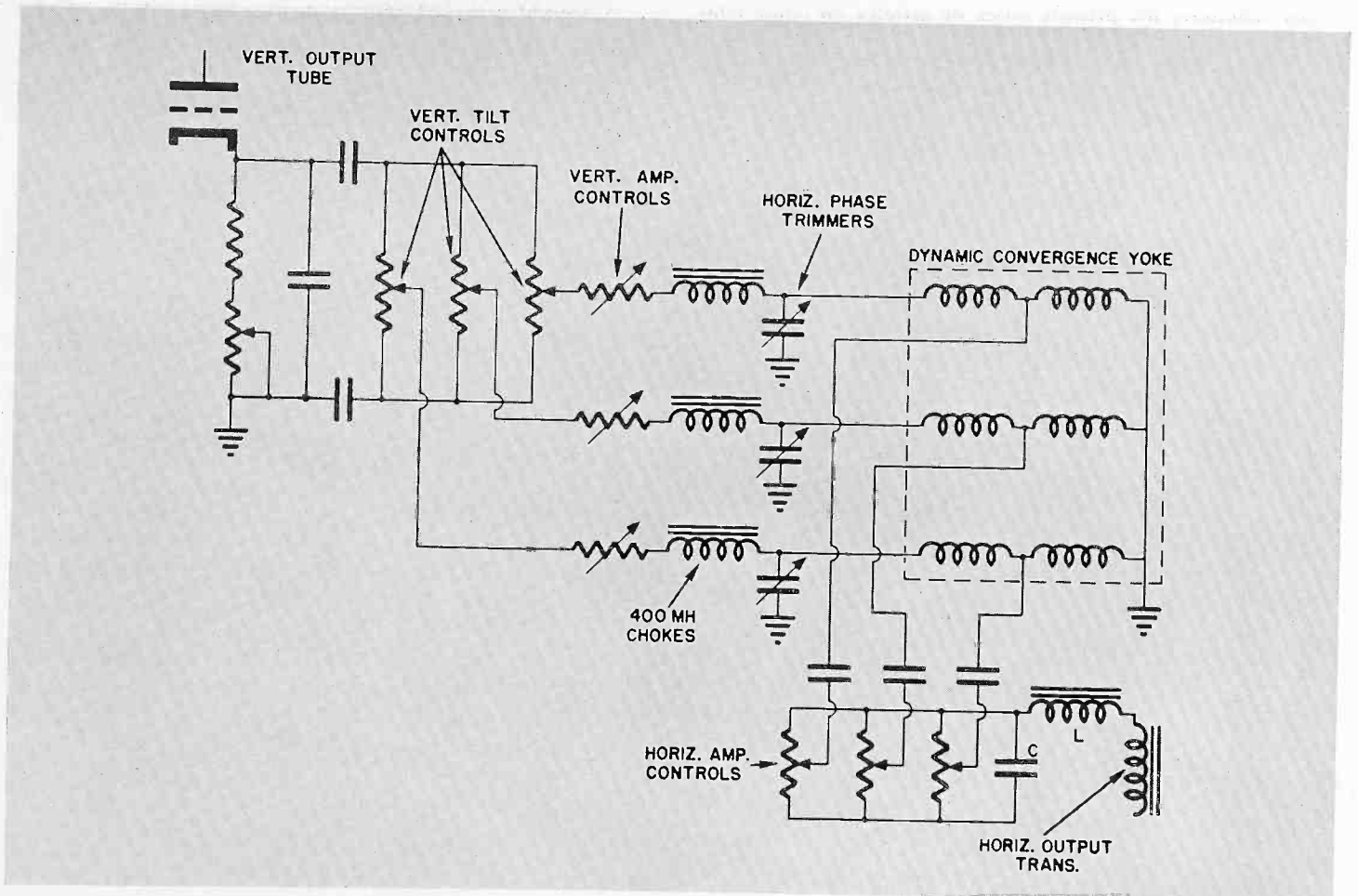
The field neutralizing yoke has been greatly simplified. The yoke for the 21AXP22 is located in the same position as the earlier model, at the edge of the faceplate, but it now consists of permanent magnets which can be rotated and moved closer or further from the tube. Each magnet controls a localized area of the raster.

### Deflection and HV Circuits

The deflection and high voltage circuits are essentially the same as those described for the earlier color receivers except that more vertical and horizontal output are required to furnish the extra amount needed for convergence, the extra scan and the extra HV. The high voltage supply has been simplified in that a high static convergence voltage is no longer needed, Figure 3. The Type 21AXP22 requires 25 Kv at about 800 uamp. A shunt type high voltage regulator is utilized to maintain a constant HV.

The low voltage requirements are the same as for the earlier receivers, except that the higher boost voltage is used for the picture tube screen voltage. Voltages for the other elements do not differ appreciably from those described for the Type 15GP22.

Figure 2 A 21" Color TV Dynamic Convergence Circuit





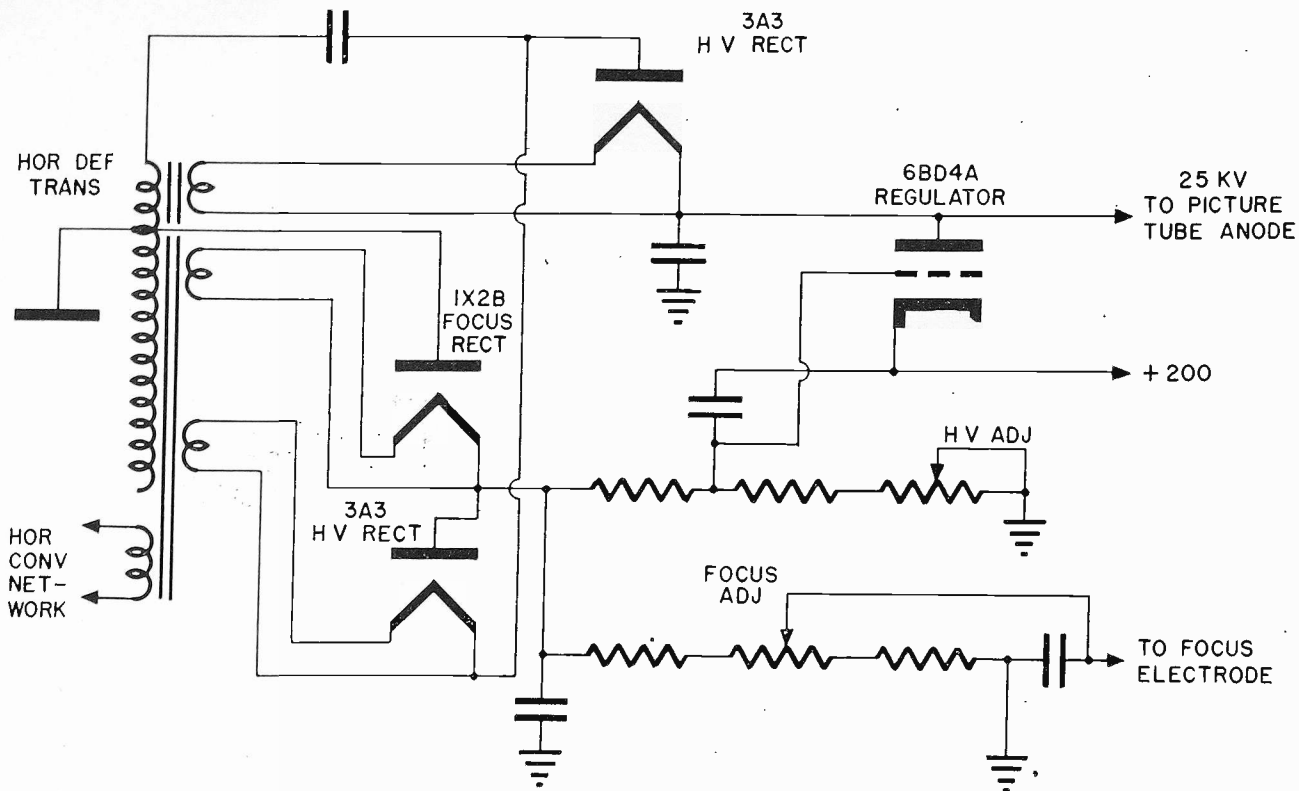


Figure 3 Circuit diagram of a high voltage supply employed in color receivers utilizing the 21AXP22 picture tube.

### Editor's Note

This concludes the present series of articles on color television. It is hoped that these articles have given the serviceman a better understanding of the circuitry peculiar to color television receivers, thus providing a more practical and eco-

nomical approach to service problems.

A second series of articles dealing with specific service problems and the use of color test equipment is in preparation and will be presented in the SYLVANIA NEWS, Technical Section, at a future date.

# A LABORATORY COLOR GENERATOR

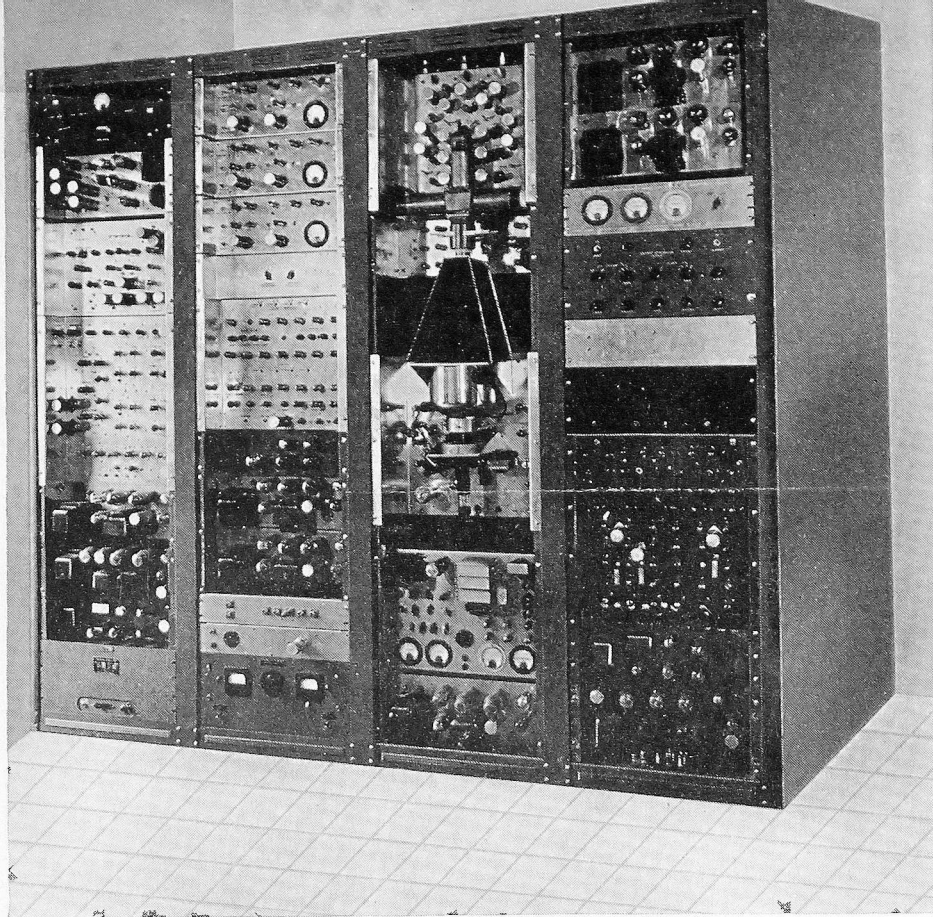
To check the performance of color television receivers and develop tubes for specific color receiver applications, a source of color signal under direct control of the laboratory is desirable. Such a signal is usually derived from a color bar generator and a color flying spot scanner, suitably encoded and modulated upon an RF carrier.

To aid the serviceman studying color television a general description of a typical signal source is given herein.

The color signal generator as a whole includes a number of sub-assemblies such as a color bar generator, color flying spot scanner, encoder, video distribution amplifier, synchronizing signal generator, radio frequency signal generator and associated power supplies. As described, the generator is self-contained, no external equipment or signals being required except a source of 110 volts AC. The generator occupies four standard-width rack cabinets seven feet high.

### Color Bar Generator

The color bar generator produces four color bars, two green bars and one each of red, blue and gamma bars, that is, bars of varying shades of gray. Proper combinations of the color bars provide a signal which contains the three primary colors—red, green and blue, and their complements, cyan, magenta and yellow, as well as white and black. The gamma bars are useful in checking black and white performance of a color set. The generator is arranged so that the display on the screen of the color set being checked may be split so that the top half of the color picture consists of color bars with the bottom half as gamma bars. The order can be reversed so that the top half is gamma bars, with color bars on the bottom. The bar generator will also produce all gamma bars in place of the color bars.



*Figure 1 Laboratory Color Generator—  
The sync generator is located in the  
bottom half of the right-hand cabinet.  
The upper unit of the second cabinet from  
the right contains three photomultiplier  
tubes and associate amplifiers. The box  
where the photomultipliers meet contains  
the dichroic mirrors and gelatin filters.  
The color slide carrier is immediately  
above the light shield (pyramid shaped  
box). The scanner tube is directly under  
the light shield. The bar generator  
is in the third cabinet, slightly above and  
to the left of the scanner tube.  
The RF signal generator is in the top  
of the last cabinet on the left with  
the video distribution amplifiers beneath,  
followed by the encoder.*

The advantage of a color bar generator is the definite waveshape of the video signal. Each color will occupy a fixed "step" position equal to the width of the bar and its height being determined by its color. Such a signal can easily be observed on an oscilloscope.

The color bar generator is limited, however, to producing only color, that is, each bar is a broad expanse of one fully saturated color with no detail or variable degree of saturation. A flying spot scanner enables the viewing of color slides, thus providing a signal for checking of detail, resolution, background, shading and a multitude of other requirements in a color receiver.

### **Color Reproduction**

The flying spot scanner derives its name from the manner in which the video signal is produced. Referring to Figure 1, the scanner tube, a special type cathode ray tube, designed specifically for this application, is deflected at normal horizontal and vertical scanning frequencies and produces on its face a blank white raster at a 4-to-3 aspect ratio. The "flying" spot is then the light source for the three photomultiplier tubes. The light from the spot is focussed on the 2 x 2 slide transparency. As the spot traverses the transparency, its intensity is modulated by the slide density.

The modulated light is then passed through condensing lenses to a pair of crossed dichroic mirrors. These are special mirrors which have the characteristic of reflecting light of one color while passing the remainder. The red reflecting mirror thus shunts the red component from the slide to one photomultiplier tube. The blue reflecting mirror shunts the blue component to a second photomultiplier tube. The remaining green component passes to the third photomultiplier.

Gelatin filters are also inserted in the red and blue light channels to supplement the action of the dichroic mirrors.

The three signals are simultaneously passed through pre-amplifiers to raise the signals to a useful level, through gamma correctors which correct for the non-linear relationship between control grid voltage and brightness in television picture tubes, and through black level setters which clamp the black level to a fixed value with respect to blanking. The three color signals are then applied to the inputs of the encoder.

### **Encoding and Transmission**

The encoder which receives its signal from either the bar generators or the flying spot scanner, combines the three primary colors, which contain all the picture information, into the composite color video signal. The construction of the composite video signal is described in SYLVANIA NEWS, Technical Section, May-June, 1954, "Color TV for the Serviceman."

The resultant signal which contains the video intelligence, blanking, horizontal and vertical sync pulses and burst signal is then used to modulate a television signal RF generator, the original of which may be piped by means of coaxial cable to wherever necessary. The RF signal generator also produces a sound carrier modulated by a 600 cycle tone.

All sync signals required for the color equipment are generated by a sync generator locked in with a subcarrier generator which is crystal controlled at 3579.545 Kc. The subcarrier generator also provides the signal for the encoder.

Signals are available at the outputs of each unit of the system. By proper use of these, it is possible to make performance tests on any portion of a color receiver.

*Sylvania*

# news

TWENTY-FIFTH YEAR OF PUBLICATION      DECEMBER 1955

DAVE TOLINS, JR., EDITOR • COPYRIGHT 1955 • SYLVANIA ELECTRIC PRODUCTS INC. • VOL. 22, NO. 10

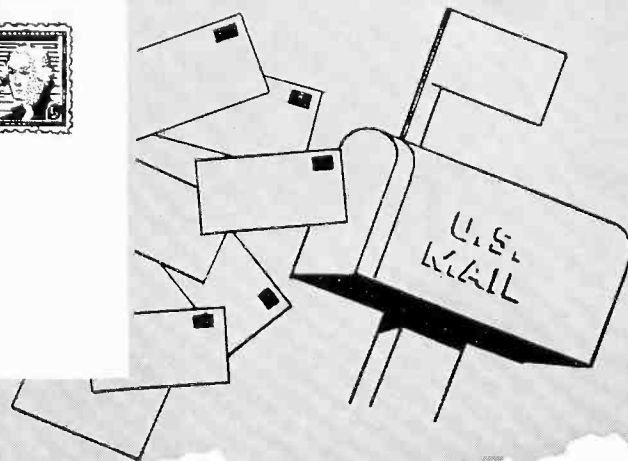


SYLVANIA WISHES YOU A MERRY CHRISTMAS AND A PROSPEROUS NEW YEAR



in

# Sylvania's Mail Box



Note: The letters below were voluntarily written to Sylvania and Sylvania Distributors.

Gentlemen:

We have had two Sylvania Type 403 Oscilloscopes in operation for several days now, and we wish to express our appreciation to Sylvania for having designed almost as though expressly for our application.

The large tube is particularly helpful for us, since we often have faces of these 'scopes at some little distance. We find that the appearance of these 'scopes is quite compatible with our professional equipment. You may be interested to know that we have previously used professional laboratory oscilloscopes costing 50 to 70 percent more than Sylvania's Type 403, but we have obtained from them considerably less satisfactory display. Please thank your engineers for us!



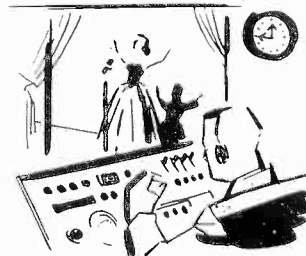
Very truly yours,  
Charles B. Graham  
Fairchild Recording  
Equipment Company  
Whitestone 57, New York

Gentlemen:

I was in the service business in Marion, Indiana, for several years, during which time I serviced many thousands of radio and television receivers. I am proud to state that Sylvania tubes played no little part in the success I achieved in this business.

Some two years ago, I gradually switched from my service business to communications engineering. Presently, I am Chief Engineer of WMRI, Marion. We experienced no end of trouble in keeping the station operating at first, but in going completely over all pieces of equipment which we use here, I found considerable tube troubles. Again, I called on the fine products of Sylvania, and presto, our troubles have all been little ones since.

Again, I want to thank you for really fine products, and I wholeheartedly recommend Sylvania tubes for any electronic needs as being the best available.



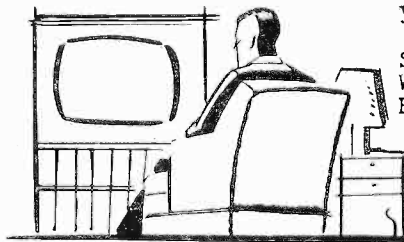
Sincerely yours,  
Lloyd V. Smith  
Chief Engineer  
WMRI and WMRI-FM  
Marion, Indiana

Dear Sir:

Recently, we received the new picture tube for our TV set. Please let me inform you that our reception of various channels has been far better than at any time in the past, thanks to the new Sylvania picture tube.

This new tube is giving us a definite black and sharp picture. Our serviceman said it might be possible that the old tube would test OK. But he believed that it had become dull and weak at intervals too numerous to mention, due to corrosion.

Because we are so satisfied with our new Sylvania picture tube, I wanted to take this opportunity to let you know.



Sincerely yours,  
Wayne Blilen  
Blue Mound, Illinois

# "MY SYLVANIA ADVERTISING PROGRAMS PAY EXTRA DIVIDENDS YEAR AFTER YEAR"

—says Vincent Lutz, St. Louis, Mo., service-dealer and regional Vice President of NATESA.



Vincent Lutz, of St. Louis, Mo., Service-Dealer and regional Vice-President of NATESA.

Vincent Lutz, of St. Louis, Mo., was awarded last year's NATESA President Cup, an annual award to the regional Vice President of the Na-

tional Alliance of Television & Electronic Service Associations doing the most outstanding job in his region of the country in advancing the ideals and principles of good electronic servicing. Vince is currently Chairman of the Board of the local Television Installation Service Association, Affiliate of NATESA, and a former President. He is also NATESA Vice President of the West-Central region.

Vincent Lutz, as a service-dealer, has used Sylvania tubes since 1924, and recalls his first Sylvania tube type as the 200A. His business today enjoys an enviable reputation in the St. Louis area.

Regarding sales promotion, Vince says:

"I have used practically all the

promotions Sylvania has sponsored through the years. They've all paid me well. And my recent mailings of 'Silver Screen 85' post cards did an unusually big sales job.

"I'm currently taking full advantage of the 'Beat The Clock' Home Prize Contest—with displays in the store windows and contest entry blanks given out on home service calls. The traffic is really coming in. And much of this traffic becomes business.

"Over the years, the Sylvania promotions I've used have kept old customers happy and have brought new ones in. *My thriving business today proves that all my mailings of Sylvania consumer advertising material have paid dividends in EXTRA sales year after year.*"

# "'SILVER SCREEN 85' NEWSPAPER ADS MULTIPLY OUR PICTURE TUBE SALES,"

say Lowell Bennett and Harry Showers, owners of Royal Radio Service, Royal Oak, Michigan

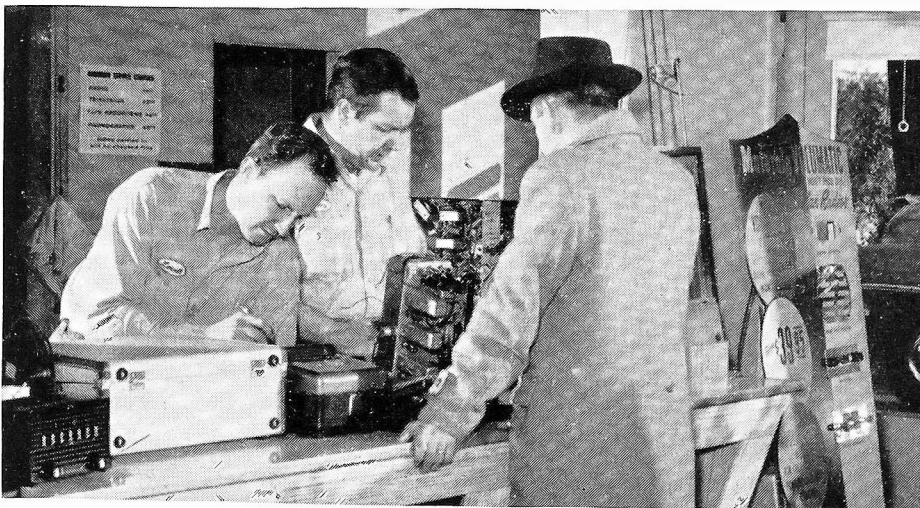
"We've advertised 'Silver Screen 85' and our service in the two major Detroit newspapers 21 times this year; and the combined circulation of these newspapers—595,000 reader-families—certainly paid off in plenty

of EXTRA 'Silver Screen 85' sales," say Lowell Bennett and Harry Showers, owners of Royal Radio Service, Royal Oak, Michigan. Messrs. Bennett and Showers go on to say:

"We've been in business together

since 1945. We now total 8 men, 3 of which run home service trucks, since 60% of our repair work is done in the home. *Over 40% of our entire business is in receiving tube and picture tube sales. And it's a profitable, pretty trouble-free business, thanks to the customer satisfaction with Sylvania tubes and the enormous response our newspaper ads and direct-mail ads bring in.*

"Our picture tube business has multiplied several times since we started advertising Sylvania's great 'Silver Screen 85' picture tubes in local newspapers. And we wholeheartedly advise service-dealers everywhere to put Sylvania's free 'Silver Screen 85' newspaper ad-mats to work for them. *These ads repay the newspaper space cost many times over in extra NET profits from EXTRA picture tube sales.*"



At Royal Radio Service, 612 North Main, Royal Oak, Michigan, are owners (left to right) Lowell Bennett and Harry Showers.

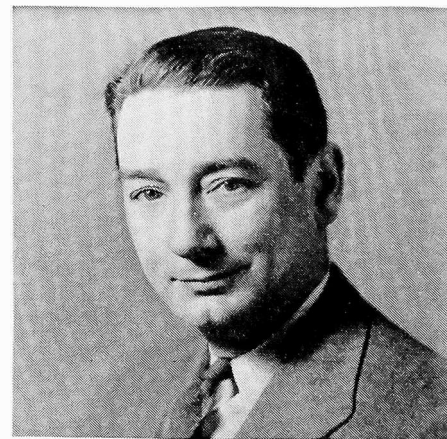
# Thanks, MR. SERVICE DEALER

...for helping Sylvania curb vacuum tube counterfeiting. We'd like to take this opportunity to express our appreciation to all you dealers for the cooperation which you have given us in our efforts to clean up the evils in our industry. Your response to our letter of September 1st, concerning Sylvania's \$1,000.00 reward, has been most helpful. We are following many of the leads which you've given us—in order to help protect you and Sylvania from "bargain" tube racketeers. However, the fight against counterfeiters is far from over. These racketeers are getting rich at the expense of honest dealers throughout the country. And they will continue to operate until they are apprehended or are forced out of business by the combined efforts of service-dealers, distributors and manufacturers.

Sylvania believes that one of the

best ways in which to combat the counterfeiter and gyp operator is to make all dealers aware of the methods which these people employ. For this reason, we mailed reprints of the *TECHNICIAN & CIRCUIT DIGEST* article, "Inside Story of the Reprocessed Tube Racket," to all Sylvania service-dealers. Many of you have written us saying that this information has been most helpful. We have also received letters telling how many of you have fallen prey to "bargain" tube deals. We might mention that the only way in which you can be absolutely sure you are obtaining genuine unused Sylvania tubes is to purchase them in Sylvania cartons from authorized Sylvania distributors.

Sylvania is still very anxious to obtain leads concerning possible counterfeiting activities. If you have any



information, please send it to us immediately. We feel sure that with continued vigilance by you, your distributor, and the tube manufacturers, we will be able to make great strides toward eliminating the unscrupulous operators from the electronics industry.

Sincerely yours,  
SYLVANIA ELECTRIC PRODUCTS INC.  
D. W. Gunn  
General Sales Manager,  
Electronic Products Sales

## have an Idea?



*What's an idea worth?* Have any tricks of the trade that save you time and money? Well, if you do, we'd like to give you ten bucks for it. Yes sir, we said \$10! It's much easier than falling off a log, and the ten bucks won't be just some dough in your pocket for an evening's fun. Better than that, we're going to give you the equivalent of that sum in advertising material. So really, it's more than just ten, because that advertising material will be something that will put more dollars in your pocket.

*Have You a Money Maker?* All this is well and good, but naturally you want to know just what you have to do. Well, it's simple. Just relax a minute. What have you done to make your business run better? Have you a novel advertising scheme? Do you have some homemade gadgets in your shop to speed up your work? What is the best way you keep your customers coming back and the new ones flocking into your store? They

probably don't get there by chance.

These are just some of the ideas you might work on. Maybe you have plenty of ideas for running your business that others guys don't know about. Let them in on it and cut yourself in for \$10 worth of loot from Sylvania's "Pennies" folder.

*Paper, Pencil, Stamp* If you're game to try it, here's all you do. Write us a letter about your brainstorm. (You don't have to be a genius at writing, because we can read most anything.) Put the idea on paper and, if you can, draw us a picture. (You don't have to be an artist either.) We will look the thing over, and if it's good we will put it in SYLVANIA NEWS and send you a \$10 certificate. Easy, isn't it?

*Must Be Serviceman* Of course, you must be a radio-TV serviceman to compete and your idea must be tested. If it has worked successfully for you, that is all that matters.

## \$10 REWARD

### *In Merchandising Aids*

Don't worry about something world shaking. No matter how small a thing it is, it probably has merit. And in case you win some money once, don't think that's the end. You can win as many times as you have a good idea. We're not too fussy about receiving a couple of ideas along the same line from different people, and we'll send along two \$5 certificates to all concerned if the duplicate idea is used and doesn't come from your partner. That means you won't lose out if someone sends in an idea like yours at the same time you do. If your idea is published, we will give you full credit for it in SYLVANIA NEWS.

That's it in a nutshell. Sit down and write us a letter. Try to include a drawing or snapshot. Then sit back. Your \$10 certificates may be in the mail in a few days. Our address is: Editor, SYLVANIA NEWS, 1740 Broadway, New York 19, N. Y.

## TESTING 600 MA SERIES STRING TV TUBES



that never would have been possible should the radio industry have continued to use a power transformer.

We mention the foregoing facts in order to draw a comparison between the past and the present. Now series string heater circuits are in use in TV receivers. The number of such receivers has been increasing and will continue to increase for the same economic reasons that brought the ac/dc radio to the forefront. Television dealers and technicians now have to service TV receivers that can also present problems in the heater circuits. We want to set forth here in the most elementary terms the basic problems which appear in the series string TV sets that may not have been observed in series string radio receivers. The purpose of the introduction of the series string tubes was to permit design of TV receivers with no power transformer, through utilization of heater circuitry not unlike that found in the ac/dc radio receiver.

### Series String Tubes

Television receiving tubes were developed and placed at the disposal of the set manufacturer similar to existing types in all respects except heater construction. These tubes are

Many of you will remember the first of the transformerless radios to appear on the market and will recall the first time you tackled the problems found in servicing these radios with their unusual method of obtaining heater power. Servicing radios had already presented enough problems without having to concern one's self with looking for troubles in the heater

circuit. Some looked upon these radios with heaters hooked all in series as the passing fancy of a few manufacturers. There are millions of these radios with series connected heaters in service today. Technicians service these in a matter-of-fact manner. The series connected heater circuits have been the means of reducing the cost of the table model radio to a point

Vol. 1: \$1.00—Vol. 2: \$1.00—Vol. 3: \$1.00—Vol. 4: \$1.00

Binders With Complete File of Technical Sections

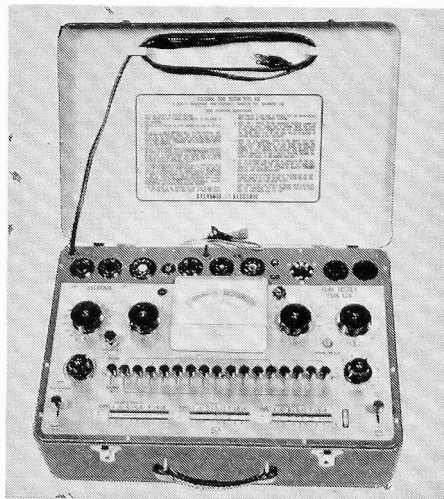


probably familiar to most service technicians today and can be recognized immediately by the unusual recommended filament voltages. Since they are connected in series across the power line, the current in each heater will be the same. This current has been established at 600 ma by common consent of tube and set engineers. The primary consideration in designing any heater is to insure that a given amount of power is consumed by each heater to provide proper cathode temperature. Since we started with an arbitrary value of heater current, it follows that voltage requirements will not necessarily be the same as that of tubes heretofore found in TV receivers. Hence, the TV service technician is faced with an unusual set of variables in the series string TV set. Ohm's law, while simple in itself, comes into play in connection with voltage distribution in series string sets in a manner that may not be readily apparent.

### Heater Voltage and Current in Series Strings

At this point it should be noted that improper voltage distribution may exist in the ac/dc radios, but it doesn't assume the importance that it has and will assume in the series string TV sets. In TV sets having conventional heater circuitry, the heater voltage remains constant on each tube. Should the tube's heater change in resistance, the current will vary. Should the resistance of the heater increase, obviously the power supplied to the heater will diminish in proportion to the decrease in filament current. Should the tube's heater resistance decrease, the power will increase. In the case of series connected heaters found in series string TV sets, the constant is the value of the current flowing in the heater circuit. The voltage drop across the tube will be proper as long as the tube's heater resistance does not vary. There is a natural tendency for a tube's heater resistance to increase with age. A change in any one tube's heater

resistance will be minor with respect to the total overall resistance of the string. Consequently, the string current will remain relatively constant. Such a change, however, will upset the power absorbed in that tube's heater. In a series string set, a decrease or increase in heater resistance will cause a change in the power dissipated in the heater exactly opposite to the change caused under similar conditions in a conventional or constant voltage circuit.



### Problems Involved in Testing

Let us therefore consider the problems of testing 600 ma tubes for a moment. The important point to note is that when a 600 ma tube with low resistance is placed in a tube tester under constant voltage with no effort made to regulate the heater current to that found in the TV set, more power than normal will be absorbed by the heater because of the higher current and a test with erroneous conclusions will result. Conversely, a 600 ma tube with high heater resistance, when placed in a Tube Tester under constant voltage conditions with no effort made to regulate the heater current, will absorb less than normal power in the heater circuit and again tests with erroneous conclusions can result. In considering the foregoing conditions and other considerations that will be apparent to the reader if he mentally substitutes varying amounts of heater resistance to any 600 ma tube operated in series string circuits, it can easily be seen

that these tubes must be tested while 600 ma of current flows in the heater circuit.

### Sylvania 620 Tube Tester

We have discussed at considerable length the basic reasons for and the need to test the 600 ma tubes under the conditions found in circuits where they operate. Let us now consider a piece of test equipment specifically designed to provide the proper environment for testing these tubes.

The appearance of the 600 ma tube in actual use coincided with completion of a considerable amount of basic tube tester engineering in Sylvania Electric Products' Test Equipment Laboratory in Williamsport, Pa. Sylvania, being one of the top two receiving tube manufacturers, was in an excellent position to utilize its early design and testing experience with 600 ma tubes, to make available to the service dealer at this early date factory proven testing methods. The Sylvania Type 620 Tube Tester, announced recently, was the outgrowth of this and other engineering studies. This advanced tester incorporates many innovations valuable to the service technician in both time saved and income gained.

The 600 ma constant current conditions are established in this tester by means of switching the circuitry to utilize the tube tester meter as a milliammeter while the current in the heater circuit is manually adjusted to 600 ma as indicated on the meter. After this simple adjustment is made, the tester is set up for a quality test in the conventional manner.

While the set-up procedures for the Type 620 are conventional, the results obtained are certainly more than conventional. Sylvania Engineers have kept foremost in mind the need for a new tester which will spot a bad tube "the first time around!". The evidence of their success may be found in the overwhelming acceptance the industry has given the Type 620 since its announcement only a few weeks ago.

# REPLACING CASCODE AMPLIFIER TUBES

Availability sometimes makes it necessary to substitute tubes when making replacements. The following chart compares the electrical characteristics and ratings of two cascode amplifier tubes, the 6BZ7 and 6BQ7A. Both tubes employ 6.3 volt, 400 Ma heaters and have the same basing and bulb. The chart makes it apparent that these two types may be interchanged without circuit alterations.

		ELECTRICAL DATA			
DIRECT INTERELECTRODE CAPACITANCES*		6BZ7		6BQ7A	
		Sec. I	Sec. II	Sec. I	Sec. II
Grid to Plate		1.15	1.15	1.15	1.15
Input		2.5		2.85	
Output		1.35		1.35	
Input (Grounded Grid)			4.95		4.95
Output (Grounded Grid)			2.27		2.27
Plate—Cathode (Max.)		0.15	0.15	0.15	0.15
Heater—Cathode		2.6	2.7	2.65	2.70
Plate—Plate (Max.)		0.010		0.010	
Plate Sec. 2 to Sec. 1 Plate and Grid		0.024		0.024	
<b>RATINGS (Design Center—Each Section)</b>					
Plate Voltage**		250		250	Volts Max.
Plate Dissipation		2.0		2.0	Watts Max.
Heater—Cathode Voltage					
Heater Negative with Respect to Cathode					
Total D C and Peak**		200		200	Volts Max.
Heater Positive with Respect to Cathode					
D C		100		100	Volts Max.
Total D C and Peak		200		200	Volts Max.
Cathode Current		20		20	Ma Max.
<b>CHARACTERISTICS (Each Section)</b>					
Plate Voltage		150		150	Volts
Cathode Bias Resistor		220		220	Ohms
Plate Current		10		9.0	Ma
Transconductance		6800		6400	umhos
Amplification Factor		38		39	
Plate Resistance		5600		6100	Ohms
Grid Volts for 10 ua <sub>b</sub>		-11		-10	

NOTES:  
\*External Shield No. 315 connected to cathode.  
\*\*Under cutoff conditions when operated as a cascode amplifier and the two sections are connected in series, these voltages may be as high as 300 volts maximum.

## INTERCHANGEABILITY OF SERIES STRING TUBES AND THEIR PROTOTYPES

In recent months several inquiries have been received regarding the substitution of prototypes for series string tubes and vice-versa.

Series string types differ from their prototypes only in those characteristics necessary to insure dependable operation in series string television receivers. All other characteristics and ratings are identical to those of the prototypes.

Heater voltage and heater current ratings of the new series string types may, due to the requirements of such operation, differ widely from those of their prototypes. All the new series string tubes have 600 Ma heaters and controlled heater warm-up time for series string operation. To insure proper steady-state voltage distribution, heater current production tolerances have been tightened for all series string tubes. Two examples are shown in the above table:

It should be noted that the 5T8 and 6T8 differ in all characteristics shown. Direct substitution of either type for the other would obviously

not be satisfactory.

The 6SN7GTB and 6SN7GTA are identical except for heater current tolerance and controlled series string heater warm-up time. However, substitution of a 6SN7GTA in a series string receiver may, due to the absence of the controlled series string heater warm-up characteristic and wider heater current production tolerances, cause premature failure.

The 6SN7GTB, however, may be used to replace a 6SN7GTA. As previously mentioned, these two tubes are identical except for controlled warm-up time and heater current tolerance. These characteristics will not influence tube or set operation when substituting a series string type for its prototype. Thus we can say that series string tubes may be used as re-

placements for their prototypes providing both tubes have the same nominal heater voltage, heater current and heater cathode voltage ratings.

Differences between series string types and their prototypes are reflected in the type number. The first digits indicate heater voltage. When both types have the same heater voltage and consequently identical basic number designations, different letter suffixes are employed. For example, the series string version of the 6SN7GTA is the 6SN7GTB. When replacing tubes strict attention should be given to the complete type number. When making substitutions, attention should be given to the direction of the substitution as well as the type number.

	Series String Type	Proto-Type	Series String Type	Proto-Type
	5T8	6T8	6SN7GTB	6SN7GTA
Series String Controlled Heater Warm-up Time	YES	NO	YES	NO
Heater Voltage	4.7	6.3	6.3	6.3
Heater Current (ma)	600	450	600	600
Tolerance (ma)	±25	±50	±25	±50

## SERVICE HINTS



### CHECKING CATHODE VOLTAGES WITH A MULTIMETER

Checking the cathode voltages with a multimeter can be costly if the cathode circuit happens to be open. The meter will act as a cathode return permitting the tube to conduct through the low resistance of the meter. If the meter is on a low voltage scale, there could be enough current flow through the meter to burn out the resistors or damage the movement. A technician would do well to develop a simple habit when taking voltage readings to prevent this from happening. Connecting the meter, switched to a suitable scale, between cathode and plate of the tube and measuring the voltage will quickly check an open cathode circuit or even an open plate circuit. If there is no deflection in the meter, one of these circuits is open. A resistance check, with the set turned off, between plate and B+ or cathode and ground will tell which one is open. The technician is insured against an expensive repair bill for his meter by not checking a cathode voltage with his multimeter until after the plate to cathode voltage is measured.

E. R. Nelson  
Buffalo, N. Y.

### HUM DUE TO LOOSE I.F. CAN

While working on a General Electric Model 511F clock radio, same as Models 510F, 513F, 515F, 516F, 517F, 518F, 512F, 521F and 522F according to Sam's Diagram service, a vexing case of hum that would increase in volume as the volume control was advanced was encountered. The model worked on had miniature, slug tuned, if cans held in position

to the chassis by a U shaped brass bracket that came up from the bottom of the chassis and held against the sides of the can. The 2nd if can bracket had lost some of its tension and was the cause of the hum.

By removing the bracket and bending it then replacing it, the hum cleared up. Apparently this trouble could be caused in any receiver using this type of bracket as this would cause the can to be floating above ground.

A. Adams  
Williamsport, Pennsylvania

### ELIMINATING PILOT LAMP BURN OUT IN AC-DC SETS

In AC-DC sets using a 35Z5 rectifier tube, the pilot lamp often gives trouble. It can be eliminated by substituting a 35Z4 and removing the pilot lamp connections, *If the Plate Supply is Not in Series with the Pilot Lamp*. A neon bulb may then be placed across the 110 V line as a pilot lamp. An NE51 will fit a miniature bayonet socket.

A neon bulb pilot lamp can also be added to 3 way battery portables which do not ordinarily come equipped with a pilot lamp.

Harold J. Weber  
Sparta, Illinois

#### EDITORS NOTE:

In sets which have the plate supply in series with the pilot lamp, simply wire in a 25 ohms or more resistor between pin 3 on the rectifier tube socket and the line voltage which is on either pin 2 or 7.

When using an NE51 neon bulb across 110 volts, a 56,000 ohm series resistance is necessary. Whatever bulb is used check to be sure a resistor is either built into the bulb or that one is added to limit the current within the bulb's ratings.

### SPURIOUS OSCILLATIONS ON ALL-WAVE RECEIVER

G.E. Models X317 and X757—A type of spurious oscillations known as "birdies" occasionally pop up in these sets on band 4. It is unstable; first tunable on one spot on the dial then shifts to another frequency.

This trouble was traced to a defective .05  $\mu$ f r.f. by-pass on the "B" plus line. This capacitor is located on the first detector end of the chassis near the oscillator coil. Change this to end the trouble.

Jesus Ongchua  
Mindanao, Philippines

### AIRLINE TV—FOLD OVER AND KEYSTONE

A complaint of no picture or a very dark picture which has a folded over portion in center of screen and may or may not have a slight keystone effect at the sides can be traced to C-111 in the boost circuit which is a 50  $\mu$ f at 300 volt job. The center of screen referred to above is, of course, horizontally speaking and most often looks like a large V. The models affected have been: 45BR3061, 45BR-3067, 45BR3068, 45BR3069 (all Airline tv).

George's Radio Service  
Santa Ana, California

### AIRLINE TV—INSUFFICIENT HEIGHT

On Airline models 4000, 4001, 4003 and 4005 which have insufficient height, no control of brightness, poor vertical hold and retrace lines, the chances are that you will find C225 has shorted and burned out R223. C225 is a coupling capacitor in the retrace eliminator circuit.

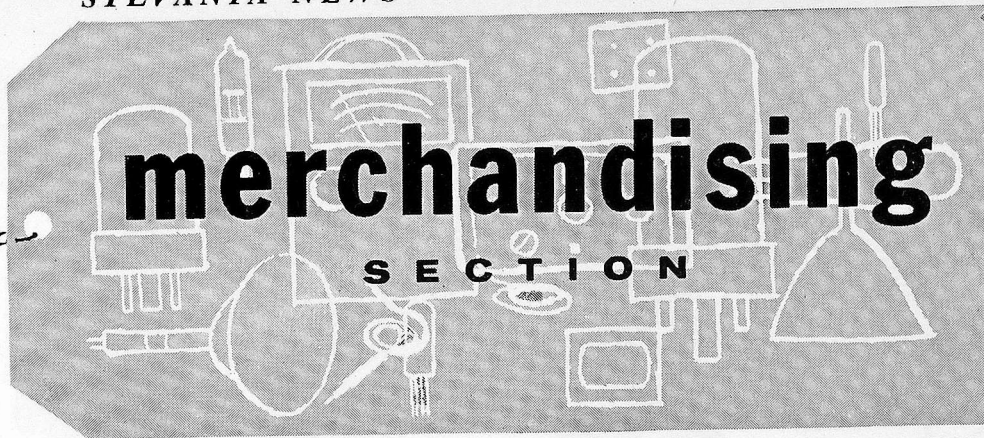
George's Radio Service  
Santa Ana, California

New Mailing Piece Sells

# 3 WAYS

for you

1. Attracts the prospect
2. Sells your service
3. Sells "Silver Screen 85"



DECEMBER 1955 VOL. 22 NO. 10

Now you can have a **FREE** mailing piece that sells 3 ways for you . . . It's Sylvania's attractive HOME PRIZE CONTEST CONSUMER ENVELOPE STUFFER

## Here's How It Works

The front page of this attractive folder sells in one important way—it attracts the prospect with news of Sylvania's popular "Beat The Clock" Home Prize Contest. At the bottom of the front page, it says: **FREE ENTRY BLANK INSIDE.** You would fold a contest entry blank, stamped with your name and address, and slip it inside each envelope stuffer.

When the prospect looks inside this beautiful folder, page 3 will catch his eye. Here is the second way in which this mailing piece sells for you: The headline on page 3 reads, "Be a **WINNER** on TV and Radio Service,

Page 2 sells "Silver Screen 85"

Page 3 sells your service.

Last, but so important, is the back cover, which helps close the sale and leads into a third of the page in white space for your stamped or printed address.

There's more customer attraction and more selling power for you in Sylvania's new 2-color Home Prize Contest Consumer Envelope Stuffer than in any mailing piece ever produced for the Radio-TV Service Dealer. And it's **FREE.**

Order as many of these hard-selling pieces as you need for a hard-hitting direct-mail advertising program—either from your Sylvania Distributor or by writing to Sylvania, 1100 Main Street, Buffalo 9, N. Y. If you want your shop name, address and 'phone number *printed* on the back cover, Sylvania will do it for you at cost—\$1.00 per 100 envelope stuffers. Be sure to include proper imprinting message: shop name, address, telephone number, plus a check or money order to cover imprinting costs. Whether you want them imprinted or not, be sure to get and use these new envelope stuffers. They'll really do a selling job for you.

The front cover attracts the prospect.

The back cover closes the sale with your shop name, address and telephone number imprinted or stamped.

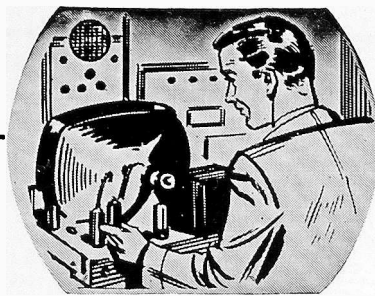
too!" The page continues with the following offer: "FREE tube testing." And below this illustrated announcement comes another, which sells your service: "We test the nearly 100 OTHER things that can go wrong with your TV or radio... AT A FAIR, NOMINAL CHARGE."

After reading page 3, which is the inside right-hand page, the prospect's eye goes to page 2—a complete, illustrated, hard-selling story on "Silver Screen 85" picture tubes. This is the 3rd way in which Sylvania's Home Prize Contest Consumer Envelope Stuffer sells for you: It helps you sell your best performing, most profitable picture tube—Sylvania's "Silver Screen 85."

Start your 1956 advertising program with this hard-selling mailing piece. Order Today!



## SERVICE HINTS



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Buffalo, N. Y.

### HUM DUE TO LOOSE I.F. CAN

While working on a General Electric Model 511F clock radio, same as Models 510F, 513F, 515F, 516F, 517F, 518F, 512F, 521F and 522F according to Sam's Diagram service, a vexing case of hum that would increase in volume as the volume control was advanced was encountered. The model worked on had miniature, slug tuned, if cans held in position

to the chassis by a U shaped brass bracket that came up from the bottom of the chassis and held against the sides of the can. The 2nd if can bracket had lost some of its tension and was the cause of the hum.

By removing the bracket and bending it then replacing it, the hum cleared up. Apparently this trouble could be caused in any receiver using this type of bracket as this would cause the can to be floating above ground.

A. Adams  
Williamsport, Pennsylvania

### ELIMINATING PILOT LAMP BURN OUT IN AC-DC SETS

In AC-DC sets using a 35Z5 rectifier tube, the pilot lamp often gives trouble. It can be eliminated by substituting a 35Z4 and removing the pilot lamp connections, *If the Plate Supply is Not in Series with the Pilot Lamp*. A neon bulb may then be placed across the 110 V line as a pilot lamp. An NE51 will fit a miniature bayonet socket.

A neon bulb pilot lamp can also be added to 3 way battery portables which do not ordinarily come equipped with a pilot lamp.

Harold J. Weber  
Sparta, Illinois

#### EDITORS NOTE:

In sets which have the plate supply in series with the pilot lamp, simply wire in a 25 ohms or more resistor between pin 3 on the rectifier tube socket and the line voltage which is on either pin 2 or 7.

When using an NE51 neon bulb across 110 volts, a 56,000 ohm series resistance is necessary. Whatever bulb is used check to be sure a resistor is either built into the bulb or that one is added to limit the current within the bulb's ratings.

### SPURIOUS OSCILLATIONS ON ALL-WAVE RECEIVER

G.E. Models X317 and X757—A type of spurious oscillations known as "birdies" occasionally pop up in these sets on band 4. It is unstable; first tunable on one spot on the dial then shifts to another frequency.

This trouble was traced to a defective .05  $\mu$ f rf by-pass on the "B" plus line. This capacitor is located on the first detector end of the chassis near the oscillator coil. Change this to end the trouble.

Jesus Ongchua  
Mindanao, Philippines

### AIRLINE TV—FOLD OVER AND KEYSTONE

A complaint of no picture or a very dark picture which has a folded over portion in center of screen and may or may not have a slight keystone effect at the sides can be traced to C-111 in the boost circuit which is a 50  $\mu$ f at 300 volt job. The center of screen referred to above is, of course, horizontally speaking and most often looks like a large V. The models affected have been: 45BR3061, 45BR3067, 45BR3068, 45BR3069 (all Airline tv).

George's Radio Service  
Santa Ana, California

### AIRLINE TV—INSUFFICIENT HEIGHT

On Airline models 4000, 4001, 4003 and 4005 which have insufficient height, no control of brightness, poor vertical hold and retrace lines, the chances are that you will find C225 has shorted and burned out R223. C225 is a coupling capacitor in the retrace eliminator circuit.

George's Radio Service  
Santa Ana, California

New Mailing Piece Sells

# 3 WAYS

# merchandising

O N

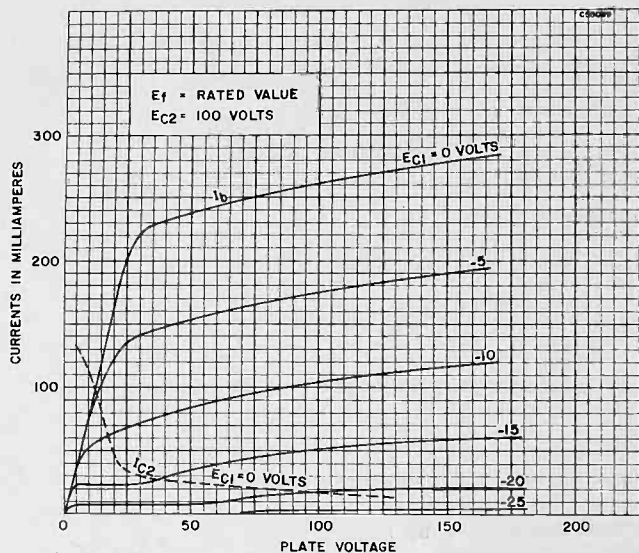
## 6DN6 (Cont'd) 25DN6

### APPLICATION DATA

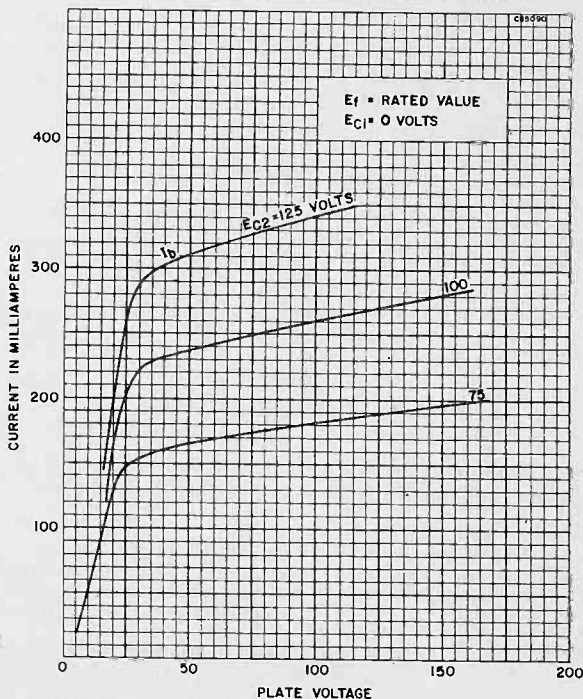
The Sylvania Types 6DN6 and 25DN6 are beam power amplifiers designed for use as horizontal deflection amplifiers in television receivers having low B supply voltages. These types exhibit extremely low plate knee characteristics at zero bias.

The 25DN6 features a 25.0 volt, 600 Ma heater and controlled heater warm-up time for series string operation. Except for heater characteristics, the 25DN6 is identical to the 6DN6.

### AVERAGE PLATE CHARACTERISTICS



### AVERAGE PLATE CHARACTERISTICS



SYLVANIA ELECTRONIC TUBES

MBER 1955 VOL. 22 NO. 10

## ways for you . . . It's R ENVELOPE STUFFER

ast, but so important, is the back  
er, which helps close the sale and  
els into a third of the page in white  
space for your stamped or printed  
ress.

There's more customer attraction  
and more selling power for you in  
sylvania's new 2-color Home Prize  
Contest Consumer Envelope Stuffer  
in any mailing piece ever pro-  
duced for the Radio-TV Service  
Dealer. And it's FREE.

Order as many of these hard-sell-  
pieces as you need for a hard-  
selling direct-mail advertising pro-  
gram—either from your Sylvania  
distributor or by writing to Sylvania,  
100 Main Street, Buffalo 9, N. Y. If  
I want your shop name, address  
and phone number *printed* on the  
back cover, Sylvania will do it for you  
at no cost—\$1.00 per 100 envelope  
offers. Be sure to include proper  
printing message: shop name, ad-  
dress, telephone number, plus a  
check or money order to cover im-  
printing costs. Whether you want  
them imprinted or not, be sure to get  
them used use these new envelope stuffers.  
They'll really do a selling job for you.

Start your 1956 advertising program  
with this hard-selling mailing piece.  
*Order Today!*

# SERVICE HINTS



## CHECKING CATHODE VOLTAGES WITH A MULTIMETER

Checking the cathode voltages with a multimeter can be costly if the cathode circuit happens to be open. The meter will act as a cathode return permitting the tube to conduct through the low resistance of the meter. If the meter is on a low voltage scale, there could be enough current flow through the meter to burn out the resistors or damage the movement. A technician would do well to develop a simple habit when taking voltage readings to prevent this from happening. Connecting the meter, switched to a suitable scale, between cathode and plate of the tube and measuring the voltage will quickly check an open cathode circuit or even an open plate circuit. If there is no deflection in the meter, one of these circuits is open. A resistance check, with the set turned off, between plate and B+ or cathode and ground will tell which one is open. The technician is insured against an expensive repair bill for his meter by not checking a cathode voltage with his multimeter until after the plate to cathode voltage is measured.

E. R. Nelson  
Buffalo, N. Y.

## HUM DUE TO LOOSE I.F. CAN

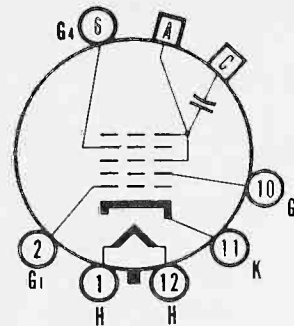
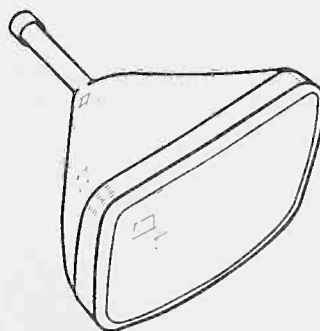
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## SYLVANIA TYPE 21ALP4B

Silver Screen "85"

### TELEVISION PICTURE TUBE

21" Direct Viewed	Magnetic Deflection
Rectangular Glass Type	Electrostatic Focus
Gray Filter Glass	Spherical Faceplate
External Conductive Coating	Single Field Ion Trap
Aluminized Screen	



12-L

### CHARACTERISTICS

#### GENERAL DATA

Focusing Method	Electrostatic
Deflecting Method	Magnetic
Deflecting Angle (approx.)	
Horizontal	85 Degrees
Diagonal	90 Degrees
Phosphor	P4
Fluorescence	White
Persistence	Medium
Faceplate	Gray Filter Glass
Light Transmittance (approx.)	71 Percent

#### ELECTRICAL DATA

Heater Voltage	6.3 Volts
Heater Current (approx.)	0.6 Ampere
Direct Interelectrode Capacitances (approx.)	
Cathode to All Other Electrodes	5 $\mu\text{f}$
Grid No. 1 to All Other Electrodes	6 $\mu\text{f}$
External Conductive Coating to Anode	750 $\mu\text{f}$ Max.
	500 $\mu\text{f}$ Min.
Ion Trap Magnet	External, Single Field Type

#### MECHANICAL DATA

Minimum Useful Screen Dimensions	19 $\frac{1}{8}$ x 15 Inches
Bulb Contact (Recessed Small Cavity Cap)	J1-21
Base (Small Shell Duodecal 6-Pin)	B6-63
Basing	12L

### RATINGS

#### MAXIMUM RATINGS (Design Center Values)

Anode Voltage	20000 Volts d c
Grid No. 4 Voltage (Focusing Electrode)	-500 to +1000 Volts d c
Grid No. 2 Voltage	500 Volts d c
Grid No. 1 Voltage	
Negative Bias Value	125 Volts d c
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	410 Volts
After Equipment Warm-up Period	180 Volts
Heater Positive with Respect to Cathode	180 Volts

### SYLVANIA PICTURE TUBES

Issued as a supplement to the manual in Sylvania News for December 1955



New Mailing Piece Sells

# 3 WAYS

for you

1. Attracts the prospect
2. Sells your service
3. Sells "Silver Screen 85"



DECEMBER 1955 VOL. 22 NO. 10

Now you can have a **FREE** mailing piece that sells 3 ways for you . . . It's Sylvania's attractive HOME PRIZE CONTEST CONSUMER ENVELOPE STUFFER

## Here's How It Works

The front page of this attractive folder sells in one important way—it attracts the prospect with news of Sylvania's popular "Beat The Clock" Home Prize Contest. At the bottom of the front page, it says: FREE ENTRY BLANK INSIDE. You would fold a contest entry blank, stamped with your name and address, and slip it inside each envelope stuffer.

When the prospect looks inside this beautiful folder, page 3 will catch his eye. Here is the second way in which this mailing piece sells for you: The headline on page 3 reads, "Be a WINNER on TV and Radio Service,

Page 2 sells "Silver Screen 85"

Page 3 sells your service.

Last, but so important, is the back cover, which helps close the sale and leads into a third of the page in white space for your stamped or printed address.

There's more customer attraction and more selling power for you in Sylvania's new 2-color Home Prize Contest Consumer Envelope Stuffer than in any mailing piece ever produced for the Radio-TV. Service Dealer. And it's FREE.

Order as many of these hard-selling pieces as you need for a hard-hitting direct-mail advertising program—either from your Sylvania Distributor or by writing to Sylvania, 1100 Main Street, Buffalo 9, N. Y. If you want your shop name, address and 'phone number *printed* on the back cover, Sylvania will do it for you at cost—\$1.00 per 100 envelope stuffers. Be sure to include proper imprinting message: shop name, address, telephone number, plus a check or money order to cover imprinting costs. Whether you want them imprinted or not, be sure to get and use these new envelope stuffers. They'll really do a selling job for you.

The front cover attracts the prospect.

The back cover closes the sale with your shop name, address and telephone number imprinted or stamped.

too!" The page continues with the following offer: "FREE tube testing." And below this illustrated announcement comes another, which sells your service: "We test the nearly 100 OTHER things that can go wrong with your TV or radio... AT A FAIR, NOMINAL CHARGE."

After reading page 3, which is the inside right-hand page, the prospect's eye goes to page 2—a complete, illustrated, hard-selling story on "Silver Screen 85" picture tubes. This is the 3rd way in which Sylvania's Home Prize Contest Consumer Envelope Stuffer sells for you: It helps you sell your best performing, most profitable picture tube—Sylvania's "Silver Screen 85."

Start your 1956 advertising program with this hard-selling mailing piece. Order Today!

December—last month to get your

# SYLVANIA CHRISTMAS GIFT SCRIP



Helps You Start The New Year Right—

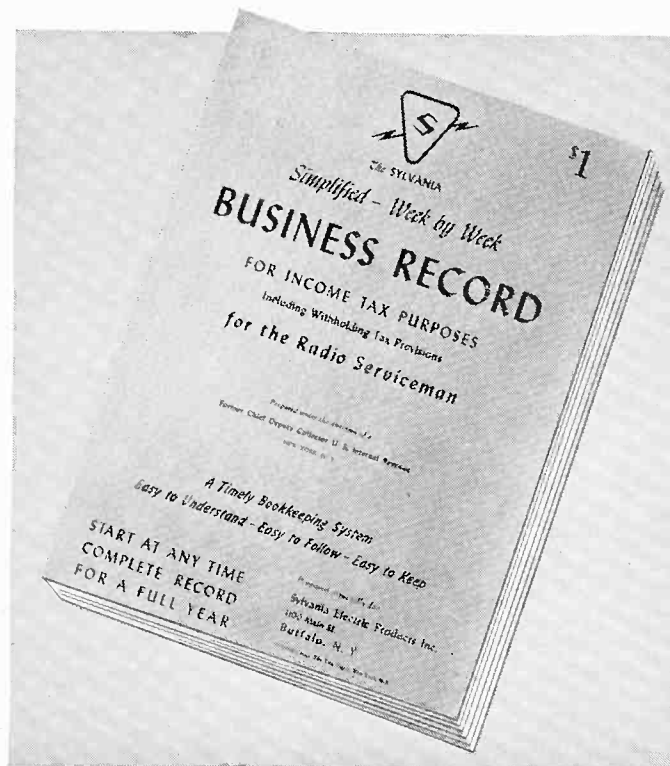
## SYLVANIA'S BUSINESS RECORD BOOK

*Simplified, Centralized Bookkeeping*

At A Cost Of Only **\$1.00**



Your 1956 Journal, Ledger and Tax Record all in one handy book—that's what Sylvania's handy BUSINESS RECORD BOOK will be to you. Specially prepared for the radio-TV service-dealer by experts, this valuable book provides forms for daily records of your business purchases, income, payroll, payment on notes, fixtures and equipment, monthly cash balance, etc. Everything you need to know about your business is at your fingertips—with a Sylvania BUSINESS RECORD BOOK. You'll find it mighty valuable at tax time, too. And it costs only \$1.00. Order one today from your Sylvania Distributor, or write, enclosing your check for \$1.00, to Sylvania, 1100 Main St. Buffalo 9, N. Y.



# FREE WITH YOUR PURCHASES OF SYLVANIA TUBES



You have only a few short weeks in which to pile up *your* Sylvania Christmas Party Scrip. The Scrip is available FREE with your purchases of Sylvania tubes from your Sylvania Distributor. Your Sylvania Distributor will give you a 50-Tube Sylvania Christmas Party Certificate with every 2 Sylvania Picture Tubes or 50 Sylvania Receiving Tubes you buy from him. You can also get 100-Tube Scrip and 300-Tube Scrip.

Your collection of Sylvania Christmas Party Scrip will serve as full payment for valuable gifts shown in the Sylvania Christmas Stocking Club catalog, which you have already received. If you have misplaced your Sylvania Christmas Stocking Club catalog and order form, ask your Sylvania Distributor for additional copies—or write right away to Sylvania, 1100 Main Street, Buffalo 9, New York.

Sylvania Gift Headquarters is loaded with over one hundred different gifts—gifts for everyone on your Christmas list, gifts to suit every taste. Just a small part of the wide gift selection you can choose from is shown on this page. Be sure to get *your* share of these wonderful gifts. It's an extra at no extra cost—from Sylvania. See your Sylvania Distributor today for your Sylvania Christmas Party Scrip.

The Advertisement Every Customer Sees 20 Times—

## THE NEW "SILVER SCREEN 85" MATCH-BOOK

Twenty matches to a book—20 times when a customer will see *your* name, telephone number, address and the great "Silver Screen 85" picture tubes you sell—that's the kind of selling punch you get with Sylvania's attractive new 3-color "Silver Screen 85" Match-Book.

See a sample "Silver Screen 85" Match-Book at your Sylvania Distributor, or write for one to Sylvania, 1100 Main Street, Buffalo 9, N. Y. You'll like the bright colors—aluminum, yellow and black. You'll like the solid sales message. And you'll like the picture tube format in which *your* shop name, address and 'phone number can be imprinted by Sylvania.

The cost, complete with imprinting, is as follows:

1,000 Match-Books . . . . .	\$ 5.50 Plus 40¢ Fed. Tax
2,500 Match-Books . . . . .	\$13.13 Plus \$1.00 Fed. Tax
5,000 Match-Books . . . . .	\$22.50 Plus \$2.00 Fed. Tax
10,000 Match-Books . . . . .	\$42.50 Plus \$4.00 Fed. Tax

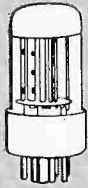




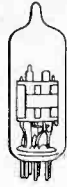

You'll find that your advertising has a way of getting around—in Match-Books. You can give them to your prospects and customers, sell them at a reduced rate to local cigarette and cigar retailers to be given to each smoker-customer. Your name and 'phone number will be handy to thousands of local people just when they need TV or radio repairs—when imprinted on Sylvania's eye-stopping "Silver Screen 85" Match-Books. Order them today from your Sylvania Distributor.





# How to get the jump on call-backs in **6 easy moves**

Here are six tube types called for most in your daily service work. Eliminate the call-backs from these types and your biggest share of headaches is over. It's easy to do just that, too, simply by getting into the habit of using Sylvania tubes...in the familiar yellow and black carton. These 6 types alone incorporate over 14 design and production improvements to eliminate the most common causes of "quick failures" and costly call-backs. It's no wonder more and more servicemen consider the yellow and black carton their "calling card of top quality service."

<b>SYLVANIA</b> 6SN7GTB <b>ELECTRONIC TUBE</b>		<b>SYLVANIA</b> 6AU6 <b>ELECTRONIC TUBE</b>	
	<b>SYLVANIA</b> 6BQ6GTA <b>ELECTRONIC TUBE</b>		<b>SYLVANIA</b> 5U4GB <b>ELECTRONIC TUBE</b>
		<b>SYLVANIA</b> 6CB6 <b>ELECTRONIC TUBE</b>	
	<b>SYLVANIA</b> 1B3GT <b>ELECTRONIC TUBE</b>		

## 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.



Richard Kerr  
R. D. #1  
Syracuse, N. Y.

For

**NOTICE SENT**

Form 3547 Requested  
PRINTED IN U.S.A.

VOL. 22, NO. 10

DECEMBER 1955

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, RADIO AND TELEVISION RECEIVERS

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