NATIONAL RADIO NEWS

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Let Us Live By The Golden Rule

RECENTLY I received a letter from Mr. L. Lyman Brown, one of our graduates. This letter is quoted in this issue of NR NEWS on page 28. I would like you to read it.

Mr. Brown conducts a Radio Servicing business in Springfield, Mass. He is a member of a local Radio Servicemen's Organization. Mr. Brown, in some way, became afflicted with Blood Poisoning and, of course, was temporarily unable to work. When the Secretary of the local Radio Servicemen's Organization heard of this he immediately took steps to line up some fellow members to carry on the radio business for Mr. Brown during the time the latter was incapacitated.

Mr. Brown was deeply touched by this spirit of neighborly cooperation. He points out that nowadays not many people are interested in helping others.

That got me to thinking. Here at NRI it has always been our policy to do everything within reason to accommodate our students and graduates. That is the foundation upon which NRI was built to its present high place in the field of Radio education.

But I wondered how many times we may have missed a chance to do some simple thing that would have been greatly appreciated. How many times have you and I failed to offer help that would have made another's job a little easier.

If ever there was need for a brotherly spirit among men it is now. If the world is to get back on an even keel it is you and I and our neighbors who must put it there. We can do our share if we will try to make the burden a little lighter for someone who may need a helping hand.

Let us resolve to be a little more considerate, a little less selfish in going about our daily tasks. Let us live a little closer to the Golden Rule. Let us be reminded that a kind deed is its own reward.

J. E. SMITH, *President.*

Color Television

Louis E. Garner, Jr.

By LOUIS E. GARNER, JR.

NRI Consultant

Fundamental considerations: In order to transmit television in full colors, it is necessary to do two things. First, it is necesary that the pick-up used at the studio (the television camera) be capable of distinguishing between the colors of the scene being transmitted. Secondly, it is necessary that the reproducing system used at the TV receiver be capable of reproducing the colors. We will not discuss the various methods that might be used for picking up the scene since they correspond, roughly, to the methods used for reproducing the scene in full color. In addition, these methods are not too important to the serviceman—he is mainly concerned with the methods that may be used for reproducing the full color image.

White light is a combination of all colors. However, the sensation of white may be produced by the proper addition of just two colors. For example, certain blue and yellow light projected on a white screen will produce the effect of white upon the unaided eye. In general, when two colored lights are combined to produce the sensation of white they are called additive complementary colors.

It is possible to reproduce full-color images if we are able to reproduce three primary colors —blue, green and red. As shown in Fig. 1, blue and red can be combined to produce magenta; green and red to produce yellow; and blue and green to produce peacock blue. If all three colors are combined together, we have white light.

By varying the proportions of any two colors, it is possible to vary the exact shade. For example, if we combine more green than red, the resulting yellow light will tend more to the green than towards the red—we will have a type of "yellow-green" light.

The process of adding colored light must not be confused with that of mixing paints or dyes, which is a subtraction process. For example, when yellow and a blue primary color (light) are added, they give white as a result. Whereas, if we mix yellow and blue paints, we get green paint as a result.

The difference lies in the fact that when paints are mixed, the light suffers an absorption for each paint in the mixture. The yellow paint

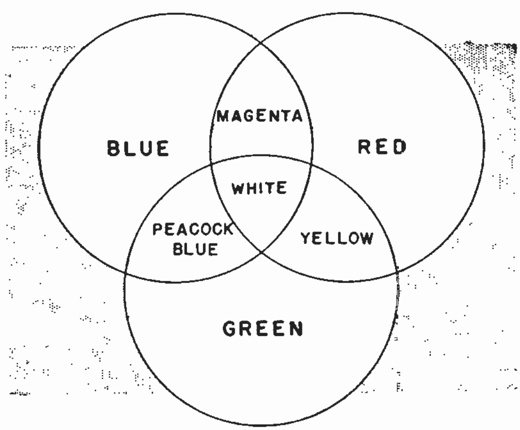


Fig. 1. The combination of three primary colors produces all colors necessary for reproducing a full-color image.

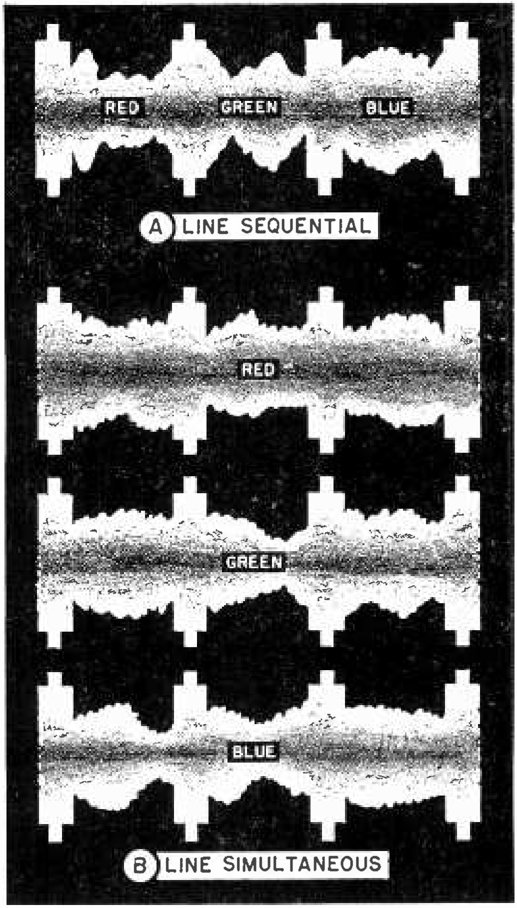


Fig. 2A. Outline of modulation envelope as it might appear using the line sequential method of color television transmission.

Fig. 2B. Appearance of modulation envelope using the line simultaneous color television system.

takes out (absorbs) from the white light all but the red, yellow and green components. The blue paint absorbs all the colors except the blue and green. When the paints are mixed, green is the only color not absorbed by either paint and it is, therefore, reflected.

Color Television, then, consists simply of taking three separate color shots of the image to be transmitted and involves, at the receiving end, corresponding color production and superimposition of these separate color scenes on the viewing screen to form the composite full-color scene. If the mixing of the separate color scenes can be carried out at a rate above the flicker frequency, the effect of proportionate mixing of colors will take place and the original scene will be reproduced in practically its true colors.

Thus, when sending colored television, it is not only necessary to transmit the information concerning the variation of light intensity along the line, the information concerning the synchronizing pulses for both horizontal and vertical sweep, but it is also necessary to transmit information concerning the color value of the scene.

There are several ways that this might be accomplished. First, the information on the three basic colors could be sent in order—that is, the carrier signal may appear as in Figure 2A. This is quite similar to the carrier signal for conventional black and white television.

The first line to be scanned is red, the next green, and the next blue. Instead of scanning the lines in succession, it would be just as practical to scan successive fields—instead of using two fields per frame, three fields per frame might be employed. One field would represent the red color values, one the green color values, and the remaining field the blue color values.

This system of transmitting the color television signal is called the *sequential* system since the colors are sent in sequence.

The other scheme that may be used for transmitting the color information is to employ three separate carriers—one modulated with the signal representing the red color values, another modulated with a signal representing the blue color values, and the third modulated with a signal representing the green color values, as illustrated in Fig. 2B. This system is called the simultaneous system since all three color values are sent simultaneously.

Regardless of which system is used, a considerably wider band-width is normally required for color television. If the simultaneous system is employed, three separate modulated carriers are used so that the total band width required for one station is much greater than that required for a station employing black and white transmission. If the sequential system is used, a much larger band width may or may not be necessary, depending upon whether line scanning or field scanning is employed. That is, whether the different lines are scanned in different colors or whether separate fields are scanned in different colors. If separate fields are scanned in different colors, it is necessary to increase the field frequency in order to eliminate color flicker. This requires a wider band width for the color channel because the number of elements sent per second is increased. Thus the modulating frequency of the video signal becomes greater, and the side bands occupy a greater portion of the radio spectrum.

The problems involved in the design of the color television receiver are quite similar to those involved in the design of a black and white television set. Wider band width may be required where the sequential system is used; and where the simultaneous transmission system is employed, separate i.f. and video channels may be required. Otherwise, the front ends, i.f.'s, detectors, and video amplifier in a color television set are quite similar to those in a conventional black and white TV set.

The method of transmitting the audio portion of the TV signal has not been decided as yet. Because a much wider band width is required for certain types of color television, it has been suggested that the separate sound channel be eliminated by transmitting the sound as a series of pulses during the horizontal fly-back time. Since the frequency of the horizontal sweep is higher than the average person's range of hearing, it is possible to transmit sufficient intelligence during this period to reproduce the audio portion satisfactorily. However, at this time, a definite decision has not been reached as to standards.

In any case, it is not expected that full-color television will achieve the same popularity as black and white television in the near future unless a system can be used which will permit color television receivers to be built at a price comparable to the price of present black and white TV sets. It is also unlikely that much work will be done in the immediate future unless a system is used which will permit the same receiver to receive either black and white or full color television without an appreciable increase in cost.

Just as there are several methods for transmitting the color information concerning the scene being televised, so there are a number of possible methods for reproducing the scene in color. We do not know, at this time, which system will be eventually used as a commercial standard. Each of the systems shows promise and, in addition, each system seems to give reasonably satisfactory results when properly designed and installed. Undoubtedly, the system used will be one that is economical as well as one that gives good results. It is difficult to say, however, which system will be the cheapest from a production viewpoint since few, if any, commercial receivers have been manufactured for color television. The sets so far built have been experimental only.

Let us discuss the various methods which might be employed for reproducing full color images.

Color Disc: One system that might be used where the sequential system of transmission is employed is illustrated in Figure 3. The reproduced television image appears on the face of a cathode ray tube. The light from the cathode ray tube passes through a color filter to the lens and then is projected onto a screen.

The color filter is made up of a disc of three separate filters—one for red, one for green, and one for blue light. The disc will have six, nine, twelve or more segments (it will always be a multiple of three where three colors are used for transmission.)

The disc is rotated by a synchronous motor so that the proper color segment is in front of the cathode ray tube for the color value to be reproduced at a specific instant. This system must be used with the sequential method of transmitting the color information and the sequence must be at a field rather than a line rate. This is necessary in order to keep the speed of the motor to a reasonable value. If the line sequence method of transmitting the color information is used, the speed of the motor (and

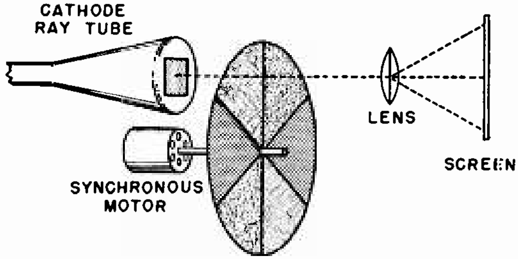


Fig. 3. Color disc system, used with sequential method of transmission.

of the disc) would have to be so high as to be impractical from a construction viewpoint.

This system is capable of giving excellent results but suffers from certain disadvantages. A certain amount of light is lost, of course, due to the color disc. That is, the color filter is not 100% efficient and any light lost in the filter will tend to reduce the overall brilliancy of the reproduced scene.

Another disadvantage is the necessity for maintaining the speed of the motor in synchronism with the transmitted signal. That is, the blue segment must be in front of the cathode ray tube when the image representing the blue portion of the scene is being transmitted. Similarly, the red filter segment must be over the cathode ray tube when the image representing the red portion of the scene is being transmitted. If this is not done, the color values will be completely lost and the resulting distortion would be quite undesirable.

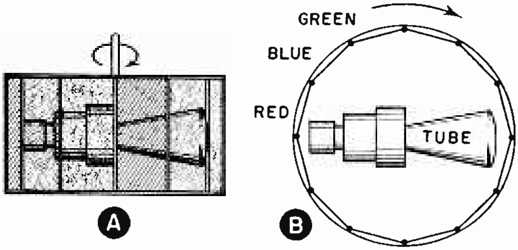


Fig. 4A. Top view of rotating drum system of presenting proper color filters in front of the picture tube.

Fig. 4B. Side view of rotating drum system. (Used in sequential color transmission.)

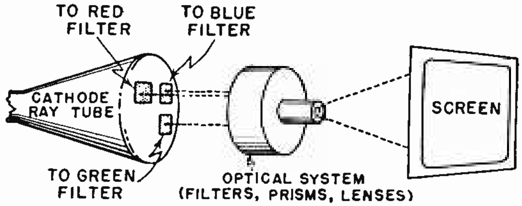


Fig. 5. Thomascolor System, used either with sequential or simultaneous method. (Three electron guns are mounted within one picture tube when the simultaneous method is used.)

The problem of maintaining the motor in synchronization with the transmitted scene represents certain electrical and mechanical difficulties. In addition, this system suffers from a disadvantage in that a mechanical arrangement must be employed—something that is subject to wear, friction, dust collection, etc. The bearings on the motor may dry with time and require oiling, dust may accumulate—slowing the motor up, the shaft or disc may bend or warp, etc.

Notwithstanding these difficulties, this system has been successfully used in experimental television receivers and good results have been obtained.

In order to simplify the mechanical arrangement of the color disc and in order to reduce the size of the television set, a slightly different arrangement of presenting the filters has been suggested. This is illustrated in Figures 4A and 4B.

Rather than use a segmented color disc, a large drum is used. A short cathode ray tube is mounted within the drum and the color filters are mounted around the drum so that they are presented in order as the drum rotates.

By using a system of this sort, it is possible to reduce the speed of rotation necessary. In addition, by using rectangular filters, practically the entire filter surface can be used for filter purposes. This results, naturally, in a smaller and less cumbersome system. The drum system also allows a smaller TV receiver to be built because the various mechanical and electrical parts can be more conveniently arranged.

Thomascolor System: A system which has been suggested for use in producing color motion pictures has also been suggested for use in color television. This system is illustrated in Figure 5 and is suitable for use where either the sequential or the simultaneous method of transmitting the color information is employed.

The scene, as picked up by the studio, is split into three separate images. One image represents the red color values, another the blue color values, and the third the green color values. All three images are reproduced as black and white images, however.

In fact, the three images can be reproduced simultaneously on the screen of a single cathode ray tube. The light from the image representing the red color values passes through a red filter in the optical system; that representing the blue color values passes through a blue filter in the optical system; and that representing the green color values passes through a green filter in the optical system. Lenses and prisms are then used to combine all three images together and to project the resulting composite image on the screen. Thus, even though each separate image is a black and white image, by passing the separate images through appropriate filters and recombining them into one image, we are able to achieve a full color reproduced scene.

This system is purely optical in nature and, therefore, does not suffer from the disadvantages of the mechanical system previously discussed. There is still the disadvantage of the optical system, however, and the loss of light in the filters. This is partially offset by the increase in brilliancy obtained by combining the three separate images into one, however. That is, where the light from three images is combined into one image, the resulting single image is considerably brighter than any one of the separate smaller images. Of course, this advantage is lost when the scene is projected on to a large screen, for the light is spread out over a larger area, resulting in smaller spot brilliancy.

There are other disadvantages to the system just described. The optical system is somewhat difficult to construct from a production viewpoint and may prove somewhat expensive.

Using Three Separate Cathode Ray Tubes: A somewhat similar system is illustrated in Figure 6. Three separate cathode ray tubes are employed

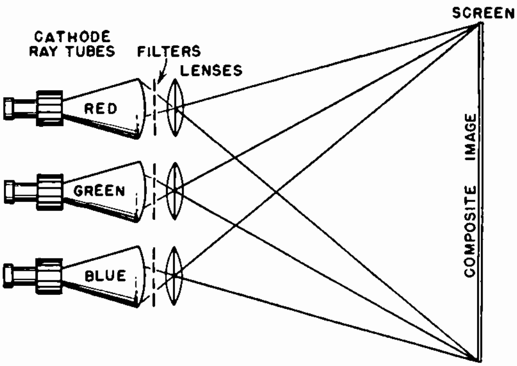


Fig. 6. Three separate cathode ray tubes can be used to form a single full-color image. This system is adaptable to either the simultaneous or sequential systems.

in this system, and the complete image results when the three separate images are combined on the screen. Since three separate tubes are employed, this system of reproducing the full color image is well adapted to either the simultaneous or the sequential method of sending the color information. The tubes themselves can be operated in sequence or they can be all operated simultaneously. Where the three separate images appear on the face of a single cathode-ray tube, as in the system previously described, the receiving equipment becomes more involved. As in the method previously described, separate color filters can be employed over the face of each cathode ray tube.

A better system, however, is to use cathode ray tubes which fluoresce in the three basic colors. That is, the phosphor used in making one tube can be designed to fluoresce with a red color; the phosphor used for one of the other tubes can be designed to fluoresce in blue; and the phosphor used for the third tube can be designed to fluoresce green. If this is done, the use of separate color filters and the resultant reduction in efficiency of light transmission is eliminated.

Of course this system does suffer from some disadvantages—it is necessary to use three separate cathode ray tubes, with the resulting increase in cost of the television receiver. Also, three separate cathode ray tubes occupy more space than will a single tube and there will be an increase in the overall size of the set. This is a serious disadvantage, of course, when it is desirable to make the television set as small as is practical for home use.

In order to avoid some of the difficulties encountered when using color filters and when using separate cathode ray tubes, two basic types of three-color cathode ray tubes have been developed. Let us discuss these two types.

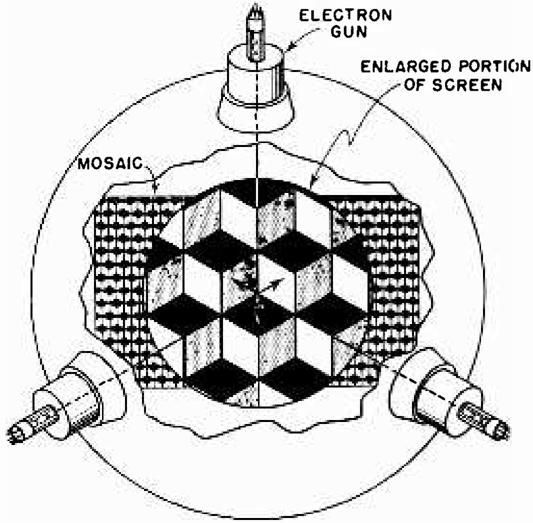


Fig. 7. Tri-chromoscope (center section of illustration shows a greatly enlarged view of the mosaic). Used with the simultaneous color system.

Tri-chromoscope: A tube which permits full-color direct viewing is illustrated in diagrammatic form in Figure 7. In it, three guns, each modulated by one of the three color channels, scans the screen from a different angle. Magnetic deflection yokes of all three guns are driven in series from a single deflection generator so that the three beams can be held in perfect synchronism. The screen surface is a series of three-sided pyramids with the sides all oriented in the same direction, so that they are all scanned by the same gun. The beam from any one of the guns strikes only one side of each pyramid as shown in the illustration. All the sides, facing in one direction, are coated with the same color phosphor but each side (of any one pyramid) has different color phosphors.

Thus, each picture element on the screen of the cathode ray tube consists of three separate areas of colored phosphor. A metal backing is used for the screen to prevent secondary electrons from one phosphor from exciting adjacent phosphors of different colors, as well as to prevent loss of back light and to conduct the charge away from the screen.

The final reproduced picture is made up of the image produced from each side of each pyramid, with each side representing different color values.

Extremely high brightness can be obtained from a tube of this sort because the pyramidal mosaic gives roughly three times the surface area of phosphor for each picture element as contrasted with a plane surfaced screen.

This tube is called a "tri-chromoscope" because it consists of a single tube having three guns ("tri" means three) and is designed for full-color reproduction ("chromo" means color).

In manufacturing the tube, the pyramidal shape is molded right into the glass surface and the different color phosphors are settled in place as in the manufacture of a conventional cathode ray tube. When the phosphor suspension is settled in place, the tube is so oriented that all the faces on the same side of the pyramids are horizontal. The phosphor of a particular color will then settle on the upturned faces and not on the others. In this way, the three different phosphors can

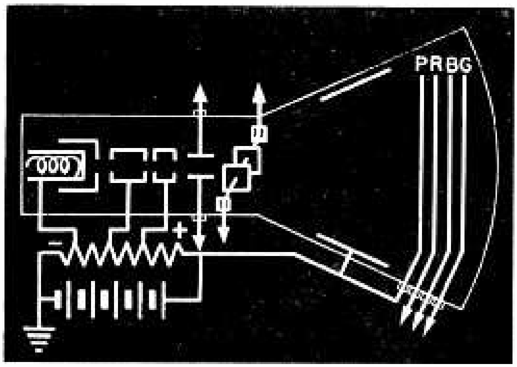


Fig. 8. Chromoscope for use in sequential system of color television.

be deposited on the appropriate sides of the small pyramids.

Chromoscope: A cathode ray tube for reproducing images in full color is shown in diagrammatic form in figure 8. This particular tube utilizes only one electron gun and can be designed to use either electrostatic or electromagnetic deflection. When using a tube of this sort, the cost of adding color to a television set, over the cost of black and white television, amounts to only a few percent of the cost of the receiver. It is designed for use in the sequential color television system. Since it is an all electronic system, the color interval can correspond to line frequency, field frequency, frame frequency, or any desired interval.

This cathode ray tube contains a single electron gun and a specially designed color image screen consisting of four parallel, semi-transparent screens, three of which are coated with phosphors corresponding to the three primary colors—red, blue, and green.

Each individual screen is electrically insulated and separated so the voltage applied to it can be independently controlled. Any one screen can be caused to fluoresce by placing a high positive potential on that screen and a low voltage on the other screens. In order to obtain a three color television picture, it is only necessary to change the screen potentials so as to place the high positive potential on the three color screens in order.

The final image formed is made up of the three separate color images superimposed and has the appearance of originating from a single three-color screen. The picture can be viewed directly or by means of a projection system.

A fourth screen (P in Fig. 8) in the assembly, that nearest the electron gun, has a constant positive voltage applied to it. It is relatively transparent to light and electrons and serves to shield the region between the electron gun and the image screen from voltage variations resulting from variations of the color screen potentials. This prevents defocusing.

Screen voltages may be changed electronically by means of a multivibrator circuit which can be synchronized by horizontal or vertical sync pulses (depending upon whether the line colors are changed in sequence or whether the fields are changed in sequence). From a circuit point of view, the multivibrators are the only additional circuits needed in the receiver to produce color television.

The color screens may take any one of a variety of different forms, but certain basic requirements must be met: (A) the screens should be conducting (or semi-conducting); (B) the screens should be relatively transparent; (C) each screen should intercept approximately one-third of the primary electrons in the beam; (D) each screen should contain the phosphors of the proper color hue and intensity to give proper color output and sufficient brilliance; (E) the final resolution should be comparable to that of black and white pictures; (F) the color screens should be close together.

One type of screen construction consists of close-mesh, parallel wires—containing small-diameter wires or metallic strips placed close together and welded to a metal frame. The phosphor is then deposited on the wire screen formed. If we are to have 525 line picture definition, each separate color screen would have to contain at least 525 parallel wires. The spacing and size of the wires in any one screen would be such that approximately one-third of the electrons on the beam strike each screen. Thus, the screens would be transparent to light and electrons, but would permit sufficient phosphor surface to be struck by the electron beam to form a picture.

Since electrons only penetrate slightly below the surface of the phosphor, a very thin layer of phosphor on the screen wire is just as effective in producing fluorescence as a thick layer.

The wires in all three color screens could not be all parallel, however, because an objectionable "picket fence" optical effect would occur. In a practical tube, this can be overcome by mounting the wires of one screen horizontally, those of another screen vertically, and those of the third screen at a 45 degree angle.

The three color screens, together with the constant voltage screen, can be clamped together and inserted in the cathode ray tube as a unit, with separate leads brought out for the electrical connections to each screen.

In an alternative type of screen construction, a thin plastic film can be used which is made slightly porous in order to allow the electrons to travel through it easily. Conductivity across the surface of the screen can be obtained by depositing a thin layer of metal on it. The metal particles and the phosphor might be mixed together before being applied to the film.

The three screens can then be either separated for additional insulation or, if the insulation provided by the film is sufficient, the screens can be put one on top of another to form a "sandwich" screen.

The principal difficulties encountered in designing and manufacturing this particular color tube are those associated with voltage breakdown between the screens and parallax errors. Extremely high voltages will be applied between the different screens in operation and good insulation is necessary to prevent breakdown.

Two types of parallax errors are encountered—one in which the beam striking the screen furthest from the electron gun produces a somewhat larger image than that closest to the gun; and the second type which occurs because of the angle at which the viewer sees the television picture. However, it is expected that both difficulties encountered can be eliminated with further development.

One great advantage of using a tube of this sort is that the total band width for the color television can be made the same as for present black and white television. This is due to the fact that sequential line scanning can be used—each succeeding line being scanned in a different color—so that the line frequency can remain approximately the same. Actually, of course, there would have to be a change from 525 lines to either 523 or 527—some number not divisible by two or three. This is necessary so that the color will change at each line and a given line will always be scanned in different colors in successive fields.

The use of a line frequency not divisible by 3 assures color rotation for any one line in successive fields.

Since a tube of this type allows color television with the present transmission standards, without an appreciable increase in band width, and with a minimum increase in receiver cost, it is felt that a system of this sort will be the most promising for future development—provided the tubes can be commercially developed and economically manufactured.

—— *n r i* ——

Philip Space says:—

My girl and I have a lot in common. We think the world of her.

My boy stole an apple off a pushcart. He was arrested for impersonating an officer.

Our maid keeps breaking dishes and if that keeps up she'll soon have us eating out of her hands.

He used to be teacher's pet. But now he's grown up and pets teachers.

I wish I was a preacher. It's a good job. Only thing, you don't get Sundays off.

If you notice he leads his band with his back to the orchestra. That's what married life did to him. He got tired of facing the music!

—— *n r i* ——

Courtesy "Radio-Electronics" Magazine

"Don't you have one with a better-looking announcer?"

Handicaps May Stop Some But Not This Boy!

Reprinted with the permission of the *Knightstown Banner*, Knightstown, Indiana.

NEXT time you think you are handicapped, think of Clark Conaway, 19-year-old Knightstown youth, who has overcome tremendous obstacles to learn a skilled trade and started a business of his own.

The son of Dr. and Mrs. Harry E. Conaway who have been operating a grocery near their home at 326 North Jefferson street, Clark cannot use either leg and must do his work from his wheel chair.

He hasn't been able to attend school since he was in the eighth grade, but about three years ago, he enrolled in a correspondence course with the National Radio Institute. Last March he was graduated and was given a diploma, which he proudly displays, indicating that he is a qualified radio repair-man.

His affliction dates back to his fifth year of school at Willow Branch. He was the victim of one of those unfortunate accidents as some older high school boys, in a moment of fun, gave him a shove down stairs, and Clark fell on his spine in such a way that he lost the use of his legs.

But Clark is very happy now, surrounded with numerous gadgets which this reporter found impossible to comprehend. He's happy because people are bringing him radios to repair from as far as Anderson, Muncie, Indianapolis, and Shelbyville. And from all reports he's received favorable reaction to his repair work.

Clark likes especially to recall the year he spent taking his correspondence course. The school sent him radio parts for experimental purposes.

These he methodically pieced together until he had built a radio receiver. He built this radio receiver in February 1948 and since then it has been running perfectly and almost continuously.

Asked if the radio course was hard to learn, Clark said that he found it comparatively easy, but you can tell that radio has become his life as he enjoys every minute of his work.

How to Build A Capacity Substitution Box

By GEORGE J. ROHRICH

NRI Laboratory Instructor

George J. Rohrich

HAVE you ever wanted some particular value of condenser connected with a pair of flexible leads for test purposes? Refer to Fig. 1. Here is a simple arrangement which lets you quickly select any one of several values of capacity from a group arranged in logical order. Selection is made by turning Switch S_1 which connects the indicated value through Switch S_2 to the output jacks, where test leads are attached.

This condenser substitution box finds its greatest use when you service a receiver where the complaint is noise, hum, or oscillation, and the offending sounds are heard whether or not the set is tuned to a program. This shows that a defect within the set is introducing a signal of its own. The origin of this offending signal usually involves any one of several condensers, perhaps an open screen by-pass condenser, a changed value of capacity, or inadequate filtering.

Running down such trouble is covered in detail in the "Radio Servicing Methods" instruction books which are a part of the NRI Lessons. Here you are taught how to localize the defective stage with the help of a .1 to .5 mfd. blocking condenser, before making individual substitution by trial of a condenser which temporarily replaces the one now suspected of causing the trouble in the defective stage.

Ordinarily, you might hold a single condenser between your thumb and forefinger, and risk getting a shock or making incomplete connections, or letting the leads slip and burn out some other part. However, with this condenser substitution box your selected condenser is securely fastened to leads provided with alligator clips. This lets you clip the condenser into the circuit before turning on the set and the gripping action of the alligator clip assures good contact being maintained as long as the condenser remains connected.

After a test condenser is removed from a circuit it is usually capable of retaining its charge, with sufficient value of voltage to produce an unpleasant shock if you came in contact with these condenser terminals. To overcome this hazard of getting shocked, the terminals of any test condenser should be momentarily shorted before setting the condenser aside. Switch S_2 in the condenser substitution box described here automatically disconnects the selected condenser and then shorts its terminals after you are through making each individual test. Consequently, the hazard of getting shocked is practically eliminated.

A highly charged test condenser also could damage a tube if its high voltage were allowed to discharge into the grid circuit of some tubes. Therefore, be constantly aware of the need for discharging any test condenser before switching it from one circuit to another. The function switch S_2 gives you this protection.

As you know, each condenser is built to withstand a specified maximum working voltage which is indicated by the manufacturer on the condenser label. You can use less than the specified working voltage but if you apply a higher voltage, there is danger of rupturing and destroying the condenser. Consequently, for your condensers, which you use in a substitution box, you must select only those which you know will stand up under the applied voltage. Refer to Fig. 2. Notice how the voltage rating is clearly specified along with each capacity on each selector switch position for ready reference.

The condensers you build into your condenser box should be capable of standing up under the highest voltage conditions which you encounter in practice. Most radio receivers seldom use working voltages which exceed 450 volts. For this type of service you can select compact oil impregnated paper dielectric condensers, non-inductively wound and rated at 600 working volts, with capacity values less than 1 mfd. For higher capacities you may select compact dry electrolytic condensers rated at 450 volts.

Table 1 shows nine condensers which will give the widest application for test purposes and which are procurable at a reasonable cost. These may be purchased from your favorite local dealer or from a mail-order house. NRI cannot supply any of these materials.

The switches also are standard equipment, readily procurable at reasonable prices from radio dealers and mail-order radio supply houses. Switch S_1 is a Mallory Single Gang Switch, Non-shorting Type 32112J, single pole with twelve positions, sold complete with bar knob.

Switch S_2 is a Centralab Type 1451 Universal Flat Switch, with Non-shorting contacts and with spring return. It is sold complete with bar knob. From Fig. 1 you will see that only three of its twelve terminals are needed here for use as a single-pole double-throw switch.

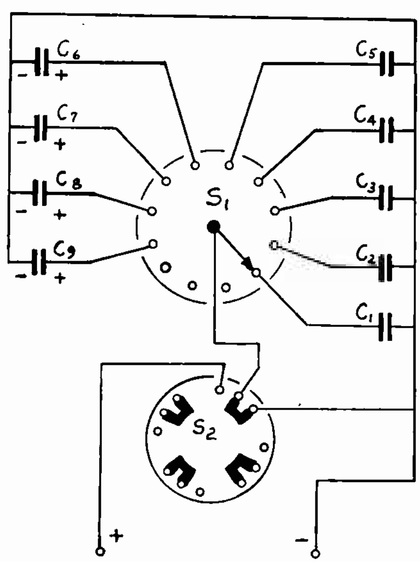


Fig. 1

Also procure a pair of test leads (one red and one black) having "alligator clips" at one end and suitable plugs (either with "banana" type or "pin-jack" type plug) at the other end. These will plug into the jacks (marked POS and NEG in Fig. 2). The clip and "banana" plug of one of these leads are shown in the lower left corner of Fig 2, near the "negative" jack.

The inside dimensions (of the box which happened to be available) are 5 by 5 by 2 inches. This size is just about the minimum but there is no restriction to selecting a larger box if you care to do so and it may be either wood or metal.

The switches S_1 and S_2 are mounted by drilling a single hole for each switch. Use a ⅜-inch drill. Space these holes so the minimum distance between them is 2½ inches. Also drill suitable holes for mounting the positive and negative jacks at a convenient location.

Temporarily mount the switches and mark the ten positions where the S_1 pointer stops, for finally reproducing the OFF position along with its nine condenser values shown in Fig. 2. (A good grade of "drawing paper" was glued to the panel of the box described here.

TABLE I

SYMBOL	CAPACITY MFD.	WORKING VOLTS	GENERAL TESTING PURPOSE
C_1	.003	600	Power tube, plate output bypass.
C_2	.006	600	Power tube, plate output bypass.
C_3	.02	600	Coupling.
C_4	.1	600	R.F. bypass for screen, cathode or across electrolytic filters.
C_5	.5	600	Blocking condenser for testing.
C_6	10.	450	Filter.
C_7	20.	450	Filter.
C_8	30.	450	Filter.
C_9	40.	450	Filter, or audio cathode bypass.

"Speaker cement" was used for the glue, such as is used for repairing the cone of a loudspeaker. This paper made it easy to mark and reproduce Fig. 2 on the panel of the condenser box.)

Also identify and mark the two positions where the pointer of S_2 stops and letter the respective positions DISCHARGE and FUNCTION, exactly as shown in Fig. 2.

With the pointer of S_1 turned to its .003 position, test with an ohmmeter, and locate the one particular terminal to which condenser C_1 (the .003 mfd.) must be now connected. You must then add the remaining condensers in progressive

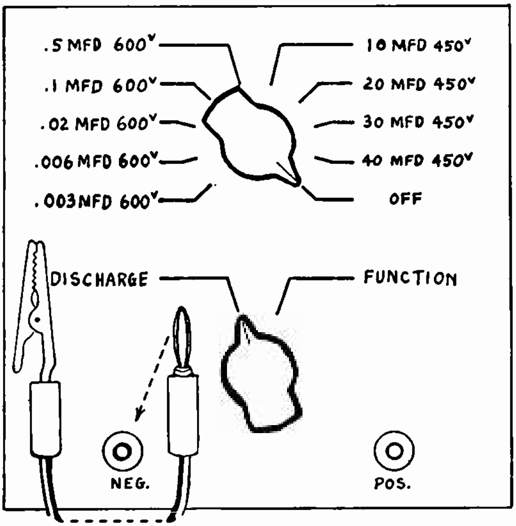


Fig. 2

counter-clockwise order (as viewed from bottom of panel), just as you see in Fig. 1. The next condenser connection (C_2) is the one which is located *counter-clockwise* from its preceding (C_1) connection.

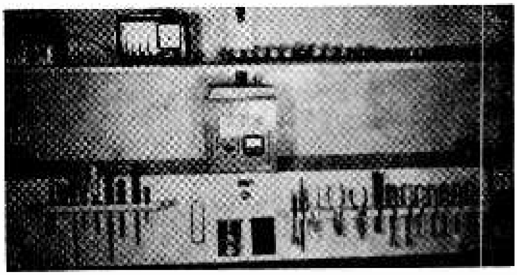
Fig. 1 also shows the terminals of S_2 exactly as you see them on the switch while you look at its back and make your soldered connections. The four movable metal contactors (shown in heavy black print in Fig. 1) are visible when you look at the back of the switch, and they permit easy identification of each group of three terminals. You may select any one of these groups (of three terminals per group) for attaching the three wires shown in Fig. 1.

Connect the remaining free terminal of each condenser to the negative output jack.

If your choice of material for the box is metal, you should take precaution to insulate all terminals from this metal. This is essential because in many instances both output jacks will be above ground potential and this preliminary precaution will eliminate the hazard of getting a shock. You can thus make your subsequent test connections in any way that is necessary and find it is safe to handle the metal chassis, although either or both test clips are connected to any terminal in the set under test.

—n r i—

NRI STUDENT'S WORK BENCH



The above photo shows the nicely constructed and well arranged work bench of NRI Student Edward T. Fitzgerald, of Corning, N. Y. Fitzgerald has completed his twenty-first lesson. The bench incorporates several of the ideas suggested in NRI lessons.

—n r i—

An Attendant in a mental hospital noticed a patient with his ear close to the wall, listening intently. The patient held up a warning finger, then beckoned the attendant over and said, "Listen here!"

The attendant listened for a few minutes and then said, "I can't hear anything."

"No," said the patient, "and it's been like that all day."

—n r i—

Philip Space says:—

When his father said, "Who cut down the cherry tree?" Washington said, "I did, father, I cannot tell a lie." And his father said, "You want to be a politician, don't you, son—well, better start learning darn quick!"

Teacher said to the students, "I'm new here—do you sleep with your windows open or closed?"

That fighter's very superstitious. He never starts a bout without a horseshoe in his glove.

HOW TO GET ALONG WITH OTHERS

By

DR. JAMES F. BENDER, DIRECTOR

THE NATIONAL INSTITUTE FOR HUMAN RELATIONS

WOULD you agree that there are no really wicked people? Of course there are many unhappy people. And when they are unhappy, they sometimes do things society doesn't approve of.

Most unhappiness springs from wrong attitudes. These attitudes go back to the first five years of our lives, say the psychologists. Yes, they go back to the home—to fathers and mothers.

Charles Darwin always suffered from nervous indigestion. It began in his childhood. He was afraid of his father. This man was stern and unsympathetic. He called his son "a rat catcher" and made fun of his being a biologist.

Lord Byron, the poet, led a neurotic life. He was virtually driven out of England because of his immorality. He never knew the security of a father's guiding hand. Alexander The Great wept as a young man because there were no more worlds to conquer. His harsh father, Philip of Macedon, frightened him into insatiable ambition. The great novelist, Balzac, spent an extravagant life. He had to dodge the sheriff and debtors' prison most of his mature years. His father was stingy as all get out. He even denied his son the normal comforts of childhood.

So we see how important it is for us to encourage fathers to do a good job of helping to bring up their youngsters. For a happy father is a nice fellow to be around, in and outside his home. As the number of first-rate fathers increases, the world becomes a better place. Isn't it important for all of us, therefore, to review from time to time the tests of a good father?

1. He loves his wife and children tenderly.
2. He always has time to listen sympathetically to their problems.
3. He builds confidence in his children by playing with them when they are small. He makes companions of them as they grow up.
4. He is a good provider and teaches his youngsters wholesome values of money.
5. He takes a deep and active interest in his home. He helps make home-life attractive and enjoyable.
6. He encourages his children to develop their inherited capacities. He develops worthy interests.
7. He sets a good example of his belief in spiritual values by accompanying his family to church regularly.
8. He welcomes his children's friends to his home.
9. He speaks gently and persuasively. He places a high value on the integrity of the spoken word.
10. He administers punishment and rewards wisely.

BE A GOOD FATHER

Installing a Television Set in the Office of President Truman

By WILLIAM F. DUNN

NRI Consultant

WHILE President Truman was vacationing in Florida a new Television receiver was installed in his office in the White House. The installation was made by Jerry McCarthy, an NRI Graduate, who along with his brother, Jay, another NRI Graduate, operate a service business in Washington known as the McCarthy Brothers Electronic Company. I went along with Jerry to observe the installation and to help in any way I could.

The TV set was a new model. A 20-inch direct view picture tube was used in the set. The unit consisted not only of a TV receiver, but also complete AM and FM coverage were available along with an automatic record changer.

The set is mounted on a swivel. The design permits turning the receiver easily on the swivel. Thus it can be viewed from any place in the room. The turning device is designed so that instead of swinging the set as though it were on an axle, the entire set swings out when it is being turned. The purpose of an arrangement of this type is to permit locating the receiver directly against the wall. If the set were built to swing about its center, it would be necessary to position the receiver away from the wall or the back of the set would strike the wall when the set was being rotated. However, with the arrangement used on the set, it can be mounted flush against the wall. When the set is turned, it swings out and the rear of the set never protrudes beyond the stand.

The front and back of the receiver, as well as the two ends, were completely finished. As a result, either the front or the back of the set may be left out facing the room. The back of the receiver and the two ends were finished in fine mahogany veneers, whereas the front of the set had a green jade finish.

There are four TV stations operating in the Washington area; two low band stations, using channels 4 and 5, and two high band stations, using channels 7 and 9. We tackled the installation with the intention of obtaining clear sharp pictures on all four stations even though considerable interference is usually encountered in locations of this type. Large, high buildings are to the east and to the west and also not too far off to the north of the White House. The TV signals are bounced around by these buildings, and in this type of location it is extremely difficult to avoid multipath reception.

Once the set had been placed inside the executive office, the work of assembling and mounting the antenna began. We planned on mounting the antenna on the chimney by means of brackets fastened directly to the chimney brick work. This placed the antenna in a spot where the transmission line could be conveniently run and also the antenna could be mounted high enough to be completely clear of surrounding objects. The mast supporting the antenna extended less than 10 ft. above the top bracket and therefore it was not necessary to use any guys. It was necessary to slightly extend the length of the mast originally supplied by the manufacturer and this was done by inserting the mast in another mast of slightly larger diameter. The two masts were then drilled and bolted together.

The antenna was a special high-low band antenna designed for sets of this type. A sketch of the antenna is shown in Fig. 1. This type of antenna is very directional, it is suited ideally for installations such as this where many reflections are encountered.

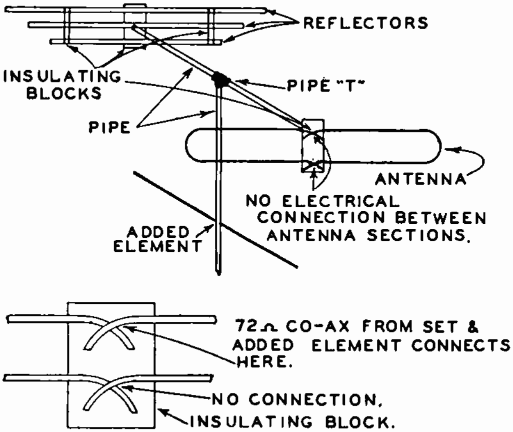


Fig. 1

Fig. 2 roughly shows the direction of the various stations with respect to the White House. The numbers on the stations indicate the channels to which the stations are assigned. Notice that three of the stations are located in the same general direction whereas the fourth station is off by itself.

Once the antenna was mounted and connected to the receiver we immediately realized that we were going to have a great deal of trouble eliminating ghosts. By rotating the antenna through the entire 360 degrees and raising and lowering the height of the antenna while examining the effects on the receiver, we soon discovered that one critical setting of the antenna would bring in the three stations grouped together with excellent results. A strong, clear, sharp, ghost free, picture could be obtained on these three stations. However, the station using channel 5 was off the back side of the antenna. The signal strength was very low, and the ghosts were so bad that the picture was completely blurred.

We tried rotating the antenna in order to improve the signal on channel 5. It was easy enough to position the antenna to pick up a good signal from this station. However, once we moved the antenna from its original setting, ghosts were picked up on the other three stations. Obviously the best thing to do was to place the antenna for a clear picture on these three stations and try something else on channel 5.

The solution proved to be connecting an additional dipole to the point where the transmission line tied on to the antenna. We found that this dipole could be positioned to give a strong signal on channel 5 and yet fail to pick up any appreciable signal or interference from the other three stations. The positioning of this element was determined by connecting the element to the transmission line and then moving it around while the effects on the various pictures were

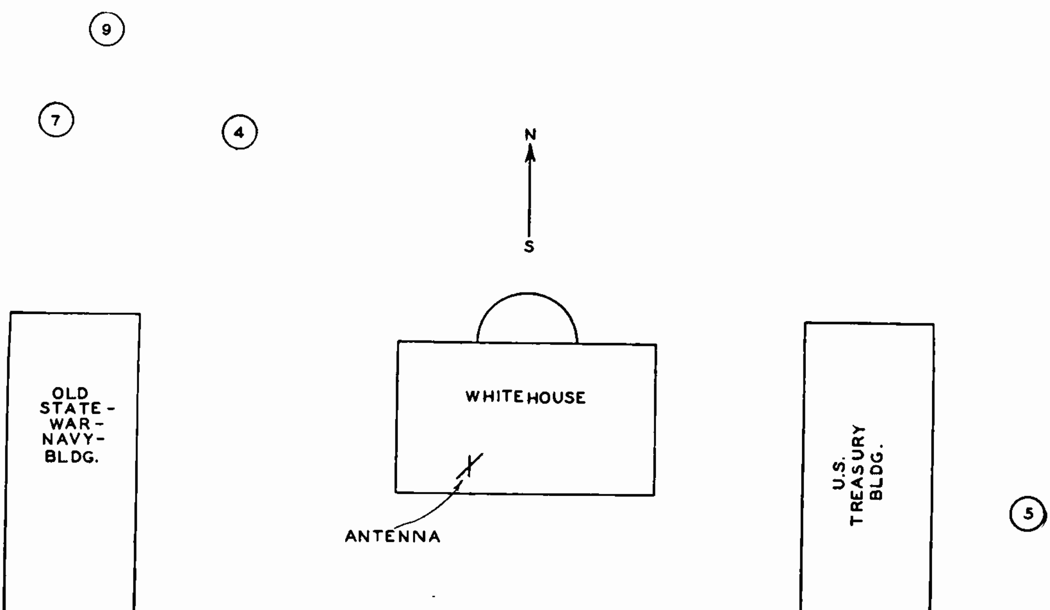


Fig. 2

observed. We found that in practically any position additional pickup on channel 5 was obtained. All we had to do then was find a position that did not cause any interference on the three stations that we already had coming in properly. By observing these stations it was comparatively easy to find the correct place to mount this element.

It was not too difficult to properly orient the antenna because we had a man stationed at the receiver and several men up on the roof. By means of telephones the results could be observed by the man at the set and those on the roof could be notified of the effects as the antenna was oriented.

Once the proper position for the antenna had been determined, it was carefully checked to be sure that everything was mechanically sound, that the antenna was securely fastened in position, and that it would not have any tendency to twist or turn during storms. A secure ground was fastened to the antenna mast and connected to the ground lead going to the lightning arrestors already on the building.

The transmission line was checked to be sure that there was no place where it would rub against the building in a wind. We felt that it was worthwhile to spend the additional time checking these things to be sure that there would be no avoidable callbacks.

When the work on the roof was finished, the set was given a final check. The focus was carefully checked. Then we checked the picture on all four channels to be sure that there were no ghosts or any other forms of interference present. The horizontal and vertical centering, as well as the linearity adjustments, were also checked and set properly.

Needless to say a great deal of painstaking care went into this installation. Every installation made by the McCarthy Brothers is made as carefully as the installation in the White House. The example set by them should be carefully followed by all NRI men doing TV installation and service work. It will pay off in repeat business from old customers and also in an ever expanding business due to new customers. Remember, there is no better advertisement than a satisfied customer.

———*n r i*———

"Who is this guy, Philip Space?" asks a reader.

"Ah ha!" exclaims the Editor, "a very handy man to have around. He is the fellow who fills up space with the lighter side of life."

Now don't tell us you don't get it.

7-RK Receiver "Dressed Up"

Dear Chief Instructor Dowie:

I received the April-May issue of Radio News. The article on Dressing Up The 7RK Radio was of special interest. I am enclosing a photograph of the way I choose to "doll" mine up.

I used a "GI" Recording Head, installed a microphone amplifier circuit on the spacious chassis, and presto I had a Radio-Phono-Recorder—P.A. that is equal to any $150 job on the market.

Just a year ago, such an assembly would have been "Greek" to me, but having just completed your Servicing course, it was comparatively easy. Since showing it to friends and neighbors I have had many requests to make other custom installations.

Sincerely,

Fred W. Uhl,
Detroit, Michigan.

TELEVISION BOX SCORE

Stations Operating	61
Construction Permits Granted	58
Applications Pending	321

(AS OF APRIL 28, 1949)

LOCAL OSCILLATORS USED IN RECEIVERS

By WILLIAM FRANKLIN COOK

Chief Editor, NRI Instruction Material

Wm. Franklin Cook

IT is possible to use any of the basic oscillators, or any of their many variations, as the local (frequency-converting) oscillator in a receiver. Certain practical factors, however, have limited the choice of oscillators to a few basic types. In sound (a.m. and f.m.) receivers today, the tuned-grid and the Hartley are the favorites. The Meissner circuit will be found in some older sets. In television sets, the local oscillator is almost universally an Ultra-Audion or a push-push circuit. Of course there are exceptions—there are a few Hartley circuits used in television, and certain f.m. receivers use the Ultra-Audion. Let's take a look at a few practical circuits.

OSCILLATORS FOR A.M. RECEIVERS

In the early days of radio, the local oscillator and the first detector were separate stages using different tubes. Modern a.m. broadcast receivers, however, almost always contain a pentagrid converter stage in which both functions are combined. The stage is given this name because the tube used in it has five grids (penta means five) and because it converts an r.f. signal to an i.f. signal, acting as both detector and oscillator.

The arrangement of the elements in a typical pentagrid converter tube is shown in Fig. 1. The grids are numbered consecutively, starting from the cathode and moving toward the plate. The first grid is the oscillator control grid. The second grid is called the anode grid because it acts as a plate in the oscillator circuit. Grids 3 and 5, which are connected within the tube, form the screen grid. Grid 4 is the control grid for the first-detector portion of the tube.

Fig. 2 shows a diagram of a typical pentagrid converter. You can see that the oscillator portion of the circuit is a standard tuned-grid oscillator if you consider grid 2 to be a tube plate. The tank circuit L_1-C_1 is in the grid circuit, and grid-leak bias is furnished by R_1 and C_2. The

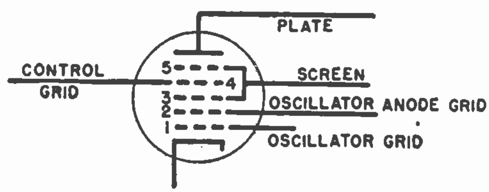


Fig. 1. A pentagrid converter tube.

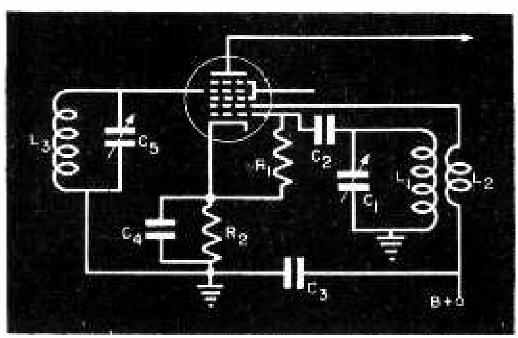


Fig. 2. A typical pentagrid converter oscillator circuit.

feedback coil L_2 is connected between the B supply and the anode grid.

You will observe that grid 2 is supplied with a positive potential, just as any tube plate would be, and that its current flow through L_2 provides feedback. A grid is used as the plate here, because it is not solid and will therefore intercept only a few of the electrons in the main cathode-to-plate current—enough to sustain oscillations, but not enough to cause a serious reduction in the plate current of the tube.

The oscillator signal applied to grid 1 causes the plate current of the tube to vary at the oscillator frequency. The incoming r.f. signal applied to control grid 4 also causes plate current variations. As a result, these signals are mixed within the tube. Since the mixing occurs in the electron stream, this process is called electronic mixing. In Fig. 2, resistor R_2, by-passed by C_4, furnishes the detector bias for control grid 4. This bias is set by the average plate current to the proper value to produce detector action. The oscillator grid is biased additionally by the action of R_1 and C_2.

The tube shown in Fig. 2 is of the very widely used 6A8 tube family. Fig. 3 shows a pentagrid converter stage in which a 6SA7 type is used. This tube also has five grids, but they are connected differently: 1 to the oscillator control grid, 2 and 4 (internally connected) make up the screen, 3 is the first-detector control grid, and 5 is a suppressor.

A Hartley oscillator is used in this stage. Notice that grid 1 is connected through C_2 to one end of the tank, the cathode of the tube is connected to a tap on the tank, and grid 2, which acts as the oscillator anode, is connected through by-pass condenser C_3 to the other end of the tank. (Follow the path through the ground from C_3 to the tank.) The action of this circuit is practically the same as that of the one in Fig. 2 except that here the oscillator "plate" is also the screen grid. The electron stream from the cathode to the tube plate is modulated by grid 1 at the oscillator frequency and by grid 3 at the incoming signal frequency.

Injection Coupling. A difficulty of the pentagrid-converter tubes is that a certain amount of coupling exists in them between the oscillator and the tuned circuit of the first detector. This is no problem at broadcast-band frequencies, but it becomes one at the high frequencies used for short wave, f.m., and television. For this reason, some modern receivers produce signal conversion by using an arrangement like that shown in Fig. 4, which produces a minimum of undesirable coupling. Here VT_2 is the oscillator; its output is applied through a tap on the tank coil L_1 to grid 1 of VT_1, the first detector. Although VT_1 looks schematically just like a pentagrid converter, it is instead a pentagrid-mixer—one of a class of tubes specifically designed to have a minimum of coupling between grid 1 and control grid 3. Grid 1 is called an injector grid, because it "injects" the oscillator signal into the electron stream of the tube.

OSCILLATORS FOR F.M. RECEIVERS

Although the f.m. tuning band is rather high in frequency—between 88 and 108 megacycles—an am-fm combination set generally uses the same oscillator for both services. When the set is switched from one to the other, of course, the tank circuit L and C values are changed so that the oscillator will produce the proper frequency.

In straight f.m. receivers (those that tune only to the f.m. band, or that have separate tuning circuits for the f.m. band), it is standard practice to use a separate oscillator tube. The Hartley, tuned grid, and Ultra-Audion are the most popular circuits for such sets (in that order).

OSCILLATORS FOR TELEVISION RECEIVERS

Television receivers use the push-push circuit or the Ultra-Audion exclusively, except for a very few that use the Hartley. These oscillators are preferred because they are best suited to the high frequencies (up to about 216 mc.) used for television.

We shall go into the reasons for choosing a particular oscillator for a particular application in

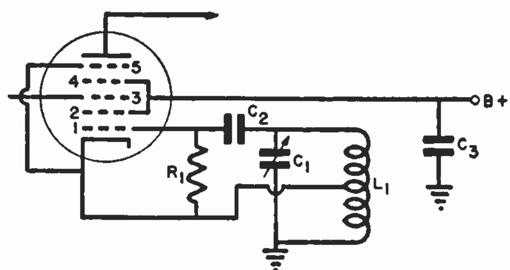


Fig. 3. A 6SA7 type pentagrid converter.

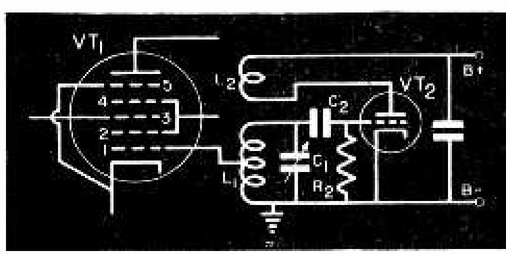


Fig. 4. An injection circuit.

more detail in a moment. Before we can do so, however, we must learn more about the tuning requirements of oscillators, because the tuning range required is one of the important factors governing the choice of an oscillator.

TRACKING AND PADDING

To produce the i.f. (intermediate frequency) in a superheterodyne, the oscillator frequency must differ from that of the desired incoming signal by the amount of the i.f. It is standard practice to have the oscillator frequency higher than that of the incoming signal, but it is just as possible to make it lower as long as the proper tuning range can be obtained.

As a practical example, a standard a.m. receiver uses an i.f. of 455 kc. If we are trying to tune in a broadcast station at 1000 kc., the oscillator circuit is adjusted to 1455 kc. When this signal of 1455 kc. is mixed with the 1000-kc. incoming signal, the difference, or 455 kc., will be produced as the i.f.

To tune over the standard broadcast band from 550 kc. to 1500 kc. and produce a 455 kc. i.f., the oscillator must tune over a frequency range of 1005 kc. to 1955 kc. All standard modern radio receivers use a single tuning control, so the oscillator tuning must be varied over this range in step with the adjustment of the first detector and r.f. preselector stage (if the latter is used).

As you know, we can tune the oscillator by varying either the inductance or the capacity in the tank circuit. Both methods are used in modern receivers. For our first example, let's suppose that the oscillator is tuned by one section of the tuning condenser gang. Now, if we use an oscillator coil that is just like the r.f. coils, the oscillator will tune to approximately the same frequency as the incoming signal at a particular dial setting, because the tuning condensers are all identical. We have just pointed out, however, that for a particular incoming signal, we want the oscillator frequency always to be higher by an amount equal to the i.f. of the set.

We can achieve this result by using a supplementary condenser, known as a padder, in the oscillator tank, arranging it as shown in Fig. 5. Here, condenser C_1 is the regular tuning condenser and L_1 is the tank coil of the oscillator. Padder condenser, C_2, a rather large capacity, is added in series with C_1. As you know, the capacity of condensers connected in series is less than that of the smallest condenser in the group. Therefore, by connecting the padder condenser in series with the tuning condenser, we have effectively reduced the capacity in the oscillator tank circuit, making the circuit tune to a higher frequency for a particular C_1 setting. If the coil and the padder condenser have the proper values,

Fig. 5. How a padder condenser is used.

the oscillator will automatically tune to a frequency the desired amount above the frequency of the incoming signal at all settings of C_1.

This padder-condenser arrangement is used only when C_1 is exactly the same as the other sections of the tuning condenser gang. Another way of keeping the oscillator frequency higher than that of the incoming signal is to use a tuning condenser having specially-cut plates in the oscillator section. In such a tuning condenser, the rotor plates of the oscillator section are smaller than the rotor plates of the preselector and first detector sections, so the oscillator condenser automatically has less capacity at all positions of the tuning condenser control, and no padder is needed. Careful design of the shape of the plates makes it possible to keep the oscillator frequency above the incoming frequency by the required amount.

When variable-inductance tuning is used, the tank condensers are fixed. Here, it is necessary only that the fixed condenser used with the oscillator coil be smaller than the others, and that the oscillator inductance be properly chosen.

Of course, none of these methods tracks perfectly, so trimmer condensers—small adjustable capacitors—are connected across the sections of the tuning condenser gang so that small adjustments can be made to improve the tracking.

WAVE-BAND CHANGING

Once the oscillator circuit is arranged to produce the proper frequency above the desired incoming frequency, it is then necessary only to change the tuning control to adjust it to any desired incoming signal within the band limits. The frequency range to which a receiver may be tuned depends on the maximum and minimum values of the adjustable control. If a tuning condenser is used, its maximum capacity determines the lowest frequency and its minimum capacity the highest frequency; if the coil is the variable item, the maximum and minimum inductances determine the lowest and highest frequencies. Because the frequency to which a tank circuit will tune depends upon the square root of the L-C product, a 9-to-1 change in the variable will produce only a 3-to-1 change in the frequency. That is if either the inductance or the capacity is reduced to one-ninth its maximum value, the highest frequency will be only three times the lowest frequency value.

The lowest frequency wanted for a particular band determines the maximum coil and condenser values that must be used.

Of course, there are many possible combinations of coil and condenser values that will all tune to a particular frequency. The values chosen must give a desirable L to C ratio, have reasonable Q, and provide the desired tuning range. The L-C ratio determines the load value—for example, with a tuned-plate circuit, the higher the inductance, the higher the load impedance for the same Q. However, we must not go too far because high inductance necessitates low tuning capacity and introduces a restriction on the tuning range. Further, the oscillator values are limited by the design requirements of the preselector and first detector circuits, because their L and C values set the starting points for the oscillator circuit.

The shunting effects of distributed capacity, stray circuit capacity, and the internal tube capacities make it necessary to use a larger tuning capacity to get a wide band width. For example, let's suppose we have a 400-mmfd. tuning condenser having a minimum capacity of 25 mmfd. This is a 16-to-1 ratio of maximum to minimum. A tank circuit in which this condenser is used may well have shunting capacities of as much as 15 mmfd., which add to both the maximum and minimum values. Our capacity range is now 415 to 40, or only about 10-to-1 instead of our original 16 to 1.

With a 200-mmfd. maximum and a 12.5-mmfd. minimum, we can again get a 16-to-1 range. However, if we now add the same 15-mmfd. shunting capacity, our values become 215 to 27.5,—only a 7.8-to-1 range. Obviously, we get a wider tuning band by using a larger tuning condenser; for this reason, fairly large condensers are used in a.m. sets intended for the broadcast band. However, when a short-wave band is to be covered, the tuning condenser must be smaller to permit reasonable inductance values. This compromise means that a 3-to-1 frequency range (9-to-1 capacity range) is about the best we can expect.

One reason oscillators using capacitive voltage dividers are more common in high-frequency receivers, such as f.m. and television sets, is that such circuits have less shunting capacity. The inductance of a feedback coil is reflected into the tank as additional shunting capacity; eliminating this coil thus reduces the shunting effects somewhat.

Also, tickler resonance becomes a worse problem at the higher frequencies; if it occurs, the oscillator may "lock-in" to its frequency and be uncontrollable. Finally, eliminating tickler coils means that fewer switch contacts are needed in the band-switching arrangement of the set. This last is a desirable feature because switch contacts frequently give trouble at very high frequencies.

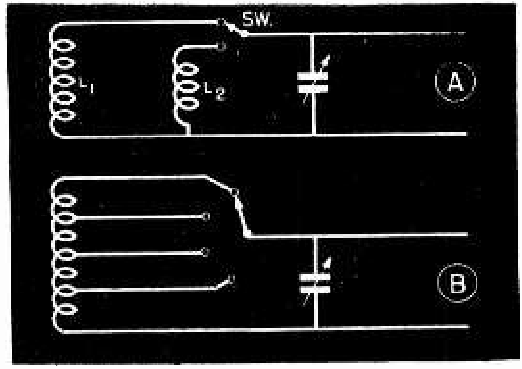


Fig. 6. Two basic wave-band switching circuits.

Thus, you may find almost any oscillator in a set designed only for the broadcast bands; certain types are more apt to be used if the set can receive short waves also; and, in f.m. and television sets, you generally will find only capacitive-feedback oscillators.

It is interesting to note that the push-push circuit reduces the effects of tube capacities by having the two tubes effectively in series across the tank insofar as shunting effects go. This reduces the total tube capacity to one-half that of a single tube. (The total capacity of equal condensers in series is half that of one of them.) This accounts in part for the popularity of this circuit at high frequencies.

PRACTICAL WAVE-BAND SWITCHING

Fig. 6 shows the two standard methods of changing the frequency band, both of which change the tuning inductance. In one, a different coil is switched in for each band.

In the other, the tuning coil is tapped, and a switching arrangement is used to disconnect a certain number of turns (thus reducing the inductance) when a higher-frequency band is wanted.

Both these methods are in use in a.m. sound receivers and combination a.m.-f.m. receivers. In sets in which the same oscillator circuit is used for both a.m. and f.m. bands, however, it is common practice to change the tuning condenser on the f.m. band to a smaller size also, so that a practical inductance value can be used with it.

Of course, in the straight f.m. radio, or in those using separate tuning units for the f.m. bands

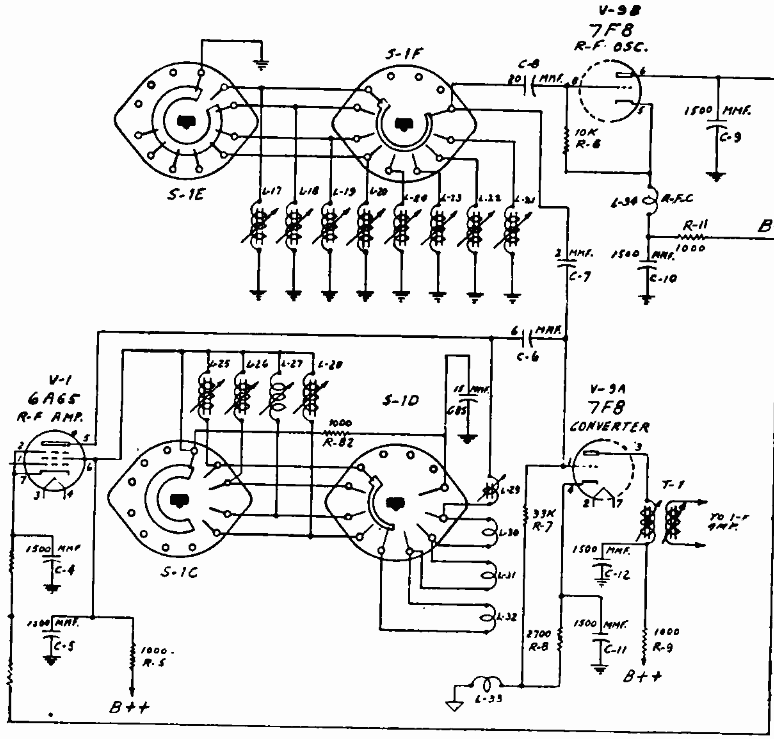


Fig. 7. The oscillator and converter sections of the wave-band switching arrangement in a Motorola television set.

alone, the coil and condenser combination is designed to cover the entire f.m. band. This is not too difficult, as the frequency range from 88 to 108 mc. is only 1.23 to 1.

Television presents a different problem, because television station channels are not arranged in continuous bands. There is an a.m. channel every 10 kc. in the broadcast band. In television, however, there may be a gap of 10 mc. or more between stations. (As a matter of fact, when you tune from channel 6 to channel 7 on a television set, you skip over the entire f.m. band as well as the bands covered by several other services.) Therefore, what amounts to a wave-band changing arrangement is used in most television receivers to switch from station to station.

Now, let's study some practical diagrams of oscillator circuits in which wave-band switching is used.

TYPICAL SWITCHING DIAGRAMS

Wave-band switching diagrams are complicated by the fact that draftsmen frequently try to show the mechanical appearance of the switch. This makes it harder to read the schematic, but, on the other hand, makes it somewhat easier to locate connections in the receiver. Fig. 7 shows a typical schematic. We are using a television set in this example, but the same style of drawing will be found on schematics of a.m. or f.m. receivers.

In Fig. 7, we have reproduced both the oscillator and converter switches—similar switches are also used in this receiver in the r.f. amplifier. Let's concentrate on the oscillator.

In this diagram, the oscillator switching sections are the sections S-1E and S-1F. S-1E is a shorting switch; its purpose is to short-circuit completely coils that are not connected in the circuit by switch S-1F. This arrangement is used to prevent any coil from becoming self-resonant and absorbing energy from the oscillator circuit. This prevents undesirable loading of the oscillator.

Switch S-1F permits any one of the coils L-17 through L-24 to be selected. Coil L-17 is shown connected in the diagram.

The essentials of this oscillator circuit are shown in Fig. 8. As you can now see, with the switch S-1F in the position shown, coil L-17 is the tuning inductance. It is variable, as indicated by the tuning symbol, so that a final adjustment can be made by varying the core position. As the switch is set to other positions, other coils, and hence other tank circuits, are connected to the oscillator. Stray capacities that exist across the tank coil and in the switch, together with the distributed capacity in the coil make up the tank circuit "condenser." These capacities, though

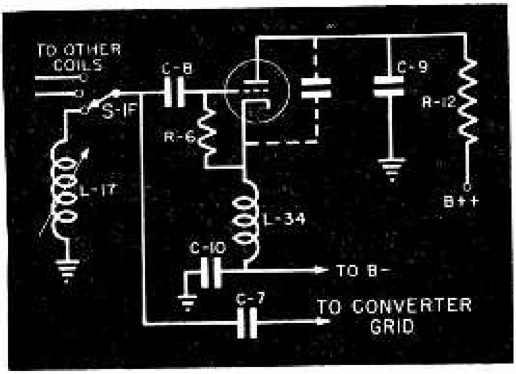


Fig. 8. Oscillator circuit of the set shown in Fig. 7.

small, are sufficient for the television channels.

In Fig. 8, coil L-34 is just a choke coil. The plate of the tube is essentially grounded through condenser C-9, so in effect it is connected to the end of the tank coil. Condenser C-8 and resistor R-6 are the grid condenser and grid leak. Condenser C-7 serves as the coupling condenser to couple the oscillator energy to the converter tube grid for mixing with the incoming signal.

If we now draw in the internal capacities of the tube (Fig. 9), we find this to be an Ultra-Audion oscillator. The tank circuit consisting of L-17 and stray capacity C is effectively between the grid and plate. The amount of feedback is determined by the internal tube capacities. To assist in producing feedback, some of the later models of this set had an additional condenser, shown in Fig. 8 by dotted lines, connected between the plate and cathode.

Fig. 10 shows another circuit and a different way of showing the wave-band switching. Once again we have chosen a television set for our example.

You will notice at once that there are three different tuning circuits, which look somewhat alike. The manufacturer's labeling tells us that tube V_1 is the r.f. amplifier, so the tuning circuit connected to it must be the preselector. Tube V_2, at the center, is the converter; this identifies the corresponding tuning unit. Tube V_3 is the oscillator.

If the manufacturer hadn't labeled the circuits so conveniently, we could identify the oscillator by its connections. Notice that the r.f. amplifier tube is connected to the antenna circuit and the converter tube is connected to the i.f. amplifier. Since the oscillator is never connected to either of these circuits, the remaining tube must be the oscillator.

An examination of this oscillator circuit shows it to be a tuned-plate, push-push oscillator. The wave-band switching arrangement is very clear here. As the switch is moved along from position 1 at the left toward position 13, it short-circuits sections of the tank coil. When the switch is in position 1, as shown in the diagram, the tank coil consists of all the coils from plate 1 of tube V_3 starting at L_{77} through L_{53}, L_{54}, and all the intervening coils through L_{78} to plate 2 of this tube. This entire string of inductances is tuned by the fine tuning control C_{15}. The B+ connection is made through resistor R_7 to what amounts to the coil center tap. Coupling to the converter is through a link coupling coil between this oscillator inductance string and the grid coil of the converter tube. (Between coils L_{77} and L_{52}.)

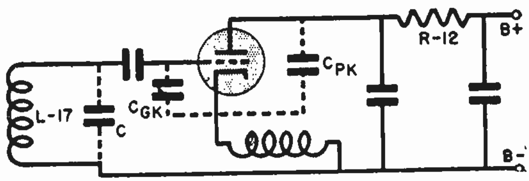


Fig. 9. Drawing in the internal tube capacities shows the circuit in Fig. 8 to be an Ultra-Audion.

As the wave-band switch is moved toward position 13, the inductance in the tank circuit is reduced, making the oscillator tune to higher frequencies. The inductances are chosen so that the set tunes to the television stations and skips over the undesired in-between bands.

Fig. 11A shows a circuit in which the frequency is changed by switching in the proper condenser C_3 to C_7. The actual tank, therefore, consists of coil L_1, the tuning condenser C_1,—one of the condensers C_3 to C_7, and the blocking condenser C_2. Once this circuit is redrawn (Fig. 11B), we find that the oscillator is an Ultra-Audion.

Although we have chosen television receivers in our examples of wave-band switching and tuning methods, the same principles apply to a.m. and f.m. sound receivers. In general, when you are analyzing the circuit diagram of a set you are

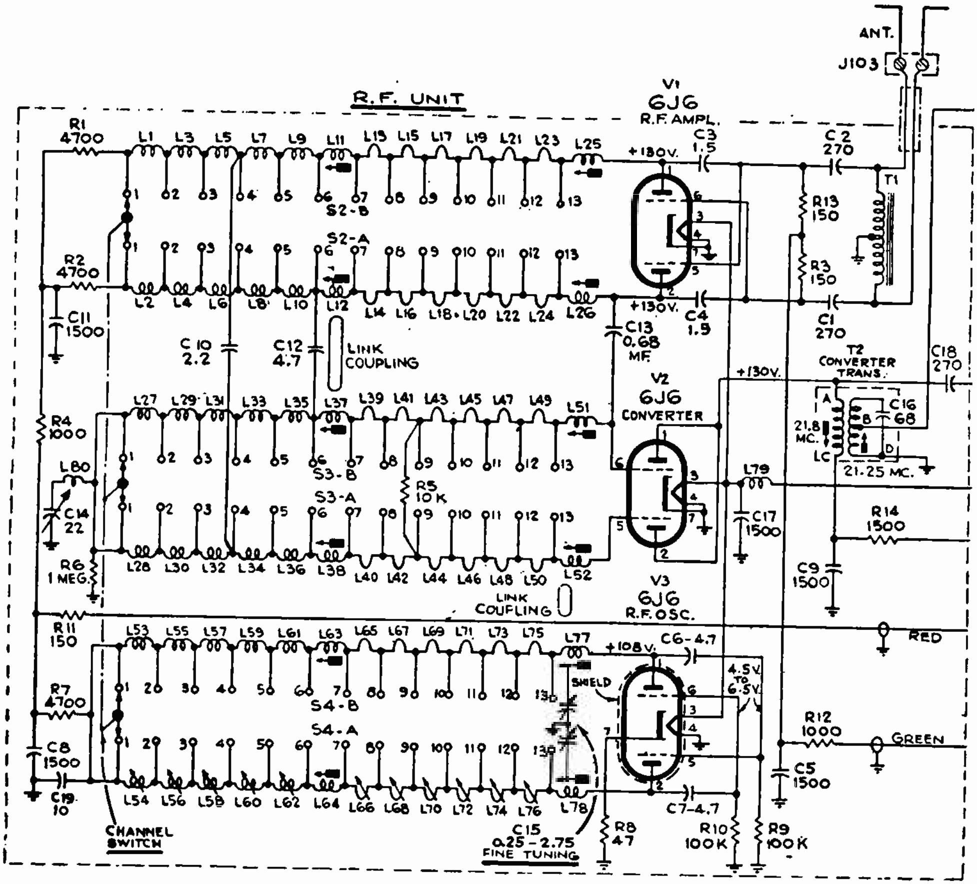


Fig. 10. R.F. amplifier, converter and oscillator sections of an RCA television set.

servicing, you need to concentrate only on the circuit that is defective. If you have a defective oscillator, you must wade through the wave-band switch connections to determine just what circuit is being used. However, if the trouble is elsewhere, there is no reason to worry about the oscillator unless you are curious about its operation.

SERVICE HINTS FOR OSCILLATORS

We shall not attempt to cover completely the subject of how to service defective oscillator stages. Instead, we shall point out the most common oscillator defects so that you can learn what they are while the theory of oscillators is fresh in your mind.

FREQUENCY DRIFT

You have learned that the oscillator is supposed to operate above the incoming signal frequency by a fixed amount. Therefore, the oscillator must produce one particular frequency when the tuning dial is set at a particular point. The manufacturer adjusts the circuit so that it does so when the set leaves the factory. Unfortunately, however, aging of the set may cause changes in the inter-electrode capacity of the oscillator tube, changes in the tank circuit Q, and changes in the supply voltage; heat may warp condenser plates or cause shifts in the positions of coil wires, thereby causing changes in the capacity and inductance of the circuit; and any or all of these effects may cause the frequency of the oscillator to drift from what it should be at any specific setting of the tuning controls.

Any such changes that have gradually developed over a long period of time can be compensated for by replacing the tube and correcting operating voltages if these are at fault, or by re-

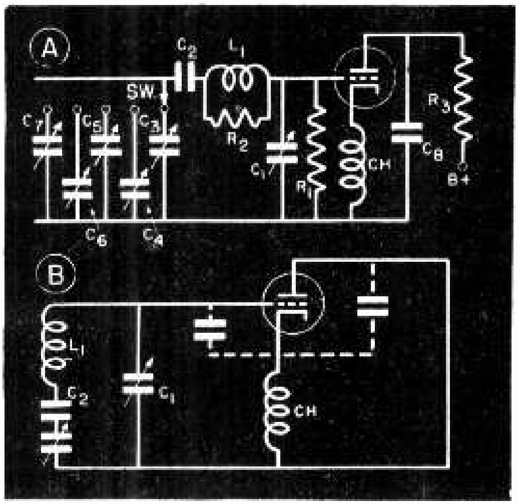


Fig. 11. Wave-band switching system in which the oscillator frequency is changed by changing the tuning condenser.

adjusting the trimmer condensers if the circuit constants have changed slightly.

Certain f.m. and television receivers use temperature-compensating parts, which are usually fixed condensers whose capacities change as the temperature varies. It is possible to make them so that they will either increase or decrease in capacity as the temperature increases. Such parts are used to compensate for the actions of other parts in oscillator circuits. For example, if the capacities of other parts in a circuit tend to increase as the temperature rises, use of a condenser whose capacity decreases with temperature will make the overall capacity relatively constant and so keep the frequency fairly well fixed.

DEAD OSCILLATOR

Most radio stages will work to some extent if the applied voltages become less than the design values. An oscillator stage may stop altogether, however, if the plate or filament voltage drops appreciably, especially if the coupling to a feedback coil is kept at a low value by design, if the tank circuit has low Q (is heavily loaded), or if the grid resistor is fairly high in value. For this reason, you should make careful voltage readings on a dead oscillator stage and compare them closely with those given in the manufacturer's service notes.

Most receivers (see Fig. 12) contain a resistor R_1 in series with the anode grid (or plate) of the oscillator to stabilize the plate voltage. The plate current, flowing through R_1, provides a voltage drop. Now, should anything happen to

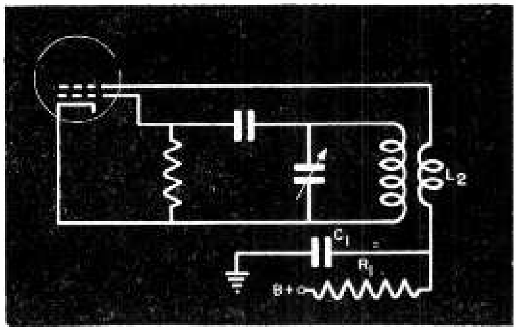


Fig. 12. Use of a stabilizing resistor to keep the plate voltage of an oscillator stage constant.

reduce the B+ voltage, the plate current will drop; this will reduce the drop across R_1 and so tend to keep the anode voltage more nearly the same.

A reduction in filament voltage is not likely in a standard a.c. receiver that uses a power transformer. However, in a.c.-d.c. and battery receivers that use series filaments, an increase in the series resistance may reduce the filament voltage on the oscillator tube so much that oscillation stops. In many of the modern three-way portable (a.c.-d.c.-battery operated) receivers, the filaments of several of the tubes (including the oscillator) operate from the plate current of the power output tube when the set is operating from a power line. A typical arrangement is shown in Fig. 13. As you can see, the plate current of power output tube VT_1 flows through the filament of the other tubes. This is an efficient arrangement, because the plate current flow is enough to heat the filaments of the other tubes, which are of the low-current battery type, and the drop across these tube filaments biases the output tube.

However, should anything happen to reduce the plate current of VT_1, the voltage developed across the series tube filaments will fall. The oscillator tube may be critical about this. In such cases, you may find that the set works satisfactorily on batteries, where the tube filaments are connected in parallel, but fails to work when power line operation is tried. In such cases, suspect the oscillator stage and check carefully on the filament voltage.

An oscillator may fail, particularly at the low end of its tuning range, if the tank circuit resistance increases, reducing the Q of the tank. If the tank Q is reduced, the voltage across the tank is reduced and hence the feedback falls off. The most common reason for a reduced Q is a poor connection at a coil or tank condenser terminal. Occasionally it is caused by the oscillator coil's having absorbed moisture.

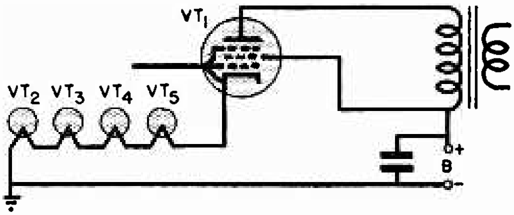


Fig. 13. Arrangements of the filament string in this fashion are common in a.c.-d.c. portable sets.

Of course, any defect such as bad oscillator tube or an open feedback coil will kill the oscillator stage. These are, in fact, among the most common causes of oscillator failure; we mention them last simply because their effect is obvious.

Replacing the oscillator tube in a television set (and certain f.m. types) isn't just a case of plugging in a new tube, because the internal tube capacities affect the tuning of the resonant circuit. In the Ultra-Audion, for example, the grid-cathode and plate-cathode capacities set the feedback, but are in series across the tank. Also, the grid-plate capacity is across the tank, so all the tube capacities affect the tuning. Therefore, because tubes have variations in their inter-electrode capacities, it is frequently necessary to try several tubes of the same type to find one that affects the tuning the least. Tubes that are unsatisfactory in one set may be perfect for another that is aligned for a different tube capacity. Of course, if necessary, the set can be realigned to suit any ordinary range of tube capacities, but this process takes so much time that servicemen avoid it if possible.

OSCILLATOR MODULATION

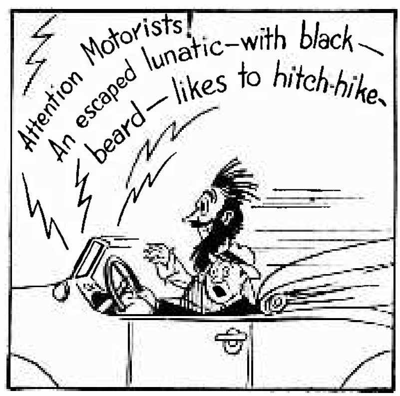
The local oscillator must produce a pure r.f. signal; any hum or noise would be mixed with the incoming signal in the conversion process, and would come through with the desired modulation. Condenser C_1 shown earlier in Fig. 12 is used to prevent this. It is usually a large by-pass or filter condenser, connected so that C_1 and R_1 act as an R-C filter to keep hum voltages and other power supply disturbances from the oscillator. Should the by-pass condenser C_1 open or lose capacity, this filtering will be poorer, and a certain amount of hum may get into the oscillator circuit. You should therefore check this by-pass condenser, as well as test the tube for cathode-to-heater leakage, when hum is traced to the oscillator.

Incidentally, C_1 and L_2 also act as a filter to keep the oscillator signal from getting into the power supply and hence into other stages over undesired paths. Hence, the R-C filter R_1 and C_1 in Fig. 12 enter into three different actions: 1, They both form an R-C filter to keep hum out of the oscillator; 2, the condenser acts with L_2 to keep the oscillator signal from the B supply; and 3, the resistor serves to stabilize the plate voltage on the oscillator tube because current variations produce corrections in its voltage drop.

Self modulation of the oscillator produces a blocking action that can be described as a "roar" resembling a rasping hum if of sufficiently high frequency. This occurs when the grid resistor that furnishes the bias in an oscillator circuit increases in value. If so, it will develop more bias than is normal for a particular amount of feedback signal. This bias may be so high that the plate current will be completely cut off after the oscillator has run for a few cycles. This of course will kill the feedback, and the grid current flow will cease. The charge stored in the grid condenser will then leak off through the grid leak until it becomes so low that oscillations can start again. The blocking-unblocking action will then occur again and again; in effect, the oscillator output will be modulated at a rate determined by how long it takes the blocking and unblocking to occur. If slow, the signal will be chopped or interrupted at the blocking rate. If at an audio frequency rate, the oscillator is modulated at this rate. This modulation of course will travel along with the incoming signal, eventually becoming audible as an undesirable tone.

This condition is caused, as we said, by an increase in the value of the grid-leak resistor. It could also occur if the grid condenser increased in capacity, but it is extremely unlikely that a mica condenser will do so.

Incidentally, it is also possible for the grid-leak resistance to decrease rather than increase. If this occurs, insufficient bias will be produced, and the tube will pass more plate current than it should. As a result, the oscillator tube will age more rapidly than is normal. If you are servicing a set that has a defective oscillator tube, and find that it has a history of frequent tube replacements, check the value of the grid-leak resistance —it may be lower than was originally intended.



Philip Space says:—

Speaking about prices and things, President Truman is a lot like Samson, you know. Samson raised the roof and Truman lifted the ceiling!

I asked one fellow in a bar after the parade who was the most popular Irishman in the World—and he said "Tom Collins—his name is on everybody's lips."

During the baseball game a group of men kept shouting. "Kill the umpire!" They were undertakers.

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Our Cover Photo

The well equipped Radio service shop appearing on the front cover of this issue has become an important part of the Abrams-McDonald Home and Auto Store, of Dadeville, Alabama. One of the owners, Mr. Wilbur M. McDonald, shown at his service bench, is an NRI Graduate.

Graduate McDonald tells us he has the best equipped shop in his part of the state and that he handles most of the servicing business in his section. He enjoys every minute spent at his work bench.

Mr. McDonald also says that his bound copies of NRI lessons have taken their place on his reference shelf and are referred to frequently when a tough case comes up. With NRI training and good equipment he feels he is giving good service to their customers.

McDonald's shop is set up to handle FM service work. A large portion of his work is on FM receivers as other local shops are not equipped to handle it.

Although Radio service was originally thought of as a side line, McDonald now devotes his full time to this work.

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A New Glass for television picture tubes contains no lead and will therefore be lighter and cheaper to produce. Corning, it might be said, is shaking the lead out of its glass.—Gleaned from April *Electronics* magazine.

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Bell System Announces 1949 Television Network Expansion

In 1949 the Bell System will double the number of miles of television network channels now available and will bring its network service to thirteen additional cities, according to the Long Lines Department of A.T. & T. By the end of this year the Bell System inter-city network will extend 2,850 miles and link 27 cities.

By summer, under present plans, the fourteen cities already on this network will be joined by Providence, R. I., and Wilmington, Del. By Fall it is expected that the following cities will be linked: Lancaster and Erie, Pa., and Rochester, N. Y.; Dayton, Columbus, and Cincinnati, Ohio. It is planned to equip the existing coaxial route between New York City and Albany, N. Y. for television transmission and to extend it, by radio relay, to Syracuse, which would permit Bell System service to Schenectady, Utica and Rome as well.

All through 1949 work will go forward on the radio relay project which is to provide long distance telephone and television service between New York and Chicago.

The cities listed above will be linked to the network in the following manner:

1. The coaxial cable being constructed between Toledo and Dayton will be equipped for television transmission, but from Dayton radio relay will be used to Columbus and Cincinnati.

2. Both Lancaster and Erie will be added to the present coaxial circuits in Pennsylvania but the link from Buffalo to Rochester, N. Y. will make use of radio relay.

3. Radio relay will also be relied upon for the Philadelphia-Wilmington and the Boston-Providence additions to the Bell System network.

4. Coaxial cable will form the link between New York City to Albany, N. Y. but the additions beyond to Syracuse will be via radio relay.

The 1949 construction program also makes provision for additional channels along certain existing main routes on the inter-city network. An accelerated program to increase the number of circuits between Philadlphia and Chicago has already been announced. It is also planned to add three additional television channels between New York and Philadelphia and one extra channel to those already in operation between Philadelphia and Washington, D. C.

The Pacific Telephone & Telegraph Company has announced a project of its own, intended to provide both long distance telephone and television channels between Los Angeles and San Francisco. Initially, one radio relay circuit will travel northward over a series of eight or nine towers to be constructed on mountain ridges overlooking the San Joaquin Valley from the West side. Service is expected in about a year.

.R.I. ALUMNI NEWS

"There Are Real People Left in this World"

Dear Mr. Smith:

"Kindly take a moment and carefully read the following as I believe it is worth-while. I would like very much to have others know that there are real people left in this world.

Back in March of 1948 several of the Radiotricians in the Western Massachusetts area organized a chapter of the Radio Technicians Guild whose purpose is to improve the working conditions and standing of the Radio Serviceman. While we have all benefited by the organization in many ways, its greatest service, I believe, was extended to me just a few days ago.

I had the misfortune to contract blood poison in my right hand which has now put me on the shelf for six weeks. On the day after it became known that I was unable to do my service work, the Secretary called and offered as much help as I needed to keep my store open and to care for my work, all without any cost to me and for as long as I was unable to work. This gentleman, I think, deserves all the thanks those of us in the radio industry can muster, for it meant more to me, not only in dollars and cents, than words can describe."

L LYMAN BROWN,
Forest Park Radio Co.
Springfield 8, Mass.

CHAPTER CHATTER

Philadelphia Chapter

We are sorry that our Chairman, Bob Meili, is not able to be with us at present. Bob recently changed jobs and is working on meeting nights. Vice Chairman Harvey Morris has been conducting meetings in Bob's absence. Harvey is giving a practical Television Installation and Service Course, based on his experiences. This course will continue at each meeting night until the whole field is covered.

Our meetings are going better and better. Fifty members attended one of our last television sessions. We had two Philco Television chassis for the discussion. Portable antennas were used and three stations were received with good results. Harvey Morris traced the TV signals from antenna to picture tube and loudspeaker, with clear demonstrations all the way. After this, we conducted a question and answer period. Our members are extremely enthusiastic about Television now that we work with the actual equipment.

NRI men in our locality should not miss the excellent programs we are enjoying. We cordially invite those who are sincerely interested to visit our Chapter. We meet at 4510 Frankford Avenue, Philadelphia, at 8:00 P.M., the second and fourth Monday of each month.

ROBERT L. HONNEN, *Secretary*

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Baltimore Chapter

Television seems to be of great interest here, as in other principal cities. We were fortunate in having Mr. Beauchamp as a speaker. He is employed in Radio maintenance by the Signal Corps. His subject was, "T.V. Antennas and High Voltage Power Supplies."

At another meeting, our Mr. Rathbun gave a demonstration on using an oscilloscope. The scope used was a new G.E. model, recently acquired by our Chairman Percy Marsh.

At other meetings members have conducted discussions on varied Radio and Television subjects. Our Mr. Keller plans to show some sound movies on Army Radar. This should be an interesting feature.

We were pleased to have NRI Graduate Emory Fahenstock, of Baltimore, as a visitor and our members cordially invite him back. We also extend a hearty welcome to other NRI men in our locality. Pay us a visit. You will enjoy our fellowship. Meeting nights are the 2nd and 4th Tuesday of each month at Red Man's Hall, 745 W. Baltimore St., in Baltimore.

ARTHUR LUTZ, *Secretary*

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New York Chapter

Our attendance is averaging between 45 and 50 at each meeting. We are very happy to have our Chairman, Bert Wappler, back with us even though he has been unable to stay through an entire meeting. Bert is slowly but surely recovering from his recent illness.

Alex Remer has been handling the Chairmanship in fine style during the absence of Chairman Wappler. Two good men!

Alex Remer, Vice Chairman of New York Chapter, at the Mike. Mr. Remer is doing a fine job as acting Chairman during the illness of Chairman Wappler.

We are fortunate in having several excellent speakers among our own membership. Informal talks given by these men are the real backbone of our technical discussions. Morris Friedman has delighted us on several occasions with his talks on his own Radio repairing experiences. Ralph Georg, assisted by Marty Corrar, gave a fine demonstration on "Aligning I.F. Coils." They used our RCA Demonstration Board and Marty's NRI Signal Tracer. On another occasion Ralph talked on "Trouble Shooting in Receivers" using the Demonstration Board.

At several other meetings Ralph Baer has spoken. His subjects included "Television" and "Radio in General." Ralph's talks go over very well.

Our old favorites, William Fox and Alex Remer used our RCA Demonstrator in their joint lecture on "Trouble Shooting in Radios." One of our younger members, Michael Soyka, spoke on "By-Pass Condensers" at a recent meeting. Peter Guzy spoke on "Field Coils."

New York Chapter meets on the first and third Thursday of each month at St. Mark's Community Center, 12 St. Mark's Place, between Second and Third Avenues in New York City. Come and see us.

LOUIS J. KUNERT, *Secretary*

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Chicago Chapter

We have had our first meeting in our new hall, located in the American Furniture Mart Building. All members seem very pleased with the new quarters. Our hall has parlor chairs and davenports, which add to our comfort.

After our first meeting in these new quarters refreshments were taken care of by our newly appointed Entertainment and Refreshment Committee, namely, Lloyd Immel, Louis Brodhage and Steve Bognar.

We were pleased with the first inspection of our new laboratory. Test benches and lights have been installed for our members by Charles Mead and Arthur Fullam. These two members deserve much credit for all these arrangements.

Louis Brodhage gave us a very interesting talk on "The Impedance Matching Transformer—In a Power Amplifier Output Stage."

New members include E. F. Janeczko, A. S. Marko, W. E. Pauschke, Richard McGregor, G. J. Smutny. New associate members are A. T. Fullam, T. L. McCann, Willard Emerson and A. C. Freitag.

We welcome visitors. Student Wolkotte was a recent visitor. At present we are meeting on the second Wednesday of each month in the Assembly Hall, West End of the 17th Floor in the American Furniture Mart Building, 666 Lakeshore Drive, Chicago.

RICHARD McCOY, *Secretary*

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Detroit Chapter

We are all looking forward to June 17 . . . the date of our annual party. This year we are holding the party at Veterans Hall, Woodward at Davison Streets, in Detroit. The P.A. system and records for the party will be furnished by Leo Blevins. Mr. Novosel is helping by furnishing refreshments at cost. Everyone is enthusiastic about the party and we feel it is sure to be a great success.

Topics for discussion at our regular meetings have been very worth while. Our Floyd Buehler delivered a lecture on RC circuits in Television. Floyd is always well prepared for his talks, and we find them very interesting and beneficial. Chairman Bob Mains gave a talk and demonstration using our RCA Demonstration Board and using NRI test equipment. This lecture was very helpful to our newer numbers. Discussion at our meetings indicates our members favor further use of our RCA Demonstration Board and the Service Forum type of group discussion.

Technical films are very popular. We had one on "Television Servicing," showing the actual service operations and the equipment needed. Another film was on "Vacuum Tubes."

Our annual party on June 17 will be our last meeting until September. We regularly meet on the second and fourth Friday of each month . . . at the Electronics Institute (4th floor), 21 Henry Street, Detroit.

F. EARL OLIVER,
Recording Secretary

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Local Chapter Meetings and Officers

NEW YORK—Meet at 8:15 P.M., on 1st and 3rd Thursday of each month at St. Mark's Community Center, 12 St. Mark's Place—between 2nd and 3rd Ave., New York City.
Chairman: Bert Wappler, 27 W. 24th St., New York City.
Secretary: Louis J. Kunert, 145-20 Ferndale Ave., Jamaica 4, N. Y.

PHILADELPHIA—Meet at 8:00 P.M., on 2nd and 4th Monday of each month at 4510 Frankford Ave.
Chairman: Robert Meili, 6250 Erdrick St., Philadelphia 35, Penna.
Secretary: Robert L. Honnen, 132 S. 58th St., Philadelphia 39, Penna.

BALTIMORE—Meet at 8:15 P.M., on 2nd and 4th Tuesday of each month at 745 West Baltimore St.
Chairman: P. E. Marsh, Box 2556 Arlington Station, Baltimore 15, Md.
Secretary: Arthur F. Lutz, 1101 Overbrook Rd., Baltimore 12, Md.

DETROIT—Meet at 8:15 P.M., on 2nd and 4th Friday of each month at Electronics Institute, 21 Henry St., Corner Woodward (fourth floor).
Chairman: Robert Mains, 1368 Swancea Ct., Willow Run Village, Ypsilanti, Mich.
Secretary: F. Earl Oliver, 3999 Bedford, Detroit Mich.

CHICAGO—Meet at 8:15 P.M., on 2nd Wednesday of each month at Room 1745, 666 N. Lake Shore Drive, Chicago, Ill.
Chairman: Harry Andresen, 3317 N. Albany, Chicago 18, Ill.
Secretary: Richard McCoy, 6149 Kenwood Ave., Chicago 37, Ill.

Here And There Among Alumni Members

An interesting letter from Japan tells us that Graduate Theodore Gadek is teaching Radio repair at the U. S. Signal School located at Kilo University in Hiyoshi, Japan. Gadek's air mail letter was received by us only four days after mailing!

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Graduate Eddie Bolds of Long Branch, New Jersey, visited NRI recently. Bolds was just passing through Washington and his visit was necessarily short. He works for the Signal Corps, at Camp Evans, Belmore, New Jersey.

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One year ago Alumnus Oscar Ruble had the misfortune of losing his Radio shop in a fire. We were very glad to hear that Mr. Ruble has now re-built his shop and has it fully stocked with new test equipment and parts. Ruble lives in Culver City, California.

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Quite a coincidence, but we just received a letter from Graduate Aime Bazinet of Winston-Salem, N. C., telling us that he lost nearly all of his belongings in a recent fire. We hope that Graduate Bazinet will be able to surmont this loss as well during the coming year as Graduate Ruble has done during the past year.

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Graduate A. C. Tinner is now happily employed with the Farnsworth Distributing Co. Tinner, who lives in Willowick, Ohio, wrote to mention that he appreciates all TV dope included in Alumni Bulletins.

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Graduate H. H. Black, 1000 So. 10th Street, Burlington, Iowa, tells us he plans to move to Arizona or Texas soon. Black is experienced in arc and gas welding as well as radio servicing. He is interested in contacting an NRI man in that area as soon as possible.

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Graduate Carl Saglimben, Gowanda, New York, now has the amateur call W2ZPV. Also has a spare time radio service business, and is getting along swell. Has just acquired a new home of his own.

———— *n r i* ————

Adrien Gaynier of Verdun, P. Q., Canada, visited NRI while on a short vacation. He has been engaged in the installation of inter-communication systems in hospitals and sanatoriums. Gagnier now plans to try to get a position which will give him experience in Television.

———— *n r i* ————

Albert J. Haladay of Kingston, Penna., has just received his first-class Radiotelephone license. He tells us that the NRI FM and TV lessons were of great help.

———— *n r i* ————

Graduate Ralph Sutherland of Chester, Penna., tells us that he is now employed part time by the Sheftz Television Company. We understand that the owner, Mr. Sheftz is also an NRI graduate.

———— *n r i* ————

Gerard R. St-Amand has purchased the Radio Service Department from the Stevens Company in Orleans, Vermont. He is now operating this new business under the name of "Jerry's Radio Service." Graduate St-Amand has been repairing radios full time for the past three years.

———— *n r i* ————

J. C. Akins of Brady, Texas, has just become a member of the NRIAA. He has his own spare time business and recently sent us several photos of a resistor-condenser-loudspeaker substitution box which he has designed and built.

———— *n r i* ————

Graduate James H. L. Beane of Roanoke, Va., has accepted a position as an instructor at a trade school in his city. He also holds a contract with the General Electric Supply Corp. to handle their service work and helps a Stromberg-Carlson dealer with the service on the large AM-FM-Phono combinations. Here's a graduate who is keeping himself busy!

———— *n r i* ————

Thomas M. Clark informs us he is now back in Boston, Mass., and is working at television installation and servicing. Getting along fine. Also does some spare time service in the evenings.

———— *n r i* ————

Graduate Odis Dickerson, operator of "The Radio Hospital," in Paris, Texas, gives us a fine report about his full time servicing business. Time was when he averaged $35 to $40 a month spare time, and now he does double this per week, full time; plus profit on parts. He expects to take on Radio sales soon.

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