The Sun

Television Data Sheets

Compiled by RALPH R. BATCHER.

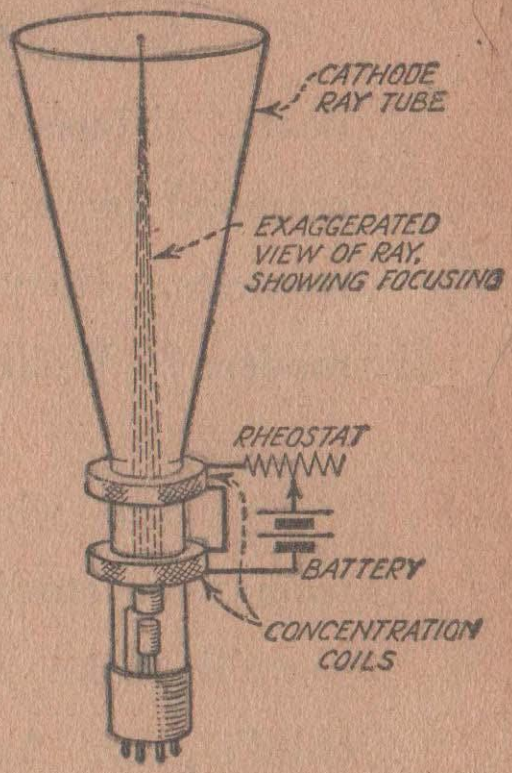
DEFINITIONS

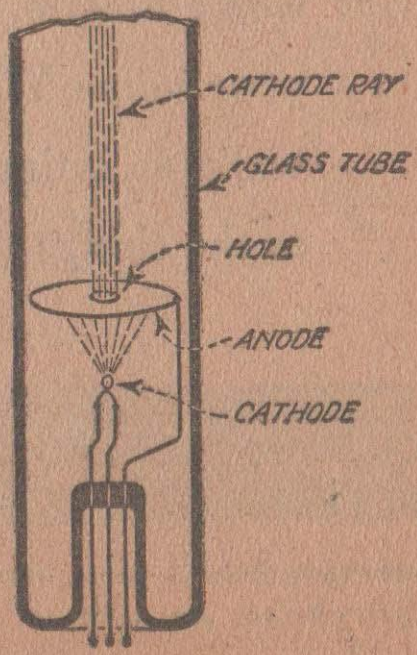
CATHODE RAY—Jet of electrons emitted from a cathode and projected through space in a more or less confined stream. Also known as an electron ray or an electron jet.

COAXIAL CABLE—A particular type of telephone cable capable of passing a wide range of frequencies without the usual prohibitive losses and distortion. Each pair of conductors in such a cable consists of a hollow metallic conductor with a single wire accurately confined along its inner axes.

CONTRAST—Refers to the sharpness of the border lines that mark the edges between the light and dark portions of the scene. In natural vision the outline of dark objects against a white background is exceedingly sharp. In a photograph such edges may be softened or blended on occasion, but in television the best picture detail and naturalness are obtained when great contrast is provided. The solution to this requirement is the most difficult problem in television.

CONCENTRATION COILS—One or more large solenoids of wire placed around the neck of a cathode ray tube for focusing the ray. The polarity and position of these coils must be definitely fixed, and the current through them suitably controlled. These coils may be substituted for the focusing electrodes inside the cathode ray tube and so reduce its cost, but their use is less convenient.





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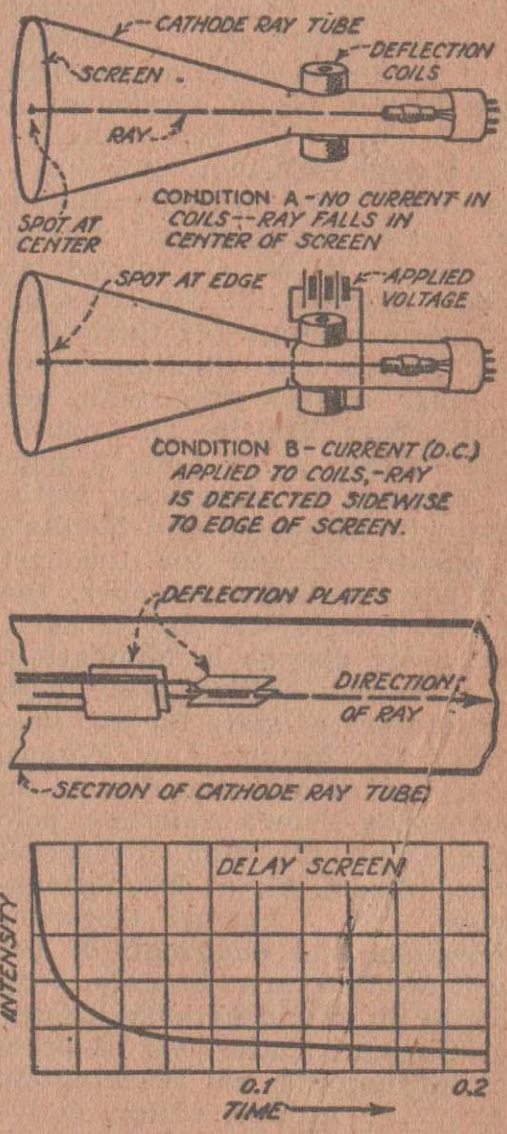
DEFINITIONS

DEFLECTION COILS—A pair of coils placed alongside the neck of a cathode ray tube with their axes perpendicular to the ray to deflect the path of the latter in a new direction. The amount of deflection is proportional to the current through the coils. The direction of movement is the same as that which a wire, held loosely in the same field, would take if it carried current flowing in the same direction as the current in the ray.

DEFLECTION PLATES—A pair of small condenser plates placed within the cathode ray tube, between the anode and the fluorescent screen, so that the ray must pass between them as it leaves the anode orifice. When a potential is placed on these plates the ray is deflected from its original path in proportion to the applied potential. Two pairs of such plates are normally used in most tubes now available, mounted at right angles to each other. When voltages are placed on one pair the spot will move across the screen in one direction; if placed on the other pair of plates the ray will move at right angles. Since most tubes are viewed with its axes horizontal, such plates are known as the vertical and the horizontal deflection plates, depending upon whether the spot is moved up and down or sideways.

DELAY SCREEN—A fluorescent screen used in cathode ray tubes, which has the property of phosphorescence. The light intensity of any particular spot dies out gradually after the ray moves to a new position when this material is used. A curve showing the delay characteristics of one type of material is shown herewith.



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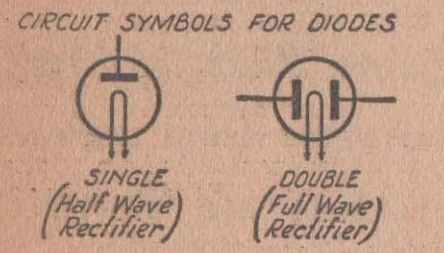
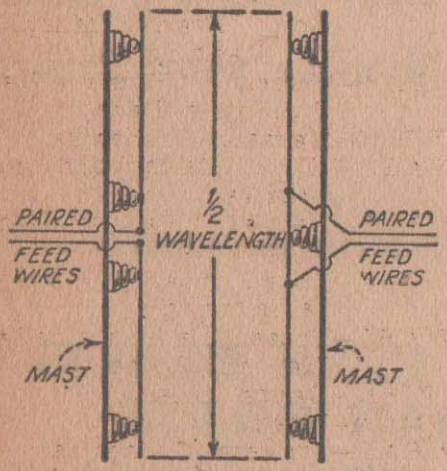
DEFINITIONS

DETAIL—The clarity and sharpness with which minute objects in a scene can be distinguished.

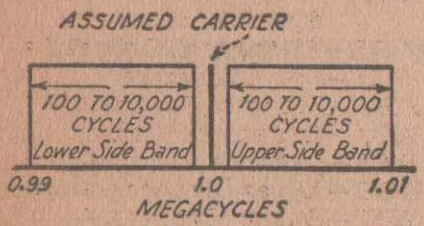
DIODE—A vacuum tube having two elements, one of which emits electrons (the cathode), and the other the anode. It is used for rectification (detection), that is, the conversion of alternating currents into direct currents. Frequently two separate diodes are built into the same tube, as, for instance, the type 80 and 6H6 tubes.



DIPOLE ANTENNA, Doublet—An antenna consisting of two conductors, usually of equal length extending in the same straight line, with a pair of lead or feeder wires connected at or near the inner ends, is known as a doublet. For short waves the physical dimensions are such that self-supporting metal rods or tubes can be used—two rods with their ends separated one-half wave length. Such an arrangement is known as a dipole. In another arrangement a single rod, one-half wave length long, may be used, with the feeder leads connected at a particular distance each way from the exact center, as shown in the figure. They may be mounted either vertically or horizontally.



TYPES OF DIPOLE ANTENNAE



DOUBLE SIDE-BAND—Specifically, when a carrier is modulated by a plurality of frequencies, two distinct bands of frequencies appear due to the modulation process, one on each side of the carrier frequency.

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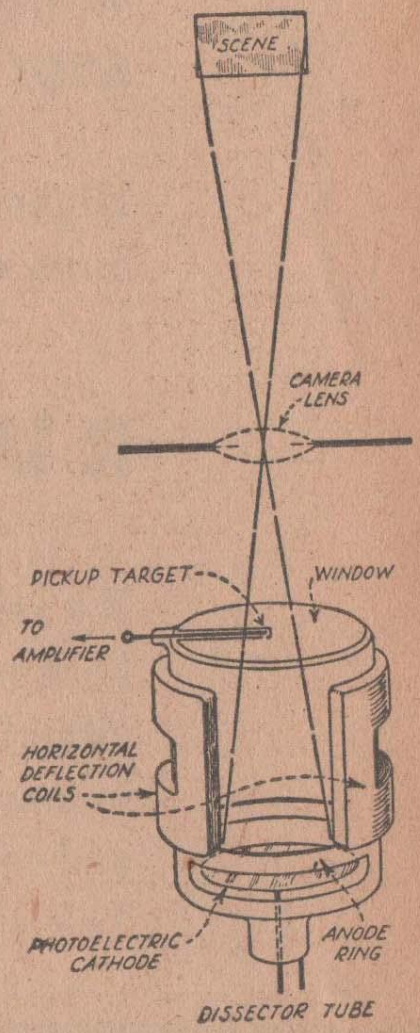
DEFINITIONS

DISSECTOR TUBE—The special type of cathode ray tube used in the pick-up camera in the Farnsworth system. In a television studio this device is analogous to the microphone in a sound studio. It is characterized by a large photo-electric emitter surface for a cathode, upon which the intercepted scenes are focused through a window at the opposite end. The resulting scene, reproduced in electrons, is oscillated back and forth, and up and down by means of deflection coils (only one pair of which is shown in the diagram) before a small pick-up target. This target is located on the axis of the tube, near the window end, and has an exceedingly small exposed area, theoretically equivalent to a picture element in area. The diagram herewith omits the focusing arrangement, which is usually a concentric electromagnetic coil.



DISSECTOR TUBE

DIVERGENCE—The spreading of a cathode ray stream due primarily to the mutual repulsion between the electrons that compose it. The function of the focusing arrangement in the tube is to counteract this effect.

ELEMENT, PICTURE—In scanning, a scene is broken up into a large number of dots which are transmitted successively. The greater the number of these dots the greater the detail. Numerically the number of picture elements is considered to equal the square of the number of scanning lines multiplied by the aspect ratio.

ELECTRODE — A metallic conductor introduced into a vacuum tube for a specific purpose. It must be electrically connected to the external circuit. In general each electrode is referred to by its specific use, such as cathode, grid, anode, &c.

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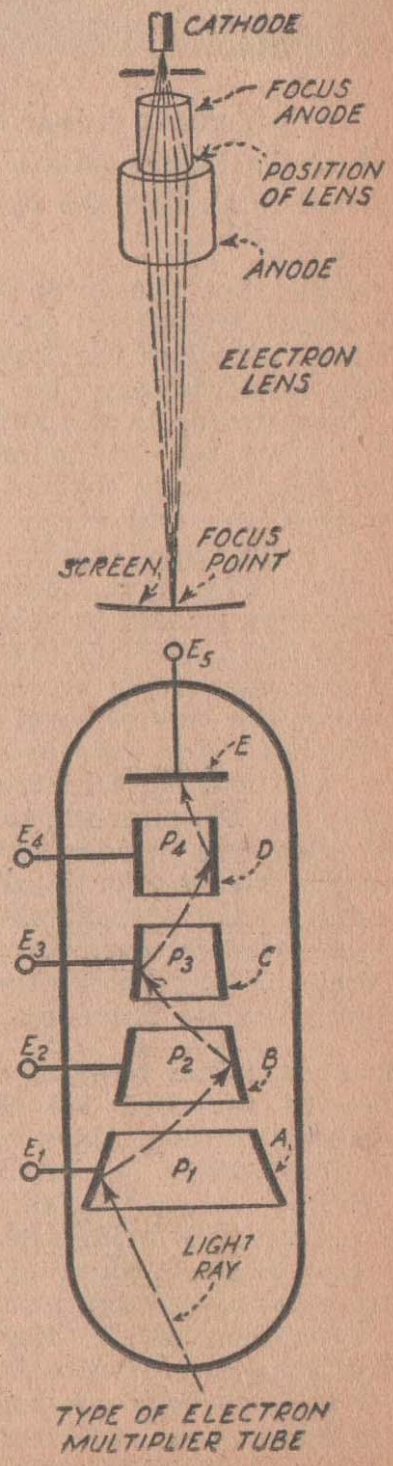
DEFINITIONS

ELECTRON LENS—A systematic arrangement of electromagnetic or electrostatic fields, having symmetry about the axis of a cathode ray tube, as to their radial components, established for the purpose of controlling the divergence and convergence of the electron ray.

ELECTRON RAY—See Cathode Ray.

ELECTRON MULTIPLIER—An evaluated amplifier tube in which the anode has a prepared photoelectric surface which is exceedingly active as to secondary emission. Whenever the current density of the secondary emission exceeds that of the incident ray this anode will serve as the cathode in a new and independent circuit. The anode in this second circuit can be similarly arranged to emit secondary electrons so as to serve as cathode for a third circuit, &c. In order that the electronic emissions from each surface do not intermingle, special guiding or focusing arrangements are applied to regulate the path of each group. A number of such focusing arrangements have been designed by research groups in various countries, resulting in a number of practical amplifier systems based on this principle, differing mainly in the focusing methods. The illustration shows a U. S. S. R. development for television amplifier applications. Light falling on the inner surface of A causes secondary emission which is projected to B. The emission from B falls on C, &c., until it is finally collected on the electrode E. High amplification is obtained in a single tube.



TYPE OF ELECTRON MULTIPLIER TUBE

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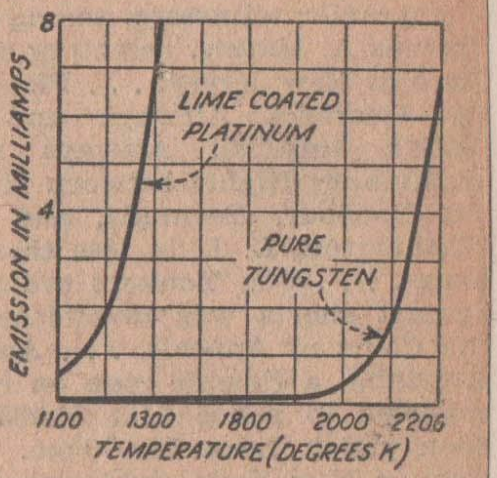
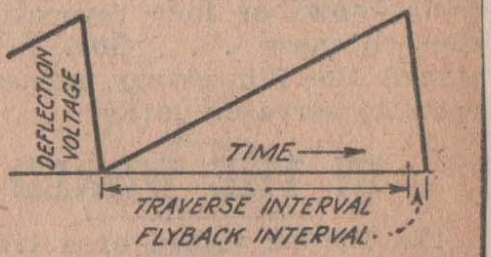
DEFINITIONS

EMISSION—The continuous liberation of electrically charged particles, either ions or electrons, into space (usually evacuated) from a surface. The most important case practically is where these particles are negatively charged, i. e., electrons.



EMISSION, THERMIONIC—Electron emission from a heated surface. The curves show the emission characteristics of two common materials.

EMISSION, SECONDARY — The liberation of electrons from a surface due to the impact of other electrons or ions upon it.



EMISSION, PHOTOELECTRIC—Electron emission from a surface exposed to light. Specially prepared surfaces are necessary for this condition.

FACSIMILE—The electrical transmission over wires or radio circuits of printed records and pictures. While this term originally referred to black and white reproductions only, it is now considered to include processes producing half-tone and shaded effects as well.

FILTER, AMPLITUDE—In television reception circuits it is necessary to sort out from the continuous series of received pulses all those that exceed a certain amplitude. An amplitude filter is a vacuum tube circuit that is unaffected by any pulses except those that have sufficient amplitude to exceed the applied cut-off bias.

FILTER, FREQUENCY—A tuned circuit that passes only those frequencies that fall within certain definite bands, cutting off all others.

FLY-BACK TIME—In scanning, the spot is moved across the screen at a definite rate in one direction for each scanning line. Thereupon, it is necessary to restore it to the start of the next line in a very short interval of time, say three or four millionths of a second. The actual time used up on this return trip is called the fly-back time. A somewhat longer time interval is permissible in the case of restoring the framing frequency sweep to the other edge of the picture.

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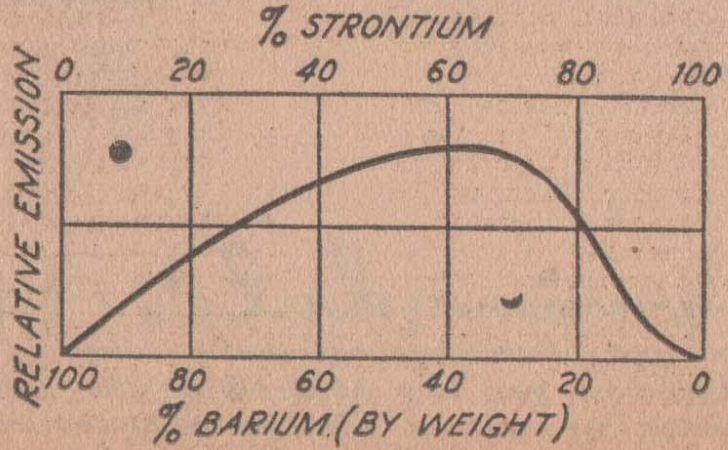
DEFINITIONS

FILAMENT—The heating element by which the cathode (q. v.) is kept at its operating temperature. It has been known for a couple of hundred years that, while air is a fairly good insulator at ordinary temperatures, when exposed to the surface of a heated solid it rapidly loses this insulating property. It was later shown that this change was due to the emission of electrical charges from the surface. The effect was demonstrated in 1883 by Edison. (See EMISSION, page 010.7 and CATHODE, page 010.1).

FILAMENT SURFACES—Several types of filaments are in ordinary use in the various types of vacuum tubes, such as: 1. Pure tungsten: has a very high melting point and is easily cleaned from contamination, but on the other hand it must be operated at a much higher temperature for satisfactory emission rates. 2. Thoriated tungsten: the emission properties of tungsten can be improved by adding a small amount of thorium (say 1 per cent) as an alloy to the tungsten. It reduces the crystallization and thus increases the life. It permits the filament temperature to be reduced, for an equivalent emission rate. On the other hand thoriated filaments must be operated at definite temperatures or they will suffer from deactivation, or a loss in emission due to the evaporization of the thorium from the surface. 3. Oxide coated, where a layer of certain alkaline oxides is painted on the heated surface. It will increase the emission greatly and will therefore permit the filament to be operated at a much lower temperature. The most effective oxides are barium, strontium and calcium in the order named. Even better results are found with mixtures of these oxides. For instance a combination of Barium Oxide (40 per cent) and Strontium Oxide (sixty per cent) is many times more effective than Barium Oxide alone (see figure).

Indirectly heated cathodes (sheet 010.1) are generally of the oxide coated type, using materials of this nature.



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DEFINITIONS

FLUORESCENCE—A chemical property of certain materials which refers to the production of visible light when exposed to cathode rays, X-rays, ultra-violet rays, radium, etc. In a cathode ray tube it is used to make the electron beam (ordinarily invisible) visible. The resulting light may have any color, depending on the type of material used, or upon the mixture of materials having different basic colors. A common color found in present day cathode tubes is a greenish hue, produced by Zinc Silicate. Television tubes generally have a white spot produced on the unilluminated background.

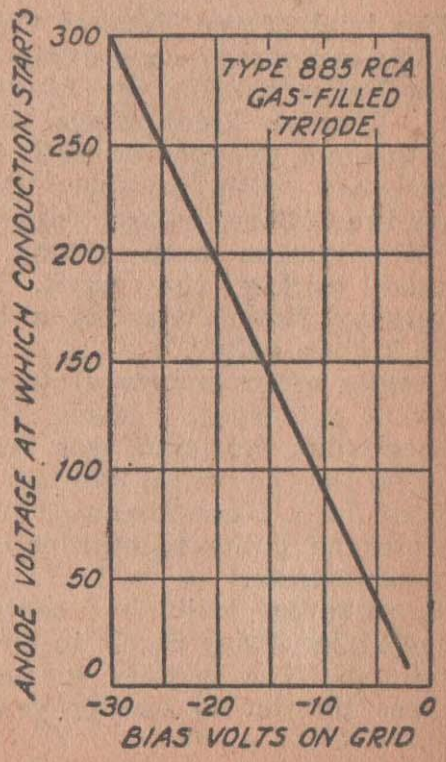
FLUX—1. Magnetic—a term used to denote the magnetic lines of force, which make up a magnetic field. 2. Light—a term referring to light rays.

FORMAT—The same as ASPECT RATIO (see page 010.1).

FRAME—One of a series of complete pictures that are successively projected so as to simulate moving scenes. From 16 to 30 of these frames are set up each second of time, in the various moving picture and television applications. This rate is called the FRAMING FREQUENCY. In motion picture practice a framing frequency of 24 is ordinarily used, while in television a value of 30 has been tentatively selected.

FUNDAMENTAL—The basic frequency of a wave or sound. It is sometimes referred to as the "first" harmonic.

GAS FILLED TRIODE—A type of vacuum tube in which the elements operate in an atmosphere of gas, such as mercury, argon, helium, &c. In the usual circuit the plate (anode) circuit is nonconductive, unless the anode potential exceeds a certain value, whereupon it becomes a good conductor of current. The anode potential at which this effect takes place depends upon the voltage applied to the grid circuit. It is variously known by the names of THYRATRON, GRID GLOW TUBE, &c.



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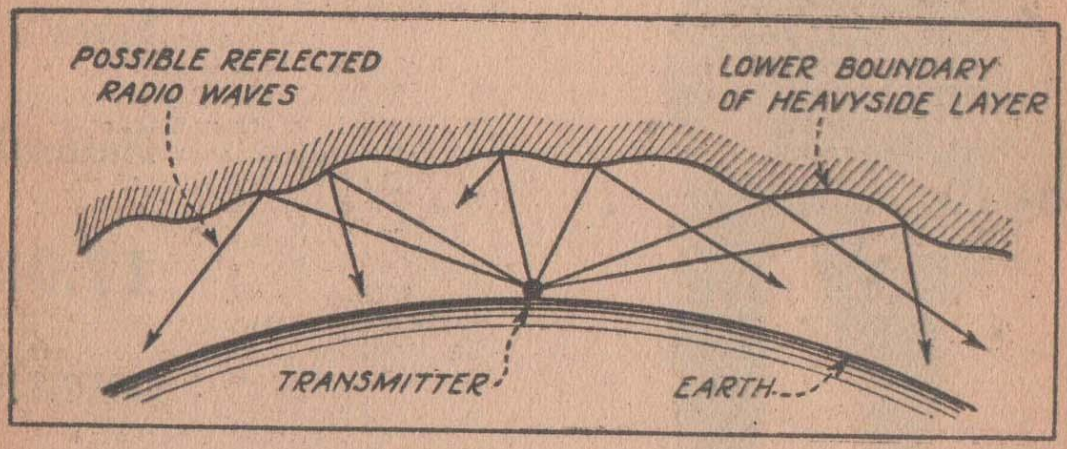
DEFINITIONS

HALFTONE—A method whereby photographs having various degrees of lights and shadows can be reproduced in ordinary printing, using a system of dots which are substantially undistinguishable with the unaided eye. However the dots are graded as to size or density so as to produce the highlights and shadows of the pictures.

HARMONICS—In the study of music and the science of sounds and noises it is found that any tone is made up of vibrations of a certain tone (called the fundamental, or the first harmonic), together with a number of over-tones an octave apart, which are referred to as the upper harmonics. The number of intensity of these harmonics together with the number of octaves separation between them determine the tonal quality of the sound. Pure tones without harmonics are rare.



In electrical and radio circuits also, the fundamental current waves are usually accompanied by others whose frequencies are equal to some multiple of that fundamental. These multiples are also called harmonics.

HEAVISIDE LAYER—The ionosphere. A region of ionized air some fifty miles above the surface of the earth. Its lower boundary acts as a reflective surface or mirror for radio waves. Rapid changes in the height of this lower boundary and its contour cause much of the radio interference and fading.

HORIZONTAL DEFLECTION PLATES—That pair of deflection plates which produce a deflection of the cathode ray that is horizontal. 'Which of the two pairs of plates found within the tube gives such a deflection, however, depends, upon how the tube is rotated on its own axis.

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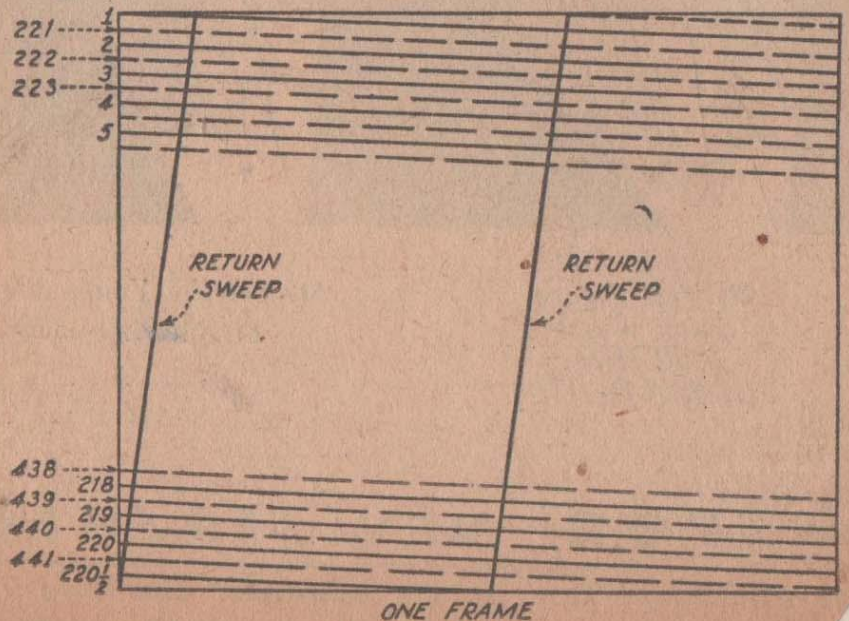
DEFINITIONS

ICONOSCOPE—A designation used by the R. C. A. for a particular type of cathode ray tube developed for the purpose of picking up the scenes to be televised. It is the essential part of a studio camera.

INTERLACED SCANNING—In transmitting a television program each scene is divided up into a predetermined number of strips of "lines" which are fed into a radio transmitter, one after the other in rapid succession. In some systems alternate lines are transmitted so that two series of lines are necessary to reproduce a single scene. This system is known as interlaced scanning and is in general use in the U. S. A. and Great Britain. In the figure shown, lines 1, 2, 3, &c. up to 220 are sent in one-sixtieth of a second. When the 220th line is half completed the framing oscillator operates and that line is interrupted so that the spot returns to the top edge again. From 220.5 to the 441st line the lines will fall between the lines 1 to 220.5 during the next one-sixtieth of a second. Actually a few of the lines at the edges are "smeared up" by the border interval when synchronization pulses occur so that they are not present, but the action is theoretically as shown.

INTERLOCK PULSES—SYNCHRONIZING PULSES—Are definite breaks in the carrier output level, accurring at the end of each scanning line and at the bottom (or top) edge of the picture. These changes are noted by an amplitude filter (q. v.) and are used to control the discharge interval of the scanning oscillators.

ION—IONIZATION—Atoms from which electrons are missing are called ions. The process whereby atoms are broken down by the loss of electrons is called ionization. In any evacuated tube where electrical conduction occurs, ionization takes place if the evacuation is not complete.



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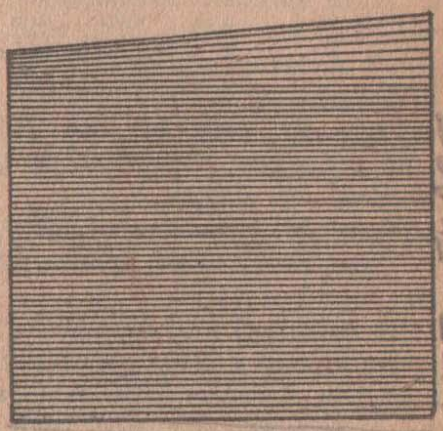
DEFINITIONS

KERR CELL—A chemical cell that has the property of a light intensity control valve. It is based on the principle that any alteration in an electrostatic field applied to the fluid, will change the plane of polarization of the light. If polarized light is transmitted through this cell therefore, the amount that is blocked off in its passage through depends upon the electrical potential applied to the electrostatic field electrodes.

KEYSTONE EFFECT—A distorted field or background noticed in some cases with television pictures, wherein the opposite edges are not parallel. The most common cause is the use of a cathode ray tube in the receiver that has one plate of each pair connected internally to the anode. Another cause is the irregularity of the scanning oscillators or the use of too strong a synchronizing pulse. The shape of the picture is that of the keystone of an arch, or else of a kite (see sketch).



KEYSTONE EFFECT

KINESCOPE—A name applied to the cathode ray tubes used in the television receivers built by the RCA.

LENARD RAY TUBE—A cathode ray tube operated at a very high voltage, some hundred kilovolts, and having a screen of thin glass or metal. The velocity of the electrons is so high that they penetrate the screen into the outer air. These external rays have certain useful chemical and biological effects. They have been used for the rapid comparison of fluorescent materials for cathode ray tubes.

LENS—A radial field (electrostatic or magnetic) applied concentric, with a cathode ray to concentrate the diverging electrons into a single slender beam, is called a lens.

LINE FREQUENCY—The number of lines scanned each second. Present standards in the United States call for a line frequency of 13,230 cycles per second. In any system it is equal to the number of scanning lines per frame, multiplied by the framing frequency.

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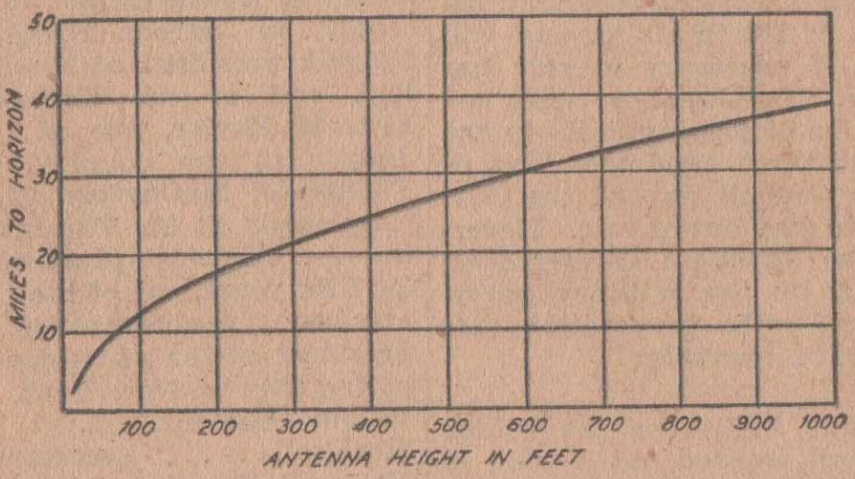
DEFINITIONS

LINE OF SIGHT—The visible distance from an observer to the horizon, assuming level territory and no obstacles. The higher the observer off ground the farther is his horizon, as shown in the curve. An ultra-high frequency radio signal will be propagated this distance without an unusually large loss in signal intensity, or without requiring that the waves be reflected or refracted around the contour of the earth's surface.

LINEARITY—A term used to refer to the straightness of the characteristic curve, or a portion of that curve, that shows the relation between two quantities or circuit factors.



LUMEN—A lumen is a unit of light flux. A foot-candle is equal to the illumination that falls on a screen that is placed one foot away from a standard candle power. One foot-candle is equal to one lumen per square foot of surface.

MASTER OSCILLATOR—An oscillator that controls the frequency of a system.

MEGACYCLE—One million cycles.

MEGOHM—One million ohms.

MICALEX—An insulating material composed of ground mica fused in glass.

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MICROWAVE—This term generally refers to radio waves having a wavelength of less than one meter, that is, one having a frequency greater than 300 megacycles. The application of waves of this class is in the experimental stage, but it is possible that they will be found to be of value in television service in the future.

MIRROR DRUM—MIRROR WHEEL—the former a small cylinder or drum, the latter a disk or wheel, each of which contains a certain number of small mirrors affixed to the outer edge or surface. A fixed spot of light falling on the surfaces of these mirrors is projected to another surface or screen. The point at which this spot falls depends (1) upon the angle at whch the mirror face is mounted with respect to the surface of the disk or drum, and (2) upon the instantaneous position of the wheel itself as it rotates. A combination of these two factors will cause the spot to be projected along a series of lines and thus produce the effect of scanning. It is necessary that the face of each mirror be tilted slightly with respect to adjacent mirrors so that the angle of reflection is gradually increased during the time taken for a revolution.

MIRROR -(VIEWING)—A large cathode ray tube, such as is used in television reception, is often too long (some two feet) to be mounted horizontally in a cabinet having convenient dimensions. The tube is then mounted vertically with its screen uppermost and the picture is viewed through a mirror set at an angle of 45 degrees. This mirror may be a highly polished metal plate or a glass sheet silvered on the outer surface. Double reflection would occur at both surfaces of the glass if an ordinary mirror were to be used, which would cause some confusion. The picture on the screen of the cathode ray tube must be inverted in order to appear right side up in the mirror, but this is easily done by reversing the leads to the deflection plates.

MODULATION GRID—An electrode interposed between the cathode and focusing electrodes in a cathode ray tube (see 400.1) to control the amount of emission and thereby the brilliance of the spot This controlling effect is produced by altering the potential of this grid with respect to the cathode.

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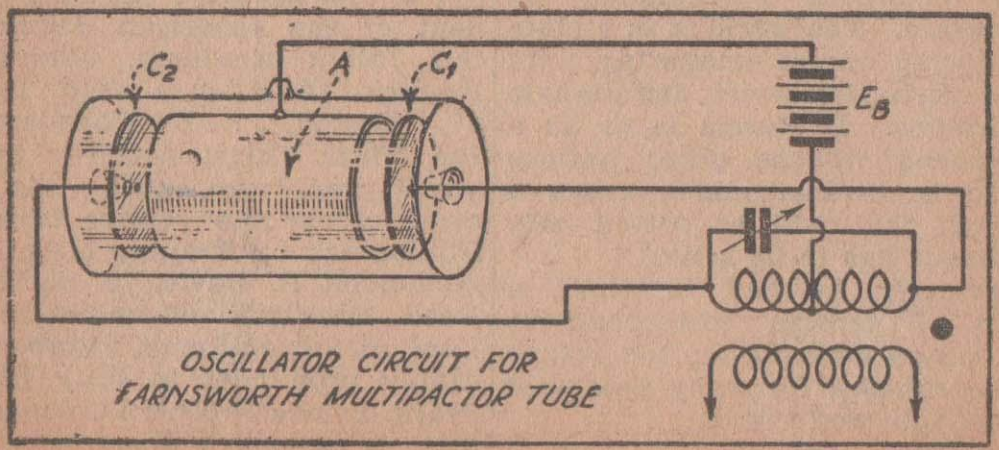
DEFINITIONS

MONEY—At present the most serious handicap to television progress.

MOSAIC—The screen used in an Iconoscope (see 240.1) so called due to its similarity to that form of art wherein a great many bits of colored tile are combined so as to form a picture.

MULTIPACTOR—A secondary emission type of amplifier tube devoloped by Farnsworth, consisting of a metal cylinder forming the anode, flanked at either end by a metal disc or plate, which act as cathodes. These discs have specially prepared surfaces that are extremely active as secondary emitters. The tube is placed in a coil, the magnetic field of which is directed along the axis of the anode and perpendicular to the end discs. If a high frequency potential is applied across the end plates so that they alternately have a positive potential with respect to the other, any electrons which exist between them will oscillate back and forth. The extent of this excursion will, of course, depend upon the speed at which they travel and the time taken up by one-half cycle of the applied frequency.

If it were not for the magnetic field the electrons would all be immediately attracted to the anode. As it is, the magnetic field and the anode field are both balanced against the applied frequency so that a number of excursions take place before they hit the anode, and under certain conditions some may hit one or the other of the cathodes. When this occurs the secondary emission liberates other electrons, which cause the action to be self-sustaining. These tubes can be used as an amplifier (i. e., an electron multiplier) or as an oscillator, and as such are quite useful in high frequency applications of television.



OSCILLATOR CIRCUIT FOR
FARNSWORTH MULTIPACTOR TUBE

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DEFINITIONS

NEUTRALIZATION OF RETURN SWEEP—The cathode ray spot is moved across the screen from one side to the other in scanning, whereupon it is rapidly returned to the starting point for the transmission of the next line. This return sweep is often visible on the screen and represents a bright curved streak across the scene. In order to make this streak less visible several methods have been developed to squelch the spot during this interval.

ODD LINE INTERLACED SCANNING—Under the subject of interlaced scanning (sheet 010.11) it was shown that alternate lines are scanned in successive vertical deflection cycles of the framing oscillator. An odd number of lines was assumed in each complete picture. This introduces the relation that if the return sweeps of the framing oscillator occur at definite intervals, say one-sixtieth of a second apart, alternate return sweeps will occur when a scanning line is only half completed. This insures that the two sets of lines that make up a single picture are correctly interleaved. This system is the simplest method of securing interlaced scanning.

In the other system of EVEN LINE INTERLACED SCANNING the alternate vertical (or half-picture) deflections must be biased slightly different so that alternate pictures are offset by the required amount so that the two series of lines are correctly positioned.

OSCILLOGRAPH—OSCILLOSCOPE—The former usually refers to a device that shows the relation between an electrical current with respect to time. The term has also become common for devices that show the relation between two electrical quantities in addition to the relation between current and time. In other words, it refers to an indicator that gives a two dimensional figure. An oscilloscope generally refers to a device that contains a cathode ray tube and an associated power supply, without means of producing a timing wave or sweep, while an oscillograph is an oscillograph with a time base. These definitions have not been made official by any organization however.

OSCILLOGRAM—A permanent record of a diagram appearing on the screen of an oscillograph.

RADIO MAG T used in Great Britain.

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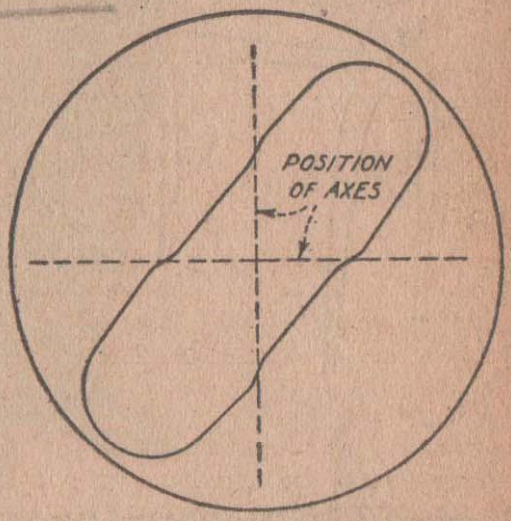
DEFINITIONS

OPTICAL CENTER—The axis of a lens, determined where a line connecting the focal points pass through the glass. The optical center may not coincide with the physical center. In a lens type of scanning disk the lenses must be placed so that their optical centers are located at equal angular distances along a spiral.

OPTICS—The science of utilizing light rays. The applications of lenses, mirrors, prisms light filters, &c., used for the control of the direction and intensity of light are made here. These devices are of utmost importance in the mechanical television scanning systems and also find frequent application in the electronic arrangements as well.

OPTICS, ELECTRON—The science of controlling the direction of the path of electrons. See also ELECTRON LENSES, sheet 010.6.

ORIGIN DISTORTION—An effect that appears on the screen of a gas-filled cathode ray tube, or on one that has not been fully evacuated, wherein a kink appears on the trace of the spot each time it passes through one of the axes of the screen, showing up on either the oscillograms or television pictures. The effect is caused by the spot hesitating for an instant while the potential that causes the deflection passes through zero while changing from a positive to a negative value or vice versa. The appearance is as if the diagram were creased vertically and horizontally along the centers. "Soft" tubes are not particularly satisfactory for television. For oscillographic work the effect can be corrected in measuring deflection amplitudes by adding a small amount to each distance.



OSCILLATOR—A circuit arranged for the continuous generation of alternating currents, generally using vacuum tubes in doing so. The term also embraces circuits for generating other wave forms, such as saw-toothed waves, &c.

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DEFINITIONS

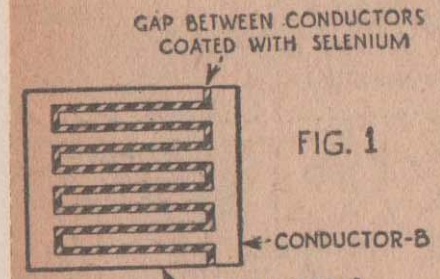

FIG. 1

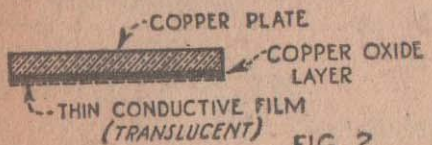

FIG. 2.

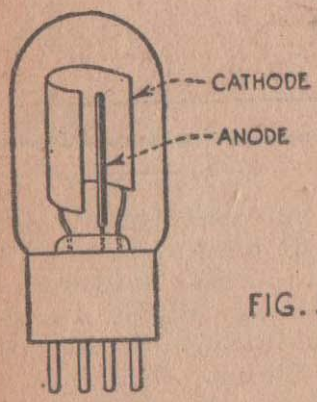

FIG. 3.

PARAXIAL RAYS: Made up of those electrons in a cathode ray that are not moving on the axis of the ray, but in the space in the immediate neighborhood around this axis. It is to confine these rays in a small jet that focusing is necessary.

PHOSPHORESCENCE: A type of luminescence where the visible light produced by certain substances when excited by cathode rays, X-rays. This effect is used in slow-decay screens in cathode ray tubes. Distinguished from fluorescent materials which have no decay.

PHASE: A term used to designate the time relation between the maximum points of two recurrent electrical quantities such as volts, amperes, &c. It is expressed in degrees of a circle, one complete revolution of which represents one cycle of one of the waves.

PHOTOCELL: A device which exhibits variations in its electrical characteristics when exposed to light. Three main types are found:

1. Photo-conductive, where the ohmic resistance of the cell is changed when illuminated, such as a selenium cell, Fig. 1.

2. Photo-voltaic, which generates a potential when exposed to light, such as the copper oxide cell, Fig. 2. The potential can be picked off the copper plate and the translucent coating.

3. Photo-emissive, where a cathode emits electrons when illuminated. This type is always an evacuated type, Fig. 3, and contains an anode in addition to the cathode.

PICTURE CONTRAST: The sharpness with which abrupt changes between light and dark areas in a scene are reproduced on the television receiver screen.

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Omit

TELEVISION OPPORTUNITIES

The present opportunities in the television field are increasing rapidly on account of the activity spurred by the projected schedule of programs arranged for public participation. In the radio servicing field there are many opportunities, as evidenced by the activities of several manufacturers at the present time in lining up television servicing forces and arranging for the supplemental training necessary to handle installation problems.

It seems that the complexity of television receivers will set a sales policy of establishing receiver prices that include the installation charge and service for a definite time after installation. The latter will also include the necessary instructions to the owner in the adjustments required to secure optimum reproduction.

Servicing opportunities will ultimately extend to those who are trained in the fundamentals, such as: (1) A general knowledge of the whole principle of reception, (2) the erection and adjustment of short-wave antennas, under the many installation difficulties encountered, (3) the adjustment of the coaxial or the balanced types of lead-in cables and (4) the principles of the cathode ray tube.

As to the first item, the matter of amplifier design, together with the circuits developed for video frequency amplification, is of especial importance. The term "high and wide" fits a television amplifier in no uncertain manner.

As to actual servicing it is probable that most manufacturers will prefer factory-trained repair men for routine apparatus servicing, at least for a time, but the matter of erection and the installation of antenna facilities will be mainly a problem for local service men, it is anticipated.

The problem of assembling receivers from parts or from prepared kits has occupied the attention of many radio men in Great Britain, and it can be assumed that a certain mount of business will be done in this field. However, the assembly and adjustment of these receivers will require extensive knowledge of reception principles. In a short time even the most enthusiastic purchaser of receivers assembled from kits will get over the attitude of the mystery and novelty and will look at a television receiver in its true light—as a source of entertainment. The degree of satisfaction that a general observer receives from a televised program depends upon the minimum of equipment design imperfections.

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TELEVISION APPLICATIONS.

History shows that any new technical development brings with it, within a comparatively short time, many opportunities for the application of its fundamental principles to still other fields. It seems already true that this rule will continue in the case of television. Here are a few items that can be mentioned without speculating on fantastic possibilities.

The scanning principle is easily applied to the point-to-point transfer of scenes, permitting the personalization of telephone messages, with each caller seeing the party he is talking to. This development has already been made available between certain telephone stations in Germany, and it also has been used experimentally in the U. S. A.

Using coaxial cables as the interconnecting links the plan is entirely feasible except for the relatively high cost at the present time. However, the installation of televisor facilities between points in a single building would permit an observer to note what is going on in another room, &c. It acts, as it were, like a sort of horizontal periscope that permits seeing around corners. As a specific example it has been shown that a television camera can be installed near the operating table in a hospital to permit students obtaining a full view of the work without being actually present in the room. This application has already been tested and found to be entirely feasible, and doubtless many other similar uses will be found in the future.

There are other uses. For instance, it is not impractical to drop a container holding a camera and a searchlight overboard to examine the ocean bed for wrecks, ores, or for biological studies, &c. Again, a similar container could be floated to the surface above a submarine to act as a periscope which would permit the boat itself to remain at a much lower level.

In another field, a similar device might be lowered below the cloud level from an airship for observation of conditions, while permitting the ship itself to remain concealed. Its uses in the military intelligence service in obtaining views under unusual conditions, may take numerous forms.

There are some possible applications in industrial work such as the viewing of manufacturing operations at locations where direct observations are not possible. The size of the viewed image need not be the actual size of the object itself, but may be considerably reduced or enlarged as conditions require.

It happens that the usual television camera will be sensitive not only to visible light but to the infra-red and ultra-violet ranges as well, a feature that may extend its usefulness in other fields.

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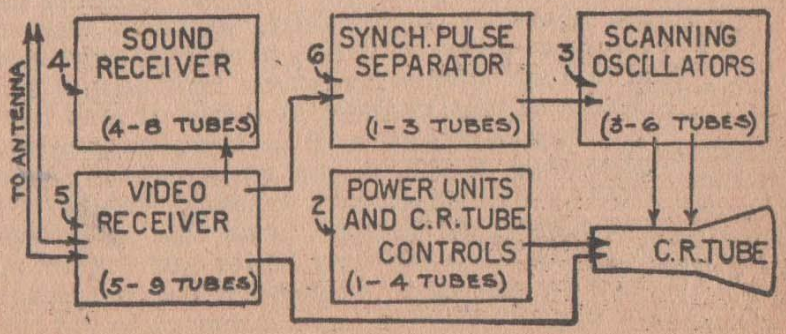
TELEVISION SERVICING PROBLEMS

There are many things to be learned before the problems associated with servicing television receivers should be tackled, and there are several ways in which such information can be obtained. Enrollment in a television course may help, but in all events this information should be supplemented by actual experimental training. Probably the best way of taking care of the latter is by constructing a receiver, or at least by assembling and testing a "kit" of parts. A well known television engineer expressed to the writer his disbelief that any television receiver could be assembled and adjusted without the use of test equipment valued at many times the cost of the kit itself. Development engineers who have such apparatus handy soon find that such conveniences are necessities. It might seem that there is little hope of getting results without such items as a square-wave generator, high frequency range oscillographs, high frequency microvolters, &c., but actually the problem is not so impossible as some have made out.

A It can be shown that there are around six classes of troubles experienced in television receivers, and in starting in with a set "cold," without any knowledge of what is wrong, a certain routine series of tests are necessary. These will be listed on this sheet, and followed by detailed checking schedules, in which suggestions as to test equipment will be made.

B In general the troubles may be due to (1) the antenna or its connecting wires, (2) the cathode ray tube and its associated controls, (3) the scanning oscillators that furnish the deflection potentials, (4) the sound receiver, (5) the video receiver, (6) the synchronizing pulse circuit.

Practically all commercial television receivers that have been prepared for this year's sale follow the basic principles outlined in the following block diagram:



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TUBES—AND THEIR APPLICATIONS

A closer analysis of the elements of the television receivers which were blocked out in the Data Sheet 020.4 can now be made. An examination of several commercial receiver designs shows that the principle circuits in all of them do not differ greatly. The table below shows the tubes used in the various sections of the block diagram of sheet 020.4.

BLOCK 5						BL. 6	BLOCK 3		BLOCK 2		BLOCK 4				MANUFACTURER
R.F. AMPLIFIER	CONVERTER	OSCILLATOR	VIDEO I.F. AMP.	DETECTOR AND AVC.	VIDEO AMPLIFIER	PULSE SEPARATOR	VERTICAL SCANNER	HORIZONTAL SCANNER	HIGH VOLT. RECTIFIER	LOW VOLT. RECTIFIER	SOUND CHANNEL I.F.	SOUND DETECTOR	AUDIO AMPLIFIER	CATHODE RAY TUBE	
1853	1852	6J5	1853 1853 1853 1852	6H6 6H6 1853	1853 6L6G	1853 6F8G 6H6	6F8G	6L6G 6F8G	879 879	5U4G 5U4G	6SK7 6SK7	6Q7	6L6G	1803 (P4)	GENERAL ELECTRIC CO. (12" TUBE)
—	1852		1853 1853 1853 1852	6H6	6F8G		6F8G 6F8G	6F8G 6F8G	879	5U4G	6SK7 6SK7	6Q7G	6K7	1802 (P4)	GENERAL ELECTRIC CO. (5" TUBE)
—	1852	6J5	1853 1853 1853 1853 1852	6H6	1852	6N7 6Y6G 6N7	6N7 6J5	6N7 6L6 5V4G	2V3G	5T4	1853 6SK7	6H6	6SF5 6F6G	1803 (P4)	RADIO CORP. OF AMER. (12" TUBE)
—	1852	6J5	1853 1853 1852	6H6	6V6	6N7	6N7 6N7	6N7 6F8G	879	5U4G	1853	6B8	6F6	1802 (P4)	RADIO CORP. OF AMER. (5" TUBE)
1853	1852	6J5	1853 1853 1852	6H6	6V6G 6H6	6SJ7 6N7	6N7 6C5	6N7 6V4G 6L6	2V3G	5V4G	6SK7 6SK7			1803 (P4)	ANDREA (12" TUBE)
—	1852	6J5	1852 1852	6H6	6V6G	1852	6N7 6F8G	6N7 6F8G	879	5V4G	1852	6SQ7	6V6G	1805 (P4)	ANDREA (5" TUBE)
1853	1852	6J5	1853 1852	6H6	1851 6V6G NEON	6J7G 6J7G	6AD5G 6R6G	6AD5G 6R6G	2Y2	5X3 5Z3	6J7G 6J7G	6Q7G	6V6G	144-9-T	DUMONT (14" TUBE)
—	1852	6J5	1852 1852	6H6	6F6	1852	6L7G 6F8G	6L7G 6F8G	879	5V4G	1853	6SQ7	6V7	1802 (P4)	MEISSNER (5" TUBE)
1852 1852				1852	1852 6V6	6H6	885	885 77 6V6	80	80				906 (P4)	AMER. TELEVISION (3" TUBE)
1852 1852 1852 1852				1852	1852 6V6	6F8G 76	885	885 77 6V6	879	80				1802 (P4)	AMER. TELEVISION (5" TUBE)

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TELEVISION SERVICING

There are a few instruments and pieces of equipment that radio service men may need to check a receiver, but no attempt should be made to rush around getting a wide variety of special gadgets purported to give a yes and no answer to all service troubles. A good service laboratory which will handle modern receivers will in all likelihood be able to handle television receivers, with but little extra equipment.

For example, it will be necessary to have a high voltage low drain voltmeter, having a range up to, say 7,500 volts. In addition an r-f signal generator covering television carrier frequencies is essential—calibrated for the frequencies of 5 to 100 megacycles. This oscillator must be modulated. In its simplest form this means that the dial may be turned manually over a certain range, to correspond to a video signal. Another type of modulation will be outlined later.

There are many special devices which are useful tools in the hands of an expert but will give little or no information to the service man without special training. Among these is the square wave generator which gives a special signal useful for testing video amplifiers. Its use will be confined in most cases to the designer. Another device which has been advocated uses a monoscope for giving a made-to-order signal for test purposes, by connecting it to the signal generator, so as to supply a video frequency modulated test carrier.

An oscillograph of the usual 3-inch to 5-inch service type will form a valuable asset in servicing work, but its bulk will in all probability make it difficult to transport to a field job. Television receivers cannot be carried under arm to the shop and left on the counter for fixing, and unless conveniently carried, service equipment may not be easy to transport to the service job.

An important part of television servicing will be the erection and adjusting of antenna structures and the installation of balanced down leads to the receiver. It also happens in the majority of commercial receivers that most of the less used controls are concealed, or inaccessible to casual operation. It seems that many owners may call on service men to make such adjustments in focusing brilliance, picture size or other controls that are not associated with tuning to various stations, and many service calls may be completed by the turning of a knob, associated with a scanning oscillator or a focusing control. It may also be expected that many service calls will be to track down interference sources, as well.

(To be continued.)

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SPECIAL TUBES FOR TELEVISORS

In analyzing the circuits which have been used in commercial television receiving sets a certain number of unusual tubes will be noted. The now common high transconductance tubes 1851, 1852 and 1853 have been described heretofore, and find frequent use. The power amplifier equivalent of this series is the 6AG7, a beam power amplifier tube. It is particularly useful in a video frequency amplifier to modulate a cathode ray tube. This tube combines a high transconductance value (7,700 micromhos) and a large power output. It has an amplification factor of 770, and is capable of delivering a voltage output great enough to modulate the largest cathode ray tube, even when it operates into a relatively low load resistance.

In deflection amplifiers for cathode ray tubes arranged for electrostatic deflection plates it is necessary to provide a linear amplifier delivering a voltage swing of many hundreds of volts across the output load resistor. In order to do this, a high anode voltage must be applied to the amplifier tube. The 6AD5G (Arcturus) used by DuMont and others is a high-voltage, linear amplifier tube. It is a triode capable of being operated with 1,500 volts on its plate. This tube requires a plate resistance of at least 0.2 megohm in this application. Having the relatively high amplification factor of 100, it can be driven by voltage amplifier circuits having normal characteristics and operating at normal voltages. Another tube used in a similar role is the 6R6G (Arcturus), a pentode. It requires a 0.1 megohm (minimum) plate load when operated with 1,500 volts on the anode. Both tubes are equipped with octal bases, but have the plate terminal isolated from the rest.

In another line a special converter-oscillator tube has been made available—the 6F8-G, a double triode, one section of which acts as the oscillator. The same tube has also been used in some receivers as a push-pull deflection amplifier stage (inverter circuit connections) for use with tubes with electrostatically deflection tubes.

A special high voltage horizontal deflection amplifier tube, the 6AL6G, has been provided for use in horizontal deflection amplifier circuits for electromagnetic deflection coils. This tube will not be affected by the high voltage surge that occurs when the return sweep current must be handled in this amplifier. The current through the coils must drop to a minimum value in less than seven millionths of a second, so that a high voltage is generated in the circuit which would affect the operation of ordinary tubes.

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TELEVISION NETWORK OPERATION

Since television must compete with moving pictures in the entertainment field, all of its inherent advantages must be utilized to greatest advantage. The important factor in this regard is its ability to handle local news happenings and sports events without delay. One of the expensive propositions, however, has been the need for an elaborate set-up of ultra short short-wave transmitters or special transmission lines over which the program can be returned to the main transmitter.

However in spite of the enormous losses introduced by ordinary telephone cables when television video-frequencies are handled, the Bell Telephone Laboratories have shown that television program transmission over such lines is far from hopeless. A mile of ordinary 22 or 26 gauge cable such as is used in regular telephone conversations may have over five million times as great a power loss at 3 megacycles as at 3 kilocycles. This loss can be compensated for by a high-gain amplifier. The problem is complicated, however, by the selective frequency requirements of such an amplifier. The amplification of a 0.50 megacycle signal for a certain length of cable might be twenty to one, but for a 3 megacycle signal the gain required for the same cable would be around 3,700 times.

In tests conducted in transmitting actual television programs it was found that by greatly exaggerating the higher video frequencies before connecting the signal to the line it was possible to equalize the rest of the difference at the other end, with the result that the losses were constant at all frequencies in the normal video range. At the same time the travel speed of the signals was equalized so that "ghost" images were avoided. Before the telephone line is actually used it is subjected to special transmission loss tests that show whether abnormal characteristics are present. Special amplifiers having these characteristics have been subjected to tests by both NBC and CBS, with promising results over distances up to about one mile. Particularly severe checks were applied to see that interference was not introduced into the television signal, and, on the other hand, to see that additional disturbances were not caused by that signal in other pairs of wires in the same cable.

The pick-up cameras and associated microphones, with their regular amplifier, are taken to the point of interest and set up in the normal manner. The signal from the pick-up camera is transferred to the telephone line through high-frequency booster amplifiers that over-emphasize the high frequency end of the video range. At the receiving end (which is located at the transmitter) other high-pass amplifiers are used to bring about an equality in the signal strength at all frequencies. The resulting video signal closely corresponds to the output of the pickup camera. The sound program is handled in the usual manner.

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COAXIAL CABLES FOR VISION FREQUENCIES

As reported in the previous Data Sheet, it has only been recently that distance as great as one mile could be covered using regular telephone cables for transmitting video signals from an outside pickup point, back to the transmitter. For several years great distances have been covered by using coaxial cables, consisting of a tubular conductor containing a wire centrally located and spaced with numerous inslating beads from the outer conductor. The actual amount of insulation, however, is kept at a minimum so that the losses are low. The cable is sealed to exclude all moisture.

By careful design and installation, the losses are easily compensated since the attenuation is linearly proportional to the frequency. With proper terminal amplifiers and other equipment installed at specified intervals, the upper limit of the frequency that can be economicaly handled is as great as is needed in television.

The coaxial cable between New York and Philadelphia has been used at frequencies of more than one megacycle, but this limit was set by the characteristics of the amplifiers used at the time of the tests.

Coaxial cables are not well adapted to the use of temporary pickup locations on account of installation difficulties, but will become important means for interconnecting studios and transmitters. It is generally inconvenient to locate studios, which must be large and easily accessible for the talent, near the transmitter. The latter must be near its antenna which is always on a high building or other elveated place that might be relatively remote from the best studio locations. In this case, coaxial cables can be installed with permanent terminal amplifiers having correct characteristics for equalizing the frequency range.

Another application for the coaxial cable is for the interconnection of studios in various cities in system networks so that a single program can provide entertainment to greater areas than that supplied by the limited horizon of a single transmitter. When network operation is started the cost of putting on elaborate stage presentations and special features is spread over a larger audience coverage, and an added entertainment value is assured. In a later Data Sheet other types of interstation connecting links will be described—using ultra-high frequency radio carriers as the connecting medium. These carrier frequencies are higher than used in television transmission for public participation. As was shown in Fig. 1 sheet 200.3, twelve of these special bands have already been set aside by the FCC for this use.