Nov. 17, 1942. A. N. GOLDSMITH 2,302,311

ELECTRONIC SYSTEM

Filed Oct. 30, 1941 2 Sheets-Sheet 1

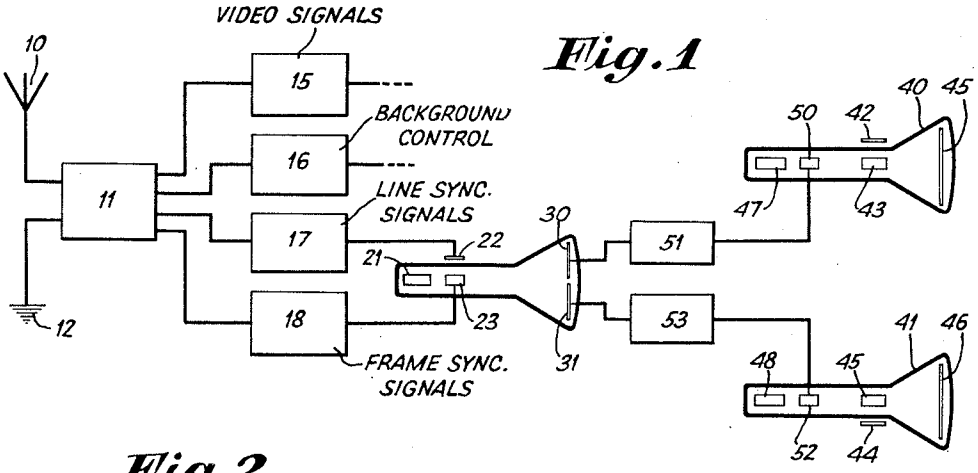


Fig. 1

Fig. 2

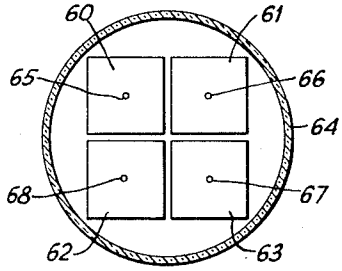


Fig. 3

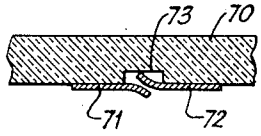
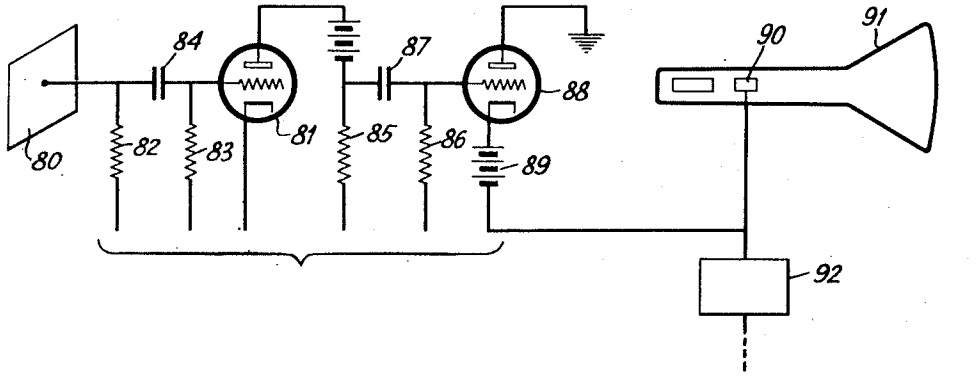


Fig. 3a



Fig. 4



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Fig. 5

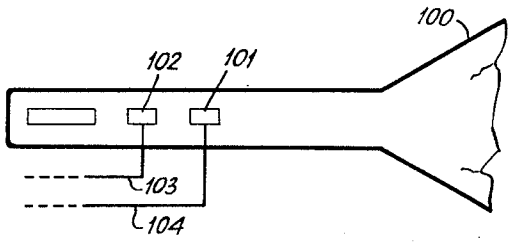


Fig. 6

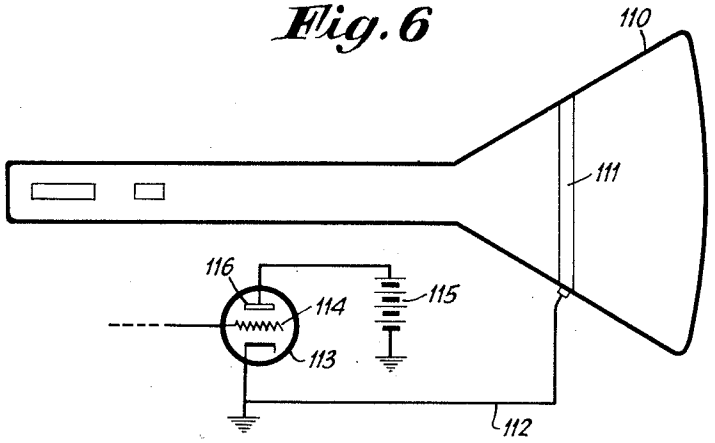
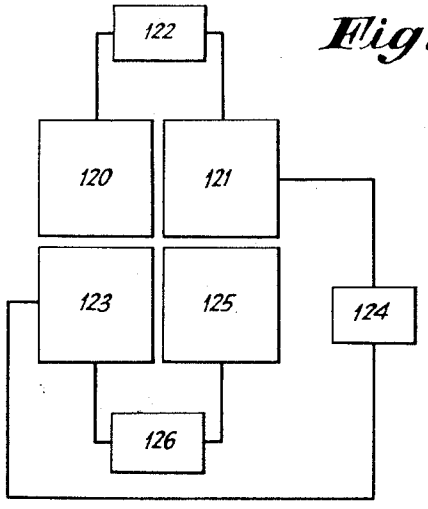


Fig. 7



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ELECTRONIC SYSTEM

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Application October 30, 1941, Serial No. 417,065

4 Claims. (Cl. 178—7.5)

My invention, in general, relates to commutating apparatus, and more particularly to an electronic type of commutator.

There has been shown in my Patent No. 2,219,149, granted on Oct. 22, 1940, a large screen type of television apparatus which is made possible by the production of a plurality of sectional image areas, each of which is formed on the screen of a cathode ray reproducing device, all of the sectional image areas being arranged so as to form compositely the large screen image. Since scansion of an image is usually accomplished by a single tube and the signals are transmitted sequentially, it will be appreciated that some means must be provided for impressing the proper portion of the signals onto a particular tube at the receiver in order that this tube may form the correct sectional image area. Even if the signals be broken up into groups during the time of their transmission, some arrangement must be provided which operates synchronously with the scanner in order to provide the proper tube at the receiver with the corresponding proper signals. Since very high speeds are necessary in these operations, it will be appreciated that a commutating device not only is necessary, but that the commutating device must be one which will operate satisfactorily at high speeds. Accordingly, it is one of the objects of my invention to provide such a commutator.

In addition to the operation of the device at high speeds, it must be assured that the device will act positively and will disrupt or break a circuit without any appreciable time lag. Accordingly, it is another of the objects of my invention to provide a device which will accomplish these functions accurately.

Since present day television receiving apparatus is complex in nature, anything which tends to simplify arrangements which are used or known is to be desired. Accordingly, it is another of the objects of my invention to provide a commutating device which will be easy to construct and simple to operate.

Also, among the objects of my invention are:

1. To provide high speed commutating devices operable according to a predetermined sequence of steps, in such fashion that each step is initiated at a time related to a space arrangement of electrodes of selected configuration and relative placement.

2. To operate a high speed commutating device efficiently by removing or minimally controlling the power supply from all controlled elements except the one element which is switched into operation by the device, and only during the period of such operation.

3. To operate a high speed commutating device in such fashion that the changeover shall be of the "make" or "break" type as desired.

4. To minimize the abruptness of changeover or switching in a high speed commutating device.

My invention, in general, contemplates the receipt of video signals by a television receiver and the separation of the line and frame synchronizing signals therefrom. There is provided an electronic commutating tube which will be referred to hereinafter as a "commuscope," and the line and frame synchronizing signals are impressed onto electronic beam deflection apparatus within the commuscope tube. This deflection apparatus causes the traversal of the electron beam onto individual, particularly arranged commutating sections sequentially, each of which in turn control the operating potential of the control electrode of one of the electronic reproducing devices for reproducing a sectional image area of the composite picture. Hence, the electron reproducing device may be operated for a time which corresponds to the scansion time for the particular section of the image which is to be reproduced by that device.

My invention will best be understood by reference to the drawings in which:

Fig. 1 is a schematic representation of the operation of two segments of the commutating device.

Fig. 2 is a view showing an arrangement of a plurality of commuscope segments.

Figs. 3 and 3*a* show a particular commutating segment arrangement.

Fig. 4 is an alternative form of Fig. 3.

Fig. 5 shows the use of a commuscope for controlling the operation of a cathode ray tube.

Fig. 6 shows an arrangement alternative to Fig. 5.

Fig. 7 is a schematic showing of commuscope segment interconnections.

Considering the television applications of the electronic commutator hereinafter to be described, the action thereof will be explained by assuming that the device is added functionally to equipment of the nature already described in United States Patent 2,219,149. In this patent there is shown a method of large screen television wherein a multiplicity of "kinescopes" are actuated sequentially in suitable fashion, the sequence of action being determined by biasing voltages or currents impressed onto the deflecting circuits so as to compel each kinescope to con-

tribute its portion of the entire picture only during the correct periods of time during the reception of the picture, it being understood that there are as many component areas or sections to the picture as there are component kinescopes. In general, the mode of transmission is in no way altered from the conventional television transmission. The accuracy with which the component sections of the assembled television picture lie next to each other without noticeable lines of joining depends in part on the accuracy of the deflector bias voltages or currents, and on the accuracy of the deflector voltages or currents themselves, in an arrangement such as described in the hereinbefore referred to patent. An additional element of accurate control of the substantially invisible juxtaposition of the component sections of pictures produced according to the teachings of Patent 2,219,149 may be provided by the electronic commutator shown in this disclosure, although it will be realized that the device may be applied to many other usages and for many other purposes. For convenience the electronic commutator hereinafter to be described will, as stated, be referred to in this specification as a "commuscope."

Referring to Fig. 1, there is shown a schematic representation of the operation of two segments of the commutating device. In this figure signals are received on an antenna 10 feeding into a receiver 11 which is grounded at 12. The receiver normally has separating circuits contained therein, and for purposes of convenience the separated sets of signals are merely indicated schematically. For instance, the video signals are indicated at 15, the background control signals at 16, the horizontal or line synchronizing signals are indicated at 17, and the vertical or frame synchronizing signals are indicated at 18. A commuscope tube 20 is shown containing an electron gun 21 for producing, controlling and accelerating a beam of electrons. The line synchronizing signals are impressed on one or both of the plates 22 of the commuscope 20, and the frame synchronizing signals on one or both of the plates 23 of the vertical deflecting means of the commuscope (it being appreciated that this view is shown looking down onto the commuscope rather than from the side). Positioned at the end of the commuscope tube, remote from the electron gun, are a plurality of commutating means, two of which are illustrated here as 30 and 31. Since these commutating means are to control the actuation of a "kinescope" tube in the application of this device to television, it will be appreciated that each of the commutating segments will control the actuation of one kinescope and hence there will, in an application of this nature, be as many commutating segments as there are kinescopes forming a complete optical image. Since, however, this device is not limited in its usage to a television arrangement, although particularly adaptable therefor, this example is given for illustrative purposes only. In the illustration of this figure two kinescope image reproducing tubes 40 and 41 are illustrated. Each of the tubes has the normal cathode ray deflecting apparatus, the tube 40 having one plate 42 of the plate pair thereof illustrated, and another, 43 of the plate pair for deflecting the beam in a different co-ordinate, is illustrated. Similarly, the tube 41 has the plates 44 and 45 corresponding to the plates 42 and 43. It will be appreciated that although electrostatic control of deflection has been shown in each instance, electromagnetic type of deflection will be equally adaptable for the purposes of this invention. The reproducing screen 45 of the kinescope 40 is illustrated, and similarly the screen 46 of the kinescope 41 is illustrated. The cathode 47 of the kinescope 40 is illustrated, and the cathode 48 of the kinescope 41 is illustrated. It will be appreciated that for purposes of simplicity, some parts of the kinescope tubes have been omitted. However, such tubes are well known and do not per se form a part of this invention. The control or modulating electrode 50 of the kinescope 40 is connected to the commutating segment 30 of the commuscope through amplifying means 51, and the control electrode 52 of the kinescope 41 is connected to the commutating segment 31 through amplifying means 53. It will be appreciated that amplifiers 51 and 53 are amplifiers capable of amplifying voltages having a frequency at least as high as the line frequency of a television picture, and at least as low as the frame frequency of the picture, or any required harmonics thereof in each case.

When the scanning beam of the commuscope falls on the segment 30, for instance, this segment becomes more negatively charged, and the amplifier 51 is so arranged that the amplified output current thereof will then increase the scanning beam intensity in kinescope 40 from zero to an appropriate operating value. When the scanning beam of the commuscope passes off the segment 30, this segment becomes less negatively charged and amplifier 15 is arranged so that a cut-off bias is produced in its output circuit and applied to the scanning beam intensity control of kinescope 40, thereby reducing the beam intensity thereof to zero. It will be noted that this procedure saves kinescope beam power during the inactive periods. In other words, any kinescope of an array which contributes its component section picture to the entire assembled television picture in suitable fashion is active and contributory thereto only when the scanning beam of the commuscope impinges on the segment which is electrically connected to the control electrode thereof.

In Fig. 2 is shown an end view of a commuscope tube which is adapted to control four kinescopes which form the reproduced picture. As long as the beam impinges on a particular segment, then an electron beam will be produced and directed toward the screen in the particular kinescope electrically connected to the particular segment. It will be appreciated, of course, that each kinescope will have particular means provided for deflecting the cathode ray beam contained therein, and that this device does not control the deflection of the beam, but controls its intensity. In this figure the relative position of four commutating segments 60, 61, 62 and 63 is illustrated, and the end wall of the kinescope tube is illustrated at 64. The connections to the appropriate amplifying means are indicated at 65, 66, 67 and 68.

Referring to Fig. 3, there is shown one particular form of a commutating segment such as illustrated at 60 in Fig. 2. This view is a cross-section and hence in appearance will be different from the particular view thereof in Fig. 2. However, it represents the physical arrangements at the adjacent edges of 60—63.

The sections of the commutating segments of the commuscope which have been illustrated in Fig. 2 represent, in miniature, the component

sections of the picture to be produced by the array of kinescopes, two of which are shown at 40 and 41. Accordingly, the sections of the commutating segments or anodes will have aspect ratios identical with those of the desired picture sections, and dimensions proportionate to the dimensions of such picture section. The segments of the commutator are insulated from each other and may consist, for example, of metallic coatings, other conducting coatings, or metal or conducting sheets, mounted preferably upon a plane or curve insulating support, for example, a sheet of glass or mica, with adjacent-edge arrangements as shown in Figs. 3 and 3a, and each is provided with a separate insulated connection to the outside of the commuscope.

The amplifiers such as 51 and 53, etc., may be arranged for substantially instantaneous response to potential variations of the corresponding commutating segments or anodic sections of the commuscope, or small delays in action of these amplifiers may be provided as may be found more desirable for the smooth joining of the component picture sections produced by the array of projection kinescopes such as 40 and 41, etc.

The other connections of the elements such as 15, 16, 17 and 18, to the kinescopes have not been shown since one form thereof already has been disclosed in Patent 2,219,149. The release of the cut-off biasing voltages impressed on the scanning beam intensity control of any kinescope of the array by the corresponding amplifier output as, for instance, the amplifier 51 on the kinescope 40, is arranged to permit the video frequency voltage impressed on this kinescope to become effective in controlling the scanning beam intensity of the particular kinescope in question. This may be accomplished by several means, amongst which are:

1. Suitably separating the cut-off biasing voltages from the video frequency voltages by electrical filters so as to prevent their inter-action, in which case the cut-off bias from the control amplifier when effective must exceed in its steady value the greatest value of the video frequency voltage impressed on the beam intensity control element by an amount which still corresponds to the beam cut-off potential.

2. Providing the kinescopes of the picture array with two separate beam intensity control members, one of which is used for the control of the beam by the cut-off amplifier output, the other of which is arranged for control of the beam by the video frequency voltage which corresponds to the picture modulation.

Referring to Fig. 3, there is shown schematically an arrangement by which the abruptness of the transition from one component picture of a multi-cathode ray picture tube array to the next component picture, whether in going along a horizontal line of the picture, or in passing from one set of horizontal sections of the combined picture to the next lower sections may be controlled. In this view an insulating member 70 has attached thereto two conducting members 71 and 72. A keyway 73 is cut in the insulating material and the end of one of the conductors is bent inwardly toward the keyway, and the end of the conductor positioned adjacent thereto is bent outwardly away from the keyway. It will be seen that the member 71 might, for instance, be the member 60 in Fig. 2, and the member 72 might, for instance, correspond to the member 61 of Fig. 2. Hence, the scanning beam of electrons will pass directly from one commuscope plate to the next without any time lag in its transition from one of the conducting elements to another. If a lesser separation of the adjacent edges of the conducting members 72 and 71 is desired, this can be accomplished by the arrangement shown in Fig. 3a, in which the edge of the member 74 is bent toward the electron scanning beam, whereas the edge of the member 75 is unbent.

There is no functional reason why the sections of the commuscope anode should be coated with a fluorescent material unless the material is of a good conducting nature, since primarily the commuscope is a picture section distributor only, although it can be used as a monitoring means.

The electrical transition from one section of the commuscope anode to the next may be made more or less abrupt as desired, by connecting between adjacent commuscope sections leakage resistance capacitors or inductances, or combinations of these, to produce electrical modifications well known in the art.

The commuscope is used relative to the synchronizing circuits exactly as if it were a kinescope receiving the entire picture. Whether it is connected to the video frequency source and the background control signal source, and provided with conductive fluorescent coatings on the segments, or alternatively only to a source of constant anode voltage and with means for electron supply for the electron gun, depends on whether or not it is to be used as a monitoring device as well as a component picture section distributor. The commuscope screen, when used for monitoring, may be viewed through a window on the inner side of the anode. If it is to be viewed from the end of the tube envelope then both the conducting coating of the anode and/or the fluorescent material thereon must be translucent.

In the illustration hereinbefore described the commuscope controls are arranged to be effective on the beam intensity control of the kinescopes of the array corresponding in each case to the active section of the commuscope anode. However, there are other ways in which this commuscope control may be made effective. Thus, the anode voltage of the kinescope which is to be made inactive might be blocked, for example, by the plate circuit of an amplifier controlled by the potentials originating on the corresponding commuscope anode section.

There has been referred to hereinbefore that the release of the cut-off biasing voltage impressed on the scanning beam intensity control in order to render a kinescope inactive until its activation by a commuscope section connected in controlling relationship thereto, permits the video frequency to become effective in controlling the scanning beam intensity of the particular kinescope controlled by the commuscope, and two ways have been pointed out how this may be done.

Referring to Fig. 4, there is shown an arrangement for accomplishing the first of these methods, and in which the cut-off biasing voltages of the tube may be separated from the video frequency voltages by electrical filters so as to prevent their inter-action. In this figure a commuscope section 80 is connected to the control grid of a thermionic amplifying tube 81 through the resistance-condenser combination compris-

ing resistances 82 and 83 and condenser 84. The output of the thermionic tube is connected through a conventional resistance condenser coupling circuit comprising resistances 85 and 86 and condenser 87 to the control electrode of a thermionic tube 88. The connections of these resistances in each of the conventional circuits is made to ground, as well as the cathode of tube 81. The anode of tube 81 is connected through a plate supply battery 93 which is connected between the common terminal of the resistor 85 and condenser 87 and the anode of the tube. The cathode of tube 88 is connected through a biasing means 89 to the control electrode 90 of a kinescope 91 which is partially illustrated. Also connected to the control electrode 90 is amplifying means 92, through which is impressed the video frequency signals onto the control electrode 90. Whenever the scanning beam strikes the section 80 of the commuscope the potential at the top of resistance 82 becomes more negative, and accordingly the potential at the top of resistance 84 becomes more positive. Accordingly, the potential at the upper end of resistance 85 becomes more positive, and the potential at the upper end of resistance 86 becomes more negative. Thus, the application of the negative potential to the grid of the thermionic tube 88 renders the tube non-conductive in effect, and thus the negative potential from the cut-off biasing source 89 is no longer applied to the control member 90 of the tube 91. The tube 88, therefore, is in effect a control switch in the cut-off biasing circuit of electrode 90. Accordingly, the video frequency signals are then active on the control electrode 90 to modulate the electron beam. If desired, a low pass filter may be inserted in the lead between the biasing arrangement 89 and the control electrode 90 to minimize the flow of video frequency currents through this lead to ground. If the number of partial image sections is n and if the field frequency is f, then the low pass filter, if used, should cut off as closely above nf as practicable, with due consideration for the desired speed of control. Time constants of the circuits 82, 83, 84 and 85, 86, 87, together with the associated inter-electrode capacities of the thereto connected tubes and the wiring, may be given appropriate values such that the response of the cut-off bias applying and removing circuit which is illustrated in this figure can be made as abrupt as necessary.

The second method of release of the cut-off biasing voltages described hereinbefore related to the provision in the kinescopes of the picture array with two separate beam intensity control members, one of which is used for the control of the beam by the cut-off amplifier output, the other of which is arranged for the control of the beam by the video frequency voltage.

Referring to Fig. 5, there is shown an arrangement for carrying out the method hereinbefore recited. In this figure a kinescope 100 has two control electrodes 101 and 102. The video frequency signals may be impressed onto the electrode 102 by means of the conducting lead 103. On the other hand, the control electrode bias may be released as in the arrangement shown in Fig. 4, and in this case the lead 104 which is connected to the control electrode 101 would be connected to the negative side of the source of energy 89 shown in Fig. 4.

There has also been related hereinbefore in this specification a method whereby the commuscope control may be made effective by applying the anode voltage to the commuscope when a corresponding partial image section of the commuscope is scanned, and removing the anode voltage from the kinescope at all other times. Referring to Fig. 6, there is shown an illustrative arrangement of this nature. In this figure a kinescope 110 has the last anode 111 thereof connected through lead 112 to the cathode of a thermionic tube 113, this tube corresponding to the tube 88 of Fig. 4. The signal appearing across the resistor 86 in Fig. 4 may be impressed onto the control grid 114 of the tube 113 when the commuscope section is energized. Thus, when a given section or partial image area in the commuscope is scanned, the grid 114 will become more positive, thus permitting current from an anode source 115 which is connected serially with the anode 116 of the tube 113 to flow, and hence energizing of the last anode of the kinescope will take place.

There has been referred to hereinbefore in this specification the fact that suitable impedances may be connected between successive partial image sections of the commuscope in order to control the transition from one section to another. Referring to Fig. 7, there is shown schematically such an arrangement as applied to a four section commuscope. For instance, the line scanning may be horizontal from left to right and the field scanning vertical from top to bottom. The impedances, therefore, are connected in accordance with this scanning procedure, and the first section of the commuscope which would be impinged on by the cathode ray beam would be the section 120 which is adjacent the section 121. Therefore, connected between 120 and 121 may be suitable impedance members indicated schematically as 122. Since the section 123 of the commuscope would be next energized in the sequential arrangement, the impedance or impedances 124 are connected schematically as connected between section 121 and 123 of the commuscope. Since section 125 is the last section energized, then suitable impedance members 126 may be connected between section 123 and 125 of the commuscope, and this general sequence of connections would be kept up in a multi-unit commuscope having a greater number of sections.

If desired, non-frequency discriminatory delay circuits may be introduced into the units 51, 53 or in the leads between these elements and the respective kinescopes in Fig. 1. Also, amplifiers may be located at suitable places as, for instance, an amplifier might be inserted between the element 30 and the element 51 of Fig. 1, or between the element 31 and the element 53 thereof.

The commuscope surface should preferably have small secondary emission in order to hold an applied negative charge without loss.

It will be obvious that there may be departures from the particular showing or showings which have been made herein without departing from the spirit and scope of the invention, and accordingly I claim all such modifications as may fall fairly within the spirit and scope of the invention as identified in the hereinafter appended claims.

What I claim is:

1. An electro-optical image reproducing system comprising, in combination, a plurality of cathode ray tubes arranged in a plurality of rows and columns boundarywise-individual-spaced juxtaposable and interlockable internally con-

tinuous bidimensional partial image areas, each of said tubes including electrode means for developing a cathode ray beam and a target responsive to the impact of the cathode ray beam to produce electro-optical image representations, means for controlling the electro-optical effect produced in each tube under the control of signalling impulses, means for normally mantaining each of the tubes in an inoperative state to reproduce images, a cathode ray switching tube including electrode means to develop a cathode ray beam, and a multi-segmental target having a number of mutually electrically insulated segments corresponding to the number of tubes in the bidimensional array included within the last named tube and arranged to be impacted by the cathode ray beam, means for causing the cathode ray beam to traverse the said segmental targets so as to render the cathode ray tube of the bidimensional array which is connected to each impacted segment operative to reproduce signals during the time period of impact of the cathode ray beam upon said segment, said individual segments of the target of the switching cathode ray tube being so positioned and overlapping as to be gapless to the traversal of the beam.

2. An electron tube commutator comprising a cathode ray device having included therein electrode means to develop a cathode ray beam, a multi-segmental target element located in the path of the said electron beam, said multi-segmental target comprising a plurality of overlapping segments each electrically insulated one from the other, means to connect each independent segment to a ultilization circuit, and means for sweeping the cathode ray beam across the individual segments in a cyclic manner so that the said cathode ray beam impacts the several segments in sequence and without observable time interruption in moving from segment to segment.

3. An electronic commutator as claimed in claim 2, wherein the said segmental target is arranged with the various segments forming a plurality of rows and columns.

4. An electronic commutator as claimed in claim 2, wherein the said segmental target is arranged with the various segments forming a plurality of rows and columns, and a plurality of impedance means connecting the independent segments of each row and of each column.

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