March 30, 1943. C. F. MATTKE 2,315,291

APPARATUS FOR AND METHOD OF GENERATING TELEVISION SIGNALS

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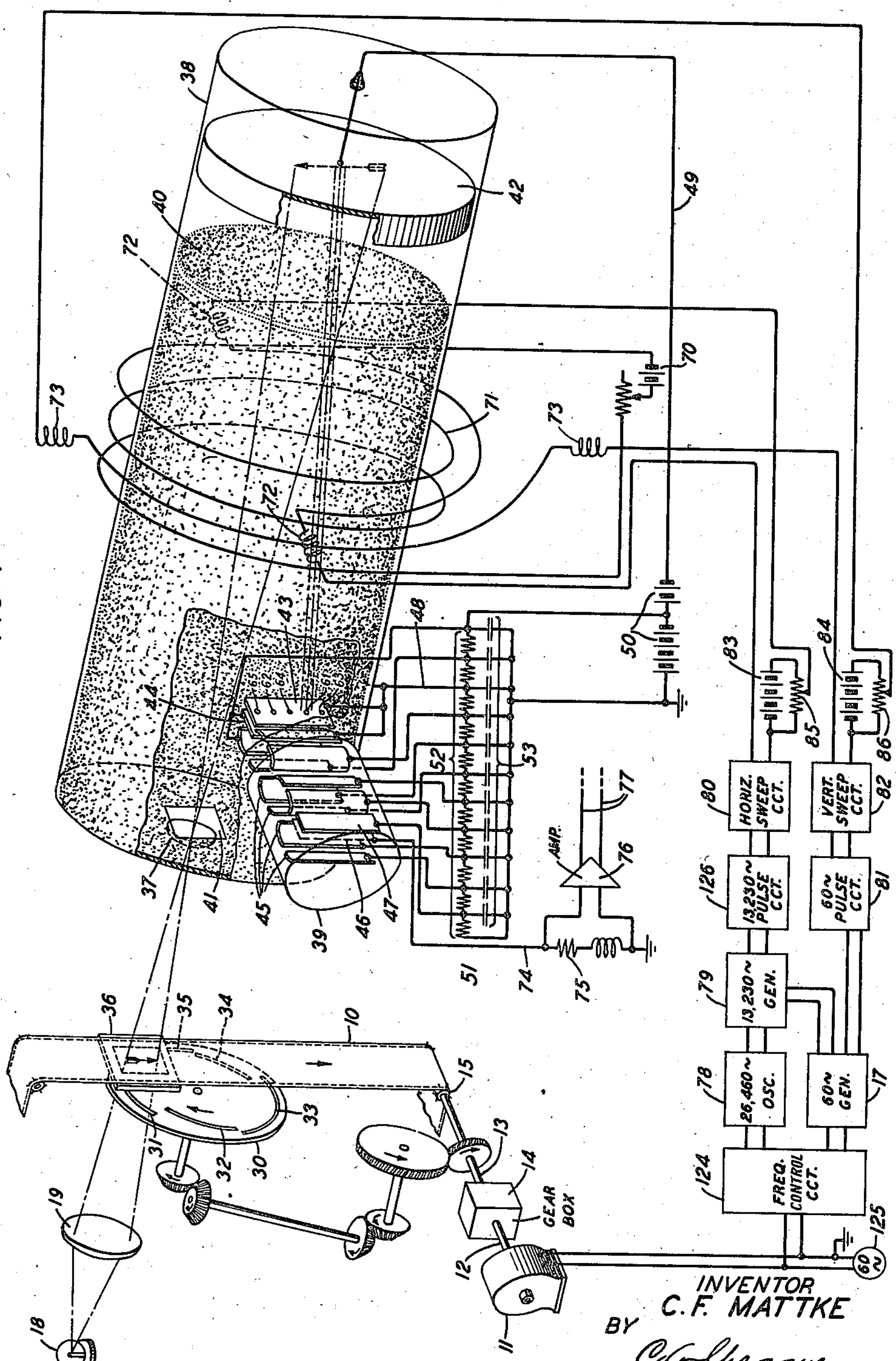
FIG. 1



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APPARATUS FOR AND METHOD OF GENERATING TELEVISION SIGNALS

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FIG. 2

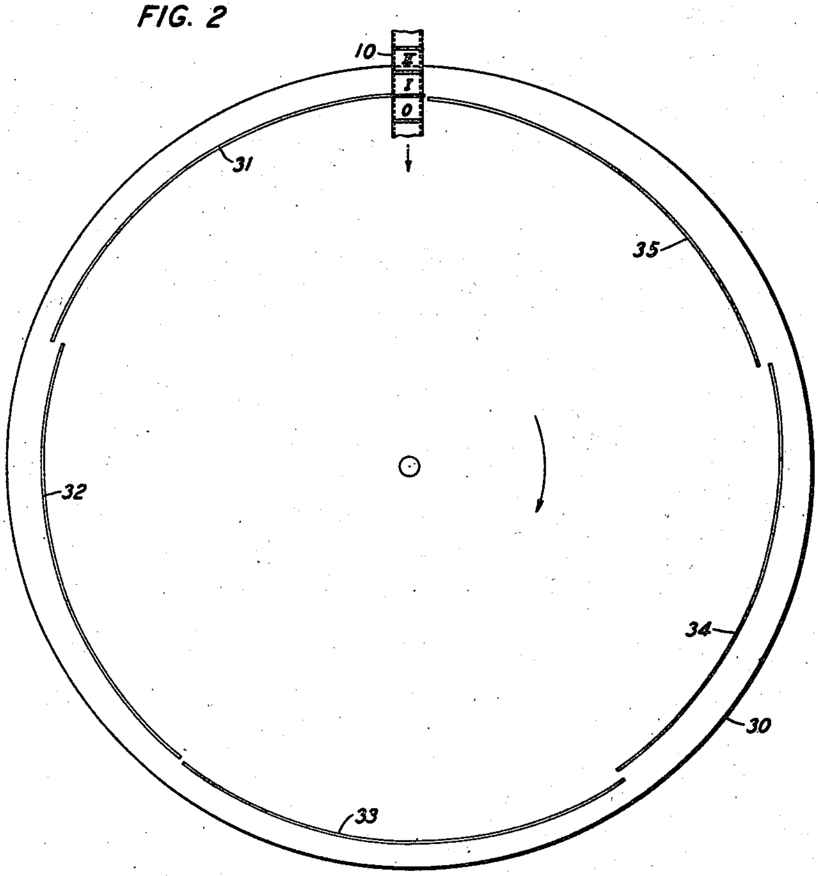

FIG. 3

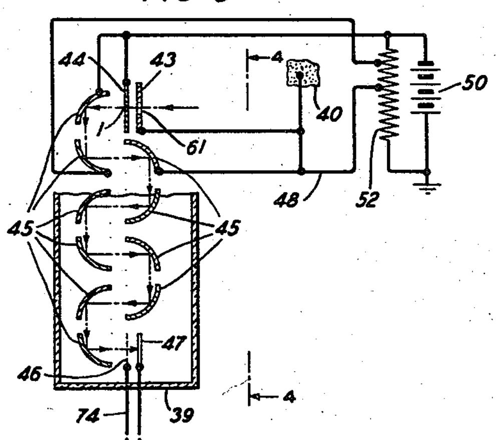

FIG. 4

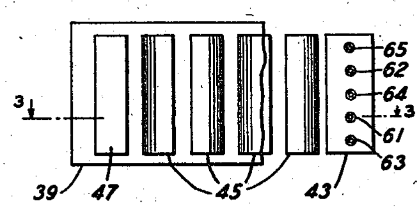

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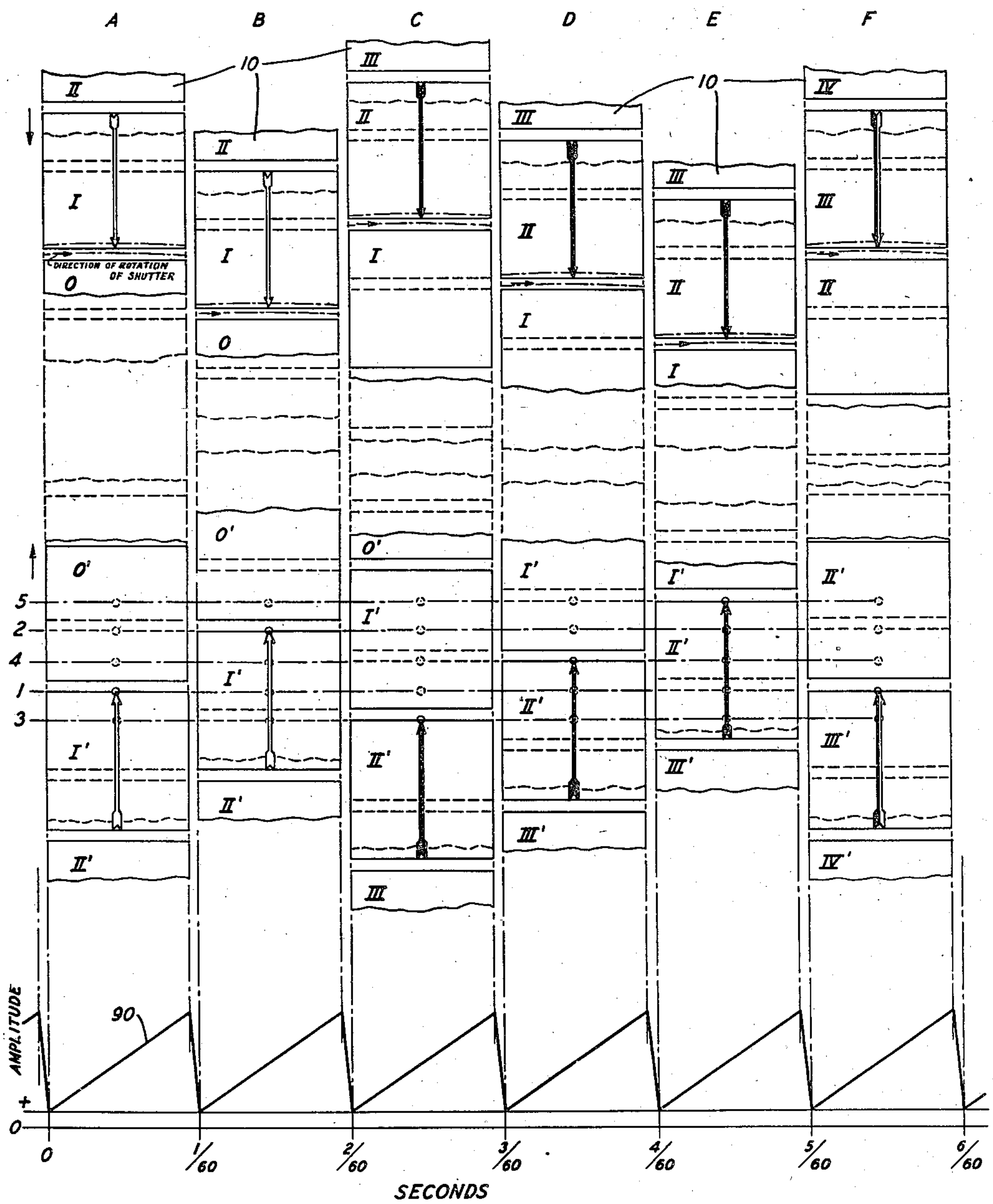
FIG. 5



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APPARATUS FOR AND METHOD OF GENERATING TELEVISION SIGNALS

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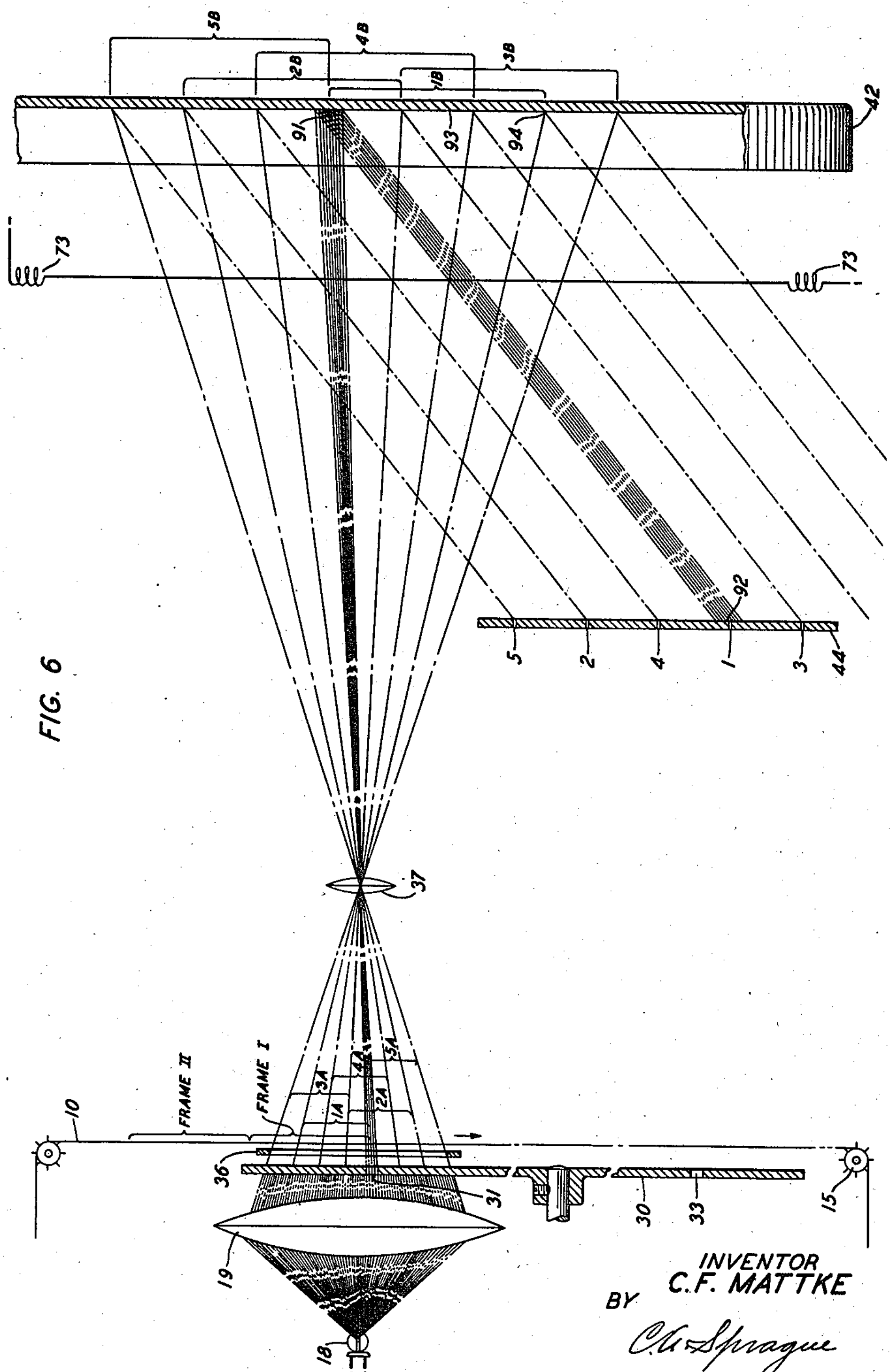

FIG. 6

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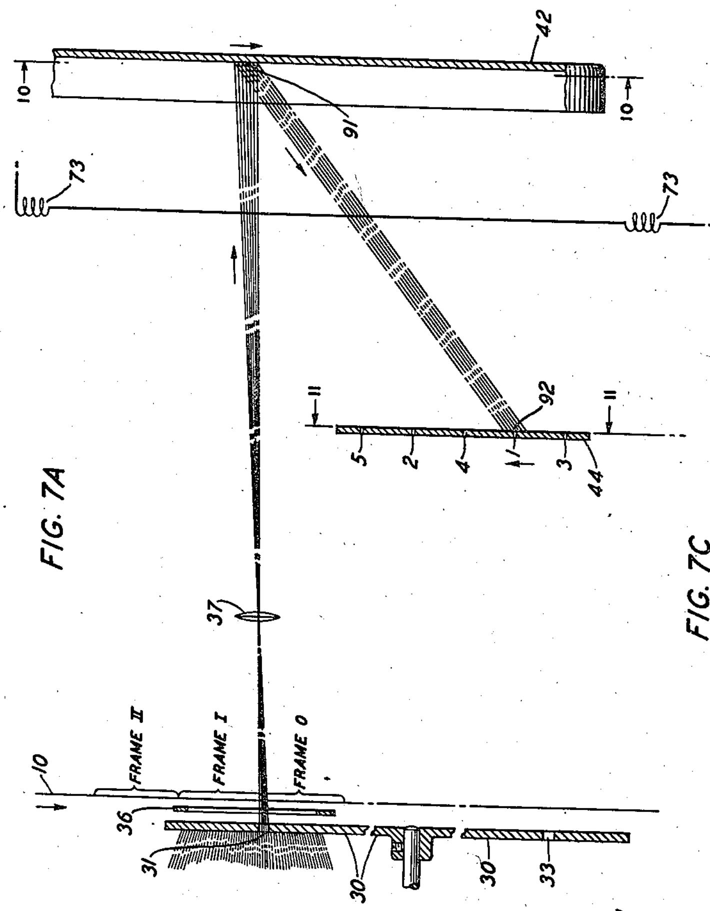

FIG. 7A

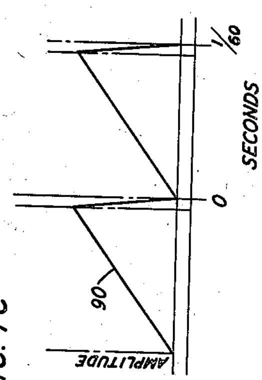

FIG. 7C

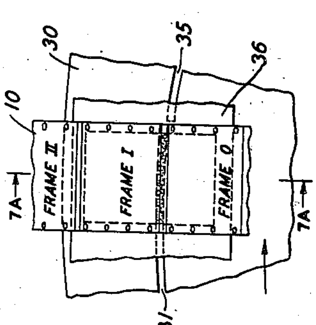

FIG. 7B

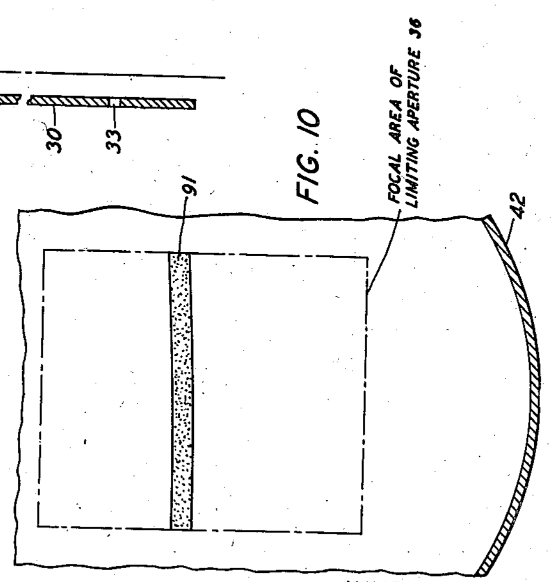

FIG. 10

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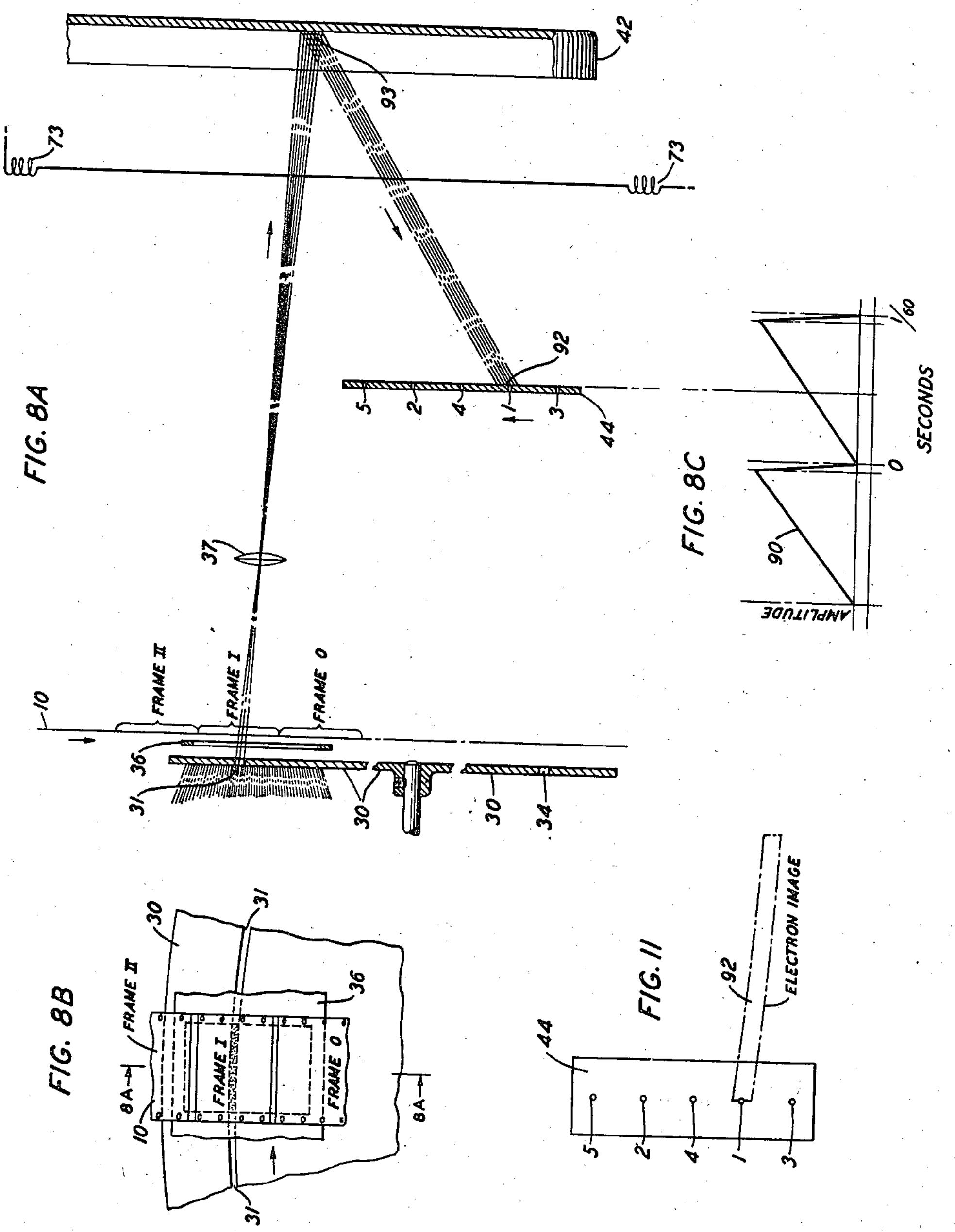

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APPARATUS FOR AND METHOD OF GENERATING TELEVISION SIGNALS

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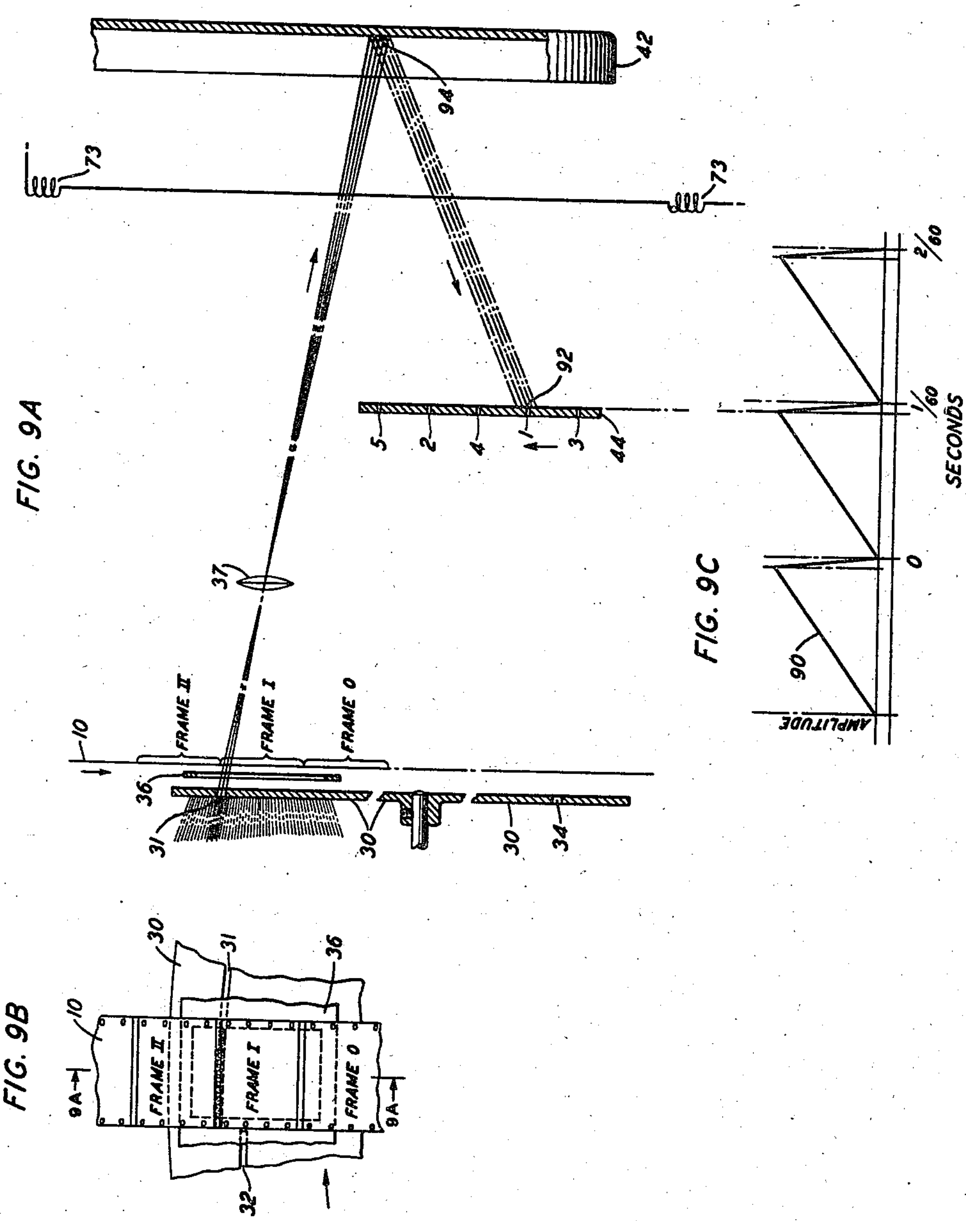

FIG. 9A

FIG. 9B

FIG. 9C

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Patented Mar. 30, 1943 2,315,291

UNITED STATES PATENT OFFICE

2,315,291

APPARATUS FOR AND METHOD OF GENERATING TELEVISION SIGNALS

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Application February 27, 1941, Serial No. 380,774

6 Claims. (Cl. 178—7.2)

This invention relates to signaling and particularly to a method of and apparatus for scanning motion picture film for generating television signals.

An object of the invention is to provide an improved apparatus for scanning motion picture film for television transmission.

Another object is to provide an improved cathode ray scanning device.

In accordance with standard motion picture practice a motion picture film is exposed at the rate of 24 film frames per second and pictures are projected from the film at the same rate. However, in transmitting television images, in accordance with standards adopted by Radio Manufacturers' Association, a field of view is scanned at the rate of 60 field scans of 220½ lines each per second with the lines of one field scan interlaced with the lines of the preceding and following field scans so that 30 complete frame scannings of 441 lines each take place in one second. Therefore, in scanning for television transmission a motion picture film which is moved continuously at the rate of 24 film frames per second, it is desirable to scan the odd film frames, for example, twice and even frames three times so that there are five field scans of 220½ lines each in 1/12 second, that is, 60 field scans or 30 complete frame scannings of 441 lines each, interlaced, per second.

In accordance with a preferred embodiment of the present invention shown and described herein for the purpose of illustration, a cathode ray image dissector tube of special construction is employed for generating a television image current under control of light projected through a continuously moving motion picture film upon the light sensitive cathode of the image dissector tube. The image dissector tube is provided with an aperture plate having five spaced apertures therein (instead of a single aperture heretofore employed), the centers of the apertures lying on a line substantially parallel to the direction of vertical movement of the electron image which is focussed in the plane of the aperture plate and substantially parallel to the direction of motion of the motion picture film. The usual horizontal and vertical deflecting coils and the usual sources of current for energizing the deflecting coils are provided but, since the motion picture film, and therefore the image projected upon the cathode of the dissector tube, is moved continuously at a constant rate, the amplitude of the current supplied to the vertical deflecting coils is correspondingly reduced. In order that electrons emitted from the cathode of the image dissector tube may pass through only one of the five scanning apertures at a time, and through different apertures in succession, there is provided in the path of the light beam for projecting images from the film upon the cathode of the image dissector tube, a rotating shutter disc having five arcuate light transmitting slots therein. The movement of the film, the rotation of the light intercepting shutter and the deflecting fields for controlling the deflection of the electron image are all maintained in synchronism so that the pictures recorded on the film are scanned at a desired rate different from the rate of movement of the film.

The invention will now be described with reference to the accompanying drawings in which

Fig. 1 is a diagrammatic view of a motion picture film scanning apparatus in accordance with the present invention;

Fig. 2 is a view of the motion picture film and shutter disc as viewed from the cathode ray image dissector tube shown in Fig. 1, the disc and the film being shown in approximately correct dimensional relationship;

Fig. 3 is a diagrammatic view of a portion of the apparatus shown in Fig. 1 including in plan view the electron multiplier of the image dissector tube;

Fig. 4 is a view taken along the line 4—4 of Fig. 3; and

Figs. 5 to 11, inclusive, are diagrams to which reference will be made in connection with an explanation of the operation of the apparatus shown in Figs. 1 to 4.

Referring now to the drawings, a modified motion picture projector projects the successive images recorded on a motion picture film 10 upon the cathode of a cathode ray image dissector tube. The motion picture film 10 is driven by synchronous motor 11, through shafts 12 and 13, gear box 14, and film sprocket 15. The motor 11 is energized by current from the 60-cycle power source 125 for controlling the motor speed, the motor speed and the gearing in gear box 14 being such that the film is driven continuously at the rate of 24 frames per second. Light from source 18 is directed through condensing lens 19, through slotted rotatable disc 30 having slots 31, 32, 33, 34 and 35 therein, through the opening in frame aperture plate 36 and film 10 and thence through lens 37 which focusses an image of the subject-matter recorded on film 10 upon the cathode of an image dissector tube comprising an evacuated glass housing 38 of substantially cylindrical shape from which extends a side tube 39 of smaller diameter. Ignoring for the present the fact that the disc 30 intercepts a portion of the light beam, it is seen that the lens 37 projects an image of a picture recorded on the film upon the cathode 42, the image on the cathode being inverted with respect to the image recorded on the film, as indicated by the arrows.

The inner surface of the housing 38 has a metallic coating or anode 40 in which is formed a window 41 through which the light beam from source 18 is projected to the cup-shaped light sensitive cathode 42, the cathode 42 being positioned near the end of the cylinder 38 opposite the end having the window 41 and beyond the anode 40. The remaining electrodes within the housing 38, 39 constitute an electron multiplier comprising a shield 43, aperture plate 44, multiplier plates 45, collector grid 46 and anode 47. An electromotive force is applied between cathode 42 and anode 40 through leads 48 and 49 from a circuit comprising battery 50, the positive terminal of which is grounded, and a network 51 made up of voltage dividing resistors 52 and condensers 53, as shown. Leads from the circuit 51 are connected to the electrodes of the electron multiplier as shown for applying appropriate potentials thereto. The electrons emitted from cathode 42 due to the light activation thereof are focussed to form an electron image in the plane of the aperture plate 44 having therein five small spaced apertures 1, 2, 3, 4, and 5, the centers of which are in alignment with the centers of the somewhat larger apertures 61, 62, 63, 64 and 65, respectively, in the shield 43 (see Figs. 3 and 4), the electron image being focussed by means of an axial magnetic field set up due to the current from source 70 flowing through the coil 71 which surrounds the glass envelope 38 and which extends substantially the full length of the tube.

There are provided two pairs of deflecting coils the horizontal or high frequency deflecting coils 72 and the vertical or low frequency deflecting coils 73. The magnetic field set up when these deflecting coils are suitably energized cause the beam of electrons emitted from the cathode 42 and, therefore, the electron image focussed in the plane of the scanning apertures 1 to 5, inclusive, to be deflected along both horizontal and vertical coordinates. The electron beam reaching the apertured shield 43 is of such size that electrons can pass through only one of the apertures 61 to 65, inclusive, at a time but electrons can pass through different apertures in succession due to the action of the rotating slotted disc 30 and to the deflection of the electron beam by the vertical deflecting field. The motion of the electron image with respect to the scanning apertures results in progressively selecting elemental areas of the image. Due to the bombardment of the first of the plurality of multiplier plates 45 by the electrons from different portions of the cathode 42 in succession, an image current is set up in the circuit including lead 74 connected to the collector grid 46, the terminating impedance element 75 and ground. This image current may be amplified by the vacuum tube amplifier 76 if desired, and transmitted over a suitable transmission medium such as a balanced line 77.

In Fig. 1, the film 10 and disc 30, for example, are not shown in their correct relative dimensions. In Fig. 2 the relative dimensions of the film 10 and disc 30 are shown more nearly correctly.

Any suitable means may be employed for supplying deflecting currents of saw-toothed wave form to the deflecting coils 72 and 73. As shown diagrammatically in Fig. 1 the drawings, there are provided a 26,460-cycle controlled oscillator 78 from which is derived by successive steps the submultiple frequency sources 79 and 17 of 13,230-cycle and 60-cycle waves, respectively, of generally square-topped wave form. The 60-cycle wave from the power source 125 and the 60-cycle wave from the submultiple frequency generator 17 are impressed upon the frequency control circuit 124. There is produced by the circuit 124 as the result of beating together the waves from sources 125 and 17, a control current which is impressed upon the oscillator 78 for maintaining the frequency of the wave produced by the oscillator 78 in step with the frequency of the 60-cycle power source 125, that is, for maintaining the frequency of source 78 at the 441st multiple of the frequency of power source 125. Of course, a line frequency scanning rate, other than 440 lines per frame scanning period may be used in which case the frequency of source 78 would be maintained at some harmonic of the 60-cycle power source other than the 441st harmonic. The 13,230-cycle source 79 controls a 13,230-cycle impulse generating circuit which, in turn, controls the horizontal sweep circuit 80 for supplying a 13,230-cycle saw-toothed current wave to the horizontal deflecting coils 72. An arrangement of the type described for generating waves for controlling the sweep circuits which, in turn, control the deflection of a cathode ray beam and for maintaining the waves in synchronism with an alternating current power source is disclosed in an article by A. V. Bedford and John Paul Smith on page 51 of "RCA Review" for July 1940, published by RCA Institute Technical Press, 75 Varick Street, New York, New York. Sixty cycle pulses produced by the generator 81 under control of the subharmonic generator 17 control the vertical sweep circuit 82 which supplies a 60-cycle saw-toothed current wave to the vertical deflecting coils 73. In order that the electron image produced in the plane of the aperture plate 44 may be brought into correct vertical and horizontal alignment, there are provided batteries 83 and 84 from which direct current is supplied through potentiometers 85 and 86 to the horizontal and vertical deflecting coils 72 and 73, respectively.

The operation of the scanning system shown in Fig. 1 may best be understood by referring to Figs. 5 to 12, inclusive.

Referring to Fig. 5 the film 10 is moved downwardly, as viewed in the figure, at the rate of 24 film frames per second, so that, at the beginning of successive equal periods of 1/60 second, the film is in positions marked A, B, C, D, E and F, respectively. The time periods are indicated at the lower portion of the figure. Assuming for the present that frame I is projected upon the cathode 42 of the image dissector tube, then the electron image corresponding to frame I formed in the plane of the aperture plate 44 would appear at I'. Due to the downward motion of the film 10 from position A to position B, the image formed on the cathode 42 and therefore the electron image formed in the plane aperture plate 44 will move upwardly by a corresponding amount, that is, an amount corresponding to 2/5 of a film frame in 1/60 second or one field scanning period. This vertical motion of the electron image is supplemental by deflecting the cathode beam to cause the electron image to move through a distance corresponding to 3/5 of a film frame by applying to the vertical deflecting coils 73 a regular saw-toothed wave 90 from source 82. Of the apertures 1, 2, 3, 4 and 5 in the aperture plate 44, one only is effective in the process of scanning the image during a certain field scanning period, the apertures becoming effective successively during successive field scanning periods. In Fig. 5 the apertures are shown aligned on equally spaced horizontal lines which are numbered at the left-hand side of the drawing. During the first field scanning period only aperture 1 is effective and during this period the electron image of frame I moves vertically with respect to aperture 1 through a distance corresponding to a film frame. While the electron image is thus moved along a vertical component, it is also moved horizontally in the usual manner at the rate of 441 lines per frame scanning period of 1/30 second or 220½ lines per field scanning periods of 1/60 second by applying a saw-toothed wave current from the horizontal sweep circuit 80 to the horizontal sweep coils 72.

At the start of the second field scanning period, the film and the electron image are in the positions shown at B in Fig. 5. Aperture 2 is now effective and due to the continuous movement of the film 10 and the deflection of the electron beam from cathode 42, film frame I is scanned a second time. At the beginning of the third field scanning period aperture 3 becomes effective in the process of scanning film frame II. Aperture 4 next becomes effective in the scanning of film frame II a second time during the fourth field scanning period and then aperture 5 becomes effective in the process of scanning film frame II a third time. At the beginning of the sixth field scanning period, as shown by F in Fig. 5, frame III occupies the position which was occupied by frame I and electron image III' occupies the position which was occupied by electron image I' at the beginning of the first field scanning period A. Thus, alternate film frames are scanned twice and the remaining frames are scanned three times along 441 lines per frame scanning period, the lines on one field scanning being interlaced with those of the preceding or following field scanning. The film moving continuously at 24 film frames per second is thus scanned at the rate of 60 field scans per second.

As will be apparent from a consideration of Figs. 2, 6, 10 and 11, the apertures 1, 2, 3, 4 and 5 in the aperture plate 44 are made effective for scanning one at a time in succession by the rotating slotted disc 30 which permits only a narrow strip of the film 10 to be illuminated at a time and, therefore, an optical image 91 of this narrow strip to be focussed upon the cathode 42 and an electron image 92 corresponding to this narrow strip to be focussed in the plane of the aperture plate 44. The position of film frames I and II of film 10, as indicated in Fig. 6, corresponds to the condition depicted at A of Fig. 5 and the relative positions of the disc 30 and film 10 are as shown in Fig. 2.

At the commencement of scanning of film frame I, the leading portion (lower portion, as viewed in Fig. 6) of film frame I is illuminated and the light beam from this portion of the film reaches position 91 on the light sensitive surface of cathode 42, light from the first scanned line of frame I being at about the central portion of the beam. The electron beam from portion 91 of the cathode is focussed upon the aperture plate 44 so that, as the electron beam is deflected, electrons corresponding to the elemental areas of the first scanned line pass successively through aperture 1 in aperture plate 44. It is apparent that if the slotted disc 30 were omitted, the size of the light beam and of the electron beam would be limited only by the opening in aperture plate 36 and electrons would pass simultaneously through a plurality of apertures in aperture plate 44. The width of the slots in disc 30 is sufficiently narrow that electrons emitted from cathode 42 can pass through only one of the apertures in aperture plate 44 at a time.

During the first field scan of film frame I, the film moves downwardly, as viewed in Fig. 6, through a distance of 2/5 frame and the slot 31 in disc 30 in effect moves upwardly through a distance of 3/5 frame, that is, through a distance indicated by 1A in Fig. 6. During this period the light beam intercepted by cathode 42 moves from position 91 downwardly through a distance indicated by 1B in Fig. 6. A saw-toothed wave deflecting field 90 (Fig. 1) is applied to the vertical deflecting coils 73 so that, as the light beam impinging on cathode 42 moves downwardly through a distance 1B, the position of the electron beam at electrode 44 remains fixed with respect to the vertical coordinate. Thus electrons emitted from cathode 42 in response to light from successive elemental areas along successive lines of film frame I pass, in order, through aperture 1 in electrode 44 and impinge upon the first multiplier electrode or target 45 of the electron multiplier 39 to set up a corresponding image current in the output circuit of the multiplier.

In a similar manner, during the second field scan of frame I, the film is illuminated by light passing through slot 32 in disc 30, the light beam leaving the film moves upwardly through a distance indicated at 2A, the light beam impinging on the cathode 42 moves downwardly through a distance indicated at 2B and electrons emitted from the cathode pass through the aperture 2 in electrode 44. Similarly, film frame II is illuminated three times during the next three field scanning periods, the light beam from the film being swept over the area indicated at 3A during the first field scan, over the area 4A during the second field scan, and over the area 5A during the third field scan of frame II. During the three field scans of frame II the areas of the cathode indicated at 3B, 4B and 5B, respectively, are illuminated a narrow section at a time and the electrons emitted from the cathode pass through the scanning apertures 3, 4 and 5, respectively, of the aperture plate 44.

In accordance with the standards adopted by the Radio Manufacturers' Association, there is an interval, about 7 per cent of the field scanning period, at the end of each field scanning period during which the beam of the image producing cathode ray tube is preferably reduced in intensity and is returned to its initial scanning position. During this interval, frame synchronizing impulses are transmitted and no image production takes place. As may be seen from Fig. 7B, for example, there is an interval between successive field scanning periods during which one slot of disc 30 is moving out of alignment with the opening in the aperture plate 36 and the succeeding slot is moving into alignment with the opening in aperture plate 36. In Fig. 7B, for example, slot 35 has just moved out of alignment with the opening in aperture plate 36 and slot 31 has moved into position for scanning of the first line of film frame I during the first field scanning period. The length of each of the slots 31 to 35 is preferably such with respect to the width of the opening in plate 36 that one slot can move completely out of, and a succeeding slot can move completely into, alignment with the opening in plate 36 within the period of about 7 per cent of the field scanning period alotted to the vertical synchronizing impulses.

Fig. 7A shows the position of the optical image at 91 and the position of the electron image at 92, as is shown in Fig. 6, for the condition depicted in Fig. 7B and also at A of Fig. 5. In Fig. 7C is shown a saw-toothed electric wave 90, as shown in the lower part of Fig. 1, for energizing the vertical deflecting coil 73. It will be noted that the zero point on the horizontal time axis of Fig. 7C is in vertical alignment with the scanning aperture plate 44. This is intended to indicate that at the beginning of the first field scanning period of film frame I the vertical deflecting saw-toothed wave is at its minimum amplitude.

Figs. 8A, 8B and 8C are similar to Figs. 7A, 7B and 7C, respectively, but depict a condition encountered about 1/120 second after the condition depicted in Figs. 7A, 7B and 7C. As shown in Fig. 8B, at this time about the central portion of film frame I is being scanned. As shown in Fig. 8A, and also in Fig. 6, the light beam is intercepted by the cathode 42 at a lower position 93 as viewed in the figure. As shown in Fig. 8C at a time about half way between zero and 1/60 second, the amplitude of the vertical deflecting wave 90 is about one-half its maximum amplitude, this amplitude of the deflecting wave causing the electron beam to be deflected so as to reach position 92 on the aperture plate 44. Figs. 9A, 9B and 9C are similar to Figs. 8A, 8B and 8C, respectively, but depict a condition encountered just prior to the end of the first field scanning of film frame I. As shown in Fig. 9B slot 31 is about to start moving out of, and slot 32 about to start moving into, alignment with the opening in plate 36. Fig. 9A shows that at this time the light beam is intercepted by the cathode 42 at a still lower position 94, which is also shown in Fig. 6. The vertical sweep wave 90 is now at its maximum amplitude to cause the electron beam to be deflected to position 92 on the aperture plate 44.

In a similar manner, during a different field scanning period when light is directed through some other slot of disc 30, the light beam will be intercepted initially at some other position of cathode 42 such that the electron beam will pass through a corresponding aperture in aperture plate 44 and, as the light beam illuminates different portions of cathode 42 in succession, the saw-toothed wave 90 impressed upon vertical deflecting coils 73 will set up a beam deflecting field to cause the position of the electron image to remain substantially fixed with respect to the vertical coordinate, the electron image being moved only along a horizontal coordinate to effect the scanning of the motion picture film.

In accordance with the standards adopted by the Radio Manufacturers Association, as previously stated herein, there is an interval, about 7 per cent of the field scanning period, at the end of each field scanning period during which the electron beam of the image producing cathode ray tube is reduced in intensity and returned to its initial scanning position. During this interval frame synchronizing impulses are transmitted and no image production takes place. This 7 per cent of the field scanning period is also required for the return sweep of the cathode ray beam emitted from the cathode 42 of the image dissector tube. In standard motion picture film the dimension along the length of the film of the frame line between two successive picture portions is about 15 per cent of the length of an entire film frame consisting of a picture portion and a frame line. In order to avoid waste of transmission time, it is desirable to scan a picture portion only of a film frame during 93 per cent of a field scanning period, thus allowing 7 per cent of the field scanning period between the time of scanning the last scanned elemental area of one field scanning period and the first scanned elemental area of the succeeding field scanning period. In order that the picture portion only of the motion picture film may be scanned during 93 per cent of the field scanning period of one-sixtieth second, the slots 31 to 35 in the disc 30 may be laid out so that a picture portion of the film is traversed by a slot in 93 per cent of a field scanning period and the amplitude of the vertical deflecting current from source 82 reduced so that the electron image corresponding to a picture portion only of the motion picture film is scanned in 93 per cent of the field scanning period.

The subject-matter of this application is related to that of my application Serial No. 380,773, filed concurrently herewith.

What is claimed is:

1. Scanning apparatus comprising a cathode ray image dissector tube having a light sensitive electron emitting cathode, a target and an electrode having a plurality of spaced apertures therein through which electrons from said cathode may pass to reach said target, means for directing a light beam upon said cathode to illuminate in succession different areas of said cathode which may overlap in part, each area being illuminated a small section at a time and different sections in succession by moving the light beam to cause electrons emitted from different of said areas of said cathode to reach different apertures, respectively, in said electrode and means for deflecting the electron beam to compensate in part at least for the movement of said light beam so that electrons emitted from any section of a certain area of said cathode will pass through the corresponding aperture in said electrode.

2. An image dissector tube comprising a light sensitive cathode for emitting electrons in accordance with the illumination of elemental areas thereof, an anode, means for producing an electron image corresponding to an optical image focussed on said cathode, an electron multiplier comprising an aperture electrode having a plurality of spaced scanning apertures therein substantially in the plane of said electron image, a shielding electrode located between said aperture electrode and said cathode and having therein a plurality of apertures in alignment with said scanning apertures respectively, a plurality of multiplier electrodes, the first of which is in position to be bombarded by electrons passing through said scanning apertures, and means for deflecting the electron beam from said cathode to move said electron image with respect to said scanning apertures and to cause electrons from said cathode to

pass through different apertures in succession when different portions of said cathode are successively illuminated.

3. Scanning apparatus comprising a light sensitive cathode for emitting electrons in accordance with the illumination of elemental portions thereof, means for illuminating portions of a field of view in succession, means for directing light from the successively illuminated portions of the field of view upon said cathode to illuminate portions thereof in succession, an aperture electrode having a plurality of spaced scanning apertures therein through which electrons emitted from said cathode may pass, means for focussing the electrons from said cathode in the plane of said aperture electrode, and means for causing the electrons emitted from different elemental areas of said cathode to pass in succession through one of said scanning apertures and through different apertures during successive time intervals.

4. Apparatus for scanning continuously moving motion picture film comprising a cathode ray scanning device having a light sensitive cathode and an aperture electrode having a plurality of scanning apertures therein, means for projecting an optical image from said film to said cathode while said film is in motion, means for accelerating the electrons emitted from said cathode to produce an electron beam, means for focussing said electrons to produce substantially in the plane of said aperture electrode an electron image corresponding to the optical image produced on said cathode, means for causing said scanning apertures one at a time in succession to scan the electron image formed in said plane, said means comprising means for deflecting said electron beam, and means under control of electrons transmitted through said scanning apertures as the result of the scanning by said apertures successively of the electron image formed in said plane for producing an image current which may be used for controlling the production of television images corresponding to the pictures recorded on said motion picture film.

5. Apparatus for scanning motion picture film for television transmission comprising means for continuously moving the motion picture film at a substantially uniform rate, a cathode ray scanning device having a light sensitive cathode, means for projecting an optical image from said film to said cathode while said film is in motion, means for accelerating the electrons from said cathode to produce an electron beam, means for focussing said electrons to produce in a certain plane an electron image corresponding to the optical image produced on said cathode, said cathode ray device comprising an electrode substantially in said plane having a plurality of electron transmitting scanning apertures therein, means for deflecting said electron beam to cause a scanning aperture to scan elemental areas in succession of the electron image formed in said plane, means for shifting the electron image to different positions in said plane in succession to cause different scanning apertures in succession to scan the electron image, and means under control of electrons transmitted through said scanning apertures as the result of the scanning of the electron image by said apertures successively for producing an image current which may be used for controlling the production of television images corresponding to the pictures recorded on said motion picture film.

6. Apparatus for scanning continuously moving motion picture film so that each frame of the motion picture film is scanned a plurality of times comprising a light sensitive cathode and an aperture electrode having a plurality of scanning apertures therein, means for projecting an optical image from said film upon said cathode, means for accelerating the electrons emitted from said cathode to produce an electron beam, means for focussing said electrons to produce in the plane of said aperture electrode an electron image corresponding to said optical image, means for deflecting said electron beam in a direction substantially perpendicular to the direction of motion of the film to cause elemental areas in succession of the electron image to be scanned, means for deflecting the electron image in a direction substantially parallel to the direction of motion of the film to cause a frame of the film to be scanned in a period less than that in which a frame of the film moves past a fixed point, the scanning apertures in said electrode being so positioned that an electron image corresponding to a frame of the motion picture film is completely scanned at least two times in succession by different apertures, respectively, means for preventing electrons of said electron image from reaching more than one of said plurality of apertures at a time, and means under control of electrons transmitted through said scanning apertures as the result of the scanning of the electron image by said apertures successively for producing an image current which may be used for controlling the production of television images corresponding to the pictures recorded on said motion picture film.

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