July 16, 1935. J. A. BRIGGS 2,008,272

SCANNING SYSTEM FOR TELEVISION APPARATUS

Filed Jan. 16, 1932 2 Sheets-Sheet 1

Fig. 1

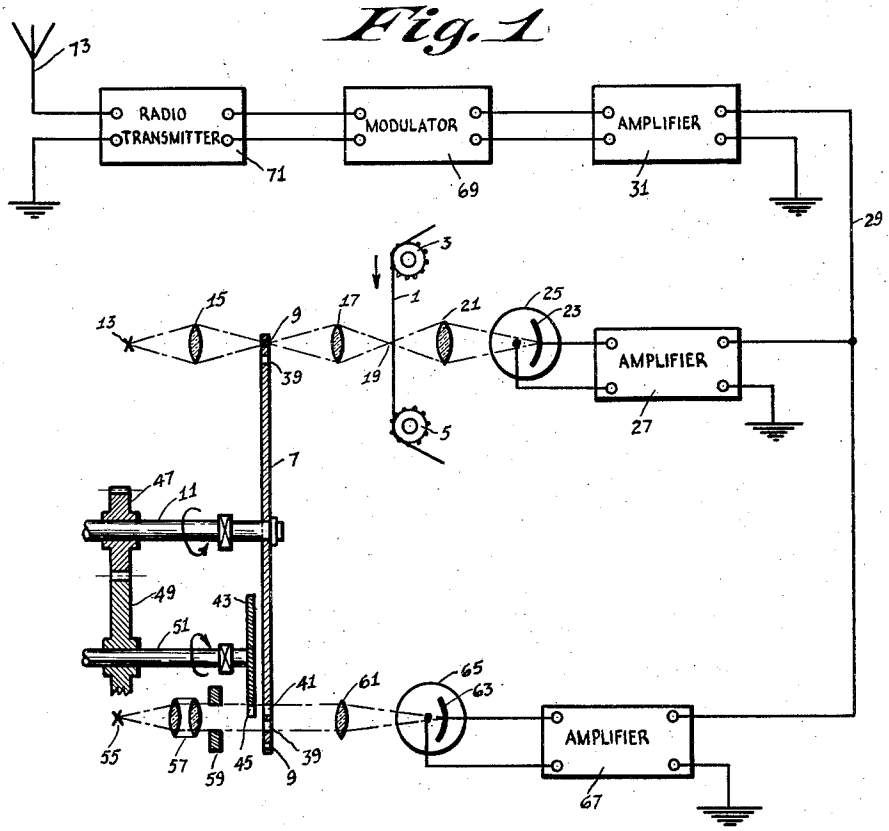
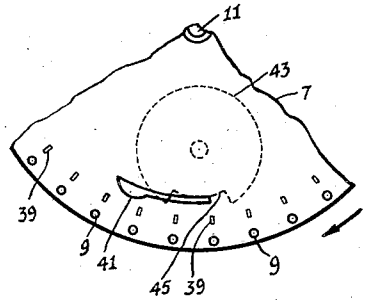


Fig. 2



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SCANNING SYSTEM FOR TELEVISION APPARATUS

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Fig. 3

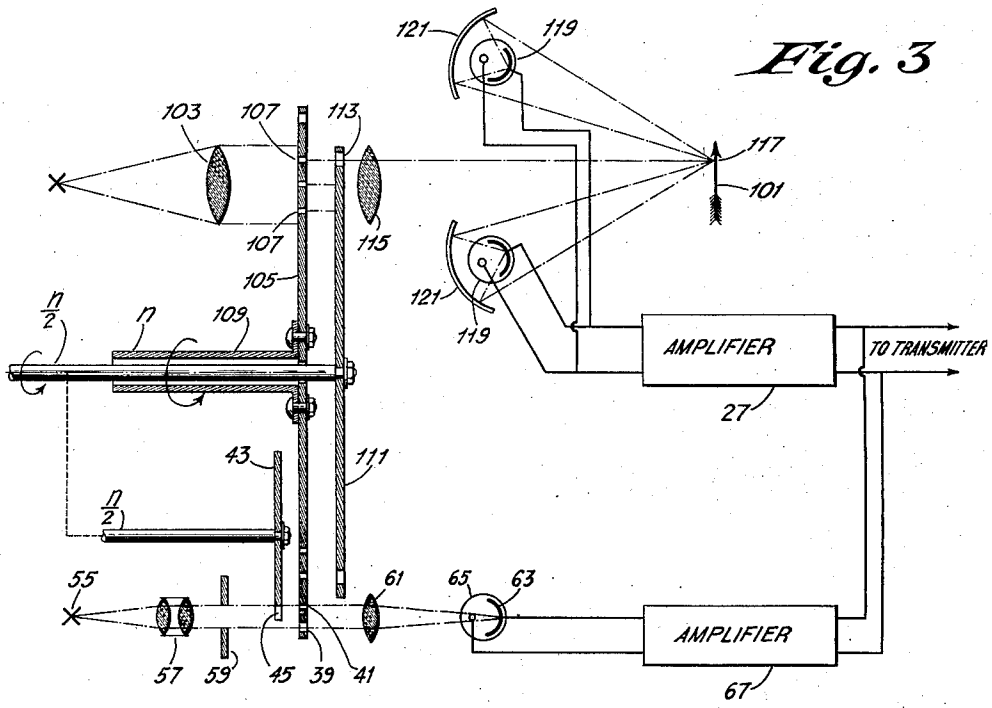
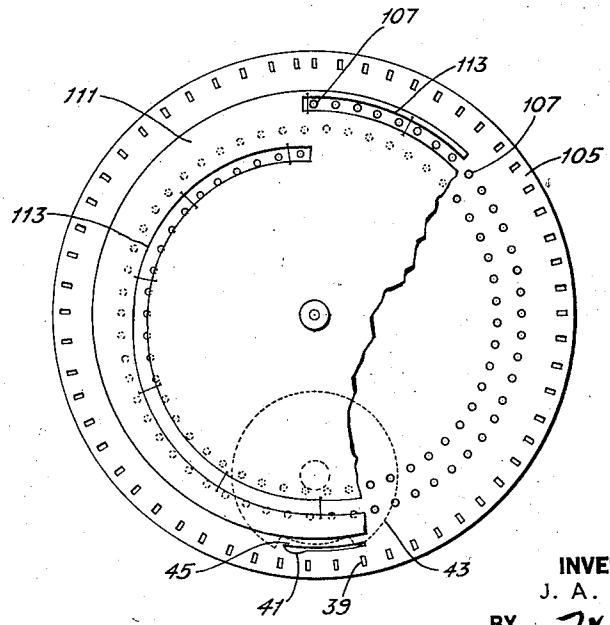


Fig. 4



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Patented July 16, 1935

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UNITED STATES PATENT OFFICE

2,008,272

SCANNING SYSTEM FOR TELEVISION APPARATUS

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Application January 16, 1932, Serial No. 587,006

3 Claims. (Cl. 178—69.5)

The present invention relates to television system and is directed principally to the transmitting end of the system, that is, to the means by which the subject, of which an image is to be transmitted, is scanned at the point of transmission, and the manner in which impulses, used at the points of reception of the transmitted image signals, may be generated to insure synchronous operation of the various receivers with the transmitter.

Various ways and means have already been suggested in the art for transmitting television images and motion picture film, but, for the most part, these systems, so far as I am aware, have not made provision for scanning the subject in a sufficiently large number of lines to insure sufficient detail in the transmission unless cumbersome and excessively large scanning elements are used to achieve the desired result.

When it is desired to transmit television images from motion picture film, it is preferable to use transmitter scanning systems of a type such that the film is advanced at a uniform and continuous rate during the scanning operation. This is desirable for many reasons, but one of the main points of advantage is that with continuously moving film it is possible to utilize substantially the entire time period of transmission for actually transmitting or sending records of intelligence from the transmitting point to the various points of reception. With systems known in the art using the so-called intermittent feed for the film, as is used in most motion picture projectors, the full utilization of the transmission time for sending intelligence is not attainable because it is necessary to interrupt the transmission following the scanning of each individual picture frame of the film during the time period when the film is intermittently advanced to present a new film frame before the scanning device. This time period of interruption in the intermittent film advance usually requires from fifteen to twenty-five percent of the total time available, so that to transmit any predetermined amount of detail in the picture the intermittent operation would require a frequency band of a width greater than that for the same amount of intelligence using constant feed film proportionate to the ratio of the transmission time periods available for each system.

It has already been suggested in connection with scanning objects or subjects of which an image is to be transmitted that the size of the scanning element, assuming this to be a rotary disk or drum or the equivalent, might be reduced by providing this scanning element with a plurality of continuous spiral tracks and then screening by means of a rotary shutter element all but one of these tracks at any instant, as has been disclosed by Ramsey Patent #1,602,121 of October 5, 1926. An arrangement of this general type is, of course, necessary where the scanning element itself must provide for the scanning in two directions, i. e., transverse to the subject and, at the same time, vertical of the subject. When motion picture film which is being advanced continuously and uniformly is to be scanned, it is well known from the prior art that it is unnecessary to arrange the scanning elements along a spiral path but, on the other hand, they must be arranged along a path upon the scanning element so that all scanning apertures or lenses or the equivalent are placed upon equal radii. Therefore, for continuously moving film, if it is desired to divide each motion picture film frame into one hundred and twenty elemental strips transverse to the film, for example, to correspond to one hundred and twenty lines of scanning per frame, it would be possible to have a scanning device with the scanning apertures or lenses arranged thereon on equal radii while at the same time providing only a relatively small number of apertures upon the scanning element. Thus, for example, the scanning element might be provided with thirty, forty, sixty or more or less apertures, assuming that the number of revolutions of the scanning element during the period when the film was uniformly and continuously advanced one picture frame corresponded to four, three and two revolutions, or a number of revolutions per film frame proportionate to the number of scanning apertures, and still the same result would be obtained as if a scanning element provided with one hundred and twenty apertures all arranged on equal radii were rotated relative to the film in such manner that the scanning element made one complete revolution during the time period within which the film was advanced one picture film frame.

Consequently, the present invention, as applied to motion picture film transmission, is directed to a scanning element having a lesser number of scanning apertures or lens elements than the number of lines or elemental strips into which the film picture frame is to be divided for the purpose of scanning. To illustrate a concrete example, it is assumed that the scanning element shown in the present invention shall include sixty scanning elements and that the film picture frames are to be divided into one hundred and

twenty elemental strips, so that the scanning element will make two complete revolutions during the time period required for the film to be advanced for one complete film picture frame, although these values are merely illustrative and the invention should not be regarded as limited to the number of scanning lines or to the number of separate scanning elements to produce the chosen number of scanning lines suggested.

In connection with the television transmission of film or other subjects, it is desirable that the transmitter send out signals which are to be received at all receiving points for indicating the instantaneous position of the transmitter relative to the subject, so that all receiving points may be synchronized properly with the transmitter. It has been proposed to provide for this transmission of the synchronizing pulsations of current by omitting, for example, two or three elemental areas of each line or elemental strip, into which the subject or film picture record is assumed to be divided, at one side of the picture record, and then, for example, to omit two or three complete lines of scanning from the bottom of the picture record. This being done, it is, of course, obvious that as the subject for transmission is scanned there will occur a transmission of signals representative of the light and shadow on elemental sections or areas of each elemental strip followed by a signal indication of position or synchronism, and then after a complete series of these signals has been transmitted, which would, according to the example above suggested, be signals corresponding to one hundred and twenty elemental strips, a second signal indicating the completion of the period of scanning a complete subject might be transmitted. This latter time period, it will be recognized, is really a slight loss in the utilization of the full transmission time available but is justifiable because the synchronizing signals are thus definitely separated from the image signals and because of the improvement resulting in the image reception due to positively synchronizing the received record with that transmitted.

In film transmission this period during which synchronizing signals are transmitted would usually be lost whether or not a synchronizing impulse is transmitted at the end of scanning a complete film picture frame or not. This loss would be because of the fact that the frame line separating successive picture portions of successive motion picture frames does not contain intelligence and yet the film at the frame line portion requires a certain time interval to pass before the scanning apparatus. Therefore, it is most convenient to use this otherwise unusable time period, which is effectively blank on the picture record, to provide for transmitting a synchronizing pulse.

As has been suggested in the copending application filed by Ray D. Kell as Serial No. 565,953 on September 30, 1931, a distinction is made between the type of signal transmitted at the end of each line of scanning and the signal transmitted at the end of scanning of each complete picture frame. The two types of signals may be identical in amplitude but different in time duration and in the steepness of the wave front, or may be of equal duration and different amplitude, so that by suitably arranging the receiving devices selection between the two types of signals may be provided. In order to provide for this same type of synchronizing signal separation and selection when using a multi-spiral scanning element or the type of motion picture film scanner hereinabove suggested, the apertures or the equivalent used to generate the synchronizing pulses to indicate horizontal and vertical synchronism are arranged in the same general manner as shown by the aforesaid Kell disclosure.

Since by the example illustrated above provision has been made for scanning one hundred and twenty elemental strips with a sixty element scanning device for film transmission or with a multi-spiral scanning device of two sixty element spiral turns for direct pickup purposes, it is seen that unless provision is made for screening the element used to generate the indication of vertical synchronism every second revolution of the scanning device an indication of vertical synchronism will interfere with the transmission of the picture record. To overcome this difficulty, a masking or shutter device has been used to screen in suitable manner the element used to generate the vertical synchronizing signal and to permit it to function only every second revolution of the scanning device. Thus, the element used to generate the vertical synchronizing signal will be screened after the scanning element has made one complete rotation but will be uncovered after two complete rotations, then again screened as the scanning element makes its third complete rotation but uncovered after four complete rotations, and so on until a complete transmission of the motion picture film or of a complete scene of action has been transmitted.

With the foregoing in mind, it is an object of the present invention to provide a scanning system for motion picture film adapted at the same time to function as an element for the production of indications of synchronism to accompany the picture record.

A still further object of the invention is to provide an arrangement wherein a reduced size scanning element may function both as a means for scanning or analyzing successive elemental picture areas of the subject or film record for transmission and, at the same time, serve as a means to control the production of signal indications of horizontal and vertical synchronism.

A further object of the invention is to provide a novel means for preventing indications of vertical framing or synchronism from occurring at points other than at the end of the transmission of a sufficient number of image signals to represent in the pre-established detail a complete representation of the subject or of each complete picture film frame.

Other objects of the invention are to provide a scanning device and a device for use in the production of synchronizing signals to accompany the picture signals which is relatively simple in its construction and arrangement of parts, a system which occupies a minimum amount of space, a system wherein the scanning and synchronizing signal producing means are coordinated and related in operation so as to maintain always the desired relative position of occurrence of each and to provide a system which is simple and easy to operate.

Still other and further objects of the invention will become apparent and at once suggest themselves to those skilled in the art to which this invention is directed from a reading of the following specification and claims in connection with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic illustration of one suitable form which the invention may assume when applied to film transmission;

Fig. 2 is a sectional view of the motion picture film scanning element and shutter element for cooperating therewith shown by Fig. 1;

Fig. 3 is a diagrammatic representation of the principles of the invention applied to the scanning of subjects other than film; and,

Fig. 4 represents the invention as applied to the multi-spiral Nipkow-type scanning element of Fig. 3.

To refer now to the drawings, and first to Figs. 1 and 2 thereof, the film subject 1 of which an electro-optical image is to be reproduced at the various points of reception is advanced uniformly and continuously by means of the sprocket wheels 3 and 5 which may be driven through suitable gearing, as disclosed in my copending application relating to television apparatus which was filed concurrently herewith as Serial No. 587,005, and is arranged to move immediately in front of a scanning element 7. The scanning element 7 is provided with a plurality of scanning apertures 9 extending completely around the circumference thereof and all arranged on equal radii, so that as the scanning element 7 is rotated in the direction shown by the arrow about the supporting shaft or spindle 11, these apertures will, when directing light from a light source 13 which is focused by means of an optical system 15 upon the apertures 9, trace by means of a focusing lens system 17 light spots 19 across elemental strips of the film record 1.

The light which passes beyond the film and which varies in intensity in accordance with the varying intensities of light and shadow on successive elemental areas of these elemental strips as explored by the passage of the light spot transversely to the film may then be focused by means of a lens element or optical system 21 upon the light sensitive electrode 23 of a photo tube 25. It is preferable to focus the light which passes beyond and through the film upon a particular point of the light sensitive element so that no unfaithful or exact responses will be produced from the photo tube due to possible variations or unevenness in the distribution of the photosensitive material upon the light sensitive electrode.

The minute photoelectric currents produced within the photo tube 25 by the varying intensities of illumination thereon may then be amplified in any suitable type of amplifying medium 27, and the resulting amplified currents are then supplied to a connecting line 29 from which these currents are fed to the line amplifier 31 which may also be of any suitable form and design.

The scanning element 7 is also provided with a plurality of apertures 39, each of equal size, which are also arranged circularly thereof and upon equal radii. The function of these apertures, as was disclosed in the aforementioned application of Ray D. Kell, is to produce at the end of the scanning period for each elemental strip an indication of the time when this elemental strip is scanned so as to produce the effect of horizontal synchronizing signals which may be used at the various points of reception to control the reproduction and synchronism of the receiving instrumentalities used to reconstruct the electro-optical image. The scanning element 7 is also provided with an elongated aperture 41 which is arranged to produce, in a manner which will become apparent from what hereinafter follows, an indication of the time of completing the scanning of each individual picture frame and the resulting signal which is produced at this time may then be utilized at the various points of reception to frame properly the picture or electro-optical image produced.

As was hereinabove suggested, it is desirable to have the number of scanning apertures on the scanning element of a number less than the number which would correspond to the lines or paths into which each film frame is assumed to be divided and, therefore, to scan each complete film frame more than one rotation of the scanning element is necessary. In order to prevent the aperture 41 used to indicate vertical framing from functioning at times other than a time when a complete motion picture film frame has been scanned, a shutter element 43 has been provided immediately adjacent the scanning element 7. This shutter disk or element is provided with a slot 45 which is arranged to uncover at suitable time intervals a synchronizing aperture 41 while at other times block or mask the aperture 41. As can be seen from the drawings, and especially Fig. 2 thereof, the aperture 41 which is used to produce the indication of vertical framing or synchronism is arranged a slight distance inwardly of the scanning element from the apertures 39 used to indicate horizontal synchronism, so that all that will be necessary in order to mask or screen the aperture 41 without masking the apertures 39 is a disk or screen element 43 which extends outwardly of the scanning element from a distance only as far as the outer edge of the aperture or slot 41.

If it is assumed now that each film frame is divided into one hundred and twenty elemental strips and assumed that the scanning element 7 is provided with only sixty scanning apertures 9, then it is clear that the scanning element must rotate twice during the time that a single picture frame of the film 1 passes in front of the point 19 where the light from the source 13 passing through the scanning apertures 9 is focused. Consequently, since it is desirable to transmit only a single indication of vertical framing or synchronism during the time that one hundred and twenty elemental strips of the picture film have been scanned, it will be necessary to rotate the screen disk 43 only half as fast as the scaning element. To accomplish this result a suitable gearing arrangement, such as has been herein indicated conventionally, has been provided so that the small gear wheel 47 secured rigidly to the shaft 11 driving the disk is arranged to rotate a larger gear wheel 49 which is secured rigidly to the shaft or spindle 51 upon which the masking or screening disk 43 is supported. Thus, if the gear ratio is designed for a two to one reduction in speed, the shutter or screen disk 43 will rotate only half as fast as the scanning disk or element 7.

To generate the horizontal and vertical indication of synchronism, light from any suitable source 55 is projected through an optical system 57 and screened by a diaphragm 59 so as to be projected along a path which will include only the width between the outside of the apertures 39 and the inside of the aperture 41, and the light which passes through these apertures may then be focused by means of a lens element 61 or the equivalent upon the light sensitive electrode 63 of the photo tube 65 in the manner above explained. From this it is seen that by designing the diaphragm 59 of suitable height and width, the time period during which the light

from the source 55 may activate the photo tube 65 is limited to the time period required for the slot 41 or the apertures 39 to pass before a light beam of a width equal to the width of one of the synchronizing apertures 39, and, further, it is apparent that due to the slot 41 being elongated light will pass through the slot at every second revolution of the scanning element for a time period corresponding, as shown by the drawings, to a time required to scan three picture lines, but after one complete rotation of the scanning element the slot or aperture 41 will not be uncovered because the slot 45 of the shutter or screening disk 43 is now at the top position or advanced through an angle of one hundred and eighty degrees and thus it requires two complete rotations of the disk or element 7 to uncover the slot 41, whereas the apertures 39 are uncovered and pass light to the photo tube 65 after each elemental strip of the picture film 1 is explored or analyzed.

As was suggested in copending application Serial No. 544,959, filed June 17, 1931, by A. W. Vance, it is desirable to have the indications of synchronism one hundred and eighty degrees out-of-phase with the picture signal indications, so that if the receiving systems used to reconstruct the electro-optical image of the picture film are cathode ray tubes the effect of the synchronizing pulse on the tube will be to cause extinction of the light spot on the fluorescent screen of the tube, and thus prevent any observable effects during the reversal of the cathode ray stream necessary for unilateral or one-way scanning. Therefore, the photo tube amplifier 67 which is used to amplify the currents produced within the photo tube 65 is provided with one less or one more stage of amplification than the photo tube amplifier 27 which produces a phase shift in the signals from both photo amplifiers of one hundred and eighty electrical degrees, so that when the output energy from the photo tube amplifier 67 is connected with the supply conductor 29 to the line amplifier 31 there will be produced therein signal indications corresponding both to white and to black where it is assumed, for example, that the picture signals produce white indications and the synchronizing signals produce black indications. The output energy of the amplifier 31 may then be supplied to the modulator 69 and then to a radio transmitter 71 and from the transmitter 71 signals are distributed to various points of reception by transmission from the antenna 73. Of course, it is within the scope of the present invention to utilize, where desired, wire line or network transmission of the resulting picture and synchronizing signals, and while a radio system of transmission has been suggested, it is obvious that any other desired form might be substituted.

Furthermore, it is, of course, to be recognized that it is, as above suggested, within the scope of the present invention to provide a system wherein the number of complete revolutions of the scanning element relative to the shutter or screen element is greater than two, and which may be, for example, three, four or five or more complete revolutions.

In order to frame properly the picture record or film 1 with the scanning element, so that the picture film frame will be in a position such that the aperture 41 used to indicate vertical framing or synchronism will pass in front of the light source 55 at the exact time when a picture film frame has been scanned, it is to be understood that recourse may be had to my aforesaid copending application, wherein was disclosed a method of adjusting an impedance roller used to advance the film so as to position the film in any desired frame relationship relative to the film gate (not shown herein) through which the film is passing during the periods of exploration.

By the form in which the invention is shown in Figs. 3 and 4, provision has been made for scanning a subject of which an electro-optical image is to be produced at the various points of reception by a scanning element which provides, itself, for two directions of scanning, that is, both horizontally and vertically of the subject.

To refer now to Figs. 3 and 4, the subject for transmission 101 is illuminated by the source of light 13 projected through an optical system 103 which spreads the beam of light to a width corresponding to the height of the scanning apertures or lenses, or the equivalent, arranged on the scanning element 105. These scanning apertures or the like 107 are arranged along spiral paths, according to the teachings of Nipkow, but extend about the disk or drum for a plurality of turns. In the example shown, these apertures extend for two complete turns and thus, of course, it is possible to increase the height of the scanning area materially without increasing the diameter of the scanning element.

As was shown by the Ramsey Patent, #1,602,121, above mentioned, the scanning element 105 may be rotated about a shaft 109, and then rotating upon a shaft or spindle coaxially therewith is a shutter or screen disk, or the equivalent, 111. The shutter or screening disk 111 is provided with a single spiral path 113 which assumes the form of a wide slot of a width at least as great or greater than the height of two adjacent scanning apertures. If now the scanning element 105 is rotated at a speed n, so as to permit light from the source 13 as directed through the optical system 103 to pass through these apertures 107, it is seen that if the screening or shutter element 111 is positioned correctly with respect to the scanning element 105 at the start of the scanning operation that light from the source will pass through a single scanning element only if the shutter or screening element 111 is rotating in the same direction as the scanning element but at a speed equal to

$$\frac{n}{2}$$

With this type of scanning system, the light which is passed through the scanning element 105 and the screening element 111 may then be directed by means of an optical system 115 toward a spot 117 on the subject 101 of which the electro-optical image is to be transmitted.

In accordance with the varying intensities of light and shadow on successive elemental areas 117 of the subject 101 varying amounts of light are reflected from the subject 101 and these varying amounts of reflected light may then be directed upon the photoelectric light translating elements 119 by means of the collecting reflecting devices 121 which are preferably in the nature of parabolic reflectors having their focus point on the light sensitive element of the photoelectric devices 119.

In accordance with the illumination upon the photoelectric light translating elements 119, which have their outputs connected in parallel, varying currents flow in the output circuits. These currents may be amplified in any suitable

manner by the amplifying system 27 and then directed to a transmitter in the manner disclosed by Fig. 1.

In a manner similar to that disclosed by the film transmitting scanner of Fig. 1, the scanning element 105, corresponding to the scanning element 7 of Fig. 1, is provided with apertures or slots 39 about the periphery thereof which serve to generate signal indications representative of the time when each transverse elemental strip of the subject 111 has been scanned. Similarly, the scanning element 105 is provided with a slot-like aperture 41 similar to the aperture 41 of Fig. 2, which is for the purpose of producing a vertical framing signal to indicate the completion of each time period of scanning the subject. Since it is necessary to transmit this signal only upon the completion of two rotations of the scanning element 105, assuming that there are two spiral turns on the scanning element, a screening disk 43 has also been provided. This disk, as was shown by Fig. 1, rotates at a speed equal to

$$\frac{n}{2},$$

where n is the speed of rotation of the scanning element.

Consequently, after the completion of each transverse elemental strip of picture, the width of which may be determined by any suitable mask or diaphragm, the light from the source 55, as directed through the optical system 57 and limited as to area in both a vertical and horizontal plane by the diaphragm 59, is projected through the apertures 39 and 41 of the scanning element 105 each time these scanning elements pass within the field of illumination of the light source 55 as limited by the diaphragm 59. In accordance with the time period when light from the source 55 is projected through the apertures of the scanning element 105 this light is then directed by means of the optical system 61 to fall upon the light sensitive electrode 63 of the photoelectric translating element 65. As was shown and explained in connection with Fig. 1, these currents generated in the photoelectric element 65 are then amplified in any suitable manner by the amplifier 67 and are 180 degrees out-of-phase with respect to the signals amplified by the amplifier 27. These amplified output signals from the amplifier 67 may then be combined with the amplified signals from the amplifier 27 and directed to the transmitter in a manner similar to that shown by Fig. 1.

While the invention of the form suggested by Figs. 3 and 4 has been illustrated in connection with a screening element having only a single spiral turn, having a spiral width equal to the combined width of both spirals of the scanning element, it is nevertheless to be understood that a small eccentrically mounted screening element may be substituted without involving any change in the spirit or scope of this application. Such a screening element might be in the nature of a small shutter or screening disk of about the size shown by the disk 43 but provided with several spiral slots which extend inwardly from the periphery thereof and serve, when the screen disk is rotated at a suitable speed, to permit the light from the source 13 to pass at any instant through a single aperture of the scanning element only. Such a screening disk would, of course, be rotated at reduced speed from that of the scanning element in a manner well known in the art.

Also, it is apparent that in cases where it is not desirable to transmit the indication of vertical synchronism or framing at the time of completion of each scanning of the subject but to transmit this signal only after several complete scannings the shutter or screen disk of each type of apparatus herein shown may be operated at still further reduced speed from that of the scanning element. That is, for example, if the vertical synchronizing or framing indication is desired only after three complete picture scannings, the shutter or screen disk 43, when operating in conjunction with the scanning devices 7 or 105 might turn one-sixth as fast as the scanning element or at a speed

$$\frac{n}{6}$$

Of course, other speeds to coordinate the time period of the production of this signal indication with the time of completion of still different numbers of pictures would be used where desired.

Also it is to be understood that a pair of photoelectric tubes parallelly connected may be used to produce the signal indications used to synchronize the receiving apparatus reproducing electro-optical images of the subject scanned. Under such conditions one photoelectric tube will be adapted to produce the horizontal synchronizing current impulse and the other parallelly connected photoelectric tube will be adapted to produce the vertical synchronizing or framing current impulse. So arranged, the use of the shutter element or screen 43 might be avoided by a switch arranged to connect the photoelectric tube, used to reproduce the vertical synchronizing or framing signals, with the amplifier 67 only at such times as the scanning element 7 or 105 had turned through an angle (720 degrees as shown) sufficient to scan a complete subject. It is, of course, clear that when using this suggested form of the system, it would be possible to rotate the scanning element through any suitable angle and then produce the synchronizing impulse, so that the angular rotation suggested is intended to be regarded as illustrative only and in no sense limited to any particular angular movement.

It is to be understood that while the present disclosure does not suggest any arrangement by which the sound accompaniment on the usual motion picture film may be transmitted, it is nevertheless understood that this sound record may be translated from the picture film and transmitted to the various points of reception in any manner known in the art without departing from the spirit and scope of the present invention.

Also, it is equally within the scope of the present invention to provide for the simultaneous sound accompaniment in the studio type of scanning arrangement shown by Figs. 3 and 4.

The invention has herein been shown in only two of a great number of forms and embodiments which it may assume, and it will, of course, be obvious to those skilled in the art to which the invention relates that many modifications and changes may be made without departing from the spirit and scope of this disclosure.

I, therefore, believe that I am entitled to make and use any and all of these modifications pro-

vided they fall fairly within the spirit and scope of the hereinafter appended claims.

Having now described my invention, what is claimed and desired to protect by Letters Patent is the following:—

1. In television apparatus a rotary scanning element having a plurality of scanning apertures arranged about the periphery thereof at equal distances from the center of rotation and a plurality of apertures used for synchronizing also arranged about the periphery thereof and positioned on equal radii, and an elongated aperture adjacent said synchronizing apertures and extending over an arc of the element at least the arcuate distance of a pair of adjacent synchronizing apertures, means for directing light beams through said scanning and synchronizing apertures at substantially diametrically opposite points thereon, means for causing the scanning element to rotate so as to trace through each scanning aperture predetermined paths of light across a subject of which an electro-optical image is to be reproduced, means for causing light of unvaried intensity to produce a signal indication of the time of completion of each individual scanning path and normally to produce a signal indication of the time of completion of each rotation of the scanning element, and independent means for limiting the production of said last named signal indications to predetermined time periods.

2. A scanning system for television apparatus or the like comprising a rotary element provided with a plurality of apertures arranged upon a plurality of continuous spiral paths, means for producing the light of constant intensity and directing said light through successive apertures of said spiral paths so that after a predetermined plurality of rotations of said scanning element the complete area of a subject, of which an image is to be reproduced, is scanned, means for limiting the effect of illumination of said subject to a single aperture of said scanning element only at any instant, a plurality of synchronizing apertures also arranged about the periphery of said scanning element and positioned on equal radii and a slot for producing an indication of vertical synchronism also positioned on said scanning element, means for projecting light of constant intensity through said synchronizing apertures and said synchronizing slot to produce signal indications of predetermined strength to designate the instantaneous positions of said scanning element, and means for limiting the production of synchronizing indications of vertical synchronism to a single occurrence during the number of revolutions required for each complete scanning of the subject.

3. A scanning system for television apparatus or the like comprising a rotary scanning element provided with a plurality of apertures arranged upon a continuous circular path, a subject for transmission, means for moving the subject at uniform speed continuously relative to said rotary element, means for producing the light of constant intensity and directing said light through successive apertures of said path so that after a predetermined plurality of rotations of said scanning element a complete area of the subject, of which an image is to be reproduced, is scanned, said scanning element also having a synchronizing slot arranged as a part thereof, means for projecting light of constant intensity through said synchronizing slot to produce a signal indication of predetermined strength to designate upon the passage of light through said slot the completion of each rotation of said scanning element, and means for limiting the production of said signal indication to a single occurrence during the number of revolutions of said scanning element required for each complete scanning of the subject.

JOSEPH A. BRIGGS.