Aug. 23, 1938. R. L. DAVIS 2,128,078

TELEVISION SYSTEM

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Fig. 1.

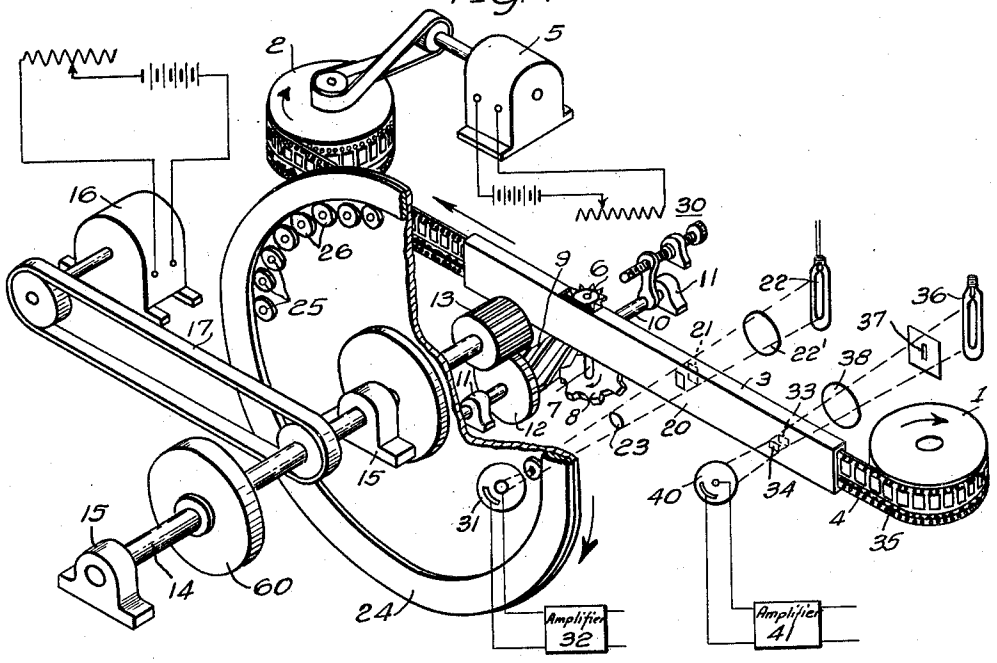


Fig. 2.

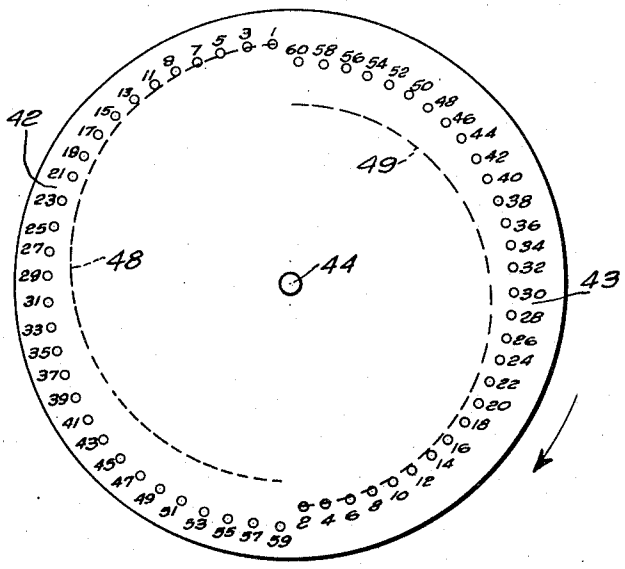
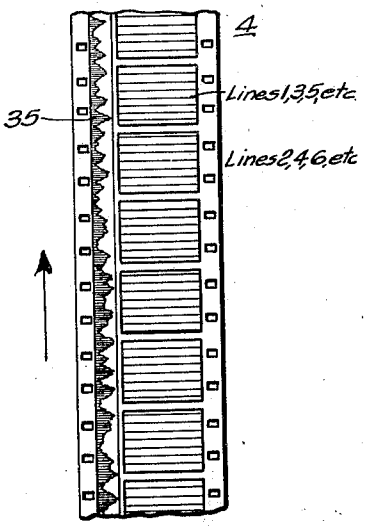


Fig. 3.



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TELEVISION SYSTEM

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Fig. 4.

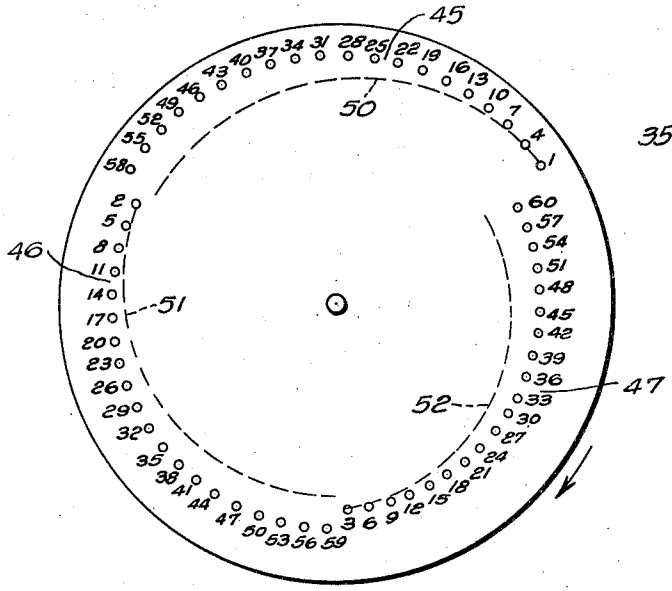


Fig. 5.

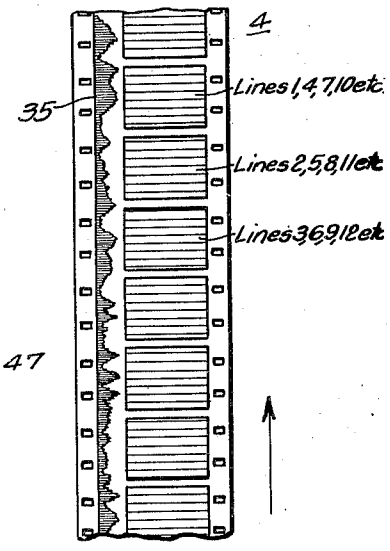
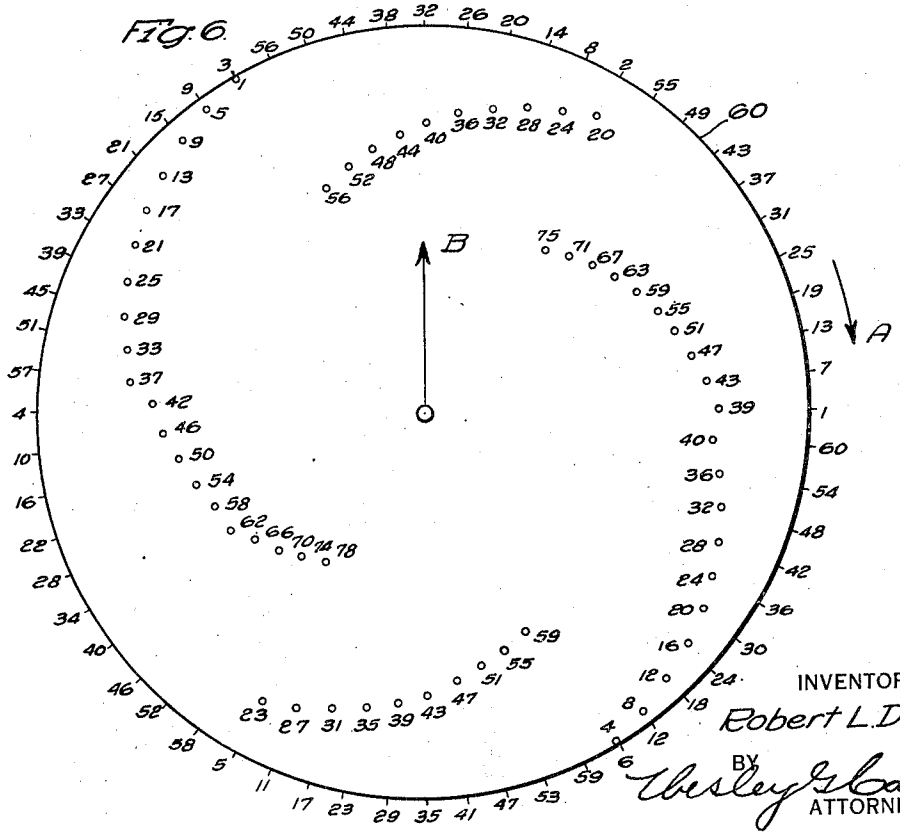


Fig. 6.



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UNITED STATES PATENT OFFICE

2,128,078

TELEVISION SYSTEM

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Application March 6, 1929, Serial No. 344,788

28 Claims. (Cl. 178—5.6)

My invention relates, broadly, to television systems and it has particular relation to the electrical reproduction, at a distance, of printed or written messages, moving pictures, combined sound and picture films, and the like.

A system of the general type to which my invention pertains is exemplified in the copending application of Frank Conrad, Serial No. 334,413, filed Jan. 23, 1929, now Patent No. 1,853,661, granted April 12, 1932, and assigned to the Westinghouse Electric and Manufacturing Company, wherein is disclosed a film transmitting device comprising means for causing a film to advance, at a constant speed, between a light source and a photo-electric cell, and means, constituted by a rotatable disc having a peripheral series of 60 perforations, interposed between the film and the photo-electric cell, for scanning the moving film.

In apparatus constructed according to the Conrad application the rate of advance of the film is so correlated to the peripheral speed of the scanning disc that a single "frame" of the film is scanned at each revolution of the said disc. Satisfactory moving pictures may be transmitted if sixteen frames are scanned per second although, even at this relatively low rate, the frequency-band necessary for radio, or wired-radio transmission is 60 k. c. wide unless single side band transmission is used, which is not likely, the frequencies generated by the sixty line scanning per frame ranging from 16 per second to approximately 30,000 per second.

In the event that it is desired to transmit a combined sound and picture film, of the type now generally being utilized in "talking movies," wherein the sound is photographically recorded upon one of the margins of the film, it is found that the sounds can be much more satisfactorily reproduced if the film-speed is increased to twenty-four, thirty-two, or more frames per second. Such increase in the speed of film travel, if each frame is scanned by sixty lines, however, greatly increases the difficulty of transmitting the pictures since much higher frequencies must be handled by the amplifiers associated with the transmitting and receiving stations, and the frequency-band necessary for transmission is unduly widened.

It is, accordingly, an object of my invention to provide a television system whereby a motion picture film, or the like may be electrically transmitted to a plurality of receiving stations at a much higher rate of speed than has hereto been attainable.

Another object of my invention is to provide a television system whereby a talking motion picture film may be transmitted to a plurality of receiving stations, whereat the picture and the sounds may be reproduced in synchronism, or a duplicate film may be made by photographic processes.

Another, and more specific, object of my invention is to provide a scanning-disc of an improved type.

In practicing my invention, I provide means for moving a continuous film, or the like at a constant rate of speed between a fixed light source and a photoelectric cell.

The longitudinal component of the scanning operation is furnished by the movement of the film. The transverse component is introduced by interposing a scanning disc, provided with a plurality of small openings, between the moving and the photoelectric cell, the disc being supported for rotation in a plane parallel to the plane of the moving film.

The rate of travel of the moving film is so correlated to the angular velocity of the scanning disc that two or more frames pass between the light source and the photoelectric cell per revolution of the disc or before repetition of the scanning order. If the ratio of frames to disc-revolutions is two to one each individual frame, however, is not scanned by sixty lines, as is disclosed in the forementioned Conrad application, but is scanned by thirty lines only, the openings in the disc being so disposed that the scanning lines on one frame lie intermediate the scanning lines on the frame immediately preceding it.

The ratio between the film velocity and the angular velocity of the disc, as well as the total number of scanning lines and the number of scanning lines per frame, have been given merely by way of example, the essential features of my invention being broadly concerned in the partial scanning of successive frames instead of the complete scanning of each frame, and not being restricted to the specific number of scanning lines nor the specific velocity-ratio between the film and the disc referred to.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment, when read in connection with the accompanying drawings, wherein:

Fig. 1 is a diagrammatic view, partly in per-

spective, of a portion of the apparatus and circuit connections constituting a television transmitter of the type to which my invention pertains.

Fig. 2 is a view, in elevation, of a scanning disc constructed according to my invention.

Fig. 3 is a view of a portion of a combined sound and picture film to which reference will later be made in the description of the scanning disc illustrated in Fig. 1,

Fig. 4 is a view, in elevation, of a scanning disc constructed according to my invention.

Fig. 5 is a view of a portion of a combined sound and picture film to which reference will later be made in the description of the scanning disc illustrated in Fig. 4.

Fig. 6 is a view, in elevation of a scanning disc constructed according to my invention.

The apparatus illustrated in Fig. 1 of the drawings comprises a storage reel 1, a take-up reel 2, a guiding device 3 for supporting a film or web 4, and a motor 5 for applying power to the take-up reel. The film is also given motion longitudinally thereof by a rotating sprocket wheel 6, the teeth of which engage marginal perforations in the film. The sprocket wheel 6 is mounted upon a shaft 7 to which is affixed a spiral gear wheel 8 that meshes with a spiral gear wheel 9 mounted upon a countershaft 10 rotatably supported in suitable bearings 11.

A gear wheel 12 is also affixed to the countershaft, which gear wheel meshes with a relatively long gear wheel 13 that is affixed to the end of a main shaft 14 which extends parallel to the countershaft and is rotatably supported between a plurality of bearings 15.

Motive power is applied to the main shaft by a suitable constant-speed motor 16, preferably through a belt 17.

The guide 3, through which the film travels, is provided with a plurality of oppositely disposed transverse openings 20 and 21. Light from a source 22 is focused, by a lens 22', on the opening 21 to brightly illuminate an element of the film as it travels past the opening in the direction of the arrow. An image of the illuminated portion of the film is formed, by lens 23, upon the face of a disc 24 that is mounted upon the main shaft 14 between the bearing 15 and the elongated gear wheel 13.

The disc is provided with a plurality of small square, or sector-shape openings 25 disposed in circular or spiral paths as will hereinafter be described more in detail, the said disc being so positioned that each of the openings is caused to traverse the film-element image where it falls upon the face of the disc. The individual openings 25 are preferably formed in small discs 26 that overlie larger openings (not visible) in the disc itself, and are affixed to the disc in any convenient way.

The countershaft 10 is slidably supported in the bearings 11 and an adjusting device 30 is provided whereby the shaft may be moved slightly in an axial direction. Such axial movement of the countershaft, inasmuch as the said shaft is prevented from rotating by the engagement of the gear wheels 12 and 13, causes the spiral gear wheel 8, to rotate slightly in the one or the other direction, depending upon the direction in which the shaft is moved. The rotation of the spiral gear wheel causes the film-engaging sprocket 6 to move the film slightly forward or back, without interrupting the constant advance thereof, in the direction of the arrow, to properly adjust the relation between the film and the openings in the disc.

A photoelectric cell 31, preferably of a type that has substantially zero time-lag, is mounted rearwardly of the scanning disc 24, and is connected to the input terminals of an amplifier 32. The amplifier, which preferably comprises a plurality of thermionic tubes, should be capable of amplifying a wide range of frequencies. Amplifiers of the necessary type are familiar to those skilled in the art and need not be described in detail.

The manner in which the output-currents from the amplifier may be utilized to control a radio transmitter, or a transmitter of any other desired type, forms no part of the present invention, being already familiar to those skilled in the art.

The guiding device 3 is further provided with a plurality of oppositely disposed small openings 33 and 34, between which the photographic sound-track 35 on the film is visible. Light from a source 36 after passing through a slot 37, is focused, by a lens 38, on the sound-track as a fine line. An image of the illuminated portion of the sound-track falls upon a photoelectric cell 40 that is disposed adjacent to the opening 34 in the guiding device, thus causing the output current from the said cell to vary in accordance with the character of the sound-track. An amplifier 41 is associated with the photoelectric cell 40, and the currents, after amplification, may be utilized for controlling a radio transmitter in any well known manner.

In the transmitting apparatus shown and described in the aforementioned Conrad application, the openings 25 in the scanning disc are disposed in a single circular path that is concentric with the axis of rotation of the disc. The total number of the openings substantially corresponds to the number of scanning lines per frame of the film sixty openings being mentioned as being sufficient for ordinary purposes.

It will be noted, from an inspection of Fig. 1, that the film travels diametrically across the face of the disc, the countershaft 10 being offset downwardly to permit placing of the guiding device in the proper position. It is thus evident that, if the film travels, in the direction of the arrow, at a speed such that it is advanced a distance approximately equal to the length of one "frame" during the time it takes the disc to make one complete revolution, each successive opening in the disc will trace a transverse line across the image of the illuminated portion of the film and that each frame, therefore, will be traced by as many lines as there are openings.

Each scanning line, accordingly, gives rise to fluctuations in the output current from the photoelectric cell 31, the frequencies involved in the fluctuations ranging from 16 cycles to a maximum of 30,000 cycles, neglecting harmonics, when the film is caused to travel at a speed of approximately sixteen frames per second. The frequency-band, therefore, covered by the radio, or carrier current transmitter for the minimum number of frames per second necessary to satisfactorily transmit a motion picture film, is of the order of 60 kilocycles, unless one side-band is suppressed.

If the film speed is increased, in order that more satisfactory sound transmission may be attained, the angular velocity of the scanning disc must also be proportionately increased to retain the sixty line per frame scanning. Any increase in the speed at which the scanning open-

ings in the disc across the film, however, results in raising the upper limit of the frequency-range involved in transmitting the pictures, thus causing a widening of the frequency-band covered by the radio, or carrier current. For example, if the film speed and the angular velocity of the disc are both doubled, the amplifiers associated with the photoelectric cell must handle frequencies from 32 cycles to 60,000 cycles, while the band covered in the radio transmission of the pictures is of the order of 120 kilocycles wide.

Both of these consequences of increased film speed are undesirable and it is a further object of my invention to provide means whereby a combined sound and picture film may be caused to travel through television transmitting apparatus, of the general type of the apparatus shown in Fig. 1, at higher speeds than have heretofore proved practical, without increasing the speed at which the individual scanning openings in the disc traverse the several picture frames of the film.

Assume, for purposes of explanation, that it is desired to "televise" a combined sound and picture film that has been photographed at a speed of thirty-two frames per second. Obviously, in such a film, the change in the appearance of four successive frames is the same as the change between two successive frames if the film had been photographed at a speed of sixteen frames per second, and the change between two frames is substantially imperceptible. I have, accordingly, found that it is unnecessary to scan each successive frame of the higher speed film by the total number of scanning lines desirable for normal speed films and, instead, I have discovered that entirely satisfactory results may be obtained by so correlating the spacing of the scanning openings, the speed of the disc, and the speed of the film that, in the specific example chosen, each frame of the higher speed film is scanned by only thirty lines.

The manner in which the higher speed film is satisfactorily scanned without increasing the angular velocity of the scanning disc will be made clear from an inspection of Figs. 2 and 3 of the drawings, wherein Fig. 3 is a view of a portion of a combined sound and picture film that has been photographed at a speed of thirty-two frames per second.

The scanning disc illustrated in Fig. 2 is provided with two series of 30 openings each that are disposed semi-circular paths **42** and **43** concentric with the axis **44** of the disc. The openings are equally spaced around the disc, and the distances of the said paths from the axis of the disc differ by the width of one scanning line on a picture frame or, more accurately, by one sixtieth of the distance between the centers of the spaces bounding a single frame of the film.

The scanning openings 1, 3, 5, 7, etc., therefore trace 30 double spaced scanning lines across a single frame, if the film advances two frames per revolution of the disc while the openings 2, 4, 6, 8, etc., trace intermediate lines across the next successive frame, as shown in Fig. 3. The angular velocity of the disc, however, is no greater than it is when sixteen frames per second are scanned by sixty lines each, as previously explained, and the range of frequencies developed in the photoelectric cell output current is no greater than in the case of normal-speed film.

It also lies within the scope of my invention to provide the disc shown in Fig. 2 with two spiral series of thirty openings each, the relative speed of the film and the spacing of the openings in the spirals being such that one half of one frame is scanned by the first spiral, while the second half of the second frame is scanned by the second spiral, each spiral tracing thirty closely spaced lines on the frame, rather than thirty widely spaced lines, as described in connection with the said figure. Or, as a still further modification, the disc may be provided with a single spiral covering 360 degrees, the spacing of the holes being such that each alternate frame of a film is skipped when the said film is caused to pass through the device at the rate of two frames per revolution of the disc.

An ordinary scanning disc having a single spiral series of openings, of the type now well known to those skilled in the art, may be used in receiving pictures transmitted from stations wherein discs of the last above mentioned types are employed in the transmitters.

If it is desired to apply the principle underlying my invention to the transmission of combined sound and picture films, or to picture films alone, or the like, that necessitate still higher rates of travel through the transmitting apparatus, still further modifications of the scanning disc are possible.

For example, a disc, such as that shown in Fig. 4, provided with three series of 20 openings each that are disposed along circular paths **45**, **46** and **47**, may be utilized to scan, at normal speed, a film that has been photographed at the rate of forty-eight frames per second. In such event the openings in series **45** trace triple-spaced lines across a frame of the film, the openings in series **46** trace similar triple-spaced lines across the next frame, and the openings in series **47** trace another group of triple-spaced lines across the third frame, as clearly indicated in Fig. 5, the lines in the three frames being complementary and, together, constituting the equivalent of tracing a single frame by sixty lines. The scanning rate, however, of each individual opening, is no greater than it is in apparatus constructed according to the modification illustrated in Figs. 3 and 4, thus restricting the frequencies involved to the normal range.

I have chosen film-speeds of sixteen, thirty-two and forty-eight frames per second, sixteen revolutions per second of the scanning discs, and a total of 60 openings, merely by way of example, since it is impracticable to describe, in detail, the substantially infinite number of combinations capable of being utilized.

For example, the discs may be made sufficiently large, and may be supplied with a sufficient number of series of scanning openings, that the equivalent of more than one complete scanning of a picture frame may be obtained per each revolution. In particular, the disc shown in Fig. 2 may be provided with four groups of openings of thirty each, disposed in segmental circular paths, two of the paths being disposed diametrically opposite to each other on a circle of given diameter and the remaining paths being disposed intermediate the first mentioned paths and on a circle that is one scanning line less in radius than the first mentioned circle. In such event, the angular velocity of the disc may be cut in half.

To satisfactorily receive the pictures transmitted from a station comprising a scanning disc such as that illustrated in Fig. 2 a scanning disc

rotating in synchronism with the transmitting disc must be employed, together with a variable light source, appropriate amplifiers, and other apparatus so well known to those skilled in the art that no illustration or explanation is necessary. The openings in the receiving disc, however, should be spirally disposed, as indicated by the dotted line spirals **48** and **49** in Fig. 2, in order that the vertical component of the scanning operation which, at the transmitting station, is supplied by the motion of the film, may be introduced.

The receiving discs for use in systems utilizing transmitting discs of the type shown in Fig. 4 should be supplied with spiral series of openings, as indicated by the dotted spirals **50**, **51** and **52** in the said figure.

During the course of numerous experiments with scanning systems of the type so far described I have noticed that the brilliancy of the received picture has a slight tendency to flutter, particularly when transmitting film that has been photographed at twenty-four pictures per second at a scanning rate of twelve pictures per second by half-speed scanning systems utilizing discs of the type shown in Fig. 2. By using a scanning disc of a modified type, however, wherein each semicircular series of scanning openings is replaced by a plurality of spirally disposed series of openings, each frame of the picture is partially scanned oftener, and the light-flutter at the receiving station is accordingly reduced.

The spirals may be so disposed that the scanning lines traced by the outermost hole of each spiral lie in consecutive order on each frame, or the order of the spirals may be so chosen that the scanning lines do not follow consecutively. For example, if three spirals are utilized instead of the series **42** in Fig. 2, and three spirals instead of the series **43** in the same figure, the first three spirals may be scanning lines 1, 7, 13, 19, 25, 31, 37, 43, 49, 55; 2, 8, 14, 20, 26, 32, 38, 44, 50 and 3, 9, 15, 21, 27, 33, 39, 45, 51, 57, respectively, of the first picture frame, while the second series of three spirals may be scan lines 4, 10, 16, 22, 28, 34, 40, 46, 52, 58; 5, 11, 17, 23, 29, 35, 41, 47, 53, 59 and 6, 12, 18, 24 in the order given, on the second frame. The spirals in each group may also be so re-arranged that the order of scanning is 1, 7, 13, 19 etc., 4, 10, 16 etc., and 6, 12, 18 etc. for frame one, while the order of scanning for frame two is 2, 8, 14, etc., 5, 11, 17, etc., and 3, 9, 15, 21, etc. Other ways of disposing the spirals will be apparent to those skilled in the art.

A disc of the type referred to above is illustrated in Fig. 6, wherein the sixty scanning openings are arranged in two groups of three spirals each, each spiral comprising ten openings. When the disc is rotated in the direction of the arrow A, and the film is moving in the direction of the arrow B, the numbers around the periphery refer to the relative position of the scanning lines on the two picture frames covered per each revolution of the disc. The numbers immediately adjacent to the openings give the distance from the reference circle **60**, in scanning-line widths, to each of the openings.

In the drawings, the radial separation of the holes constituting the spirals is greatly exaggerated since, if the drawings were made strictly to scale, the actual distance would scarcely be perceptible and the individuality of the spirals would not be sufficiently clear.

When the scanning lines traced by the first holes of the spirals fall in consecutive order, such as 1, 2, 3, etc., exact formulae may be derived for the spacing of the individual openings. Assume, for example, a half-speed scanning disc having M openings and N spirals, whereby the first spiral scans lines 1, N+1, 2N+1, etc., the second spiral scans lines 2, N+2, 2N+2, etc., the third spiral scans lines 3, N+3, 2N+3, etc., and so on. In a disc of this type the radial distance, measured in scanning-line widths, if the distance toward the center of the disc is considered to be positive between consecutive holes in the same spiral is N−2; the radial distance between the 1st hole of one spiral and the first hole of the next spiral

$$=-\left(\frac{2M}{N}-1\right);$$

the radial distance between the first hole of spiral

$$\text{No. } \frac{N}{2}$$

and the first hole of the next spiral

$$=M-\left(\frac{2M}{N}-1\right).$$

The illuminated area of the disc for the above spacing of holes is given by the equation:

$$A=2\left[M-2\left(\frac{M}{N}-1\right)-(N-1)\right]+N-2.$$

For a two-spiral disc, wherein the spirals are, in reality, segments of circles, the illuminated area has a width of two scanning lines, and for a disc of the type shown in Fig. 6 the area must be at least substantially 78 lines wide.

It will thus be apparent that, by my invention, I have provided a television system wherein a combined sound and picture film, of the high speed type, may be satisfactorily transmitted by radio, or by carrier current over metallic conductors without the generation of the high frequencies representative of the transmitted pictures that are generated in systems of the type heretofore constructed.

Other advantages of my invention, as well as numerous modifications thereof, will be apparent to those skilled in the art to which it pertains. My invention, therefore, is not to be restricted to the specific apparatus illustrated and described herein, but is to be limited only by the prior art or by the spirit of the appended claims.

I claim as my invention:

1. In a television system, a web having impressed thereon a plurality of frames; means for imparting movement to said web and means for scanning a plurality of different complementary portions of successive frames of said web during motion of said web.

2. In a television system, a web composed of successive frames, means for causing said web to advance longitudinally, a light-sensitive device, and a scanning device for presenting a plurality of different complementary portions of successive frames to said light-sensitive device during motion of said web.

3. In combination, a web composed of successive frames, a light source, a light-sensitive device, and means for causing light from said source to traverse a plurality of different complementary portions of successive frames during motion of said web and fall upon said light-sensitive device.

4. In combination, a film carrying a sound and picture record, means for deriving from said sound record electrical fluctuations representative of the recorded sounds, means for advancing said film through said deriving means at a speed

sufficiently high to give proper electrical reproduction of said recorded sounds, and means for scanning complementary portions of successive picture elements.

5. In television apparatus, a web provided with a plurality of representations, means for imparting continuous movement to said web, a scanning disc having a plurality of groups of means for exploring elements of a representation on said web to be transmitted, the corresponding means of each of the various groups being spaced unequal distances from the edge of the disc and means for determining the relative speeds of the disc and said web whereby said disc may scan more than one representation per revolution.

6. In television apparatus, a web provided with a plurality of representations, means for imparting continuous movement to said web, a scanning disc provided with spirally arranged means for exploring elements of the representations on said web, and means for determining the relative speed of said disc and web whereby a plurality of said representations will be scanned per revolution of said disc.

7. In television apparatus, a film provided with a plurality of pictures, means for imparting continuous movement to said film, a scanning disc provided with means for exploring the elements of said pictures, said means comprising a plurality of non-overlapping groups of light directing agencies, the agencies in each group being spaced unequal distances from the edge of the disc and the distance between the circles defined by the innermost and outermost agencies of each group being materially less than the length of one side of a picture, whereby a plurality of complete pictures in motion may be scanned.

8. As an article of manufacture, a scanning disc having a plurality of openings therein, said openings being aggregated into N spirally disposed sets and said sets being subdivided into R groups, the radial distance between successive openings in each set being N—R units where a unit is the distance between two successive lines traced on a plane moving parallel to the plane of said disc and having a velocity of R times the linear velocity of said openings.

9. As an article of manufacture, a scanning disc having a plurality of openings therein, said openings being aggregated into N spirally disposed sets and said sets being subdivided into R complementary groups, the radial distance between successive openings in each set being N—R units where a unit is the distance between two successive lines traced on a plane moving parallel to the plane of said disc and having a velocity of R times the linear velocity of said openings.

10. As an article of manufacture, a scanning disc having a plurality of openings therein, said openings being aggregated into N spirally disposed sets and said sets being subdivided into two groups, the radial distance between successive openings in each set being N—2 units where a unit is the distance between two successive lines traced on a plane moving parallel to the plane of said disc and having a velocity of two times the linear velocity of said openings.

11. As an article of manufacture, a scanning disc having M openings therein, said openings being aggregated into N spirally disposed sets and said sets being subdivided into R groups, the radial distance between the first openings of two successive sets in any one group being

$$\left(\frac{RM}{N}-1\right)$$

units, where a unit is the distance between two successive lines traced on a plane moving parallel to the plane of said disc, and having a velocity of R times the linear velocity of said openings.

12. As an article of manufacture, a scanning disc having M openings therein, said openings being aggregated into R spirally disposed sets and said sets being subdivided into R groups, the radial distance between the first openings of the last set in one group and the first opening in the first set in the next group being

$$M-\left(\frac{RM}{N}-1\right)$$

units, where a unit is the distance between two successive lines traced on a plane moving parallel to the plane of said disc, and having a velocity of R times the linear velocity of said openings.

13. As an article of manufacture, a scanning disc having M openings therein, said openings being aggregated into N spirally disposed sets and said sets being subdivided into R groups, the radial distance between the first openings of two successive sets in any one group being

$$\left(\frac{RM}{N}-1\right)$$

units and the radial distance between the first opening of the last set in one group and the first opening in the first set of the successive group being

$$\left(\frac{RM}{N}-1\right)-M$$

units.

14. As an article of manufacture, a scanning disc having M openings therein, said openings being aggregated into N spirally disposed sets and said sets being subdivided into R groups, the radial distance between the first openings of two successive sets in any one group being

$$\left(\frac{RM}{N}-1\right),$$

the radial distance between the first opening of the last set in one group and the first opening on the first set of the successive group being

$$\left(\frac{RM}{N}-1\right)-M$$

and the radial distance between successive openings in each set being R—N units.

15. As an article of manufacture, a scanning disc having M openings therein, said openings being aggregated into N spirally disposed sets and said sets being subdivided into R groups, the radial distance between the first openings of two successive sets in any one group being

$$\left(\frac{RM}{N}-1\right)$$

and the radial distance between two successive openings in each set being (N—R) units.

16. The method of transmitting combined sound and picture films, comprising increasing the normal speed of the film to above that of the customary sixteen frames per second and scanning only complementary portions of successive picture frames.

17. Electro-optical apparatus for transmitting images and accompanying sound effects recorded on a sound motion picture film, comprising means including a light sensitive electric element for scanning complementary picture portions of successive frames of the motion picture film for pro-

ducing a current which varies in accordance with the tone values of the complementary areas of said successive frames, means including a second light sensitive electric element for scanning the sound track of said sound motion picture film separately from the scanning of said picture portions for producing a current which varies in accordance with the sounds recorded on the film, and means for transmitting the current variations set up by said light sensitive electric elements.

18. Electro-optical apparatus for transmitting images and accompanying sound effects recorded on a sound motion picture film, comprising means including a light sensitive electric element for scanning complementary picture portions of successive frames of said motion picture film for producing a current which varies in accordance with the tone values of the complementary areas of said successive frames, sound pick-up means for scanning the sound track of said motion picture film separately from the scanning of said picture portions for producing a current which varies in accordance with the sounds recorded on the film, and means for transmitting the current variations set up by said light sensitive electric element and said sound pick-up means.

19. The method of electrically transmitting motion picture films having a sound accompaniment therewith which comprises converting said sound indications into electrical impulses at a predetermined rate, and simultaneously converting the picture elements of the film into electrical impulses at a lesser relative rate.

20. The method of electrically transmitting motion picture films having a sound accompaniment therewith which comprises analyzing the said sound record at a rate corresponding to a predetermined frame projection rate, and analyzing the picture elements of the film at a rate different from the predetermined frame projection rate.

21. The method of electrically transmitting motion picture films having a sound accompaniment which comprises electrically transmitting the sound accompaniment at a rate commensurate with the sound pitch thereof and simultaneously transmitting the picture elements of the film at a different rate.

22. The method of electrically transmitting motion picture films having a sound accompaniment which comprises electrically transmitting the sound accompaniment at a rate commensurate with the sound pitch thereof and simultaneously transmitting the picture elements of the film at a rate less than that commensurate with the sound pitch.

23. The method of electrically transmitting motion picture films having a sound accompaniment adjacent each picture frame thereof which comprises converting the sound track portion of the film into a series of electrical impulses at a rate corresponding to a predetermined frame projection rate, analyzing the picture portion of the individual frames of the picture film at a rate different than the said predetermined frame projection rate, and simultaneously transmitting signals corresponding to each of said series of electrical impulses.

24. A system for the electrical transmission of motion picture film having a sound accompaniment therewith which includes, in combination, means for analyzing the sound accompaniment at a rate corresponding to a predetermined frame projection rate and means for simultaneously analyzing the picture frame portion at a rate different from said predetermined frame projection rate.

25. A system for the electrical transmission of a motion picture film and a related sound accompaniment which includes, in combination, means for converting the sound accompaniment into electrical energy at a rate corresponding to a predetermined picture frame projection rate, and means for simultaneously converting the picture into electrical energy at a rate different from the predetermined frame projection rate for sound accompaniment.

26. A system for the electrical transmission of motion picture film having a sound accompaniment therewith which includes, in combination, means for converting the sound accompaniment recordings into a series of electrical impulses at a predetermined frame projection rate, and means for simultaneously converting the sequential picture elements into a series of electrical impulses at a rate different from the predetermined frame projection rate.

27. A system for the electrical transmission of motion picture film having a sound accompaniment therewith which includes, in combination, a sound head for converting sequential sound recordings into electrical current impulses, and a scanning device for converting sequential elements of a picture into a series of electrical impulses at a rate different from the predetermined frame projection rate.

28. A system for the electrical transmission of motion picture film and a related sound accompaniment which includes, in combination, a sound converting means for converting sequential sound recordings into electrical current impulses at a rate corresponding to a predetermined film projection rate, and a scanning device for converting sequential elements of a picture into a series of electrical impulses at a rate different from the predetermined film frame projection rate.

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