Oct. 28, 1930. A. McL. NICOLSON 1,779,747

METHOD AND APPARATUS FOR TELEVISION AND THE LIKE

Original Filed Sept. 9, 1927 2 Sheets-Sheet 1

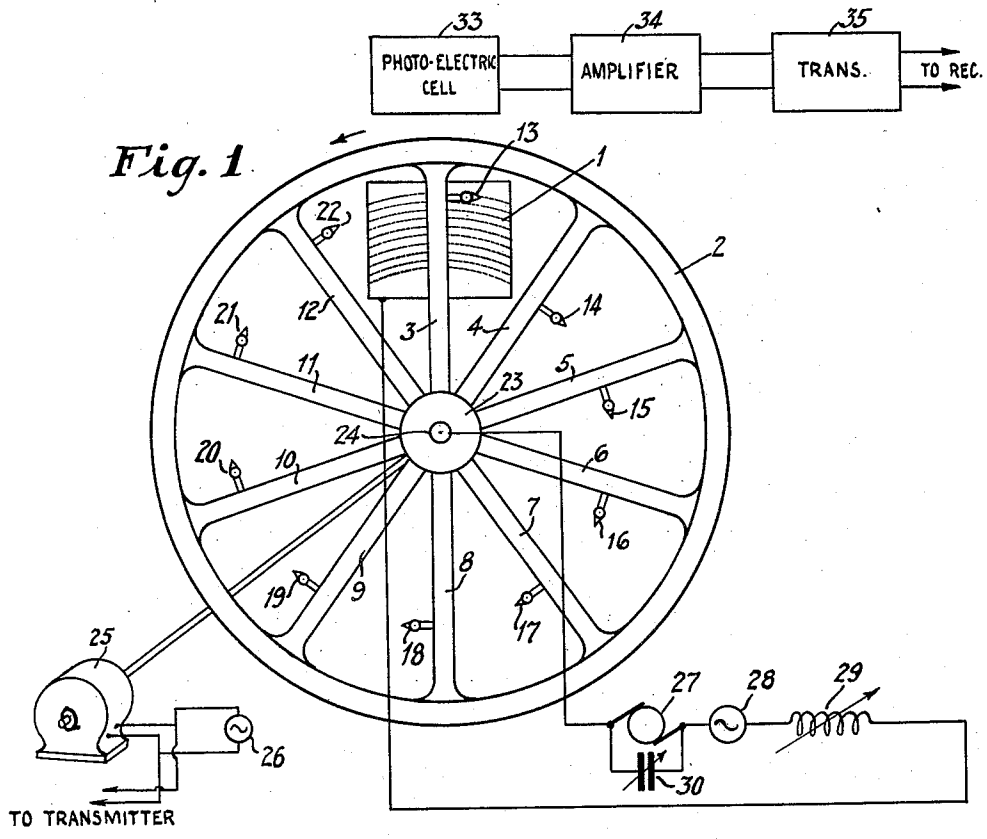


Fig. 1

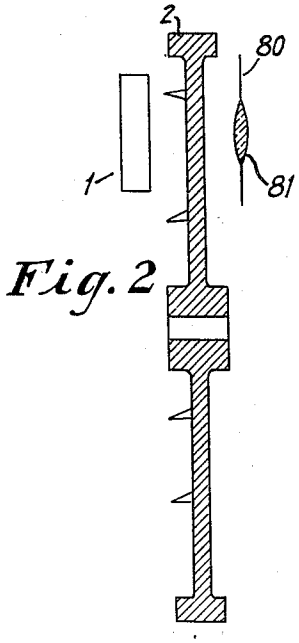


Fig. 2

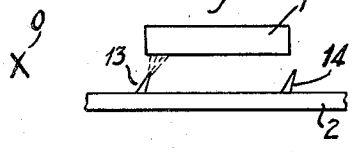


Fig. 3

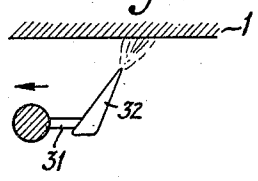


Fig. 4

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Fig. 5

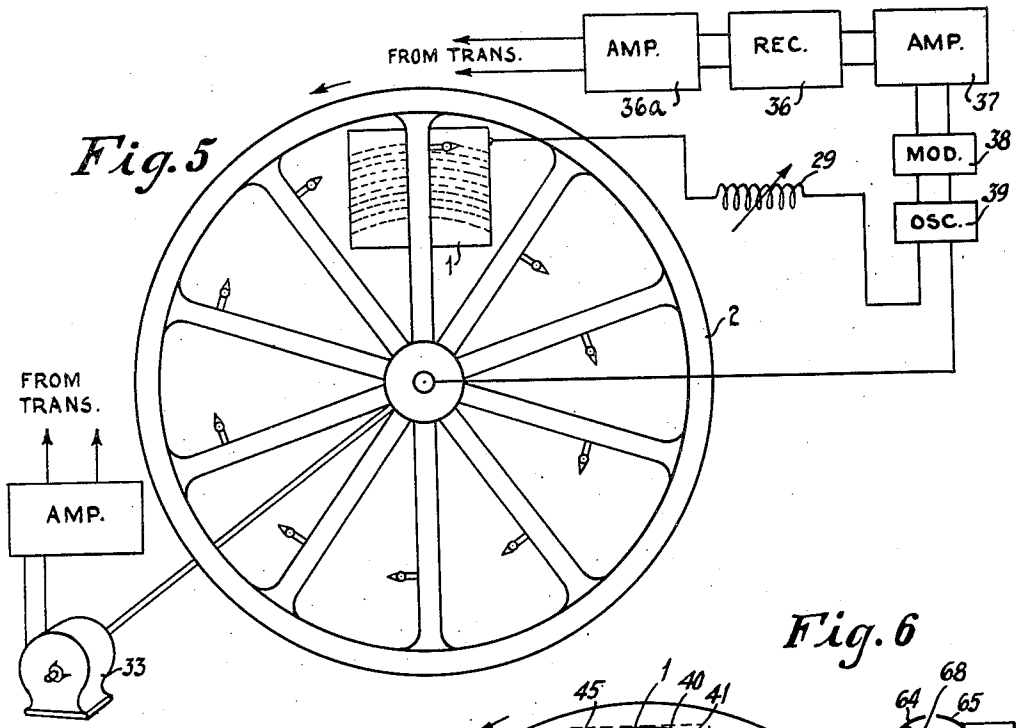


Fig. 6

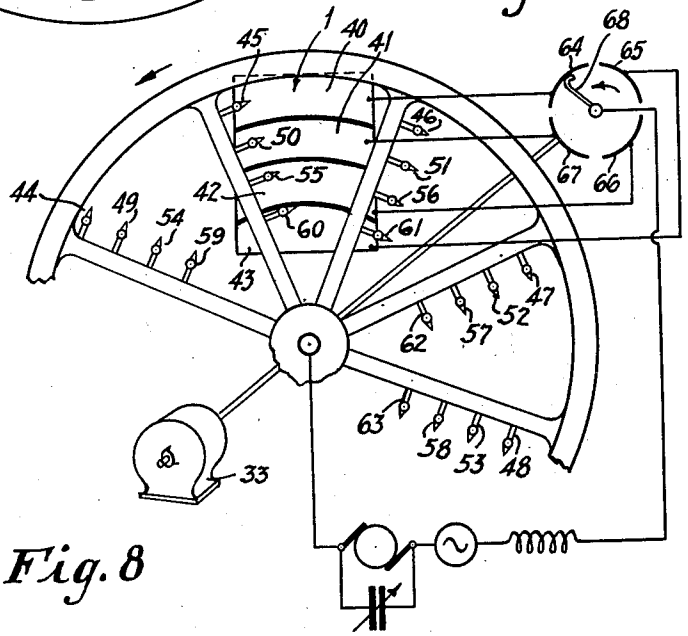


Fig. 7

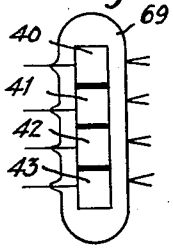
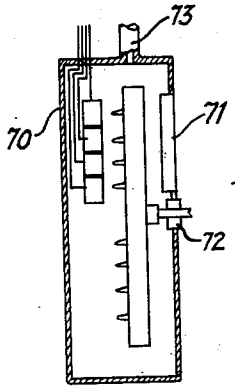


Fig. 8



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR TELEVISION AND THE LIKE

Application filed September 9, 1927, Serial No. 218,425. Renewed March 21, 1930.

This invention relates to a method and apparatus for television and the like, and more particularly to a method and apparatus for so-called scanning, adapted both for transmission and reception.

It is well known that for the purpose of transmission of images, whether by wire line, or radio, it is necessary to determine the light intensity of each unit area of the object whose image is to be transmitted and to send an indication of some sort which is proportional to the light intensity of such area. At the receiver, it is necessary to control a source of light so that its intensity corresponds or is proportional to the light intensity of the particular corresponding unit area of the object, and also so that its relative position on the receiving screen corresponds to the relative position of the corresponding unit area of the object.

It is also well known that in order to achieve "television" of moving objects, it is necessary to transmit approximately sixteen complete images of the object per second. In most of the systems heretofore proposed, it has been suggested to control the intensity of a spot of light at the receiver in accordance with the intensity of light desired, and to cause the spot to move by reflection across the receiving screen, in synchronism with the exposure of a unit area of the object upon the photo-cell at the transmitter.

If it is desired to cover a screen having 100 units of area in each dimension, and therefore containing 10,000 units of area, and if an image of a moving object is to be transmitted, the spot remains on one unit for only 1/160,000 of a second traveling over the screen, and for only 1/10,000 of a second in the case of sixteen complete pictures per second. The necessity of controlling the light intensity operates, as will be understood, to prevent the use of a very powerful source of light, to compensate for the shortness of exposure on any one area. As a result of these problems, it is very difficult, if not impossible, with known systems, to obtain sufficient illumination of the receiving screen to permit of practical operation of a system.

It is an object of this invention to provide an improved method and apparatus for electrically reproducing images at any desired point.

It is a further object of this invention to provide an improved method and apparatus of the class described, in which the screen on which the reproduced images appear is illuminated directly by an electrical discharge playing upon the screen.

It is a further object of this invention to provide an improved method and apparatus of the class described in which the object whose image is to be transmitted may be illuminated by light playing upon successive unit areas, rather than by a strong beam playing constantly upon the entire object.

It is still a further object of this invention to provide improved apparatus of the class described, which shall be simple and rugged in construction and in which the possibilities of trouble are minimized. Still other objects and advantages of my invention will be apparent from the specification.

The features of novelty which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its fundamental principles and as to its practical embodiments will best be understood by reference to the specification and accompanying drawing, in which:

Figure 1 is a diagrammatic view of transmitting apparatus according to one form of my invention, showing the focusing lens and screen removed.

Figure 2 is a side view, partly in section, of the scanning apparatus of Figure 1, with the focusing lens and screen in place.

Figure 3 is a fragmentary top plan view of the screen and electrode rotor.

Figure 4 is a detail horizontal section showing one arrangement of electrodes.

Figure 5 is a diagrammatic view of one form of receiving apparatus.

Figure 6 is a diagrammatic view of a modified form of scanning apparatus; and

Figures 7 and 8 are diagrammatic views of modified forms of discharge devices which may be utilized according to my invention.

In accordance with my invention, I pro-

duce on the transmitting and receiving screens, a primary source of light which is caused to move over the screen in a predetermined pattern such that all unit areas of the screen are successively instantaneously illuminated by an electrical discharge playing upon the screen. The screen itself preferably constitutes one of the electrodes between which the discharge takes place, and the location of the discharge is determined by the position of a plurality of movable electrodes which sweep across the screen in a predetermined pattern and sequence. In the transmitter, the strength of the discharge and thereby its luminous intensity, is maintained constant, whereas in the receiver, it is regulated in accordance with the intensity of illumination desired at the particular point or position of the discharge. By this means, it is possible to produce the light directly at the point where it is desired, whereby the losses in reflection at the receiver are eliminated, with the result that a great deal more light energy reaches the eye of the observer than would otherwise be possible. Moreover, the increased strength of light reaching the eye of the observer, produces a greater stimulus therein, which will persist for a longer time than the stimulus resulting from a relatively much weaker light, with the result that the illusion of a complete picture seen at the same time is much more perfect, than in the case of reflected light playing over the screen.

While I have described this arrangement as particularly advantageous for reception, it is to be understood that the invention may be equally well applied to transmission. In the past, it has been the practice to place the object, whose image was to be transmitted, in front of a photo electric cell and to play a strong light upon the object: scanning apparatus was interposed between the object and the photo cell in such manner that the light from successive unit areas of the object fell upon the photo cell. The constant illumination of the object with light of high intensity, objectionable for many reasons, is not necessary since the light from any particular unit of area of the object is utilized on the photocell, for only a relatively small instant of time.

In the case above referred to, in which the object whose image is to be transmitted occupies 10,000 units of area and a complete image is to be transmitted sixteen times per second, the light from any particular unit of area falls upon the photo cell for only 1/10,000 of a second.

The illumination of the entire object by very strong light, is not only unnecessary, but in many cases, actually harmful and, in the case of a person, may cause irritation of the eyes and skin and other ill effects. In order to eliminate these effects, I utilize apparatus for scanning the object similar to that utilized for scanning the receiving screen but, in this instance, of course, the light must be thrown upon the object from the electrode screen, since it is not possible to play an electrical discharge over the object itself. If, however, the object be placed in front of the transmitting scanning screen and a photo-electric cell associated therewith in such manner that the light reflected from the object falls upon the photocell, then as the scanning discharge is caused to pass progressively over all unit areas of the scanning screen, the light from such discharge, after passing through a suitable system of lenses, will be thrown on a particular part of the object and then upon the photo cell and, since the light plays over the object at high speed, it may be made as strong as desired. If desired, the entire object may be illuminated by a source of light or a plurality of sources of light, so adjusted that the illumination falling upon the photo-electric cell has a threshold value sufficient to maintain the cell at its most sensitive point, whereupon additional light falling upon any particular unit of area of the object during the process of scanning will produce the maximum effect in the photo cell. While I have here referred to "light" it should be understood that the term is not intended to be restricted to visible light but includes invisible light, both ultra-violet and infra-red, and in fact, under certain conditions, it may be preferable to use only invisible light, usually infra-red, particularly for scanning at the transmitter. The output currents from the photo cell, as is well understood, may be amplified to the extent desired, and transmitted in any suitable manner either directly by wire line or as modulations of carrier or radio frequency oscillations traveling either on wires or through space.

For the purpose of providing such a discharge, I prefer to utilize a screen which constitutes one electrode; the screen may be made up of any desired metal or other conductor chosen in accordance with the characteristics of light desired, and also with reference to the life of the material itself as an electrode. For example, the electrodes may comprise platinized tungsten, carbon, cadmium, or cadmium coated with platinum.

A plurality of movable electrodes are also provided adapted to sweep over the electrode screen in a predetermined sequence, pattern and speed; and a difference of potential is maintained between the stationary screen electrodes and the movable electrodes, in such manner that as each movable electrode comes into discharge relation with the screen an illuminating discharge passes between the screen and the particular electrode. As the movable electrode moves, the discharge moves with it, and if the moving electrodes be ar-

ranged in a particular predetermined pattern, the illuminating discharge may be caused to travel successively over all unit areas of the screen. Many arrangements of movable electrodes may be utilized, but I prefer to arrange the electrodes upon a rotor in the form of a spiral. The rotor may comprise an annular rim supported by spokes, and a series of electrodes may be mounted supported from the spokes in a spiral path in such manner that the outer electrode corresponds to or traces a path across one extremity of the screen, while the inner electrode traces a path across the other extremity of the screen.

Under such conditions, the successive electrodes trace concentric arcs across the screen, and are preferably positioned at the proper distance apart, so that as one electrode passes off one side of the screen, the next succeeding electrode is just passing on to the screen at the other side.

In the transmission scanning device, an illuminating arc of constant intensity will be utilized. In the receiving scanning device, however, the illumination must be controlled and may vary, from time to time, in accordance with the currents received from the transmitter and, for this reason, the change in intensity of the receiving scanning arc will be controlled by the received currents.

An additional source of current may be provided to supplement the varying light controlling current, which current, in itself, may not be sufficient to produce any illumination or, may be just sufficient to produce relatively feeble illumination, whereby the addition of the currents from the transmitter, or controlled by the transmitter, may serve to reinforce the current first referred to and thereby cause relatively large changes in the illumination.

I prefer to use alternating currents for the purpose of scanning, both at the transmitter and at the receiver and, preferably, currents of high frequency. In the receiver the high frequency currents may be modulated in accordance with the intensity of light desired, and may be supplemented by constant direct current or alternating current of different frequency, having a value sufficient to maintain the discharge on the threshold of illumination, whereby the added energy from the modulated current causes illumination of the desired intensity.

Referring now more particularly to Figs. 1 and 2, 1 designates the transmitting screen electrode which may be of any desired material, suitably chosen to have the maximum life as an electrode, and which, also, may be suitably chosen with respect to the characteristic of light emitted. The discharge surface may be provided, if desired, with a relatively large number of closely disposed projections operating as discharge points; in addition, the electrode 1 may be enclosed within a suitable envelope containing any desired gas such as neon or helium or mixture of gases at greater or less than atmospheric pressure, or finely divided solid material, or other vaporizable substance such as mercury for the purpose of modifying the character or intensity, or both, of the discharge.

For the purpose of causing the discharge to play over the surface of the screen 1, there is provided a rotor 2, which may be in the form of a wheel having a rim and having a plurality of spokes 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12. Electrodes 13, 14, 15, 16, 17, 18, 19, 20, 21 and 22 are arranged, for example, one on each spoke, the successive electrodes being slightly displaced radially in such a manner that upon the rotation of the rotor 2 the electrodes will trace adjacent concentric arcuate paths across the screen 1, as indicated in dotted lines in Fig. 1. A suitable discharge potential is maintained between the electrode screen 1 and the rotor 2, which will preferably be a high frequency alternating current derived from an alternating current source 28, which may for example, be a high frequency vacuum tube oscillator. In addition, there may be provided a direct current biasing voltage derived from direct current source 27. The circuit, as a whole, may be tuned to the alternating current frequency, by means of inductance 29 and condenser 30. The rotor 2 may be driven by a suitable motor such as 25, which may be arranged to operate as a synchronous motor driven from an alternating current source 26. As the rotor 2 spins, discharges will be produced successively from the electrodes 13, 14, 15 and 16, etc. In order to prevent as far as possible, the illumination produced by the discharges being obscured by the spokes, it may be desired to offset the electrodes upon the spokes, as for example shown in Figure 4, in which 31 represents a bracket extending laterally from the spoke and 32 the discharge electrode mounted thereupon. As the spoke moves in the direction shown by the arrow in Figure 4, the discharge will tend to lag slightly and pass at an angle to the screen electrode 1, and the light thereby produced will not be obscured to any considerable extent by the spokes of the movable electrode structure. If the electrodes are so arranged that the screen is scanned in one complete revolution of the rotor, it will only be necessary to operate the rotor at a speed of sixteen revolutions per second, and difficulty due to excessive speed will not be met.

The movable electrodes are preferably placed apart a sufficient distance such that no two electrodes are in discharge relation with the electrode screen 1 at the same time, as shown in Figure 3, in which the electrode 13 is about to pass out of discharge relation with the screen and the electrode 14 is about to pass into the same.

The object whose image it is desired to transmit, will be placed in front of the screen at 0 so as to be illuminated by the discharge playing thereupon, and a suitable opaque screen 80 carrying a lens 81, or the like, may be utilized to concentrate the light in the field desired. In addition, suitable fixed lights of constant intensity may be played on the object, if desired.

A photo electric cell 33 of any suitable type known in the art, is placed in such manner as to be exposed to the light reflected from the object, and the output of the photo electric cell will be amplified to the extent desired by a suitable amplifier 34, the output of which may be used to control a transmitter 35 supplying a wire line or an antenna. In the case of transmission by wire line, the amplifier output may control the transmitter directly, which transmitter may operate on direct current or on any desired alternating current frequency. In case of transmission by radio or carrier, the output of the amplifier will preferably be utilized to modulate the high frequency oscillations in a known manner.

Since it is necessary that the rotors at the transmitter and the receiver be run synchronously, a connection may be made between the source 26 and the transmitter to transmit a synchronizing frequency, which may be utilized to modulate the radio frequency output of the transmitter in a separate modulation band from the signal currents, or as a modulation of different radio frequency oscillations or, in the case of a wire line, may be transmitted independently.

Referring now more particularly to Figure 5, I have shown a receiver adapted to cooperate with the transmitting apparatus shown in Figure 1. In this instance, the electrode screen and rotors are in general similar to those shown in Figure 1, and are therefore not described in detail. The received currents from the transmitter may be amplified by a suitable amplifier 36ª, and the radio frequency oscillations may be detected by the receiver 36, and further amplified if desired, by a suitable amplifier 37. The output of the amplifier 37 may be supplied to modulator 38 operating to control in accordance with the incoming signals, the amplitude of the current generated by oscillator 39, the frequency of which will be chosen for optimum results. The modulated currents are impressed between the screen electrode and the rotor 2. The high frequency circuit may be tuned by suitable inductance 29 and by one or more condensers, not shown.

The synchronizing currents from the transmitter may be amplified, if desired, and supplied to a suitable synchronous motor 33, operating to drive the rotor 2. In the case where both synchronizing and signal currents are transmitted as modulations of one or more carriers, the necessary filters will be utilized for the purpose of separating the various currents, as will be understood. Moreover, in case the transmitted oscillations, modulated in accordance with light intensity, have the desired frequency, they may be amplified and supplied directly to the discharge path, thereby eliminating the necessity for a separate oscillator and modulator at the receiver.

Referring now more particularly to Figure 6, I have shown a modified arrangement in which the movable electrodes are arranged in a spiral having a plurality of convolutions or turns for the purpose of securing a greater number of scanning lines upon the screen and thereby achieving greater detail of transmission and reproduction. In this instance, the screen electrode 1 comprises a plurality of insulated sections, 40, 41, 42 and 43, etc., and the electrodes are so arranged that the spiral path thereby defined has a complete turn or convolution for each section. For example, the electrodes 44, 45, 46, 47, 48, etc., form a spiral having one complete turn, and so arranged that in one revolution of the rotor, the electrode section 40 is completely scanned by the outer convolutions of the movable electrodes: in a similar manner, electrodes 49, 50, 51, 52, and 53 completely scan the section 41: electrodes 54, 55, 56, 57 and 58 completely scan the electrode section 42: and electrodes 59, 60, 61, 62 and 63 completely scan electrode section 43.

It will be seen that there are four electrodes in sparking position with respect to the screen at any particular time, and while it is possible to produce discharges at each of these electrodes simultaneously, if desired, such an arrangement will necessitate multiple channel transmission, one channel for each discharge operating, which under certain conditions, is undesirable, and to eliminate the necessity of such transmission, I provide a commutator device comprising sections 64, 65, 66 and 67 and a traveling contact 68, which passes over the stationary contacts successively. The contact 68 is driven at such speed with respect to the rotor 2, that it passes over one segment in the time required by the rotor to make a complete revolution. Connections are established between the segment 64 and electrode section 40, segment 67 and electrodes section 41, segment 66 and electrode section 42, segment 65 and electrode section 43: and the contact 68 is connected through a suitable tuning coil to one terminal of the source the other terminal of which is connected to the rotor 2.

Since the electrodes on the rotor 2 must be spaced apart a distance equal to the width of the screen, it will be understood that by the use of this arrangement it is possible to provide a greatly increased number of electrodes in order to increase the detail of transmission without increasing the periphery of the rotor, which would be necessary if only a single

turn spiral were used. Of course, it will be necessary to operate the rotor at a greater speed with the arrangement shown in Figure 6, since the rotor is required to make four complete revolutions in order to scan the entire screen: but since this arrangement permits the use of a smaller rotor, the increased speed is not objectionable.

Under certain conditions, it may be desired to enclose the screen electrode in an envelope 69, as shown in Figure 7. The envelope will preferably be of glass or at least the front side thereof will be of glass or other suitable material transparent to the type of light waves desired to be used. The envelope 69 may be sealed and may contain air at a pressure greater or less than atmosphere, or may contain gas or a mixture of gases such for example as neon, helium, etc., at greater than or less than atmospheric pressure, or finely divided metal, salts or the like, as by burning of an electrode and coating applied thereto. In this case, the rotor is preferably arranged so that the movable electrodes sweep across the front of the envelope and in close proximity thereto, the currents, as will be understood, being transferred across the gap, at least in part, by capacity action. In this arrangement, the direct current biasing potential may be omitted since the discharge electrodes are positively insulated one from the other.

Referring now more particularly to Figure 8, under certain conditions, it may be desirable to enclose the entire rotor and screen within an envelope, such as 70; the envelope in this instance, will preferably be of metal and may be provided with a transparent insert, such as glass or quartz 71, corresponding in size and position to the screen. A suitable stuffing box 72 will be provided to admit the shaft bearing into the casing or, under certain conditions, the driving motor may also be mounted within the casing if, for instance, it is desired to operate with relatively higher vacuum. In this arrangement, as in the other arrangements described, the discharge may take place in air or in a suitable gas or mixture of gases at any desired pressure, it being understood that an increase of pressure above atmospheric tends to cause a concentrated discharge, whereas, a decrease in pressure tends to cause diffusion of the discharge. The interior of the envelope 70 may be maintained in communication with a pump by means of pipe 73, for the purpose of maintaining an optimum operating pressure or, if desired, a circulation of gas within the envelope may be maintained, the gas being withdrawn through pipe 73 and admitted through a suitable additional pipe, not shown.

In the receiving arrangements shown and described, it will be understood that the strength and luminous intensity of the discharge is controlled and made to assume the value desired, whereby if the eye of the observer is fixed upon the screen, he will see there the reproduction of the image transmitted. It will be understood that if desired, the light may be reflected to a second and larger screen by the use of reflectors, lenses and the like, which may be viewed by the observer.

While I have shown and described certain preferred embodiments of my invention, it will be understood that modifications and changes may be made without departing from the spirit and scope of my invention, as will be understood by those skilled in the art.

I claim:

1. Scanning apparatus for television and the like, comprising in combination, means for producing a self-luminous electrical discharge corresponding to a unit area of the subject, and means for causing said discharge to travel progressively over the area to be scanned in a predetermined scanning pattern.

2. Scanning apparatus for television and the like, comprising in combination, means for producing a self-luminous electrical discharge, corresponding to a unit area of the subject, and means for causing said discharge to travel progressively over the area to be scanned in a predetermined scanning pattern at a speed such that the area is scanned repeatedly at a speed sufficient to present the illusion of motion.

3. Scanning apparatus for television and the like, comprising in combination, means for producing a self-luminous electrical discharge corresponding in position to a predetermined unit area of the subject, and corresponding in luminous intensity to the light value of the corresponding unit area of the subject, and means for causing said discharge to travel progressively over the area to be scanned in a predetermined scanning pattern.

4. Scanning apparatus for television and the like, comprising in combination, means for producing a self-luminous electrical discharge corresponding in position to a predetermined unit area of the subject, and corresponding in luminous intensity to the light value of the corresponding unit area of the subject, and means for causing said discharge to travel progressively over the area to be scanned in a predetermined scanning pattern at a speed such that the area is scanned repeatedly at a speed sufficient to present the illusion of motion.

5. In a system for television and the like, means for producing a self-luminous electrical discharge corresponding in position to a unit area of the subject to be scanned, means for causing said discharge to travel progressively over the area to be scanned in a prede-

termined scanning pattern, to illuminate successively all unit areas of the subject, and means for producing a second illuminating discharge corresponding in position to the position of said first discharge, and in luminous intensity to the light intensity of the corresponding unit area of the subject.

6. Scanning apparatus for television and the like, comprising a screen electrode system, and a second electrode system maintained out of contact therewith and insulated therefrom only by space insulation movable relatively thereto, means for producing an electrical discharge between said electrode systems, said electrode systems being so arranged that said discharge progressively travels over all unit areas of said screen in a predetermined scanning pattern.

7. Scanning apparatus for television and the like, comprising a screen electrode system, and a second electrode system maintained out of contact therewith and insulated therefrom only by space insulation movable relatively thereto, means for producing an illuminating electrical discharge between said electrode systems, said electrode systems being so arranged that said discharge progressively travels over all unit areas of said screen in successive concentric arcs.

8. Scanning apparatus for television and the like, comprising a screen electrode system, and a second electrode system rotatable relatively thereto, and having a plurality of electrodes arranged at different distances from the center of rotation, and means for producing an illuminating electrical discharge between said electrode systems, said electrodes being so disposed that rotation of said electrode system causes said discharge to travel progressively over all unit areas to be scanned.

9. Scanning apparatus for television and the like, comprising a screen electrode system, and a second electrode system rotatable relatively thereto, and having a plurality of electrodes disposed in a substantially spiral path about the center of rotation, means for producing an illuminating electrical discharge between said electrode systems, and means for rotating said second system to cause successive travel of said discharge over said screen electrode in concentric arcuate paths to scan said screen.

10. Scanning apparatus for television and the like, comprising a screen electrode system, and a second electrode system rotatable relatively thereto, and having a plurality of electrodes arranged progressively angularly displaced about the center of rotation to form points on a spiral having a plurality of convolutions and means for causing an electrical discharge between said screen electrode system and successive rotatable electrodes from the outer end of said spiral to the inner end thereof.

11. Scanning apparatus for television and the like, comprising a screen electrode system and a second electrode system rotatable relatively thereto and having a plurality of electrodes arranged progressively peripherally displaced about the center of rotation to form points on a spiral having a plurality of convolutions, said screen electrode having a plurality of sections corresponding to successive convolutions of said spiral, means for causing an electrical discharge between said screen electrode system and means for causing said discharge to pass over sections of said screen electrode successively.

12. The method of scanning for television and the like, which comprises successively illuminating unit areas of the area to be scanned by a self-luminous electrical discharge progressively traveling in a predetermined scanning pattern over the area to be scanned.

13. The method of scanning for television and the like, which comprises successively illuminating unit areas of the area to be scanned by a self-luminous electrical discharge progressively traveling in a predetermined scanning pattern comprising adjacent paths over the area to be scanned.

14. The method of scanning for television and the like, which comprises successively illuminating unit areas of the area to be scanned by a self-luminous electrical discharge progressively traveling in a predetermined scanning pattern over the area to be scanned, and controlling the luminous intensity of said discharge at each unit area in accordance with the light intensity desired at such area.

15. The method of television which comprises scanning the object to be reproduced by means of a self-luminous electrical discharge illuminating a unit area of the object and progressively moving said discharge to successively illuminate all unit areas of the object, controlling an electric current in accordance with the light intensity of each of such unit areas, producing a second self-luminous electrical discharge and progressively moving said discharge in a pattern and at a speed corresponding to said first discharge and controlling the intensity of illumination of said second discharge in accordance with said electric current.

16. Scanning apparatus for television and the like, comprising means for producing a luminous electrical discharge of relatively high frequency currents, means for causing travel of said discharge in a predetermined scanning pattern, and means for modulating said high frequency currents to control the luminous intensity of said discharge.

17. The method of scanning for television and the like, which comprises producing a self-luminous illuminating electrical discharge by passing relatively high frequency

currents between a pair of spaced and relatively moving electrode systems, and modulating said high frequency currents to control the luminous intensity of said discharge.

18. The method of scanning for television and the like, which comprises producing a self-luminous electrical discharge by passing relatively high frequency currents between a pair of the relatively moving electrode systems, producing travel of said discharge in a predetermined path at a predetermined speed, and modulating said high frequency currents to control the luminous intensity of said discharge.

Signed at New York, in the county of New York and State of New York this 11th day of August, A. D. 1927.

ALEXANDER McLEAN NICOLSON.

DISCLAIMER

1,779,747.—*Alexander McLean Nicolson*, New York, N. Y. METHOD AND APPARATUS FOR TELEVISION AND THE LIKE. Patent dated October 28, 1930. Disclaimer filed September 5, 1931, by the assignee, *Communication Patents Inc.*

Hereby enters a disclaimer restricting claims 1, 3, 6, 7, and 16, as listed below to scanning apparatus in which the scanning speed is faster than that necessary to cover the area to be scanned in one tenth of a second:

"1. Scanning apparatus for television and the like, comprising in combination, means for producing a self-luminous electrical discharge corresponding to a unit area of the subject, and means for causing said discharge to travel progressively over the area to be scanned in a predetermined scanning pattern."

"3. Scanning apparatus for television and the like, comprising in combination, means for producing a self-luminous electrical discharge corresponding in position to a predetermined unit area of the subject, and corresponding in luminous intensity to the light value of the corresponding unit of area of the subject, and means for causing said discharge to travel progressively over the area to be scanned in a predetermined scanning pattern."

"6. Scanning apparatus for television and the like, comprising a screen electrode system, and a second electrode system maintained out of contact therewith and insulated therefrom only by space insulation movable relatively thereto, means for producing an electrical discharge between said electrode systems, said electrode systems being so arranged that said discharge progressively travels over all unit areas of said screen in a predetermined scanning pattern.

"7. Scanning apparatus for television and the like, comprising a screen electrode system, and a second electrode system maintained out of contact therewith and insulated therefrom only by space insulation movable relatively thereto, means for producing an illuminating electrical discharge between said electrode systems, said electrode systems being so arranged that said discharge progressively travels over all unit areas of said screen in successive concentric arcs."

"16. Scanning apparatus for television and the like, comprising means for producing a luminous electrical discharge of relatively high frequency currents, means for causing travel of said discharge in a predetermined scanning pattern, and means for modulating said high frequency currents to control the luminous intensity of said discharge."

Your petitioner further enters a disclaimer restricting claims 12, 13, 14, 17 and 18, as listed below to the method of scanning in which the scanning speed is faster than that necessary to cover the area to be scanned in one tenth of a second.

"12. The method of scanning for television and the like, which comprises successively illuminating unit areas of the area to be scanned by a self-luminous electrical discharge progressively travelling in a predetermined scanning pattern over the area to be scanned.

"13. The method of scanning for television and the like, which comprises successively illuminating unit areas of the area to be scanned by a self-luminous electrical discharge progressively travelling in a predetermined scanning pattern comprising adjacent paths over the area to be scanned.

"14. The method of scanning for television and the like, which comprises successively illuminating unit areas of the area to be scanned by a self-luminous electrical discharge progressively travelling in a predetermined scanning pattern over the area to be scanned, and controlling the luminous intensity of said discharge at each unit area in accordance with the light intensity desired at such area."

"17. The method of scanning for television and the like, which comprises producing a self-luminous illuminating electrical discharge by passing relatively high frequency currents between a pair of spaced and relatively moving electrode systems, and modulating said high frequency currents to control the luminous intensity of said discharge.

"18. The method of scanning for television and the like, which comprises producing a self-luminous electrical discharge by passing relatively high frequency currents between a pair of relatively moving electrode systems, producing travel of said discharge in a predetermined path at a predetermined speed, and modulating said high frequency currents to control the luminous intensity of said discharge."

[*Official Gazette October 6, 1931.*]