Feb. 28, 1939. N. E. METHLIN 2,148,954

ELECTRIC TELE-INDICATOR DEVICE

Filed July 13, 1934 3 Sheets-Sheet 1

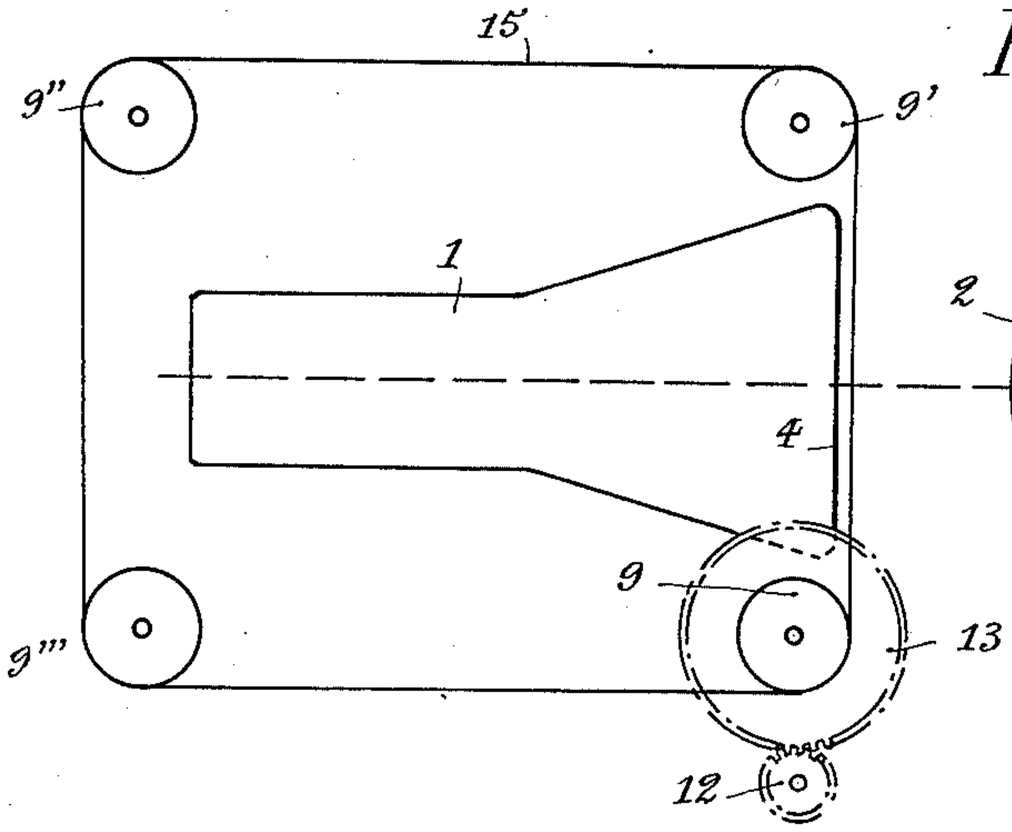


Fig. 1.

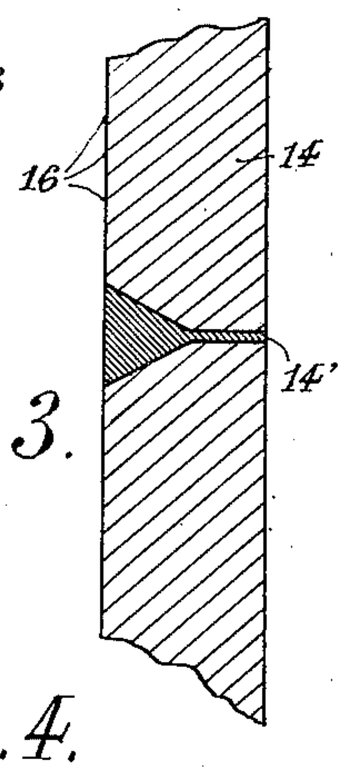


Fig. 3.

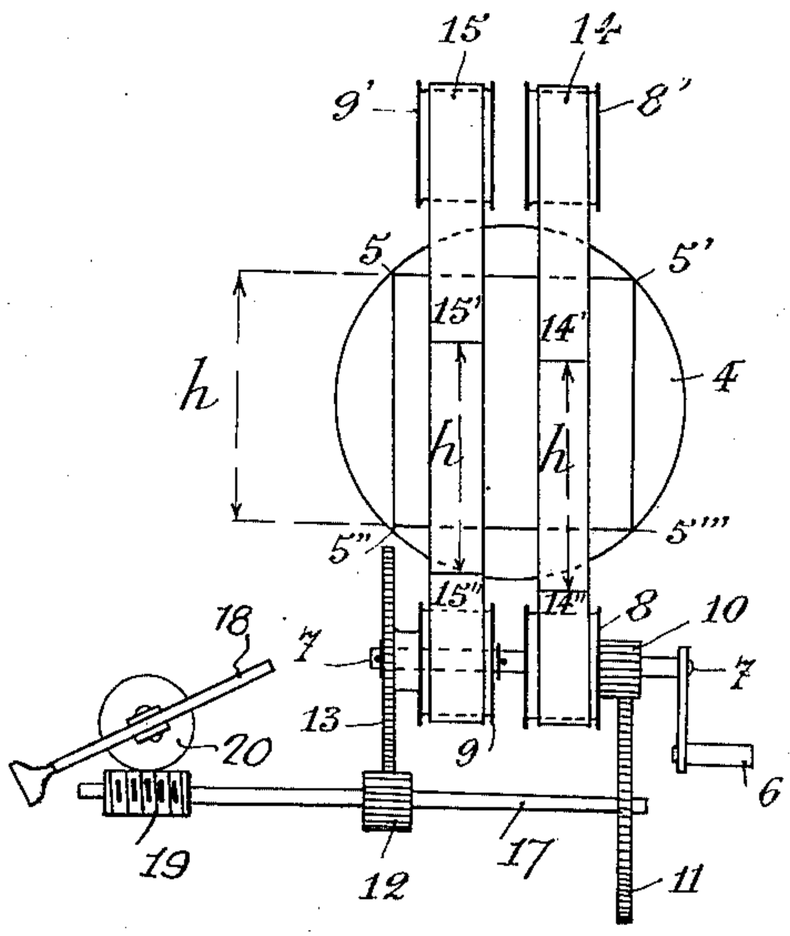
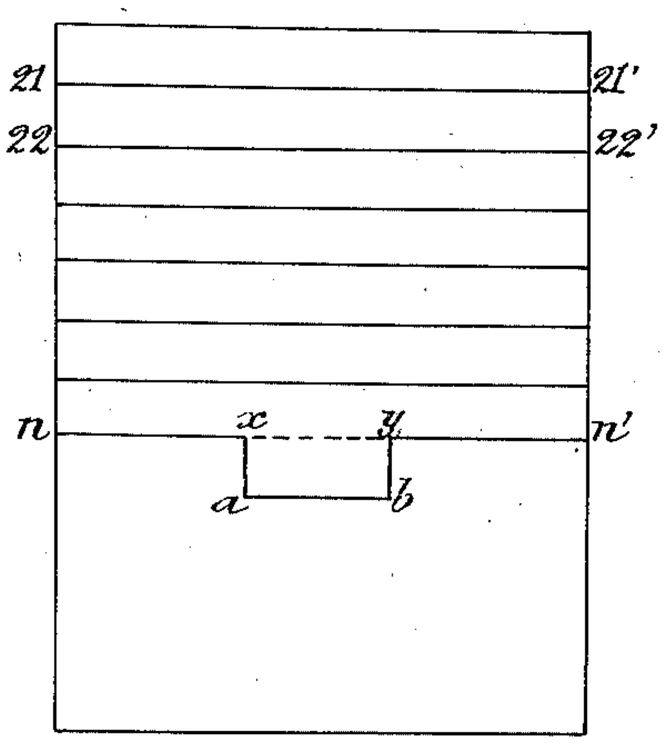


Fig. 2.

Fig. 4.



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Feb. 28, 1939. N. E. METHLIN 2,148,954

ELECTRIC TELE-INDICATOR DEVICE

Filed July 13, 1934 3 Sheets-Sheet 2

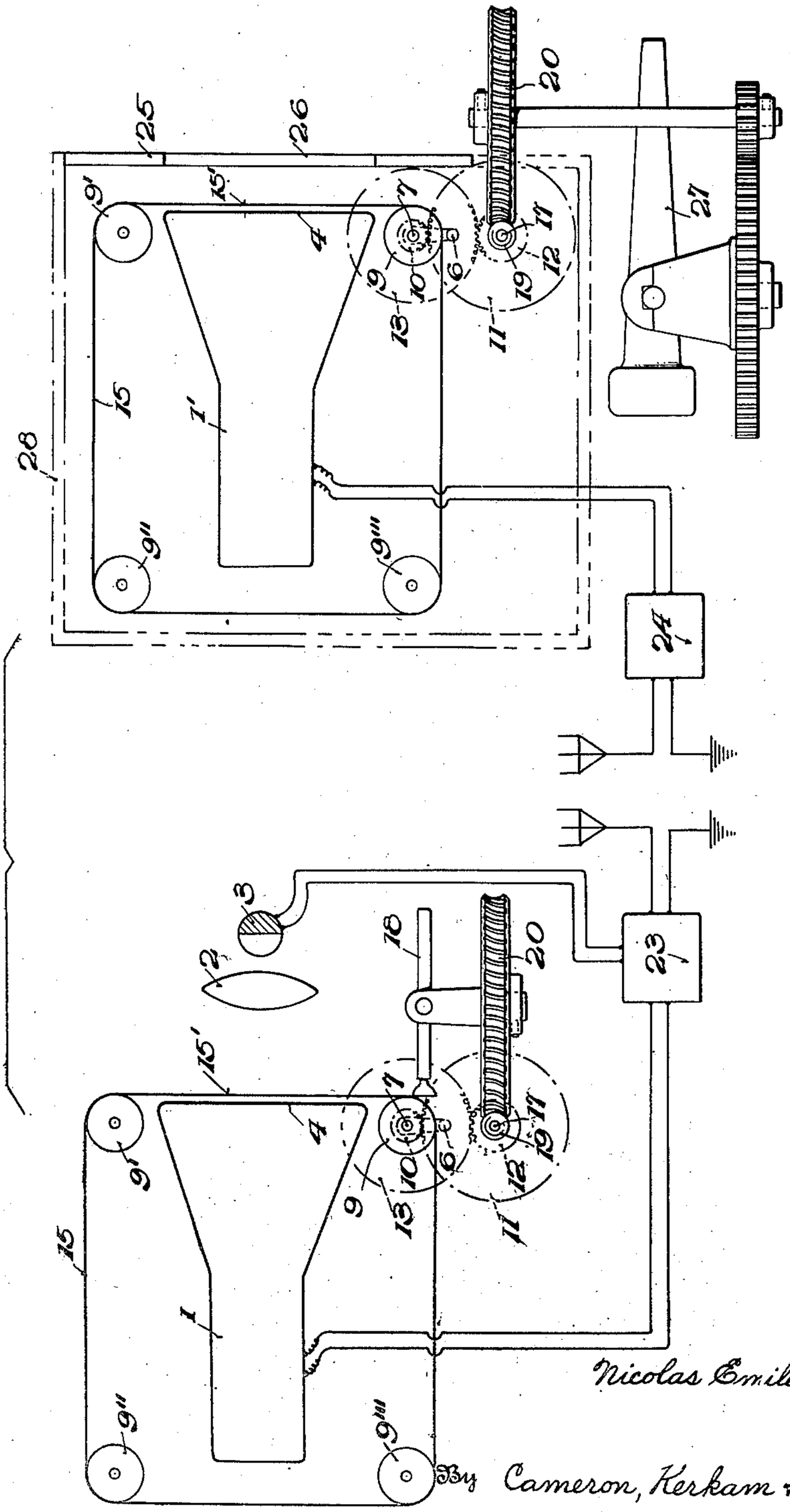

Fig. 5.

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Feb. 28, 1939. N. E. METHLIN 2,148,954

ELECTRIC TELE-INDICATOR DEVICE

Filed July 13, 1934 3 Sheets-Sheet 3

Fig. 6.

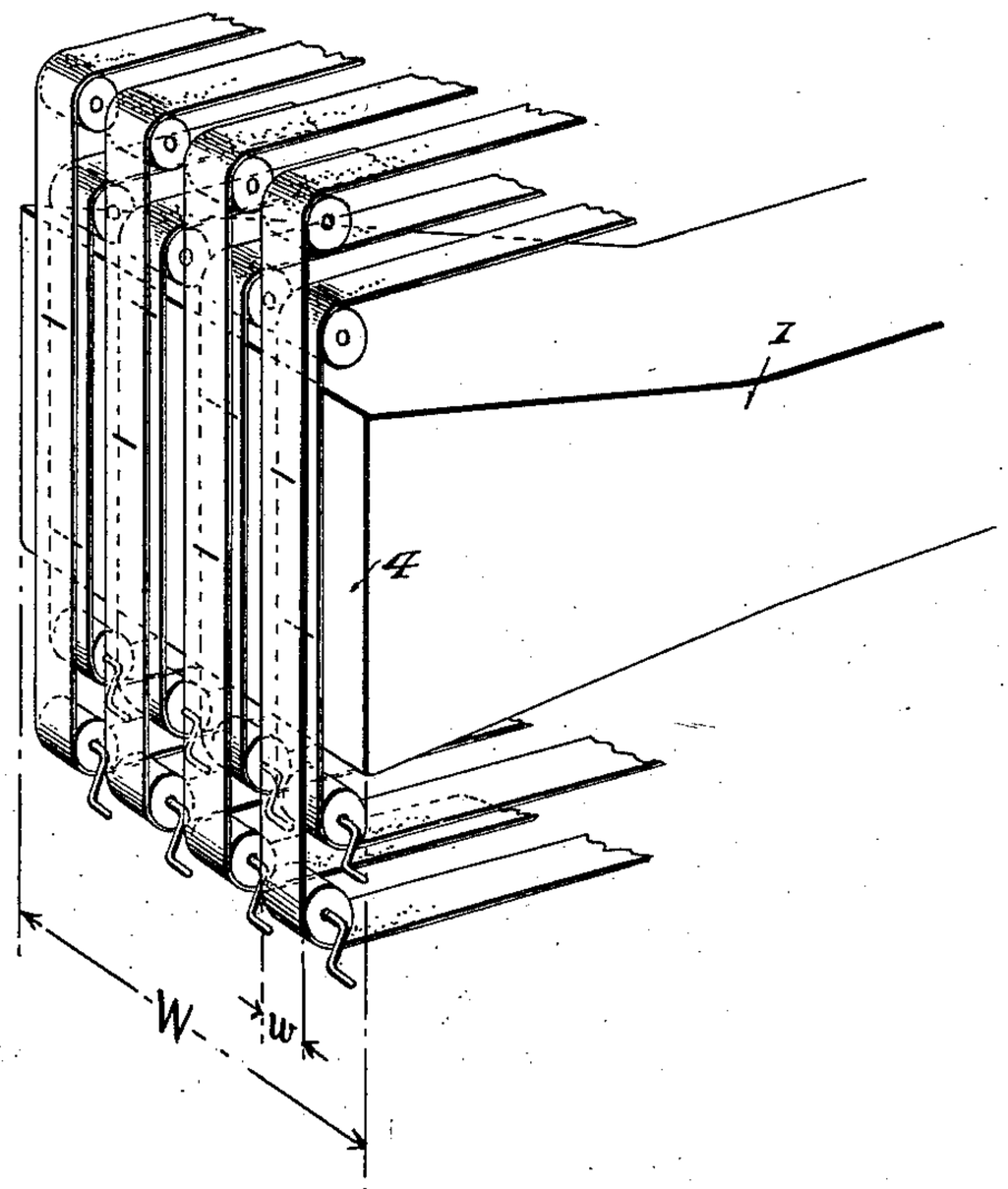
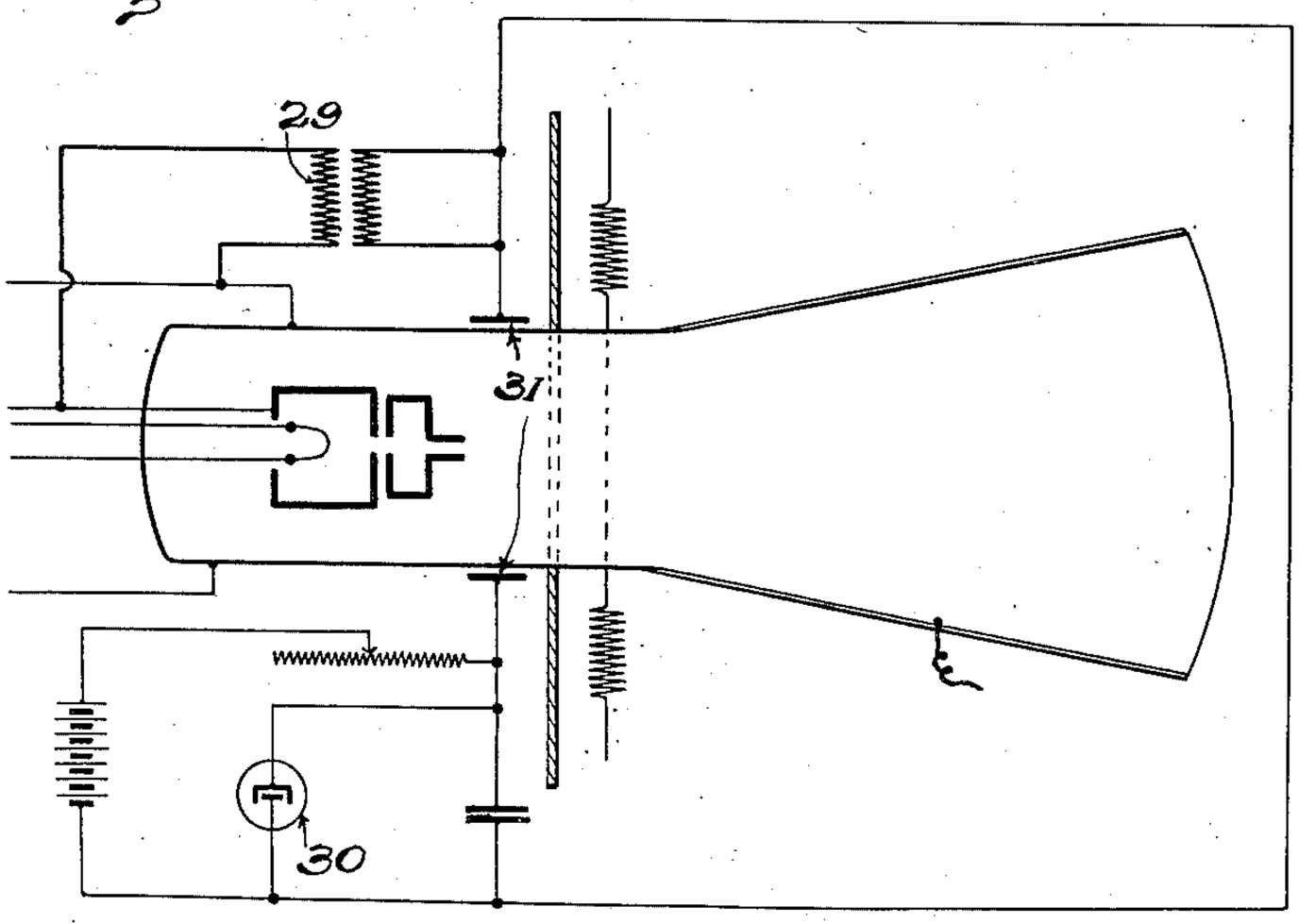


Fig. 7.



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UNITED STATES PATENT OFFICE

2,148,954

ELECTRIC TELE-INDICATOR DEVICE

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Application July 13, 1934, Serial No. 735,046
In France July 29, 1933

5 Claims. (Cl. 177—351)

This invention relates tc electrical tele-indicating devices for simultaneously transmitting any desired number of indications or signals from a transmitting station to one or more receiving stations, and is more particularly directed to a device for use in gunnery fire control systems for the transmission of aiming angles or the angles of position of the objective relative to the observing stations of wide-base rangefinders.

The transmission of the indications from one station to another may be effected either over wires connecting the stations or by Hertzian waves; in the latter case, the device of the present invention affords the advantage of permitting the simultaneous transmission and reception of a plurality of distinct indications while utilizing only a single wave length for the transmission.

The principal object of the invention is to provide transmission and reception devices of novel construction which may be combined with television apparatus of known form for the purpose of permitting the said apparatus to be utilized as a tele-indicator.

Another object is to provide a tele-indicating system of new and improved construction by means of which a plurality of indications or signals may be simultaneously transmitted from one station to another and reproduced in a single image.

A further object is to provide a tele-indicating device embodying television apparatus for observation and reproduction of the indications to be transmitted with novel means for accentuating the images of said indications produced at the receiving station.

These and other objects will appear more fully upon a consideration of the detailed description of the embodiments of the invention which follow. Although only one form of tele-indicating system embodying the invention, and one modification of a portion of the system, are described and illustrated in the accompanying drawings, it is to be expressly understood that these drawings are for the purpose of illustration only and are not to be construed as defining the scope of the invention, reference being had for this purpose to the appended claims. Referring now to the drawings, wherein like reference characters indicate like parts throughout the several views:

Figure 1 is a diagrammatic side view of one form of transmitting member of a tele-indicator embodying the invention, said member being adapted to communicate to a distance the magnitude of an angle, for example, by simultaneously furnishing both rough and precise indications thereof;

Figure 2 is a front view of a portion of the device shown in Figure 1;

Figure 3 is a cross section, on a greatly enlarged scale, of a portion of one of the index-bearing films of the tele-indicating system of the present invention;

Figure 4 is a diagrammatic illustration of a modified method of reproducing at the receiving station and accentuating an image of the index scanned by the television tube of the transmitting station;

Figure 5 is a diagrammatic showing of a complete tele-indicating system embodying transmitting and receiving members of the construction illustrated in Figures 1 and 2;

Figure 6 is a perspective view of a portion of a transmitting or receiving member constructed in accordance with the present invention for effecting the simultaneous transmission or reception of a plurality of independent indications; and

Figure 7 is a diagrammatic representation of a television tube adapted for use in a receiving apparatus of the type employing the method of image reproduction illustrated by Figure 4.

Referring first to Figure 1, at 1 is shown a cathode ray tube adapted, according to known means, for use as a television transmitter. 2 denotes a lens so disposed as to focus in known manner upon a photo-electric cell 3 the image of the point of light formed on the fluorescent screen 4 by the cathode ray which constantly sweeps out or scans the rectangle 5—5′—5″—5‴ traced on the end of the tube 1 by describing, in the embodiment illustrated, a series of substantially vertically directed adjacent lines.

According to the invention, this television transmitter is combined with novel mechanism for forming the indication to be transmitted to the receiving station; in the embodiment illustrated, the indication to be transmitted is that of the angular position in azimuth of the sighting telescope of a gunnery fire control system or of one station of a wide-base rangefinder. As shown, an operating handle 6 is secured to a shaft 7 supported in suitable bearings below and adjacent the fluorescent screen 4 of television tube 1, said shaft having securely fixed thereto a pulley 8. A second pulley 9 is also mounted on shaft 7 adjacent pulley 8 but is rotatable relatively to said shaft. The pulley 9 is driven from the shaft 7 through a train of reduction gearing comprising a pinion 10 fixed to the shaft 7,

a gear 11 and a pinion 12 fixedly mounted on a shaft 17, and a gear 13 which is secured to pulley 9 and rotatable therewith on shaft 7. Drivably associated with pulley 8, and passing around three guide rollers 8', 8'' and 8''', is a translucent film 14 which bears a plurality of opaque marks or indices 14', 14'', etc., separated from one another by intervals equal to the height *h* of the rectangle 5—5'—5''—5'''. A similar translucent film 15 is drivably associated with the pulley 9 and passes over three guide rollers 9', 9'' and 9''', this film also bearing opaque marks or indices 15', 15'', etc., separated by intervals of height *h*. The pulleys 8 and 9 and the guide rollers 8', 8'', 8''', 9', 9'' and 9''' are so positioned that the films 14 and 15 pass vertically in front of and closely adjacent the fluorescent screen 4 of television tube 1, the driving and tensioning of the films being effected by any suitable known means.

The diameter of the driving pulleys 8 and 9, and the sizes of pinions 10 and 12 and gears 11 and 13, are so selected that when the shaft 7 makes a complete revolution the film 14 moves through a distance equal to the interval *h* while the film 15 moves only a distance equal to *h*/20.

The shaft 17 is also drivably connected in any suitable manner to the sighting telescope 18 the angular position of which is to be indicated by the positions of the indices of films 14 and 15. In the present instance, this driving connection is diagrammatically illustrated as a worm 19 mounted on the shaft 17 and a worm wheel 20 on which the telescope 18 is operatively supported.

As is indicated diagrammatically in Figure 5, the electrical circuits of the television tube 1 and photo-electric cell 3 of the transmitter may be connected in a manner known in the television art to a vacuum tube device 23 of any desired construction wherein the carrier frequency of the system is generated and modulated by the variations in current flow in the circuit of photo-electric cell 3, the modulated output of the device 23 being then transmitted to the receiving station or stations either over wire circuits or, as in the embodiment illustrated, by Hertzian waves.

The mechanism at each receiving station is, as shown in Figure 5, identical with the transmitting apparatus except for three principal changes: first, the television tube 1' is adapted according to known means for use as a television receiver, its electrical circuits being connected to the receiving station antenna through a vacuum tube device 24 of any desired construction which serves to vary the luminous intensity of the cathode ray of the receiver in accordance with the variations in current flow in the circuit of the photoelectric cell 3 of the transmitter; secondly, the lens 2 and photo-electric cell 3 of the transmitting station are omitted and replaced by a suitable rectangular frame 25 having an aperture 26 which limits the field of view of the screen 4 of receiver tube 1' by the receiving station operator; and thirdly, instead of driving the sighting telescope 18, the operating handle 6 is drivingly connected to the member, such as the alidade of a rangefinding or plotting instrument or, in the embodiment illustrated, a gun 27, whose movements in azimuth are to be controlled by the movements of the sighting telescope 18 or other element at the transmitting station. Should the location of the receiver be such that it will be exposed during firing to the blast of large caliber guns, it may be protected by housing it in a suitable metal casing indicated in broken lines at 28 which may carry the view restricting frame 25 and also provide bearings for the shafts 7 and 17 with the handle 6 located outside said casing.

It will be understood that the transmitting and receiving cathode ray television tubes 1 and 1' of the embodiment of the invention just described are provided with the usual circuits incident to television apparatus so that there will be produced on the fluorescent screen 4 of the receiving station an image or picture showing the exact positions at any instant of the indices of the films 14 and 15 at the transmitter. For example, the variations in the current flow generated in the photo-electric cell 3 of the transmitter, due to cutting off of the cathode ray when the latter sweeps over the opaque indices of the films 14 and 15, may be impressed upon the grid of the receiving tube so as to decrease the intensity of the receiver ray in such a manner that its fluorescent screen is not rendered luminous during the instants that the transmitter ray is so cut off. The indices of the transmitter will thus be reproduced as black lines upon the otherwise luminous receiver screen. Since the index-bearing films 14 and 15 of the receiver pass between the fluorescent screen 4 and the rectangular frame 25 through which the image on said screen is viewed, it is obvious that the indices of said films will be clearly visible and can be brought into coincidence with the images of the transmitter indices by simply actuating handle 6 of the receiver.

The receiver having been adjusted so as to cause the two horizontal lines 5—5' and 5''—5''' traced on the screen 4 of the receiver tube to coincide with the images of the corresponding lines traced on the screen of the transmitter tube, it is clear that the images of the indices (14' and 15', for example) appearing on the receiver screen will reproduce in true magnitude the relative positions of the said indices at the transmitting station. Since the positions at any instant of the indices on the films at the transmitter constitute an indication or measurement of the position of the controlling element or sighting telescope 18 of the fire control or rangefinding system driven by shaft 17, it will be understood that the alidade or gun 27 at the receiving station may be laid at the same angle as the said controlling element or telescope by simply actuating the handle 6 of the receiver in such a manner as to bring the indices marked upon the films 14 and 15 of the receiving station into coincidence with the images of the corresponding indices of the transmitter. With a tele-indicating system of this character, it is obvious that all the movements communicated to the handle 6 and telescope 18 at the transmitter can be faithfully reproduced at the receiver.

When the transmission between the transmitting and receiving stations is effected by Hertzian waves, the device of the present invention permits the simultaneous reception on a single wave length of a number of independent indications, the permissible number of indications receivable being determined as follows: denoting by W the width of the rectangle 5—5'—5''—5''' and by *w* the width to be reserved for the space required by a single index-bearing film, it is clear that it is possible to mount within the field scanned by the rays of each television tube W/*w* films, and consequently to receive simultaneously W/*w* dif-

ferent indications on one and the same wave length. For example, there is illustrated in Figure 6 an arrangement of eight individually drivable index-bearing films associated with a single television tube in such a way that the image transmitted at any instant will reveal the positions then occupied by all eight of the indicating films.

In order to render easier the observation and reading of the indications at the receiving station, it is possible to employ at the receiver films dyed in different colors so as to constitute as many distinct vertical columns as there are indications to be received.

Amplification of the current furnished by the photo-electric cell of the transmitter may also be facilitated by employing the device of an auxiliary frequency and tracing on the films of the transmitter, in addition to the indices 14', 14'', etc., a series of equi-distant marks 16 (see Figure 3).

In the embodiment of the invention illustrated in Figure 5, the images of the indices of the films at the transmitting station are produced by a decrease in the intensity of the receiver ray such that the fluorescent screen of the receiver tube is not rendered luminous during the instants that the transmitter ray is cut off by the opaque indices of the transmitter films. By a modification of the invention, however, it is possible to obtain images at the receiver in the form of black lines or points which are also accentuated or underlined by unusually bright lines or points. The method of operation of this modified form of the invention is diagrammatically indicated in Figure 4, while Figure 7 shows how this result may be accomplished by the use at the receiving station of a Braun tube of the type usually employed in oscillographs, that is, a tube which comprises only two orthogonal electric fields for directing the cathode ray.

Assuming that the problem to be solved consists, as before, in transmitting a series of horizontal marks, the modified procedure may be carried out by disposing the two orthogonal electric fields of the receiving tube in such a manner that the fluorescent screen is swept out or scanned, not by a series of vertical lines (as was done in the embodiment first described), but by a series of horizontal lines, and by causing the current generated in the photo-electric cell of the transmitter to act upon that element of the receiver tube which causes the vertical translation of the said horizontal lines. As illustrated by Figure 7, this result may be accomplished by simply adding to a cathode ray oscillograph receiver of known type a transformer 29 connected as shown.

In Figure 4, which shows diagrammatically and for a single signal the mode of operation under consideration, 21—21', 22—22' ... *n*—*n'* represent with an intentionally exaggerated spacing the horizontal luminous lines traced by the cathode ray on the receiver screen. These lines correspond to and are traced in synchronism with the lines scanned by the ray at the transmitter, the successive movements from one horizontal line to the next in a vertical direction being caused by a neon lamp relaxation device of well known construction indicated at 30 which acts upon the condenser 31. As long as the receiver ray maintains the same luminous intensity, no variation in the operation of the apparatus takes place. However, if at a given moment, for example, while traversing the line *n*—*n'*, the luminous intensity of the receiver ray is reduced by reason of a diminution in the amount of current received due to a simultaneous interception of the transmitter ray by one of the opaque horizontal indices of the transmitter films, the transformer 29 will cause the ray of reduced luminosity to be displaced vertically downwardly to the line *a*—*b* and to move along said line during the time that the transmitter ray continues to scan the opaque index, said displacement of the ray being equal in height to the height of the line scanned by the ray at any time. Consequently, there is not only a total disappearance of luminosity along line *n*—*n'* between the points *x* and *y*, but there will also be an increase in the luminosity of line *a*—*b* which will accentuate or underline the black line *x*—*y* because of the fact that this zone *a*—*b* will be scanned by the cathode ray twice in succession, first by the fraction of light remaining when the ray is shifted downwardly from line *n*—*n'* and then by the normal illumination of the ray during its passage along the next lower horizontal line of which zone *a*—*b* is a part. As soon as the transmitter ray passes beyond the index momentarily intercepting it, the current flow generated by the photo-electric cell returns to normal and the receiver ray moves back to the line *n*—*n'*.

Although one specific form of tele-indicating system embodying the present invention, and one modification of a portion of that system, have been disclosed herein, it will be obvious that the invention is not limited to the particular apparatus shown in the drawings but is capable of a variety of mechanical embodiments. For example, while the system illustrated is adapted to transmit to a receiving station located at a gun rough and precise indications of the instantaneous position of a sighting telescope, it is clear that the invention is capable of application in a broader sense to any system wherein it is desired to simultaneously transmit from one station to another a plurality of indications which are independently variable. Likewise, it will be understood that the cathode ray tube shown in Figure 7 represents only one specific expedient that might be employed for causing the current supplied by the photo-electric cell of the transmitting station to act on one of the two orthogonal electric fields which, in the receiving tube, cause and regulate the movements of the cathode ray thereof. Various other changes, which will now become apparent to those skilled in the art, may be made in the form, details of construction and arrangement of the parts without departing from the spirit of the invention. Reference is therefore to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. A tele-indicating system for transmitting indications from a transmitting station to one or more receiving stations, comprising a movable controlling element at the transmitting station an indication of the position of which at any instant is to be transmitted to the receiving station, an index drivably connected with said element and movable thereby in a defined field, a television apparatus connecting said stations including transmitter scanning means so constructed and arranged as to scan the field in which said index moves, a screen at the receiving station and means for producing on said screen an image of the position at any instant of said movable index at the transmitting station relative to its field of movement, a translucent film at the receiving station positioned between said screen and the position from which the latter is viewed by the receiving station oper-

ator and overlying the image-producing area of said screen, said film being positioned in the same relation to said screen as the movable index of said transmitting station is positioned relatively to the field scanned by said scanning means, an opaque index on said film, a controlled element at the receiving station which is to be moved to a position corresponding to that of the controlling element at the transmitting station, and means in driving relation with said controlled element for moving said film relatively to the screen of said receiver tube to bring said opaque index into coincidence with the image of the transmitting station index formed on said screen, coincidence of said opaque index and image bringing said controlled element into a position corresponding with that of said controlling element.

2. A tele-indicating system for transmitting indications from a transmitting station to one or more receiving stations, comprising a movable controlling element at the transmitting station an indication of the position of which at any instant is to be transmitted to the receiving station, a translucent film at the transmitting station having thereon an opaque index, means for moving said film in a defined field in accordance with the movements of said controlling element in such manner that the position of said index in said field at any instant constitutes an indication of the position of said controlling element, a television apparatus connecting said stations including transmitter scanning means so constructed and arranged as to scan the field in which said index moves, a screen at the receiving station and means for producing on said screen an image of the position at any instant of said opaque index at the transmitting station relative to its field of movement, a second translucent film at the receiving station positioned between said screen and the position from which the latter is viewed by the receiving station operator and overlying the image-producing area of said screen, said second film being positioned in the same relation to said screen as the film of said transmitting station is positioned relatively to the field scanned by said scanning means, an opaque index on said second film, a controlled element at the receiving station which is to be moved to a position corresponding to that of the controlling element at the transmitting station, and means in driving relation with said controlled element for moving said second film relatively to the screen of said receiver tube to bring said second opaque index into coincidence with the image of the transmitting station index formed on said screen, coincidence of said second opaque index and image bringing said controlled element into a position corresponding with that of said controlling element.

3. A tele-indicating system for transmitting indications from a transmitting station to one or more receiving stations, comprising a controlling element at the transmitting station, a cathode ray television transmitter tube including a fluorescent screen having a defined field adapted to be scanned by the ray produced in said tube, a light-sensitive cell adjacent said screen, means for focusing upon said cell the luminous image produced by impingement of said ray upon said screen, a translucent film positioned between said screen and said focusing means and having thereon an opaque index, means for moving said film to vary the position of the index with respect to the field of said screen scanned by the ray of said tube, said last named means being operatively associated with said controlling element in such manner that the position of said index with respect to said field at any instant constitutes an indication of the position of said controlling element, a cathode ray television receiver tube at the receiver station including a fluorescent screen, means for producing on said last named screen an image of the said index at the transmitting station in its position relative to the field of the screen of said transmitter tube, a second translucent film positioned between the screen of said receiver tube and the position from which the latter is viewed by the receiving station operator and overlying the image-producing area of said last named screen, said second film being positioned in the same relation to its screen as the film of said transmitting station is positioned relatively to the field of the screen scanned by the ray of said transmitter tube, an opaque index on said second film, a controlled element at the receiving station which is to be moved to a position corresponding to that of the controlling element at the transmitting station, and means in driving relation with said controlled element for moving said second film relatively to the screen of said receiver tube to bring the index carried thereby into coincidence with the image of the transmitting station index formed on said screen, coincidence of said index and image bringing said controlled element into a position corresponding to that of said controlling element.

4. A tele-indicating system according to claim 3 including cathode ray television tubes of the type embodying two orthogonal electric fields for moving the ray in two directions only at right angles to one another, each of the indices upon said translucent films being parallel to one of said two fields, and means for varying the other electric field of the receiver tube in accordance with the variations in current flow produced in the light-sensitive cell at the transmitting station when the transmitter ray is cut off from said cell by the opaque index of the transmitter film.

5. A tele-indicating system according to claim 3 wherein the cathode ray television tube at the receiving station is provided with two orthogonal electric fields one of which effects a movement of the ray at right angles to the direction of scanning movement thereof in response to variations in current flow produced in the light-sensitive cell at the transmitting station when the transmitter ray is cut off from said cell by the opaque index of the transmitter film.

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