

[54] **DISPLAY UNIT WITH RADIATION SENSITIVE CONTROL**

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[22] Filed: **June 15, 1970**

[21] Appl. No.: **46,441**

[52] U.S. Cl. **250/219 FR, 40/53**

[51] Int. Cl. **G09f 11/00**

[58] Field of Search **250/219 C-219 D, 250/219 DD, 219 FR, 208, 209; 40/31, 32, 53**

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[57] **ABSTRACT**

A display unit comprises a box housing two spools between which a strip of film frames is wound past a window first in one direction and then in the other direction. Reversal of the direction of film drive is initiated by two photo-electric cell arrangements adapted to detect the approach of the end of the strip in each direction. As each individual frame registers with the window, the strip is stopped to display the frame for a predetermined period. The registering of a frame with the window is detected by a photo-electric cell arrangement detecting marks suitably distributed along an edge of the strip to correspond to the individual frames. The three photocells are connected in electrical control circuitry, each photocell being connected to the input of a respective Schmitt trigger circuit. The outputs of the Schmitt triggers associated with the direction reversing photo-cells are fed to a first relay operative to effect reversal of a motor driving the spools. The output of the other Schmitt trigger is fed via a timing circuit to a second relay operative to initiate rear illumination of a frame registered with the window and to cause the application of a brake to the motor. To ensure that the film strip is tensioned during its movement in either direction, in one embodiment of the invention each spool is driven through a retarder providing resistance to rotation in the direction applying when the strip is being unwound from that spool.

9 Claims, 7 Drawing Figures

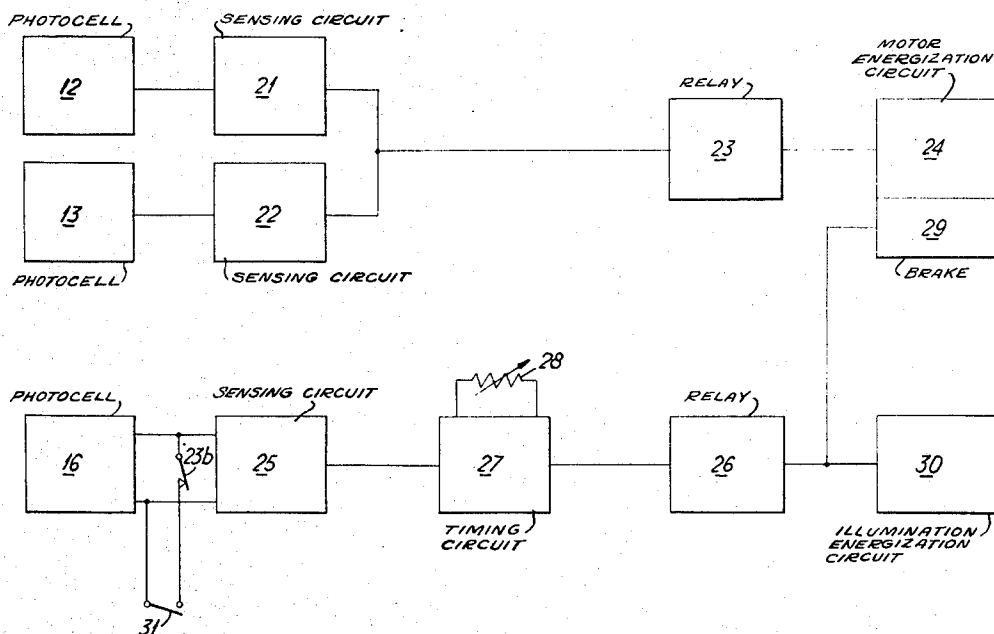


Fig. 1

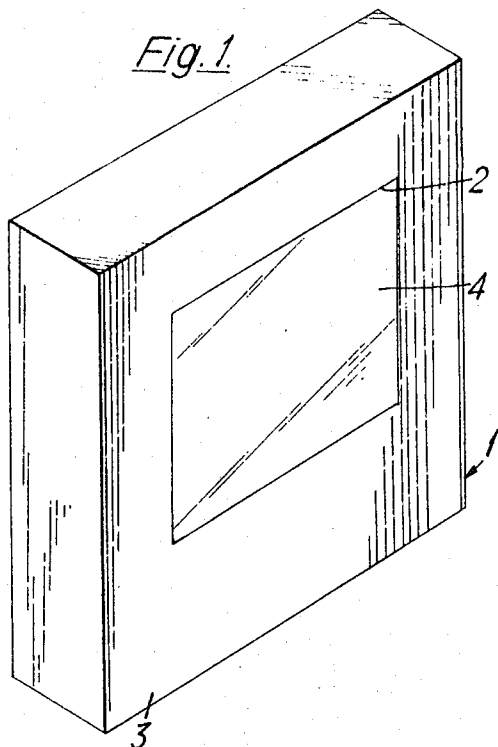


Fig. 2

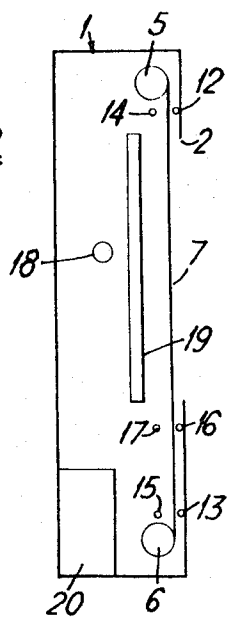
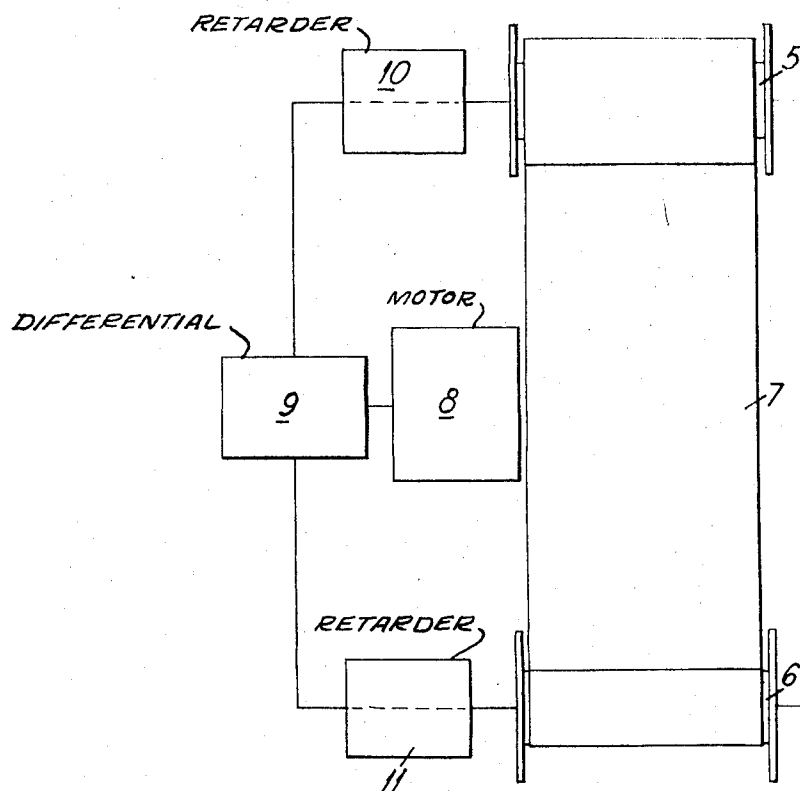
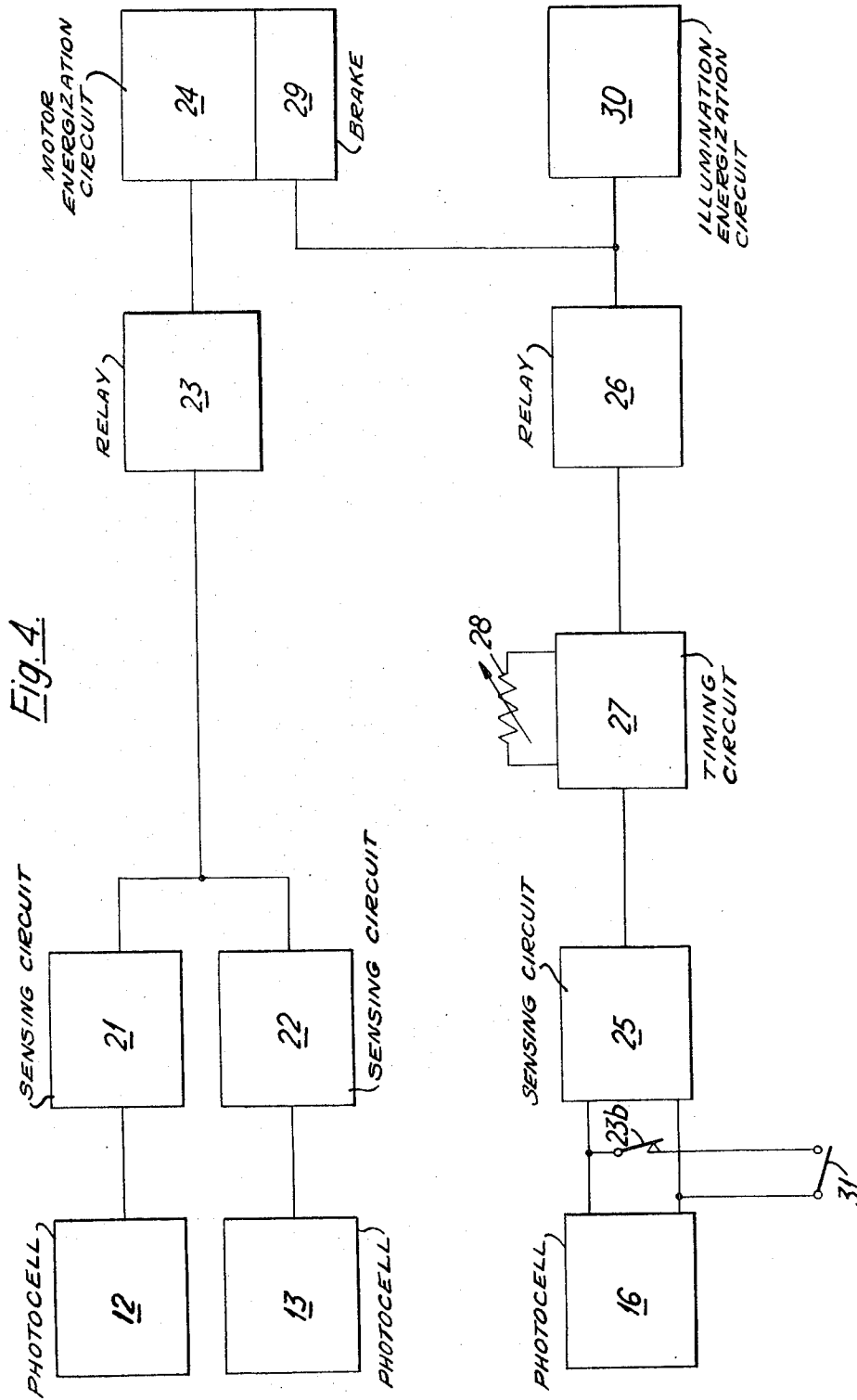


Fig. 3.





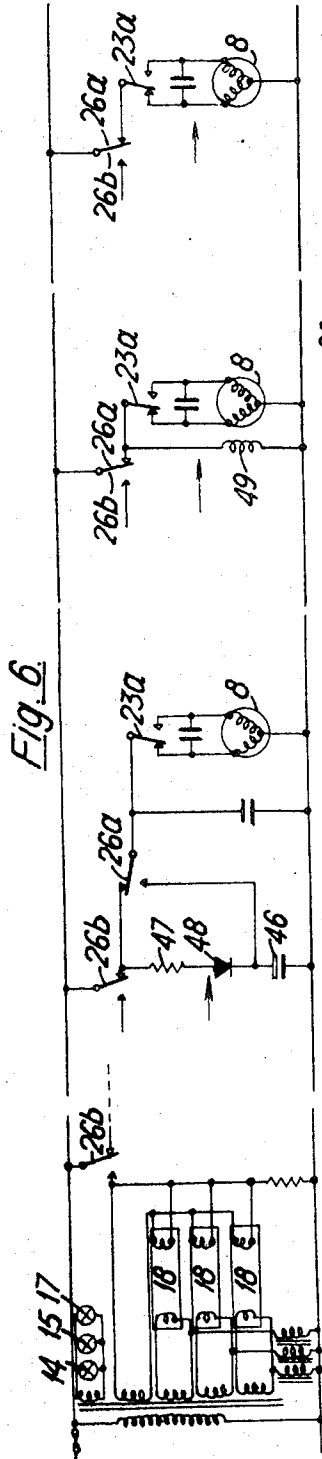
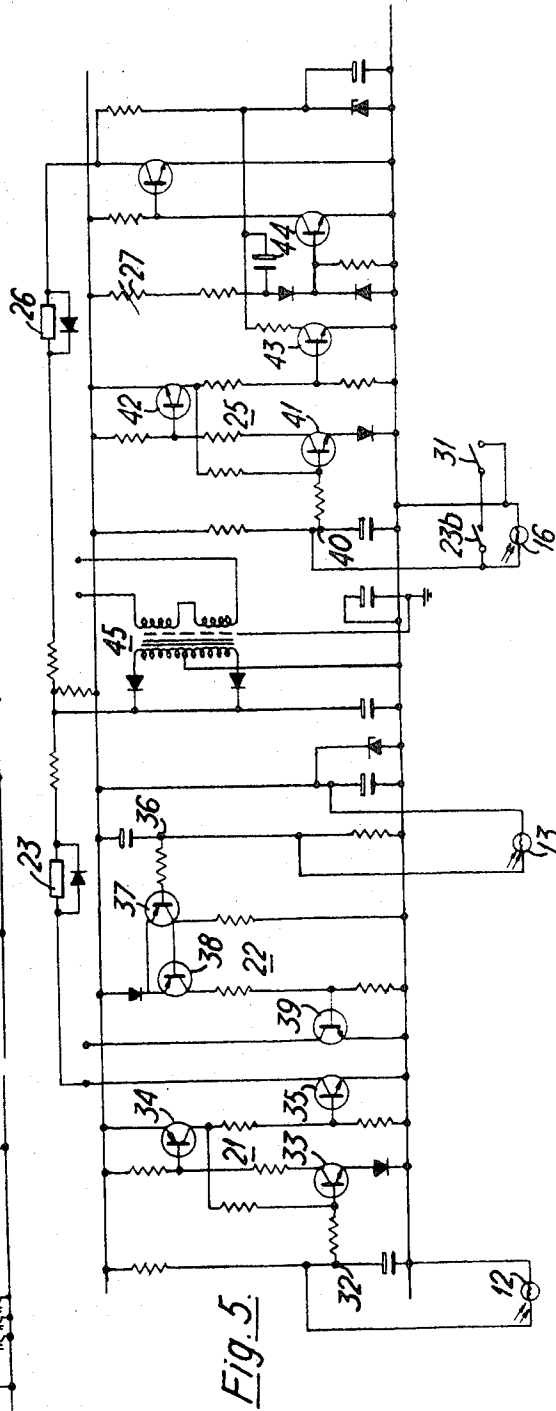
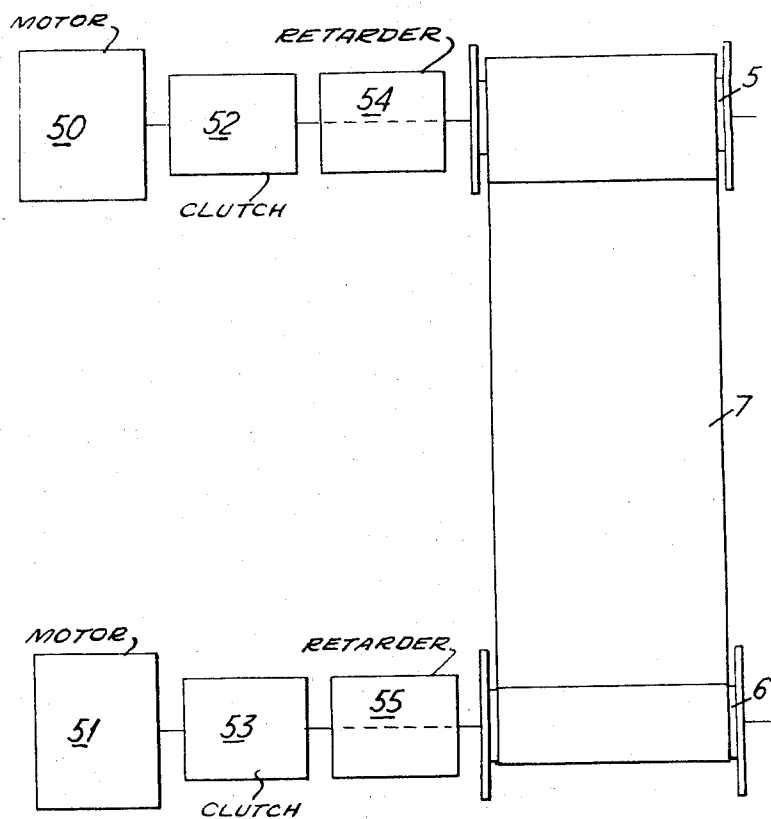


Fig. 7.



DISPLAY UNIT WITH RADIATION SENSITIVE CONTROL

This invention relates to a display unit for displaying, in turn, a number of frames which are to be viewed. The invention lends itself particularly to displaying, in a common display area, a number of advertisements represented by individual frames.

In accordance with the broadest aspect of this invention, a display unit comprises a box formed with a window, supports inside the box for a strip of frames which are to be individually displayed while spanning across the window, a drive for moving the strip in the direction of its length past the window, a sensor which responds to the registration of each frame with the window by stopping the drive and starting a timer, and means controlled by the timer for restarting the drive after a predetermined display time of the frame in the window has elapsed.

A display unit of the invention has the advantage that it may be compactly constructed and enables a large number of frames, such as advertisements, to be displayed in turn in a small area defined by the window. The frames may be opaque so that the ambient illumination is sufficient for them to be identified. However, the invention is particularly suited for the display of illuminated film frames.

In accordance with a second aspect of this invention, a film display unit comprises a box formed with a window, supports inside the box for strip of film frames which are to be individually displayed while spanning across the window, a drive for moving the strip in the direction of its length past the window, a sensor which responds to the registration of each frame with the window by stopping the drive and starting a timer, a source of illumination disposed behind the film and adapted to be energized while the film drive is inoperative, and means controlled by the timer for restarting the drive and extinguishing the source of illumination after a predetermined display time of the frame in the window. The time taken for the drive to replace one frame in the window with another is quite short, being preferably less than a second, and during this period an observer's attention is not distracted by the moving film, as the source of illumination is extinguished.

The supports inside the box for the film strip preferably comprise a pair of spools, and the film strip comprises a length of film which is received on said spools and which is alternately moved from by frame past the window in one direction and then reversed when the final frame has been displayed.

Means are provided for sensing when the final frame has been displayed in either direction of movement of the strip, such mean controlling the drive to obtain reversal of the direction of movement following display of the final frame. Suitably, one edge of the film is marked adjacent each end by a single dark area, the edge of the film between these dark areas being transparent. A photo-electric cell is disposed adjacent each spool to detect a respective one of these dark areas and each such photo-electric cell has a light-sensitive surface which is normally illuminated by a beam of light, the illumination being interrupted when the corresponding dark area passes over the face of the sensitive surface. Each photo-electric cell produces an electric pulse indicating that the end of the film has been reached in a respective direction, and this pulse is used to initiate reversal of the drive.

The drive suitably includes means for tensioning the strip as it is driven in either direction. A single electric motor arranged to run in either direction may be used to drive both the spools through a differential unit and, in this case, the tensioning means conveniently comprises a one-way retarder for each spool, such retarder providing resistance to rotation in the direction of rotation applying when the strip is being unwound from that spool. Alternatively separate electric motors arranged to run in opposite directions may be used to drive the spools independently, the motors being energized alternately to provide the direction of strip movement required. Each motor is connected to a respective spool through a one-way clutch and a one-way retarder, such retarder providing re-

sistance to rotation in the direction of rotation applying when the strip is being unwound from the respective spool.

Various forms of sensor may be used to detect when each frame of the strip registers, that is to say is centered within, the window. Suitably, the sensor comprises a photo-electric cell having a light-sensitive face toward which a beam of light is directed. A marginal portion of the other edge of the strip from the edge having the dark areas denoting the ends of the strip is transparent and passes across the face of the photo-electric cell so that the cell is normally illuminated by the light beam. The transparent marginal portion at the said other edge of the strip is provided with a number of dark marks, one for each frame of the strip, which are so positioned that they come opposite the face of the photo-electric cell when the associated frame registers with the window. The photo-electric cell, therefore, provides an electric pulse each time a frame is displayed in the window. By suitable electrical circuitry, this pulse can be used to stop operation of the drive motor moving the film and to start a timing circuit. A relay controlled by the photo-electric cell is adequate for this purpose and the timing circuit is so arranged that the relay is de-energized at the end of the timing period so that the drive motor is re-energized after each frame has been displayed in the window for a predetermined time.

Embodiments of the invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a display unit embodying the invention;

FIG. 2 is a side view of the display unit with a side wall removed, the contents of the unit being illustrated schematically;

FIG. 3 is a schematic illustration of the drive system of the display unit;

FIG. 4 is a block diagram of the electrical control circuitry of the display unit;

FIG. 5 is a circuit diagram of the electrical control circuitry;

FIG. 6 is a circuit diagram illustrating the energization circuit for the illumination of the film strip and photo-electric cells and the energization circuit for the drive motor, three motor braking arrangements being shown; and

FIG. 7 illustrates schematically an alternative drive system for the display unit.

A display unit comprises an upstanding shallow rectangular box 1 formed with a rectangular window 2 arranged in one of its larger vertical faces, hereinafter called the display face 3. The window 2 is spanned by a sheet 4 of transparent methyl methacrylate material, such as the material known commercially under the Registered Trade Mark "Perspex."

Mounted inside the box 1, close behind the display face 3, are two spools 5 and 6 arranged for rotation about vertically aligned horizontal axes, a first spool 5 being disposed at the top of the box 1 and the second spool 6 being disposed at the bottom.

Means are provided for rotating the spools in order to move a film strip 7 received on the spools past the window 2 in either direction. A suitable drive, shown schematically in FIG. 3, comprises an electric motor 8 adapted to run in either direction and connected to drive a differential unit 9 through the planet carrier. Each of two output belt pulleys from the differential unit 9 is coupled by a belt to a pulley rigidly attached to a drive spindle of a respective one of the spools 5 and 6. The spool 5 or 6 is provided with a one-way retarder 10 or 11 in the form of a friction brake attached to a one way clutch which selects the direction of rotation in which the brake acts. The retarder 10, 11 provides resistance to rotation of its associated spool 5, 6 in the direction of rotation applying when the strip 7 is being unwound from that spool and thereby tensions the strip.

The film strip 7 comprises a length of film carrying longitudinally spaced printed frames thereon. Each film frame is of the same size as the window in the box so that it can be registered therewith.

A marginal portion of one edge of the strip 7 is transparent and is provided adjacent either end with a single dark area denoting the end of the strip. First and second photo-electric cells 12 and 13 (FIG. 2) are respectively associated with the first and second spools 5 and 6, each such photo-electric cell 12, 13 being arranged to detect a respective one of the dark areas denoting the ends of the strip 7. Each of the first and second photo-electric cells 12, 13 is disposed in front of the strip 7 opposite a respective low power light bulb 14, 15 arranged behind the strip 7 so that it directs towards the photo-electric cell 12, 13 a beam of light which normally illuminates a light sensitive face of the cell through the transparent marginal portion of the one edge of the strip 7.

A marginal portion of the other edge of the strip 7 is also transparent and is provided with a series of dark areas associated with the individual frames of the strip. One dark area is provided for each frame and it is precisely positioned so that it comes opposite the light sensitive face of a third photo-electric cell 16 (FIG. 2) when the associated frame registers with the window. This third photo-electric cell 16 is disposed in front of the strip 7 and a low power light bulb 17 is arranged behind the strip so that it directs towards the photo-electric cell 16 a beam of light which normally illuminates the light sensitive face of the cell through the transparent marginal portion of the said other edge of the strip 7.

A frame registering with the window 2 is illuminated from behind by a source of illumination 18, shown schematically in FIG. 1, comprising a number of fluorescent tubes shining through a diffuser plate 19. A reflector plate may be disposed behind the fluorescent tubes to ensure that the bulk of the light is evenly distributed over the area of the frame registering with the window.

Fitting inside the lower portion of the box 1 is an enclosure 20 containing electrical control circuitry for the display unit. The circuitry has two basic sections, as shown schematically in FIG. 4, namely a first control section concerned with control of the direction of movement of the film strip 7 and a second control section concerned with control of the stopping of the film 7 when a frame registers with the window 2 in the box 1 and the illumination of the film.

The first control section comprises two light level sensing circuits 21, 22 each of which includes a Schmitt trigger. The input of each of the Schmitt triggers is connected to a respective one of the first and second photo-electric cells 12, 13, and the output of each Schmitt trigger is connected to a first relay 23. Each of the first and second photo-electric cells 12, 13 has a low resistance when its sensitive face is illuminated and a high resistance when such face is dark. When either of the first and second photo-cells 12, 13 detects the respective dark area on the one marginal edge of the strip 7, the change in resistance of the cell is transmitted as an input pulse to the respective Schmitt trigger circuit 21, 22 which gives an output signal to the first relay. A contact 23a (FIG. 6) of the first relay is included in the energization circuit 24 of the drive motor 8 and operation of the relay 23 changes the polarization of the electrical supply to the motor 8, thereby causing the motor to run in the opposite direction to that in which it was running prior to the actuation of the photo-cell in question and the direction of movement of the film 7 is thereby reversed.

The second control section comprises a light level sensing circuit 25 including a Schmitt trigger, the input of which is connected to the third photo-electric cell 16. The output of the Schmitt trigger is connected to a second relay 26 via a capacitor-resistance timing circuit 27 having a time constant adjustable by a resistor 28. The third photo-electric cell 16 has a low resistance when its sensitive face is illuminated and a high resistance when such face is dark. When the photo-electric cell 16 detects a dark area on the said other edge of the film strip 7, the change in the resistance of the cell 16 is transmitted as an input pulse to the Schmitt trigger circuit 25 which gives an output signal to the second relay 25. A contact 26a (FIG. 6) of the second relay 26 is included in the energization

circuit 24 of the drive motor 8 and operation of the second relay 26 de-energizes the drive motor 8 and causes application of a brake 29 to the motor, if such a brake is fitted. Another contact 25b (which in some cases is combined with contact 25a) of the second relay 26 also controls the energization circuit 30 of the source of illumination 18 behind the film strip 7. This contact is so arranged that the de-energization of the drive motor 8 occurs simultaneously with illumination of the film frame in the window 2. The third photo-electric cell 16 is shunted by a loop including a contact 23b of the first relay 23 and an index switch 31 which permits a choice of whether the film 7 is to be stopped and illuminated frame-by-frame in both directions of film movement or in one direction only.

The electrical control circuitry is shown in more detail in FIG. 5 where the first photo-electric cell 12 is shown connected to the input 32 of the Schmitt trigger circuit 21 comprising NPN transistor 33, PNP transistor 34 and NPN transistor 35, the last transistor having its collector connected to the first relay 23. Similarly, the second photo-electric cell 13 is connected to the input 36 of the second Schmitt trigger circuit 22 comprising PNP transistor 37, PNP transistor 38 and NPN transistor 39, the last transistor having its collector connected to the first relay 23. The third photo-electric cell 16 is connected to the input 40 of the Schmitt trigger circuit 25 comprising NPN transistors 41, 42 and 43, the last transistor having its collector coupled to the second relay 26 via a timing circuit including capacitor 44 and variable resistor 27. A transformer-rectifier arrangement 45 provides d.c. power from the mains.

Various braking arrangements, shown in FIG. 6, may be used to effect braking of the motor 8 when it is de-energized. One arrangement employs a capacitor 46 which is connected in a charging circuit including resistor 47 and diode 48 so as to be charged while the motor 8 is energized. On operation of the second relay 25 to break the energization circuit of the motor 8, the capacitor 46 is simultaneously connected across the motor 8 and the energy stored in the capacitor 46 is used to effect braking. In another arrangement, the drive motor is fitted with a spring-loaded brake. This brake is held in an inoperative position by a solenoid 49 when the motor 8 is energized. On operation of the second relay 26 to de-energize the motor 8, the solenoid 49 is de-energized and the brake is applied by the action of the spring. In yet another arrangement, overrun of the motor on de-energization is prevented by a brake in the film drive which does not act directly on the motor.

Normal operation of the display unit with display of the frame for both directions of movement of the strip is as follows. When the unit is first switched on, the film strip 7 will initially be set moving downwards, thereby placing all the film frames onto the lower, second spool 6. When the first photo-electric cell 12 detects the dark area on the one edge of the strip associated with the end of the strip received on the upper, first spool 5, the first relay 23 is operated and the drive motor 8 is reversed to move the strip upwardly. As the first frame registers with the window 2 of the box 1, the third photo-electric cell 16 detects the dark area associated with this frame and the second relay 26 is energized to stop the drive motor 8 and illuminate the frame. After elapse of the predetermined period of the timing circuit 27, 44, the output signal to the second relay 26 is cut off and the relay de-energized. As a result, the source of illumination 17 is extinguished, the brake is removed from the drive motor 8 and the motor is energized. The strip 7 thus continues its upward movement and each succeeding frame is displayed in the window 2 for the predetermined period. After the last frame has been displayed and the strip 7 continues its upwards movement, the second photo-electric cell 13 detects the dark area on the one edge of the strip received on the second spool 6. The first relay 23 is again operated and the drive motor 8 is reversed to move the strip downwardly. The film frames are then again each displayed for the predetermined period in a sequence starting with the last displayed frame and ending with the first displayed frame. This display sequence continues as long as the unit remains switched on.

During operation of the display unit, the drive for the spools operates in such a manner that the strip 7 is maintained in tension. Assuming that the strip 7 is being moved downwardly and is, therefore, being unwound from the first spool 5 and wound onto the second spool 6, the electric motor 8 applies a torque to the planet carrier of the differential unit 9. The differential unit 9 transmits half of this torque to each of its output belt pulleys, and these partial torques are transmitted via the belts to the pulleys on the spool drive spindles. The part of the torque applied to the first spool 5 acts against the retarder 10 of that spool and provides a reaction through the differential unit 9 to allow an equal torque to be applied to the second spool 6. The whole of the torque applied to the second spool 6 is reacted by tension in the film strip 4 as the retarder 11 of this spool is inoperative for the direction of rotation under consideration. The film tension is in turn reacted by the first spool 5 and hence the retarder 10 of the first spool must resist the torque due to the drive reaction plus the torque due to the film tension. The film tension may, therefore, be adjusted by adjustment of the value of the retarder torque. During transfer of the film strip 7 from the second spool 6 to the first spool 5, the film 7 is similarly maintained under tension by the retarder 11 of the second spool 6.

In alternative embodiment schematically illustrated in FIG. 7, the drive for the spools includes separate electric motors 50 and 51 for the two spools 5 and 6, such motors being arranged to run in opposite directions and being energized alternately under the control of the first relay 23 to provide the direction of strip movement required. Stopping of the motor 50 or 51 operative during movement of the strip 7 for the purpose of displaying the individual frames in the window 2 is effected by the second relay 26 as before. Each motor 50, 51 is connected to its respective spool 5, 6 through a one-way clutch 52, 53 and the spool is provided with a one-way retarder 54, 55, such retarder providing resistance to rotation in the direction of rotation applying when the strip 7 is being unwound from the respective spool 5, 6. In this embodiment also, therefore, the film strip 7 is maintained under tension during its movement. Assuming that the strip 7 is being unwound from the first spool 5 and wound onto the second spool 6 the motor 51 driving the second spool 6 is energized and that driving the first spool 5 is de-energized. The motor 51 drives the second spool 6 through the respective one-way clutch 53 which is devised to drive in this direction only. The retarder 55 attached to the second spool is inoperative with this direction of rotation, but the retarder 54 attached to the first spool 5 is operative and the film strip 7 is therefore transferred from the first spool 5 to the second spool 6 under tension applied by the retarder 54 of the first spool 5. The tension applied to the film strip 7 and the speed of film transfer will vary throughout the transfer cycle, but these variations can be minimized by suitable dimensioning of the spools 5, 6. During transfer of the film strip 7 from the second spool 6 to the first spool 5, the film 7 is similarly maintained under tension by the retarder 55 of the second spool.

A protection circuit (not illustrated) may be provided for the display unit to prevent damage to the motor or other parts of the drive in the event of malfunctioning. Such protection circuit may include a third relay and an associated electrical timer, such as a CR timing circuit. The timing circuit is arranged to give a short time period when the machine is operated in the index mode to provide step-by-step movement of the film, and a long time period when the machine is operated in the rewind mode.

The contacts of the third relay are wired in series with the supply to the motor and thus cut off the electrical supply to the motor in the event of malfunctioning of the unit to prevent damage to the motor or other parts of the drive.

The timing circuit is reset each time the dark areas on each frame pass in front of the third photo-cell. This is effected using a contact of the second relay to short circuit the timing capacitor of the timing circuit. When the period of display of a frame ends and the film is moved on again, the timing capacitor starts to charge via a large or small value resistor depend-

ing on the time interval required. This interval would typically be 10 seconds for the index mode of the unit and 3 minutes for the rewind mode. If, due to film breakage or stalling of the motor, a further frame has not moved into position within the required period, then the timing capacitor becomes fully charged and is used to energize the third relay which is maintained energized via one of its own contacts until the electrical supply is switched off. Should the power supply be reconnected and a fault still be present, then the timing circuit will again cause cut-out as before and the supply to the motor will be disconnected.

We claim:

1. A display unit comprising:

a box formed with a window;

support means inside the box for supporting a strip of film frames to be individually displayed while spanning across the window;

said support means including a pair of spools on which the film strip is received for movement frame by frame past the window;

a film drive for moving the film strip longitudinally past the window;

a timer;

sensing means responsive to the registration of each frame with the window for stopping the film drive and starting the timer;

a source of illumination disposed behind the strip of film frames and operative to illuminate the registered film frame while the film drive is stopped;

means controlled by the timer for restarting the film drive and extinguishing the source of illumination after a predetermined display time of the registered frame in the window; and,

means for sensing when the final frame has been displayed in either direction of movement of the film strip and for controlling the film drive to obtain reversal of the direction of movement imparted to the film strip following the display of the final frame;

said means for sensing when the final frame has been displayed including:

a dark area marked on each of the film strip adjacent each end of the film strip, the edge of the film strip between the dark areas being transparent; and,

a photoelectric cell disposed adjacent each spool to detect a respective one of the dark areas, each photoelectric cell being normally illuminated by a beam of light, the illumination being interrupted when the corresponding dark area passes over the photoelectric cell, whereby the cell produces an electric pulse indicating that the end of the film strip has been reached in a respective direction.

2. A display unit as claimed in claim 1, wherein each photoelectric cell is connected to the input of a Schmitt trigger circuit the output of which is connected to a relay having a contact operative to effect reversal of the direction of rotation of a drive motor when the photoelectric cell produces a pulse indicating that the end of the film strip has been reached.

3. A display unit as claimed in claim 1, wherein the drive for the film strip comprises an electric motor arranged to run in either direction, a differential unit through which the drive motor drives both the spools, and a one-way retarder through which each spool is driven by the differential unit, each such retarder providing resistance to rotation in the direction of rotation applying when the film strip is being unwound from that spool.

4. A display unit as claimed in claim 1, wherein the drive for the film strip comprises an electric motor for driving each spool independently, such motors being arranged to run in opposite directions and each motor being connected to drive its respective spool through a one-way clutch and a one-way retarder which provides resistance to rotation in the direction applying when the strip is being unwound from the respective spool.

5. A display unit as claimed in claim 1, wherein the sensing means which responds to the registration of each frame of the film strip with the window is a photo-electric cell.

6. A display unit as claimed in claim 5, wherein a transparent marginal portion of an edge of the film strip is provided with a number of dark marks, one for each frame of the strip, which are so positioned that they come opposite the photo-electric cell when the associated frame registers with the window, the photo-electric cell being normally illuminated through the marginal portion of the film strip by a beam of light whereby the photo-electric cell provides an electric pulse each time a frame is displayed in the window.

7. A display unit as claimed in claim 6, wherein the photo-electric cell is connected to the input of a Schmitt trigger circuit the output of which is connected via the timer to a relay having contacts operative to stop the operation of the drive and to energize the source of illumination disposed behind the film strip when the photo-electric cell provides a pulse indicating that a frame is displayed in the window, the relay being de-energized by the timer after a predetermined display time of the frame in the window so that the drive is again set in operation and the source of illumination is extinguished.

8. A display unit comprising:

a box formed with a window defining a viewing area in one side thereof;

support means mounted inside said box for receiving an elongated strip of image frames to be individually displayed in said viewing area;

drive means operatively connected to said support means for moving said strip longitudinally past said window;

a timer;

sensing means disposed along one edge of said strip end responsive to the registration of each image frame with said window for deenergizing said drive means and energizing said timer;

a source of illumination for projecting light toward said window and through an image frame in registration with said

window;

said source of illumination being energized in response to the deenergization of said drive means;

braking means operative in response to said sensing means for applying a braking force to one of said strip and said drive means when the registration of an image frame with said window is sensed;

means operative in response to said timer for restarting said drive means and extinguishing said source of illumination after a predetermined display time of an image frame;

a dark area carried by the other edge of said strip of image frames adjacent each end of said strip, the edge of said strip between said dark areas being transparent;

first and second light sources spaced along the length of said strip adjacent said other edge of said film strip outside said viewing area defined by said window and on one side of said film strip;

first and second light responsive cells each disposed adjacent a respective one of said light sources on the other side of said strip so that said cells are normally illuminated by light from said associated light sources, the illumination being interrupted when one of said dark areas on said strip passes between one of said light sources and its associated cell;

means for generating an electrical signal responsively to the interruption of the illumination of said cell to indicate that an end of said strip has been reached; and,

means for reversing the direction of said drive means in response to said electrical signal.

9. The display unit as claimed in claim 8, wherein the drive for the strip of image frames comprises an electric motor arranged to run in either direction, a differential unit through which the electric motor drives both of the spools, and a one-way retarder through which each spool is driven by the differential unit, each retarder providing resistance to rotation in the direction of rotation applying when the strip is being unwound from that spool.

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