

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO CINE PROJECTORS

- (71) We, AGFA - GEVAERT AKTIEN-GESELLSCHAFT, a body corporate recognised under German Law, of Leverkusen, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention relates to cine projectors.
- The invention provides a cine projector comprising receiving means for a plurality of film cassettes, a pair of reels mounted about a common first axis and so positioned that, when in use the receiving means contains a plurality of cassettes, one of the reels is in a position for receiving film from a cassette in the projection position and the other is in a position from which film can be re-wound into that cassette after the cassettes have been advanced to bring the next cassette into the projection position, and means for permitting the pair of reels to be pivoted about a second axis through 180° to interchange the positions of the reels.
- With such a projector, it is possible for a plurality of films in cassettes to be projected one after another, without having to wait for one film to be re-wound before the next is projected, because the rewinding of one film can be accomplished during projection of the next. Further, the means provided to achieve this can be made at comparatively low cost while being reliable in operation.
- Advantageously, the pivoting of the reels to interchange their positions is arranged to cause the cassettes to be advanced to bring the next cassette into the projection position. Preferably, the said advancement of the cassettes is achieved by an advancement of the cassette receiving means; preferably, the said advancement of the cassette receiving means is in a direction parallel to the axis of the cassettes and is equal to the thickness of a cassette in that direction. Preferably, the pivoting means includes a control spindle which is arranged to rotate through 180° when the reels are interchanged, and which so engages the cassette receiving means as to effect the said advancement thereof in response to a rotation through 180°. The engagement between the spindle and the cassette receiving means may be by means of a rack on the cassette receiving means and a pinion secured to the spindle.
- Advantageously, the pivoting of the reels to interchange their positions is arranged to actuate displacing means for displacing film out of the means for guiding the film between the cassette and the take-up reel (for example, the film platform and the film guide channel).
- Advantageously, the pivoting means includes a control spindle, the axis of which coincides with the said second axis, and which is secured to the means on which the reels are mounted so that the reels are together pivoted about 180° when the spindle is rotated through 180° about its axis.
- Advantageously, there is provided drive means arranged so that, when in use the receiving means contains a cassette in the projection position and the film therein is being projected, the reels are pivoted through 180° to interchange their positions in response to the end portion of the film being projected being reached. Preferably, the drive means is arranged to sense the end portion of the film being projected, the sensing being by means of a beam of light incident on the film.
- Preferably, the drive means includes switching means arranged to receive light transmitted through the film being projected, the switching means being arranged to pivot the reels in response to the intensity of light incident thereon changing between the values for when the picture section, and for when the tail section, is passing through the light incident on the switching means. Such an arrangement can be used with a film having a tail section which transmits a proportion of light incident on a given area which is greater than, or less than the proportion of light transmitted by substantially any given area of picture section. The switching means may be arranged to arrange to pivot the reels in response to the intensity of light incident

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thereon falling below a certain value. The projector can thus be used with films having a tail section which transmits a lower proportion of light than does the picture section, provided the said certain value is only reached when the tail section of the film moves into the path of light incident on the switching means.

The switching means preferably includes a photo-sensitive device, the electrical value of which is dependent on the intensity of the light incident thereon. Preferably, the photo-sensitive device forms an input to a control device having two states, the pivoting of the reels being arranged to take place in response to a change from one state to the other. The control device may include a semi-conductor which is conductive in one state of the device and non-conductive in the other. The control device may include a tripping stage.

Preferably, there is provided a retarding circuit arranged to render the switching means operative from an inoperative condition after a delay after actuation of the retarding circuit in order to prevent the premature pivoting of the reels. By arranging, when the drive means is operated to pivot the reels in response to the tail section of the film passing through the path of light incident on the switching means, that the delay is of suitable magnitude, it is possible to use films in the projector having a leader section of the same light transmission as the tail section of the film without there being any danger of the drive means being operated prematurely in response to the leader section as the film is being threaded through the projector. The retarding circuit may be arranged to be actuated by the film in the projection position as it is being threaded into the projector. Preferably, the retarding circuit is arranged to be actuated by being connected to a voltage source by means of a feeler switch actuated by the film. Preferably, the retarding circuit includes a tripping stage, the input of which is connected to a time section for providing the delay consisting of a resistor and a capacitor. The output of the retarding circuit preferably includes an electromagnet for rendering the switching means operative and inoperative.

The drive means may be arranged to be switched off after pivoting of the reels through 180° by means of a cam switch of a cam which is arranged to be driven during the pivoting. Preferably, the cam is arranged to maintain a switch in series with the power supply for the drive means closed while the reels are being pivoted through 180°.

Preferably, the light incident on the film and arranged to sense the end portion thereof is produced by the projection lamp.

As an alternative to the arrangement in which the drive means includes switching

means arranged to pivot the reels in response to the differences between the proportion of light transmitted through the picture section and the proportion transmitted through the tail section, the drive means may include switching means arranged to receive light transmitted through the film being projected, the switching means being arranged to pivot the reels in response to the transition between the switching means receiving light transmitted through the picture section and receiving light transmitted through the tail section and as a result of the uniform light transmission of the tail section and the locally varying light transmission of the picture section. Thus, if the projector is used with a film in which the portion to the rear of the picture section has a uniform light transmission (which is generally the case in practice), the pivoting of the reels can be arranged to take place in response to the tail section of the film moving into the path of light incident on the switching means.

Two cine projectors which are capable of the projection of several films in succession and which are in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a diagrammatic view of a first cine projector with the side wall removed;

Figure 2 is a section through the first cine projector along the line II—II in Figure 1;

Figure 3 shows the first cine projector in the same view as Figure 2, but at a later stage of the operation;

Figure 4 shows a part of a second cine projector;

Figure 5 shows a circuit diagram of a part of the circuitry of the second cine projector; and

Figure 6 shows the light transmission curve for the transition between the tail section and the picture section of a film suitable for use in the second cine projector.

Referring to Figures 1 to 3, the first cine projector, which illustrates the basic principles of the switching operations to be carried out to enable several films to be projected in succession, consists of a housing 1, an objective 2, a projection lamp 3, a film platform 4, having a picture gate, arranged between the projection lamp 3 and the objective 2, a film guide channel 5 and film guide rollers 6. Inserted in a recess in the housing 1 are several films arranged in cassettes 7. The first film to be projected is in the cassette 7¹, which is in a projection position. Also accommodated in the housing 1 of the cine projector are two take-up reels 9 and 10. The take-up reels 9 and 10 are each rotatable about the same axis which is carried by a spindle 12 normal thereto. The spindle 12 is rotatably sup-

ported in a bearing 14 fixed to the housing and, as shown in Figures 1 to 3, can be rotated by means of a handle 13. The axis 11 of the take-up reels 9 and 10 is arranged parallel to the direction 15 in which the cassettes 7 are advanced for projection by means (not shown).

Referring to Figures 1 and 2, a known threading mechanism 16 projects into the cassette 7¹ and guides the film (or film strip) 17¹ out of the cassette 7¹, over one of the film guide rollers 6, and to the film platform 4. The film 17 then passes over the other film guide roller 6 and is led into the film guide channel 5. The film guide channel 5 guides the film 17¹ to the take-up reel 9, which automatically engages the film 17¹ and secures it to the hub of the take-up reel 9. A known friction roller drive 18 then takes over the drive of the take-up reel 9, and the film, which is at this stage being projected, is wound up onto the take-up reel 9. Since one end of the film 17¹ is attached to the hub of the reel 19¹ in the cassette 7¹, when the film 17¹ is fully unwound from the cassette reel 19¹, a pull is exerted on the film 17 as a result of the take-up reel 9 being driven further, causing the friction roller drive 18 of the take-up reel 9 to be switched off in a known manner. The take-up reel 9, during the whole of the time that the film 17¹ is being wound on the reel 9, is in a take-up position 8 and, at the same time, the cassette 7¹ is in a projection position 8¹.

In order to allow re-winding of the film which has just been projected, and to cause the film in the cassette 7¹¹ to be projected, the shaft on which the take-up reels 9 and 10 are mounted is pivoted in the direction of the arrow 20 through 180° by rotation of the spindle 12 through 180°. The full take-up reel 9 is thus moved out of the take-up position 8 (Figure 2) into a re-winding position 21. Figure 3). The empty take-up reel 10 which previously occupied the re-winding position 21 is simultaneously moved into the take-up position 8. At the same time as the take-up reels 9 and 10 are pivoted, the film 17¹ is led laterally out of the film platform 4 and the film guide channel 5, the cassette 7¹ is transported from the projection position 8¹ (Figure 2) into a re-winding position 21¹ (Figure 3) (in which it can receive film from the take-up reel 9 or 10 in the re-winding position 21), and a cassette 7¹¹ is transported into the projection position 8¹ (Figure 3).

When the cassette 7¹¹ is in the projection position 8¹, the threading mechanism 16 guides the film 17¹ out of the cassette and to the empty take-up reel 10 which is in the take-up position 8, in the same manner as for the film 17 described hereinbefore. At the same time, re-winding of the film 17¹ into the cassette 7¹ begins. For this purpose,

a known re-winding drive 22 engages with the cassette reel 19¹ of the cassette 7¹. The film 17¹, which due to the pivoting of the take-up reels 9 and 10 through 180° has also rotated through 180° in the longitudinal direction, is rotated back into its original position in front of the cassette 7¹ in a manner which is not shown.

The pivoting of the take-up reels 9 and 10 by means of the spindle 12 is effected manually in the first cine projector by means of the handle 13 secured to the spindle 12.

Referring to Figures 4 and 5, the second projector is basically the same as the first, but the spindle 12 is not rotated manually and forms part of drive means arranged to begin the pivoting of the reels in response to the end portion of the film being projected being reached, and the film is guided from the cassette reel to the take-up reel in a slightly different manner.

The second projector has a cassette carriage 23 provided as receiving means for the cassettes, which is guided for movement in a direction 15 normal to the planes of the sides of the cassettes (and normal to the objective ray path 2d) in the housing 1 of the cine projector, in a manner which is not shown. Successive advancement of the cassette carriage 23 in the direction 15 serves to bring the cassettes 7 in succession into the projection position, and subsequently into the re-winding position. Fitted onto the spindle 12 is a pinion 24 which engages in a rack 23a of the cassette carriage 23. When the take-up reels 9 and 10 are pivoted by means of the spindle 12 through 180° in the direction of the arrow 20, the cassette carriage 23 is advanced by one cassette width in the advance direction 15 by means of the rack 23a and pinion 24, so that the cassette 7¹, for example, is transported from a projection position into a re-winding position.

The film 17¹ as shown in Figure 4 is guided rather differently by means of film guide rollers 6 than in the first cine projector in Figures 1 to 3, but still runs through the film platform 4 and the film guide channel 5 (neither of which are shown in Figure 4).

Fitted onto the control spindle 12 are film guiding means 25 by means of which the film 17¹, as described for the first cine projector, is displaced laterally out of the film platform 4 and film guide channel 5 when the control spindle 12 is rotated in order to pivot the take-up reels 9 and 10.

The films in the cassettes 7 have a tail section, which ensures that the whole of the exposed film is projected, the path length from the hub of the cassette 7 to the picture gate being arranged to be less than, or equal to, the length of the tail section. The tail section has a lower light transmission for a

given area than does the picture section of the film, that is to say, the tail section transmits a smaller fraction of the light incident on a given area than does the picture section of the film. This difference in light transmission is utilised in order to allow the various operations which take place when the end of the film being projected is reached (described hereinbefore for the first cine projector) to be carried out automatically.

Referring to Figure 6, which shows the light transmission over a length l of the film 17^1 , the light transmission of the exposed portion $17f$ (the picture section) fluctuates in a particular range having a lower value for the light transmission of d_{Fn} . The tail section $17n$ has a light transmission value d_n , which is less by a certain amount than the lower light transmission value d_{Fn} of the exposed portion of the film $17f$. The reference numeral 26 indicates the point of transition between the exposed portion of the film $17f$ and tail section $17n$. The film 17^1 is arranged to be scanned by means of a photo-sensitive device, and switching operations are arranged to take place in response to the transition point being reached.

Referring to Figure 4, the drive means is indicated generally by the reference numeral 27. The drive means 27 is, when the end of the film in the projection position is reached, arranged to drive, by means of an arrangement comprising meshing gearwheels 28 and 29, the spindle 12 in such a way as to rotate it through 180° and thereby pivot the take-up reels 9 and 10 through 180° in the manner described for the first cine projector. The rotation of the take-up reels and the cassette reels for the purposes of threading, forward film transport for projection, and re-wind are arranged to take place by means of friction drive rollers as in the first cine projector. The spindle 12 itself is used to carry out the other required switching operations.

The termination of the forward film transport when the end of the film being projected is reached may be effected by any suitable method, for example, by means of the pull exerted on the film as in the first cine projector, or in response to the tail section of the film passing in the path of light incident on the photo-sensitive device.

The drive means 27 is connected by means of leads 30 and 31 to a photo-sensitive device in the form of a photo-resistor 32, which is arranged in advance of the picture gate so that any particular part of the film passes the photo-resistor 32 before it passes the picture gate. On the opposite side of the film 17^1 to the photo-resistor 32 a lamp 33 is arranged by means of which light passes through the film 17^1 and onto the photo-resistor 32. As an alternative to the use of the lamp 33, the projection lamp 3 of the projector could be used with advantage.

By the arrangement of a light-conducting rod which is not shown, part of the projection light could be led through the film 17^1 onto the photo-resistor 32.

The drive means 27 is connected by means of leads 133 and 34 to a feeler switch 35 which is arranged in the film guide channel (not shown) corresponding to the film guide channel 5 of the first cine projector. The feeler switch 35 may, however, be positioned elsewhere in the path of the film strip if desired. The feeler switch 35 is closed when the film is in front of the switch, and open when the film is clear of the switch.

The drive means 27 is also connected, by means of leads 36 and 37, to a cam contact 38, the opening and closing of which is controlled by means of a cam 39 secured to the spindle 12.

Figure 5 shows the circuit diagram of the drive means 27 and the components to which it is connected. Referring to Figure 5, the drive means 27 comprises switching means consisting of an electronic control device indicated generally by the reference numeral 40 and the photo-resistor 32, a drive circuit which is indicated generally by the reference numeral 41 and can be actuated by the control device 40, and a retarding circuit which is indicated generally by the reference numeral 42 and by means of which the control device 40 can be switched on.

The control device 40 has a tripping stage consisting of the transistors 43, 44 and 45. The input of the tripping stage is connected to the photo-resistor 32 and the output is connected to an electro-magnet 46. The electro-magnet 46 is energised when the resistance of the photo-resistor exceeds a certain value.

The photo-resistor 32 is connected in series with a variable resistor 47. Connected to the junction of the photo-resistor 32 and the variable resistor 47 is the base of the transistor 43, the emitter of which is connected to the positive pole of a voltage source 48 and to a resistor 49. The other end of the resistor 49 is connected to the emitter of the transistor 44, the base of which is connected to a resistor 50 and to the collector of the transistor 43. The collector of the transistor 44 is connected to a resistor 51 and to the base of the transistor 45. The emitter of the transistor 45 is connected to the positive pole of the voltage source 48, and the collector is connected to an electro-magnet 46. The resistors 47, 50 and 51, and the electro-magnet 46 are capable of being connected by means of a switch 52^1 to the negative pole of the voltage source 48.

The switch 52^1 can be operated by means of an electro-magnet 52 which is connected to the output of a further tripping stage, which forms part of the retarding circuit 42 and which comprises the transistors 53, 54

and 55. The electro-magnet 52 is energised when the capacitor 56 has charged to a certain amount.

The input of the tripping stage of the re-
tarding circuit 42 is connected to a time
section consisting of a capacitor 57 and a
resistor 56. The base of the transistor 53
is connected to the junction of the resistor
56 and the capacitor 57. The capacitor 57
can be short-circuited by the closure of a
contact 67 which is associated with the feeler
switch 35 in such a way that the contact 67
is open when the switch 35 is closed and
vice-versa. The emitter of the transistor 53
is connected via a resistor 59 to the positive
pole of the voltage source 48, and via a
resistor 58 to the emitter of the transistor 54.
The base of the transistor 54 is connected to
the collector of the transistor 53 and to a
resistor 60. The collector of the transistor
54 is connected to a resistor 61 and to the
base of the transistor 55. One end of the
electro-magnet 52 is connected to the col-
lector of the transistor 55. The other end
of the electro-magnet 52, the resistors 56,
60 and 61 are connected to the negative pole
of the voltage source 48 when the feeler
switch 35 and a main contact 62 are closed.

A contact 46¹ of the drive circuit 41 is
closed when the electro-magnet 46 in the
control device 40 is energised. An electro-
magnet 63 (connected to a voltage source
which is not shown) of the drive circuit 41
is arranged to be energised when the contact
46¹ and/or the cam contact 38 are closed.
By means of the electro-magnet 63, a pivot
lever 64 can be actuated in such a way
that it closes a contact 65 of a drive motor
66. The gearwheel 26 can be driven by
means of the drive motor 66. The method of
operation of the second cine projector is
as follows.

The main contact 62 is closed by switch-
ing on the cine projector. In a manner
already described, the film 17¹ is introduced
into the projector. When the film 17¹, on its
way from the cassette 7¹ to the take-up reel
9 or 10, reaches the feeler switch 35, it
closes the feeler switch 35 and opens the
contact 67. The retarding circuit 42 is thus
connected to the voltage source 48, and the
capacitor 57 can be charged. After a delay
time which is determined by the time con-
stant of the resistor 56 and the capacitor 57,
the capacitor 57 has charged sufficiently for
the potential of the base of the transistor 53
to have fallen sufficiently for the transistor
53 to conduct. The transistor 54 is thus
rendered non-conducting and the transistor
55 conducts and therefore energises the
electro-magnet 52. The contact 52¹ is there-
fore closed, and the voltage source 48 is
connected to the control device 40.

The control device 40 is therefore switched
on after a delay. The switching operations

required when the end of the film is reached
are carried out when the resistance of the
photo-resistor exceeds a certain value in
response to the tail section of the film (of
low light transmission values) passing in
front of the source 33. If the film used in the
projector has a leader section having the
same light transmission as the tail section
(or of another comparably low value) the
switching operations would be carried out,
if the control device 40 was switched on,
when the leader section of the film passed in
front of the source 33. The fact that the re-
tarding circuit 42 imparts a delay to the
switching on of the control device 40 ensures
that the premature initiation of the switch-
ing operations cannot take place (the delay
being arranged to be such that the leader
section has completely passed the source 33
before the control device is switched on).

As long as the exposed portion of the film
17f, whose lowest light transmission value is
 d_{min} , passes the source 33, a comparatively
high light intensity is incident on the photo-
resistor 32 through the film, so that the
photo-resistor 32 has a low resistance. The
base of the transistor 43 is therefore at a
positive potential and the transistor 43 is
non-conducting. The transistor 44 thus con-
ducts, so that the base of the transistor 45
is also at a positive potential and the tran-
sistor 45 is also non-conducting. The electro-
magnet 46 is therefore de-energised so that
the contact 46¹ is open and the electro-
magnet 63 is also de-energised. The contact
65 of the drive motor 66 is thus open.

When the tail section 17n of the film 17¹
reaches the path of light from the source 33
to the photo-resistor 32, due to the reduced
light transmission d_n of the tail section 17n,
the intensity of light incident on the photo-
resistor 32 falls below the lowest value of
the intensity of light incident on the photo-
resistor 32 when the exposed portion of the
film was in the light path. The photo-resistor
32 now has a sufficiently high resistance to
cause the potential of the base of the tran-
sistor 43 to move so far in a negative direc-
tion that the transistor 43 conducts. The
transistor 44 is then rendered non-conducting
and the transistor 45 becomes conducting.
The electro-magnet 46 is therefore supplied
with current by way of the emitter-collector
section of the transistor 45. The contact 46¹
is closed and the electro-magnet 63 is con-
nected to its voltage source. The electro-
magnet 63 causes the pivot lever 64 to pivot
in an anti-clockwise direction so that the con-
tact 65 is closed, and the drive motor 66 is
thus switched on.

The drive motor 66 drives the spindle 12
in the direction of the arrow 20 (Figure 4)
by means of the gearwheels 29 and 28. The
cam contact 38, one contact arm of which
initially lies in a recess 39a of the cam 39,

is open before the spindle 12 begins rotating. When the spindle 12 is rotated, the cam contact 38 is closed by the action of the cam 39 on the contact arm, and the contact 38 remains closed until the contact arm can drop into a recess 39b which is off-set by 180° in relation to the recess 39a, after rotation of the spindle 12 through 180°.

During the rotation of the spindle 12, the film strip 17¹ is guided laterally out of the picture platform 4 and the film guide channel 5 by way of the film guide means 25 as described hereinbefore. The result of this is that the film strip 17¹ is pulled away from the feeler switch and the switch 35 opens and the contact 67 closes. The retarding circuit 42 is thus disconnected from the voltage source 48, and the capacitor 57 is discharged. The electro-magnet 52 is therefore de-energised, so that the contact 52¹ opens. The control device 40 is therefore also disconnected from the voltage source 48. The electro-magnet 46 is also therefore de-energised and the contact 46¹ is opened. The electro-magnet 63, however, is not de-energised because it remains connected to its voltage source by means of the cam contact 38 which is closed. It is now insignificant that there is no longer a film in front of the photo-resistor 32 and light of comparatively high intensity meets the photo-resistor 32.

After rotation of the spindle 12 through 180°, the cam contact 38 opens and the electro-magnet 63 is de-energised. This causes the contact 65 of the drive motor 66 to be opened, and consequently causes the spindle 12 to stop. As described hereinbefore, rotation of the spindle 12 through 180° causes the take-up reels to be pivoted through 180°.

The electro-magnet 46 may equally well be arranged in the output circuit of a photo-sensitive control circuit, by means of which the difference in brightness modulation of film and tail section can be utilised for switching pulses.

Switching measures other than those described to be actuated by means of the electro-magnet 46 at the moment in which the end of the film actually being projected is reached. Thus, for example, the projection lamp 3 could be switched off by the electro-magnet 46, or an objective covering pivoted in front of the objective 2.

WHAT WE CLAIM IS:—

1. A cine projector comprising receiving means for a plurality of film cassettes, a pair of reels mounted about a common first axis and so positioned that, when in use the receiving means contains a plurality of cassettes, one of the reels is in a position for receiving film from a cassette in the projection position and the other is in a position from which film can be rewound into that

cassette after the cassettes have been advanced to bring the next cassette into the projection position, and means for permitting the pair of reels to be pivoted about a second axis through 180° to interchange the positions of the reels.

2. A cine projector as claimed in claim 1, in which the pivoting of the reels to interchange their positions is arranged to cause the cassettes to be advanced to bring the next cassette into the projection position.

3. A cine projector as claimed in claim 2, in which the said advancement of the cassettes is achieved by an advancement of the cassette receiving means.

4. A cine projector as claimed in claim 3, in which the said advancement of the cassette receiving means is in a direction parallel to the axis of the cassettes and is equal to the thickness of a cassette in that direction.

5. A cine projector as claimed in claim 4, in which the pivoting means includes a control spindle which is arranged to rotate through 180° when the reels are interchanged, and which so engages the cassette receiving means as to effect the said advancement thereof in response to a rotation through 180°.

6. A cine projector as claimed in claim 5, in which the engagement between the spindle and the cassette receiving means is by means of a rack on the cassette receiving means and a pinion secured to the spindle.

7. A cine projector as claimed in any one of claims 1 to 6, in which the pivoting means includes a control spindle, the axis of which coincides with the said second axis, and which is secured to the means of which the reels are mounted so that the reels are together pivoted about 180° when the spindle is rotated through 180° about its axis.

8. A cine projector as claimed in any one of claims 1 to 7, in which the pivoting of the reels to interchange their positions is arranged to actuate displacing means for displacing film out of the means for guiding the film between the cassette and the take-up reel.

9. A cine projector as claimed in any one of claims 1 to 8, in which there is provided drive means arranged so that, when in use the receiving means contains a cassette in the projection position and the film therein is being projected, the reels are pivoted through 180° to interchange their positions in response to the end portion of the film being projected being reached.

10. A cine projector as claimed in claim 9, in which the drive means is arranged to sense the end portion of the film being projected, the sensing being by means of a beam of light incident on the film.

11. A cine projector as claimed in claim 10, for films having a tail section which trans-

is open before the spindle 12 begins rotating. When the spindle 12 is rotated, the cam contact 38 is closed by the action of the cam 39 on the contact arm, and the contact 38 remains closed until the contact arm can drop into a recess 39b which is off-set by 180° in relation to the recess 39a, after rotation of the spindle 12 through 180°.

During the rotation of the spindle 12, the film strip 17¹ is guided laterally out of the picture platform 4 and the film guide channel 5 by way of the film guide means 25 as described hereinbefore. The result of this is that the film strip 17¹ is pulled away from the feeler switch and the switch 35 opens and the contact 67 closes. The retarding circuit 42 is thus disconnected from the voltage source 48, and the capacitor 57 is discharged. The electro-magnet 52 is therefore de-energised, so that the contact 52¹ opens. The control device 40 is therefore also disconnected from the voltage source 48. The electro-magnet 46 is also therefore de-energised and the contact 46¹ is opened. The electro-magnet 63, however, is not de-energised because it remains connected to its voltage source by means of the cam contact 38 which is closed. It is now insignificant that there is no longer a film in front of the photo-resistor 32 and light of comparatively high intensity meets the photo-resistor 32.

After rotation of the spindle 12 through 180°, the cam contact 38 opens and the electro-magnet 63 is de-energised. This causes the contact 65 of the drive motor 66 to be opened, and consequently causes the spindle 12 to stop. As described hereinbefore, rotation of the spindle 12 through 180° causes the take-up reels to be pivoted through 180°.

The electro-magnet 46 may equally well be arranged in the output circuit of a photo-sensitive control circuit, by means of which the difference in brightness modulation of film and tail section can be utilised for switching pulses.

Switching measures other than those described to be actuated by means of the electro-magnet 46 at the moment in which the end of the film actually being projected is reached. Thus, for example, the projection lamp 3 could be switched off by the electro-magnet 46, or an objective covering pivoted in front of the objective 2.

WHAT WE CLAIM IS:—

1. A cine projector comprising receiving means for a plurality of film cassettes, a pair of reels mounted about a common first axis and so positioned that, when in use the receiving means contains a plurality of cassettes, one of the reels is in a position for receiving film from a cassette in the projection position and the other is in a position from which film can be rewound into that

cassette after the cassettes have been advanced to bring the next cassette into the projection position, and means for permitting the pair of reels to be pivoted about a second axis through 180° to interchange the positions of the reels.

2. A cine projector as claimed in claim 1, in which the pivoting of the reels to interchange their positions is arranged to cause the cassettes to be advanced to bring the next cassette into the projection position.

3. A cine projector as claimed in claim 2, in which the said advancement of the cassettes is achieved by an advancement of the cassette receiving means.

4. A cine projector as claimed in claim 3, in which the said advancement of the cassette receiving means is in a direction parallel to the axis of the cassettes and is equal to the thickness of a cassette in that direction.

5. A cine projector as claimed in claim 4, in which the pivoting means includes a control spindle which is arranged to rotate through 180° when the reels are interchanged, and which so engages the cassette receiving means as to effect the said advancement thereof in response to a rotation through 180°.

6. A cine projector as claimed in claim 5, in which the engagement between the spindle and the cassette receiving means is by means of a rack on the cassette receiving means and a pinion secured to the spindle.

7. A cine projector as claimed in any one of claims 1 to 6, in which the pivoting means includes a control spindle, the axis of which coincides with the said second axis, and which is secured to the means of which the reels are mounted so that the reels are together pivoted about 180° when the spindle is rotated through 180° about its axis.

8. A cine projector as claimed in any one of claims 1 to 7, in which the pivoting of the reels to interchange their positions is arranged to actuate displacing means for displacing film out of the means for guiding the film between the cassette and the take-up reel.

9. A cine projector as claimed in any one of claims 1 to 8, in which there is provided drive means arranged so that, when in use the receiving means contains a cassette in the projection position and the film therein is being projected, the reels are pivoted through 180° to interchange their positions in response to the end portion of the film being projected being reached.

10. A cine projector as claimed in claim 9, in which the drive means is arranged to sense the end portion of the film being projected, the sensing being by means of a beam of light incident on the film.

11. A cine projector as claimed in claim 10, for films having a tail section which trans-



mits a proportion of light incident on a given area which is greater than, or less than the proportion of light transmitted by substantially any given area of picture section, in which the drive means includes switching means arranged to receive light transmitted through the film being projected, the switching means being arranged to pivot the reels in response to the intensity of light incident thereon changing between the values for when the picture section and for when the tail section, is passing through the light incident on the switching means.

12. A cine projector as claimed in claim 11, in which the switching means is arranged to pivot the reels in response to the intensity of light incident thereon falling below a certain value.

13. A cine projector as claimed in claim 11 or claim 12, in which the switching means includes a photo-sensitive device, the electrical value of which is dependent on the intensity of the light incident thereon.

14. A cine projector as claimed in claim 13, in which the photo-sensitive device forms an input to a control device having two states, the pivoting of the reels being arranged to take place in response to a change from one state to the other.

15. A cine projector as claimed in claim 14, in which the control device includes a semi-conductor which is conductive in one state of the device and non-conductive in the other.

16. A cine projector as claimed in claim 14 or claim 15, in which the control device includes a tripping stage.

17. A cine projector as claimed in any one of claims 14 to 16, in which an electro-magnet is provided in the output of the control device and is arranged to be energised in one state of the control device and de-energised in the other.

18. A cine projector as claimed in any one of claims 11 to 17, in which there is provided a retarding circuit arranged to render the switching means operative from an inoperative condition after a delay after actuation of the retarding circuit in order to prevent the premature pivoting of the reels.

19. A cine projector as claimed in claim 18, in which the retarding circuit is arranged to be actuated by the film in the projection position as it is being threaded into the projector.

20. A cine projector as claimed in claim 19, in which the retarding circuit is arranged

to be actuated by being connected to a voltage source by means of a feeler switch actuated by the film.

21. A cine projector as claimed in any one of claims 18 to 20, in which the retarding circuit includes a tripping stage, the input of which is connected to a time section for providing the delay consisting of a resistor and a capacitor.

22. A cine projector as claimed in claim 21, in which the output of the retarding circuit includes an electro-magnet for rendering the switching means operative and inoperative.

23. A cine projector as claimed in claim 10, for films having a tail section of uniform light transmission and a picture section of locally varying light transmission, in which the drive means includes switching means arranged to receive light transmitted through the film being projected, the switching means being arranged to pivot the reels in response to the transition between the switching means receiving light transmitted through the picture section and receiving light transmitted through the tail section and as a result of the uniform light transmission of the tail section and the locally varying light transmission of the picture section.

24. A cine projector as claimed in any one of claims 9 to 23, in which the drive means is arranged to be switched off after pivoting of the reels through 180° by means of a cam switch of a cam which is arranged to be driven during the pivoting.

25. A cine projector as claimed in claim 24, in which the cam maintains a switch in series with the power supply for the drive means closed while the reels are being pivoted through 180°.

26. A cine projector as claimed in any of claims 10 to 25, in which the said light is produced by the projection lamp.

27. A cine projector substantially as hereinbefore described with reference to, and as shown in, Figures 1 to 3 of the accompanying drawings.

28. A cine projector substantially as hereinbefore described with reference to, and as shown in, Figures 4 and 5 of the accompanying drawings.

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