

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN THE SYNCHRONISING OF CINEMATOGRAPHIC CAMERAS WITH PROJECTORS

(71) We, BOLEX INTERNATIONAL S.A., a Swiss Company, of 18 Avenue des Alpes, CH 1450 Sainte-Croix, Switzerland, 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:—

The present invention relates to a cine camera and is particularly concerned with the saving of film in photographing still images such as film titles.

Still images can be projected by merely arresting the film for the desired length of time. To prevent damage to the film as a result of excessive heating, when projecting a single frame for an extended period, a heat filter is placed in the path of the rays. The heat filter at the same time absorbs some of the light so that arresting a film in a projector can only be effected without danger to the film at the cost of image brightness. For this reason, titles have hitherto been filmed and projected at the normal filming speed to avoid loss of image brightness.

The present invention is based on the principle of extending the projection time of each frame as long as practicable without risk of damage to the film thus enabling a fewer number of frames to be used for displaying still images without loss of image brightness.

In accordance with one aspect of the invention, there is provided a cine camera having a pre-selector mechanism for setting, before filming is initiated, the number of frames to be recorded, and means for recording on the film strip at a pre-determined position, clear of the film frames, a marking for indicating that each of the pre-set number of frames is to be projected for an extended time period.

Conveniently, the pre-selector mechanism is graduated with a scale indicating the

intended projection time, assuming a pre-determined projection time for each recorded frame.

It will be appreciated that the number of frames may be pre-set either by determining the number of frames recorded or by determining the length of time during which filming takes place, if the filming speed, that is to say the frequency of frame recording, is known.

The present invention is based on and is a modification of that in British Patent Specification No. 1,355,756. The latter Patent provides a device controlled in accordance with the speed at which the film is shot and which records on the film strip at a predetermined position clear of the film frames a marking which is indicative of the shooting speed, and a cine projector provided with a monitor controlling the speed of film projection and arranged to indicate or to respond to markings on the film significant of the speed at which the film is to be exposed. As in the above Patent, the present invention also provides for recording on the film strip a marking serving to determine the speed at which projection takes place. The marking indicates that the film is to be projected in stop motion, that is to say each frame is projected for as long a period as practicable without damage to the film strip. Once the frequency of frame projection has been determined within the camera, the length of time that the image is projected in stop motion may be determined during shooting by pre-setting the number of frames on which the image is recorded.

The maximum thermal load which may be applied to a single frame depends on several factors, notably the material of which the film is made (a thin film of polyester or cellulose triacetate), on the lamp which is used in the projector, on the optical elements in the path of the light

rays, on the use of a dichroic mirror, and on the distance between the lamp and the film gate.

5 If the various factors are known, it is possible to determine the optimum exposure time for each frame and from that it is possible to calculate the number of frames which need to be recorded for the image to be projected for a given time.

10 If a projector such as that described in the above Patent is used, in which there is a window through which the markings on the edge of the film are visible, it is possible to move the film forward in accordance with the markings visible in the window. In this case, it is preferable that the markings corresponding with a given frame should appear in the window before the frame is projected, thus giving the operator time to react and adjust the controls for stop motion projection. It is evident that in this case, the cine camera must have a means of marking the edge of the film ahead of the corresponding frames.

25 As has earlier been mentioned, it is convenient to graduate the pre-selector mechanism with a scale indicating the intended projection time. In order to take into account the various factors affecting the optimum projection time of each frame, the pre-selector mechanism or the scale may be adjusted in accordance with these factors. This is possible either by providing several interchangeable scales for the various projection times per frame or by a method often to be found in telemeters which involves inscribing the graduations on a scale which is extensible in terms of these factors.

40 The invention will now be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a cine-camera in cross-section;

45 Figure 1A is an enlarged side-view of part of Figure 1 showing the selector mechanism of the speed control of the camera;

Figure 1B shows the selector mechanism from above;

50 Figures 2 and 3 show modifications to the camera;

Figure 4A is a side-view of a cine camera;

Figure 4B shows part of the camera shown in Figure 4A from the front;

55 Figure 4C shows the printed circuit of the speed control mechanism of the camera; and

Figure 4D shows a length of film with coding marks.

60 The means for marking the edge of the film in the cine camera 50 is described in British Patent Specification No. 1 355 756 and need not be repeated. The camera has a driving shaft 51 at one end of which is a cam 52 which controls a claw 53 and a

shutter 54. A stopping cam 55 on the shaft 51 has a catch 56 which comes into contact with a fixed counter catch 57 controlled by the trigger 58 in order to bring the shaft 51 to a standstill in a position in which the shutter is closed, that is in which it closes the film gate.

The trigger 58 acts upon a transmission rod 59 which is linked with a cranked lever 60. One arm of the cranked lever 60 is connected by means of a toggle spring 61 to one of the arms of a second cranked lever 63, at the other end of which is a pin 64 which acts upon the counter catch 57.

The counter catch 57 is shown more clearly in Figure 1B. It consists of a sleeve of circular or square section which is slidable along the pin 64 and which has a raised collar 65 half way along its length. One end of a helical spring 66 rests against this collar 65 and its other end rests against the cranked lever 63. The pin 64 passes through the counter catch 65 and has a small knob 67 at its end. The spring 66 pushes the counter catch in a direction to urge the knob 67 into a recess in the end of the counter catch 57 against a shoulder 68.

If pressure is applied to the trigger so as to move it to the right, as viewed in Figure 1, the cranked lever 63 turns clockwise on its pivot and moves the pin 64 to the right. Thus, the knob 67 presses on the shoulder 68 and moves the counter catch 57 out of the path of the catch 56.

Figures 1A and 1B show a shaft 70 which carries a selector 71 and which fits into a hollow axle 72 which has a flange 75 at the end nearest the casing of the cine camera. A sector 73 of a disc is connected to the axle 72 by a friction coupling. A spring 76 which presses against the flange 75 holds back the sector 73 and brings it into contact with a ratchet wheel 77 on the shaft 72.

There is a cut-out parallel with one of the radial edges of the sector 73 which carries an axle 78. A bent strip 79 is pivotable around the axle 78 and is urged in an anti-clockwise direction by a spring which is not illustrated. The shorter arm of the bent strip 79 opposes the effort of the spring by pressing against the sector 73, with the result that the longer arm is approximately at right angles to the sector 73. The longer arm of the strip 79 is of such a length that it comes into the path of the collar 65 on the counter catch 65 and forms a stop mechanism which allows the collar to move past in one direction but not the other. Furthermore, the sector 73 carries the axle 81 of a pawl 82 which fits into the teeth of the ratchet wheel 77. This pawl 82 is held under tension by a torsion bar 83. A control knob 85 situated at the end of the cine camera case is mounted on a bent rod 130

which is in turn connected to the pawl 82.

The control knob 85 has two distinct areas 86 and 87 where pressure may be applied. When pressure is applied to the area 86, the control knob moves along a slot 88 (see Figure 1A) causing the sector 73 to rotate clockwise pushing the longer arm of the strip 79, and with it the collar 65 to the right. This position is shown in Figures 1 and 1B in which the collar 65 of the counter catch is arranged behind the longer arm of the strip 79. If the trigger is now pressed, the motor is started and the pin 64 moves to the right. Filming can now take place. When the trigger is released, the pin 64 moves back to its original position but not the counter catch 57 because the strip 79 counteracts the effect of the spring 66. The spring pulls on the sector 73 which is retained by the combined effect of the pawl 82 and the ratchet wheel 77. During this time, the motor remains energised so that filming continues to take place.

The shaft 51 continues to be turned by the motor and the claw continues to move the film forward. The movement of the claw 53 is transmitted by a leaf-spring 88 (Figure 1) to a double catch 89. The catch 89 has a slot 90 the sides of which are in contact with a pin 91 in the cine camera. Each time the catch 89 moves downwards, the spring 88 causes it to rotate bringing the teeth of the arm 92 into contact with a ratchet wheel 93 and causing it to turn. When the claw 53 moves up, the leaf-spring causes the catch 89 to pivot in the opposite direction, thus bringing the teeth on the arm 94 into contact with the ratchet 93 and causing it to turn in the same direction as before.

A driving wheel 95 transmits the rotation of the ratchet wheel 93 to the hollow axle 72. The wheel 95 turns in an anti-clockwise direction and by means of the ratchet wheel 77 the pawl 82 and the spring 66 causes the sector 73 to turn at the same time. The intermittent movement causes the counter catch to move back into the path of the catch 56 in discrete steps until eventually it stops the rotation of the shaft 51 and the motor. On account of the step-wise movement of the counter catch 57, the noise which would be caused by contact between the catch and the counter catch if they were to approach each other gradually, does not occur. It will be appreciated that whilst there has been disclosed a ratchet wheel 77 driven by another ratchet wheel 93 coupled to one another by a transmission, it would be alternatively possible to use a single ratchet wheel directly connected to the claw 53.

A second area 87 where pressure may be applied to the control knob 85 is used if the sector 73 has been turned in error through a too great angle. Pressure applied to the

area 87 disengages the pawl 82 from the ratchet-wheel 77, thus enabling the control knob 85 to be turned in an anti-clockwise direction simultaneously with the sector 73. The position of the sector 73 can be ascertained from the control knob 85, but as shown in Figure 1A a window 96 is provided to show a red area 97 on an element 98 on the sector 73. As shown in Figure 1A one of the edges of this red part corresponds with a scale 98a graduated in seconds which is to be found along one edge of the window 96. In addition to, or in place of, the scale graduated in seconds it is possible to provide a scale with several settings along the opposite side of the window. This scale gives indications concerning the utilization of the cine-camera for close-up filming when the length of time of subsequent stop-motion projection is preferably short whereas in the case of normal filming, the length of time may be longer.

As explained above, it is possible to establish a scale which makes it possible to take into consideration a number of factors which influence the maximum thermal load to which a film may be subjected without the occurrence of any noteworthy deformation. In this case, it would be advisable to put this scale also in a rectangular window. In any case the red area 97 indicates whether or not the filming is terminated. A scale graduated to indicate the number of frames necessary for stop-motion projection, for a predetermined length of time could replace the scale graduated in seconds, but this would necessitate the conversion of the time of projection into the number of frames corresponding with this time. Both scales could be indicated.

For subsequent projection, the number of frames to be projected in a given length of time can vary according to the type of film or the projector utilized. For example, the projector can be adjusted to project one frame per second. Therefore, for a subsequent projection time of 5 seconds, five frames must be exposed. If the red area is set at 5 seconds on the scale graduated in seconds, this signifies that the cine-camera will expose five frames from when it is started until the counter catch 57 comes into the path of the catch 56 and stops the cine-camera. The number of frames per second exposed during filming is regulated by the pre-selector knob 71. As the sector 73, controlled by the knob 85 is only used when the exposed frames are intended for subsequent stop-motion projection, it is preferable to lock the control knob 85 when the pre-selector 71 is not in a filming for stop-motion projection position, as shown in Figure 1A.

In order to make this possible, the axle 70 is connected to a sector 99 of a disc which

undergoes an angular displacement corresponding with each adjustment of the pre-selector 71. Except in the filming position for stop-motion projection the bent rod 5 84 is blocked by this sector 99 preventing it and the pawl 82 from turning in a clockwise direction about the axle 81 and sliding along the sloping sides of the teeth of the ratchet-wheel 77. Thus, it is only possible 10 to adjust the control knob 85 when the preselector 71 is in the position shown in Figure 1A where the sector 99 does not block the pawl 82. In Figure 1 the sector 73 and the various parts connected with it 15 make up a mechanical timing device. As shown in Figure 2, electric or electronic timing devices could equally well be used. In this Figure only the parts necessary to make the functioning of this device clearly 20 understood have been indicated. Furthermore, each part whose function corresponds with that of a part in Figure 1 has been indicated with the same number.

Figure 2 shows the drive-shaft of the cine-camera 51 with the stop-cam 55 and the catch 56. The counter catch 57 which is the coil of an electro-magnet 100, has a collar 65 and a compression spring 101 which is retained at one end by the collar 65 30 and at the other end by the coil of the electro-magnet 100. The coil of the electro-magnet 100 is connected through a switch 58a to a circuit which is not shown in detail. A switching circuit 71a, which is controlled 35 by the pre-selector 71 and which connects the switch 58a to the coil of the electro-magnet 100, supplies an electric current to the coil in all positions of the pre-selector 71, except in that of filming for subsequent 40 stop-motion projection. When the pre-selector is adjusted to filming for subsequent stop-motion projection the switching circuit 71a cuts off the current. In parallel with the switching circuit 71a a circuit is provided 45 including a timing circuit 102, e.g. an RC-circuit, and a threshold switch 103. Depending on the original adjustment of the timing circuit 102, current flows in the electro-magnet during a length of time determined 50 by the original setting of the threshold switch 103. The time constant of the timing circuit 102 may be adjusted by the switching circuit 71a.

Preferably the circuit 71a and the pre-selector 71 are so combined that the latter 55 not only controls the number of frames exposed per second but also the number of frames to be exposed using the scale graduated in seconds. In this case the pre-selector 71 connects the supply directly to 60 the coil of the electro-magnet through the switching circuit 71a, at all camera speeds other than for subsequent stop-motion projection.

In this last case, the circuit may be inter-

rupted by rotating the pre-selector 71 in a clockwise direction. In this position the time constant selected for the timing circuit 102 corresponds exactly with the exposure time 70 of one frame. The time constant of the timing circuit 102 may be considerably increased by a further rotation of the pre-selector in a clockwise direction. Furthermore, the time constant may be varied in the timing circuit 102, as represented in 75 Figure 1, by incorporating a system of gear wheels between the driving wheel 95 and the ratchet-wheel 93. The speed resulting from this mechanism may be adjusted 80 gradually or in stages.

Figure 3 shows a modified version of Figure 2 for cine-cameras but is also particularly useful for 8mm projectors. The parts which are analogous with parts already 85 mentioned are indicated by the same references.

In the Patent Specification No. 1 355 756 the markings on the edge of the film are read automatically in the projector by photo-electric cells, and depending on 90 whether one or more cells are activated by the light ray shining through the markings on the film, one or another position of the timing circuit connected to the electro-magnet is selected. An electro-magnetic 95 control is therefore particularly appropriate for projectors which are equipped with an electronic device for reading the optical markings on the film. The rate of projection can be controlled by the electro-magnet as 100 described in Austrian Patent 282 351, although a control for stop-motion projection as described with reference to Figure 2 may be used.

In this case, the projector must also have 105 a drive shaft 51, a stop-cam 55 and a catch 56. In the case of a cine-camera, the catch must be placed so that when it engages with the counter catch 57, the shutter is closed, whereas in a projector, the shutter must be 110 open when the catch 56 engages with the counter catch 57. The coil of the electro-magnet 100 is connected to a timing circuit 105 (corresponding with one of the circuits 35, 36, of Patent Specification 1 355 756), 115 but in a cine-camera the control circuit 104 carries out the same function as the circuit 71a described above. The setting and control of the circuit 104 have been described in detail in the above patent. The timing 120 circuit is switched on by means of the circuit 104 and transmits an impulse, after a predetermined interval of time, to the electro-magnet 100, thus causing the film 125 to move forward one frame. In cameras or projectors where the electro-magnet is equipped with a stopping-mechanism 55, 56 the current only flows through the electro-magnet for a very short time so that the 130 axle 51 makes only one complete rotation,

which causes the film to move forward one frame as when it is moved on by the claw.

If the construction conforms with that described in the Austrian Patent No. 282 351, the timing circuit should transmit impulses during the whole time a single frame is being projected. The length of this time is again determined in dependence upon the maximum thermal load which can be applied to the film without causing deformations. In cine-cameras in which the functions of the circuit 71a described above are carried out by the control circuit 104 it is necessary to be able to cut out or short-circuit the timing circuit 105 as shown by the dotted line in Figure 3.

Figure 4A shows another version of the selector drive intended for use with a film contained in a cassette. The camera has a shutter 132 set in motion by an axle 133. Mounted on the axle 133 is an eccentric wheel which causes a lever 135 to pivot round an axle 136. At the other end 137 of this lever is a pawl 138 which is held constantly in position against the ratchet-wheel 110 by the action of a spring 139. A circuit consisting of six concentric circular tracks A-F is printed onto this ratchet-wheel, and these tracks A-F are contacted by the flexible contactor I-VI of a contactor block 112. The eccentric wheel 115 at the end of the axle 133 (Figure 4B) fits into an elongate opening 116 in a V-shaped lever 134, one arm of which pivots round the axle 113. Each time the axle 133 rotates, the end of the lever 134 with the opening 114 moves to and fro causing the lever 135 and the pawl 138 to move simultaneously. Part of the circumference of the ratchet-wheel 110 is toothed, 118 and part is smooth, 117. The wheel is in one piece with the selector 111 and may be set manually in any one of the 20 positions indicated by the sectors 0-19 of the printed circuit shown in Figure 4C.

The brushes I and II transmit the current to the film-marking device, and the brush III which transmits the current to the metallized part of the printed circuit is connected to one of the current supply terminals (not shown) of the camera.

The brushes IV, V and VI transmit the current to the motor and correspond with the three speeds of the camera, e.g. 36, 18 or 9 frames per second. The marking device (not shown) has two light emitting diodes of negligible inertia which makes it possible to mark the edge of each frame with its own corresponding marking, as shown in Figure 4D, in which is shown a short length of film 120 with an exposed frame 121 and one sprocket hole perforation 122. The markings may appear singly, simultaneously, or not at all beside a frame. The presence or absence of one or more of these markings corresponds with a well defined mode of pro-

jection, according to the programme described below.

If the selector is in the initial position O, only the brush III is in contact with the metallized part of the printed circuit. In position I, brush III transmits current and brush V is in contact with track E and the camera is ready to film at a speed of 18 frames per second. The pawl 138 slides over the smooth surface 117 of the ratchet-wheel and no marking is put on the edge of the film, which is interpreted during projection as a normal speed of 18 frames per second. In position 2, brush III transmits the current and brush IV comes into contact with track F of the printed circuit causing the camera to film at a speed of 9 frames per second. The pawl 138 is on the smooth part 117 of the ratchet-wheel, and brush II is in contact with track B which causes an impulse to be transmitted to the light emitting diodes thus producing a coded marking on the edge of the film, so that the film will automatically be projected at a speed of 9 frames per second.

In position 3, brush III transmits the current, brush V is in contact with track E of the circuit printed on the selector III, and the pawl 138 slides over the smooth surface 117 of the ratchet-wheel. Brush II is again in contact with track B, which, as before, causes a coded marking to be made on the edge of the film. On projection this marking causes the film to be projected at a reduced speed of 9 frames per second. This produces a slow motion effect in which the ratio of the filming speed to the projection speed is 2:1.

In position 4, the brush III transmits the current, and brush V as before closes the circuit between the supply and the motor of the camera causing it to film at a speed of 18 frames per second. The pawl 138 slides over the smooth part 117 of the ratchet-wheel 110, without coming into contact with the toothed part 118. The brush I is in contact with track A with the result that an impulse is transmitted to a second light emitting diode which makes a coded marking on the edge of the film in a different position from that made in the preceding case. On projection this marking causes the film to be projected at the speed of 36 frames per second which produces a speeded-up effect in which the ratio of the filming speed to the projection speed is 1:2.

In positions 5 to 19 the circuit is closed by brush IV which is in contact with the metallized part of track D on the printed circuit, causing the camera to film at a speed of 36 frames per second. The pawl 138 engages in one of the teeth on the toothed part 118 of the ratchet-wheel 110. Each time the shutter rotates, i.e. each time a frame is exposed, the pawl 138 moves to and

fro as described above, and turns the wheel in a clockwise direction through an angle of 18°, which is the equivalent of one of the sectors numbered 5-19, until the selector 5 which is in one piece with the ratchet-wheel 110 has returned to its original position at O. The brushes I and II remain in contact with the tracks A and B of the printed circuit and transmit impulses to the two 10 light emitting diodes which cause the coded markings to be made on the edge of the film. On projection each frame remains for two seconds, thus the total length of time taken for projecting a scene frame-by-frame 15 is equal to the product of the number of frames by two seconds.

The utilization of the present invention brings about a considerable reduction in the amount of film used and a scene projected 20 at stop-motion is absolutely stable which can never be the case in normal projection, even in the best conditions.

In the case of an ordinary cine-camera, for example, a 30 second scene filmed at 36 25 frames per second uses 1080 frames. The same scene projected with superior stability as described herein, for the same length of time uses only 15 frames. In the first case 72 times more film will have been used than 30 in the procedure herein described.

WHAT WE CLAIM IS:—

1. A cine camera having a pre-selector 35 mechanism for setting, before filming is initiated, the number of frames to be recorded, and means for recording on the film strip at a predetermined position, clear

of the film frames, a marking for indicating that each of the pre-set number of frames is 40 to be projected for an extended time period.

2. A cine camera as claimed in Claim 1, in which the pre-selector mechanism is graduated with a scale indicating the intended projection time, assuming a pre- 45 determined projection period for each recorded frame.

3. A cine camera as claimed in Claim 1 or 2, including a control knob for controlling the frequency of frame shooting by 50 the camera.

4. A cine camera as claimed in any preceding claim, in which the pre-selector mechanism is connected to a film driving mechanism of the camera and is manually 55 adjustable.

5. A cine camera as claimed in any preceding claim, in which the pre-selector mechanism is driven by a mechanism comprising a pawl and ratchet wheel toothed 60 over at least a part of its circumference.

6. A cine camera as claimed in any of Claims 1 to 4, in which the pre-selector mechanism includes a timing circuit actuated by a trigger of the camera and 65 operative to inhibit recording after a pre-determined time period.

7. A cine camera substantially as herein described with reference to and as illustrated in the accompanying drawings. 70

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