

PATENT SPECIFICATION

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(54) PROCEDURE AND DEVICE FOR SYNCHRONISING CINEMATOGRAPHIC CAMERAS WITH PROJECTORS

(71) We, BOLEX INTERNATIONAL S.A., of 18 Avenue des Alpes, CH 1450 Sainte-Croix, Switzerland, a Swiss Company, 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 concerns a procedure for synchronising cinematographic equipment and a means of applying the procedure. More particularly the invention allows synchronisation of the speed of a camera shooting a film with that of a projector projecting the film.

Generally, such a synchronisation, i.e. between the speed of a camera when shooting a film and that of the images projected by a projector, is not desirable. Indeed it normally is preferable to produce certain effects by using a frequency when projecting different to that used when shooting. It may happen, however, that without wishing to produce a particular effect, the film is shot more slowly than normal, for example, simply to economise on film, or to suit particular lighting conditions. Thus, the lighting conditions encountered for example in churches do not allow the shooting of a film at the normal speed. But if the film is shot at half the normal speed, it is possible to increase the relative aperture. In the same way when a subject is brightly lit it is possible to double the speed at which the film is shot. In these cases the projector must be synchronised with the camera, i.e. when the film is projected the projector must have the same speed as the camera when shooting.

An object of this invention is to facilitate such synchronisation.

In accordance with one aspect of this invention a cine camera is provided with a device controlled in accordance with the speed at which the film is shot and which records on the film strips at a predetermined

position clear of the frames a marking which is indicative of the speed of shooting. Such a marking is preferably optically produced and either its intensity or its colour may be used to indicate the film shooting speed. The marking may extend lengthwise of the film along one border, or it may extend across the film between the film frames. The marking is so positioned that it can be read, during projection, while at a predetermined position in the film gate and the projection speed adjusted accordingly. Although it is preferred to mark the film optically, other ways are possible for example the film may be provided with magnetically sensitive striping onto which is placed a magnetic signal signifying the speed of shooting.

The term "marking" on a film is used throughout this specification to signify a way of recording data on the film which does not involve actual mutilation of the film strip.

In accordance with a second aspect of this invention a film projector is provided with a monitor controlling the speed of film projection and arranged to read markings (as herein defined) on the film significant of the speed at which the film is to be projected and positioned on the film strip at a position clear of the film frames, the monitor being equipped with means for comparing the read markings with pre-arranged references and for varying the projection speed until identity occurs when the read-out of the marking matches one of the references.

The monitor may be an optical sensor and take the form of a light detector responsive to the intensity or the colour of striping provided on the film at a position to one side of or between consecutively projected film frames, the striping being conveniently read from the film in the film gate during projection. Alternatively a magnetically operated read-out head may be used as the monitor when the film is marked

magnetically. The optical monitor may also be used manually to control the film speed.

In one example of a camera embodying the invention the film marking device takes the form of a source of light of constant luminosity, the rays of which are directed towards one of the edge margins of a film frame in the camera film gate. This edge margin can either be the longitudinal one or a transverse one perpendicular to the direction of the film displacement. If a constant luminosity is used, as different speeds produce different lengths of time during which the edge margin is exposed, the brightness of the marking varies according to the speed of filming. In order to conserve energy the use of a light can be avoided by providing a marking device connected to the frequency control and having a certain number of masks or filters corresponding with the various speeds of filming. These masks or filters may then be placed in the path of the rays directed towards the margin of the film. In this way the external light can be used as a source of light, and the luminosity at the edge of the image and thus the projection speed is determined by the dimension of a marking or by the degree of blackening produced by a variable grey filter placed in the path of light rays.

The marking described above can be influenced by dirt particles adhering to the masks or filters; therefor the method of marking using coloured filters is to be preferred, in which a different colour corresponds with each image frequency. Such markings are much less sensitive to external influences.

The invention will now be described in more detail, by way of examples, with reference to the accompanying drawings, in which:—

Figure 1 represents schematically one embodiment of a marking device in a cine-camera;

Figures 2 and 2A represent a second embodiment schematically;

Figure 3 represents schematically one embodiment of the reading device or monitor in a projector; and

Figure 4 represents a second form of monitor.

Figure 1 shows a marking device in a cine-camera provided with an objective made up of the lenses 1, 2 and 3. In the path of the rays travelling through the objective is a film gate 4 of a film 5, having a hole 6 in front of which is a light conductor 7. The light conductor 7 directs a beam of light from a light source 8 onto an edge margin of the film 5. The luminosity of the light source 8, which is, in the example described, a miniature lamp, is maintained at a constant level by a circuit, represented diagram-

matically which includes a photo-resistant cell 9 on which part of the rays from the lamp 8 continuously fall.

Depending on the speed of the film 5, the edge of the film lying in the hole 6 is exposed for a longer or shorter length of time thus producing a brighter or darker area. Thus, the luminosity is in proportion to the speed of shooting. Inversely, the speed of shooting can be determined from the luminosity of the edge marking of the film.

In a projector, a light beam is directed through the hole 6 provided in the film gate 4 on the marked edge of the film. The speed control on the projector is controlled by a monitor fitted with a shaded filter graded from grey to black the position of which is adjusted until the luminosity of an opening through which the rays that have been through the marked film and filter shine, is equal to that of a reference opening of constant luminosity. The change in position of the graded filter adjusts the speed control. In order to avoid complications caused by dust particles on the filters, it is preferable to replace the variation of luminosity by a colour code as is described below with reference to Figure 2 or 2A.

Figure 2 shows diagrammatically a multi-position switch 10A for the selection of image frequency i.e. a device which allows the film to be projected either frame by frame or at the following speeds: 9, 18, 24, or 54 frames per second. This switch is connected by a worm shaft to a disc 10 made up of a series of filters shown in detail in Figure 2A. On this disc there is a red filter 11, a green filter 12, a yellow filter 13, a blue filter 14, and an opaque area 15. The disc 10 is placed in the path of the marginal rays from the objective made up of the lenses 1, 2 and 3. At each rotation of the camera shutter a coloured mark is made on the edge of the film 5 so that when, for example a film is being exposed at the rate of 54 frames per second, the opaque area 15 is opposite the aperture 6 whereas when it is exposed frame by frame the filter 11 is opposite the aperture 6.

A pointer 10B driven by a toothed wheel engaging the worm of the worm shaft, indicates on a coloured scale calibrated in terms of the image frequency, the position of the disc 10.

In the same way as in the embodiment shown in Figure 1 the rate of projection is controlled by reading the marks on the edge of the film. These marks are projected through an opening in the projector film gate and compared with a reference opening of a monitor controlling the speed of projection and which is provided with a traveller visible in a reference opening and bearing the same colours as the disc 10. The rate of projection is correct when the

colours are identical in the two openings. Such a monitor therefore is used to control the projection speed manually.

Figure 3 shows a projector fitted with an automatic monitor which evaluates the marks on the edge of the film 5 and adjusts the projection speed accordingly. A projection lamp 17 sends a beam onto the film 5. This beam is interrupted sequentially by a shutter 18. The projection opening is made up of two film-guiding plates 19 and 20. The plates bear two adjacent holes 21 and 22 which correspond with the edge margin of the film 5. Part of the rays from the source of light 17 pass through the holes 21 and 22. Behind these openings in the path of the rays are two semi-transparent mirrors 23 and 24 and a totally reflecting mirror 25. These three mirrors 23, 24 and 25 divide the rays which pass through the openings 21 and 22 and direct them through the filters 26, 27 and 28 onto photoelectric transducers, e.g. photoresistances or photodiodes 29, 30 and 31 shown in Figure 3.

If the frames have coded coloured markings made by the marking device shown in Figure 2, each differently coloured mark on the film is analysed by the filters 26, 27 and 28 e.g. red, blue and yellow. The filters are such that the colour red, blue or yellow produce an output signal from the photoelectric transducers 29, 30 or 31 respectively. A green mark gives a signal to the blue and yellow photoelectric transducers and if there is no mark, no signal is given to the transducers 29, 30 and 31. The photoelectric transducers 29, 30 and 31 are each connected in series with threshold switches 32, 33 and 34 respectively. The signals from the threshold switches are transmitted to control circuits of impulse generators 35, 36 and 37 respectively, each of which has a different operating frequency. These generators may be revolving discs bearing contacts which connect with fixed contacts. Another system could be devised without mechanical connections but having a revolving magnet fixed on an axle of the projector. The magnet induces a magnetic flux in a coil or influences magnetic field-sensitive resistance. In any case, the output signals from the impulse generators 35, 36 and 37 respectively provide a train of impulses the frequency of which depends on the marking of the film 5.

An electro-magnet 38 is connected to the terminal of the impulse generators. This magnet is connected to a claw which makes the film move forward, in such a way as to prevent one cycle of movement when the magnet 38 is activated by an impulse. The functioning of such a magnet is described in the Austrian Patent No. 282,351 in detail

and will not therefore be described further here.

The result is that if the film is not marked, no impulse is transmitted to the magnet 38 and the film 5 moves forward at a maximum speed. Preferably yellow and blue markings are used to correspond with film frequencies of half and a third respectively of the normal speed. If the film bears a green mark the impulse generators connected to the blue and to the yellow react simultaneously and both their frequencies are transmitted together. The red marking can be attributed to an impulse generator whose frequency corresponds with a minimum speed of projection, in this manner a red marking causes the film to stop moving forward. In this case the film can then be moved on manually or a timing relay can be connected to this generator which prevent the generator from interrupting the movement for a desired lapse of time.

If the cine-camera is fitted with the marking device shown in Figure 1, or the disc 10, shown in Figure 2 bears filters which modify the intensity of light instead of coloured filters, it is sufficient to place one totally reflecting mirror identical with mirror 25, behind the opening 22 in Figure 3. This mirror directs the beam of light onto a photoelectric cell 39 (Figure 4). This photoelectric cell is placed at the input of a circuit having several operating conditions. Each of these conditions correspond to a different threshold. Such a circuit is described in DAS No. 916 534, therefore its exact functioning will not be described herein. Depending on the level of the threshold one of the control circuits 40, 41 or 42 comes into action and all the others are blocked. Impulse generators such as those illustrated in Figure 3 are connected to the terminals of the control circuits 40, 41 and 42 by means of relays 43, 44 and 45 respectively. The relays 43, 44 and 45 can be replaced by electronic control circuits or electronic impulse generators.

The optical signals could be replaced by magnetic signals. Where the circuit represented in Figure 4 is concerned several variations are possible. For example a single threshold switch could be provided to which the signal would be conducted in rapid succession by way of several resistances having different resistance values.

The switch to different resistances is accompanied by the simultaneous switch to different impulse generators, depending upon the resistance value to which the threshold switch responds. The impulse generator associated with this resistance also continues to function.

Another possibility would be the comparison of the signal with a reference signal

in the form of steps or saw-teeth, where the switch from one impulse generator to another is made at the same time as an increase in the voltage with respect to the reference signal. Another possibility consists in preventing the insertion of the picture frequency values into the lightmeter circuit when switching on the filter 10 or lamp 8 in order to shoot in bad lighting conditions using a lower speed which brings about longer exposure of each image. In all these cases, the procedure described in this invention reduces film-consumption.

WHAT WE CLAIM IS:—

1. A cine camera provided with 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 (as herein defined) which is indicative of the speed of shooting.
2. A camera as claimed in claim 1, in which the device produces a stripe along one marginal edge of the film.
3. A camera as claimed in claim 1, in which the device produces striping extending transversely of the film edge.
4. A camera as claimed in any one of the preceding claims, in which the marking is recorded on the film strip while held stationary in a film gate of the camera.
5. A camera as claimed in any one of the preceding claims, in which the device includes an electric lamp and apparatus for maintaining constant the strength of its light falling on the film at the predetermined position.
6. A camera as claimed in claim 5, in which the apparatus includes a photo-sensitive device on which light from the lamp is incident and which controls an electric supply circuit to the lamp, a light conductor for carrying light from the lamp to the position of the marking.
7. A camera as claimed in any one of claims 1 to 4, in which the marking is varied by an adjustable light filtering arrangement through which light incident on the film at the predetermined position passes.
8. A camera as claimed in claim 7, in which the colour of the filter through which the light passes is determined by the speed at which the film is shot as selected by a switch.
9. A camera as claimed in claim 8, in which the light passing through the filter towards the predetermined position is ambient light.
10. A camera as claimed in claim 1, including a magnetic write-in head for marking a magnetic stripe provided on the film with a signal signifying the speed at which the film is shot.
11. A cine projector provided with a

monitor controlling the speed of film projection and arranged to read markings (as herein defined) on the film significant of the speed at which the film is to be projected and positioned on the film strip at a position clear of the film frames, the monitor being equipped with means for comparing the read markings with pre-arranged references and for varying the projection speed until identity occurs when the read-out of the marking matches one of the references.

12. A projector as claimed in claim 11, in which the references comprise marks of different colours.

13. A projector as claimed in claim 12, in which the monitor responds to the colours of the markings by altering the speed of projection with change in the markings.

14. A projector as claimed in claim 13, including an optical system for projecting a beam of light through the markings when in a film gate in the projector, and controlling the speed of projection in accordance with the light content of the beam after it has passed through the marking.

15. A projector as claimed in claim 14, including colour-sensitive channels each corresponding to a different speed of projection and arranged to be selectively energised in dependence upon the colour content of the beam leaving the marking position.

16. A projector as claimed in claim 15, in which each channel includes an input filter, a photo-electric element, a threshold switch operated when the element output exceeds a threshold value, and a pulse generating circuit influencing, with its output train of pulses which is different for each channel, a mechanism controlling the frame-by-frame advance of the film through the film gate.

17. A projector as claimed in claim 14, including a single photo-electric element on which the beam traversing the film is incident, the magnitude of the output of the photo-electric element being applied to a circuit which controls the speed of projection in accordance with such magnitude.

18. A projector as claimed in claim 11, in which the monitor includes a magnetic pick-up head for reading marking signals from a magnetic stripe on the film, the output of the monitor controlling a circuit for adjusting the speed of projection.

19. A cine camera as claimed in claim 1, having a marking device arranged and adapted to operate substantially as described with reference to Figure 1, of the accompanying drawings.

20. A cine projector as claimed in claim 11, arranged and adapted to operate substantially as described with reference to Figures 2 and 2A, or Figure 3 or Figure 4 of the accompanying drawings.

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in the form of steps or saw-teeth, where the switch from one impulse generator to another is made at the same time as an increase in the voltage with respect to the reference signal. Another possibility consists in preventing the insertion of the picture frequency values into the lightmeter circuit when switching on the filter 10 or lamp 8 in order to shoot in bad lighting conditions using a lower speed which brings about longer exposure of each image. In all these cases, the procedure described in this invention reduces film-consumption.

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3. A camera as claimed in claim 1, in which the device produces striping extending transversely of the film edge.
4. A camera as claimed in any one of the preceding claims, in which the marking is recorded on the film strip while held stationary in a film gate of the camera.
5. A camera as claimed in any one of the preceding claims, in which the device includes an electric lamp and apparatus for maintaining constant the strength of its light falling on the film at the predetermined position.
6. A camera as claimed in claim 5, in which the apparatus includes a photo-sensitive device on which light from the lamp is incident and which controls an electric supply circuit to the lamp, a light conductor for carrying light from the lamp to the position of the marking.
7. A camera as claimed in any one of claims 1 to 4, in which the marking is varied by an adjustable light filtering arrangement through which light incident on the film at the predetermined position passes.
8. A camera as claimed in claim 7, in which the colour of the filter through which the light passes is determined by the speed at which the film is shot as selected by a switch.
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monitor controlling the speed of film projection and arranged to read markings (as herein defined) on the film significant of the speed at which the film is to be projected and positioned on the film strip at a position clear of the film frames, the monitor being equipped with means for comparing the read markings with pre-arranged references and for varying the projection speed until identity occurs when the read-out of the marking matches one of the references.

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14. A projector as claimed in claim 13, including an optical system for projecting a beam of light through the markings when in a film gate in the projector, and controlling the speed of projection in accordance with the light content of the beam after it has passed through the marking.

15. A projector as claimed in claim 14, including colour-sensitive channels each corresponding to a different speed of projection and arranged to be selectively energised in dependence upon the colour content of the beam leaving the marking position.

16. A projector as claimed in claim 15, in which each channel includes an input filter, a photo-electric element, a threshold switch operated when the element output exceeds a threshold value, and a pulse generating circuit influencing, with its output train of pulses which is different for each channel, a mechanism controlling the frame-by-frame advance of the film through the film gate.

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19. A cine camera as claimed in claim 1, having a marking device arranged and adapted to operate substantially as described with reference to Figure 1, of the accompanying drawings.

20. A cine projector as claimed in claim 11, arranged and adapted to operate substantially as described with reference to Figures 2 and 2A, or Figure 3 or Figure 4 of the accompanying drawings.

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