

PATENT SPECIFICATION

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(54) CINEMATOGRAPHIC APPARATUS

(71) We, BOLEX INTERNATIONAL S.A., of 18 Avenue des Alpes, CH-1450 STE-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:—

The present invention relates to a cinematographic apparatus and to an intermittent film driving mechanism for such apparatus.

Claw mechanisms are known which produce forward and reverse motion of a film in cinematographic apparatus. Generally, they have several cams controlling the claw motion; one cam controlling the traction and recovery movements of the claw and another cam controlling the penetration of the claw into the film perforations during film motion. Reverse action is sometimes brought about by the intervention of another cam working out of phase with the first or by reversing a driving mechanism for the claw.

Cams are mechanical parts which must be manufactured with precision, with the result that the price of the film traction apparatus increases in proportion to the number of cams included.

A disadvantage of reversing a drive motor of a cinematographic projector is that, during the motor reversal phase, the film ceases moving and the frame in the film-gate can be damaged or at least become distorted by the heat of the projection lamp. This fault cannot be remedied by a ventilator driven by the same motor as the projector, as it would cease to function simultaneously with the claw mechanism.

In accordance with one aspect of the present invention, there is provided an intermittent film driving mechanism for a motion picture apparatus coupled to a device for intermittently exposing the film to a light beam, said mechanism comprising a claw device of the sliding claw type, an eccentric cam means for driving said claw device and rotatable at a constant rate in the same direction and a control means for

preventing the claw device from operatively engaging the film perforations, said claw device comprising two symmetric claws, rigidly fixed together, which are operative to engage the film perforations respectively during forward and backward transportation of said film, the ratio of exposures to complete revolutions of the eccentric cam means being a non-integer and in which the control means comprises an electromagnet for preventing said claws from engaging the film at least during exposures to the light beam

In accordance with a second aspect of the present invention, there is provided a cinematographic apparatus having an intermittent film driving mechanism coupled to the driving mechanism of a rotatable shutter, the intermittent film driving mechanism comprising a claw, of the sliding claw type, movable into and out of operative engagement with a film perforation, and a claw drive means for driving the said claw in a forward or reverse direction and including a drive wheel to turn constantly in the same direction at a rotation ratio of four shutter movements to three turns of the drive wheel to rotate the claw in a plane that extends across the plane of a film, and claw control means to move the claw into and out of an operative position relative to the film during predetermined portions of each cycle consisting of three rotations of the drive wheel, said claw comprising a claw bar with a pair of claws near one end thereof, one claw to engage the film during forward movement thereof and the other to engage the film during reverse movement thereof, and wherein means are provided to sense a predetermined rotational position of the shutter and operate said claw control means in response thereto, and wherein the claw control means comprises an electromagnet to move the claw bar toward and away from the film and said last mentioned means comprise a magnet arranged on at least one of the blades of the shutter and co-operating with a reed pick-up device to transmit a control impulse to the electromagnet.

According to a third aspect of the present

invention, there is provided an intermittent film driving mechanism for a film projector, comprising two sliding claws capable of advancing the film in opposite directions respectively and selectively engageable one at a time with the film, drive means for causing both claws to reciprocate in a direction parallel to the film, and cyclically operable engagement control means for displacing the claws in a direction normal to the plane of the film; the operating cycles of the engagement control means being synchronised to the cycles of the drive means in such a manner that the direction in which the film is advanced during projection may be changed solely by alteration of the claw engaging the film.

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

Figure 1 is a perspective view of basic parts of a schematically illustrated film driving mechanism;

Figure 2 is a timing diagram showing the movements of various parts during a cycle of the film driving mechanism in Figure 1; and

Figure 3 shows a modification of the film driving mechanism of Figure 1.

With reference to Figure 1, a claw member is made up of an elongate bar 1 with two claws 2 and 3 at one extremity. The other extremity is pivoted on an arm 4 secured to and rotatable with an axle 5. The centre part of the bar 1 is pivoted to one end of a link 6, whose other end is pivoted to an eccentric 7 on a wheel. The arm 4 pivots between two extreme positions which correspond respectively with two positions of the claw. These two positions are shown in Figure 1, the first in continuous lines, the second in dash-dot lines.

The axle 5 has a permanent magnet 11 at the opposite end to the arm 4, which is located between the poles of an electromagnet 12 supplied with direct current and capable of having its polarisation changed, by reversing the direction of electric current through its coil. The current direction is reversed by a change-over switch, not shown, which causes the permanent magnet 11, and thus the arm 4, to turn through 180°.

The arm 4 also has its position controlled by a second electromagnet 8 having pole pieces which define two pole gaps 9 and 10 corresponding to the two positions of the arm 4. Energisation of the electromagnet 8 causes the arm 4 to be attracted into one or other of the pole gaps so that the claw member is retracted bodily from a perforated film strip 15.

When the film 15 is moving forwards the first claw 3 functions while the second claw 2 does not come in contact with the film. Each of these claws has one edge 13 sub-

stantially perpendicular to the plane of the film 15 and an adjacent edge 14 at an angle to the plane of the film 15.

Figure 2 is a diagram of the film driving mechanism described above, coupled to a two-bladed shutter. A four-bladed shutter turning at half the speed could alternatively be used.

A complete cycle of the claw is broken down into six successive phases numbered I to VI. The vertical columns A, B, C, D and E respectively show the relation of the eccentric 7 on the wheel; the claw when driving the film forward; the claw when driving the film in reverse; energisation periods of the electromagnet 8 which retracts the claw bar 1; and, the phases of the shutter. In the columns B and C the direction of the movement of the claw bar is indicated by an arrow for each phase of the operation as well as the initial and final positions of the claw in that phase when operating forwards or in reverse. In column E the shaded areas indicate the periods when the shutter is closed. It should be noted that the wheel carrying the eccentric 7 and the shutter mechanism are coupled in such a way that three turns of the wheel correspond with four shutter cycles.

In phase I, the eccentric wheel makes half a rotation indicated by a semi-circle in thick line. If the mechanism is driving the film forwards the corresponding claw 3 is engaged in a perforation of the film and its edge 13 which is perpendicular to the film pushes on one side of the perforation in such a way that this phase corresponds with a movement of the film. During the portion of this phase in which the film is moved, one of the blades of the shutter closes a film-gate and the electromagnet 8 is not energised.

If the mechanism is working in reverse the other claw 2 is engaged in a perforation and its inclined edge 14 contacts the perforations so that during this phase the claw 2, being a sliding claw, slides along the film 15 without causing it to move.

In phase II, the electromagnet 8 is energised to retract the claw bar 1 from the film perforations whether the mechanism is working forwards or in reverse. This phase is divided into two equal parts, during the first of which the film-gate is opened by the shutter and during the second the next blade of the shutter closes the film-gate.

In phase III the electromagnet 8 continues, initially, to hold the claw bar 1 retracted but is de-energised in the second half of the phase to allow the claws moved by the rotation of the eccentric 7 and corresponding to respective forward or reverse movements of the film to engage in the perforations. The second blade of the shutter continues to hold the film-gate closed during the beginning of the third

phase, but the film-gate is open for the second part of this phase.

During phase IV of the mechanism is running with reverse motion the claw 2 corresponding with reverse movement penetrates into a perforation at the end of the preceding phase III and its edge generally perpendicular to the film pushes on the side of the perforation and makes the film move backwards. However, if the mechanism is running forwards during phase IV the inclined edge 14 of the corresponding claw 3 engages the side of the perforation and the drive of the eccentric wheel therefore causes the claw to slide out of the perforation and over the surface of the film without causing it to move or disturbing its stability in front of the film-gate. During virtually the whole of phase IV the electromagnet 8 is de-energised and the film-gate is closed by the second blade.

During phase V the electromagnet 8 is energised and retracts the claw 1 from the film. The film-gate is opened by the shutter during the first half of this phase but is closed during the second half.

In phase VI the electromagnet 8 initially continues to hold the claw bar retracted from the film while the film-gate is closed by the second blade of the shutter but the electromagnet is de-energised to release the claw bar during the second part of the phase when the film-gate is open. During phase VI the claw bar is initially held retracted, irrespective of whether the mechanism is running forwards or in reverse, and in both cases engages in the film perforations during the second half of the phase in order to recommence the cycle.

It should be noted that the closing of the film-gate always coincides with the phases during which the film is moved either forwards or in reverse, without either reversing the direction of rotation of the eccentric wheel or modifying the working of the shutter mechanism. When projecting onto a small screen, shutter frequencies lower than 72 per second cause flickering, and therefore the two-bladed shutter must turn at a minimum rate of 36 turns per second. In this case the eccentric wheel makes 54 turns per second which corresponds with a film speed of 18 frames per second. It will be noted that the electromagnet 8 makes it possible to withdraw the claw from its working position thus interrupting the movement of the film for a pre-determined length of time without modifying the rotation of the eccentric wheel. It is therefore, a simple matter to project a single frame or to vary the speed of filming or projecting without offering a basic constant speed for the eccentric wheel. In other words the eccentric wheel 7 can continue to run at 54 revolutions per

second, enabling the film to move at 54 frames per second, if the electromagnet 8 does not withdraw the claw.

A variation of Figure 1 is shown in Figure 3. A claw bar 51 ending in two claws 52, 53 is connected at the end opposite the claws to a lever 54 which pivots on an axle 55. A spring 56 provides a resilient bias to retract the claw from the film perforation. An electromagnet 57 acts on the lever, when energised, in the opposite direction to the spring 56 and has an armature 60 connected by a link 61 to the lever 54. As before, a wheel driven eccentric 58 turning constantly in the same direction drives the claw mechanism by means of a link 59 irrespective of whether the film is being driven forwards or in reverse. The parts 54, 55, and 61 are displaceable in the direction of the lever 54 to bring the claw bar 51 to a position analogous to that shown in dash-dot line in Fig. 1, when the film is to be driven in reverse.

During the phases when the film is moving the electromagnet is supplied with current and the armature 60 and link 61 are drawn into the electromagnet. The lever 54 rocks on its axle 55 and pushes the claw into a perforation in the film. When the claw is to be withdrawn the electromagnet is de-energised and the spring 56 alone acts upon the lever 54. This form has the advantage that when the apparatus stops running, the claw is always withdrawn from the film.

WHAT WE CLAIM IS:—

1. An intermittent film driving mechanism for a motion picture apparatus coupled to a device for intermittently exposing the film to a light beam, said mechanism comprising a claw device of the sliding claw type, an eccentric cam means for driving said claw device and rotatable at a constant rate in the same direction and a control means for preventing the claw device from operatively engaging the film perforations, said claw device comprising two symmetric claws, rigidly fixed together, which are operative to engage the film perforations respectively during forward and backward transportation of said film, the ratio of exposures to complete revolutions of the eccentric cam means being a non-integer and in which the control means comprises an electromagnet for preventing said claws from engaging the film at least during exposures to the light beam.

2. An intermittent film driving mechanism as claimed in claim 1, wherein the said ratio of exposures to complete revolutions of the eccentric cam means is 4 to 3.

3. An intermittent film driving mechanism as claimed in claim 1 or 2, wherein the claw device comprises a claw bar supporting on one end thereof the two symmetric claws



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phase, but the film-gate is open for the second part of this phase.

During phase IV of the mechanism is running with reverse motion the claw 2 corresponding with reverse movement penetrates into a perforation at the end of the preceding phase III and its edge generally perpendicular to the film pushes on the side of the perforation and makes the film move backwards. However, if the mechanism is running forwards during phase IV the inclined edge 14 of the corresponding claw 3 engages the side of the perforation and the drive of the eccentric wheel therefore causes the claw to slide out of the perforation and over the surface of the film without causing it to move or disturbing its stability in front of the film-gate. During virtually the whole of phase IV the electromagnet 8 is de-energised and the film-gate is closed by the second blade.

During phase V the electromagnet 8 is energised and retracts the claw 1 from the film. The film-gate is opened by the shutter during the first half of this phase but is closed during the second half.

In phase VI the electromagnet 8 initially continues to hold the claw bar retracted from the film while the film-gate is closed by the second blade of the shutter but the electromagnet is de-energised to release the claw bar during the second part of the phase when the film-gate is open. During phase VI the claw bar is initially held retracted, irrespective of whether the mechanism is running forwards or in reverse, and in both cases engages in the film perforations during the second half of the phase in order to recommence the cycle.

It should be noted that the closing of the film-gate always coincides with the phases during which the film is moved either forwards or in reverse, without either reversing the direction of rotation of the eccentric wheel or modifying the working of the shutter mechanism. When projecting onto a small screen, shutter frequencies lower than 72 per second cause flickering, and therefore the two-bladed shutter must turn at a minimum rate of 36 turns per second. In this case the eccentric wheel makes 54 turns per second which corresponds with a film speed of 18 frames per second. It will be noted that the electromagnet 8 makes it possible to withdraw the claw from its working position thus interrupting the movement of the film for a pre-determined length of time without modifying the rotation of the eccentric wheel. It is therefore, a simple matter to project a single frame or to vary the speed of filming or projecting without offering a basic constant speed for the eccentric wheel. In other words the eccentric wheel 7 can continue to run at 54 revolutions per

second, enabling the film to move at 54 frames per second, if the electromagnet 8 does not withdraw the claw.

A variation of Figure 1 is shown in Figure 3. A claw bar 51 ending in two claws 52, 53 is connected at the end opposite the claws to a lever 54 which pivots on an axle 55. A spring 56 provides a resilient bias to retract the claw from the film perforation. An electromagnet 57 acts on the lever, when energised, in the opposite direction to the spring 56 and has an armature 60 connected by a link 61 to the lever 54. As before, a wheel driven eccentric 58 turning constantly in the same direction drives the claw mechanism by means of a link 59 irrespective of whether the film is being driven forwards or in reverse. The parts 54, 55, and 61 are displaceable in the direction of the lever 54 to bring the claw bar 51 to a position analogous to that shown in dash-dot line in Fig. 1, when the film is to be driven in reverse.

During the phases when the film is moving the electromagnet is supplied with current and the armature 60 and link 61 are drawn into the electromagnet. The lever 54 rocks on its axle 55 and pushes the claw into a perforation in the film. When the claw is to be withdrawn the electromagnet is de-energised and the spring 56 alone acts upon the lever 54. This form has the advantage that when the apparatus stops running, the claw is always withdrawn from the film.

WHAT WE CLAIM IS:—

1. An intermittent film driving mechanism for a motion picture apparatus coupled to a device for intermittently exposing the film to a light beam, said mechanism comprising a claw device of the sliding claw type, an eccentric cam means for driving said claw device and rotatable at a constant rate in the same direction and a control means for preventing the claw device from operatively engaging the film perforations, said claw device comprising two symmetric claws, rigidly fixed together, which are operative to engage the film perforations respectively during forward and backward transportation of said film, the ratio of exposures to complete revolutions of the eccentric cam means being a non-integer and in which the control means comprises an electromagnet for preventing said claws from engaging the film at least during exposures to the light beam.

2. An intermittent film driving mechanism as claimed in claim 1, wherein the said ratio of exposures to complete revolutions of the eccentric cam means is 4 to 3.

3. An intermittent film driving mechanism as claimed in claim 1 or 2, wherein the claw device comprises a claw bar supporting on one end thereof the two symmetric claws



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and the other end of which is coupled to film direction control means to selectively move said claw bar between a first position in which only the first mentioned claw can
5 operatively engage the film and a second position in which only the other claw can operatively engage the film.

4. An intermittent film driving mechanism as claimed in claim 3, wherein the device for
10 intermittently exposing the film to a light beam is a shutter and means are provided to sense a predetermined rotational position of the shutter and to operate said claw control means in response thereto.

5. An intermittent film driving mechanism as claimed in claim 4, wherein the shutter is
15 a two-bladed rotational shutter one of said blades at least comprising a magnet which co-operates with a reed pick-up device to transmit a control impulse to the electro-
20 magnet.

6. A cinematographic apparatus having an intermittent film driving mechanism coupled to the driving mechanism of a
25 rotatable shutter, the intermittent film driving mechanism comprising a claw, of the sliding claw type, movable into and out of operative engagement with a film perforation, and a claw drive means for
30 driving the said claw in a forward or reverse direction and including a drive wheel to turn constantly in the same direction at a rotation ratio of four shutter movements to three turns of the drive wheel to rotate the
35 claw in a plane that extends across the plane of a film, and claw control means to move the claw into and out of an operative position relative to the film during predetermined portions of each cycle
40 consisting of three rotations of the drive wheel, said claw comprising a claw bar with a pair of claws near one end thereof, one claw to engage the film during forward movement thereof and the other to engage

the film during reverse movement thereof, and wherein means are provided to sense a
45 predetermined rotational position of the shutter and operate said claw control means in response thereto, and wherein the claw control means comprises an electromagnet
50 to move the claw bar toward and away from the film and said last mentioned means comprise a magnet arranged on at least one of the blades of the shutter and co-operating with a reed pick-up device to transmit a
55 control impulse to the electromagnet.

7. An intermittent film driving mechanism for a film projector, comprising
60 two sliding claws capable of advancing the film in opposite direction respectively and selectively engageable one at a time with the film, drive means for causing both claws to reciprocate in a direction parallel to the film, and cyclically operable engagement
65 control means for displacing the claws in a direction normal to the plane of the film; the operating cycles of the engagement control means being synchronised to the cycles of the drive means in such a manner that the
70 direction in which the film is advanced during projection may be changed solely by alteration of the claw engaging the film.

8. An intermittent film driving mechanism for a film projector as claimed in claim 1,
75 arranged and adapted to operate substantially as described with reference to Figures 1 and 2 of the accompanying drawings.

9. An intermittent film driving mechanism for a film projector as claimed in claim 8,
80 modified substantially as described with reference to Figure 3 of the accompanying drawings.

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