

PATENT SPECIFICATION

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(54) FILM-SPOOL DRIVE IN CINEMATOGRAPHIC EQUIPMENT

(71) We, BOLEX INTERNATIONAL SA, 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:—

In cine-projectors and cameras with intermittent drive the film is moved forwards in jerks by a claw operating adjacent the film gate. At each movement of the claw it penetrates into a perforation in the film and pulls the film forwards at a varying speed for the length of one frame. The pull of the claw must overcome the inertia of a spool containing the film, the friction of the edges of the film, and it must also move the film. The traction force the claw must exert may be quite considerable and the forces it is required to overcome are often the cause of instability of the image. Unwinding mechanisms already exist in which the film unwinds at a constant speed, and forms a loop to absorb the tension between the spool and the film gate. Such mechanisms cannot be adapted in all cameras and projectors because they take up a lot of space, furthermore they increase the cost of the equipment considerably because their manufacture calls for a high degree of precision. They also tend to complicate the loading of the apparatus, and in the case of projectors prevent rapid rewinding and the use of the projector as biformat equipment.

In the case of film cassettes where the spools have parallel axes the lack of space makes it impossible to have a large loop of the film. Proposals have been made to utilise an oscillating bar acting on the film between the spool and the gate but the stability of the image remains unsatisfactory where there are joins in the film, which is usually the case in amateur films

after editing.

The invention provides cine-film handling apparatus including a film gate, a film spool support arranged upstream or downstream of the film gate and being displaceable from a second to a first position when upstream or from a first to a second position when downstream against a bias, a continuously-rotatable drive to rotate the support when in the first position and which is disengaged from the support when the support is in the second position, wherein the displacement of the support from the second to the first position when upstream or from the first to the second position when downstream occurs if the tension in a portion of a film strip when extending between a spool, mounted in use on the support, and the film gate exceeds a predetermined value, and the effect of the displacement of the support when upstream is to establish a drive connection which rotates the support in a direction to reduce the tension in the film strip portion, and when downstream to disengage a drive connection, thereby restoring the tension to the predetermined value.

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

FIGURE 1 is a front view of a winding mechanism for two film spools in film handling apparatus;

FIGURE 2 is a section on the line and in the direction indicated by the arrows I-I in Figure 1; and

FIGURE 3 is a front view of another form of the winding mechanism.

In Figure 1 a motor shaft 1 drives a belt 2 which travels around two pulleys 20 and 21 which are respectively associated with discs 3 and 4. The discs are provided with respective central hubs 5 and 6 around which a film strip is unwound and wound 90

respectively. The discs 3 and 4 are rotatable about their axes and are mounted at intermediate positions on respective levers 7 and 8. The levers 7 and 8 are pivoted at their adjacent ends, by way of pivot pins 9 and 10, to a bar 11 which is tiltable about a centre fulcrum 25.

The remote ends of the levers 7 and 8 carry pins 12 and 13 which locate in respective notches 28 and 29 formed in respective opposite ends of the tiltable bar 11.

Each of the discs 3 and 4 is provided on one of its two circular faces with a ring-shaped trough. The trough associated with the plate 3 is referenced 16 and is shown in more detail in Figure 2 in partial cross-section, and the trough associated with the other disc 4 is referenced 17. Riding inside the troughs with a clearance fit are rubber rings 32 and 33 each of which is fitted to a boss 18, 19 fixed to the end of a stub shaft projecting from the centre of respective pulleys 20 and 21. The rings 32 and 33 are a clearance fit in the troughs 16 and 17 so that they are capable of running on either the inside or the outside walls of the trough, as shown in Figure 2, depending on the relative position of the disc 3 or 4 with respect to the fixed pulleys 20 and 21, or between them so as not to engage either.

The angular position of the bar 11 is determined by a tension spring 24 attached to one end of the bar and which urges it in a counter clockwise direction so that it abuts an unreferenceed stop shown in Figure 1, and by an electromagnet 22 which, when energised, rotates the bar 11 against the bias of the spring 24 in a clockwise direction until an end of the bar abuts the electromagnet armature.

A tension spring 14 urges the lever 7 in a clockwise direction with respect to the bar 11, and a similar tension spring 15 urges the lever 8 in a counterclockwise direction with respect to the bar 11.

The path of the film between the hubs of the two discs 3 and 4 is illustrated in chain dotted outline 30 and includes a portion 23 which travels in the direction of an arrow 27 through a film gate 26.

The operation will now be described on the basis that the film is moving in the direction of the arrow 27 under the influence of a traction claw not shown in the drawing and which draws the film intermittently, that is to say in short jerks each corresponding to one frame, through the film gate 26.

The movement of the film may be considered in two stages. The first stage occurs when the film is being moved through the film gate by the claw and the second stage occurs when the film is

stationary during projection through the film gate.

The effect of the film being pulled by the claw in stage 1 is to produce a tension in the loop 30 of the film if it is extremely small. This sudden tension is applied to the disc 3 pivoted on the lever 7, and causes the lever to pivot from right to left as shown in Figure 1 about pivot pin 9 against the bias of the spring 14. The movement of the disc 3 brings the rubber driving ring 32 into contact with the outer wall of the trough 16 and, as the pulley 20 is rotating in the direction of the arrow shown in Figure 1, a drive is imparted to the disc 3 causing it to rotate in the film-unwinding direction to relieve the tension.

As soon as the second stage commences, that is to say the projection of the stationary film, the tension in the portion 30 of the film disappears and the spring 14 returns the lever 7 and the disc 3 to the position shown in Figure 1 at which the rubber ring 32 is held approximately centrally in the trough so that it does not impart drive to either of its walls. The film therefore ceases to unwind from the hub 5. The relative positions of the parts of Figure 1 are so arranged that when the pin 12 is engaging the righthand edge of the notch 28 shown in Figure 1, the rubber ring 32 occupies the central portion of the trough 16. This prevents any risk of re-winding of the film on the disc 3 through too great a movement of the disc 3 to the right in Figure 1 under the influence of the spring 14. The force exerted by the spring 14 on the lever 7 is extremely slight.

Turning now to the disc 4 it will be seen that it is driven by the rubber ring 33 associated with the pulley 21 in the film winding direction as a result of the engagement of the ring 33 with the outside wall of the trough 17. As long as there is no tension in the loop of film 31 leaving the film gate, the lever 8 is pulled by the spring 15 towards the right-hand wall of the notch 29 as shown in Figure 1, but without actually touching it, so that the movable disc 4 has the radially-outer wall of its trough 17 held resiliently against the rotating rim of the rubber ring 33.

If the portion of the film strip leaving the film gate becomes tensioned, which implies that the film is being wound on to the disc 4 more rapidly than it is being drawn through the film gate 26, the tension in the loop 31 acts on the disc 4 and thus on the lever 8 causing it to swing in a clockwise direction about pivot pin 10 until the pin 13 on the lever abuts the other side of the notch 29. This movement interrupts the driving contact between the rubber ring 33 and the trough 17 so that the disc 4 ceases to be driven in the wind-

ing-on direction and, as the rubber ring 33 is now centred in the trough 17 out of contact with both of its side walls, the drive to the disc 4 is interrupted and the tension in the film portion 31 is immediately relieved.

When the film is wound backwards, the functions of the various parts associated with the two discs 3 and 4 are reversed. For drive-back of the film, the electromagnet 22 is energised to cause the arm 11 to tilt in a clockwise direction about the fulcrum 25. This movement causes the pin 12 to be approximately centred in the notch 28 so that the spring 14 applies a force via the lever 7 and the disc 3 which provides the reaction necessary for the rubber ring 32, now engaging the inside wall of the trough 16, to drive the disc 3 in the clockwise direction. This drive is maintained until a tension appears in the loop 30 which causes the lever 7 to rock to the left, in Figure 1, and the disc 3 to be displaced so that the rubber ring 32 is centred in the trough 16 and the drive to the disc 3 is interrupted.

Likewise, any tension appearing in the strip portion 31 during reverse drive causes the lever 8 to rock in a clockwise direction so that the disc 4 is rotated also in a clockwise direction by the engagement of the rubber ring 33 with the inside wall of the trough 17, thus relieving the tension in the film strip.

It will be noted that in the arrangement shown in Figures 1 and 2 the speed of the disc 4 in the winding-on direction is not the same as the speed of the disc 3 when winding-on, because the rubber rings 32 and 33 are engaging respectively opposite walls of the associated troughs 16 and 17. In practice this speed difference causes no inconvenience.

Turning now to the embodiment shown in Figure 3, parts corresponding in function to parts already described with reference to Figures 1 and 2 carry the same reference numerals and will not be again described in detail.

In Figure 3 a motor shaft 1 drives a belt 2 which passes, in turn, around pulleys 18, 19, 17 and 16. The direction of belt movement and the corresponding movement of the pulleys is shown by arrows.

The film, denoted by a broken line, extends through a film gate 26 and is driven, with the parts in the positions shown in Figure 3, in the direction of the arrow 27. A small film loop occurs immediately before and after the film gate 26. The film is shown as being unwound from a disc 3 rotatably mounted on a lever 7, and being wound up on a disc 4 rotatably mounted on a second lever 8. The lever 7 is pivoted

at 9 and the lever 8 is pivoted at 10. The levers carry respective abutment pins 12 and 13 which cooperate, selectively, with abutment surfaces 28 and 29 provided on a cranked bar 11 which is pivoted at 25 and is provided at its opposite ends with the springs 14 and 15 which respectively urge the corresponding ends of the levers 7 and 8 towards the ends of the bar 11.

In Figure 3 a tension spring 24 is shown as urging the bar 11 in a clockwise direction so that its abutment surface 28 engages the pin 12 whereas the other abutment surface 29 is spaced from the pin 13. The positions of the abutment surfaces 28 and 29 with respect to the pins 12 and 13 may be interchanged by energising an electromagnet 32 causing the bar to rock in a counterclockwise direction.

The pulleys 16, 17, 18 and 19 are driven by the belt at constant speed and have fixed axes 20, 21, 22 and 23. When the film is being unwound from the disc 3, i.e. forwards, any sudden tension exerted by the traction claw (not shown) on the loop of the film 30 causes the lever 7 to pivot to the right in Figure 3 and thus bring the rim of the disc 3 into engagement with the hub 20 of the pulley 16. In consequence rotational drive is imparted to the disc 3 to unwind the film and thus relieve the tension in the film portion 30. As soon as the tension is relieved, the weak spring 14 restores the lever 7 to the position shown in Figure 3 and the driving connection between the hub 20 and the disc 3 is interrupted so that the film is no longer unwound. The purpose of the abutment surface 28 is to prevent the disc 3 moving sufficiently for its rim to come against the hub 23 of the pulley 18.

As shown, the rim of the disc 4 engages the hub 22 of the pulley 19 which drives the disc 4 in the film winding-on direction. If a tension develops in the film portion 31 the lever 8 is moved in a counterclockwise direction against the weak bias of the spring 15 and this movement brings the rim of the disc 4 out of engagement with the hub 22 so that wind-on ceases and the tension in the film portion 31 is immediately relieved. If the tension in the film portion 31 increases to any great extent, the lever 8 is free to move sufficiently to bring the rim of the disc 4 into engagement with the hub 21. This causes the disc 4 to be driven momentarily in the unwinding direction to ensure relief of the film tension.

To change the direction of movement of the film between the two discs 3 and 4, the electromagnet 32 is energised to interchange the engagement of the abutment surfaces 28 and 29 with the pins 12 and 13. In consequence, the disc 4 is moved to

an intermediate position where it is out of driving engagement with both of the hubs 21 and 22, and the disc 3 is biased by the spring 14 into driving engagement with the hub 23 which causes it to rotate in the wind-on direction.

If tension in the film portion 30 subsequently occurs, the drive connection between the disc 3 and the hub 23 is broken and, if the tension is large enough in the portion 30, a reverse drive is applied by engagement of the rim of the disc 3 with the hub 20. Likewise, if a tension builds up in the film portion 31, the disc 4 engages the hub 21 which drives it in the unwinding direction.

The above-described film driving mechanisms allow a small loop of film to be maintained before and after the film gate so that the work done by the claw is reduced and it is required to exert an almost constant light force on the film for each traction movement. A much enhanced image stability during film projection is obtained in consequence. Also, as the arrangement is almost symmetrical in the case of Figure 1 and symmetrical in the case of Figure 3, the drive arrangement can be put into reverse motion at almost any time during projection without trouble. Also, by using an electromagnetic control, the driving connection can be remotely controlled with ease. The invention is particularly well suited to be used with cassette films of small size.

WHAT WE CLAIM IS:—

1. Cine-film handling apparatus including a film gate, a film spool support arranged upstream or downstream of the film gate and being displaceable from a second to a first position when upstream, or from a first to a second position when downstream against a bias, a continuously-rotatable drive to rotate the support when in the first position and which is disengaged from the support when the support is in the second position, wherein the displacement of the support from the second to the first position when upstream or from the first to the second position when downstream occurs if the tension in a portion of a film strip when extending between a spool, mounted in use on the support, and the film gate exceeds a predetermined value, and the effect of the displacement of the support when upstream is to establish a drive connection which rotates the support in a direction to reduce the tension in the film strip portion, and when downstream is to disengage a drive connection, thereby restoring the tension to the predetermined value.

2. Apparatus as claimed in claim 1, in which the support is mounted on a pivoted arm which is angularly pivotable to dis-

place the support between its two positions.

3. Apparatus as claimed in claim 2, in which the arm is formed as a lever resiliently biased in one direction and being displaceable by the tension in the film strip portion against the bias.

4. Apparatus as claimed in claim 3, in which the lever is provided with a stop arranged to engage a movable abutment surface in the second upstream or first downstream position of the support, the abutment surface being integral with a part carrying one end of a tension spring whose other end is connected to the lever and which provides the bias urging the lever towards the second upstream or first downstream position respectively of the support spool.

5. Apparatus as claimed in any one of claims 1 to 4, including two support levers respectively pivoted at opposite sides of a fulcrum of a lever bar and carrying intermediate their ends respective spool supports which are rotatably mounted and are selectively drivable in a film wind-on direction by movement of the lever bar in one or other direction about its fulcrum.

6. Apparatus as claimed in claim 5, in which the lever bar has a first operating position in which it abuts against a bar stop and towards which it is biased by a spring and at which one of the spool supports is biased towards its second position and the other spool support is biased towards its first position, the lever bar being rockable to a second position by excitation of an electromagnet against the bias of the spring to interchange the function of the two spool supports and thereby reverse, in use, the direction of film movement through the film gate.

7. Apparatus as claimed in claim 6, including two pulleys belt-driven by a continuously-rotatable drive source and having fixed rotational axes, each pulley providing a circular friction surface within outer and inner walls of an annular channel formed in one face of the spool supports rotatably mounted on the associated support lever, the width of the channel being greater than the diameter of the circular friction surface which is so arranged that the support lever can move the spool support to engage the outer wall of the channel in the first position of the lever bar, to be disengaged from both walls of the channel, or to engage the inner wall of the channel in the second position of the lever bar.

8. Apparatus as claimed in claim 4, including two spool supports rotatably mounted on respective levers each having a stop for cooperation with a respective abutment surface provided on opposite sides of a fulcrum of a lever bar having

an intermediate position where it is out of driving engagement with both of the hubs 21 and 22, and the disc 3 is biased by the spring 14 into driving engagement with the hub 23 which causes it to rotate in the wind-on direction.

If tension in the film portion 30 subsequently occurs, the drive connection between the disc 3 and the hub 23 is broken and, if the tension is large enough in the portion 30, a reverse drive is applied by engagement of the rim of the disc 3 with the hub 20. Likewise, if a tension builds up in the film portion 31, the disc 4 engages the hub 21 which drives it in the unwinding direction.

The above-described film driving mechanisms allow a small loop of film to be maintained before and after the film gate so that the work done by the claw is reduced and it is required to exert an almost constant light force on the film for each traction movement. A much enhanced image stability during film projection is obtained in consequence. Also, as the arrangement is almost symmetrical in the case of Figure 1 and symmetrical in the case of Figure 3, the drive arrangement can be put into reverse motion at almost any time during projection without trouble. Also, by using an electromagnetic control, the driving connection can be remotely controlled with ease. The invention is particularly well suited to be used with cassette films of small size.

WHAT WE CLAIM IS:—

1. Cine-film handling apparatus including a film gate, a film spool support arranged upstream or downstream of the film gate and being displaceable from a second to a first position when upstream, or from a first to a second position when downstream against a bias, a continuously-rotatable drive to rotate the support when in the first position and which is disengaged from the support when the support is in the second position, wherein the displacement of the support from the second to the first position when upstream or from the first to the second position when downstream occurs if the tension in a portion of a film strip when extending between a spool, mounted in use on the support, and the film gate exceeds a predetermined value, and the effect of the displacement of the support when upstream is to establish a drive connection which rotates the support in a direction to reduce the tension in the film strip portion, and when downstream is to disengage a drive connection, thereby restoring the tension to the predetermined value.

2. Apparatus as claimed in claim 1, in which the support is mounted on a pivoted arm which is angularly pivotable to dis-

place the support between its two positions.

3. Apparatus as claimed in claim 2, in which the arm is formed as a lever resiliently biased in one direction and being displaceable by the tension in the film strip portion against the bias.

4. Apparatus as claimed in claim 3, in which the lever is provided with a stop arranged to engage a movable abutment surface in the second upstream or first downstream position of the support, the abutment surface being integral with a part carrying one end of a tension spring whose other end is connected to the lever and which provides the bias urging the lever towards the second upstream or first downstream position respectively of the support spool.

5. Apparatus as claimed in any one of claims 1 to 4, including two support levers respectively pivoted at opposite sides of a fulcrum of a lever bar and carrying intermediate their ends respective spool supports which are rotatably mounted and are selectively drivable in a film wind-on direction by movement of the lever bar in one or other direction about its fulcrum.

6. Apparatus as claimed in claim 5, in which the lever bar has a first operating position in which it abuts against a bar stop and towards which it is biased by a spring and at which one of the spool supports is biased towards its second position and the other spool support is biased towards its first position, the lever bar being rockable to a second position by excitation of an electromagnet against the bias of the spring to interchange the function of the two spool supports and thereby reverse, in use, the direction of film movement through the film gate.

7. Apparatus as claimed in claim 6, including two pulleys belt-driven by a continuously-rotatable drive source and having fixed rotational axes, each pulley providing a circular friction surface within outer and inner walls of an annular channel formed in one face of the spool supports rotatably mounted on the associated support lever, the width of the channel being greater than the diameter of the circular friction surface which is so arranged that the support lever can move the spool support to engage the outer wall of the channel in the first position of the lever bar, to be disengaged from both walls of the channel, or to engage the inner wall of the channel in the second position of the lever bar.

8. Apparatus as claimed in claim 4, including two spool supports rotatably mounted on respective levers each having a stop for cooperation with a respective abutment surface provided on opposite sides of a fulcrum of a lever bar having



two control positions at one of which one of the spool supports is biased into its second position and the other spool support is biased into its first position at which the said other spool support is rotated by the continuously-rotatable drive in a film wind-on direction, the lever bar being angularly movable about the fulcrum to a second control position at which the functions of the two supports are interchanged.

9. Apparatus as claimed in claim 8 in which the lever bar is biased towards one control position by a spring and is rockable to the second control position by energisation of an electromagnet in order to reverse the functions of the two spool supports.

10. Apparatus as claimed in claim 9, in

which each spool support is driven by circular friction surfaces provided on respective bosses of pulleys which are belt-driven by a common drive source, which circular friction surfaces are selectively engageable with the associated spool support in the first position thereof when the lever bar is in the first or second control positions, thus determining the direction of rotation of the respective spool support.

11. Cine-film handling apparatus substantially as herein described with reference to Figures 1 and 2 of the accompanying drawings.

12. Cine-film handling apparatus arranged and adapted to operate substantially as described with reference to Figure 3 of the accompanying drawings.

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