

PATENT SPECIFICATION

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(54) MOTION PICTURE PROJECTOR

- (71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America of 343 State Street, Rochester, New York 14650, United States of America, 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 motion picture projectors, and particularly to mechanical control systems therefor.
- 15 Motion picture projectors are known in which some form of reel braking is provided. U.S. Patent Specification No. 1,944,022, for example, is arranged to brake both supply and take-up reels with the intention of maintaining a desired tension on the film. Such an arrangement does not avoid film "spillage" from the reels under certain conditions, and is not suitable in a projector having several modes of operation. It is an object of the present invention to provide an improved motion picture projector having a relatively simple control system for driving and braking the film reels in different modes of operation.
- 20 In accordance with the invention there is provided a motion picture projector of the kind having a projection gate, a first spindle adapted to support a supply reel of film, a second spindle adapted to support a take-up reel for the film, a drive mechanism arranged to drive the two reels selectively for forward and rewind movements of the film through the projection gate according to the projector mode selected, and a mechanical brake mechanism associated with each spindle, wherein a manually actuated control device for selecting the projector mode is connected by a mechanical linkage with the brake mechanisms such that, irrespective of the direction
- of film movement through the projection gate, a braking effect is applied to the reel which is supplying film before a braking effect is applied to the reel which is taking up film, and in that the brake mechanism associated with one of the spindles is of the self-energising or differential type such that a greater braking force is applied when film is being unwound from its associated reel than when film is being taken up by its associated reel.
- In the detailed description of the preferred embodiment of the invention presented below, by way of example, reference is made to the accompanying drawings, in which:
- Fig. 1 is a perspective view of a motion picture projector according to the present invention;
- Fig. 2 is an enlarged elevation view of the selection plate and control lever of the projector as shown in Fig. 1 illustrating various operating positions;
- Fig. 3 is a somewhat schematic view taken along line 3-3 of Fig. 1 showing the driving and braking elements of the projector being shifted by the control mechanism between the "still" position shown in solid lines on the left, the "project" position shown in phantom in dashed lines in the middle, and the "fast forward" position shown in phantom in dashed and dotted lines on the right; and
- Fig. 4 is a view similar to Fig. 3 showing the driving and braking elements of the projector moved between the "still" position shown in solid on the right and the "rewind" position shown in phantom in dashed lines on the left.
- Referring first to Figure 1 of the accompanying drawings, the illustrative projector 10 comprises a box-like housing 12 for the various internal components hereinafter described. A pair of spaced film reel spindles 14 and 16 project from the housing to re-

movably support the respective film supply and take-up reels 18 and 20 in a common plane at the opposite ends of one side of housing 12. Housing 12 includes a portion 22 that projects into the plane between the reels 18 and 20. A projection lens 24 projects from housing portion 22 and the optical axis of the lens oriented to direct light from a lamp (not shown) onto a mirror 23. A slot in housing portion 22 defines a film path 26 which extends between the two reels, between the lamp and the projection lens 24 and through a film gate (not shown) therebetween, and past a film advancing mechanism (not shown) that is located along the film path within housing portion 22.

The movement of the film along path 26 is controlled by the operator moving a mode selection lever 30 along a generally "H" shaped opening or slot 27 in the selection or face plate 28 to the "off", "still", "project", "rewind", or "fast forward" positions which are identified upon the enlarged view of the face plate depicted in Figure 2. Movement of the selection lever 30 to the various operating positions affects the control mechanism of the present invention as will be discussed later in greater detail, and also controls other projection linkage as described in detail in Patent Application No. 31870/74 (Serial No. 1 479 303) and in Patent Application No. 31868/74 (Serial No. 1 479 301). As best shown in Figure 2, there are a plurality of downward extending protrusions such as shown at 29 along the opening 27 that separate the various operating positions of lever 30 and are effective to positively maintain the selection lever 30 in the "off", "still", "project", "rewind" or "fast forward" positions once the operator has depressed the selection lever 30 against the upward urging of the spring 70 and has positioned the selection lever laterally to one of the plurality of positions to obtain the desired mode of operation of the projector.

Referring now in detail to Figures 3 and 4, the film reel spindles 14 and 16 are rotatably supported by a frame plate 40 which is carried by the projector housing 12. Secured to spindle 14 is a drum 42 having a peripheral lip 44 that defines a cylindrical internal braking surface 46 and a cylindrical external driving surface 48. Spindle 16 is preferably a weight-sensitive type such as disclosed in Patent Specification No. 1 442 680. Secured to spindle 16 is a pulley 78 which, along with an idler pulley 52 and a drive pulley 50, carry a continuous elastic belt 54. Drive pulley 50 is driven by conventional drive means (shown schematically in Figure 3) such that the belt 54 is driven in a clockwise direction as

viewed in the drawings.

A supply reel control plate 56 is pivotally mounted to the frame plate 40 by a pivot stud 58 received in an arcuate slot 60 in the plate. Control plate 56 includes an extension 62 which supports a brake pad 64 in position for contacting braking surface 46 to brake or retard the rotation of the drum 42. Also supported by the control plate 56 is a freely rotatable roller 74 which is located in a common plane with the belt 54 and is movable in that plane by the clockwise pivoting movement of the control plate 56 for urging the belt 54 into engagement with the driving surface 48 of drum 42 for rotatably driving the drum. Roller 74 also is engageable with a stop member 76 secured to the frame plate 40 to define a pivot for the movement of the control plate 56 when the control plate is pivoted in the counter-clockwise direction. These functions of roller 74 will be explained in detail later.

As shown in Figures 3 and 4, selection lever 30 acts through a control rod 72 to alter the position of the control plate 56 and thereby change the operating mode of the supply spindle 14 as described in more detail in Patent Application No. 31870/74 (Serial No. 1 479 303). A first end portion 72a of control rod 72 extends through an opening 66a in extension 66 of control plate 56 for moving the control plate through a range of positions as the rod 72 is moved by the selection lever 30. As may be seen in Figures 3 and 4, selection lever 30 cooperates with a generally "U-shaped" portion of control rod 72 which is defined by vertical legs 72b, 72d and a horizontal connecting segment 72c. In the preferred embodiment, leg 72d is shorter than leg 72b such that selector lever 30 will pass over leg 72d and not cause movement of control rod 72 when the selector lever is moved upwardly and then laterally to the upper left hand position (i.e., to the "off" position) in opening 27 of the face plate 28. As will be explained later in greater detail, in the preferred embodiment the movement of the selection lever 30 from the still position to the off position is the only movement of the lever 30 which will not cause corresponding movement of control rod 72 and the associated projector mechanism.

A second end portion 72e of the control rod 72 extends through an opening 88a in an extension 88 of a control lever 80 which is pivotally mounted to the frame plate 40 by a pivot stud 82. The lateral movement of control rod 72 to the right to the "fast forward" position shown in the dotted and dashed lines in Figure 3 causes relative pivotal movement of the control lever 80 for moving a pressure wheel 84, which is

supported by the control lever 80, into radial alignment with a hub member 86 for causing spindle 16 to be driven more positively in a clockwise direction in a manner such as described in Patent Specification No. 1,442,680. The radial force or load exerted on spindle 16 by the pressure wheel 84 is substantially greater than the force attributed to the weight of reel 20 and the film which may be wound thereon and it increases the friction between clutch elements of the spindle 16, thereby increasing the torque transmission to the spindle. Movement of the control rod 72 by the operator is also effective to control the operation of the take-up spindle 16 by causing braking of the spindle as will be described now.

A brake lever 90 is pivotally supported to the frame plate 40 by a pivot stud 92. Brake lever 90 includes a finger-like member 94 that extends through a slot 96 in the housing 12 adjacent the rim of the take-up reel 20 as illustrated in Figure 1. A brake pad 98 is carried by finger-like member 94 in edgewise alignment with the peripheral edge of the inner flange of reel 20. A hairspring 100 urges the brake lever in a clockwise direction around stud 92 to urge the friction pad toward the reel. A cam follower 102 on the brake lever 90 is aligned with a notch-like cam surface 80a of the take-up reel control lever 80. A portion of cam surface 80a is intended such that brake pad 98 engages reel 20, under the influence of spring 100, whenever cam follower 102 is received in the indented portion, and when the follower 102 is removed from the indented portion the brake pad is restrained from engaging the reel.

Because of the relative placements of stud 92, the brake pad 98 and the take-up reel 20, the braking action between the pad 98 and the reel 20 tends to be self-energizing whenever the brake pad is brought into engagement with the reel as the reel is being driven in the counterclockwise or film rewinding direction. That is, as the brake pad 98 is urged into peripheral engagement with the reel 20 while it is being rotatably driven in the counterclockwise direction, the pad tends to be urged more firmly into contact with the edge of flange of the reel 20. The faster the reel is turning in the counterclockwise direction, the greater is the tendency of the reel to urge or pull the pad into contact with the flange itself and thereby create a greater braking force between the reel and the pad. When the reel 20 is driven in the clockwise direction during the project or fast forward mode of operation, the force of hairspring 100 is the only effective force which applies braking force to the reel 20. The rotation of the reel 20 tends to urge the

brake pad 98 away from the reel instead of urging the brake pad 98 into engagement with the reel. Thus, it is realized that the self-energizing, or differential, feature which tends to increase the braking effectiveness is a function of both the direction of rotation and the speed of rotation of the reel.

Referring now specifically to Figure 3, mode selection lever 30 is shown in solid lines as it would be positioned for the still mode of operation wherein control rod 72, plate 56 and lever 80 are positioned by the lever 30 such that the brake pad 64 is fully in engagement with the braking surface 46 and the brake pad 98 is in engagement with the reel 20. In the still position, both the supply reel 18 and the take-up reel 20 are thereby inhibited from rotating by this braking action and a single image frame of the film can then be projected.

If the operator shifts the selection lever 30 from the still position shown in solid in Figure 3 to the project mode of operation, the movement of lever 30 moves control rod 72 to the right (to the middle position shown in phantom in dashed lines in Figure 3). This movement of the control rod 72 rotates the control plate 56 in a counterclockwise direction about pivot stud 58 against the urging of spring member 68, wherein brake pad 64 is removed from contact with braking surface 46 of drum 42, thereby conditioning the spindle for a free-wheeling mode of operation and permitting the film to be freely removed from the supply reel 18. At the same time, this movement of control rod 72 also causes control lever 80 to be pivoted in a counterclockwise direction around pivot stud 82, thereby causing cam follower 102 to ride up a ramp on cam surface 80a and be removed from the indented portion of the cam surface. This removes brake pad 98 from contact with the peripheral surface of reel 20 so that reel 20 can be rotatably driven by the weight sensitive spindle 16. When the projector is in the project mode as described above, the pressure wheel 84 remains a spaced distance from hub member 86 (as indicated in phantom in dashed lines in Figure 3) such that the reel 20 is driven through the force applied by the spindle which results from the weight of the reel and film alone.

To terminate the project mode of operation, the operator must depress lever 30 slightly so that it can be moved under the protrusion 29 of the face plate 28 and then the operator can move the lever horizontally to the left toward the still position shown as a solid line in Figure 3 wherein spring member 68 again returns control plate 56 in the clockwise direction

about the pivot stud 58 to the braking position wherein brake pad 64 is initially moved into engagement with braking surface 46 as previously described. Continued movement of rod 72 results in control plate 56 pivoting about the brake pad 64 with the arcuate slot 60 being slid along the pivot stud 58 while spring 68 continues to maintain brake pad 64 in braking engagement with braking surface 46. Through the control rod 72, the control lever 80 is sequentially returned in the clockwise direction about pivot stud 82 to the position wherein the cam follower 102 passes into the indented portion of cam surface 80a allowing brake pad 98 to again contact reel 20. In the preferred embodiment of the projector shown, the shape and position of the cam surface 80a is such that this movement of the control rod 72 is effective first to initiate braking of the supply spindle 14 through brake pad 64 acting with braking surface 46 and then to subsequently initiate braking of the take-up reel 20 by the brake pad 98. This sequential braking feature results in a braking force being applied to the supply spindle first and then to the take-up reel so as to effectively eliminate "spilling" of the film from supply roll due to inertia of the roll.

If the operator were then to move the selection lever 30 downward from the still position, against the urging of the spring 70, lever 30 then can be shifted horizontally along the lower opening in face plate 28 to either the fast forward or rewind positions. Moving the selection lever 30 to the lower right-hand position (into the fast forward position shown in phantom in dot and dashed lines in Figure 3) causes movement of control plate 56 and control lever 80 further in the counterclockwise direction than previously described for the project mode of operation and thereby additionally causes pressure wheel 84 to apply a radial force to the hub member 86 of the weight sensitive take-up spindle for causing a faster rotation of the spindle 16. As described in more detail in Patent Specification No. 1 442 680, the radial force applied to the hub member 86 effects a more positive drive of the spindle 16 than provided by the weight of the reel and the film upon the spindle 16. The continued rotation of control plate 56 causes idler roller 74 to be urged into a contact with a stop member 76 which is secured to the frame plate 40 such that control plate 56 then pivots about stop member 76 until the left end of the arcuate slot 60 is positioned near the pivot stud 58. This is the position shown in phantom at the upper right in Figure 3. If the operator then moves the lever 30 from the fast forward position to the left and once again

into the still position, spring 68 urges control plate 56 in a counterclockwise direction such that brake pad 64 engages braking surface 46 for braking reel 18 and the control rod 72 urges control lever 80 to also return counterclockwise direction toward the still position causing braking of reel 20, such braking occurring sequentially as previously described. When in the still position as shown in solid lines in Figures 3 and 4, the pivot stud is at or near the right end of the arcuate opening 60.

Referring now specifically to Figure 4, if the operator has depressed the selection lever 30 and moved the lever horizontally to the left from the still position (shown in solid lines) to the rewind position (shown in phantom in dashed lines) control lever 80 and control plate 56 are rotated in a clockwise direction by the control rod 72. The rotation of control lever 80 in this direction restrains the pressure wheel 84 from contacting the hub member 86 and causes the cam follower 102 to be removed from the indented portion of cam surface 80a resulting in brake pad 98 being removed from contact with the reel 20. The rotation of control plate 56 about the pivot stud 60 releases the brake pad 64 from the braking surface 46 to permit reel 18 to be driven and causes the idler roller 74, which is supported by control plate 56, to urge belt 54 into resilient driving contact with the drive surface 48 on spindle 14 for driving the spindle in a counterclockwise direction as is described in Patent Application No. 31870/74 (Serial No. 1 479 303).

When the operator depresses the shift lever 30 below the protrusion and returns the lever to the right to remove the projector from the rewind mode of operation, the control rod 72 urges both the control lever 80 and the control plate 56 in a counterclockwise direction. The movement of control lever 80 in this direction causes the cam follower 102 to return to the indented portion of cam surface 80a resulting in the brake pad 98 returning into contact with the reel 20 and removing the idler roller 74 from contact with the belt 54. In the preferred embodiment of the present invention, the indentation in the cam surface 80a is positioned such that movement of the control rod 72 to the right toward the still position (shown in solid lines) results in the braking of reel 20 by the brake pad 98 slightly in advance of the engagement of the braking surface 46 with the brake pad 64. Also, as previously described, the self-energizing feature of the brake pad 98 results in increasing braking force being applied to the reel 20 so as to prevent the spilling of the film from the take-up reel 20 as the projector is removed from the rewind mode of operation.

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A particular advantage of the braking system of the invention is that it ensures proper differential braking, both when the selection lever 30 is moved very quickly from one mode to another and when the lever 30 is moved slowly from one mode to another. Thus, if the lever 30 were to be moved very quickly from one mode to another, say, from project to fast forward, or from fast forward to rewind, the braking action, at times, can be virtually instantaneous because of the speed of lever movement. In this event, of primary importance to avoid "spillage" is the self-energisation of the appropriate brake, which provides for a greater braking force on the reel which is feeding or supplying film. On the other hand, it can be appreciated that the mode selection lever 30 can be moved quite slowly from one mode to another by a projector operator. Such slow lever movement may be intentional or accidental. Under such a very slow movement condition, the sequential braking produced by the mechanical structure ensures that the appropriate brake is applied first mechanically, even if the self-energisation features are not fully effective because of the slowness of movement of the lever 30. After a certain point in movement of the lever 30, which point will vary for example with the speed of rotation of the reels, and with the amount of film on the reel, the self-energisation feature of the brakes becomes effective to apply a greater force to that reel which is feeding film and thereby to complement the sequential application of the brakes by the mechanical linkage.

40 WHAT WE CLAIM IS:—

1. A motion picture projector of the kind having a projection gate, a first spindle adapted to support a supply reel of film, a second spindle adapted to support a take-up reel for the film, a drive mechanism arranged to drive the two reels selectively for forward and rewind movements of the film through the projection gate according to the projector mode selected, and a mechanical brake mechanism associated with each spindle, wherein a manually actuated control device for selecting the projector mode is connected by a mechanical linkage with the brake mechanisms such that, irrespective of the direction of film movement through the projection

gate, a braking effect is applied to the reel which is supplying film before a braking effect is applied to the reel which is taking up film, and in that the brake mechanism associated with one of the spindles is of the self-energising or differential type such that a greater braking force is applied when film is being unwound from its associated reel than when film is being taken up by its associated reel.

2. A projector as claimed in Claim 1, wherein the second spindle is of the weight-responsive type, the driving of a take-up reel supported on this spindle being a function of a radial force applied to this spindle, and wherein a force-applying means is arranged to apply an additional radial force to this spindle in response to actuation of the control device to one control position.

3. A projector as claimed in Claim 2, wherein the brake mechanism associated with the second spindle comprises a brake pad movable into contact with a reel supported on the second spindle to produce a braking effect on this spindle.

4. A projector as claimed in Claim 3, wherein a cam is arranged to move the brake pad to an inoperative position when the force applying means moves to apply the said additional force to the second spindle.

5. A projector as claimed in Claim 4, wherein the cam is carried by a pivotally mounted plate which also carries a roller for applying the said additional force to the second spindle, this plate being movable by a control lever acting through a control rod.

6. A projector as claimed in Claim 5, wherein driving and braking of the first spindle is controlled by a movably mounted plate and wherein the control rod is also connected to the plate for simultaneous movement with the plate.

7. A projector as claimed in any preceding claim, wherein the spindles are both arranged to be driven directly by an endless belt.

8. A motion picture projector as claimed in Claim 1, substantially as hereinbefore described with reference to the accompanying drawings.

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A particular advantage of the braking system of the invention is that it ensures proper differential braking, both when the selection lever 30 is moved very quickly from one mode to another and when the lever 30 is moved slowly from one mode to another. Thus, if the lever 30 were to be moved very quickly from one mode to another, say, from project to fast forward, or from fast forward to rewind, the braking action, at times, can be virtually instantaneous because of the speed of lever movement. In this event, of primary importance to avoid "spillage" is the self-energisation of the appropriate brake, which provides for a greater braking force on the reel which is feeding or supplying film. On the other hand, it can be appreciated that the mode selection lever 30 can be moved quite slowly from one mode to another by a projector operator. Such slow lever movement may be intentional or accidental. Under such a very slow movement condition, the sequential braking produced by the mechanical structure ensures that the appropriate brake is applied first mechanically, even if the self-energisation features are not fully effective because of the slowness of movement of the lever 30. After a certain point in movement of the lever 30, which point will vary for example with the speed of rotation of the reels, and with the amount of film on the reel, the self-energisation feature of the brakes becomes effective to apply a greater force to that reel which is feeding film and thereby to complement the sequential application of the brakes by the mechanical linkage.

WHAT WE CLAIM IS:—

1. A motion picture projector of the kind having a projection gate, a first spindle adapted to support a supply reel of film, a second spindle adapted to support a take-up reel for the film, a drive mechanism arranged to drive the two reels selectively for forward and rewind movements of the film through the projection gate according to the projector mode selected, and a mechanical brake mechanism associated with each spindle, wherein a manually actuated control device for selecting the projector mode is connected by a mechanical linkage with the brake mechanisms such that, irrespective of the direction of film movement through the projection

gate, a braking effect is applied to the reel which is supplying film before a braking effect is applied to the reel which is taking up film, and in that the brake mechanism associated with one of the spindles is of the self-energising or differential type such that a greater braking force is applied when film is being unwound from its associated reel than when film is being taken up by its associated reel.

2. A projector as claimed in Claim 1, wherein the second spindle is of the weight-responsive type, the driving of a take-up reel supported on this spindle being a function of a radial force applied to this spindle, and wherein a force-applying means is arranged to apply an additional radial force to this spindle in response to actuation of the control device to one control position.

3. A projector as claimed in Claim 2, wherein the brake mechanism associated with the second spindle comprises a brake pad movable into contact with a reel supported on the second spindle to produce a braking effect on this spindle.

4. A projector as claimed in Claim 3, wherein a cam is arranged to move the brake pad to an inoperative position when the force applying means moves to apply the said additional force to the second spindle.

5. A projector as claimed in Claim 4, wherein the cam is carried by a pivotally mounted plate which also carries a roller for applying the said additional force to the second spindle, this plate being movable by a control lever acting through a control rod.

6. A projector as claimed in Claim 5, wherein driving and braking of the first spindle is controlled by a movably mounted plate and wherein the control rod is also connected to the plate for simultaneous movement with the plate.

7. A projector as claimed in any preceding claim, wherein the spindles are both arranged to be driven directly by an endless belt.

8. A motion picture projector as claimed in Claim 1, substantially as hereinbefore described with reference to the accompanying drawings.

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