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(54) SPINDLE FOR 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 spindle assemblies for use in motion picture projectors for supporting film supply rolls, and to motion picture projectors incorporating such spindles.

To simplify the use of motion picture projectors, considerable attention has been directed to providing means whereby such equipment can be threaded automatically upon being loaded with a supply roll housed within a cartridge; thereby facilitating the handling and storage of the supply rolls and eliminating manual threading operations.

A cartridge loaded self-threading motion picture projector is disclosed in Patent Application No. 26873/68 (Serial No. 1,241,997). In this construction, a film supply roll wound onto a hub member is housed within a cartridge provided with axial openings through which the hub member can be rotatably supported and driven by a film supply spindle member when the cartridge is operatively positioned on the projector. With the cartridge so positioned on the projector, the film roll is radially accessible to a stripping mechanism movable into temporary engagement with the roll through another cartridge opening; such mechanism being adapted to separate the leading end of the strip from the roll and to feed it along a predetermined threading path.

Further details and features of this general type of film stripping and threading mechanism and of film supply cartridges adapted for use therewith are also disclosed in related Patent Specification No. 1,110 538 and Patent Application No. 26874/68 (Serial No. 1,234,812).

By employing means of the type disclosed in the above-identified applications, it is therefore possible to provide projectors or related devices capable of being loaded or unloaded almost instantaneously by an unskilled operator, and if desired, to provide additional means which allow the device to function entirely automatically from the time the cartridge is loaded thereon and the projection cycle is initiated until such time as the cartridge is again fully rewound following completion of the machine cycle.

In spite of the foregoing advantages, however, presently known machines of this type are not entirely suitable for applications in which both cartridges and conventional supply reels may be appropriate for different purposes.

Due to the substantially greater amount of strip material that can be accommodated by supply reels as compared to supply cartridges, considerations of maximum roll diameter and momentum require changes in the mode of operation of the machine according to whether the material is supplied from a reel or from a cartridge. In the case of a motion picture projector, for example, the use of a film roll supply reel dictates the employment of film tension control means which are incompatible with maintaining the film within corresponding tension limitations while a cartridge is being used. Similarly, the possibility of rewinding the film into a supply cartridge through the film gate becomes impractical in conjunction with the use of a film supply reel, which preferably should be rewound directly from the film take-up reel.

According to the present invention there is provided a coaxially arranged spindle assembly for use in a motion picture projector to support a film supply roll wound onto a hub member, said assembly comprising a rotatable drum member, a roll drive member supported by and extending beyond the drum member to support the hub member of the film supply roll, the roll drive member being rotatable relative to the drum

member in opposition to friction developed between the drive member and the drum member as a function of the weight of the film roll supported by the roll drive member, a rotatable first clutch member adjustable into and out of positive rotational driving engagement with the roll drive member, a second clutch member, including a rotatable body member and a friction member frictionally coupled to the body member and rotatable relative thereto in opposition to a predetermined frictional resistance to such relative rotation, means supporting the second clutch member for movement to a first position in which the friction member is engaged with the first clutch member adjusted to positive rotational driving engagement with the drive member thereby to couple the drive member with the body member through the torque limiting agency of the friction member, and a second position in which the friction member is disengaged from the first clutch member to allow free independent rotation of the second clutch member and the drum member.

The spindle assembly may also include a power input member and third clutch means adapted selectively to establish positive driving engagement between the power input member and the drum member, and to disengage the power input member from the drum member to allow free independent rotation of these two members.

The invention also includes a motion picture projector incorporating such a spindle assembly to support a film supply roll.

A motion picture projector system incorporating an illustrative preferred embodiment thereof, of spindle assembly for supporting a supply roll will now be described by way of example, reference being made to the accompanying drawings, in which:—

Fig. 1 is an elevational view of the right side of the projector, showing a film cartridge in loaded position and indicating in broken lines the positions assumed by the film reels and the film supply spindle arm when the projector is converted to accommodate such reels;

Fig. 2 corresponds to an enlarged portion of Fig. 1, partially cross sectioned and broken away and supplemented with phantom views to depict the positions of various elements of the film stripping and threading mechanism of the subject projector;

Fig. 3 is a cross sectional front view of the camshaft assembly employed to operate various elements of the projector;

Fig. 4 is an elevational view of the portion of the projector shown in Fig. 2 taken from inside the projector to show the arrangement of internally located components of the control assembly and the film stripping and threading mechanism;

Fig. 5 is a partially cross sectioned rear

elevational view of the film stripping and threading mechanism and of the control assembly shown in Figs. 2 and 4;

Fig. 6 is a view from the same viewpoint as Fig. 4, depicting the relative positions assumed by the various illustrated elements of the film stripping and threading mechanism and of the control assembly prior to or following completion of the film stripping and threading phase of the operating cycle of the projector;

Fig. 7 corresponds to Fig. 6 and shows the relative positions of the illustrated elements during the film stripping and threading phase of the operating cycle with the projector adapted to accommodate a film cartridge;

Fig. 8 corresponds to Figs. 6 and 7 and shows the relative positions of the illustrated elements during the film stripping and threading phase of the operating cycle with the projector adapted to accommodate a film supply reel;

Fig. 9 is a somewhat schematic right side elevational view of the projector, illustrating the driving and shifting means associated with the film winding and rewinding mechanism;

Fig. 10 is a top plan view of a portion of the structure shown in Fig. 8;

Fig. 11 is a partially cross sectioned rear elevational view of the film take-up spindle assembly and of the shifter bar connected thereto; and

Fig. 12 is a partially cross sectioned rear elevational view of the film supply spindle assembly and of portions of the adjusting members associated therewith.

Referring to Fig. 1 of the drawings, the projector comprises a generally rectilinear casing member 11 including a housing 12 which extends laterally towards the right side of the projector and supports a forwardly facing projection lens assembly 13.

Above housing 12, rotatable take-up reel drive member 14 extends beyond vertical wall member in coaxial alignment with a corresponding pulley member, which rotates constantly in a clockwise direction during operation of the projector. Drive member 14 is adapted to receive either a relatively small film take-up reel, as shown at 16 in Fig. 1, or a larger take-up reel shown in broken lines in Fig. 1. A similar rotatable drive member 18 likewise extends beyond wall member 15 through mechanism plate 19 in coaxial alignment with another pulley member which is constantly rotated in a counterclockwise direction. This drive member is carried by support arm 21, which is movable about shaft 22 between the lower position shown in solid lines in Fig. 1 and the raised position shown in broken lines in Fig. 1.

With the arm in its lower position, reel

drive member 18 is adapted to receive a film reel, housed within a cartridge loaded onto the projector as shown at 23. To accommodate the film 24 supplied by such a cartridge, the film take-up reel 16 can be of a size generally equivalent to the size of the cartridge as shown in Fig. 1. When the arm is in its raised position, however, substantially larger conventional unenclosed film supply and take-up reels can be installed on the respective drive members 18 and 14, thereby allowing greater lengths of film to be projected without interruption. To distinguish between conventional unenclosed film supply reels and film supply reels housed in film cartridges, the latter reels will hereinafter be referred to as spools. Thus, the term "reel mode of operation" will be understood to refer to the operation of the projector with a film supply reel mounted on the raised support arm, as opposed to the term "cartridge mode of operation", which relates to the use of the projector employing a film supply cartridge aligned with drive member 18 of the lowered support arm.

CARTRIDGE MODE OF OPERATION

To operate the projector utilizing a film supply cartridge 23, support arm 21 is moved to its lower position and latched in place by a latch member 25, shown in Figs. 9 and 10, which also serves to releasably retain the arm in its raised position. The film cartridge is then moved laterally into its illustrated position adjacent the cartridge plate, where it is releasably latched in place with the cartridge spool in coaxial driving engagement with drive member 18. During this phase of the projector's operating cycle, drive member 18 is positively connected to the corresponding pulley member so that the cartridge spool is rotated in a counterclockwise direction, tending to maintain the film in a tightly wound condition thereon.

To initiate the film stripping and threading operation, the operator manually depresses ear 26 to a position in which it is releasably retained by a latch mechanism. This causes stripper finger 27 to enter the slotted base portion of the cartridge and thereafter moves stripper belt member 28 in a counterclockwise direction about shaft 29 to bring stripper belt 30 into contact with the periphery of the roll of film on the film supply spool. Concurrently, drive member 18 is released from driving connection with the rotating pulley member so that the cartridge film spool can rotate freely. Correspondingly, drive member 14 is coupled to its pulley member through a frictional clutch adapted to slip under a torque load proportional to the weight of the take-up reel, as determined partially by the amount of film wound thereon.

As described in Patent Specification No. 1,110,538 the stripper belt is constantly driven in a counterclockwise direction. Therefore, its peripheral engagement with the film supply roll rotates the film roll in a clockwise direction. Accordingly, the leading end of the film is separated from the roll by the stripper finger and is delivered out of the cartridge through a narrow guide path defined between a portion of the stripper belt and an adjacent edge of the stripper finger.

As the leading end of the film emerges beyond the path defined between the stripper belt and the stripper finger, it enters a curved guide channel established between stationary film guide member 31 and movable snubber member 32, which is pivotable downwardly about pin 33 but biased temporarily into firm resilient engagement with the guide member during the stripping and threading operation. This curved guide channel directs the leading end of the film downwardly into engagement by the film advancing mechanism of the projector, whereby it is advanced intermittently past a projection position aligned with the projector's optical system and delivered into contact with the hub of take-up reel 16. The hub of the take-up reel is provided with a plurality of teeth adapted to engage the edge perforations in the film, whereby the film is automatically attached to the hub upon being brought into contact therewith.

When the film has been engaged by the film advancing mechanism, its presence at a predetermined location is detected by an appropriate sensing device which then allows ear 26 to return to its initial position, thereby initiating the projection phase of the operating cycle. This causes the stripper finger and the stripper belt members to retract from the cartridge to their respective positions shown in Fig. 1 and releases the snubber member for downward pivotable movement about pin 33 against the influence of leaf spring 35, so that the snubber thereafter serves to stabilize the film tension between the gate and the supply reel in the manner well known in the prior art.

As the film is being projected, it can be stopped and displayed in reverse by manually moving control lever 36 from its illustrated raised (forward) position to an extreme downward (reverse) position. Additionally, the projector is provided with a review mechanism by means of which the operator can rewind and then reproject any desired portion of the film by manually moving control lever 37 to a rearward position to actuate the film rewinding mechanism.

The inner end of the roll of film 24 on the film supply spool within the magazine is attached to the core of the spool. Therefore, when all of the available film has been

unwound from the cartridge, the resulting tightening of the film between the gate and the spool causes the snubber member to pivot downwardly to a position in which trigger lever 38 is engaged and depressed by shoe member 39 on the snubber member. Such depression of the trigger member initiates the rewind phase of the projector's operating cycle by opening the gate and withdrawing the film pull-down claw therefrom, by reestablishing positive rewinding rotation of drive member 18, and by releasing drive member 14 from the corresponding pulley member to allow the take-up reel to rotate freely as film is unwound therefrom. Thus, the film is automatically rewound entirely into the cartridge through the film gate, whereupon the rewound cartridge can be removed from the projector.

20 REEL MODE OF OPERATION

To convert the projector to accommodate a conventional film supply reel 40 on drive member 18, arm release car 41 is moved forwardly against the resistance of spring 42, thereby withdrawing latch tooth 43 from opening 44 in the curved front wall member 45 of arm 21, (Figs. 9 and 10). Due to the location of car 41, it is inaccessible whenever a cartridge is loaded onto the projector, thereby preventing the arm from being released from its lowered position until the cartridge has been removed. Upon releasing the latch, the arm can be moved to its previously described raised position where it is releasably retained by the reception of the latch tooth within a second opening 46 in wall member 45. Such movement of the arm automatically readjusts the film supply spindle assembly to establish frictional engagement between drive member 18 and the related pulley member through a drive unit corresponding to the one employed with the take-up reel, whereby the torque applied to the drive member is proportional to the weight of reel 40 supported thereon.

Since the internal structure of the film cartridge comprises essential elements of the film stripping means described above, that mechanism is ineffective when supply reel 40 is mounted on drive member 18. Therefore, when the operator now depresses car 26, the stripper finger and the stripper belt member remain in their respective inoperative positions shown in Fig. 1. However, a guide roller 47, which remained in the inoperative position shown in Fig. 1 during the above-described mode of operation, now moves automatically into contact with the constantly moving stripper belt 30. Thus, when the operator manually removes the leading end of the reel loaded film 48 from the supply reel and inserts it in the nip between the drive belt and the roller, the stripper belt serves to guide the film through the

guide channel between guide member 31 and the temporarily immovable snubber member 32, whereby the end of the film is threaded through the gate and attached to the take-up reel as previously described. Upon release of car 26, guide roller 47 retracts to its inoperative position and the snubber member is released so that the projection phase of the operation cycle can proceed, as related above.

During the projection of film 48, the projector can be adjusted manually by means of lever 37 to display the film either forwards or backwards. However, since the projector is not adapted to rewind the film through the gate except when loaded with a film cartridge, the film review mechanism is rendered inoperative when the film supply spindle arm is in its raised position.

In this mode of operation, the film is not attached to the supply reel. Upon completion of the projection phase, therefore, the trailing end of the filmstrip will have been separated from the film supply reel and wound onto the film take-up reel, and must be reattached manually to the supply reel in order to be rewound thereon. When this has been accomplished, the film supply spindle assembly is manually adjusted to establish positive driving connection between the film supply reel and the corresponding pulley member, thus causing the supply reel to rewind the film by overpowering the opposing torque frictionally applied to the take-up reel. When the rewinding operation has been completed, the supply spindle assembly is manually readjusted to reestablish the weight sensitive frictional engagement of the supply reel with the pulley member, whereupon the supply reel can be removed from the projector and replaced to prepare the projector for another operating cycle. If the arm 21 is moved to its lower position to convert the projector to its cartridge mode of operation before the film supply spindle assembly has been thus manually readjusted, the lowering of the arm automatically accomplishes this result to insure proper subsequent functioning of the apparatus.

Guide roller 47 is rotatably supported in alignment with stripper belt member 28 by a shaft 131 extending through an arcuate slot 132 in the mechanism plate as shown in Fig. 2. Shaft 131, in turn, is attached to roller lever 133, shown in Figs. 4-8, which is pivotally supported by pivot stud 134. Accordingly, the roller is movable between an inoperative and an operative position, as shown respectively in solid and broken lines in Fig. 2, in response to corresponding movement of lever 133 by the hereinafter described control mechanism.

When the projector is loaded with a film cartridge, the corresponding lowered posi-

tion of arm 21 automatically causes the roller to remain in its inoperative position, in which it is located out of the movement path of the stripper finger. However, when arm 21 is raised to convert the projector to its reel mode of operation, the stripper finger and the stripper belt member are disabled from moving from their respective inoperative positions and the roller is allowed to move to its operative position in response to depression of ear 26. In this position, the roller is resiliently engaged with moving stripper belt 30, so that the manual insertion of the end of the film 48 on the supply reel into the nip of roller 47 and belt 30 causes the film to be driven into guide channel 89 by the belt, until the roller is subsequently returned to its inoperative position by the control mechanism upon upward movement of ear 26.

Still referring principally to Fig. 2, it will be seen that film guide member 31 is rigidly attached to the exterior surface of the mechanism plate by rivets 142 and pivotally supports snubber member 32, which is attached to the guide member by pivot pin 33. The respective lower and upper surfaces of the guide member and the snubber member cooperate to define a film guide passageway when the snubber is pivoted upwardly against the guide member, as illustrated.

During the projection of the films, the snubber member serves to stabilize the tension of the portion of film between the film gate and the supply reel or spool by moving downwardly against the influence of spring 35 in response to momentary increases in such tension; similar devices being well known in the projector art. To be effective for this purpose, however, the snubber member must be capable of being pivoted away from the guide member quite easily. For that reason, the upward force exerted on the snubber by spring 35 is insufficient to ensure that the snubber will remain in contact with the guide member to preserve the closed passageway as the film is being fed therethrough by the stripper belt. Therefore, lug 147 is provided with a pin 148 extending through arcuate slot 149 in the mechanism plate so that a snubber blocking lever incorporated in the control mechanism can engage the inner end of that pin to resiliently retain the snubber member temporarily in its raised position under the influence of a much stronger spring.

Fig. 2 also illustrates the previously mentioned shoe member 39 extending downwardly from the snubber member above trigger lever 38, which projects through slot 151 in the mechanism plate. The purpose of this shoe is to depress the trigger lever to initiate the film rewinding phase of operation when the snubber member is moved to its lowermost position by the increase in

film tension accompanying withdrawal of all of the available film from the film magazine loaded onto the projector.

CAM CONTROL MECHANISM

Cam Drive Means

The cam control mechanism of the subject projector is illustrated in detail in Figures 5—8. The central element of this mechanism is shaft 29, which extends freely through the bore of a multiple lobe cam member 156 located between the mechanism plate and support plate 157. The support plate is mounted rigidly to the mechanism plate by pedestals as indicated at 158 in Fig. 5 and rotatably supports sleeve portion 159 of the cam member, which is keyed to disk member 161 beyond the support plate by a drive key shown at 162. At the opposite end of the cam member shaft 29 is rotatably supported in the mechanism plate by bushing 163 attached to elongate side plate 112 of the stripper belt member 28. At the external end of the shaft, belt drive pulley 111 is attached thereto between the side plates 112 and 113 of the stripper belt member, as shown in Fig. 5.

Throughout the operation of the projector, shaft 29 is rotated constantly in a counter-clockwise direction by spur gear 164 attached to the internal end of the shaft and meshed with a smaller spur gear 165 rotatably supported on stub shaft 166 and driven by pulley 167 through a drive belt mechanism described below with reference to Figs. 9 and 10.

To rotate the cam member intermittently with shaft 29, a dog member 168 is pivotally mounted to disk member 161 by a pin 169 and is biased by spring 171 to urge dog ear 172 toward engagement with the multiple toothed peripheral surface of hub member 173 of gear 164, as best illustrated by Figs. 4 and 5. Thus, when the dog ear is received between two of the teeth of the constantly rotating hub member 173, the cam member is coupled positively to shaft 29 for rotation therewith.

In order to engage and disengage the cam member from shaft 29, a clutch operating lever 174 is pivoted to support plate 157 by pin 175 and is urged upwardly by spring 176 to bias lower lever ear 177 into contact with the periphery of disk member 161. In this position, lever ear 177 is adapted to be engaged by lip 178, which extends beyond disk 161 from dog member 168, thereby holding dog ear 172 out of engagement with hub member 173 and allowing the cam to remain at a stationary initial position as shaft 29 rotates. When ear 26 is depressed manually to the bottom of mechanism plate opening 179, however, ear 177 is moved downwardly beyond lip 178 as the upper lever ear 180 simultaneously moves down-

wardly into contact with disk 161 as shown in broken lines in Fig. 4. Accordingly, the dog member immediately pivots about pin 169 under the influence of spring 171 to engage ear 172 with hub member 173, thereby coupling the cam member to shaft 29. As soon as the cam has rotated through an angle of approximately 120 degrees, however, the corresponding rotation of disk 161 brings lip 178 into contact with lever ear 180, whereupon the cam member is again immobilized at its intermediate position by the disengagement of the dog ear from the hub member. As shown at 181, a spring loaded pivotal latch member is adapted to retain lever 174 temporarily in its depressed position by engaging upper lever ear 180 thus causing the cam member to remain at its intermediate position until the latch member is released from ear 180 by solenoid 182. The solenoid, in turn, is connected to an appropriate power source, not shown, through a normally open switch device 183 (Fig. 2) provided with a sensing finger 184 extending into the film gate to close the switch in response to the presence of film within the gate. Therefore, lever 174 remains in its lower position until the film has been fed into engagement with the projector's film advancing mechanism, whereupon latch member 181 is released from ear 180. When this occurs, lever 174 is returned to its raised position by spring 176, whereby the disengagement of ear 180 from lip 178 again temporarily engages the cam member to shaft 29 to restore the cam and clutch members to the initial condition shown in Fig. 4. For a description of the film gate and associated mechanism, reference should be made to Patent Application No. 55365/68.

Cam Member

Cam member 156 comprises a cylindrical hub 185 concentric with the bore of the cam member at one end thereof, and four differently profiled cam lobes; namely, stripper finger lobe 186, reset lobe 187, roller and snubber lobe 188, and stripper belt lobe 189.

Selector Slide

Selector slide 215 is supported for vertical sliding movement by stationary pins 216 extending through slots 217 in the slide and is biased upwardly by a relatively strong spring 218. As long as arm 21 is latched in its lower position to allow the projector to accommodate film cartridges, the slide plate is also retained in its lower position, as shown in Figs. 4-7, against the influence of spring 218, by the engagement of slide lip 219 by abutment finger 221 attached to the movable arm 21. When arm 21 is raised, however, spring 218 moves the selector slide upwardly to the position shown in Fig. 8,

defined by the engagement of pins 216 with the lower ends of slots 217.

As long as the selector slide is in its lower position, a notch 222 in the slide is adapted to receive lip 195 of slide bar 191 as that bar moves to the position shown in Fig. 7 to operate the film stripping mechanism. When the selector plate is raised as shown in Fig. 8, however, notch 222 is above the path of movement of lip 195. Therefore, as the cam member rotates from its initial position to its intermediate position, lip 195 encounters edge surface 223 of the selector slide, which blocks further movement of the stripper finger from its inoperative position by preventing cam follower ear 197 from being retained in contact with cam lobe 186 by spring 198. Additionally, since lever 199 cannot rotate about pivot stud 201 to move the stripper belt member into operative position until arm 103 has pivoted sufficiently to align notch 209 with ear 207, which cannot occur as long as slide bar lip 195 is blocked by the selector slide, it is apparent that the stripper belt member also remains in its inoperative position.

The position of the selector slide also determines the operativeness of guide roller 47 by allowing the roller to move from its inoperative position to its operative position only when the projector is in the reel mode of operation. This is accomplished by means analogous to those just described, as will be hereinafter explained in connection with describing the roller positioning elements of the control cam mechanism.

For reasons later explained, the projector is adapted to rewind film through the film gate only when loaded with a film cartridge. Therefore, still another function of the selector slide is to prevent the initiation of the cartridge rewinding phase of the projector cycle except when arm 21 is positioned to accommodate a film supply cartridge. This function is performed by providing the selector slide with a lateral ear 224 extending beneath trigger lever 38. During the cartridge mode of operation, ear 224 is below the lowermost position of the trigger lever defined by slot 151 in the mechanism plate, as shown in Fig. 6, and therefore has no effect on the operation of the trigger. In the reel mode of operation, however, the raised position of the selector slide illustrated in Fig. 8 locates ear 224 in overlapping relation to the lower portion of slot 151 immediately below the trigger lever so that the trigger can be depressed only by a force sufficient to overcome the heavy spring 218 urging the selector slide upwardly. Since the film advancing mechanism is incapable of applying sufficient tension to the film to produce such a force on the snubber member, the trigger member is thus rendered inoperable by the snubber member. Although the trigger could still be

released manually, such an operation could not be performed accidentally due to the substantial resistance of spring 218.

Guide Roller

5 Guide roller lever 133 is pivotally supported by stud 134 attached to the mechanism plate and is provided with a cam follower ear 227 extending upwardly from the base member 228 of the lever and urged toward engagement with cam lobe 188 by
10 spring 229. When the cam member is in its initial position, the engagement of ear 227 with lobe 188 displaces lever 131 against the influence of spring 229, as shown in
15 Fig. 6, whereby roller 47 at the top end of the lever is located at its inoperative position depicted in solid lines in Fig. 2.

If selector slide 215 is in its lower position, i.e. during the reel mode of operation,
20 a blocking ear 230 on the selector slide is disposed immediately above base member 228 of the lever, as illustrated in Fig. 6. Consequently, during rotation of the cam member, the roller is maintained in its in-
25 operative position by the engagement of the lever base member with blocking ear 230, as shown in Fig. 7, while the stripper finger and the stripper belt perform the film stripping operation. Conversely, when the projec-
30 tor is adjusted to the reel mode of operation, the corresponding raised position of the selector slide removes blocking ear 230 from the path of movement of base member 228,
35 allowing cam follower ear 227 to follow cam lobe 188 under the influence of spring 229. Accordingly, the roller moves into resilient contact with the stripper belt as the stripper
40 belt member and the stripper finger are retained in their respective inoperative positions by the selector slide.

During either type of threading operation, it is of course essential that the film advancing mechanism be adjusted to its forward projection condition so that the film
45 will be engaged by that mechanism and thereby moved away from rather than toward the supply roll. Therefore, an interlock device is employed to prevent ear 26 from being depressed unless control lever 36 is in its
50 raised (forward) position. As illustrated in Fig. 9, this device comprises a cam slide 231 slidably supported for vertical movement of studs 232. At its lower end, the cam slide is bifurcated as shown at 233 to straddle
55 the adjacent end of control lever 36 so that the vertical position of the slide plate corresponds to the position of the control lever. A blocking slide 234 is similarly supported for horizontal sliding movement by studs
60 (not shown) and is biased rearwardly by a light spring 236 to maintain the rearward end by the blocking slide in contact with cam surface 237 along the adjacent edge of the cam slide. As long as control lever 36 is in

its raised (forward) position, its blocking slide is located as shown in solid lines in
65 Figs. 4 and 9, with its upwardly extending leg 238 behind the path of movement of car 26. Upon movement of control lever
70 36 to its lower (reverse) position, however, the corresponding movement of the cam slide brings the sloped upper portion of a cam surface into engagement with the blocking
75 slide, thereby camming the latter slide forwardly to position leg 238 directly below ear 26 as shown in broken lines in Figs. 4
80 and 9. Consequently, it will be apparent that leg 238 prevents downward movement of the car so long as the projector is adjusted for reverse projection, thus positively
85 eliminating the employment of the threading mechanism until lever 36 is returned to its raised position.

Snubber

As previously described, snubber member 85 32 is pivotable downwardly from film guide member 31 about pivot pin 33 against the resistance of a relatively weak leaf spring 35, but is held in contact with the guide member under a substantially stronger resilient force during the film threading operation. This is accomplished by means of snub-
90 ber blocking lever 239, which is pivotally mounted on stud 134 and provided with cam follower ear 240 aligned with cam lobe 188. A relatively strong spring 241 biases the rearwardly projecting arm 242 of lever
95 239 in an upward direction, thereby maintaining cam follower ear 240 in constant engagement with cam lobe 188.

When the cam member is in its initial position, arm 242 is depressed against the resistance of spring 241 to the location shown
100 in Fig. 6. In this position, the arm is vertically aligned with pin 148 extending from the snubber member through the mechanism plate, but is below the lowermost position of that pin as shown in broken lines in Figs.
105 2 and 6. Consequently, the snubber blocking lever in no way influences the movement of the snubber member produced by variations in film tension. Whenever the cam member is rotated to its intermediate position, however, arm 242 is raised into engage-
110 ment with pin 148 as shown in Figs. 7 and 8, thereby resiliently biasing the snubber member against film guide member 31 under the combined forces of the relatively weak leaf spring 35 and the substantially stronger
115 spring 241.

Reset Lever

As will be described below in detail, the depression of trigger lever 38 releases a
120 latched spring loaded mechanism to initiate the cartridge rewinding phase of the projector's operating cycle. Therefore, still another function performed by the cam member is to reset that mechanism during

the subsequent film stripping operation in preparation for another operating cycle.

To perform this resetting operation, reset lever 243 is centrally supported for pivotal movement by the upper selector slide support pin 216, with the forwardly extending leg 244 of the lever located directly above cam lobe 187. The rearwardly extending leg 245 of the same lever projects above the adjacent end of the cocking arm 246.

For purposes of understanding the operation of the reset lever, it will be understood that the end of the cocking arm below the reset lever is resiliently biased to the position shown in cross section in Figs. 4 and 6; and that the spring loaded mechanism is reset by depressing the lever to the position shown in cross section in Figs. 7 and 8 and then allowing it to return to its former raised position. Accordingly, as the cam member rotates from its initial position to its intermediate position, the periphery of cam lobe 187 causes the rearwardly extending leg 245 of the reset lever to move downwardly with sufficient force to depress the cocking arm. Thereupon, as the cam member continues to rotate through the remainder of a single revolution, the radius of cam lobe 187 engaged by leg 244 decreases, allowing the reset lever to be restored to the position shown in Fig. 6. During the projection of the film on a film supply reel, the spring loaded mechanism cannot be released due to the fact that the trigger member is automatically disabled by the selector slide.

The film review feature of the subject projector allows the operator to rewind the film into the cartridge at any time by moving the externally accessible end of review lever 37 rearwardly and holding it in that position until the desired amount of film has been rewound, thereby permitting any portion of the film to be displayed again. To perform this operation, the review lever is pivotable in a horizontal plane about a fixed pivot stud and is provided with a forwardly facing tongue 342 received within a mating hole 343 at the top end of a latch support bar. Thus, when the review lever is moved rearwardly, the latch support bar is pivoted toward the film gate against the resistance of a relatively heavy spring which normally holds it in contact with a fixed abutment. Accordingly, the cam finger member is moved to its operative position by a spring wire while still latched to the latch support bar by a latch member; thereby temporarily opening the gate. As soon as the review lever is released, however, the latch support bar is returned to its former position by the heavy spring, thus restoring the gate to its closed condition as the cam finger member is retracted by the latch member against the influence of the spring wire.

FILM TAKE-UP SPINDLE ASSEMBLY

As best illustrated by Fig. 11, the film take-up spindle assembly is supported by a non-rotatable horizontal shaft 351 rigidly attached at its left end to the projector casing member 11, and includes a rotatable pulley member 352 and a rotatable weight sensitive drive unit 353 comprising drum member 354 and reel drive member 14.

Referring first to the weight sensitive drive unit, drum member 354 thereof is freely rotatable on the shaft but is retained in a fixed position by an annular spring clip 355 received in a circumferential groove in the shaft and in a corresponding groove within the drum member bore 356. The drum member, in turn, is provided with a flat internal face surface 357 surrounded by a cylindrical wall member 358 to define a cylindrical receptacle adapted to freely accommodate flange 359 of the reel drive member, which is retained in place by an annular disk 360. Thus, the reel drive member is rotatable relative to the drum member, but only by overcoming the friction developed between the contacting surfaces of those two members. When a film reel is installed on the spindle stub 361 of the reel drive member, the weight of the reel tends to tilt the drive member out of alignment with the drum member, thereby increasing the friction encountered between the internal surfaces of the drum member and the surfaces of the flange in contact therewith during relative rotational movement between those two members. Therefore, when the film take-up reel is rotatably engaged with the spindle stub by resilient key member 362, it will be seen that the amount of torque transmittable from the drive member to the reel, or vice versa, is a function of the reel weight, which is partially determined by the amount of film wound thereon.

Pulley member 352 comprises a single sheave member 363 attached to a hub member 364 provided with an annular groove 365 by which the pulley is positioned axially along shaft 351 by a mechanism described later. At the right end of hub member 364, a lug 366 projects axially therefrom in alignment with a similar lug 367 projecting in the opposite direction from drum member 354 of the weight sensitive drive unit. As long as the pulley member is positioned axially as shown in Fig. 11, the two lugs are in engageable relation with one another, thereby coupling the film take-up reel to the pulley through the torque limiting weight sensitive drive unit. When the pulley is moved to the left, however, the lugs move apart to allow independent rotation of the pulley and the drive unit.

FILM SUPPLY SPINDLE ASSEMBLY

Fig. 12 best illustrates the film supply

(15)

spindle assembly, which is supported to the movable back wall member 370 of arm member 21 by a nonrotatable horizontal shaft 371. The unsupported end of shaft 371 is provided with a weight sensitive drive unit 72 similar to the one incorporated in the film take-up spindle assembly, comprising a rotatable drum member 373 supporting the flange portion 374 of reel drive member 18, which is adapted to accommodate a film supply reel or spool.

A finger member 375 is rotatably and slidably mounted on shaft 371 to the left of the weight sensitive drive unit and is axially movable by the hereinafter described shifting mechanism between its illustrated position and a retracted position slightly to the left thereof. When the finger member is positioned as shown, a plurality of radially spaced fingers 376 thereof extend through corresponding holes 377 in drum member 373 and project into similarly disposed holes 378 in the flange portion 374 of reel drive member 18, thereby coupling the drive reel member directly to the finger member. Upon movement of the finger member to its retracted position, fingers 376 are withdrawn from the drive member flange but still project into holes 377 in the drum member, thus establishing a driving connection between the drive member and the finger member through the torque limiting weight sensitive drive unit.

The supply spindle pulley member 379 is rotatably and slidably supported on shaft 371 and includes a sleeve 381, extending to the right of pulley sheave 382. This pulley member is also movable axially by the shifting mechanism between its illustrated position and a position in which axial lug 383 on sleeve 381 is engaged with a corresponding axial lug 384 on the finger member to couple the finger member and the pulley in positive driving engagement with one another.

A friction clutch collar 386 is slidably mounted on sleeve 381 and is keyed thereto as shown at 387 to prevent relative rotation between the collar and the pulley. As depicted at 388, a resilient wire member partially encircles the end of the collar member adjacent the finger member within a peripheral groove 389, with one end of the wire forming a clutch finger 391. As long as the various spindle components are positioned as illustrated, the inwardly projecting tip 392 of this finger is spaced beyond the right edge of radial extension 393 of finger member lug 384, whereby the finger member and the drive member coupled thereto can rotate freely on shaft 372, independently of the rotation of the pulley member 379. Upon sliding axial movement of the collar member toward the pulley member by the shifting mechanism, however, tip 392 of the clutch

finger 391 moves into alignment with lug extension 393. Hence, the finger member is then coupled to the pulley member through the frictional engagement of wire clip member 388 with groove 389, so that, only a predetermined amount of torque can be transmitted from the pulley member to the finger member or vice versa.

DRIVE SYSTEM

The drive system of the projector system, shown in Figs. 9 and 10, is driven from motor pulley 395 at the rearward end of motor shaft 276 by means of three drive belts, namely, main belt 396, take-up spindle belt 397, and supply spindle belt 398. Above the motor pulley, two idler pulleys 401 and 402 are supported for independent rotation on shaft 22 which also serves as the pivotal support for supply spindle support arm 21. As illustrated in Fig. 10, each of the idler pulleys includes two unitarily connected sheaves, such sheaves being identified from right to left by numerals 403 through 406.

The main drive belt 396 runs upwardly from the left side of motor pulley 395, behind and over idler sheave 405, over and around control mechanism pulley 167, back over idler sheave 403 and down to the right side of the motor pulley. Accordingly, the continuous movement of the main drive belt along the above-described path, in the direction indicated by the corresponding arrows in Fig. 9, imparts continuous counterclockwise rotation to idler pulley 401 and continuous clockwise rotation to idler pulley 402 and control mechanism pulley 167. The take-up spindle belt 397 is simply trained around pulley member 352 of the take-up spindle assembly and around idler sheave 406, thereby rotating pulley 397 continuously in a clockwise direction. Similarly, supply spindle belt 398 connects supply spindle pulley member 379 to idler sheave 404, thereby imparting continuous counterclockwise rotation to the supply spindle pulley regardless of the position of support arm 21.

SHIFTING MECHANISM

Overall Description — Projection Phase (Cartridge)

The shifting mechanism is employed to adjust the various components of the film supply and take-up assemblies in accordance with carrying out different phases of the projector's operating cycle.

In Figs. 9—12, the various components of the subject shifting mechanism and of the film supply and take-up spindle assemblies are shown in solid lines in the respective positions which they assume during the forward projection phase of the projector's operating cycle when the projector is in its cartridge mode of operation. Accordingly, the following explanation will begin on that

premise with a description of the four basic elements with the shifting mechanisms in their respective positions shown in the above-mentioned figures.

5 A rewind shifter bar 411 is pivotally supported for movement about a vertical pivot axis by a stationary pivot structure shown at 412, and is biased into resilient engagement with the upper end portion 413 of
10 shifter bar operating rod 414 by a spring 415. At the rearward end of the shifter bar, a tongue 416 extends upwardly and is received within annular groove 365 of the
15 film take-up pulley member 352 to establish the axial position of that member along shaft 351. Similarly, another tongue member 417 extends upwardly from the forward end of the shifter bar and is received in the
20 tapered annular groove 418 of the supply spindle pulley member 379 to locate that member along shaft 371.

Shifter bar operating rod 414 is rotatably supported along its horizontal centre portion by stationary bearings 421 and is bent upwardly and downwardly at its opposite ends
25 as shown respectively at 413 and 422; the upper end of the rod being positioned in abutting engagement with the left side of the shifter bar and the lower end being held to the left against the influence of spring 415
30 by ear of a retracted cam finger member (not shown).

Mode selector lever 424 extends upwardly into annular groove 425 of finger member
35 375 of the film supply spindle assembly and is pivotally supported on the back wall member 370 of movable arm 21 by a pivot construction shown at 427. At its lower end, the lever is biased to the right by spring
40 428 and into engagement with a stationary abutment pin 429, thereby positioning the lever as shown to define the corresponding axial location of the finger member along shaft 371.

45 Lastly, reverse lever 431 is also pivotally supported to the rear wall member of arm 21 in a diagonal position by pivot structure 432. The upper end of this lever is biased toward the right by spring 433 and is received
50 in annular groove 434 of friction clutch collar 386, thereby establishing the depicted position of the collar by maintaining it in abutment with the adjacent face of finger member lug 384. At its lower end, the reverse
55 lever extends to the left of an upwardly extending arm of control lever 36.

From the previous description of the film supply and take-up spindle assemblies, it will be recalled that the illustrated positioning of
60 the various components of those assemblies allows the film supply reel to rotate freely and impart clockwise rotation to the take-up reel through weight sensitive drive unit 353. Accordingly, the film unwinds freely
65 from the cartridge as it is advanced through

the gate by the pulldown mechanism and absorbed by the film take-up reel under controlled tension.

Reverse Projection Phase (Cartridge)

To project the film in reverse, the operator depresses control lever 36, thus adjusting the cam controlled claw mechanism to advance the film intermittently through the gate in an upward (reverse) direction rather than in the normal downward (forward)
70 direction. Simultaneously, such movement of lever 36 rocks its upwardly extending arm to the right, whereby it engages and effects corresponding displacement of the lower end of reverse lever 431 against the influence of
75 spring 433. Accordingly, the friction clutch collar member is moved to the left to align the tip 392 of clutch finger 391 with radial lug extension 393 on finger member 375, thus imparting counterclockwise rotation to the film supply spool through the torque
80 limiting friction clutch assembly. Consequently, as the film is fed upwardly through the gate by the claws it is unwound from the film take-up reel under the control of weight sensitive drive unit 353 and snubber shoe 263 and is rewound smoothly onto the film supply
85 spool.

The reason for employing this frictional clutch arrangement during the reverse projection operation, rather than utilizing weight sensitive drive unit 372 for this purpose, is that the torque characteristics required of the latter unit for proper performance of the projector during its reel mode of operation
90 preclude that unit from supplying sufficient torque to the film to perform the subject operation due to the significant weight discrepancy between a cartridge film spool and a film supply reel.
95

When control lever 36 is returned to its raised position, the film advancing mechanism is again adjusted to advance the film downwardly through the gate and the reverse lever is restored to its former position by
100 spring 433 to re-establish the former position of friction clutch collar 386, thereby allowing the forward projection operation to proceed.

Review Phase (Cartridge)

When review lever 37 is displaced manually in a rearward direction, the cam finger member is moved to its operative position to open the gate, as previously explained. The position of shifter bar 411 illustrated in Figs. 9—12 is defined by the respective
115 engagement of the upper and lower ends of operating rod 414 with the left surface of the rearward end of the shifter bar and with an ear of the cam finger member. Therefore, such movement of the cam finger member now allows spring 415 to pivot the rearward
120 end of the shifter bar to the left into contact with fixed abutment member 436 by displac-

ing the operating rod appropriately, thereby simultaneously moving the forward end of the bar to the right. Since the pivotal position of the shifter bar determines the axial positions of pulley members 352 and 379 along their respective shafts 351 and 371, it will be recognized that the pulley member 352 is thus disengaged from weight sensitive drive unit 353 and that pulley member 379 is positively coupled to the corresponding reel drive member 18 by the driving engagement of pulley sleeve lug 383 with finger member lug 384. Accordingly, the film is rewound onto the cartridge spool from the freely rotatable take-up reel until review lever 37 is returned to its forward position, whereupon the resulting retraction of the cam finger member causes operating rod 414 to restore the shifter bar to its former position, thus allowing the film projection phase to proceed.

Rewind Phase (Cartridge)

The rewind phase of the projector's operating cycle is initiated by the depression of trigger lever 38, either manually or in response to downward movement of snubber member 32, whereby a latch member (not shown) is released from the cam finger member to allow that member to assume its operative position. Therefore, it will be seen that this movement of the cam finger member adjusts the shifter bar in exactly the same manner previously described in connection with the operation of the review mechanism, thereby causing the film to be rewound into the cartridge through the open film gate. In this case, however, the rewinding adjustment of the spindle assemblies by the shifter bar remains in effect until the cam finger member is again retracted by the cocking arm in response to corresponding movement of the reset lever during the subsequent operation of the control cam mechanism.

REEL MODE OF OPERATION

Due to the relatively small diameter of the roll of film that can be accommodated in a film cartridge, the film tension required to unwind the film is considerably greater than that needed to unwind a larger diameter roll on a film reel. Therefore, the cartridge spool is allowed to rotate freely during the projection of the film supplied thereby, retarded only by the friction inherent in the spindle assembly. As a result of normally encountered variations in film speed and tension, the freely rotatable reel will occasionally rotate faster than the speed at which the film is being used, thus causing the film to expand on the roll. Due to the relatively low inertia of the spool, however, such expansion cannot cause film tension variations exceeding the tension control capabilities of the snubber member. Additionally, the in-

ternal structure of the cartridge prevents the film from ever expanding beyond the spool flanges. Conversely, when the projector is loaded with a relatively large and heavy film supply reel, its correspondingly greater momentum and the absence of any film restraining structure necessitate the employment of means for restraining free rotation of the reel to prevent such film roll expansion from occurring. Accordingly, whenever a film supply reel is loaded into the subject projector, it is coupled to the supply spindle pulley member, either directly or through the weight sensitive drive unit 372, but is never allowed to rotate freely.

During the rewinding of the film onto the film supply reel, the length of film between the two reels necessarily assumes a very high linear velocity as the supply roll approaches its maximum diameter; such high velocity being unavoidable if the supply reel is rotated with sufficient speed to rewind the film in a reasonably short length of time. Accordingly, since such high velocity movement of the film is incompatible with rewinding it through the open gate and the various film guide members associated therewith, the previously described review and rewind mechanisms are simply disabled during the reel mode of operation.

Projection Phase (Reel)

When arm member 21 is raised to its upper position, the corresponding movement of mode selector lever 424 moves the lower end of that lever out of engagement with stationary abutment pin 429. Therefore, spring 428 moves the upper end of the lever 424 to the left to effect corresponding movement of finger member 375 to its retracted position by overpowering weaker spring 433 as collar member 386 is also moved to the left by lug 384 of the finger member. In its retracted position, the finger member is coupled to supply spindle pulley 379 by the engagement of axial lugs 383 and 384. As previously related, the movement of the finger member to its retracted position withdraws fingers 376 thereof from engagement with the flange portion 374 of reel drive member 18, but not out of engagement with holes 377 in drum member 373. Consequently, pulley member 379, finger member 375 and drum member 373 are positively connected to one another and rotate continuously in a counterclockwise direction; with finger member 375, in turn, being coupled to a reel on drive member 18 through the now operative weight sensitive drive unit 372.

By virtue of the raised position of the film supply spindle assembly, pulley 379 is out of engagement with the forward end of shifter bar 411, but the rearward end of shifter bar remains engaged, with pulley

member 352 of the take-up spindle assembly. Therefore, as the film is advanced through the film gate, the tension exerted on the film by the supply and take-up reels is controlled in proportion to the sizes of the respective film rolls by the corresponding weight sensitive drive units.

Review (Reel)

If the review control lever were moved to its rearward position during the film projection phase, the film gate would be temporarily opened and the film take-up reel would be disengaged from driving relation with the corresponding pulley member. However, the film could not be rewound onto the supply reel inasmuch as the weight sensitive drive unit of the supply spindle assembly cannot exert sufficient torque on the supply reel to effectively rewind the film in opposition to the inertia and frictional forces opposing unwinding rotation of the film take-up reel, and the friction encountered by the film in the gate and film guide passageways. Therefore, the film would remain stationary in the gate and would be in danger of melting or burning due to the continuous exposure of a single frame of the film to the projection lamp. To prevent this occurrence, the review control lever is blocked from movement to its rearward position whenever arm 21 is raised. As illustrated in Fig. 9, this is effected by slide member 437: which is slidably supported by studs 438 extending through elongate slot 439 and urged upwardly by spring 440. Whenever arm 21 is in its lowered position, the slide member is positioned by the engagement of the upper end of the slide member with lower edge surface 441 of the left wall member 370 of arm 21. Accordingly, blocking ear 442 at the lower end of the slide member is below and out of the path of movement of the forwardly extending tongue 342 of review control lever 37. When arm 21 is raised, however, the slide member moves upwardly under the influence of spring 440 to a position established by the engagement of the lower end of slot 439 with the lower stud 438. In this position, blocking ear 442 is aligned with the right edge of the forwardly extending tongue of control lever 37, thereby positively preventing rearward movement of the externally accessible end of that lever.

Reverse (Reel)

Although reverse lever 431 is also raised by the upward movement of arm 21, thereby removing its lower end from engagable relation with an upwardly extending arm of control lever 36, the projection of the film in reverse can nevertheless be accomplished by moving the control lever downwardly. This operation is possible because of the fact the film supply and take-up reels are frictionally coupled through the corresponding

weight sensitive drive units to the respective pulley members 379 and 352, each of which rotates continuously in the direction in which film is wound onto the corresponding reel. Thus, as the film is now moved upwardly through the gate, the resulting film tension below the gate overpowers drive unit 353 to allow the film to be unwound from the take-up reel as the corresponding decrease in film tension above the gate enables the supply reel to be rotated by drive unit 372 in a rewinding direction.

Rewind (Reel)

When the film has been completely projected, i.e. when it is wound entirely onto the take-up reel, its trailing end is manually reattached to the supply reel hub, whereupon the supply spindle assembly is adjusted to rewind the film in opposition to the weight sensitive drive unit of the take-up assembly by coupling drive member 18 directly to pulley 379. This adjustment is accomplished by means of a manually operable shifting cam member 444, which is pivotally supported to the movable back wall member 370 of arm 21 adjacent pulley member 379 by a pivot pin 445. In its inoperative position shown in Figs. 9 and 10, the cam member is entirely out of engagement with the pulley member, with operating lever 446 received in slot 447 of the curved front wall 45 of the arm member. When the lever is manually pivoted downwardly to its operative position defined by pin 448 as shown in broken lines in Fig. 9, the arcuate tapered end portion 449 of the cam member is wedged between wall member 370 and the left face of pulley member 379, thereby displacing the pulley member to the right. Since the pulley member is already in axial engagement with finger member 375, such movement also displaces the finger member by overpowering spring 428, thereby re-engaging fingers 376 with holes 378 in flange portion 374 of reel drive member 18. Thus, as long as the cam member remains frictionally retained in its operative position, the film supply reel is coupled directly to pulley member 379.

Upon completion of the rewinding operation and removal of the rewind supply reel, lever 446 is manually returned to its inoperative position to readjust the film supply spindle assembly to its former condition. If the operator lowers arm member 21 without having first repositioned lever 446, this is accomplished automatically by the engagement of the forwardly extending lever with the top wall of the projector casing. This feature therefore prevents possible misalignment between tongue member 417 of shifter bar 411 and the pulley member groove 418, which is tapered to further ensure proper reception of the tongue member therein. Similarly, if reverse control lever 36 should

happen to be in its downward (reverse) position when arm 21 is lowered, the slanted rearward end portion 450 of reverse lever 431 will nevertheless engage the left side of the upwardly extending arm of the lever 36, thereby adjusting the film supply spindle assembly as lever 431 is cammed to the right in response to the movement of arm 21.

10 WHAT WE CLAIM IS:—

1. A coaxially arranged spindle assembly for use in a motion picture projector to support a film supply roll wound onto a hub member, said assembly comprising a rotatable drum member, a roll drive member supported by and extending beyond the drum member to support the hub member of film supply roll, the roll drive member being rotatable relative to the drum member in opposition to friction developed between the drive member and the drum member as a function of the weight of the film roll supported by the roll drive member, a rotatable first clutch member adjustable into and out of positive rotational driving engagement with the roll drive member, a second clutch member, including a rotatable body member and a friction member frictionally coupled to the body member and rotatable relative thereto in opposition to a predetermined frictional resistance to such relative rotation, means supporting the second clutch member for movement to a first position in which the friction member is engaged with the first clutch member adjusted to positive rotational driving engagement with the drive member thereby to couple the drive member with the body member through the torque limiting agency of the friction member, and a second position in which the friction member is disengaged from the first clutch member to allow free independent rotation of the second clutch member and the drum member.

2. A spindle assembly as claimed in claim 1, including a power input member and third clutch means adapted selectively to

establish positive driving engagement between the power input member and the drum member, and to disengage the power input member from the drum member to allow free independent rotation of these two members.

3. A spindle assembly as claimed in claim 1, including a shaft adapted to support rotatably the drum member and the pulley member at opposite ends thereof, the first and second clutch members being supported in coaxial relation to the shaft between the power input member and the drum member.

4. A spindle assembly as claimed in claim 3, wherein the power input member includes a tubular sleeve adapted to support the body member for axial movement relative to the input member, the tubular sleeve and the body member including cooperating means for preventing relative rotation therebetween.

5. A spindle assembly as claimed in claim 3, wherein the first clutch member is slidably supported by the shaft between the drum member and the power input member, the first clutch member including a plurality of fingers movable axially into driving engagement with the drive member through corresponding openings in the drum members.

6. A spindle assembly for use in a motion picture projector constructed and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

7. A motion picture projector incorporating a spindle assembly as claimed in any preceding claim for supporting a film supply roll.

8. A motion picture projector having a spindle assembly adapted to support a film supply roll, substantially as hereinbefore described with reference to the accompanying drawings.

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happen to be in its downward (reverse) position when arm 21 is lowered, the slanted rearward end portion 450 of reverse lever 431 will nevertheless engage the left side of the upwardly extending arm of the lever 36, thereby adjusting the film supply spindle assembly as lever 431 is cammed to the right in response to the movement of arm 21.

10 WHAT WE CLAIM IS:—

1. A coaxially arranged spindle assembly for use in a motion picture projector to support a film supply roll wound onto a hub member, said assembly comprising a rotatable drum member, a roll drive member supported by and extending beyond the drum member to support the hub member of film supply roll, the roll drive member being rotatable relative to the drum member in opposition to friction developed between the drive member and the drum member as a function of the weight of the film roll supported by the roll drive member, a rotatable first clutch member adjustable into and out of positive rotational driving engagement with the roll drive member, a second clutch member, including a rotatable body member and a friction member frictionally coupled to the body member and rotatable relative thereto in opposition to a predetermined frictional resistance to such relative rotation, means supporting the second clutch member for movement to a first position in which the friction member is engaged with the first clutch member adjusted to positive rotational driving engagement with the drive member thereby to couple the drive member with the body member through the torque limiting agency of the friction member, and a second position in which the friction member is disengaged from the first clutch member to allow free independent rotation of the second clutch member and the drum member.

2. A spindle assembly as claimed in claim 1, including a power input member and third clutch means adapted selectively to

establish positive driving engagement between the power input member and the drum member, and to disengage the power input member from the drum member to allow free independent rotation of these two members.

3. A spindle assembly as claimed in claim 1, including a shaft adapted to support rotatably the drum member and the pulley member at opposite ends thereof, the first and second clutch members being supported in coaxial relation to the shaft between the power input member and the drum member.

4. A spindle assembly as claimed in claim 3, wherein the power input member includes a tubular sleeve adapted to support the body member for axial movement relative to the input member, the tubular sleeve and the body member including cooperating means for preventing relative rotation therebetween.

5. A spindle assembly as claimed in claim 3, wherein the first clutch member is slidably supported by the shaft between the drum member and the power input member, the first clutch member including a plurality of fingers movable axially into driving engagement with the drive member through corresponding openings in the drum members.

6. A spindle assembly for use in a motion picture projector constructed and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

7. A motion picture projector incorporating a spindle assembly as claimed in any preceding claim for supporting a film supply roll.

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