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(54) WEB HANDLING APPARATUS

(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:—

This invention relates to web handling apparatus having a reel support member arranged to support a reel of web material in operational position for rotation about the reel axis as the web material is unwound from the reel, and a slip clutch, having co-operating friction surfaces, associated with the reel support member and adapted to apply a retarding force which is dependent on the weight of the reel of web material, and to motion picture projectors of this kind.

Devices have been developed for driving supply reels of motion picture projectors in a take-up or rewinding direction through a friction clutch during normal film advance in order to tension the web. These devices are generally referred to as tendency drives and prevent the film from becoming slack; which might otherwise result in damage to or destruction of the film. In devices of this type, the supply reels are carried by a spindle on a driven shaft having a horizontal axis of rotation, the driven shaft being connected to a driving shaft through a slipping clutch which automatically varies its coupling force in accordance with the weight of the roll of film on the reel. However, in apparatus having spindles mounted on horizontal shafts, automatic elimination of the clearance which occurs between the friction surfaces of the clutch by reason of wear may cause the occurrence of non-parallelism of the driving and driven shafts. It will be obvious that this nonparallelism of the shafts produces a tendency towards misalignment of the reel flanges which must be

compensated for by other means, such as by universally pivotable spindles and/or reels. The present invention provides an alternative to these known devices.

To simplify the use of motion picture projectors considerable attention has been directed toward providing means whereby film may be automatically stripped from a film supply reel rotatably mounted on the projector, advanced along a threading path of the projector, wound upon a take-up reel and then, upon completion of the projection cycle, rewound upon the supply reel. To facilitate film handling, the supply reel is often rotatably mounted in a film cartridge which is adapted to be received and supported by the projector in a predetermined orientation.

A representative example of such a cartridge-loading projector is disclosed in Patent Specification No. 1,254,705, means being provided for receiving film cartridges of various capacities, each cartridge being adapted to rotatably support therein a film reel of corresponding capacity. The cartridges are commonly provided with an opening in the side walls thereof through which a rotatable spindle of the projector may enter and drivingly engages the film reel contained thereby. With the cartridge positioned on the projector, the film wound upon the reel is radially accessible to a stripping mechanism adapted to separate the leading end of the film from the roll and to feed it along or toward a predetermined threading path. Upon completion of the projection cycle, a rewind mechanism initiates a rewind cycle, whereupon the film is rapidly rewound onto the supply reel. Further details and features of the aforementioned film stripping and threading mechanism and of film supply cartridges adapted for use therewith are disclosed in Patent Specifications Nos. 1,241,997, 1,241,998, 1,241,999, 1,110,538, 1,234,812, 1,235,382, 1,261,525, 1,261,526 and 1,261,527.

In order that film supply reels of different

[Price 25p]

capacities can be loaded onto the subject type of projector, similar film supply cartridges of different sizes can be provided with substantially identical locating and supporting surfaces as disclosed in Patent Specification No. 1,266,631.

To enable the stripping and threading mechanism to perform properly notwithstanding the substantial difference in diameters of the film rolls housed in such cartridges, the locating and supporting surfaces of the cartridges may be adapted to cooperate with mating means on the projector to position and respective supply reels within the different size cartridges at predetermined, noncoaxial locations. Accordingly, means may be provided for locating the reel spindle, which rotatably supports and drives the supply reel within the cartridge, at such different locations.

In accordance with one aspect of the invention there is provided a web handling apparatus comprising a housing plate arranged to extend substantially horizontally in operation, a sleeve bearing carried by the housing plate and extending through a slot in the housing plate to permit adjustment of the sleeve bearing along the slot to a selected one of spaced positions on the housing plate so that different sized web reels can be supported at different positions, a shaft mounted for rotation and for limited axial movement in the sleeve bearing perpendicular to the housing plate, a reel support member secured to the shaft at its upper end in use, and a friction clutch arranged to oppose rotation of the reel support member inversely as a function of the weight of a web roll carried by the reel support member, the friction clutch comprising a driving clutch member rotatably mounted on the sleeve bearing and having a friction surface extending parallel to the housing plate, and a driven clutch member secured to and movable axially with the shaft into engagement with the friction surface of the driving clutch member.

The driving clutch member may be rotatable with a pulley which is coaxial with the shaft. The pulley may be rotatable on the said sleeve bearing. Detent means co-operable with the shaft may locate the shaft in at least two predetermined positions spaced along the slot in the housing plate.

The pulley may be arranged to be driven by a resilient belt which also tends to maintain the shaft in the selected predetermined position along the slot.

The apparatus may include means for positively coupling the clutch members of the friction clutch. The positive coupling means may include a prong coupled to one of the clutch members, a lug coupled to the other of the clutch members, the prong and lug being at the same radial distance from the

shaft axis but normally spaced axially from one another, and means for raising the prong or the lug into the rotational path of the lug or prong respectively. The means for coupling may be operative in all positions of the shaft along the slot and includes a member which is arranged to be pivoted about a fixed pivot by a solenoid which is mounted in a fixed position in relation to the housing plate. The said member may be a plate which is arranged to raise a cap depending from the said prong.

The sleeve bearing may be flanged and supported by means of this flange on the housing plate, and the means for positively coupling the clutch members of the friction clutch may include a member which is rotatable with the driven clutch member and is movable axially against the bias of a compression spring to engage the pulley and be rotated thereby.

The web handling apparatus referred to may be included in a cartridge-loading motion picture projector.

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

Figure 1 is a perspective view of a fragmentary portion of a motion picture projector showing a film reel for such projector adjacent to the projector;

Figure 2 is an enlarged, exploded view illustrating one preferred embodiment of a spindle assembly of the present invention;

Figure 3 is an enlarged, cross sectional view of part of the mechanism shown in Figure 1;

Fig. 4 is an enlarged and inverted, fragmentary view of the reel supporting portion of the spindle assembly shown in Fig. 2; and Fig. 5 is an enlarged and inverted view of the driving part of the clutch assembly shown in Fig. 2.

The preferred embodiment is a motion picture projector but it will be appreciated that the invention may be embodied in machines adapted to receive and transport other types of web material.

The illustrative portion of a projector depicted in Fig. 1 of the accompanying drawings generally is of the type disclosed in United States Patent Specification No. 3,734,427, noting however that the film reel, denoted generally by reference numeral 10 is supported in a horizontal plane above an upper, substantially horizontal plate 12 by a spindle 14. Although only one size reel has been shown, it should be understood that various sizes of reels loaded in correspondingly sized cartridges may be mounted on spindle 14. Not shown, but in accordance with the disclosure of aforementioned Patent Specifications Nos. 1,254,705 and 1,266,631 and United States Patent Specification No. 3,734,427, all such film cartridges are pro-

vided with similar locating ribs. These ribs are adapted to be received in mating positioning slots, not shown, defined by plate 12. Additionally, latching openings are similarly located with reference to the locating ribs of each of the cartridges and are adapted to be engaged by releasable latch members, not shown, extending through openings in the projector plate 12, whereby a cartridge installed on the projector is releasably held in its operative position.

The cooperation between the locating ribs on the different size cartridges and the mating positioning slots on the projector positions the different sized cartridges with their respective reel hub axes at predetermined different locations. As will be described later in detail, supply reel spindle 14 is adapted to be adjusted to these same predetermined different locations to rotatably support the film supply reel of whichever cartridge is mounted on the projector.

Spindle 14 is adapted to receive reel 10 which comprises a pair of spaced and generally parallel flanges 16 and 18 which project radially outwardly from a centrally located hub member 20. There is an opening 22 in the reel hub for receiving a portion of spindle 14 which supports the hub. Reel hub member 20 has radial slots 24 for receiving reel drive keys which will be described hereinafter in further detail. A roll of web material, such as motion picture film F, may be wound on hub member 20.

Spindle Assembly

Referring now to Figs. 1—4, the spindle assembly comprises a shaft or roll drive member 26 rotatable about a vertical axis and spindle 14 which is mounted on shaft 26 for pivotal movement with respect to the shaft. More specifically, the upper end of shaft 26 has a pressed-on cap 28 having four circumferentially spaced, upwardly projecting teeth 29. Positioned between the teeth on the end of shaft 26 is a socket comprising a mounting or pivot surface 30 (Fig. 2). Surface 30 is preferably in the shape of a segment of a sphere having a centre of curvature located along the axis of rotation of shaft 26.

Spindle 14 is hollow and has stepped interior and exterior surfaces. The interior of spindle 14 includes an inner, substantially cylindrical recess formed by a wall 32 and a somewhat larger outer recess formed by a wall 34. Four spaced teeth 36 project into the inner recess from wall 32 and are dimensioned so that they fit between teeth 29 on the upper end of shaft 26, thereby establishing a driving connection between the shaft and the spindle so that when the parts are assembled as illustrated in Fig. 3 rotation of shaft 26 simultaneously effects rotation of spindle 14. Secured to the hub and pro-

jecting downwardly into the inner recess is a shaft 38 having a threaded bore 40 which receives an adjustable stud 42 having a generally spherical lower portion 43. The radius of curvature of lower portion 43, of stud 42 is substantially equal to the radius of curvature of spherical surface 30 on shaft 26. When assembled, the surface of spherical portion 43 contacts surface 30 to provide a universal connection between stud 42 and shaft 26, and this connection permits pivotal movement of spindle 14 about a pivot point located on the axis of rotation of shaft 26. This type of connection is described in Patent Specification No. 1,307,588. The height of spindle 14 relative to shaft 26 and plate 12 may be adjusted by stud 42.

Spindle 14 is locked onto shaft 26 by a retainer ring 44 which fits into an annular recess 46 (Fig. 4) in the interior of spindle 14 and is locked in position by a plurality of tabs 48 on spindle 14 which may be bent under the ring. The inside diameter of ring 44 and the outside diameter of shaft 26 cooperate to determine the extent of pivotal movement of spindle 14 with respect to shaft 26. The inside diameter of ring 44 is less than the outside diameter of cap 28 to retain spindle 14 on shaft 26.

The outer surface of spindle 14 comprises a cylindrical upper surface portion 50 positionable within opening 22 in reel hub 20. Spindle 14 has a plurality of slots 52. Keys 54 of a locking member 56 project through slots 52 and into the radial slots 24 of a received reel to connect the spindle and reel non-rotatably. Locking member 56 is held in a raised position as shown in Fig. 3 by a spring 58 that is compressed between a retainer ring 60 and member 56. Ring 60 is held in a recess 62 in wall 34 by bent tabs 64.

When a reel is mounted on spindle 14 with its slots 24 misaligned with respect to keys 54, locking member 56 will be depressed against the biasing force of spring 58. As soon as the spindle begins to rotate relative to the reel, keys 54 will align with slots 24 and locking member will be raised by the spring to its position shown in Fig. 3.

Spindle 26 is rotatably carried in a flanged sleeve bearing 66 which projects through a lower plate 68 that is substantially parallel to and just below plate 12. The flange of bearing 66 rests on and cooperates with plate 68 to prevent rotation of shaft 26 about a horizontal axis. Rotatably mounted on sleeve bearing 66 below plate 68 is a pulley member 70 which is abutted at its end by a pair of thrust washers 72 and 74. Pulley 70 is prevented from sliding axially along bearing 66 by plate 68 and by a retaining ring 76 that has teeth on its inner periphery for gripping the shaft. A drive belt 78 is trained about an annular groove in pulley 130

member 70 and about a drive pulley 80 powered by a motor 82. The internal features of pulley member 70 are more clearly shown in Fig. 5. These features include
 5 four circumferentially spaced, ramped lugs 84 on upper plate 85, a key 86 extending axially down the inner wall 88 of pulley member 70 and four prongs 90 projecting radially inwardly from the edge of cylindrical wall 88 opposite from plate 85. The inner
 10 ends of prongs 90 are turned upwardly toward plate 85 to hold a wire retainer 92 (Fig. 3) in the pulley member as will be explained in greater detail hereinafter. Axial movement of shaft 26 is limited in an upward
 15 direction by cooperation between the lower edge of bearing 66 and a snap-ring 94 which fits into an annular groove 96 in shaft 26 just below the bearing.

20 An upper clutch part 98 is fixed to shaft 26 by a knurled connection and includes an annular flange 100 having four openings 102 circumferentially spaced therein. The lower wall of flange 100 defines one friction surface of a clutch. A lower clutch part or
 25 ring 104 has an upper friction surface 106 lying in a plane perpendicular to the axis of shaft 26. Clutch part 104 is formed with slots 108 in its periphery that are aligned with prongs 90 of pulley member 70 and with
 30 a peripheral slot 110 that is aligned with key 86 during assembly of the lower clutch part into the pulley member. Once assembled, the lower clutch part is held in the pulley by insertion of wire retainer 92 therebelow. Key
 35 86 and slot 110 ensure that lower clutch part 104 rotates with pulley 70.

A lower cap 112 is provided with four upwardly extending, flexible prongs 114 having radial tabs 116. During assembly prongs
 40 114 may be deflected slightly radially inwardly to permit their entry through openings 102 in flange 100 of upper clutch part 98. Tabs 116 then prevent the inadvertent withdrawal of prongs 114 back through the
 45 openings. When assembled, prongs 114 are radially aligned with and positioned below lugs 84 of pulley member 70. A compression spring 118 pushes cap 112 and upper clutch member 98 apart. Thus spring 118
 50 biases tabs 116 away from lugs 84 and into engagement with upper clutch member 98.

Cap 112 rests against a plate 120 which is mounted for rotation about a shaft 122. The
 55 plate may be rotated about shaft 122 to raise cap 112 during rewind and review operation of the projector by energization of a solenoid 124 connected thereto by a wire 128.

60 *Operation of Spindle Assembly*

During operation of the projector, motor 82 drives pulley 80 in the direction indicated by arrow 126, thereby turning pulley member 70 in the direction shown by arrow
 65 127. Since lower clutch part 104 is non-

rotatably held in pulley 70 by cooperating key 86 and slot 110, rotation of pulley member 70 rotates the lower clutch part. The lower surface of upper clutch part 98 is pressed in frictional contact against the upper surface 106 of lower clutch part 104 so that rotation of pulley member 70 tends to rotate spindle 14 and film reel 10 in a take-up direction. The force which the friction surfaces are pressed together is dependent upon the weight of, and therefore the instantaneous diameter of, the film roll on the reel, whereby shaft 26 is movable, by film tension, relative to the driving clutch part in opposition to the friction developed between the friction surfaces inversely as a function of the weight of the roll of film supported on the spindle.

To rewind film onto reel 10 during rewind and/or review operation of the projector, it is desirable to directly couple drive motor 82 and spindle 14. By energizing solenoid 124 through any suitable rewind switch 129, plate 120 is rotated in a counterclockwise direction as viewed in Fig. 3 to raise cap 112 against the force of spring 118. In this manner, prongs 114 are raised into the path of the flat sides of lugs 84 on pulley 84 on pulley 70 which is rotating in a direction whereby these flat sides lead the ramped sides. Thus, as long as solenoid 124 remains energized, a direct coupling is formed between pulley member 70 and spindle 14 through lugs 84, prongs 114, upper clutch part 98, shaft 26, teeth 29 and teeth 36. When solenoid 124 is deenergized, spring 118 withdraws prongs 114 from engagement with lugs 84 to reestablish the variable coupling between the clutch parts.

Spindle Locating Means

In accordance with the disclosure of United States Patent Specification No. 3,734,427, projectors of the type described are adapted to receive any of several different diameter film supply reels loaded in cartridges of corresponding sizes. All of the film cartridges are provided with similar locating ribs which are adapted to be received in mating positioning slots defined by a wall member such as plate 12 of the instant application. Additionally, latch openings are similarly located with reference to the locating ribs of each of the cartridges and are adapted to be engaged by releasable latch members extending through the openings in the projector wall member, whereby a cartridge installed on the projector is releasably held in its operative position. The cooperation between the locating ribs on the different size cartridges and the mating positioning slots on the projector positions the different size cartridges with their respective reel hub axes at predetermined different locations along an arc. Therefore, as will be described later in detail, supply reel spindle
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14 of the present application is adjustable to these same predetermined different locations to rotatably support the film supply reel of whichever cartridge is mounted on the projector.

Referring to Fig. 1 of the instant application, upper plate 12 and lower plate 68 are provided with aligned arcuate slots 130 and 131, respectively, through which shaft 26 extends. Slot 131 is somewhat wider than slot 130 to accommodate sleeve bearing 66. Along one edge of each slot is provided means defining three arcuate detent indentations in respective coaxial alignment with the required three positions of the supply reel spindle. The indentations in plate 12 are referenced by numerals 132—134. The upper surface of upper plate 12 is recessed in the region of reference numeral 136 to accommodate the lower portion of spindle 14. Shaft 26 and the hub of flanged bearing 66 are held against the indented edges of slits 130 and 131 solely by the force exerted by resilient drive belt 78, the drive belt being stretched somewhat as it is mounted on pulleys 70 and 80.

From the foregoing, it is apparent that spindle 26 may be manually shifted within slots 130 and 131 so as to occupy any one of the several detented positions. To shift spindle 14 from one detent to another, the projector operator merely grasps the spindle and urges it out of the detent it had originally occupied, moves the spindle along the slots to a point opposing the detent in which the spindle is to be set, and then release the spindle, thereby permitting the resilient force exerted by drive belt 78 to urge shaft 26 into its new position.

Detent indentations 132—134 are shown on an arcuate locus. However, it will be readily understood that the detent indentations may be aligned so that spindle 14 is held in one of three predetermined positions along a straight line.

WHAT WE CLAIM IS:—

1. Web handling apparatus comprising a housing plate arranged to extend substantially horizontally in operation, a sleeve bearing carried by the housing plate and extending through a slot in the housing plate to permit adjustment of the sleeve bearing along the slot to a selected one of spaced positions on the housing plate so that different sized web reels can be supported at different positions, a shaft mounted for rotation and for limited axial movement in the sleeve bearing perpendicular to the housing plate, a reel support member secured to the shaft at its upper end in use, and a friction clutch arranged to oppose rotation of the reel support member inversely as a function of the weight of a web roll carried by the reel support member, the friction

clutch comprising a driving clutch member rotatably mounted on the sleeve bearing and having a friction surface extending parallel to the housing plate, and a driven clutch member secured to and movable axially with the shaft into engagement with the friction surface of the driving clutch member.

2. Apparatus as claimed in Claim 1, wherein the driving clutch member is rotatable with a pulley which is coaxial with the shaft.

3. Apparatus as claimed in Claim 2, wherein the pulley is rotatable on the said sleeve bearing.

4. Apparatus as claimed in Claim 1, including detent means co-operable with the shaft to locate the shaft in at least two predetermined positions spaced along the slot in the housing plate.

5. Apparatus as claimed in Claim 2 or Claim 3, and Claim 4, wherein the pulley is arranged to be driven by a resilient belt which also tends to maintain the shaft in the selected predetermined position along the slot.

6. Apparatus as claimed in Claim 1, including means for positively coupling the clutch members of the friction clutch.

7. Apparatus as claimed in Claim 6, wherein the positive coupling means include a prong coupled to one of the clutch members, a lug coupled to the other of the clutch members, the prong and lug being at the same radial distance from the shaft axis but normally spaced axially from one another, and means for raising the prong or the lug into the rotational path of the lug or prong respectively.

8. Apparatus as claimed in Claim 6, wherein the means for coupling the clutch members is operative in all positions of the shaft along the slot and includes a member which is arranged to be pivoted about a fixed pivot by a solenoid which is mounted in a fixed position in relation to the housing plate.

9. Apparatus as claimed in Claims 6, 7 and 8, wherein the said member is a plate which is arranged to raise a cap depending from the said prong.

10. A web handling system as claimed in Claims 1, 2, 3 and 6, wherein the sleeve bearing is flanged and is supported by means of this flange on the housing plate, and wherein the means for positively coupling the clutch members of the friction clutch includes a member which is rotatable with the driven clutch member and is movable axially against the bias of a compression spring to engage the pulley and be rotated thereby.

11. Web handling apparatus as claimed in any preceding claim, incorporated in a cartridge-loading motion picture projector which includes means for mounting cartridges of more than one size in predetermined posi-

14 of the present application is adjustable to these same predetermined different locations to rotatably support the film supply reel of whichever cartridge is mounted on the projector.

Referring to Fig. 1 of the instant application, upper plate 12 and lower plate 68 are provided with aligned arcuate slots 130 and 131, respectively, through which shaft 26 extends. Slot 131 is somewhat wider than slot 130 to accommodate sleeve bearing 66. Along one edge of each slot is provided means defining three arcuate detent indentations in respective coaxial alignment with the required three positions of the supply reel spindle. The indentations in plate 12 are referenced by numerals 132—134. The upper surface of upper plate 12 is recessed in the region of reference numeral 136 to accommodate the lower portion of spindle 14. Shaft 26 and the hub of flanged bearing 66 are held against the indented edges of slits 130 and 131 solely by the force exerted by resilient drive belt 78, the drive belt being stretched somewhat as it is mounted on pulleys 70 and 80.

From the foregoing, it is apparent that spindle 26 may be manually shifted within slots 130 and 131 so as to occupy any one of the several detented positions. To shift spindle 14 from one detent to another, the projector operator merely grasps the spindle and urges it out of the detent it had originally occupied, moves the spindle along the slots to a point opposing the detent in which the spindle is to be set, and then release the spindle, thereby permitting the resilient force exerted by drive belt 78 to urge shaft 26 into its new position.

Detent indentations 132—134 are shown on an arcuate locus. However, it will be readily understood that the detent indentations may be aligned so that spindle 14 is held in one of three predetermined positions along a straight line.

WHAT WE CLAIM IS:—

1. Web handling apparatus comprising a housing plate arranged to extend substantially horizontally in operation, a sleeve bearing carried by the housing plate and extending through a slot in the housing plate to permit adjustment of the sleeve bearing along the slot to a selected one of spaced positions on the housing plate so that different sized web reels can be supported at different positions, a shaft mounted for rotation and for limited axial movement in the sleeve bearing perpendicular to the housing plate, a reel support member secured to the shaft at its upper end in use, and a friction clutch arranged to oppose rotation of the reel support member inversely as a function of the weight of a web roll carried by the reel support member, the friction

clutch comprising a driving clutch member rotatably mounted on the sleeve bearing and having a friction surface extending parallel to the housing plate, and a driven clutch member secured to and movable axially with the shaft into engagement with the friction surface of the driving clutch member.

2. Apparatus as claimed in Claim 1, wherein the driving clutch member is rotatable with a pulley which is coaxial with the shaft.

3. Apparatus as claimed in Claim 2, wherein the pulley is rotatable on the said sleeve bearing.

4. Apparatus as claimed in Claim 1, including detent means co-operable with the shaft to locate the shaft in at least two predetermined positions spaced along the slot in the housing plate.

5. Apparatus as claimed in Claim 2 or Claim 3, and Claim 4, wherein the pulley is arranged to be driven by a resilient belt which also tends to maintain the shaft in the selected predetermined position along the slot.

6. Apparatus as claimed in Claim 1, including means for positively coupling the clutch members of the friction clutch.

7. Apparatus as claimed in Claim 6, wherein the positive coupling means include a prong coupled to one of the clutch members, a lug coupled to the other of the clutch members, the prong and lug being at the same radial distance from the shaft axis but normally spaced axially from one another, and means for raising the prong or the lug into the rotational path of the lug or prong respectively.

8. Apparatus as claimed in Claim 6, wherein the means for coupling the clutch members is operative in all positions of the shaft along the slot and includes a member which is arranged to be pivoted about a fixed pivot by a solenoid which is mounted in a fixed position in relation to the housing plate.

9. Apparatus as claimed in Claims 6, 7 and 8, wherein the said member is a plate which is arranged to raise a cap depending from the said prong.

10. A web handling system as claimed in Claims 1, 2, 3 and 6, wherein the sleeve bearing is flanged and is supported by means of this flange on the housing plate, and wherein the means for positively coupling the clutch members of the friction clutch includes a member which is rotatable with the driven clutch member and is movable axially against the bias of a compression spring to engage the pulley and be rotated thereby.

11. Web handling apparatus as claimed in any preceding claim, incorporated in a cartridge-loading motion picture projector which includes means for mounting cartridges of more than one size in predetermined posi-



tion so that the corresponding sized film reels therein can be supported by the said reel support member on the said shaft in the corresponding one of the said spaced positions
5 along the said slot.

12. Web handling apparatus substantially as hereinbefore described with reference to the accompanying drawings.

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