1264008

# PATENT SPECIFICATION (11) 1 264 008

DRAWINGS ATTACHED

(21) Application No. 26257/69 (22) Filed 22 May 1969

(31) Convention Application No. 731 880 (32) Filed 24 May 1968 in

(33) United States of America (US)

(45) Complete Specification published 16 Feb. 1972

(51) International Classification G 03 b 21/32

(52) Index at acceptance G2E A6A2 A6A3 A6A4

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## (54) FILM REEL SPINDLE FOR MOTION PICTURE PROJECTORS

(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 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 spindles for supporting film reels on motion picture projectors, and to motion picture projectors, particularly cartridge loading motion picture projectors, having such spindles.

Cartridge loading motion picture projectors have operated successfully with cartridges containing 50 foot or 100 foot reels of film. However with larger cartridges, such as those containing 200 foot or 400 foot reels of film, certain detrimental effects are exaggerated or compounded by the size and weight of the reel, and make previously known spindles and reels somewhat unsatisfactory. For example, it has been found unexpectedly that the increase in weight, compared with that of small reels increases the frictional resistance to movement of the reel on the spindle to the extent that the reel will not position itself correctly within the cartridge. Moreover, the spindle may be tilted with respect to the projector and to the cartridge walls to the extent that the reel flanges will frictionally engage or even bind between opposite walls of the cartridge. This last mentioned effect is particularly apparent with weight-sensitive spindles of the type described in U.S. Patent Specification No. 3,310,251, wherein the proper operation of the spindle may result in a tilting of the spindle from the horizontal.

An object of the present invention is to provide improved means for mounting a relatively large and heavy reel on a projector.

According to the present invention there is provided a motion picture projector arranged to receive a film supply reel contained in a cartridge, the projector supporting the cartridge in a non-rotatable manner such that a projector spindle can extend through an opening in the cartridge to engage in an axial bore in the film reel and permit rotation of the reel within the cartridge, wherein the reel-engaging surface of the projector spindle is movable axially during rotation of the film reel in response to frictional forces between the film reel and the cartridge to assist positioning of the film reel within the cartridge.

One example of a motion picture projector including a spindle for supporting a film reel in accordance with the invention will now be described by way of example with reference to the accompanying drawings in which:—

Fig. 1 shows an elevation of the cartridge-loading motion picture projector illustrating the manner in which a cartridge containing a film reel may be positioned on the projector;

Fig. 2 is a cross-sectional view of the cartridge and reel and a portion of the projector of Fig. 1;

Fig. 3 is a fragmentary cross-sectional view similar to Fig. 2 but showing the reel-receiving portion of the projector spindle at an angle with respect to the cartridge walls;

Fig. 4 is a fragmentary cross-sectional view of the spindle and reel of Fig. 2 showing the manner in which the reel is rotatably supported and driven by the spindle;

Fig. 5 is a fragmentary cross-sectional view similar to Fig. 2 showing the reel axially displaced within the cartridge and the manner in which the spindle is adapted to correct for such displacement.

Referring now to the drawings and particularly to Fig. 1, the cartridge-loading motion picture projector shown is of the type disclosed in Patent Application No. 55365/68 (Serial No. 1254705). As shown, the projector comprises a casing 3 defining a front wall 5 adapted to support a supply cartridge 7 and a film take-up reel 9. The cartridge 7 contains a reel of motion picture film and may be oriented and retained on the wall 5 of the projector by cooperating surface formations on the cartridge and projector (not shown) and by latch-

ing surfaces on the cartridge and latching levers on the projector (not shown).

Movably secured to the front of the projector are means 13 and 15 for engaging and removing film F from the cartridge and for directing the film to a threading mechanism of the projector which automatically feeds the film along a path to the take-up reel 9 in a manner well known to those skilled in the art. After projection in the usual manner, the film is rewound back into the cartridge by an automatic rewind means.

The cartridge 7 to be latched to the projector may be of any suitable type, for example the two part casing adapted to contain a reel of 400-foot capacity such as described in Patent Application No. 26255/69. Generally, the cartridge defines side-walls 17 and 19 having central openings 21 and 23, respectively, through which the projector spindle 25 may extend. Previously mentioned latching and orienting surfaces (not shown) on the cartridge and projector are adapted to retain the cartridge in an accurately located position against the wall 5 of the projector.

Referring now to Figs. 2 to 5, the spindle 25 comprises a rotatable portion in the form of an elongated cylinder or sleeve 27 and an elongated member in the form of shaft 29. Shaft 29 passes through an opening 31 in the projector front wall 5 and is fixed to a spindle supporting means such as the inner wall 33 of the projector.

At one end of the spindle 25 and preferably behind the projector front wall 5, the sleeve 27 is provided with means for rotatably driving the spindle, this means taking the form in the disclosed embodiment of a pulley 35 which is non-rotatably fixed to the sleeve 27 by a key 37 on pulley 35 are received in a slot 39 on the sleeve 27. Pulley 35 and sleeve 27 are rotatably driven by a motor (not shown) of the projector, which is operably connected to the pulley by belt 30.

At the other end of the spindle remote from the projector the sleeve 35 defines an external surface 41 adapted to support the reel carrying processed motion picture film. The reel rotates with the spindle and can be rotatably driven thereby through driving member or detent 43 (Fig. 4) which extends within a cooperating recess 45 in a core 47 of the reel.

Sleeve 27 also defines interior surfaces such as an annular opening or bore 49 having an internal diameter slightly larger than the external diameter of shaft 29. Thus the sleeve can be received on the shaft in the usual manner for rotation with respect to the shaft and projector. However, the sleeve is also mounted for axial movement with respect to the shaft and projector. Such axial movement is provided for in the disclosed embodiment by a pin 51 on sleeve 27 which cooperates with a circular recess 53 on shaft 29. Pin 51 can move axially in recess 53 to permit axial movement of the sleeve 27, and the pin prevents excessive axial movement or disengagement of the sleeve from the shaft.

For satisfactory operation of the cartridge-loading motion picture projector, the supply reel should be centred between the cartridge walls to reduce frictional contact between the reel and the cartridge. However, it has been found with reels of 200′ or larger capacity that, due to the frictional resistance to movement between the reel core and the outer surface of the spindle, the reel will not centre itself adequately in the cartridge. This resistance to axial movement is due in part to the weight of the reel and film thereon and in part to the relatively high coefficient of friction between the plastic surfaces of the reel and the spindle which are not lubricated. Since the movable portion of the spindle is lubricated, the coefficient of friction between the relatively movable surfaces of the spindle is much lower than the coefficient of friction between the reel core and the outer spindle surface. Moreover, as disclosed, the axially movable portion of the spindle is preferably the same as the rotatable portion thereof, and such portion will always be in motion during operation of the projector. Therefore only the dynamic coefficient of friction need be overcome to shift the spindle sleeve and reel axially, rather than the greater static coefficient of friction which must be overcome with previously known spindles.

The amount of axial movement desirable for satisfactory operation depends on the dimensions and clearances of and between the particular reel and cartridge. Preferably, the reel supporting portion of the spindle should be capable of sufficient axial shifting for the reel to move freely between the sides of the cartridge. In the embodiment disclosed the permissible axial shifting is at least 0.05 inches and is preferably 0.1 of an inch.

Reel 11 contained in the cartridge 7 comprises a hub 52 saving an annular outer surface 54 on which film may be wound and an inner surface 55. A pair of spaced side flanges 57 and 59 extend radially outwardly from the hub to guide successive convolutions of film onto the hub when the reel is first loaded with film or during a rewind cycle of the projector. A web 61 extends radially inwardly from the hub and supports a core 47 coaxially therewith for mounting the reel on the projector spindle 25.

The reel illustrated is constructed as disclosed in Patent Application 26253/69 (Serial No. 1264007).

The core 47 of this reel 11 comprises a central opening or bore 65 having an internal diameter at the axial centre which is less than the diameter at the ends of the bore. In the embodiment disclosed, the bore defines two opposed frustro-conical openings tapered toward the axial centre of the reel to a diameter

which is slightly larger than the outer diameter of the projector spindle. While the degree of taper may be of any suitable amount for the intended purpose a taper within the range of 2°—7° and preferably about 5° has been found satisfactory.

Referring now particularly to Fig. 3, the reel supporting surface of the spindle has been shown at an angle to the horizontal and out of alignment with the perpendicular to the projector wall. Such misalignment can occur for several reasons, such as poor manufacturing tolerances or wear between the rotatable and fixed portions of the spindle. This misalignment may be between the shaft 29 and the projector wall 5 or between the sleeve 27 and the shaft 29. Moreover, in weight sensitive spindles of the type disclosed in U.S. Patent Specification No. 3,310,251, a certain amount of off-axis bending is expected during normal operation of the spindle.

In projectors which operate only with unenclosed reels, and in projectors operating with small size cartridges, this misalignment of the spindle may not be intolerable. However, in projectors adapted to operate with larger cartridges, such as those containing 200 or 400-foot reels, the effect of any misalignment of the spindle is exaggerated due to the large diameter of the reel in such cartridges. Since the reel is closely confined within the cartridge, even a small amount of misalignment of the spindle will cause previously know reels to engage the side-walls of these larger cartridges.

As the reel core is provided with a tapered or arcuate bore, the reel can wobble on the spindle or assume in angular position on the spindle as shown in Fig. 3, to thereby to align itself within the cartridge in response to frictional and other forces between the cartridge and reel, regardless of the angular orientation or misalignment of the spindle.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the scope of the invention as defined in the appended claims.

WHAT WE CLAIM IS:—

1. A motion picture projector arranged to receive a film supply reel contained in a cartridge, the projector supporting the cartridge in a non-rotatable manner such that a projector spindle can extend through an opening in the cartridge to engage in an axial bore in the film reel and permit rotation of the reel within the cartridge, wherein the reel-engaging surface of the projector spindle is movable axially during rotation of the film reel in response to frictional forces between the film reel and the cartridge to assist positioning of the film reel within the cartridge.

2. A motion picture projector as claimed in claim 1, wherein the projector spindle comprises an elongate member supported on the projector and a reel-engaging sleeve rotatably mounted on the elongated member and movable axially thereon to a limited extent.

3. A projector as claimed in claim 2, wherein the sleeve is movable axially through a distance of approximately 0.1 inch.

4. A motion picture projector having a spindle constructed to receive a film reel and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

5. A motion picture projector having a film reel contained in a cartridge mounted on a spindle of the projector, all being constructed and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1972.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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2. A motion picture projector as claimed in claim 1, wherein the projector spindle comprises an elongate member supported on the projector and a reel-engaging sleeve rotatably mounted on the elongated member and movable axially thereon to a limited extent.

3. A projector as claimed in claim 2, wherein the sleeve is movable axially through a distance of approximately 0.1 inch.

4. A motion picture projector having a spindle constructed to receive a film reel and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

5. A motion picture projector having a film reel contained in a cartridge mounted on a spindle of the projector, all being constructed and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

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