April 14, 1925. 1,533,546

C. B. HALL

MOTION PICTURE PROJECTOR

Filed Aug. 9, 1921 2 Sheets-Sheet 1

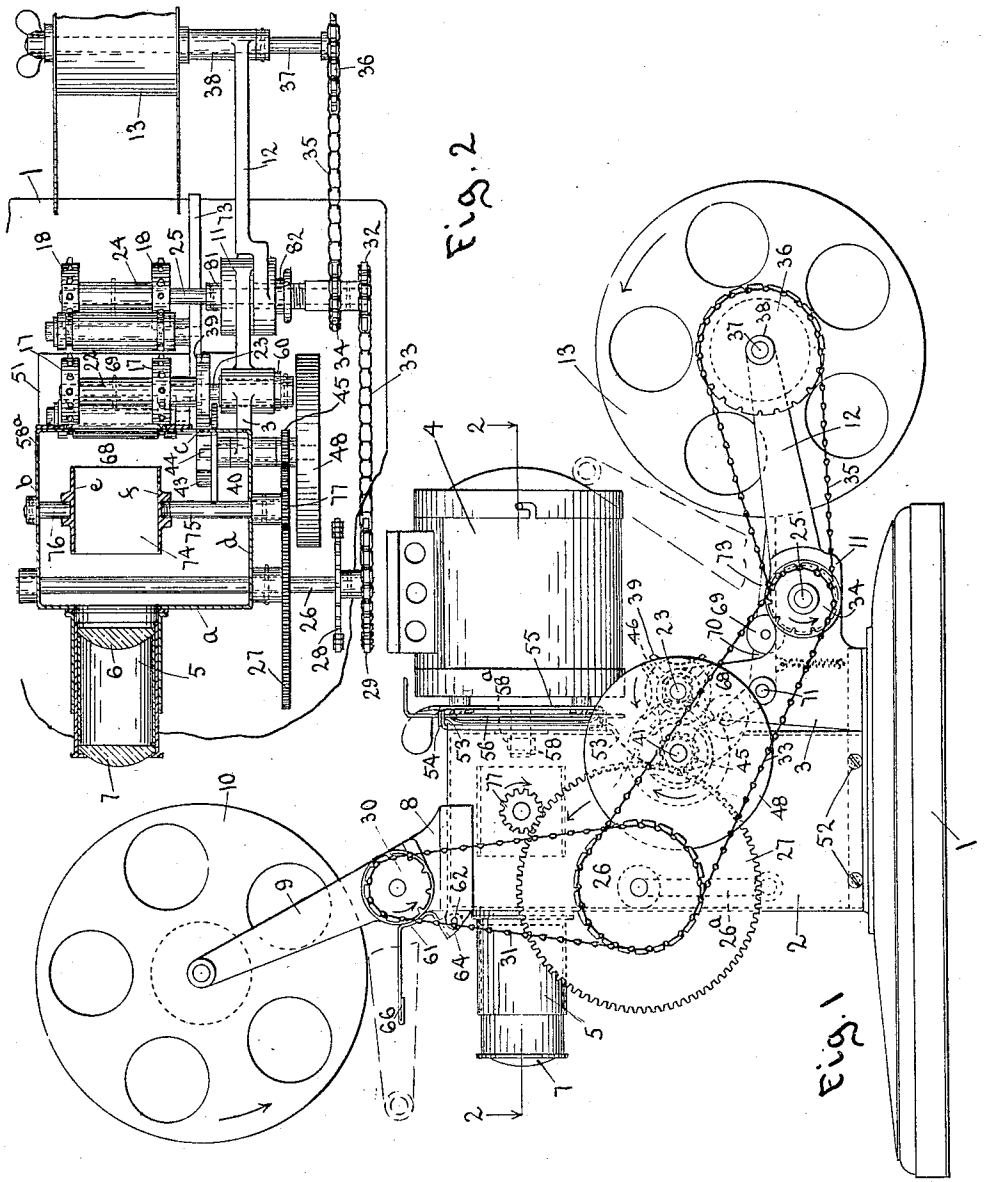

Fig. 2

Fig. 1

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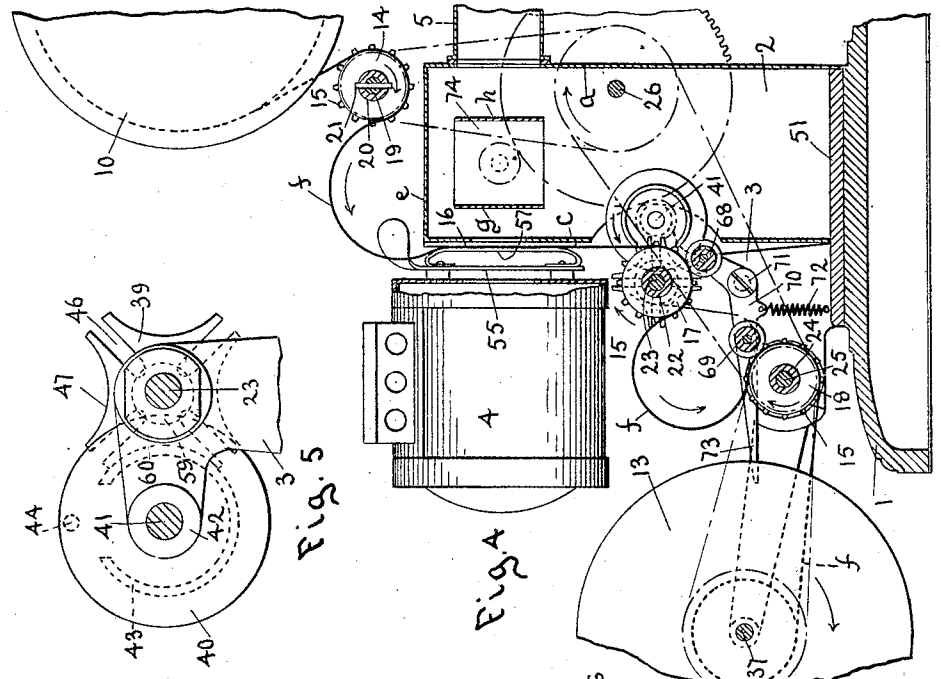

Fig. 5

Fig. 4

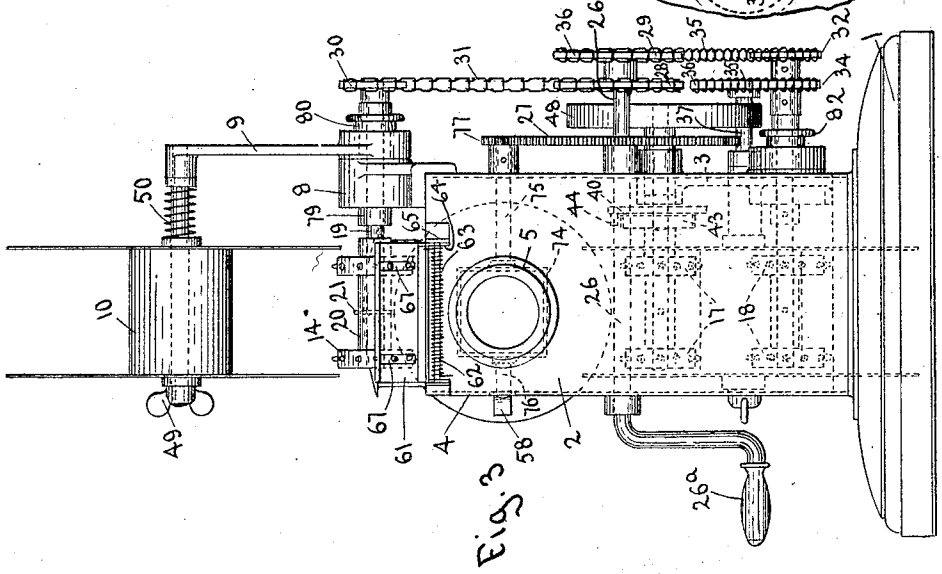

Fig. 3

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Patented Apr. 14, 1925. 1,533,546

UNITED STATES PATENT OFFICE.

CLARENCE B. HALL, OF WINTHROP, MASSACHUSETTS, ASSIGNOR TO HALL PROJECTOR COMPANY, INC., OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

MOTION-PICTURE PROJECTOR.

Application filed August 9, 1921. Serial No. 490,878.

To all whom it may concern:

Be it known that I, CLARENCE B. HALL, a citizen of the United States, residing at Winthrop, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Motion-Picture Projectors, of which the following is a specification.

This invention relates to machines adapted to project so-called moving pictures on a screen. Such machines are commonly known as "motion picture projectors," and the machine hereinafter described and in which is embodied the invention for which I here seek protection will be so called in the following specification.

The object of the invention is to provide a machine of this sort of such simple character, small size and inexpensive construction that it can be sold for private use for the purposes of instruction and amusement in the home, in schools, etc., and is at the same time so accurate and steady in operation as to give equally good effects in the exhibition of moving pictures as the projectors used for public exhibitions. In the accomplishment of this object I have devised certain features of construction, arrangement and operation which contribute to the smooth and accurate propulsion of the film strip, elimination of objectionable flickering in the picture projected on the screen, and ability to produce and assemble the constituent parts at low manufacturing cost, all of which will be explained in detail in the following specification with reference to the drawings forming a part thereof, which exhibit a commercially practicable form of motion picture projector in which the invention is embodied.

In the drawings,—

Figure 1 is a side elevation, as viewed from the left hand side of the operator, of the machine above referred to.

Figure 2 is a horizontal sectional plan view taken on line 2—2 of Figure 1.

Figure 3 is a front elevation of the machine.

Figure 4 is a partial longitudinal section of the machine as seen from the opposite side of said machine from the view point of Figure 1.

Figure 5 is a detail elevation of the intermittent mechanism by which the film strip is propelled past the projected light beam.

Like reference characters designate the same parts wherever they occur in all of the figures.

In its fundamental mode of operation and the result which it accomplishes of projecting so-called moving pictures, this machine conforms to long known and well understood principles. It is in the new means by which these principles are applied to practical use to produce a simplified machine capable of being manufactured at moderate cost and operable to project motion pictures with substantial freedom from objectionable flickering, vibration, and injury to the film strip, that the present invention consists and to which the following description in detail is principally directed.

The base 1 of the machine supports a column 2 and a bracket 3. On the column is mounted a casing 4 containing a source of light of suitable character, preferably a small, low voltage incandescent electric lamp to avoid danger of generation of enough heat to ignite the film strip, wherefore such casing is called for the purposes of the present description a lamp house. There is also mounted upon the opposite side of the column from the lamp house a telescopic focusing tube 5 containing lenses 6 and 7 through and by which a beam of light from the source within the lamp house is projected, and such rays, passing through a transparent film strip, are focused on the reflecting screen.

On top of the column is mounted a bracket 8 to which is pivoted an arm 9 whereon the reel or spool 10 carrying the transparent film strip is mounted. The bracket 3 previously described has a branch 11 on which is pivoted an arm 12 carrying the spool or reel 13 for winding up the film strip after it has been fed across the projected beam of light.

The film strip or film, as it will be called for convenience, is shown at *f* in Figure 4. It passes from the supply spool 10 around a pair of driving wheels 14 which have pins or teeth 15 in their rims adapted to enter holes arranged in rows near the opposite edges of the film. From the drive wheels 14 the film extends in a sufficiently wide loop into and through the guideway 16 across

the projected light beam to a pair of intermittent drive wheels 17, thence to a third pair of drive wheels 18 with enough slack to form a second loop, and finally to the take-up spool 13.

The drive wheels or disks 14, 17 and 18 are like one another in size and in the fact that all carry pins 15 adapted to enter lines of holes in the edge zones of the film to propel the latter in a positive manner. The wheels 14 are mounted on a shaft 19 which has its bearings in the bracket 8, and are made fast to a sleeve 20 which surrounds the shaft and is keyed thereto by a pin 21. The wheels 17 are similarly connected to one another by a sleeve 22 and similarly mounted and keyed on a shaft 23 which has its bearings in the upper end of the bracket 3; and the wheels 18 are connected by a sleeve 24 and similarly mounted and keyed on a shaft 25 which has its bearings in the lateral extension 11 from the bracket 3. All of the film driving wheels are driven in proper time with one another by the main shaft 26 having a crank 26^a and being mounted in bearings in the column 2. On this shaft is secured a gear wheel 27 and two sprocket wheels 28 and 29, respectively. The sprocket wheel 28 drives the shaft 19 by means of a sprocket wheel 30 on the latter and a chain 31; while the sprocket wheel 29 drives the shaft 25 by means of a sprocket wheel 32 on the latter and a chain 33. Also attached to the shaft 25 is a sprocket wheel 34 which drives a chain 35 passing around a sprocket 36 on the shaft or spindle 37 which is mounted in a bearing 38 at the end of arm 12 and carries the take-up spool 13.

The intermittent driving wheels 17 are driven from the gear wheel 27 through an intermittent mechanism, preferably of the type known as the "Geneva stop motion," which consists of a disk 39 upon the shaft 23 and a disk 40 on the parallel shaft 41 which has a bearing in a branch 42 of the bracket 3. The disk 40 carries on one face a cam rib 43 of cylindrical formation and with an open side, and a pin 44 outside of the circuit of the rib but opposite to the break or opening in the side thereof. Connected to the shaft 41 is a pinion 45 which meshes with the gear 27. Thus when the crank shaft is in motion the cam disk 40 rotates continuously.

In the disk 39 are radial slots 46 adapted to receive the pin 44, and in the periphery of the disk between the slots are recesses 47 complemental to the cam rib 43 and adapted to receive the cam rib and to be prevented thereby from rotation at all times except when the pin enters and traverses one of the slots. At such times the slotted part of disk 39 enters the opening in the cam rib. By this means the disk 39 is turned through a fractional part of one rotation with each rotation of the cam disk while the cam disk turns through the angle which causes the pin 44 to enter, traverse and withdraw from any one of the notches 46. At all other times the disk 39 is stationary. A fly wheel 48 is mounted on the shaft 41 to make the rate of rotation thereof uniform.

The ratio of the gears 27 to 45 is so large in proportion to the equal ratios of the sprockets 28 to 30 and 29 to 33 that the cam disk 40 is caused to turn as many times faster than the shafts 19 and 25 as the number of notches in the disk 39, while the shafts 19 and 25 are caused to rotate at the same angular speed. Thus the drive wheels 14, 17 and 18 all make complete revolutions in the same length of time, but the rotation of the wheel 17 is composed of a number of quick steps with pauses between them, the loops in the film following the wheels 14 and 17 providing enough slack to prevent damage to the film by reason either of the quick impulses or the pauses of the intermittent drive wheels.

The wheels 14 draw the film positively from the supply spool 10 and the latter is held on its bearing spindle between a nut 49 at one side and a spring 50 at the other side by which enough drag is afforded to maintain tension in the film and prevent too rapid delivery by overrunning of the reel.

The wheels 18 deliver the film positively to the take-up spool at the same rate that it is drawn from the supply spool, and the take-up spool shaft is geared to rotate faster than the feed wheels to insure winding up of the film under tension, but the spool is adapted to slip on its shaft to avoid putting too great tension on the film.

The novel and useful features of the invention to which I desire to call particular attention include the following: The column 2 is given ample strength and rigidity with low cost of production by being made substantially as a box of sheet metal having four rectangularly arranged sides *a*, *b*, *c*, *d* and a top wall *e*. Its bottom is open and its sides are cut to fit around and embrace a plate 51, which is preferably made as the integral base plate of the bracket 3 and is attached by screws to the machine base 1; the box column being made fast by screws 52 set through its sides into the edges of said plate. Bearings for the crank-shaft and the shutter shaft, later described, are provided in the opposite side walls *b* and *d* of this column. The rear side of the column is partly cut away to admit the shaft 41 which carries the cam disk of the intermittent mechanism. The film feeding mechanism is assembled as a complete unit on the bracket 3, and the latter affords a rigid support for the parts which require accurate alignment and registration. The shutter mechanism is separately mounted as a complete unit on

the column 2, and the latter affords a relatively light and inexpensive, yet amply strong, support, which is subsequently assembled with and secured to the bracket, first making sure that the driving gear 27 and the driven pinion 45 are correctly meshed to ensure relative timing of the film feed and shutter movements. In assembling the column with the base, it is slipped on the plate 51 from front to rear until the large gear 27 comes correctly into mesh with the pinion 45, when it is made fast as described.

The focusing tube 5 is fastened to the front side of the column in register with an opening in the wall *a* thereof, and the lamp house is hinged to the rear side of the column opposite to a hole in the rear wall *c* which is aligned with the focusing tube. The lamp house hinge is made by ears 53 bent back from the rear wall of the column and ears 54 bent forward from a plate 55 which is secured to the front end of the lamp house, the ears 54 being placed to overlap the ears 53 and a pintle rod 56 being passed through both pairs of overlapping ears. This hinge is at one side of the light beam and enables the lamp house to be swung aside to permit threading of the film between it and the column. The film is confined in its path when crossing the light beam by two spring strips 57 fastened at their ends to the plate 55 and so arranged between their ends as to press on the edge parts of the film, which are then pressed against guide surfaces on the column at opposite sides of the light opening. A latch 58 made as a spring tongue integral with plate 55 and bent over to snap into an opening 58^a in the wall *b* of the column secures the lamp house in its operative position.

The disks of the intermittent feed mechanism are accurately made and fitted together, and means are provided for eliminating any lost motion or looseness between these disks. Such means comprise a bushing 59 (see Figure 5) which provides the bearing for the shaft 23 and has its own bearing in the bracket 3, these two bearings being eccentric to one another. The bushing projects toward the outer end of the bearing and terminates in a lip or flange 60 which is flattened on its opposite sides, or otherwise so formed as to engage with a wrench, whereby it can be turned to adjust the disk 39 into firm contact with the rib 43. By making the bushing to fit closely in its bearing, enough friction is created to maintain the adjustments thus given, without need of further securing means, but a lock nut or other securing means of well known character may be applied in a well understood way to the bushing if additional security should be needed.

The movement necessary for the adjustment just described is given to the shaft 23 rather than to the shaft 41 because the latter shaft must be immovable as to position since it derives motion from a pair of intermeshing gears, but the shaft 23 may be shifted as far as is ever necessary for adjustment purposes without impairing the certainty or accuracy of the motion of the film. The accuracy and capacity for adjustment of the intermittent mechanism give the result that when the film is fed across the light beam, each step of the feed movement is carried out without interruption to its end and that in the pauses between such steps there is no possibility of the film being shifted in position due to looseness of the feed mechanism and causing blurring of the projected image.

The film is held in contact with the several toothed driving wheels by pressers which are spring actuated to maintain a constant, firm pressure against the film while being displaceable instantly to permit threading in of a new film. The presser for the initial driving wheels 14 is a plate 61 which is hinged to the column on a pin 62 and pressed by a spring 63 toward the wheels. This plate is conveniently made of a stamping from sheet metal of sufficient width to extend over both wheels of the pair and a space between them, and having lugs 64 bent down from opposite corners and confined between lugs 65 bent out from the column; the hinge pin passing through these pairs of lugs, and the spring being coiled around the pin with one end bearing on the column and the other end on the under side of the presser. From the hinge the plate extends toward the drive wheels and then is bent sharply upward and curved to fit the circumference of the wheels, and is again bent sharply outward to form a handle projection 66 by which it may be withdrawn from the wheels to admit a new film. Slots 67 are cut in the presser to clear the pins on the driving wheels.

The pressers with corresponding function for the drive wheels 17 and 18 are provided by rolls 68 and 69, respectively, which are mounted on pins set in a lever 70, which lever is pivoted on a stud 71 attached to a part of the bracket 3. The roll 68 extends across both drive wheels 17 and has peripheral grooves to admit the pins of said wheels; while the roll 69 extends across the wheels 18 and is similarly grooved for the same purpose. These rolls are at opposite sides of the fulcrum 71 of the lever, whereby one is caused to bear upwardly on the under part of the wheels 17 and the other to bear downwardly on the upper part of the wheels 18. A spring 72 connected to the lever and to the bracket presses these rolls yieldingly against their complemental feed wheels. The rearwardly extending arm 73 of the lever provides a handle which may be raised by the operator to displace both

presser rolls from the feed wheels far enough to permit application of the film.

A shutter 74 is interposed between the film and the focusing tube 5, being mounted on a shaft 75 and a stud 76 having bearings, respectively, in the opposite side walls of the column, and the shaft 75 having on its outer end a pinion 77 which meshes with the large gear 27 previously described. The shutter involves in its construction an invention new in this art, being formed substantially as a cubical box having two of its opposite sides entirely open, or it may be likened to a short square tube, of which tube two oppositely disposed sides *e* and *f* are made fast to the supporting shaft sections and the intermediate sides *h* and *g* interrupt the light beam from time to time. When the shutter is in the position shown in Figures 1 and 2 the light beam streams through the open space surrounded by the four walls of the shutter, while when it is in the position shown in Figure 4 the light is shut off. Preferably the pinion 77 is of the same size as the pinion 45, wherefore the shutter is driven at the same angular speed as the pin 44 of the intermittent feed mechanism. And since the latter mechanism feeds the film one step at each revolution, it follows that the shutter interrupts the light beam twice during the same period. The shutter is so adjusted that one of these interruptions occurs while the feeding is taking place, and the other occurs at the middle of the pausing period of the film.

These interruptions not only prevent blurring of the picture as seen by the spectator by cutting off the projected light while the film is being fed, but they also largely eliminate the visual effect of flickering of the picture on the screen according to known optical laws.

The particular character of shutter here disclosed has the mechanical advantage of rotating on an axis parallel to that of the main shaft, whereby it is driven by a single pair of spur gears, which does away with the complication of mechanism necessary to drive a shutter about an axis transverse to the drive shaft.

The reels 10 and 13 are removable from the spindles or shafts on which they are respectively mounted and the arms 9 and 12 which carry said spindles are angularly movable so as to lie close to the other parts of the machine, as shown by dotted lines in Figure 1, to enable packing of the machine, without disassembling other than removal of the reels, with the least waste of space, in a box or carton. This adjustment is provided, in the case of the arm 9, by mounting said arm on a bushing 79 (see Fig. 3) in which the shaft 19 has its bearing, and on which adjustments of the arm are secured by a lock-nut 80; and in the case of the arm 12 by mounting the same on a bushing 81 (see Fig. 2) on the bracket arm 11, in which bushing the shaft 25 has its bearing, and securing the adjustments of the arm by a lock nut 82.

It will be appreciated from the foregoing description that the present invention combines means for exhibiting motion pictures with precision and a high quality of clearness, and such simplicity of construction as will permit its sale to the public at a moderate price. The frame structure is simple and inexpensive but at the same time amply rigid; and the operating parts are of such character that they can be made at moderate cost. Of these parts only the intermittent mechanism need be shaped by machine tools and made of wear resisting material. All of the other parts, except only the shafts and the sheet metal parts, can be made with sufficient accuracy and precision by the die casting method. The shafts can be made from rods of stock size without finishing except for such threading or knurling at their ends as is necessary for assembling with the associated parts; and some of the die cast parts may be cast directly upon their associated shafts. By this means the number of separate parts requiring to be assembled to make an operative machine is reduced to the minimum, and all corresponding parts for a series of machines are interchangeable with one another, making the operation of assembling a simple and inexpensive one.

What I claim and desire to secure by Letters Patent is:

1. In a motion picture projector, the combination of two reels; mechanism, including two shafts and driving connections between said shafts and said reels, respectively, for causing the film to be unwound from one reel and wound onto the other; and two reel supporting arms, one for each reel, one arm being mounted to swing about the axis of one shaft from a normal, extended position to an approximately upstanding, retracted position without interrupting the driving connection of such shaft with its reel, and the other arm being mounted to swing about the axis of the other shaft from a normal, extended position to an approximately depending, retracted position without interrupting the driving connection of such shaft with its reel.

2. In a motion picture projector, the combination of two reels; mechanism including two shafts for causing a film to be unwound from one reel and wound onto the other; two reel-supporting arms, one for each reel; a sleeve presenting interiorly a bearing for one of said shafts and presenting exteriorly a pivotal mounting on which one arm is mounted to swing from a normal, extended position to an approximately upstanding.

retracted position; and a sleeve presenting interiorly a bearing for the other shaft, and presenting exteriorly a pivotal mounting on which the other arm is mounted to swing from a normal, extended position to an approximately depending, retracted position.

3. In a motion picture projector, the combination of two reels; mechanism including two shafts for causing a film to be unwound from one reel and wound onto the other; two reel supporting arms, one for each reel; and a frame presenting a base, an upright, a bushing in said frame presenting a pivotal mounting on which one arm is mounted relatively near said base to swing about the axis of one of said shafts from a normal, extended position to an approximately upstanding, retracted position with reference to said upright, and a bushing in said frame presenting a pivotal mounting on which the other arm is mounted relatively remote from said base to swing about the axis of the other shaft from a normal, extended position to an approximately depending, retracted, position, said shafts extending through said bushings and being coaxial with said pivotal mountings, respectively.

4. In a motion picture machine, the combination of film feeding mechanism including a shaft, a sleeve presenting interiorly a bearing for said shaft, a reel, a reel supporting arm pivoted on the exterior of and angularly adjustable about the axis of said bearing, and a nut threaded on and about said sleeve and normally securing said arm in fixed position.

5. In a motion picture machine, the combination of film feeding mechanism including a shaft, a reel, a reel supporting arm, a pivot for said arm distinct from but concentric with said shaft, and a nut threaded on and concentric with said pivot and normally securing said arm in fixed position.

6. In a motion picture machine, the combination of film feeding mechanism including a shaft, a film-engaging sprocket carried by said shaft, a reel for the film, a reel supporting arm, a pivot for said arm distinct from but concentric with said shaft and said sprocket, and a nut threaded on said pivot and about said shaft and normally securing said arm in fixed position.

In testimony whereof I have affixed my signature.

CLARENCE B. HALL.