June 14, 1932. A. J. HOLMAN 1,862,750

AUTOMATIC VARIABLE FRICTION DRIVE

Filed Dec. 16, 1929 3 Sheets-Sheet 1

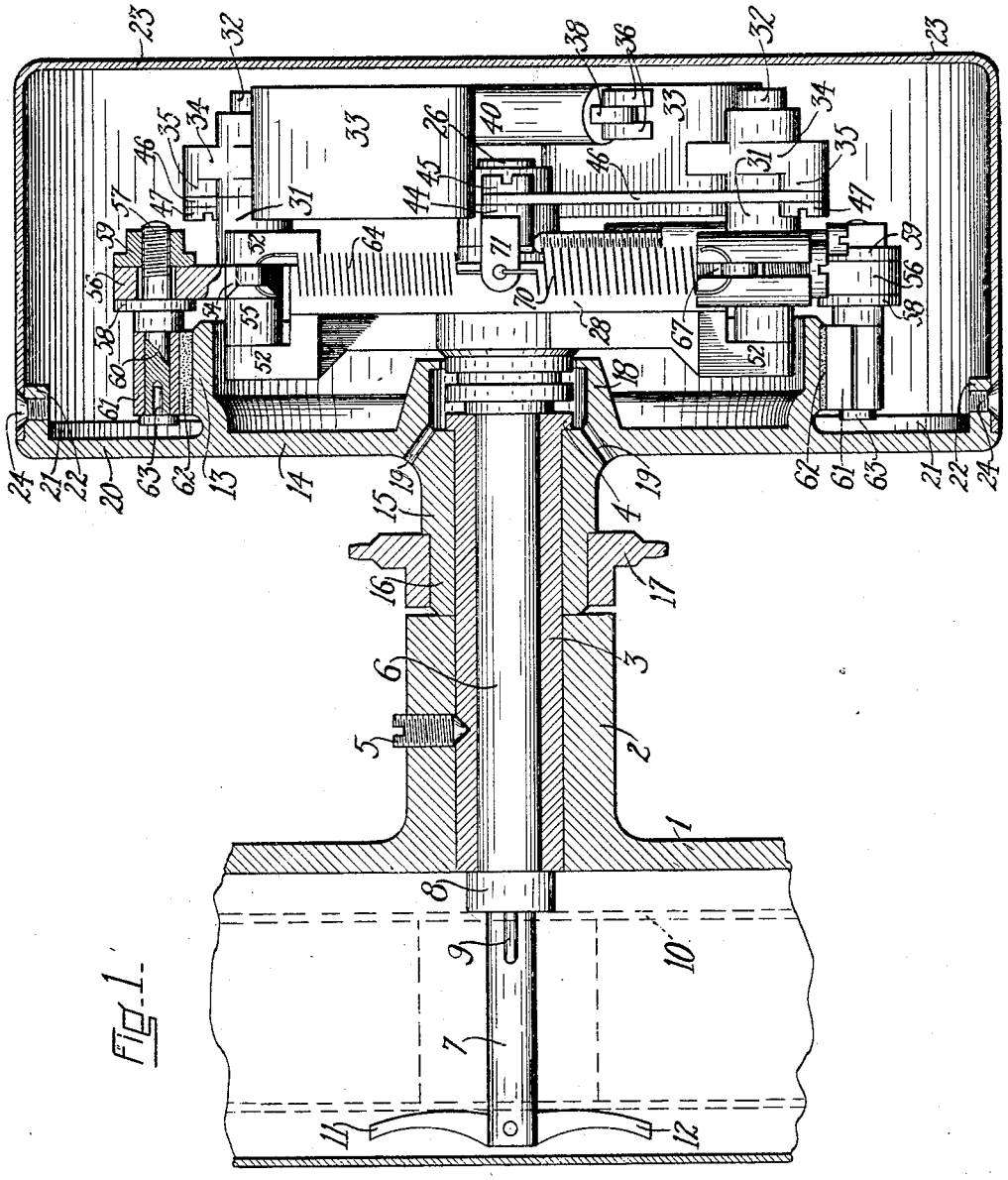


Fig. 1.

INVENTOR =
Arthur J. Holman.

June 14, 1932. A. J. HOLMAN 1,862,750

AUTOMATIC VARIABLE FRICTION DRIVE

Filed Dec. 16, 1929 3 Sheets-Sheet 2

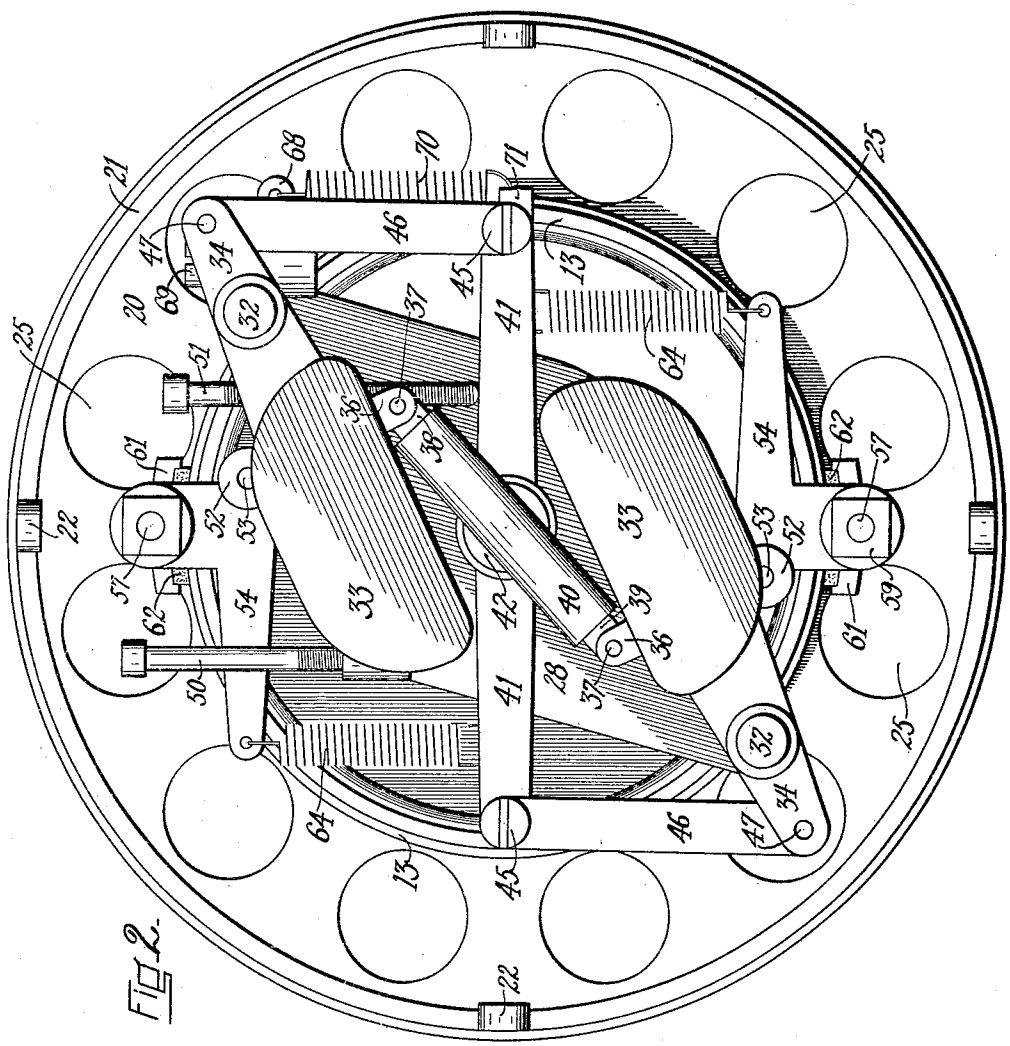


Fig. 2.

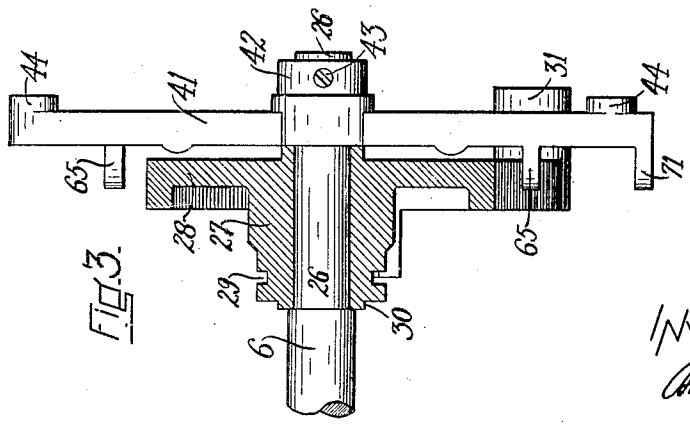


Fig. 3.

INVENTOR=
Arthur J. Holman

June 14, 1932. A. J. HOLMAN 1,862,750

AUTOMATIC VARIABLE FRICTION DRIVE

Filed Dec. 16, 1929 3 Sheets-Sheet 3

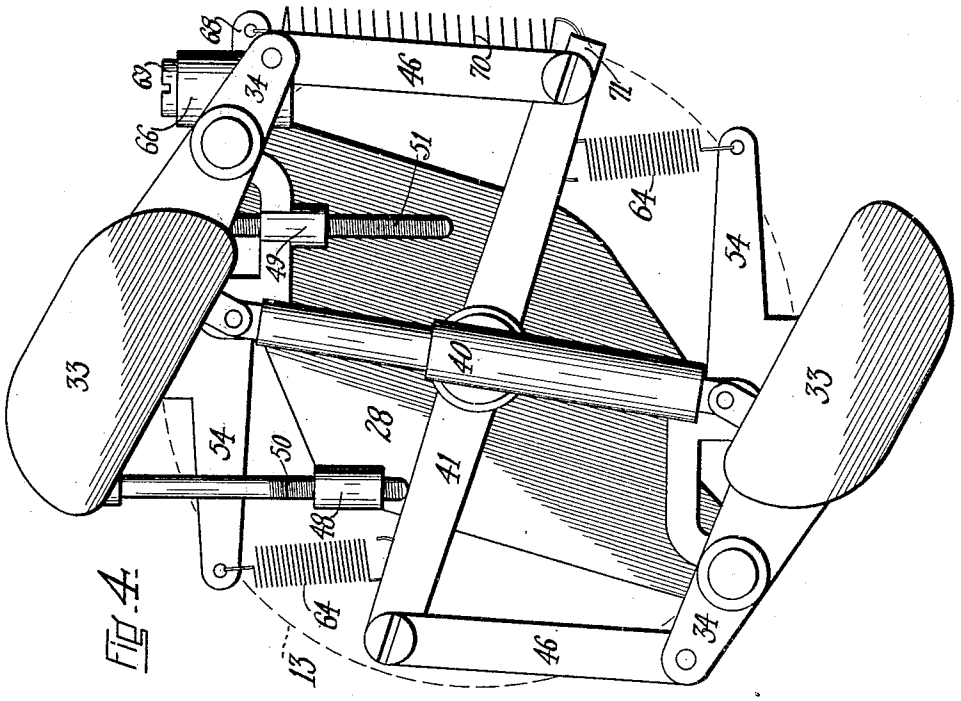


Fig. 4.

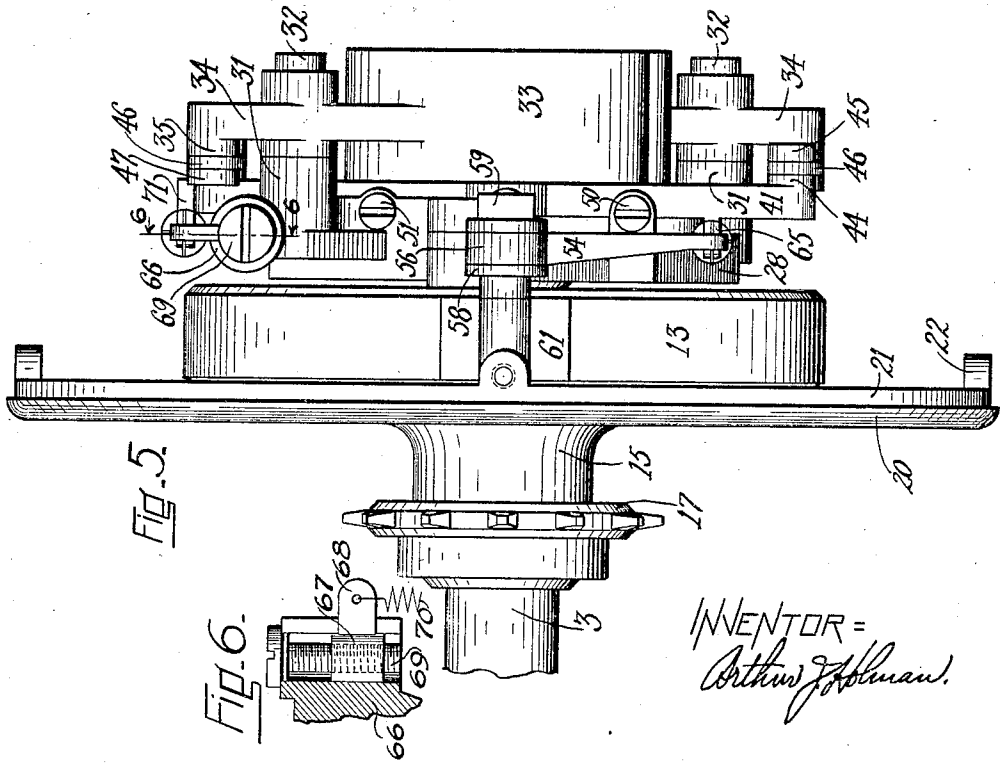


Fig. 5.

Fig. 6.

INVENTOR =
Arthur J. Holman.

Patented June 14, 1932 1,862,750

UNITED STATES PATENT OFFICE

ARTHUR J. HOLMAN, OF BROOKLINE, MASSACHUSETTS

AUTOMATIC VARIABLE FRICTION DRIVE

Application filed December 16, 1929. Serial No. 414,483.

My invention relates to an improved type of friction drive designed to be used to actuate a spool whereon material is to be wound, and to operate in such a manner that the tension on the material being wound up may be kept approximately uniform at all diameters of the wound mass as the spool fills. Such a device, particularly useful in connection with the take-up reel of a moving picture projector, is described in my U. S. Patent No. 1,721,734 of July 23, 1929, and my present invention relates to improvements therein. The device described in my said patent, functions in a manner superior to the ordinary take-up drives, maintaining a practically constant tension on the film, but it is complicated and somewhat sluggish in action particularly in respect to the initial take-up when the projector is first started. It has been the special object of my invention to produce a device having fewer and lighter parts which will be more sensitive in action and less expensive to manufacture. My improved take-up control hereinafter described is a necessary adjunct to the projector mechanism described in my co-pending patent application, Serial No. 413,348, filed December 11, 1929, for exhibiting my improved positive prints.

My device may be best understood by reference to the accompanying drawings in which—

Fig. 1 is a front elevation of my device shown in connection with the take-up reel of a moving picture projector, showing the case, the friction drum, the upper friction shoe, and the film magazine and supporting bracket in cross section on the vertical plane through the axis of the reel shaft.

Fig. 2 is an end view with the case removed, showing the centrifugal control mechanism in static position.

Fig. 3 is a horizontal cross-section through the centrifugal control supporting member, showing a portion of the reel shaft with the spring tension control arm mounted thereon.

Fig. 4 is an end view of the centrifugal control mechanism in maximum speed position, the position of the friction drum being indicated by the broken line.

Fig. 5 is a top view of my device with the case removed.

Fig. 6 is a cross-sectional view on line 6—6 Fig. 5, through the bored and slotted boss 66, showing means for adjusting tension of coil spring 70.

It will be noted that in Fig. 1 the reel shaft has been rotated through an angle of 180 degrees from the position shown in the other views.

Referring now more specifically to the drawings, in which like numerals indicate like parts, 1 is the lower film magazine of a moving picture projector, provided with a hub 2 within which is a sleeve 3 having an enlarged end 4. The sleeve 3 is retained in position by a set screw 5 which passes through hub 2 and enters a conical depression in the periphery of the sleeve 3. The sleeve 3 journals the reel shaft 6, the extremity 7 of which is of lesser diameter and is provided with a collar 8 and a key pin 9. The collar 8, retained in position by a suitable set screw, shoulders on one side against the sleeve 3 and on the other side against the reel 10. The key pin 9 is adapted to engage a slot in the hub of reel 10 so as to cause the reel 10 to rotate with the reel shaft 6. Hinged retaining clips 11 and 12 hold the reel on the end 7 of the reel shaft 6.

A friction drum 13 provided with integral annular web 14 and integral hub 15 is arranged to rotate on the sleeve 3, being retained in position by the enlarged end 4 of the sleeve 3 and the hub 2 of the lower film magazine. A portion 16 of reduced diameter at the end of hub 15 has press fitted thereon the sprocket 17 which is driven at constant speed by a suitable chain from a sprocket on the main drive shaft of the projector. The hub 15 is provided at its other end with annular projection 18 which prevents oil from working its way from the reel shaft 6 and sleeve 3 to the surface of the friction drum 13, the excess oil passing out through holes 19 in the hub 15. Extending beyond the friction drum 13 and integral with web 14 is an annular web 20 provided with an integral flange 21 and bosses 22 which form a seat for the case 23, the case 23 being

retained thereon by screws 24. Holes 25 (Fig. 2) are formed in web 20 to lighten the structure.

The reel shaft 6 (Fig. 3) has a portion 26 of reduced diameter whereon is press fitted the hub 27 of the centrifugal supporting member 28, the hub 27 being provided with groove 29 and notch 30 to prevent the passage of oil along the hub. The centrifugal control supporting member 28 is provided with a pair of diametrically opposite bosses 31 (Figs. 1 and 5) in each of which is press fitted a pin 32 which retains in position and forms a pivot for a centrifugal weight 33. An arm 34 integral with centrifugal weight 33 projects beyond the pivot pin 32 and carries at its extremity the boss 35. The centrifugal weights 33 are each provided with forked projections 36 (Figs. 1, 2 and 4) into which are press fitted pins 37 whereon are hinged the ends 38 and 39 of the pneumatic time lag regulator 40. Pivoted on the end 26 (Fig. 3) of reel shaft 6 and freely rotatable thereon is the spring tension control arm 41 which is held in position by collar 42 retained on the reel shaft by set screw 43. The control arm 41 is provided at each end with a boss 44 which is tapped to receive a screw 45 (Figs. 1 and 2) which pivots one end of a link 46, the other end of which is pivoted on a screw 47 entering the boss 35 on the arm integral with centrifugal weight 33. Bosses 48 and 49 (Fig. 4) integral with centrifugal control supporting member 28 are tapped to receive adjusting screws 50 and 51 respectively, which fit snugly therein and serve as stops limiting the rotational movement of spring tension control arm 41 on the reel shaft 6. An examination of Fig. 2 shows that the centrifugal weights 33, the links 46, the spring tension control arm 41, and the pneumatic time lag regulator 40 are coacting elements in the centrifugal control mechanism carried on the centrifugal control supporting member 28.

The centrifugal control supporting members 28 is also provided with two pairs of diametrically opposite integral forked lugs 52 (Figs. 1 and 2) within each pair of which is press fitted a pin 53 whereon is pivoted one end of a lever arm 54, the pin 53 being a free fit in hub 55 integral with lever arm 54. A lug 56 integral with lever arm 54 is bored to receive threaded stud 57 having integral flange 58 and a flanged nut 59 which lock stud 57 in any desired position within the bore in lug 56. The stud 57 is provided with a portion 60 of reduced diameter whereon is pivoted the friction shoe 61 having a suitable lining 62. The friction shoe 61 is held on the stud 57 by the head of the pin 63 which is press fitted into the end of stud 57. Attached to the free end of each brake arm 54 is a coil spring 64 the other end of which is attached to a lug 65 on the spring tension control arm 41.

The centrifugal control supporting member 28 has an integral boss 66 which is bored and slotted to receive a tapped plug 67 having a lug 68 projecting beyond the boss 66 (Figs. 1, 4 and 6). A screw 69, having its head bearing against one end of boss 66, enters the tapped plug 67 and provides a means of adjusting the position of lug 68 along the boss 66. A coil spring 70 has one end connected to the lug 68 and the other end is attached to a lug 71 on the spring tension control arm 41. Referring to Fig. 2 again, it is seen that the centrifugal spring tension control mechanism consists of supporting member 28 fast mounted on the reel shaft, control arm 41, centrifugal weights 33, links 46, pneumatic time lag regulator 40, coil spring 70, and stop screws 50 and 51, all of which coact to influence the tension on coil springs 64 which control the pressure of the friction shoes on the friction drum and thereby regulate the driving torque applied to the reel shaft.

The operation of my device is a follows:— Power applied to the sprocket 17 causes the friction drum 13 to rotate on the sleeve 3. Rotation is also imparted to the reel shaft 6 through the contact of the friction shoe linings 62 with the friction drum 13, since the friction shoes are carried on the centrifugal control supporting member 28 which is fixed on the reel shaft. At the instant of starting the frictional torque is greatest for the reason that the friction shoes are under the maximum pressure, the centrifugal control mechanism being in the position shown in Fig. 2, in which position the coil springs 64 are under maximum tension since the spring tension control arm 41 is actuated in a counterclockwise direction on the reel shaft under the full influence of coil spring 70 which is not opposed by centrifugal force at the instant of starting.

As the reel shaft accelerates, centrifugal force, acting on the weights 33, exerts a force on the control arm 41 tending to rotate it in a clockwise direction on the reel shaft, thereby stretching the coil spring 70. Any rotation of the control arm 41 on the reel shaft in a clockwise direction immediately lessens the tension on the coil springs 64 thereby reducing the pressure on the friction shoes and thus reducing the driving torque applied by the friction drum 13 to the reel shaft. In order to maintain maximum driving torque for a sufficient length of time after starting to quickly accelerate the reel shaft and reel to the maximum speed, thereby securing a quick initial winding up of the film when the projector is first started, I have provided the pneumatic time lag regulator 40 which slows down the rate at which the friction shoe pressure is reduced as the reel shaft accelerates. This time lag regulator consists merely of a

tube open at one end into which is fitted a freely sliding plunger. The plunger may be provided with grooves offering a constricted passage for air entering or leaving the tube as the plunger is withdrawn from or forced into the tube by the movement of the centrifugal weights. However, since the only function of the time lag regulator is to prevent a too sudden reduction in the driving torque applied to the reel shaft for the first second or so, after the initial starting of the projector, a preferable arrangement of the time lag regulator includes a one-way orifice or ordinary check valve of any convenient type. The check valve is arranged to prevent the entrance of air into the tube and provide free passage of air out of the tube. If an adjustable air passage is desired it may be secured by providing an adjustable orifice in the closed end of the tube. The minimum reel shaft driving torque which is required to exert the desired pull on the film when the reel is up to speed, is adjusted by means of screw 50 which limits the clockwise rotation of control arm 41 on the reel shaft.

As the diameter of the wound mass increases, the film, of course, being fed to it at a uniform rate, there is need for a diminishing rate of reel rotation because of the growth of circumference of the wound mass. Moreover, as a constant pull is required on the film, there is need for an increased driving torque. It will be apparent that each of these requirements is satisfied when the driving torque, applied to the reel shaft, varies inversely as the rate of rotation of the reel shaft. This is taken care of automatically by the centrifugal control mechanism, and the pull on the film is maintained fairly constant during the entire take-up period. The maximum reel shaft driving torque, required initially to bring the reel quickly up to speed and finally to wind the film on the maximum reel diameter, is adjusted by means of screw 51 which limits the counter-clockwise rotation of the control arm 41 on the reel shaft.

The film pull at intermediate conditions of wound mass diameter is determined largely by a proper balancing of the coil springs 64 and 70 and the weights 33 in the original design but considerable adjustment may be had through varying the tension on coil spring 70 by means of the adjusting screw 69. Since all of the adjustments are more or less inter-related, it is obvious that the most uniform film pull for all conditions will be obtained by trial.

As previously stated, the device described in my said patent is far superior to all ordinary film take-up drives but it is very slow in initial acceleration because of features of the design which result in large and heavy masses such as the plate 30, the cover 70, and the four weights being carried on the reel shaft and therefore requiring excessive driving torque to quickly accelerate the reel shaft to maximum speed. When the maximum frictional driving torque is adjusted to give a quick initial take-up with my former device, I find that the reel shaft and the heavy masses carried thereon attain such momentum that the reel overspeeds, thus tending to draw film from the projector more quickly than it is fed, thereby damaging the film perforations on the lower sprocket in the projector. Another feature of my former device tending to make it sluggish in action is the great amount of friction to be overcome in moving the controlling sleeve, especially when oil has become gummed on the sliding parts.

In my improved device I have greatly reduced the number of parts, simplified and lightened the centrifugal control mechanism and parts carried on the reel shaft, and assembled the heavier and larger diameter parts including the friction drum and case 23 on the constant speed member thereby eliminating the necessity of accelerating these parts through the friction drive. Moreover, I have added a pneumatic time lag regulator which, together with the greatly reduced weight carried on the reel shaft, permits a very quick initial film take-up without requiring an excessive maximum frictional torque, thus completely eliminating the danger of overspeeding the reel. Another important feature of my new design is the elimination of all sliding parts in the centrifugal control mechanism and the use of tension instead of compression springs, thereby reducing the frictional resistance to movement of the control parts and making the device more sensitive to speed variations.

It is to be noted that all movements of the centrifugal spring tension control mechanism, in my improved device, occur in planes perpendicular to the reel shaft and all movements of the parts with respect to each other take place around pivot pins. This design provides the most compact and therefore the lightest construction, and the least friction between the parts of the centrifugal control mechanism.

Having thus fully described my invention, what I claim is—

1. In a device of the character specified, a centrifugal spring tension control mechanism comprising a supporting member fast mounted on a variable speed friction driven reel shaft, a pivotally mounted spring tension control arm, pivotally mounted centrifugal weights, links pivotally connected to said control arm and said centrifugal weights in a manner whereby all relative movements of said parts take place in planes perpendicular to said reel shaft, and yielding means opposing the relative movements of said parts in response to acceleration of said reel shaft.

2. In a device of the character specified, a

centrifugal spring tension control mechanism comprising a supporting member fast mounted on a variable speed friction driven reel shaft, a spring tension control arm, pivotally mounted centrifugal weights, links connecting said control arm and said centrifugal weights, a time lag regulator connected with said control mechanism and adapted and arranged to prevent sudden relative rotation, in one direction of said spring tension control arm with respect to said reel shaft, and yielding means opposing the relative rotation of said control arm with respect to said reel shaft in response to acceleration of said reel shaft.

3. In a device of the character specified, a centrifugal spring tension control mechanism comprising a supporting member fast mounted on a variable speed friction driven reel shaft, a pivotally mounted spring tension control arm, pivotally mounted centrifugal weights, links connecting said control arm and said centrifugal weights, a time lag regulator pivotally connected to said centrifugal weights and adapted and arranged to retard the movement of said weights in response to sudden increases in the rate of rotation of said reel shaft, and adjustably mounted spring means yieldingly opposing the movement of said weights in response to acceleration of said reel shaft.

4. In a device of the character specified, a centrifugal spring tension control mechanism comprising a supporting member fast mounted on a reel shaft, a pivotally mounted spring tension control arm, pivotally mounted centrifugal weights, links connecting said control arm and said centrifugal weights, a pneumatic time lag regulator pivotally connected to said weights, an adjustably mounted tension spring connected to said control arm and adapted to yieldingly oppose the relative rotation of said control arm on said reel shaft under the influence of increasing centrifugal force, and adjustable means for limiting the maximum relative rotation in each direction of said control arm with respect to said reel shaft.

5. In a device of the character specified, the combination of a constant speed member having a suitable friction surface, a rigidly supported sleeve whereon said constant speed member rotates, a reel shaft journaled in said sleeve, a centrifugal control supporting member fixed on said reel shaft, lever arms pivotally mounted on said centrifugal control supporting member, friction shoes carried on said lever arms and adapted to contact with said friction surface, a centrifugal control mechanism, and springs connected with said lever arms and said control mechanism, adapted and arranged to vary the pressure of said friction shoes on said friction surface under the influence of said control mechanism.

6. In a device of the character specified, the combination of a constant speed positively driven friction drum, a rigidly supported sleeve whereon said friction drum rotates, a reel shaft journaled in said sleeve, a centrifugal spring tension control mechanism carried on said reel shaft, pivotally mounted lever arms associated with said control mechanism, friction shoes carried on said lever arms and adapted to contact with said friction drum, and tension springs connecting said lever arms with said control mechanism in such a manner that the pressure of said friction shoes on said friction drum will respond, under the influence of said control mechanism, to changes in the rate of rotation of said reel shaft, the pressure increasing as the speed of said reel shaft decreases and vice versa.

7. In a device of the character specified, the combination of a constant speed positively driven friction drum, a rigidly supported sleeve whereon said friction drum rotates, a reel shaft journaled in said sleeve, a control mechanism supporting member fast mounted on said reel shaft, a spring tension control arm rotatably mounted on said reel shaft, centrifugal weights, links connecting said control arm and said centrifugal weights, a time lag regulator adapted to prevent sudden rotation of said control arm on said reel shaft, an adjustably mounted coil spring connected to said control arm and adapted to restrain the rotation of said control arm on said reel shaft in response to increasing centrifugal force, adjustable means for limiting the rotation of said control arm on said reel shaft, lever arms pivotally mounted on said control mechanism supporting member, friction shoes carried on said lever arms and adapted to contact with said friction drum, and coil springs connecting said lever arms with said spring tension control arm in such a manner that rotation of said control arm on said reel shaft, in response to acceleration of said reel shaft, will reduce the tension of said coil springs thereby reducing the driving torque exerted on said reel shaft by said constant speed friction drum; and conversely, deceleration of said reel shaft will increase the tension of said coil springs thereby increasing the driving torque applied to said reel shaft.

8. An automatic variable speed variable friction drive comprising a constant speed friction member, a rigidly supported sleeve whereon said member rotates, a variable speed friction driven reel shaft journaled in said sleeve, a centrifugal control mechanism carried on said reel shaft, friction means associated with and influenced by said control mechanism in a manner whereby the frictional driving torque applied to said reel shaft may vary inversely as the rate of rotation of said reel shaft, and means within said

control mechanism for producing rapid initial acceleration of said reel shaft.

9. An automatic variable friction drive, comprising a constant speed friction member, a rigidly supported sleeve whereon said member rotates, a variable speed friction driven reel shaft journaled in said sleeve, a centrifugal spring tension control mechanism mounted on said reel shaft, and friction means associated with and influenced by said control mechanism to vary the driving torque applied to said reel shaft in inverse ratio to the rate of rotation of said reel shaft.

10. An automatic variable friction drive, comprising a constant speed friction member, a variable speed friction driven reel shaft, means adapted and arranged to journal said friction member and said reel shaft, a centrifugal control mechanism provided with pivotal movement throughout, and friction means associated with and influenced by said control mechanism to provide a substantially uniform pull on a film being wound upon a reel mounted on, and driven by, said reel shaft.

11. An automatic variable friction drive, including a time lag regulator and a control mechanism provided with pivotal movement throughout, said time lag regulator and said control mechanism being adapted and arranged to provide quick initial take-up and approximately uniform tension during the constant-feed winding operation.

ARTHUR J. HOLMAN.