ABSTRACT: A tape winding device for picture projecting, picture producing, sound recording and sound reproducing apparatus in which the tape is always moved with uniform speed regardless of the diameter of the tape spool on the winding core. This is accomplished by a friction clutch operatively connected with the drive of the winding core in such a manner that the frictional power of the friction clutch is gradually increased with the increasing diameter of the tape spool forming on said winding core.
The invention relates to a winding device for tapes in apparatus used for picture producing, picture projecting, sound recording and sound reproduction.

In devices of this type it is important that during the winding of the tape there is always exerted a uniform pulling power on the tape regardless of the constantly increasing diameter of the tape spool. The better this condition is fulfilled the less complicated may be the means which effect a uniform movement of the tape which carries the sound record or which receives the picture during the photographic exposure. In particular it is important that during the picture projection a steady position is obtained. In sound recording and sound reproduction it is customary to arrange steady flywheel masses in the neighborhood of the recording point or the scanning point respectively, while for the picture projection the tape is engaged by sprockets.

Steady flywheel masses are, however, particularly disturbing in amateur devices which should be as small in size as possible. It would therefore be advisable when by the use of simple means one could entirely omit any flywheel masses or at least could reduce the same substantially.

When longer picture films, for instance having a length of 120 meters, are to be projected by means of a motion picture projector which is constructed without any sprockets then it is necessary to have a pull on the tape spool as uniform as possible. Only when this condition is fulfilled is one able to obtain a steady or faultless picture position.

It is known to arrange in the drive of the winding shaft a friction clutch the pressure force of which varies and depends upon the weight of the wound up tape. Construction details of this type operate, however, relatively inaccurately. The reason for this is that the weight of the wound up spool is not a correct measure for the spool diameter. The spool diameter and the uniform pull on the tape, however, is derived from the torque to be transmitted by the friction clutch.

If it should happen that the tape in one instance is wound up somewhat loose then the diameter of the spool at the same weight is somewhat greater and this means that the torque transmitted by the friction clutch grows too slow during the winding operation as it is necessary for maintaining a uniform pull on the tape. This effect is particularly noticeable when the motion picture projector projects a film which is provided with a magnetic sound track.

On the other hand, the spool may be wound up in a non-circular manner which happens not too frequently, and then the principle of compensation depending on the weight of the spool does not work satisfactorily. The transmission power of the weight controlled friction clutch remains uniform over the entire circumference of the spool up to the increase in weight while the torque comprising the product of tape pull and the attack radius varies.

It is an object of the present invention to overcome these disadvantages of the prior devices.

In accordance with the present invention a winding device is provided which is equipped with a friction clutch in its drive mechanism for the winding core whose transmission power depends on the diameter or the radius respectively, of the wound spool.

The friction clutch in accordance with the invention may be controlled by the changing diameter of the spool on the winding core, whereby the winding core is carried by a pivotally mounted spool arm. It is also possible in accordance with the invention to construct the friction clutch in the form of a disc clutch subjected to the action of a spring arranged concentric to the pivot axis of the spool arm, whereby the friction of the disc clutch may be changed in the spring tension by means of a cam drive operated by the pivotally mounted spool arm during the winding operation.

In the following is described by way of example one embodiment of the invention whereby, however, those details are not illustrated which are not important for the invention in order to disclose the invention more clearly.

In the drawing:

FIG. 1 is a side elevation view of a motion picture projector constructed in accordance with the invention whereby, however, a portion of the projector housing is broken away and other parts are shown in section.

FIG. 2 is a side elevation view similar to FIG. 1 however with a large film spool.

FIG. 3 is a sectional view along the line III-III of FIG. 2 on an enlarged scale, and

FIG. 4 shows a detailed view of the cam drive for the changing of the friction corresponding to FIG. 3.

Referring to the drawings, a motion picture projector 1 is provided in its front wall photographic objective 2, while the upper rear portion of the camera casing has mounted thereon about a shaft 4 a pivoted spool arm 3. The end of the spool arm 3 remote from the shaft 4 carries on a shaft 5 which may be rotated by an endless cord drive 6, 7, and 8 mounted on the spool arm 3 and driven by the drive mechanism of the projector. The spool arm 3 is provided adjacent the shaft 4 with a short projection 9 to which is attached one end of a tension spring 10. The shaft 5 carries a winding core 11 for a film spool. The winding core 11 cooperates with a roller 13 having the flanges 14 and 15. This roller 13 is mounted on a fixed shaft 16, 7 indicates a piece of a film guide for automatically threading the film 18 onto the winding core 11. The rear portion of the projector housing is provided with a vertically arranged slot 19 which has mounted therein the spool arm 3 and the parts 4 to 18. This slot 19 is covered outwardly by a hood-shaped flap 20. This flap 20 is pivotally mounted on an axis 21 fixedly arranged in the upper portion of the projector housing. The other end of the previously mentioned tension spring 10 is attached to this flap adjacent its pivot axis 21. The flap 20 carries a roller 22 on a pivot pin 23 and is similarly constructed as the roller 13. Both rollers 13 and 22 are arranged in the same vertical plane. Between these rollers 13 and 22 is arranged the winding core 11. A magazine 24 containing 120 meter film is arranged on the upper front part of the projector housing. The shaft 4 is journaled in a bearing 25 which is fixedly secured in spaced walls 26. The bearing 25 is mounted in a radially spaced bearing sleeves 27 which assure a smooth rotation of the shaft 4. On the exterior diameter of the bearing 25 is arranged a rotatable bearing sleeve 28 which is riveted to one end of the spool arm 3. On the end of the shaft 4 which extends from the projector housing into the slot 19 of the projector housing is mounted a cord pulley 6 which is attached to the shaft 4 with a locking disc 29 and a keeper 30. The exterior surface of the bearing sleeve 27 which faces away from the cord pulley 6 is engaged by a pressure disc 31 which enters into an annular groove 32 in the shaft 4. The pressure disc 31 engages under the action of a helical spring 33 a friction disc 34 which is connected by a keeper pin with the shaft 4. One end of the helical spring 33 engages a disc 37 held in place by a nut 36 attached to one end of the shaft 4.

The friction disc 34 is urged under the pressure of this helical spring 33 against a friction surface 38 disposed in an annular recess in a gearwheel 39 whose teeth engage a not illustrated worm wheel mounted on a motor shaft whose center axis is indicated by the dash-dotted line 40. With a friction surface 41 which is arranged opposite the friction surface 38 the gearwheel 39 engages another friction disc 42 which by means of a keeper pin 43 is also attached to the shaft 4 against rotation relative to the same. The face of the friction disc 42 which faces away from the friction disc 41 forms an abutment surface for an axial ball bearing 44. The balls of this axial bearing 44 are received by an annular bearing groove 45 provided in the end face of an annular part 46 of a cam drive. The part 46 forms a drive portion 47 which engages a keeper bolt 48 which in turn is riveted to the spool arm 3. The counterpart to the part 46 of the cam drive is designated with 49 and forms a
drive fork 50 which engages a stationary holding bolt 51 which prevents a rotation of the counterpart 49. The two parts 46 and 49 of the cam drive have clamp 52 and 53 which are in engagement with one another. Through the bores 54 and 55 of these parts 46 and 49 extends a tension sleeve 56 which has mounted therein the helical spring 33. This tension sleeve 56 is secured by a pin 57 against rotation relative to the shaft 4, but an axial movement of the tension sleeve 56 along the shaft 4 is permitted. The tension sleeve 56 engages with a collar 58 a second axial ball bearing 59 whose balls are received in an annular bearing groove 60 provided in the end face of the counterpart 49 of the cam drive. Locking discs 61 prevent a movement of the bolt 51 in an axial direction.

When the film spool 12 increases in size the spool arm 3 by means of the bolt 48 thereon and the fork 47 rotates the part 46 in the direction of the arrow 62 in FIG. 4. The inclined surfaces of the cams 52 and 53 on the parts 46 and 47 slide one upon the other because the counterpart 49 is prevented to rotate owing to the provision of the bolt 51. This has the result that the counterpart 49 is axially displaced in the direction of the arrow 63 in FIG. 4. This displacement is transmitted to the ball bearing 59 and the tension sleeve 56 and thereby the helical spring 33 is pressed together. In this manner the pressure of the helical spring 33 is increased and the nut 36, the disc 37, and the shaft 4 urge the pressure disc 31 against the friction disc 34. This friction disc 34 is therefore pressed with increased force against the friction surface 38 of the gear 39 which latter with its friction surface 41 acts with increased pressure on the friction disc 42. This has the result that the transmission power of the friction clutch 34, 39, 42 from the gear 39 to the shaft 4 is increased.

The inclined faces of the cams 52 and 53 engage with each other at such an angle with reference to the tension of the spring 33 and the diameter and the friction coefficient of the friction clutch 34, 39, 42 that the torque transmitted from the gear 39 to the shaft 4 will always be equal to the torque which comprises the product of the radius of the film spool 12 and the pull on the film on the outer winding of the spool 12.

When in a device as described in the foregoing the film 18 is introduced between the supporting roller 13 and the winding spool core 11, for the purpose of winding a spool thereon, this has the advantage that the film pull takes place always on that point of the film spool which determines also the pivoted position of the spool arm 3. In other words, the transmission power of the friction clutch which controls the pivoted spool arm will always produce the same torque which is calculated as the product of the film pull and the distance of the circumference of the roller 13 from the axis of rotation of the winding core 11.

We claim:

1. Winding device for tapes in picture projecting, picture taking, sound recording and sound reproducing means, comprising a winding core, means for driving said winding core, and a friction clutch in said driving means for transmitting a torque which is dependent on the diameter of the spool of tape on said winding core, wherein the improvement comprises a pivotally mounted arm for carrying at its free end said winding core, means on said arm and connected with said driving means for rotating said winding core, said friction coupling being rotatable about the pivot axis of said arm.

2. Winding device according to claim 1, in which said friction clutch includes rotary friction surfaces and spring means for urging said friction surface against each other, and means including a conical cam member for varying the axial distance and the frictional pressure between said rotary friction surfaces during their rotation.

3. Winding device according to claim 1, in which said friction coupling comprises friction discs mounted concentrically about the pivot axis of said arm, a spring surrounding said pivot axis and urging said friction discs against each other, and means including interengaging inclined cam means (46, 49) operated by said arm when the latter is pivoted for changing the pressure of said spring against said friction discs.

4. Winding device according to claim 1, in which said arm is pivotally mounted with its end opposite the one carrying said winding core about a fixed axis, an endless cord drive extending from said pivot axis to said winding core, said friction clutch being rotatable about said fixed axis and having a driven member operatively connected with said cord drive for rotating said winding core, a tape spool engaging supporting roller arranged rotatable about a fixed axis and engaging the circumference of the tape spool formed on said winding core, whereby upon an increase of the diameter of the tape spool on the winding core the pivoted arm is moved away from said supporting rollers, and cam means operated by said arm during said pivotal movement for increasing the pressure exerted in said friction clutch in accordance with the increasing diameter of the tape spool on said winding core.

5. A winding device according to claim 4, including means for guiding the tape over said supporting roller and then onto said winding core in such a manner to cause a pivotal movement of said arm when the tape spool increases in diameter.