Feb. 25, 1941. M. E. COLLINS 2,233,284

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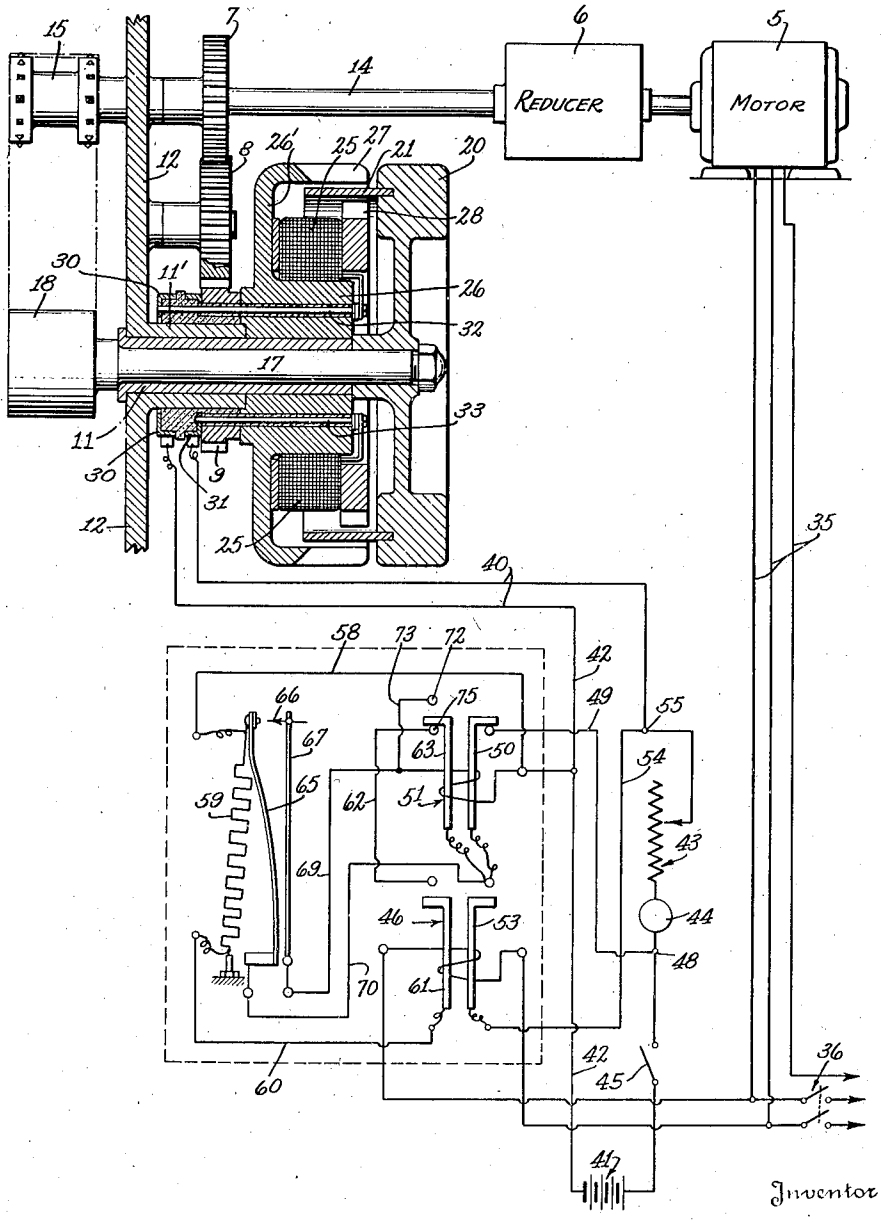
Filed April 23, 1938



Inventor

MILFORD E. COLLINS

By Ira R. Goshaw

Attorney

Patented Feb. 25, 1941 2,233,284

UNITED STATES PATENT OFFICE

2,233,284

FILM DRIVE STARTING APPARATUS

Milford E. Collins, Hollywood, Calif., assignor to Radio Corporation of America, a corporation of Delaware

Application April 23, 1938, Serial No. 203,880

9 Claims. (Cl. 271—2.3)

This invention relates to sound film apparatus, and particularly to a film drive starting system whereby the film advancing elements are accelerated to their uniform running speed in a shorter period of time than heretofore.

It is well known in the art of film recording and reproduction of sound that the film should be advanced or driven past a modulated light beam in the case of recording, and past a constant intensity light beam in the case of reproduction, at a constant uniform speed. This is essential for the maintenance of high quality sound reproduction.

A preferred method of maintaining constant film speed at the translation point, as the point of contact between the film and light beam is usually called, is to pass the film at this point over a drum or smooth roller interposed between feed and takeup sprockets. Ordinarily the film drum has a mass attached thereto in the form of a flywheel and may be rotated solely by the pull of the film passing thereover, although preferably the drum is positively driven through a flexible connection such as is obtainable by a magnetic clutch. For an illustration of such a magnetic clutch, reference is made to the E. W. Kellogg Reissue Patent 19,270, of August 14, 1934.

In the usual sound recorder or reproducer, the film is threaded through the machine from the supply reel to a takeup reel. A starting switch is then thrown to energize the driving motor to accelerate the apparatus and bring the film up to a uniform speed, which is usually 90 feet per minute. If all elements were positively driven through mechanical connections, the period between the time the switch is thrown and the time uniform constant speed is obtained would depend upon the power of the motor. As a rule, the period of time for the motor to obtain constant speed is a few seconds after the switch is thrown. However, as the flywheel and drum combination has considerable inertia and is not positively connected to the driving motor except through only sufficient magnetic coupling to maintain its speed during operation, the period required to bring the drum up to speed is considerably longer. Furthermore, there is a likelihood of film damage due to slipping of the film over the drum as well as the wastage of film during the long period of starting.

The present invention, therefore, has for its primary object the shortening of the starting time of film recording and reproducing apparatus.

Another object of the invention is to automatically increase the stiffness of the flexible connection between the film drum element and the driving element during the starting period.

A further object of the invention is to automatically increase the magnetic coupling of a magnetic clutch between the driving portion of the apparatus and the flywheel and drum elements and to automatically reduce the magnetic coupling to operative conditions at a predetermined subsequent time such as when the apparatus has attained uniform speed.

Although the novel features which are believed to be characteristic of this invention are pointed out with particularity in the claims appended hereto, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawing forming a part thereof, in which the single figure diagrammatically represents the essential film drive elements such as the drum, flywheel and magnetic clutch of a recorder or reproducer, and a schematic wiring diagram of the apparatus embodying the invention.

Referring now to the drawing, a motor 5 through a gear reduction box 6 drives a main gear 7, which meshes with an intermediate gear 8 for driving a gear 9. The gear 9 is adapted to rotate upon a bearing formed by a stationary sleeve or quill 11 located within an extension 11' of a wall 12 of a recorder or reproducer. The drive shaft 14 driving the gear 7 also directly drives a feed or drive sprocket 15. Upon a rotatable shaft 17 is mounted a smooth drum 18 over which the film passes at the time the light beam strikes it. Upon the other end of the shaft 17 is mounted a flywheel 20 having a copper cylindrical member 21 inserted in one side thereof.

The gear 9 drives a magnetic coil 25 mounted upon an enlarged hub portion 26, the coil 25 magnetizing a serrated cup member 26' formed integral with hub 26, thus producing a magnetic field between pole pieces 27 and 28 in which the member 21 rotates. Electrical current is supplied to the coil 25 through slip rings 30 and 31 and connections 32 and 33, respectively.

The above-described apparatus may be employed in either a recorder wherein the modulated light beam is projected on a sensitized film while passing over the roller 18, or may be a portion of a reproducer wherein a constant intensity light beam is projected through the processed sound track portion of the film overhanging the roller to modulate the beam before impression upon a photosensitive pickup element such as a photocell. It will be realized, of course, that the

motor being directly connected to the sprocket 15 and other sprockets (not shown) of the apparatus, these sprockets and, consequently, the film, will be brought up to speed as rapidly as the motor accelerates. However, since the roller 18 is connected to the driving apparatus only through the coupling produced by the magnetic field existing between pole pieces 27 and 28, there will be slippage of the film over the roller in accordance with the rate of acceleration and the strength of the field. Even though this slippage may not be sufficient to damage the film, it nevertheless increases the period of starting of the recorder or reproducer.

The present invention, therefore, contemplates making the connection between the positively driven element or magnet 26 and flywheel and roller combination 18—20 more positive by increasing the strength of the magnetic field during the acceleration period, after which the magnetic coupling may be reduced to a value which has been found suitable to provide the proper operation loops on either side of the roller 18 to prevent speed variations of the sprockets from affecting the constant speed of the film over the roller 18.

Referring now to the lower portion of the drawing, it will be noted that electrical energy is supplied to the motor 5 over three conductors 35. A source of such energy may be a 3-phase, 220-volt, 60-cycle alternating current supply. A manually operated starting switch 36 is inserted in two of the conductors for starting and stopping the apparatus. Direct current is supplied to the winding 25 from a direct current energy source 41 under control of a switch 45 over a pair of conductors 40. Ordinarily and during operating conditions, the energy is supplied over conductor 42 and through a series resistance 43 and a meter 44. However, to increase the coupling between driven and driving elements of the magnetic clutch during starting, the current in the winding 25 is increased by shorting out the resistance 43 and meter 44 by an automatic thermal controlled relay combination. This short circuit is formed as follows: When the switch 36 is thrown to energize the motor 5, a two-pole, normally open, 220-volt relay 46 is also energized, completing a circuit from point 48 over conductor 49, through the right hand contact element 50 of relay 51, over the right hand contact element 53 of relay 46, over conductor 54 to the point 55.

Closure of the relay 46 also completes a circuit from the battery 41, over conductor 42, over conductor 58, through a hot-wire resistance element 59, conductor 60, the left hand contact member 61 of relay 46, conductor 62, the left hand element 63 of relay 51, and the right hand element 50 of relay 51, conductor 49 and back to the battery 41 through point 48. This circuit heats and thereby lengthens the hot-wire element 59 allowing a contact member 65, which is held under tension by wire 59, to move to the right and make contact at 66 with member 67. When contact is made at 66, the relay 51 is energized over a circuit from battery 41, over conductor 42, winding of relay 51, conductor 69, element 67, element 65, conductor 70, the right hand element 50 of relay 51, conductor 49 to battery 41 through point 48. Thus, contact at 66 causing operation of relay 51 not only breaks the circuit just traced, but also the short-circuit across resistance 43 and meter 44. Removal of the short-circuit decreases the current to coil 25 and reduces the magnetic coupling to operating conditions. To maintain the relay 51 energized after operation, element 63 makes contact at 72 to complete a new energizing circuit from battery 41, over conductor 42, through winding of relay 51, over conductor 73, the left hand contact element 63 of relay 51, the right hand element 53 of relay 46, conductor 54, resistance 43, meter 44 and back to battery 41. The break between contact 75 and element 63 removes the heating circuit for the hot-wire 59 which permits the contraction of the wire 59 to reset the tension element 65.

In the operation of this circuit various predetermined times of operation are obtainable by adjustment of the tension in the element 65 which varies the distance between the contacting elements 65 and 67, the length of time required to cause contact at 66 determining the length of time the short-circuit exists across elements 43 and 44.

In the operation of the above starting apparatus, switch 45 is first closed to permit adjustment of rheostat 43 to provide the proper operating current to coil 25 as indicated by meter 44. It is then only necessary to close the switch 36, which simultaneously energizes the driving motor 5 and the master relay 46. Immediately the full voltage of the source 41 is impressed on the winding 25 to produce a strong magnetic field and bring the flywheel mass 20 and roller 18 up to speed practically as rapidly as the directly driven elements of the apparatus. At the same time the current is fed through the hot wire 59 which begins to lengthen and in accordance with its setting should make contact at 66 at the time the apparatus has reached uniform speed, thus reducing the current to the coil 25 and permitting the apparatus to normally function.

It has been found that the starting speeds have been materially shortened with the above-described system to accomplish a saving of film and time in film recording and a saving of film leader and time in sound reproduction.

I claim:

1. Apparatus for decreasing the starting time of film drive apparatus comprising a motor, film advancing sprockets directly connected to said motor, film advancing elements magnetically connected to said motor, and means for strengthening the magnetic connection during the period of acceleration of said motor.

2. Apparatus for decreasing the time of acceleration of film driving elements comprising a driving motor, a plurality of sprockets directly connected to said motor for advancing film through said apparatus, another film advancing element, a magnetic clutch interconnecting said last-mentioned film advancing element and said motor, and means for increasing the magnetic field of said magnetic clutch during acceleration of said apparatus and for decreasing said magnetic field a predetermined time after starting.

3. Apparatus for decreasing the time of acceleration of a film driving mechanism comprising a magnetic coupler and circuit control apparatus therefor comprising a plurality of magnetic relays and a thermal relay, means for energizing one of said magnetic relays, a plurality of impedance elements short-circuited by operation of said relay, operation of said relay also energizing said thermal relay, and means for operating another of said plurality of relays by operation of said thermal relay, the operation of said second relay removing the short circuit from said impedance

elements while maintaining energization of said second relay.

4. Apparatus for controlling the acceleration time of a film driving mechanism comprising means for advancing a film, a source of energy for driving said film advancing means, a second source of energy, a magnetic device energized from said second source of energy, means for connecting said film advancing means to said magnetic device, a plurality of impedance elements in the energizing circuit between said second source of energy and said magnetic device, a magnetic relay adapted to short-circuit said impedance elements upon operation thereof, a second magnetic relay adapted to remove said short circuit, and time delay means energized by operation of said first relay for energizing said second relay.

5. Apparatus for decreasing the starting period of film drive apparatus comprising a driving motor, field producing means, a plurality of film advancing elements directly connected to said motor, another film advancing element having mass, said last-mentioned element being connected to said driving motor through the reaction of the field of said field producing means, a source of energy for said field producing means, a circuit connecting said source and said field producing means, a plurality of impedance elements in said circuit, and means operable upon energization of said motor for short-circuiting said impedance elements only during the period of acceleration of said motor.

6. Apparatus in accordance with claim 5 in which said last-mentioned means comprises a thermal time delay relay adapted to remove the short-circuit from said impedance elements a predetermined time after energization of said motor.

7. A film drive starting system comprising a motor, a magnetic field producing element, a plurality of film advancing elements directly driven by said motor together with said magnetic field producing element, a rotatable element located in said magnetic field, and means for increasing the energy supplied to said field producing element during a predetermined period of rotation thereof.

8. Apparatus for decreasing the starting time of a rotating element comprising a motor, magnetic means for coupling said motor to said rotating element, a source of energy, and means independent of said rotating element and said motor for supplying a definite amount of energy from said source to said magnetic coupling during the acceleration period of said motor, and another definite but lesser amount of energy after said motor has reached a uniform speed.

9. Apparatus in accordance with claim 8 in which said energy supply means includes a hot wire relay.

MILFORD E. COLLINS.