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APPARATUS FOR ADVANCING FILAMENTARY MATERIAL

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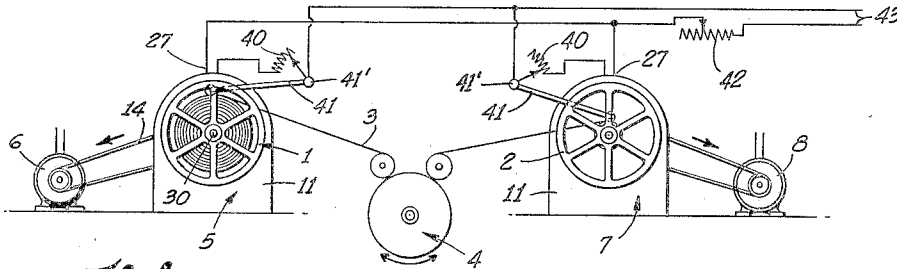


Fig. 1.

Fig. 2.

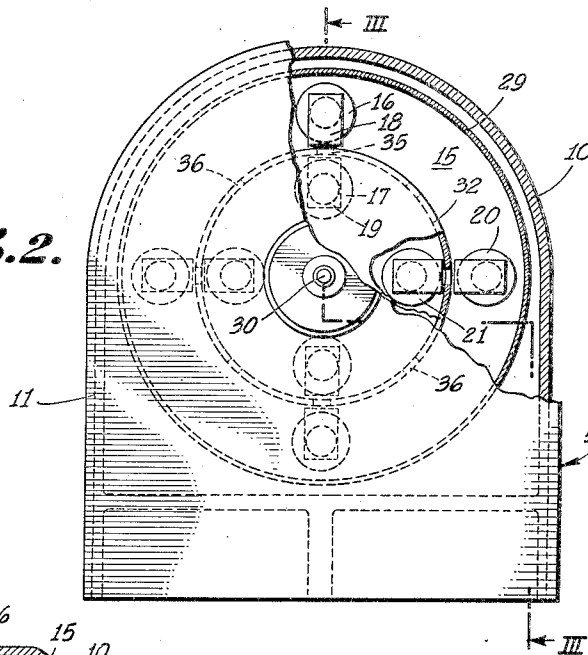
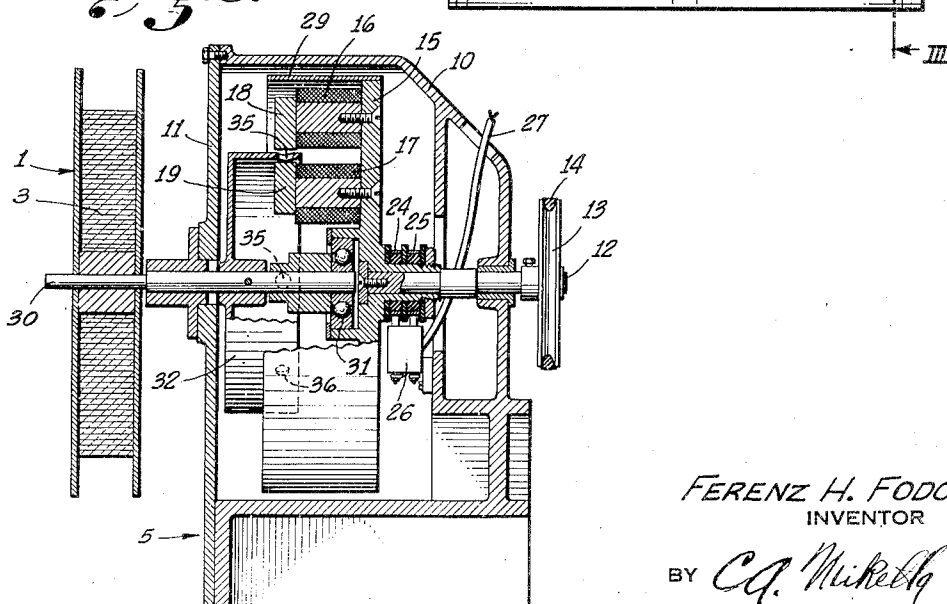


Fig. 3.



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APPARATUS FOR ADVANCING FILAMENTARY MATERIAL

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3 Claims. (Cl. 242—75)

This invention pertains to improved methods of handling long strips of material, films, wires, threads, ribbons or any other material of long length in comparison with other dimensions. Materials answering this description will be generally referred to hereinafter as "filamentary."

More specifically, the invention pertains to devices particularly adapted for use in moving, advancing or driving filamentary materials carried on reels, spools, bobbins and other elements on which they may be collected or wound. The devices and methods of this invention are capable of numerous industrial, educational and technical uses but in order to simplify explanation, the adaptation of the methods and devices to the handling of sheet or strip material such as, for example, motion picture film, will be specifically described.

In common with most filamentary materials, continuous strip film can not be subjected to undue tension without breakage. Moreover, in many cases undue tension applied to strip material of this character results in a stretching of the film which destroys its ability to register perfectly with sprockets or other devices with which it comes in contact.

In many instances as, for example, where strip film is used for recording or reproduction of sound, it is highly desirable to provide means whereby the strip film may be advanced, stopped, reversed, etc., in rapid succession. Heretofore, difficulty has been experienced in rapidly changing the direction of movement of a filamentary material such as film, since any appreciable and rapid increase in the tension to which the film is subjected may result in breakage. Complicated arrangements of loops, counterweights, weighted pulleys and the like have been suggested for use in recording, reproducing, developing, drying and other machinery employed in the manufacture and use of strip film, but none of these prior expedients has been found completely successful. The present invention not only permits filamentary material to be wound and unwound or moved longitudinally in any desired direction, but in addition prevents breakage of such material due to sudden stress, stops or reversals in direction of movement. Other advantages will become apparent from the following description.

Generally stated, the apparatus comprises a pair of reels, bobbins or the like, each of the reels being provided with a separate electromagnetic driving means and an independent, substantially constant speed motor for each of the

electromagnetic driving means. The motors drive the electromagnetic means in opposite directions and no direct mechanical engagement exists between the driving means and the driven reels. The reels are rotated in opposite directions whereby filamentary material extending between the reels is maintained under tension. A positive drive mechanism is placed in contact with the filamentary material between the reels and the direction of movement and rate of movement of the material is determined by this separate, positively driven drive mechanism.

The filamentary material may be subjected to various operations either at or near the positive drive mechanism which controls the movement of the material. When the material consists of motion picture film, operations such as sound recording, sound reproduction, printing, projection or the like may take place at this zone. With other materials, operations such as perforating, printing, dyeing, etching and the like may be performed on the filamentary material.

It is an object of the present invention, therefore, to disclose and provide an apparatus for moving filamentary material in an effective and simple manner.

A further object is to provide means and constructions adapted to perform the purposes and functions hereinabove stated in an effective manner.

Another object is to provide an apparatus whereby continuous material may be wound up without exerting more than a predetermined tension upon such material.

A still further object is to provide an apparatus for feeding and taking up filamentary material past a positive and independent material driving means without subjecting the material to excessive variations in tensile stresses.

These and other objects, uses, advantages and modifications will become apparent to those skilled in the art from illustrative embodiments of the invention described hereinafter. In order to facilitate the description, reference will be had to the appended drawing, in which:

Fig. 1 is an elevation, diagrammatic in form, showing the general arrangement of the elements included in the apparatus.

Fig. 2 is a front elevation of one of the units, portions thereof being removed.

Fig. 3 is a vertical section taken along the plane III—III of Fig. 2.

As shown in Fig. 1, reels 1 and 2 carry a continuous strip of film 3 which passes over an in-

dependently driven film advancing mechanism 4. The positive drive mechanism between the reels and in contact with the filamentary material extending between the reels may be of any desired type. A form of driving mechanism shown in Patents Nos. 2,008,402 and 2,242,548 may be used to good advantage whenever the filamentary material is in the form of a strip such as continuous motion picture film. Sound recording or reproduction, printing or projection may take place at the element 4. The film 3 is maintained under tension because the reels 1 and 2 are driven by electromagnetic driving means in opposite directions. The electromagnetic driving means of the device indicated at 5 may be driven by a motor 6 whereas the electromagnetic driving means of the device 7 may be driven by the motor 8. It will be noted that the arrows show that the electromagnetic driving means of these two devices 5 and 7 are being driven in opposite directions so that the reels 1 and 2 are urged to rotate in opposite directions also. In the event the intermediate driving means 4 is rotating counter-clockwise, the film 3 will move from left to right, such film being wound upon the reel 2 which will be driven by its electromagnetic driving means. At the same time, even though the electromagnetic driving means of the device 5 are rotating in a counterclockwise direction, the pull of such means upon the reel 1 will be insufficient to prevent the reel 1 from rotating in a clockwise direction and the electromagnetic drive of the device 5 will simply cause the film 3 to be maintained at a suitable tension.

This general operation of the apparatus will be made more clear from a consideration of the structures shown in Figs. 2 and 3.

Each of the devices may include a suitable base and housing 10 and a removable front panel 11. Journaled in the housing is a shaft 12 capable of being driven by a motor as, for example, by means of the pulley 13 and a belt 14. An electromagnetic driving member comprising a disc 15 is carried by the shaft 12. Electromagnetic coils are carried by the member 15, one set of coils being shown in section in Fig. 3. As there shown, the coils 16 and 17 are provided with cores attached to the member 15, the cores having pole pieces 18 and 19 respectively with their opposing faces forming a gap. The pairs of coils 16—17, 20—21, etc., are preferably arranged symmetrically around the axis of rotation of member 15 so that the air gaps are circularly arranged around such axis. These various electromagnetic coils of the member 15 are connected to commutator rings 24—25 supplied with current through suitable brushes mounted in a brush block 26 connected to the current input line 27. A shielding member 29 may be carried by the edge of the disc 15.

The reel 1 is carried by the driven shaft 30 journaled in the removable cover plate 11. The inner end of the shaft 30 may be carried by ball bearings 31 within an axial recess in the member 15. Mounted upon the shaft 30 is an armature member 32 in the form of a disc or spider having a cylindrical flange, such flange being adapted to extend into the air gaps between the pole pieces of the electromagnets as, for example, between the pole pieces 18 and 19.

It has been found that in order to produce uniform non-fluctuating, non-chattering drive of the shaft 30, that portion of the armature member 32 which extends into the gaps of the electromagnetic devices must be perforated, apertured or

otherwise treated so as to permit the flux to pass through the armature member periodically. The total area of these openings in the armature member must bear a particular relationship to the cross-sectional area of the gaps intercepted by the armature member. The area of a gap, as used herein, may be defined as the surface area of one face of a pole piece forming a gap with a similar pole piece. For example, the area of the face or pole piece 18 constitutes the area of the gap. In the event four sets of electromagnetic coils are employed as shown in Fig. 2, the total air gap area is four times the face area of the pole piece 18. It has been found that the area of the apertures or openings in the driven or armature member 32 should comprise from about 40% to 110% of the total area of the air gaps intercepted by such driven member 32. Although the total area of the apertures may equal or even slightly exceed the total area of the air gaps, a single aperture should not have an area in excess of the area of an air gap. For this reason, the apertures formed in the driven member 32, such as the apertures 35 and 36, are preferably of the same number or more numerous than the number of air gaps.

It is to be understood that the shaft 30 may carry either a reel, bobbin, spindle or other appropriate device. The reel, bobbin or other device should preferably be light in weight so that the entire driven assembly including the driven member 32, shaft 30 and reel 1, has a relatively low inertia. The driven member 32 may be made of aluminum, which is a non-magnetic material. In order to further smooth the operation of the device, it has been found desirable to employ a shielding member 29 attached to the driving member 15 and in most cases it is desirable that the motor 6 used in driving the shaft 12 and the driving member 15 be somewhat removed from the shaft 12 and not directly connected thereto. It is for this reason that a belt drive 14 is shown connecting the motor 6 to the pulley 13 and shaft 12.

It will be evident that rotation of the shaft 12 and member 15 will generate eddy currents within the driven member 32 and normally cause the driven member 32 to rotate in the same direction as the member 15. Since there is no mechanical connection between the member 32 and the driving disc 15 or shaft 12 and the rotor 32 is not in mechanical contact with the electromagnets carried by the member 15 but instead simply extend into the air gaps between the poles of the electromagnets, the shaft 30 can be stopped (due to tension on the filamentary material carried by the reel 1) without subjecting such filamentary material to excessive tension. The low inertia of the driven assembly permits almost instantaneous pick-up as soon as the filamentary material is free to move.

As shown in Fig. 1, the current supply to the brushes 26 may include a variable resistance 40 which is automatically varied as by means of a lever arm 41 pivotally mounted as at 41', said lever arm being provided with a roller at the free end, such roller riding upon the accumulated film 3 within the reel 1. In this manner, the amount of current supplied from a source 43 is automatically varied in accordance with the amount of film within the reel 1, so that a greater magnetic flux passes through the air gaps when a smaller amount of film is carried by the reel 1, and vice versa. In this manner, a substantially uniform linear speed of film being taken up by

a reel can be maintained. A similar variable resistance device is applied to the device 7.

Another variable resistance, generally indicated at 42, may be included in the current supply line for the purpose of establishing the overall effectiveness of the electromagnetic means carried by the member 15. Although either alternating or direct current may be used in energizing the electromagnetic devices, the use of direct current is preferred when the filamentary material comprises strip film used in the recording or reproduction of sound.

The motors 6 and 8 must be separately supplied with current or they may be supplied with current from the same source 43. In some instances it may be desirable to somewhat vary the speed of the motors 6 and 8 by introducing a variable resistance into the supply lines, such variable resistance being actuated by changes in the amount of filamentary material carried by the reels, bobbins, or the like. In most instances, however, the motors 6 and 8 may be run at a constant speed.

It is to be understood that the device described in Figs. 2 and 3 is illustrative of but one form of the present invention. The method of this invention may be used in devices of various forms and the apparatus and method may be employed to very good advantage in numerous industries and forms of equipment. Coin-actuated machines for simultaneously reproducing sound and projecting pictures may include an apparatus of the character described herein to good advantage.

This application is a continuation-in-part of application Serial No. 251,199 filed January 16, 1939, now abandoned.

All changes, modifications, uses and adaptations of the invention coming within the scope of the appended claims are embraced thereby.

I claim:

1. An apparatus for moving filamentary material which comprises: a supply reel for filamentary material, a take-up reel for material from said supply reel, an electromagnetic means associated with each of said reels, each thereof including a rotatable driving field member provided with electromagnets having pole pieces forming circularly arranged air gaps; means for driving said electromagnetic means in opposite directions; a driven armature member extending into air gaps of said electromagnets, said driven member being connected to one of said reels, that portion of said driven member extending

into said air gaps being provided with openings, the total area of said openings comprising from about 40% to 110% of the total area of faces of the pole pieces, whereby filamentary material carried by and extending between said reels may be maintained under tension, a positive drive mechanism in operative engagement with said filamentary material between said reels and adapted to control the travel of filamentary material from one reel to another, and means adapted to vary the current to said electromagnets in accordance with changes in the amount of filamentary material on each of said reels.

2. A pair of rotatable reels carrying portions of a common strip of filamentary material, each reel being connected to an axially symmetrical armature member of non-magnetic material, a field member unconnected with said reel, such field member carrying pole pieces forming circularly arranged air gaps, the edge area of the armature member extending into the air gaps, such edge area being provided with openings therethrough, the total area of the openings comprising from about 40% to 110% of the total area of faces of the pole pieces; separate means for positively driving each of said field members in opposite directions and means actuated by variations in the amount of filamentary material on the reels for varying current supplied to the field members.

3. A pair of rotatable reels adapted to receive portions of a common strip of filamentary material, each reel being connected to an axially symmetrical armature member of non-magnetic material, a field member unconnected with said reel, such field member carrying pole pieces forming circularly arranged air gaps, the edge area of the armature member extending into the air gaps, such edge area being provided with openings therethrough, the total area of the openings comprising from about 40% to 110% of the total area of faces of the pole pieces; separate means for positively driving each of said field members in opposite directions; means actuated by variations in the amount of filamentary material on the reels for varying current supplied to the field members and a separate positive drive mechanism in operative engagement with the filamentary material at a point between the reels and adapted to control the travel of the filamentary material from one reel to the other.

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