June 2, 1931. M. P. HOLMES 1,808,224

MINING MACHINE

Filed May 22, 1929 2 Sheets-Sheet 1

Fig. 1.

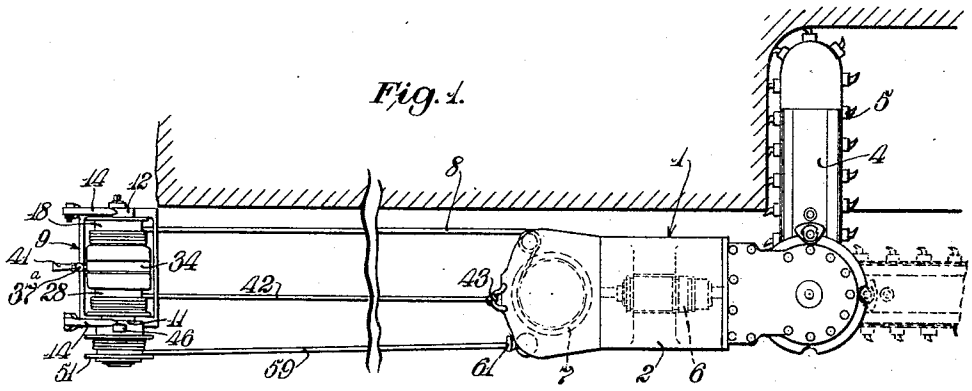


Fig. 2.

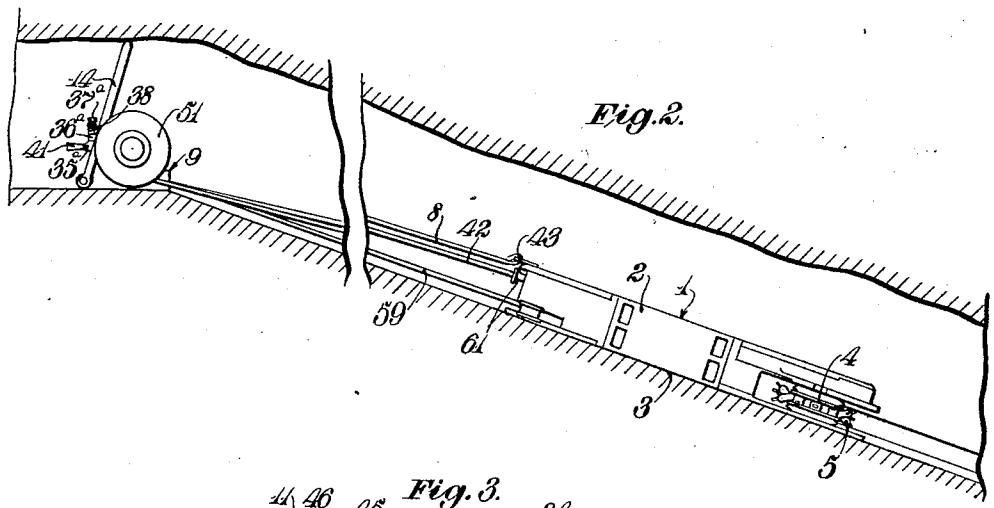
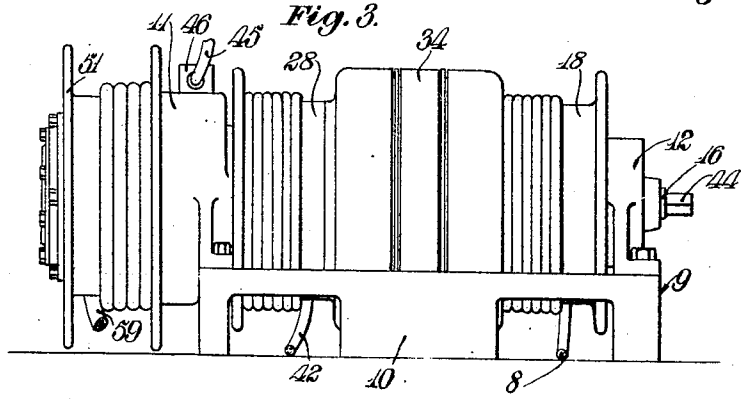


Fig. 3.



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Fig. 4.

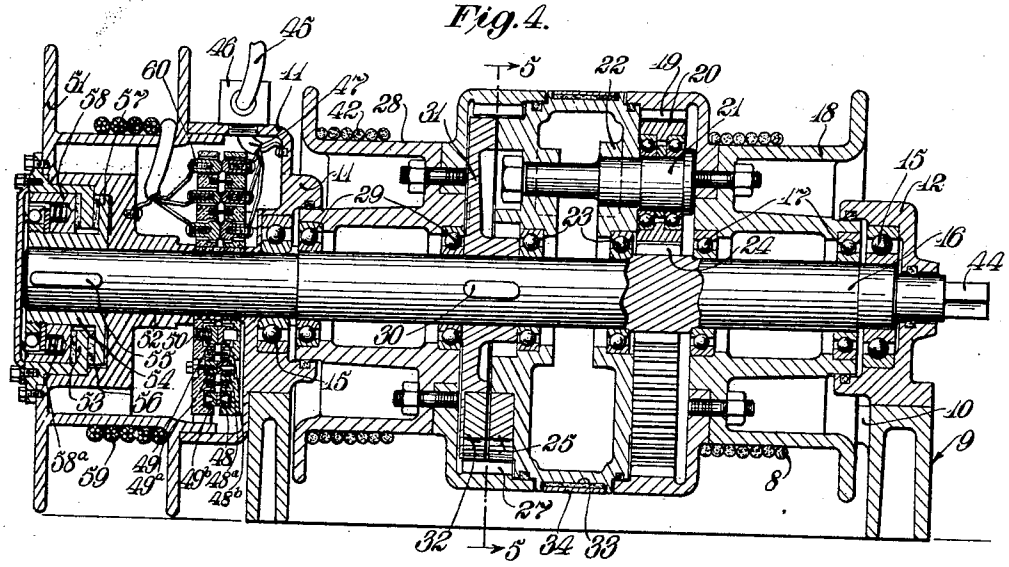


Fig. 6.

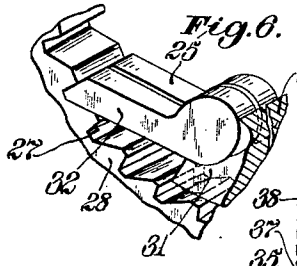


Fig. 5.

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Patented June 2, 1931 1,808,224

UNITED STATES PATENT OFFICE

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MINING MACHINE

Application filed May 22, 1929. Serial No. 365,168.

This invention relates to mining machines and more particularly pertains to coal mining machines of the flexibly fed, bottom cutting type.

In cutting coal in seams which are steeply inclined, it is the common practice to feed the machine up a pitch during the cutting operation, this being a better method for a number of reasons. During this cutting operation the resistance to movement of the machine is, of course, substantially greater than during cutting on the level mine floor, for not only must the resistance of the cutter opposed by the coal be overcome, but in addition the weight of the machine is in part supported by the flexible feeding means employed in the traction of the machine during cutting, thereby causing a substantially greater load to be imposed upon the feeding means than is present under normal cutting conditions. As a result the possibility of breakage of the flexible feeding means is materially increased, and it is therefore desirable to provide in some manner for the safety of the operator and the machine in the event of the breakage of the flexible feeding means or its driving mechanism. Even under the conditions which exist during cutting on the level mine floor the jack to which the flexible feeding element is secured is apt to slip and this possibility also gives rise to a need of additional safety provision in cutting up a steep pitch. Moreover, in the event that the motor is stopped for any reason while the machine is cutting up a steep pitch, it is possible with certain types of feed operating gearing for the weight of the machine to cause the feed gearing to turn backwards and the machine to slide back down the incline.

A primary object of this invention is to provide in a coal mining machine of the flexibly fed, bottom cutting type adapted to operate in a steeply inclined coal seam, improved safety means whereby in the event of breakage of the flexible feeding means for the machine or the driving mechanism therefor the machine will be held automatically against uncontrolled movement down the steep pitch. Another object of this invention is to provide an improved coal mining machine having an improved safety device associated with the machine feeding mechanism whereby when the machine is operating on a steep pitch and the machine feeding mechanism fails for any reason, the safety device will automatically prevent uncontrolled movement of the machine down the incline. A further object is to provide an improved safety mechanism adapted to be associated with a mining machine of the aforesaid type for the purpose of providing an auxiliary flexible connection together with means for controlling the length of said connection normally operative to wind in the connection as the flexible feeding element is wound in and automatically operative to prevent paying out of said auxiliary connection, whereby failure of the feeding means will not result in the machine sliding back down the incline with the possibility of injury to the operator and damage to the machine. Still another object of this invention is to provide an improved safety device associated with a coal mining machine and operated by the mining machine feeding mechanism, the improved safety device also including means for complementing the feed cable of the machine to aid in the propulsion of the machine up the incline. These and other objects and advantages of this invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one embodiment which the invention may assume in practice.

In these drawings,—

Fig. 1 is a diagrammatic plan view and Fig. 2 a diagrammatic side elevational view illustrating a machine operating up an incline and having associated therewith the illustrative embodiment of the improved safety device.

Fig. 3 is a front elevational view of the improved safety device.

Fig. 4 is a central longitudinal vertical sectional view of the improved safety device shown in Fig. 3.

Fig. 5 is a transverse vertical sectional

view taken substantially on line 5—5 of Fig. 4, with parts in different position.

Fig. 6 is a detail perspective view illustrating the improved ratchet and double pawl mechanism.

In this illustrative embodiment of the invention there is shown a longwall coal mining machine generally designated 1, which herein may be of the same general type as that disclosed in a copending application, Seral No. 136,446, filed September 20, 1926, although it is obvious that the improved safety device may be used equally as well with mining machines of various other types. The machine includes a machine frame 2 slidable on its bottom 3 on the mine floor and having pivotally mounted thereon at its rear end upon a vertical axis a horizontal plane cutter bar 4 carrying on its margin a usual cutter bit carrying chain 5. The cutter chain 5 is driven from a usual motor 6, herein an electric motor, which also drives the machine feeding mechanism including a winding element or drum 7 rotatable on a vertical axis on the front end of the machine frame and a cooperating flexible feeding element or rope 8 wound upon the winding drum. As is usual in mining machines of the type disclosed, the cutter bar 4 is adapted to be swung from the dotted line position in Fig. 1 to the full line position in that figure to effect its sumping cut, the cutter bar thereafter being rigidly locked to the machine frame in a usual manner and the machine propelled bodily upwardly along the inclined coal face under the traction of the feed drum 7 and cooperating feed cable, to insert a cut beneath the coal face. In the event of failure of the flexible feeding means, for instance in case of the breakage of the feed cable, it is desirable to provide some means for preventing uncontrolled movement of the machine down the incline and to this end there is provided an improved safety device generally designated 9 to prevent the occurrence of this possibility.

The improved safety device 9 comprises a base frame 10 having upstanding end supports 11 and 12. Formed integral with the base frame at the rear side thereof are perforated lugs 13 to which adjustable roof jacks 14 are pivotally connected, these roof jacks being adapted to engage the mine roof to hold the safety device rigidly in position on the mine floor at the top of the incline. As shown in Fig. 4, journaled within ball bearings 15 carried within the upstanding supports 11, 12 of the base frame is a horizontal transversely extending shaft 16. Journaled on the shaft 16 on ball bearings 17 is a winding drum 18 upon which the free end of the feed cable 8 is wound. Secured to this drum 18 and rotatable therewith is an internal gear 19 meshing with planetary gears 20 rotatably supported on transverse studs 21 carried by a rotatable reaction member 22. The member 22 is journaled on ball bearings 23 supported by the shaft 16. As illustrated, meshing with the planetary gears 20 is a spur pinion 24, herein preferably formed integral with the shaft 16. Also carried by the rotatable reaction member 22 is a plurality of pawls 25 which are maintained, by spring-pressed plungers 26, in engagement with ratchet teeth 27 formed on a winding drum 28 which is herein called the safety drum. This drum 28 is journaled on ball bearings 29 supported by the shaft 16. Keyed at 30 to the shaft 16 is a drive member 31 which carries a plurality of spring pressed pawls 32 similar to the pawls 25 mentioned above, and likewise engaging the ratchet teeth 27 on the drum 28. The rotatable reaction member 22 is provided with a peripheral groove 33 with which a brake band 34 cooperates. The operating means for this brake band comprises a bolt 35 pivotally connected at 35^a to the rear side of the base frame 10, one end of the brake band 34 also being pivotally connected to the base frame at 35^a. This bolt 35 extends upwardly through an opening 36 formed in a lug 36^a suitably fixed to the other end of the brake band 34. Engaging the upper surface of this lug is a washer 37 and interposed between this washer and a nut 37^a on the bolt and encircling the bolt is a coil spring 38. The spring 38 normally tends to maintain the brake band in its applied position. The means for releasing the brake band comprises a nut member 39 threadedly connected at 40 to the bolt 35 and having a pivoted operating handle 41. It is evident that when the operator grasps the handle 41 and rotates the nut 39 in the proper direction the lugged end 36^a of the brake band 34 is moved upwardly against the tension of the spring 38, thereby releasing the brake. When the operator releases the handle 41 the screw threads on the bolt and nut are of such an inclination that the spring 38 causes the nut 39 to be automatically rotated into its released position. Wound upon the safety drum 28 is a safety cable 42 having its free end connected in a suitable manner, as at 43, to the frame of the mining machine 1. From the foregoing it is evident that when the feed cable 8 is wound in by the feed drum 7, the drum 18 of the safety device is rotated, thereby causing rotation of the internal gear 19, planetary gears 20 (it being understood that the reaction member is held stationary and the gears 20 rotate about stationary axes at that time), and spur pinion 24 secured to the shaft 16, and as a result the safety drum 28 is driven through the drive member 31 secured to the shaft 16 and the pawls 32 engaging the ratchet teeth 27 carried by the drum 28. Therefore as the drum 18 is rotated by

the machine feeding mechanism, the drum 28 is rotated to wind in the cable 42. As the drum 28 rotates in a direction to wind in the cable 42, the pawls 25 carried by the reaction member 22 slip freely over the ratchet teeth 27 on the drum. To enable drums 18 and 28 to be manually rotated one end of the shaft 16 is made square at 44 to receive a suitable wrench or hand lever.

Electrical energy may be supplied to the driving motor 6 through a conductor cable 45 connected through a usual connector plug 46 carried by the support 11 on the base frame. The connector plug 46 is connected through a conductor cable 47 to stationary slip rings 48, 48a and 48b suitably secured to the support 11 and engaging rotatable slip rings 49, 49a and 49b carried by a rotatable cable reel 51 and resiliently held in engagement with the stationary rings by springs 50. This cable reel is journaled at 52 on the shaft 16 and is driven by the shaft through a friction slip drive clutch 53. This drive clutch comprises a clutch plate carried by a clutch member 54 keyed at 55 to the shaft 16 and frictionally engaging a friction clutch plate 56 on the reel. Slidably mounted on the sleeve portion 57 of the clutch member 54 is a clutch member 58 carrying a clutch plate frictionally held in engagement with the clutch plate on the reel by means of coiled springs 58a. It will thus be seen that this friction clutch is adapted to slip upon overload of the reel or in case the winding in of a conductor cable 59 wound on the reel is prevented. The conductor cable 59 is connected at 60 to the slip rings 49, 49a and 49b and the free end of this cable is connected in a suitable manner as at 61 to the electrical circuit of the driving motor 6.

The operation of the improved safety device will now be briefly described. After the mining machine 1 is suitably positioned at the bottom of the inclined coal face as shown in Fig. 1, and the cutter bar 4 suitably sumped beneath the coal face and locked to the frame, the feed cable 8 is extended upwardly along the face and is wound upon the winding drum 18 of the safety device 9. The safety cable 42 wound upon the safety drum 28 is then extended down the pitch and is connected at 43 to the frame of the machine. The conductor cable 45 is then connected to any suitable source of power and the cable 59 is unreeled from the reel 51 and extended down the face and connected to the machine at 61. Following this the handle 41 is in the position shown in Fig. 5, and the brake band 34 is in its applied position, the spring 37 automatically maintaining the brake band applied. The operator then suitably connects the feed drum 7 to the driving motor 6 and the feed cable 8 is wound in, causing the machine to be fed bodily up the incline and at the same time effecting rotation of the winding drum 18 in a direction to pay out the feed cable 8. As this drum 18 is rotated, the drum 28 is driven in a direction to wind in the cable 42 through the internal gear 19, planetary gears 20, spur pinion 24 on the shaft, the pawl carrier 31 and pawls 32 carried thereby, and the ratchet teeth 27 formed on the drum 28. As the drum 28 is rotated in a direction to wind in the cable 42 the ratchet teeth 27 on the drum slip freely over the pawls 25 carried by the stationary reaction member 22, this reaction member being held against rotation by the brake band 34. As the drum 28 is rotated, the cable reel 51 is also rotated and therefore as the machine moves up the incline the conductor cable 59 is also wound in and maintained taut. It is obvious that the rate of rotation of the drum 18 relative to the rate of rotation of the drum 28 may be so proportioned as to cause the drum 28 to impart a substantial pull to the cable 42 sufficient to aid materially the feed cable 8 in propelling the machine up the incline, or, if desired, the drum 28 may be rotated with only enough power to maintain the cable 42 taut. However, in this instance, the pull imparted to the feed cable 8 by the winding element may be approximately 4,800 lbs., and the parts may be so proportioned that when the cable 8 is wound in by the feeding element 7 approximately twenty-two and one-half inches a minute, the cable 8 is paid out by the drum 18 substantially four and one-half inches a minute. As the gear ratio between the safety drum 28 and the drum 18 is four to one, when the drum 18 is rotated to pay out the feed cable four and one-half inches a minute the drum 28 is rotated to wind in the cable 42 substantially eighteen inches a minute and the pulling force transmitted thereby is substantially 1,200 lbs. Therefore the 4,800 lb. pull on the feed cable 8 is complemented by the 1,200 lb. pull of the safety cable 42, and as a result a machine feeding force of substantially 6,000 lbs. and a machine feeding speed of eighteen inches a minute are obtained. It is obvious that the proportion of the parts and gear ratio may be varied as desired, it being possible to attain any desired pull on the cables 8 and 42 and any desired feeding speed. Moreover, it will be noted that although the drums 18 and 28 are shown to be of equal diameters, it is obvious that differential drums may be used with a suitable change in the gear ratio between the drums so that the same ultimate result may be attained as with drums of equal size.

In the event of failure of the feed cable 8 or the driving mechanism for the feed drum 7, uncontrolled movement of the machine down the incline is prevented by the safety cable 42. Rotation of the drum 28 in a direction to pay out the cable 42 is prevented by the pawls 25 carried by the stationary reac-

tion member 22 and engaging the ratch teeth 27 on the drum 28, the safety cable thereby being prevented from being paid out and thereby holding the machine against movement down the pitch. If, however, it is desired to move the machine down the incline under control of the safety device, this may be accomplished simply by releasing or partially releasing the brake band 34, permitting the reaction member 22 to rotate and thereby permitting the drum 28 to be slowly rotated to pay out the cable 42. It is obvious that as the safety cable 42 is paid out by the drum 28 the conductor cable 59 is unwound from the cable reel 51 and the rope 8 from reel 18.

As a result of this invention an improved mining machine is provided having associated therewith improved safety means whereby when the machine is operating up a steep incline and in event of the failure of the flexible feeding means, uncontrolled movement of the machine down the incline is prevented by the safety device. It will further be evident that an improved safety device is provided which is operated by the feeding mechanism of the machine and is so designed that the safety cable complements the feed cable in propelling the machine up the incline. It will further be noted that an improved safety device is provided which is of an exceedingly rugged and compact construction, the device being readily portable and adapted to be quickly set up. These and other advantages of this invention will, however, be clearly apparent to those skilled in this art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

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

1. The combination with a mining machine adapted to operate on a steeply inclined coal face and having feeding means for feeding the machine upwardly along the coal face, of a safety device operated by the machine feeding means and complementing the latter in the feeding of the machine up the incline and operative upon failure of the machine feeding means to prevent automatically uncontrolled movement of the machine down the incline.

2. The combination with a mining machine of the flexibly fed bottom cutting type adapted to operate on a steeply inclined coal face and having feeding means including a flexible feeding means and feed operating means cooperating therewith and adapted to draw in the flexible feeding means to effect movement of the machine up the incline, of a safety device operated by the machine feeding means and complementing the latter in the feeding of the machine up the incline and operative to prevent uncontrolled movement of the machine down the incline upon failure of the flexible feeding means and including a safety flexible connection, winding means associated therewith, and means cooperating with said winding means to maintain the free length of the safety flexible connection substantially the same as the free length of the flexible feeding means.

3. The combination with a flexibly fed mining machine adapted to operate on a steeply inclined coal face and having feeding means including a feed operating member and a cooperating flexible feeding element for feeding the machine upwardly along the coal face, of a safety device operated by the flexible feeding element and complementing the latter in the feeding of the machine up the incline for preventing automatically uncontrolled movement of the machine down the incline upon failure of the flexible feeding element.

4. The combination with a flexibly fed mining machine adapted to operate on a steeply inclined coal face and having feeding means for feeding the machine upwardly along the coal face, of a safety device operated by the machine feeding means and complementing the latter in the feeding of the machine up the incline and operative upon failure of the machine feeding means to prevent automatically uncontrolled movement of the machine down the incline, said safety device including means releasable at will to permit controlled movement of the machine down the incline.

5. In an apparatus of the character described, a support, a rotatable shaft journaled thereon, driving means for said shaft adapted for actuation by the feeding mechanism of a mining machine and including a winding drum, a second relatively rotatable winding drum separate from the machine feeding mechanism and rotatable by said shaft and adapted to cooperate with a flexible safety member, and ratchet and pawl mechanism comprising elements rotatable relative to each other, one of said elements being operatively connected with one of said rotatable members and the other normally held stationary.

6. In an apparatus of the character described, a support, a rotatable shaft member journaled thereon, driving means for said shaft member adapted for actuation by the feeding mechanism of a mining machine and including a winding drum, a relatively rotatable winding member separate from the machine feeding mechanism and concentric with and rotatable by said shaft member and adapted to cooperate with a flexible safety

member, and ratchet and pawl mechanism comprising elements rotatable relative to each other, one of said elements being operatively connected with one of said rotatable members and the other normally held stationary.

7. In an apparatus of the character described, a support, a rotatable shaft journaled thereon, driving means for said shaft adapted for actuation by the feeding mechanism or a mining machine and including a winding drum, a relatively rotatable winding member separate from the machine feeding mechanism and rotatable by said shaft and adapted to cooperate with a flexible safety member, and ratchet and pawl mechanism comprising elements rotatable relative to each other, one of said elements being operatively connected with said winding member and the other normally held stationary.

8. In an apparatus of the character described, a support, a winding drum journaled thereon, driving means for said drum adapted for actuation by the feeding mechanism of a mining machine, a second relatively rotatable winding drum on said support separate from the machine feeding mechanism and driven by said first mentioned winding drum and adapted to cooperate with a flexible safety member, said first mentioned winding drum being adapted to effect rotation of said second mentioned winding drum in a direction to wind in its cooperating cable, and means for preventing rotation of said second mentioned winding drum in the reverse direction when rotation of said first mentioned winding drum is disconnected from its driving means.

9. In an apparatus of the character described, a support, a winding drum journaled thereon, driving means for said drum adapted for actuation by the feeding mechanism of a mining machine, a second relatively rotatable winding drum journaled on said support and driven by said first mentioned drum and adapted to cooperate with a flexible safety member, and ratchet and pawl mechanism for permitting rotation of said second mentioned winding drum in one direction while preventing rotation of said drum in the other direction.

10. In an apparatus of the character described, relatively rotatable winding members, a flexible driving element engaging one of said members for driving the same and a safety flexible element engaging said other member, said member engaging said flexible driving element constituting a driving member for said safety element engaging member, and means for controlling rotation of said safety element engaging member to pay out said safety flexible element at a controlled rate and including manually regulatable means cooperating with said safety element engaging member and releasable at will to permit free rotation of said safety element engaging member.

11. In an apparatus of the character described, relatively rotatable winding members, a flexible driving element in engagement with one of said members for driving the same and a safety flexible element engaging said other member, said member engaging said flexible driving element constituting a driving member for said safety element engaging member, and frictionally controlled means cooperating with said safety element engaging member to effect rotation thereof in a direction to draw in said safety flexible element, said safety element engaging member being operative upon release of its frictional control to rotate in a direction to pay out said safety flexible element at a controlled rate.

12. In an apparatus of the character described, relatively rotatable winding members, a flexible driving element engaging one of said members for driving the same and a safety flexible element engaging said other member, said member engaging said flexible driving element constituting a driving member for said safety element engaging member, and means cooperating with said safety element engaging member to effect rotation thereof in a direction to draw in said safety flexible element and having associated therewith a ratchet means for preventing reverse rotation of said safety element engaging member.

13. In an apparatus of the character described, relatively rotatable winding members, a flexible driving element engaging one of said members for driving the same and a safety flexible element engaging said other member, said member engaging said flexible driving element constituting a driving member for said safety element engaging member, and means cooperating with said safety element engaging member to effect rotation thereof in a direction to wind in said safety flexible element and having associated therewith frictionally controlled ratchet means for preventing reverse rotation of said safety element engaging member and releasable at will to permit free reverse rotation of said safety member.

14. In an apparatus of the character described, relatively rotatable members, a flexible driving element cooperating with one of said members for driving the same and a safety flexible element engaging said other member, said member engaging said flexible driving element constituting a driving member for said safety element engaging member, and driving connections between said driving member and said safety element engaging member to effect driving of said latter member at a different rate from that of said driving member and including means releasable

at will to permit free relative rotation between said members.

15. In an apparatus of the character described, relatively rotatable members, a flexible driving element cooperating with one of said members for driving the same and a safety flexible element engaging said other member, said member engaging said flexible driving element constituting a driving member for said safety element engaging member, driving connections between said driving member and said safety element engaging member to effect driving of said latter member at a different rate from that of said driving member and including controlling means operable at will to vary the relative rates of rotation of said members.

16. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said driving member and said safety element engaging member whereby said driving member upon rotation thereof in one direction effects rotation of said safety element engaging member at a higher speed in the opposite direction.

17. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said driving member and said safety element engaging member whereby said driving member upon rotation thereof in one direction effects rotation of said safety element engaging member at a higher speed in the opposite direction, and controlling means for said driving connections whereby the rate of rotation of said safety member may be varied.

18. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said driving member and said safety element engaging member whereby said driving member upon rotation thereof in one direction effects rotation of said safety element engaging member at a higher speed in the opposite direction, and control means for said driving connections operable at will to permit or prevent rotation of said safety element engaging member in the reverse direction.

19. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members for driving the same and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, and differential gearing between said members whereby said driving member upon rotation effects rotation of said safety element engaging member at a different speed.

20. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, a differential gearing between said members whereby said driving member upon rotation in one direction effects rotation of said safety element engaging member at a different speed in the opposite direction.

21. In an apparatus of the character described, relatively rotatable winding members, a flexible driving element engaging one of said members for driving the same and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said members including a power transmission device adapted to drive in one direction and adapted to automatically release upon rotation of said safety element engaging member in the reverse direction.

22. In an apparatus of the character described, relatively rotatable winding members, a flexible driving element engaging one of said members and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said members including an element which must be held stationary to effect driving of said safety element engaging member and means for holding said third mentioned element stationary; releasable at will to permit free rotation of said safety element engaging member in one direction.

23. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said members including an element which must be held stationary to effect driving of said safety element engaging member and means for holding said third mentioned ele-

ment stationary, releasable at will to permit free rotation of said safety element engaging member in one direction, and a ratchet and pawl device for preventing rotation of said safety member in the reverse direction.

24. In an apparatus of the character described, relatively rotatable winding members, a flexible driving element engaging one of said members and a safety flexible element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, and driving connections between said members including a slip control device having an element which must be held stationary to effect drive of said safety element engaging member and means for holding said third mentioned element stationary releasable at will to permit said safety element engaging member to rotate freely in one direction.

25. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members, a safety flexible element engaging another member, and a flexible power conductor element engaging a third member, said flexible driving element engaging member constituting a driving member for said other members, and driving connections between said driving member and said other members.

26. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members, a safety flexible element engaging another member, and a flexible power conducting element engaging a third member, said flexible driving element engaging member constituting a driving member for said other members, and driving connections between said driving member and said other members including means operable at will to permit free rotation of said safety element engaging member and said power conductor engaging member while said driving member is continuously rotated by its cooperating flexible element.

27. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members, a safety flexible element engaging another member, and a flexible power conducting element engaging a third member, said flexible driving element engaging member constituting a driving member for said other members, and driving connections between said driving member and said other members to effect drive thereof in one direction and means for automatically preventing rotation of said members in the reverse direction.

28. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members, a safety flexible element engaging another member, and a flexible power conducting element engaging a third member, said flexible driving element engaging member constituting a driving member for said other members, and driving connections between said driving member and said other members to effect drive thereof in one direction and means for automatically preventing rotation of said members in the reverse direction, said means being releasable at will to permit free rotation of said safety and power conductor engaging members in the reverse direction.

29. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a flexible safety element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said driving member and said safety element engaging member whereby said driving member upon rotation thereof in a direction to pay out its cooperating flexible element effects rotation of said safety element engaging member at a higher speed in a direction to draw in its cooperating flexible safety element.

30. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a flexible safety element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said driving member and said safety element engaging member whereby said driving member upon rotation thereof in a direction to pay out its cooperating flexible element effects rotation of said safety element engaging member at a higher speed in a direction to draw in its cooperating flexible safety element, and controlling means for said driving connections whereby the rate of rotation of said safety element engaging member may be varied.

31. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a flexible safety element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, driving connections between said driving member and said safety element engaging member whereby said driving member upon rotation thereof in a direction to pay out its cooperating flexible element effects rotation of said safety element engaging member at a higher speed in a direction to draw in its cooperating flexible safety element, and control means for said driving con-

nections operable at will to permit or prevent rotation of said safety element engaging member in a direction to pay out its cooperating flexible safety element.

32. In an apparatus of the character described, relatively rotatable members, a flexible driving element engaging one of said members and a flexible safety element engaging said other member, said flexible driving element engaging member constituting a driving member for said safety element engaging member, a differential gearing between said members whereby said driving member upon rotation in a direction to pay out its cooperating flexible element effects rotation of said safety element engaging member at a different speed in a direction to draw in its cooperating flexible safety element.

In testimony whereof I affix my signature.

MORRIS P. HOLMES.