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E. G. PARVIN
REELING MECHANISM
Filed Dec. 2, 1939

2,237,112

3 Sheets-Sheet 1

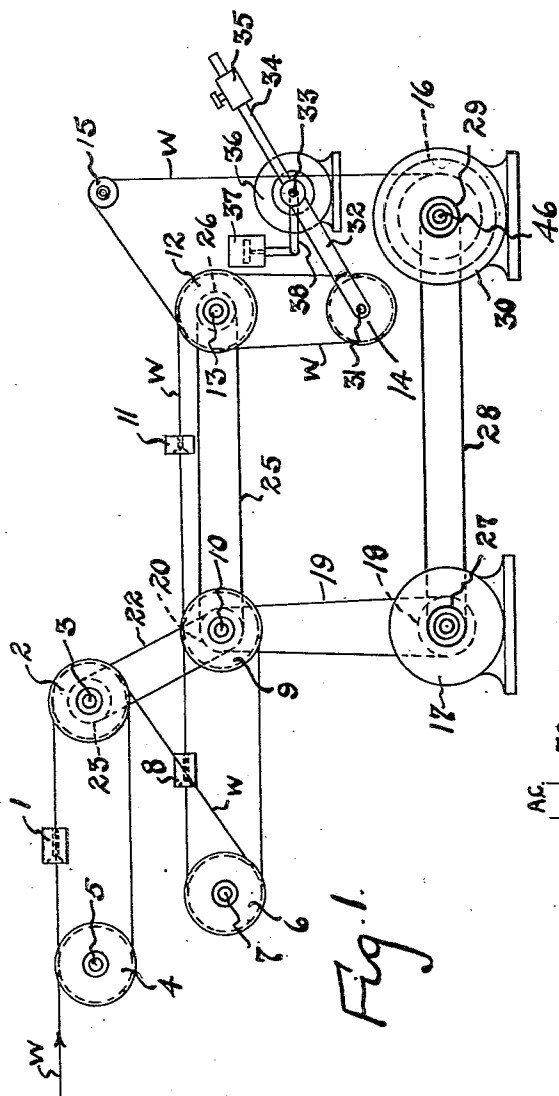


Fig. 1.

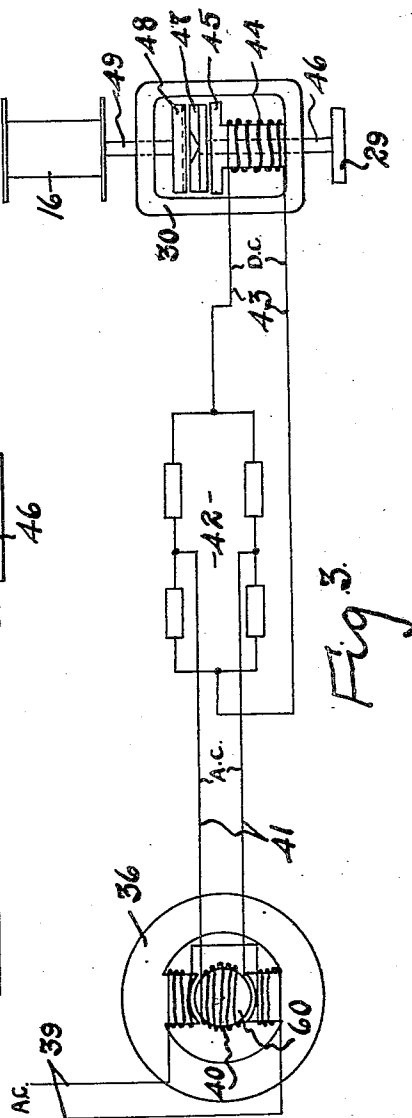


Fig. 3.

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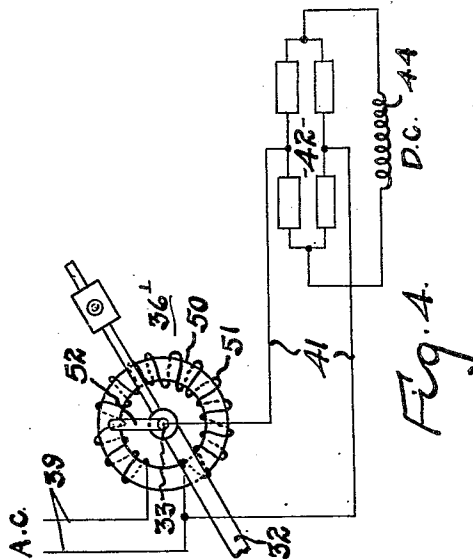
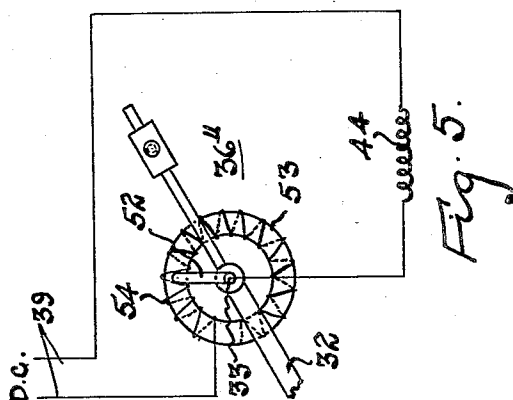
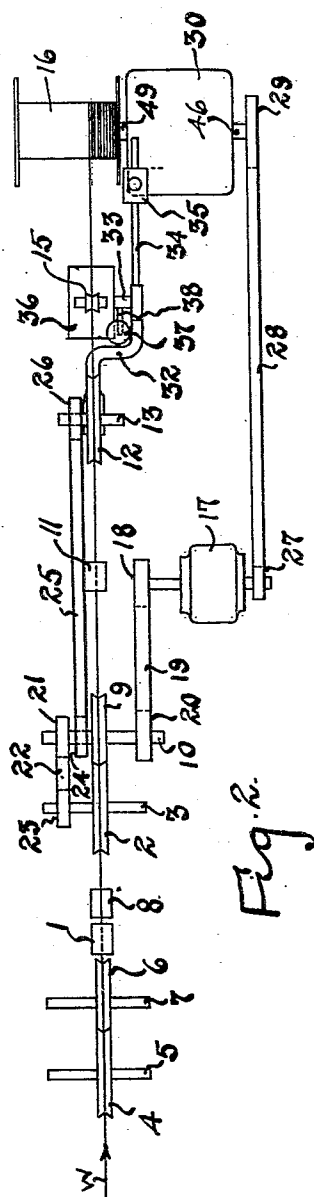
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3 Sheets-Sheet 2



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REELING MECHANISM

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3 Sheets-Sheet 3

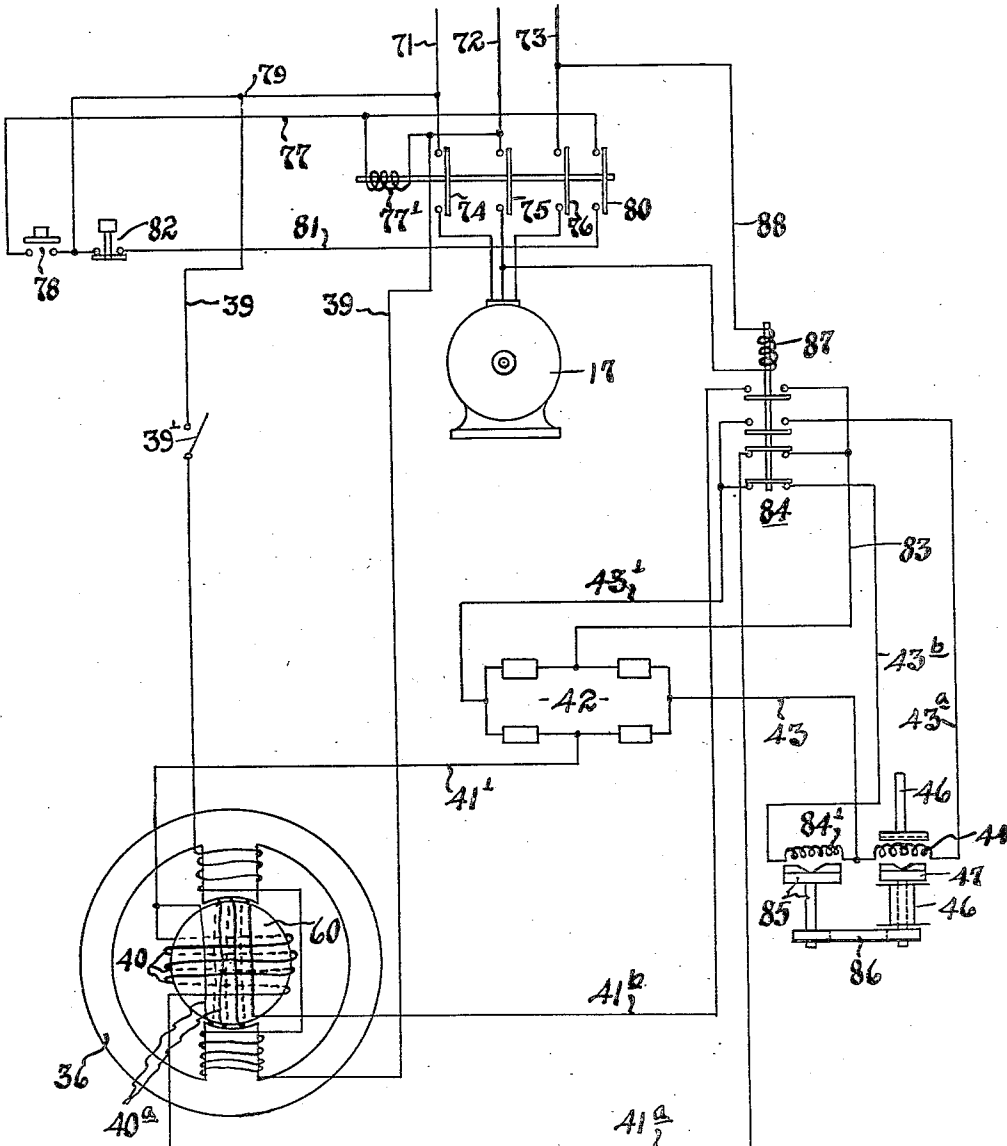


Fig. 6.

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UNITED STATES PATENT OFFICE

2,237,112

REELING MECHANISM

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Application December 2, 1939, Serial No. 307,203

10 Claims. (Cl. 242—45)

This invention relates to improvements in reeling mechanism, particularly of the type employed with wire drawing, coating, annealing, and the like apparatus, with particular relation to the drive and the control thereof for the takeup reel or spool.

The main object of this invention is the provision of an automatically acting takeup reel operating mechanism controlled by the wire itself for maintaining a substantially uniform tension in the wire as it is wrapped onto the takeup reel while compensating for the gradual increase in diameter of the coil as the reel is filled.

A more specific object of this invention is the provision in a mechanism of this type of a magnetic slip clutch drive for the takeup reel controlled by the tension in the wire, any desired adjustment for which can be established and maintained, whereby the wire is wrapped onto the takeup reel under sufficiently uniform tension.

A still further object of the invention is the provision of a variable power supply for energizing the magnetic slip clutch wherein the variations in the power supply are controlled directly by the tension in the wire.

Other and more specific objects of this invention will become apparent from the following detailed description when taken in connection with the attached drawings.

This invention resides substantially in the combination, construction, arrangement, and relative location of parts, all in accordance with this disclosure.

In the accompanying drawings,

Figure 1 is a diagrammatic elevational view of an apparatus in accordance with this invention as applied to a wire drawing machine;

Figure 2 is a diagrammatic top plan view thereof;

Figure 3 is a diagrammatic circuit layout illustrating the manner of controlling the supply of energy to the magnetic slip clutch;

Figures 4 and 5 are, respectively, auto-transformer and variable resistance arrangements which may be used in place of the arrangement of Figure 3; and

Figure 6 is a diagrammatic layout of a modified arrangement in accordance with this invention, employing an automatically acting brake.

One of the oldest and most difficult problems which has long existed in the reeling art and for which many unsuccessful solutions have been suggested is that of compensating for the increase in diameter of the coil being reeled so as to maintain a uniform tension in the wire being reeled

and hence in the turns on the takeup reel. This difficulty is increasingly noticeable as the speed of the reeling mechanism is increased in accordance with modern demands, and in the case of fine strands as the diameter of the strand decreases. For example, in the wire drawing, coating and annealing arts, there is extensively encountered today the problem of reeling extremely fine wire, such as, for example, enamel copper wire of a diameter of 0.004 inch. In view of the fact, for example, that a pound of wire this small runs to great lengths, it is desirable in the handling thereof to have a rapidly operating machine. The apparatus of this invention has demonstrated itself to be capable of reeling, under a substantially uniform tension, a wire of this diameter at the rate of a mile a minute. In order to attain such remarkable results it is obvious that the reeling mechanism must be exceedingly sensitive while at the same time stable and capable of responding rapidly to any changes in tension in the wire and to compensate faithfully for the increase in diameter of the reel in order to prevent breakage of the wire at such high speeds.

In describing in detail the apparatus illustrated in the drawings, as practical embodiments thereof, it may be noted at the outset that although the reeling mechanism has been shown in connection with a wire drawing machine it is, of course, apparent that it may be used in connection with any type of strand treating machine from which the strand is delivered for reeling onto a reel or spool. Thus the invention, as will become apparent later, may be used not only with wire drawing machines but may be used with wire coating and annealing machines and with all types of machines for treating threads, as in the case of spinning cotton threads, natural and artificial silk threads, and the like.

Referring to Figure 1, the wire W fed from any suitable source moves from the left towards the right through a wire drawing die 1, is wrapped one and a half times around the wheel or pulley 2, back around the wheel or pulley 4, forward again to the wheel or pulley 2, and thence to and partially around the wheel or pulley 6. It then passes through the drawing die 8, which further reduces its diameter, and from there it is wrapped one and a half times around the wheel or pulley 9, travels back around wheel or pulley 6, and thence forward to and through the drawing die 11. From the drawing die 11 it passes partially around the wheel or pulley 12, down to and partially around the wheel or pulley 14, and thence back up to the idler

roller 15. From this roller it passes down onto the takeup reel or spool 16. The wheels 4 and 5 are idler wheels and are mounted upon the shafts 5 and 7, respectively, which are journaled in suitable bearings, not shown. The wheels 2 and 9 are secured to the shafts 3 and 10, respectively, and mounted in suitable bearings, not shown. Shaft 10 is rotated through any suitable form of drive, as for example a belt 19, which cooperates with a pulley 20 on the shaft 10 and a pulley 18 on the shaft of the drive motor 17. A second pulley indicated by the reference numeral 21 secured to shaft 10 is connected by a suitable drive, such as a pulley 22, to a pulley 23 secured to the shaft 3. Pulley 12 is secured to a shaft 13 journaled in suitable bearings, not shown, which shaft is provided with a pulley 26 connected to a pulley 24 on the shaft 10 by means of a belt 25. It may be noted that chain belts, gears, or other suitable forms of drive may be employed instead of belts.

Referring to Figure 3, the takeup reel or spool 16 is mounted on a shaft 49 journaled in the frame of the magnetic slip clutch 30. The inner end of the shaft 49 is provided with a disc 48, preferably of a magnetic material, on which a suitable squirrel cage winding is mounted. Thus the spool 16, shaft 49 and disc 48 rotate as a unit. Mounted in the frame of the clutch is a magnetic field pole 45 having a circular head and having wound on the shank thereof a direct current magnetizing winding 44. Passing axially through the field pole is a shaft 46, on the inner end of which is mounted a magnetizable poled disc 47 and on the inner end of the shaft is a drive pulley 29. The disc 47 is caused to rotate by reason of a belt 28 connecting the pulley 29 with a pulley 27 on the motor 17. The discs 47 and 48 are mounted with respect to each other and disc 47 is mounted with respect to the end face of the field pole 49 so as to provide minimum air gaps.

The full details of construction of a suitable magnetic clutch of this type are set forth in co-pending application Serial No. 280,768, filed June 23, 1939, entitled "Magnetic slip clutch." The pulley or wheel 14 is journaled for rotation on a spindle 31 mounted in the end of a lever 32. This lever is a continuation of a diametrically extending arm 34 upon which a weight is mounted for adjustment in a radial direction. The combined lever 32—34 is secured to a shaft 33 in a device for controlling the amount of current supplied to the magnetic slip clutch, which device is in the form of an induction transformer 36. Also secured to the shaft 33 is a lever 38 which is pivotally connected to a piston in a dash-pot 37 for stabilizing the movement of shaft 33 and the parts connected thereto.

The induction transformer device 36 consists, as is illustrated diagrammatically in Figure 3, of a magnetic field structure having a pair of poles on which are field windings supplied from an alternating current source through the supply leads 39. Mounted in the field flux is a rotor 60, on which is mounted a rotor winding 40 connected by the leads 41 to a full wave alternating current rectifier 42 of any suitable form. The rectifier, which has been shown diagrammatically, may be of the vacuum tube type, the oxide coated dry plate type, or any other available rectifier suitable for the purpose. The direct current output leads 43 of the rectifier are connected to the field winding 44 of the magnetic slip clutch.

In the operation of this apparatus, it will be noted that the wheels 2, 9 and 12 are power driven, and that the wire W is wrapped there-around, so as to be pulled without slipping through the die blocks 1, 8 and 11. The wheels or pulleys 4, 6 and 14 are idlers in that they simply serve to guide the wire and are driven by it. The wire after leaving pulley 12 passes one-half turn around the wheel 14 and returns to pulley 15 over pulley 12. Thus the weighted arm 32—34 is supported by a single loop in the wire W and any change in the tension of the wire travelling to the takeup spool 16 will tend to move shaft 33 through a lever 32. The response in movement of arm 32 to changes in tension of the wire W may be controlled by shifting the weight 35 on the lever 34. The rotary movements of shaft 33 cause a proportionate rotational movement to the rotor 60 and the winding 40 thereon, varying the number of lines of force linking it and thereby varying the A. C. flowing in the leads 41. The result is that the output of the rectifier 42 is likewise varied, changing the strength of the D. C. flowing to the winding 44. As the current increases in winding 44 it will be seen that the force required to cause slippage at the spool 16 will increase, while decreasing the amount of current in winding 44 will decrease the force necessary to cause slippage of the spool 16. Thus, with this arrangement, as the coil on the spool 16 increases in diameter, requiring more wire per turn, the tension in the wire increases, causing clockwise rotation of lever 32 and rotor 60 and reducing the flux linkages for the coil 40, with the result that the current in winding 44 is reduced and the magnetic field thereof weakened. Thus, slippage or relative movement between the driving member 47 and the driven member 48 of the clutch may increase, with the result that the tension in the wire going to the takeup spool returns to a desired pre-set value.

There are other arrangements which may be used in place of the induction transformer. Thus in the arrangement of Figure 4 an auto-transformer 36' is employed comprising a magnetizable core 50 having a winding 51 thereon. This device is provided with a movable contact finger 52 secured to the shaft 33 on which the arm 32 is mounted. The alternating current output leads 41 supply the rectifier 42 as before, which in turn supplies direct current to the winding 44. Thus the auto-transformer provides an arrangement equivalent to the induction transformer for proportioning the current in accordance with the tension in the wire.

An entirely D. C. circuit arrangement may be employed, as illustrated by the variable resistance 36''. In this case a suitable support 53 is provided on which is wound a resistance winding 54, and movable contact finger 52 connected to the shaft 33 moves over the resistance, including more or less of it in the circuit to the winding 44 depending upon the tension in the wire passing to the wheel mounted on the arm 32. In this, as well as in the previous arrangement, the adjustable weight is provided to initially adjust the apparatus for a desired tension which is to be maintained by the apparatus notwithstanding the fact that the reel tends to demand more wire per turn as the coil on there builds up in diameter.

In the arrangement of Figure 6 the principles of this invention have been expanded to include a braking mechanism which goes into action automatically with deenergization of the main

driving motor to gradually bring the takeup reel to a stop without breaking the wire. The action of the brake is controlled in accordance with variations in the tension in the wire, so that as the tension tends to build up the brake energization is decreased, with the result that before the wire can break the strain on it is relieved. With proper adjustment the braking apparatus of this invention acts, in effect, to maintain a substantially uniform tension in the wire as the takeup reel is brought to a stop.

A mechanism which may be incorporated as a part of the system previously described is illustrated diagrammatically in Figure 6. For purposes of illustration, the main driving motor 17 has been illustrated as a three-phase alternating current motor. It may be observed, as will be apparent from the following description, that the circuit arrangement of Figure 6 is, in effect, a more complete disclosure of the arrangement of Figure 3 and embodying therein, and in addition, the braking features.

The energy supply wires from a suitable three-phase alternating current source are shown as comprising the wires 71, 72 and 73 which are connected to the motor 17 through a relay switch, the movable contacts 74, 75 and 76 of which make and break this circuit. They cooperate in accordance with common practice with related pairs of fixed contacts as shown. The relay is operated by means of solenoid winding 77' which is connected at one terminal to the neutral lead 72 of the three-phase circuit. The other terminal is connected to a wire 77 which terminates at one end at one of a pair of fixed contacts of the normally open push button switch 78 and at the other end at one of a pair of fixed contacts controlled by the movable contact 80. The remaining contact of the pair of switch 78 is connected to one of a pair of fixed contacts of the normally closed push button switch 82 and by wire 79 to wire 71. The other contact of the pair of switch 82 is connected to the other contact of the pair controlled by the movable contact 80.

The wires 39 for the stationary winding of the induction transformer are shown connected across one phase of the three-phase circuit on the live side of the main circuit breaker. A switch 39' is included in the circuit of the field winding of the induction transformer. This switch is illustrated diagrammatically but it may be, as those skilled in the art can appreciate, a time delay switch which will automatically open this circuit a predetermined time after the machine has come to rest. Thus as soon as the motor is energized the field of the induction transformer is energized.

The rotor 60 of the transformer is illustrated as being provided in addition to the winding 40 with a similar winding 40a which is wound on the rotor in a plane at right angles to the plane of the winding 40. Thus when the maximum number of lines of magnetic force from the field are threading the winding 40, no magnetic lines of force are threading the winding 40a. As the rotor moves this relationship is disturbed to the extent that the number of lines of force threading the coil 40 decreases from a maximum, while the number of lines of force threading the winding 40a increases from a minimum. These two windings have one common terminal which is connected by wire 41' to the input of the full wave rectifier 42, as previously described. The other terminal of winding 40 is connected by wire 41a to one of a pair of fixed contacts which are interconnected by a movable contact of the relay 84

when its winding 87 is deenergized. The other terminal of winding 40a is connected by wire 41b to one contact of another fixed pair normally disengaged by a movable contact of the relay. The remaining contacts of these two pairs of relay 84 are connected by a common wire 83 to the other input terminal of the rectifier 42.

One contact of a normally closed pair of relay 84 is connected by wire 43b to one terminal of the energizing winding 84' of the magnetic brake. One contact of a normally open pair of contacts of relay 84 is connected by wire 43a to one terminal of the slip clutch energizing winding 44. The windings 84' and 44 have a common terminal which is connected by wire 43 to one of the output terminals of the rectifier 42. The other output terminal of this rectifier is connected by wire 43' to the remaining contacts of the normally open and the normally closed pair to which the wires 43a and 43b are connected. The magnetic slip clutch of which the winding 44 is a part is diagrammatically shown in this figure and is the device disclosed in the co-pending application Serial No. 230,768 referred to above.

The magnetic brake of which the winding 84' is a part is similar to the slip clutch in that it has a rotor 85 similar to the rotor 47 of the slip clutch but has no second rotor with its squirrel cage winding. The two rotors are belted together by means of a belt 86, as illustrated. At this point it may be noted that the slip clutch and brake may be built into a single unit, as illustrated in my copending application Serial No. 307,204 filed December 2, 1939.

The operating solenoid 87 of the relay 84 is connected at one terminal by wire 88 to wire 73 and its other terminal is connected to the neutral leg of the three-phase circuit between the main relay switch and the motor 17. The induction transformer of this arrangement is, of course, operated as before, its rotor being connected to the arm 32 with its wire engaging pulley 14 journaled on the end thereof.

In the operation of this system, in order to set the apparatus in motion, switch 39' is first closed and then push button switch 78 is closed with the result that winding 77' is energized from wire 71 through wire 79, switch 78, wire 77, the winding itself and thence to the neutral leg 72. The closing of switch 39' completes the circuit to the field windings of the induction transformer. This causes all of the movable contacts of the relay to engage the fixed contacts with the result that the motor 17 is energized and a holding circuit for the winding 77' is completed through wire 77, contact 80, wire 81, normally closed switch 82, and wire 79 to wire 71. By reason of this holding circuit the starting switch 78 need only be closed momentarily.

In order to deenergize motor 17 the switch 82 is momentarily opened, breaking the holding circuit for the winding 77' with the result that the relay opens all the circuits at the movable contacts. At the same time as the motor 17 is energized, alternating current is supplied to the field winding of the induction transformer 36, and at the same time the winding 87 is energized, so that relay 84 is operated to close the two upper pairs of contacts and open the two lower pairs.

The closing of the uppermost pair completes the input circuit to the rectifier 42 from the winding 40 of the induction transformer. The closing of the next lower pair completes the

output circuit from the rectifier 42 including the slip clutch winding 44, with the result that the machine is in full operation and the takeup reel 46 is revolving. This operation continues with the rotor of the induction transformer being automatically positioned as the tension in the wire W going to the takeup reel changes, all as previously described. The brake winding 84' is, of course, deenergized.

When it is desired to stop the machine, switch 82 is opened momentarily with the result that the main relay opens because its winding 77' is deenergized. Relay 84 also returns to normal position because of the deenergization of its winding 87 with the result that the two lower pairs of contacts are closed. The field winding in the induction transformer remains energized. The circuit for the winding 40a of the rotor of the induction transformer is completed through the third lowest pair of contacts so that this winding is connected to the input of the rectifier 42. The lowest pair of contacts of relay 84 connects the output circuit of the rectifier 42 with the brake winding 84'. Thus the brake acts to bring the reel to a stop but the braking action thereof is varied in accordance with changes in tension in the strand, so that it remains during stopping substantially uniform, thereby preventing breakage of and undue slackness in the strand. When the machine comes to rest switch 39' is opened or, as explained above, it may be opened automatically by a suitable time delay switch.

From the above description it will be apparent to those skilled in the art that the principles of this invention may be embodied in various physical forms and I do not, therefore, desire to be strictly limited to the arrangement as shown for the purpose of illustration. What I seek to protect by patent is defined by the scope of the claims granted me.

What I claim is:

1. In a strand spooling machine, the combination including a magnetic clutch having a fixed magnetizable structure and an energizing winding, driving and driven members, one of said members being magnetizable and the other having short circuited conducting paths thereon, a reel rotated by said driven member, a current supply circuit for the winding of said clutch, and means controlled by the strand being wrapped on said reel for varying the current in said circuit whereby the slippage of the clutch is varied to maintain a substantially constant tension in the strand.

2. In a strand spooling machine, the combination including a magnetic clutch having a fixed magnetizable structure and an energizing winding and rotatable driving and driven members, one of said members being magnetizable and the other having a short circuited winding on it, a reel connected to said driven member for rotation thereby, a current supply circuit for the winding of said clutch, means in said circuit for varying the flow of current therethrough, and means controlled by a strand being wrapped on said reel for operating said current varying means whereby the slippage of said clutch is varied to maintain a substantially uniform tension in said strand.

3. In a mechanism of the type described, the combination including means for feeding a strand in the direction of its length, a motive device for operating said means, a magnetic slip clutch having a fixed energizing winding and driving and

driven members, a reel connected to said driven member for rotation thereby, a current supply circuit for the winding of said clutch, current control means in said circuit, means for connecting said driving member to said motive device, and means controlled by a strand being wrapped on said reel for operating said current control means whereby the tension in the strand is maintained substantially uniform.

4. In a spooling machine, the combination comprising a magnetic slip clutch having a direct current energizing winding, a reel connected to said clutch for rotation thereby, an alternating current supply circuit, means operated by changes in tension in the strand for varying the current in said circuit, a full wave rectifier connected to said circuit, and connections from the output of said rectifier to said direct current winding.

5. In a strand spooler, the combination comprising a magnetic slip clutch having a fixed energizing winding, a takeup reel rotated by said clutch, power driven means for moving a strand to said reel along a path which forms a loop therein, a circuit for energizing said winding, means in said circuit for controlling the current therein, and means connected to said last means and engaging the loop in the strand to operate it as the size of the loop varies with changes in tension in the strand.

6. In a strand spooling machine the combination including a clutch having an energizing winding, a reel rotated by said clutch, a brake for said reel having an energizing winding, current supply circuits for said windings, and means controlled by the strand being wrapped on said reel for varying the current in said circuit whereby the slippage of the clutch and the braking action of the brake during operation of the reel thereby and stoppage thereof is varied to maintain a substantially constant tension in the strand.

7. In a strand spooling machine, the combination including a magnetic clutch having an energizing winding, a reel driven by said clutch, a motor for operating the clutch, a current supply circuit, relay means for completing the circuit to said clutch and motor to effect operation of the reel, means controlled by a strand being wound on the reel for varying the energization of the clutch, an electromagnetic brake for bringing the reel to a stop, circuits for the brake controlled by said relay, means for energizing the brake when the clutch and motor are deenergized, and means controlled by the strand for varying the energization of the brake to maintain a substantially constant tension in the strand as the reel is brought to a stop.

8. In a strand spooling mechanism, a current supply circuit, a reel, a magnetic clutch, a driving motor connectable to said reel by said clutch, means for connecting the clutch and motor to said circuit, means controlled by a strand being wound on said reel for varying the energization of said clutch, a magnetic brake for bringing the reel to a stop, and an energizing circuit for said brake including said controlling means whereby the energization of said brake is varied in accordance with changes in tension in said strand during stopping.

9. In a mechanism of the type described, the combination including a magnetic clutch comprising a fixed magnetizable structure having an energizing winding, a magnetizable member rotatably supported in the field of said winding, a second member having a short circuited winding

rotatably supported closely adjacent to said magnetizable member, a reel connected to one of said members, and means for driving the other of said members, a circuit connected to said winding, a rotatable control device in said circuit 5 for controlling the current therein, and means connected to the control device and engaged by a strand going to said reel for operating it to vary the current to said winding.

10. In a mechanism of the type described, the combination including a magnetic clutch comprising a fixed magnetizable structure having an energizing winding, a magnetizable member rotatably supported in the field of said winding, a second member having a short circuited winding 15 rotatably supported closely adjacent to said mag-

netizable member, a reel connected to one of said members and means for driving the other of said members, a circuit connected to said winding, a brake winding for bringing the member connected to the reel to a stop when energized, a circuit for said brake winding, a multiple contact switch for controlling both of said circuits, means in the circuit to the clutch winding for controlling the current therein, and means engaged by a strand going to said reel for controlling said last means, said multiple contact switch in one position energizing the clutch winding and in the other position deenergizing it and energizing the brake winding.

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