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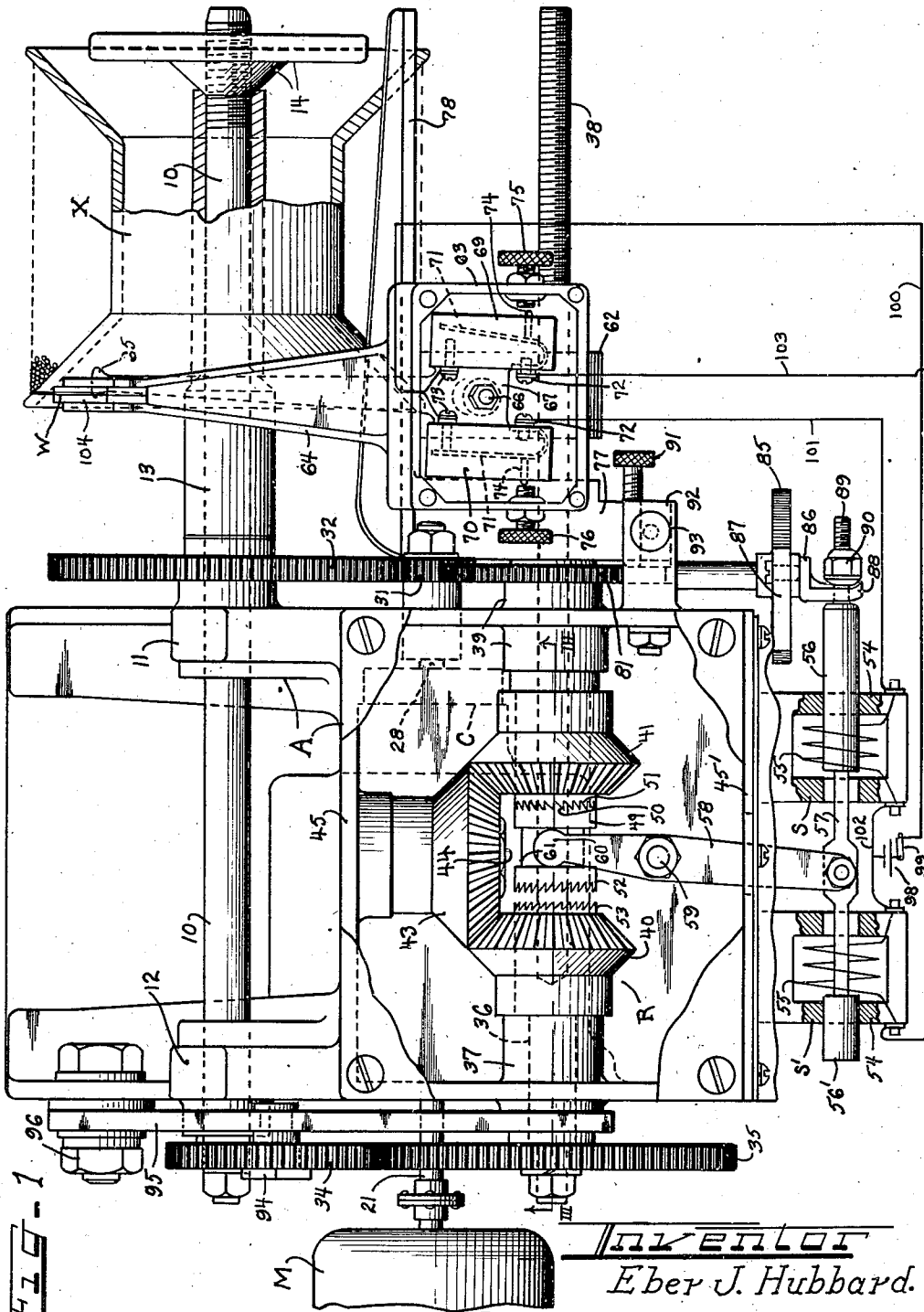
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2,254,221

SPOOLING MACHINE

Filed Nov. 18, 1940

3 Sheets-Sheet 1



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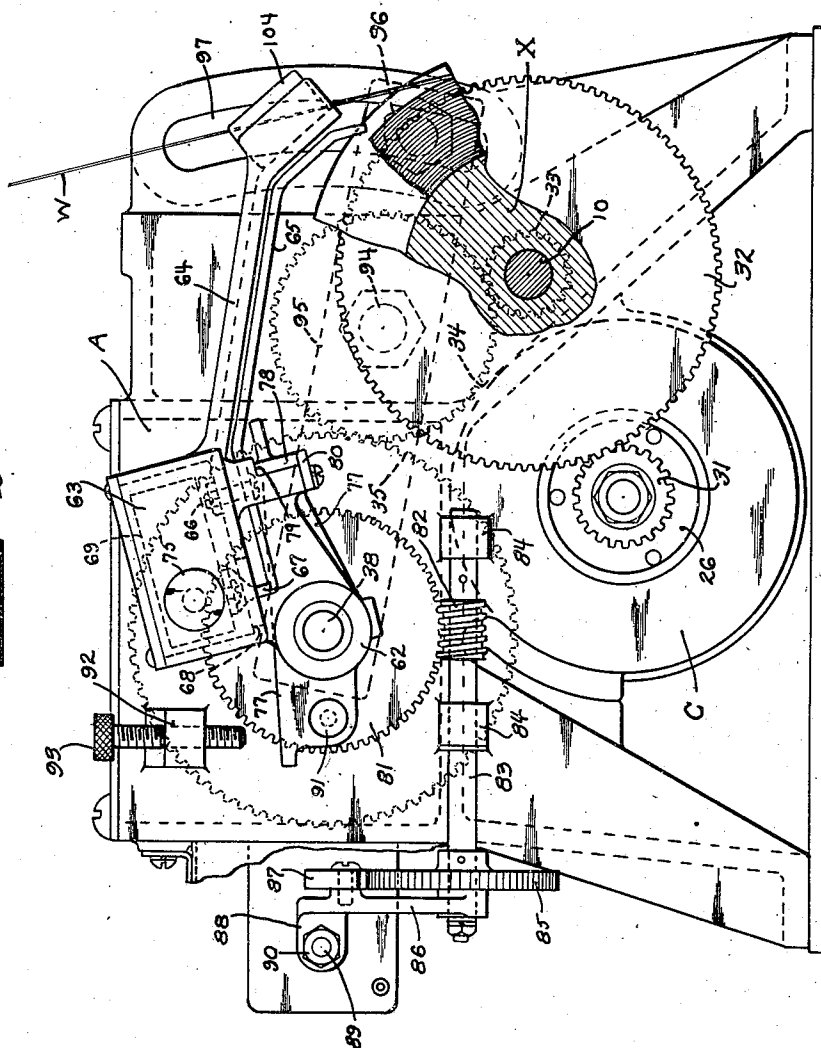
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Fig. 2



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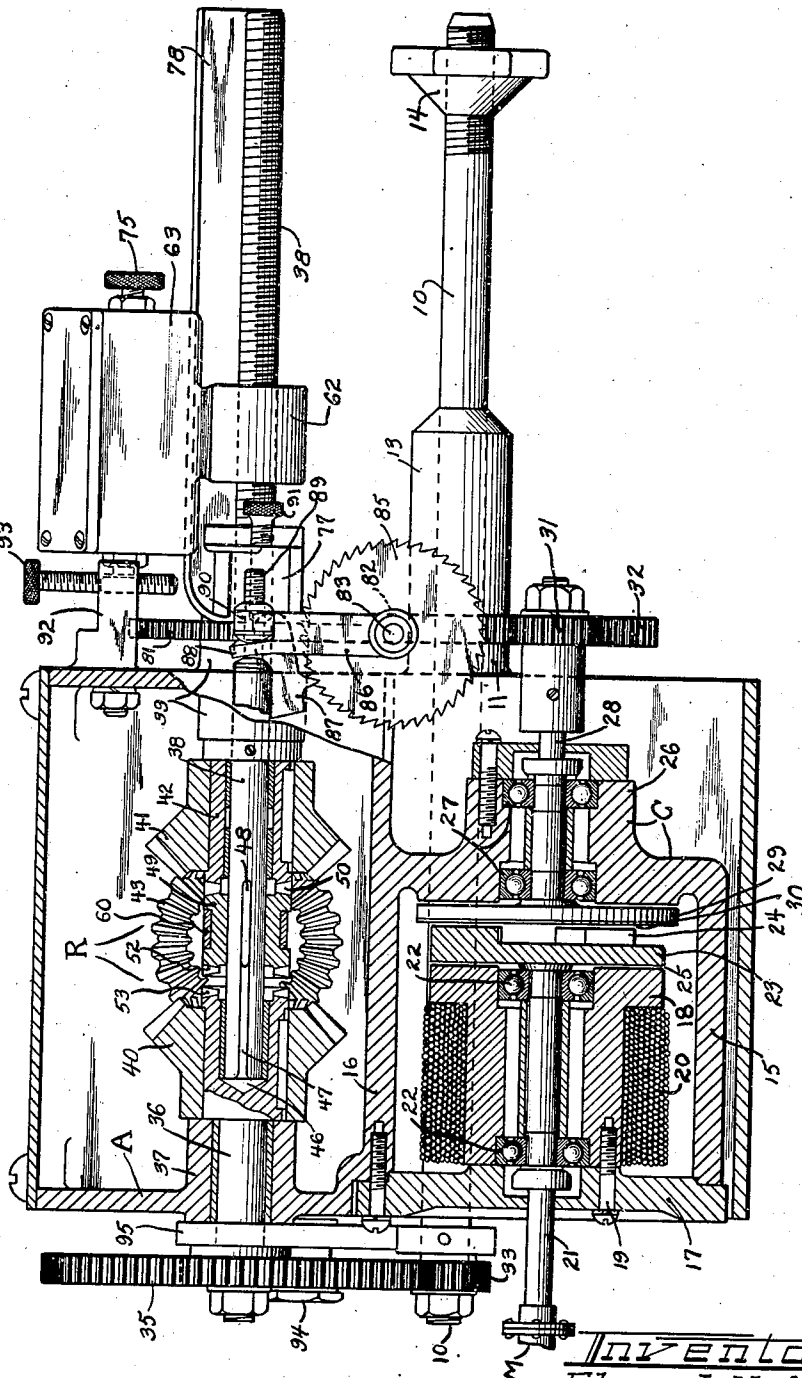
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FIG-3



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SPOOLING MACHINE

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7 Claims. (Cl. 242--25)

This invention relates to spooling machines adapted particularly for the spooling of wire, as for example the spooling of wire after passage thereof through an enameling machine for insulation thereof, and my invention may be considered as an improvement over the spooling machine disclosed in my co-pending application Serial No. 295,168 filed September 16, 1939.

An important object is to provide arrangements by which the length of wire measured from the end of a wire guiding arm to the point of contact of the guided wire with the spool is held to a minimum and which length of wire is held taut at all times so as to insure uniform application and distribution of the wire turns on the spool.

A further important object is to provide improved means for automatically electrically controlling the reversal of movement of the wire guiding means at the end of each wire layer and under control of a switch actuating lever terminating close to the end of the wire guiding arm and cooperable with the spool flanges for actuation for switch control.

Still another important object is to provide means for automatically operating at the end of two wire layers to raise the end of the wire guide arm and the switch controlling lever away from the wire on the spool by a distance substantially equal to two wire diameters so that the proper distance of the ends of the arm and lever from the wire on the spool may be maintained.

Still another object is to provide improved arrangement for adapting the machine to wind with equal efficiency spools having straight flanges or angled flanges.

In addition to the above enumerated features, my improved machine embodies other important features, and all of these features are included in the structure shown on the drawings, in which drawings:

Figure 1 is a plan view of the machine;

Figure 2 is an end view;

Figure 3 is a side view partly in section substantially on plane III—III of Figure 1.

The various operating parts of the machine are supported on a frame structure A. The shaft 10 for supporting a spool to be wound is journaled in bearings 11 and 12 provided on the side walls of the frame A. At its front end and outside of the frame A, the shaft 10 has a collar 13 secured thereto forming a backing for a spool X to be wound, the end of the shaft being threaded for reception of a clamp member 14 between which

and the collar 13 the spool is clamped for rotation with the shaft.

For driving the spool shaft, a magnetic slip coupling structure C is provided which is mounted between the side walls of the frame A. Referring to Figure 3, this coupling comprises a cylindrical body 15 depending from the horizontal partition wall 16 in the frame A, the outer end of the body having a removable cover 17. Within the body or housing 15 is the electromagnetic field frame 18 supported by and secured to the cover 17 as by means of screws 19, an energizing coil 20 surrounding the field frame. Within the field frame a drive shaft 21 is journaled as by bearing structures 22, the shaft at its outer end being coupled to a suitable electric driving motor M. Secured to the inner end of the drive shaft is a drive disk 23 having projections or poles 24 on its outer side. This pole disk is rotated by the driving motor and is included in the magnetic field created by the coil 20. To avoid friction, a suitable air gap 25 is maintained between the pole disk and the adjacent end of the field frame 18.

At its inner end the coupling body or housing 15 has the extension 26 for housing suitable bearings 27 for the transmission shaft 28 which supports an armature disk 29 adjacent to the poles 24 from which it is separated by a suitable gap 30. With this arrangement, the armature disk 29 is magnetically rotated for rotation of the shaft 28. The motor M is a substantially constant speed motor for substantially constant speed drive of the magnetic driving disk 23, and the magnetic drag on the armature disk tends to keep this disk rotating with the drive disk 23, but, depending upon the load on the transmission shaft 28, the armature disk will not always keep up with the driving disk.

Secured to the outer end of the shaft 28 is a gear pinion 31 which meshes with the gear 32 secured to the spool driving shaft 10. Thus the spool will be driven from the driving motor M through the electromagnetic slip coupling C.

Traverse means, to be described in detail later, guides the wire to the spool and is operated by a traverse shaft connected by a gearing train with the spool shaft 10. At its rear end, and outside of the supporting frame A, the spool shaft 10 carries a gear pinion 33 which meshes with an intermediate gear 34 which in turn meshes with a larger gear 35 on the end of a shaft 36 journaled in the bearing 37 on the frame A.

The traverse shaft 38 is journaled in a bearing structure 39 on the frame A and is in axial

alignment with the shaft 36 and between these shafts clutch operated reversing gearing R is interposed. This reversing mechanism comprises a beveled gear 40 keyed to the shaft 36 inside of the bearing 37, and a beveled gear 41 keyed to a bushing 42 which is freely rotatable on the traverse shaft 38 inside of the bearing 39. A transmission bevel gear 43 is in mesh with both of the driving gears 40 and 41 and is journaled on a stud 44 extending from the vertical wall 45 forming part of the frame structure A.

The traverse shaft extends at its inner end into the bore 46 in the shaft 36 and the end of the shaft 38 has the keyway 47 for the key 48 in the clutch collar 49 on the shaft 38 between the gears 40 and 41. This clutch collar at one end has clutch teeth 50 for mesh with clutch teeth 51 on the bushing 42, and its other end has clutch teeth 52 for meshing with the clutch teeth 53 on the shaft 36. When, as shown on Figure 3, the clutch collar is in mesh with the bushing 42 secured to gear 41, the rotation of the gear 40 will be transmitted through the transmission gear 43 to the gear 41 and through the clutch collar 49 to the traverse shaft 38 for rotation of this shaft in one direction. When the clutch collar is released from the gear 41 and meshed with the teeth 53 on the shaft 36, the clutch collar will be directly driven by the shaft 36 for turning of the traverse shaft in the opposite direction.

Solenoid means are provided for controlling the shift of the clutch collar 49. Solenoid structures S and S' are mounted on the wall 45' of the frame A, these structures being shown more or less diagrammatically. Each comprises a field frame 54 for a solenoid coil 55. The solenoid cores 56 and 56' are in axial alignment and connected by a rod 57 to which is pivoted the outer end of the clutch lever 58 fulcrumed at 59 and having its inner end 60 engaging in the annular channel 61 of the clutch collar 49. With this arrangement when the solenoid S is energized, the clutch collar will mesh with the gear 40, and when the solenoid S' is energized, the clutch collar will mesh with the gear 41.

The wire guide structure comprises a body 62 having a threaded bore to receive the threaded outer end of the traverse shaft 38. The body 62 supports a housing 63 from the front of which extends the wire guide arm 64. Below the guide arm and housing 63 is the switch arm 65 which is fulcrumed at 66 on the bottom of the housing for lateral swing, the inner end 67 of the lever 65 projecting upwardly into the housing through an opening 68 and secured at its sides to switch structures 69 and 70 which switch structures are preferably of the quick acting or snap action type known in the trade as micro switches. As shown diagrammatically, each switch has a contact spring blade 71 anchored at one end by a terminal 72 for engagement with another terminal 73, an actuating pin 74 extending to the exterior of the switch to be normally displaced from the switch blade so that the blade may disengage from the terminal 73, and adapted to be shifted in to swing the blade for engagement with the terminal so as to complete a circuit between the terminals 72 and 73. Abutment screws 75 and 76 are mounted on the housing 63 for the actuating pins 74 of the switches 69 and 71 respectively. The arrangement is such that when the switch lever 65 is swung a predetermined distance in one direction the actuating pin of one switch will engage with the corresponding abut-

ment screw and will be shifted inwardly for closure of that switch, while at the other switch the actuating pin will be withdrawn from the abutment screw for opening of the switch. The switches are connected in circuit with the solenoid structures S and S' and are operated by engagement of the end of the switch arm 65 with the flanges of a spool with the timing of operation such that, when the wire guided to the spool by the guide arm 64 reaches the end of a winding layer on the spool, the switch lever 65 will have been swung for opening of one switch and closing of the other and the inclusion in circuit of the corresponding solenoid structure for operation of the reversing clutch mechanism for reversal rotation of the traverse shaft and reverse in direction of travel of the guide structure along the traverse shaft.

For supporting and guiding the wire guide structure as it travels back and forth along the traverse shaft during rotation of the shaft, a guide frame 77 of L-shape is provided, this frame receiving the outer end of the bearing 39 for the traverse shaft to be rotatable thereon, the frame guide arm 78 extending horizontally below the outer part of the wire guide structure housing 63 and parallel with the traverse shaft. As best shown on Figure 2, the arm 78 is received between the shoulder 79 on the frame 63 and a detachable guide plate 80 secured to the frame. With this arrangement, when the frame 77 is rotated, the wire guide frame is swung vertically for adjustment thereof relative to the spool being wound. For successful spooling, that is accurate and uniform spacing of the winding turns, the length of the wire measured from the end of the wire guiding arm to the point of contact of the wire with the spool should be held to a minimum, and provision must be made for raising the guiding arm as the wire depth on the spool increases so that the length of the wire from the end of the arm to the spool will be held constant as closely as possible and the end of the switch arm will be held clear at all times from engagement with the wire and engagement thereof only with the inner sides of the flanges for swing thereby for switch operation for reversal of the direction of travel of the guiding structure. I have therefore provided efficient means for automatically adjusting the guide structure for movement of the end of the guide arm from the spool a distance equal to the thickness of two layers after two layers have been deposited. The adjustment is effected by an increment of rotation of the supporting frame 77 each time two layers have been deposited on the spool. Rotatable on the bearing 39 for the traverse shaft 38 behind the supporting frame 77 is a worm gear 81 which is meshed by a worm pinion 82 on a shaft 83 extending horizontally below the worm gear 81, this shaft being journaled in suitable bearings 84 provided on the frame structure A. Secured to the outer end of this shaft is a ratchet wheel 85, and receiving the outer end of the shaft, to swing thereon, is the upwardly extending lever 86 on which a pawl 87 is pivoted for engagement with the top of the ratchet wheel 85.

Extending outwardly from the upper end of the pawl lever 86 is a wall or wing 88 which is apertured to receive the threaded end 89 on the core 56 for the solenoid structure S. This threaded end receives an abutment nut 90, the wing 88 of the lever being interposed between this abutment nut and the outer end of the core 56. Referring to Figure 1, when the solenoid

cores are shifted to the right by the energization of the coil for the solenoid S', the pawl will be dragged toward the right over the ratchet wheel 35, and when the core structure is shifted to the left upon energization of the solenoid coil S, the ratchet wheel 85 will be rotated by the pawl. Such rotation of the ratchet wheel results in corresponding rotation of the worm pinion 82 and the worm gear 81 driven thereby. Suitable means are provided for detachably and adjustably coupling the supporting frame 77 to the worm gear. As shown, a set screw 91 extends through the frame 77 for engagement with the worm gear, and the arrangement is such that when the ratchet wheel 85 is turned, the frame 77 will turn with the worm gear and the wire guide structure will be swung with the frame 77 for raising the end of the guide arm 64 a distance equal to the increased depth of wire on the spool caused by two layers of wire thereon. The distance that the guide arm must be raised after the application of two wire layers depends of course upon the diameter of the wire being wound. By setting of the abutment nut 90 on the threaded end 89 of the solenoid core 56 the distance of rotation of the ratchet wheel 85 by the pawl for the proper raising distance of the guide arm can be established. When the solenoid core is shifted outwardly it abuts the wing 88 of the pawl lever for swing of this lever and sliding of the pawl over the ratchet wheel. Upon inward shift of the solenoid core the pawl lever will not be swung back until it is engaged by the abutment nut 90 and, therefore, by proper setting of the abutment nut the rotation of the ratchet wheel by the pawl may be established for the desired adjustment swing of the wire guide arm at the proper time.

When the wire guide arm is raised at the end of two layers, the switch arm is likewise raised. When an empty spool is inserted in the machine for winding, the guide structure is set so that the end of the switch lever will be as close as possible to the spool barrel but sufficient clearance is allowed so that the switch lever will never contact the wire. For such setting of the guide structure, the set screw 91 is released and the guide structure swung downwardly. A bracket 92 on the frame structure A is threaded to receive an abutment screw 93 for engagement by the supporting frame 77 for the wire guide structure. This screw is set to be abutted by the frame 77 when the guide frame is swung down for setting of the end of the switch lever relative to the empty spool barrel. The set screw 91 is then set to secure the frame 77 to the worm gear 81 for automatic swing of the guide structure after each two layers of winding on the spool. After a spool has been fully wound, the set screw 91 is released so that the guide frame may be swung upwardly so that the filled spool may be removed. Then when an empty spool is applied the wire guide frame is swung down until the abutment screw 93 is engaged and then the set screw 91 is tightened and winding of the spool is proceeded with.

When a different size wire is to be wound by the machine, adjustment must be made for the speed of travel of the wire guiding structure by the traverse shaft so that the wire will be wound with the desired number of turns per inch on the spool. For such an adjustment a different size drive pinion is substituted for the driving pinion 33 on the end of the spool shaft. To permit such substitution, the intermediate trans-

mission gear 34 is journaled on a stud 94 extending from a bar 95 which is mounted at one end of the bearing 37 for the shaft 36 to which the clutch gear 40 is secured. The outer end of the bar is engaged by a bolt 96 extending through a slot 97 in the frame A for securing the bar in adjusted position. When it is desired to substitute another pinion 33, the bolt 96 is loosened and the bar 95 is swung upwardly to unmesh the intermediate gear 34 from the pinion, so that the pinion can be withdrawn and another sized pinion applied. The bar 95 is then swung down to bring the gear 34 into mesh with the new pinion and the bolt 96 is then tightened.

Referring to Figure 1, the circuit arrangement is shown for the solenoids and the guide arm switches. The solenoids could be designed for operation by commercial circuits or, as shown, by current from a battery 98. A switch 99 is provided for shutting off the current if desired. A conductor 100 extends from the switch for connection with the terminals 73 of the switches 69 and 70. A conductor 101 extends from the switch blade terminal 72 for the switch 70 and connects with one terminal of the coil 55 for the solenoid S, the other terminal of the coil being connected by conductor 102 with the other terminal of the battery. A conductor 103 extends from the switch blade terminal 72 of the switch 69 to one terminal of the coil for the solenoid S' whose other terminal is connected by conductor 102 with the current source or battery 98.

Where the wire W to be wound is enamel insulated, the wire can be fed directly from the insulating machine to the winding machine, the wire traveling through the enameling machine at a fixed rate to which the winding machine must cater. The end of the guide arm 64 is formed to provide a U-shaped channel into which a felt packing 104 is applied through which the wire W travels for application to the spool, the friction of the felt packing serving to steady the wire on its way to the spool.

Describing now the operation, when the machine is to be started, adjustment is made by suitable means well known in the art for current flow through the coil 20 of the electromagnet slip clutch for the desired driving torque for the spool shaft. The switch 99 for the solenoid circuit is closed and then the motor M is connected with the supply circuit. Referring particularly to Figure 1, the wire guiding and switching assembly is at the end of its movement to the left, the wire guide arm having just applied the last turn of the wire to the spool and the engagement of the switch arm 65 with the spool flange having caused engagement of the actuating pin 74 of the switch 70 with the abutment screw 76 for closure of the switch 70 and consequently closure of the circuit through the coil of the solenoid S for shift of the solenoid core structure to the left and swing of the clutch lever 58 for operation of the clutch collar 49 for setting of the reversing mechanism R for reverse turning of the traverse shaft 38. During such movement to the left of the solenoid core structure, the abutment of the nut 90 with the pawl lever wing 88 caused this lever to swing for movement of the pawl 87 to rotate the ratchet wheel 85 for turning of the worm gear 81 and upward swing of the guide frame to move the end of the guide arm the distance of substantially two wire diameters above the wire on the spool. The wire guide structure is now

shifted by the traverse shaft toward the right until the last turn of the wire is applied to the spool outer flange and for movement of the switches to the right and opening of the switch 70 and closure of the switch 69 and closure of the circuit through the coil of the solenoid S' for shift to the right of the solenoid core structure and swing of the clutch lever for operation of the clutch collar for reverse drive of the screw shaft. During shift to the right of the solenoid core, the pawl lever 86 is swung to the right for gliding of the pawl 87 over the ratchet wheel 85 for setting of the pawl for turning of the ratchet wheel as the wire guiding structure returns to the left side of the spool. When the switch arm 65 encounters the inner flange of the spool, the switches will be shifted for opening of the switch 69 and closure of the switch 70 and closure of the coil for the solenoid S and then, as the solenoid cores are shifted to the left, the abutment nut 90 will encounter the pawl lever and the ratchet wheel 85 will be turned by the pawl for the next upward adjustment of the guide arm structure.

The cycle of operation continues until the spool is filled, drive reversal taking place only when the guide arm has fully applied the last layer against the corresponding spool flange, and the wire guide arm being adjusted upwardly for winding of the next two layers before the guide structure starts its movement for the winding of these layers. By means of the adjustable abutment screws 75 and 76, the operation of the switches can be accurately determined for reversal of travel in accord with the feed of the wire to the spool. By adjustment of the abutment nut 90 the lift of the wire guiding arm after winding two layers will be in accord with the size of the wire being wound.

When the spool has been completely wound, the set screw 91 is released so that the guide mechanism may be swung up out of the way for removal of the filled spool and the application of an empty spool. The guide mechanism is then swung down, and by its engagement with the abutment screw 93 the end of the switch arm will be at the proper distance from the spool barrel, and then when the set screw 91 is reset to connect the frame 77 with the worm gear 81, the machine is ready for its winding operation, and during the winding operation, the end of the switch lever will be kept its adjusted distance above the wire. This adjusted distance is as small as possible in order that the end of the wire guide arm may be kept as close as possible to the wire on the spool for a minimum length of wire between the end of the guide arm and the spool during winding of the spool.

The torque of the slip driving coupling C is such that it will tend at all times to rotate the spool to keep taut the wire between the spool and the end of the guide arm but without undue strain on the wire. By keeping the wire taut the wire will be applied evenly and uniformly to the spool and any tendency toward climbing or crossing of the wire will be eliminated and the final wire layer on the spool will be uniform and the turns will be in a straight line from flange to flange of the spool.

The machine will efficiently wind wire on spools whether the spool flanges are at an angle with or at right angles to the spool barrel. When a straight flange spool is to be wound the set screw 91 is withdrawn to release the guide structure supporting frame 77 from the ratchet mechanism

driven worm gear 81 and the stop screw 93 is set down against the frame 77 so that the end of the wire guide arm will be above and just clear of the spool flanges and the end of the switch arm will be between the flanges a short distance inwardly of the edges thereof for cooperation with the flanges for operation of the switches for control of the solenoid circuits and reversal of the traverse shaft.

I thus produce a comparatively simple but efficient winding machine in which the adjustment for spool drive reversal and for wire application and distribution are accurately and automatically accomplished at the proper times. By virtue of the magnetic slip drive coupling the wire is at all times kept properly tense without straining of the wire and any slack is immediately taken up.

I have shown practical and efficient embodiment of the various features of my invention but I do not desire to be limited to the exact structure, arrangement and operation shown and described as changes and modifications may be made without departing from the scope of the invention.

I claim as follows:

1. In a spooling machine of the class described, a spool support, drive means for rotating the spool, a guide structure for guiding wire to the spool, reversing means for said guide structure, adjusting means for said guide structure for setting of the end thereof a predetermined distance from the barrel of the spool to be wound, and electrical means operable at the end of two succeeding wire layers on the spool for automatically setting said guide structure for setting of its end away from the wire on the spool a distance equal to the combined depth of the two layers, and switch means movable with said guide structure and cooperable with the flanges of the spool for controlling said electrical means.

2. A wire spooling machine comprising means for rotating a spool to be wound, a guide structure for guiding wire to the spool, drive means including reversing means for effecting reciprocation of said guide structure, a switch lever fulcrumed on said guide structure for co-operation at its outer end with the flanges of the spool, unitary switch structures mounted on said switch lever and each provided with an actuating element, abutments on said guide structure for said actuating elements, engagement of the end of said switch lever with the spool flanges causing bodily movement of said switch structures for alternate engagement of their actuating elements with the respective abutments for opening of one switch and closure of the other, electromagnetic means for controlling the operation of said reversing structure, electrical circuits between said switch units and said electromagnetic means whereby the direction of travel of said guide structure is reversed when said switch arm engages one of the spool flanges, and adjusting means operable by said electromagnetic means coincidentally with operation thereby of said reversing means for effecting movement of said guide structure a predetermined distance away from the wire on the spool.

3. In a spooling machine of the class described, a spool support, drive means for the spool, traverse means for guiding wire to the spool, reversing means for the traverse means, adjusting means for adjusting the distance of the guide end of the traverse means from the wire wound on a spool, and an electromagnetic device for

operating said reversing means at each end of a winding layer and for directly operating said adjusting means only at the end of two consecutive winding layers on the spool for movement of the guiding end of the traverse means a distance from the wire on the spool equal to the combined depth of two layers.

4. In a machine for spooling wire comprising a spool support, drive means for the spool, traverse means for guiding the wire to the spool, reversing means for the traverse means, electrical means controlled by the distance between the spool flanges for each layer being wound for causing operation of said reversing means, and adjusting means mechanically operated by said electrical means only at the end of each two consecutive layers wound on the spool for moving said traverse means a predetermined distance away from the wire on the spool.

5. A wire spooling machine comprising means for rotating a spool to be wound, a guide structure for guiding wire to the spool, drive means including reversing means for effecting reciprocation of said guide structure, an electromagnetic device for operating said reversing means, an electrical circuit for said electromagnetic device, switch means for said circuit movable with said guide structure for cooperation with the spool flanges to control said circuit for operation of said reversing means by said electromagnetic device at the end of each layer wound on the spool, and adjusting means directly operable by said electromagnetic device for effecting movement of said guide structure a predetermined distance away from the wire on the spool.

6. A wire spooling machine comprising means for rotating a spool to be wound, a guide structure for guiding wire to the spool, driving means

including reversing means for effecting reciprocation of said guide structure, an electromagnetic device comprising windings and an armature structure connected with said reversing means, switch means movable with said guide structure and circuits for said windings controlled by said switch means, said switch means being cooperable with the spool flanges at the ends of winding layers on the spool for controlling the circuits for said windings for operation of the reversing means by the armature structure, and adjusting means directly operable by said armature structure for moving said guide structure at the end of a winding layer a predetermined distance away from the layer.

7. A wire spooling machine comprising means for rotating a spool to be wound, a guide structure for guiding wire to the spool, driving means including reversing means for effecting reciprocation of said guide structure, an electromagnetic device comprising windings and an armature structure connected with said reversing means, switch means movable with said guide structure and circuits for said windings controlled by said switch means, said switch means being cooperable with the spool flanges at the ends of winding layers on the spool for controlling the circuits for said windings for operation of the reversing means for the armature structure, a mechanical adjusting train comprising a rotary member, means for detachably connecting said guide structure to said rotary member, and means connecting said armature structure with said adjusting train for effecting rotation of said rotary member only at the end of two winding layers on said spool a distance equal to the combined depth of two layers.

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