July 17, 1934. C. H. FRANKS 1,966,494

COIL WINDING MACHINE

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Fig. 1.

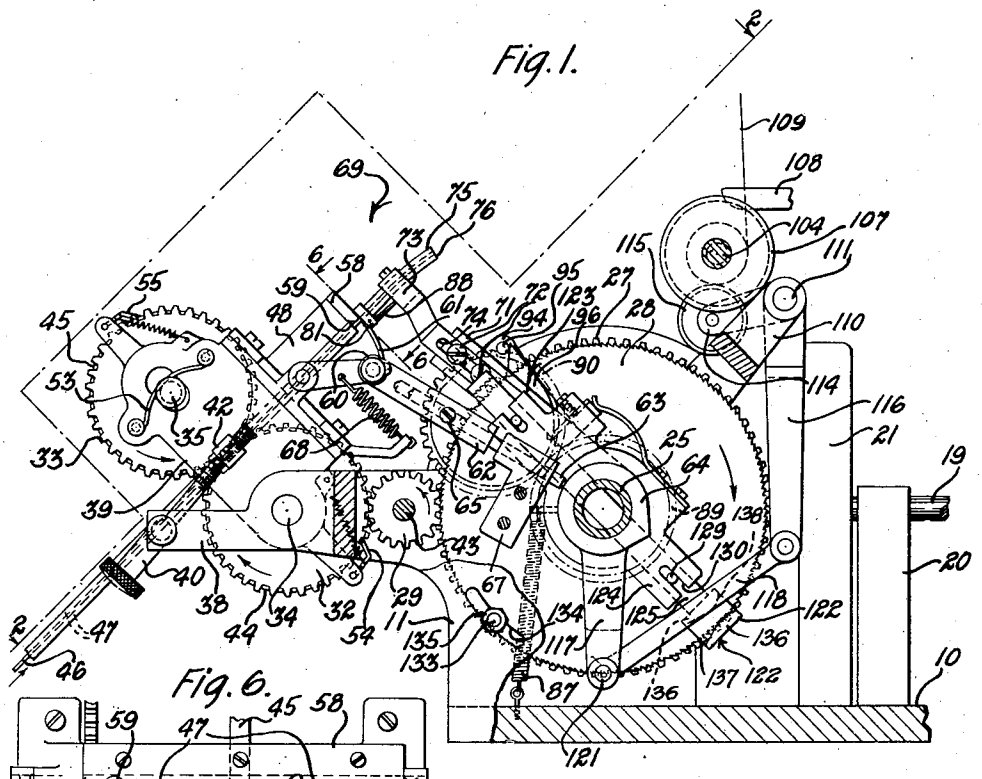


Fig. 6.

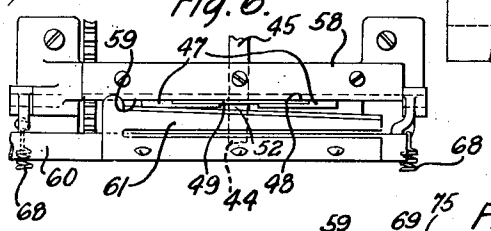
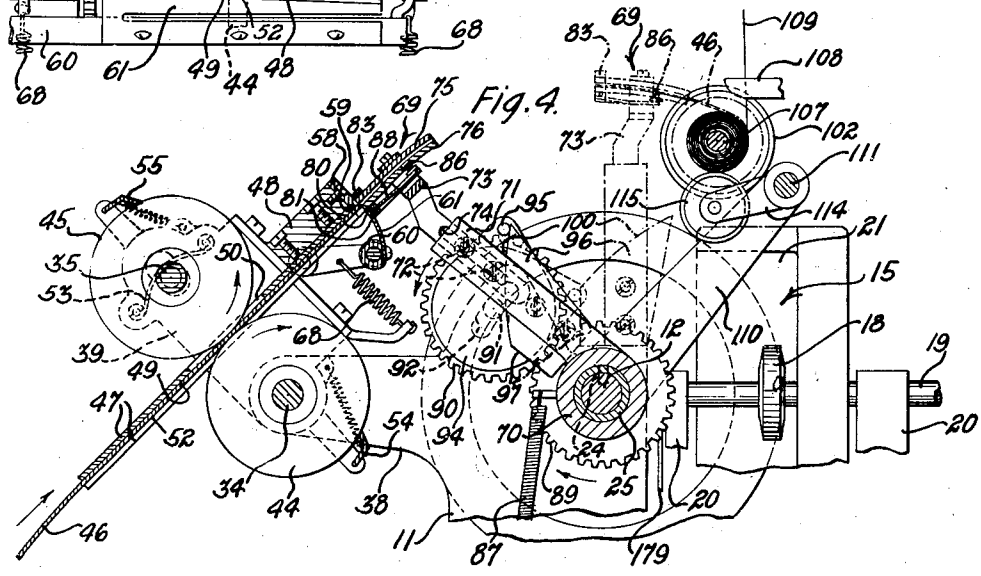


Fig. 4.



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Fig. 2.

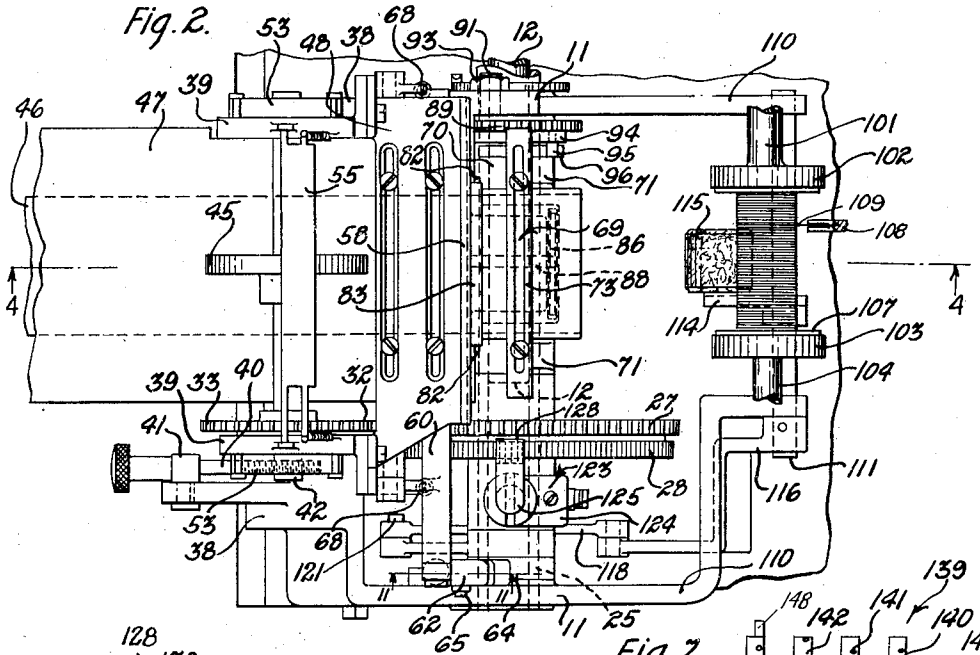


Fig. 5.

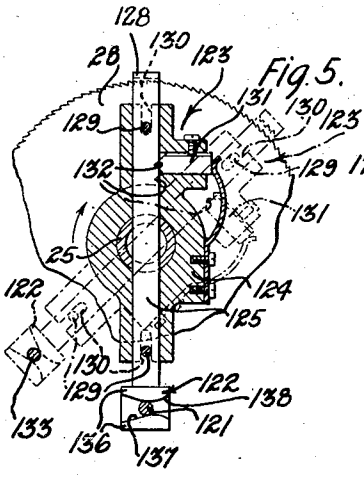


Fig. 7.

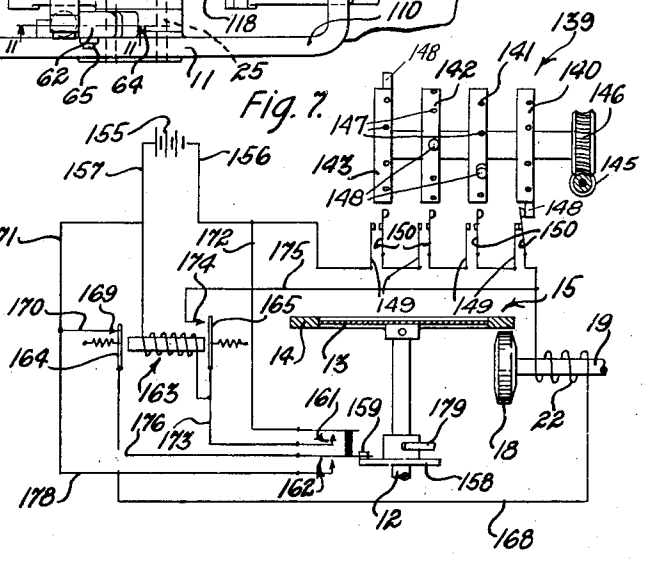
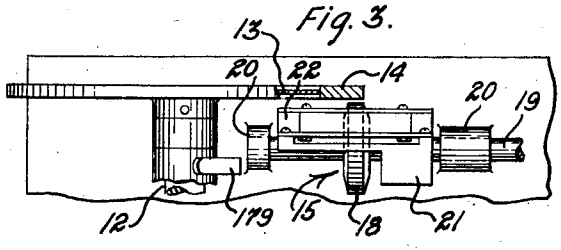


Fig. 3.

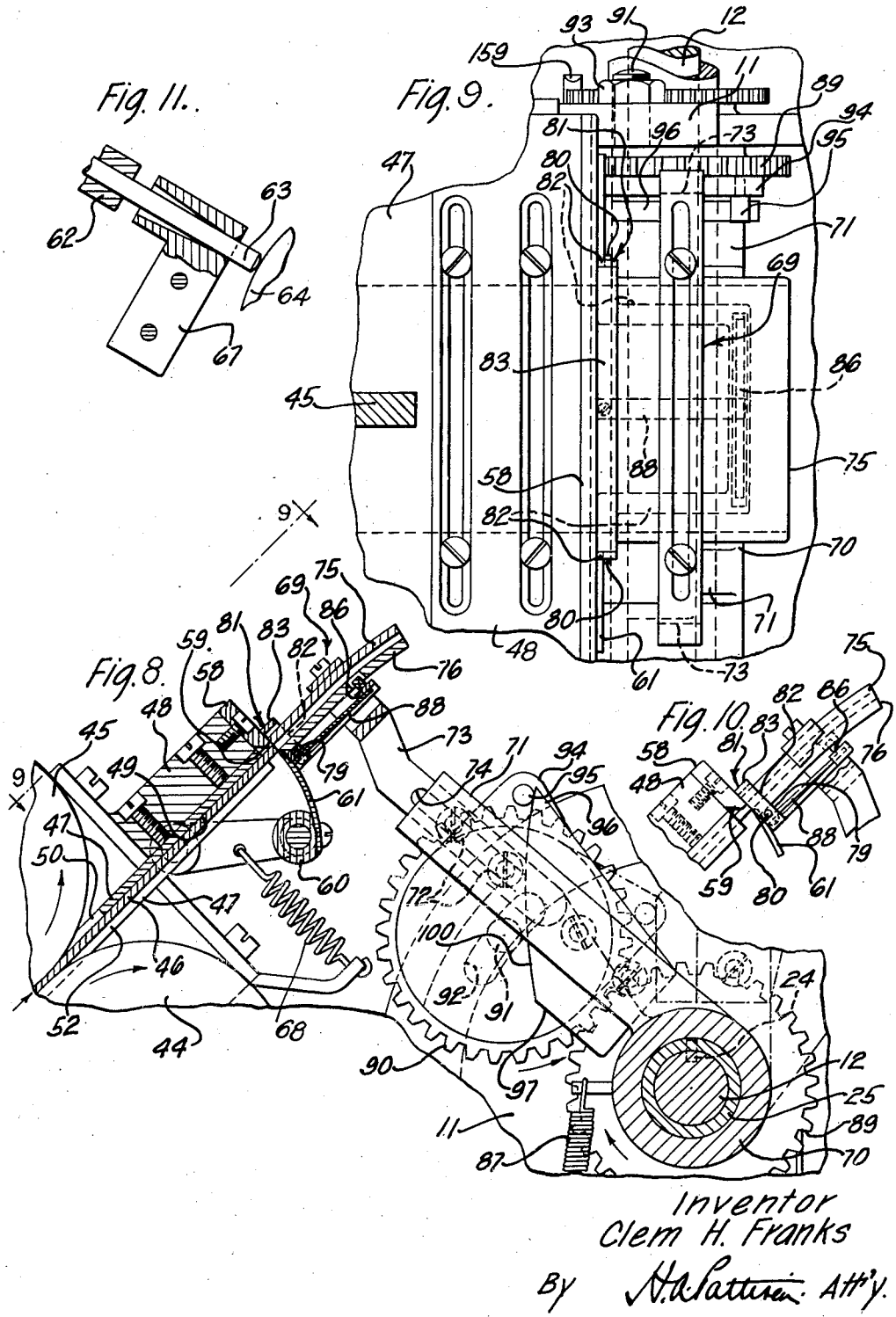


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UNITED STATES PATENT OFFICE

1,966,494

COIL WINDING MACHINE

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Application May 4, 1928, Serial No. 274,984

9 Claims. (Cl. 242—10)

This invention relates to coil winding machines, and more particularly to machines for winding electrical coils arranged with strip material between the layers of conductor forming the coil.

In the construction of electrical wire wound coils it is usual to insert strip insulating material between the windings of the coil at predetermined intervals during the winding thereof, either for the purpose of separating different windings, preventing short circuited turns of the wire due to the dropping down of turns between adjacent turns, or to neutralize the tendency of a winding to become uneven and rough or for insulating or other purposes.

The primary object of this invention is the provision in a coil winding machine of a simple and efficient mechanism for inserting at predetermined intervals strip material of predetermined length into the coil.

In accordance with one embodiment, the invention comprises a coil winding machine provided with means operated at predetermined intervals during the winding of the coil to feed a varying length of strip insulating material from a continuous length as determined by the diameter of the coil, following which the measured portion is severed and gripped by mechanism which advances it to a point where it is inserted in the coil being wound. The variation of the length of strip is controlled by the distance between movable and stationary stop members which serve to control the engagement and disengagement, respectively, of a clutch serving to govern the operation of the means for feeding the predetermined length of material. The movable stop member is automatically retracted from the stationary stop as the coil increases in diameter by a roll which engages the periphery of the coil during the winding thereof, the movement of the roll caused by the increasing diameter of the coil being transmitted to the movable stop by an interconnecting lever and link mechanism.

Other objects and advantages of this invention will more clearly appear from the following detailed description taken in connection with the accompanying drawings, in which

Fig. 1 is a fragmentary side view of a coil winding machine embodying the features of this invention with a portion of the frame removed;

Fig. 2 is a fragmentary oblique view on the line 2—2 thereof;

Fig. 3 is a fragmentary detail plan view of a magnetic clutch for connecting the paper inserting mechanism to a source of power;

Fig. 4 is a vertical section on the line 4—4 of Fig. 2 showing in dotted outline the position of the parts during the insertion of the severed strip material into the coil;

Fig. 5 is a fragmentary detail section of the strip feeding mechanism showing a clutch thereof at the beginning of the feeding movement and in dotted outline, the completion thereof;

Fig. 6 is a fragmentary section on the line 6—6 of Fig. 1 showing the strip severing means;

Fig. 7 is a diagrammatic illustration of a counter and the magnetic clutch controlled thereby for actuating the mechanism for inserting strip insulating material into the coil at predetermined intervals during the winding thereof and the electrical circuits therefor, and

Fig. 8 is a fragmentary view of Fig. 4 showing on an enlarged scale the strip severing, gripping and conveying mechanism;

Fig. 9 is a fragmentary oblique view on the line 9—9 of Fig. 8;

Fig. 10 is a fragmentary side view of Fig. 1 showing on an enlarged scale the strip severing, gripping and conveying mechanism, and

Fig. 11 is an enlarged fragmentary detail section on the line 11—11 of Fig. 2.

Referring now to the drawings in detail in which like reference numerals designate similar parts throughout the several views, a main frame 10 (Fig. 1) is provided at opposite sides with upright standards 11 upon which is journaled a horizontally disposed secondary driving shaft 12. The shaft 12 at one end (Figs. 3 and 7) has fixed thereto a circular flexible metallic disk 13, to the periphery of which is fixed an annular ring 14 serving as an armature of an electromagnetic clutch 15 which includes a clutch wheel 18 fixed to a horizontally disposed main driving shaft 19 supported in journals 20 secured to the frame 10. The shaft 19 in the operation of the mechanism is continually rotated, the shaft deriving its power from a source (not shown). The peripheral face of the wheel 18 is disposed at right angles to the flat circular face of the armature ring 14, the axes of the shafts 12 and 19 being on the same plane and at right angles to each other. Fixed to the frame 10 is a standard 21 supporting an electromagnetic coil 22 (Fig. 7) which surrounds a portion of the wheel 18. The coil 22 at predetermined intervals in the operation of the winding machine with which the paper inserting mechanism is associated is energized, whereupon the wheel is magnetized, the armature ring 14 being drawn against the peripheral face of the wheel, the flexible disk 13 supporting the wheel,

flexing sufficiently to permit this operative engagement and thus motion is transmitted to the shaft 12 and the paper inserting mechanism is operated through one complete cycle of operations. It will be understood that the speed of the shaft 19 and the diameter of the clutch wheel 18 with respect to the diameter of the cooperating face of the armature ring 14 is such that the shaft 12 will be driven at a predetermined speed. A detailed description and disclosure of the electromagnetic clutch coil 22 are not believed necessary since this type of clutch is well known, but the operation thereof will again be referred to in the description of the electrical circuit (Fig. 7).

Strip feeding and guiding mechanism

The shaft 12 has secured thereto by means of a key 24 (dotted outline Fig. 4) a sleeve 25, opposite ends of the sleeve being journaled in the standards 11. Rotatably carried upon the sleeve 25 adjacent one end thereof is a gear 27 and attached to one side face of the gear is a clutch wheel 28 which is slightly smaller in diameter than the gear and provided upon its peripheral face with comparatively fine ratchet teeth. The wheel 28 is clutched to the rotary sleeve 25 at predetermined intervals in the operation of the mechanism by means to be later described. Referring particularly to Fig. 1 the gear 27 meshes with a pinion 29 which in turn meshes with a gear 32, the latter gear meshing with a gear 33. The gears 32 and 33 are identical and are fixed to shafts 34 and 35, respectively, journaled in angularly disposed arms 38 and 39, respectively. The arms 38 are integral with the standards 11, while the arms 39 are pivoted on the shaft 34.

The angular position of the arms 39 may be changed and retained in their adjusted position by turning a screw 40 which is freely revolvable at one end in a block 41 pivoted upon the forward standard 11 (Fig. 2), the opposite end of the screw being threaded into a block 42 fixed to the adjacent arm 39. It will be apparent that by turning the screw 40 one way or the other the angular position of the arms 39 and a mechanism carried thereby which will hereinafter be described may be varied. The adjusted position of the arms 39 as will be clearly brought out as this description progresses depends on the diameter of the coil to be wound and served with strip insulating material between the layers thereof. The pinion 29 is fixed to a short shaft 43 journaled in the adjacent arm 38. Fixed to each of the shafts 34 and 35, respectively, intermediate the arms 38 and 39 are rollers 44 and 45 which cooperate in the operation of the mechanism to feed a predetermined length of strip insulating material 46, in the present instance treated paper, in the direction of the arrows (Figs. 4 and 8).

The paper 46 is directed from a continuous length thereof preferably in the form of a supply coil (not shown) and between the rollers 44 and 45 by a plurality of spaced plates 47 (Figs. 4, 6 and 8) supported from the lower surface of a member 48 interconnecting the pivotal arms 39. The lower surface of the upper plate 47 forms the upper side of a paper guiding channel 49 and the distance between opposed shoulders on the two laterally spaced lower plates 47, which plates are adjustable to and from each other, determine the width of the channel, the depth thereof being the height of the shoulders on the lower plates. A portion of the roller 45 extends through a slot 50 provided in the upper plate 47 and grips the paper 46 against the opposite roller 44 extending into a continuous slot 52 formed between the inner opposed edges of the two lower plates 47. The shaft 35 carrying the roller 45 is mounted at either end in elongated bearing apertures provided in the arms 39 and pressed downward so as to provide enough friction between the rollers 44 and 45 to feed the paper when the rollers are rotated by leaf springs 53 (Figs. 1 and 4) mounted on the arms 39 and engaging the periphery of the shaft 35. Bearing against the peripheries of the rollers 44 and 45 are spring pressed plates 54 and 55, respectively, which serve to keep the cooperating peripheral paper feeding surfaces of the rollers free of dust or any foreign matter likely to gather thereon, the plates 54 and 55 being pivoted on the arms 38 and 39, respectively.

Strip severing mechanism

Fixed to the member 48 is a stationary shearing blade 58 provided along its lower surface with a shearing edge 59 which is in line with the upper surface of the paper 46. Pivoted upon the member 48 below the lower surface thereof is a U-shaped lever 60 which extends across the space between the arms 39. Fixed to the right face of the connecting arm of the U-shaped lever 60 is a shearing blade 61 normally positioned immediately below the lower surface of the paper 46. Pivoted to the forward end of the lever 60 (Figs. 1 and 2) is a link member 62 carrying a pin 63 with the lower end thereof arranged to engage the periphery of a rotary cam 64 fixed to the sleeve 25. The pin 63 is adjustable in an aperture formed in the link member 62 for the purpose of causing a predetermined movement of the blade 61 by the cam 64 in case the angular position of the arms 39 is changed, a clamping screw 65 retaining the pin in its adjusted position. The pin 63 is guided in a fixed bearing block 67 (Fig. 1) attached to the inner surface of the adjacent standard 11 of the frame 10. Referring to Fig. 11 it will be observed that the aperture in the bearing block 67 through which extends the pin 63 is of such a size and shape as to permit a free movement of the link member 62 and the lever 60 when the cam 64 engages and moves past the pin 63. The pin 63 is maintained in engagement with the cam 64 by a tension spring 68 having opposite ends attached to the lever 60 and the member 48. It will be apparent upon imparting rotary motion to the gear 27 in the direction of the arrow (Fig. 1) that the rollers 44 and 45 will rotate clockwise and counter-clockwise, respectively, (Fig. 4) and thus a length of paper 46 will be fed forward between the stationary and movable shearing blades 58 and 61, respectively, and during a complete rotation of the cam 64 the movable shearing blade 61 will be actuated to sever the length of paper projecting forward of the member 48 and thereafter return to its normal position as shown in the drawings.

Strip gripping and conveying mechanism

The paper 46 in being fed forward by the rollers 44 and 45 is associated with a mechanism 69 for supporting the free end thereof, which mechanism is later actuated to grip the severed portion of the paper upon completion of the severing operation and then advance it to a point where it is inserted in the coil being wound. Free to rotate upon the sleeve 25 intermediate the standards 11 is a sleeve 70 provided at either end with arms 71. Adjustably attached to the upper ends of the arms 71 by means of screws 72 is a bracket 73, spaced parallel arms of which are fitted in

pockets formed in the arms 71, the arms having longitudinally extending slots 74 through which the screws 72 extend and are threaded into the arms 71. Upon loosening the screws 72 the bracket 73 may be adjusted longitudinally of the arms 71 to vary the radius of the arc through which the bracket 73 will travel when the sleeve 70 is rotated. The purpose of this adjustment will be made apparent hereinafter. Fixed to the outer end of the bracket 73 is a pair of guide plates 75 and 76, the plates being slightly curved inwardly at their right ends (Figs. 1, 4 and 8). The plates 75 and 76 are spaced apart a distance equal to the depth of the guiding channel 49 provided between the guide plates 47 and are normally aligned therewith so that in their normal position the paper 46 being fed forward will freely pass from between the plates 47 and into the space or channel between the plates 75 and 76. Attached to the plate 76 is a bar 79 having a pin 80 (Figs. 9 and 10) at either end upon which is pivoted a member 81 comprising end arms 82 connected together at their upper ends by a bar 83 extending across the upper surface of the plate 75 and spaced therefrom; the lower ends of the arms 82 extend inward under the plate 76 a short distance and then to the right (dotted outlines Figs. 2 and 9) and support at their ends a gripping bar 86 which projects into a slot formed in the lower plate 76, and as will be made apparent hereinafter, at a predetermined period in the operation of the mechanism serves to grip the severed strip of paper to the under surface of the plate 75.

The mechanism 69 is maintained in its normal position by a tension spring 87 opposite ends of which are attached to the sleeve 70 and the frame 10 (Figs. 1 and 4). It will be noted that in this position the left end of the bar 83 of the member 81 lies parallel with the right surface of the stationary shearing blade 58 and the gripping bar 86 is positioned slightly below the guide channel formed between the plates 75 and 76, the force of the spring 87 maintaining the mechanism 69 in this position. A leaf spring 88 fixed at one end to the bar 79 intermediate its ends and its free end pressing upwardly against the lower surface of the gripping bar 86 is adapted to cause the member 81 to turn counter-clockwise upon the pins 80 when it is swung to the right, against the tension of the spring 87, by means to be presently described, the counter-clockwise movement of the member 81 under the action of the leaf spring 88 causing the gripping bar 86 to enter the space between the guide plates 75 and 76 and thus the severed paper strip 46 entered in this space is lightly gripped between the plate 75 and the bar 86.

Fixed to the sleeve 25 adjacent one end of the sleeve 70 (Figs. 2, 8 and 9) is a gear 89 which meshes with a similar gear 90 rotatable upon a stud shaft 91 adjustably secured to the adjacent standard 11. The shaft 91 extends at one end through an arcuate slot 92 formed in the standard on a radius struck from the axis of the sleeve 25 and is clamped in position after adjustment by a nut 93 (Fig. 9). The purpose of adjustably mounting the shaft 91 and the gear 90 carried thereon will be described hereinafter. Attached to the inner face of the gear 90 is a plate 94 having an inwardly extending pin 95. Secured to the outer face of the arm 71 adjacent the gears 89 and 90 is a cam plate 96. Upon the sleeve 25 being rotated in the direction of the arrow (Fig. 4) the gear 89 attached thereto will cause the gear 90 to rotate counter-clockwise and at a predetermined period during each revolution of the sleeve 25 the pin 95 will come into engagement with a flat cam face 97 of the plate 96 (Fig. 8) and cause the sleeve 70 with the paper gripping and advancing mechanism 69 to be rotated in a clockwise direction to the position thereof shown in dotted outline (Fig. 4), which will be later referred to. Thereafter the pin 95 continuing its counter-clockwise rotation will ride onto a curved cam face 100 of the plate 96, which it will be apparent permits the mechanism 69 to rotate counter-clockwise and return quickly to its normal position (full lines Figs. 4 and 8), the tension of the spring 87 insuring this latter movement of the mechanism 69 as the pin 95 moves from the dotted line position to its normal position. The mechanism 69 resting against the right face of the stationary shearing blade 58 under the action of the spring 87 overcomes the tension of the leaf spring 88 and thus draws the gripping bar 86 out of the space between the guide plates 75 and 76, thus clearing this channel for the insertion of the strip of paper 46 during the next cycle of operation.

Coil winding machine

A winding spindle 101 of a coil winding machine with which the paper feeding, severing and advancing mechanism hereinbefore described is associated carries at its inner end a chuck 102 which cooperates with a companion chuck 103 attached to a reciprocable and revolvable shaft 104 and between these chucks a spool or coil core 107 is clamped (Figs. 1 and 2). A reciprocable wire guiding finger 108 is associated with the winding spindle 101 for delivering a wire 109 to the rotatable spool 107 so that adjacent turns of the wire will lie close together. It is to be understood that the speed of the winding spindle 101 and the speed of reciprocation of the guide finger 108 are in timed relation so as to produce a coil having closely wound smooth layers. The driving mechanism for the winding spindle 101 and the guiding finger 108 and other parts of the coil winding machine with which the paper feeding, severing and advancing mechanism herein described is associated have not been disclosed, since it is not believed necessary to a complete understanding of this invention.

Strip measuring mechanism

In winding coils layer upon layer it will be understood that the diameter of the coil increases with each layer and therefore successive strips of paper 46 inserted into the coil for insulating or structural purposes must be increased an amount proportional to the increased diameter of the coil in order to surround the coil and overlap a constant amount for each insertion. As clearly illustrated in Fig. 4 in dotted outlines, the strip of paper 46 after being severed is gripped and conveyed by the mechanism 69 to the spool 107, the forward edge of the strip engaging the traveling wire 109 where it is caught at once and carried into the coil, it being drawn from between the plate 75 and the yieldable gripping bar 86. Successive strips of paper 46 to be inserted into a coil travel through the same arc which coincides with a point intermediate the thickness of the wire to be ultimately wound on the spool 107. In the drawings the spool 107 is shown as half wound, which is the reason that the paper 46 and the last layer of wire 109 wound on the spool coincide. As the

coil grows larger the forward edge of the strip of paper 46 will first engage the rotating periphery of the coil and be carried thereby to the tangent point of the oncoming wire 109 and the coil and thence into the coil.

The means for controlling the length of paper 46 fed by the feed rollers 44 and 45 in accordance with the increasing diameter of the coil comprises the following mechanism. Extending angularly and upwardly from the right side of each of the standards 11 is an arm 110 and freely journaled in the free ends thereof is a rod 111 to one end of which is fixed a lever 114. On the free end of the lever 114 is rotatably mounted a cork roller 115 which is positioned immediately below and rides lightly on the periphery of the coil as it grows in diameter. Attached to one end of the rod 111 is a depending lever 116 which is pivotally connected to a depending lever 117 by an interconnecting link 118, the lever 117 being pivoted on the sleeve 25. Due to the rod 111 being freely pivoted in the arms 110 and the gravitational force exerted by the lever 116 fixed thereto along with the link 118 pivoted at the lower end of the lever upon the lever 114, the roller 115 carried by the latter is maintained in positive contact with the periphery of the coil at all times but without any deleterious pressure thereon. The lever 117 and the link 118 are pivoted together by a pin 121 which extends rearwardly from the lever and link as viewed in Fig. 1 into the path of a cam block 122 of a clutch 123 (Figs. 1, 2 and 5) revolvable with the sleeve 25, the projecting end of the pin serving as a stop pin. A double ended arm 124 is pinned to the sleeve 25 between the cam 64 and the clutch wheel 28 and reciprocably mounted in aligned apertures formed in the arm and the sleeve 25 is a clutch bar 125, which is circular in cross-section having at one end an arm 128 which extends over the periphery of the clutch wheel 28. The inner horizontal surface of the arm 128 is provided with a plurality of ratchet teeth similar to those formed on the periphery of the wheel 28. The bar 125 is prevented from rotating in the arm 124 and the sleeve 25 and is limited in its reciprocable movement therein by pins 129 extending through the bar and into slots 130 formed in the ends of the arm 124. A spring pressed latch pin 131 is carried in an enlargement on the arm 124 and is adapted to engage in one or the other of a pair of cooperating notches 132 formed in the bar 125 and thus maintains the bar in either an intermediate, inoperative or operative position as shown in dotted and full lines, respectively, in Fig. 5.

Adjustably mounted in the forward standard 11 (Figs. 1 and 2) by means of an arcuate slot 134 and a nut 135 is a stationary gauge or stop pin 133 which extends inwardly into the path of the cam block 122 (Fig. 5) and is positioned slightly closer to the axis of the sleeve 25 for a purpose which will be made apparent shortly. The cam block 122 as viewed in Figs. 1 and 5 has two forwardly extending spaced arms 136 provided with opposed cam faces 137 and 138 which cooperate with the stop pins 121 and 133 during the rotation of the sleeve 25 to engage and disengage, respectively, the clutch 123.

During the rotation of the sleeve 25 the cam face 137 moves into engagement with the pin 121, which has been predeterminedly positioned in accordance with the diameter of the coil being wound by the lever and link mechanism interconnecting the cork roll 115 and the pin 121, and thus the ratchet teeth on the clutch bar 125 are engaged with the ratchet wheel 28 and through the gearing previously mentioned the rollers 44 and 45 are set in motion to feed the strip of paper 46 forward. It will be apparent that the duration of the feeding motion of the rollers 44 and 45 and consequently the length of the strip of paper 46 fed forward depends on the distance between the pins 121 and 133, which it will be apparent will vary during the winding of the coil, the movable stop pin 121 being automatically retracted from the stationary stop pin 133 as the coil increases in diameter. Upon the cam face 138 moving into engagement with the stationary stop pin 133 the ratchet teeth on the clutch bar 125 will be disengaged from the ratchet wheel 28 and the feeding of the paper will cease.

Counting mechanism and electrical circuit therefor

For the purpose of setting in motion the paper inserting mechanism herein described through a complete cycle of operations at predetermined intervals during the winding of the coil a counting mechanism 139 (Fig. 7) is employed for controlling an electrical circuit which upon being closed energizes the electro-magnetic coil 22 and starts the mechanism through a complete cycle of operations. A detailed description and disclosure of the counting mechanism 139 are not believed necessary for a complete understanding of this invention since it may consist of the ordinary type of counter having the usual number wheels 140 to 143, inclusive, corresponding to units, tens, hundreds, thousands, etc., respectively, and which is driven from the winding spindle 101. Although only four number wheels are disclosed it will be apparent that a greater number may be employed. The shaft of the spindle 101 is operatively connected to the shaft of the counting mechanism 139 by a worm and worm wheel 145 and 146, respectively, the driving ratio being such that one revolution of the spindle 101 during which one turn of wire is wound on the coil registers one unit, or one turn of wire, on the unit wheel 140.

The wheels 140 to 143, inclusive, are each provided upon their peripheries with a series of apertures 147, one adjacent each number thereon, the apertures are adapted to receive removable pins 148 which project from the periphery of the wheels, one pin being provided for each wheel in the particular set up illustrated in Fig. 7. The pins 148 cooperate with contact springs 149 which control electrical contacts 150, a spring 149 and a set of contacts being provided for each number wheel. The pins 149 are set in each wheel according to predetermined intervals in the winding of the coil at which a strip of paper 46 is to be inserted, the setting for example may be such that after 1000, 2000, 3000, etc., turns, successively, of wire have been wound on the coil a strip of paper is to be inserted. Referring to the circuit (Fig. 7) a source of electrical power which may be a battery 155 has one side connected to a conductor 156 which includes the normally open contacts 150 and is connected to one end of the electromagnetic coil 22, the opposite side of the battery being connected to a conductor 157. The shaft 12 to which is secured the armature ring 14 of the electromagnetic clutch 15 carries a disk 158 having a cam stud 159 fixed thereto adjacent its periphery and operatively associated with a set of movable springs and stationary contacts 161 and 162, respectively, the springs being insulated from each other and united for move-

ment in unison by means of a block of insulation extending therebetween to make or break with their respective contacts when the cam stud moves away from or comes into engagement, respectively, with the free end of the spring 162. Included in the circuit is an electromagnetic locking relay 163 having two armatures 164 and 165. The purpose of the relay 163 is to insure a flow of current through the circuit, first through the series of springs 149 and associated contacts 150 which are closed momentarily upon completion of the winding of a predetermined number of turns of wire as determined by the setting of the pins 148 and simultaneously thereafter, when due to the continued rotation of the winding spindle 101 the circuit through the contacts is immediately broken, to hold the clutch wheel 18 magnetized by means of the coil 22 during one complete rotation of the shaft 12 so that the mechanism will be operated through a complete cycle of operations.

Upon the counting mechanism 139 stepping off the predetermined number of turns of the wire 109 wound on the coil, at which point the strip of paper 46 is to be inserted, the pins 148 will have moved into alignment to cause the springs 149 to engage the contacts 150, whereupon current will flow from the battery 155 through the conductor 156, contacts 150, coil 22, which is immediately energized, the current flowing to the other side of the battery through a conductor 168, armature 164 and associated contact 169 and conductors 170, 171 and 157. Upon the coil 22 being energized the armature ring 14 is drawn against the rotating clutch wheel 18 and motion is imparted to the shaft 12, the cam stud 159 being disengaged from the spring 162 and the springs 161 and 162 making contact with their associated contacts, the locking relay 163 is immediately energized. The circuit may then be traced from the battery 155, through the conductor 156 and a conductor 172, spring and contact 161, conductor 173, coil of the relay 163 and conductor 157 to the other side of the battery. The flow of the current through the relay 163 draws the armature 165 into engagement with an associated contact 174, the current then dividing and flowing to the coil 22 through a conductor 175 and the conductor 156 and thence to the other side of the battery by the conductor 168, a conductor 176, engaged spring and contact 162, a conductor 178 and conductors 171 and 157. The circuit through the coil 22 is thus maintained closed due to the energization of the locking relay 163, until the cam stud 159 completes one revolution and again engages the spring 162, whereupon the circuit through the springs and contacts 161 and 162 is broken and the coil 22 is thereby de-energized, the electromagnetic clutch 15 being disengaged and the shaft 12 quickly comes to a standstill. A suitable friction drag 179 is associated with the periphery of the hub portion of the disk 158 fixed to the shaft 12 for the purpose of insuring that the shaft will immediately stop upon the clutch 15 being disengaged and in a position which will hold the springs 161 and 162 away from their associated contacts.

Adjustment of mechanism for a particular coil

In adjusting the paper feeding, severing and conveying mechanism for use in forming a coil having a certain diameter of core and which is to be wound with a certain thickness of wire thereon, the following adjustments are made. The stationary stop pin 133 is first adjusted in the slot 134 to a predetermined distance from the movable stop pin 121, the roller 115 at this time being in contact with the periphery of the empty core 107, which will cause a length of paper 46 to be fed sufficient to surround the periphery of the particular core 107 and overlap a certain amount. Thereafter the bracket 73 is adjusted in the arms 71 so that the strip conveying mechanism 69 carried thereby will carry the forward end of the strip of paper 46 along an arc which coincides with a point intermediate the thickness of wire to be wound on the spool. The shaft 91 carrying the gear 90 is also adjusted in the arcuate slot 92 to cause the pin 95 movable with the gear 90, which as hereinbefore described engages the cam plate 96 during the rotation of the gear, to move the mechanism 69 a predetermined distance toward the spool 107. It will be apparent that by varying the position of the shaft 90 along the slot 92 either upwardly or downwardly the distance traveled by the mechanism 69 will be greater or less, respectively. It is desirable to provide a maximum travel for the mechanism 69 in order to carry the forward edge of the strip of paper 46 close to the wire 109 but the diameter of the wire to be ultimately wound on the core is the determining factor, since the forward ends of the plates 75 and 76 must clear the periphery of the finished coil as shown in dotted lines (Fig. 4). Whenever the arc of travel of the mechanism 69 is changed it is necessary to adjust the angular portion of the arms 39 by turning the screw 40, hereinbefore described, until the paper strip guiding channel 49 is aligned with the channel formed between the guiding plates 75 and 76. Also upon adjusting the arms 39 which carry the stationary shearing blade 58 it is necessary to adjust the pin 63 in the link 62 to cause a predetermined movement of the movable shearing blade 61 with respect to the blade 58 which it will be apparent is changed when the angular position of the arms 39 is altered due to the lever 60 pivoted to the upper end of the link 62 being pivotally carried by the arms 39.

Operation of the mechanism

In the operation of the coil winding machine with which is operatively associated the mechanism hereinbefore described in detail for inserting at predetermined intervals strip insulating material of predetermined length into the coil during the continued winding thereof a spool 107 is clamped to the winding spindle 101, any adjustments necessary to the mechanism, as hereinbefore described, for the particular coil to be wound are made and the counting mechanism 139 is set to close the associated electrical circuit hereinbefore described at predetermined intervals during the winding of the coil for setting in motion the paper inserting mechanism.

The shaft 12 in rotating clockwise when the clutch 15 is energized carries the clutch 123 therewith, the cam face 137 of the cam block 122 thereof moving into engagement with the movable stop pin 121, which has been automatically retracted from the stationary stop pin 133 by the movement of the cork roll 115 as the coil increases in diameter through the interconnecting mechanism. The cam face 137 engaging and riding past the pin 121 draws the clutch bar 125 into operative engagement with the normally stationary ratchet wheel 28 and thus the feeding rolls 44 and 45 through the interconnecting

gears and pinion hereinbefore described are set in motion to feed the paper strip 46 forward along the guiding channel 49 and past the stationary shearing blade 58, until the cam face 138 of the clutch 123 has moved into engagement with the stationary stop pin 133 which serves to disengage the clutch bar 125 from the wheel 28 and the feeding of the strip 46 ceases. Immediately thereafter the cam 64 rotating with the shaft 12 moves into engagement with the pin 63 and through the interconnecting mechanism the shearing blade 61 is actuated to shear the length of paper strip 46 extending forward of the blade 58 and which is supported by the conveying mechanism 69. As the shearing blade 61 moves back to its normal position the pin 95 rotating counter-clockwise with the gear 90 in turn driven from the gear 89 fixed to the sleeve 25 engages the flat cam face 97 of the plate 96 secured to the strip gripping and conveying mechanism 69 and in the continued rotation of the pin 95 rocks or oscillates the mechanism 69 about the axis of the shaft 12 to the dotted outline position thereof as shown in Fig. 4. Immediately this movement of the mechanism 69 commences the leaf spring 88 acts to move the gripping bar 86 to enter the space between the guide plates 75 and 76 and lightly presses the severed paper strip 46 supported by the plates against the plate 75. Upon the forward edge of the severed strip engaging the traveling wire 109 or the rotating periphery of the coil, it is caught at once or is carried to the tangent point of the oncoming wire and then caught, respectively, and thence into the coil, the strip being freely drawn from between the gripping bar 86 and the guide plate 75. In the continued rotation of the pin 95 it rides onto the cam face 100 of the plate 96 which permits the conveying mechanism 69 to quickly return to its normal position. Simultaneously with the return oscillatory movement of the conveying mechanism 69 the cam stud 159 on the disk 158 moves into engagement with the spring 162 and in the manner hereinbefore described causes the de-energizing of the coil 22, the mechanism having been operated through one complete cycle of operations.

It is to be understood that during the operation of the mechanism to feed a predetermined length of paper strip 46, sever and convey it to the coil, the winding of the coil continues without interruption, the counting mechanism 139 and the associated pins 148 and contacts 150 also continuing to operate for again closing the electrical circuit for the next paper inserting cycle of the mechanism as determined by the setting of the pins 148 in the number wheels 140 to 143, inclusive.

What is claimed is:

1. In a coil winding machine, means for winding strand material on a core, a plurality of means for successively feeding a predetermined length of strip material from a supply thereof, severing, positively advancing and inserting it into the coil during the winding thereof, the strip material advancing means traveling with the material in its advance, means including a rotatable element continually engaging the periphery of the rotating strand material wound on the coil responsive to the increased diameter thereof for controlling the length of strip material fed and severed.

2. In a coil winding machine, means for winding strand material on a core, means for successively feeding a predetermined length of strip material from a supply thereof to the coil in accordance with its increased diameter, rotating controlling means therefor, movable and stationary spaced cooperating elements with which the controlling means is operatively engaged successively to actuate the same in accordance with their relative positions for setting in motion and then stopping the strip material feeding means, and means responsive to the increased diameter of the coil for retracting the movable element from the stationary element in proportion to the increased diameter of the coil.

3. In a coil winding machine, means for winding strand material on a core, means for successively feeding different lengths of strip material to the coil during the winding thereof in accordance with its increased diameter, means for causing the actuation of the strip material feeding means, said means including a driven clutch element, a rotating driving clutch element, means arranged in predetermined spaced relation in the path thereof for successively causing the engagement and disengagement of the clutch elements to cause a length of strip material to be fed, and means operatively associated with the latter means responsive to the increased diameter of the coil for predeterminedly spacing the same for controlling the length of strip material fed.

4. In a coil winding machine, means for winding strand material on a core, means for feeding a predetermined length of strip material from a continuous length thereof for insertion in the coil, conveying means for receiving the fed material, severing means arranged between the feeding and conveying means, means operable upon a predetermined length of strip material being fed to the conveying means for causing the actuation of the severing means, yieldable means carried by the conveying means for automatically gripping the fed material thereto simultaneously with a movement of the conveying means to insert the strip material into the coil, power actuated means for actuating the several aforementioned means in timed relation, and means for predeterminedly setting in motion the power operated means to complete a cycle of operations.

5. In a coil winding machine, means for winding strand material on a core, means for feeding a predetermined length of strip material from a supply thereof for subsequent insertion in the coil, rotating controlling means therefor, movable and stationary spaced elements with which the controlling means is operatively engaged successively to actuate the same in accordance with their relative positions for setting in motion and then stopping the strip material feeding means, means responsive to an increase in the diameter of the coil for automatically retracting the movable element from the stationary element in proportion to the increased diameter of the coil, means for severing the predetermined length of material from the supply thereof, and means traveling in an arcuate path for advancing and inserting the severed material in the coil.

6. In a coil winding machine, means for winding strand material on a core, a plurality of means for feeding a predetermined length of strip material from a supply thereof, severing and inserting it into the coil, means including an element engaging the periphery of the coil being wound arranged at one side of the axis thereof and at a single point for automatically controlling the length of strip material fed and severed, and means for causing a complete cycle of op-

erations of the strip material feeding, severing and inserting means after a predetermined number of turns of wire have been wound on the core.

7. In a coil winding machine, means for winding strand material on a core, rolls for feeding a predetermined length of strip material from a supply thereof for subsequent insertion in the coil, means for imparting rotary motion to the rolls comprising a driven clutch element, a rotating driving clutch element, means arranged in predetermined spaced relation in the path thereof for successively causing the engagement and disengagement of the clutch elements to cause a predetermined length of strip material to be fed, and means operatively associated with the latter means for automatically spacing the same in proportion to the increased diameter of the coil.

8. In a coil winding machine, means for winding strand material on a core, means for feeding a predetermined length of strip material from a supply thereof, means for advancing and inserting the length of material into the coil comprising an oscillatory member having a channeled portion at its outer free end into which the material is fed with the forward end of the material extending therefrom at the termination of the feeding movement, and yieldable means carried by the oscillatory member for automatically gripping the fed material thereto simultaneously with a movement of the member to insert the material into the coil.

9. In an apparatus for feeding strip material to a coil being wound, means intermittently operative for predetermined intervals of time for positively feeding the material to the coil, and means including an element engaging the coil being wound for varying the duration of operativeness of the feeding means in accordance with variations in the diameter of the coil to thereby vary the length of material fed to the coil.

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