May 23, 1939. P. K. RANNEY 2,159,635

COIL WINDING APPARATUS

Filed June 23, 1937 2 Sheets-Sheet 1

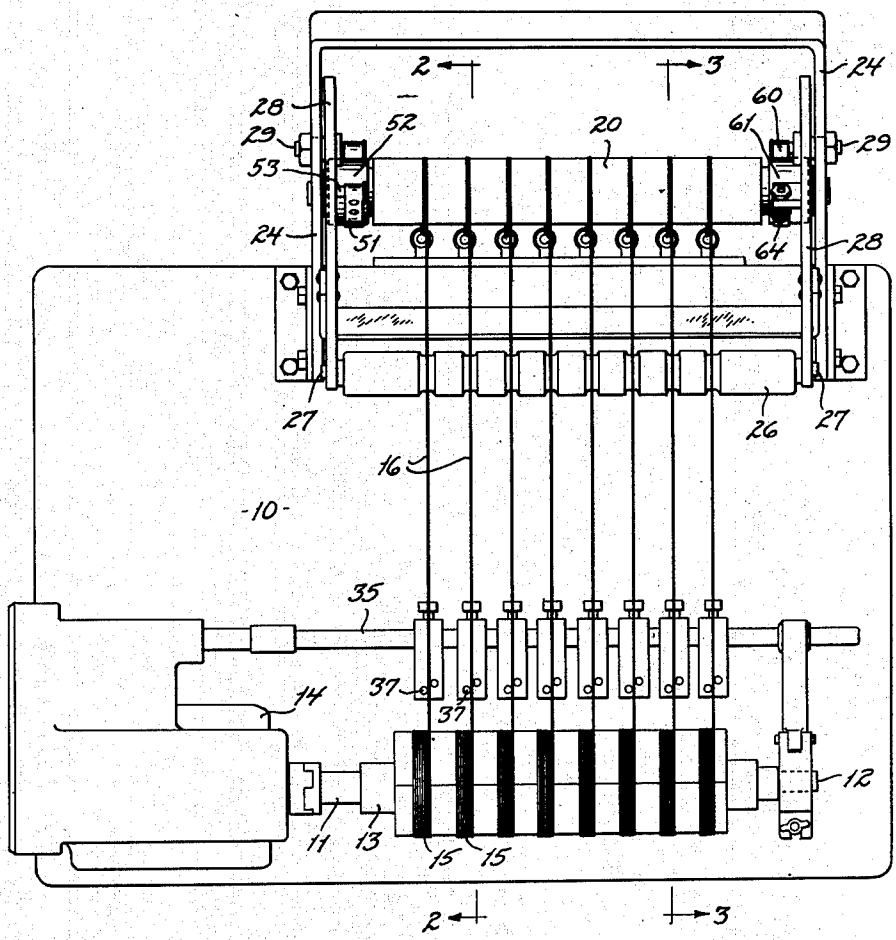


FIG. 1

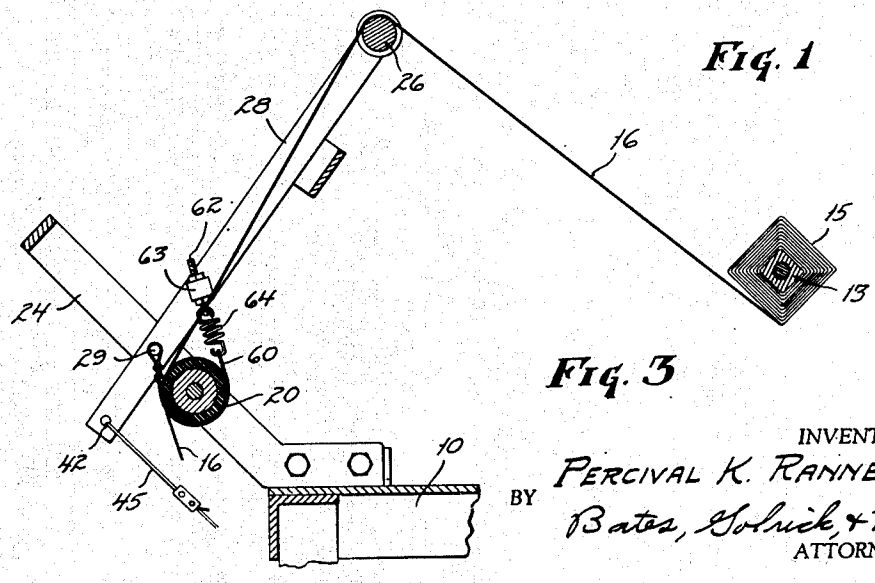


FIG. 3

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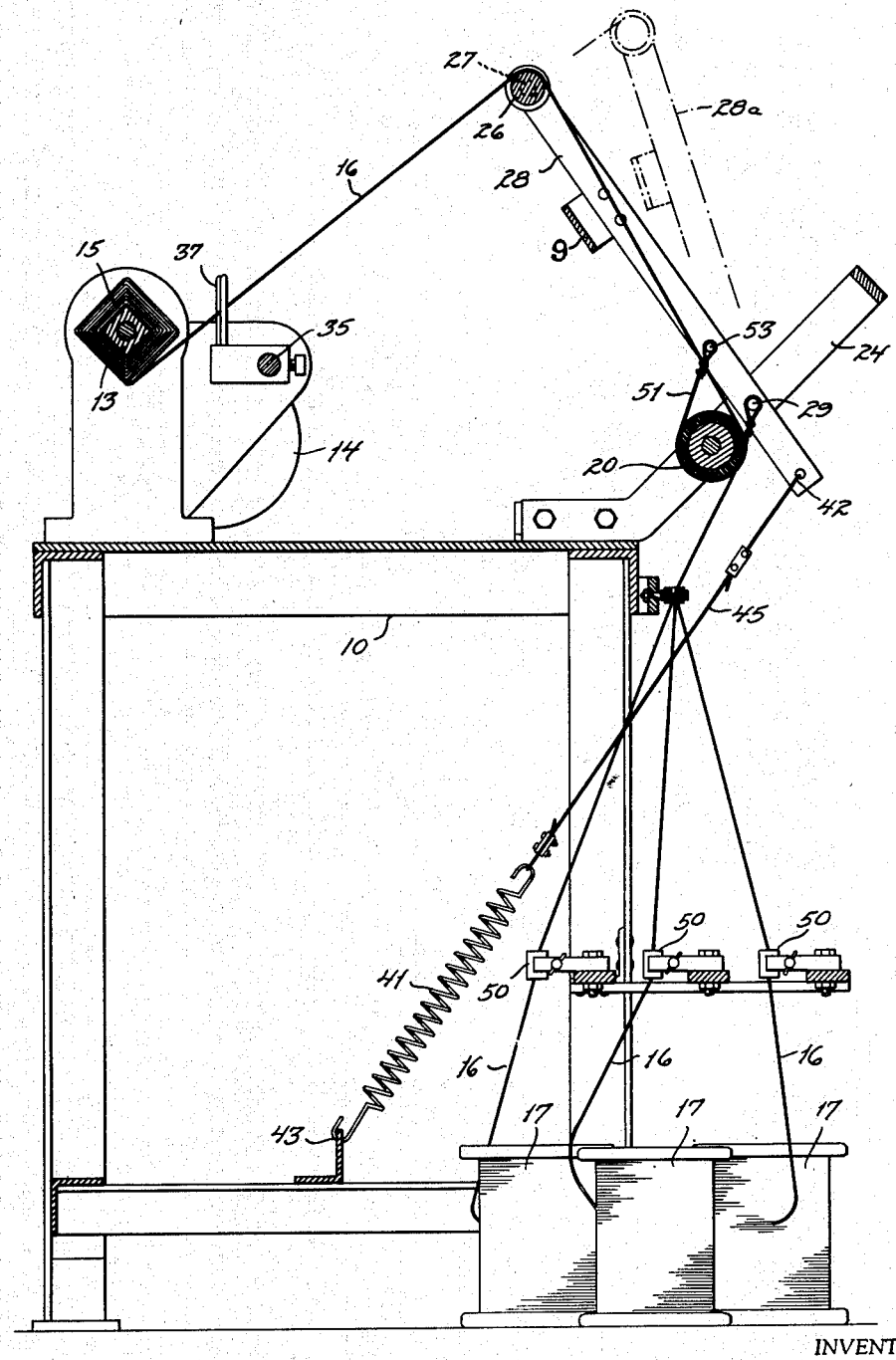


Fig. 2

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COIL WINDING APPARATUS

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Application June 23, 1937, Serial No. 149,835

9 Claims. (Cl. 242—25)

This invention relates to coil winding machines and particularly to those which are used to wind insulated layer coils having many turns of fine wire. This type of coil is used in the secondary of the ignition coils or transformers having a relatively high secondary voltage with relatively small secondary currents. Gas or oil ignition coils and transformers for the energizing of gaseous tubes and ignition devices for oil burners utilize coils of this nature. The invention is particularly adapted in any instance where it is desirable to wind insulated layer coils in multiple. Heretofore the practice of winding such coils in multiple has included a mandrel on which two or more coils have been wound in spaced relationship. The insulated wire for each coil has been supplied from a spool and each wire has had an adjustable tension device for the purpose of winding the coils identically. The independent regulation of each tension device however has required considerable skill by the operator and has been unsatisfactory because it required too frequent attention to maintain uniform tension on the wire. The tension on the wires varies chiefly as a result of the variating momentum of the rotating spools, and the variations in tension therefore causes some coils to be wound tighter than others. This, in turn, wrinkles the paper that is used for insulating the layers from each other. If any wrinkling occurs, its presence is amplified as succeeding layers of wire and paper are wound around the mandrel so that the finished coils are not in as perfect condition as could be desired.

The spools of wire heretofore used have been mounted upon horizontal spindles but I have found that such mounting limits the spool capacity to a few pounds of wire because of the problem of braking the momentum which the spool possesses while in rotation during the stopping operation, and because of the problem of starting a heavy spool without breaking the fine wire. The fact, therefore, that each spool can contain only a few pounds of wire has necessitated many stoppages for replenishment during each winding of the coils and at each stoppage there is the danger of varying the tension, because some spools being fuller than others, will possess greater momentum and hence will not tend to stop, as quickly as others.

All of the foregoing considerations have materially limited the speed of starting and stopping the mandrel and also the number of coils which can be made thereon and have necessitated the painstaking development of skilled operators who can start and stop a machine without breaking the wires and without winding the coils unevenly. Moreover, the necessity for individual tension regulation of the various wires and the necessity for frequent stoppages to replenish a depleted spool, have been decidedly uneconomical factors of coil winding.

An object of my invention therefore is to produce a system of winding coils in multiple upon a mandrel by means of which all of the coils may be wound uniformly at high speed with quick starting and stopping of the mandrel and with less stoppages than heretofore required. Furthermore my invention includes a method whereby individual wire tensioning is eliminated and whereby the supply spools have materially greater capacity than heretofore has been considered practical.

An advantage of my invention is the fact that coils may be wound in multiple upon a mandrel without the need for skillful training and without wrinkling the insulating paper as a result of non-uniformity in tension of the various wires. A further advantage is the fact that a far greater number of coils may be obtained with less stoppages of the machine, thereby resulting in a better product and at less cost.

Referring now to the drawings, Fig. 1 is a top plan view of a coil winding machine embodying my invention and Figs. 2 and 3 are vertical sections taken on the planes indicated by the lines 2—2 and 3—3 in Fig. 1.

In the drawings, 10 indicates the standard of a machine which supports a live spindle 11, and a tail spindle 12, between which a mandrel 13 is mounted for rotation. The live spindle may be driven by any suitable source of power, such as an electrical motor, which is indicated in general at 14. The mandrel has a length of sufficient size to receive the desired number of coils 15, which are wound thereon in spaced relationship, it being understood that at the completion of the winding operation, the mandrel is removed and the layers of insulating paper are separated transversely between the coils, whereby the coils may be thereafter handled as individual units.

The wire for making each coil is indicated at 16 as being supplied by spools 17 that rest upon the floor or other supporting surface at the rear of the machine. The spools are non-rotatably supported and so the wire may be taken off the upper end and led over a suitable guide and control device as will hereinafter be described, to the mandrel. By utilizing non-rotating spools, the capacity can be greatly increased over that heretofore used and the objection incident to the mo-

mentum of the rotating spool is thereby avoided whenever the machine is stopped. Additionally, by increasing the capacity of each spool a larger number of coils can be wound before it is necessary to replenish any spool.

To insure uniformity of movement of all of the wires and to limit the necessity for constant manipulation of individual tensioning devices, I utilize a roller 20 around which all of the wires pass after they leave the spools and before they are wound upon the mandrel. Each wire, may be wound one or more times around the roller or may contact only a part of it, but in each instance sufficient contact is made to assure adequate traction therewith. The wire engaging surface of the roller preferably comprises rubber, or other elastic material, which aids in preventing slippage between the roller and the wires. Rotation of the roller is governed by a braking arrangement which can be adjusted in accordance with the desired speed of the mandrel on which the coils are being wound. The roller is shown as being journalled in brackets 24 which extend upwardly at the rear of the machine.

Each wire, as it passes around the roller 20, preferably extends over a guide roller 26, and thence between spaced guide pins 37 before it contacts the mandrel. The roller 26 may be journalled at 27 in arms 28, which in turn, are pivoted at 29 in brackets 24 and are connected together by a brace 9. The arms are thereby adapted to be oscillated, and are shown in two positions by the full and broken lines 28 and 28—*a* respectively in Fig. 2. The oscillating action is a result of a balancing of forces that are exerted upon the arms by the rotating mandrel and by a spring 41. Normally, when the machine is stopped, the arm occupies the position shown at 28—*a*, but while the machine is in operation, the increased tension on the wires, as a result of the mandrel rotation, overcomes the tension of the spring 41 and moves the arms to the full line position, as shown in Fig. 2. The yieldable characteristic of the arms thereby minimizes any possibility of breaking of the wires at the time of starting the machine.

The spacing of the wires upon the mandrel is controlled by the guide pins 37 which project upwardly from a bar 35 that is adapted to be reciprocated by any suitable mechanism under the control of the motor 14. At the end of each stroke of the bar 35, a sheet of insulating paper is fed onto the wires either by hand or by a feeding device (not shown) and is carried by them around the mandrel, as a result of which each layer is insulated from the adjacent layer.

To permit variation in the tension that is exerted by the spring 41 upon the bars 28, I have shown one end of the spring as being anchored at 43 to the frame and the other end as being attached to the arm 28 at 42. The tension on the spring may be adjusted by varying the length of the cord or cable 45 which extends between the spring and the point of connection 42. The action of the spring 41 therefore is to urge the arms 28 to the broken line position 28—*a* and thereby to maintain in taut condition that portion of each wire in the form of a bight or shed between the roller 20 and the mandrel.

Whenever the machine is started from a condition of rest, the starting torque exerts tension of sufficient force on the wires to overcome the tension of the spring 41, and as a result, the sheave bar 27 is lowered as shown in the full line position in Fig. 2; and as the speed of the mandrel increases, the tension on the wires gradually diminishes until an equilibrium is reached between the wire tension and the tension of the spring 41. During such movement, all of the wires will be paid out at precisely the same speed because of the snubbing action of the roll 20 upon the wires, and inasmuch as the wires are prevented from slipping around the roll, it is obvious that no one wire can possibly be fed to the mandrel at a rate which is different from that of any other wire.

To maintain the wires in taut condition, I utilize a tension device 50 which is associated with each spool and which places only a slight tension on the wire so as to make it unwind from the spool in orderly fashion and to assure simultaneous movement of the roller 20 and the mandrel. I utilize a retarding device that acts constantly on the roller to prevent overrunning whenever the mandrel is stopped, and that permits relatively free rotation of the mandrel at the time of starting.

In the preferred arrangement, the retarding device comprises two brakes, one of which acts constantly upon the roller 20, and the other of which acts intermittently upon the roller. The constantly operating brake is disposed at one end of the roller, while the intermittently operating brake is disposed adjacent the other end of the roller. The intermittent brake is arranged to engage the roller and to stop rotation thereof whenever the arms 28 occupy the broken line position 28—*a* on Fig. 2, i. e., whenever the mandrel is stopped. The intermittent brake, however, is adapted automatically to be released, as soon as the mandrel is rotated, and the tension exerted thereby upon the wires is sufficient to swing the bars 28 to the full line position shown in Fig. 2. The automatic setting and releasing of the intermittent brake is effected solely by movement of the arms, and this may be accomplished by employing a brake band 51 which extends around a brake drum 52 on the roller, and which is attached at its ends to pins that project from the arms. One of the pins comprises one of the pivot pins 29, and the other a pin 53, which is carried by one of the arms between the pivot 29 and the guide roller 26. The arrangement shown is such that when the arms 28 are in the full line position in Fig. 2 the brake is released, but as the arms are moved to the broken line position 28—*a*, the band is tightened, and a retarding force is thereby applied to the roller. This retarding force is sufficient to assure substantially simultaneous stopping of rotation of the mandrel and roller.

I prefer to utilize a constantly acting brake for the purpose of mantaining a predetermined tension upon the wires along that portion which extends between the roller and the mandrel. Accordingly, I utilize a band 60, which extends around a drum 61 and which has one end thereof attached to one of the pivot pins 29, and the other end to a spring 64, the tension of which can be adjusted by a bolt 62 which extends through a threaded swivel block 63 on the arm 28. The swivel block is disposed between the pivot 29 and the roller 26. The operation of the braking system which I have disclosed makes it unnecessary for the operator to exercise caution either in starting or in stopping the machine.

An advantage of the present invention is the fact that I have entirely eliminated the most serious objection to multiple coil winding machines, in that I have obtained absolute uni-

formity in the degree of tightness with which the coils are wound. Additionally, I have provided an arrangement whereby one adjustment automatically results in the coils being wound tighter or looser as may be required to wind all of them identically.

The identity of the coil size is obtained because the roller acts as a metering device to allow only the same length of wire to pass to all of the coils. Consequently, if one coil starts to increase in size, then it automatically get tighter until it gets back to normal. In this way, wrinkling of the insulating sheet is avoided and the resulting product is kept uniform in size and quality. Furthermore, the number of coils which can be wound in a given length of time is very materially increased.

I claim:

1. In a coil winding machine, the combination of a rotatable coil support, a plurality of sources of wire supply, a roller engaging all of the wires, braking devices acting on said roller, one being intermittently and the other being continuously operating, and means yieldably engaging the wires for actuating the braking devices.

2. In a coil winding machine, the combination of a support upon which a plurality of coils of wire is adapted to be wound, means for rotating the support, a source of wire supply for the coils, a movable restrictive device common to and acting upon more than one wire, a movable guide interposed between said device and the support, and engaging more than one wire, means yieldably acting upon the guide to maintain the wires in taut condition, a brake acting upon the restrictive device for retarding the movement of it whenever the rotating means is stopped and means for automatically diminishing the force of the brake when the rotating means is started.

3. In a coil winding machine, the combination of a support upon which a plurality of coils of wire is adapted to be wound, means for rotating the support, a stationary source of wire supply for each coil, means for guiding all of said wires so as to form a shed, means common to all of the wires for engaging and retarding them, said means being movable by the wires, a brake acting on said means and mechanism for automatically applying the brake when the rotating means is stopped and for automatically releasing the brake when the rotating means is started.

4. In a coil winding machine, the combination of a support upon which a plurality of coils is adapted to be wound, means for rotating the support, a source of wire supply for each coil, a roller having its axis substantially parallel to the axis of the support and engaging the wires for maintaining equality in the speed of the wires, means common to all of the wires for holding them in a bight between the roller and the support, said means being movable to compensate for variations in stresses that are exerted upon the wires when the machine is started or stopped, and a brake controlled by said means and acting on said roller.

5. In a coil winding machine, the combination of a mandrel upon which a plurality of coils is adapted to be wound in spaced relationship, a source of wire supply for each coil, means common to all of the wires for exerting a restraining force against the movement thereof, a member common to all of the wires for holding them in a bight between the point at which the restraining force is applied and the mandrel, said member being movable to compensate for variations in the stresses that are exerted upon the wires when the machine is started and stopped, and a brake engaging said means and controlled by movement of said member.

6. In a coil winding machine, the combination of a mandrel upon which a plurality of coils is adapted to be wound, a source of wire supply for each coil, a member common to all of such wires for engaging and retarding them, said member being movable by the wires, a brake acting upon the member, and means engaging all of the wires between the member and mandrel for automatically actuating the brake upon starting or stopping of the mandrel.

7. In a coil winding machine, the combination with a mandrel upon which a plurality of coils is adapted to be wound, a source of supply for each coil, a roller common to and engaging the wires and presenting a non-slipping surface thereto, a yieldable tension device acting on each wire between the roller and the mandrel, and a brake operating upon the roller and actuated by the yieldable tension device.

8. A method of winding a plurality of coils simultaneously upon a mandrel, comprising taking wires from a source of supply, extending them to spaced points on the mandrel, engaging all of the wires simultaneously and imparting a variable restraining force thereto, the variable restraining force being governed by the average tension of the wires leading to the mandrel.

9. In a coil winding machine, the combination of a support upon which a plurality of coils of wire may be wound, means for rotating the support, a source of wire supply for each coil, means for guiding all of said wires so as to form a shed, means movable by the wires and common to all of them for engaging and retarding them, a brake acting on said means and mechanism for automatically actuating the brake upon starting and stopping of the rotating means.

PERCIVAL K. RANNEY.