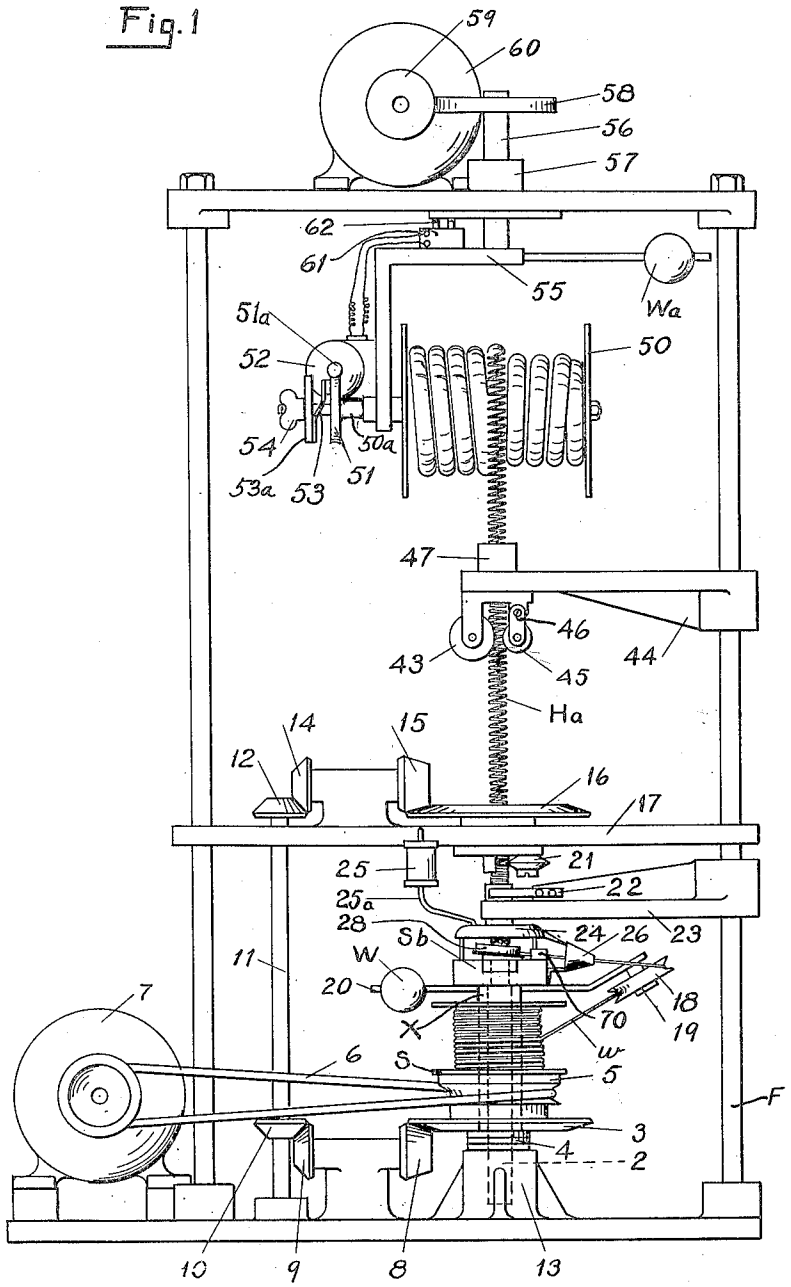
April 3, 1934. A. E. REIMERS 1,953,502

METHOD OF AND MECHANISM FOR PRODUCING HELICAL COILS

Filed July 24, 1930 2 Sheets-Sheet 1

Fig. 1




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Fig. 2

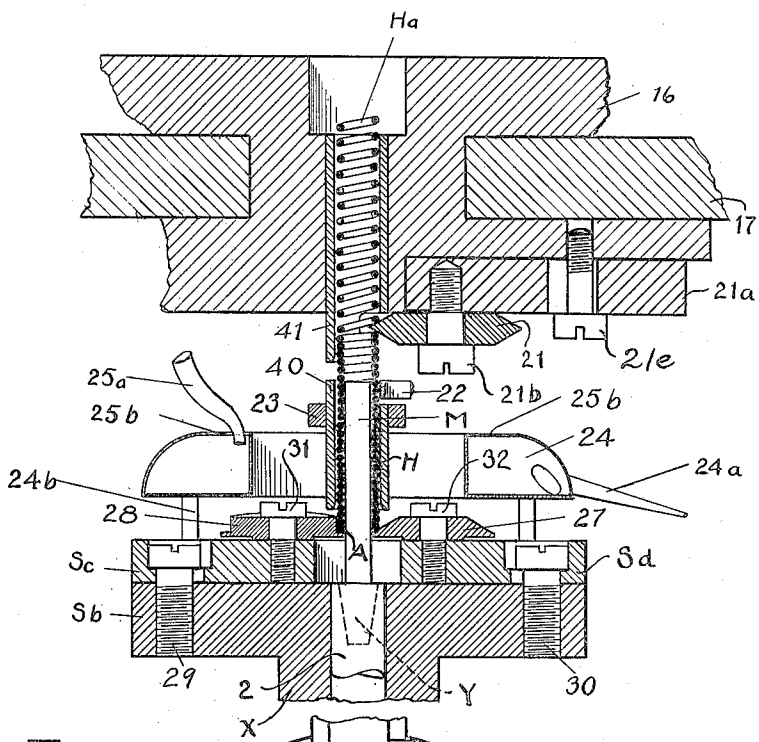
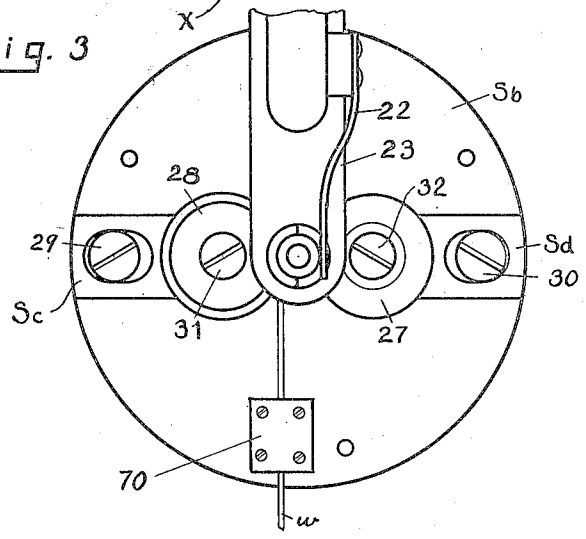



Fig. 3




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# UNITED STATES PATENT OFFICE

1,953,502

## METHOD OF AND MECHANISM FOR PRODUCING HELICAL COILS

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Application July 24, 1930, Serial No. 470,373

4 Claims. (Cl. 153—65)

My invention relates to a new and improved method of and mechanism for producing helical coils.

One of the objects of my invention is to provide a method of making a coil of springy or non-springy wire, said coil being of any desired length and being wound up upon a reel or spool.

Another object of my invention is to provide an automatic mechanism whereby a helical coil of any desired length and of any desired pitch can be made and wound up upon a spool or reel.

Another object of my invention is to produce a device by means of which the helical coil is first wound closely, and the pitch of the coil is then increased to the desired extent.

Other objects of my invention will be set forth in the following description and drawings which illustrate a preferred embodiment thereof, it being understood that the above general statement of the objects of my invention is intended merely to generally explain the same and not to limit it in any manner.

Fig. 1 is a front elevation of the machine utilized for carrying out my invention.

Fig. 2 is an enlarged sectional view of the primary coil-forming devices, and

Fig. 3 is a plan view of the bottom member shown in Fig. 2.

Heretofore in making wire coils, and particularly in making coils of wire to be used in electrical apparatus for conducting current, it has been customary to use an intermittently operating device which produced a coil of a specified length at each operation. It has been proposed to use continuous machines, which would produce a coil of great length, but such machines have heretofore not proved satisfactory.

According to the invention, the wire is fed into the machine, and the wire is automatically formed into a coil of any desired length, the length of the coil being only limited by the capacity of the winding reel. Although it is a particular advantage of my invention that it is adapted to operate upon resilient wire, the invention is not to be restricted to forming a coil from any particular material.

The device comprises a frame F having an upright bearing 13, in which the stationary spindle 2 is mounted. A hollow spindle X is revolubly mounted upon the stationary spindle 2, by means of an anti-friction bearing 4, and this hollow spindle is provided with a bevel gear 3 at its lower end, and with a pulley 5 above its lower end. This pulley 5 is driven by a belt 6 which passes around a pulley on the shaft of an electric motor 7. The bevel gear 3 meshes with a bevel gear 8 which is on the same shaft as the bevel gear 9. The bevel gear 9 meshes with the bevel gear 10, mounted upon the upright shaft 11, and having the bevel gear 12 at its upper end. The bevel gear 12 meshes with the bevel gear 14, which is on the same shaft as the bevel gear 15, in order to drive the bevel gear 16, which has a hub provided with a bearing in the stationary frame member 17. The wire which is to be formed into a helical coil is wound upon the spool or reel S, and the bottom of said reel S rests upon the top of the upper hub-portion of the pulley 5. The spool S is freely mounted on the hollow spindle, so that it can turn with respect to said hollow spindle. It is desirable, however, to prevent or to limit this free relative rotation, and this can be done by providing the bottom face of the spool S and the adjacent bearing portion of the pulley 5, with suitable friction material in order to provide a friction drive between the hollow spindle and the spool S. The wire *w* is led around an idler 18 which is mounted on the bearing 19, which is connected to the arm 20. The arm 20 is provided with an adjustable weight W so as to prevent vibration when the idler 18 is rotated about the vertical central axis of the spindle 2.

The upper end of the hollow spindle X has an enlarged winding head S*b*, so that this winding head turns in unison with the hollow spindle X. Hence, the spool S, the hollow spindle X, and the winding head S*b* revolve in unison about the fixed spindle 2. The wire *w* is led through a funnel 26 which is supplied with waste or other absorbent material which is kept saturated with oil, so that the wire *w* is thoroughly lubricated before the coil is formed.

As shown in Fig. 2, the wire *w* is then led to the point A. The fixed spindle 2 has a tapered socket Y at its upper end and a removable mandrel M can be situated in this socket, in order to be held stationary therein. The removable mandrel M has a tapered head which enters the socket Y. Mandrels M of different diameters can be utilized in order to produce helices of different size.

At the point A, the wire is held between the mandrel M and the disc 28. The bottom of this disc is provided with an enlarged flange, as shown in Fig. 2. The disc 28 is held by means of the pivot screws 31 upon the adjustable support S*c*. The disc 27 whose periphery has a frusto-conical shape is pivotally mounted by means of the pivot screw 32 to another adjustable support

Sd. The laterally adjustable member Sc is adjustably clamped to the hub head Sb of the hollow spindle X by means of a clamping screw 29. The other laterally adjustable member Sd is clamped to the head Sb by means of the clamping screw 30. Hence, the discs 27 and 28 are caused to rotate about the central longitudinal axis of the mandrel M. This rotating movement forms the helical coil around the mandrel M, and it forces the helical coil upwardly as the same is formed, without causing the helical coil to substantially rotate about the axis of the mandrel M. It is permissible to permit a slight rotation or slip of the helical coil about the axis of the mandrel M in order to relieve the cumulative tension on the coil, or else it would be impossible to continue to form the turns of this helical coil. The mechanism for holding the coil against substantial rotating movement, while permitting the proper relief to this tension, is later described herein.

The disc 28 operates to form the turns of the helical coil, and as each turn or winding of the coil is formed around the mandrel M, the flange of the disc 28 and the periphery of the disc 27 both upwardly push the preceding turns of said coil. Hence, the closely wound helix H, which is thus formed, is pushed off the top of the mandrel M. The initial operation of the device is therefore to form a helical coil of very small pitch.

As the closely wound helix H is formed, its upward movement is guided by a bushing 40 which is held in position by means of a stationary frame member 23, which is rigidly attached to the frame F.

In order to prevent the helical coil from turning around its axis to a substantial extent, while permitting a sufficient relative rotation to relieve the cumulative tension which is produced if resilient wire is utilized, I have provided a flat or blade spring 22, which is adjustably mounted on the frame member 23. This spring member 22 bears upon the coil at the cut-away portion of the bushing 40, in order to limit the turning movement of the coil to an extent sufficient to relieve the tension previously mentioned.

This frictional resistance produced by the spring 22 causes the turns of wire in the closely wound helix H to substantially contact with each other and it permits only enough rotation or slip which is necessary in order to maintain the winding operation.

A member 21 is connected to the bottom of the hub of the bevel gear 16, in order to separate the coils of the initially formed and closely wound helix H. This produces a coil Ha which has the desired pitch. A member 21 is adjustably clamped to the hub of gear 16 by screw 21b. A suitable anti-friction bearing can be provided to enable bevel gear 16 to freely turn in member 17.

The periphery of the roller 21 has a V-shaped cross-section, and this roller 21 is connected by means of a pivot screw 21b to the laterally adjustable support 21a, which is mounted on the hub of the bevel gear 16. Hence, said member 21 can revolve about the screw 21b, and said member 21 also rotates about the central longitudinal axis of the coil, with the same angular speed as the bevel gear 3. That is, the bevel gears 16 and 3 turn the same number of revolutions per minute, and the separating member 21 turns in unison with the bevel gear 16.

The helix Ha is guided upwardly through a bushing 41, which is mounted in the hub of the bevel gear 16. The helix Ha is then led between an idler roller 43 which is pivotally mounted upon the frame member 44, and a second idler roller 45. The idler roller 45 is pivotally mounted upon a short depending rod which is pivotally connected at 46 to the frame member 44.

The wire is then led through a sleeve 47 which is preferably free to turn about a vertical axis, being provided for this purpose with a suitable bearing in the frame member 44. The helix Ha is now wound upon a reel 50 which is connected to a shaft 50a mounted in a suitable bearing provided in the support 55. The shaft 50a is provided with a loose worm wheel 51, which is driven by the small electric motor 52, which is also connected to the arm 55. The motor 52 turns worm wheel 51 by means of worm 51a. The worm wheel 51 drives the disc 53a which is slidably keyed to the shaft 50a, by means of a friction drive provided by the spring 53.

The wing nut 54 can be used for tightening or loosening this friction drive. When the helix Ha is being initially wound up upon the reel 50, the outer diameter of the coils upon the reel 50 is small. As the helix is wound up upon the reel 50 it is desirable to manipulate the wing nut so as to permit a certain slip in the friction drive whereby the angular turning velocity of the reel 50 is lowered, to provide for the increased outer diameter, so that the speed with which the helix Ha is wound up upon the reel 50 corresponds to the speed at which it is pushed off the mandrel M. That is, it is desirable that the upward movement of the helix should be substantially a pushing movement, and that little or no tension should be exerted upon the helix in order to wind it up upon the reel 50. It is desirable to maintain the pitch of the helix Ha, as it is wound up upon the reel 50, and if any undue tension were exerted upon the helix Ha in order to wind it up, the pitch of this helix would be increased beyond the desired limit. If the helix is made of springy wire, a certain amount of tension will not make any substantial difference because the springiness of the wire will cause it to maintain the desired pitch. The arm or bracket 55 is mounted at the bottom of a shaft 56 which projects through a suitable bearing 57. The shaft 56 is turned by means of a worm-drive comprising a worm-wheel 58 and a worm 59 which is mounted on the shaft of the motor 60. The motor 60 is suitably mounted upon the top of the frame F.

In order to energize the motor 52 during its rotation together with the arm 55, said motor 52 is provided with current through collecting rings 61 having brushes 62.

If it is assumed that the observer is above the spool S, then this spool S is revolved in the counterclockwise direction in the embodiment shown herein. The spool S for instance may be turned at seventeen hundred and fifty (1750) revolutions per minute. The arm 55 is turned in the same direction, but at a speed sufficient to cover the rate of slip—in this instance, 80 revolutions per minute, so that said arm 55, together with the reel 50, have a turning speed of about eighty revolutions per minute.

According to the invention, a closely wound helix H is first formed without causing the same to turn about its central axis, except for the necessary rate of slip. The closely wound helix then has its pitch increased, and it is then wound upon a reel which turns about a horizontal axis, as well as around a vertical axis, the tension on the helix being relieved to the desired extent, as it is wound upon the collecting reel.

It will be noted that when the reel 50 turns about its horizontal axis, that it does not operate to exert any pull, or at least any substantial pull upon the coil of wire. The essential part of the operation is the pushing action which is accomplished by means of the members 28 and 27, whereby each turn of wire is caused to move the previously formed turns of wire in an axial direction.

It will be noted that the wire *w* is led through the guide 70 before it is subjected to the action of the members 28 and 27. The funnel 26, which can be packed with waste or any other suitable absorbent material, is connected by means of a spout 24*a* to the oil distributor 24. This receives oil from the container 25 through the pipe 25*a*, and said oil enters the member 24 through the annular opening 25*b*. The member 24 is connected by means of members 24*b* to the member S*b* so that the member 24 turns together with the spool S to produce the required centrifugal force. The oil receptacle 25 is connected to the frame member 17.

I have shown a preferred embodiment of my invention, but it is clear that numerous changes and omissions can be made without departing from its spirit.

I claim:

1. A method of forming a helical coil of wire which consists in winding the wire around a mandrel and pushing the coil off the mandrel, while collecting the advancing end of the coil upon a reel which is turned to wind up the coil and which is also turned in a direction which is the same as the direction in which the wire is wound to form the coil.

2. A device for forming a helical coil of wire comprising a mandrel, means adapted to lead wire to said mandrel, and a pair of coil-forming members turnably connected to a mount, said coil-forming members being adapted to wind said wire around said mandrel, the outer end of said mandrel being substantially unobstructed so that the helical coil which is thus formed can be pushed off the outer end of the mandrel, and auxiliary means located beyond the outer end of the mandrel and adapted to increase the pitch of the helical coil which is formed on the mandrel.

3. A coil-forming device comprising a stationary mandrel and a support therefor, a member revolubly mounted so that it can be revolved about the central longitudinal axis of said mandrel, means adapted to revolve said member, said member having a pair of revoluble coil-forming members connected thereto so that said coil-forming members which turn with said member can also revolve independently thereon, the peripheries of said coil-forming members being closely adjacent the peripheries of said mandrel, one of said coil-forming members having a flange at the inner end thereof, the other of said coil-forming members having a tapered periphery which is adapted to force the wire towards the outer end of said mandrel.

4. A device for forming a helical coil comprising a stationary spindle, a revoluble spindle mounted on said stationary spindle, said stationary spindle having a mandrel connected to the outer end thereof, the outer end of said revoluble spindle having an enlarged head, a pair of laterally adjustable members adjustably connected to said enlarged head, each of said laterally adjustable members having a turnable coil-forming member mounted thereon, the peripheries of said coil-forming members being closely adjacent the periphery of said mandrel, one of said coil-forming members having an enlarged flange at its inner end and the other of said coil-forming members having a tapered periphery, a spool mounted on said revoluble spindle and adapted to be turned in unison with said spindle, guide means adapted to guide wire from said spool to the mandrel at a point directly adjacent said enlarged flange, means adapted to lubricate the wire while it is being so guided, a bushing having an opening therein and surrounding the inner part of said mandrel, a friction spring having its end extending through the opening of said bushing to frictionally bear upon the coils of wire which have been formed upon said mandrel in order to retard the turning of said coils of wire around said mandrel, revolving means located beyond the outer end of said mandrel and adapted to increase the pitch of the coil which has been formed upon said mandrel, a reel adapted to take up the coil of wire after the pitch thereof has been increased, means adapted to turn the reel in order to wind up the coil of wire, and means adapted to turn said reel about the longitudinal central axis of the mandrel and at a lower speed than said hollow spindle.

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