

[72] Inventor **Cord Albrecht**
Erlangen, Germany
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 [73] Assignee **Siemens Aktiengesellschaft**
Berlin and Erlangen, Germany
a corporation of Germany
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Primary Examiner—Billy S. Taylor
Attorney—Curt M. Avery

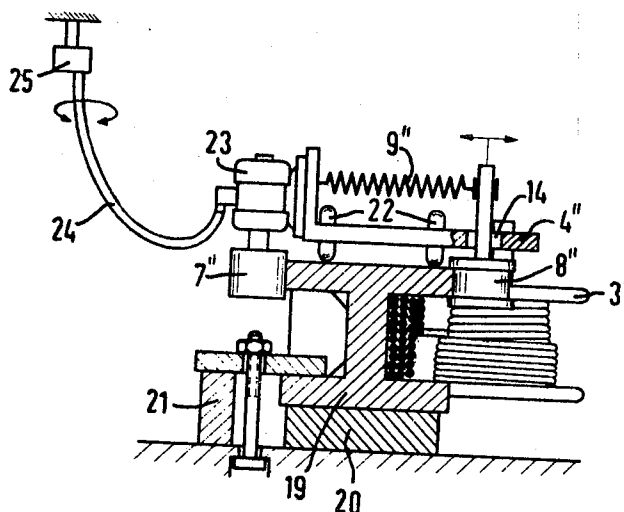
[54] **COIL WINDING APPARATUS**
19 Claims, 8 Drawing Figs.

[52] U.S. Cl..... **242/7.07,**
242/7.22
 [51] Int. Cl..... **H01f 41/06**
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7PS, 11PS, 2, 3, 4, ; 156/189, 457, 446

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ABSTRACT: Coil winding apparatus includes a stationary device and a movable device, one of the devices including a coil frame of curved noncircular configuration and the other device including a carriage. A mechanism is operatively connected to the movable device for moving it relative to the stationary device. A guide structure is aligned with and has a configuration conforming to that of the coil frame and a pair of guide members carried by the carriage guidingly engages the guide structure so as to thereby guide the movable device, during movement thereof by the moving mechanism, along a path conforming to the configuration of the frame. A supply source for a filamentary structure to be coiled onto the frame is carried by the carriage, and elastic force-storing means such as a spring urges the guide members and the guide structure into engagement with each other so as to maintain the carriage and coil frame at least approximately at the same orientation one relative to the other and direct the filamentary structure tangentially onto the frame while issuing from the supply source at a location situated at a substantially constant distance from the location where the filamentary structure is wound onto the frame, whereby a substantially constant length of the filamentary structure extends from the supply source tangentially to the frame during winding of the filamentary structure thereon.



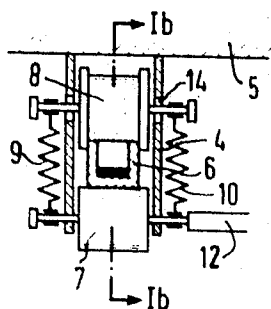


Fig.1a

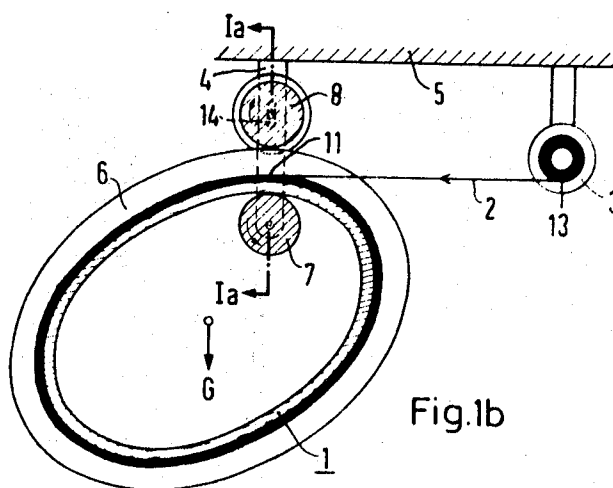


Fig.1b

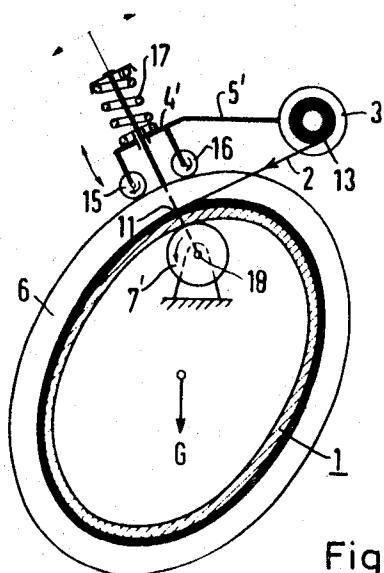
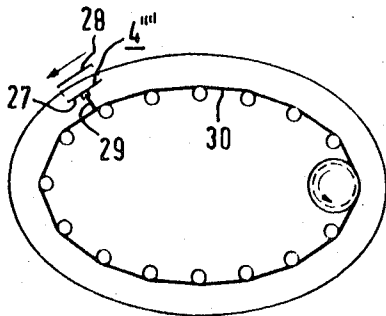
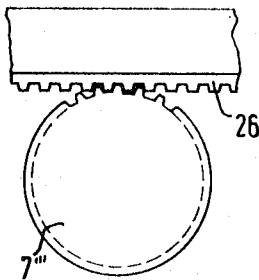
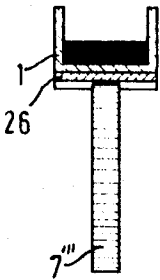
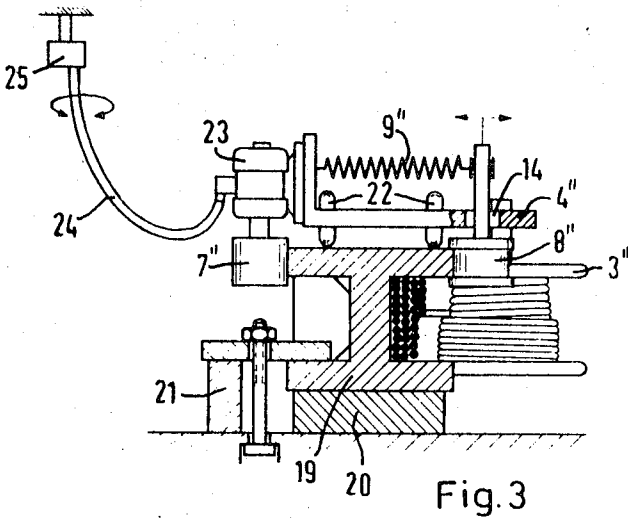


Fig.2



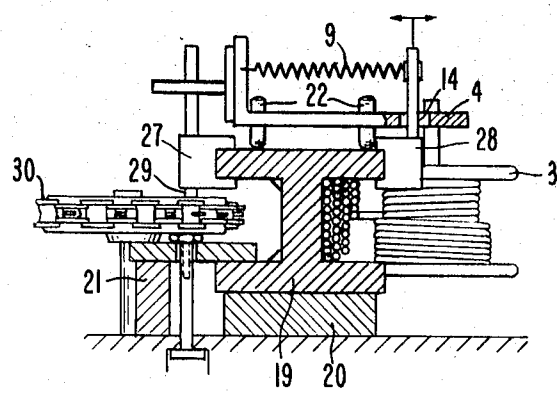


Fig. 6

COIL WINDING APPARATUS

My invention relates to a coil winding apparatus.

In particular, my invention relates to that type of coil winding apparatus which is used during the manufacture of coils for electrical apparatus.

My invention deals more specifically with apparatus for winding filamentary structure onto a coil frame which is curved but is of a noncircular configuration, although along its entire periphery the frame has a radius of curvature, which while of different lengths at different parts of the frame, nevertheless is of a uniform character all along the frame which carries the filamentary structure of the coil, this filamentary structure being, for example, in the form of a suitable wire which is unwound from a supply roll as it is wound onto the frame of the coil.

With conventional winding apparatus of this type, used, for example, in the manufacture of coils of elliptical or saddle-shaped configuration, considerable difficulties are encountered in guiding the wire or the like during the winding thereof onto the coil. It is only by using structures having complex kinematic compensating structure a balanced uniform operation which will provide a coil having a desired uniformity throughout its structure. Particularly difficult conditions are encountered when winding the wire or the like onto a relatively large coil frame, such as, for example, an elliptical frame having a major and minor axes respectively on the order of 50 cm. and 30 cm., especially when the wire is relatively fine and has, for example, a diameter on the order of 0.1 mm.

Thus, it is a primary object of my invention to provide a coil winding apparatus which will avoid the above drawbacks.

In particular, it is an object of my invention to provide a coil winding apparatus which is simple and operates in a manner far superior to any conventional coil winding structure while at the same time being capable of winding onto the coil frame the filamentary coil structure which can be any wire, whether in braided or stranded form, any band structure, any foil structure, etc., so that my invention is applicable to all types of filamentary structures in general.

Thus, while avoiding complex units, it is an object of my invention to provide a structure which is capable of effectively winding a coil, even one of relatively large dimensions, in such a way that the filamentary coil structure is uniformly wound throughout the entire coil and is under a substantially constant tension throughout the entire coil.

A more specific object of my invention is to provide a construction which will reliably maintain the filamentary structure in a position where it is necessarily wound tangentially onto the coil while issuing from a suitable supply means such as a supply roll, as pointed out above.

Furthermore, it is an object of my invention to provide a construction which will maintain the distance of the location where the filamentary structure unwinds from the supply roll to the location where it is wound tangentially onto the coil substantially constant, so that during winding of the filamentary structure on the coil a substantially constant length of the filamentary structure extends between the coil and the supply roll.

It is, therefore, a further object of my invention to provide a construction where the direction along which the filamentary structure extends while it is wound onto the coil is in no way influenced by the supply means from which this filamentary coil structure is obtained.

Yet another object of my invention is to provide between parts which move relative to each other during winding of the coil a substantially constant speed, so that in this way a substantially constant tension can be maintained in the filamentary structure which is wound onto the coil. This maintenance of the constant speed between the relatively moving parts of the apparatus of my invention greatly improves the manner in which the filamentary structure is guided onto the coil and in addition because the filamentary structure necessarily moves at a constant speed to the coil the possibility of transverse vibrations in the filamentary structure is avoided, such transverse vibration resulting from nonuniform tension in the filamentary coil structure as it is wound onto the coil.

Furthermore, as a result of the uniform stressing of the wire or the like during winding thereof onto the coil, the danger of undesirable deformations, cracks, or tearing of the wire is avoided and at the same time a uniform pretreatment of the wire can easily and conveniently be provided, such a pretreatment being, for example, a heat treatment, covering the wire with a coating of a suitable lacquer, providing the wire with a galvanic coating or with any desired wrapping material which is wrapped around the wire.

The coil winding apparatus of my invention includes a stationary means and a movable means, one of these means including a coil frame of curved but noncircular configuration and the other of these means including a carriage. A moving means is operatively connected to the movable means for moving the latter relative to the stationary means, and a guide means of my invention is aligned with and has a configuration conforming to that of the coil frame, this guide means guiding the movable means, during movement thereof by the moving means, along a path conforming to the configuration of the frame. The guide means of my invention maintains the carriage and coil frame at least approximately at the same orientation one relative to the other. A supply means is carried by the carriage for supplying a filamentary structure which is to be coiled onto the frame, and the guide means of my invention, by maintaining the above orientation between the carriage and coil frame, directs the filamentary structure tangentially onto the coil frame while this filamentary structure issues from the supply means at a location situated at a substantially constant distance from the location where the filamentary structure is wound onto the frame. In this way a substantially constant length of this filamentary structure extends from the supply means tangentially to the frame during winding of the filamentary structure thereon.

My invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1a is a transverse section of the structure shown in FIG. 1b, FIG. 1a being taken along line 1a-1a of FIG. 1b in the direction of the arrows;

FIG. 1b is a sectional schematic side elevation of an apparatus of my invention, the section of FIG. 1b being taken along line 1b-1b of FIG. 1a in the direction of the arrows;

FIG. 2 is a schematic partly sectional elevation of another embodiment of a winding apparatus of my invention;

FIG. 3 shows in a transverse section part of the structure of yet a further embodiment of a winding apparatus of my invention;

FIG. 4a is a transverse section of a further embodiment of a structure of my invention for advancing a coil frame during winding of filamentary structure thereon;

FIG. 4b is a fragmentary schematic side elevation of the structure of FIG. 4a;

FIG. 5 is a schematic illustration of yet another embodiment of a coil winding apparatus of my invention; and

FIG. 6 is a cross-sectional view of the embodiment of FIG. 5 corresponding to the view of the embodiment shown in FIG. 3.

Referring now to FIGS. 1a and 1b, the winding apparatus of my invention illustrated therein includes a stationary means and a movable means. In this embodiment the stationary means includes the schematically illustrated carriage 4, while the movable means includes the coil frame 1 which in the illustrated example has an elliptical configuration, so that the coil frame is curved but noncircular. The carriage 4 has a portion 5 which serves to mount on the carriage 4 a supply means 3 for the filamentary structure to be wound onto the coil. In the illustrated example this supply means 3 takes the form of a supply roll which is supported for rotary movement and which has a supply of wire 2 thereon, this wire being unwound from the roll 3 and wound onto the frame 1, during operation of the apparatus of my invention.

A guide means of my invention guides the movable means, which in FIGS. 1a and 1b includes the coil frame 1, for movement with respect to the stationary means, which in the example of FIGS. 1a and 1b includes the carriage 4, and this guide

means takes the form of a pair of coil flanges 6 which conform to the configuration of the coil frame 1 and extend along the periphery thereof. Thus, in the example of FIGS. 1a and 1b the guide means 6 is fixed to and forms part of the coil frame 1, this guide means extending along and forming part of the periphery of the coil frame itself. The guide means 6 will function to maintain the movable means 1 and the stationary means 4 at a substantially constant orientation one with respect to the other, this being the orientation shown in FIG. 1b. This orientation is such that the carriage 4 extends at all times approximately tangentially with respect to the outer peripheral edge of the coil frame 1 formed by the outer edges of the frame flanges 6. These flanges have a constant width so that their outer peripheral edges conform to the configuration of the inner peripheral surface of the frame 1. The supply means 3 is carried by the part 5 of the carriage 4 at a location where in the direction of orientation of the carriage 4 with respect to the frame 1 the supply means 3 will be situated at a predetermined distance from the frame 1.

The carriage 4 includes a pair of guide members which engage and cooperate with the guide means 6 of the invention, these guide members in the illustrated example taking the form of rollers 7 and 8. The roller 7 engages the inner edges of the flanges 6, and thus the inner periphery of the frame 1, while the roller 8 engages the outer peripheral edges of the flanges 6. Springs 9 and 10, diagrammatically illustrated in FIG. 1a, urge the rollers toward each other so as to maintain them in engagement with the guide means 6. Thus, when the movable means 1 moves with respect to the stationary means 4 of FIGS. 1a and 1b, a straight line which is perpendicular to and intersects the parallel axes of the rollers 7 and 8 will also be perpendicular to the tangent to the periphery of the outer edge of each flange 6 at the place where this straight line intersects this periphery. Therefore, any line which extends horizontally in FIG. 1b and is perpendicular to a straight vertical line passing through the parallel axes of the rollers 7 and 8 in FIG. 1b will have a tangential relationship with respect to the frame 1, and it will be seen that at the point 11 the wire 2 extends tangentially in this manner with respect to the frame 1. This point 11 is the location where the wire is wound onto the coil frame 1, and with the structure of my invention during winding of the wire 2 onto the frame 1 it will always have a tangential relationship with respect to the frame 1.

The free movability of the movable means 1 with respect to the stationary means 4 of FIGS. 1a and 1b is brought about by simply permitting the frame 1 together with the guide means 6 to be supported between the rollers 7 and 8 without providing any other support for the parts 1, 6 and without restraining movement thereof in any way. Thus, in this embodiment the carriage 4 remains stationary and the supply roll 3 will remain at a predetermined location.

A moving means is operatively connected with the movable means to move the latter with respect to the stationary means, and in the illustrated example this moving means takes the form of a driving motor shaft 12 schematically shown in FIG. 1a and operatively connected with the roller 7 to rotate the latter so that as a result of the frictional engagement of the roller 7 with the inner periphery of the frame 1, the latter is moved with respect to the carriage 4. Thus, the roller 7 functions not only as a guide member but also as a drive member. By way of a simple coupling of the driving motor shaft 12 to the roller 7, it is possible to provide for the roller 7 a uniform speed of rotation so that in this way a uniform speed of movement of the wire 2 can be achieved. As is apparent from FIG. 1b, through this exceedingly simple construction it is possible to achieve all of the requirements for a good guiding of the wire during the winding thereof onto the coil. The wire extends tangentially with respect to the frame 1 at all times so as to be wound only in a tangential manner onto the coil frame 1, and in addition the distance between the location 11 where the wire is tangentially wound onto the coil and the location 13 where the wire issues from the supply means 3 remains constant, so that at all times during the winding operations

there is a constant length of wire extending between the locations 11 and 13. As a result of advancing the wire at a constant speed onto the coil, the wire remains at all times at a constant tension.

In order to make it possible to move the frame 1 into and out of the space between the rollers 7 and 8 in an extremely simple manner, it is possible to provide bearings which support the rollers 7 and 8 for rotary movement on only one side of the rollers 7 and 8, so that the other side thereof is free to provide unobstructed movement of the frame into and out of the space between the rollers. However, in the illustrated example the roller 7 is removably mounted so that in the illustrated example it is equally convenient simply to remove the roller 7, place the frame 1, 6 in engagement with the roller 8, and then return the roller 7 to the assembly so that the parts will have the position shown in FIG. 1b. Thus, a shaft which has, for example, a splined connection with the roller 7 and onto which the springs 9 and 10 are hooked has also a keyed connection with the drive shaft 12, and this shaft which drives the roller 7 can be slipped out of the latter and then back through the axial bore of the roller 7 to again have a driving engagement therewith. It will be noted that the frame members through which the shafts for the rollers 7 and 8 extend are respectively formed with elongated slots 14 along which the shaft for the roller 8 is freely movable. This shaft is of course connected to the top ends of the springs 9 and 10, and these springs when fully tensioned with a frame 1, 6 situated between the rollers will locate the shaft for the roller 8 between the ends of the slots 14. The force exerted by the springs 9 and 10 through the rollers 7 and 8 on the frame 1 must be at least great enough so that the frame 1 will at all times have between the rollers a position providing for a horizontally extending tangent at the point 11, so that in this way the guide means 6 cooperates with the rollers and the moving means 12, 7 cooperates with the frame 1 to provide for the latter only rolling contact between the rollers 7 and 8 and no slip.

As is apparent from FIG. 1b, the center of gravity of the frame 1 is situated at a location where the weight G of the frame 1 together with the filamentary structure 2 already wound thereon will exert a turning moment with respect to the carriage 4. In the case where the frame and filamentary structure thereon are relatively heavy and where a considerable moment arm is provided as a result of a substantial eccentricity in the location of the center of gravity of the frame with respect to the rollers 7 and 8, it becomes necessary to provide extremely powerful springs 9 and 10 as well as to provide very strong bearings for the rollers 7 and 8. Thus, in such case certain difficulties will be encountered, but these difficulties can be avoided in a number of ways. For example, the vertical winding plane of FIG. 1b can be turned through 90° so as to be in a horizontal plane, and thus the weight of the coil frame and the wire wound thereon will exert a force extending parallel to the axis of the coil frame rather than perpendicularly to this axis. Thus, all that is required for this purpose is to arrange the entire structure horizontally rather than vertically. With such an arrangement it is only necessary to support the coil frame 1 during the winding operations on a suitable antifriction structure such as on suitable rollers or on a support with which the coil frame can easily slide, so that in this way the above difficulties are avoided.

However, it is also possible to provide an arrangement as shown in FIG. 2, this arrangement permitting the winding plane to be maintained in a vertical situation. With the apparatus of my invention which is illustrated in FIG. 2, the carriage 4', which also forms part of the stationary means of this embodiment, has a pair of guide rollers 15 and 16 which are tangentially arranged with respect to the guide means 6 having a rolling contact with the outer peripheral edges thereof. A spring 17 presses the guide rollers 15 and 16 against the peripheral guiding edges of the guide means 6. The entire carriage 4' is capable of swinging in the manner of pendulum about the stationary axis of the shaft 18 on which the roller 7' is mounted. Thus, with this arrangement the entire carriage 4'

can swing in the manner of a pendulum about the shaft 18 so that it will automatically assume at all times a position where the wire 2 will extend tangentially onto the coil frame at the point 11'. The spring 17 by maintaining the rollers 15 and 16 in engagement with the guide means 6 will maintain a line in the plane of FIG. 2 extending through the axes of the rollers 15 and 16 parallel to the direction in which the wire 2 extends, and this direction is always parallel to a tangent to the outer periphery of each flange 6, so that in this way the tangency is automatically maintained with the structure of my invention which is illustrated in FIG. 2. The supply means 3' is still supported for rotary movement by the structure 5' of the carriage 4' so that the supply means 3' executes the pendulum motions together with the entire carriage 4', and in this way the substantially constant distance between the locations 11' and 13 is maintained with the embodiment of FIG. 2. Of course, the axis of the driving roller 17 will remain stationary. With this arrangement of my invention the center of gravity of the frame 1 is situated at all times directly beneath the driving roller 7', and in fact beneath the location 11 where the wire is tangentially wound onto the coil and where the inner periphery of the coil frame 1 actually engages the roller 7'. Thus, it will be noted that the frame 1 does not necessarily engage the roller 7' at the uppermost part thereof. Because of the noncircular configuration of the frame 1 and the guide means 6 the area of engagement between the roller 7' and the inner periphery of the frame 1 is always situated in alignment with the point of tangency 11, and the center of gravity is always situated beneath this location 11. Thus, with this construction the weight of the frame 1 together with the wire wound thereon will simply urge the frame 1 against the roller 7' without any turning moment since the eccentricity has been eliminated, so that there is no moment arm, and therefore the problems encountered with an arrangement as shown in FIG. 1b are eliminated, so that even in the case where the coil frame 1 and the wire wound thereon are heavy and are of a substantial size, there nevertheless will be no difficulty with the embodiment of FIG. 2.

Where the coil is of the type which is to be subjected to relatively large forces during operation, then the coil frame must be provided with a suitable supporting structure having suitably robust dimensions so as to provide a stable support for the coil. In such a case, it is possible to simplify the construction by winding the filamentary structure directly onto the assembly which includes the robust frame structure of the coil instead of first winding the filamentary structure onto a relatively light coil body which subsequently is assembled with the frame supporting structure. Thus, to take care of this situation the relatively heavy coil frame carrying structure is fixedly clamped on a suitable support and in this case the coil winding apparatus of my invention provides a movable means which includes the carriage which runs in the manner of a cable trolley of a lifting crane along the guide means which again is capable of being formed by part of the coil itself as, for example, out of peripheral edges thereof.

A construction of this latter type is illustrated in FIG. 3. FIG. 3 shows the rugged and robust frame supporting structure 19 in transverse section. This structure rests on suitable blocks 20 or the like so as to be supported horizontally, and conventional clamping assemblies 21 are provided for fixedly clamping the frame 19 on its supporting structure. The frame 19 has surfaces along which the rollers 7'' and 8'' can advance as well as surfaces along which the rollers 22 can roll. The driving roller 7'' is operatively connected with the driving motor 23, and the guide roller 8'' has its shaft guided through an elongated slot 14'' of the carriage 4'' which directly carries the motor 23 as well as the supply roll 3'', in the manner indicated in FIG. 3. The spring 9'' which directly carries the motor 23 as well as the supply roll 3'', in the manner indicated in FIG. 3. The spring 9'' acts on the shaft of the roller 8'' to urge the latter toward the roller 7'', and thus the guide members 7'' and 8'' of the carriage 4'' of this embodiment are maintained in rolling contact with the guide means formed by

the upper flange of the frame 19, as viewed in FIG. 3. An elongated flexible cable 24 connects the motor 23 with a source of electricity through a suitable slide member 25 which guides the cable 24 and which is situated centrally over the frame 19, so that in this way the motor 23 remains in communication with its source of energy while driving the rollers 7'' so as to advance the carriage 4'' while the stationary means is formed by the coil frame 19. The dimensions of the components of the apparatus of my invention shown in FIG. 3 need only be concerned with the winding operations themselves, as well as with the tension of the filamentary structure, and the curvature of the path along which the winding takes place. However, it is completely unnecessary with this embodiment to be concerned with the weight of the components, since it becomes completely unnecessary to handle substantial weights with the arrangement of my invention which is shown in FIG. 3, although a relatively massive coil can be wound with this construction.

With the embodiments of my invention which are illustrated in FIGS. 1—3, the transmission of motion provided by the moving means to the driving roller for the purpose of advancing the movable means with respect to the stationary means takes place by way of frictional engagement between the driving roller and the surface with respect to which it has rolling contact. In the case where a particularly accurate movement of the movable means with respect to the stationary means is required, or in the case where a relatively great winding tension is required, other types of motion transmission may be required. Also, in a situation where the coil frame does not provide a sufficient surface for the necessary friction drive and guiding of the winding apparatus it may become necessary to provide a different type of driving arrangement. Possible variations in the driving structure are schematically illustrated on the one hand in FIGS. 4a and 4b, and on the other hand in FIG. 5.

With the arrangement shown in FIGS. 4a and 4b, there is removably fixed to the inner periphery of the coil frame 1 a belt 26 having teeth along its inner surface, and driving roller 7'' has the configuration of a gear meshing with the inner toothed periphery of the belt 26. This belt 26 can be releasably fixed with the frame 1 in any suitable way as, for example, by having at its outer surface recesses which receive pins fixed to the frame 1 and extending inwardly therefrom at its inner periphery into the recesses of the belt 26. With this construction because of the releasable fixing of the toothed belt 26 to the frame 1, the rotary deliver member 7'' will reliably advance the coil frame 1. Of course, the drive member 7'' is in this case also driven from a suitable electric motor.

With the winding apparatus of my invention which is schematically illustrated in FIG. 5 and shown in section in FIG. 6 the carriage again forms part of the movable means, as was the case with FIG. 3. In this case, however, the carriage 4'' includes a pair of slide members 27 and 28 which form the guide members and which cooperate by sliding contact with the guide means, these slide members 27 and 28 having a tangential sliding contact with respect to the guide means which extends along and conforms to the configuration of the coil frame, as pointed out above. In this case it is the carriage 4'' which forms a passive element acted upon to be advanced with respect to the coil frame which forms the stationary means of this embodiment. The drive takes place in the illustrated example through a motion-transmitting pin 29 which is connected with the carriage 4'' and which is also connected with and extends from a drive chain 30 in the form of an endless sprocket chain, for example, positioned on suitable guiding sprockets so that it will have a configuration conforming to that of the coil frame, and aligned with and extending along the coil frame in the manner shown in FIG. 5. One of the sprockets is driven by a suitable motor so that the sprocket chain 30 advances without changing its position in space, and thus the motion transmitting pin 29 will serve to advance the carriage 4'' around the coil frame while the guide members 27 and 28 cooperates slidably with the guide means to maintain

the orientation referred to above. Thus, the drive chain 30 can have a configuration conforming to that of the frame but being smaller than the latter in the case where it is situated at the interior of the frame, or it may have a larger size than the frame in the case where it is situated at the exterior thereof, although it is also possible to situate the drive chain in other planes either above or below the coil from where the latter is arranged horizontally or before or behind the coil frame where the latter is arranged vertically.

I claim:

1. In a coil winding apparatus, stationary means and movable means, one of said means including a coil frame of curved but noncircular configuration and the other of said means including a carriage, moving means operatively connected to said movable means for moving the latter relative to said stationary means, guide means aligned with and having a noncircular configuration conforming to that of said coil frame, a pair of guide members carried by said carriage and guidingly engaging said guide means so as to thereby guide said movable means, during movement thereof by said moving means, along a path conforming to the configuration of said frame, supply means carried by said carriage in front of said guide members in the direction of movement of said movable means for supplying a filamentary structure to be coiled onto said frame, and elastic force-storing means urging said guide members and said guide means into engagement with each other so as to maintain said carriage and coil frame at least approximately at the same orientation one relative to the other and direct said filamentary structure tangentially onto said frame at a location between said guide members while issuing from said supply means at a location situated at a substantially constant distance from the location where said filamentary structure is wound onto said frame, whereby a substantially constant length of said filamentary structure extends from said supply means tangentially to said frame during winding of the filamentary structure thereon.

2. The combination of claim 1 and wherein said supply means includes a rotary supply roll from which the filamentary structure unwinds.

3. The combination of claim 1 and wherein said guide means is fixed to and forms part of said frame, said guide means extending along and forming a peripheral portion of said frame.

4. The combination of claim 1 and wherein said guide members of said carriage comprise substantially straight slide members which slidably engage said guide means.

5. The combination of claim 1 and wherein said guide members of said carriage comprise a pair of guide rollers having rolling contact with said guide means.

6. The combination of claim 5 and wherein said elastic force-storing means comprises a spring urging said rollers and

guide means into engagement with each other.

7. The combination of claim 1 and wherein said guide means is fixed to and forms an inner peripheral portion of said frame.

8. The combination of claim 1 and wherein said frame has a radially inner wall on which said filamentary structure is wound and said frame includes a flange of uniform width extending outwardly beyond and fixed to said inner wall and terminating in an outer peripheral edge which forms said guide means.

9. The combination of claim 8 and wherein said frame has an inner periphery directed inwardly away from said outer edge of said flange and said carriage has guide members which respectively engage said inner and outer peripheries of said frame.

10. The combination of claim 9 and wherein said guide members are respectively in the form of rollers turnably carried by said carriage and having rolling contact with said frame.

11. The combination of claim 10 and wherein said moving means is operatively connected with one of said rollers for rotating the latter to displace said movable means with respect to said stationary means.

12. The combination of claim 11 and wherein said movable means includes said carriage which travels along said frame.

13. The combination of claim 11 and wherein said movable means includes said frame which moves relative to said carriage.

14. The combination of claim 1 and wherein said movable means includes said frame, said frame having an inner toothed periphery and said moving means including a rotary gear engaging said inner toothed periphery for displacing said frame.

15. The combination of claim 1 and wherein said movable means includes said carriage, said moving means including a drive chain having a configuration conforming to that of said guide means and connected with said carriage, and said moving means displacing said chain while maintaining it at a configuration conforming to that of said guide means so as to displace said carriage with respect to said frame.

16. The combination of claim 1 and wherein said carriage includes a rotary supporting roller on which said frame is supported.

17. The combination of claim 15 and wherein said frame is supported on said supporting roller so that its center of gravity is always situated beneath said supporting roller.

18. The combination of claim 1 and wherein said frame is positioned in a substantially horizontal plane during winding of said filamentary structure thereon.

19. Combination of claim 18 and wherein said horizontally positioned frame is part of said stationary means and supports said carriage for movement along said frame.