Nov. 19, 1963 L. LORENZ 3,111,286

WIRE COILING APPARATUS

Filed Oct. 2, 1959

FIG. 1

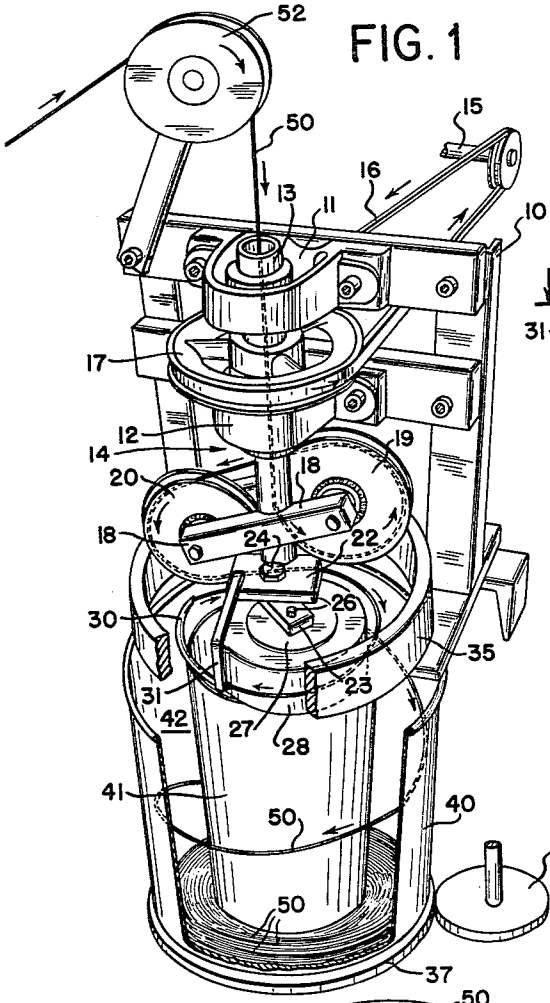


FIG. 2

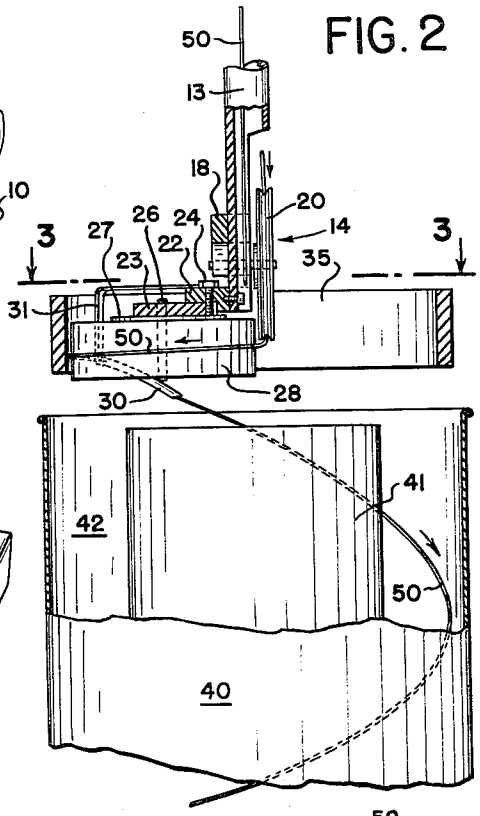


FIG. 3

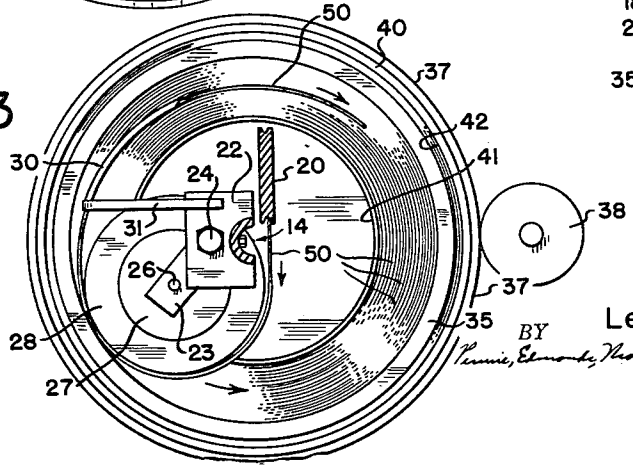
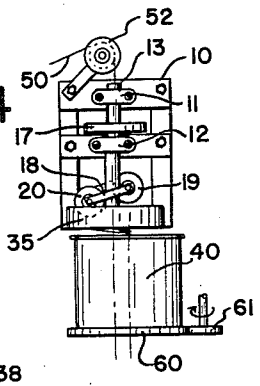


FIG. 4



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3,111,286

WIRE COILING APPARATUS

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This invention relates to apparatus for coiling fine magnet wire in cylindrical pails and, more particularly, to coiling apparatus wherein magnet wire is drawn between a pinch-roll and a circular capstan ring against which the pinch-roll bears, so that the wire falls from the ring into a cylindrical pail in substantially circular coils.

Fine magnet wire heretofore has generally been packaged on reels or spools. The amount of fine wire that can as a practical matter be wound on a single spool is limited to not more than 5 to 10 pounds. There is a substantial demand for fine magnet wire in packages of much larger size, but heretofore it has been impractical commercially to make such larger packages.

In recent years means have been developed for packaging relatively large magnet wire (say No. 20 B. & S. gauge and larger) in drums containing several hundred pounds, but such packages are too large for the finer sizes and the apparatus used to prepare such packages is not suited to handling fine wire sizes.

The present invention provides an improved wire coiling apparatus which is well suited to packaging fine magnet wire sizes in pails, in weights up to about 100 pounds. The new apparatus serves to draw the wire from any suitable source and to coil it in a pail or like container. A feature of the new coiling apparatus, which makes it especially suitable for coiling fine sizes of magnet wire, is that it imparts a circular cast to the wire in a horizontal plane before dropping it into the substantially cylindrical pail. As a result, the wire emerges from the feeding device already possessing substantially the desired configuration, and falls into position in circular loops. The apparatus of the invention is of sturdy and quite simple construction and does not require any form of traversing or oscillating mechanism.

Broadly stated, the inventive improvement is made in apparatus for coiling wire wherein a length of the wire is advanced downwardly through the bore of an axially rotatable driven vertical hollow shaft and is thereafter directed in a circular track about the inside surface of a stationary capstan ring coaxial with and spaced beneath the shaft and caused to fall from the ring in substantially circular coils. The invention provides improved feeding means for directing the wire from the shaft to the circular track on the inside of the ring. It comprises a first pulley above the track rotatably mounted about a first horizontal axis which is fixed in spaced relation to the shaft on one side thereof. This first pulley has a peripheral edge portion substantially tangent to the vertical axis of the shaft at a point beneath the lower end of the shaft bore. A second pulley substantially coplanar with the first pulley is rotatably mounted about a second axis which is fixed in spaced relation to the shaft on the opposite side thereof from the first horizontal axis. This second pulley has a peripheral edge portion within the circumference of the track and substantially tangent to a plane defined by the track. A single pinch-roll is in rolling engagement and substantially coplanar with the track and is rotatably mounted about a vertical axis which is fixed with respect to the shaft. This pinch-roll has a peripheral edge portion substantially tangent to the common plane of the first and second pulleys.

A horizontal table may be rotatably mounted beneath the capstan ring and powered by driving means. This table is adapted to have a cylindrical pail secured coaxially thereto and may be rotated about an axis offset from the

axis of the feeding head by constant and/or variable speed drives.

Preferred embodiments of the new wire coiling apparatus are described hereinbelow with reference to the accompanying drawing, wherein—

FIG. 1 is a perspective schematic view partly broken away of an embodiment of the apparatus wherein the pinch-roll is mounted about a vertical axis and is adapted to roll about a track formed on an internal surface of the capstan ring;

FIG. 2 is a partial vertical section taken substantially through the vertical axis of the apparatus of FIG. 1 showing the lower portion of the feeding head and the upper portion of a pail mounted in position in the apparatus;

FIG. 3 is a section taken along the line 3—3 of FIG. 2; and

FIG. 4 is a simplified elevation showing another embodiment of the apparatus in which the axis of the horizontal table is offset from that of the feeding head.

In FIG. 1, a bolted frame **10** has secured thereto a pair of coaxial roller bearings **11** and **12**. Secured to the inner race of each of these bearings is a hollow shaft **13**, the greater portion of which extends downwardly from the lower roll bearing **12**. The shaft **13** is part of a wire feeding head **14** which may be rotated by a driving means **15** through a belt **16** engaging a sheave **17** on the shaft **13** between the roller bearings **11** and **12**.

As seen in each of FIGS. 2 and 3, half of the lower end portion of the vertical shaft **13** is cut away and that half of the shaft which remains has a cross-bar **18** rigidly affixed to its outer surface. Two freely rotatable pulleys **19** and **20** are mounted on opposite ends of the cross-bar **18**. The cross-bar **18** is angled slightly in such a manner that one pulley **19** is at a slightly higher elevation than the other pulley **20**. Also, the higher pulley **19** is positioned sufficiently close to the axis of the feeding head **14** (i.e., the axis of the hollow shaft **13**) so that its peripheral groove extends into the cut-away portion of the shaft **13** in substantially tangential relation to such axis. The pulley **20** is at a sufficiently low elevation that its lower edge extends below the lower end of the shaft **13**.

Bolted to the lower end of the shaft **13** is a mounting plate **22** to which is secured a pivotal adjustment arm **23** by a cap screw **24**. A vertical pin **26** depends from the outer end of the adjustment arm **23** and has a roller bearing **27** attached thereto. This bearing provides a mounting for rotatably supporting a cylindrical pinch-roll **28**, which is preferably made of rubber or similar resilient material. By this construction, the axis of the pinch-roll **28** is parallel to but offset from the axis of rotation of the feeding head **14**, and the mid-point of the face of the pinch-roll **28** is at substantially the same level as the lower edge of the pulley **20**. By loosening the cap screw **24** and turning the pivotal adjustment arm **23**, the displacement between the axis of the feeding head and the axis of the pinch-roll may be increased or decreased as desired. A guide tube **30** is also affixed to the mounting plate **22** by means of a bracket **31** and is directed slightly downwardly and tangentially relative to the pinch-roll **28**.

Rigidly attached to the frame **10** is a cylindrical capstan ring **35**, which is positioned coaxially relative to the feeding head **14** and is disposed in the plane of the pinch-roll **28**. The radius of the pinch-roll **28** and its adjustable mounting on the feeding head **14** are such that the pinch-roll **28** can be made to bear against the inside diameter of the capstan ring **35**; thus, when the feeding head is rotated, the pinch-roll **28** rolls around the inside of the capstan ring **35** in continuous contact with a track defined by the inside surface of the ring.

In the embodiment of the apparatus illustrated in FIG. 1, a rotatable table **37** is mounted coaxially with the feed-

ing head 14 of the apparatus beneath the capstan ring 35. The table 37 may be turned by any suitable driving means, such as a friction drive wheel schematically illustrated at 38 rotatable in either direction and preferably at either a constant or a variable speed. By any suitable attachment means, the table 37 is adapted to have temporarily secured thereto a cylindrical pail 40 of a type designed to contain coils of magnet wire and to serve as a shipping package. Such a pail advantageously includes a concentric interior core 41, and thus defines an annular wire-receiving space 42. The mean diameter of the annular space 42 should be approximately equal to the inside diameter of the capstan ring 35. To accommodate pails of various sizes the capstan ring 35 may be detachable so that it may be replaced by one of greater or lesser diameter as desired and the position of the pinch-roll 28 may be adjusted accordingly to keep it in contact with the track defined by the inside surface of the ring 35.

To prepare the apparatus of FIG. 1 for operation, a continuous length of magnet wire 50 is directed downwardly into the hollow shaft 13 along its axis. This may be done, for example, by carrying the wire 50 over a suitably positioned idling pulley 52 from a source of wire supply. The wire is brought through the hollow shaft 13 into the open split lower end portion and passes tangentially onto and around the pulley 19. Thence, it crosses over to the other pulley 20 and is discharged from the lower edge thereof substantially horizontally and radially relative to the feeding head axis. The wire 50 is then received between the face of the pinch-roll 28 and the inside surface of the capstan ring 35 at their common point of tangency. It then extends into the guide tube 30 which directs it into the annular space 42 of the cylindrical pail 40.

When the driving means 15 is actuated so that the belt 16 travels in the direction of the arrows in FIG. 1, the entire feeding head 14 rotates about the vertical axis of the shaft 13 in a counterclockwise direction as viewed from above. The pinch-roll 28 is therefore caused to travel about the inside diameter of the capstan ring 35 in planetary fashion and to bear continuously against the track defined on the inside diameter of the ring. Since the wire 50 is held by the roll 28 against the stationary capstan ring 35, it is drawn into the apparatus through the feeding head 14 as the feeding head is rotated and the pinch-roll advances about the ring. Because it is rolled in a circular path in this manner, a circular cast is imparted to the wire 50 as it leaves the pinch-roll 28 and enters the guide tube 30. The guide tube directs the wire downwardly into the annular space 42 into which it freely drops.

The arrangement of the coils of the wire 50 in the cylindrical container 40 may be varied by rotating the container on its table 37 by means of the driving wheel 38. For example, if it is desired to lay the coils close to the interior core 41 of the container, the table 37 is rotated clockwise slightly as the feeding head is rotated counterclockwise (each as seen from above); and, conversely, if it is desired to lay the coils near the wall of the pail the table 37 is rotated slowly counterclockwise. It is also possible cyclically to vary the size of the coils so that they are laid as successive flat spirals, which alternately grow larger as each successive turn advances away from the core 41 until the last turn is approximately the diameter of the outer wall of the container and then grow smaller until the last turn is approximately the diameter of the core 41. This may be accomplished simply by cyclically varying the speed (and if desired also the direction) of rotation of the table 37 by suitable actuation of the driving wheel 38. A correlation must, of course, be established between the maximum and minimum speeds of such a variable speed drive and the constant speed of rotation of the feeding head of the apparatus.

In another embodiment of the apparatus, shown in FIG. 4, the axis of rotation of a table 60 is offset with respect to the vertical axis of the feeding head. By this modification it is possible to lay coils eccentrically relative to the axis of the cylindrical container. Its particular advantage is that it permits the coils to be disposed eccentrically relative to the pail axis and to each other, thereby avoiding a build-up of superimposed coils which may eventually slip sidewise and tend to snarl. To this end the table 60 of the apparatus of FIG. 4 is slowly rotated at constant speed in either direction by a drive means 61 as the feeding head is rotated in the manner described previously.

In each embodiment of this wire coiling apparatus, either the pinch-roll or the capstan ring may be made of some resilient material, such as rubber. It is preferable, however, that that element of the two which is not of such resilient material should be of a hard material such as metal so that good traction is provided during the travel of the pinch-roll about its capstan ring.

I claim:

1. In apparatus for coiling wire wherein a length of the wire is advanced downwardly through the bore of an axially rotatable driven vertical hollow shaft and is thereafter directed against a circular track about the inside surface of a stationary capstan ring coaxial with and spaced beneath said shaft and caused to fall from said ring in substantially circular coils, improved feeding means for directing said wire from said shaft to the circular track on the inside of said ring comprising:

(*a*) a first pulley above said track rotatably mounted about a first horizontal axis which is fixed in spaced relation to said shaft on one side thereof, said first pulley having a peripheral edge portion substantially tangent to the vertical axis of said shaft at a point beneath the lower end of the shaft bore;

(*b*) a second pulley substantially coplanar with said first pulley and rotatably mounted about a second horizontal axis which is fixed in spaced relation to said shaft on the opposite side thereof from said first horizontal axis, said second pulley having a peripheral edge portion within the circumference of said track and substantially tangent to a plane defined by said track; and

(*c*) a single pinch-roll in rolling engagement and substantially coplanar with said track and rotatably mounted about a vertical axis which is fixed with respect to said shaft, said pinch-roll having a peripheral edge portion substantially tangent to the common plane of said first and second pulleys.

2. Apparatus according to claim 1 which includes a horizontal table rotatably mounted beneath said capstan ring and powered by driving means, said table being adapted to have a cylindrical pail secured coaxially thereto, whereby said coils are caused to fall from said ring into said pail.

3. Apparatus according to claim 2 wherein said horizontal table is rotatably mounted about a vertical axis offset from the vertical axis of said hollow shaft.

4. Apparatus according to claim 2 wherein said horizontal table is powered by a variable speed drive.

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