Feb. 25, 1947. W. T. FIELDS ET AL 2,416,518

APPARATUS FOR CUTTING SPIRAL GROOVES IN GROOVED ROLLS

Filed July 22, 1944 2 Sheets-Sheet 1

FIG. 1.

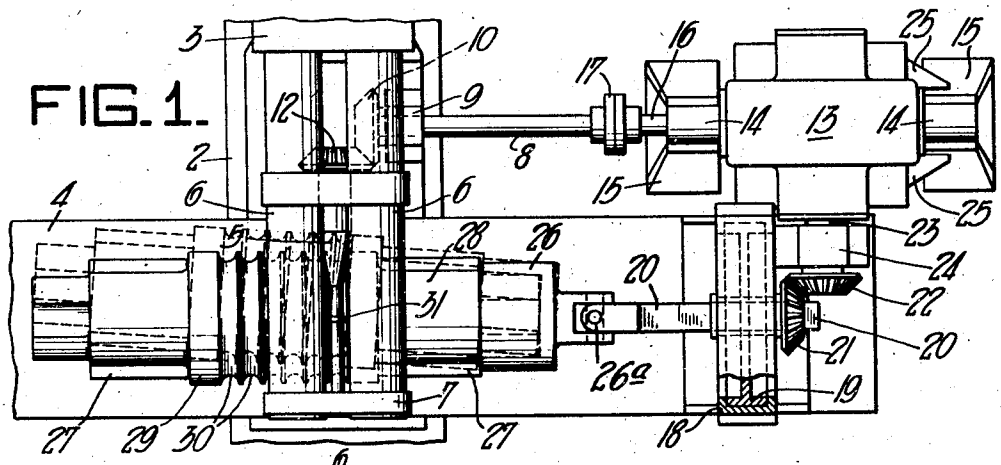


FIG. 2.

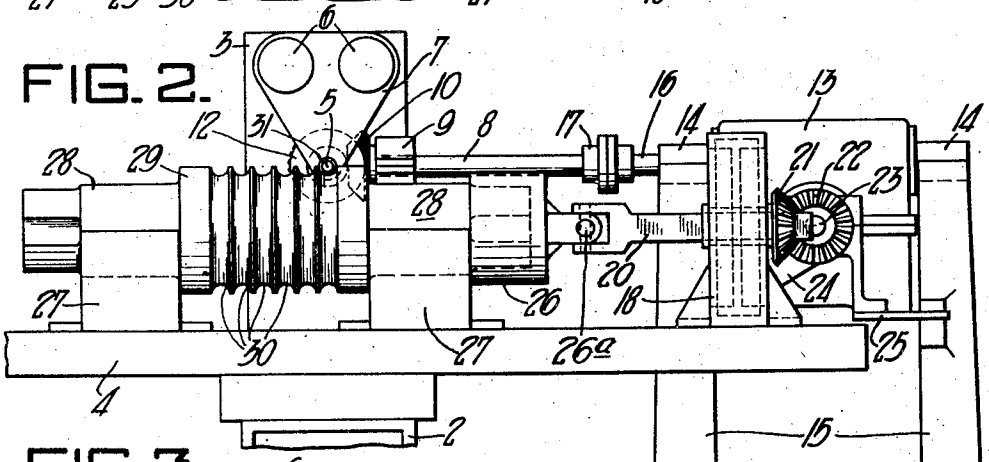
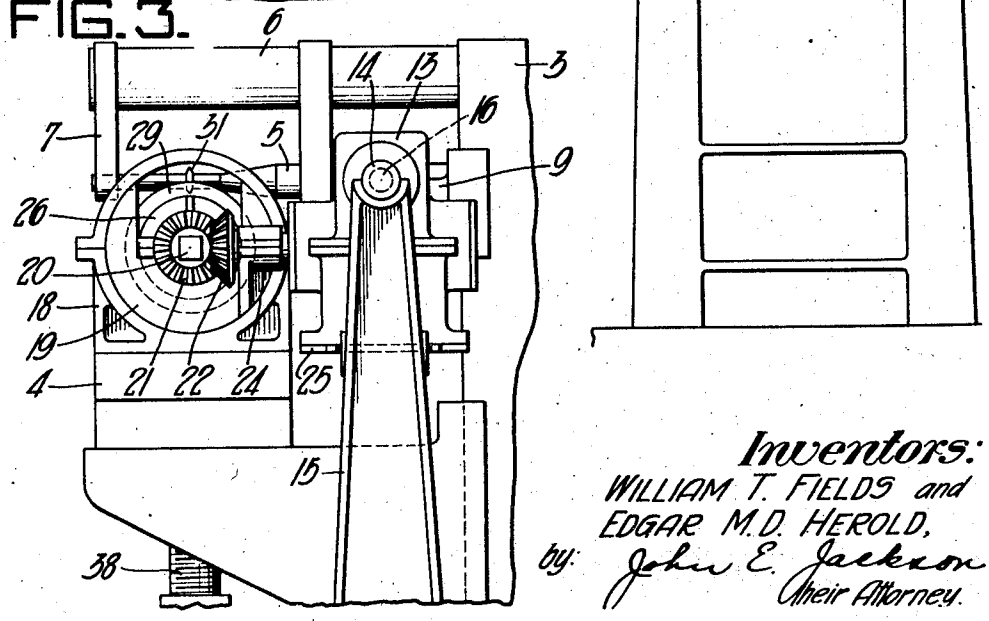


FIG. 3.



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FIG. 4.

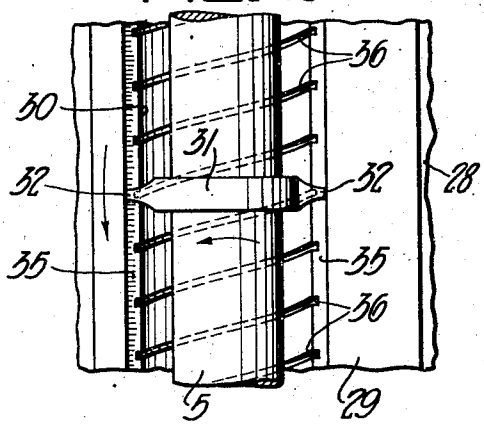


FIG. 5.

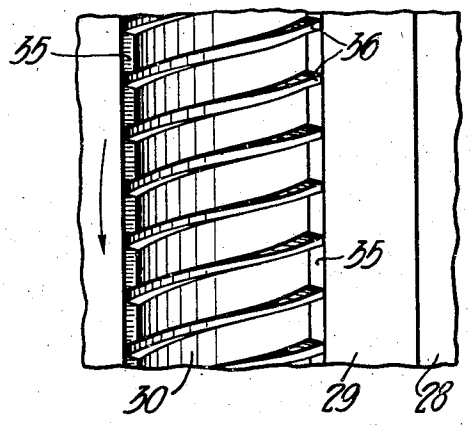


FIG. 6.

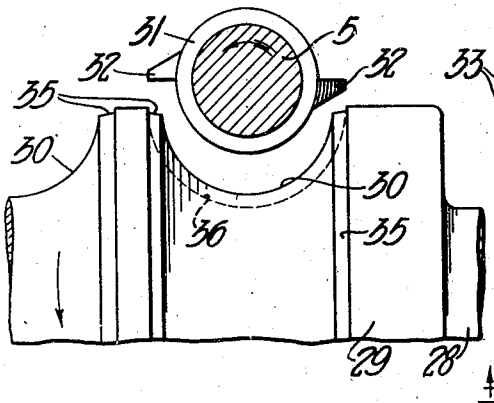


FIG. 8.

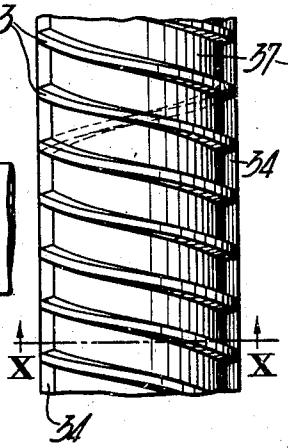


FIG. 9.

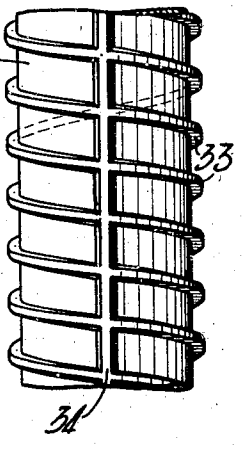


FIG. 7.

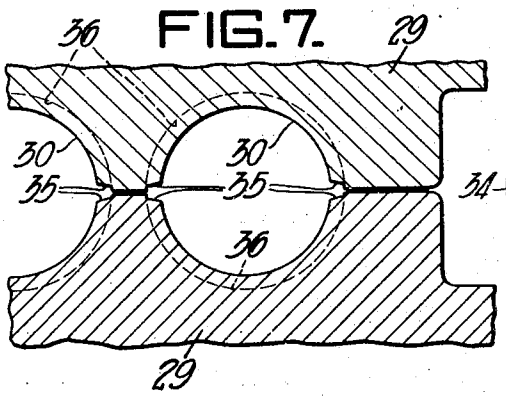
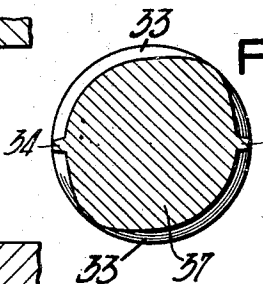


FIG. 10.



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UNITED STATES PATENT OFFICE

2,416,518

APPARATUS FOR CUTTING SPIRAL GROOVES IN GROOVED ROLLS

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Application July 22, 1944, Serial No. 546,148

1 Claim. (Cl. 90—20)

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This invention relates to rolling mill rolls and, particularly, to an improved apparatus for cutting spiral grooves in the grooves of rolling mill rolls, this application being a continuation-in-part of our prior application Serial No. 472,264, filed January 13, 1943.

For the purpose of reinforcing concrete, it is customary to use reinforcing bars or rods which are imbedded in the concrete. It is desirable that such rods and bars have lugs, ribs, offsets, etc. formed on the surface thereof so that they will be more effective in their use and they are usually rolled to shape by means of a rolling mill. To produce such reinforcing rods and bars in a rolling mill, it will be seen that it is not only necessary to provide rolls having grooves arranged around the periphery thereof in order to form the roll passes but it is also necessary that proper shapes be formed in the grooves of the roll in order to form the desired lugs, ribs, or other configurations on the finished reinforcing rods and bars.

It has been found that a cylindrical bar or rod having radially extending double spiral lugs arranged throughout the length thereof is most desirable for the purpose of reinforcing concrete, and it is to a roll for rolling such bars or rods that the present invention relates.

In order to produce a reinforcing bar or rod having such double spiral lugs arranged thereon continuously by rolling in a rolling mill, it will be readily apparent that it is necessary that there be formed in the grooves of the rolls of the mill, a plurality of double spiral grooves in the periphery of the grooves with such spiral grooves being spaced equi-distant apart. Heretofore, it has not been possible to cut such spiral grooves in the grooves of the rolling mill rolls by means of a conventional type milling machine or by any other known machine. It will be seen that it would be impractical to cut such spiral grooves in the roll by hand as such procedure would be laborious as well as expensive, and considering the life of such a roll would be prohibitive.

Accordingly, it is the general object of the present invention to provide an improved apparatus for cutting spiral grooves in the grooves of rolling mill rolls which are efficient and effective in their use, so as to provide rolls which will form effectively the desired lugs on the finished reinforcing bar or rod product.

It is another object of the invention to provide an improved apparatus for cutting spiral grooves in the grooves of rolling mill rolls which is simple and inexpensive in construction and use, and, by which, the spiral grooves can be cut in the rolls

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in a minimum amount of time with the least amount of effort.

Various other objects and advantages of this invention will be more apparent in the course of the following specification and will be particularly pointed out in the appended claim.

In the accompanying drawings there is shown, for the purpose of illustration, an embodiment which our invention may assume in practice.

In these drawings:

Figure 1 is a plan view of the improved apparatus of our invention showing it incorporated with a conventional type milling machine;

Figure 2 is a front elevational view thereof;

Figure 3 is a side elevational view of the same;

Figure 4 is a plan view of a portion of one of the grooves in a roll showing the initial cutting of double spiral grooves in the groove of the roll;

Figure 5 is a plan view similar to Figure 4 showing the double spiral grooves cut in the groove of a roll after the cutting operation has been completed;

Figure 6 is an end view of the cutter showing double spiral grooves being cut in the groove of a roll;

Figure 7 is a longitudinal section through the opposed grooves which form the roll pass of a pair of rolls showing the spiral grooves formed therein;

Figure 8 is a plan view of a portion of a reinforcing bar or rod to be formed by passing through the groove or roll pass of the rolls as shown in Figure 7;

Figure 9 is a plan view of a portion of a reinforcing bar or rod as shown in Figure 8 with the bar turned 90 degrees from the position as shown therein; and

Figure 10 is a sectional view taken on line X—X of Figure 8.

Referring more particularly to the drawings, as shown in Figures 1, 2 and 3 thereof, the improved apparatus of our invention is shown incorporated with a conventional type milling machine comprising a base 2, a vertical column 3, and an adjustable table 4 which is adapted to support the work-piece. There is carried by the column 3, a rotatable arbor 5 and a pair of horizontally extending supporting members 6 upon which there is mounted a bracket member 7 in which the outer end of the arbor 5 is journaled.

According to the present invention, there is arranged to one side of the arbor 5 of the milling machine, a horizontally extending shaft 8 which is disposed substantially perpendicular to the axis of the arbor. The shaft 8 is journaled in a

bracket member 9 mounted on the column 3 of the milling machine and on the inner end of the shaft there is positioned a bevel gear 10 which meshes with a similar bevel gear 12 securely mounted on the arbor 5. At the opposite end of the shaft 8, there is arranged a conventional type gear reducer 13 having trunnions 14 by which it is rotatably supported. The trunnions are journaled in the upper end of a trunnion stand 15 which is positioned on the floor to one side of the milling machine. One of the shafts 16 of the gear reducer 13 is connected to the outer end of the shaft 8 preferably by means of a coupling 17.

On top of the adjustable table 4 of the milling machine, there is arranged an adjustable journal bracket member 18, preferably having a floating bearing element 19 carried thereby. The bracket 18 is preferably bolted to the top of the table 4 and so arranged that it may be loosened therefrom so that the bracket may be adjusted endwise of the table for a purpose hereinafter to be described. There is arranged through the bearing element 19, preferably a square shaft 20 which extends substantially parallel to the shaft 8. On the outer end of the shaft 20, there is movably arranged a bevel gear 21 which meshes with a similar bevel gear 22 disposed on the outer end of the slow speed shaft 23 of the speed reducer 13, shaft 23 being supported in a suitable bearing 24.

The gear 22 is prevented from rotating on the shaft 23, preferably by means of splines which permit the shaft to move endwise through the bevel gear 22. To prevent undue rotation of the gear reducer 13, there is provided preferably a striking plate or stops 25 which are disposed on each side of the stand 15 and preferably attached to the base of the gear reducer, as shown in Figures 2 and 3 of the drawings.

A wabbler or coupling 26 is adapted to fit over and around the end of the work roll, the said wabbler being connected to the shaft 20 by a universal joint 26a. There is also mounted on top of the table 4 of the milling machine, a pair of adjustable spaced apart bearing members 27 in which the necks 28 of a roll 29 are journaled. The bearing members 27 are held in position on the top of the table 4 preferably by means of bolts extending into the table.

By providing such an arrangement, it will be seen that upon rotation of the arbor 5 of the milling machine the roll 29 will be rotated by the action of the bevel gears 10 and 12, the shaft 8, the gear reducer 13, the bevel gears 21 and 22, the shaft 20 and the coupling or wabbler 26.

It will be understood that the above described apparatus is provided primarily for cutting spiral grooves in the grooves of a rolling mill roll. Such a roll is shown positioned in the milling machine in position to be machined and there is arranged circumferentially around the periphery thereof, in side by side relation, a plurality of semi-circular shaped grooves 30 which are adapted to provide roll passes for the product to be formed when the rolls are mounted in a rolling mill in a manner well known to those skilled in the art. In order to cut a plurality of spiral grooves in the grooves 30 of the roll, there is mounted on the arbor 5 of the milling machine, a cutter 31 which is adapted, of course, to be rotated with the arbor. If it is desired to cut double spiral grooves in the periphery of the grooves 30, as in the present instance, there is provided a cutter having two substantially radial teeth 32 which are spaced 180

degrees apart, i. e., diametrically opposed. It will be understood that if single spiral grooves are adapted to be cut in the grooves of the roll, a cutter having one tooth is used and if it is desired to cut triple spiral grooves in the roll grooves, a cutter having three teeth is used.

As shown in the drawings, the cutter teeth 32 have transverse cutting profiles corresponding to the cross-section of the spiral grooves 36 to be cut thereby, and have a constant maximum radius equal to the maximum radius of said spiral grooves.

The apparatus of our invention functions in the following manner. It will be understood that the roll 29 to be worked upon is circumferentially grooved as at 30 prior to the formation of the spiral grooves thereon by means of the present apparatus. The grooved work roll 29 is mounted on the bearings 27 on top of the work table 4 of the milling machine so that one of the grooves 30 in the roll is positioned below the cutter 31, as shown in Figures 1 and 2 of the drawings.

The coupling or wabbler 26 on the end of the shaft 20 is then positioned over the end of the roll and the bracket 18 is properly adjusted on the table 4 and secured in place on the table. The milling machine is then set in operation and upon rotation of the arbor 5 together with the cutter 31 carried thereby, the work roll 29 will be rotated by the apparatus of our invention in a manner hereinbefore described. The table 4 together with the work roll 29 carried thereby, is then moved upwardly by means of the usual screw adjustment 33 provided on such milling machines, the proper distance in order that the teeth 32 of the cutter 31 will make the proper initial cut in the periphery of the groove 30 being cut, as shown in Figure 4 of the drawings. It will be seen that if a two tooth cutter is used, as in the present instance, that the teeth will cut double spiral grooves 36 in the groove 30 of the roll upon rotation of the cutter and the work roll. The initial cutting of the spiral grooves 36 in the groove of the roll is continued until the spiral grooves have been initially cut entirely in the groove around the periphery of the roll. After the first or initial cut has been made entirely around the groove, the table 4 together with the work roll 29 is moved upwardly so that the spiral grooves 36 will be cut deeper by the cutter 31. This procedure is followed until the spiral grooves 36 are cut to the desired depth in the groove of the roll, as shown in Figure 5 of the drawings. After the spiral grooves 36 have been cut in one of the grooves of the roll, it will be understood that the next groove and each succeeding groove thereafter is disposed below the cutter 31 and the spiral grooves 36 cut thereon until all of the grooves 30 have spiral grooves formed therein of the work roll. In order to dispose the respective grooves 30 below the cutter 31, the table 4 of the milling machine is moved to the right or left as the case may be. As shown in Figure 2 of the drawings, the table is moved to the right and in so doing the square shaft 20 will be moved through the floating bearing element 19 and the bevel gear 21 so that the bevel gears 21 and 22 are at all times meshed with each other.

In the full line position of the roll 29 in Figure 1, the arbor 5 together with the cutter 31 revolves in a plane parallel to the axis of said roll and, at the same time, the work roll is rotated by the arbor at a predetermined ratio to that of the rotating cutter. In order for the cutter 31 to follow in the same spiral groove on the second and each succeeding revolution of the roll, it will be

seen that the speeds of the cutter and the roll must be synchronized. To produce a continuous double spiral groove cut in the roll groove, it is necessary to use a speed reduction ratio so that the circumference of the roll is an exact multiple of twice the distance between the spiral grooves. In such case of a two tooth cutter, this ratio is based on the following formula:

$$\frac{\text{Diameter} \times \pi}{2 \times S}$$

equals the ratio of the cutter to the R. P. M. of the roll, wherein, S is the space between the double spiral grooves and the diameter is approximately that of the outside diameter of the work roll. By revolving the roll at the above ratio with reference to the revolution of the cutter, it will be seen that the spiral grooves are cut gradually deeper upon each revolution of the roll.

It has been found that in cutting spiral grooves in the grooves of two newly sized work rolls, namely, 12½ inches and 10⅞ inches in diameter, so as to roll eight sizes of reinforcing bars from ⅜ of an inch to 1⅜ inches in diameter, that the reduction ratio varies from 88 to 1 maximum, to 44 to 1 minimum. Thus a reduction gear having a 44 to 1 ratio combined with a variable speed reducer with the range of from 1 to 1 to 2 to 1 may be used to produce any ratio between 44 to 1 and 88 to 1. An alternate means for obtaining such a ratio requires four sets of bevel gears to provide a 2 to 1 ratio with suitable steps combined with a 44 to 1 reduction gear. A second alternate method for obtaining such a ratio is to use a spur gear or a combination spur and bevel gears.

It will be understood that after the spiral grooves **36** have been cut in the grooves **30** of the work rolls, by means of the apparatus of the present invention, that the rolls **29** are then assembled in a rolling mill in a manner shown in Figure 7 of the drawings, with the grooves disposed opposite each other so as to provide a roll pass for the reinforcing bars between the rolls. The bars are then passed through the roll passes of the rolls and a finished reinforcing bar **37** is provided, as shown in Figures 8 through 10 of the drawings. There is formed on such a reinforcing bar by the rolls **29**, a plurality of double spiral lugs **33** which are spaced equi-distant apart throughout the length of the bar. It will be seen that there is also formed on the reinforcing bar **37**, a pair of longitudinally extending ribs **34** which bisect the spiral grooves **36**. In other words, there is formed two longitudinally extending ribs with one positioned to the either side of the bar, i. e., diametrically opposed. In order to form such a longitudinally extending rib **34** on each side of the

reinforcing bar, it will be understood that the outer edges of each of the grooves **30** in the work roll **29** are relieved or cut away as at **35**, as shown in Figures 6 and 7 of the drawings. To provide such a construction, it will be seen that the ends of the spiral grooves **36** terminate at the relieved portions **35** and do not extend to the outer surface of the roll.

The grooves **36** cut in the manner hereinbefore described with the roll **29** disposed in the full line position of Figure 1, may be characterized as having equal pitch and lead, the cutter **31** forming said grooves being rotated in the plane of the axis of said roll. When it is desired to vary such relation to produce spiral grooves having a lead greater than their pitch, the roll **29** may be disposed at an angle to the plane of said cutter in the manner indicated by the dotted line position in Figure 1, causing cutter **31** to be at an angle to the roll axis. It will be understood that such angularity of the roll is permitted by the universal joint **26a** and by adjusting the position of bearing members **27** upon the table **4**.

While we have shown and described one specific embodiment of our invention, it will be understood that this embodiment is merely for the purpose of illustration and description and that various other forms may be devised within the scope of our invention, as defined in the appended claim.

We claim:

In combination with a milling machine having a rotatable arbor and a table for supporting a circumferentially grooved work roll, a cutter on said arbor, bearing members on said table for rotatably supporting the work roll with the cutter engaging a circumferential groove thereof, drive means for rotating said arbor and cutter, and means arranged between said drive means and one end of the work roll for rotating the roll a predetermined distance upon each revolution of said cutter, said bearing members being adjustable on said table to vary the angle between the plane of the cutter and the axis of the work roll.

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