Feb. 6, 1940. P. BETZLER 2,189,646

METHOD AND APPARATUS FOR TWISTING METAL BARS INTO A UNITARY STRUCTURE

Filed Aug. 17, 1939 2 Sheets-Sheet 1

FIG. 1

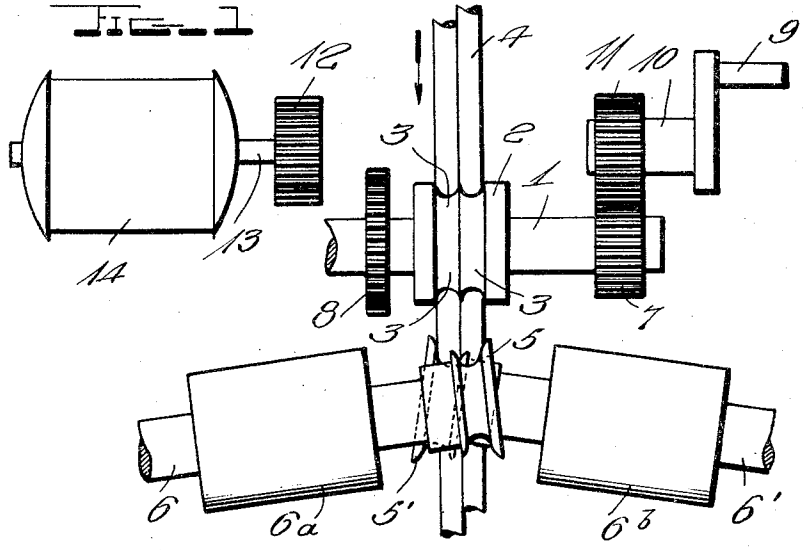
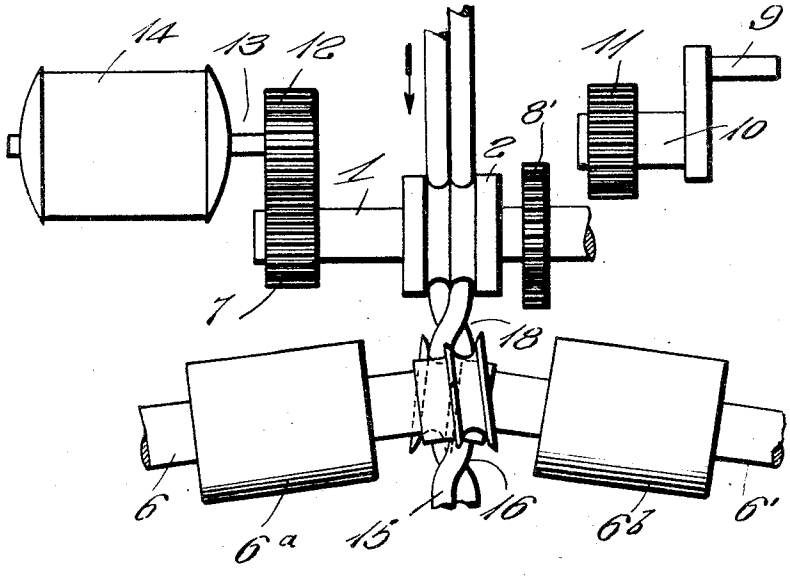


FIG. 2



INVENTOR.

Paul Betzler,

BY

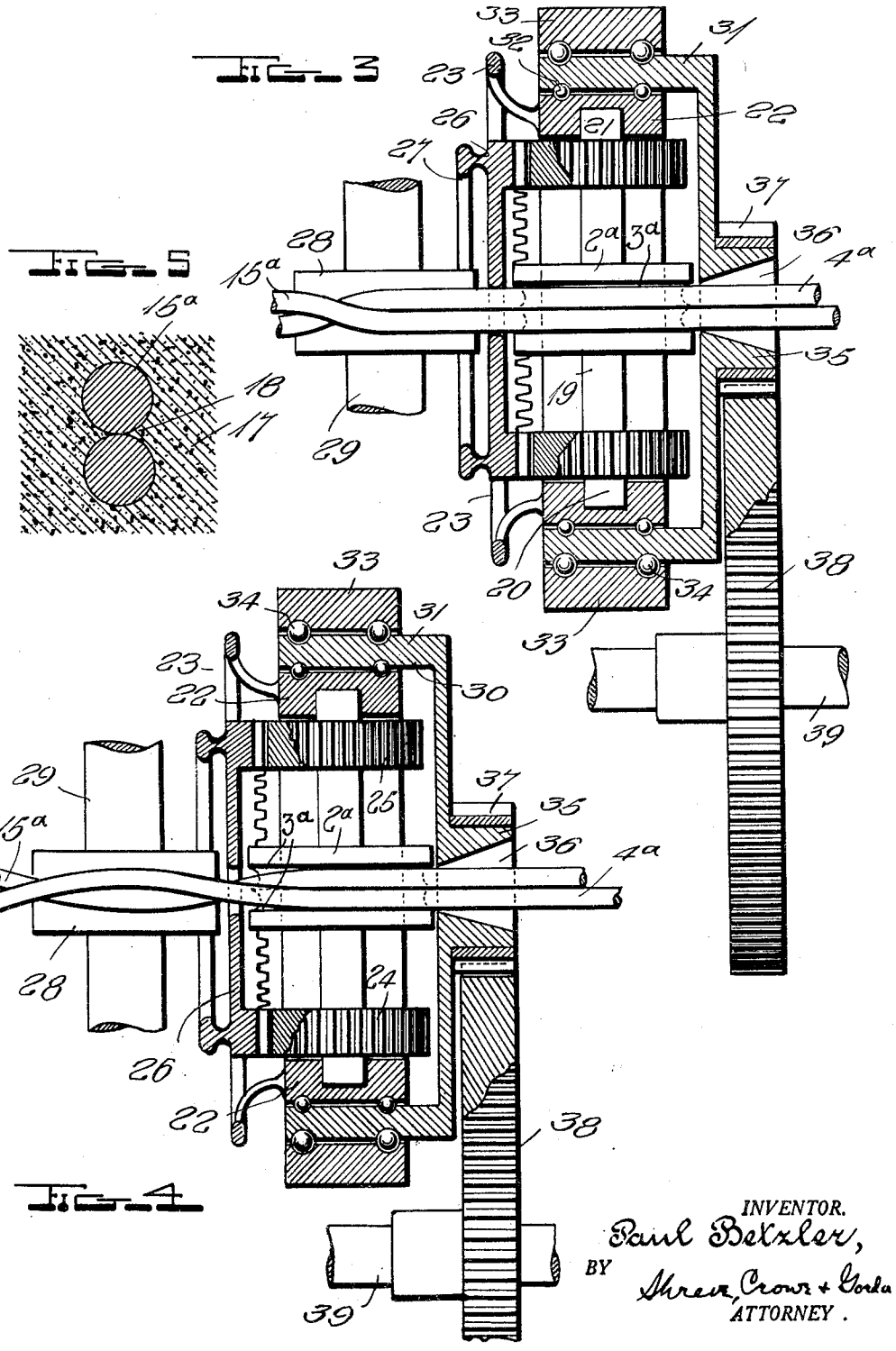
Shroeder, Crowe & Gordon

ATTORNEY.

Feb. 6, 1940. P. BETZLER 2,189,646

METHOD AND APPARATUS FOR TWISTING METAL BARS INTO A UNITARY STRUCTURE

Filed Aug. 17, 1939 2 Sheets-Sheet 2



INVENTOR.
Paul Betzler,
BY Shrewe, Crowe & Gorda
ATTORNEY.

Patented Feb. 6, 1940 2,189,646

UNITED STATES PATENT OFFICE

2,189,646

METHOD AND APPARATUS FOR TWISTING METAL BARS INTO A UNITARY STRUCTURE

Paul Betzler, Karlsruhe (Baden), Germany

Application August 17, 1939, Serial No. 290,703
In Germany December 28, 1937

9 Claims. (Cl. 140—149)

Generically this invention relates to bar or rod twisting machines but it more especially is directed to a method and apparatus for twisting or roping a pair of metal bars or rods into a spiral unitary bar.

One of the principal objects of this invention is the provision of method and apparatus for forming a pair of steel or metal bars into a unitary spiral reinforcing bar especially adapted for use in concrete construction.

An important object of this invention is the provision of a method and apparatus for twisting or spirally forming a pair of steel bars into a unitary bar, the pitch of the thread-like formation being such as to permit the concrete aggregate when the bar is embedded therein to intimately contact the spiral or thread-like surface of the bar to firmly lock the latter therewith.

A further important object of this invention is the provision of a method and apparatus for twisting metal bars or rods into a unitary bar in such a manner as to compensate for the stretch in the material incident to the twisting operation so that the molecular structure and tensile strength of the material will not be impaired.

Another important object of this invention is a method and apparatus for twisting metal bars or rods into a unitary bar in such a manner, that in effect, there will be no stretch of the material incident to the twisting operation so that the tensile strength and molecular structure will not be impaired and including means for controlling the spiral pitch in accordance with different sized bars or the size of the aggregate in which the spiral bar is to be embedded as desired.

With these and other objects in view, which will become apparent as the description proceeds, the invention resides in the construction, combination and arrangement of parts, hereinafter more fully described and claimed, and illustrated in the accompanying drawings, in which like characters of reference indicate like parts throughout the several figures, of which:

Fig. 1 is a fragmentary top plan view of my improved apparatus.

Fig. 2 is a similar view to Fig. 1 after the feeding rollers have been given a turn of 180° on an axis extending between them and in the direction of the arrow.

Fig. 3 is a fragmentary horizontal section with parts in elevation, of a modified apparatus.

Fig. 4 is a similar view to Fig. 3 after the feeding rollers and shaft have been given a turn of 180°, as in Fig. 2.

Fig. 5 is a detail section through the embedded bar and concrete.

It is known that two or a multiple of soft steel reinforcing bars for concrete construction can be cold twisted into a rope-like or spiral structure in order to produce a structural steel of high tensile strength and adhesive power or bond stress. The yield point by this method is extended but the molecular structure of the material by such cold stretching is greatly impaired, since the skin of the bars, which to some extent protects against rust, flakes off, and the modulus of elasticity, which is of considerable importance in reinforced concrete construction, is considerably lowered. On the other hand if the twist of the bars is only a slight one the stretch of the material naturally is minimized, and the purpose of the twisting, which is the increase of the yield point, is thereby defeated.

Careful and experienced contractors and engineers will not use the present method of cold twisting, or such cold rolled material made by such method, especially in connection with such structures as bridges, with changing loads.

If the twisting of the bars takes place while the material is in a hot state, then the yield point is not raised, and therefore makes such method futile. Even if "hard steel" were used by simply twisting the bars together the elasticity of the material would be reduced. Furthermore, in the case of cold twisting of the bars, the pitch of the twist is limited by the elastic limit of the material regardless of whether it is weak or strong. However, the pitch of the twist also has a marked influence upon the bond stress and depends also upon the aggregates used in the concrete, since, for instance, if the pitch of the twist is a short or small one, the in-bond of the aggregates into the threads of the twist will be an imperfect one, because the size of the stone or gravel, as a rule, is too large and will not conform to the threads of the twist, only the cement and sand would have intimate contact therewith.

In order to secure proper bonding of the bars with the concrete it is necessary that the aggregates be embedded in the twist of the bars and in the instant invention only high grade "hard steel" is used and the pitch is controlled by being made longer or shorter in relation to the diameter of the bars or the aggregates to be used so that a maximum bond stress when the reinforcing bars are embedded in the concrete may be effected. Therefore, to overcome the deficiencies of the methods heretofore in use in the formation of reinforcing bars for concrete construction,

I provided a mechanism for twisting two or more steel bars or rods into a unitary structure without stretch or change of molecular structure whereby the tensile strength is not impaired by the twisting operation and which is accomplished by passing the bars to be twisted, preferably in a state of white heat, through a set of feed rollers which are operable to give an initial twist to the bars and then through a set of diagonal twist rollers, said feed rollers traveling at a greater speed than the discharge twist rollers, thereby crowding the feed to the twist rollers and causing an increase in the molecular density of the material to compensate for the stretch of the material during the twisting operation, and thereby forming a twisted or spiral unitary bar, in effect, without stretch, and retaining the original molecular structure and tensile strength of the bars, and the pitch of the twist being controlled by increasing or decreasing the distance between the feeding and discharging rolls.

In the illustrated embodiment characterizing this invention there is shown a pair of shafts 1 having suitably mounted thereon feed rollers 2 the faces of which are formed with grooves 3 corresponding to the configuration of rods or bars 4 adapted to be received thereby and fed to the diagonal rollers 5 and 5' mounted on shafts 6 and 6' respectively. Mounted on the ends of shafts 1—1 are the pinions 7—7 and mounted on said shafts on the opposite side of said rollers 2 are the pinions 8 and 8'. A handle 9 is connected to stub shaft 10 carrying gear 11 adapted to mesh with pinion 7 (Fig. 1), and said rollers 2 are spotted by handle 9 until bars 4 are in the center of the rollers 5—5'. Then rollers 2 are given a turn of 180°, by means of suitable mechanism not shown, on an axis extending between the rollers 2—2 and in the direction of the arrow, as shown in Fig. 2, so that pinion 7 engages gear 12 on shaft 13 of motor 14, as shown in Fig. 2. The pinion 8 (Fig. 1) engages pinion 8' (Fig. 2) of the lower feed roller and thereby drives both rollers 2—2. After the rollers 2—2 have been turned 180° the diagonal rollers 5—5' and gear 12 are started, causing bars 4 to be twisted and discharged by the diagonal rollers 5—5' (Fig. 2), in the form of a unitary spiraled bar structure 15.

The pitch of bar 15 is regulated by varying the distance between the rolls 2—2 and 5—5' by suitable mechanism not shown.

It will be noted that in making the twist between the rollers 5—5' ordinarily the material stretches and contracts, thereby impairing its elasticity. In order to overcome this disadvantage the feed rollers 2—2 are accelerated in speed with respect to the diagonal or resisting rolls 5—5' in the same measure as the material, otherwise, would be shortened by the twist, or in other words, the rollers 2—2 are accelerated to increase the molecular density of the bars in direct ratio to their stretch incident to the twisting operation. By this accelerated feed, a stretch in the material is avoided since the rolls 2—2 feed faster than rollers 5—5' discharge, and therefore it is evident that by this method the material is not stretched and its molecular structure, elasticity and tensile strength is retained.

With further reference to the diagonal shafts 6 and 6' (Figs. 1 and 2), it is to be understood that these shafts are adapted to be driven by the pulleys 6a and 6b.

It will be apparent that when the bar 15 is embedded in the aggregate of concrete 17 the bonding of the bar therewith will be effected by the intimate contact of the aggregate in the thread-like formation 18 as shown in Fig. 5.

Figs. 3 and 4 illustrate a modified form of mechanism for accomplishing the same result as above described. In this form the rods 4a are adapted for insertion in the grooves 3a of roller 2a mounted on shaft 19 substantially central of its length. Said shaft 19 has its opposite ends 20 rotatably mounted in the raceway 21 circumscribing the inner surface of the annular member 22 formed with hand wheel 23, and mounted on shaft 19 adjacent its opposite ends are the gear wheels 24 and 25 adapted to mesh with ring gear 26 formed with hand wheel 27, the turning of which is adapted to move rods 4a into engagement with the twist wheels 28, the lower one only of which is shown mounted on shaft 29, the means for rotating said shaft 29 not being shown.

When bars or rods 4a have been positioned in twist wheels 28, hand wheel 26 is fixed. Member 22 is mounted on the inner annular surface 30 of the wheel-like member or cage 31 on ball bearings 32 suitably mounted intermediate said members 22 and 31. Member 31 is suitably mounted on the inner surface of the outer annular member 33 on the larger ball bearings 34 suitably mounted intermediate said members 31 and 33, as will be well understood. Member 31 has a hub portion 35 formed with a cone-shaped opening 36 adapted to direct the rods in frictional relation with roller 2a and suitably mounted on said hub portion is pinion 37 adapted to mesh with gear 38 mounted on drive shaft 39, the drive means for which is not shown.

The operation in this form is substantially similar to that described in connection with Figs. 1 and 2. Initially, rods 4a are inserted in opening 36 and feed roller 2a, and hand wheel 26 is turned, rotating said roller and positioning the rods in the twist wheels 28, then hand wheel 23 connected to hand wheel structure 26 is turned, moving roller 2a through 180° and imparting the initial twist to said rods 4a, fixing the position of gear wheel 26, the members 22 and 31 are rigidly coupled, and the member 31 with pinion 37 is turned by gear 38 and, at the same time, the twist wheels 28 are revolved at a speed in conformity with the twist desired, thereby producing continuously twisted bar 15a, as shown in Fig. 4. After the ring gear 26 is fixedly connected with members 22 and 31 gears 24 and 25 are kept in motion by member 31, which in turn also operates the roller 2a to feed rods 4a, as hereinbefore described. While the means for connecting hand wheels 27 and 23, and cage member 31, is not shown, it is to be understood that any well known means may be employed. While only one feed roller 2a and twist roller 28 is shown it will be apparent that complemental rollers may be employed therewith.

As in Figs. 1 and 2 the roller 2a in Figs. 3 and 4 is also adapted to be accelerated for the same purpose, that is, to swage the material as heretofore explained.

In conclusion, while it is apparent that with the foregoing mechanism it is possible to preferably twist rods or bars at white heat into a unitary structure without materially impairing their original molecular arrangement, it is also possible with such mechanism to twist the rods in a cold state, if desired.

Although in practice I have found that the form of my invention illustrated in the accompanying drawings and referred to in the above description as the preferred embodiment, is the

most efficient and practical; yet realizing the conditions concurrent with the adoption of my invention will necessarily vary, I desire to emphasize that various minor changes in details of construction, proportion and arrangement of parts, may be resorted to within the scope of the appended claims without departing from or sacrificing any of the principles of this invention.

Having thus described my invention, what I desire protected by Letters Patent is as set forth in the following claims:

1. A method of twisting a plurality of rods consisting in subjecting the rods to a feeding operation and a twisting and discharge operation, and causing the feeding operation to crowd the feed of the rods to the twisting and discharge operation to increase their molecular density sufficiently to compensate for the stretch imparted to the rods during the twisting and discharge operation.

2. In a machine for twisting steel rods and the like into a unitary bar structure, the combination of a set of feeding rollers and a set of twisting discharge rollers, means for accelerating the feeding rate of the former to crowd the feed with respect to the discharging rate of the latter to increase the molecular density of the work in proportion to the stretch of the material incident to the twisting operation, whereby the tensile strength of the material is not impaired.

3. In a machine for twisting steel rods and the like into a unitary structure, the combination of a set of feeding rollers and a set of twisting discharge rollers, means in connection with the feeding rollers to impart the initial twist to said rods, means for accelerating the feeding rate of the feeding rollers to crowd the feed with respect to the discharging rate of the discharge rollers to increase the molecular density in proportion to the stretch of the material incident to the twisting operation, whereby the molecular structure and tensile strength of the material will not be impaired.

4. In a machine for twisting steel rods and the like into a unitary structure, the combination of a set of feeding rollers and a set of twisting discharge rollers, the latter diagonally positioned with respect to each other, the feeding rate of the feeding rollers being accelerated with respect to the discharging rate of the diagonal rollers in proportion to the stretch of the material incident to the twisting operation, whereby the molecular structure and tensile strength of the material will not be impaired.

5. In a machine for twisting steel rods and the like into a unitary structure, the combination of a feeding roller means and a twisting roller discharge means, drive shaft means for said feed roller means, said shaft and roller means being movable through a predetermined arc to impart the desired initial twist to said bars, means for accelerating the feeding rate of the feeding roller means to crowd the feed with respect to the discharge rate of the twisting roller means to increase the molecular density of the material in proportion to the stretch of the material incident to the twisting operation, whereby the tensile strength of the material will not be impaired.

6. In a machine for twisting steel rods and the like into a unitary structure, the combination of feeding rollers and twisting discharge rollers, means for accelerating the feeding rate of the former to crowd the feed with respect to the discharging rate of the latter to increase the molecular density of the rods proportionate to the stretch of the material incident to the twisting operation, whereby the tensile strength of the material will not be impaired, the pitch of the twist of the bar being regulated by varying the distance between the feeding and discharge rollers.

7. In an apparatus for twisting rods into a unitary structure, the combination of a feeding roller means and a twisting roller discharge means, a rotatably mounted cage means, drive shaft means for said feeding roller means, a mounting for said shaft means carried by said cage and circumferentially adjustable with respect thereto, manually controlled means for operating said feeding roller means, said cage, shaft mounting, and manually controlled means being operable as a unit to drive said feed roller means, the feeding rate of said feeding roller means and the discharge rate of said discharge means being relatively adjustable to effect twisting of said rods without impairing their molecular structure.

8. A method of twisting a plurality of rods consisting in subjecting the rods to a feeding operation and a twisting and discharge operation, accelerating the feeding operation with reference to the twisting and discharging operation to crowd the feed to the latter operation for the purpose of increasing the molecular density of the rods sufficiently to compensate for the stretch imparted to the rods during the twisting and discharge operation.

9. A method of twisting a plurality of rods consisting in subjecting the rods to a feeding operation and a twisting and discharge operation, accelerating the feeding operation with reference to the twisting and discharging operation to crowd the feed to the latter operation for the purpose of increasing the molecular density of the rods sufficiently to compensate for the stretch imparted to the rods during the twisting and discharge operation and adjusting the operations relatively to effect a pitch variation.

PAUL BETZLER.