W. C. CORYELL.

REINFORCING BAR FOR CONCRETE AND SIMILAR STRUCTURES.

APPLICATION FILED JULY 25, 1908.

1,002,565. Patented Sept. 5, 1911.

FIG. I.

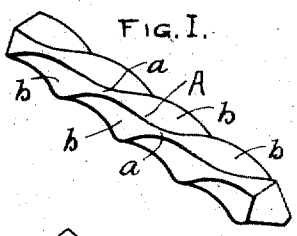


FIG. III.

FIG. II

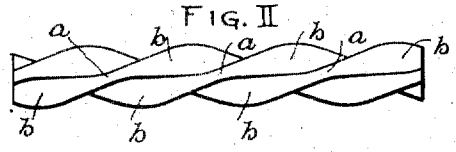
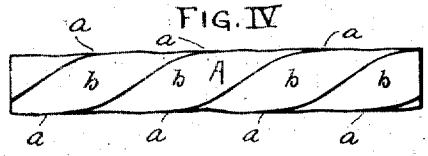


FIG. IV



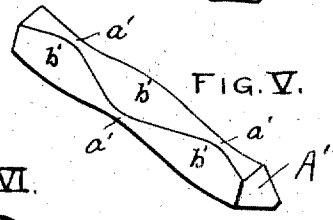
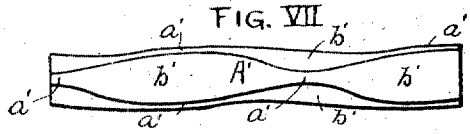


FIG. V.

FIG. VI.

FIG. VII



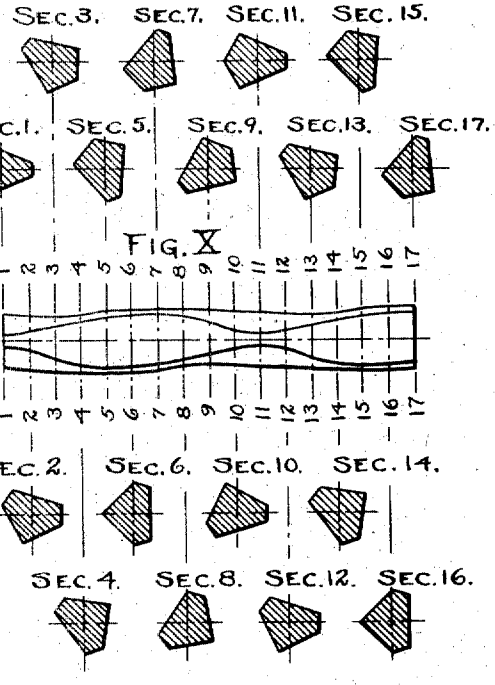


FIG. VIII

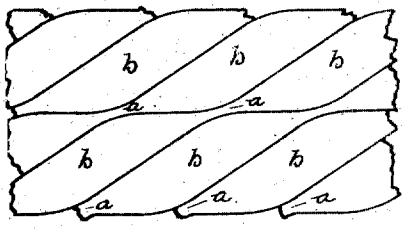
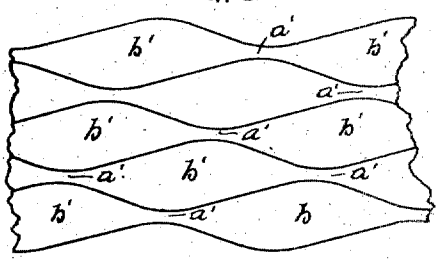


FIG. IX



WITNESSES

Carolyn Weber

L. D. Wells 99

INVENTOR

William C. Coryell

by Thomas H. Ferguson

Atty.

UNITED STATES PATENT OFFICE.

WILLIAM C. CORYELL, OF YOUNGSTOWN, OHIO.

REINFORCING-BAR FOR CONCRETE AND SIMILAR STRUCTURES.

1,002,565. Specification of Letters Patent. Patented Sept. 5, 1911.

Application filed July 25, 1906. Serial No. 445,298.

To all whom it may concern:

Be it known that I, WILLIAM C. CORYELL, a citizen of the United States, residing at Youngstown, county of Mahoning, State of Ohio, have invented certain new and useful Improvements in Reinforcing-Bars for Concrete and Similar Structures, of which the following is a specification.

The present invention relates to reinforcing bars of metal for use in concrete and similar structures, and the general object of the invention is to produce a bar of this type which may be economically manufactured and which may effectively and efficiently perform its functions in the constructions in which it is employed. To this end, I have provided a bar having a plurality of undulating faces which extend lengthwise of the bar, either in right lines parallel with the axis of the bar, or spirally about said axis. The undulations of the several faces, of which there may be any desired number, are preferably arranged so that the elevations of one face lie approximately in the same transverse planes as the depressions of the adjoining faces.

In carrying out my invention, the bar is first produced with the undulating faces extending spirally about its axis, and then if it is desired to produce a bar in which the undulating faces extend in right lines lengthwise of the bar, the same is twisted in opposition to the spirality of the undulating faces until such faces are brought into straight lines. The spiral arrangement of the faces is preferably such that the depressions, which call for the greatest reductions in the process of rolling, lie at the top and bottom of the bar, while the elevations of the several undulating faces lie at the sides of the bar where little or no reduction is required. In this way, the greatest efficiency in rolling is obtained, since the portions requiring heavy reductions are located at points where the pressure of the rolls is most directly applied, while the portions requiring little or no reduction are located at the sides where the pressure of the rolls is least. It is obvious that in twisting the bar from the spiral form into which it has been rolled, any desired degree of twist may be given to it; in some instances, the twisting may be stopped before the right line position of the faces is reached; while in others, it may be carried beyond that position. By this method of manufacture, I am enabled to most efficiently produce a bar having heavy reductions upon its sides as well as its top and bottom.

The character of the invention and its fulfillment of the requirement of economical production at the rolling mill and of efficient service in the reinforced structures in which it is employed, will be more fully understood from the following detailed description, taken in connection with the accompanying drawing, and the scope of the invention will be particularly pointed out in the appended claims.

In said drawing, Figure I is a perspective view of that form of the bar having spirally arranged undulating faces; Figs. II, III and IV are side, end and bottom views, respectively, of the same; Fig. V is a perspective view of the bar of the preceding figures, twisted so as to bring the undulating faces in longitudinal right lines; Figs. VI and VII are end and side views, respectively, of the bar of Fig V; Figs. VIII and IX are developments of the surfaces of the bars of Figs. I and V respectively; and Fig. X is a figure illustrating the bar of Fig. V in side elevation with sections of the same taken on planes indicated by lines 1—1, 2—2, etc., to 17—17, and designated "Sec. 1", "Sec. 2", etc., to "Sec. 17".

Throughout these views, like characters refer to like parts.

In the form of the invention illustrated in Figs. I to IV inclusive, the bar A, as previously indicated, is provided with a plurality of undulating faces which extend spirally around the bar from end to end. Obviously, there may be any desired number of such faces. In the form illustrated, there are five faces which vary in width from a minimum at the crest of the undulation, to a maximum at its trough. In order to bring the maximum reductions at the top and bottom of the bar, the crests or elevations *a—a* of the several undulating faces are located in right lines at the sides of the bar, while the depressions or troughs *b—b* are located in right lines at the top and bottom of the bar. The relative variation in width of the undulating faces is apparent from Fig. VIII, which shows a development of the surface of the bar of Figs. I to IV.

As before indicated, the bar may be left with the spirally arranged faces as indicated in Figs. I to IV, or it may be subjected to a twisting operation which will

bring the undulating faces in right lines, as indicated by the bar A′ of Figs. V to VII inclusive, in which the elevations *a′* and depressions *b′* of any given face lie in planes extending lengthwise of the bar and intersecting its axis. This arrangement is clearly shown by the development of the surface of the bar illustrated in Fig. IX. As indicated by the sections of Fig. X, the section of the bar at any point is reproduced at regular intervals throughout the bar and there is a progressive rotation of the figure of the section in its own plane about the axis of the bar. Thus, in said figure, the sections bearing the odd numbers have the same cross-sectional configuration, and in passing progressively from one section to the next in the order of numbering, we see that the figure of the section is rotated about the axis of the bar through the same angle. Likewise, the sections bearing the even numbers are alike and the figure of the section is rotated progressively as we pass from one section to the next. The two sets of sections, however, differ. Both are pentagons, but the lengths of the sides differ. From this consideration, it will be seen that the bar is made up of short blocks or elements having a section like that of Sec. 1 at one end, and a section like that of Sec. 2 at the other end, the sections between being of continuously varying configuration. This element is repeated and rotated in order to produce the complete bar. Obviously, a different configuration could be given to the bar of Fig. V by varying the undulating faces of the bar of Fig. I before subjecting it to the twisting operation. Such modification could be made according to the requirements of any given case, or at the will of the designer.

From the above, it will be seen that in both forms of the bar, I have provided elevations and depressions which are transformed from one to the other through gradual gradations occurring regularly and evenly throughout the extent of the bar. These changes are such that they may be formed in the last pass of the rolling mill and without heavy reductions. I thus avoid the difficulty of getting two sets of rolls to work accurately with reference to the changed surface of the bar, as would be necessary were heavy reductions required, and from the bar without an excessive temperature in the running passes and with a continued working in the neighborhood of the critical temperature (700° to 800° C.), thus producing a finer grain in the steel with a correspondingly greater strength to the bar. The rolling of the steel at a low pressure in this way leaves the bar practically free from scale and enables it to be rolled more accurately and uniformly as to size with a resulting economy of material.

Since the depressions of the undulating faces extend transversely and obliquely of the bar in its rolled form, the reductions on its upper and lower sides can be made very readily. The obliquely transverse depressions on the upper and lower sides of the bar are formed by the rolls practically as easily as longitudinal depressions. In forming these depressions, the metal has only to flow upward and forward and its flow is greatly facilitated by the uniform cross-sectional area of the bar.

As before indicated, in rolling irregular bars in horizontal mills from bars of regular standard shapes, the deformations can be more easily and accurately formed at the top and bottom of the bar than at its sides, by reason of the more direct application of pressure by the rolls to the top and bottom of the bar as it passes between them. Accordingly, as before indicated, the depth of the depressions *b* is a maximum at the top and bottom of the bar, that is, at or near the center of the depressions, and is gradually diminished to a minimum at the sides of the bar. Bars constructed in this way, whether left with the spiral arrangement of the faces or twisted so as to wholly or partially remove the spirality, are of equal volume and practically of equal exposed area per unit length, as indicated by the elements illustrated by Fig. X, and consequently are of practically uniform temperature as they enter the last pass of the mill. This gives the finished bar uniformity of texture, strength, hardness, ductility and elasticity, and hence an equal elongation per unit length when under strain. The rolled bar is of such form that the rolls for its production may be accurately and economically manufactured. They may be of chilled cast-iron or steel castings, turned and grooved by suitable and easily obtained tools.

Another feature of economy in the production of my bars consists in the ease of changing the mill from standard bars such as rounds, squares, hexagons, octagons, ovals, etc., to my bar, and vice versa, since in either case it is only necessary to change the rolls of the last pass. Consequently, a minimum of time is consumed in shut-downs and changes. My bars may be readily produced from any of these standard shapes by working them through the proper rolls in the last pass of the mill.

The bar is also constructed so as to efficiently perform its functions in the reinforced structure of which it is part. For this purpose, it is free from large flat surfaces which tend to destroy the mass effect of the reinforced structure and which, when placed near the surface of reinforced concrete structures, are likely to cause the adjacent concrete to spall. It is also free from

sharp corners and long sharp edges which tend to split the concrete. Where the bar is subjected to the twisting operation so as to bring the undulating faces in longitudinal right lines, it is free from any tendency to twist when subjected to strain in its final position. Again, all the depressions in the finished bar are of such size and form that the pouring of the concrete about the bar during construction will drive out the contained air and completely fill them, thus obtaining the maximum available adhesion. The shape of the bar in its different forms is also such that the centers of gravity of all right sections lie in a practically straight line coincident with the axis of the bar, and consequently the elongation of the bar will be in direct ratio to the load it carries; and local stresses, due to the tendency of the bar to straighten under load, will be avoided. As before indicated, the uniform cross-sectional area of the bar gives a maximum tensile strength for the material employed.

I have employed the term "concrete reinforcing bar" in this application, but it will of course be apparent that the bar may be employed in structures made up of other material than concrete. It will also be apparent that in practicing my invention, the character of the undulating faces, the cross-section and other features of the bar, may be greatly varied without departing from its spirit and scope. I therefore do not wish to be limited to the specific forms herein disclosed, but aim to cover by the terms of the appended claims all such alterations and modifications of the same as will ordinarily occur to persons skilled in this art.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. A concrete reinforcing bar having its exterior composed wholly of undulating faces extending each throughout the length of the bar and having cross-sections of like configuration occurring at intervals throughout the length of the bar and having the figure of each section rotated in its plane about the axis of the bar relative to the next like section and portions between said sections having cross-sections of continuously varying configuration.

2. A concrete reinforcing bar having its exterior composed wholly of undulating faces each extending throughout the length of the bar, the depressions of each face lying in the same transverse planes as the elevations of the adjoining faces and each face varying in width continuously throughout its length.

3. A concrete reinforcing bar having its exterior composed wholly of undulating faces each extending spirally about the bar throughout its length, the depressions of each face lying in the same transverse planes as the elevations of the adjoining faces and each face varying in width continuously throughout its length.

4. A concrete reinforcing bar having its exterior composed wholly of undulating faces extending spirally about the bar and having the elevations of the undulating faces in right lines extending lengthwise of the bar.

5. A concrete reinforcing bar having its exterior composed wholly of undulating faces extending spirally about the bar and having the elevations of the undulating faces in right lines extending lengthwise of the bar and in the same transverse planes as the depressions of the adjoining faces.

6. A concrete reinforcing bar having its exterior composed wholly of undulating faces each extending throughout the length of said bar, the depressions being broad and the elevations narrow and each face varying in width continuously throughout its length.

7. A concrete reinforcing bar of uniform cross-sectional area throughout its length having its exterior composed wholly of merging depressions and elevations forming faces each extending continuously throughout the length of the bar, each depression continuously varying in depth throughout its length.

8. A concrete reinforcing bar of uniform cross-sectional area throughout its length having its exterior composed wholly of merging depressions and elevations forming faces each extending continuously throughout the length of the bar, each depression continuously varying in depth and having its greatest depth near its center.

In witness whereof, I hereunto subscribe my name this 22nd day of July, 1908.

WILLIAM C. CORYELL.

Witnesses:
L. D. KELLOGG,
CAROLYN WEBER.

Correction in Letters Patent No. 1,002,565.

It is hereby certified that in Letters Patent No. 1,002,565, granted September 5, 1911, upon the application of William C. Coryell, of Youngstown, Ohio, for an improvement in "Reinforcing-Bars for Concrete and Similar Structures," an error appears in the printed specification requiring correction as follows: Page 2, line 55, for the word "from" read *form;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3d day of October, A. D., 1911.

[SEAL.]

E. B. MOORE,
Commissioner of Patents.