A. L. JOHNSON.

REINFORCING BAR.

APPLICATION FILED DEC. 6, 1907.

967,390.

Patented Aug. 16, 1910.

2 SHEETS—SHEET 1.

Fig. 3b.

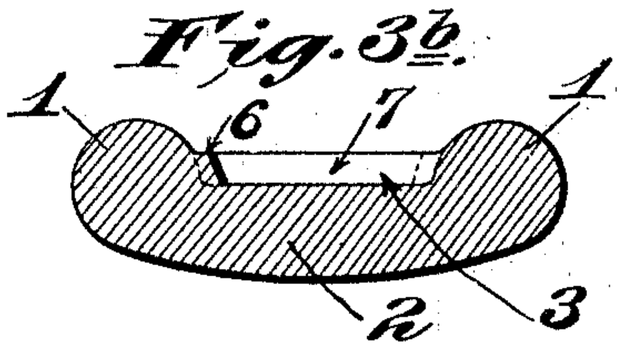

Fig. 3.

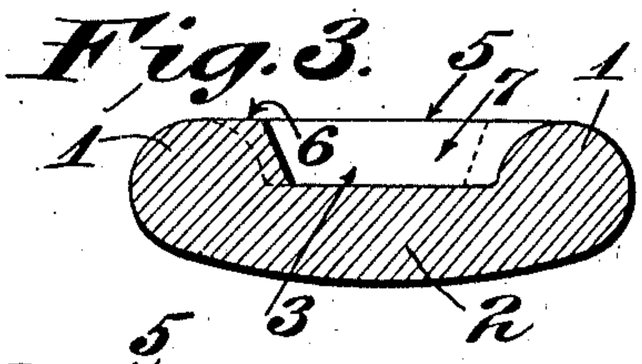

Fig. 1.

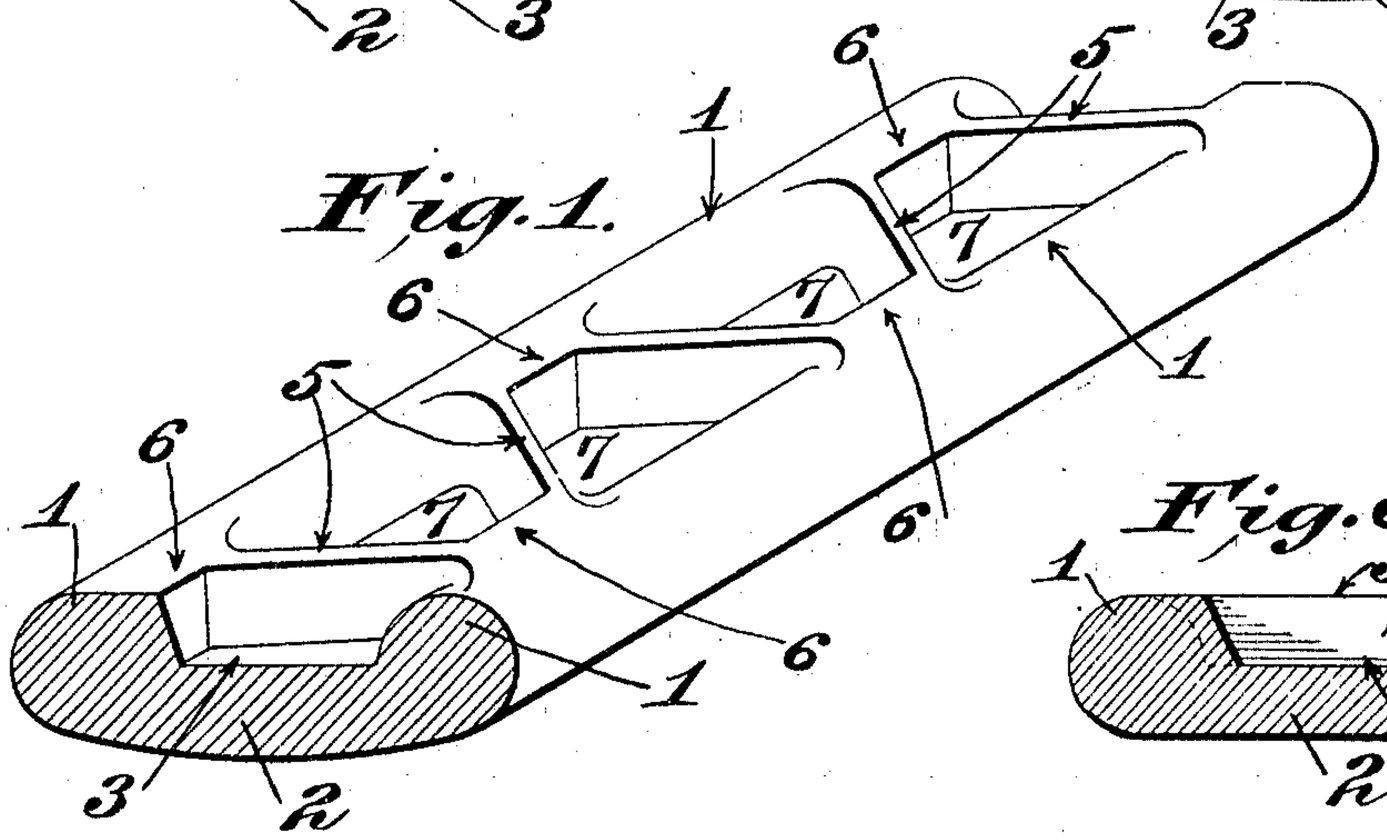

Fig. 3a.

Fig. 2.

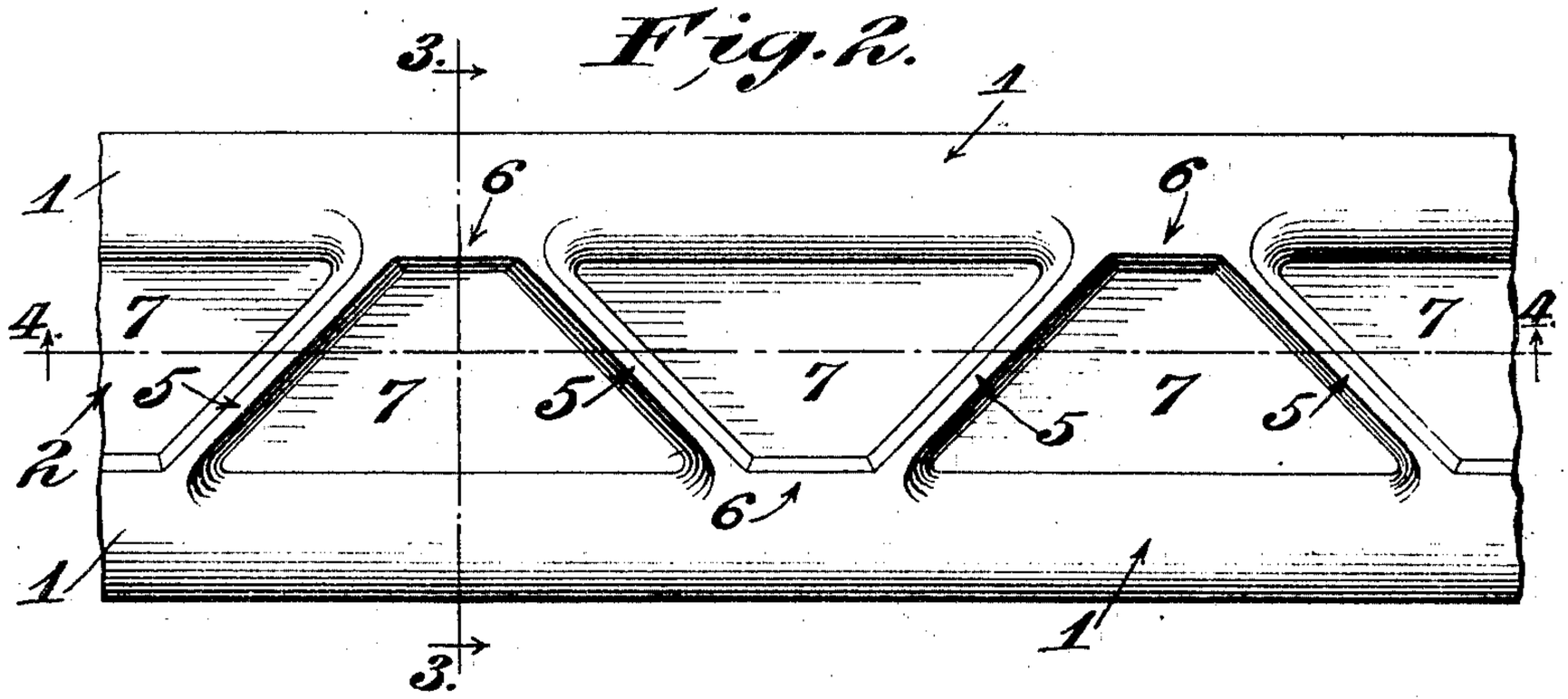

Fig. 4.

Witnesses:

G. A. Pennington

J. B. Megown

Inventor:

Albert L. Johnson,

By Cameron & Cameron,

Attys.

A. L. JOHNSON.

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2 SHEETS—SHEET 2.

Fig. 5.

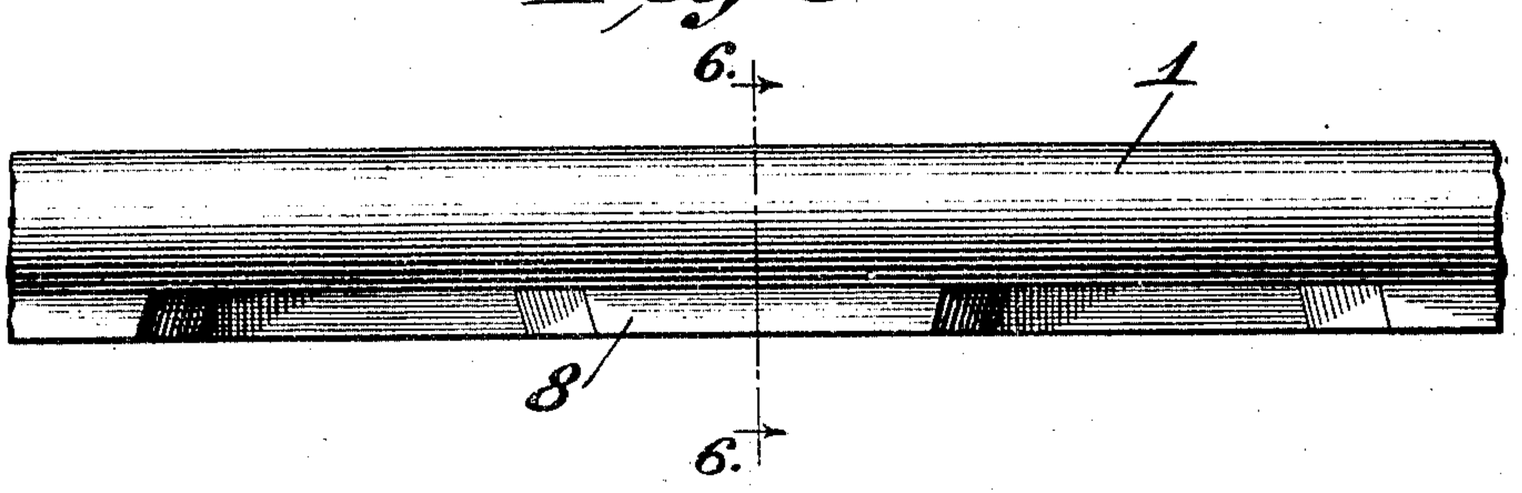


Fig. 6.

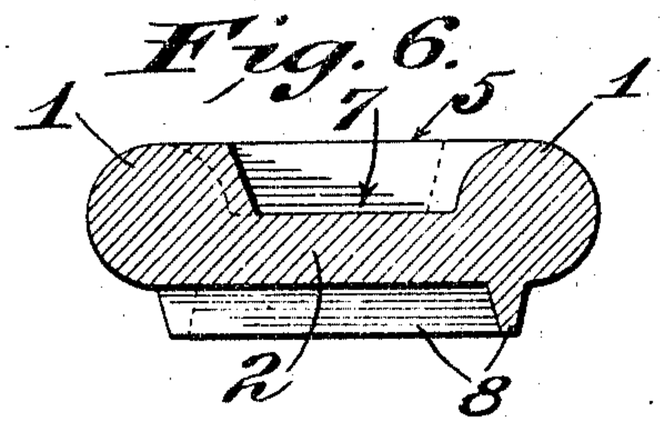


Fig. 7.

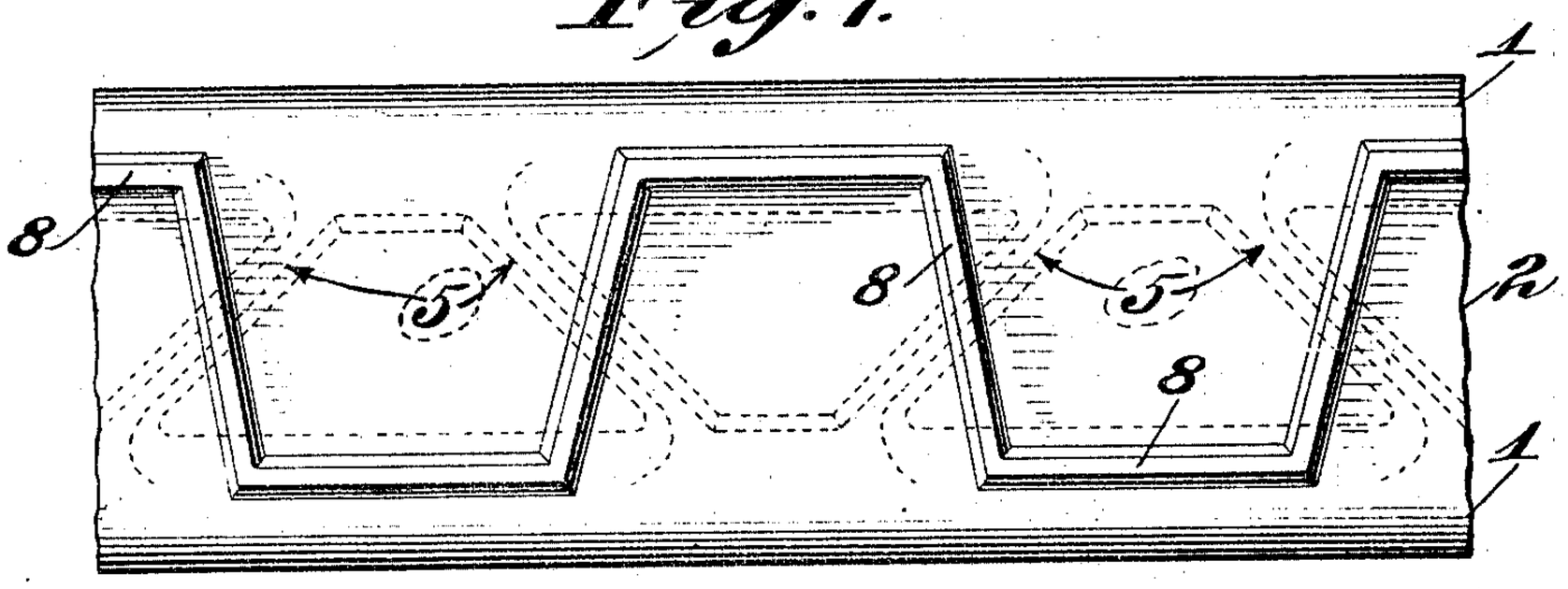


Fig. 8.

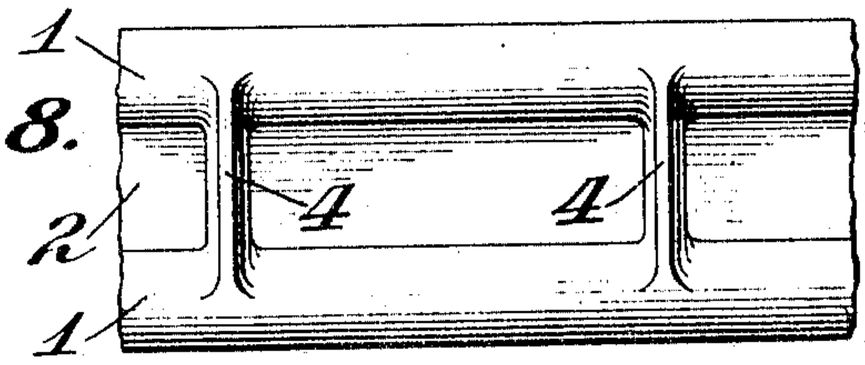
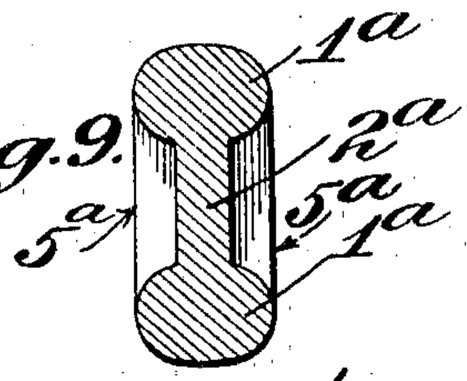


Fig. 9.



Witnesses:

G. A. Pennington

J. B. Megown

Inventor:

Albert L. Johnson

By Connett & Connett,

Attys.

UNITED STATES PATENT OFFICE.

ALBERT L. JOHNSON, OF ST. LOUIS, MISSOURI, ASSIGNOR TO CORRUGATED BAR COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

REINFORCING-BAR.

967,390. Specification of Letters Patent. **Patented Aug. 16, 1910.**

Application filed December 6, 1907. Serial No. 405,332.

To all whom it may concern:

Be it known that I, ALBERT L. JOHNSON, a citizen of the United States, and a resident of the city of St. Louis and State of Missouri, have invented a new and useful Improvement in Reinforcing-Bars, of which the following is a specification.

Heretofore bars of substantially uniform section have been used for reinforcing concrete; but such bars have usually been provided with projections or depressions of the surface thereof arranged to form a mechanical bond with the concrete. On account of the unevenness of the surface of such bars, their ductility or capacity for cold bending or uniform elongation was diminished and they were not well suited for use where they were required to be bent. Besides, on account of the irregularity of the surface, that is, the lack of straightness in the main strength elements or areas, the stress in such bars is greater at some sectional areas than at others even though the total sectional areas might be practically the same.

The purpose of the present invention is to overcome these objections or disadvantages.

The principal object of my invention is to provide a bar of uniform section which will have all the ductile and cold bending qualities of a plain bar together with an efficient mechanical bond.

Another object of this invention is to distribute the metal in such a way as to fully develop its ductility or capacity for cold bending and elongation.

Another object is to locate the mechanical bonding means close to the neutral axis of the bar.

Another object is to localize the mechanical bonding means in a bar of constant cross section in such a way that they do not cause any material change in the line of action of longitudinal tensile stresses, that is to say, in such a way that throughout the body of the bar the longitudinal tensile stresses will be parallel with the axis thereof.

The invention consists principally in arranging the mechanical bonding means close to the neutral axis of the bar.

It also consists in localizing the mechanical bonding means in such a way that the greater portion of the surface of the main body is even or without irregularities.

It also consists in forming in the top of a bar a longitudinal series of alternately reversed trapezoidal depressions, and preferably, also, in thickening the apical wall of such trapezoidal depressions by an amount sufficient to take up the tensile stress transmitted by the inclined rib between such depressions.

In the accompanying drawing, which forms part of this specification and wherein like symbols refer to like parts wherever they occur, Figure 1 is an isometric projection of a reinforcing bar embodying my invention; Fig. 2 is a view of the top side thereof; Fig. 3 is a cross section; Fig. 4 is a longitudinal section of the bar on the line 4—4 of Fig. 2; Fig. 3^a is a cross section of a flat bottomed bar; Fig. 3^b is a cross section of a modification; Fig. 5 is a side view of a bar like the bar of Fig. 1 modified by a bonding rib on the bottom thereof; Fig. 6 is a cross section of this modified form of bar on the line 6—6 of Fig. 5; Fig. 7 is a bottom view of the bar illustrated in Fig. 5; Fig. 8 is a view of a modified form of bar wherein the mechanical bonding means are located close to the neutral axis but fail to give a constant section; and, Fig. 9 is a cross section of a modified form of bar.

The body of my bar is of compact section and comprises three main strength elements or areas, namely, two thick side portions 1, 1 connected by a thick and comparatively short middle portion or web 2. Between the enlarged side portions and above the web portion is a longitudinal groove 3, which groove on account of the mass of metal concentrated in the side portions relative to the mass in the web portion, reaches close to the neutral axis of the bar. With the exception of the bar illustrated in Fig. 9, the bars illustrated in the accompanying drawings may be briefly characterized as channel bars. It is noted that by reason of the concentration of the metal above mentioned, the thickness of the web or middle portion is approximately half or more than half of the thickness of the side portions. The exterior surface of the bar illustrated in Fig. 1 is even or regular, that is to say, the longitudinal elements of the surface are straight lines parallel with the axis of the bar, and consequently except for the groove portion, the contour of the bar is of uniform size and shape throughout its length. In consequence of this freedom from irregularities throughout the entire

length of the bar, the longitudinal stresses act parallel with the axis thereof.

In order to provide for the proper mechanical bonding of the bar with the concrete, the groove between the side portions of the bar is crossed at intervals by ribs. In the construction illustrated in Fig. 8, these ribs 4 are perpendicular to the axis of the bar. This arrangement furnishes a sufficient bond and the bond is located close to the neutral axis of the bar; but with the ribs so arranged, the bar has the disadvantage of not being uniform in section.

In the construction illustrated in the other figures, the section is substantially uniform. In these other figures, the ribs 5 are inclined and the portion of the wall between adjacent ends of the inclined ribs is thickened (as shown at 6 in the accompanying drawing) by an amount sufficient to take care of the stresses transmitted to it through the inclined ribs. Preferably, the ribs are inclined at an angle of approximately 45° and the sectional area thereof in a plane at right angles to the axis of the bar is substantially equal to the area by which the connecting portion of the side wall is increased on account thereof. The groove in the side of the bar is thus broken up into a continuous series of alternately reversed trapezoidal depressions 7. For purposes of description, the inclined ribs and the connecting increment added to the side walls may be considered as one continuous rib crenelated or offset at an inclination at intervals, and having its longitudinal portions coalescing with the respective sides of the groove.

It is noted that each thickened portion 6 of the side walls of the groove constitutes the apical side of a trapezoidal or triangular depression. This apical side may be of any length desired, but in order to develop the required shearing strength, it should preferably be more than double the depth of the rib 5. The shortening of the apical side of the trapezoid has the tendency to more equally distribute the tension to the two sides of the bar; whereas the lengthening thereof has the effect, which is sometimes advantageous, of increasing the area of individual depressions. The acute angles of the trapezoidal depressions are rounded or formed with a fillet to facilitate manufacture and to insure the proper filling of the same with concrete. As the trapezoidal depressions are inclosed on all four sides, the pitch or inclination of the ribs with respect to the sides of the groove is a matter of slight significance and need not be calculated with respect to the angle of friction. In the practical rolling of this bar, however, the side faces of the ribs will be formed with a bevel or taper. The inclination due to this bevel or taper will have a tendency to split the concrete if such inclination exceeds the angle of friction and, therefore, it is important that the bevel of the rib (meaning the departure of the face of the rib from the position it would occupy if the ribs were right shouldered like a square threaded screw) should be less than the angle of friction. It is noted that the total sectional area of the rib is only a small proportion of the total cross-sectional area of the entire bar. When the bars are intended to be bent, it is preferable to form them with a substantially flat surface on the bottom of the bar, that is, the surface of the web portion opposite that which is crossed by the ribs. By reason of the massing of the metal at the sides, this bar will bend to great advantage with this flat surface innermost.

When the bar is used in beams, the side containing the series of trapezoidal depressions will be uppermost and for this reason it is herein referred to as the top thereof. When laid in said position, the depressions may be entirely filled with concrete without difficulty. On the other hand, depressions in the bottom of the bar are liable to form air and water pockets and thereby exclude concrete therefrom. For this reason, the bottom of my bar is formed with a continuous rib or projection 8 extending the full length thereof in a broken line consisting of transversely inclined portions connected by longitudinal portions. Preferably the several portions of the rib are straight lines but they may be curved to approximate a sinusoidal form. This rib does not affect the uniformity of the cross section of the bar. In this case, the transverse portions of these ribs are inclined with respect to a plane at right angles to the axis of the bar by an amount sufficiently less than the angle of friction so that the faces of these ribs may make angles with this plane at right angles to the axis of the bar less than the angle of friction.

It is noted that the ribbing of the underside of the bar is of particular advantage with straight bars, as such ribbing detracts somewhat from the bending quality of the bar owing to their location at some distance from the neutral axis. For this reason, the ribbing on the lower side is preferably omitted when the bars are intended to be curved or bent. When the bottom of the bar is ribbed, the bottom should be comparatively flat, and the sinuses formed by the rib should be left open.

The construction illustrated in Fig. 9 may be characterized as a thick or compact bulbular I-beam having the mechanical bonding means located on the sides thereof. This type of construction is particularly designed for use in the position shown, that is to say, with its depressed areas at the sides. In other respects, it is quite similar to the

construction above described and requires no additional description. In this form the middle member 2^a corresponds with the web 2 of the channel bar and the top and bottom members 1^a correspond with the side members 1 of the channel bar.

Obviously, the cross sectional contour of my bar may be modified without departing from my invention. For instance, the bulbular side enlargements of the body may be of polygonal section. So, too, as illustrated in Fig. 3^b, the upper surface of the bonding ribs may be lower than the uppermost portions of the sides; and instead of the individual ribs extending across the groove, such ribs may take the form of lugs or shoulders or the like located on either the walls or the bottom of the groove.

What I claim as my invention and desire to secure by Letters Patent is:

1. A bar of compact section having a longitudinal groove reaching close to the neutral axis thereof and mechanical bonding projections in said groove, the thickness of the side portions of said bar being approximately double the thickness of the middle portion thereof.

2. A bar comprising two thick side portions connected by a thick and comparatively narrow middle portion arranged to form a longitudinal groove, and projections in said groove constituting mechanical bonding means, the surface of said bar outside of said groove being parallel with the axis thereof, the thickness of said side portion being approximately double the thickness of the middle portion thereof.

3. A bar comprising two thick side portions connected by a thick and comparatively narrow middle portion arranged to form a longitudinal groove, and ribs extending entirely across the inner face of the middle portion.

4. A bar having a single longitudinal groove crossed at intervals by ribs, the surface of said bar outside of said groove being otherwise free from material irregularities.

5. A bar of substantially constant cross section having a single longitudinal groove therein, and ribs crossing said groove at intervals, the longitudinal elements of the surface of said bar outside of said groove being straight lines.

6. A bar having a longitudinal groove in one side thereof and a continuous bending member coalescing at intervals with the sides thereof and arranged to divide said groove into a series of trapezoidal pockets, the cross-sectional area of the bar being substantially uniform.

7. A bar having a longitudinal groove, the opposite walls of said groove being alternately thickened at intervals and inclined ribs connecting the ends of the thickened portions of one wall to the adjacent ends of the thickened portions of the opposite wall whereby the cross sectional area of the bar is substantially uniform.

8. A bar having a longitudinal groove, the opposite walls of said groove being alternately thickened at intervals, the intervals between the thickened portions of one wall being greater than the length of the corresponding thickened portion of the opposite wall, and inclined ribs connecting the ends of the thickened portion of one wall to the adjacent ends of the thickened portions of the opposite wall, whereby the cross-sectional area of the bar is substantially uniform.

9. A bar having a body portion of substantially uniform sectional area and a longitudinal groove therein, and a continuous bonding portion of substantially uniform section, which bonding portion comprises inclined ribs connected by longitudinally arranged enlargements at the sides of the groove.

10. A bar having in one side a longitudinal groove reaching close to the neutral axis thereof and mechanical bonding means located in said groove, the opposite side of said bar having a substantially flat surface and a continuous bonding member thereon of generally sinusoidal form.

11. A bar of compact section having in one face a longitudinal groove reaching close to the neutral axis thereof and having ribs across said groove and having a continuous bonding member on the opposite face of said web, said bonding member comprising a series of inclined ribs connected by longitudinal ribs arranged to form open sinuses.

Signed at St. Louis, Mo., this 4th day of December, 1907.

A. L. JOHNSON.

Witnesses:
G. A. PENNINGTON,
J. B. MEGOWN.