May 22, 1945. F. E. FAHY 2,376,761

REINFORCING BAR

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Fig. 1.

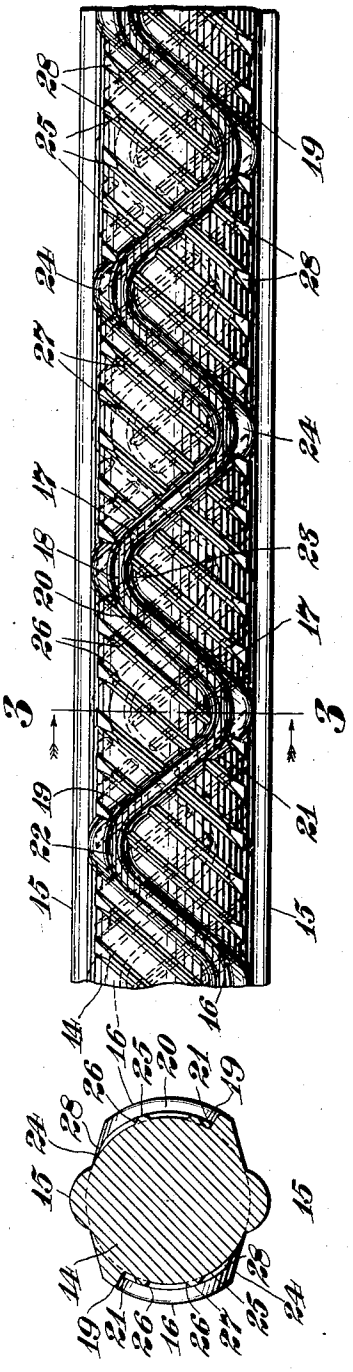


Fig. 2.

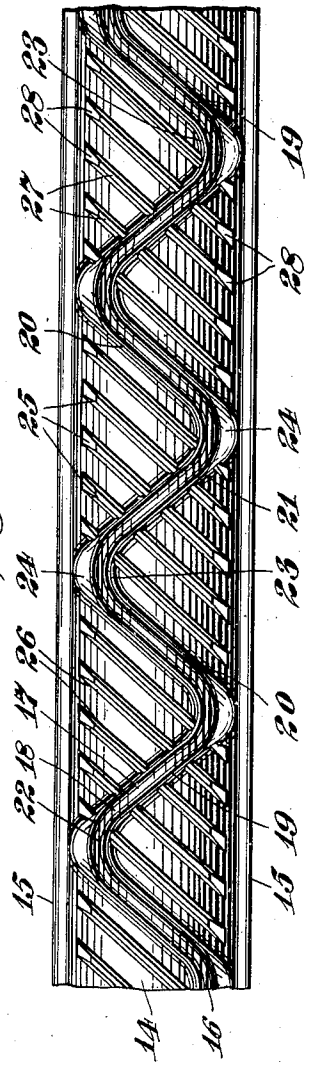


Fig. 3.

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REINFORCING BAR

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Fig. 4.

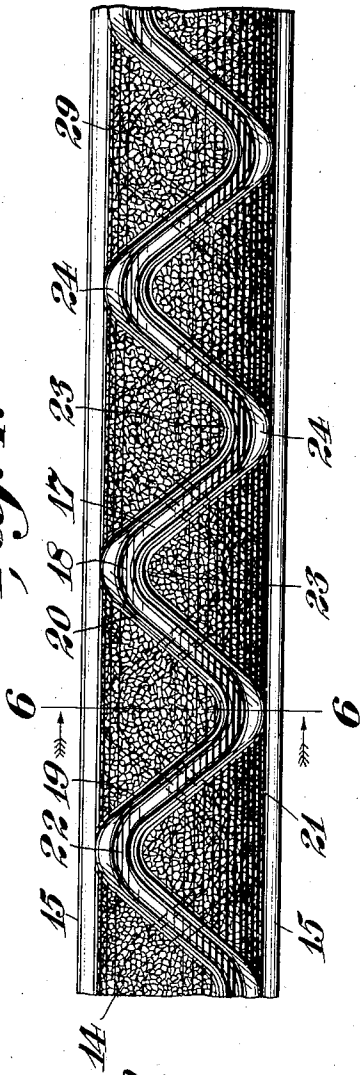


Fig. 5.

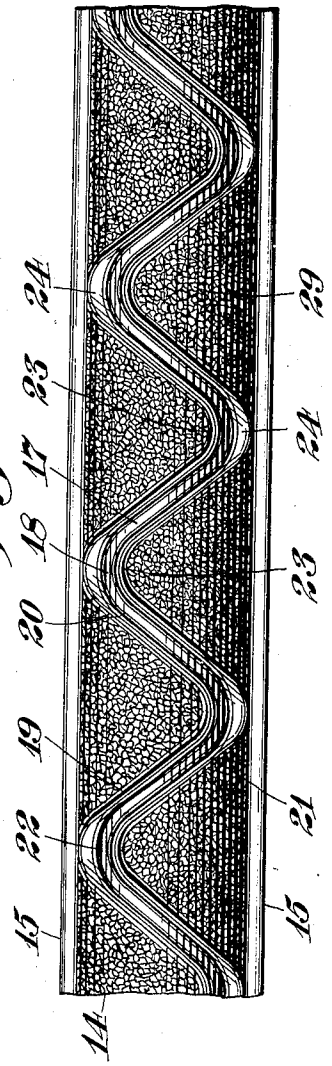
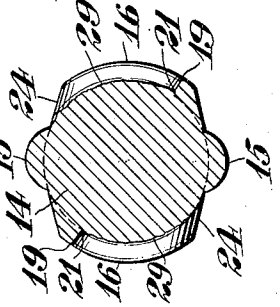


Fig. 6.



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REINFORCING BAR

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Fig. 7.

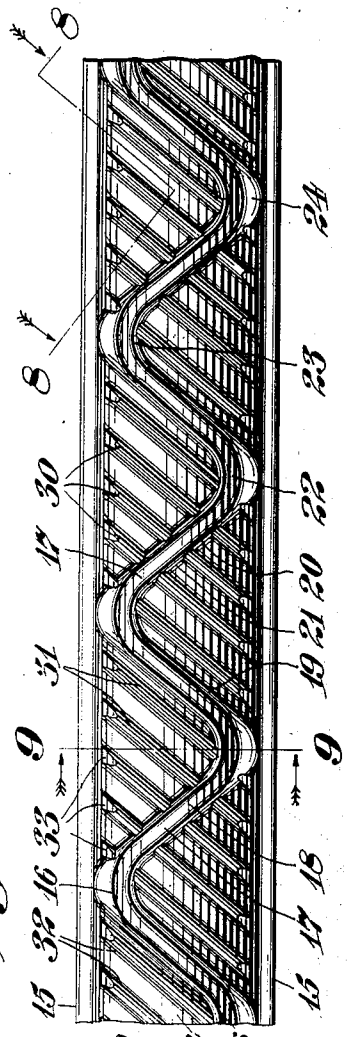


Fig. 8.

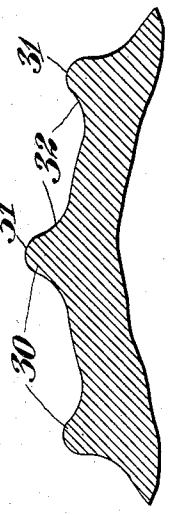


Fig. 9.

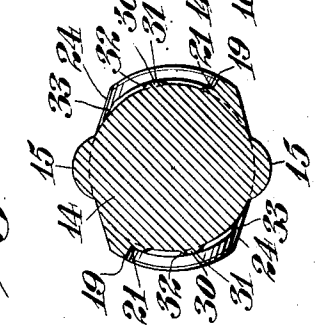
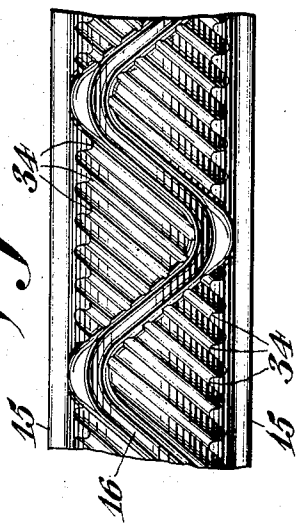


Fig. 10.



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REINFORCING BAR

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Fig. 17.

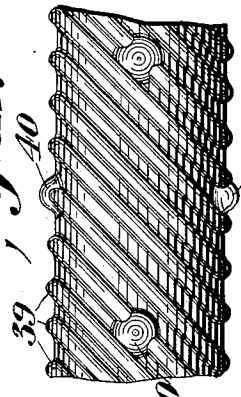


Fig. 18.

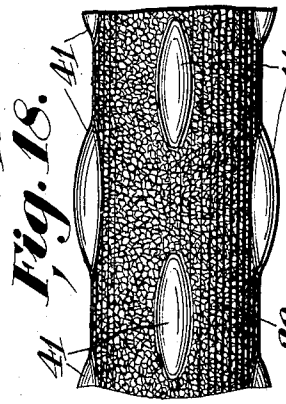


Fig. 19.

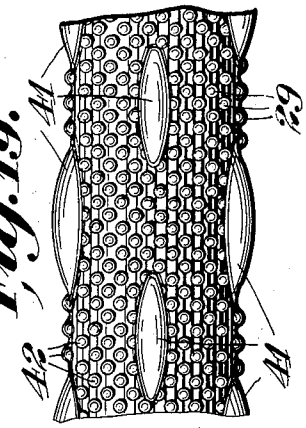


Fig. 14.

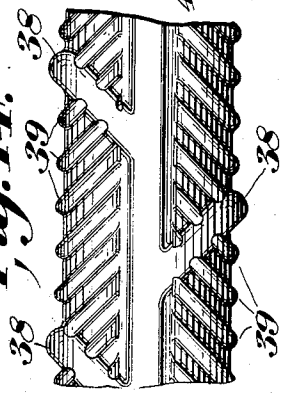


Fig. 15.

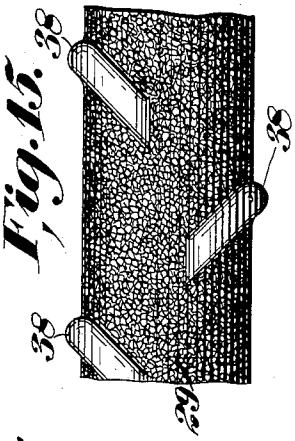


Fig. 16.

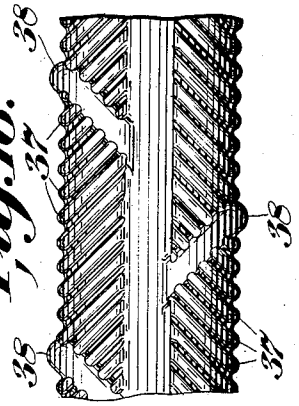


Fig. 11.

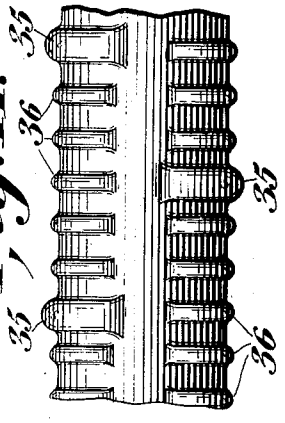


Fig. 12.

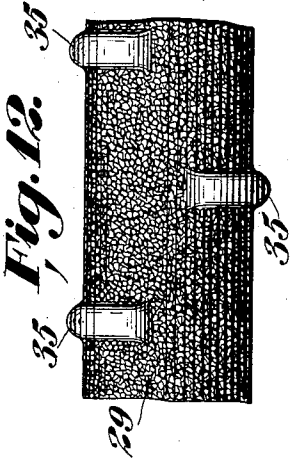
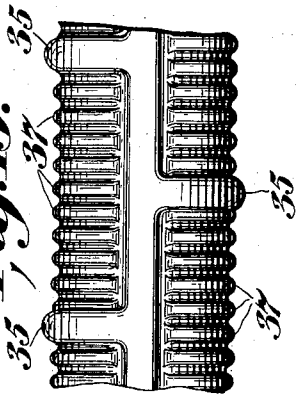


Fig. 13.



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Patented May 22, 1945

2,376,761

UNITED STATES PATENT OFFICE

2,376,761

REINFORCING BAR

Frank Edward Fahy, Bethlehem, Pa., assignor to Bethlehem Steel Company, a corporation of Pennsylvania

Application February 24, 1942, Serial No. 432,117

4 Claims. (Cl. 72—111)

My invention relates to improvements in reinforcing bars, and more particularly to reinforcing bars for use in reinforced concrete construction or the like.

It is a well known fact that large and relatively widely spaced deformations such as lugs or transverse or zigzag ribs on reinforcing bars as used in reinforced concrete construction add substantially to the resistance of such bars, when subjected to axial loads, against ultimate pull-out, that is, against completely slipping through the concrete in which they are embedded. Compared with plain bars, that is, bars relatively smooth surfaces with no such deformations, the resistance which such deformed bars offer against ultimate pull-out is substantially greater. However, while such large and relatively widely spaced deformations increase the resistance of bars to ultimate pull-out, they do not provide a substantial increase of resistance against some initial slip or against small degrees of slip. Conversely, while very small continuous or closely spaced deformations or surface markings on reinforcing bars, such as may be found in knurled or similarly roughened surfaces, add substantially to the resistance of such bars against small slips relative to the surrounding concrete, such small deformations or markings cannot be expected to add substantially to the resistance of the bar against ultimate pull-out, once initial slip has taken place.

Heretofore, commercial deformed reinforcing bars have been provided only with relatively large and relatively widely spaced deformations, such deformations being so widely spaced that the greater portion of the bodies of the bars has a plain surface, with the result that resistance against small degrees of slip is not increased materially over that of plain bars. It has been found that the resistance against small degrees of slippage can be substantially increased by providing small closely spaced ribs or other deformations on the surface of the bar, or by roughening or otherwise deforming substantially the entire surface of the bar.

It is the primary object of my invention to provide a bar having both large and small deformations which are so arranged and proportioned that the bar is effective in resisting initial slippage and is also effective in resisting ultimate pull-out once slippage has started, and at the same time is economical because it requires practically no greater amount of metal for the same strength than do bars provided only with the usual types of large widely spaced deformations.

A further object of my invention is to provide a reinforcement bar having a cylindrical body portion with sinuous or zigzag ribs and other bonding means formed thereon.

Another object of my invention is to provide a reinforcement bar with major ribs and in addition either small ribs or a heavily roughened surface between the major ribs.

A further object of my invention is to provide a reinforcing bar with major bonding means comprising spaced large transverse ribs, large inclined ribs, or lugs, and in addition minor bonding means comprising a substantially continuous deformation of the surface of the bar intermediate the major bonding means.

Another object of my invention is to provide a reinforcing bar with a plurality of bonding means comprising minor ribs or a heavily roughened surface to prevent initial slip and a major sinuous or zigzag rib to prevent ultimate pull-out when embedded in concrete.

Another object of my invention is to provide a reinforcing bar made of a steel having high tensile strength in contradistinction to the usual mild steel, said bar having a body portion provided with sinuous or zigzag ribs on opposite surfaces thereof and additional smaller ribs or other deformations on the surfaces between said major ribs.

Other objects of my invention will appear from the following description taken with the accompanying drawings in which:

Figure 1 is a top plan view of a portion of one form of bar illustrating my invention;

Fig. 2 is a bottom plan view of the bar shown in Fig. 1;

Fig. 3 is a transverse sectional view of the bar taken on the line 3—3 of Fig. 1;

Fig. 4 is a top plan view of a portion of a modified form of my invention;

Fig. 5 is a bottom plan view of the bar shown in Fig. 4;

Fig. 6 is a transverse sectional view of the modified bar taken on the line 6—6 of Fig. 4;

Fig. 7 is a top plan view of a portion of another modified form of my invention;

Fig. 8 is an enlarged fragmentary cross sectional elevation of the modified bar taken along the line 8—8 of Fig. 7;

Fig. 9 is a transverse sectional view of the modified bar taken on the line 9—9 of Fig. 7;

Fig. 10 is a top plan view of another modification of my invention;

Fig. 11 is a side view of another modification of my invention;

Fig. 12 is a side view of another modification of my invention;

Fig. 13 is a side view of another modification of my invention;

Fig. 14 is a side view of another modification of my invention;

Fig. 15 is a side view of another modification of my invention;

Fig. 16 is a side view of another modification of my invention;

Fig. 17 is a side view of another modification of my invention;

Fig. 18 is a side view of another modification of my invention; and

Fig. 19 is a side view of another modification of my invention.

Referring now to the drawings more in detail 14 indicates the body portion of the bar, 15 the straight longitudinal rib formed on diametrically opposite surfaces of the bar, and 16 a sinuous or zigzag rib formed on the top and bottom surfaces of the bar. In this embodiment of my invention, the sinuous rib 16 constitutes the major bonding means and is designed to resist ultimate pull-out. The apices of the sinuous rib on the top of the bar as illustrated are in staggered relation and centrally disposed to the apices of the sinuous rib on the bottom of the bar, but I wish it understood that this position may be varied or the ribs may be formed in transverse alignment opposite each other if desired without departing from the spirit of my invention.

The sinuous ribs each extend longitudinally of the bar and substantially from one side surface of the bar to the other, having inclined portions 17, with a blunt apex portion 18, rounded corners 19, inclined sides 20, and fillets 21, at the base thereof where they join the cylindrical body portion of the bar. The apices of the ribs are made somewhat narrower at the top as at 22, the inner walls being formed radially as at 23, while the outer surface extends tangentially as at 24 from the top rounded corner to the cylindrical side surface of the bar. It will be observed that the base of the apices of the ribs are of considerably greater width than the longitudinally inclined portions of the ribs, but the cross sectional area will be the same in each case. If the sinuous ribs 16 had the same contour throughout their length a section taken through the longitudinally inclined portion of the sinuous ribs would be somewhat greater in area than a section taken through the apex portions, but in thickening the base of the apex portions and forming it with a fillet of considerable thickness with the top outer surfaces tangential with the rounded surface of the bar, the same transverse sectional area of the rib and bar is obtained throughout its entire length.

Another object in forming the outer surfaces of the apex portions tangential to the side surfaces of the bar is to permit the bar to be more easily rolled.

Referring to Figs. 1 to 3 inclusive, I show a number of ribs 25 which are smaller in cross section than the sinuous rib 16 formed on both the top and the bottom surfaces of the bar, and disposed at intervals intermediate the inclined portions 17 of the sinuous rib 16. The ribs 25 are shown disposed at an angle of approximately 45°, although it should be understood that I do not so limit my invention. Each of the ribs 25 comprise inclined sides 26, blunt apex portions 27 and inclined end portions 28 which blend tangentially into the side surface of the bar. The ribs 25 constitute one form of the minor bonding means of my invention and are provided for the purposes of resisting initial slippage between the bar and the concrete.

Referring to Figs. 4 to 6, inclusive, I show, as a modification of the bar in which the minor bonding means comprise a roughened surface 29 disposed intermediate the inclined portions 17 of the sinous rib 16. This roughened surface is extremely effective in resisting initial slip and may be in the form of indentation or other deformations of the surface of the bar.

In Figs. 7 to 9, inclusive, I show still another modification of the minor bonding means. In this modification ribs 30 are formed on the surface of the bar and disposed at intervals between the inclined portions 17 of the sinuous ribs 16. The ribs 30 comprise an arcuate crown 31 which merges into the bar through fillets 32. The terminal portions of the ribs 30 are inclined as at 33 to blend tangentially into the cylindrical side surface of the bar.

In Figs. 10 to 19, inclusive, I show various modifications and combinations of major and minor bonding means formed on concrete reinforcing bars coming within the scope of my invention. In Fig. 10, for example, the sinuous rib 16 is shown in conjunction with minor bonding means comprising inclined continuous deformations 34. In Figs. 11, 12 and 13 I show major bonding means comprising transverse ribs 35 in combination with minor bonding means comprising relatively small transverse ribs 36, roughened surface 29, and transverse continuous deformations 37, respectively. In Figs. 14, 15 and 16, I show major bonding means comprising inclined ribs 38 in combination with minor bonding means comprising inclined relatively small ribs 39, roughened surface 29, and continuous deformations 37, respectively. In Fig. 17, I show major bonding means comprising substantially hemispherical lugs 40 in combination with minor bonding means comprising relatively small inclined ribs 39. In Figs. 18 and 19 I show major bonding means comprising substantially shuttle-shaped projections or lugs 41 in combination with minor bonding means comprising roughened surface 29 and continuous deformations 42, respectively.

My invention is particularly adaptable to reinforcing bars possessing higher tensile strength than do the ordinary reinforcing bars. In order to carry a given load, such high strength bars will ordinarily be somewhat smaller than the corresponding bars of ordinary grade, and will consequently have a smaller bonding surface in contact with the concrete in which they are embedded. Because of their smaller contacting surface, efficient utilization of such high strength bars requires that the bonding means provided therein be as effective as possible in resisting both initial slippage and ultimate pull-out.

Although I have shown and described my invention in considerable detail, I do not wish to be limited to the exact and specific details shown and described, but may use such substitution, modifications or equivalents thereof, as are embraced within the scope of my invention, or as pointed out in the claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A reinforcing bar for concrete structures or the like comprising a body portion having major and minor bonding means on its surface, said major bonding means comprising an integral

sinuous rib provided with inclined portions and apices, and said minor bonding means comprising small deformations intermediate said major bonding means, said major bonding means extending outwardly of said surface a substantial distance greater than said minor bonding means.

2. A bar for reinforcing concrete and the like comprising a body portion, a series of major bonding means formed on said body in spaced relation to one another to resist substantial axial movement between the concrete and the bar when a load is applied thereto, and minor bonding means formed on the bar intermediate said major bonding means to resist initial axial movement between the concrete and the bar, said minor bonding means comprising a multiplicity of small closely spaced protuberances, said major bonding means extending outwardly of said body portion a substantial distance greater than said minor bonding means.

3. A reinforcing bar for concrete structures or the like comprising a body portion having major and minor bonding means on its surface, said major bonding means comprising ribs, and said minor bonding means comprising small deformations intermediate said major bonding means, said major bonding means extending outwardly of said surface a substantial distance greater than the outermost surfaces of said minor bonding means.

4. A bar for reinforcing concrete and the like comprising a body portion, a series of major bonding means formed on said body in spaced relation to one another to resist substantial axial movement between the concrete and the bar when a load is applied thereto, and minor bonding means formed on the bar intermediate said major bonding means to resist initial axial movement between the concrete and the bar, said minor bonding means comprising a multiplicity of small closely spaced deformations, said major bonding means extending outwardly of said body portion a substantial distance greater than the outermost surfaces of said minor bonding means.

FRANK EDWARD FAHY.