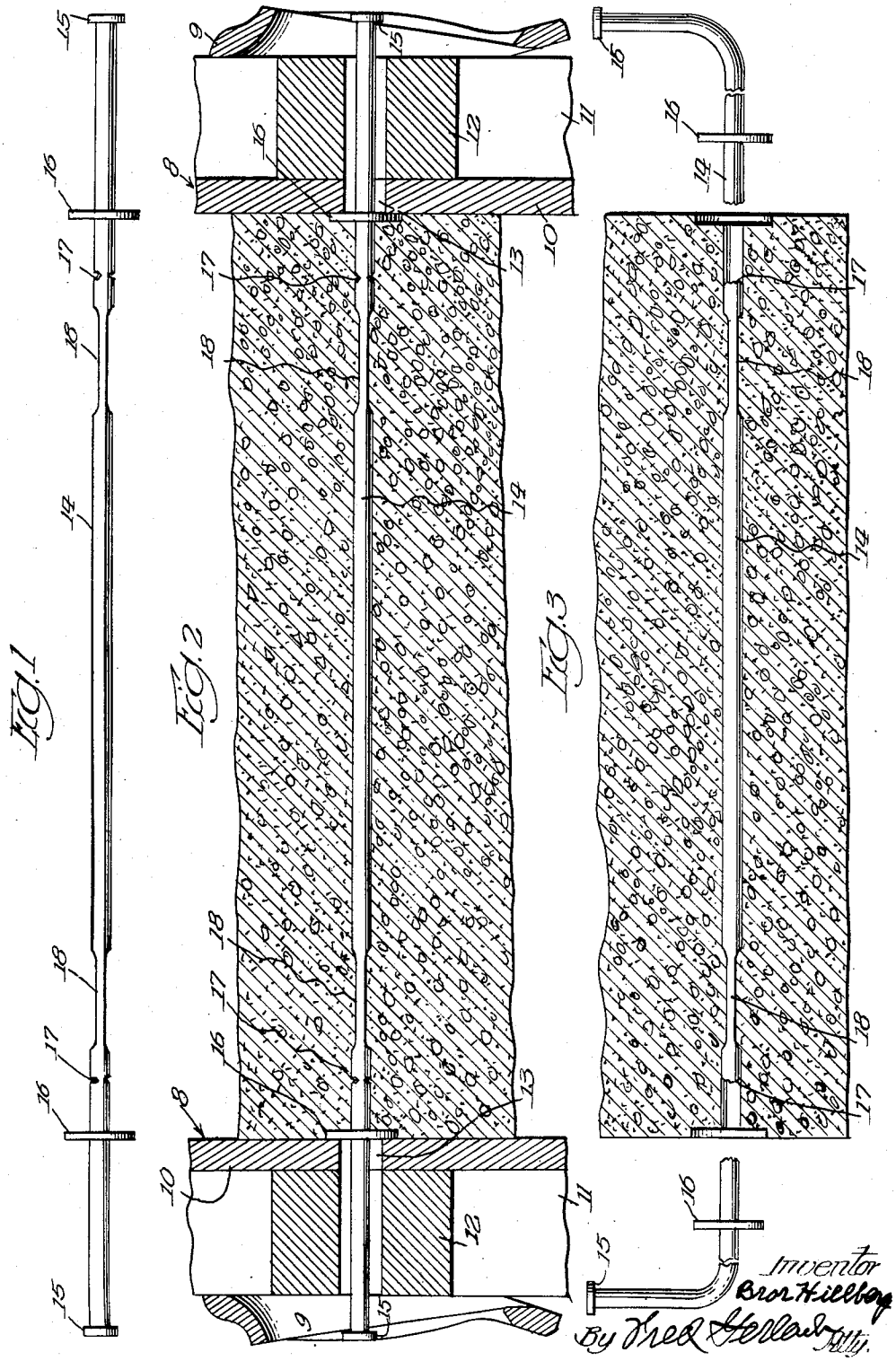
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METHOD OF MANUFACTURING TIE RODS FOR CONCRETE WALL FORMS

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Fig. 4

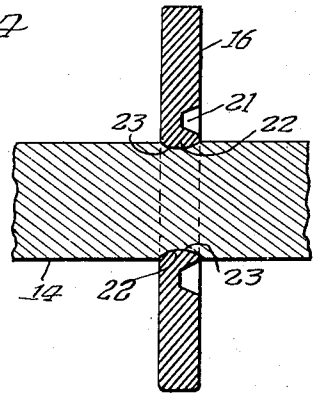


Fig. 7

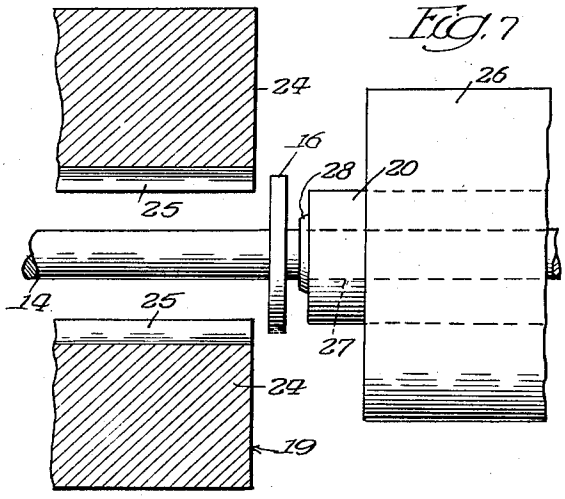


Fig. 5

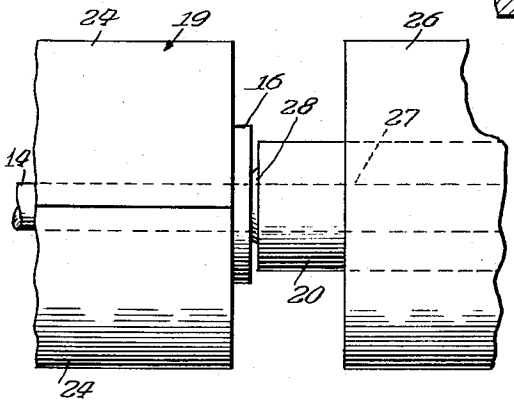
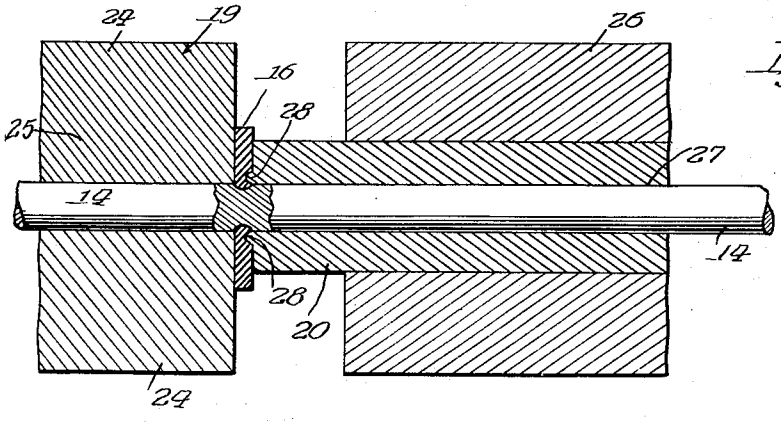


Fig. 6



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METHOD OF MANUFACTURING TIE RODS FOR CONCRETE WALL FORMS

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2 Claims. (Cl. 29—155)

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The present invention relates generally to the manufacture of tie rods for use in concrete construction. More particularly the invention relates to the manufacture of that type of tie rod which is designed for use with a pair of spaced apart, vertically extending wall forms having oppositely disposed holes therein and wedge variety attaching devices outwards of the holes, is adapted when in use to extend horizontally and have its ends project through the holes in the forms and attached to the attaching devices, has stop-forming washers directly inwards of its ends for engagement with the inner surfaces of the hole defining portions of the forms, embodies at predeterinmed distances inwards of the washers break-off points and inwards of the break-off points flats, serves while in its operative position and in connection with pouring of concrete between the forms to hold the forms against inward and outward displacement, and is adapted after hardening of the concrete, release of the attaching devices and removal or dismantlement of the forms, to have its projecting ends bent at substantially right angles and then turned or twisted in order to break or sever them from the central portion of the rod at the break-off points within the side faces of the concrete wall.

In connection with the manufacture of a tie rod of this type it has heretofore been proposed to utilize a rod formed of steel of a certain hardness and after formation of the break-off points and flats by suitable dies, to mount conical washers of harder steel on the rod at the proper locations outwards of the break-off points. After mounting or proper positioning of the washers the latter are flattened in any suitable manner in order to cause such contraction of the inner margins that the washers become interlocked with the rod. In practice it has been found that a tie rod that is made in accordance with the aforementioned technique or method of manufacture is subject to several objections. In the first place, flattening of the conical washers results in the corners of the inner margins of the washers so digging into the adjacent portions of the rod that they rupture or sever the steel fibers of the rod to such an extent that when the ends of the rod are bent and twisted they break off adjacent the washers instead of at the break-off points. In the event that the ends of the tie rod break off at the stop-forming washers instead of at the inwardly disposed break-off points the portions of the rod between the actual break-offs and the intended break-off points are either left in place or removed. If left in place such

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portions, because the outer extremities thereof are flush with the side faces of the concrete wall, are unsightly and in connection with rusting thereof discolor the concrete. If the portions are removed difficulty is encountered in connection with the removal operation and it is generally necessary to deface or chip away the concrete around the portions. Another objection to a tie rod, the washers of which are mounted in place as heretofore indicated, is that the washers grip the adjacent portions of the tie rod with such force or so tightly that when the projecting ends of the rod are bent at right angles and turned in connection with the break-off operation the washers turn with the rod ends and hence spall the concrete around the washers, thus necessitating a costly patching operation.

The principal object of this invention is to provide a manufacturing method for fabricating a tie rod which is an improvement upon, and eliminates the objections of, previously designed tie rods and is characterized by the fact that the stop-forming washers are flat when originally mounted on the rod and have the inner margins thereof so compressed by the action of suitable dies that they are inwardly extruded in such manner as to form in the adjacent portions of the rod shallow annular grooves which are of arcuate cross section and are so interlocked with the extruded portions of the inner margins of the washers that the washers are held against longitudinal or axial displacement with respect to the rod, while at the same time they permit the rods, in connection with turning of the projecting ends thereof, to rotate relatively thereto. By having the washers mounted on the rod in this manner there is no cutting or rupture of the fibers of the rod that are within the washers and hence in connection with bending and turning of the projecting ends of the rod the ends break off at the break-off points instead of at the washers. In addition, the projecting ends of the rod in connection with the break-off turn relatively to the washers and hence the washers do not effect spalling of the portions of the concrete in which they are embedded.

Another object of the invention is the provision of a tie rod manufacturing method which is essentially simple and may be carried out at low cost.

Other objects of the invention and the various advantages and characteristics of the present tie rod manufacturing method of fabrication will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a side view of a tie rod made in accordance with the improved method;

Figure 2 is a view, partly in side elevation and partly in vertical section, showing the tie rod in operative or connected relation with a pair of spaced apart, vertically extending wall forms having oppositely disposed holes therein for receiving the ends of the tie rod and wedge variety attaching devices outwards of the holes for connection to the outer projecting extremities of the tie rod;

Figure 3 is a view partly in side elevation and partly in section showing the tie rod of Figure 2 after removal of the wall forms after hardening or solidification of the concrete and illustrating the manner in which the projecting ends of the rod are bent at right angles and then turned to effect break-off at the break-off points that are inwards of the stop-forming washers;

Figure 4 is an enlarged fragmentary longitudinal section illustrating in detail the construction and design of the stop-forming washers on the rod and showing the manner in which they are mounted on the rod and so interlocked therewith that they are held against longitudinal or axial displacement with respect to the rod while at the same time permitting the ends of the rods to turn relatively thereto in connection with a break-off operation;

Figure 5 is a plan view showing the coacting washer compressing dies before they are actuated to extrude the inner margin of one of the washers so as to cause it to form in the adjacent portion of the rod a shallow annular groove of arcuate cross section;

Figure 6 is a horizontal section showing the coacting dies after they have been actuated so as to extrude by compression the inner margin of the stop-forming washer therebetween; and

Figure 7 is a plan view showing the dies in retracted open position after a washer compressing operation.

The tie rod which is shown in the drawings is made in accordance with the improved method. It is designed and adapted for use in connection with a pair of spaced apart, vertically extending wall forms 8 and serves, in conjunction with a pair of wedge variety attaching devices 9, as hereinafter described more in detail, to hold the forms against inward and outward displacement during pouring of concrete between the forms for purposes of forming a vertical wall. The forms 8 are of standard or conventional construction and each, as shown in Figure 2, consists of a rectangular panel 10 and a rectangular reenforcing frame 11 on the outer side of the panel. The frame 11 of the forms 8 have pairs of horizontal, spaced apart intermediate crosspieces 12 and these are adapted to be positioned in horizontal alignment when the forms are in their operative or concrete wall forming position. The holes 13 are formed in the panels 10 between the central portions of the crosspieces 12. When the tie rod is in its operative position with respect to the forms 8 its ends project through the holes 13 and between and beyond the frame crosspieces 12 as shown in Figure 2 of the drawings. As well understood in the art, the forms 8 are arranged in an opposed laterally spaced, upstanding position preparatory to pouring of concrete therebetween. In connection with positioning of the forms the ends of the tie rod are inserted through the holes 13 in the panels 10 of the forms. After insertion of the ends of the tie rod through the holes the wedge variety attaching devices 9 are applied so as operatively to connect the tie rod to forms. As soon as the devices 9 are connected to the extremities of the tie rod the tie rod serves to hold the forms 8 in proper position. Formation of a concrete wall is accomplished by pouring concrete between the two forms. After hardening or solidification of the concrete the attaching devices 9 are withdrawn from the extremities of the tie rod and the forms are removed from the concrete wall by shifting them outwards. After removal or dismantlement of the forms the projecting ends of the tie rod are bent at right angles and turned in order to break or sever them from the central portion of the rod at points inwards of the side faces of the concrete wall.

The tie rod is formed of comparatively hard steel to the end that it possesses the desired tensile strength. It is designated in the drawing by the reference numeral 14 and for the most part is circular in cross section. Preferably the tie rod is formed of ¼ inch steel stock, the carbon content of which is approximately $\frac{4}{10}$ of 1%. As shown in Figure 1 of the drawings the tie rod is provided with heads 15, stop-forming washers 16 inwards of the heads, break-off points 17 inwards of the washers, and flats 18 inwards of the break-off points. The heads 15 are formed at the extremities of the tie rod 14 and when the tie rod is in its operative position are located small distances outwards of the crosspieces 12 of the form frames 11. They are slightly smaller than the holes 13 in the panels 10 and, in connection with use of the tie rod, are adapted to abut against the outer surfaces of the attaching devices 9, as shown in Figure 2. The attaching devices 9 are downwardly tapered and have longitudinal slots therein. They are adapted after application to the outer ends of the rods to be driven downwards between the heads 15 and the frame crosspieces 12 and serve to clamp the forms against the stop-forming washers 16. The latter, as described hereafter, are mounted on the rod 14 against longitudinal or axial displacement relatively thereto and serve when the tie rod is in its operative position to prevent inward movement of the forms 8. The break-off points 17 are located but comparatively small distances inwards of the stop-forming washers 16 and are in the form of opposed pairs of notches. When the projecting ends of the tie rod are bent at right angles and then turned or twisted after removal of the forms 8 from the concrete wall they break off at the break-off points 17. The flats 18 are formed on the central portion of the tie rod 14, i. e., the portion of the rod that is embedded in the concrete, and serve to prevent rotation of the central portion of the tie rod in the concrete when the ends of the rod are turned or twisted for break-off purposes. It is contemplated that the break-off points and flats will be formed before the stop-forming washers 16 are mounted on the rod as described hereafter.

The washers 16 are formed of harder steel than the tie rod proper. Preferably they are formed of steel stock of 14 gauge and with a carbon content of approximately $\frac{6}{10}$ of 1%. The washers before mounting on the rod are flat and have an

internal diameter slightly greater than the diameter of the rod. They are secured to, or interlocked with, the rod by compressing the inner margins thereof in such manner between a pair of coacting dies 19 and 20 that they embody annular grooves 21 in their outer faces and annular extruded portions 22 inwards of the grooves. Due to the manner in which the inner margins of the washers are compressed between the dies 19 and 20 of the extruded portions 22 are segmental in cross section. In connection with the compressing operation the extruded portions 22 compress the adjacent portions of the tie rod proper so as to form therein annular grooves 23 which are of arcuate cross section and coact with the extruded portions 22 to hold the washers 16 against longitudinal or axial displacement with respect to the rod. Due to the cross sectional shape of the extruded portions 22 and the manner in which such portions are formed the steel fibers of the portions of the rod that are within the washers are not cut or ruptured and hence adjacent the washers the rod is not so weakened that in connection with turning of the projecting ends of the rod it will break off at the washers instead of the break-off points 17. The grip between the extruded portions 22 of the washers and the adjacent groove portions of the rod is such that the washers and rod are normally not relatively rotatable but when the ends of the rod are turned for break-off purposes the rod's ends will turn relatively to the washers and hence not cause the washers to rotate and cause or effect spalling of the portions of the concrete wall in which they are embedded. The annular grooves 21 which are formed in connection with compressing of the inner margins of the washers 16 are inwardly tapered and extend approximately half way through the washers. As best shown in Figure 4 of the drawings the grooves 21 are trapezoidal in cross section.

The dies 19 and 20 which are utilized to compress the inner margins of the washers 16 into interlocked relation with the adjacent portions of the rod are disposed one opposite the other as well as in spaced apart relation, as shown in Figures 5, 6 and 7. The die 19 is a split die and consists of a pair of complemental, oppositely disposed sections 24. The latter are movable to and from one another and have in the opposed faces thereof full length grooves 25 which are semicircular in cross section and when the sections 24 are in abutment with one another define a cylindrical hole through which the tie rod is adapted to extend. The faces of the sections 24 of the split die 19 that are opposite the die 20 are flat and coplaner. The die 20 is mounted in a tubular guide 26 to slide to and from the split die 19. It has a centrally disposed, open ended rod-receiving hole 27 in coaxial relation with the grooves 25 in the opposed faces of the sections 24 of the die 19 and embodies on the end face thereof that is adjacent the die 19 an annular rib 28. This rib is disposed directly outwards of the adjacent end of the hole 27 and is outwardly tapered so that it is trapezoidal in cross section. The portion of the outer end face of the die 20 that is outwards of the rib 28 is flat, as shown in Figure 6.

In connection with mounting of one of the washers on the tie rod proper the washer in truly flat form is mounted between the two dies 19 and 20 in such manner that its hole is in centered relation with the hole in the die 19 and the hole 27 in the die 20, it being understood that insertion of the washer into place or position occurs while the sections 24 of the die 19 are in abutment, as shown in Figure 5. After proper positioning of the washer one end of the tie rod 14 is inserted through the hole in the die 19, the hole in the washer and the hole 27 in the die 20. As soon as one end of the rod is inserted to the proper extent the movable die 20 is slid towards the die 19 until the annular rib 28 on the outer end thereof becomes fully embedded in the inner margin of the washer. In connection with embedment of the rib the inner margin of the washer is deformed by compression so that it embodies the annular inwardly tapered groove 21 and the inwardly extending extruded portion 22. Such portion, in connection with formation thereof, is forced into the adjacent portion of the rod and forms the shallow annular groove 23, which, as heretofore pointed out, coacts with the extruded portion to hold the washer against axial displacement with respect to the rod. After deformation of the inner margin of the washer the movable die 20 is retracted and the sections 24 of the die 19 are spread apart or separated. Thereafter the rod with the washer mounted on one end thereof is removed from the two dies 19 and 20. The other washer is mounted on the other end of the tie rod in precisely the same manner. After mounting of the two washers on the rod the heads 15 are formed on the extremities of the rod.

The tie rod, due to its particular method of manufacture, is characterized by the fact that the ends of the rod, in connection with a break-off operation, will break off at the break-off points 17 instead of within the washers. It is further characterized by the fact that although the washers are fixedly held against longitudinal or axial displacement with respect to the rod the ends of the rod during twisting for break-off purposes are permitted to turn relatively to the washers and hence there is no likelihood of the washers spalling the portions of the concrete in which they are embedded. Due to the manner in which the washers are mounted on the rod the tie rod as a whole may be manufactured or fabricated at an extremely low cost and effectively and efficiently fulfills its intended purpose.

Whereas the present method has been described in connection with the manufacture of a washer equipped tie rod for wall forms it is to be understood that it may be employed in the fabrication of any rod and washer assembly. It is also to be understood that the method is not to be restricted to the precise details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

This application is a division of application Serial No. 79,141, filed by me on March 2, 1949.

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

1. That improvement in the manufacture of a tie rod of the type that is adapted to hold in spaced apart relation a pair of concrete forms and has a break-off point inwards of one end thereof and a form-engaging washer a small distance outwards of the break-off point, which comprises mounting at the proper location on a cylindrical steel rod of certain hardness a flat washer of harder steel and with a circular inner periphery of minutely greater diameter than the rod, and then die-forming in the washer at an

extremely small distance outwards of its inner periphery such a concentric inwardly tapered truly continuous annular groove that the portion of the washer directly inwards of the groove is extruded inwards and is caused to be of shallow segmental cross section and to form in the contiguous portion of the rod without rupture of the fibers thereof a shallow correspondingly shaped truly continuous annular groove whereby the washer is so interlocked with the rod that it is positively held against displacement lengthwise of the rod while at the same time it grips the rod tightly but permits the rod to turn reltively to it in response to application of a comparatively heavy turning force to the rod while the washer is held against rotation.

2. That improvement in the manufacture of a rod and washer assembly, which comprises mounting on a cylindrical metallic rod of certain hardness a flat washer formed of harder metal and having its inner periphery circular and of minutely greater diameter than the rod, and then die-forming in the washer at an extremely small distance outwards of its inner periphery such a concentric inwardly tapered truly continuous annular groove that the portion of the washer directly inwards of the groove is extruded inwards and is caused to be of shallow segmental cross section and to form in the contiguous portion of the rod without rupture of the fibers thereof a shallow correspondingly shaped truly continuous annular groove whereby the washer is so interlocked with the rod that is positively held against displacement lengthwise of the rod while at the same time it grips said contiguous portion of the rod tightly but permits the rod to turn relatively to it in response to application of a comparatively heavy turning force to the rod while the washer is held against rotation.

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