

Oct. 22, 1968

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3,406,443

METHOD OF PROVIDING AN ENLARGED END ON A MEMBER

Filed Aug. 28, 1963

6 Sheets-Sheet 1

FIG-1

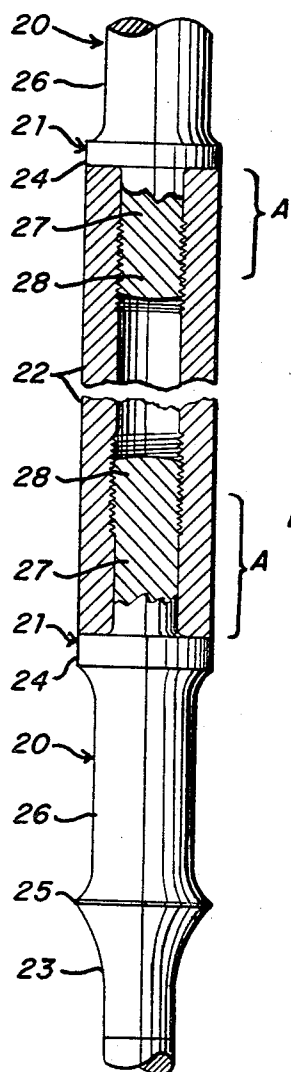


FIG-2

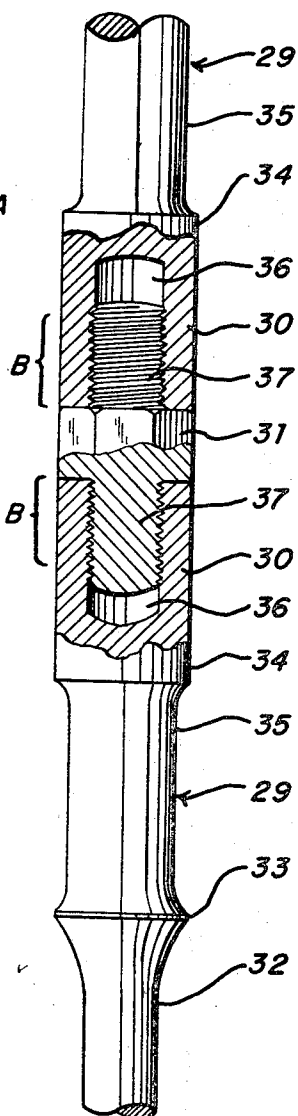
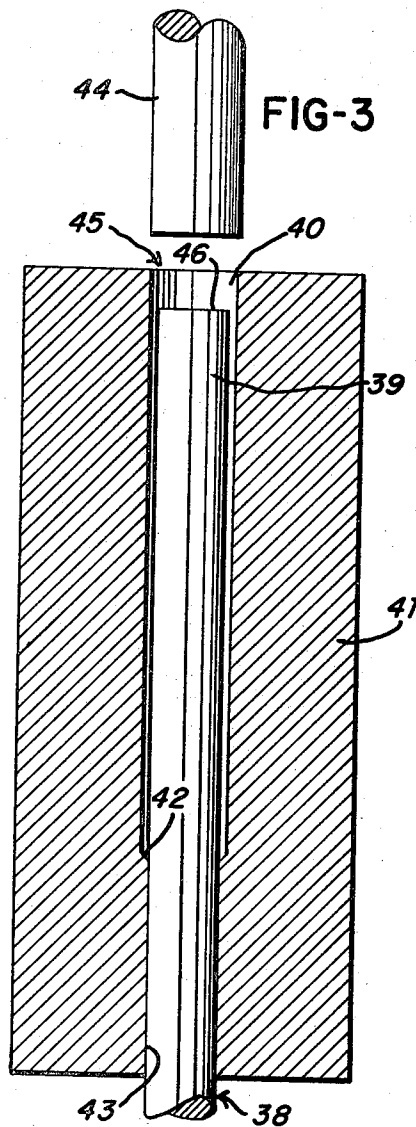


FIG-3



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FIG-4

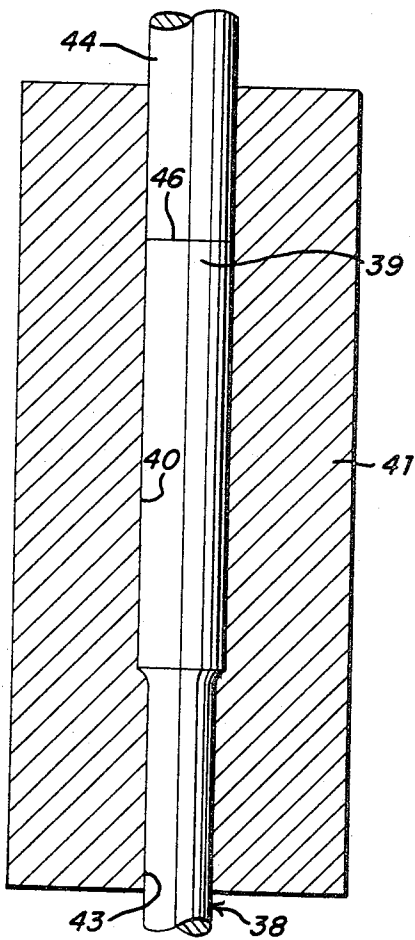
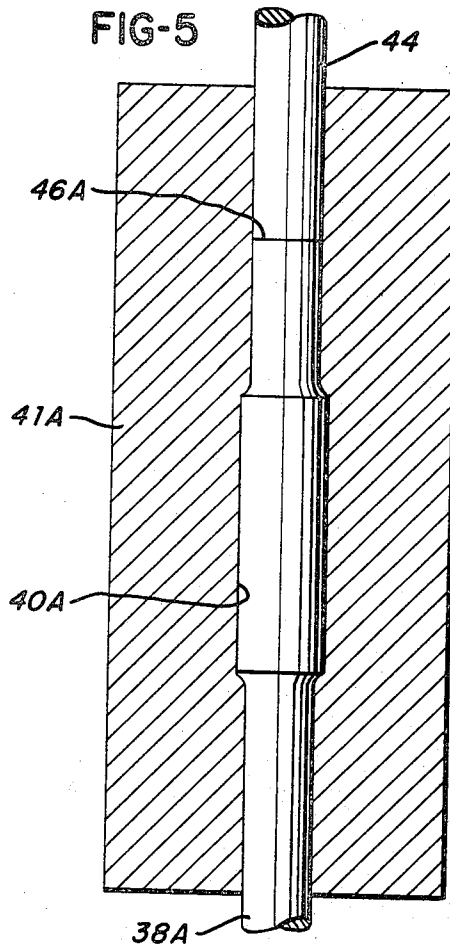


FIG-5



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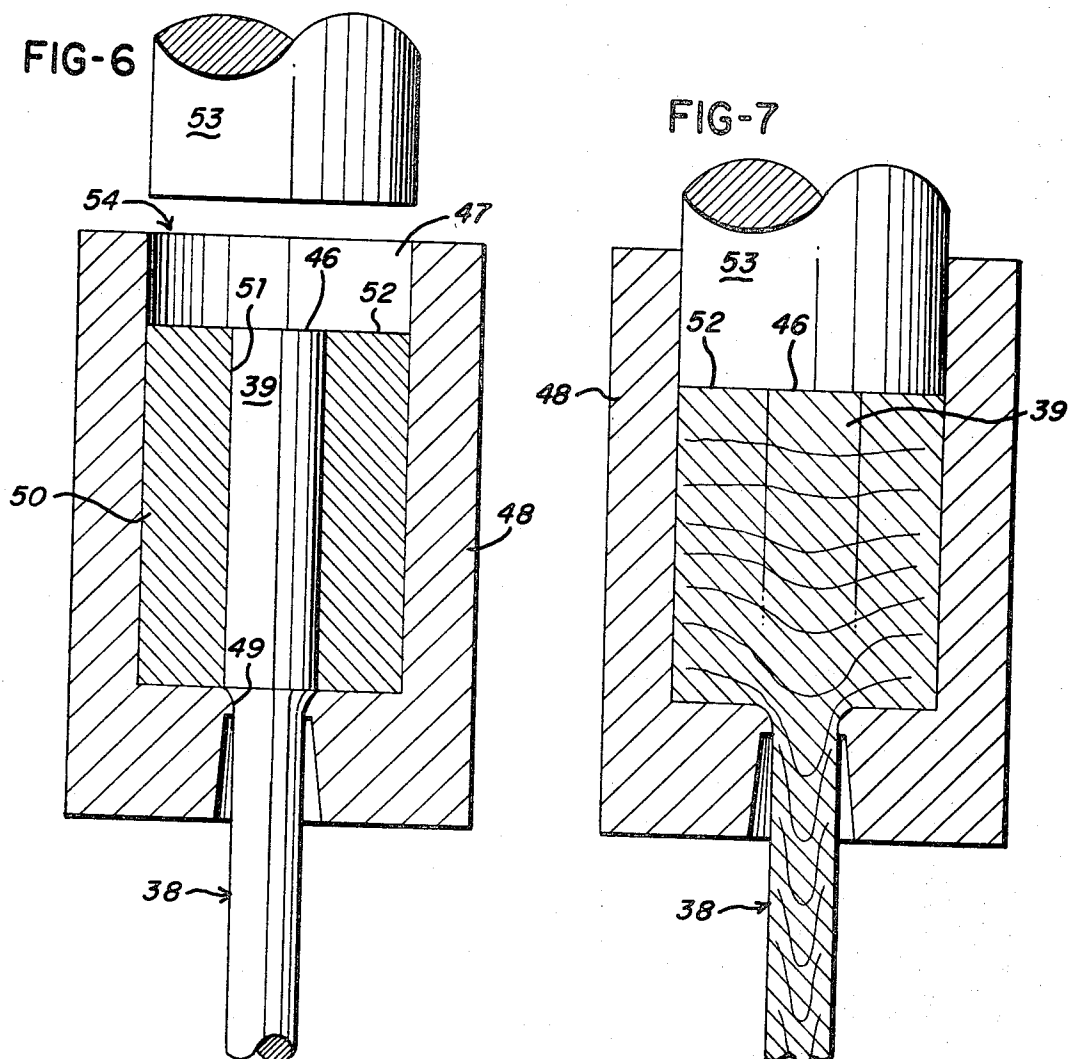
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METHOD OF PROVIDING AN ENLARGED END ON A MEMBER

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METHOD OF PROVIDING AN ENLARGED END ON A MEMBER

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FIG-8

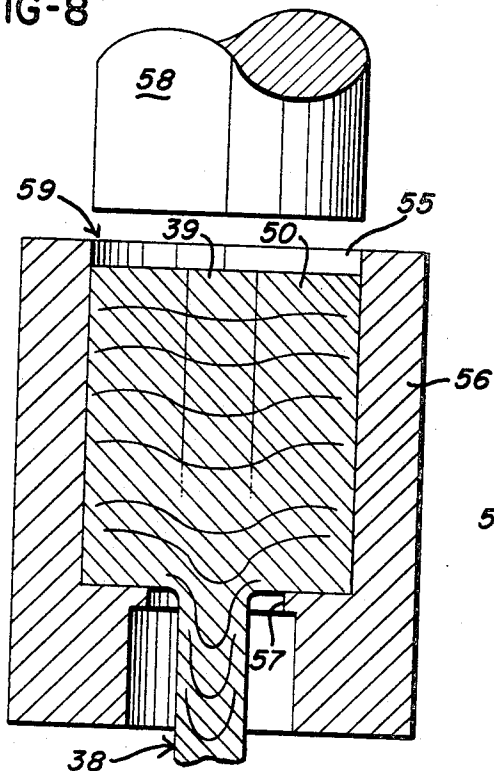


FIG-9

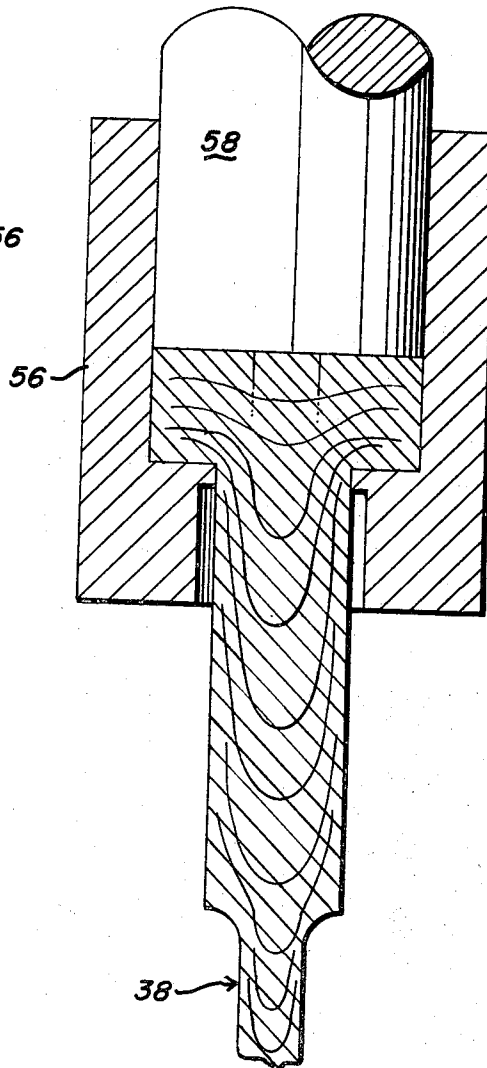
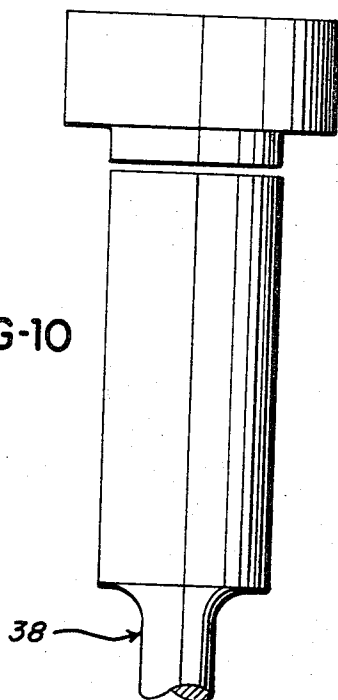


FIG-10



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FIG-16

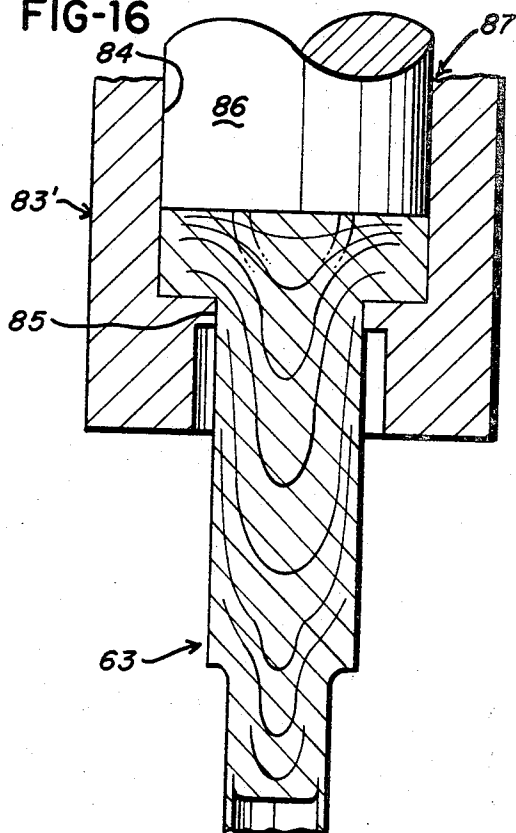
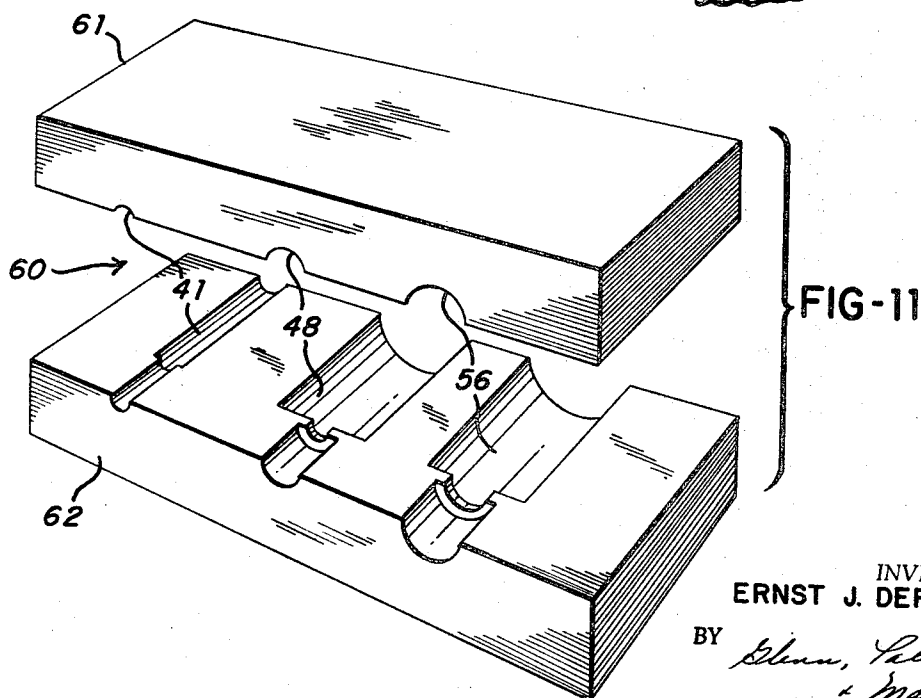
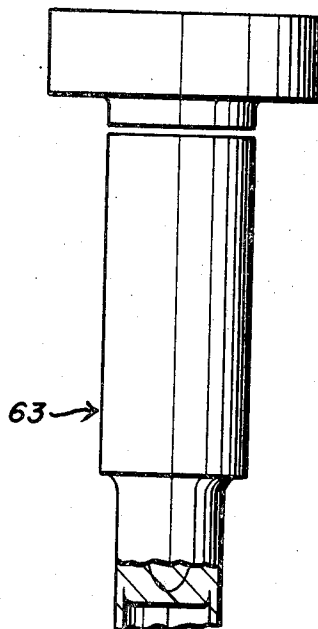


FIG-17



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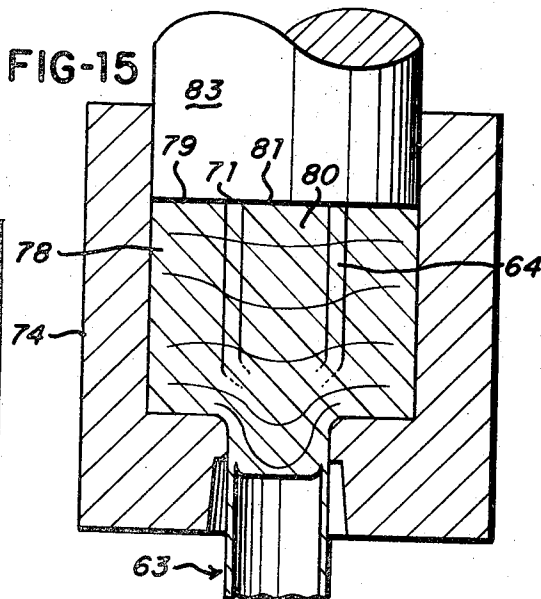
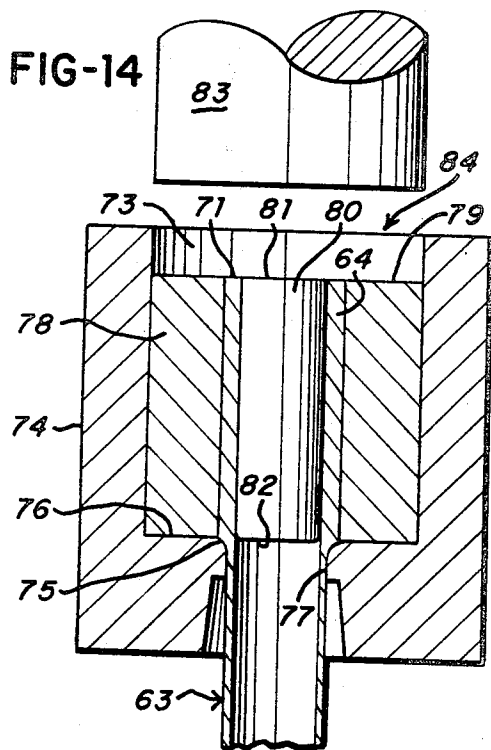
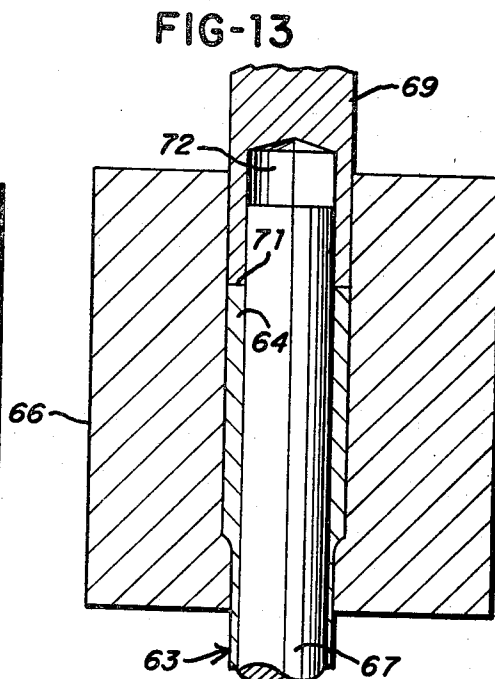
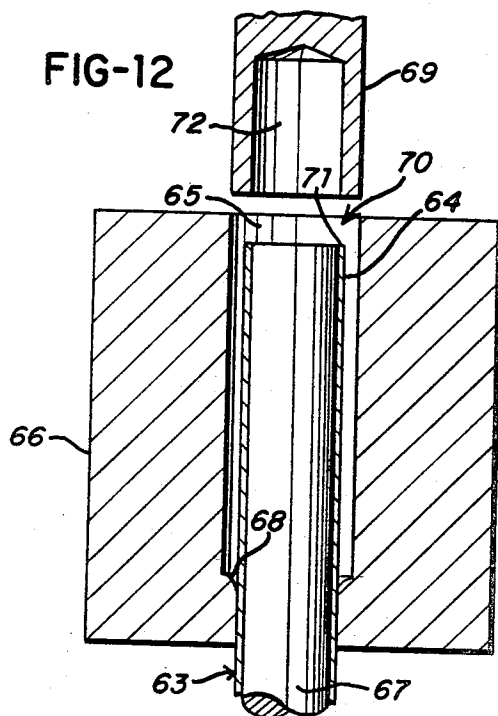
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METHOD OF PROVIDING AN ENLARGED END ON A MEMBER

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6 Sheets-Sheet 6



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3,406,443 METHOD OF PROVIDING AN ENLARGED END ON A MEMBER

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Filed Aug. 28, 1963, Ser. No. 305,059
4 Claims. (Cl. 29—472.3)

This invention relates to an improved rod or tubular member having an enlarged end integrally formed thereon. This invention also relates to an improved method and apparatus for making such a rod or tubular member.

It is well known that when sucker rods are to be utilized in drilled wells or the like, each sucker rod has opposed enlarged ends permitting those enlarged ends to be readily coupled to adjacent large ends on adjacent sucker rods by suitable coupling devices.

It is also well known that when the sucker rods are formed of steel or the like, the enlarged ends can be formed thereon by upsetting the ends of the rods in substantially six upsetting operations.

However, when following the methods normally utilized to provide enlarged ends on steel sucker rods and applying the same to aluminum sucker rods, the resulting structure has been unsuccessful because the incorrect flow of the aluminum material during the upset process cuts down the fatigue properties considerably in an area where they are most needed.

Further, using a rolled on thread and screwing on the coupling device with an additional area for adhesive bonding does not lead to a strong sucker joint when utilizing an aluminum sucker rod.

Thus, up to now it has not been possible to design a fatigue-proof coupling device which connects aluminum sucker rods at both ends with adjacent aluminum sucker rods.

However, according to the teachings of this invention, an improved sucker rod or the like is provided which can be formed of aluminum-containing metallic material and will be substantially fatigue-proof for the desired purposes thereof.

Accordingly, it is an object of this invention to provide an improved rod or tubular member having an enlarged end provided thereon, the rod or tubular member having one or more of the novel features hereinafter described or illustrated.

Another object of this invention is to provide an improved method for making such a tubular member or rod.

A further object of this invention is to provide an improved apparatus for making such a tubular member or rod.

Other objects, uses and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIGURE 1 is a fragmentary, partial cross-sectional view illustrating two sucker rods of this invention interconnected together by a coupling device.

FIGURE 2 is a view similar to FIGURE 1 and illustrates another embodiment of this invention.

FIGURE 3 is an axial cross-sectional view illustrating one of the steps in the method of this invention for upsetting the end of a rod or the like.

FIGURE 4 is a view similar to FIGURE 3 and illustrates the rod having the end thereof upset according to the teachings of this invention.

FIGURE 5 is a view similar to FIGURE 4 and illustrates another embodiment of this invention.

FIGURE 6 is an axial cross-sectional view illustrating

another step in the method of this invention for pressure welding a hollow billet to the upset end of the rod or the like.

FIGURE 7 is a view similar to FIGURE 6 and illustrates the hollow billet pressure welded to the rod.

FIGURE 8 is an axial cross-sectional view illustrating another step in this invention for extruding the enlarged end of the rod.

FIGURE 9 is a view similar to FIGURE 8 and illustrates the enlarged end of the rod after the same has been extruded.

FIGURE 10 is a fragmentary view illustrating the step of cutting off the unextruded portion of the improved rod of this invention.

FIGURE 11 is a perspective view illustrating one embodiment of the apparatus of this invention.

FIGURE 12 is an axial cross-sectional view illustrating one of the steps in forming an upset end on a hollow tubular member.

FIGURE 13 is a view similar to FIGURE 12 and illustrates the upset end of the hollow tubular member of FIGURE 12.

FIGURE 14 is an axial cross-sectional view illustrating the upset tubular member being assembled together with billets utilized to form an enlarged end thereon.

FIGURE 15 is a view similar to FIGURE 14 and illustrates the billets pressure welded to the end of the hollow tubular member.

FIGURE 16 is an axial cross-sectional view illustrating the extrusion step of the pressure welded tubular member illustrated in FIGURE 15.

FIGURE 17 is a fragmentary view illustrating the step of cutting off the unextruded portion of the tubular member illustrated in FIGURE 16.

While the various features of this invention are hereinafter described and illustrated as being particularly adaptable for forming a sucker rod or the like, it is to be understood that the various features of this invention can be utilized singly or in any combination thereof to provide rods or tubular members for other purposes as desired.

Therefore, this invention is not to be limited to only the embodiments illustrated in the drawings, because the drawings are merely utilized to illustrate one of the wide variety of uses of this invention.

Referring now to FIGURE 1, a pair of improved sucker rods of this invention are generally indicated by the reference numeral 20 and respectively have adjacent enlarged ends 21 thereof interconnected in aligned relation by a coupling sleeve 22 in a manner hereinafter described.

As illustrated in FIGURE 1, it can be seen that each sucker rod 20 has a substantially uniform cylindrical portion 23 throughout the major length thereof and integrally interconnected to the enlarged ends 21 at the opposed ends thereof, the enlarged ends 21 being suitably machined to define lands 24 and 25 separated from each other by an intermediate land 26 having a diameter greater than the major portion 23 of the rod 20.

A central portion 27 extends from the land 24 of each rod 20 and is provided with a threaded end 28 to be threadedly received in the coupling sleeve 22 in the manner illustrated in FIGURE 1, whereby it can be seen that sleeve 22 is adapted to couple together adjacent ends 21 of adjacent rods 20.

Therefore, it can be seen that the enlarged ends 21 of the sucker rods 20 of this invention readily permit torques to be applied thereto to permit the ends 21 to be coupled together by the sleeve 22 to form an effective sucker rod string for a drilled well or the like, whereby the major intermediate portions 23 of each rod 20 can have a reduced diameter so that the overall cost of each sucker rod 20 is substantially small when compared with a

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sucker rod having a uniform diameter throughout its length to provide sufficient material at the opposed ends thereof for the coupling operation.

Referring now to FIGURE 2, another pair of sucker rods of this invention are indicated by the reference numerals 29 and have adjacent enlarged ends 30 thereof coupled together by a coupling member 31 in a manner hereinafter described.

As illustrated in FIGURE 2, each sucker rod 29 of this invention has the major portion 32 thereof of a reduced diameter relative to the ends 30 thereof whereby the ends 30 can have the necessary torques applied thereto to couple the sucker rods 29 together in the manner previously described, each end 30 of the sucker rod 29 having a pair of opposed lands 33 and 34 separated from each other by an intermediate land 35 having a diameter greater than the major portion 32 of the rod 29.

The land 34 of each sucker rod 29 is provided with an internal bore 36 suitably threaded to receive a threaded projection 37 of the coupling member 31 in the manner illustrated in FIGURE 2, whereby the threaded projections 37 of the coupler 31 are adapted to interconnect the ends 30 of the aligned sucker rods 29 to provide a suitable sucker rod string for a drilled well or the like.

Returning now to FIGURE 1, since the coupler sleeve 22 has to be screwed on the projections 28 of the sucker rods 20 in a relatively tight fashion, a tension force is introduced into each rod end portion 28 in the area indicated by the reference letter "A." An additional tension force is caused by the pumping action on the sucker rod string and this has to be added to the tension force A, whereby it can be seen that an extremely large tension force is provided on the end portions 28 of the sucker rods 20.

However, since the parts of the coupling illustrated in FIGURE 1 are screwed together, the tension in each end portion 34 of each sucker rod 29 is indicated by the reference letter "B" in FIGURE 2. However, this tension force B will have a compression force subtracted therefrom, whereby the tension in the end portions 34 of the sucker rods 29 of this invention will be less than the tension in the end portions 28 of the sucker rods 20.

Thus, by forming the coupling member 31, in FIGURE 2, of aluminized steel, the steel coupler 31 will have higher fatigue properties than the aluminum sucker rods 29 and will have a tension plus tension force thereon.

Therefore, it can be seen that improved sucker rods 20 and 29 are provided by this invention and the same can be formed of aluminum containing metallic material when made by the methods and apparatus of this invention hereinafter set forth so that the sucker rods 20 and 29 will be substantially fatigue-proof at the enlarged ends 21 and 30 thereof in a manner heretofore unattainable for aluminum sucker rods.

The method and apparatus for forming the sucker rods 20 and 29 or the like will now be described and reference is made to FIGURE 3.

As illustrated in FIGURE 3, a cylindrical rod 38 is provided and is substantially uniform throughout its length.

However, it is desired to form an enlarged end on the end 39 of the rod 38 in order to permit the same to form the sucker rod 20 or 29 or the like.

Therefore, the end 39 of the rod is disposed in an enlarged chamber 40 formed in a split upsetting female die means 41 so that the desired length of the end 39 will extend beyond the bottom wall 42 of the cavity 40 while the remainder of the rod 38 passes through a closely fitting bore 43 in the manner illustrated in FIGURE 3.

For example, should the rod 38 have a diameter of approximately 1", the internal diameter of the cavity 40 is approximately 1 1/4" and the length of the end 39 of the rod projecting into the cavity 40 is approximately 8".

After the end 39 of the rod 38 has been disposed in the cavity 40 of the die means 41 and the rod 38 has been

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suitably heated before insertion in the die means 41 or thereafter, a suitable ram 44 is forced into the opened end 45 of the die means 41 in the manner illustrated in FIGURE 4 to upset the end 39 of the rod 38 to fill the cavity 40 in the manner illustrated in FIGURE 4, it being understood that the rod 38 is held from movement during the impacting by the ram 44 whereby the end 39 of the rod 38 has an overall length of approximately 5" when the same is upset in the manner illustrated in FIGURE 4.

While the die means 41 has been heretofore illustrated as upsetting the end 39 of the rod 38 from the upper edge 46 thereof toward the other opposed edge thereof in the manner illustrated in FIGURE 4, it is to be understood that the die means 41 can be so constructed and arranged that the same upsets the end 39 at a point spaced from the upper edge 46 thereof.

For example, reference is made to FIGURE 5 wherein die means 41A are provided and has the cavity 40A thereof so constructed and arranged that when the ram 44 engages against the end edge 46A of the rod 38A to impact the same, the rod 38A only expands in the region of the cavity 40A in the manner illustrated in FIGURE 5 to provide an upset end on the rod 38A which is disposed inwardly from the upper edge 46A thereof.

After the end 39 of the rod 38 has been upset in the manner illustrated in FIGURE 4 or in the manner illustrated in FIGURE 5, the rod 38 has the upset end 39 thereof disposed in an enlarged cavity 47 of a split pressure welding die means 48 in the manner illustrated in FIGURE 6, whereby the unupset portion of the rod 38 fits in a complementary bore 49 formed in the die means 48 in the manner illustrated in FIGURE 6 with the rod 38 being held in any suitable manner from movement relative to the die means 48.

Thereafter, a hollow billet 50 is disposed in the cavity 47 of the die means 48 and telescopically receives the upset end 39 of the rod 38 in a bore 51 passing completely therethrough.

For example, the billet 50 can comprise aluminum containing metallic material or the like suitably extruded in tubular form and cut to the desired length so that the upper edge 52 thereof is disposed substantially coplanar with the upper edge 46 of the rod 38 in the manner illustrated in FIGURE 6.

While the billet 50 can have any suitable dimensions, the embodiment thereof illustrated in the drawings has an outside diameter of approximately 4" and is snugly received in the cavity 47 of the die means 48.

Thereafter, a suitable ram 53 is forced down into the open end 54 of the cavity 47 of the die means 48 to impact against the ends 46 and 52 of the rod 38 and billet 50 to cause the same to pressure weld together at least at the inner portion of the upset end 39 of the rod 38 in the manner illustrated in FIGURE 5, the rod end 39 and billet 50 being previously heated to effect the pressure welding operation.

In this manner, it can be seen that when the billet 50 is pressure welded to the upset end 39 of the rod 38 in the manner illustrated in FIGURE 5 an enlarged end is provided on the rod 38 to be finished in a manner now to be described.

After the billet 50 has been pressure welded to the rod end 39 in the manner illustrated in FIGURE 7, the assembly is placed in a cavity 55 of a split extruding die means 56 having an extruding die surface 57 coaxially aligned with the cavity 55 in the manner illustrated in FIGURE 6.

Thereafter, a suitable ram 58 is forced into the open end 59 of the die means 56 in the manner illustrated in FIGURE 9 to cause the enlarged head formed by the billet 50 and upset end 39 of the rod 38 to extrude through the die means 57 in the manner illustrated in FIGURE 9 to reduce and elongate the enlarged end of

the rod 38 to the desired dimensions, the enlarged head having been previously heated to effect the extruding operation.

It can be seen that as the billet 50 and upset end 39 of the rod 38 pass through the die means 57, the same forms a substantially homogeneous structure in the manner illustrated in FIGURE 9, whereby the resulting enlarged end on the rod 38 is substantially integral therewith.

Subsequently, the extruded rod 38 is removed from the die means 56 in the manner illustrated in FIGURE 10 and the upper portion thereof is cut off in the manner illustrated in FIGURE 10 to remove the un-pressure welded portion of the billet 50 and enlarge end 39 of the rod 38 to produce the homogeneous structure illustrated in FIGURE 10.

Thereafter, the final product illustrated in FIGURE 10 can be suitably machined to produce the sucker rod 20 illustrated in FIGURE 1, or the sucker rod 29 illustrated in FIGURE 2 or in any other suitable configuration as desired.

While the aforementioned method and apparatus for producing the enlarged end on the rod of material 38 has been described in connection with aluminum containing material, such as aluminum alloy 6061, it is to be understood that other aluminum alloys can be utilized as well as other metallic materials as desired.

Therefore, it can be seen that the method and apparatus of this invention is readily adaptable to produce an enlarged end on a suitable solid rod or the like without requiring multiple upsetting steps as in the prior art and without producing an enlarged end that is not fatigue-proof.

While the apparatus previously described has been illustrated as having the upsetting die means 41, pressure welding die means 48 and extruding die means 56 as separate units, it is to be understood that the same could be formed in a single unit, if desired, whereby only one heating step is required for the entire die unit.

For example, reference is made to FIGURE 11, wherein a die apparatus of this invention is generally indicated by the reference numeral 60 and comprises a pair of cooperating die members 61 and 62 adapted to cooperate together to define the upsetting die means 41, the pressure welding die means 48 and the extruding die means 56, whereby each step on a particular rod 38 can be formed in the single apparatus 60 by merely moving the same after each step to the next adjacent die section thereof in the manner previously described.

While the means for providing an enlarged head on a rod or the like has been previously described in connection with a solid rod, it is to be understood that the enlarged end can be provided on a hollow tubular member if desired.

For example, reference is made to FIGURE 12, wherein a hollow tubular member 63 is provided and is substantially uniform throughout the length thereof, the tubular member 63 having the end 64 thereof disposed in an enlarged chamber 65 of a split upsetting die means 66.

Thereafter, a steel mandrel 67 or the like is inserted into the tubular member 63 in the manner illustrated in FIGURE 12 and extends beyond the end wall 68 of the chamber 65.

With the tubular member 63 being held in the position illustrated in FIGURE 12 to prevent movement thereof relative to the die means 66, a suitable ram 69 is forced downwardly into the open end 70 of the cavity 65 and engages the annular edge 71 of the end 64 of the tubular member 63 to upset the end 64 in the manner illustrated in FIGURE 13 so that the end 64 fills the cavity 65, the ram 69 having a suitable bore 72 formed therein to receive the mandrel 67 in the manner illustrated in FIGURE 13.

Thereafter, the mandrel 67 is removed from the tubular

member 63 and the tubular member 63 is removed from the die means 66 to be placed in an enlarged chamber 73 of a pressure welding split die means 74, the end 75 of the upset portion of the end 64 of the tubular member 63 cooperating with an end 76 of the cavity 73 while the remainder of the tubular member 63 is snugly received in a bore means 77 of the die means 74.

Thereafter, a hollow billet 78 is disposed around the upset end 64 of the tubular member 63 and has its upper surface 79 disposed coplanar with the upper edge 71 of the tubular member 63.

A solid mandrel billet 80 is snugly disposed in the upset end 64 of the tubular member 63 in the manner illustrated in FIGURE 14 so that the upper edge 81 thereof is disposed coplanar with the upper edges 71 and 79 of the tubular member 63 and hollow billet 78, the lower end 82 of the mandrel billet 80 extending slightly below the end 75 of the upset portion 64 of the tubular member 63.

Thereafter, a suitable ram 83 is forced into the open end 84 of the cavity 73 to impact against the end edges 79, 71 and 81 of the billet 78, tubular member 63 and billet 80 to cause pressure welding together of the billets 78 and 80 to at least the inner portion of the upset end 64 of the tubular member 63 in the manner illustrated in FIGURE 15.

In this manner, an enlarged solid end is provided on the tubular member 63, the enlarged end adapted to be reduced and elongated by an extruding die means 83' in the manner illustrated in FIGURE 16.

In particular, the enlarged end of the tubular member 63 is placed in a cavity 84 of the split die means 83', with the remainder of the tubular member 63 projecting through an extruding die portion 85 of the die means 83'.

Thereafter, a suitable ram 86 is forced downwardly through the open end 87 of the cavity 84 of the die means 83' to extrude the enlarged end of the tubular member 63 through the die portion 85 to reduce the enlarged end to the desired dimensions and elongating the same to the desired dimensions.

Subsequently, the extruded end of the tubular member 63 is cut off in the manner illustrated in FIGURE 17 to remove the unextruded and un-pressure welded portion thereof so that the resulting structure is substantially homogeneous and provides an enlarged solid end on the tubular member 63 so that the enlarged end can be suitably machined in the manner illustrated in FIGURES 1 and 2 to produce the desired sucker rod structure or other desired configurations.

Therefore, it can be seen that this invention provides improved rods of either the solid or hollow type having enlarged ends provided thereon in such a manner that the enlarged ends are substantially fatigue-proof and homogeneous therewith.

Further, this invention provides improved methods and apparatus for forming such rods or tubular members.

While the die means 66, 74 and 83 for forming the enlarged solid end on the tubular member 63 have been illustrated and described as being separate apparatus, it is to be understood that the same can be formed in a single apparatus in the same manner as illustrated in FIGURE 11 and previously described.

While the form of the invention now preferred has been disclosed as required by the statutes, other forms may be used, all coming within the scope of the claims which follow.

What is claimed is:

1. A method for providing an enlarged end on a rod comprising the steps of:

- (a) placing said rod having a given diameter in a chamber,
- (b) disposing a hollow billet around an end of said rod and within said chamber,
- (c) heating the end of said rod and said billet within said chamber,
- (d) axially impacting adjacent ends of said billet and

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said rod to pressure weld said billet to said rod end to provide an enlarged end on said rod while supporting said billet and said rod so as to prevent extrusion,

(e) placing said enlarged heated end in an extruding apparatus, 5

(f) and thereafter extruding at least part of the inner portion of said enlarged heated end through a die means having an extrusion aperture larger than said given diameter of said rod to reduce and elongate 10 said enlarged end to the desired dimensions.

2. A method for providing an enlarged end on a rod as defined in claim 1 including the additional step of impacting the end of said rod to be heated to upset said end prior to disposing a hollow billet around said end of said rod within said chamber. 15

3. A method for providing an enlarged solid end on a hollow tubular member comprising the steps of:

(a) placing an end of said tubular member having a given diameter in a chamber, 20

(b) disposing a hollow billet around said end and within said chamber,

(c) disposing a solid mandrel billet inside said end,

(d) heating the end of said tubular member and said billets within said chamber, 25

(e) axially impacting adjacent ends of said billets and said tubular member to pressure weld said billets to said end of said tubular member to provide an enlarged end on said tubular member while supporting said hollow billet and said tubular member so as to prevent extrusion. 30

(f) placing said enlarged heated end in an extruding apparatus,

(g) and thereafter extruding at least part of the inner portion of said enlarged heated end through a die 35

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means having an extrusion aperture larger than said given diameter of said tubular member to reduce and elongate and enlarged end to the desired dimensions.

4. A method for providing an enlarged end on a tubular member as defined in claim 3 including the additional step of impacting the end of said tubular member to be heated to upset said end prior to disposing a hollow billet around said end of said tubular member within said chamber.

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