Dec. 29, 1936. A. S. LYNCH 2,065,595

TUBULAR PRODUCT AND MANUFACTURE THEREOF

Filed Aug. 9, 1934 2 Sheets-Sheet 1

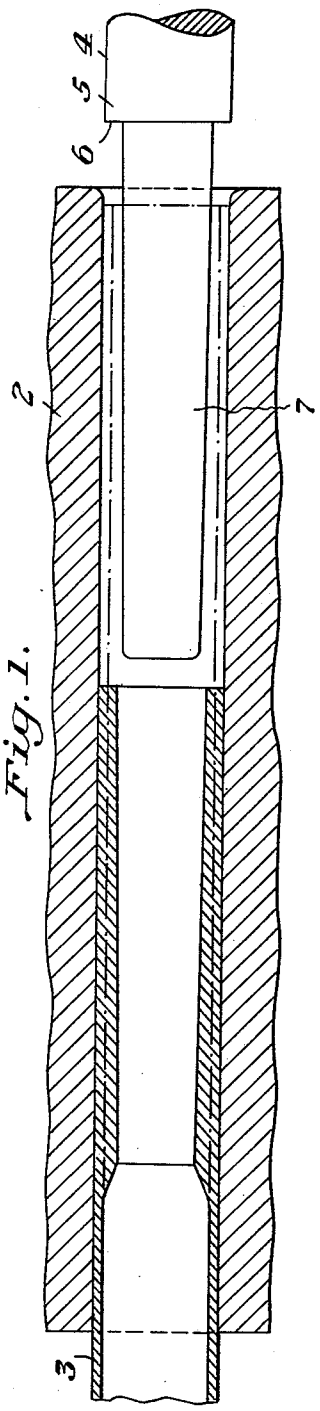


Fig. 1.

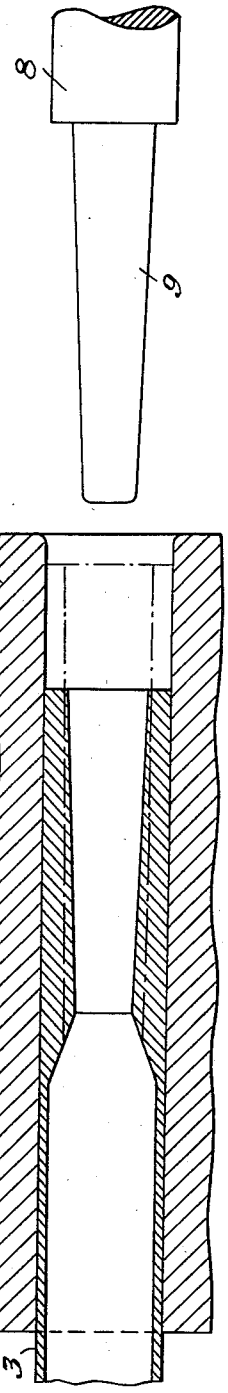


Fig. 2.

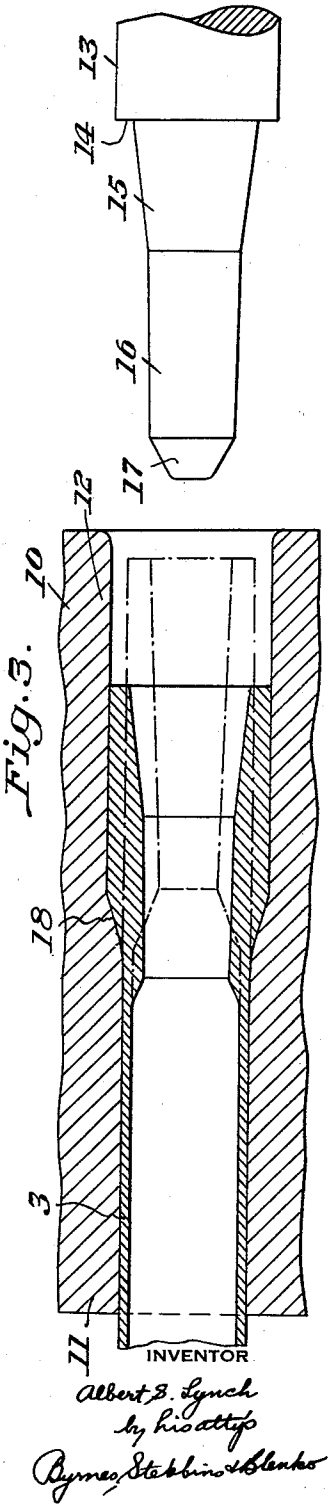


Fig. 3.

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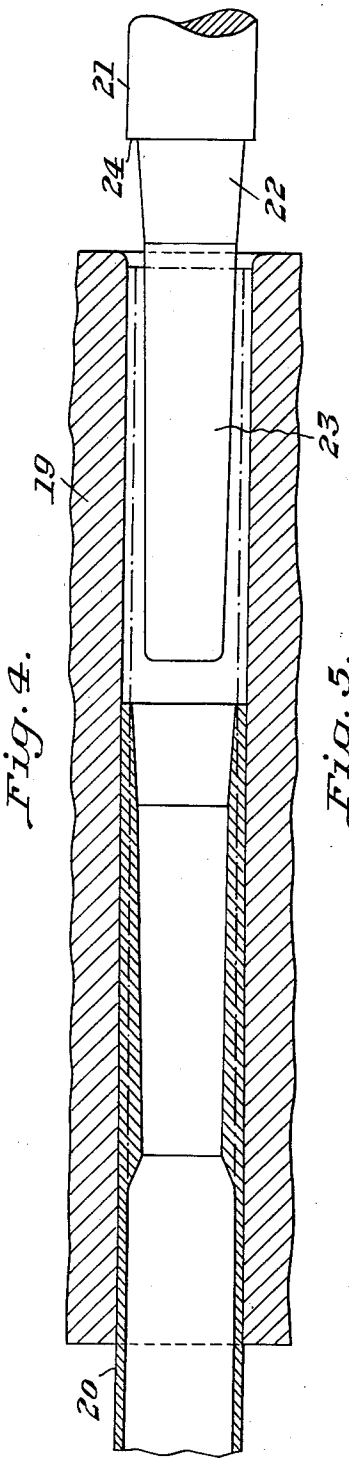


Fig. 4.

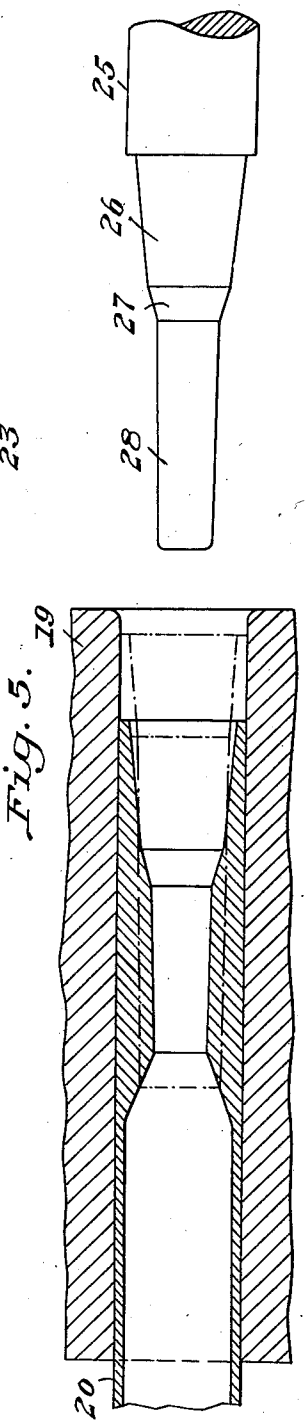


Fig. 5.

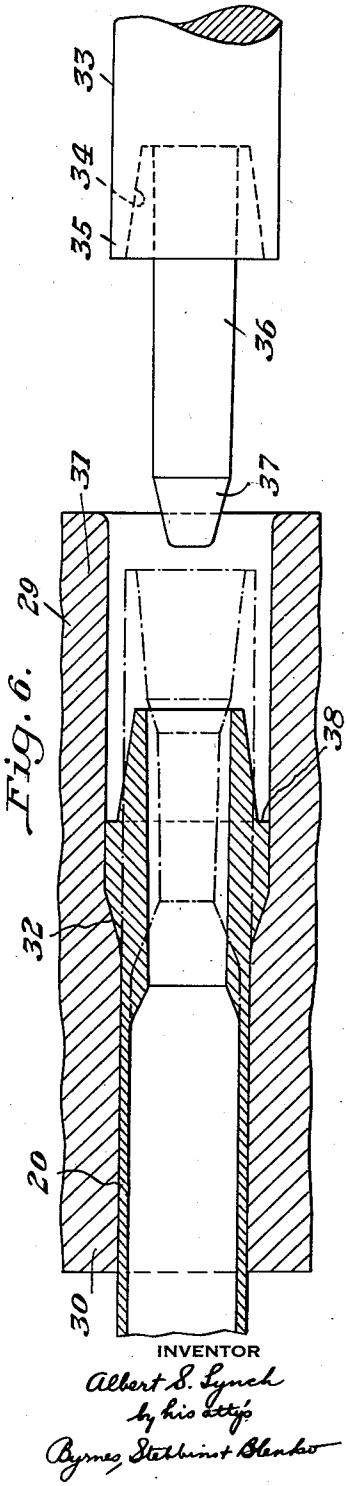


Fig. 6.

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UNITED STATES PATENT OFFICE

2,065,595

TUBULAR PRODUCT AND MANUFACTURE THEREOF

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Application August 9, 1934, Serial No. 739,122

16 Claims. (Cl. 29—156)

This invention relates broadly to tubular products and the manufacture thereof, and more particularly to the formation of tubular products by upsetting. It relates still more particularly to certain novel steps in the formation of upset tubular products and to a drill pipe section formed by upsetting a tubular blank.

Although the invention is of broad application it is especially well adapted for the formation of sections of drill pipe having integral coupling portions, and purely for the purpose of explanation and illustration the invention will be described in connection with the manufacture of such a product.

The advantages of drill pipe having integral coupling portions have long been recognized, but due to various disadvantages and difficulties incident to the manufacture of such products they have not prior to the present invention gone into actual use to any appreciable extent. For example, reference may be made to Boyd and Saunders Patent No. 1,325,073 which discloses a method of forming coupling ends on drill tube sections, but for reasons mentioned below the Boyd-Saunders method is undesirable from the commercial standpoint.

In the Boyd-Saunders process the pipe end is formed by a relatively great number of relatively light upsetting operations, the patent disclosing eight such operations requiring the use of a very large amount of speçal equipment including dies and mandrels of numerous different sizes and shapes with the necessary auxiliary equipment and replacement parts. The initial investment necessary for carrying out the Boyd-Saunders process is itself almost prohibitive. Other disadvantages incident to the Boyd-Saunders process are even more serious. The relatively great number of relatively light upsetting operations would necessitate frequent reheating of the end of the blank, and in each reheating operation great care would have to be taken to insure reheating of only a predetermined portion of the blank. This would require a high degree of skill in addition to the greatly increased cost due to reheating and handling of the blanks.

Furthermore, the Boyd-Saunders process, by reason of the relatively great number of relatively light upsetting operations and the relatively great number of reheatings, would produce in the metal a structure unsatisfactory for the intended purpose. This would doubtless result in a high percentage of rejects and failures. Still further, in the formation of the male coupling end the upset extremity of the blank must be swaged before it is ready for threading, and this swaging operation further undesirably influences the metallurgical structure as well as increasing the cost of the product by reason of the extra step. Likewise, in threading the female coupling end it is necessary to machine off a large volume of metal, resulting in a very considerable wastage and further increasing the cost.

The Boyd-Saunders process shows the point to which the art had developed prior to my invention. Although the advantages of the use of drill pipe with integral coupling portions has long been recognized, the Boyd-Saunders process has not been found suitable for commercial operation, and, so far as I am aware, no such drill pipe has been manufactured on a commercial scale by any prior process.

I provide a process or method of making drill pipe sections having integral coupling portions, and, more broadly, a method of forming tubular products, obviating the disadvantages of the Boyd-Saunders process. I require in most cases not more than three dies and three cooperating plungers for the production of any given product, and sometimes even less than this, no swaging equipment at all and, ordinarily, no necessary reheating, although under certain circumstances I prefer to reheat. The actual number of steps is materially reduced with respect to the Boyd-Saunders process. The product is preferably upset in not more than three steps into its ultimate final form ready for threading. The metallurgical structure of my product is superior. The relatively great number of relatively light upsetting operations of the Boyd-Saunders process, as well as the swaging operation in formation of the male coupling end, are done away with. The cost incident to my process is materially less than that incident to the Boyd-Saunders process, and the number of rejects and failures of products formed by my process is negligible.

In one manner of practicing my invention I confine an end portion of a tubular blank against diametral enlargement, and hold the blank as a whole against endwise movement when axial pressure is applied to the confined end and apply axial pressure to such end, thereby to shorten and inwardly thicken the end portion of the blank, and thereafter apply axial pressure to such end of the blank to cause outward thickening of part of said end portion while preventing increase in the wall thickness

of the extremity of said end portion. I provide for forming a final upset product with a tapered extremity and, so far as the male coupling end is concerned, with a reduced tapered extremity formed entirely by upsetting.

There are also other features of importance in connection with my invention, and these will, together with the details thereof, become apparent as the following description of certain present preferred embodiments thereof proceeds.

In the accompanying drawings I have shown certain present preferred embodiments of the invention, wherein

Figures 1, 2 and 3 are, respectively, central longitudinal cross-sectional views, somewhat diagrammatic, through upsetting dies showing successive steps in the formation of an upset tubular product, the plungers or mandrels used in the respective steps being indicated at the right-hand side of the respective figures; and

Figures 4, 5 and 6 are views similar to Figures 1, 2 and 3 showing successive steps in the formation of a somewhat different upset tubular product.

Referring more particularly to Figures 1, 2 and 3, there is shown an elongated tubular die 2 in which snugly fits a tube blank 3 which is initially of uniform diameter and wall thickness and whose initial position in the die is shown by chain lines. The end of the blank is preheated before it is inserted into the die 3 and when in place in the die the blank as a whole is held against endwise movement toward the left, viewing Figure 1, as by any suitable gripping device or backstop.

An upsetting mandrel 4 is provided in axial alignment with the die 2. Such mandrel has a portion 5 of such diameter as to fit snugly within the die and which terminates in an upsetting shoulder 6 from which projects axially of the mandrel a tapered forward portion or nose 7. The nose 7 serves, in conjunction with the die, to confine the upset metal so as to prevent buckling and provide on the upset blank a tapered extremity. The plunger is moved toward the left, viewing Figure 1, into the die 2 with sufficient force to upset the end portion of the blank 3, the blank, after such upsetting operation, having the cross-sectional shape shown in cross section in Figure 1. The blank is shortened and its end portion is inwardly thickened as shown and the extremity of such end portion is tapered toward the tip thereof.

The upset blank thus formed in the first step is then moved forward in the die 2 to the position indicated in chain lines in Figure 2. The blank as a whole is held in this position against movement toward the left, viewing such figure, and is subjected to a second upsetting operation similar to the first but with a mandrel 8 having a nose 9 somewhat shorter and thinner than the nose 7 of the mandrel 4 and of greater taper. In this step the end portion of the blank is further shortened and inwardly thickened, such end portion, after the second upsetting step, being shown in cross-section in Fig. 2.

The twice upset blank is then removed from the die 2 and inserted into a die 10 having a rearward portion 11 of substantially the same diameter as the die 2 but having an enlarged forward portion 12. The portions 11 and 12 are joined by an inclined connecting portion or shoulder 18 as shown. The blank is introduced into the die 10 to the position shown in chain lines in Figure 3 and is held in such position against movement toward the left, viewing such figure. It is then acted on by a mandrel 13 having an upsetting shoulder 14 from which projects axially a series of three successive portions 15, 16 and 17, respectively of different taper, as shown in Figure 3. The taper of the portion 15 is relatively great and that of the portion 16 relatively small, the end portion 17 being tapered off fairly sharply at a convenient angle.

The blank is acted on by the mandrel 13 which further shortens its end portion, enlarges the bore or hole, and thickens it outwardly against the enlarged forward portion 12 of the die 10 and against the connecting or shoulder portion 18. The extremity of the end portion of the blank remains tapered as shown. The thickened end portion lies in alignment with the unthickened part of the blank, the product thus formed being adapted to be internally threaded at its tapered extremity to serve as a drill pipe section having an integral female coupling portion. No swaging or other similar after-operations are necessary.

Only two dies and three mandrels are necessary to form the product according to the method just described, although for convenience a separate die may be used for each of the three steps. If this is done the die for the second step will be the same, at least in cross section, as that for the first step. Each upsetting operation is normally performed in a single stroke of the mandrel, although under certain conditions and with certain grades of steel it may be desirable to use two strokes in quick succession or, in rare instances, more than two strokes, particularly in the initial step. If more than one stroke is used in a single step the blank is preferably moved forward between strokes. The blank may be reheated between steps. The time element of course has a direct bearing on the question of reheating, and if the blank is moved rapidly through the successive steps it need not be reheated at all. If, however, there is a delay reheating may be necessary or desirable.

When the blank is placed in the die 10 for the third step, shown in Figure 3, I preferably position the inwardly upset portion only thereof opposite the enlarged portion of the die. This gives a particular advantage as it insures proper outward movement of the metal and complete filling up of the space originally existing between the blank and the die. If a non-thickened portion of the blank is positioned opposite the enlarged portion of the die before the final upsetting step there is danger that the metal will not completely fill the space originally existing between the blank and the die.

Figures 4, 5 and 6 illustrate the formation of a drill pipe section having an integral male coupling portion adapted to cooperate with the pipe section formed by the method of Figures 1, 2 and 3. The three steps are generally analogous although there are certain differences, particularly in the third step. The die 19 shown in Figures 4 and 5 may be identical with the die 2 shown in Figures 1 and 2, and the blank 20 may be identical with the blank 3. The mandrel 21, however, is different from the mandrel 4 in that it has two tapered portions 22 and 23 extending axially from the upsetting shoulder 24. The portion 22 is of greater taper than the portion 23, resulting in formation of an upset blank whose extremity is of greater taper than the upset portion behind

the extremity. This assists in providing for progressive increase in the end area of the blank in the successive steps, allowing for a slight gather at the extremity of the blank in each step.

The mandrel 25 for the second step has three successive tapered portions 26, 27 and 28, as shown, resulting in the formation after the second step of a blank of the shape shown in cross section in Figure 5.

This blank is then inserted into the die 29 having a rearward portion 30 of the same size as the die 19, a forward enlarged portion 31 and an inclined connecting portion or shoulder 32 connecting the portions 30 and 31 of the die. The blank is positioned as shown in chain lines in Figure 6 and is held in such position against endwise movement toward the left, viewing such figure.

The mandrel 33 used for the final step is of the collar type having an annular recess 34 surrounded by a tapered forwardly extending collar 35 and from which axially projects the mandrel nose 36 having a sharply tapered tip 37. As the mandrel 33 is advanced to act on the blank the extremity of the blank is received within the recess 34 which holds it against outward movement as in Figure 3. The end portion of the blank beyond such extremity is, however, outwardly thickened against the portions 31 and 32 of the die as shown. Thus there is formed entirely by upsetting a drill pipe section having an integral male coupling portion which is properly tapered and of the right size and ready to be threaded for cooperation with the corresponding female portion. During the final step, shown in Figure 6, the extremity of the blank is maintained at least as near the axis of the die and of the blank as prior to such step and, in fact, as clearly appears from Figure 6, the tip of the extremity is somewhat reduced in diameter. Furthermore, in this last step the inclination of the inner surface of the blank is greatly reduced and the outer surface is given a substantial inclination. A shoulder 38 is formed at the base of the extremity of the blank for cooperation with the corresponding female section.

Thus I form entirely by upsetting and by relatively few steps with a limited amount of machinery and at extremely low cost a tubular product having a thickened end portion provided with a tapered extremity, such product being of very high quality and requiring no after-operations other than threading (except possibly a heat treatment) to render it suitable for use.

While I have shown and described certain present preferred embodiments of and methods of practicing the invention, it is to be distinctly understood that the same is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

I claim:

1. A method of forming a tubular product, comprising confining an end portion of a tubular blank against diametral enlargement, holding the blank as a whole against endwise movement when axial pressure is applied to said end, applying axial pressure to said end of the blank, thereby to shorten and inwardly thicken said end portion, and thereafter confining the extremity of the thickened end portion against diametral enlargement and, while said extremity is so confined, applying axial pressure to said end of the blank to cause outward thickening of part of said end portion.

2. A method of forming a tubular product, comprising confining an end portion of a tubular blank against diametral enlargement, holding the blank as a whole against endwise movement when axial pressure is applied to said end, applying axial pressure to said end of the blank, thereby to shorten and inwardly thicken said end portion, and thereafter applying axial pressure to said end of the blank to cause outward thickening of part of said end portion while preventing increase in the wall thickness of the extremity of said end portion.

3. A method of forming a tubular product, comprising confining an end portion of a tubular blank against diametral enlargement, holding the blank as a whole against endwise movement when axial pressure is applied to said end, applying axial pressure to said end of the blank, thereby to shorten and inwardly thicken said end portion, and thereafter applying axial pressure to said end of the blank to cause outward thickening of part of said end portion while confining the extremity of the thickened end portion against diametral enlargement and preventing increase in the wall thickness of such extremity.

4. A method of forming a tubular product, comprising confining an end portion of a tubular blank against diametral enlargement, holding the blank as a whole against endwise movement when axial pressure is applied to said end, applying axial pressure to said end of the blank to shorten and inwardly thicken said end portion while confining the extremity of said end portion so that such extremity becomes tapered, and thereafter applying axial pressure to said end of the blank to cause outward thickening of at least part of said end portion while maintaining the extremity thereof tapered.

5. A method of forming a tubular product, comprising confining an end portion of a tubular blank against diametral enlargement, holding the blank as a whole against endwise movement when axial pressure is applied to said end, applying axial pressure to said end of the blank to shorten and inwardly thicken said end portion while confining the extremity of said end portion so that such extremity becomes tapered, and thereafter applying axial pressure to said end of the blank to cause outward thickening of at least part of said end portion while maintaining the extremity thereof tapered and confining such extremity so as to be of less external diameter than other parts of said end portion.

6. A method of forming a tubular product, comprising confining an end portion of a tubular blank against diametral enlargement, holding the blank as a whole against endwise movement when axial pressure is applied to said end, applying axial pressure to said end of the blank, thereby to shorten and inwardly thicken said end portion, and thereafter applying axial pressure to said end of the blank to cause outward thickening of at least part of said end portion while confining the extremity of said end portion so as to be of less external diameter than other parts of said end portion.

7. A method of forming a tubular product, comprising confining an end portion of a tubular blank against diametral enlargement, holding the blank as a whole against endwise movement when axial pressure is applied to said end, applying axial pressure to said end of the blank,

whereby to shorten and inwardly thicken said end portion, and thereafter applying axial pressure to said end of the blank to cause outward thickening of at least part of said end portion while confining the extremity of said end portion so that such extremity becomes tapered.

8. A method of forming a tubular product, comprising confining an end of a tube within a die, inserting a tapered mandrel into said end of the tube and upsetting said end inwardly against the mandrel, removing said tube end from said die and introducing it into a larger die, and upsetting at least a portion of said tube end outwardly against said second mentioned die while maintaining the extremity of said tube end tapered.

9. A method of forming a tubular product, comprising inwardly upsetting a tube end so as to have an inclined inner surface at its extremity and then outwardly upsetting said tube end so as to have an inclined outer surface at its extremity while maintaining the tip of said extremity at least as near to the axis of the tube as it was prior to said outward upsetting step.

10. A drill pipe section having an integral coupling portion at an end thereof formed entirely by upsetting, the external diameter of at least a part of the coupling portion being greater and the internal diameter thereof less than the external diameter and internal diameter, respectively, of the body of the pipe section.

11. A drill pipe section having an integral coupling portion at an end thereof, said coupling portion having a tapered extremity and being formed entirely by upsetting, the external diameter of at least a part of the coupling portion being greater and the internal diameter thereof less than the external diameter and internal diameter, respectively, of the body of the pipe section.

12. A drill pipe section having at an end portion thereof an outwardly enlarged integral upset length a part only of which is internally tapered to relatively small internal diameter away from the extremity of said section at said end portion and internally threaded.

13. A drill pipe section having at an end portion thereof an outwardly enlarged integral upset length a part only of which is internally tapered to relatively small internal diameter away from the extremity of said section at said end portion and internally threaded, said outwardly enlarged integral upset length extending to a point more remote from said extremity than said tapered and threaded part thereof.

14. In the manufacture of a drill pipe section, the steps comprising outwardly upsetting an end portion of a tubular blank and internally tapering to relatively small internal diameter away from the extremity of said blank at said end portion and internally threading a part only of said outwardly upset end portion.

15. In the manufacture of a drill pipe section, the steps comprising heating an end portion of a tubular blank, inwardly upsetting said end portion to reduce the bore thereof, then outwardly upsetting at least a part of said end portion, and forming in said end portion an internal thread-receiving surface tapered to relatively small internal diameter away from the extremity of said blank at said end portion, said outwardly upset part extending to a point more remote from said extremity than said thread-receiving surface.

16. In the manufacture of a drill pipe section, the steps comprising heating an end portion of a tubular blank, inwardly upsetting said end portion to reduce the bore thereof and then outwardly upsetting at least a part of said end portion so as to provide thereon a smoothly tapered extremity to serve as an integral tool joint.

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