Feb. 2, 1943. H. R. AUSTIN 2,310,158

METHOD FOR FLANGING TUBULAR BODIES

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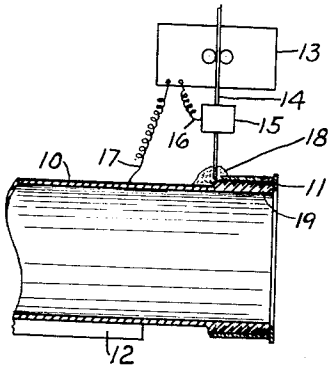


FIG. 1

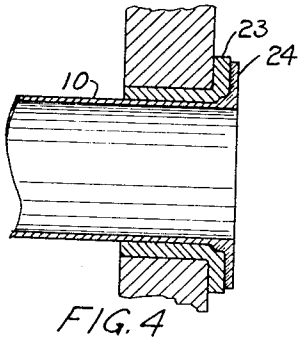


FIG. 4

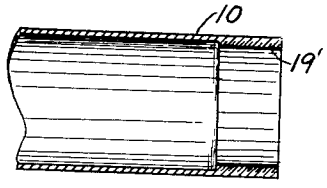


FIG. 2

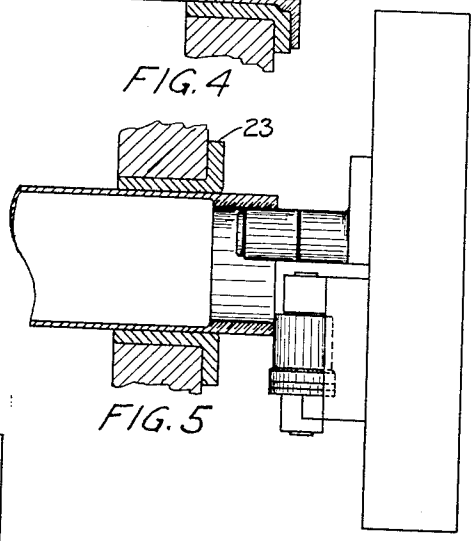


FIG. 5

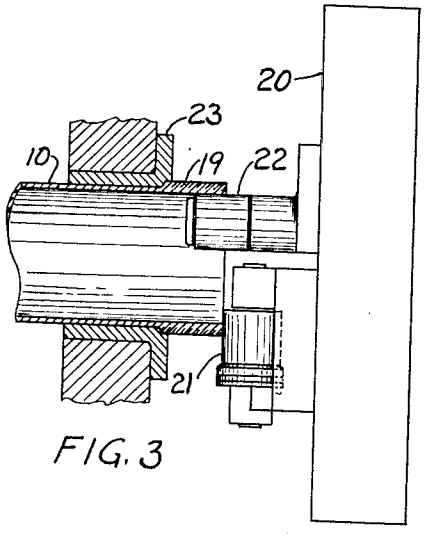


FIG. 3

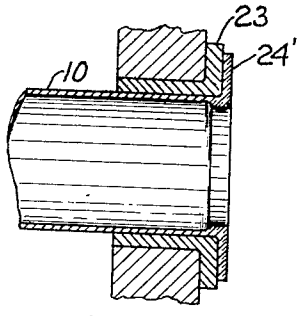


FIG. 6

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METHOD FOR FLANGING TUBULAR BODIES

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Application November 9, 1940, Serial No. 364,975

1 Claim. (Cl. 29—148.2)

This invention relates in general to the flanging of the ends of tubular bodies and in particular to the formation of integral flanges at the ends of pipes and similar tubular bodies.

The well known "Van Stone" joint which is in common use for uniting the ends of tubular bodies, and particularly those intended for high pressure service, requires flanges at the ends of the tubular bodies. For this purpose, and for other purposes as well, it is common practice to form integral flanges at the ends of tubular bodies by work deforming the metal thereof while in a properly heated condition. Apparatus, usually called "Van Stone machines" are available for carrying out the flanging operation.

"Van Stone" machines of various designs are commercially available. Functionally, however, practically all of the available machines fall into one or the other of two groups. The machines of the first group, while they upset the metal, form the flange primarily by bending the metal. The machines of the second group, while they likewise bend the metal, form the flange primarily by upsetting the metal.

The flanges produced by the machines of the first group are seldom defective while it is not uncommon to find flanges produced by the machines of the second group that are defective by reason of folds and shuts formed during the upsetting of the metal. The machines of the first group form the flange as a one step operation and require but a single heating of the metal. The machines of the second group on the other hand, produce their result progressively in a plurality of steps and repeated heating of the work is necessary. For these reasons flanges are produced with the machines of the first group whenever possible since rejections are lower and the cost per flange is materially less.

With the machines of the first group it is seldom possible to produce a finished flange that is as thick as the metal out of which it was formed. Thus, a 100% joint, while it may be approached, cannot invariably be produced. With the machines of the second group on the other hand, flanges of any thickness, within reasonable limits, may be produced at will.

One of the primary objects of this invention is to provide a method for forming integral flanges at the ends of tubular bodies by means of which flanges may be produced of a thickness equal to or greater than the thickness of the metal of the tubular bodies without the necessity of upsetting, to a marked degree, the metal formed into the flange.

It is a further object of the invention to provide a method for forming integral flanges at the ends of tubular bodies wherein the metal of the body to be formed into the flange is increased in thickness by depositing thereon and uniting thereto molten metal and the flange formed by a single hot working step in which the metal is deformed primarily by bending.

It is also an object of the invention to provide a method for forming integral flanges at the ends of tubular bodies wherein the metal of the body to be formed into the flange is increased in thickness by uniting thereto a thickness of metal, under the influence of a flux submerged electric arc, and the flange formed by a single hot working step in which the metal is deformed primarily by bending.

The further objects and advantages of the invention will be apparent from a consideration of the following description taken with the accompanying drawing in which:

Fig. 1 is a diagrammatic view partly in section, illustrating the manner in which metal is added to a pipe end,

Fig. 2 is a sectional view showing the added metal united to the inside metal of a pipe end, and

Figs. 3, 4, 5, and 6 are sectional views illustrating the flange forming operation and the apparatus employed.

The invention is of general application in forming integral flanges at the ends of tubular bodies but is of special value when used in forming such flanges at the ends of tubular bodies intended for high pressure service. Also, while the invention is applicable to the forming of flanges of any thickness it is especially useful in forming flanges which when in the finished condition are as thick or thicker than the wall of the vessel. The invention will be disclosed in detail in connection with the flanging of pipe.

In accordance with the invention, the end of the pipe to be formed into the integral flange is increased in thickness to the necessary extent by uniting metal to the metal of the pipe wall.

It is at present preferred to unite the required metal by the well known flux-submerged electric arc-welding operation. By means of this expedient an inseparable bond throughout between the pipe metal and the added metal is easily secured, the added metal is dense, homogeneous and, when of the same analysis as the pipe metal, is superior to the pipe metal in strength and in other desirable properties. Also, by means of

this expedient these results can be obtained at a minimum cost.

The metal added may be of the same, or substantially the same, analysis as the metal of the pipe or the added metal may be of a different analysis. The added metal may be united to the outside or the inside metal of the pipe.

When the added metal is united to the outside metal of the pipe apparatus of the character shown in Fig. 1 is employed. When the added metal is united to the inside metal of the pipe apparatus capable of depositing metal within the pipe is required. A satisfactory apparatus for the latter purpose is disclosed in the patent application of Martin A. Mikesh Serial No. 347,390 filed July 25, 1940, now U. S. Patent No. 2,260,260. Both apparatus include the same fundamental elements so that a description of the operation as carried out with the apparatus of Fig. 1 will suffice.

The end of pipe 10, after having retaining ring 11 tack welded to it, is positioned on a suitable support 12 beneath welding head 13. Support 12 should be such as to provide for the rotation of pipe 10 about its longitudinal axis at a predetermined rate. Welding head 13 may be any of the commercial welding heads suited for the purpose and should include arrangements for feeding electrode 14 toward pipe 10 at a predetermined rate and for maintaining the characteristics of the electric discharge at predetermined values. The welding current is supplied to electrode 14 through contact device 15 by cable 16, the other side of the welding current supply is connected to pipe 10 in a manner such that the rotation of pipe 10 is not interfered with. In the schematic showing of Fig. 1 cable 17 is directly connected to pipe 10.

Electrode 14 is positioned over the end of pipe 10 and then lowered until it approaches the pipe wall. When in this position the electrode end should be spaced sufficiently from the end of the pipe so that arcing will not take place between electrode 14 and retaining ring 11. An arc starter such as a wad of steel wool, or the like, is interposed between the pipe wall and the electrode end. The end of the electrode and the adjacent portion of the pipe wall are then covered with a deep blanket of protective flux 18. The flux 18 is preferably in the granular form and may be applied manually or welding head 13 may include means for depositing flux 18 around the electrode end as electrode 14 is fed. When pipe 10 is of such a diameter that a sufficient depth of flux 18 to properly blanket the electric discharge cannot be retained on it, the end of pipe 10 may be rotated in a suitable flux container in which the pipe end is completely flux submerged.

The initial current surge destroys the arc starter and establishes an arc between the end of electrode 14 and the metal of pipe 10. The arc is automatically maintained at predetermined characteristics by welding head 13. The arc fuses metal of electrode 14 and metal of pipe 10 and flux 18. The molten metals intermingle to form deposit 19 which is integrally united to the metal of pipe 10 and extends below the original surface of pipe 10. By choosing electrode 14 of proper composition deposited metal 19 may be obtained having the same composition as the metal of pipe 10 or it may have, within limits, any desired composition. Thus, a deposited metal 19 may be formed which has properties such as corrosion resistance, strength and the like, superior to the metal of pipe 10; deposited metal 19 may be 18—8 chromium-nickel steel, high chromium steel, etc. In any event the metal 19, by reason of the way it is produced, is dense clean metal of fine grain structure which even when of the same analysis is superior to the metal of pipe 10. The molten flux covers the deposited metal 19 and protects it from the atmosphere.

Metal 19 may be deposited in the form of rings or by moving head 13 relative to pipe 10 in the form of a helix. In either case the deposit is overlapped an amount sufficient to assure continuous metal.

The thickness of deposited metal 19 above the original surface of pipe 10 may be varied within limits by varying the rate of movement of the electrode, the characteristics of the current discharge, etc. When thicknesses greater than those obtainable by these variations are required, the required thicknesses may be obtained by repeating the metal depositing operation on the already deposited metal. While the length of the deposit 19 should at least be equal to the length of the desired flange it has been found better practice to make deposited metal 19 extend a substantial distance beyond that required by the flange. The same is true of the deposited metal 19' of the pipe 10 of Fig. 2.

The surfaces of deposited metal 19 of Fig. 1 and deposited metal 19' of Fig. 2 are generally sufficiently smooth for the work deforming operation. However, since the surface of deposited metal 19 becomes the back surface of the flange, and irregularities in it may serve as starting points for serious defects, it is often advisable to machine deposit 19 until a smooth surface is obtained.

The flanges are formed in the apparatus shown in Figures 3 and 5 after the pipe end has been brought to the proper working temperature. The apparatus of Fig. 3 is used for flanging the pipe end of Fig. 1 while that of Fig. 5 is used for flanging the pipe end of Fig. 2. The apparatus each includes a rotatable head 20, that carries rollers 21 and 22 and is movable longitudinally, and a fixedly positioned split die 23 which is arranged to hold the pipe end. Roller 21 is journalled to rotate about an axis at right angles to the line of movement of head 20 while roller 22 is journalled to rotate about an axis parallel to the line of movement of head 20. The rollers are not driven. Die 23 of Fig. 1 is recessed to accommodate part way within it the enlargement that results from deposited metal 19 while the hole through die 23 of Fig. 5 is of substantially uniform diameter throughout.

The end of the pipe is clamped in its proper die 23 with a sufficient portion extending outside of the die towards head 20 to provide the metal required to form the flange. Head 20 is then set in rotation and moved toward the die 23. Roller 21 rolls over the end of pipe 10 and works the heated metal towards die 23 while roller 22 rolls over the inside surface of the pipe end and maintains the original inside diameter. The net results of the action of the rollers is to bend the metal against the face of die 23. The resulting flange, flange 24 or flange 24', is somewhat thicker at and adjacent its base than the pipe end prior to working while at and adjacent its periphery it is about the same or even a little thinner. Thus, the action of the rollers is primarily a bending action and the upsetting action is an incidental result.

The formed flanges are then machined as by

boring, facing, etc., to bring them to the required finished dimensions. Since, as above pointed out, any thickness of metal 19, or 19' may be deposited, flanges 24 of any required final thickness may be readily produced.

In the manufacture of pipe 10 the metal thereof is subjected to considerable working with the result that longitudinal extending fibre is developed. In the finished flange the fibre persists in the portion formed out of the original metal while the portion that results from the deposited metal is practically free from fibre. While fibrous metal has great strength in the direction of the fibre it is not equally strong in directions at an angle to the fibre. The fibre free deposited metal is, to all practical purposes, equally strong in all directions. The deposited metal, furthermore, by reason of the manner in which it is produced is remarkably clean, is homogeneous and of a fine grain structure. Thus, the ring of metal in the finished flange that results from the deposited metal, when of the same analysis, is stronger and better metal than the original metal and serves as reenforcement therefore.

It is often necessary to provide a corrosion resistant facing on flanges at the ends of pipes used in the chemical and oil refining arts. The invention provides a simple expedient for obtaining this result. By making the deposit 19' of Fig. 2 of the required corrosion resistant alloy the flange is formed and faced with resistant alloy in one operation. Furthermore, when pipe 10 is lined with corrosion resistant alloy, by extending metal 19' until it is united to the lining metal the usual troublesome welding required to unite the corrosion resistant lining to the corrision resistant flange facing is eliminated.

I claim:

The method of forming an integral flange at an end of a tubular body which comprises covering surface of the tubular body with a deep blanket of protective flux, discharging electric current through a gap beneath the surface of the flux blanket between the end of a metal electrode and the metal of the tubular body to fuse metal of the electrode and metal of the tubular body into a common metal deposit integrally united to the metal of the tubular body, moving the electrode over the surface of the metal of the tubular body required for the desired flange to form a continuous deposit, heating the thickened end of the tubular body to render the metal thereof sufficiently plastic for hot working, positioning the heated thickened end of the tubular body in a die with a portion of the heated thickened end extending outwardly from a face of the die disposed substantially transversely to the longitudinal axis of the tubular body, and deforming said extending portion to move it into contact with said face of the die primarily by bending.

HAROLD R. AUSTIN.