Sept. 10, 1940. C. A. NICHOLS 2,214,108

MANUFACTURE OF TUBING

Filed Nov. 5, 1938 2 Sheets-Sheet 1

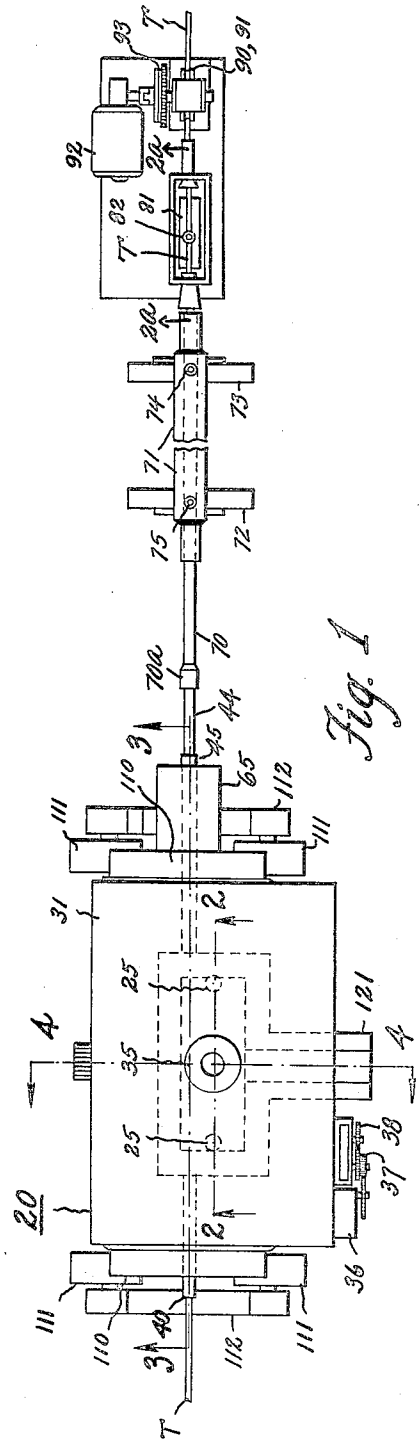


Fig. 1

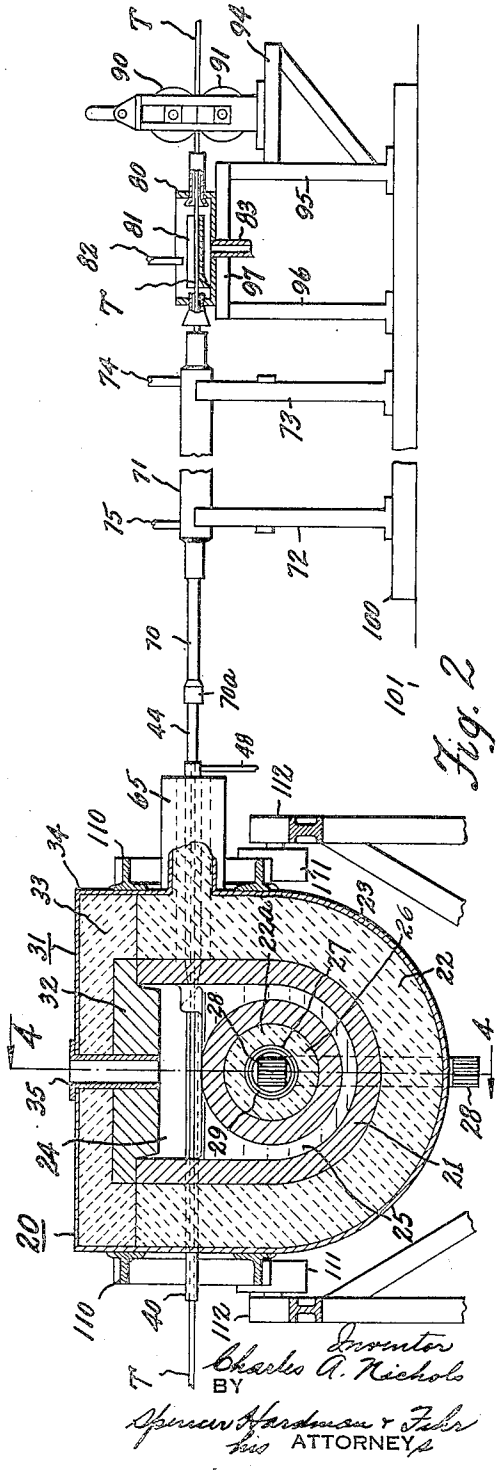


Fig. 2

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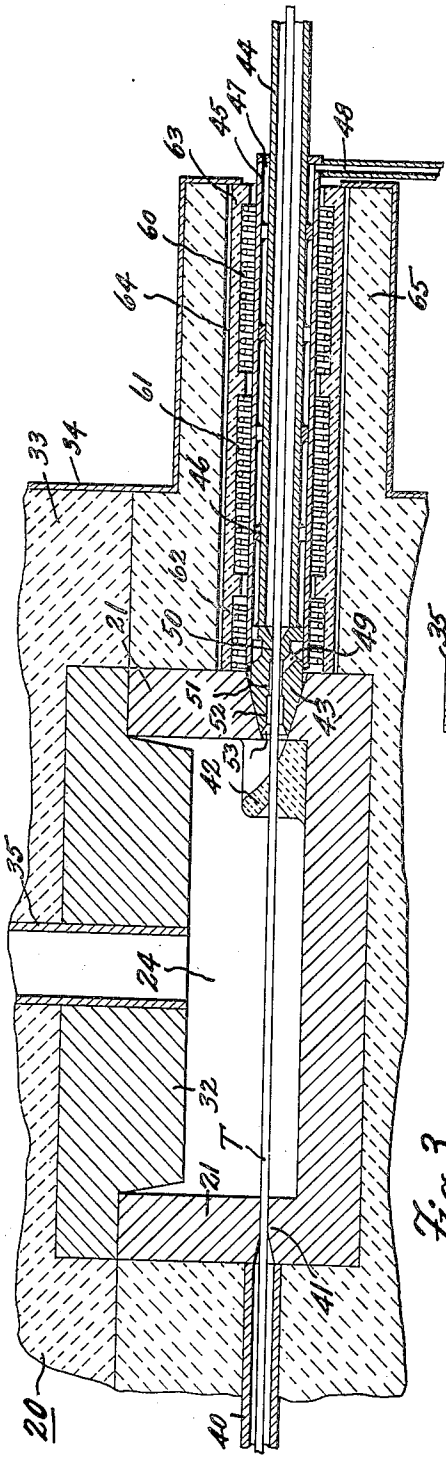


Fig. 3

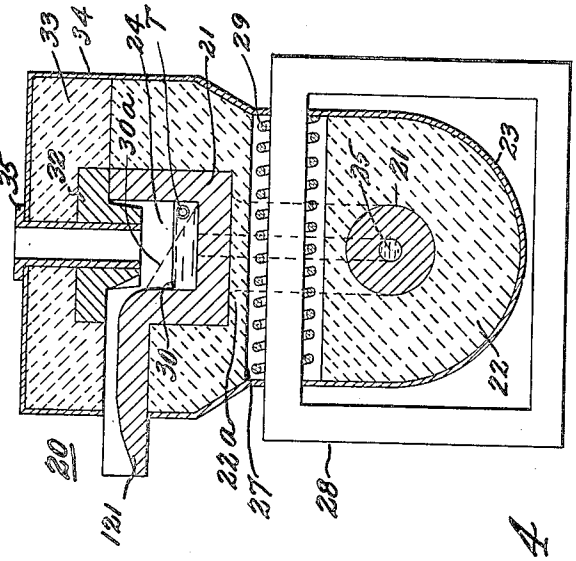


Fig. 4

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UNITED STATES PATENT OFFICE

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MANUFACTURE OF TUBING

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Application November 5, 1938, Serial No. 239,165

3 Claims. (Cl. 219—12)

This invention relates to the manufacture of seamed tubing and more particularly to multiply seam tubing in which the seams and ply are bonded together by passing the tubing through a bath of molten copper.

It has been the practice, when bonding by means of molten copper, to preheat the tubing to a temperature at or nearly the temperature required for copper bonding so that the tubing does not extract a substantial quantity of heat from the bath. This practice has been followed where the copper is melted by a source of heat external to the copper, such as by electrical resistance heating elements.

It is the aim and object of the present invention to eliminate the preheating of the tubing preparatory to passing the tubing through a bath of molten copper. To accomplish this object I use apparatus by which heat units are conveyed to the copper at such a rate, not only to melt the copper and to keep it in molten condition, but sufficiently to supply to the tubing heat from the molten copper for the purpose of raising the temperature of the tubing to that required for copper welding.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a plan view of the apparatus embodying the present invention;

Fig. 2 is a side view partly in section, the section being taken on the lines 2—2 and 2*a*—2*a* of Fig. 1;

Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 1, being drawn to a larger scale; and

Fig. 4 is a sectional view taken on the line 4—4 of Figs. 1 and 2. Fig. 4 is drawn to a scale greater than Fig. 2 and less than Fig. 3.

In the drawings the tubing or work to be bonded is indicated by the letter T. The tubing T is formed from strip steel stock by any suitable forming apparatus, not shown. Preferably the tubing is two ply, being made of two strips of stock so formed that the seams are diametrically opposite. The tubing T passes continuously from the forming apparatus through an electrical induction furnace 20 of the type now available on the market for the melting of copper by induction heating. A furnace of this type is disclosed in Wyatt Patent #2,120,223. The furnace 20 comprises a pot 21 surrounded by a refractory jacket 22 of heat insulating material which is confined within a metal jacket 23. The pot 21 is made of material which will withstand high temperature and will not be readily affected by copper. The pot 21 provides an upper chamber 24 and a communicating U-shaped passage 25 which is looped around a tubular thermal insulator 26 which is open. The U-shaped passage 25 extends around a portion 22*a* of the refractory insulation 22. There is a cylindrical opening 27 extending clear through the furnace 20 for receiving one leg of a transformer core 28. This leg is surrounded by the primary winding 29 of the transformer. Winding 29 is connected with a suitable current source. The secondary winding of the transformer is a single closed turn provided by the leg of molten copper in the U-shaped passage 25 and by the copper which extends to the level 30 in the chamber 24, see Fig. 4, when the furnace is in use.

The pot 21 is closed by a cover 32 comprising a slab 32 of material the same as the material of the pot 21, a refractory heat insulating line 33 and a metal jacket 34. A pipe 35 extends through the cover 31; and, through pipe 35, a copper wire may be fed by a power feed comprising an electric motor 36 driving geared feed wheels 37 and 38.

The tubing T passes into the furnace through a lead-in pipe 40 and thence through a flared opening 41 in one wall of the pot 21. The tubing T fits fairly snugly in the hole 41, but there is sufficient clearance to prevent obstruction of the movement of the tubing. The tubing passes across the pot 21 and is below the normal level 30 of the copper therein. The tubing passes through a fire clay baffle 42 and thence through a gas wiper block 43, which is integral with a lead-out pipe 44 and with a jacket pipe 45 which is maintained concentric with respect to the pipe 44 by means of spaced lugs 46. The annular space 47 between pipes 44 and 45 receives a supply of reducing or non-oxidizing gas admitted through a pipe 48. This gas is forced under pressure through a passage 47 and finds an outlet through a passage 49. The block 43 is provided with a stepped bore comprising portions 50, 51, 52 and 53. The bore 50 fits fairly closely around the tubing but not too closely to obstruct free movement thereof. The bore 51 is larger than bore 50 and it is in communication with the lateral passage 49. Bore 52 is still larger than passage 51; and bore 53 is conically tapered. These passages 51, 52 and 53

provide for the issuance from the wiper block 43 of an annular jet of heated nonoxidizing gas which removes any globules or small globules of copper which cling thereto. The gas carries these globules of copper against the baffle 42 which deflects the gas and globules upwardly the bottom of the slab 32, thus deflecting particles of copper down to the end of the bath.

The gas admitted to the pot 21 through the gas wiper 43 is preheated to the required temperature by electrical resistance heating elements 60, 61 and 62 which are connected to a suitable source of current. These elements are housed within a porcelain tube 63 fitting within a cylindrical passage 64 formed in a tubular extension 65 of the furnace wall and extending within the furnace as far as the outer right wall of pot 21. The electrical heating elements 60, 61 and 62 heat the gas temperature above the melting point of copper. This gas is used not only to remove copper particles from the tube but to supply the interior of the chamber 24 with a non-oxidizing or reducing atmosphere under sufficient pressure to exclude air from the chamber.

By the method of electrical induction heating the copper of the bath within the chamber 24 and the leg of copper in passage 25 receive heat developed internally by so-called molecular friction at a rate sufficient to maintain the copper molten while permitting the transfer of heat from the bath of copper to the tubing to raise the temperature of the tubing to the required copper bonding temperature. This temperature is preferably 2100° F.

The lead-out pipe 44 guides the tubing into a pipe 70 which is surrounded by a metal jacket 71 supported on legs 72 and 73. Into the space between the jacket 71 and the pipe 70 water is admitted through a pipe 74 and carried off by a pipe 75. In this way the temperature of the tubing is reduced to a temperature below that at which copper will be rapidly oxidized in open air.

Then the tubing passes to an open vessel 80 containing a tray or shelf 81 over which the tubing slides while water admitted to a pipe 82 descends upon the tubing to cool the same for handling. The vessel 80 is drained by pipe 83.

The tubing T is moved from left to right as viewed in the drawings partly by rollers of the tube-forming apparatus (not shown) and partly by pull-out rolls 90 and 91 which are geared together and are driven by an electric motor 92 through a friction slipping clutch 93. This clutch is so adjusted as to limit the traction applied by the rolls 90 and 91 of the tubing T to the amount sufficient to move the tubing but not so great as to cause a rupture of the tubing in the copper bath where the tubing is hot-short due to its being heated to a relatively high temperature in a bath of copper.

The rolls 90 and 91 and the framework supporting them and the motor 90 are carried by a suitable shelf 94 supported by leg 95 which together with leg 96 support a platform 97 carrying the vessel 80. All of the supporting legs 72, 73, 96 and 95 may be mounted on a base 100 which can be moved horizontally along the floor represented by line 101, the base being provided with rollers or casters for this purpose. The lead-out pipe 44 may be integral with the pipe 70 or may be connected therewith with coupling 78. In any event when the platform 100 is moved horizontally toward the right as viewed in the drawings the assembly of the gas wiper block 43, lead-out pipe 44 and jacket pipe 45 may be removed as a unit from the furnace. This construction is advantageous when making repairs or replacements of the gas wiper assembly.

The cooling of the tubing within the lead-out pipe 40 in the water jacket of the cooling pipe 70 is carried out in a non-oxidizing atmosphere. This atmosphere is provided by some of the wiper gas which escapes through the passage 50 through which the tubing T passes. There is sufficient clearance between the tubing T and passage 50 to permit some of the gas to escape and to fill the pipes 44 and 70, with reducing gas under sufficient pressure to exclude any substantial amount of air which might enter the pipe 70 at its right-hand end.

During the copper welding operation, while the tubing T is passing through the furnace pot copper does not escape therefrom because the tubing is moved at such a rate that any copper which would tend to escape out through the hole 41 (see Fig. 3) is dragged back into the chamber 24 since the tubing is moving toward the right. Copper does not escape through the right-hand wall of the pot because the wiper gas is continually blowing the copper back from the gas wiper block 43 into the chamber 44.

Obviously, if there is no tubing passing through the pot the copper would escape. In order to avoid this escape of copper when there is no tubing in the furnace, the furnace is constructed so as to be tilted coaxially with the tube. For this purpose two opposite walls of the furnace are provided each with an annular band or drum 110. Each band 110 rests on a pair of trunnions 111 supported by a pedestal 112. This will permit tilting the furnace sufficiently to bring the level of the copper indicated by the broken line 30*a* in Fig. 4 below the level of the holes in the pot 21 through which the tubing passes. As shown in Figure 4, the tubing is indicated at T and is located outside of level 30*a* which indicates the relation of the level of copper to the tubing when the furnace is tilted. The furnace may be tilted still further than that required to bring the copper bath to the level 30*a* so that the contents of the furnace may be discharged out through a channel provided by a spout 121 integral with the pot 21. It may be necessary to remove the copper when making repairs to the furnace; and it is also desirable to remove the copper when it has been contaminated to a certain extent by reason of contact with the tubing passing through it.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

What is claimed is as follows:

1. Apparatus for welding seamed tubing which moves continuously longitudinally comprising a vessel having side walls and end walls for containing a bath of molten welding metal and having openings through opposite end walls through which the tube moves when passing through the bath, said openings being on a line closer to one side wall of the vessel than the other, means for maintaining the bath at the proper welding temperature, and means for so tilting the vessel about an axis substantially coincident with the axis of the opening through which the tubing passes through the bath that the bath metal gravitates toward the side of the vessel remote from said openings so as to lower the level of the bath below said openings in the end walls of said vessel.

2. Apparatus for welding seamed tubing which

moves continuously longitudinally comprising a vessel for containing a bath of molten welding metal, means for heating the vessel and its contents, said vessel having openings through opposite end walls through which the tube moves when passing through the bath, the entrance passage being occupied by the tubing to such extent that the tubing, when moving into the bath, effectually blocks escape of welding metal through that passage, means for plugging the exit passage of the vessel and comprising a gas wiper nozzle through which the tubing passes, said nozzle having a tapered head fitting into a tapered bore in the vessel, said nozzle directing the wiper gas toward the bath to remove excess welding metal from the tubing and to prevent escape of welding metal through the exit passage, and a unitary structure including said nozzle and means for heating wiper gas and conducting heating gas to said nozzle, said structure being removable while the vessel remains assembled with its heating means.

3. Apparatus according to claim 2 in which the wiper gas nozzle is included in a unitary assembly which also comprises an outlet guide tube for the tubing, a jacket providing an annular space around the guide tube for receiving the wiper gas, said jacket space being connected with the nozzle, and means for heating the jacket.

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