Sept. 9, 1941. C. A. NICHOLS ET AL 2,255,550

MANUFACTURE OF TUBING

Filed Nov. 9, 1938 2 Sheets-Sheet 1

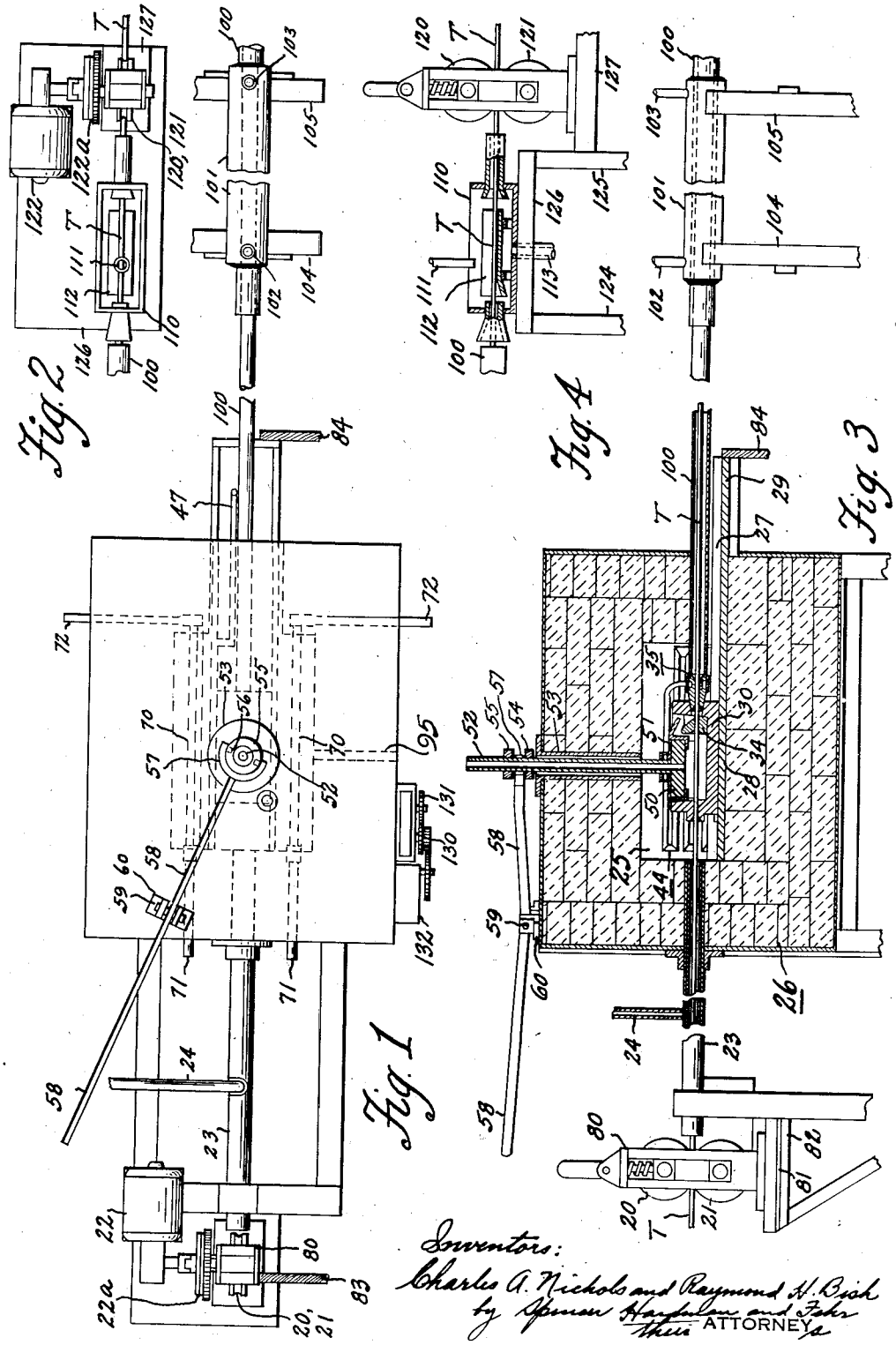


Fig. 2

Fig. 4

Fig. 3

Fig. 1

Inventors:
Charles A. Nichols and Raymond W. Bish
by Spencer Hapgood and Fisher
their ATTORNEYS

Sept. 9, 1941. C. A. NICHOLS ET AL 2,255,550

MANUFACTURE OF TUBING

Filed Nov. 9, 1938 2 Sheets-Sheet 2

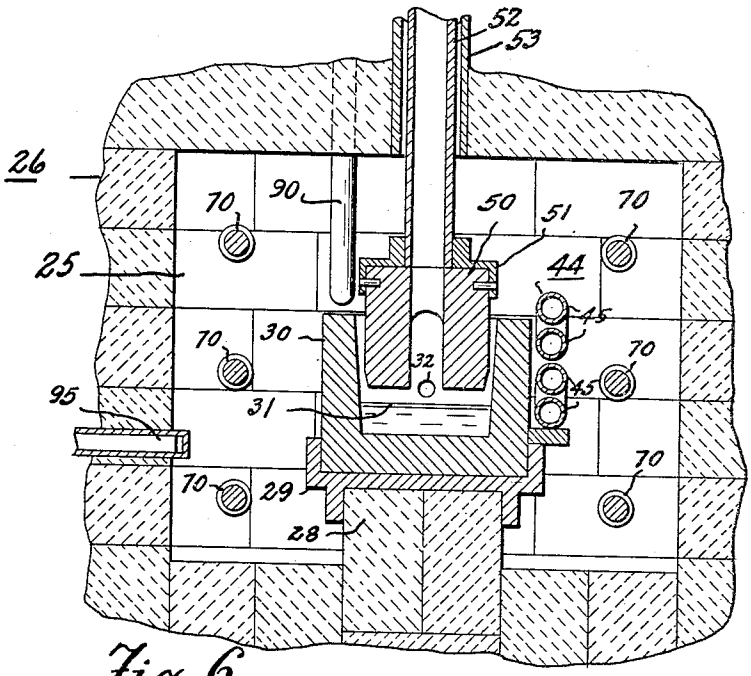


Fig. 6

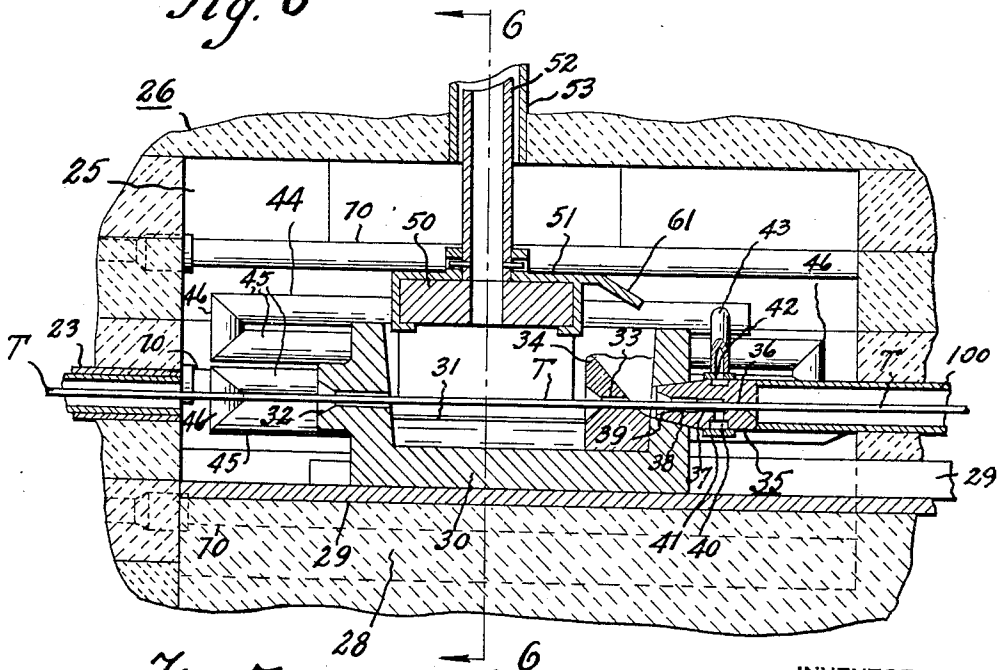


Fig. 5

INVENTORS
Charles A. Nichols and Raymond H. Bish
BY
Spencer Hardyman & Fisher
ATTORNEYS

Patented Sept. 9, 1941

2,255,550

UNITED STATES PATENT OFFICE

2,255,550

MANUFACTURE OF TUBING

Charles A. Nichols and Raymond H. Bish, Anderson, Ind., assignors to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application November 9, 1938, Serial No. 239,655

3 Claims. (Cl. 219—12)

This invention relates to the manufacture of seamed tubing including seamed multi-ply tubing, the plies and seams of which are bonded together by an intermediate sealing metal such as copper. In welding with molten copper it is necessary that the temperature of that portion of the tubing immersed in the molten copper be above the melting point of copper. Preferably the temperature of the bath of copper is approximately 2100° F. Heretofore the application of molten copper to seamed tubing has been performed in an electric furnace having resistance heating elements from which heat is radiated to the bath of copper to keep the same in molten condition. The furnace includes also a preheated zone in which the temperature of the tubing is raised to the required temperature for copper welding by means of heat radiating from resistance heating elements. The tubing being heated as well as the bath of copper is protected by a non-oxidizing or reducing atmosphere in order to prevent oxidation of the tubing or of the copper in the bath. As the rate of production of copper welded tubing is largely dependent upon the rate of transfer of heat from the resistance elements to the furnace atmosphere and to the tubing passing through it and to the parts containing the bath of copper, it is evident that a furnace of relatively large size is required. For example, we have found that a furnace approximately 25 ft. long is required for copper welding ¼" seam steel tubing at a rate of 25 ft. per minute.

The chief aim and object of the present invention is to provide an improved method and apparatus by which seamed steel tubing may be copper welded at a much higher speed of production and with much more effective utilization of electric current for heating the tubing and the bath of copper. These aims and objects are accomplished by providing a relatively small electric furnace enclosing the vessel for containing the bath of copper, said furnace being heated by resistance elements of a highly concentrated nature commercially known as "glow bars." Glow bars are rods of special resistance material so constructed as to provide for the application of intense heat within a small space. We have found the glow bar method of heating the copper bath to be very effective. In order to provide for heating the tubing without unduly extracting heat from the copper bath we prefer heating the tubing by separate means to bring the tubing nearly to the proper copper welding temperature. This heating means is preferably provided by passing an electric current directly through the tubing while it is moving from the tube-forming mill to the copper bath. Since the tubing moves through the copper bath, the bath itself can be made one terminal or electrode of the circuit through the tubing. A pair of metal rolls applying pressure to the tubing while it is still relatively cold provides the other electrode or terminal for the tube heating circuit. While the tubing is being heated before passing into the bath it is protected by a surrounding atmosphere of non-oxidizing or reducing gas which passes through a pipe surrounding the tubing leading to the interior of the furnace.

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 invention is clearly shown.

In the drawings:

Figs. 1 and 2 taken together constitute a plan view, partly fragmentary, of apparatus embodying the present invention.

Figs. 3 and 4 taken together constitute a side view thereof partly in section.

Fig. 5 is a fragmentary longitudinal sectional view of the furnace drawn to a larger scale than Fig. 3.

Fig. 6 is a sectional view on the line 6—6 of Fig. 5.

Referring to the drawings, the work or tubing is indicated by the letter T. The tubing is formed from strip stock in any suitable manner and passes between pressure rolls 20 and 21 made preferably of copper and geared together and driven by an electric motor 22 in such direction as to feed the tubing from left toward right as viewed in the drawings.

The tubing T first moves through a chamber 23 to which a suitable non-oxidizing or reducing gas is supplied to a pipe 24. Pipe 23 leads to the interior chamber 25 of furnace 26 to supply the same non-oxidizing gas, the gas being under such pressure as to exclude air from the furnace opening 27 on the right hand side thereof. The bottom wall 28 of the furnace chamber supports a track 29 upon which rests a small vessel or tank 30 of highly refractory metal for containing a bath of copper, the normal level of which is indicated at 31 in Figs. 5 and 6. The vessel 30 is provided with a flared opening 32 through which the tubing T passes on entering the chamber within the vessel. The tubing passes through an opening 33 in a baffle 34 which can be molded of fire clay or the like. Tubing T then passes out through a gas wiper block 35 having a stepped

bore comprising steps 36, 37, and 38 which are cylindrical and a portion 39 which is conical or flared. Bore 36 fits fairly close around the tubing T, but not so closely as to interfere with its movement. Bores 37 and 38 are increasingly larger. The bore 37 communicates with an annular groove 40 closed by band 41 having a hole 42 connected by a pipe 43 with a wiper gas heater stove 44 which comprises four horizontal pipes 45 connected by vertical pipes 46. Into the lower-most one of the pipes 45 a reducing gas is admitted under pressure through the pipe 47 shown in Fig. 1. This gas is forced through the stove 44, through the annular groove 40 of wiper block 35 and out through the annular passages between the tubing T and the stepped bores 36, 37, and 38. As the bar 36 fits the tubing T fairly closely most of this wiper gas passes out through the bores 37, 38 and 39 for the purpose of removing excess copper from the tubing. The baffle 34 directs the blast of wiper gas and globules of molten copper upwardly along the baffle 34.

In order to raise the level 31 of the copper bath above the tubing T in order to submerge the tubing there is provided a plunger block 50 of refractory material supported by a bracket 51 attached to a pipe 52 which extends through the top wall of the furnace, there being a guide pipe 53 surrounding pipe 52. Above the top of the furnace the pipe 52 is provided with collars 54 and 55 which together with the pipe 52 provide a groove for receiving studs 56 carried by bifurcated end 57 of a lever 58 pivoted at 59 upon a bracket 60 supported by the furnace. When the pipe 52 is held upwardly as shown in the drawings the level 31 and the copper will be below the tubing T. If the level 58 is moved clockwise as viewed in Fig. 3, pipe 53 will be lowered to cause the block 50 to plunge into the bath of copper to displace the same to raise its level above the tubing T. Obviously this is done after the tubing has started moving through the furnace from left toward right. As the tubing moves through the side walls of the vessel 30 practically no copper escapes from the opening in these side walls because any copper which starts to flow out the opening 32 (see Fig. 5) is dragged toward the right by the moving tubing T. Any copper which tries to escape through the bores 39, 38 and 37 is blown toward the left by the wiper gas issuing from the wiper block 35.

Bracket 51 which supports the displacement block 50 is provided with a baffle 61 which, when the block 50 is in lower-most position, is in close proximity to the baffle 34. Thus the baffles 61 and 34 cooperate to guide globules of gas blown by the wiper gas jet from the tubing back into the copper bath while the wiper gas may escape into the furnace chamber. Obviously the gas in the furnace chamber will be of such pressure as to exclude air from entering either of the pipes 52 or 53 as well as through the furnace opening 27.

The copper bath receives its heat from glow bars 70 which are so constructed of special resistance material as to be capable of carrying a large current and developing an intense heat which is radiated to the bath of copper to melt the same, the copper to be melted being introduced through the pipe 52 and to replenish the bath. Glow bars 70 are connected with electrodes 71 and 72 shown diagrammatically in Fig. 1 leading to a suitable source of current.

Since we have found that there is a limit to the rate of transfer of heat by radiation to a bath of copper, we have found it advantageous not to transmit from the bath to the tubing all of that heat which is necessary to bring the tubing up to the proper welding temperature. Therefore we provide means other than the copper bath itself for supplying to the tubing a part of the heat required to raise its temperature to welding temperature. We locate the framework 80 which supports the feed rolls 20 (preferably of copper) upon a nonconducting support 81 which insulates the frame 80 from the supporting bracket 82. Frame 80 is connected with a wire 83 leading to a suitable current source, the other terminal of which is connected by wire 84 with the metal rail 29 which supports the metal vessel 30 which contains the bath of copper. In this way that portion of the tubing T between the rolls 20 and 21 and the bath of copper in the vessel 30 carries an electric current of such electrical dimensions as to heat the tubing T substantially. Preferably we preheat the tubing to about 1900° F. We are not required to be very accurate about this because the completion of the elevation of the temperature of the tubing is performed by the copper bath itself so the tubing will not be rendered hotter than necessary. Thus current is conserved without requiring any temperature regulating apparatus of a refined nature. The temperature of the furnace itself may be regulated automatically by a regulator not shown operating in conjunction with a pyrometer indicated diagrammatically at 90 in Fig. 6.

So effective is our method and apparatus for heating the tubing and copper bath that we are able to materially speed up the rate of travel of the tubing T through the furnace. We can now copper-weld ¼" seam tubing at the rate of 50 ft. per minute, and might go still higher if we employ tube-forming apparatus which will stand up under such speeds.

The tubing T passes from the gas wiper block 35 through a lead-out tube 100, which is kept filled with nonoxidizing gas which seeps through the bore 38 of the wiper block 35. A portion of the lead-out pipe 100 is surrounded by a water jacket 101 having inlet and outlet pipes 102 and 103 and supported by brackets 104 and 105. As shown in Figs. 2 and 4 the tubing then passes to a final cooling vessel 110 open to the atmosphere. As the tubing T passes over a shelf 112 in chamber 110 water, fed from a pipe 111, trickles upon the tubing and shelf 112 and gravitates to the bottom of the vessel 110 and out through a drain 113.

Finally, the tubing T passes between pressure pull-out rolls 120 and 121 which are geared together and are driven by an electric motor 122 in such direction as to cause the tubing to move from left toward right in the drawings. The pull-out rolls 120 and 121 cooperate with the eletric current carrying rolls 20 and 21 to propel the tubing through the furnace. The tube forming mill (not shown) also includes forming rolls which cooperate with these rolls to move the tubing. In order that the force applied by rolls 20 and 21 for feeding the tubing will be coordinated with other feed rolls, the motor 22 drives rolls 20 and 21 through a properly adjusted friction-slip-clutch 22*a*. Likewise motor 122 drives pull-out rolls 120 and 121 through a friction-slip-cluth 122*a*. As steel tubing at high temperature in the presence of molten copper is hot-short and therefore relatively weak, the

clutch 122a is adjusted so that the traction effected by the pull-out rolls 120 and 121 will not be so great as to cause disruption of the tubing.

Legs or brackets 124 and 125 support shelves 126 and 127 which in turn support the vessel 110 and the pull-out rolls 120 and 121. These legs 124 and 125 as well as the legs 104 and 105 supporting the water jacket 101 can be provided with casters or the like, so as to be easily moved along the floor. By moving the legs 104, 105, 124 and 125 toward the right from the position shown in the drawings, all of the apparatus supported by these legs will move to the right, carrying with it the lead-out pipe 100, leaving the wiper block 35 and wiper gas preheating stove 44 assembled therewith. Quite obviously certain bricks may be removed from the opening 27 of the furnace to permit withdrawal of these parts. The vessel 30 may be separately withdrawn along the track 29; or, if preferred, the lead-out pipe 100, wiper block 35, stove 44, and tray 30 may be made up as one assembly so as to slide along the track 29 when the apparatus supported by the legs 104, 105, 124 and 125 is moved toward the right.

Copper to replenish the bath in the tray 30 is provided by feeding a wire unreeled from a supply reel (not shown) and fed by a pair of geared feed rolls 130 and 131 operated by an electric motor 132 (see Fig. 1). This wiper passes upwardly along the side of the furnace and is guided over the top of the furnace and then down through the pipe 52. When the lower end of the copper wire touches the copper bath or any part heated above the melting point of copper, the copper wire will melt to supply what is needed to replenish the bath. The speed of feed of the copper wire can be regulated to suit the conditions.

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. The method of welding seamed tubing while the tubing is continuously moving longitudinally which consists in maintaining a bath of molten welding metal at the proper temperature for welding the tubing, in preheating the moving tubing to a temperature below the welding temperature, immediately passing the preheated moving tubing through the bath, the bath being maintained in such quantity as to raise the temperature of the tubing to the welding temperature while the tubing passes through the bath.

2. The method of welding seamed tubing while the tubing is continuously moving longitudinally which consists in maintaining a bath of molten welding metal at the proper temperature for welding the tubing, in passing an electric current through a portion of the moving tubing extending from the bath to a point outside the bath to preheat the tubing to a temperature below the welding temperature, and in completing the heating of the moving tubing in the bath, the bath being maintained in such quantity as to raise the temperature of the tubing to the welding temperature while the tubing passes through the bath.

3. The method of welding seamed tubing while the tubing is continuously moving longitudinally which consists in maintaining a bath of molten welding metal at the proper temperature for welding the tubing, in passing an electric current through the bath and a portion of the moving tubing extending from the bath to a point outside the bath to preheat the tubing to a temperature below the welding temperature, and in completing the heating of the moving tubing in the bath, the bath being maintained in such quantity as to raise the temperature of the tubing to the welding temperature while the tubing passes through the bath.

CHARLES A. NICHOLS.
RAYMOND H. BISH.