

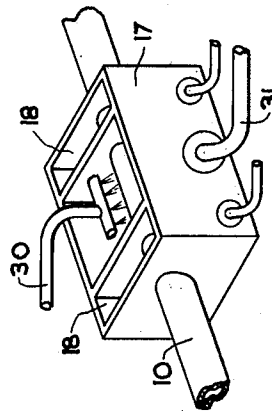
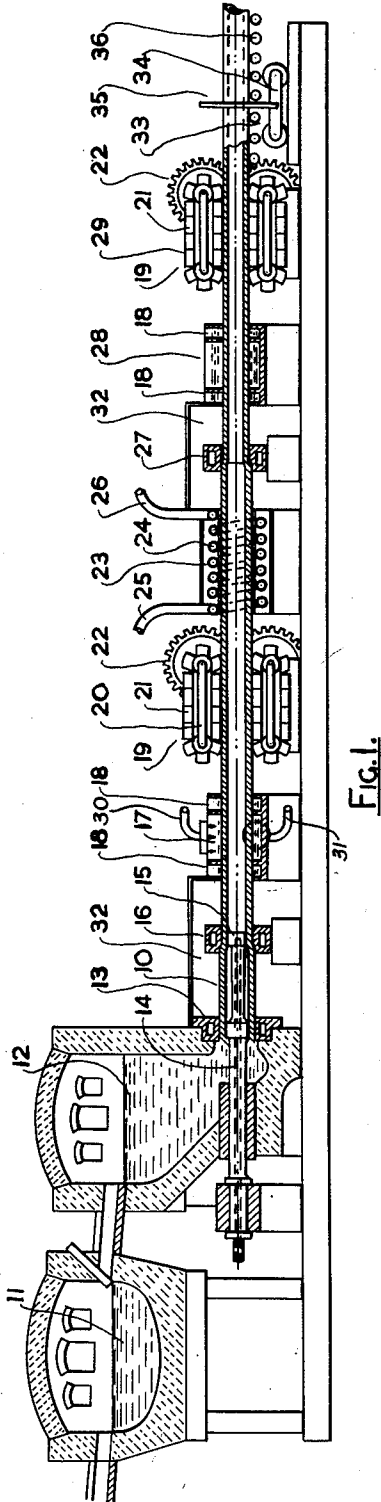
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MANUFACTURE OF SOLID DRAWN IRON AND STEEL TUBES

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MANUFACTURE OF SOLID-DRAWN IRON
AND STEEL TUBESFrederic Barnes Waldron, Eccleston Park,
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5 Claims. (Cl. 29—33)

This invention relates to improvements in the manufacture of solid drawn iron and steel tubes and has for its principal object a method and apparatus whereby the tube is drawn continuously from and in combination with a continuous supply of molten or semi-molten metal such as may conveniently be produced by the flow process described in my copending patent application No. 378,591 filed February 1941.

Another object resides in the combination of the steel flow and continuous drawing whereby it becomes possible to produce the hole in the tube without loss of metal and also to avoid loss of tube ends except at long intervals.

A further object of this invention is to give such continuity of the drawing process as will enable the tube to be heated and cooled during its travel to ensure a satisfactory crystalline structure of the steel. A still further object is to take advantage of this continuous heat treatment and control it in such a way that a uniform thickness of metal is maintained.

Yet another object is to prevent oxydisation of the surface of the hot metal by enclosing the exposed parts of the tube and filling the space with a neutral or deoxydising gas or liquid or bath of granular material so that the metal will not scale.

Still another object resides in the advantage of producing the tubes in lengths which are discontinuous only at long intervals so that lengths can be cut as required.

The flow process of manufacturing steel will give a metal of high uniform quality suitable for the direct continuous production of tubes and will lessen the evil of piping and segregation which occurs when separate solid ingots are produced.

Since this invention is applicable without change of essential details to the manufacture of tubes from all ferrous metals the word steel will be used to include iron, steel, high carbon steel or alloy steel.

Hitherto solid drawn steel tubes have been manufactured by processes well known in the art by taking an individual piece of steel and forming a hole through the centre and afterwards drawing it through a die and over a mandrel time after time until the required diameter and thickness is obtained. Such tubes are always made in separate pieces of limited length either hot for each draw or cold drawn and heat treated between one or more draws. Tubes of ferrous or nonferrous metals are also manufactured from the molten or semi-molten metal which is extruded by pushing it through a die and over a mandrel. It has also previously been proposed to manufacture rods and tubes continuously from an orifice in the wall of a chamber containing a source of molten metal by draw-

ing it out by means of rollers. The scope of this present invention is the drawing of ferrous tubes continuously in combination with a continuous supply of molten or semi-molten metal by forming a tubular shape as the metal issues from the chamber containing it and then continuing to draw the tube through one or more dies and over a mandrel during which the tube may be heat treated, controlled in thickness and protected from oxydation.

A convenient method of carrying out the invention is shown in the accompanying drawing in which

Fig. 1 is a sectional elevation through the plant.

Fig. 2 is a perspective view of the cooling elements.

Referring to Fig. 1 the steel is manufactured by a continuous process in a series of furnaces of which 11 is the final one containing molten steel of a suitable refined quality and from thence it flows to chamber 12 which is maintained at a suitable temperature and is provided in the side or bottom with an orifice 13 through which is inserted a mandrel 14. Heat resisting steel may be used for the die and mandrel and either or both may be cooled by circulating water or other method. The die in orifice 13 is made of such a shape and size as to give a suitable form to the outside of the metal tube 10 as it issues from chamber 12 while mandrel 14 forms the hole which eventually becomes the bore of the tube.

The mandrel is extended to position 15 where an outside die 16 is also fixed and as the hollow metal is drawn past them it is reduced in thickness and diameter. Any number of successive sizing collars on the mandrel and outside dies may be provided to work the hollow steel nearer and nearer to the required inside and outside diameter.

The dies may be in the form of presses to give a kneading effect on the steel and improve its crystalline structure.

One form of appliance for pulling or drawing the hollow steel over the mandrel and through the dies is shown at 19. It comprises one or more conveyors 20 arranged round the tube and driven by gearing 22. Each conveyor has electromagnets 21 attached to it and these electromagnets are switched into circuit as they come in contact with the tube and engage themselves to it with sufficient strength so that collectively the total pull is strong enough to enable the conveyors to draw the tube forward. It will be understood that the temperature of the tube must be lowered until the metal becomes magnetisable. Such a temperature may be 600 degrees centigrade. A water bath 17 is provided as a convenient means of effecting this cooling. It has a gland chamber and drain pocket 18 at each end

to control the escape of water at the holes in the ends of the bath where the tube passes through.

Provision is made for the heat treatment of the tube as it travels in order that the steel may be given a suitable crystalline structure and also brought to a temperature for further drawing operations. One method of heating is shown at 23 and comprises a copper coil 24 surrounding the tube and carrying a heavy alternating electric current of high frequency capable of inducing an electric current in the steel tube sufficient to make it rapidly rise in temperature. The copper coil may be made from a copper tube with water circulating through it to keep it cool. The water enters at 25 and leaves at 26. The heating element is not limited to what has just been described and may consist of a combustion or muffle chamber heated in any known manner by solid, liquid, gaseous or powdered fuel.

A further die 27 is shown following the heating element and will give a further correction to the outside of the tube and may improve the condition of the steel by working it in the reheated state. It is followed by a cooling bath 28 similar to the previous cooling element 17 and then is provided a drag gear 29 similar to the previous one 19. Such dies, heating elements, cooling elements and drag gears may be repeated as desired to give sufficient working to the tube until it is finished as required.

Provision is made for controlling the thickness of the metal of the tube by adjusting the relative temperature on opposite sides. This can be accomplished by regulating the cooling liquid in the elements 17 and 28 so as to give more cooling effect on one side of the tube than on the other side by causing the entering water to impinge on the side to be cooled most. This must be followed by further heating and drawing. The inlet pipe shown at 30 and the outlet pipe at 31 will be adjustable to direct the flow of the cooling liquid in the required direction. The heating element can also be arranged to raise the temperature on one side of the tube more than on the other side and it will be understood that there will tend to be a reduction in thickness of the hotter side of the tube as compared with the cooler side.

The usual practice of drawing tubes from individual pieces of steel which are heated and then transferred to the drawing machine results in the hot metal being exposed to the atmosphere for some appreciable length of time during which the surface is oxidised and scale will form. The apparatus described in this invention gives facilities for surrounding the hot portion of the tube to form a chamber 32 which is filled with a non-oxidising gas or other substance which will prevent oxydisation.

A cutting off device 33 is provided for severing pieces of tube to the required lengths. It consists of a travelling carriage 34 carrying a power driven circular saw 35 and arranged so that the carriage moves along at the same speed as the tube while the saw is cutting it off. The tube is supported on rollers 36. Any other type of cutting off device may be used such as a travelling guillotine shears.

After the tube has been cut off it may be taken to a separate plant for any further heat treatment or drawing operations which may be desired. The tube may be further treated continuously before it is cut off by mechanically working it to form a flat or shaped strip or bar.

When an interruption occurs in the continuity of the drawing of the continuous tube it will be necessary to restart the draw and there will be some loss of output until the tube is reformed throughout the process but this loss will be only a small percentage of the total product.

It is to be understood that the form of the invention herewith shown and described is to be taken as the preferred embodiment of the same and that various changes in the type, shape, size and arrangement of the parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims. The shape of the tube is generally circular but may be of any required section.

Having described my invention I declare that what I claim is:

1. Apparatus for the manufacture of solid drawn iron and steel tubes continuously comprising a chamber containing a persistent source of molten or semi-molten metal, a device for forming the tube as the metal leaves the chamber followed by one or a plurality of dies through which the tube is drawn over a mandrel, means for cooling the tube, means for propelling it forward, means for reheating the tube and means for further die drawing, cooling and propelling the tube forward.

2. In the manufacture of solid drawn iron and steel tubes continuously the combination successively of a persistent source of molten or semi-molten metal, a tube forming nozzle, a die or a plurality of dies with an internal mandrel, a cooling device and a device for taking hold of the tube by electro magnets attached to a travelling conveyor for propelling the tube forward.

3. In the manufacture of solid drawn iron and steel tubes continuously the combination successively of a persistent source of molten or semi-molten metal, a tube forming nozzle, a die or a plurality of dies with an internal mandrel, a cooling device and a device for taking hold of the tube by electro magnets attached to a travelling conveyor for propelling the tube forward, an electric induction heater followed by further means for drawing, cooling and propelling the tube forward.

4. In the manufacture of solid drawn iron and steel tubes continuously the combination successively of a persistent source of molten or semi-molten metal, a tube forming nozzle, a die or a plurality of dies with an internal mandrel, a cooling device and a device for taking hold of the tube by electro magnets attached to a travelling conveyor for propelling the tube forward, an electric induction heater followed by further means for drawing, cooling and propelling the tube forward together with means for producing a difference in temperature at the extremities of one diameter of the tube in such a way as to control its thickness.

5. In the manufacture of solid drawn iron and steel tubes continuously the combination successively of a persistent source of molten or semi-molten metal, a tube forming nozzle, a die or a plurality of dies with an internal mandrel, a cooling device, a propelling device and a reheater followed by further means for drawing, cooling and propelling the tube together with means for producing a difference in temperature at the extremities of one diameter of the tube in such a way as to control its thickness.

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