

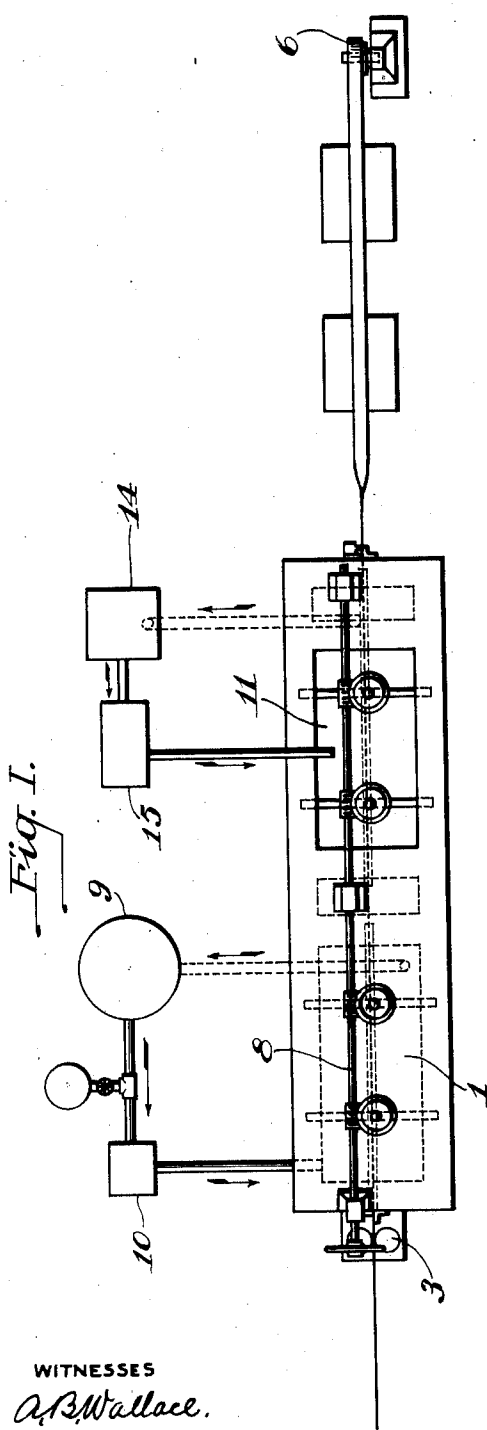
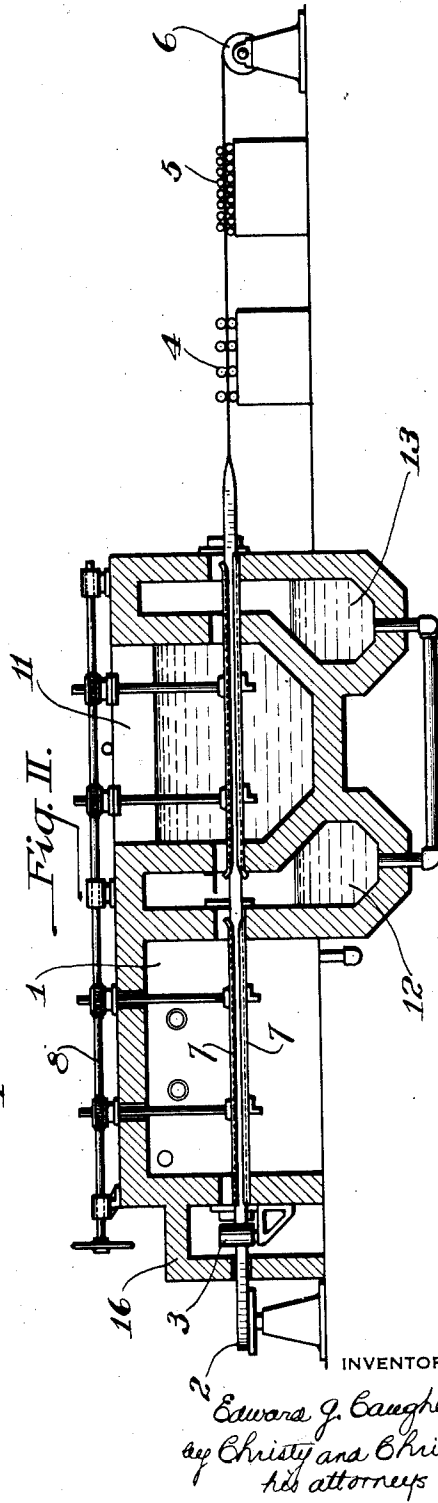
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ANNEALING APPARATUS

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ANNEALING APPARATUS.

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My invention relates to the annealing of metal and is found in the apparatus by the use of which annealing is effected. While the invention is of wider applicability, I shall show and describe it as practiced in the annealing of strip steel in continuous length. The objects of the invention are excellence of product and economy of use. This application is a division from an application filed by me February 23, 1926, Serial No. 89,856. The method of annealing which is performed in the use of this apparatus is the subject matter of a companion application filed November 18, 1926, Serial No. 149,122, a continuation of Serial No. 89,856, just mentioned. The apparatus in which my invention is found is illustrated in the accompanying drawings. Fig. I is a view of the apparatus in plan; Fig. II is a view in longitudinal and vertical section.

The annealing chamber 1 is made of such length that, under given conditions of speed and temperature, variable within permissible limits, annealing may be effected in a single passage of the material through it; in other dimensions the chamber will be sufficient to accommodate the material intended. The chamber walls will be formed of refractory material, and electric heating apparatus may be provided, to afford the desired temperature. By way of example, but merely by way of example under the foregoing statement, the chamber 1 may be twelve feet long, the temperature maintained within it may be 1400° Fahrenheit, and the speed of advance of material through the chamber may be three feet a second. Adaptation to varying gauge may be made by varying the speed and, within permissible limits, the temperature also. Another way of varying the heating effect, which will readily be understood by any engineer, is to provide a plurality of paths for material through the chamber and to feed material along one path or simultaneously along more paths than one.

The delivery to the annealing chamber may be, and preferably will be, directly from the last pass of the rolling operation. By way of alternative, the strip may be taken from a reel and such reel is indicated at 2 in Fig. II.

At the intake end of the apparatus is a pair of pinch rolls 3, and at the remote end of the apparatus may be either or both a cleaning machine 4 and a leveling machine 5, and, in addition to that, coiling means 6. By such instrumentalities a strip may be caused to progress continuously through the apparatus.

In place of the cleaning machine, leveling machine, and coiling means shown, a cold mill might manifestly be arranged at the delivery end, and the pull of the rolls be relied on to draw the material through the annealing apparatus. Or, again, cleaning machine and leveling machine being present, or other means for causing the material to advance, it may be sheared to desired lengths as it emerges from such means.

It is to be observed that the pinch rolls 3 feed the strip in vertical position. Within the annealing chamber is a guide consisting of two shallow U-shaped troughs 7 facing one another and adjustable one vertically above another by screws 8. These shallow troughs are adapted to engage the opposite upper and lower edges of the advancing strip, and guided by them the strip will advance while it is, to the fullest degree, exposed to atmospheric conditions within the annealing chamber. Furthermore, the vertical position affords rigidity against sagging and consequent change in gauge by stretching. The adjustability mentioned adapts the apparatus to material of varying width. The intake through which the strip enters the furnace may be a narrow slot, and the pressure conditions within the annealing chamber may be such that there always is an excess pressure in the chamber, and such as to prevent the ingress of atmospheric air.

The atmosphere within the annealing chamber will be non-oxidizing,—it may be pure nitrogen. It may be an inert atmosphere produced by the burning of a flame within the chamber, so that the oxygen of the atmospheric air present is eliminated to such degree that the remaining gas is inert. It might be an inert gas obtained by other means. It might even be a reducing gas. But let it be assumed that it is merely an inert gas produced in any suitable economical way. In Fig. I a gas container 9 is indicated, and a pump 10, in a circulation system which includes the annealing chamber. If the gas container holds gas under pressure, a

pressure-reducing valve will ordinarily be placed where the pump 10 is shown to be. By such means the pressure within the chamber 1 may be maintained slightly above atmospheric, say at an inch and a half above atmospheric.

Beyond the annealing chamber 1 is a cooling and coating tank 11. This cooling and coating tank is normally full, or substantially full of liquid such in character as to have no undesirable reaction with the hot metal introduced into it. Such a liquid is water. Another suitable liquid is an aqueous solution of sodium silicate (water glass). The strip advancing through a slit in the further wall of the annealing chamber 1 enters the body of liquid in tank 11, and emerges through the further wall of the tank 11. The liquid in the tank is not heated, otherwise than by the plunging of the strip material into it. In any case it is relatively cold.

In its passage through the tank the strip becomes cooled and it emerges at a temperature below that of undesired oxidation. If the liquid be water glass the strip emerges coated with water glass. This coating will continue upon it until it is removed in the cleaning machine 4. When it is removed the cold strip will be found to be bright and clean.

The wall structure which divides annealing chamber 1 from cooling tank 11 is orificed with a vertical slot or port of proper shape and size to allow the free passage of the strip of material under treatment, but with preferably little free space around the advancing strip. The walls of chamber and of tank are preferably separate walls of masonry with aligned and practically continuous openings. A pit 12 is formed external to the end wall of the tank, and to this pit liquid escapes in so far as it emerges through the orifice and through the space around the advancing strip.

The opposite end wall of the tank is similarly constructed and ported, and for like reasons a similarly constructed pit 13 is there provided. These two pits 12 and 13 are included in the circulation system shown in plan in Fig. I, which system includes also a sump 14 and a pump 15. The level of the liquid in chamber 11 is normally much above the openings through which the strip advances. And the openings in the walls through which the strip advances are, as has been said, narrow slits. By the construction indicated, the bath of liquid, replenished from suitable storage supply, will always be maintained at normal level. The spilling over into the pits will be relatively slight in any case.

With particular attention directed to the illustration afforded by Fig. II, it may be said that there is a double wall between an-

nealing chamber 1 and tank 11. And of the double wall the portion effective to divide annealing chamber from cooling tank is the second component in the direction of feed, that is to say the wall member which immediately defines the tank 11. The first component of the double wall serves in cooperation with the second to define the pit 12. The space between the two wall members and above the body of liquid within the pit is filled with inert gas and is indeed a continuation of the annealing chamber.

It will be observed that the same guide construction which is present in chamber 1 is present in chamber 11 also.

The intake from pinch rolls 3 to the annealing chamber 1 may be shielded by building a dog house 16 around the intake, including, if desired, the pinch rolls themselves, and maintaining within the dog house a non-oxidizing atmospheric condition.

I claim as my invention:

1. In apparatus for the continuous annealing of sheet metal, an annealing chamber, a pair of guides within the chamber adapted to engage a passing sheet along its opposite edges while leaving the medial surfaces of the sheet freely exposed to conditions within the chamber, and means for impelling a length of material through the chamber and between the guides.

2. Apparatus as defined in claim 1, the guides being relatively adjustable in their positions within the chamber.

3. Apparatus as defined in claim 1, the guides being arranged vertically, and adapted to receive and guide a sheet extending in vertical plane.

4. In apparatus for the continuous annealing of sheet metal the combination of an annealing chamber having a vertical and orificed end wall, a tank arranged adjacent the said annealing chamber having a vertical and orificed end wall, the orifices through the end walls of annealing chamber and of tank being aligned, a closed chamber whose opposite walls are formed by the vertical walls aforesaid of annealing chamber and of tank, means for maintaining within the tank a bath of liquid at a level higher than the orifice in the end wall of the tank, the said closed chamber being adapted to receive liquid escaping through the orifice in the end wall of the tank, and means for causing material to advance from the annealing chamber through the said aligned orifices and into the bath of liquid within the tank.

5. In apparatus for the continuous annealing of sheet metal the combination of an annealing chamber having a vertical and orificed end wall, a tank arranged adjacent the said annealing chamber having a vertical and orificed end wall, the orifices through the end walls of annealing chamber and of

tank being aligned, a closed chamber whose opposite walls are formed by the vertical walls aforesaid of annealing chamber and of tank, the said closed chamber being adapted to receive liquid escaping through the orifice in the end wall of the tank, means for circulating liquid from said closed chamber to said tank, and means for causing material to advance from the annealing chamber through the said aligned orifices and into the tank. 10

In testimony whereof I have hereunto set my hand.

EDWARD G. CAUGHEY.