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APPARATUS FOR THE MANUFACTURE OF SEAMLESS METAL TUBES

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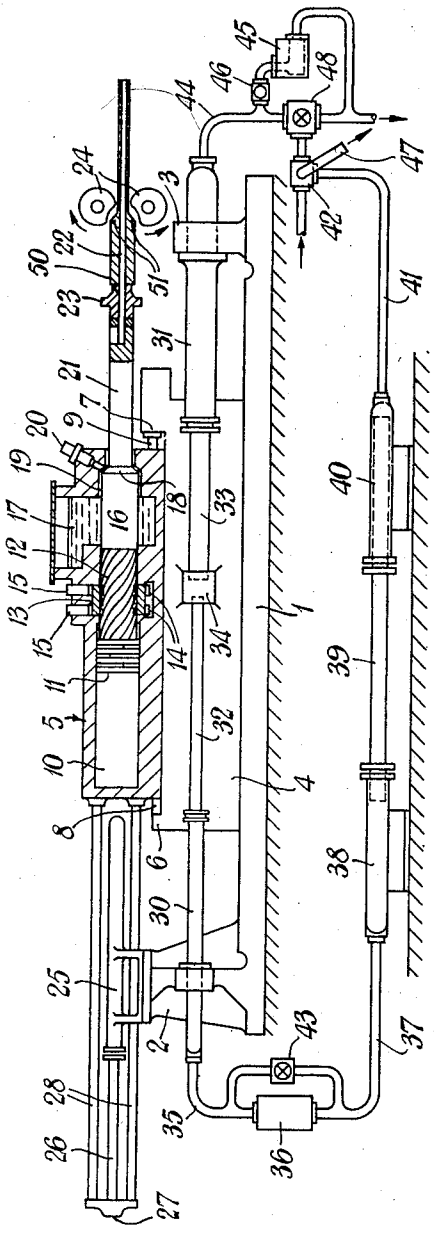

Fig. 1.

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APPARATUS FOR THE MANUFACTURE OF SEAMLESS METAL TUBES

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5 Claims. (Cl. 80—14)

This invention relates to apparatus for the manufacture of seamless metal tubes. More particularly it relates to pilger mill apparatus.

A pilger mill comprises a mandrel on which a heated open-ended cylindrical hollow or tube blank is placed and by which it is passed between a pair of driven grooved rolls having a peripheral gap therein. The mandrel is mounted on the movable part of resilient means and is forced backward to compress the resilient means as the rolls rotate and operate on the tube blank, the resilient means when the gap in the rolls is reached acting to move the mandrel forward. At the same time the resilient means and the mandrel are moved steadily forward together towards the rolls. It is desirable that this latter movement shall be at a constant velocity. In pilger mill apparatus it is known to provide the part of the resilient means on which the mandrel is mounted with a shouldered part which at the end of the forward movement caused by the resilient means forcibly engages a similarly-shaped shoulder or a wall provided on an extension of the compression part of the resilient means which is relatively fixed, thus communicating considerable shock to the latter part. To reduce this shock it has been arranged that the shouldered part shall move through a liquid container, formed at the front part of the relatively fixed part of the resilient means, into an aperture or cylinder of slightly larger diameter and drive the liquid therefrom into the container thus acting as cushioning or dashpot means when the mandrel is moved suddenly forward by the resilient means. Nevertheless, the shock transmitted to the control mechanism for the hydraulic apparatus which drives the mandrel steadily forward is considerable, with the result that the rate of movement or feed of the mandrel is found to vary considerably from the desired constant velocity and this adversely affects the quality of the work produced.

It is an object of the present invention to provide a pilger mill apparatus in which this shock is at least partly reduced.

The present invention relates to pilger mill apparatus of the kind (hereinafter referred to as "the kind described"), comprising peripherally grooved and gapped rolls, means for driving such rolls, a mandrel on which a tube blank can be placed and by which the blank is passed between the grooved and gapped rolls, a carriage supporting resilient means comprising a part which is movable forward and backward on the carriage and supports the mandrel and a companion part which is fixed relatively to the carriage, and driving means to move the carriage forward and backward.

It will be understood, or course, in regard to the terms "forward" and " backward" used herein to designate movements, that "forward" means in the direction in which the completed tubes pass from the apparatus and that "backward" has the opposite meaning.

According to the present invention, pilger mill apparatus of the kind described comprises a support table moveable forward and backward and having the carriage slidably mounted thereon to move with limited movement forward and backward with respect thereto, driving means to move the support table together with the carriage forward and backward and means operative to take up shock caused on the forward movement of the mandrel by the resilient means, and comprising a part connected to the carriage and a co-operative part fixed, for example to the ground.

Conveniently, the means operative to take up shock comprises a fluid-containing cylinder and a piston, one of these being connected to the carriage and the other being fixed.

Preferably, the support table is provided with projections to be engaged by the opposite ends of the carriage and between which the carriage is able to move.

The apparatus may have respective piston and cylinder devices to effect movement of the support table forward and backward, the cylinders being coaxial and either the pistons or the cylinders being fixed and the corresponding cylinders or pistons being connected to the support table.

One form of pilger mill apparatus according to the invention will now be described by way of example with reference to the accompanying diagrammatic drawing in which:

Figure 1 is a part sectional elevation of the apparatus.

As shown, the apparatus comprises a sole plate 1 fixed to the ground and having at the ends upstanding pillars 2 and 3. A support table 4 is mounted to slide forward and backward on the upper face of the sole plate 1 and a carriage 5 is mounted to slide backward and forward on the upper surface of the support table 4. The amount of relative movement between the support table and the carriage is of limited nature, being controlled by upstanding projections 6 and 7 at the ends of the table, cushioning blocks 8 and 9 being fixed to the projections and engaging opposite ends of the carriage. The latter is formed with a horizontal air cylinder 10 within which moves a piston 11 having at its front end an extension of which the portion 12 adjacent the piston has a series of helical grooves cut in its surface and which engage with helical grooves cut on the inner surface of a nut 13 rotatably supported on the carriage 5. The outer surface of the nut 13 is formed with ratchet teeth 14 which co-operate with spring loaded pawls 15 mounted on the carriage. The portion 16 of the extension of the piston 11 beyond the helical grooves at 12 passes through a container 17 for liquid, such as water, and has a conical shoulder 18 which is adapted to enter an aperture or space 19 having its inner end similarly conically shaped. The diameter of the space 19 is slightly greater than that of the portion 16 of the piston extension referred to and its wall preferably converges slightly towards its inner end. The container 17 forms part of the carriage 5 being in an extension from the wall of the cylinder 10. The portion 16 of the piston extension and the space 19 constitute a dashpot to cushion the outward movement of the piston 11, the liquid being forced out of the space between its wall and the wall of the part 16 as the latter moves into it. A pressure relief valve 20 controls an outlet from the end of the space 19 to permit escape of liquid when the pressure reaches a predetermined amount. The air cylinder 10 and the piston 11 constitute resilient means, of the nature already referred to, the piston being the movable part and the cylinder being considered as the companion part of such resilient means. The outer end 21 of the piston extension has the mandrel 22 connected to it. The mandrel extends through a stripper ring 23 and co-operates with the pilger rolls 24.

The rear end of the carriage 5 is connected to one part of means to take up shock the co-operating part being fixed to the ground. As shown, this means comprises as the latter part a hydraulic cylinder 25 fixed to

the top of the pillar 2 of the sole plate 1. The former part is a piston 26 movable in the cylinder 25 and fixed to a cross head 27 which is connected by rods 28, to the carriage 5. The normal hydraulic pressure in the cylinder is relatively low, for example 150 lbs. per square inch, but is, of course, raised considerably when the carriage is submitted to shock and is controlled to a predetermined value by the employment of a pressure relief valve in the feed circuit to the cylinder. Such arrangement is well known and it is not considered necessary to illustrate it.

Opposed co-axial hydraulic cylinders 30, 31 are mounted in the respective pillars 2, 3 of the sole plate 1 and the ends of their respective pistons 32, 33 engage an abutment 34 on the support table 4, the piston of the cylinder 30, termed the feed cylinder, acting to move the support table towards the pilger rolls 24 and the piston of the cylinder 31, termed the stripper cylinder, acting in the opposite direction. The feed cylinder 30 may be connected by duct 35 to a hydraulic accumulator system after well-known manner or, as shown, to a variable delivery type of hydraulic pump 36 of known form. The latter is connected by duct 37 on its suction side with a further and fixed hydraulic cylinder 38 having a piston 39 which is common to a still further and fixed hydraulic cylinder 40 which, through duct 41, is supplied with pressure liquid from a hydraulic accumulator system (not shown) through a control valve 42. This pressure liquid may be water whilst that in the hydraulic cylinder 38 and the feed cylinder 30, may be oil. Means such as a restricted and adjustable orifice type hydraulic valve 43 of known form, may be connected in parallel with the variable delivery type hydraulic pump 36 aforesaid so that the latter acts as a quantitative measuring device for the feed cylinder 30, and is only called on to deal with a part of the volumetric requirements of the feed cylinder. The stripper cylinder 31 is connected by duct 44 to exhaust through a valve 45 and means which will offer a constant resistance to the travel of the stripper cylinder ram. Such means may be as normally employed for such a purpose, namely a second hydraulic valve 46 having a restricted and adjustable orifice. The control valve 42 which controls the supply of hydraulic liquid to the cylinder 40 also controls the connection of that cylinder to exhaust at 47 and the connection of hydraulic liquid, through another valve 48, to the stripper cylinder 31 when the latter is disconnected from exhaust.

In the operation of the apparatus, a tube blank 50 having been placed on the mandrel, the feed cylinder and piston 30, 32 are operated to effect forward movement of the support table 4 and with it the carriage 5 and mandrel 22 to introduce the blank into the pilger rolls 24. As the rolls act on the blank the piston 11 of the resilient means is moved backward into the air cylinder 10 until the gaps 51 in the rolls are reached, whereupon the piston moves suddenly outwards under the pressure in cylinder 10 causing shock on the carriage 5. This shock however, is taken up by the piston and cylinder apparatus 25, 26 connected to the carriage and is thus transmitted to the ground, though a certain amount will be received by the support table 4 through the forward cushioning block 9. During this time, the mandrel 22 has been moved steadily forward by the feed cylinder piston 32 and a further part of the blank is therefore acted on. At the same time the mandrel is turned about its axis by the interaction of the helical grooves at 12 on the

aforesaid piston extension and in the nut 13 thereby bringing the work to a different radial relationship with the grooves in the rolls 24. When the tube has been completed the stripper cylinder and piston 31, 33 are operated to remove the tube from the mandrel and return the support table 4 and carriage 5 to the commencing position for the mandrel to receive another tube blank.

What I claim is:

1. Pilger mill apparatus for the production of seamless metal tubes, comprising a set of pilger rolls, a support table movable forward and backward with respect to said rolls, a carriage rested slidably on said support table, stops disposed on said support table so as to allow only limited sliding movement of said carriage on said support table, means applied directly to said support table for feeding it together with said carriage constantly towards said rolls until the latter have completed the rolling of a tube, a mandrel carrier mounted to be movable in the direction of its axis on said carriage, resilient means embodied in said carriage and activated on rearward axial movement of said mandrel carrier on said carriage under the action of said rolls on their rolling stroke, and means operative to take up thrust on forward axial movement of said mandrel carrier under the reactive action of said resilient means comprising a first braking means operative between said mandrel carrier and said carriage and a second braking means operative between said carriage and a fixture on the ground, both of said braking means being symmetrically disposed about the axis of said mandrel carrier.

2. The pilger mill apparatus of claim 1 wherein the second braking means comprises a hydraulic cylinder and piston combination of relatively low pressure rating disposed co-axially with the mandrel carrier on a pedestal fixed with respect to the ground.

3. The pilger mill apparatus of claim 1 wherein the support table is provided at its front and rear ends with projections operative as stops to determine the limited sliding movement of the carriage on such table and cushioning means are disposed between said projections and the corresponding ends of the carriage.

4. The pilger mill apparatus of claim 1 wherein respective oppositely acting hydraulic cylinders and pistons are provided for feeding the support table towards the pilger rolls and returning the table at the completion of the rolling of a tube, said cylinders and pistons all being disposed co-axially and their axis being parallel to the axis of the mandrel carrier.

5. The pilger mill apparatus of claim 4 and comprising stop valves operative to provide restricted orifice release of hydraulic medium from the respective oppositely acting hydraulic cylinders used for feeding and returning the support table.

References Cited in the file of this patent

UNITED STATES PATENTS

738,067	Reimann	Sept. 1, 1903
811,526	Stiefel	Jan. 30, 1906
869,283	Winter	Oct. 29, 1907
1,041,661	Nowak	Oct. 15, 1912
1,833,990	Dreyer	Dec. 1, 1931

FOREIGN PATENTS

9,880	Great Britain	May 10, 1905