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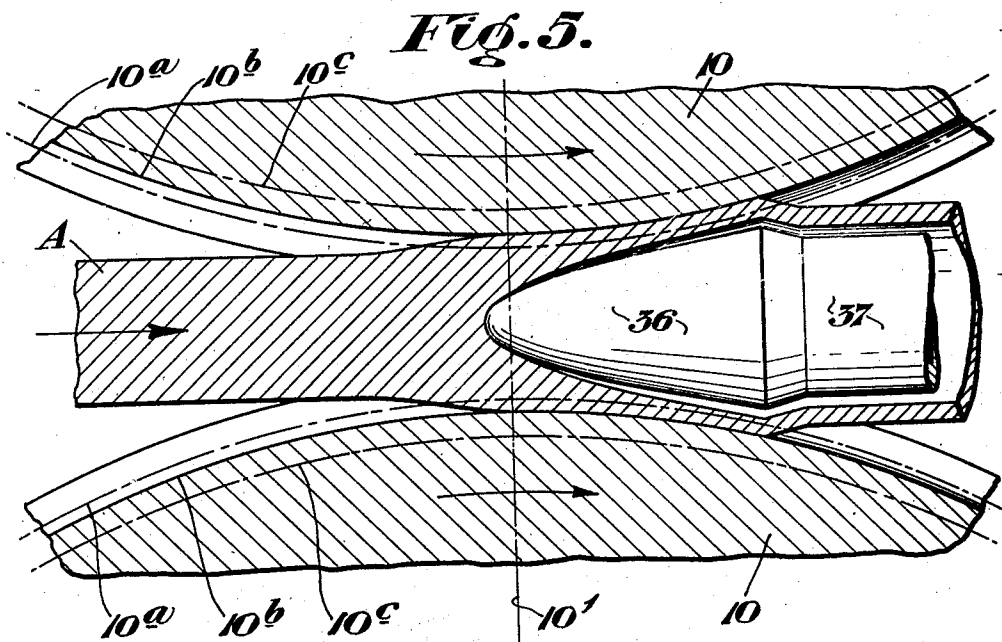
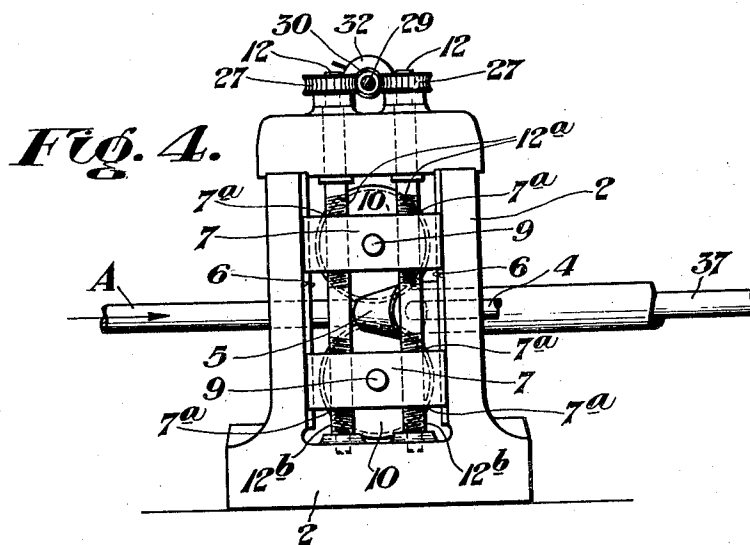
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APPARATUS FOR PROCESSING METAL WORKPIECES

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APPARATUS FOR PROCESSING METAL
WORKPIECES

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6 Claims. (Cl. 80—13)

This invention relates to the manufacture of seamless pipes and tubes from solid rounds, or "billets", and any and all of the operations used therein, such as "piercing", "expanding", "elongating", "reducing", etc., or any combination thereof.

In the manufacture of seamless pipes and tubes by the use of power-actuated metal-working rolls, considerable difficulty has been experienced in obtaining a maximum yield of flawless products, or work-pieces. The necessary processing of the metal of the work-piece by the metal-working rolls must be very carefully controlled, otherwise "upsetting" will occur, or grooves and ridges, annular bulging, tearing, uneven wall thickness, undesirable increased diameter, etc., will appear in the product. In addition, a great many other limitations are encountered, such as the inability of the metal-working rolls to effect the desired amount of processing without resorting to numerous subsequent operations, necessary slowness of operation, and the tendency of most metal-working rolls to draw metal into the inlet of the roll pass at a greater rate of speed than that at which it is expelled from the outlet. When very substantial reductions or large amounts of metal displacement are attempted, the metal of the work-piece is considerably reduced in its longitudinal movement between the rolls, and it is therefore highly desirable to hasten the delivery of metal through the outlet of the roll pass in order to prevent "crowding".

There have been some recent developments which overcome a great many of the difficulties referred to, and which particularly increase operating speeds for all types of processing mills. In accordance with these new developments, guide members are positioned intermediate the usual metal-working rolls and consist of power actuated grooved rolls rotating on axes at substantial right angles to the line of the pass defined by the metal-working rolls, and each having a peripheral velocity in the direction of, and greater than, the longitudinal travel of a work-piece progressing therethrough.

The effect of these rotating guide rolls is to divert longitudinally the peripheral flow of the metal of the work-piece, which is occasioned by the metal-working rolls. In order to satisfactorily accomplish this effect, the guide rolls should cause a tension, or at least materially reduce the compression, of the metal in that portion of the pass wherein the greater part of the processing, or displacement of the metal, is done.

The guide rolls are positioned vertically rela-

tive to one another in such manner as to permit the work-piece to assume an elliptical shape, or "ovality". If a sufficient distance between the working surfaces of the guide rolls is not provided, the work-piece will "freeze" on the mandrel. On the other hand, if the distance between the working surfaces of the guide rolls is too great, the metal of the work-piece will be excessively distorted and will not withstand the repeated bending in its changes to and from cylindrical and elliptical formation. That is to say, the pressure of the guide rolls should be as small as possible, but at the same time the distortion of the work-piece must be limited as much as possible.

If the metal of the work-piece, either in whole or in part, is not in a desired state of plasticity (occasioned by insufficient heating or characteristics inherent in the metal,) the guide roll frictional contact should be lessened. If, on the other hand, the metal is very highly heated and therefore unusually plastic, its resistance to the metal displacing effect of the work rolls will decrease. The metal will therefore have a tendency toward excessive and injurious deformation, or "ovality", and while, as before stated, the pressure of the guide rolls for limiting deformation should ordinarily be as slight as possible, the plasticity of the metal in this instance will permit the decrease of the injurious deformation by shortening the distance between them. The effect of this increased guide roll frictional contact will be to divert the peripheral flow occasioned by the metal-working rolls into a longitudinal direction at an increased rate.

One object of the invention is the provision of a novel apparatus for processing metal work-pieces in such manner as to consistently obtain perfect pipes and tubes of the "seamless" type, and by the use of which the metal of the work-piece is processed by pressures in direct ratio to its plasticity.

Another object is to provide a novel means for controlling the distortion, or "ovality", necessary in seamless tube methods in such manner as to completely obviate the possibility of flaws or defects in the processed work-piece accruing from the usual inability to cope with its varying characteristics.

A further object is to provide a novel apparatus of the class described in which the metal of the work-piece is diverted from a tangential path of travel imposed by the conventional helically-acting metal working rolls into a longitudinal direction, the diversion being exerted by a

pressure, the amount of which is determined by the plasticity of the metal.

A still further object is to provide a novel apparatus for automatically controlling the pressure of diversion in accordance with the temperature of various areas in single, or successive, work-pieces, separate means compensating for the varying decrease of plasticity characteristic of different metals at the same temperature.

These and further objects will be apparent after referring to the drawings, in which:

Figure 1 is an end elevation showing part of the apparatus of the invention in section.

Figure 2 is a plan.

Figure 3 is a sectional view on the line III—III of Figure 1.

Figure 4 is an elevation on the line IV—IV of Figure 1.

Figure 5 is an enlarged vertical sectional representation of the results obtained by the practice of the invention.

Referring more particularly to the drawings, the numeral 2 designates a housing which is provided with a pair of journals 3 for rotatably supporting a pair of shafts 4, each of which having secured to its end a conventional metal-working roll 5 such as is commonly used in the manufacture of seamless pipes and tubes.

The housing 2 is machined in such manner as to provide a vertical way 6 on either side of the metal-working rolls 5. A pair of sliding blocks 7 are adapted for movement in one of the vertical ways 6, and a similar pair of sliding blocks 8 adapted for movement in the other of the ways 6. Each of the blocks 7 and 8 is suitably apertured to provide a bearing for one end of a shaft 9 to which there is secured a grooved guide roll 10.

A pair of vertical shafts 12 are journaled on one side of the guide rolls 5 and provided with intermediate upper and lower threaded portions 12^a and 12^b, respectively, of opposite pitch. A similar pair of vertical shafts 14 are journaled in the housing 2 on the other side of the metal-working rolls 5 and provided with intermediate upper and lower threaded portions 14^a and 14^b, respectively, likewise of opposite pitch. The vertically sliding blocks 7 are screw threaded, as at 7^a, to cooperate with the upper and lower threaded portions on the shafts 12, 12^a and 12^b, respectively, and the vertically sliding blocks 8 are similarly screw threaded, as at 8^a, to cooperate with the upper and lower threaded portions on the shafts 14, 14^a and 14^b, respectively. A motor 15 is disposed adjacent the housing 2 and provided with a transmission unit 16, the latter having a lower driven shaft 17 and an upper driven shaft 18. A gear 19 is secured to the lower driven shaft 17, and a similar and cooperating gear 20 secured to the upper driven shaft 18, and are of such size as to be constantly in mesh. A drive shaft 21 is connected to the lower driven shaft 17 of the transmission unit and to the lower of the guide roll shafts 9 by means of "wobbler" connections 22 and 23, and a similar drive shaft 24 is secured to the upper driven shaft 18 of the transmission unit and the upper of the guide roll shafts 9 by means of "wobbler" connections 25 and 26.

A worm gear 27 is secured to the upper end of each of the vertically disposed shafts 12, and a similar worm gear 28 is secured to the upper end of each of the vertically disposed shafts 14. The worm gears 27 and 28 are rotated by means of a shaft 29 which is suitably journaled on top

of the housing 2 and provided with worms 30 and 31, respectively, which are in constant engagement with the worm gears. The shaft 29 receives rotation from a selective gear reduction transmission unit 32 which is associated with a motor 33, both of the latter being suitably supported adjacent the top of the housing 2.

The selective gear reduction transmission unit 32 is provided with a gear changing lever 32^a for modifying the final effect of the motor 33.

The motor 33 is suitably controlled by a motor control unit generally indicated at 34, the latter having associated therewith a heat-responsive circuit making-and-breaking device 35, such as a conventional photoelectric control unit.

The heat-responsive circuit making-and-breaking device 35 is "trained" on a work-piece A prior to its entry between the metal-working rolls 5 and the guide rolls 10. The motor control unit 34 is provided with any of the well known types of starting and stopping devices, timed relays and reversing media for controlling the operation of the motor 33 to rotate the vertically disposed shafts 12 and 14 in such manner as to move the vertically sliding blocks 7 and 8 into and out of positions that are in direct ratio to the temperature of the work-piece A. If desired, the heat-responsive circuit making-and-breaking device 35 may be disconnected and the motor control unit 34 actuated manually by an operator who is in a position to closely observe the condition of the work-piece.

A tapered piercing plug 36 is supported on a mandrel bar 37 and disposed intermediate the metal working rolls 5 and the guide rolls 10.

In operation, the work-piece A, in the present instance a solid round or "billet" which is to be pierced, is introduced into the metal-working rolls 5, where it is "necked down" to open the central fibers of the "billet" preparatory to being forced over the point of the piercing plug 36. This "necking down" operation displaces the metal of the work-piece into vertical deformation, or "ovality", in addition to which a tendency toward elongation will be present. The guide rolls 10 are continuously rotated at a more rapid rate than the rotation of the metal-working rolls 5, and tend to divert successive increments of metal of the work-piece from tangential into longitudinal movement and serve at the same time to prevent excessive distortion, or "ovality".

As before mentioned, if the metal of the work-piece, either in whole or in part, is not in a desired state of plasticity, the guide roll frictional contact should be lessened. On the other hand, if the metal is very highly heated, and therefore unusually plastic, its resistance to the metal displacing effect of the metal-working rolls will decrease and the guide rolls 10 may therefore be brought closer together to more closely restrict the vertical deformation of the work-piece.

Referring to Figure 5 of the drawings, the number 10' indicates the vertical center line of the guide rolls 10 with respect to the piercing plug 36, while the solid lines 10^b represent the "mean" positions of the guide rolls with respect to one another. To cope with the varying conditions referred to, the guide rolls are graphically represented as being spaced toward and away from the piercing plug 36 by the dotted lines 10^a and 10^c, respectively, it being understood, of course, that these positions are nominal and intended only for the purposes of illustration.

As each tube indication is recorded by the heat-responsive device 35, the motor 33 is operated

(through the motor control unit 34 and the gear-
ing hereinbefore referred to) to obtain the proper
relative positions of the guide rolls.

The lever 32^a of the selective gear reduction
unit 32 is adjusted to compensate for varying
degrees of plasticity characteristic of different
metals at the same temperature.

It is to be understood that the elements of the
motor control unit 34 and the heat-responsive
circuit making and breaking device 35 are merely
described to illustrate conventional types of
apparatus for controlling the motor 33, and form
no part of the present invention other than as
"means"; that any secondary means for modi-
fying the operation of the motor 33 may be used
in lieu of the selective gear reduction transmission
unit 32; and that while I have shown and de-
scribed one specific embodiment of several other
aspects of the invention I do not wish to be limited
exactly thereto, since various modifications may
be made without departing from the scope of my
invention, as defined in the following claims.

I claim:

1. Apparatus for processing tubular work-
pieces comprising, in combination, a pair of
power-actuated metal-working rolls, means for
continuously diverting the tangential flow of the
metal of the work-piece into a longitudinal di-
rection, means for moving said diverting means
toward and away from said work-piece in accord-
ance with the temperature of the work-piece, and
secondary regulating means for further modify-
ing the position of said diverting means in ac-
cordance with the resistance to displacement of
the metal of the work-piece.

2. Apparatus for processing tubular work-
pieces comprising, in combination, a pair of
power-actuated metal-working rolls, at least one
guide roll having its axis substantially at right
angles with respect to the pass line defined by
said metal-working rolls, means for rotating said
guide roll with its periphery in contact with the
work-piece, means for automatically moving said
guide roll toward and away from said work-piece
in direct accordance with the temperature of said
work-piece, and secondary regulating means for
further modifying the position of said guide roll
in accordance with the resistance to displacement
of the metal of the work-piece.

3. Apparatus for processing tubular work-
pieces comprising, in combination, a pair of
power-actuated metal-working rolls, at least one
guide roll having its axis substantially at right
angles with respect to the pass line defined by

said metal-working rolls and adapted for vertical
movement relative thereto, means for rotating
said guide roll with its periphery in contact with
the work-piece, means for moving said guide roll
vertically in accordance with the temperature of
said work-piece, and regulating means for modi-
fying said last named means in accordance with
the resistance to displacement of the metal of the
work-piece.

4. Apparatus for processing tubular metal
work-pieces comprising, in combination, a pair
of power-actuated metal-working rolls, means for
continuously diverting the tangential flow of the
metal of the work-piece into a longitudinal di-
rection, means for automatically moving said
diverting means toward and away from said
work-piece in such manner as to minimize the
distortion of the metal, and secondary means for
modifying the effect of said last named means.

5. Apparatus for manufacturing pipes and
tubes comprising a plurality of power-actuated
metal-working rolls, said metal-working rolls
being constructed and arranged to move the
work-piece longitudinally and work the material
of which it is composed, whereby portions of the
work-piece are caused to bulge intermediate the
metal-working rolls, at least one power-actuated
guide roll disposed intermediate said metal-
working rolls for limiting the bulging of the ma-
terial of the work-piece and moving it longi-
tudinally of its axis, in combination with means
for registering the temperature of the work-piece,
and means operated by said temperature-register-
ing means for moving said power-actuated guide
roll toward and away from the work-piece.

6. Apparatus for manufacturing pipes and
tubes comprising a plurality of power-actuated
metal-working rolls, said metal-working rolls
being constructed and arranged to move the
work-piece longitudinally and work the material
of which it is composed, whereby portions of the
work-piece are caused to bulge intermediate the
metal-working rolls, at least one power-actuated
guide roll disposed intermediate said metal-
working rolls for limiting the bulging of the ma-
terial of the work-piece and moving it longi-
tudinally of its axis, in combination with means
for registering the temperature of the work-piece,
means operated by said temperature-registering
means for moving said power-actuated guide roll
toward and away from the work-piece, and sepa-
rate means for modifying the operation of said
last named means.

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