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D. S. BELL ET AL

2,307,191

APPARATUS FOR ROLLING INTERNALLY FLANGED ANNULI

Original Filed Dec. 14, 1938 2 Sheets-Sheet 1

Fig. 1.

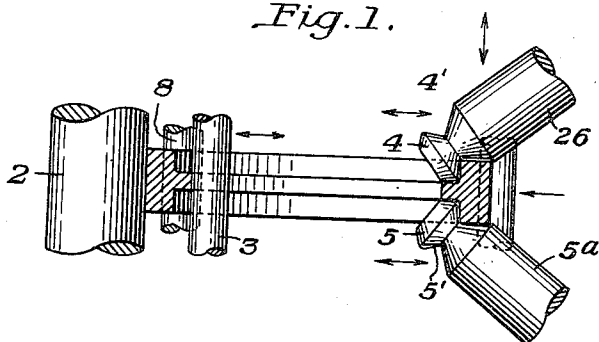


Fig. 2.

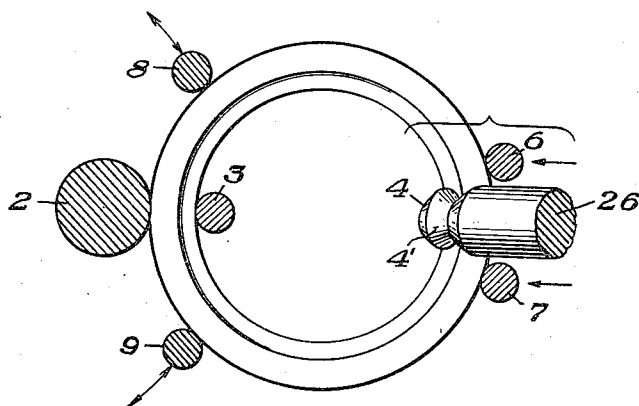


Fig. 3.

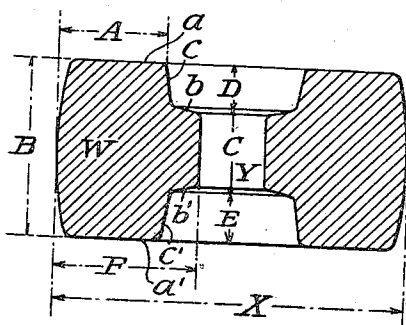
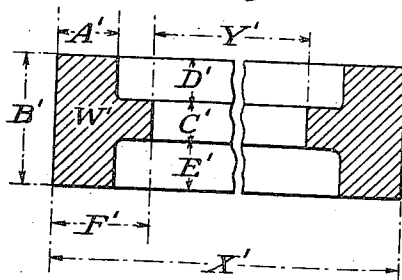


Fig. 4.



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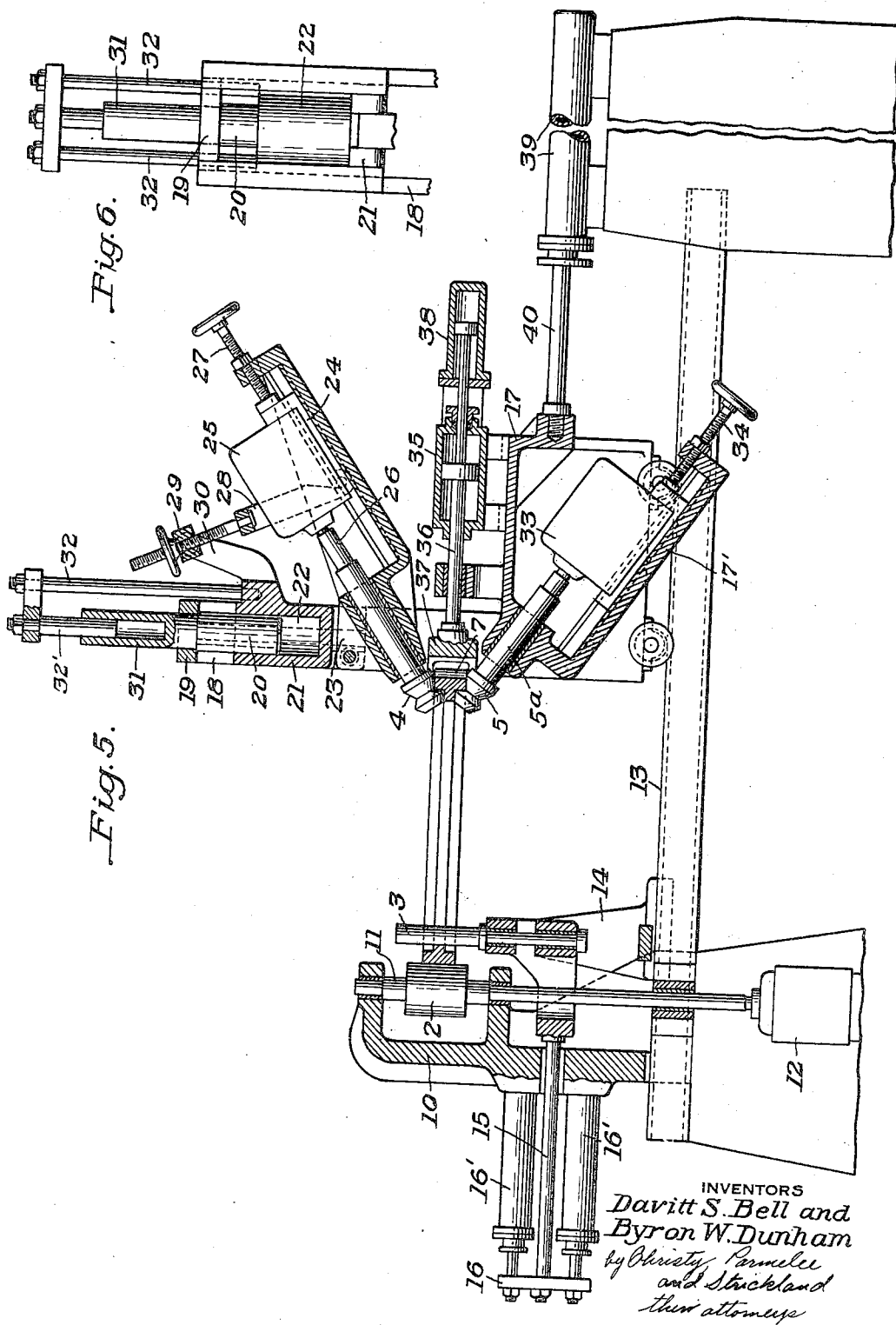
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APPARATUS FOR ROLLING INTERNALLY FLANGED ANNULI

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Original application December 14, 1938, Serial No. 245,634. Divided and this application July 25, 1941, Serial No. 404,032

4 Claims. (Cl. 80—5)

This invention is for an apparatus for rolling annuli which have internally projecting flanges thereon. The present invention is for an improvement in machines of the general type disclosed in United States Patent No. 1,350,057, granted August 17, 1920, to F. B. Bell, and this application constitutes a division of our copending application Serial No. 245,634, filed December 14, 1938, now Patent No. 2,280,783. While ring mills have heretofore been extensively used in the rolling of annuli of various cross sections, annuli which are internally flanged have, prior to the present invention, been produced largely by die-forging operations. Some success has heretofore been achieved through the use of ring mills but because of peculiar conditions which are encountered in rolling a pierced bloom from its original form to an internally flanged ring of many times the diameter of the original blank, ring mills as heretofore designed have not been well adapted to the purpose.

The present invention provides a ring mill specially adapted for the rolling of internally flanged annuli. It provides a mill of this character in which two separate rolling operations are carried on at the same time so as to properly correlate the elongation of the peripheral portion of the blank to the elongation of the portion of the blank which forms the internal flange. In common with other rolling mills of this general character, the apparatus comprises a main roll whose position is fixed and which bears against the periphery of the blank. Cooperating directly with the main roll is a pressure roll which is movable radially toward or away from the main roll. One roll pass is provided between the main roll and the pressure roll. Cooperating with the main roll and the pressure roll but positioned for adjustment independently thereof is a carriage which is movable toward and away from the main roll and on which are mounted upper and lower edging rolls, these edging rolls being shouldered to conform to the shape to be produced. One of these edging rolls is movable rectilinearly toward and away from the other edging roll. Provided on the same carriage as the upper and lower edging rolls are wheel rolls which may be moved relatively to the carriage toward or away from the edging rolls in a horizontal direction. Another roll pass is provided between the two edging rolls, while an additional pass is provided between the transverse faces of the edging rolls and the wheel rolls.

Our invention may be more fully understood by

reference to the accompanying drawings, in which—

Figure 1 is a more or less schematic view showing a side elevation of the roller arrangement of the ring mill constituting the present invention;

Figure 2 is a top elevation of the arrangement shown in Figure 1;

Figure 3 is a view showing a typical blank or bloom in the form in which it is originally made up for reduction in the mill;

Figure 4 is a similar view of the completed blank;

Figure 5 is a longitudinal section showing more or less schematically the complete ring mill construction; and

Figure 6 is a detail view showing an elevation of the arbor and support for the upper edging roll of the ring mill shown in Figure 5.

First referring to Figures 1 and 2, the apparatus employed comprises a power-driven main roll 2 adapted to bear against the periphery of the bloom or blank. Cooperating directly with the main roll 2 is a pressure roll 3. The pressure roll 3 is supported for movement in a direction toward or away from the main roll 2 as indicated by the double-ended arrow in Figures 1 and 2. The roll pass provided between the main roll 2 and the pressure roll 3 determines the reduction of the dimension F' of Figure 3 to the dimension F of Figure 4. The rolling of the blank between these rolls 2 and 3 effects reduction in the cross-section of the blank in the plane of the flange of the blank. Acting in conjunction with the rolls 2 and 3 are upper and lower edging rolls 4 and 5. These rolls 4 and 5 have their axes inclined toward each other and they are in the same vertical plane so that the roll 4 is located directly above the roll 5. The two rolls 4 and 5 are diametrically opposite the rolls 2 and 3. For rolling the particular shape illustrated in Figures 3 and 4 the upper edging roll 4 has a shouldered work-engaging portion 4' and the lower edging roll 5 has a similar shouldered working portion 5'. Roll 4 contacts the surfaces a, b and c of the blank or bloom of Figure 3. The working portion of the roll 5 contacts the surfaces a', b', and c' of the blank. The two edging rollers are supported on a carriage as will be more fully hereinafter described so that they can be moved toward and away from the main roll 2. In the operation of rolling they are moved away from the main roll 2 as the blank elongates, i. e., as its diameter increases. Equidistantly spaced to each side of the edging rolls 4 and 5 are pressure rolls 6 and 7

which we designate as wheel rolls and which bear against the periphery of the blank. As will hereinafter more fully appear, the wheel rolls are mounted on the same carriage as the edging rolls 4 and 5 so that they may be moved toward and away from the main roll 2. In addition to this they are mounted so that they can be moved in the direction of the arrows of Figure 2 toward and away from the working portions of the edging rolls. It is through the manipulation of the wheel rolls 6 and 7 toward the shouldered terminal portions of the edging rolls 4 and 5 that the change of dimension A in Figure 3 to A' in Figure 4 is effected. The combination of edging and wheel rolls effects reduction in a radial direction in that portion of the blank above and below the plane of the flange. Furthermore, the upper edging roll 4 is mounted for rectilinear vertical movement toward and away from the lower edging roll. It is through this vertical relative movement that the dimension B of Figure 3 to the dimension B' in Figure 4 is effected, and dimension C in Figure 3 is reduced to C' in Figure 4, dimension C' being the thickness of the flange. Through the joint manipulation and action of all of the rolls, the over-all dimension of the blank of Figure 3 is extended to X' of Figure 4 and the internal diameter, dimension Y in Figure 3, is extended to Y' in Figure 4.

In addition to the various rolls mentioned, the ring mill also has guide rolls 8 and 9 which are best shown in Figure 2 and which bear against the periphery of the blank and which function to keep the blank in a truly circular shape as it is rolled. The guide rolls 8 and 9 are supported for movement in an arbor as indicated by the arrows in Figure 2.

The machine itself comprises a stationary frame member 10 providing bearings for a vertical shaft 11 on which the main work roll 2 is mounted. A motor 12 is provided for driving the main work roll. The machine has a horizontally extending bed 13. Supported on the bed 13 is a slidable stand 14 having a vertical spindle thereon which carries the pressure roll 3, the pressure roll 3 having a diameter smaller than the diameter of the main roll 2. Connected to the stand 14 is a pull rod 15 whose other end is connected to a cross-head 16. This cross-head has pistons which operate stationary hydraulic cylinders 16' which cylinders are mounted on the stationary frame 10. The arrangement is such that when the cylinders 16 are operated the slide 14 may be moved back and forth for moving the pressure roll 3 toward the main roll 2.

Also mounted on the bed 13 for movement therealong is a carriage 17. This carriage has a vertically extending arbor 18 at its forward end. Mounted in the arbor is a cross-head 19 having a vertical piston 20. A vertically movable slide 21 is slidably supported by the arbor and it is provided with a vertical cylinder 22 which cooperates with the piston 20, the piston 20 being fixed and the cylinder being movable. Pivotaly suspended from the lower end of the slide 21 is a bracket 23 on which is mounted a supporting plate 24. The supporting plate 24 has a motor 25 thereon. The motor 25 drives a shaft 26 and on the lower free end of the shaft 26 is the upper edging roll 4. A screw adjustment 27 enables the motor with the shaft 26 to be moved in the direction of the axis of the shaft to advance or retract the upper edging roll.

The supporting plate 24 is suspended from a yoke 28. The upper part of this yoke is in the

form of a threaded extension which passes through a guide block 29 on an arm 30, projecting upwardly and rearwardly from the slidable cross-head 21. A hand wheel on the upper end of this threaded extension enables the yoke to be raised or lowered to adjust the angularity of the support 24 and the shaft 26.

Supported on the cross-head 19 is an upwardly extending cylinder 31. A piston, supported by pull-back rods 32, operates in the cylinder 31, this piston being designated 32'. The cylinder 31 in the piston 32' constitutes a pull-back mechanism for lifting the slide 21 and the mechanism suspended therefrom, while the cylinder 22 constitutes means for applying downward pressure to the upper edging roll during the rolling operation.

This construction enables the upper edging roll to be moved up and down in a vertically rectilinear direction. As the same time the angles of the upper edging roll may be adjusted for any particular rolling operation or for any particular shape of upper edging roll 4.

The carriage 17 is also provided with an inclined support 17' for a motor 33 which drives shaft 5a on the upper terminal of which is mounted the lower edging roll 5. A screw mechanism 34 enables the motor 33 in the shaft 5a to be adjusted in an axial direction.

The carriage 17 also supports a fixed horizontal cylinder 35 which operates a piston rod 36. On the forward end of the piston rod 36 is a yoke 37. This yoke, which extends transversely to each side of the piston rod 36, provides a support for the wheel rolls 6 and 7. In conjunction with the cylinder 35 there is a pull-back cylinder 38. By the introduction of fluid into the cylinder 35 the piston 36 may be moved relatively to the carriage to determine the position of the wheel rolls 6 and 7 with relation to the edging rolls 4 and 5. The pull-back cylinder 38 provides for retracting the wheel rolls 6 and 7 from an operating position.

The whole carriage 17 is, during the operation of rolling, gradually moved away from the main roll 2. For effecting this operation of the carriage we may provide a fluid pressure cylinder 39 having a piston with a piston rod 40. A forward end of the piston rod 40 is connected with the carriage 17. The construction is such that by operation of the cylinder the carriage 17 can be reciprocated along the bed of the machine.

We have illustrated the entire mechanism in a simple and schematic form to illustrate in a simple manner the important features of novelty in the machine and various changes may, from an engineering standpoint, be made in the construction of various parts. An important difference between the present invention and the construction shown in the said patent to F. B. Bell No. 1,315,057 is the provision of means for moving the upper edging roll 4 up and down in a direction parallel with the axis of the main roll 2. This rectilinearly vertical movement of the upper edging roll with respect to the lower one provides an important advantage in the rolling of a flanged annulus. A further important difference is the fact that the upper edging roll, in addition to being movable up and down in a direction parallel with the axis of the main roll, may also be adjusted to a desired angular inclination and retained at this inclination so long as desirable through the rolling operation. By having the upper edging roll move vertically relatively to the lower one, the reduction in the piece being rolled caused by the upper roll being moved down occurs

at a controlled and uniform rate whereas in an apparatus as disclosed in the said prior Bell patent where the upper edging roll moves through an arc unequal reduction occurs by reason of the arc travel of the upper edging roll.

In the operation of the machine the blank shown in Figure 3 is placed between the main roll 2 and the pressure roll 3 with the pressure roll projecting through the opening in the center of the blank. At this time the carriage 17 is in a position where the bottom face of the blank will rest on and be supported by the lower work roll 5. As the reduction of metal takes place, causing the diameter of the blank to be extended, the carriage 17 is moved to the right as viewed in Figure 5 away from the main roll. In the operation of rolling the reduction of the rim portion of the blank is accomplished by causing the wheel rolls 6 and 7 to move toward the edging rolls as viewed in Figures 2 and 5, even though the carriage 17 as a unit is, at the same time, moving away from the main roll 2. Reduction of the rim portion as well as reduction of the flange is also accomplished by vertical movement of the upper edging roll toward the lower edging roll through the operation of the cylinder 22 and the piston 20. As previously pointed out, reduction of the metal lying in the plane of the flange of the annulus, i. e., the dimension F of Figure 3 and F' of Figure 4 is effected through the movement of the pressure roll 3 toward the main roll 2, this being accomplished by causing the stand 14 to be moved to the left as viewed in Figure 5.

Thus, in carrying out the operation of rolling an internally flanged blank, one roll pass, i. e., the pass between the rolls 2 and 3, gives a separately regulated application of rolling pressure to the blank in the plane of the flange. The height of thickness of the rim and the flange is determined by the movement of the upper edging roll toward the lower one, while the thickness of the flange, i. e., the dimension A of Figure 3 and A' of Figure 4 is determined by the manipulation of the wheel rolls 6 and 7 with reference to the shouldered edging rolls 4 and 5. The three separate adjustments of the rolls are coordinated, as more fully explained in our said Patent No. 2,280,783, to secure the controlled reduction of each section of the blank.

In the drawings we have illustrated the invention as applied to the rolling of an annulus of a generally T-shaped cross section in which the leg of the T constitutes the internally projecting flange. By proper selection of the edging rolls or of other rolls the mechanism may also be used for the rolling of rings of L-shaped section or of Z-shaped section or of other shape. It will also be understood that the mechanism itself is more or less schematically shown and that various changes and modifications may be made in the construction and design thereof within the contemplation of our invention and under the scope of the following claims.

We claim:

1. A ring mill for rolling internally flanged annuli having a main roll and a pressure roll, one of which is movable toward and away from the other, and having a pair of edging rolls with oppositely inclined axes, and with a necked-in portion providing intersecting horizontally and vertically extending rolling faces on each roll, and means for moving one of the edging rolls during the rolling operation in a straight line

with respect to the other roll in a direction parallel with the axis of the main roll whereby the angularity of the rolls remains constant as one is moved relatively to the other.

2. A ring mill for rolling internally flanged annuli having a main roll and a pressure roll, one of which is movable toward and away from the other, and having edging rolls with oppositely inclined axes and which are necked-in to provide two intersecting rolling faces on each roll, and means for moving one of the edging rolls during the rolling operation in a straight line with respect to the other roll in a direction parallel with the axis of the main roll whereby the angularity of the rolls remains constant as one is moved relatively to the other, and other means for adjustably varying the angularity of one of the rolls with respect to the other.

3. A ring rolling mill for the rolling of internally flanged annuli comprising a vertical main roll, a vertical cylindrical pressure roll cooperating with the main roll, the main roll and the pressure roll forming a pass for reducing the section being rolled in the plane of the flange of the annulus only, and a carriage movable horizontally toward and away from the main roll, said carriage having a fixed lower edging roll thereon having its axis inclined to a vertical and horizontal plane, and an upper edging roll whose axis is inclined in an opposite direction to that of the lower edging roll so that the projection of its axis intercepts the projection of the axis of the lower edging roll, the upper edging roll being shouldered to provide conical surfaces which bear against the flange and the edge of the annulus being rolled, the shoulder being arranged to engage the inner face of the annulus between the flange and the edge, a vertically movable support on the carriage movable rectilinearly toward and away from the lower edging roll upon which the upper edging roll is mounted, and wheel rolls on the carriage adjacent the edging rolls and movable in a horizontal plane relatively to the edging rolls.

4. A ring rolling mill for the rolling of internally flanged annuli comprising a vertical main roll, a vertical cylindrical pressure roll cooperating with the main roll, the main roll and the pressure roll forming a pass for reducing the section being rolled in the plane of the flange of the annulus only, and a carriage movable horizontally toward and away from the main roll, said carriage having a fixed lower edging roll thereon having its axis inclined to a vertical and horizontal plane, and an upper edging roll whose axis is inclined in an opposite direction to that of the lower edging roll so that the projection of its axis intercepts the projection of the axis of the lower edging roll, the upper edging roll being shouldered to provide conical surfaces which bear against the flange and the edge of the annulus being rolled, the shoulder being arranged to engage the inner face of the annulus between the flange and the edge, a vertically movable support on the carriage movable rectilinearly toward and away from the lower edging roll upon which the upper edging roll is mounted, means for adjustably varying the inclination of said support, and wheel rolls on the carriage adjacent the edging rolls and movable in a horizontal plane relatively to the edging rolls.

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