April 23, 1940. L. IVERSEN 2,198,009

METHOD AND APPARATUS FOR ROLLING METAL STRIP

Filed Jan. 22, 1938 2 Sheets-Sheet 1

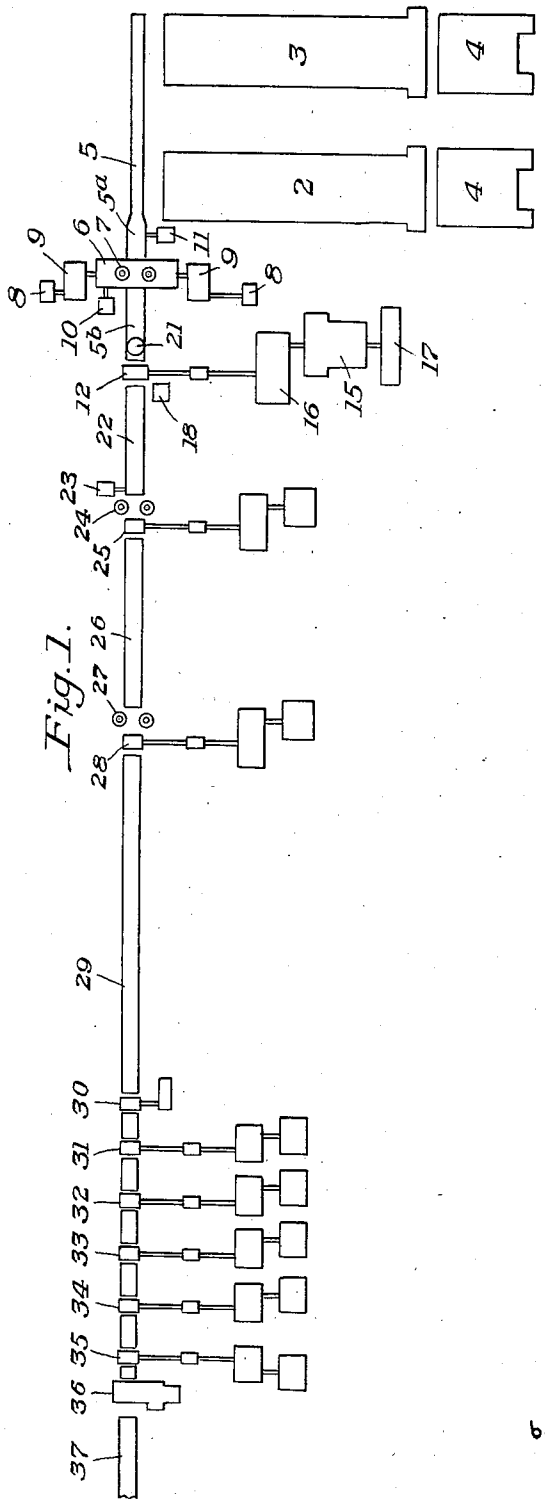


Fig. 1.

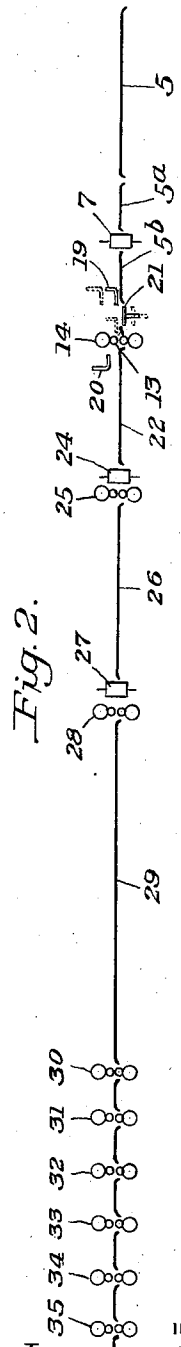


Fig. 2.

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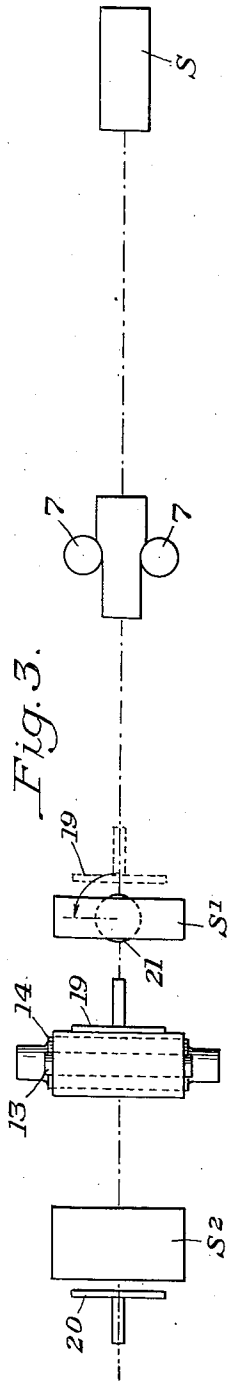


Fig. 3.

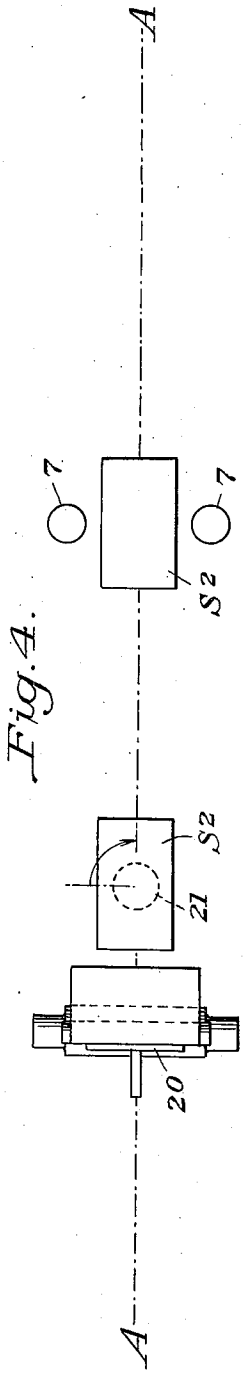


Fig. 4.

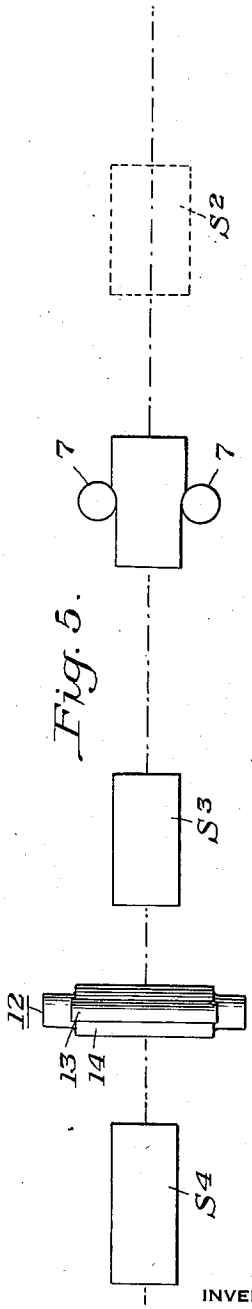


Fig. 5.

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Patented Apr. 23, 1940 2,198,009

# UNITED STATES PATENT OFFICE

2,198,009

## METHOD AND APPARATUS FOR ROLLING METAL STRIP

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Application January 22, 1938, Serial No. 186,417

8 Claims. (Cl. 80—31.1)

This invention relates to the rolling of metal strip and particularly to the hot rolling thereof.

Continuous hot strip mills of the design now in general use are effective for turning out good quality strip in large quantity, but their initial cost is so high as to preclude their use in numerous instances. By the present invention I provide a hot strip mill having low initial and operating costs and capable of turning out a satisfactory quantity of strip of high quality. The novel features of my invention will best be appreciated by a consideration of the present preferred form thereof shown in the accompanying drawings.

In the drawings,

Figure 1 is a diagrammatic plan view of a strip mill embodying the invention;

Figure 2 is a diagrammatic elevation thereof; and

Figures 3, 4 and 5 are diagrams to enlarged scale showing successive steps in the operation of the mill.

Referring first to Figures 1 and 2, I have illustrated heating furnaces 2 and 3 provided with pushers 4 whereby slabs of suitable size may be brought up to rolling temperature and discharged as required onto a roll table 5. The roll table 5 leads to an edging mill 6 having vertical rollers 7 driven by motors 8 through reducing gears 9. The rolls 7 are adapted to be adjusted toward and away from one another by a motor 10. In the preferred form of my invention the motors 8 will be ordinarily alternating current motors running in one direction only. Despite the fact that the piece is intended to be edged more than once between the rolls 7, it is possible by my invention to save very materially on the cost of the electrical machinery by using equipment of the type just stated. The manner of using the edging mill as well as the other elements of the strip mill is described in greater detail below.

The edger 6 is interposed between a section 5*a* of the roll table 5 and a section 5*b* thereof, the rolls of which sections are adapted to be driven in either direction as desired by a motor 11. At the outer end of the roll table 5*b* there is a reducing mill 12 which is preferably of the 4-high type having working rolls 13 and backing rolls 14. The working rolls are driven by a motor 15 through reducing gears 16. In the preferred form of the invention I use an ordinary alternating current motor which operates constantly in one direction only, the work pieces being rolled from right to left as viewed in the drawings. The mill is preferably provided with a flywheel 17, because by the use of such a flywheel the size of the motor may be reduced. The reducing mill 12 is provided with the customary screw-down motor 18 whereby the working rolls 13 may be rapidly brought sufficiently closely together to engage and reduce a work piece or may be spread apart so as to permit of the piece being fed through the mill without reduction.

Pushers 19 and 20 are provided on either side of the reducing mill 12 and a turn table 21, which may be raised or lowered so as to elevate a piece above the roll table 5*b*, is provided on the entering side of the mill. As hereinafter explained in greater detail, the turn table 21 may be used to turn a slab so that it will be presented broadside to the reducing mill 12. The pusher 19 serves to "square" the slab with the mill and feed it between the working rolls 13. The pusher 20 is effective for engaging the rolled slab and returning it through the mill to the entering side.

Beyond the reducing mill 12 there is a roll table 22 whose rolls may be driven in either direction by a motor 23. At the end of the roll table 22 there are edging rolls 24 and a 4-high roughing stand 25. A roll table 26 carries the piece from this stand to the edging rolls 27 and a 4-high roughing stand 28. A roll table 29 carries the piece from this stand to a scale breaker 30 and thence through five sets of 4-high stands 31, 32, 33, 34 and 35, constituting the finishing mill. A flying shear 36 is provided at the delivery end of the mill and a runout table 37 conveys the sheared pieces to a coiler or a piler as desired.

The stands 24, 25, 27, 28, 30, 31, 32, 33, 34, and 35 are all uni-directional and a piece once supplied to the rolls 24 continues uninterruptedly through the mill. The treatment of the slab in the stands 6 and 12 will best be understood by reference to Figures 3, 4 and 5, which show the several operations in sequence.

In Figure 3 a hot slab S as supplied from the heating furnace is shown. This slab travels between the edging rolls 7 which serve to break the furnace scale and to square up the longitudinal edges. The slab so treated is marked $S_1$ in Figure 3. The slab $S_1$ is carried by the roll table 5*b* to the turn table 21 which is thereupon elevated so as to clear the slab of the table rolls, and is then turned through an angle of approximately 90° as shown in Figure 3. The pusher 19 is then lowered behind the slab and advanced toward the reducing mill 12. The head of the pusher 19 engages the slab along its edge, squares

it with the reducing mill, and feeds it between the working rolls 13. The rolls will previously have been adjusted so as to effect a substantial reduction in the thickness of the slab. At this stage of the operation the slab will be of sufficient thickness that some lateral spreading will occur. Consequently the effect of this rolling step is to thin and widen the slab so that it is of the form indicated at $S_2$ in Figure 3. The pusher 20 is then lowered so as to engage the slab $S_2$ and feed it back toward the turn table 21. The motor 18 is actuated so as to open the rolls 13 and permit of feeding the slab between them. By reason of the positive feeding action of the pusher 20 it is unnecessary to reverse the mill 12 or to stop it.

After the pusher 20 has returned the slab $S_2$ to the turn table 21, the turn table is again rotated through 90° so as to align the longitudinal axis of the slab with the axis AA of the mill. The slab is then lowered onto the roll table 5b, which is actuated in the reverse direction to return the slab to the entering side of the edging mill 6. The rolls 7 will have been separated by the motor 10 so as to permit of free travel of the slab $S_2$ therebetween.

After the slab $S_2$ has been returned to the dotted line position of Figure 5, the rolls 7 are brought closer together and the slab is fed between them so as to edge it for a second time. This brings it to the form $S_3$ of Figure 5. It is fed longitudinaly over the roll table 5b to the reducing mill 12 and rolled longitudinally therein, the rolls 13 having been brought closer together so as to effect the desired reduction. This pass serves to thin and elongate the slab, bringing it to the form $S_4$. It is now ready for treatment by the subsequent stands in the strip mill for reduction to its final gauge.

The turn table and pushers will preferably be of the form shown in my copending application Serial No. 31,433, filed July 11, 1935.

By the use of my invention very material savings can be effected. As compared with usual installations, a universal mill stand and the table and table mechanism accompanying it are eliminated. Certain other elements usually employed, for example, the slab squeezer shown in my Patent 2,059,460, may be dispensed with. The electric motors and controls therefor are of relatively low cost yet will operate with full satisfaction. Despite these material savings in cost the mill will produce high quality strip in satisfactory tonnage. In this connection it should be borne in mind that the demands of the trade call for the production of strips of different widths. When rolling strips having widths which are not in excess of the slab width employed the mill is capable of producing tonnages equivalent to the usual strip mill installation and the tonnage is ony slightly reduced when a second pass is made through the spreading stand in the manner above described. This limitation is offset by the reduced installation cost.

I have illustrated and described a present preferred embodiment of the invention. It will be understood, however, that this is by way of illustration only and that the invention may be otherwise embodied or practiced within the scope of the following claims.

I claim:

1. In the method of rolling strip, the steps consisting in feeding a slab broadside through a reducing mill, thereby widening and thinning it, opening the rolls of the reducing mill, returning the slab therebetween to the entering side of the mill while continuing to drive the rolls in the original feeding direction, feeding the slab endwise through the mill, thereby thinning and elongating it, and then reducing it to strip form by a series of endwise reducing passes.

2. In the method of rolling strip, the steps consisting in feeding a slab endwise through an edging mill, rotating the slab through approximately 90°, continuing the feeding motion of the slab after such rotation to a reducing mill, thereby to present it broadside to the reducing mill, passing the slab through the reducing mill, thereby widening and thinning it, opening the rolls of the reducing mill, returning the slab between the opened rolls to the entering side of the mill while continuing to drive the rolls in the originel feeding direction, rotating the slab through approximately 90° so that it is positioned to travel lengthwise through the mill, passing the slab lengthwise through the mill, thereby thinning and elongating it, and then reducing it to strip form by a series of endwise reducing passes.

3. In the method of rolling strip, the steps consisting in feeding a slab endwise through an edging mill, rotating the slab through approximately 90°, continuing the feeding motion of the slab after such rotation to a reducing mill, thereby to present it broadside to the reducing mill, squaring the slab with the mill, passing the slab through the reducing mill, thereby widening and thinning it, opening the rolls of the reducing mill, returning the slab between the opened rolls to the entering side of the mill, rotating the slab through approximately 90° so that it is positioned to travel lengthwise through the mill, passing the slab lengthwise through the mill, thereby thinning and elongating it, and then reducing it to strip form by a series of endwise reducing passes.

4. A strip mill comprising an edging stand having its rolls adjustable relatively toward or away from one another to permit of an edging pass or an idle pass therethrough, means for moving a slab endwise in either direction between the rolls of the edging stand, a reducing stand having its rolls adjustable relatively toward or away from one another to permit of a reducing pass or of an idle pass therethrough, and means between the edging stand and the reducing stand for turning a slab whereby it may be presented endwise or broadside to the reducing stand after traversing the edging stand.

5. A strip mill comprising an edging stand having its rolls adjustable relatively toward or away from one another to permit of an edging pass or of an idle pass therethrough, means for driving the rolls thereof in a non-reversing manner, means for feeding a slab endwise to the rolls of the edging stand so that it may be engaged thereby and fed between the rolls to effect edging or for moving the slab between the rolls in the opposite direction when the rolls are sufficiently spaced apart, a reducing stand having its rolls adjustable relatively toward or away from one another to permit of a reducing pass or of an idle pass therethrough, means for driving the rolls of the reducing stand in a non-reversing manner, and means for moving a slab in between the rolls of the reducing stand in a direction opposite that in which the slab is fed when engaged by said rolls.

6. A strip mill comprising an edging stand having its rolls adjustable relatively toward or away from one another to permit of an edging pass or of an idle pass therethrough, means for driving

the rolls thereof in a non-reversing manner, means for feeding a slab endwise to the rolls of the edging stand so that it may be engaged thereby and fed between the rolls to effect edging or for moving the slab between the rolls in the opposite direction when the rolls are sufficiently spaced apart, a reducing stand having its rolls adjustable relatively toward or away from one another to permit of a reducing pass or of an idle pass therethrough, means for driving the rolls of the reducing stand in a non-reversing manner, means for moving a slab in either direction between the rolls of the reducing stand, and means between the edging stand and the reducing stand whereby it may be presented endwise or broadside to the rolls of the reducing stand.

7. In a method of rolling strip, the steps consisting in truing the edges of a slab by feeding it endwise between edging rolls and toward a reducing mill, turning the slab 90° between the edging rolls and the reducing mill, feeding the edged slab broadside through the reducing mill, thereby widening and thinning it, returning the slab to the entering side of the reducing mill, turning it 90°, and then feeding it endwise through the reducing mill, thereby thinning and elongating it.

8. In a method of rolling strip, the steps consisting in truing the edges of a slab by feeding it endwise through an edging mill and toward a reducing mill, turning the slab 90° between the edging mill and the reducing mill, feeding the edged slab broadside through the reducing mill, thereby widening and thinning it, returning the widened slab to the entering side of the edging mill, again feeding the slab endwise therethrough and edging it, feeding the widened and edged slab endwise through the reducing mill, thereby thinning and elongating it, and then reducing it to strip form by a series of endwise reducing passes.

LORENZ IVERSEN.