March 1, 1938. L. IVERSEN 2,109,904

APPARATUS FOR METAL ROLLING

Filed July 15, 1935 5 Sheets-Sheet 1

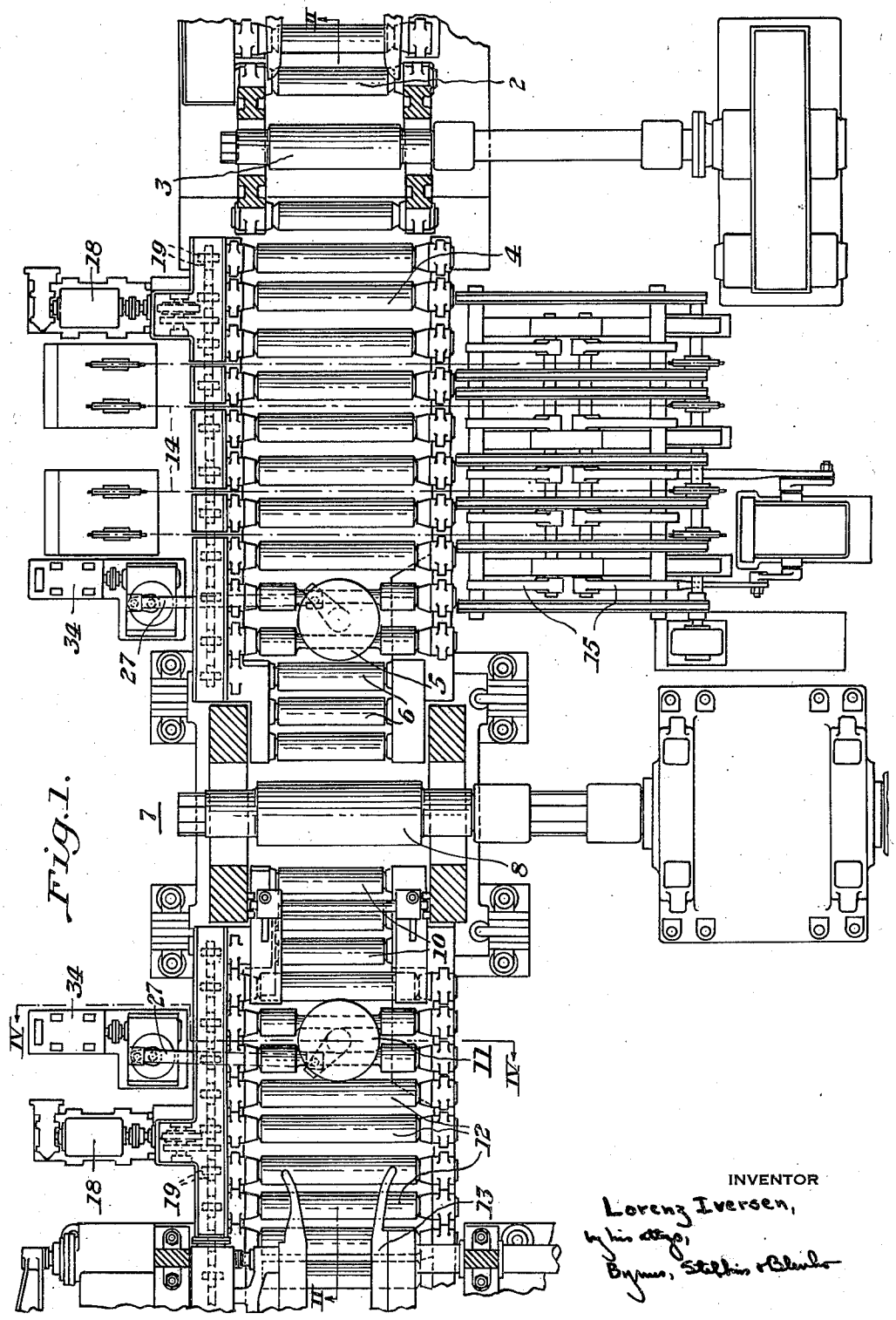


Fig. 1.

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Byrnes, Stebbins & Blenko

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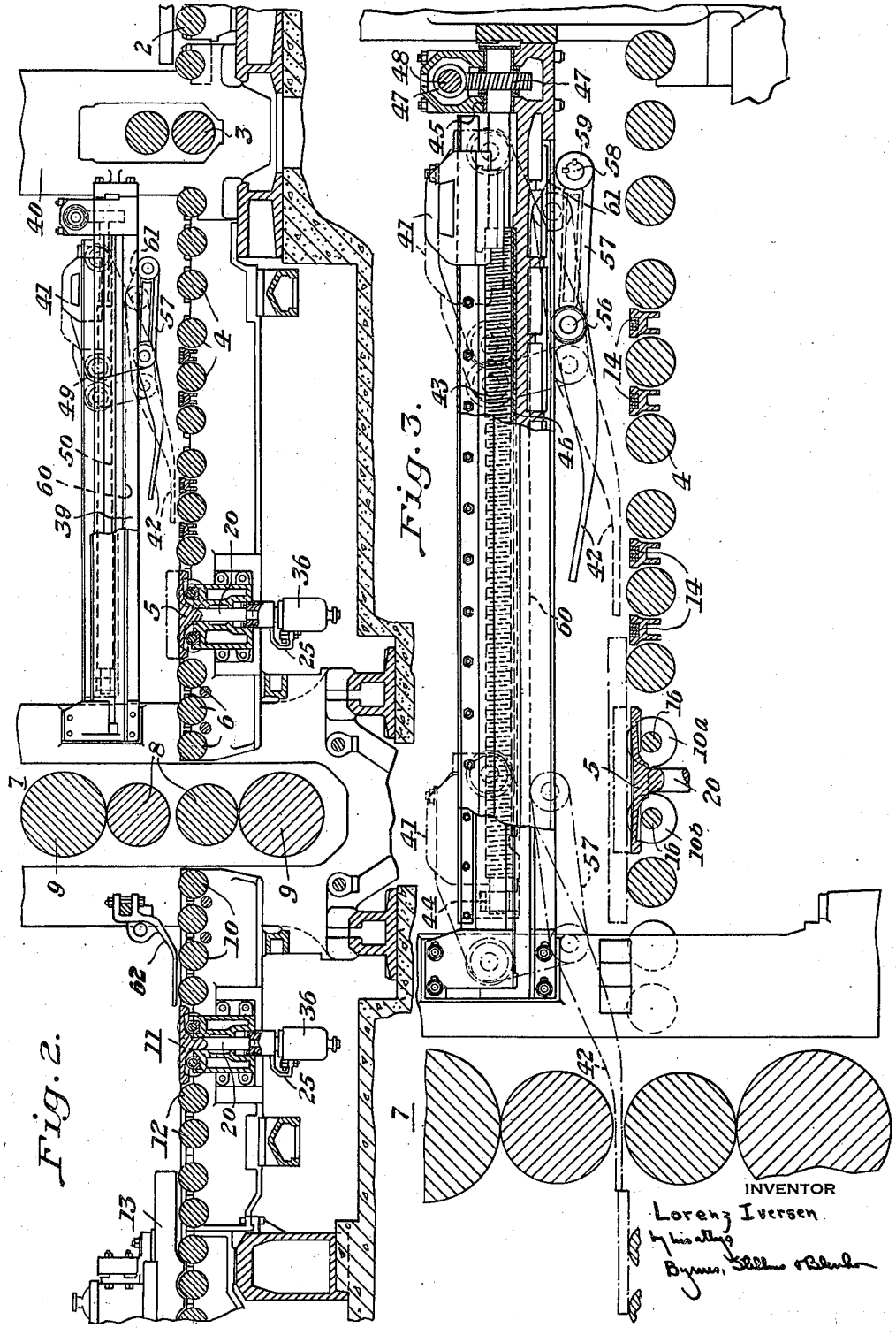


Fig. 2.

Fig. 3.

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Fig. 4.

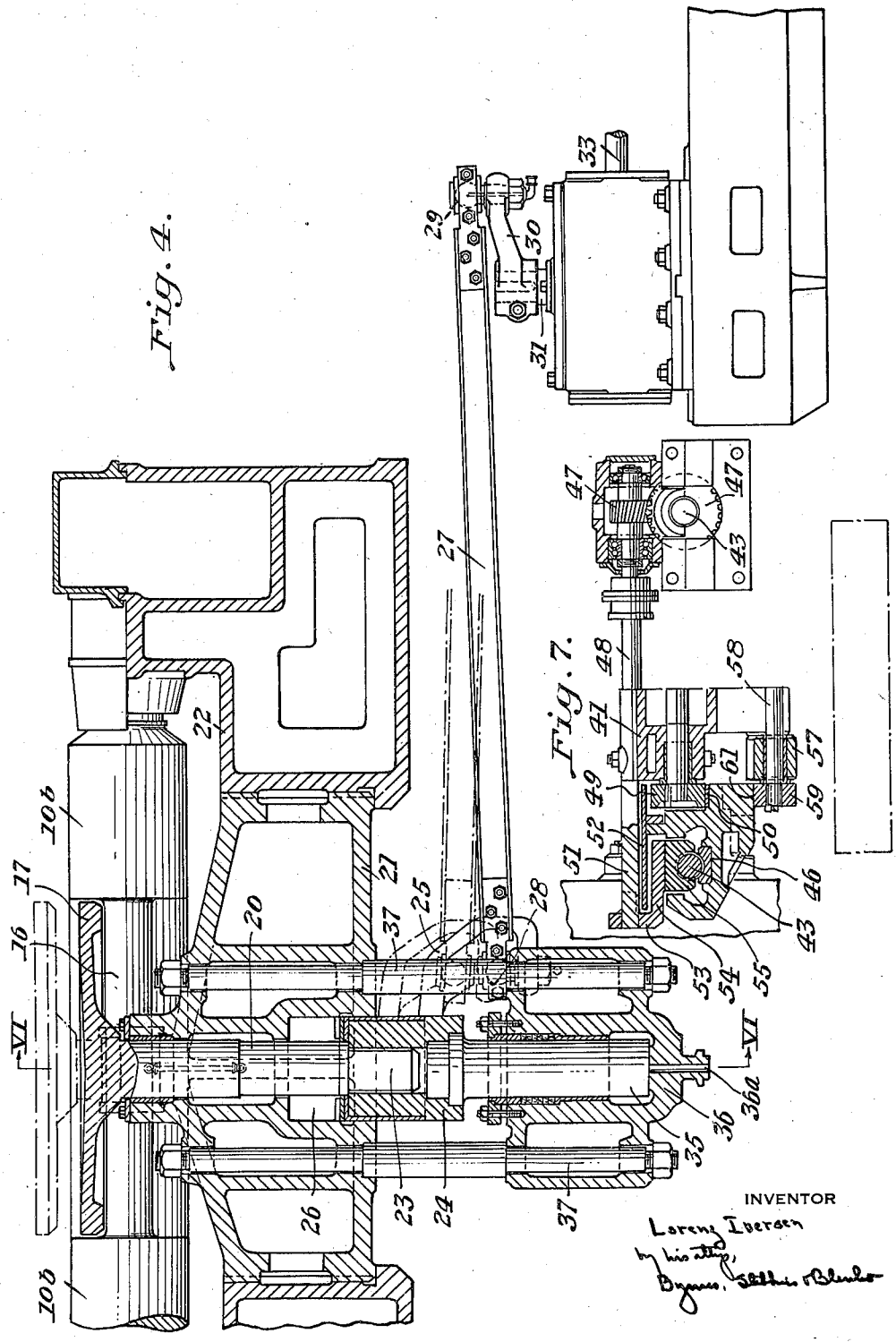


Fig. 7.

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Fig. 5.

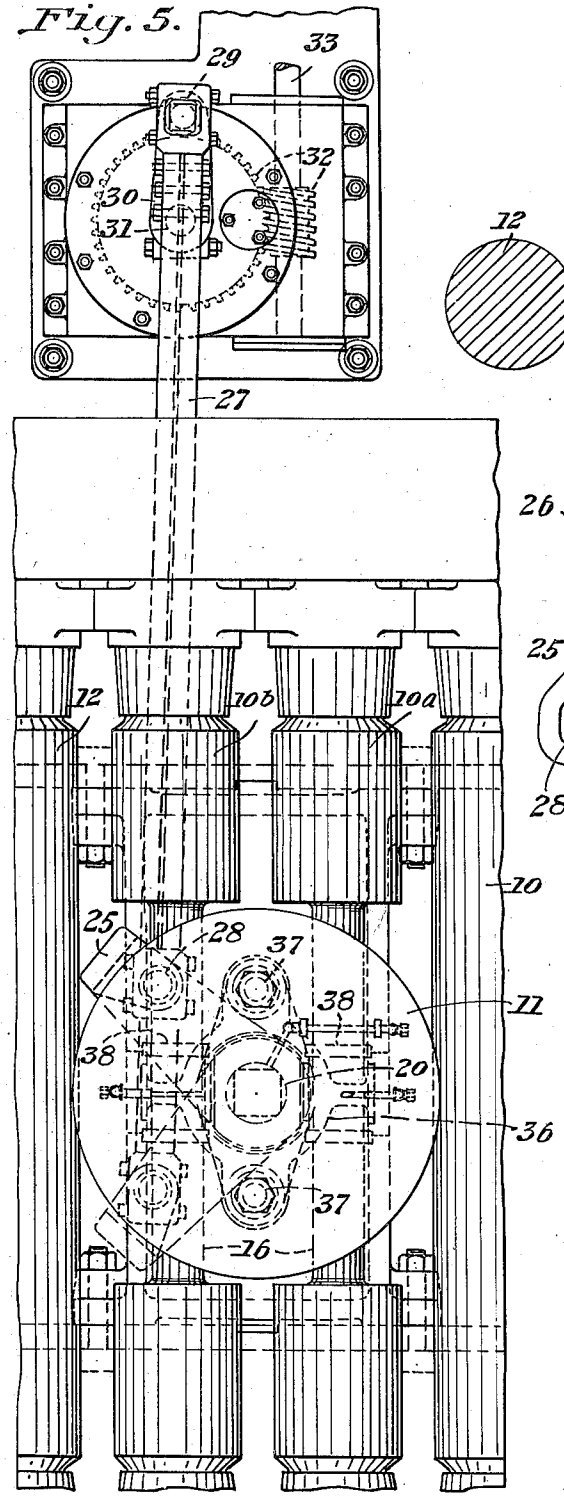
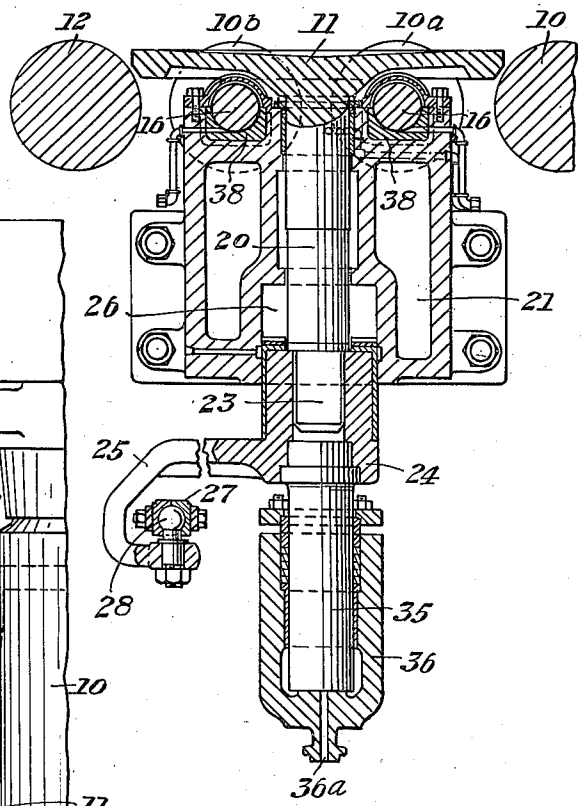


Fig. 6.



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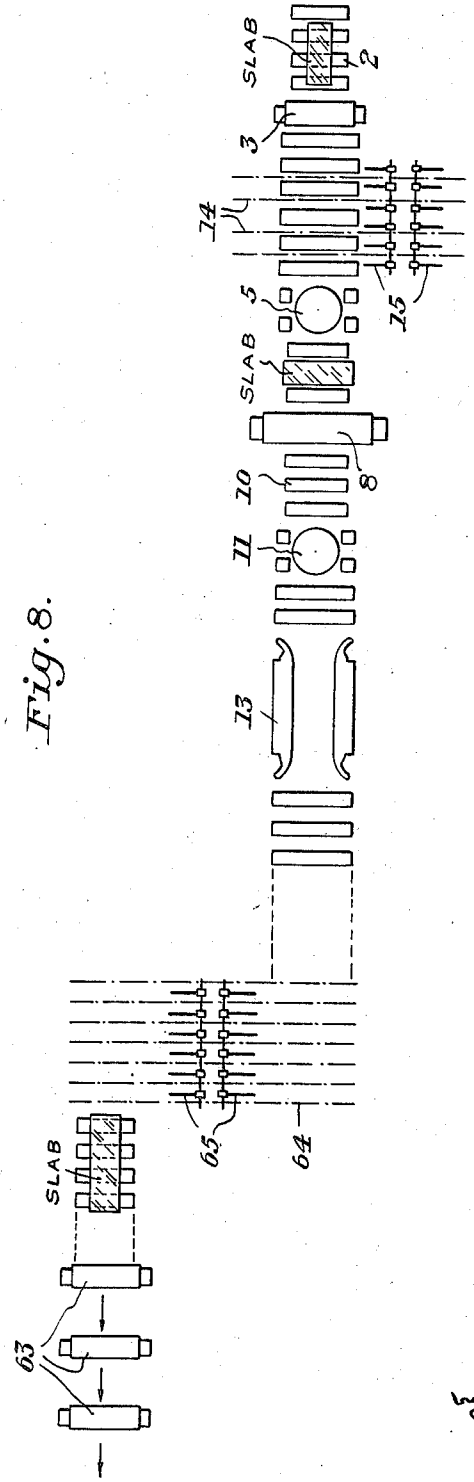


Fig. 8.

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Patented Mar. 1, 1938 2,109,904

UNITED STATES PATENT OFFICE

2,109,904

APPARATUS FOR METAL ROLLING

Lorenz Iversen, Pittsburgh, Pa., assignor to Mesta Machine Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application July 15, 1935, Serial No. 31,433

10 Claims. (Cl. 80—31.1)

This application is a continuation-in-part of my application Serial No. 633,960, filed September 20, 1932, now Patent 2,059,460.

There is a constant trend in the steel industry toward the production of strip in greater widths. In recent years mills have been built for the rolling of strips 72 inches or more in width. Such mills represent a very high capital cost, and unfortunately, as heretofore constructed, their installation and use has required additional high expenditures in the production of slab ingots of sufficient width to permit of rolling the desired wide strip.

The present invention provides apparatus whereby slabs or slab ingots of lesser width than the desired strip may conveniently be employed as starting pieces in the production of such strip. At this end I employ a cross rolling mill with means for advancing the slab to the mill, turning it so as to effect broadside entrance of the slab into the mill with consequent widening and thereafter turning the widened slab into alignment with the subsequent mill stands for further reduction therein. (The word "slab" will be used for convenience herein as a word of general definition and is intended to include slab ingots as well as rolled slab-like bodies.)

In the accompanying drawings illustrating a present preferred embodiment of the invention,

Figure 1 is a top plan view, partly broken away, showing the cross rolling mill with associated mechanism;

Figure 2 is a vertical section taken on the line II—II of Figure 1;

Figure 3 is a view to enlarged scale, partly broken away, of a portion of the apparatus illustrated in Figure 2;

Figure 4 is a transverse section, to enlarged scale, on the line IV—IV of Figure 1;

Figure 5 is a top plan view of the apparatus shown in Figure 4;

Figure 6 is a vertical section on the line VI—VI of Figure 4;

Figure 7 is a transverse section through pusher mechanism lying above the plane of travel of the slabs and further illustrated in Figures 2 and 3; and

Figure 8 is a diagrammatic view showing the mill stands in their relation to the slab-turning mechanism.

Referring first to Figure 1 there is shown a roll table 2 supplying slabs (advancing from right to left as viewed in the drawings) to a pair of scale-breaking rolls 3. The slab is delivered from these rolls to table rollers 4 which advance it onto a turn table 5. The slab is there turned through 90° and is advanced over table rollers 6 to a cross-rolling or spreading mill 7. This mill is of the 4-high type having driven work rolls 8 and backing rolls 9. It is effective for materially reducing the thickness of the slab and increasing its dimension in the direction of rolling. Since the slab is fed broadside to this mill, a substantial widening of the slab is effected, thus permitting the use of originally narrow slabs for the production of wide strip. The widened slab issues from the mill 7 and is fed over table rollers 10 to a turn table 11 where it is again turned through 90° and is then advanced lengthwise over table rollers 12 to a squeezer 13. This squeezer, which is more specifically described and claimed in my application above referred to, effects further removal of scale from the slab, straightens the edges thereof, and then releases it so that it may advance to the continuous strip mill.

If desired, the slab, before it reaches the turn table 5, may be moved transversely by broadside conveyors 14 to turnover arms 15 and then returned, upside down, to the table rollers 4. This operation is effective for removing the scale lying on top of the slab and previously loosened by the rolls 3.

The mechanism for the turn tables 5 and 11 is substantially identical and a description of the turn table 11 will suffice for both. Its construction is shown in detail in Figures 4 to 6 inclusive. Two of the table rollers 10*a* and 10*b* have body portions 16 of reduced diameter providing a recess which accommodates the table head 17. The end portions of the rolls 10*a* and 10*b* are of full diameter so that they can exert tractive effort on the slab when the table head 17 is in its lowered position. The rolls are driven by a motor 18 through gearing 19.

The table head 17 is mounted on a spindle 20 rotatable in a cross member 21 secured to the rails 22 which carry the table rollers. The bottom end 23 of the spindle 20 is squared to engage a corresponding opening in the hub 24 of a turning arm 25. The hub 24 is rotatable and slidable in a cylindrical recess 26 formed in the bottom of the cross member 21. Rotation of the arm 25 in one direction or the other causes a corresponding rotation of the table head 17, and raising or lowering of the arm and its hub causes raising or lowering of the table head as indicated in Figure 4.

Rotation of the arm 25 in one direction or the other is effected by a link 27 having a ball and socket connection 28 at one end with the arm 25

and a ball and socket connection 29 at the other end with a crank arm 30. The crank arm 30 is mounted on a shaft 31 driven through worm gearing 32 (Figure 5) from a motor shaft 33 connected to a motor 34 (Figure 1). The throw of the crank 30 is sufficient to cause a 90° movement of the arm 25 (see Figure 5) so that a half revolution of the crank causes a 90° rotation of the table head in one direction, and the next half revolution of the crank restores the table top to its original position.

Raising and lowering of the table is effected by a hydraulic ram 35 engaging the bottom of the hub 24. The ram is carried in a hydraulic cylinder 36 supported from the cross arm 21 by stretcher bolts 37. The hydraulic cylinder is provided with a fluid connection 36a so that pressure may be applied to the ram 35 for raising the table when desired. The ball and socket connections 28 and 29 permit of rotation of the table in any vertical position thereof.

In order to insure that the reduced diameter of the middle portions of the rolls 10a and 10b shall not cause undue deflection of such rolls when they are weighted with a slab, the cross arm 21 is provided with bearing saddles 38 which engage the reduced portions 16 of such rolls.

Figures 2, 3 and 7 illustrate in detail a mechanism lying above the roll tables, which mechanism is used for squaring the slab with the mill 7 after the slab has been turned crosswise on the turn table 5 and for assisting in feeding the slab to the mill. It consists of a pair of rails 39 extending between the housings 40 of the scale-breaking rolls 3 and the housings of the mill 7, which rails support a horizontally movable carriage 41 carrying a slab-engaging finger 42. The carriage 41 is advanced or retracted along the rails 39 by lead screws 43 having end bearings 44 and 45 and lying on saddles 46. The lead screws are connected through spiral gears 47 to a cross shaft 48 driven from a reversing motor (not shown). The carriage 41 has rollers 49 running on tracks 50 carried by the rails 39. Arms 51 extend sidewise from the carriage 41 over cover plates 52 which protect the lead screws 43 from scale, water and dirt. The arms 51 extend downwardly at 53, then inwardly at 54 beneath the cover plates 52, and carry saddle nuts 55 which engage the lead screws 43. Rotation of the lead screws 43 in one direction drives the nuts 55 and hence the carriage 41 toward the mill 7, while reverse rotation of the lead screws causes retraction of the carriage.

The slab-engaging finger 42 is of considerable width so that it engages the slab over a considerable area and by pushing it forward squares it with the rolls of the mill 7. The finger is pivoted to the carriage 41 at 56 and is provided with rearwardly extending arms 57 in which a cross shaft 58 is journaled. This cross shaft carries cam rollers 59 engaging translation cams 60 formed in the rails 39. The surfaces of the translation cams 60 are horizontal for the major portion of the length of the rails 39, but toward the rear end of these rails the cams 60 have inclined portions 61 which act upon the rollers 59 and depress the same when the carriage is retracted, thus raising the finger 42 as shown in full lines in Figures 2 and 3 to permit the feeding and manipulation of a slab thereunder. As the carriage 41 is advanced, however, the cam rollers 59 fall down the inclined surfaces 61 and permit lowering of the finger as shown in dotted lines in Figures 2 and 3. Continued forward movement of the carriage 41 feeds the slab to the spreading mill 7 and, if desired, the finger may be made sufficiently long and thin to permit of its being projected between the rolls 8 so as to push the slab well onto the table rolls 10. This feature is of importance because of the great size of the spreading mill 7 and the consequent difficulties of placing driven table rollers close to the work rolls 8.

A pair of additional fingers 62 is provided on the exit side of the mill 7. These fingers are rockable so that as a slab is advanced over the table rollers 10 the fingers rise upwardly and ride over the top of the slab. When the slab is rotated on the table 11, the fingers drop behind the edges of the slab and by thus limiting its rotation aid in squaring it for its forward travel. It will be found in practice, however, that these fingers need not always be used, since with proper construction and operation of the turn table 11 the slab is squared sufficiently to insure of its smooth entrance to the squeezer 13.

The slab squeezer 13, which is more specifically described and claimed in my copending application above identified, loosens and breaks the scale formed on the surfaces of the slab, thus preparing it for its subsequent rolling in the continuous strip mill.

Figure 8 shows the mill in diagram, the mechanisms hereinabove described being illustrated in their relations to one another and the rolls 63 being also shown. If desired, the descaled slab may be fed directly from the squeezer 13 to the rolls 63 by means of a roll table, but I prefer to interpose a broadside transfer 64 having a turnover 65 therein. This permits the loose scale on top of the slab to fall off by gravity and gives a cleaner product.

My invention is highly advantageous in that it permits of the use of ingots which are relatively narrow in the production of wide strip and thereby eliminates the necessity of providing ingot molds with all the associated mechanism for the casting of slab ingots substantially as wide as the desired strip. In view of the large number of ingot molds required in connection with a mill of this character, a tremendous saving in capital cost is effected. The operation is simple and relatively rapid and the investment is comparatively low. It is also important to note that the stands which precede the spreading stand need not be as wide as the subsequent stands because they operate on relatively narrower slabs.

While I have illustrated and described the present preferred embodiment of my invention, it will be understood that the same is not limited thereto but may be otherwise embodied and practiced within the scope of the following claims.

I claim:

1. In the method of rolling wide strip from slabs of lesser width than the strip, the steps consisting in forming a slab, feeding it broadside between reducing rolls and thereby thinning and widening it to a dimension substantially corresponding to the desired strip width, subjecting the widened slab to pressure along its longitudinal edges thereby to break the scale on the slab and true such edges, then rolling the widened slab lengthwise in single-ply thickness to effect a further reduction in the thickness and form it into a long strip.

2. In the method of rolling wide strip in a continuous mill, the steps consisting in forming a slab, feeding the slab broadside between reducing rolls, thereby thinning it and widening it to a

dimension substantially corresponding to the desired strip width, turning the slab through a right angle so that it thereafter travels lengthwise through the mill, and passing it lengthwise and in single-ply thickness through subsequent mill stands to further reduce its thickness and form it into a long strip.

3. A mill for rolling wide strip from slabs of lesser width comprising a roll stand, means for effecting broadside entrance of slabs thereto, the mill being effective for thinning the slabs and widening them to a dimension substantially corresponding to the desired strip width, means for descaling the widened slabs, rolls adapted to reduce the widened slabs in single-ply thickness to a long strip, and means for feeding the widened and descaled slabs to such rolls.

4. A mill for rolling wide strip from slabs of lesser width comprising a roll stand, means for effecting broadside entrance of slabs thereto, the mill being effective for thinning the slabs and widening them to a dimension substantially corresponding to the desired strip width, means for descaling the widened slabs, rolls adapted to reduce the widened slabs in single-ply thickness to a long strip, and means for feeding the widened and descaled slabs to such rolls, said means including a turn-table interposed between the first-mentioned roll stand and said reducing rolls.

5. Apparatus for rolling wide strip from slabs of lesser width comprising a roll stand, means for effecting broadside entrance of a slab thereto, the roll stand being effective for thinning the slab and widening it to a dimension corresponding to the desired strip width, a turn-table beyond the roll stand effective for engaging the widened slab and turning it at right angles, reducing rolls effective for rolling the widened slab in single-ply thickness into strip form, means for feeding the turned slab lengthwise to the reducing rolls, and scale removing means in advance of the reducing rolls.

6. A mill for rolling wide flat metal in long lengths from slabs of lesser width comprising a reducing mill, means for effecting broadside entrance of slabs thereto whereby such slabs may be thinned and simultaneously widened to a dimension substantially corresponding to the desired width of the product, a mill train consisting of a plurality of mill stands adapted to receive the widened slab and roll it in single-ply thickness, the stands being arranged to engage the slab successively and effect successive reductions thereby to reduce it to the desired thickness, and means for feeding the widened slab from the first-mentioned mill to the mill train and feeding it to the mill train in a rolling direction which is transverse to the direction of rolling in the first-mentioned mill.

7. A mill for rolling wide flat metal in long lengths from slabs of lesser width comprising a reducing mill, means for effecting broadside entrance of slabs thereto whereby such slabs may be thinned and simultaneously widened to a dimension substantially corresponding to the desired width of the product, a mill train consisting of a plurality of mill stands adapted to receive the widened slab and roll it in single-ply thickness, the stands being arranged to engage the slab successively and effect successive reductions thereby to reduce it to the desired thickness, and slab-advancing means effective for moving the slab in its broadside direction as it leaves the reducing mill, terminating its broadside travel and supplying it lengthwise to the mill train.

8. A mill for rolling wide flat metal in long lengths from slabs of lesser width comprising a reducing mill, means for effecting broadside entrance of slabs thereto whereby such slabs may be thinned and simultaneously widened to a dimension substantially corresponding to the desired width of the product, a mill train consisting of a plurality of mill stands adapted to receive the widened slab and roll it in single-ply thickness, the stands being arranged to engage the slab successively and effect successive reductions thereby to reduce it to the desired thickness, and roll table means extending between the first-mentioned mill and the mill train effective for receiving the slab as it issues broadside from the first-mentioned mill and supplying it to the mill train in a rolling direction which is transverse to the direction of rolling in the first-mentioned mill.

9. A mill for rolling wide flat metal in long lengths from slabs of lesser width comprising a reducing mill, means for effecting broadside entrance of slabs thereto whereby such slabs may be thinned and simultaneously widened to a dimension substantially corresponding to the desired width of the product, a mill train consisting of a plurality of mill stands adapted to receive the widened slab and roll it in single-ply thickness, the stands being arranged to engage the slab successively and effect successive reductions thereby to reduce it to the desired thickness, roll table means extending between the first-mentioned mill and the mill train effective for receiving the slab as it issues broadside from the first-mentioned mill and supplying it to the mill train in a rolling direction which is transverse to the direction of rolling in the first-mentioned mill, and a squeezer between the first-mentioned mill and the mill train for squeezing the slab edges.

10. A mill for rolling wide flat metal in long lengths from slabs of lesser width comprising a reducing mill, means for effecting broadside entrance of slabs thereto whereby such slabs may be thinned and simultaneously widened to a dimension substantially corresponding to the desired width of the product, a mill train consisting of a plurality of mill stands adapted to receive the widened slab and roll it in single-ply thickness, the stands being arranged to engage the slab successively and effect successive reductions thereby to reduce it to the desired thickness, slab advancing means between the first-mentioned mill and the mill train, and slab turning means interposed therein arranged to turn the slab from a broadside position to a lengthwise position in respect of the mill train, the slab advancing means being effective for feeding it lengthwise to the mill train.

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