Dec. 25, 1934. R. J. WEAN 1,985,848

METHOD AND APPARATUS FOR ROLLING SHEETS

Filed Feb. 18, 1933 3 Sheets-Sheet 1

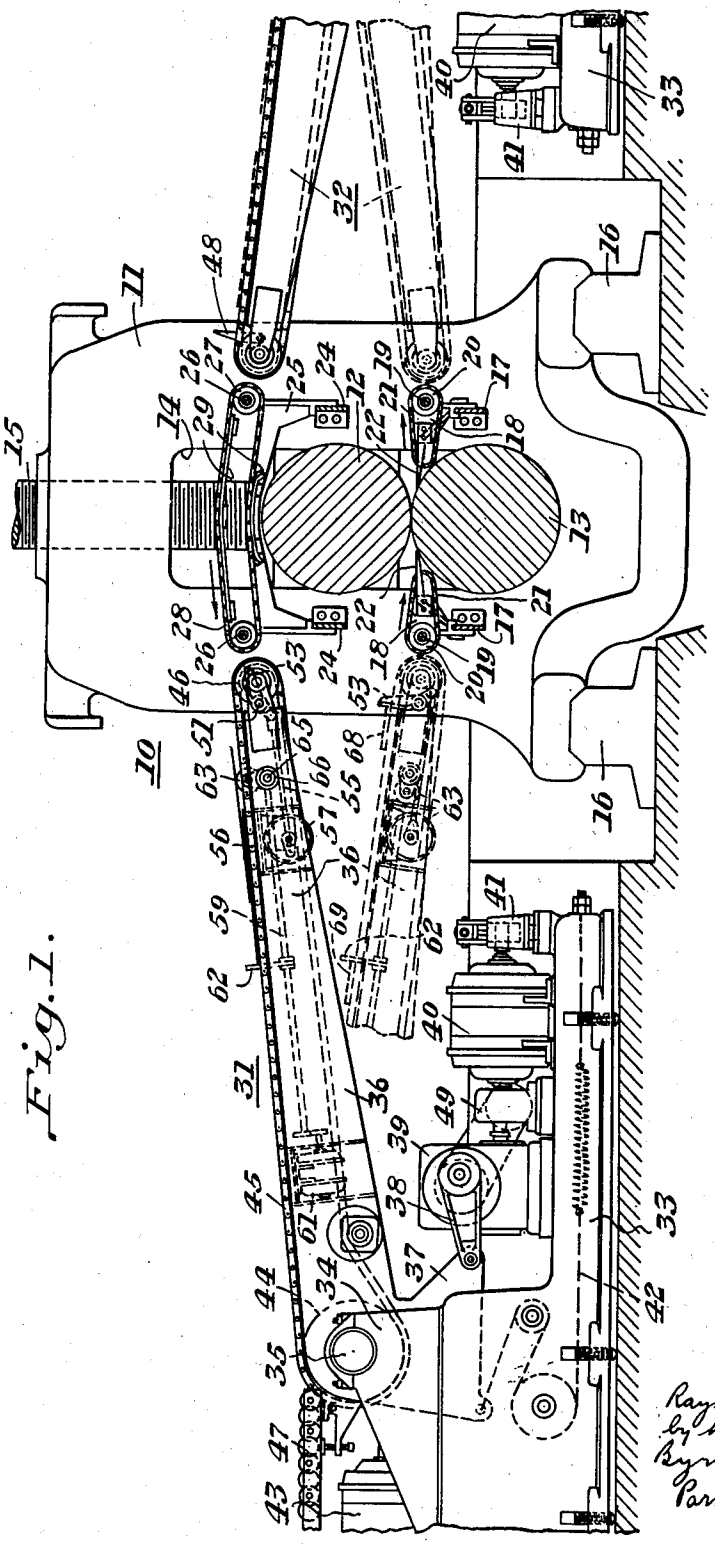


Fig. 1.

INVENTOR
Raymond J. Wean
by his attorneys
Byrnes, Stebbins,
Parmelee & Blenko

Dec. 25, 1934. R. J. WEAN 1,985,848

METHOD AND APPARATUS FOR ROLLING SHEETS

Filed Feb. 18, 1933 3 Sheets-Sheet 2

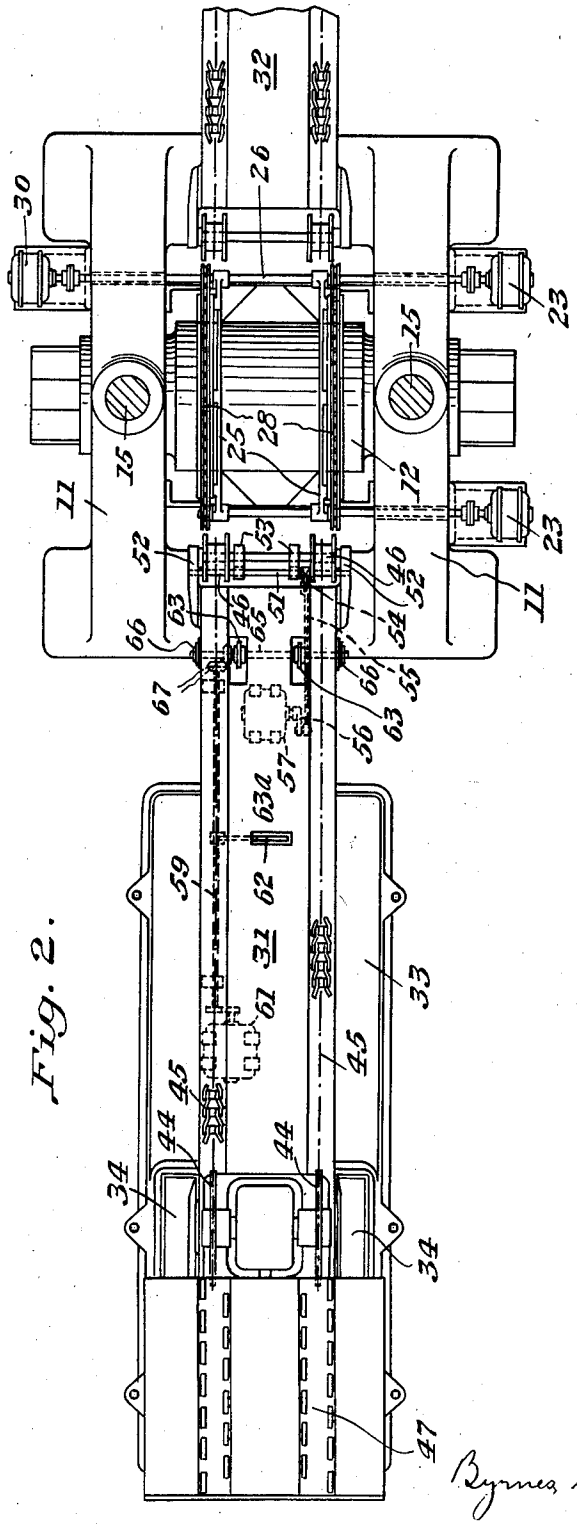


Fig. 2.

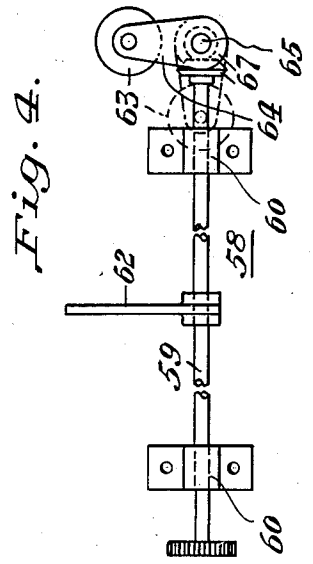


Fig. 4.

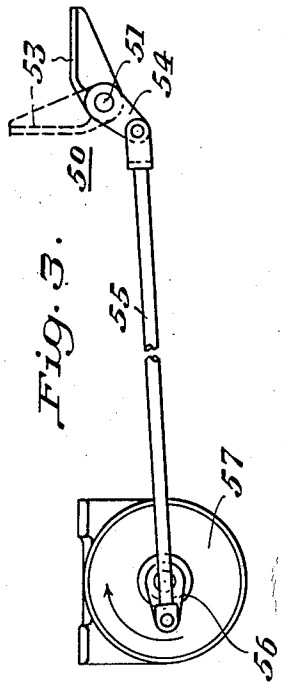


Fig. 3.

INVENTOR
Raymond J. Wean
by his attorneys
Byrnes, Stebbins, Parmelee & Bienko

Dec. 25, 1934. R. J. WEAN 1,985,848

METHOD AND APPARATUS FOR ROLLING SHEETS

Filed Feb. 18, 1933 3 Sheets-Sheet 3

Fig. 5.

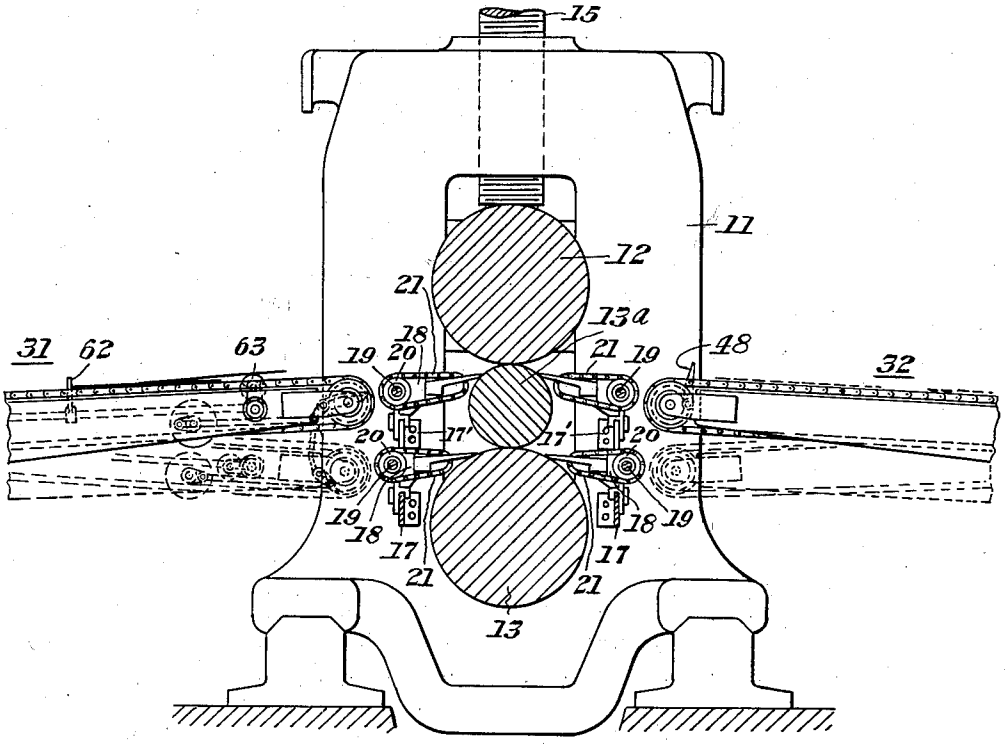


Fig. 6.

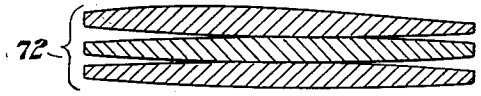
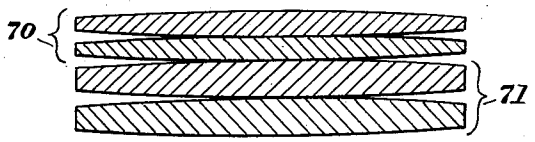


Fig. 7.



INVENTOR

Raymond J. Wean

by his attorneys

Byrnes Stebbins, Parmelee & Blenko

Patented Dec. 25, 1934 1,985,848

UNITED STATES PATENT OFFICE

1,985,848

METHOD AND APPARATUS FOR ROLLING SHEETS

Raymond J. Wean, Warren, Ohio, assignor to The Wean Engineering Company, Incorporated, Warren, Ohio, a corporation of Ohio

Application February 18, 1933, Serial No. 657,401

13 Claims. (Cl. 29—17)

My invention relates to the rolling of metal sheets and, in particular, to the manufacture of ferrous sheets, although not necessarily limited thereto.

The manufacture of steel sheets as practiced heretofore has included the heating of sheet bars to rolling temperature and the successive passage of the bars in pairs through a rolling mill to form breakdowns. The breakdowns are then matched and may also be doubled, and the pack thus formed is subjected to further rolling in the same or another mill. This method of manufacturing sheets requires a large amount of manual labor and the work is of the most gruelling character. Recent attempts to replace some of this manual labor by mechanical equipment have proved successful. In my Patent No. 1,871,102, granted August 9, 1932, I have described and claimed a Method and apparatus for manufacturing sheets in which a large amount of the manual labor necessary under the old method is replaced by mechanical equipment.

It has been thought impractical heretofore to attempt to provide mechanical equipment for handling sheet bars during the roughing down operation which produces breakdowns, because the sheet bars are initially of such width that no known handling apparatus could successfully perform the functions of the mill operators, known as the roller and catcher, who have heretofore passed the bars through the mill and back over the upper roll manually. The matching of the breakdowns, furthermore, has always been accomplished manually heretofore and the necessity for interrupting the passage of material for the manual matching has reduced the rate of production.

Since sheet bars can be rolled only in pairs by the prior manual method, when it is desired to roll packs of three breakdowns, it is necessary to split the two breakdowns made from one pair of bars between two other pairs of breakdowns to provide two packs of three breakdowns each. It is well known that, due to changing temperatures, the contour of the pass between the mill rolls changes almost constantly from time to time during rolling and, sometimes, quite rapidly. The pass is usually approaching or departing from the ideal condition but rarely maintains it for very long. It may thus happen that the contour of the roll pass will be different during the rolling of two successive pairs of bars. If one of the breakdowns of a pair is subsequently matched with the two breakdowns from another pair of sheet bars, it is quite possible and very likely that the contour of the single breakdown will differ from that of the two breakdowns of the pair with which it is matched. It is well known in the rolling art that differences in the contours of breakdowns of a pack lead to very undesirable results, such as the formation of folds, creases or cambers in the pack due to pinching and buckling, which are traceable directly to the differences in contour between the several breakdowns of the pack.

In rolling certain classes of material, furthermore, it has been the practice to pickle the breakdowns after rough rolling. The breakdowns are then matched according to length. It is obvious that the chances of the breakdowns of a pack so formed having similar contours are very slight indeed. Not only are breakdowns which were rolled at different times and have different contours matched together, but the breakdowns may be reversed end for end with respect to the direction of rolling, which further complicates the finishing of the packs.

To avoid the results above mentioned, the practice of giving a pack a run-over pass before finish rolling has grown up. According to this practice, the breakdowns after being matched into a pack are reheated and given a single pass through the finishing mill to shape the pack to the contour of the mill. The pack is then reheated and finished. Even with such precautions, it has been the experience of years that there is a difference in the elongation of the breakdowns of a pack if they were rough rolled at different times or on different mills, because of the difference in contour. Sometimes the operators, on perceiving a difference in the rate of elongation in the breakdowns of a pack, find it necessary to split the pack open, remove the breakdown which elongates at a different rate from the others, and replace it with a more suitably proportioned breakdown.

I have invented a method and apparatus for rolling breakdowns from sheet bars which replaces the roller and catcher and which, furthermore, is effective to match the breakdowns rapidly without the intervention of manual assistance except to perform certain simple control functions. In accordance with my invention, I employ tilting, feeding and catching tables on opposite sides of the mill, such as are fully described and illustrated in the U. S. patent of Raymond J. Wean and Archibald D. Evans, Patent No. 1,974,403, and auxiliary conveyors between the mill housings for cooperating with the feeding

and catching tables to advance the sheet bars to and through the mill in one direction and to lift them for passage in the reverse direction over the upper roll of the mill. On one of the tables, preferably the feeding table, I provide stops for properly positioning the individual bars of a pair which are to be worked on substantially simultaneously, before starting the rolling cycle. These stops, together with certain auxiliary devices, also perform the matching of breakdowns into packs after the roughing down operation is complete. The invention permits sheet bars to be reduced in pairs in accordance with the well established practice.

In accordance with my method, I roll all the breakdowns to be combined to form a pack substantially simultaneously so that they will have the same contour. In other words, the breakdowns to form a pack are rolled successively so that the contour of the roughing mill is the same between the reduction of successive breakdowns. To roll packs of twos, I start with a pair of sheet bars and, after reducing them to breakdowns, match them and complete the finish rolling substantially simultaneously. The breakdowns thus have corresponding contours and by finishing them immediately, the run-over pass may be entirely eliminated. The breakdowns are mechanically matched and it is impossible to reverse the breakdowns end for end with respect to the direction of rolling.

If packs of three breakdowns are to be rolled, my method contemplates the rolling of three sheet bars successively to form the three breakdowns necessary for the pack. The results above described also obtain in such case and the aforementioned objections to the old practice of splitting one pair of breakdowns between two other pairs to form two packs of three breakdowns, are eliminated.

For rolling packs of four breakdowns, I likewise roll four sheet bars successively. All the breakdowns thus have similar contour and, even though, because of a slight difference in temperature, for example, or some other reason, they are not of exactly the same gauge after the completion of the rough rolling, they at least have the same contour and the occurrence of buckling and pinching of the pack is avoided.

For a complete understanding of the invention, reference is made to the accompanying drawings illustrating a present preferred embodiment, although it will be understood that many changes in the invention as disclosed may be made within the scope of my broader claims. In the drawings:—

Figure 1 is a sectional view through a rolling mill having the invention incorporated therein, showing the feeding and catching tables in side elevation and partly broken away;

Figure 2 is a plan view of the mill and the tables, the mill screwdowns being shown in section, the details of the mill drive being omitted for the sake of clearness;

Figure 3 is an isolated view of a detail which is also shown in Figures 1 and 2;

Figure 4 is a similar view of another detail;

Figure 5 is a view similar to Figure 1 showing the invention applied to a three-high mill;

Figure 6 is a sectional view to greatly enlarged scale through a pack of breakdowns produced by the methods of the prior art; and

Figure 7 is a similar view showing the section of a pack of breakdowns produced by the present invention.

Referring now in detail to the drawings, a rolling mill 10 is composed of a pair of housings 11 having rolls 12 and 13 journaled in suitable bearings which are positioned in the housing windows 14. Screwdowns 15 are provided for adjusting the position of the top roll 12. The mill housings rest on bed rails 16 and the mill rolls are driven by a power train (not shown) substantially coaxial with the bottom roll 13, in the known manner.

Cross bars 17 are secured to the inside of the housings 11 adjacent the bottom roll 13. Conveyor frames 18 are mounted on the cross bars 17 and provide bearings for shafts 19. Sprockets 20 keyed to the shafts 19 are provided for driving chains 21 around the frames 18, which are provided with suitable guides, to constitute auxiliary conveyors for introducing sheet bars to the mill and conveying them therefrom in the direction of the arrows. Guides 22 project into the mill pass from each of the auxiliary conveyors. Motors 23 mounted on any suitable support are coupled directly to the shafts 19 for driving the auxiliary conveyors.

Cross bars 24 extend between the mill housings and are secured thereto adjacent the top roll 12. Conveyor frames 25 rest on the cross bars 24 and bridge the top roll. The frames provide bearings for shafts 26 having sprockets 27 thereon. Conveyor chains 28 are trained around the sprockets 27 and over guides 29 on the frames. A motor 30 serves to drive one of the shafts 26 so that the chains 28 move in the direction of the arrow. While the portions of the conveyor just described on opposite sides of the transverse central plane of the mill are at a slight angle to each other, this angle is preferably not more than about 10°.

Feeding and catching tables 31 and 32 are disposed on opposite sides of the mill 10. These tables are substantially identical and are disclosed in detail in U. S. Patent No. 1,974,403. Briefly, they comprise a base 33 having bearings 34 for supporting trunnions 35 extending from the sides of a tilting frame 36 at the end thereof remote from the mill. Crank plates 37 depend from the sides of the frame and are pivoted to links 38 which are in turn pivoted to eccentrics carried by a speed reducer 39. A motor 40 having a brake 41 drives the speed reducer 39. A spring chain 42 constitutes means for counterbalancing the torque exerted by gravity on the free end of the frame. A motor 43 positioned on the base 33 drives a speed reducer (Fig. 2) between the bearings 34. The speed reducer has a low speed shaft coaxial with the trunnions 35 and sprockets 44 mounted thereon. Chains 45 are trained around the sprockets 44 and sheaves 46 at the mill end of the tables. An idle roll conveyor 47 serves to conduct bars from a heating furnace (not shown) to the feeding table.

The tilting motors and conveyor chain motors of the feeding and catching tables are controlled automatically by the movement of the bars, by means of a flag switch 48 on the catching table, and limit switches 49 actuated by the movement of the tables. This system of control is disclosed in British Patent No. 390,963. This system causes automatic operation of the tables to raise them to their elevated (solid line) positions after the conveyor chains have been operated to advance a bar through the mill while the tables are in their lower (dotted line) positions.

As before indicated, the feeding table 31 is provided with mechanism for the purpose of posi-

tioning the sheet bars before the commencement of the rolling and for matching the breakdowns after the completion of the rolling. One of these devices is a front stop 50 shown in Figure 3. The stop comprises a shaft 51 journaled in bearings 52 on opposite sides of the table frame. Fingers 53 keyed to the shaft 51 are adapted to move from a horizontal (solid line) to a vertical (dotted line) position. The means for operating the fingers comprises a crank 54 keyed to the shaft 51 and a link 55 which is pivoted to a crank 56 on a motor 57. The motor 57 is secured to the bottom of the table frame and may be controlled manually to operate the stop 50.

The feeding table is also provided with an intermediate stop and matching rolls indicated generally at 58. This mechanism comprises a shaft 59 disposed longitudinally of the frame 36 and journaled in bearings 60 secured to one side of the frame. A driving motor 61 secured to the bottom of the frame is geared to the shaft 59. An L-shaped stop 62 is keyed to the shaft 59 and one end thereof is adapted to project through a slot 63^a in the deck of the table.

Matching rolls 63 are journaled on arms 64. The arms 64 are keyed to a shaft 65 journaled in bearings 66 in the sides of the table frame. Bevel gearing 67 connects the shafts 59 and 65. Operation of the motor 61 causes the rotation of the shaft 59 and movement of the stop 62 from the elevated position, which is illustrated, to a position below the level of the conveyor chains 45. At the same time, the matching rolls 63 are moved to their retracted position illustrated in dotted lines in Figure 4. The motor 61 is also manually controlled for operating the stop 62 and the rolls 63 in accordance with the wishes of the roller.

The operation of the apparatus to carry out the method of my invention will now be described. A pair of sheet bars, when heated to the proper temperature, are withdrawn from the furnace, which is preferably adjacent the mill. The bars are advanced on a run-out conveyor to the bridging conveyor 47. The table 31 and 32 are initially operated to their lower positions and the stop 50 is actuated so that the fingers 53 thereof are vertical. The conveyor chains 45 are driven to advance the bars along the table. After the first bar has passed the stop 62, the latter is raised by operating the motor 61. The first bar continues to move along the conveyor until it engages the fingers 53, where it is held in a position indicated at 68. While the matching rolls 63 are raised by the elevation of the stop 62, they do not interfere with movement of the bar or, if they do, the operation of the stops may be timed so that the bar will engage the fingers 53 before the stop 62 is raised. The second bar is likewise advanced down the feeding table and engages the stop 62, which holds it in the position indicated at 69. When the roller is ready to start the roughing down operation, the stops 50 and 62 are withdrawn simultaneously by driving the motors 57 and 61. The continued movement of the conveyor chains 45 will advance the bars on to the auxiliary conveyor on the entering side of the mill, which is continuously driven by its motor 23. The bars are thus positively fed into the path of the rolls over the guides 22. Upon emerging from the mill after the first pass, the bars successively engage the guides 22 and the auxiliary conveyor on the exit side of the mill and are advanced on to the catching table 32. The operation of the flag switch 48 by the engagement therewith of the two bars causes the tables to be raised to their elevated positions and the conveyor chains to be reversed. The bars are then returned over the top roll of the mill on the bridging conveyor and delivered therefrom to the feeding table. Both tables are then lowered and the conveyor chains reversed for a second pass. The above described cycle of operations is continued until the bars have been reduced to breakdowns of the desired gauge. An important feature of the invention is that this reduction can be accomplished so rapidly that the breakdowns are still hot enough to permit of further rolling in packs. At this point, it is generally desirable to match the breakdowns produced by the rough rolling, to form a pack. After the bars have been fed into the mill for the last pass, the roller operates the motor 61 to raise the stop 62 and the matching rolls 63. The first breakdown returning over the mill rides up on the rolls 63 and continues to move by its engagement with the conveyor chain until it engages the stop 62. The rolls 63 are effective to raise the leading edge of the second breakdown so that it clears the trailing edge of the first breakdown, and the momentum of the second breakdown causes it to slide over the first until it also engages the stop 62.

The breakdowns are now matched and are ready for further reduction. The tables are lowered under manual control and the stop 50 is operated to raise the fingers 53. On reversal of the conveyor chains, the pack of matched breakdowns advances against the fingers 53, which further aligns the edges of the breakdowns. When it is desired to proceed with the rolling of the pack, the fingers 53 are retracted by operating the motor 57 and the pack advances into the mill. It is to be emphasized that the rapidity with which the bars can be reduced to breakdowns will permit further rolling of the latter in packs without reheating. This, in fact, is the chief advantage of the invention, in addition to the fact that it also increases the rate of production considerably.

The method just described provides for the rolling of the breakdowns constituting a pack in succession so that the contour of the roll pass is the same for all breakdowns. The pack formed is immediately finished, the usual run-over pass being unnecessary since the contour of the breakdowns is already suited to that of the mill pass. It is impossible for the breakdowns to become reversed end for end and they continue to pass through the mill in the same direction.

Figure 7 shows a pack formed of two pairs of breakdowns 70 and 71. It will be observed that the breakdowns of each pair are similarly shaped. When packs of twos are finished, therefore, there will be no difficulty as a result of non-uniform elongation of the breakdowns.

Figure 6 illustrates a possible result of the practice of the method of the prior art. Of the pack 72 of three breakdowns shown in Figure 6, the top breakdown is of a contour different from that of the other two breakdowns. Such a result might follow from the rolling of breakdowns in successive pairs and the splitting of one pair between two other pairs. It is possible, of course, that the contour of the mill pass will change materially between the rolling of two pairs of bars. When the finishing of a pack such as shown in Figure 6 is attempted, the difficulties above mentioned, buckling and pinching, will inevitably result because the top breakdown does

not elongate in the same fashion as the other two breakdowns of the pack. The thickest portion of any breakdown, of course, is elongated the most.

When four breakdowns are rolled to form a pack, in accordance with my invention, even if two of the bars are of slightly different temperature than the other two, or if for some other reason they are not reduced to the same gauge, as shown in Figure 7, all the breakdowns will have similar contours even though they be of different gauge, and even if the contours are not symmetrical about the center line, as shown in Figure 7. It is more important that this similarity of contours be preserved, for successful finish rolling, than that the contours necessarily be absolutely symmetrical.

In rolling packs of three or four breakdowns, the required number of bars will be withdrawn from the furnace and advanced to the feeding table where they will be positioned by the stops already described. Obviously, an increase in the number of stops to take care of the larger number of bars will be desirable. When the bars have been positioned on the feeding table, the whole train of bars is passed through the mill and then returned in the reverse order, this cycle being continued until the required reduction has been made. Matching is then effected in the manner already described and the finish rolling completed without the necessity of the run-over pass which has heretofore been resorted to to shape the breakdowns of the pack to the outline of the pass of the finishing mill.

The invention is applicable to three-high mills with equal facility. Figure 5 illustrates a three-high mill equipped in accordance with the invention. In Figure 5, parts corresponding to those of Figure 1 are indicated by the same reference numerals. The only difference between the mills shown in Figures 1 and 5 is that the latter has, in addition to top and bottom rolls 12 and 13, a middle roll 13*a* journaled in the housings in the usual manner. The feeding and catching tables 31 and 32 cooperate with the auxiliary conveyors comprising the cross bars 17, frames 18, shafts 19, sheaves 20 and chains 21 for passing material between the middle roll and the bottom roll. Similar conveyors are mounted on brackets 17′ on the inner side of each of the housings 11. These brackets carry conveyor frames 18 in which shafts 19 are journaled having sheaves 20 for guiding chains 21 therearound. In other words, the lower auxiliary conveyors of Figure 1 are duplicated in the three-high mill of Figure 5 at the pass between the middle roll and the bottom roll and at the pass between the middle roll and the top roll, except that in the case of the latter auxiliary conveyors, the cross bars 17 are replaced by brackets to avoid interference with the passage of material through the mill.

It will be apparent that the feeding and catching tables can be designed to operate much faster than manual rollers and catchers. The machines, furthermore, do not require relief periods to rest but can operate continuously. They perform the back-breaking work of the roller and catcher and release these operators for other less laborious tasks. By reason of the auxiliary conveyors described, it is possible to employ feeding and catching tables which have been developed to a high degree of perfection for handling packs, for successively passing sheet bars through the mill for the roughing down operation resulting in breakdowns.

Although I have illustrated and described herein but one preferred form of the invention, it will be recognized to those skilled in the art that numerous changes in the method and apparatus described may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. The combination with a rolling mill of a feeding table on the entry side thereof and a catching table on the exit side, said tables having conveyor chains for moving material back and forth through the mill, and auxiliary driven conveyors between the mill and the ends of both the tables, one of said tables having a retractible stop intermediate its ends effective to match successive pieces of material moving therealong.

2. In a rolling mill, roll housings therefor, rolls journaled in said housings, feeding and catching tables for passing material back and forth between the housings, conveyors on both sides of the mill adjacent the pass between the rolls, and a conveyor above and extending on both sides of the rolls, positioned to cooperate with said feeding and catching tables in passing material between the mill housings.

3. In a rolling mill, a pair of housings, the combination with feeding and catching tables for moving material back and forth between the mill housings, of auxiliary conveyors on each side of the mill adjacent the pass, and an auxiliary conveyor bridging the upper roll of the mill, and positioned to cooperate with said tables to move material between the housings.

4. A feeding table for supplying material to a rolling mill including a frame pivoted adjacent one end, the other end of the frame being adapted to be disposed adjacent the mill, a conveyor on said table, a retractible stop adjacent the mill end of the table, a second retractible stop spaced from the mill end of the table and said first-mentioned stop, means for operating said stops individually, and matching means between the second-mentioned stop and the mill end of the table for causing successive pieces of material delivered to said table to form a pack.

5. A feeding table for rolling mills comprising a tilting frame pivoted adjacent one end, a conveyor traversing the frame, a retractible stop on the frame, and means on the table for lifting successive pieces of material received on the table over a preceding piece thereon to form a matched pack.

6. In a rolling mill, the combination with feeding and catching tables on opposite sides of said mill tiltable between upper and lower positions, of driven conveyors supported on the mill housings for feeding material to and from the mill rolls, said conveyors forming a moving support extending from the tables in their lower position to the roll pass, and a driven conveyor extending across the rolls and forming a moving support connecting the ends of the tables in their upper position.

7. A method of making metal sheets, comprising feeding a plurality of sheet bars between the rolls of a rolling mill in quick succession and by simultaneous movement in the direction of feeding on a feed table, returning the sheets to said feed table by a catching table, continuing such operation to the extent necessary to produce breakdowns of the desired gauge, which breakdowns have substantially the same contour by

reason of their passage in quick succession between the rolls of the rolling mill, forming a pack of said breakdowns, and finish rolling said pack without reheating after the first pack rolling pass.

8. A method of making metal sheets, comprising feeding a plurality of sheet bars between the rolls of a rolling mill in quick succession and by simultaneous movement in the direction of feeding on a feed table, returning the sheets to said feed table by a catching table, continuing such operation to the extent necessary to produce breakdowns of the desired gauge, which breakdowns have substantially the same contour by reason of their passage in quick succession between the rolls of the rolling mill, forming a pack of said breakdowns on one of said tables, and finish rolling said pack without reheating after the first pack rolling pass.

9. A method of making metal sheets, comprising feeding a plurality of sheet bars between the rolls of a rolling mill in quick succession and by simultaneous movement in the direction of feeding on a feed table, returning the sheets to said feed table by a catching table, continuing such operation to the extent necessary to produce breakdowns of the desired gauge, which breakdowns have substantially the same contour by reason of their passage in quick succession between the rolls of the rolling mill, forming a pack of said breakdowns, and finish rolling said pack in the same mill without reheating after the first pack rolling pass.

10. A method of making metal sheets, comprising feeding a plurality of sheet bars between the rolls of a rolling mill in quick succession and by simultaneous movement in the direction of feeding on a feed table, returning the sheets to said feed table by a catching table, continuing such operation to the extent necessary to produce breakdowns of the desired gauge, which breakdowns have substantially the same contour by reason of their passage in quick succession between the rolls of the rolling mill, forming a pack of said breakdowns on one of said tables, and finish rolling said pack in the same mill without reheating after the first pack rolling pass.

11. In a feeding table for rolling mills, a tilting frame pivoted adjacent one end, the other end being disposed adjacent the mill, conveying means on said frame, a retractible stop on the frame for arresting movement of material carried on said means, material deflecting means on the table adjacent the stop effective to form a plurality of successively advancing pieces of material into a pack, and common operating means for the stop and deflecting means.

12. The apparatus of claim 11 wherein said deflecting means comprises a retractible roller.

13. The apparatus of claim 11 wherein said common operating means includes a rock shaft extending along said frame.

RAYMOND J. WEAN.