Oct. 16, 1934. A. P. STECKEL 1,977,214

METHOD AND APPARATUS FOR HOT ROLLING STRIP METAL

Filed May 4, 1931 7 Sheets-Sheet 1

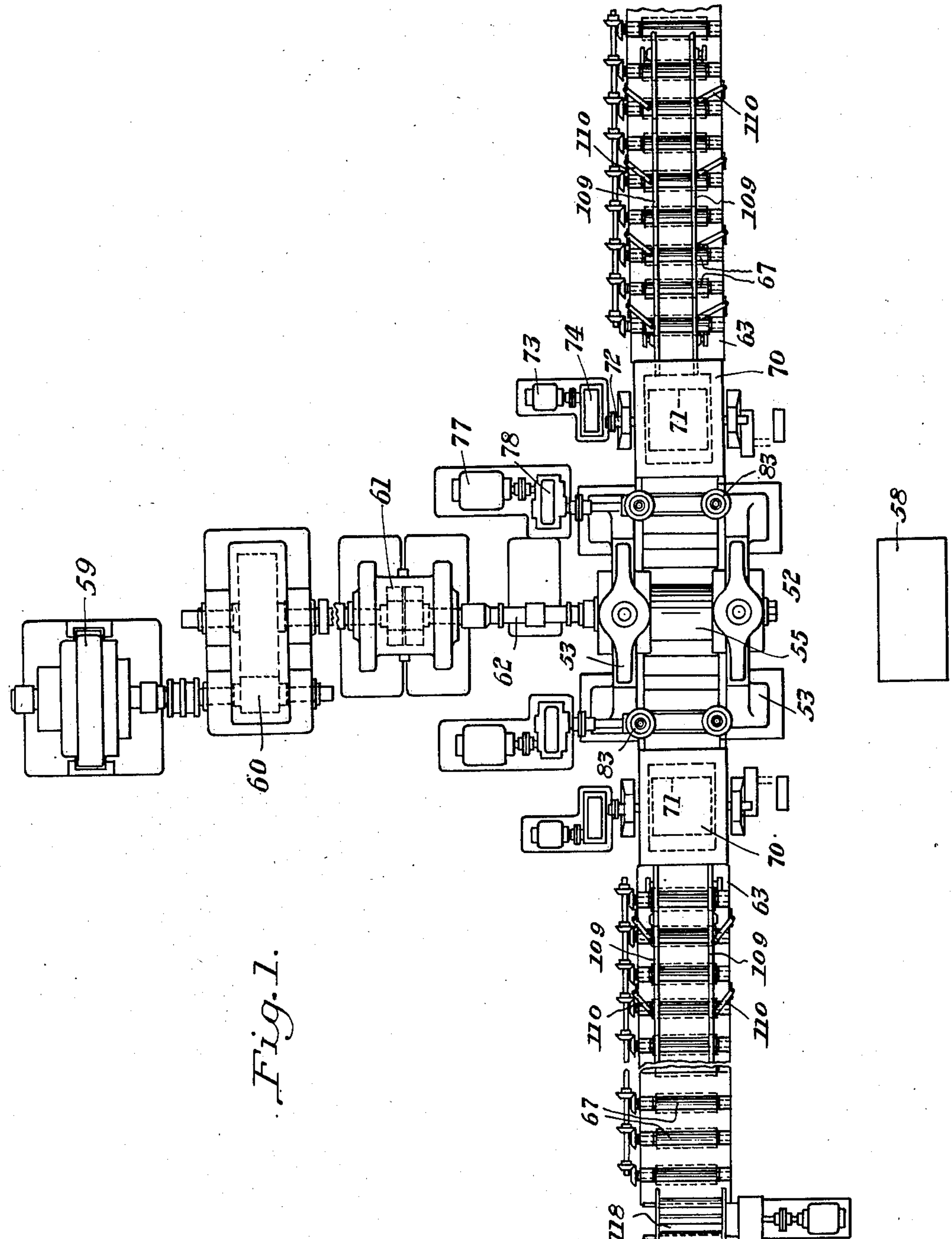


Fig. 1.

INVENTOR

Abram P. Steckel

by his attorneys

Byrnes, Stebbins, Parmelee & Blenko

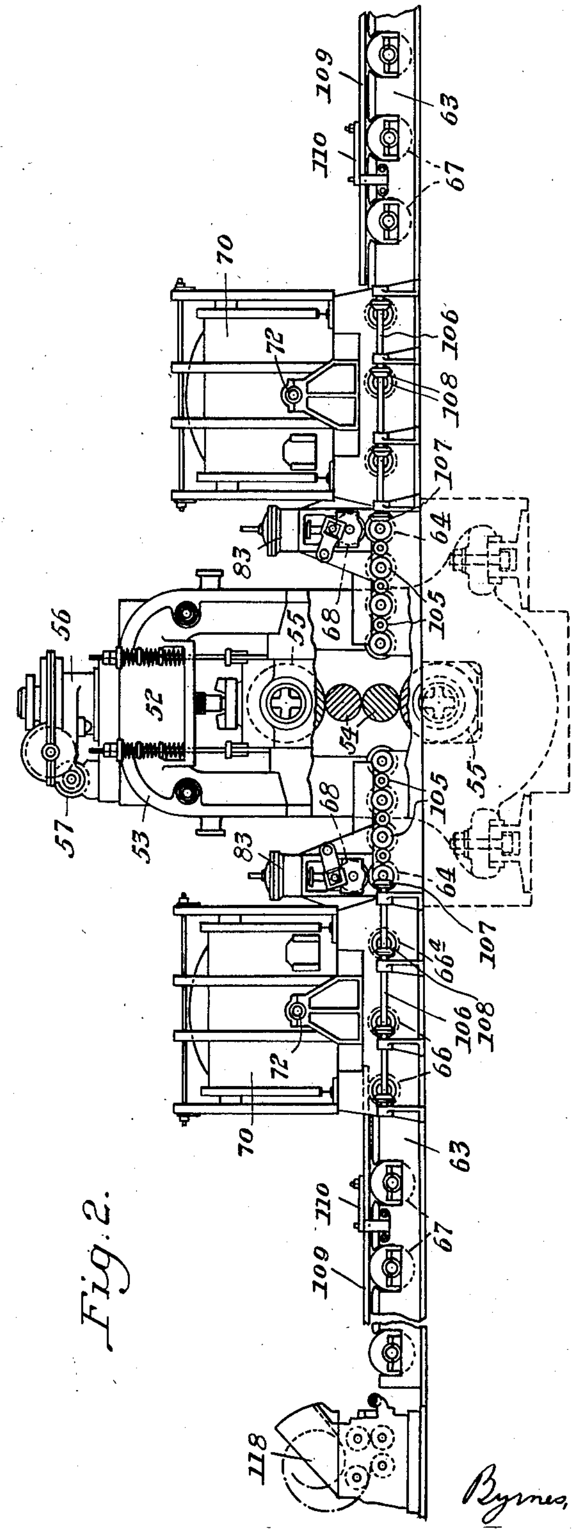


Fig. 2.

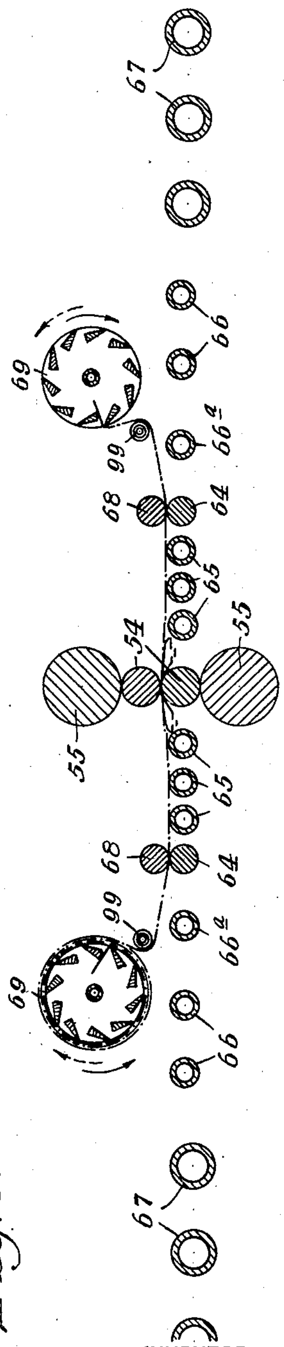


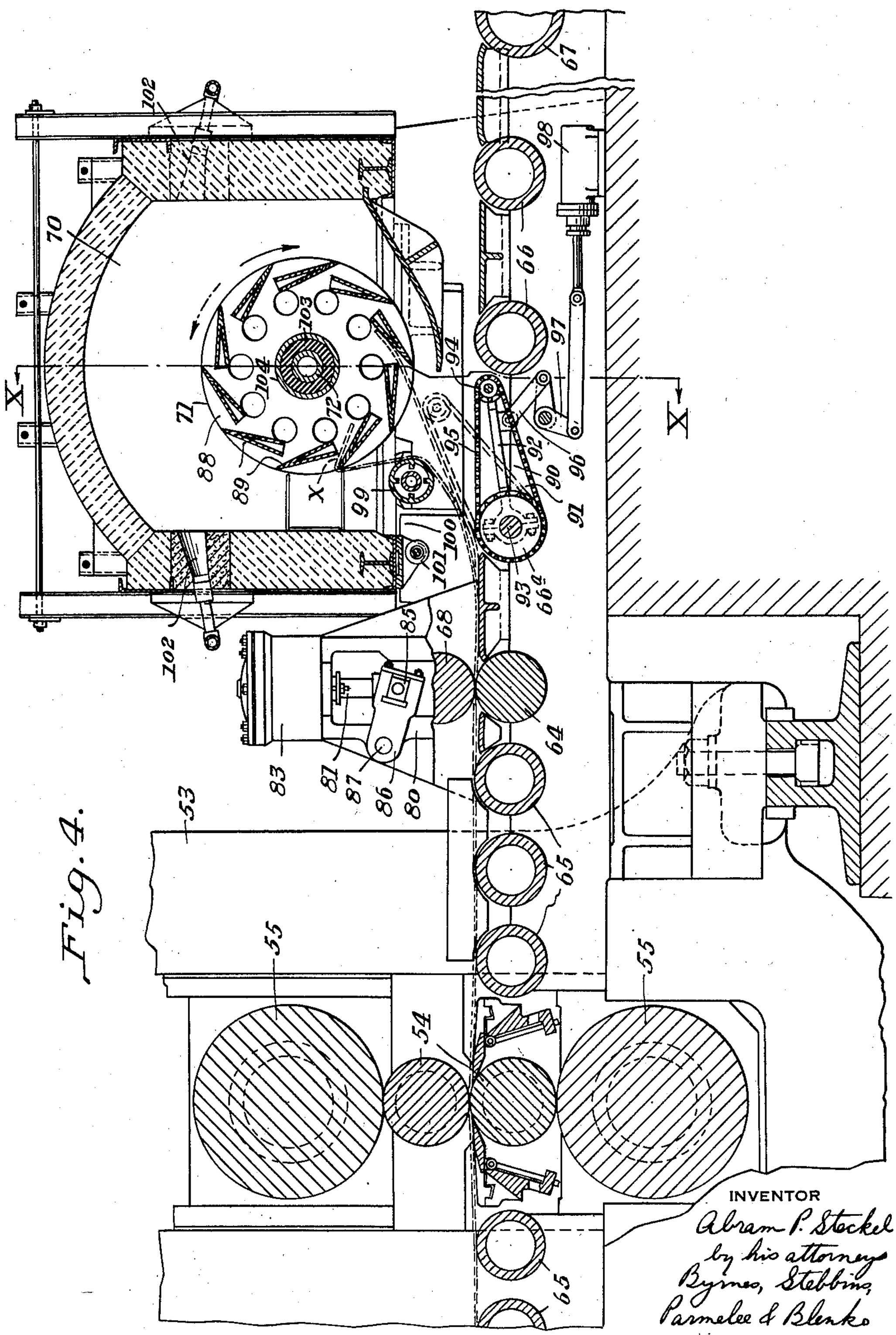
Fig. 3.

INVENTOR
Abram P. Steckel
by his attorneys
Byrnes, Stebbins, Parmelee & Blenko

Oct. 16, 1934. A. P. STECKEL 1,977,214

METHOD AND APPARATUS FOR HOT ROLLING STRIP METAL

Filed May 4, 1931 7 Sheets-Sheet 3



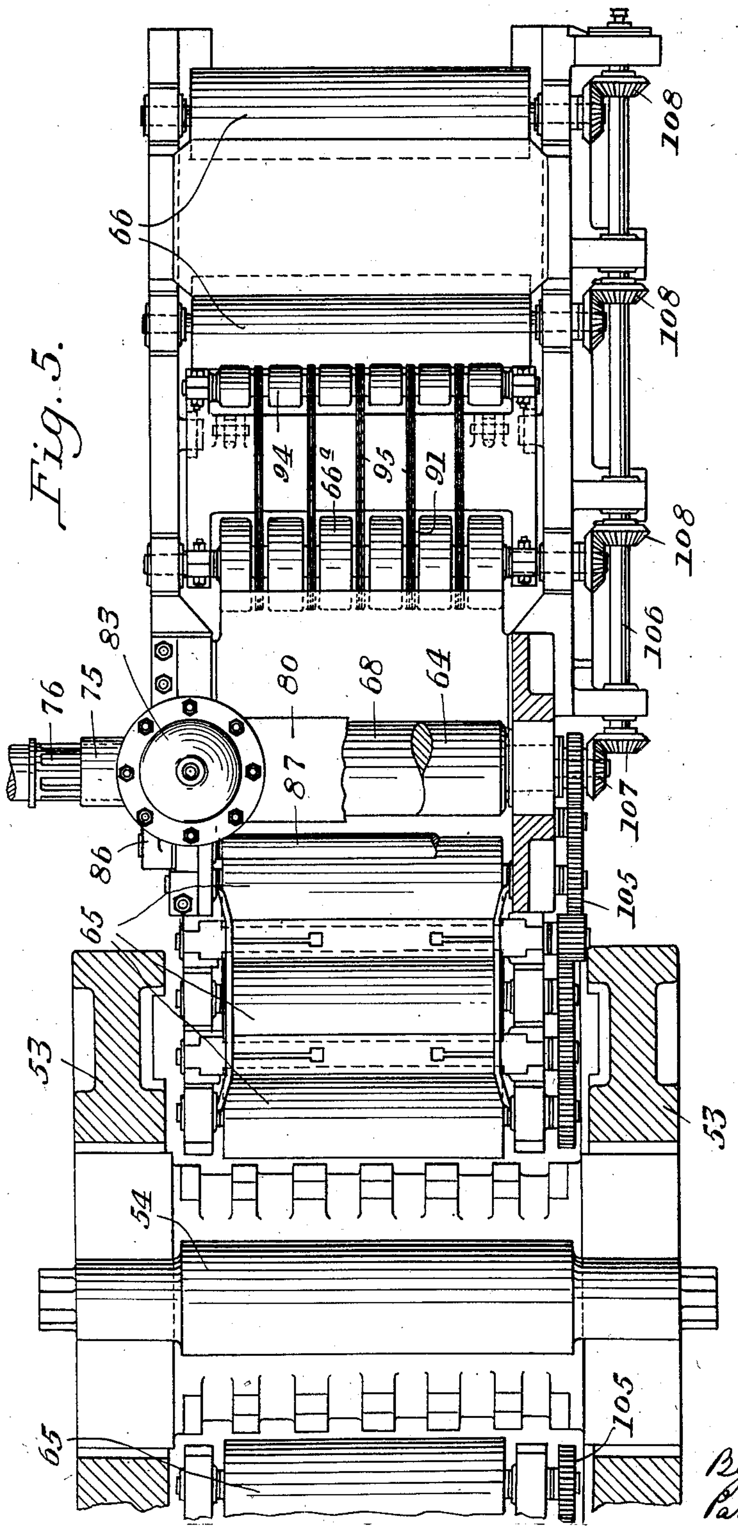
INVENTOR
Abram P. Steckel
by his attorneys
Byrnes, Stebbins,
Parmelee & Blenko

Oct. 16, 1934. A. P. STECKEL 1,977,214

METHOD AND APPARATUS FOR HOT ROLLING STRIP METAL

Filed May 4, 1931 7 Sheets-Sheet 4

Fig. 5.



INVENTOR
Abram P. Steckel
by his attorneys
Byrnes, Stebbins,
Parmelee & Blenko

METHOD AND APPARATUS FOR HOT ROLLING STRIP METAL

Filed May 4, 1931 7 Sheets-Sheet 5

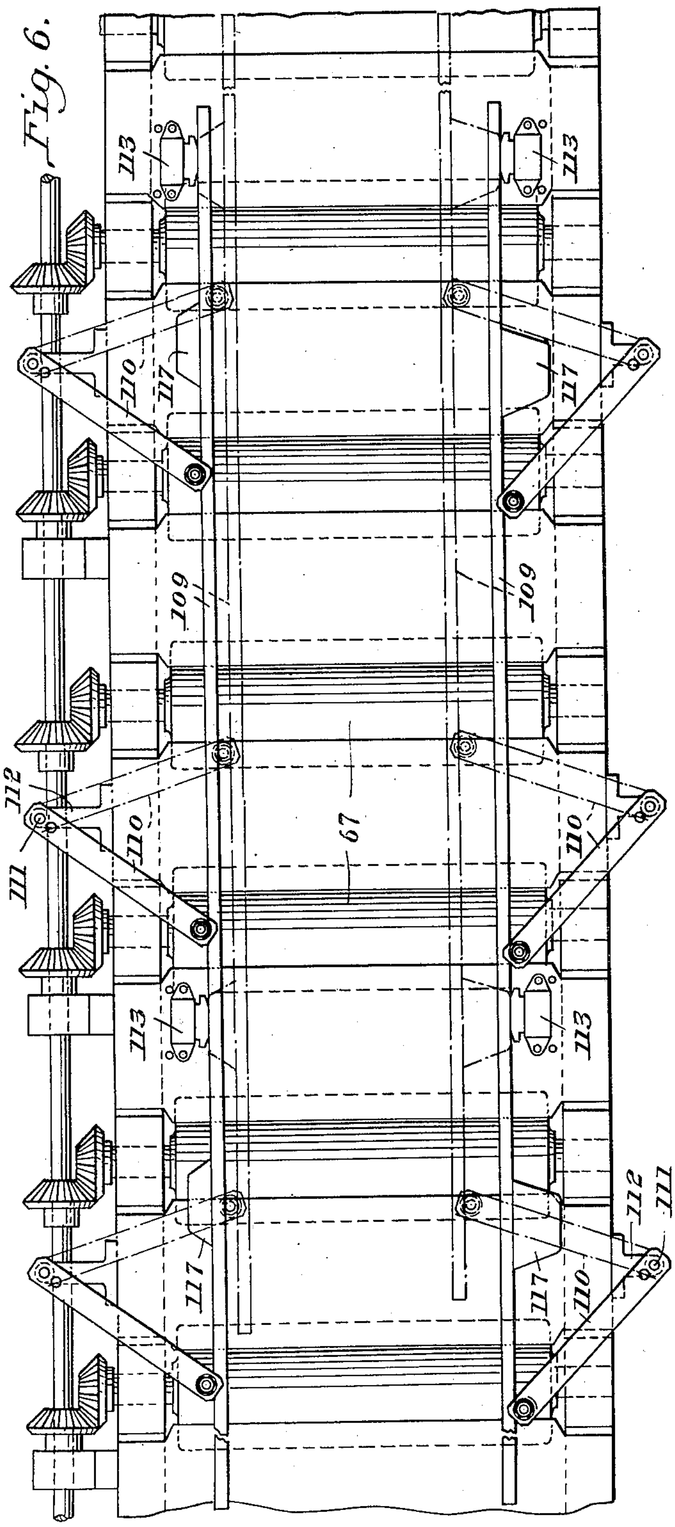


Fig. 6.

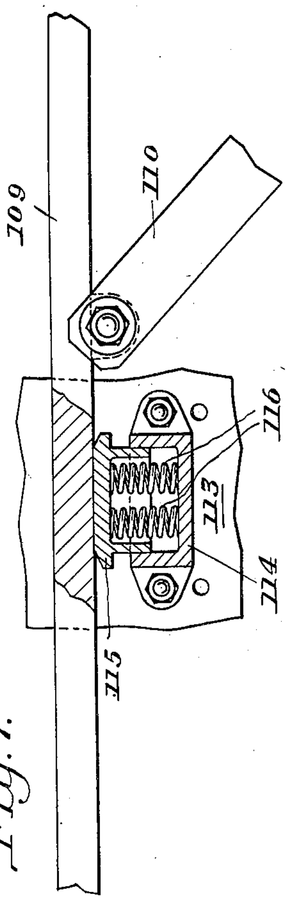


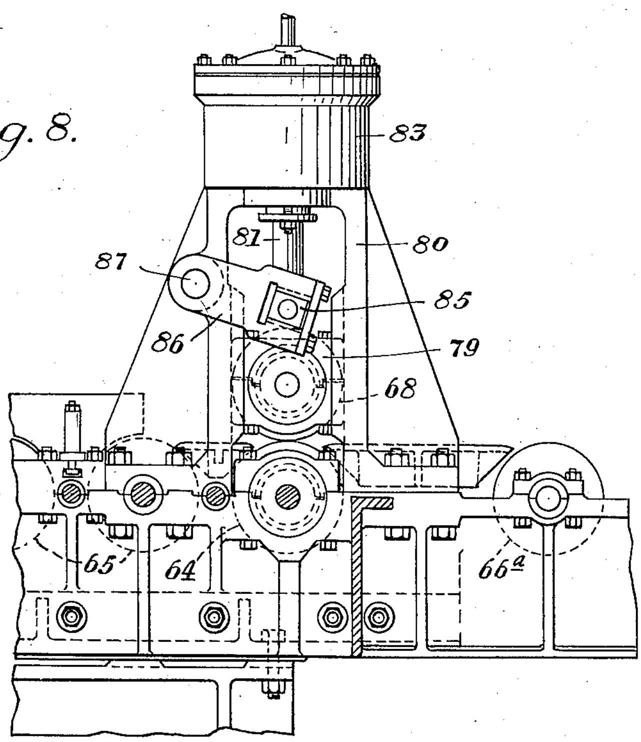
Fig. 7.

INVENTOR
Abram P. Steckel
by his attorneys
Byrnes, Stebbins,
Parmelee & Blenko

METHOD AND APPARATUS FOR HOT ROLLING STRIP METAL

Filed May 4, 1931 7 Sheets-Sheet 6

Fig. 8.



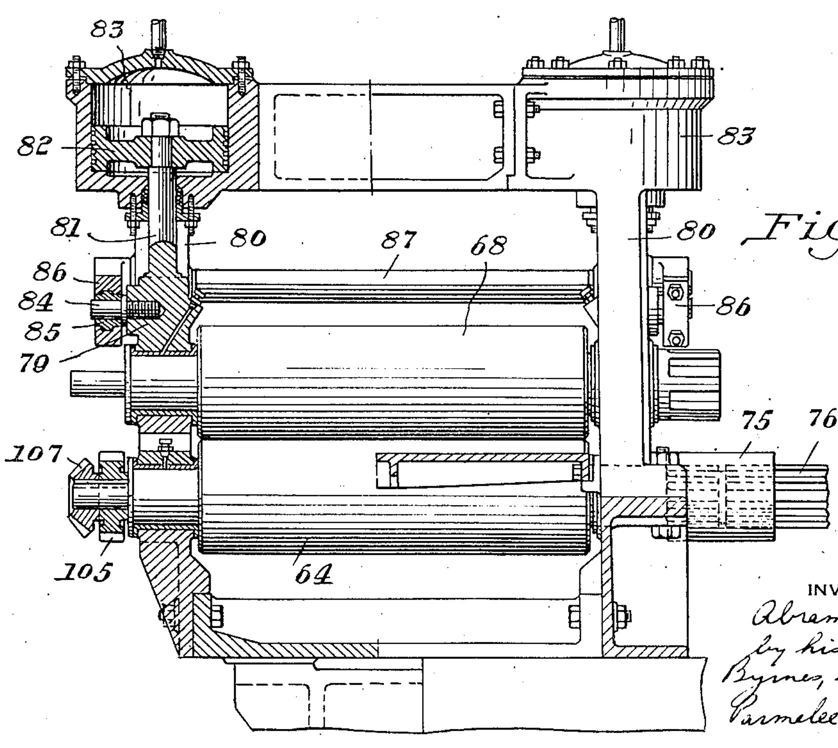


Fig. 9.

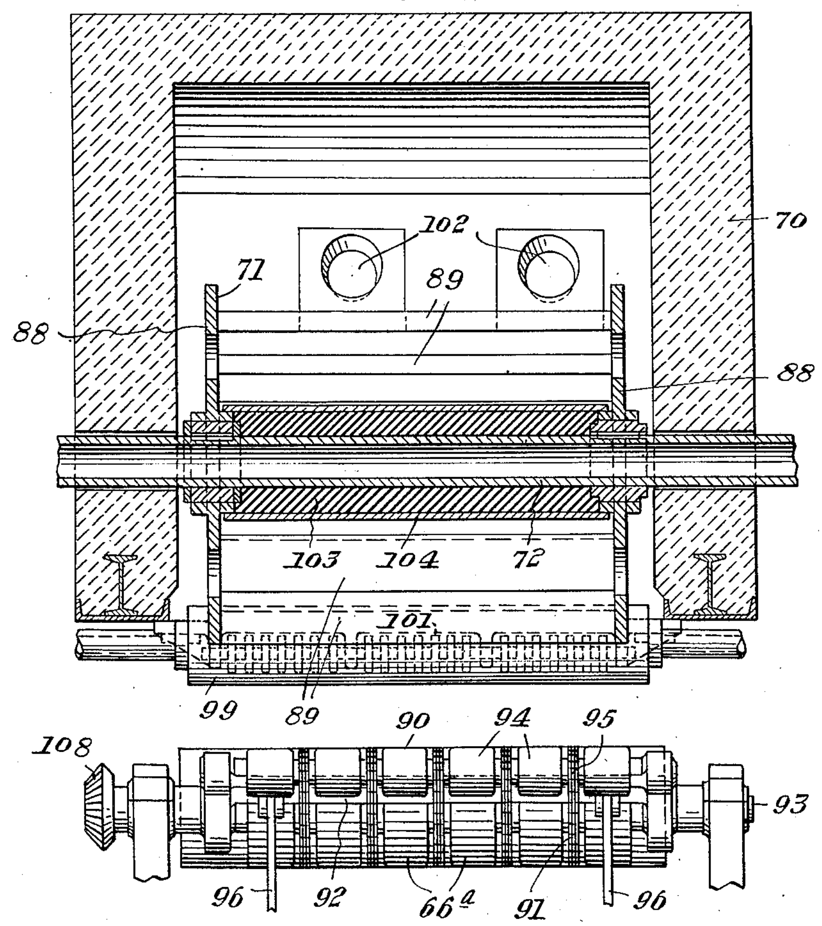
INVENTOR
Abram P. Steckel
by his attorneys
Byrnes, Stebbins,
Parmelee & Blenko

Oct. 16, 1934. A. P. STECKEL 1,977,214

METHOD AND APPARATUS FOR HOT ROLLING STRIP METAL

Filed May 4, 1931 7 Sheets-Sheet 7

Fig. 10.



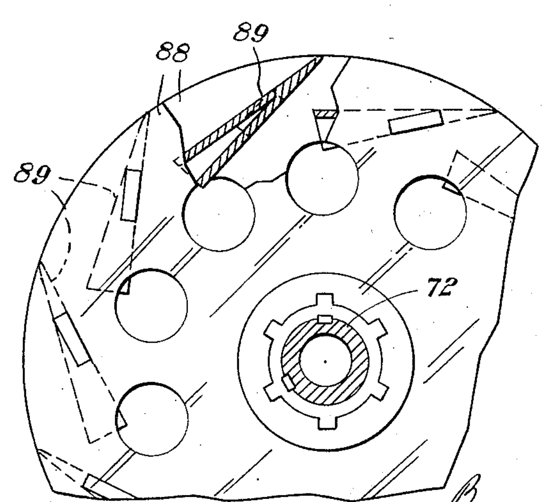


Fig. 11.

INVENTOR
Abram P. Steckel
by his attorneys
Byrnes, Stebbins, Parmelee & Blenko

Patented Oct. 16, 1934 **1,977,214**

UNITED STATES PATENT OFFICE

1,977,214

METHOD AND APPARATUS FOR HOT ROLLING STRIP METAL

Abram P. Steckel, Youngstown, Ohio, assignor to The Cold Metal Process Company, Youngstown, Ohio, a corporation of Ohio

Application May 4, 1931, Serial No. 535,029

22 Claims. (Cl. 80—2)

This invention relates to the hot rolling of strip metal, the word "strip" being used as a word of general definition, and not of limitation to those classifications of flat metal of indefinite length generally designated for commercial purposes as strip.

The accepted method of rolling strip today is to supply a heated slab to a mill train comprising a large number of stands, say ten, in alinement, the heated slab being elongated and reduced in the successive passes. The early stands operate as tandem mills, that is to say the piece is in engagement with only one stand at a time, but the later stands are generally operated as a continuous mill, that is to say the piece is in process of rolling in several passes at one time. Mills of this character require a very high capital investment and the production is relatively limited. The rate of production is limited by the capacity of the last stand. It is this stand which is operated at the highest speed, the preceding mills being run at successively lower speeds because of the fact that the piece being reduced is relatively shorter. Most of the stands in a continuous mill of this sort therefore are operating at speeds far below the possible maximum, whereas in the type of mill herein disclosed the mill may be operated on each pass at maximum speed or at speeds approaching maximum. As a consequence, it is possible, for a given capacity, to install a mill of my improved type at about one-fourth the cost of a mill of the continuous type.

Such mills also require a very large amount of floor space since all of the rolling is done while the piece is in the flat. Despite the fact that the later stands in the train are operated in a continuous manner, there must still be a reasonable spacing between the mills so as to give access to the stands and to provide for forming a buckle in the piece to accommodate minor discrepancies in the speed of revolution of successive stands which simultaneously engage the piece. There must also be a run-out table beyond the last stand, which run-out table is long enough to accommodate the product. In continuous mills for narrow strip it is common practice to turn the strip on edge and to lap it back and forth over a relatively short cooling bed, but this is not possible with wide strip. The size of such an installation may be appreciated when it is considered that a representative mill of this type having ten stands requires motors whose horse power totals 30,000 and requires a building length in excess of 800 ft. In my improved mill only about one-fifth the motor capacity is required. Yet with this relatively small capacity, approximately half as much tonnage may be produced at one-eighth the total investment.

I provide a mill which is relatively simple and compact in construction, employing preferably but a single reducing stand, although it may in certain instances be desirable to divide the work between two stands. I am able to make each pass at a speed which is determined only by the power supply of the mill and which is not limited by the requirements of a succeeding stand. I prefer to employ a four-high mill of the reversing type, although other types of mills such as a three-high mill wherein the work is fed alternately over and under the middle roll, may be employed.

Each pass will ordinarily be followed by a succeeding pass as rapidly as possible, thereby utilizing practically all of the operating time of the mill.

It is of course well known to reduce the thickness of slabs by rolling them back and forth through a mill stand, but the extent of the reduction has always been relatively limited by two factors, namely, the elongation of the material to a point where it cannot be satisfactorily handled, and the loss of heat to a point where rolling can no longer be profitably continued.

I overcome these difficulties by initially hot rolling a piece of metal in the flat so as to reduce it in thickness sufficiently to permit of coiling it, and in the same heat feeding it from the coil and further reducing it. I preferably employ coilers on each side of the mill and after the initial flat rolling the material is coiled and uncoiled on each pass, the material being fed from a coil to the mill and being coiled up on the other side as it issues.

Mills of the continuous type are designed taking into consideration the rapid loss of heat occasioned by the exposure of the entire surface to the cooling action of the atmosphere. By reason of the fact that as the piece becomes thinner a relatively greater area per unit of volume is exposed for cooling, there is a rapid loss of heat. If, however, this material is coiled, the exposed area is only a very small fraction of the total area of the piece. Furthermore, the coiling permits of using relatively short mill tables, thus saving space and mill cost. The coilers are preferably arranged in heat conserving chambers so as to still further reduce the heat loss and to minimize scaling.

There is a great advantage from the standpoint of heating in initially supplying the hot metal to the mill in slab form. It is practically impossible to uniformly heat a large coil of material to rolling temperature since the edges will always be too hot and the metal of the coil will not be of uniform temperature either from end to end or side to side. With a slab, however, it is relatively easy in existing furnaces to obtain uniformity of heating with a minimum of scale loss.

In order to operate at high speed, it is necessary to have some positive means for feeding the end of the coiled strip back to the mill. For this purpose I prefer to employ pinch rolls on either side of the stand. In practice, the operator will run the mill so as to feed the material in one direction and continue the rolling until the trailing end is out of the grip of the reducing rolls. However, he will bring the mill to a stop before the piece is freed of the pinch rolls. By driving the pinch rolls in a reverse direction, he is enabled to feed the material back to the mill.

The pinch rolls operate to maintain the material under tension and this is highly desirable. It insures straightness of the product and materially simplifies the handling. The pinch rolls on the exit side will be arranged to exert a forward pull on the material, and those on the entering side will be arranged to impart a drag thereto. This causes the material to issue straight. If there are any slight irregularities due to over-rolling at one point or another across the width of the strip, such irregularities will be largely or entirely removed.

During the early stages of the rolling mill when the material is in slab form it is sufficiently stiff even at rolling temperature that it may be thrust forward by the rolls or by the pinch rolls very rapidly. When it is quite thin there is a tendency of the material to buckle as it issues from the mill or from the pinch rolls unless it is taken up by the reel as fast as it issues. The reel must be of such construction as to engage the material positively and without delay. I employ a form of reel which serves this purpose and which also is effective in combination with other apparatus employed for breaking or loosening the scale between passes, thus insuring that no scale will be rolled into the surface of the strip, reducing its quality. This form of reeling mechanism, however, operates most satisfactorily only after the material is relatively thin. There is an intermediate stage of reduction between the flat rolling of the thick slab and the reeling of the thin material which, for purposes of heat saving, and economy of installation by reason of shortening of the tables, is best carried out by reeling the material. I employ the same reels for this material of intermediate thickness but operate them in the opposite direction, as hereinafter explained.

There are certain difficulties attendant upon rolling the material in the flat at the high speeds I contemplate, which difficulties must be overcome to make the installation desirable. As the material is reduced in thickness, it widens. In the early stages of rolling, where the slab is still relatively short, it is not so important that it be fed exactly squarely into the rolls, but as it increases in length its alinement becomes more and more important. In order to obtain such alinement, side guides must be employed, which side guides necessarily are spaced for entering the piece a distance only slightly more than the width of the piece being entered. On the exit side of the mill, however, the guides should have a relatively wider spacing in order to prevent cobbling. I provide automatically operable guides which fulfill these requirements.

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

Figure 1 is a top plan view of the mill;

Figure 2 is a side elevation to an enlarged scale of a portion thereof;

Figure 3 is a diagrammatic view illustrating the operation of the mill;

Figure 4 is a vertical longitudinal section through the mill stand and one of the coilers;

Figure 5 is a top plan view, partly broken away, of that portion of the installation illustrated in Figure 4;

Figure 6 is a top plan view of a portion of one of the tables showing the guides;

Figure 7 is a detail view, partly broken away, showing a stop for the guides;

Figure 8 is a side elevation of the pinch roll structure;

Figure 9 is an elevation at right angles to the elevation of Figure 8, and partly broken away;

Figure 10 is a transverse section taken on the line X—X of Figure 4, certain parts being omitted for sake of clearness; and

Figure 11 is a side elevation, partly broken away, of one of the coiling reels.

Referring first to Figures 1 to 3 inclusive, there is shown a mill stand indicated generally by the reference character 52 and comprising housings 53 supporting work rolls 54 and backing rolls 55. The backing rolls are preferably provided with anti-friction bearings as described and claimed in my U. S. Patent No. 1,779,195. The mill is provided with screw downs indicated generally by the reference character 56, which screw downs are actuated by an electric motor 57 controlled from the operator's pulpit 58 so that the setting of the mill may be rapidly adjusted. The work rolls 54 are driven by a motor 59 through reducing gears 60, pinions 61 and spindles 62.

A mill table indicated generally by the reference character 63 is provided at each side of the stand 52. A roll 64 spaced a short distance from the work rolls is provided on each side of the mill. Relatively closely spaced table rollers 65 lie between the stand and the rolls 64, and more widely spaced rollers 66 and 67 lie therebeyond. The rolls 64 cooperate with rolls 68 to form a pinch roll unit effective for engaging material. The rolls 68 are arranged to be raised or lowered as desired. At the beginning of a rolling a hot slab is supplied to one of the tables 63 and is fed to the mill which reduces and elongates it, delivering it to the roll table 63 on the opposite side. The mill is then reversed and the operation is repeated. This continues until the slab is thinned sufficiently to permit of coiling it. When this stage of reduction is reached, the material is deflected upwardly from the plane of the tables 63 to coilers. The coilers are indicated generally at 69 in the drawings and are contained in heated chambers 70 lying above the tables 63. The coilers comprise reels 71 mounted on shafts 72 driven by motors 73 through gears 74.

The pinch roll structure is best illustrated in Figures 4, 8 and 9. The rolls 64 are driven through coupling boxes 75 and spindles 76 from motors 77 (see Fig. 1) through reducing gears 78. The motors 77 are controlled from the operator's pulpit 58 as are the motors 73 and 59.

The rolls 68 are mounted in bearings 79 slidable in housings 80. A piston rod 81 extends upwardly from each bearing 79 to a piston 82 in a cylinder 83 formed in the upper part of the housing 80. The pistons 82 may be raised or lowered by controlling the supply of air to the cylinders 83. The movement of the cylinders is also controlled from the operator's pulpit 58. In order to insure simultaneous raising and lowering of the bearing 79 for each end of a roll 68, the bearings are interconnected. Each bearing carries a stud 84 extending through a block 85 slidable in the forked end of a lever 86. The levers 86 are keyed to a rocked shaft 87 so that the bearings 79 are bound to move up or down together.

The coiling mechanism is best illustrated in Figures 4, 5, 10 and 11. Each reel 71 comprises spaced disks 88 with V-shaped bars 89 extending therebetween to form a squirrel cage. The reels may be driven in either direction as desired.

A kick-up indicated generally by the reference character 90 is provided in each table 63 for deflecting material upwardly to the coiler. Each kick-up comprises a driven table roller 66*a* having circumferential grooves with sprocket teeth 91 therein. A frame 92 is pivoted on the shaft 93 of the roller 66*a* and carries a roller 94 having toothed circumferential grooves corresponding to those of the roller 66*a*. Sprocket chains 95 extend around these teeth, the upper flight of the chains lying in the plane of the table when the frame 92 is in its lowered position. The frame 92 is connected by a link 96 to a bell crank 97 which is actuated by a fluid cylinder 98. The cylinder is controlled from the operator's pulpit 58.

When it is desired to coil a strip of material fluid pressure is supplied to the cylinder 98, causing the bell crank 97 to be rotated in a counterclockwise direction, as viewed in Figure 4, and tilting the frame 92 upwardly about the shaft 93. This moves the kick-up to the dot and dash line position of Figure 4 and guides the leading end of the oncoming material into the chamber 70. It is preferred that the reeling be commenced when the material is relatively thick, say ¾ of an inch. For handling material of such thickness the reel 69 is driven in the direction indicated in Figure 4 by the arrow shown in dotted lines. The leading end of the relatively thick and stiff strip passes between adjacent bars of the squirrel cage 71. The peripheral speed of the reel approximates the entering speed of the material and the reel gathers such material as it is fed forward by the pinch rolls. After the reeling in one direction is completed, the direction of rotation of the pinch rolls, the mill and the reel is reversed and the piece is fed back for another pass.

After the material gets sufficiently thin (say about ½ inch) that it becomes practical to bend it sharply, it is desirable to impart such sharp bending so as to loosen the scale and permit it to fall off. Therefore, when the material reaches this thinness, the receiving reel is driven in the direction indicated by the solid arrow. The entering end of the steel being rolled passes between adjacent bars of the squirrel cage 71 and the rotation of the squirrel cage causes the strip to be doubled over the edge of one of the bars 89, as indicated at X in Figure 4. The material thereafter travels around a scale breaking roll 99.

When the material reaches this thinness the question of scale formation becomes important. If scale is not removed between passes it is rolled into the strip and also injures the face of the work rolls in the mill. The formation of a small amount of scale after the rolling has been completed is relatively unimportant, but the continued passing of scaly material through the rolls must be overcome. The flexing of the material around the roll 99 breaks the scale and it is dropped or thrown off prior to the next rolling, thus giving a cleaner product and insuring long life for the work rolls. I term the first mentioned type of coiling "tangential coiling" and the other type as "reverse coiling".

It is intended that the operator will stop the movement of the material just after its trailing end leaves the work rolls 54 and before it passes out from the grip of the pinch rolls 64 and 68, but in the event that he does not check the movement in time and the entire strip is wound on the coiler, the outer end may be readily engaged through a space 100 and fed back to the pinch rolls by tongs. A guide roll 101 protects the surface of the material during such procedure.

The chambers 70 are made of refractory material and will be kept up to a desired temperature in operation by means of fuel burners 102. Relatively only a small amount of heat will be required as the material may be rolled so rapidly in the mill and with such frequency that enough rolling energy is transformed into heat to very materially retard cooling. This is particularly so because of the fact that only a relatively small portion of the length is exposed to atmospheric cooling from the time it issues from the rolls until it is in the coiler.

The shaft 72 of the reel is provided with insulation 103 and a protecting sleeve 104. The shaft 72 being hollow, it is readily maintained at sufficiently low temperature to insure adequate strength. Air cooling alone may be sufficient, but I prefer to let a small quantity of water trickle through. Because of the insulation 103 there is no danger of loss of heat or of chilling the interior wraps of the coil of metal.

It is found in practice that the doubling back of the material over the bars 89 to obtain initial engagement of the reel with the strip is not detrimental to the quality of the material as the bend is not through an unduly large angle, and the metal thereat is kept at elevated temperature and the bend rolled out in the mill.

The construction of the roll tables 63 and the side guides is best shown in Figures 1, 2 and 5 to 7 inclusive. The table rollers adjacent the mill are driven by the motors 73. The roll 64 forming the bottom pinch roll is connected through a spur gear train 105 to the rollers 65. The roll 64 also drives a shaft 106 through miter gears 107. This shaft extends along the table 63 and, through miter gears 108, drives the table rollers 66 and 66*a*. The rollers 67 are driven in a like fashion and may be operated from a separate motor. This will usually be desirable because such rollers will be idle during the entire portion of the operation when the metal is being coiled between passes.

The side guides comprise metal bars 109 connected to parallel links 110 pivoted at 111 on brackets 112 secured to the sides of the table. The bars 109 rest on the table rollers 67. The table shown in detail in Figure 6 lies at the left hand side of the mill as viewed in Figures 1 and 2, and the solid line position of the guides is their open position which is desired when receiving material. Assume now that a slab of metal to be rolled is lying on such table and it is desired to feed the same to the mill. The rolls 67 are rotated in such direction as to carry the metal to the right. By reason of the frictional engagement of the side guides 109 with the rollers, such guides are also carried to the right, swinging on the links 110. By reason of such movement they assume the position shown by dot and dash lines, and it will be noted that the guides in this position are much closer together and are effective for accurately alining the entering material. The further movement of the guides is limited by stops 113, which stops consist of casings 114 bolted to the mill table and carrying buffers 115 backed by coil springs 116.

When the rollers 67 are driven in the reverse direction the side guides are urged to the left as viewed in Figure 6 and swing back to the solid line position, their movement in this direction being limited by the side guides proper coming into engagement with the stops 113. The side guides are provided with pads 117 which engage the stops when the guides are at their inner position. The links 110 are provided with an extra hole or holes at their outer end through which they may be pivoted at 111 so as to vary their effective length and hence the spacing of the guides. The table is provided with a corresponding series of holes as shown in Figure 7, so that the stops 113 may be adjusted to correspond.

It will be noted that the initial angularity of the links on one side of the table differs from the initial angularity of the links on the other side of the table. The reason for this is that as the links move from the solid line to the dot and dash line position they move inwardly so long as the links are traveling toward a position of perpendicularity with respect to the axis of the table, and then slightly outwardly as the links move from such perpendicular position to their position of rest. If the initial angularity of the links on the two sides of the table were the same, such links might reach a condition of perpendicularity at the same moment, thus possibly bringing the guides so closely together as to interfere with the travel of the piece. However, this does not occur with the construction shown. On the contrary, the side guide shown at the upper portion of Figure 6 reaches its innermost position somewhat ahead of the guide on the opposite side. In so doing it engages the edge of the material and alines it. Then in coming to its position of rest it moves away from the material a slight distance so as to give it utter freedom of movement toward the mill, while limiting its sidewise movement to the slight clearance afforded by the travel of the links beyond their position of perpendicularity. The side guide shown at the lower portion of Figure 6 also engages the edge of the strip if the same is mis-alined, and thereby straightens it up for its travel into the mill.

In operation a heated slab of material will be supplied to one of the tables 63 and run back and forth through the mill, the screw down being operated so as to bring the rolls successively closer together, thus thinning and elongating the piece. These passes will be very rapid and with the least possible loss of time, thus getting the strip down to a thinness suitable for coiling without serious loss of heat. When the material is thin enough to coil, the kick-ups will be actuated to feed the issuing strip to one of the coilers. The rolling will then be continued, feeding from one coil to another, the pinch rolls serving to feed the material. After the rolling has been completed the material will be permitted after the last pass to travel to the end of the left hand table 63 and to a centerless coiler 118 of usual construction, from which it may be taken away.

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 it may be otherwise embodied or practiced within the scope of the following claims.

I claim:

1. In combination with a rolling mill adapted for the rolling of material first in one direction and then in the other, a roll table, a coiler above the table, and means for diverting material from the roll table upwardly into the coiler, the coiler having a portion rotated in such direction that when it engages the leading end of the material being rolled it has a component of motion in a direction opposite to the movement of such leading end, and a guide roll associated with the coiler around which the material passes, the guide roll being spaced above the table a distance sufficient to permit of travel of the material over the table when such material is being rolled and maintained in the flat condition.

2. In combination with a mill, a mill table on either side of the mill arranged to support material while the same is rolled back and forth through the mill, means for effecting coiling of the material on either side of the mill as it issues therefrom, and pinch rolls for engaging the issuing material prior to the coiling thereof, the pinch rolls being in the plane of the table but so arranged as to be out of the way of material rolled back and forth on the mill tables.

3. In combination with a mill, pinch rolls on either side of the mill for tensioning issuing material, means beyond the pinch rolls for effecting coiling of the material, and means for retaining the heat of the coiled material.

4. In combination with a mill, a table on either side of the mill of such character as to support a flat piece of material from the time of issuance thereof from between the rolls of the mill until it has been fed back through the mill, the tables being effective for supporting the material while it is relatively thick and in an uncoiled state, and coilers adapted for automatically reeling and paying out material rolled on the mill when the same has been thinned and elongated, sections of the table being movable to divert material from the tables to the coilers.

5. In combination with a rolling mill, a mill table on either side of the mill arranged to support material while the same is rolled back and forth through the mill in the flat state, means comprising sections of the table for deflecting material upwardly from the plane of the tables, a coiler on either side of the mill for engaging and coiling the deflected material, and chambers above the plane of the tables containing the coilers, the chambers being arranged to prevent loss of heat of the coiled material.

6. In combination with a rolling mill, a table having rollers rotatable in either direction, a side guide movable on the rollers, and means for moving the side guide inwardly when the rollers rotate to move the guide in one direction and outwardly when they rotate to move it in the other direction.

7. In combination with a rolling mill, a table having means for moving material therealong, and a side guide resting on the material moving means and movable therewith, means engaging the side guide arranged to move it laterally on actuation of the material moving means.

8. In combination with a rolling mill, a table having means for moving material therealong, and a side guide movable laterally of the table

when the material moving means is actuated, there being a frictional driving connection between the material moving means and the guide.

9. In combination with a rolling mill, a table having material moving means, a side guide resting on the material moving means, laterally extending links connected to the side guides, and stop means for limiting movement of the side guides.

10. In combination with a rolling mill, a table having material moving means, side guides resting thereon, there being a side guide adjacent each side of the table, the side guides being movable with the material moving means, links connected to the side guides, and stop means for limiting the movement of the guides, the links for one side guide being at a different inclination than the links for the other side guide when the guides are at the end of their travel.

11. In the method of hot rolling, the steps consisting in subjecting hot material to successive reducing passes to thin and elongate it, coiling it between passes and flexing it between passes, and prior to coiling, sufficiently to effect removal of formed scale.

12. In the method of rolling, the steps consisting in hot rolling a flat piece of metal to reduce it sufficiently in thickness to permit of coiling it, thereafter subjecting it to repeated reducing passes, coiling it between passes, and removing scale from the material between passes.

13. In combination with a rolling mill, a coiler on each side of the mill for effecting coiling of the material, and means for flexing material between passes in the mill, and prior to coiling, sufficiently to effect removal of scale therefrom.

14. In the method of rolling, the steps consisting in subjecting material to successive reducing passes, feeding it to a coiler between passes, coiling it in one direction between certain of said passes, and coiling it in the other direction between other of said passes.

15. In the method of rolling, the steps consisting in subjecting material to successive reducing passes, coiling the material tangentially between passes, and, at a later stage in the operation, coiling it in the reverse direction between passes.

16. In the method of rolling, the steps consisting in subjecting material to successive reducing passes, coiling the material tangentially between passes, and, at a later stage in the operation, coiling it in the reverse direction between passes, and flexing the material through a relatively sharp bend during such reverse coiling so as to effect removal of scale.

17. In combination with a rolling mill adapted for the rolling of material first in one direction and then in the other, a roll table for feeding material to the mill, a pinch roll cooperating with a roll of the roll table, means for driving one of the cooperating pinch rolls, a second pinch roll cooperating with a roll of the table on the opposite side of the mill from the first-mentioned pinch roll, and means whereby said second-mentioned pinch roll exerts a restraining tension on said material.

18. In combination with a rolling mill adapted for the rolling of material first in one direction and then in the other, roll tables on each side of the mill and coilers above the roll tables, sections of the tables being movable upwardly to divert material to the coilers.

19. In combination with a rolling mill and a table therefor, a side guide positioned over the table and movable longitudinally thereof, and connections for the side guide effective for moving it laterally of the table upon longitudinal movement thereof.

20. In combination with a rolling mill and a table therefor, a side guide positioned over the table and movable longitudinally thereof, connections for the side guide effective for moving it laterally of the table upon longitudinal movement thereof, and stops for limiting such lateral movement, the stops being so positioned that the guide occupies one position laterally of the table upon longitudinal movement in one direction, and another position laterally of the table upon longitudinal movement in the other direction.

21. In combination with a rolling mill and a table therefor adapted to feed material to the mill or to receive the same therefrom, side guides lying over the table and movable longitudinally thereof, connections for the side guides effective for causing lateral movement thereof when the side guides are moved longitudinally of the table, and stops for limiting such lateral movement, the stops being so positioned as to leave the side guides relatively closely spaced for a feeding action and relatively more widely spaced for receiving material from the mill.

22. In combination with a mill for rolling material in either direction, roll tables on each side of the mill, reels arranged above the roll tables for coiling material issuing from the mill and for feeding coiled material back to the mill, heat conserving chambers surrounding the reels, the chambers lying above the roll tables and being open at the bottom, and kick-ups for diverting material from the roll tables through the bottoms of the chambers to the reels.

ABRAM P. STECKEL.