Jan. 5, 1932. R. H. NORTON 1,839,332

METHOD OF ROLLING METAL SHEETS AND STRIPS

Filed June 15, 1928 2 Sheets-Sheet 1

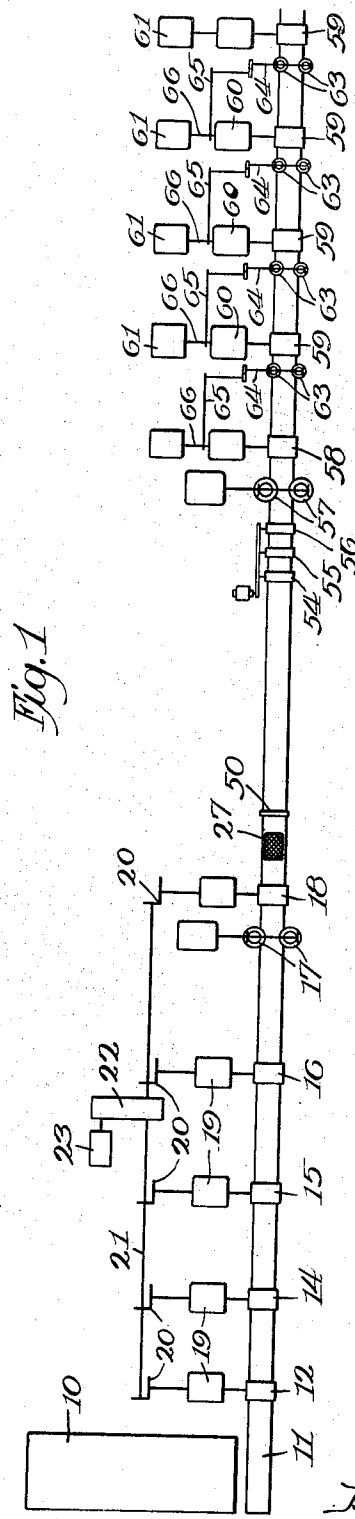


Fig. 1

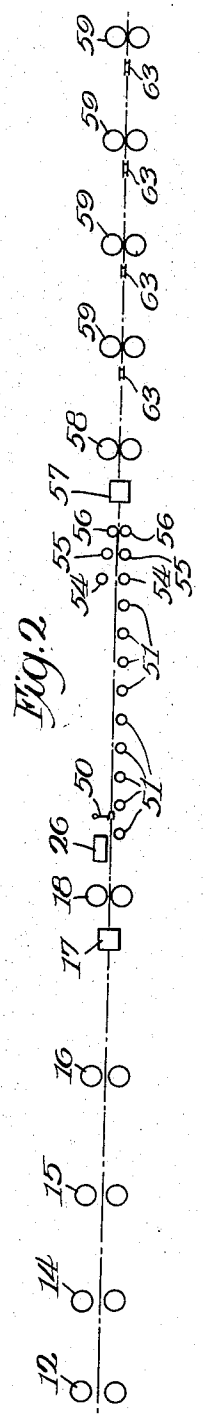


Fig. 2

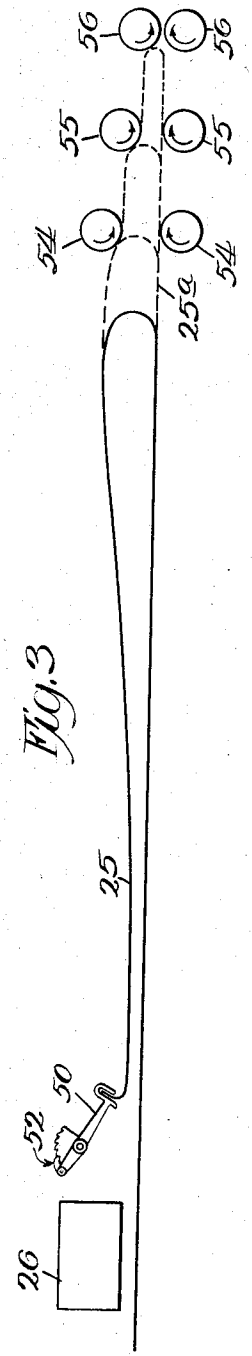


Fig. 3

Inventor
Ralph H. Norton
By Rector, Hibben, Davis & Macauley, Attys.

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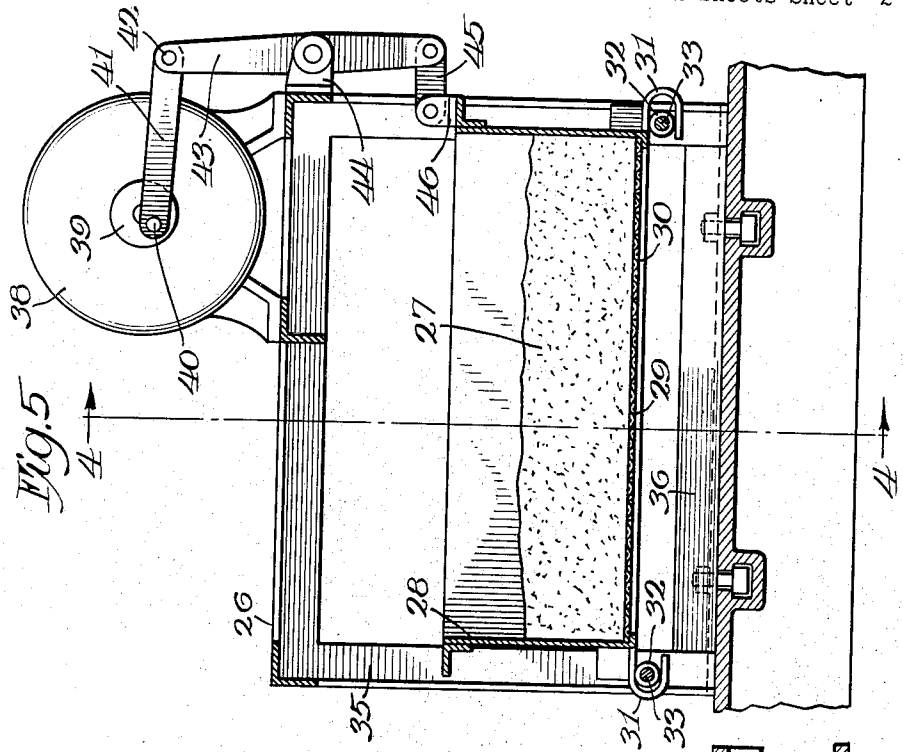


Fig. 5

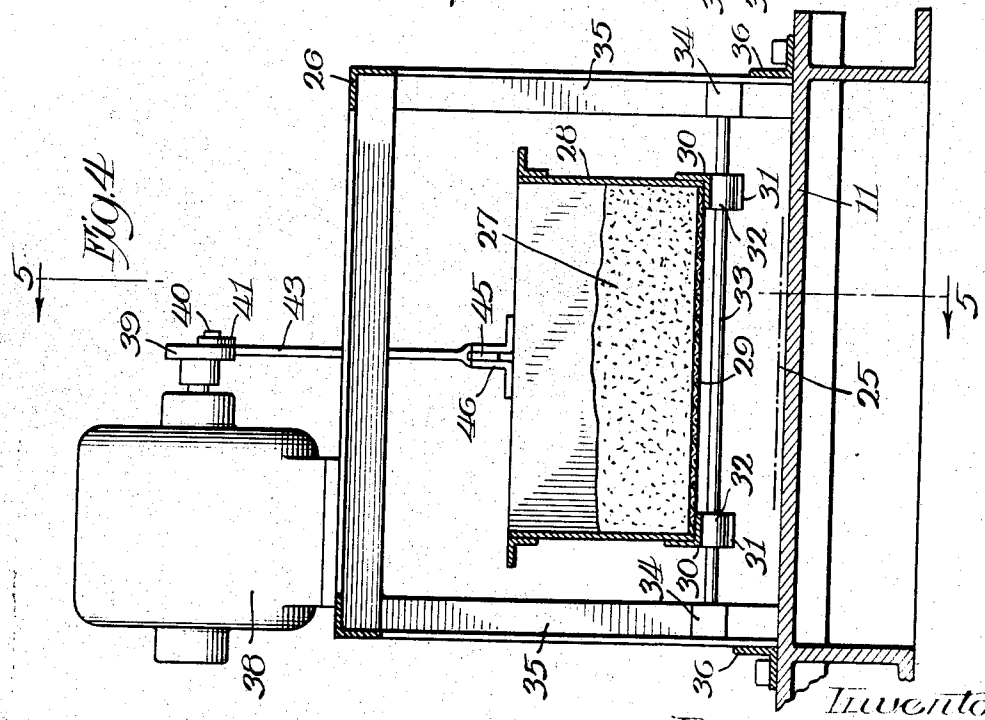


Fig. 4

Inventor
Ralph H. Norton
By Rector, Hibben, Davis & Macauley, Attys.

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UNITED STATES PATENT OFFICE

RALPH H. NORTON, OF CHICAGO, ILLINOIS, ASSIGNOR TO ACME STEEL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

METHOD OF ROLLING METAL SHEETS AND STRIPS

Application filed June 15, 1928. Serial No. 285,621.

This invention relates to an improved method of rolling metal sheets and strips such as are produced in steel mills and the like and its purpose is to provide a method by which the metal sheet may be rolled to greater thinness than has heretofore been possible with one heating of the metal. The principal object of the invention is to provide an improved method whereby superimposed hot sheets of metal may be rolled without adjacent sheets sticking to each other. In the operation of rolling metal, the initial hot metal slabs cannot be rolled into metal sheets of the thin gauges required for many commercial uses because of limitations due to cooling of the metal and the like and in order to reduce the gauge of the metal sheets it is desirable to superimpose the sheets one upon the other either by cutting several sheets and piling them or by doubling one sheet upon itself but when the hot metal sheets or strips are thus rolled in multiple layers or "packs" difficulties arise, particularly when the sheets are very hot, from the sticking of the sheets to each other which may cause portions of one sheet to be pulled out when the sheets are subsequently separated. These difficulties are overcome in the present invention by providing an improved method according to which a separating agent is applied to the hot metal sheets before they are piled or doubled upon each other and before the rolling of the pack takes place. Efforts have heretofore been made to overcome the difficulties encountered in the rolling of packs by spreading powdered materials over the sheets during their piling and before the heating of them but those efforts have not met with the degree of success required for commercial operations in rolling mills. The present method of rolling is distinguished not only by the novelty of the separating agent preferably employed but also by the fact that this agent is applied to hot metal sheets preliminary to the piling or doubling thereof and without any subsequent heating taking place before the rolling of the pack. In its preferred form, the present invention contemplates the rolling of the pack of hot metal sheets with the use of sodium carbonate (soda ash) as the agent for maintaing a separation of the sheets, although other substances may be employed with efficient results. Other features and advantages of the present invention will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one method of practicing the invention is il'ustrated. In the drawings,

Figure 1 is a somewhat diagrammatic top plan of the principal parts of a rolling mill capable of use in practicing the method of the present invention;

Fig. 2 is a diagrammatic side elevation of the apparatus illustrated in Fig. 1;

Fig. 3 shows an enlarged diagrammatic side elevation of the intermediate portion of the apparatus illustrated in Figs. 1 and 2 whereby the hot metal sheet is doubled upon itself;

Fig. 4 is an enlarged transverse section taken through the sifting apparatus whereby the separating agent is sprinkled upon the hot sheets during their travel through the mill, the section being taken on the line 4—4 of Fig. 5, and

Fig. 5 is an enlarged longitudinal section through the sifting apparatus on the line 5—5 of Fig. 4.

Although the invention may be employed in connection with various forms of rolling mills, it has been set forth in the following specification in connection with a rolling mill adapted to double the hot metal sheets upon themselves during their progress through the mill, this form of apparatus being described and claimed in the co-pending application of Ralph H. Norton and William C. Fork Serial No. 285,622 filed June 15, 1928. In carrying out the improved method with this apparatus, the metal ingots are originally formed into metal slabs several feet long, about two inches or more in thickness and having a width somewhat greater than their thickness. These slabs are heated in a suitable furnace 10 to the temperature required for the subsequent rolling thereof, for example, a temperature of 2300 degrees Fahrenheit, and

these hot metal slabs are discharged from the furnace into the longitudinal guide channel 11 of the rolling mill in position to pass longitudinally through the series of reducing rolls which are arranged to receive them in succession. The hot slab discharged from the furnace first passes through a set of roughing rolls of which the first set of rolls 12 is adapted to engage the flat slab on its edge for the purpose of producing a uniform width from end to end. The slab is then manually tilted onto its flat side before passing through the second series of rolls 14 by which its gauge is reduced. The slab is then automatically or manually set up on its edge again and passed through another set of rolls 15 before being again returned to its flat side and further reduced in the next set of reducing rolls 16. The reduced slab or bar is then engaged on its edge by a pair of edge rollers 17 and as it is discharged from these edge rollers it is engaged and further reduced by the final set of roughing rolls 18, by which time the slab is reduced to a relatively long and thin bar of metal, for example, a bar one foot wide and three-sixteenths to three-eighths of an inch in thickness. The various rolls of the roughing sets are driven through gears 19 which in turn are actuated through bevel gears 20 from a common longitudinal driving shaft 21. This shaft is driven by a reducing gear set 22 from a motor 23. When the hot metal bar 25 emerges from the last set of reducing rolls 18, it is in readiness to be doubled upon itself but before this is done, the separating agent is sprinkled on the top surface of the hot sheet by the distributing apparatus 26 which is illustrated in detail in Figs. 4 and 5. This separating agent, which is preferably sodium carbonate but which may be some other suitable agent, is illustrated at 27 in a supply vessel 28 having a perforated bottom 29 formed of wire cloth or the like through which the powdered separating agent is adapted to be sifted onto the top surface of the hot metal bar 25 as it rides over the top surface of the guide channel 11. The vessel or box 28 is carried by a pair of longitudinal bars 30 having hooked extremities 31 which extend around the rollers 32 mounted on transverse shafts 33, the ends of which are journaled in bearings 34 carried by the supporting frame 35. This frame is attached by angle bars 36 to the lateral edges of the guide channel 11 and it has secured to the upper part thereof an electric motor 38 the shaft of which has fixed thereon a disk 39. This disk is connected by an eccentrically located pin 40 with a link 41 which has its opposite end pivoted at 42 on an upright operating lever 43. This lever has an intermediate fulcrum on a bracket 44 carried by the side of the frame 35 and the lower end thereof is pivotally connected to a link 45 which in turn is pivotally connected to a pair of ears 46 carried by one end of the box 28. As the shaft of the motor is rotated, the link and lever mechanism between the eccentric disk and the box 28 causes a reciprocating motion to be imparted to the box so that the powdered separating agent 27 is sifted through the perforated bottom 29 onto the hot bar 25.

The powdered separating agent, sifted over the top surface of the hot metal bar, covers the surface of the bar so that the layers of the bar will not adhere to each other when they are subsequently piled or doubled and further rolled. The separating agent may be one, such as sodium carbonate, which is liquefied and spreads over the surface of the hot metal so that a uniform layer is obtained over the entire surface of the hot bar and this coating continues to adhere to the bar throughout the subsequent rolling. As the hot metal bar passes beneath the apparatus 26, the top surface thereof is progressively coated with the separating agent and immediately after passing beneath the apparatus 26, the forward end of the elongated metal bar engages a suspended jaw or hook 50 which automatically grips the forward end of the metal strip and at the same time swings upwardly away from the path of travel of the bar on the underlying rollers 51 so that the hook 50 then assumes an inclined position as shown in Fig. 3 in which position it may be retained by suitable ratchet mechanism 52. This elevation of the forward end of the metal bar above the path of travel of the bar on the rollers 51 permits the body portion of the bar to pass beneath the hook member 50 so that the bar 25 is doubled upon itself as shown in Fig. 3 with the opposed surfaces of the metal carrying the separating coating. When the rear end of the traveling bar reaches a position opposite the gripping jaw or hook 50, the operator releases the forward end of the bar from this jaw thereby allowing the doubled bar to continue its forward travel through the mill. The forward doubled end 25^a of the metal bar is then in position to be engaged by a pair of rolls 54 which have a relatively wide separation and which effect a partial flattening of the doubled bar. The doubled bar then engages other pairs of rolls 55 and 56, the rolls of each pair being spaced progressively closer to each other so that the superimposed layers of the doubled bar are finally flattened into close contact with each other throughout their length. Upon emerging from the rolls 56, the advancing doubled end of the bar is engaged by a pair of edge rollers 57 preliminary to passing through the first set of finishing rolls 58. The doubled bar or strip of hot metal then passes successively through a number of other pairs of finishing rolls 59, four of which pairs are illustrated in the drawings. These finishing rolls are either directly driven by electic motors or are driven by gearing 60, each

set of which is actuated by an electric motor 61. These finishing rolls are preferably driven at different speeds to compensate for the gradually reduced thickness of the superimposed layers of metal since the elongated doubled bar is simultaneously engaged by more than one pair of reducing rolls. In order to guide the doubled bar of metal properly between the reducing rolls and to maintain the edges of the top layer of the doubled bar in exact alignment with the edges of the lower layer thereof, the advancing doubled layer is preferably engaged in advance of each set of reducing rolls 59 by vertical roller guides 63 each set of which is driven by a transverse shaft 64 geared to the vertical shafts of the rollers and arranged to be actuated by a driving chain 65 connected to the shaft 66 of the motor 61 which operates the next preceding set of reducing rolls, whereby each set of guide rollers is driven at a speed corresponding to the speed of the next preceding reducing rolls by which the metal bar is still engaged, thus overcoming any tendency to stretch the metal or to cause an undue slipping of the metal between any set of rollers. The guide rollers 63 and parts associated therewith may preferably be of the form described and claimed in my co-pending application Serial No. 285,623, filed June 15, 1928. As the doubled bar of metal passes through the reducing rolls 58 and 59 it is gradually reduced to an extent wherein each layer of the doubled bar has a gauge or thickness relatively small as compared with that which could be obtained by rolling a single bar of metal and without any disadvantageous or injurious effects because the use of the separating agent prevents the hot bars from adhering to each other and permits them to be readily separated when the rolling is completed. For most purposes and for a wide range of temperatures, soda ash has been found to give more satisfactory results than any other separating agent but other sodium salts such as sodium sulphate and sodium chloride may be satisfactorily employed in most instances of rolling, the chief disadvantage of the use of sodium chloride being that it tends to explode and interfere with its distribution when applied to the hot metal sheets as well as creating a disagreeable noise. Other separating agents might be employed.

Although one example of the improved method of the present invention has been set forth in the foregoing specification in connection with a particular form of apparatus, it will be understood that the invention may be practiced in various ways within the scope of the appended claims.

I claim:

1. The method of manufacturing metal sheets and strips which consists in rolling a hot metal slab to form an elongated bar, applying to the surface of the hot bar a separating agent capable of being liquefied by the heat, placing superimposed parts of said bar upon each other to form a pack, and then reducing the pack to sheet gauges without reheating.

2. The method of manufacturing metal sheets in strip form which consists in rolling a hot metal slab to form an elongated flat bar, applying a separating agent to said bar while in motion, forming a pack of superimposed parts of said bar, and then reducing said pack.

3. The method of manufacturing metal sheets in strip form which consists in rolling a hot metal slab to form an elongated bar, applying a separating agent to the surface of said bar while it is in motion, doubling said elongated bar upon itself to form a pack, and then reducing said pack.

4. The method of manufacturing metal sheets in strip form which consists in reducing a hot metal slab to form an elongated bar, applying to the hot surface of said elongated bar while it is in motion a separating agent capable of liquefying and forming a uniform adhering coating over said surface, then forming a pack of superimposed parts of said bar, and then reducing said pack without reheating.

5. The method of manufacturing metal sheets in strip form which consists in reducing a hot metal slab to form an elongated bar, applying sodium carbonate to the hot surface of said elongated bar, then forming a pack of superimposed parts of said bar, and then reducing said pack without reheating.

6. The method of manufacturing metal sheets in strip form which consists in reducing a hot metal slab to form an elongated bar, applying to the hot surface of said elongated bar while it is in motion a separating agent capable of liquefying and forming a uniform coating over said surface, then doubling said bar upon itself to form a pack, and then reducing said pack without reheating.

7. The method of manufacturing metal sheets in strip form which consists in reducing a hot metal slab to form an elongated bar, applying sodium carbonate to the hot surface of said elongated bar while it is in motion, then doubling said bar upon itself to form a pack, and then reducing said pack without reheating.

In testimony whereof, I have subscribed my name.

RALPH H. NORTON.