Nov. 10, 1953 J. SCHMIDT ET AL 2,658,741

ROLLING MILL FOR ROLLING STRIPS OR BANDS AND SHEETS OF STEEL AND NONFERROUS METALS

Filed June 13, 1949 2 Sheets-Sheet 1

Fig. 1

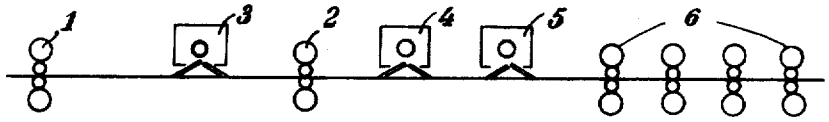


Fig. 2

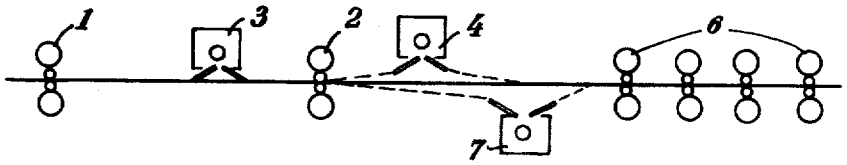


Fig. 3

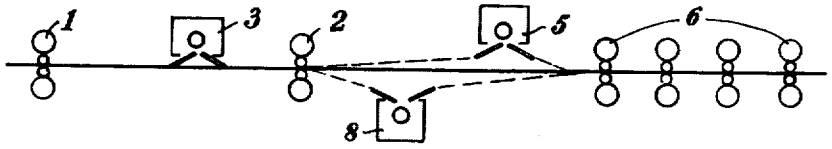
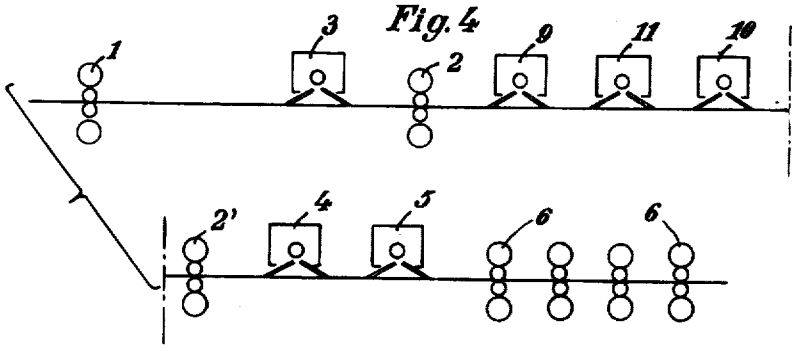


Fig. 4



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Fig. 5

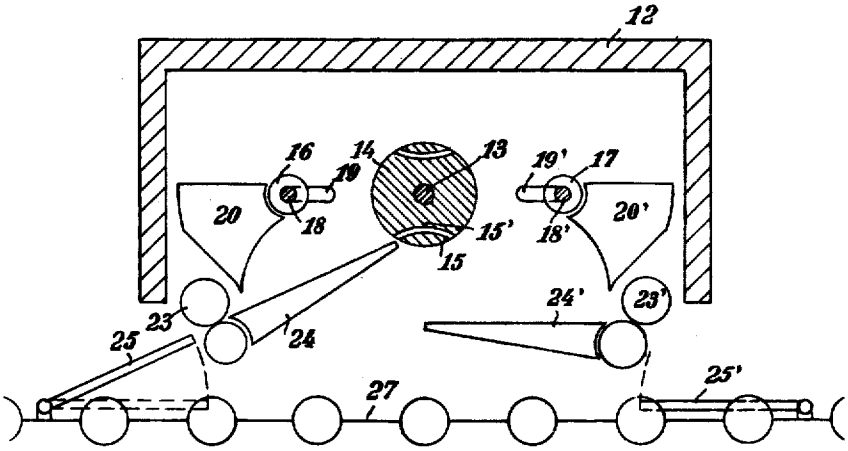
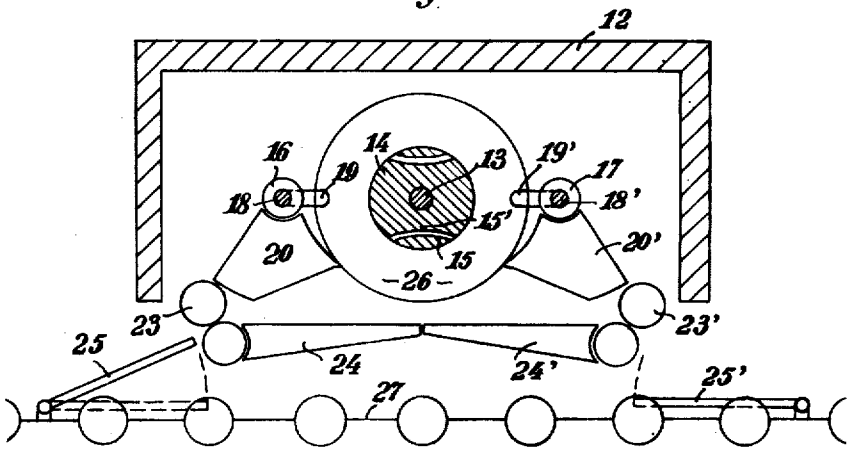


Fig. 6



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ROLLING MILL FOR ROLLING STRIPS OR BANDS AND SHEETS OF STEEL AND NON-FERROUS METALS

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Claims priority, application Germany April 11, 1949

4 Claims. (Cl. 263—3)

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This invention relates to a rolling mill for rolling strips or bands and sheets of steel and non-ferrous metals.

For this purpose rolling mills are known in which a reversing mill stand is arranged between two hot reeling furnaces. The rolling by means of these rolling mills takes place by the sheet bars or slabs being run under the front reeling furnace into the reversing mill stand in which, in the first place, a product adapted to be reeling is produced in backward and forward passes. As soon as a reeling of the strip is possible, the strip is introduced into one of the reeling furnaces and after the reversal of the mill stand, is wound into the other reeling furnace. These so-called winding passes are repeated until the desired gauge is obtained, whereupon the strip is led to a reel located on the other side of the rear furnace and is wound up into a bundle or coil.

Such rolling mills have drawbacks because of their output being comparatively low, since the whole train of rolls as well and the reversing mill stand respectively have to carry out all the passes which are necessary for the production of the finished product.

Difficulties also arise according to the fact that always a certain length of the strip or sheet adapted to be reeled has to stay outside the reeling furnace and thus is subjected to strong cooling. Furthermore, the same surface of the strip is directed upward in all the stages of the process, so that the underside of the strip is not open to inspection and any correcting measures with respect to this surface are practically impossible.

It is furthermore known to produce strips, in particular wide strips and sheets, on fully continuous or semi-continuous trains, whereby however the length of the product is restricted due to the difference of temperature between the beginning of the strip and its end. Certainly the continuous or semi-continuous trains, contrary to the trains which operate with hot reeling furnace in backward and forward passes, can attain smaller gauge in the finished product.

Contrary to this, the invention presents a rolling mill which while carrying out reeling passes takes advantage of a reversing mill stand, arranged between hot reeling furnaces, and whilst avoiding the drawbacks attached to this arrangement, permits of a semi-continuous rolling process. To this end, according to the invention, it is proposed to arrange at least two hot reeling furnaces behind a reversing mill stand. Following on the last of the train of hot reeling furnaces, there is arranged a further train of rolls which are fed by this furnace. Preferably the following train is provided with at least two mill stands arranged one behind the other. For example, a continuous train can be provided with four mill stands. The rolling mill according to the invention can, however, also be so designed that a second reversing mill stand is provided, this being inserted before the continuous train, between hot reeling furnaces.

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Such installations can operate so that a sheet bar or slab is run into the reversing mill stand and first in reversing passes is rolled down to a gauge fit to be reeled whereupon the reeling passes are commenced, and the product is rolled down to definite gauge and finally introduced into the second consecutively arranged furnace from where it is fed to the continuous train. Immediately after the termination of the reeling-up in the furnace feeding the continuous finishing train, the next pass can take place in the reversing mill stand. The arrangement of a plurality of furnaces behind the reversing mill stand furthermore easily permits of clearing away upsets since, as desired, reeling-in can take place into one or the other furnace should circumstances necessitate this.

According to the invention, it is particularly advantageous to relieve the reversing mill stand from the labour of preliminary rolling and to arrange in front of the entire installation a preliminary mill stand. Instead of one preliminary stand located in front of the first hot reeling furnaces, a number of preliminary mill stands can be set up. Thus the reversing mill stand is exclusively utilised for the so-called reeling passes.

The furnaces which appertain to the rolling mill according to the invention are so designed that the strip can be wound or reeled in or out from opposite directions, in practically the same plane. The furnaces can be arranged at the same level. In order, nevertheless, to attain a compact arrangement of small constructional length, they can also be provided at different levels, that is for example, the first furnace above the floor and the second underneath the floor, or vice versa.

In Figures 1–4, various examples of execution for rolling mills according to the invention are shown diagrammatically.

According to Fig. 1 a preliminary reversing mill stand 1 is provided and furthermore a reversing mill stand 2. The latter is arranged between hot reeling furnaces and carries out the

so-called reeling passes in the course of the rolling out. In front of this reversing stand 2 there is located one hot reeling furnace 3 and two hot reeling furnaces 4 and 5 are located at the back of it. Behind the last hot reeling furnace 5 there is provided a continuous finishing train 6 which, in the example selected, consists of four mill stands. The rolling procedure is such that the sheet bar or slab is preliminarily rolled in the mill frame 1 and is then led under the furnace 3 through to the reversing mill stand 2, and this preferably whilst already having a gauge fit for this mill at once to commence with the reeling passes, the furnaces 3 and 4 alternately reeling up the strip. The furnaces are preferably so constructed that the strip may run into them to full extent. They are furthermore so designed that the unreeling can take place both towards the front and towards the rear, the strip always leaving the furnace at practically the same level.

When the reeling passes are ended, after the last pass the strip is introduced not into the furnace 4 but into the furnace 5. Out of this furnace the strip is again unwound on the opposite side and fed to the finishing rolls. Directly after the termination of the winding-up in the reeling furnace 5, the reeling passes in the reversing mill stand 2, can be started with since both this mill as well as the hot reeling furnaces allocated thereto, are free to carry out the work. Furthermore, during the reeling passes and during the work in the continuous train 6, a slab or sheet bar can be preliminarily rolled in the front mill stand 1 down to a gauge suitable for reeling.

The front mill stand 1 can be dispensed with and the reversing mill stand 2 can take over the preliminary rolling. On the other hand, a plurality of preliminary mill stands may be arranged.

It will be seen clearly from the arrangement according to Fig. 1, that the furnace 3, 4 and 5 represent extremely suitable buffers. Should at any point of this semi-continuous train any trouble take place, for example preliminarily rolled stock ready for reeling could be fed from the mill stand 1 into the furnace 3 should the furnace 4 or 5 or the mill stand 2 respectively not be free for reason of break-down or the like. It is furthermore possible to introduce the last reeling pass into the furnace 4 and to feed the continuous train 6 from this furnace. It is also feasible for the reeling passes to be carried out utilising only the furnaces 3 and 5, the furnace 4 being by-passed.

The peculiarities of the furnaces also allow of a compact arrangement since it is possible, as can for example be seen from Fig. 2, to arrange the furnace located directly behind the reversing frame 2, above the floor and the further furnace 7, on the contrary, below the floor. Contrary to this, as shown by Fig. 3, the furnace which is arranged directly behind the mill stand 2 can, as indicated at 8, be below the floor, whilst the further furnace 5 is above the floor.

This arrangement offers the particular advantage that simply by means of the furnaces 3 and 7 or 3 and 5, reeling passes can be carried out whilst at the same time strip is delivered from the furnace 4 or 8 on to the succeeding train 6. Accordingly in this way an additional buffer is given.

Also with the arrangement according to Figs. 2 and 3, the preliminary mill stand 1 can be dispensed with if the reversing mill stand 2 is to take over the preliminary rolling.

In Fig. 4 a modification is shown in which, beside the reversing mill stand 2, there is provided a second reversing mill stand 2' before the continuous train 6 follows. As shown, there are located behind the reversing mill stand 2' two hot reeling furnaces which correspond to the furnaces 4 and 5 according to Fig. 1. Between the two mill stands 2 and 2' there are provided in the example shown, three furnaces, furnace 9 being allocated to the mill stand 2, and furnace 10 to the mill stand 2'. The furnace 11 permits of reeling simultaneously in the mill stands 2 and 2'. From the foregoing, it will be easily seen how working is carried out with such an installation. The stock ready for reeling passes from the preliminary mill stand 1 into the reversing mill stand 2 which carries out several reeling passes, whereupon the strip is introduced into the furnace 11. From this furnace the strip passes through the reversing mill stand 2' into the furnace 4. The reeling passes are now effected in this mill stand, whereupon the last pass is reeled into the furnace 5 from where the material is fed on to the connected train 6. With the furnaces, and in particular with the insertion of the furnace 11, all sorts of combinations can be contrived for equalization should troubles arise at any point of the complete installation.

As the passing of the strip from the reversing mill stand 2 through a furnace into the continuous train 6 takes place in such manner that it is wound or reeled out of the furnace in the reverse sense to that in which it is reeled in, the strip lies in the finishing train with the previous underside turned upward. The same holds good, naturally, when according to Fig. 4, material is passed from the reversing mill stand 2 to the reversing mill stand 2', through a corresponding furnace.

With such a rolling mill, preferably reeling furnaces are used which are characterised by a drum provided with a saddle-like constructed strip inrunning channel. The saddle of said conduit is directed towards the axis of the drum. The drum is fixed to the driven shaft or is adapted to be coupled thereto. Further features consist in pairs of driving rollers arranged on both sides of the drum, and pressure rollers with oscillatable stripping devices which are radially displaceable with respect to the drum.

In Figs. 5 and 6 such a furnace is shown diagrammatically in vertical longitudinal section. The drum 14 carried on an axle 13 is located within the stationary furnace housing 12. This drum is provided with a saddle-shaped in-running conduit 15. Instead of the one conduit or channel there may also be provided two such conduits opposite to each other. The saddle 15' of the conduit is directed towards the axis of the drum.

The drum 14 is either rigidly keyed on the driven shaft 13 or is adapted to be firmly coupled therewith. If the drum 14 is firmly keyed on the shaft, care must be taken by suitable electric control that the drum stops at the instant the windable strip enters the furnace, the strip so being able to run into the saddle-shaped inlet conduit 15. If the drum is adapted to be coupled to the shaft, then there is provided at one or both sides of the drum, a carrier member which is adapted to be coupled and uncoupled. By displacement of the centre of gravity of the drum, this can swing out in the position of rest, so that

the conduit 15, with the drum uncoupled, is always in a receptive position. Compression rollers 16 and 17 are provided which are rotatable and displaceable radially with respect to the drum. The rollers are carried on elastically arranged shafts 18 and 18' which, on their part, are displaceable in grooves 19 and 19'. Connected with these compression rollers are specially shaped stripping members 20 and 20' which are oscillatable on the shafts 18 or 18'.

In the immediate vicinity of the drum 14 or on the inlet and outlet openings of the furnace, there are provided the pairs of rollers 23 and 23' which, as so-called strip pullers have the task of delivering the strip to the drum or taking it from the drum. The oscillatable strip conductors 24 and 24' operate in combination with the rollers 23, 23'. Underneath the furnace there is the rollway 27 which serves to ensure the conveyance of the rolling stock when the corresponding furnace is to be by-passed. Oscillatable rockers 25 and 25' convey the rolling stock from the train of rollers to the furnace or convey it from the furnace again to the train of rollers.

The furnace, as will be seen is in connection with its individual parts made practically fully symmetrical and opposite with respect to its central axis, whereby the advantage is attained that individual parts can be used both right-handedly as well as left-handedly in the furnace.

The rolled stock runs over the rocker 25 through the driving apparatus 23 and the strip conductor 24 into the saddle-shaped conduit 15 of the arrested drum 14. When the tip of the band has passed through the conduit 15 the drum is set in rotation by suitable controls, if necessary by time relays or the like. The rolling stock is reeled up on the drum, which according to the rolling procedure, rotates clockwise or counterclockwise. The saddle-shaped conduit ensures perfect reeling even with the strip having a gauge of 30–40 mm. The end of the strip running through to the other side of conduit 15 in consequence of the shape of the conduit is preliminarily bent downward at the front end, whereby final bending over is facilitated. The bent-over end ensures the perfect reeling of the strip. The strip is fully wound into the furnace even with its end. During the reeling-up the rollers 16 and 17 and the stripping members 20 and 20' are in their extreme position. After the strip is completely reeled into the furnace, one or both rollers 16 or 17 are brought into contact with the strip so that the end of the strip always rests snugly on the coil 26 (Fig. 6). In the event of a fault or the like when the strip remains in the furnace longer than usual, it is advisable to let the drum revolve slowly, so that a uniform heating or uniform maintenance of the temperature of the stock is given.

If now the strip is to be delivered through the guide 24 and driving apparatus 23 to the rollway 27 again, the drum moves in clockwise direction whilst the stripping member 20 is brought into contact with the coil 26. (See Fig. 6.) If, on the contrary, the end of the strip is to be carried out over the strip guide 24' and driving apparatus 23' the drum is rotated in the opposite direction and the stripping member 20' is applied, whereupon the end of the strip is fed to the driving apparatus 23'. The strip thus runs out in a direction opposite to the running-in direction. The pairs of rolls 23 or 23' respectively of the driving apparatus always ensure by their drive, that the necessary conveyance is imparted.

The furnace according to the invention is, in consequence of its nature, not only extremely well adapted for the rolling mill with which it is to co-operate but has other advantages which make it suitable for use in reeling rolling mills known per se. With the usual furnaces in this system, there are frequently faults arising by the strip being unintentionally fully reeled into the furnace and when this occurs it can only be reeled out again with great difficulty. Furthermore, these furnaces in normal working make it necessary for a part of the strip to remain outside the furnace, in order to be able to carry out the reversal at all. This end of the strips cools down and consequently there arise inequalities in the final gauge. With a furnace according to the invention, on the contrary, it does not matter if, in combination with a known reeling rolling mill, the strip runs in to full extent as the furnace, on account of its design, is quite suitable to take the strip in completely. Furthermore, with such furnaces in combination with known reeling rolling mills, the difficulties can be obviated which arise from the otherwise necessary remaining of a part of the strip outside the furnace.

The rolling mill according to the invention, in combination with the furnace, obviates all troubles which appertain to previous arrangements and in addition it presents the advantage that a strip can be produced which is of uniform gauge over its whole length. Furthermore, strips can be made of extremely small gauge, it being possible to pass over to coil weights which are heavier than hitherto usual. Above all, however, the strip prior to entering the finishing rolls, in consequence of the nature of the reeling-up and unreeling processes, is turned over, so that the underside of the strip becomes the top surface of the strip. Furthermore, the end of the strip in its entry into the finishing rolls becomes the strip tip.

As in all rolling mill stands and frames, rolling can be carried out simultaneously, the outputs which are attained with known rolling mills are exceeded, so that the production costs are reduced. A further lowering of the costs takes place by the lower cost of the plant and by reduced working costs, e. g., those due to keeping a reserve and those necessary for rolls. Furthermore, the installation can be designed more compactly and with a smaller total length, last not least for the reason that the furnaces can be brought directly on to the mill stands adjoining them.

The examples of execution by which the invention has been described and explained, do not represent the only possibilities of the arrangement, since modifications can be made without thereby departing from the scope of the invention.

What we claim is:

1. A heating furnace for rolling strips of steel or non-ferrous metals adapted to be arranged in a roller train comprising a housing, a reversible reeling drum rotatable within said housing and spaced from the sidewalls thereof, said drum having a slot extending inwardly from the cylindrical portion of the periphery thereof to receive the end of a strip to be wound thereon, identical guide devices in said housing at each side of the drum symmetrically arranged with respect to the axis of the drum, said guide devices each including a roller supported in said casing on each side of the drum for movement towards and away from the drum and a stripping member concentric with and rotatable about the axis of said roller

for movement to and from operative position to enable a strip to be fed to and reeled upon the drum from one side or the other and to be guided from the drum in either direction to the fed-in direction.

2. A heating furnace as claimed in claim 1, in which the strip end receiving means on the drum comprises a channel through the drum convexly arched in a plane transverse to the axis of the drum.

3. A heating furnace as claimed in claim 1, said guide devices further including entrance and outlet opening means in said housing in the same level with respect to the axis of said drum.

4. A heating furnace as claimed in claim 1, said stripping members being identical and having two contacting surfaces, one of said surfaces being substantially complementary with the surface of said drum so as to be nestable thereagainst, the other of said surfaces constituting a guide for the stripped off strip.

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