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[54] **METHOD AND MILL FOR SKEW ROLLING**

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[52] **U.S. Cl.** **72/97**, 72/209, 72/251

[51] **Int. Cl.**.....**B21b 19/06**, B21b 25/06

[58] **Field of Search**...72/97, 209, 251, 250; 29/33 D, 29/33 T

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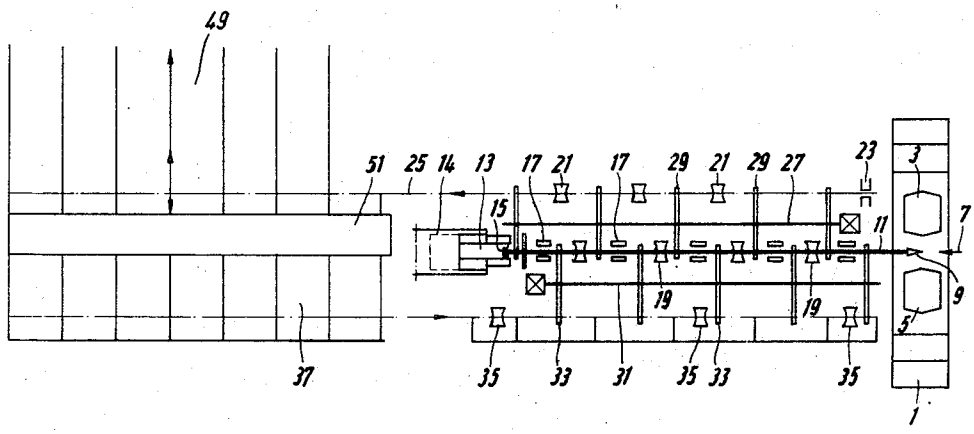
[57] **ABSTRACT**

A mill for rolling seamless tubular billets on a mandrel and mandrel rods. Plural rods circulate through the machine for stripping off the billet from one, pierce-rolling on another, and preparing a third rod for replacement, more or less concurrently.

11 Claims, 2 Drawing Figures



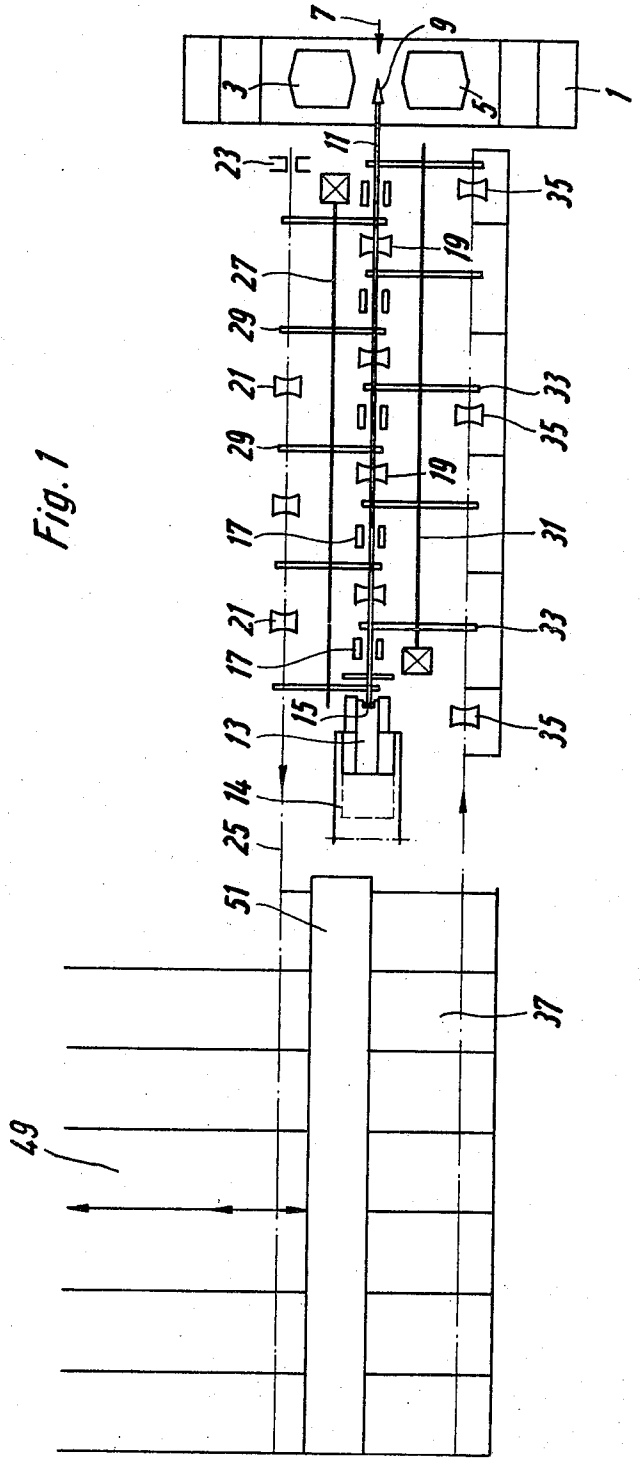

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Fig. 1

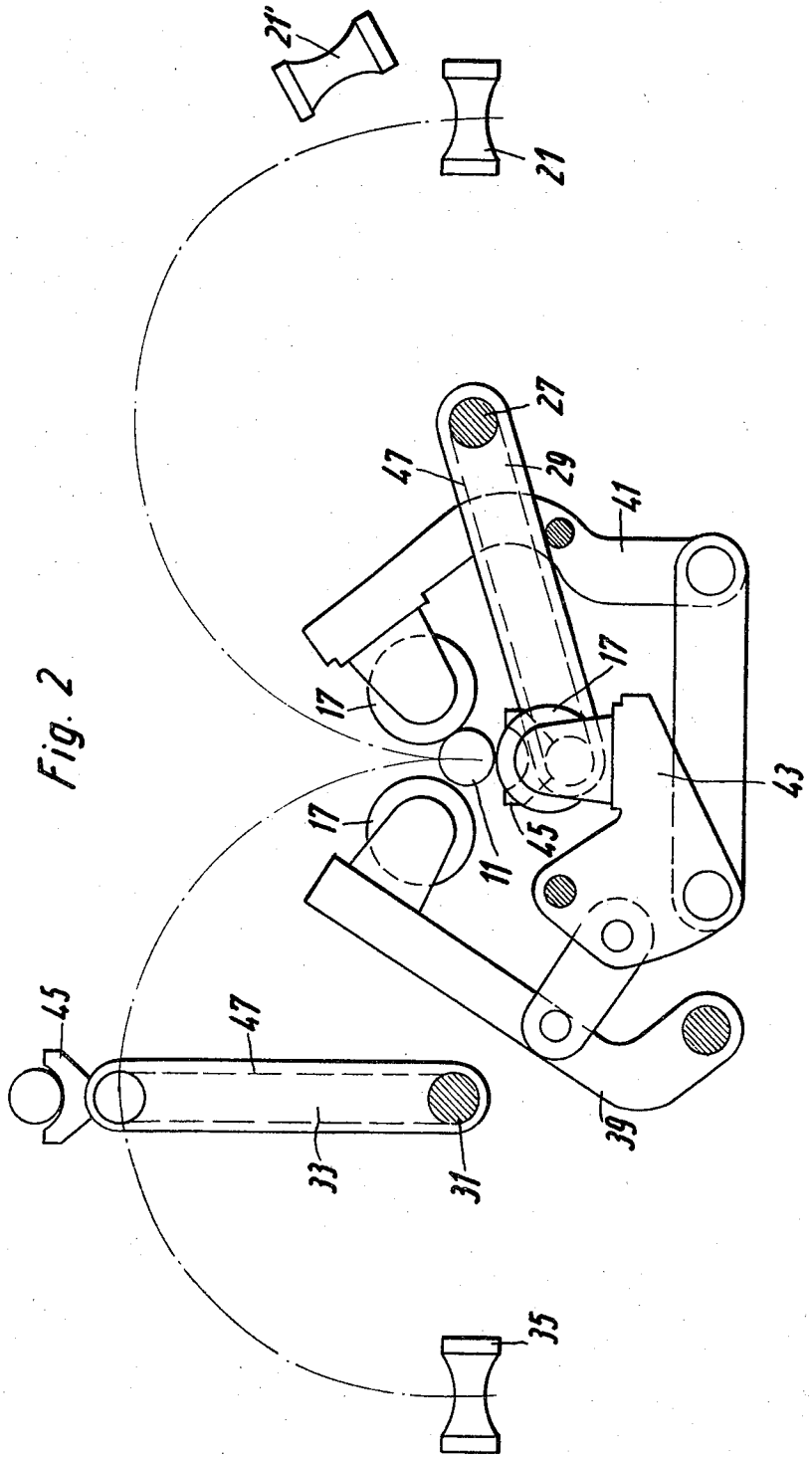

Fig. 2

METHOD AND MILL FOR SKEW ROLLING

The present invention relates to the art of making seamless, pierced billets or tubing by means of skew rolling a solid or hollow billet onto a piercing mandrel on a mandrel rod. The rolling mill in which the invention is practiced includes the required rolls as well as means for stripping a rolled, pierced billet or tube off the mandrel rod.

In the art of skew rolling, the resulting pierced billet is progressively shifted onto the mandrel rod. After completion of the rolling step as involving one billet, the mandrel as then disposed under the rolls is removed first. Next, the pierced billet is removed from the stand, and the rod, together with the thrust block holding the rod, is displaced sufficiently far so that the rod is being completely pulled out of the billet. Thereafter, the billet is removed from the rolling path for further working. The next rolling step can begin only thereafter, and for this it is necessary first to return the thrust block and mandrel rod to working and operating position.

In view of the large pressure forces set up during rolling, the thrust block must be quite heavy and very stably supported in its track. Thus, the delay or time-out in between two rolling steps as taken up by the aforedescribed removal and preparatory steps is quite large. In order to reduce this period, it has been suggested to merely move the thrust block sufficiently far for permitting removal of rod and billet from the stand, and the block is provided with a passage, through which the rod can be pulled as it is withdrawn from the billet.

Alternatively, it has been suggested to provide for relatively short, lateral displacement of the thrust block so that now the mandrel rod can be longitudinally withdrawn from the billet, at rather high speed, by means of a light carriage or a tackle or rope arrangement or the like. After stripping the billet off the mandrel rod, the latter is again rapidly returned. This way, the time out and delay in between two rolling steps is shortened, but the additional disconnection of the rod from the thrust block and reconnection to the carriage, etc., was found to lead readily to disturbances and mechanical failure. Also, the reduction in time out is obtained primarily by permitting high speed operation for stripping the billet off the rod. However, that speed was found to be a considerable source for danger. The rapidly extracted rod may damage the interior of the billet, either directly or through scale that is pulled along by the rod.

It is an object of the present invention to provide for a different operation of skew rolling billets so as to avoid the disadvantages outlined above. It is another object of the invention to improve the operating capacity of a given rolling stand by reducing the period of time between rolling steps proper.

In accordance with one aspect of the invention in the preferred embodiment thereof, it is suggested to remove the rod with piercing mandrel and billet from the rolling path while placing a new rod into that path, and a new rolling step commences, as the rolled tubular billet is stripped off the rod; the latter rod is returned to be used in one of the following rolling steps. There are thus at least three mandrel rods that, so to speak, circulate through the system. The respective mandrels remain on the rods during that circulation.

The rolling path is thus cleared in the shortest possible time, just sufficient to remove the rod with billet while a new rod is more or less concurrently put into place. It is no longer necessary to remove the mandrel first, stripping the billet off the rod, and to replace the mandrel head on the same rod. Instead, the rods circulate with the mandrel remaining in place.

It is of advantage that the billet can be stripped off a removed rod rather slowly and carefully so as to avoid any damage to the product. Actually, the larger the number of circulating rods, the slower this stripping can be carried out without introducing any delays. The two rod moving steps—removal of the one carrying the billet and placing a different one in position, may commence simultaneously or at least follow each other directly. In either case, it was found that the capacity of the mill could be doubled if this new principle of mandrel rod circulation is introduced.

A rolling mill in which the invention is practiced has the usual equipment, e.g., rolling stand, mandrel rod centering equipment and thrust block. In addition, there are provided coupling means to permit release and removal of a mandrel rod from the thrust block. The latter is moved only very little, and in longitudinal direction only, just sufficient so that a billet clears the rolls in the stand. In addition, tracks are provided for transporting the rods so as to sustain the circulation. Some of these tracks are additionally used to strip off and to remove the billet.

The transport tracks extend in parts parallely to the line of rolling, but they are laterally displaced therefrom on opposite sides of the rolling path. A rod collecting and cooling facility closes the rod circulation. Means are provided to remove a rod with billet from the rolling path onto one of the transport tracks, while other means remove a new rod from the other transport track and place same onto the rolling path for coupling to the rod holding thrust block. The centering means for mandrel rod and billet in the line of rolling can be folded back for this rod replacement operation.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed that the invention, the objects and features of the invention and further objects, features and advantages thereof will be better understood from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a schematic, top elevation of a skew rolling mill improved in accordance with the invention; and

FIG. 2 is a section view, taken between thrust block and skew rolls.

Proceeding to the detailed description of the drawings, in FIG. 1 thereof is shown a rolling stand 1 with rolls 3 and 5 for skew rolling. Solid or already pierced billets are fed to the rolls in the direction of arrow 7; the billet feed mechanism is not shown as it is conventional. Arrow 7 defines also the axis or line of rolling, the rolling path extends to the left of stand 1. A mandrel 9 such as a piercing mandrel is disposed between the rolls and maintained in position by means of a mandrel rod 11. The rod 11 is connected to a thrust block 13 via a coupling 15 that is easily releasable. In addition, rod 11 is centered by means of several, three-roller centering devices 17. Driving rolls 19 are

disposed in alignment with rod **11**, the direction being that of the line of rolling. Driving rolls **19** are adjustable as to the diameter of the billet as rolled.

A longitudinally advancing and transport mechanism or track is disposed parallel to but laterally displaced from the line of rolling. This transport mechanism advances billets and rods when removed from the rolling path, and in the direction of rolling. This track includes driving rollers **21** and **21'** as well as a device **23** for holding the mandrel rod. An open roller track **25** is disposed behind rolls **21**. A transverse roller track **49** is provided behind roller track **25**; track **49** is selectively reversible as indicated by the double arrow.

In addition, levers **29** are provided, turning on an axis **27** for swinging a used rod out of the rolling axis onto rollers **21**, while levers **33** are provided, turning on an axis **31**, for swinging a new rod onto the rolling axis. Finally, there is a rod-feeding device **35** receiving rods from a supply **37** of spare rods. Levers **33** place such a rod from rolls **35** into the rolling path, once the rod previously used has been removed from that path.

Particulars of the rod feed and swing mechanisms are shown in FIG. **2**. The rod feed mechanism is an open roller track **35** for advancing a rod from supply **37** toward the rolls of the mill, but laterally displaced thereof. A mandrel rod when in the rolling path is centered by means of rolls **17** as stated, and such centering devices include three rolls each supported on interconnected rocking levers **39**, **41** and **43**. These levers **39**, **41** and **43** can be swung out of the way to permit removal of a rod from the rolling path and replacement by a new one.

The rod placing and swinging levers **29** and **33** are similarly constructed. They pivot on their respective axes, and their free ends are provided with forklike rod holders **45**. The forks themselves can pivot on the respective lever ends. The forks pivot respectively in unison with the turning of the levers **29** and **33** when holding rods, so that a fork **45** when holding a rod always points in an upward direction, as illustrated, permitting such gripping, holding and swinging of rods.

Chains **47** are provided to transmit position-dependent motion from axes on shaft **31** or **27** to the respective fork element **45**.

It can be seen that levers **33** and **29** may be allowed to rotate completely about 360° so as to return to their respective normal positions, so to speak, from below; e.g., for lever **29** with its fork holder to return to the rolling path after having swung a mandrel rod with billet to deposit them onto the rollers **21**. Alternatively, the arms and forks **45** may be constructed to be swung out of the way completely after having disposed a rod with billet onto rolls **21** so that the levers **29** can reverse their motion, without lifting the just disposed rod with billet off the rolls **21** again. The situation is analogous for levers **33** with their forks **45** as handling the disposition of a new rod into the line of rolling.

The inclined roll **21'** establishes a pair of driving rolls, together with the respective roll **21** underneath, for stripping the pierced billet off the mandrel rod once such rod with billet has been disposed on rolls **21**. The roll **21'** must be capable of pivoting transversely to its axis so that the mandrel rod with billet can be so disposed onto rolls **21**.

The rolling mill operates as follows: After a rolling step, a completed, i.e., cogged, pierced billet is disposed on a mandrel rod **11** and held thereon by means of rollers **19**. Billet and rod are removed together from the rolling stand by these rollers **29** and to the left thereof (FIG. **1**). Concurrently, thrust block **13** is displaced to assume the position as shown in dashed lines, the mandrel rod follows that movement; so does the billet thereon. Now, as rod **11** with mandrel **9** has left stand **1**, coupling **15** is opened to free rod **11**. The billet as gripped by the forks on levers **29** are swung out of the rolling path and onto transport rolls **21**, the mandrel rod is still in the billet. The end of mandrel **9** (and of rod **11**) is now held by device **23** while the rolls **21** and **21'** slip the tubular billet off the mandrel rod, onto track **25** and from there to the transverse roller track **49** to be removed from the machine for further working and processing. After removal of the billet in this manner, rod **11** is no longer held by device **23** but is likewise advanced by rolls **21**. However, roller track **49** reverses and disposes or passes the rod into or through a water tank **51** for cooling. Subsequently, the rod is returned to the supply **37**, thereby completing a circulating cycle. As soon as the levers **29** have swung mandrel rod with billet out of the rolling path, levers **33** as holding another mandrel rod swing same into the rolling path, and particularly the one end of the rod is placed into position for connection to coupling **15**. Now thrust block **13** is returned to working position. Still in the same period a new, unrolled billet has been placed into position (to the right of rolls **3**, **5**) so that a new rolling operation can take place. During this rolling, a new mandrel rod is advanced by rolls **35**, but levers **33** have first swung back into position to be able to grip that new rod. Also, the billet as rolled previously is slowly stripped off its mandrel rod, as described, during this subsequent rolling step; the same holds true for the return of that rod to the supply. Still during this subsequent rolling step a new rod is taken from supply **37** and advanced by rollers **35** to be ready as replacement. Thus, for the system to operate efficiently, at least three rods are needed.

At some time between removal and return, a mandrel rod may be subject to inspection and be removed from circulation if damaged. One can see that speedy operation will not suffer if there is a sufficient number of spare mandrel rods in the supply **37**, and if damaged rods are repaired and/or replaced to maintain the minimum of three.

The invention is not limited to the embodiments described above but all changes and modifications thereof not constituting departures from the spirit and scope of the invention are intended to be included.

We claim:

1. In a method of making seamless tubing by means of skew rolling a billet onto a mandrel with mandrel rod held in a thrust block, in a rolling mill having a line of rolling between the thrust block and skew rollers of the mill, comprising the steps of:

removing a mandrel rod with rolled billet thereon from the line of rolling, immediately upon completion of rolling using gripping means and including separating the mandrel rod from the thrust block;

placing a different mandrel rod into the line of rolling, as between thrust block and skew rollers

for use in the next rolling step, using also gripping means;

holding the removed mandrel rod and separating the rolled billet immediately from the removed and held mandrel rod by means of stripping equipment disposed outside of the line of rolling, and moving the rolled billet parallel thereto off the held rod during the next rolling step involving a different billet as well as the different mandrel rod as placed into the line of rolling; removing the mandrel rod subsequently to the separating of the rolled billet; and

returning the removed mandrel rod to the line of rolling to be used subsequently as replacement in the line of rolling during a rolling step subsequent to the next rolling step.

2. In a method as in claim 1, using at least three mandrel rods.

3. In a method as in claim 1, the removal step comprising swinging the mandrel rod with billet laterally out of the line of rolling, the placing step comprising swinging the different mandrel rod laterally into the line of rolling and from the opposite side of the line of rolling.

4. In a method as in claim 1, wherein the placement step begins at the earliest with the beginning of the removal step.

5. In a rolling mill for making seamless tubing by means of skew rolling a billet onto a mandrel with mandrel rod held in a thrust block, and having a line of rolling extending between skew rollers and the thrust block, the improvement comprising:

gripping means disposed alongside the line of rolling between skew rollers and the thrust block for removing a mandrel rod with rolled tubular billet lateral from the line of rolling to one side thereof;

gripping means disposed also alongside the line of rolling between the skew rollers and the thrust block for placing a different mandrel rod into the line of rolling and from the other side thereof for use in the next rolling step;

stripping equipment disposed outside of the line of rolling for separating the rolled tubular billet from the removed mandrel rod during the next rolling step and including holding means for temporarily holding the mandrel rod and disposed next to the skew rollers, further including conveyor means leading from the holding means alongside the line of rolling towards and in back of the thrust block, for moving the tubular billet off the mandrel rod followed by the mandrel rod from which the rolled tubular billet has been separated, on and along the same conveyor means; and

means for removing the mandrel rod from the conveyor means separately from the tubular billet and returning the removed mandrel rod, to be used subsequently as replacement in the line of rolling.

6. Rolling mill as in claim 5, including laterally pivotable centering means for a mandrel rod when in a line of rolling, and disposed between the skew rolls and thrust block.

7. Rolling mill as in claim 5, the conveyor means including a first roller track disposed alongside the line of rolling onto which the first gripping means disposes a mandrel rod with billet, the returning means including a second roller track disposed alongside the line of rolling but on the other side for advancing a mandrel rod for engagement by the second gripping means.

8. Rolling mill as in claim 7, the roller tracks running parallel to the line of rolling, the first roller track running in the same direction as rolling of the billet in the line of rolling, the second roller track running in the opposite direction.

9. Rolling mill as in claim 8, the returning means including transverse transport means closing a circulation path between the first and second roller tracks.

10. Rolling mill as in claim 9, there being means for cooling in the circulation path, for cooling a mandrel rod prior to placement onto the second track.

11. Rolling mill as in claim 5, the first and second gripping means each including a plurality of levers with holding forks for receiving the respective rods.

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