

Oct. 15, 1957

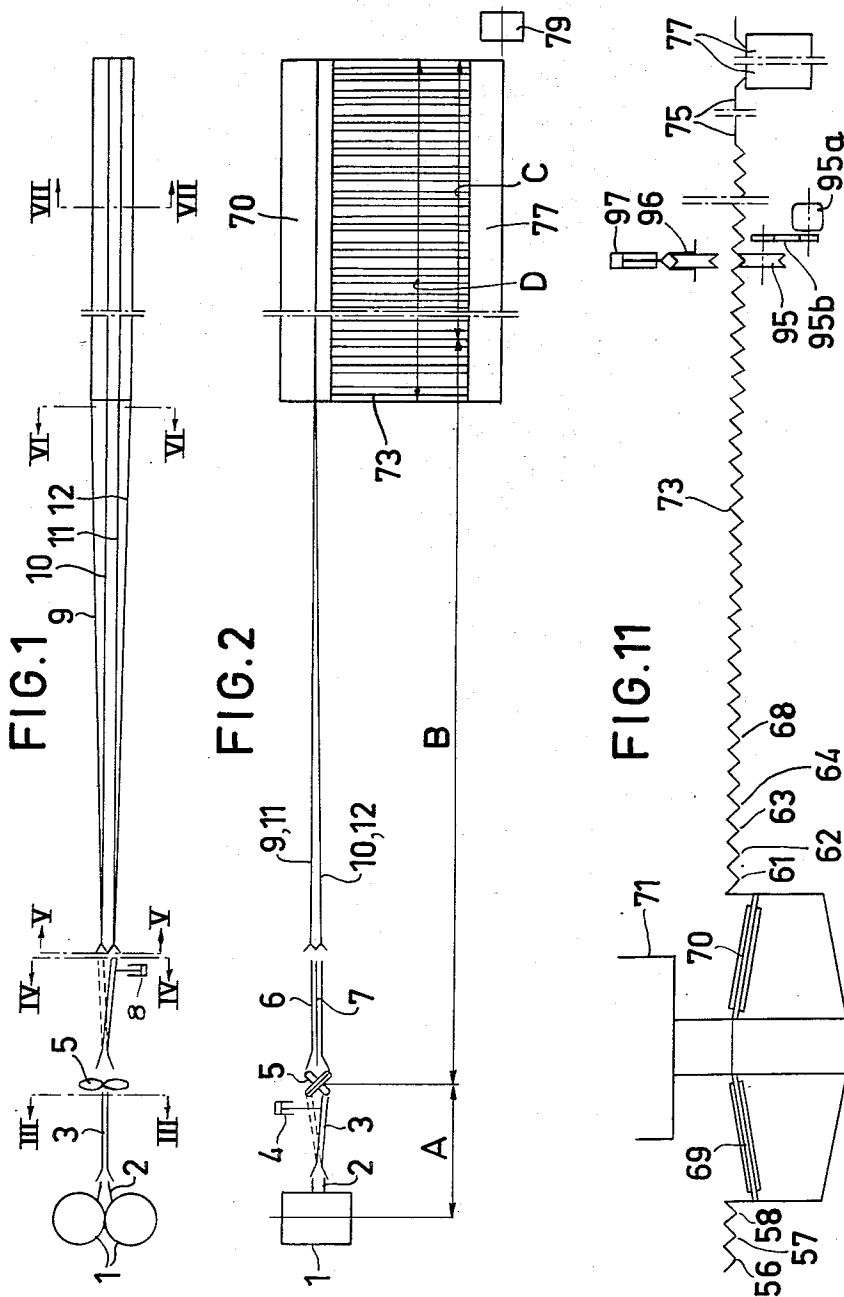
S. E. M. NORLINDH

2,809,545

ARRANGEMENT FOR ROLLING STRAIGHT BARS AT HIGH ROLLING SPEEDS

Filed Nov. 1, 1956

6 Sheets-Sheet 1



INVENTOR.
SVEN ERIK MALTE NORLINDH
BY
Pierre Schaffler & Parker
Attorneys

Oct. 15, 1957

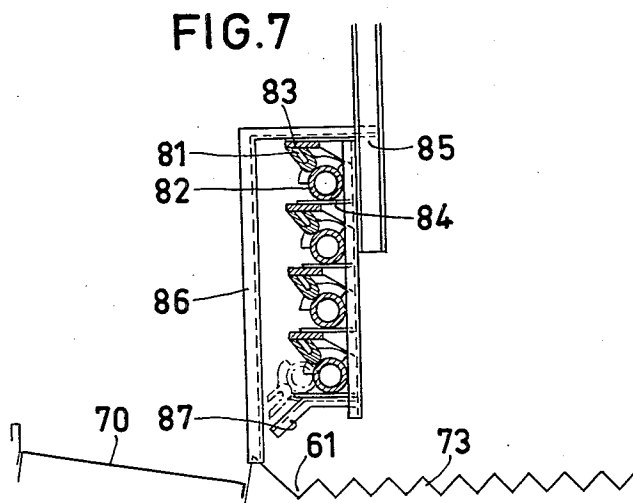
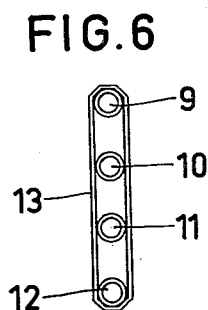
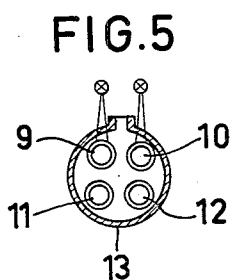
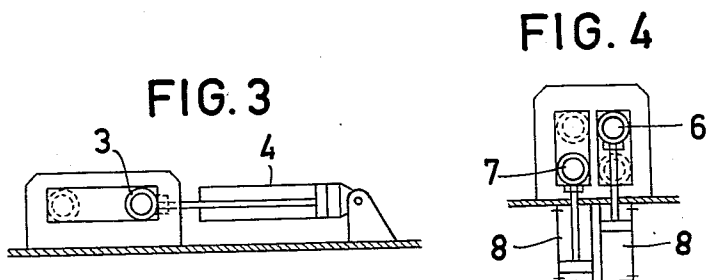
S. E. M. NORLINDH

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6 Sheets-Sheet 2



INVENTOR.
SVEN ERIK MALTE NORLINDH
BY
Pierce, Schaffler & Parker
Attorneys

Oct. 15, 1957

S. E. M. NORLINDH

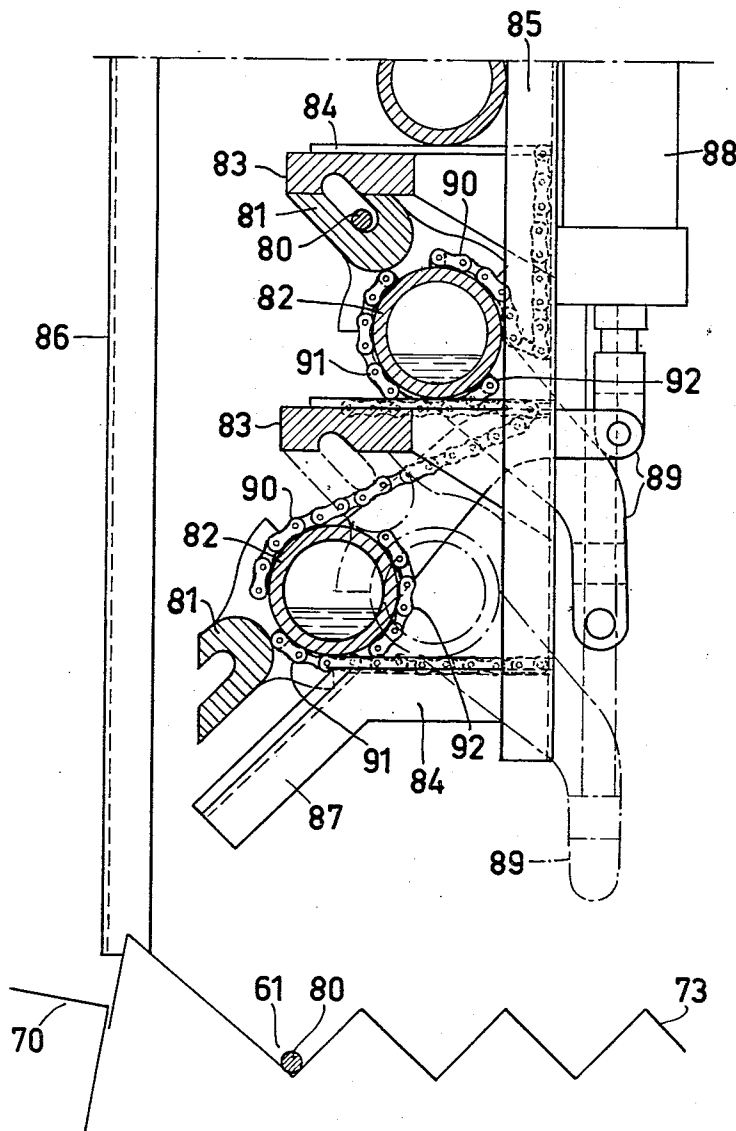
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ARRANGEMENT FOR ROLLING STRAIGHT BARS AT HIGH ROLLING SPEEDS

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FIG. 8



INVENTOR.
SVEN ERIK MALTE NORLINDH
BY
Pierce, Schiffer & Parker
Attorneys

Oct. 15, 1957

S. E. M. NORLINDH

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FIG. 9

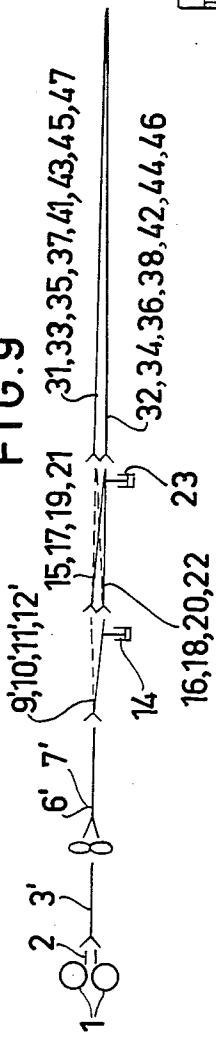
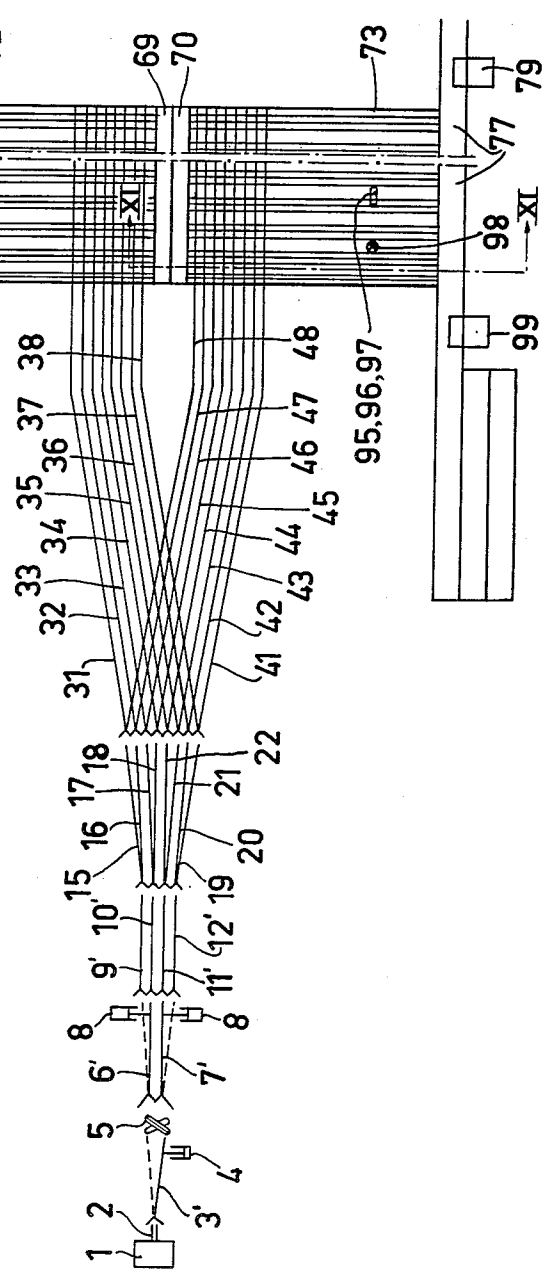


FIG. 10



INVENTOR.
SVEN ERIK MALTE NORLINDH
BY
Pierre Schiffler & Parker
Attorneys

Oct. 15, 1957

S. E. M. NORLINDH

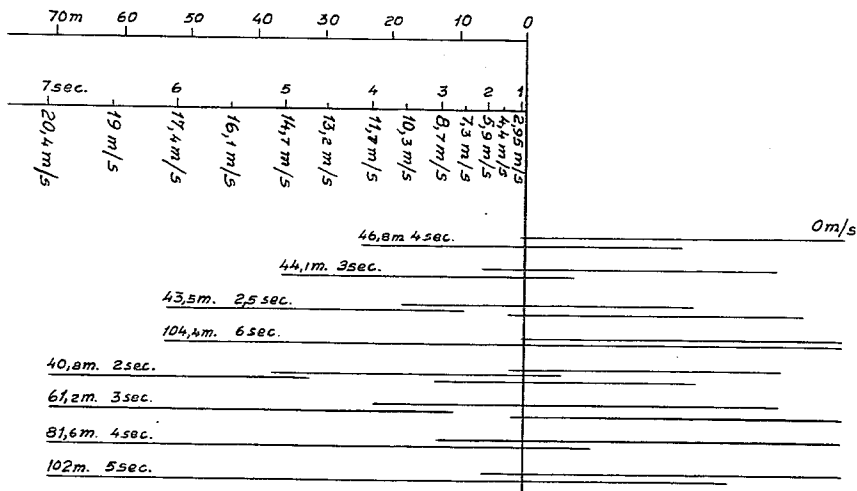
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ARRANGEMENT FOR ROLLING STRAIGHT BARS AT HIGH ROLLING SPEEDS

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FIG.12



INVENTOR.
SVEN ERIK MALTE NORLINDH
BY
Pierce, Schiffen & Parker
Attorneys

Oct. 15, 1957

S. E. M. NORLINDH

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FIG.13

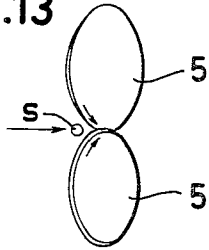


FIG.15

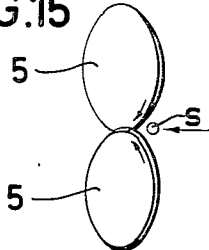


FIG.14

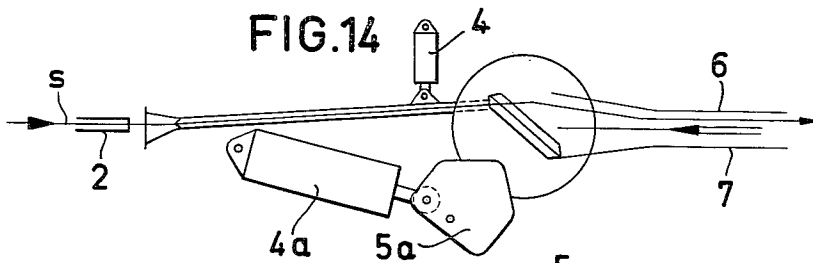


FIG.16

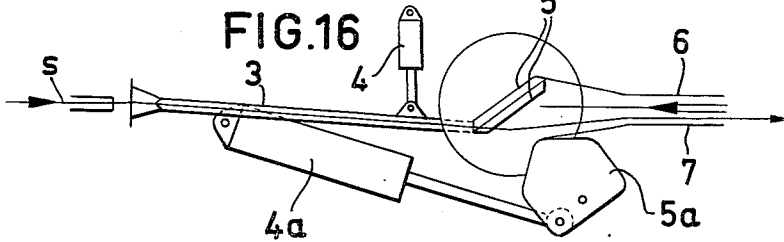
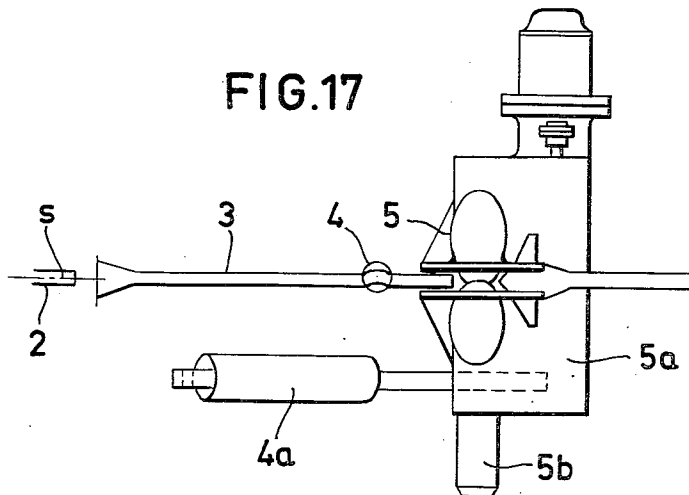


FIG.17



INVENTOR.
SVEN ERIK MALTE NORLINDH
BY
Pierre, Scheffler & Parker
Attorneys

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2,809,545

ARRANGEMENT FOR ROLLING STRAIGHT BARS AT HIGH ROLLING SPEEDS

Sven Erik Malte Norlindh, Morgardshammar, Sweden

Application November 1, 1956, Serial No. 619,659

Claims priority, application Sweden February 6, 1952

4 Claims. (Cl. 80—3)

This invention relates to an improved apparatus for rolling straight bars at high rolling speeds and in particular to an improved means for cutting the rolled bar into lengths and conveying the same via switching channels and friction-braking guide channels to a cooling bed.

In the modern small section mills hitherto used, steel has been rolled in straight lengths up to a finishing speed of about 10 meters/sec. (about 2,000 feet/min.), usually with one or two strands. In the case of two strands as a rule a double runout roller table and a "twin" cooling bed have been used. During the last decades, however, certain designs have been developed with a single cooling bed, together with four runout roller tables placed in four stories. The finishing speed has, however, always been limited to about 10 meters/sec. (about 2,000 feet/min.). The small section mills have usually been designed to roll down to 9.5 mm. (about $\frac{3}{8}$ " diameter, and in certain cases even down to 7 mm. (about $\frac{1}{2}$ " diameter. For smaller sizes, the output becomes too small. At 9.5 mm. (about $\frac{3}{8}$ " diameter, a theoretical output of 20 tons/hour at 10 m./sec. (about 2,000 ft./min.) is obtained. At 7 mm. (about $\frac{1}{2}$ " diameter, the output is theoretically as small as 10.8 tons/hour, and at 5 mm. (about 0.2" diameter, it is only 5.5 tons/hour.

After the finishing stand, the bars are cut by means of a rotary shear into a suitable number of cooling bed lengths. In this way, the weight of the billets can be kept high, e. g. 150 kgs. (330 lbs.). With regard to the considerably lower output of the smallest sizes of bars, they are very expensive to roll.

5 to 6 mm. (.2" to .24") diameter wire rod in coils is, however, normally rolled at a finishing speed of about 20 m./sec. (about 4,000 ft./min.), but hitherto it has not been possible to let the wire rod pass with this speed on to the cooling bed. The purpose of this invention is to make it possible to roll in straight lengths at a higher finishing speed than 10 m./sec. (about 2,000 ft./min.).

The difficulties in guiding the bars at high speeds onto a cooling bed of conventional design are due to the following facts.

(1) The uneven surface of the runout roller table caused by the rollers very easily gives the front end of the bar a wrong direction so that the front end turns upwards and then into any other direction. This is especially true for the smallest sizes of bars since these are considerably more flexible and tend to take a wrong direction at their front ends.

(2) The elevating flaps or the sweep-off flaps easily give the front ends of the bars a wrong direction when they are carried over to the cooling bed.

(3) At higher speeds, the braking period and stopping distances are increased so that the following bar catches up to the previously cut bar. This phenomenon is illustrated in Fig. 12 of the drawings which will be later described in detail.

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A bar of carbon steel that runs out freely and is braked by the friction caused by its own weight against apron plates of cast iron or wrought iron, has a coefficient of friction μ —about 0.3. At a finishing speed of 5.9 m./sec. (1,160 ft./min.) and with $\mu=0.3$, the braking period is 2 seconds and the stopping distance is 5.9 m. (19.3 ft.). At a finishing speed of 11.7 m./sec. (about 2,300 ft./min.) the braking period is 4 seconds and the stopping distance is 23.2 m. (76 ft.). If such a bar is cut every four seconds the previously cut bar has reached the speed zero, i. e. it stops at the very instant when the following cooling bed length is cut. Fig. 12 shows how the two bars overlap each other. When the finishing speed is 20.4 m./sec. (4,000 ft./min.) the braking period is 7 seconds and the stopping distance is 71.5 m. (235 ft.). Fig. 12 illustrates how the bars overlap each other when they are cut every two, every three, every four and every five seconds.

As has already been mentioned in my co-pending United States application Serial No. 266,419, filed January 14, 1952, relating to a plant layout for medium section, small section, wire rod and strip rolling mills, the bar is cut into bed lengths just after the finishing stand of the wire rod train. The bars can then slide through pipes to the cooling bed and the distance between the rotary shear and the cooling bed is adapted to the speed, in order that the bars will be friction braked to a standstill just above the cooling bed. The present invention is characterized in that the cut-off cooling bed lengths are, by means of switching channels, directed into different elongated guide channels wherein the slide and brake themselves by friction to a standstill at a point just above the cooling bed and are then transferred onto the cooling bed.

The invention is illustrated in the accompanying drawings wherein:

Fig. 1 is a schematic side view showing the improved arrangement of switching channels and guide channels for leading the cut bar lengths to the cooling bed;

Fig. 2 is a view similar to Fig. 1 but showing the elements in plan;

Figs. 3-7 are transverse sections taken on lines III—III, IV—IV, V—V, VI—VI and VII—VII, respectively in Fig. 1;

Fig. 8 is a section showing in detail a lower part in Fig. 7;

Figs. 9 and 10 are views similar to Figs. 1 and 2 but showing a modified embodiment of the invention utilizing additional switching channels and two cooling beds instead of one;

Fig. 11 is a schematic sectional view of the cooling bed, the view being taken on line XI—XI of Fig. 10;

Fig. 12 is a tabulation and chart indicating the movement of the bars when braked by their own friction against the guide channels at different finishing speeds and when cut into different lengths, and

Figs. 13-17 are various views of the revolvable shear device which cuts the continuously running high speed rolled bar stock into cooling bed lengths as the first switching channel is shifted between its two delivery positions.

With reference now to the embodiment of the invention illustrated in Figs. 1-8, the reference numeral 1 indicates the finishing stand, the delivery guides from the stand 1 are indicated by numeral 2, and the first switching pipe or channel and which is located between the delivery guides 2 and a revolving shear device 5, is indicated by numeral 3. The delivery end of switch channel 3 is connected to the piston of a compressed air operated cylinder 4 and which functions to shift the delivery end of switch channel 3 back and forth between two delivery positions as shown in Fig. 3 and also in Figs.

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14 and 16. A pair of switching channels 6 and 7 have their inlet ends stationary and located respectively at the two delivery positions of the first switching channel 3. The shear device 5 is located between the delivery end of switch channel 3 and the inlet ends of the pair of switching channels 6 and 7 and functions to cut the continuously running bar stock into lengths each time the switching channel 3 is shifted from one delivery position to the other. The delivery ends of the pair of switching channels 6 and 7 are each connected respectively to pistons 8, 8' of other compressed air operated cylinders and are reciprocated in alternation between upper and lower delivery positions. A guide or braking channel is provided for each delivery position of the switching channels 6 and 7. Consequently, as shown in Fig. 5, the guide or braking channels 9 and 11 are associated with the two delivery positions of switching channel 6, and guide or braking channels 10 and 12 are associated with the two delivery positions of switching channel 7.

The construction and operating sequence for the revolving shear device situated between the delivery end of switching channel 3 and the stationary entrance ends of the next following pair of switching channels 6 and 7 is illustrated in Figs. 13 to 17. The revolving shear device is comprised of a pair of rotary driven disc shears 5 supported on a housing 5a which contains the drive mechanism for the shears 5 and housing 5a is supported by a vertically extending shaft 5b in such manner as to enable the housing 5a to be revolved back and forth about the axis of shaft 5b between the two positions shown respectively in Figs. 14 and 16 and which are 90° apart. A pressure air cylinder 4a is utilized for this purpose and its piston is connected to the shear housing 5a. The axis of shaft 5b coincides with a line passed through the centers of the disc shears 5 and the latter are also thereby revolved back and forth between two cutting positions 90° apart. Fig. 13 shows the positions of the shears 5 and stock S as related to Fig. 14 wherein the switching channel 3 is feeding the stock into switching channel 6, and in a similar manner, Fig. 15 shows the positions of the shears 5 and stock S as related to Fig. 16 wherein the switching channel 3 is feeding the stock S into switching channel 7.

With reference to Fig. 14, it is seen that the rolled stock coming through the guides 2 passes through the switching channel 3 and the next switching channel 6 into one of the two guide channels 9 or 11 associated with the delivery end of switching channel 6. When a cut is to be made, the pressure air cylinder 4 is actuated to thereby shift the delivery end of switch channel 3 from the position shown in Fig. 14 to the position shown in Fig. 16. This movement causes the stock S to be pushed in the direction indicated by the arrow in Fig. 13 into the shears 5 where it is gripped by them and cut off. The cut off length of stock then passes through channel 9, for example, in sliding contact therewith and is gradually braked to a standstill upon reaching the cooling bed 73. Just after the cut is made, the pressure air cylinder 4a then operates to revolve the shears 5 to the position shown in Fig. 16. The following part of the stock then passes by the shears 5 into the entrance end of switching channel 7 and thence through the same into one of the two guide channels 10 or 12 associated with the delivery end of switching channel 7.

When the next cut is to be made, the pressure air cylinder 4 is again actuated to shift the delivery end of channel 3 from the position shown in Fig. 16 back to the position shown in Fig. 14 and the stock S is simultaneously pushed in the direction indicated by the arrow in Fig. 15 into the shears 5 where it is gripped and cut off. The cut off length of stock then passes through channel 12, for example, and is gradually friction braked to a standstill as it reaches the cooling bed 73.

The next following portion of the stock to be cut off feeds through switch channel 6 and into guide channel

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11 as air cylinder 8' shifts the delivery end of switch channel 6 from its upper to its lower position, see Fig. 4, and the next following portion of the stock to be cut off feeds through switch channel 7 and into guide channel 10 as air cylinder 8 shifts the delivery end of switch channel 7 from its lower to its upper position, see Fig. 4.

The sequence of operations then repeats itself causing successively cut off lengths to pass through guide and friction braking channels 9, 12, 11 and 10 to the cooling bed 73.

The delivery end portions of guide channels 9-12 are located near the cooling bed, are disposed horizontally one above the other as shown in Fig. 6, and are connected to the horizontally disposed terminal channels 81 as indicated in Figs. 7 and 8.

When a cut-off bar 80, Fig. 8, has stopped in the cast-iron channel 81, this channel, which is fastened to a tube 82, can be turned counter-clockwise, as shown for the lowermost channel 81 of Fig. 8, so that the cut 80 falls down, for example, into the first cooling bed notch 61.

If the rolling speed in the finishing stand 1 is e. g. 20.4 m./sec. (4000 ft./min.), a cooling bed with the length $D=80$ m. (262 ft.), Fig. 2, and the shear cuts every third second, the length of the cuts will be $C=61.2$ m. (200 ft.). The stopping distance B at $\mu=0.3$ will be 71.5 m. (235 ft.), which shall be equal to the distance between the rotary shear 5 and a short length into the cooling bed. In order to avoid that the tail end of the last cut of the strand stops at a point considerably different from those ones of the other cuts the distance A from the finishing stand to the rotary shear must be short.

In Figs. 7 and 8 an upper cover 83 is shown for each channel 81 serving as a lid. Hereby the bar becomes completely enclosed and a frictional drag is imposed upon the cut section until it has stopped. The difficulties to control the movements of the first end of the bar which are very great, when using open runout roller tables, already at a speed of 11 m./sec. (2200 ft./min.) are hereby eliminated and it is possible to roll at practically any speed. In order to secure a time margin long enough to let the cuts pass down from the guide channel 81, the length of the cuts must be sufficient or else the cuts have to be distributed into a sufficient number of pipes and guide channels. See Fig. 12. At 20.4 m./sec. (4000 ft./min.) and 40.8 m. (134 ft.) cutting-length three channels are filled the whole time and the interval from the time when a cut stops until the next one enters, is only 2.7 seconds with 4 pipes according to Figs. 1 to 8. At 61.2 m. (200 ft.) cutting-length this interval is 5.55 sec., at 81.2 m. (265 ft.) cutting-length 8.5 sec. and at 102 m. (335 ft.) 11.5 sec.

Each channel 81 with its cover 83 is preferably made in short sections with regard to the thermal expansion. The tube 82 has, however, just the same length as the cooling bed and can suitably be cooled with water, and rests on horizontal supports 84, on which the tube 82 can roll, when the bar is tipped on the cooling bed. See Fig. 8, the lower channel. The tubes 82 can suitably be guided by the chains 90, 91 and 92, when each is operated by the compressed-air cylinder 88, turning the tube by means of the lever 89, thereby to discharge a cut-off bar 80 from the associated channel 81. When the chain has been stretched, the tube cannot roll any further, and in the other direction the tube stops against the beams 85. The tube can possibly be placed upon supporting rollers or something similar. For guiding the bars towards the cooling bed notch 61 there are the vertical guide beams 86 and the inclined beams 87.

Figs. 9-11 illustrate a different embodiment of the invention and in which "twin" cooling beds are used and also two additional sets of switching tubes. In this embodiment, the switching tubes 3' and 6', 7' correspond to the tubes 3 and 6, 7 of the embodiment shown in Figs.

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1-8. However, following the pair of switch tubes 6', 7' are two pairs of switch tubes 9', 10' and 11', 12' and the delivery ends of these tubes are shifted between two delivery positions by compressed air cylinders 14. Following the switch tubes 9'-12' are four pairs of switch tubes 15-22 and the delivery ends of these tubes are shifted between two delivery positions by compressed air cylinders 23. Following the tubes 15-22 are two sets of guide friction braking channels, one set consisting of channels 31-38 leading to one half 72 of the cooling bed, and the other set consisting of channels 41-48 leading to the other half 73' of the cooling bed.

In Fig. 11 there are also shown auxiliary devices such as runout tables 69, 70 for coarser bars having a finishing speed of below 10 m./sec. (2,000 ft./min.). A footway 71 for workmen is located between the cooling beds 72, 73' and shuffle bars 75 are provided to transfer a plurality of the bars to a cold shear roller table 77 for cutting in the cold shear 79. Also shown in Fig. 11 is a pinch roller device for moving the cut stock longitudinally in the notches of the cooling bed, such device comprising a feeding roller 95 driven by an electric motor 95a through gearing 95b and a pressure roller 96 controlled by a compressed air motor 97. The pressure roller clamps the bar close to the feeding roller as long as a light beam to a photoelectric cell 98 is not interrupted by the end of the bar. In this way each bar is drawn longitudinally to a position such that a rotary cold shear 99 can cut e. g. twenty bars at a time into finished lengths.

In conclusion it will now be evident that the present invention makes it possible to roll rod stock at relatively high speeds and to cut and deliver lengths of the stock to the cooling bed via the multiple switching and friction braking guide channels in such manner that the cut lengths do not overtake each other in the channels and are brought to a standstill at the cooling bed.

I claim:

1. Guide channel means for delivering cut sections of rolled stock, said cut sections travelling slidably and in contact with the surfaces of said guide channel means thereby to frictionally brake said cut sections to substantially a standstill at the delivery end thereof, said guide channel means including a first switching channel for receiving at the inlet end thereof a continuous length of the rolled stock, means actuating said first switching channel to shift the outlet end thereof between two spaced delivery positions, a pair of switching channels having stationary inlet ends located respectively at the delivery positions of said first switching channel, a revoluble shear device located between the outlet end of said first switching channel and the stationary inlet ends of said pair of switching channels for cutting said continuous length of rolled stock as it emerges from the outlet end of said first switching channel into separate lengths for sliding movement through said pair of switching channels in alternation, means to revolve said shear device about its axis from one cutting position to another, the shearing action being effected by moving the stock across the shears upon shifting of said first switching channel and said revoluble shear device being revolved alternately as said first switching channel is shifted from one delivery position to the other delivery position, means actuating each of said pair of switching channels to shift the outlet ends thereof in alternation between two spaced delivery positions, and guide channels having their inlet ends located respectively at each of the delivery positions of said pair of switching channels for receiving the separate lengths of rolled stock delivered by said pair of switching channels.

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2. Guide channel means for delivering cut sections of rolled stock, said cut sections travelling slidably and in contact with the surfaces of said guide channel means thereby to frictionally brake said cut sections to substantially a standstill at the delivery end thereof, said guide channel means including a first switching channel for receiving at the inlet end thereof a continuous length of the rolled stock, means actuating said first switching channel to shift the outlet end thereof between two spaced delivery positions, a pair of switching channels having stationary inlet ends located respectively at the delivery positions of said first switching channel, a revoluble shear device located between the outlet end of said first switching channel and the stationary inlet ends of said pair of switching channels for cutting said continuous length of rolled stock as it emerges from the outlet end of said first switching channel into separate lengths for sliding movement through said pair of switching channels in alternation, means to revolve said shear device about its axis from one cutting position to another, the shearing action being effected by moving the stock across the shears upon shifting of said first switching channel and said revoluble shear device being revolved alternately as said first switching channel is shifted from one delivery position to the other delivery position, means actuating each of said pair of switching channels to shift the outlet ends thereof in alternation between two spaced delivery positions, guide channels having their inlet ends located respectively at each of the delivery positions of said pair of switching channels for receiving the separate lengths of rolled stock delivered by said pair of switching channels, said separate lengths of rolled stock being ultimately braked to substantially a standstill at the outlet end portions of said guide channels by friction with the surfaces of said guide channels as said separate lengths of rolled stock slide through the same, and means for removing said separate lengths of rolled stock from the outlet end portions of said guide channels.

3. Guide channel means as defined in claim 2 wherein the outlet end of said first switching channel is shifted between two spaced delivery positions in a first plane and wherein the outlet ends of said pair of switching channels are shifted between two spaced delivery positions in a second plane normal to said first plane and wherein said guide channels are longitudinally curved between their inlet ends and their outlet end portions and have their outlet end portions located generally horizontal and each above the other.

4. Guide channel means as defined in claim 2 wherein said means for removing said separate lengths of rolled stock from the outlet end portions of said guide channel comprises a generally horizontal open-topped terminal channel aligned with the outlet end of each said guide channel, a tube individual to and supporting each of said terminal channels, power means for turning each said tube to carry the associated open-topped terminal channel between an upwardly inclined stock-retaining position and a downwardly inclined stock-discharging position and a stationary cover plate for each said open-topped channel positioned to close the same when in the said stock retaining position.

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