Oct. 31, 1933. N. C. RENDLEMAN 1,932,750

ROLLING MILL

Filed May 1, 1931 3 Sheets-Sheet 1

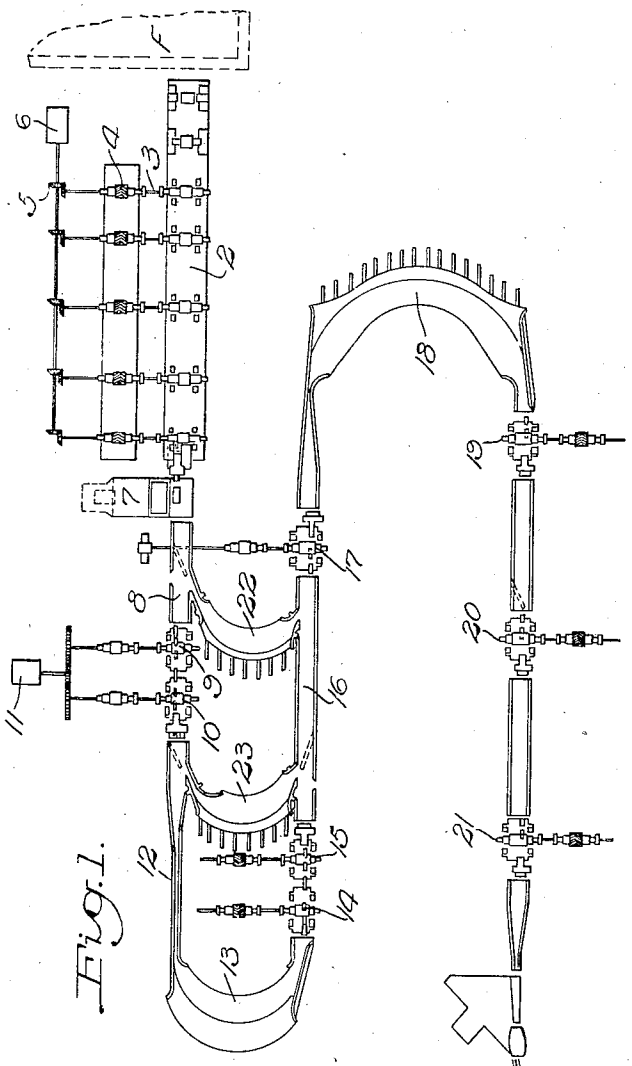


Fig. 1.

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Fig. 2.

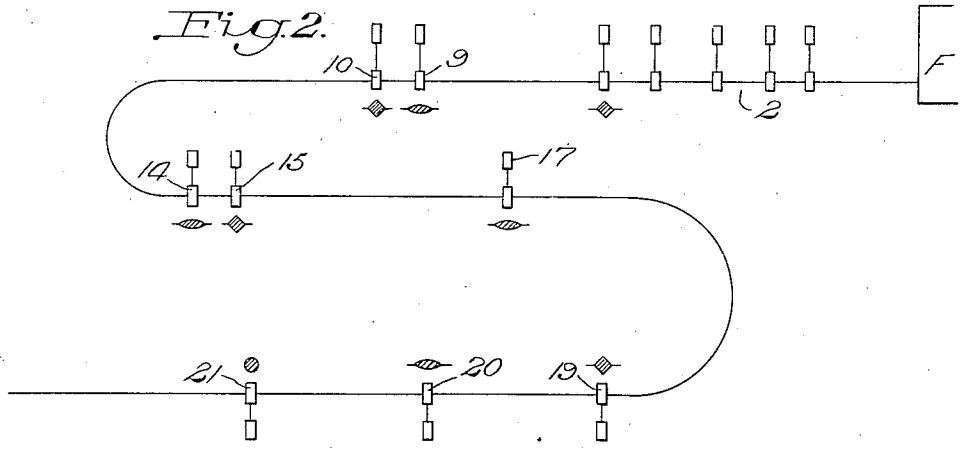


Fig. 3.

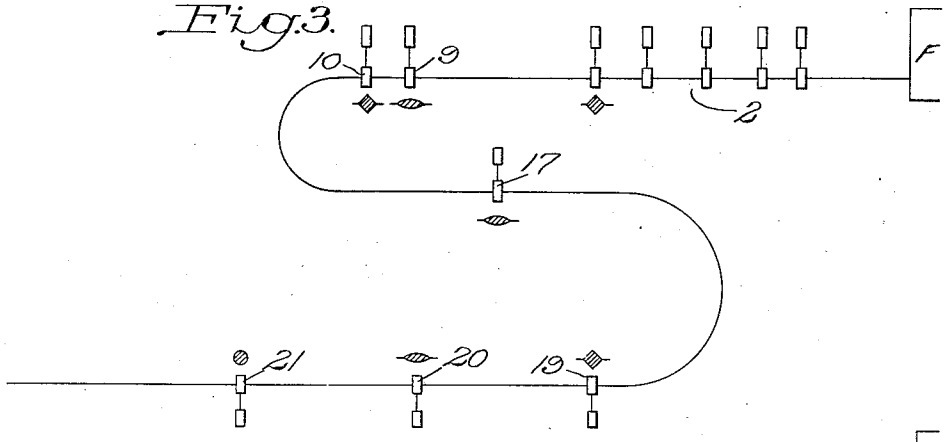
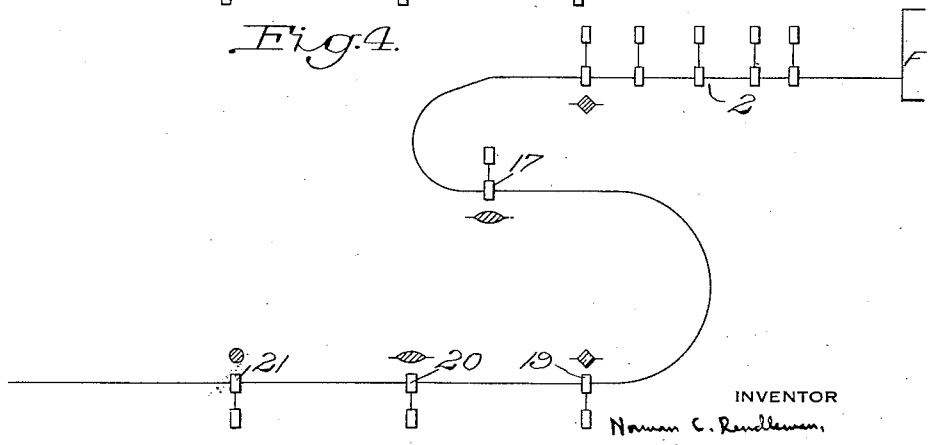


Fig. 4.



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Fig. 6.

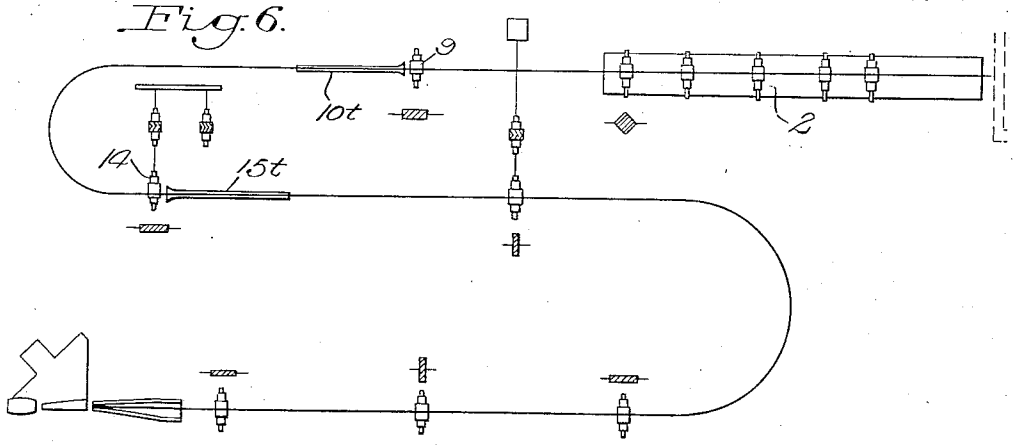


Fig. 5.

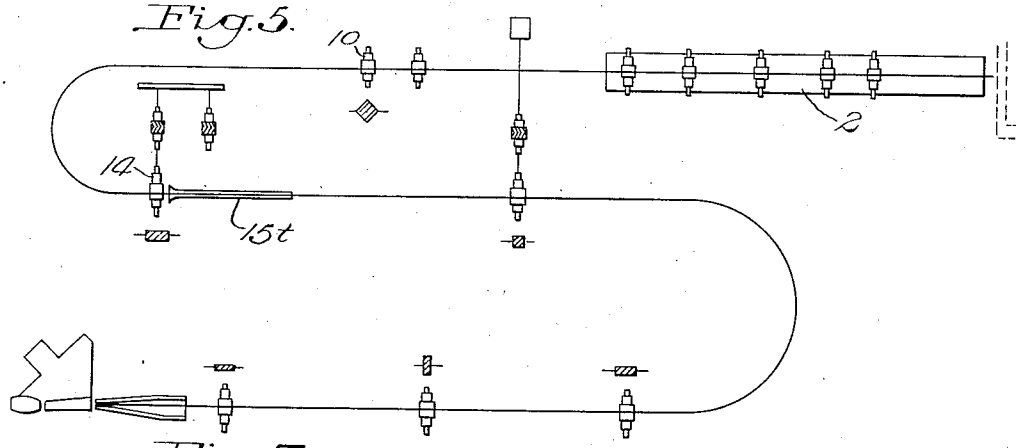
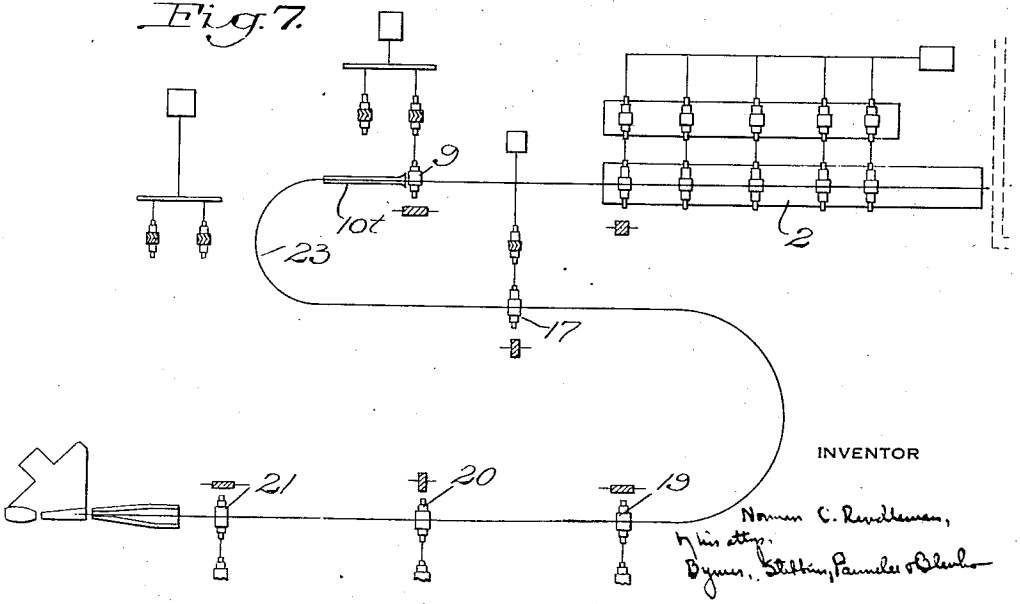


Fig. 7.



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UNITED STATES PATENT OFFICE

1,932,750

ROLLING MILL

Norman C. Rendleman, Pittsburgh, Pa., assignor to Jones & Laughlin Steel Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Application May 1, 1931. Serial No. 534,155

13 Claims. (Cl. 80—37)

This invention relates to rolling mills and particularly to a mill for the rolling of rounds, squares, light angles and the like over the usual range of commercial sizes.

This application is a continuation in part of my application Serial No. 344,275, filed March 5, 1929.

Various mill layouts have been proposed for the rolling of bars and the like, but the fact that there is a wide range of sizes to be rolled and that small orders must frequently be quickly handled has made such mills expensive to install and operate. The mill time lost in setting up these mills is an important item entering into operating cost, and with the mills heretofore employed this item has been a particularly heavy one because it has been necessary to change every pass in the mill when making any material change in the size of the product.

In these mills a reduction has usually been effected in every pass so that a change in the size of the product has required a change in every stand of the mill. In a few cases it has been proposed to run one or more stands idle, the material simply going through the stand without any reduction being effected. This has not been satisfactory because the rolls have had to be raised in the idle stand and there is always danger of cobbling. Because of the fact that most continuous mills are engine driven with all stands connected, it has been necessary to drive the idle stands as well as the working stands. There is thus afforded no opportunity to work on the idle stands.

I provide in a rolling mill a roughing train, a finishing stand and a plurality of intermediate stands so arranged that the material may be routed past the same without going through any idle stands. Preferably, the intermediate stands are arranged in staggered formation and so located that repeaters may be placed between rows of mills in such manner as to avoid stands which it is desired to drop out of the train.

With this arrangement the adjustment of the roughing stands will not be disturbed but will produce the same intermediate product for a wide range of sizes. The number of intermediate stands employed will depend upon the amount of reduction required for shaping this intermediate product into the final desired product. A repeater may be quickly set so as to drop out of the stand or stands desired, and the mill is therefore highly flexible and is particularly suited for quick changes from one size to another. The number of roll changes is reduced to a minimum, the material is routed past the idle stands without being passed therethrough, and the stock of rolls required is materially reduced in number.

For the rolling of rounds, squares and the like, an even number of passes for reducing the billet leaving the roughing train is always required. In changing from one size of a product of this character to another size, the stands will be dropped out in pairs. However, in the rolling of other sections, such as flats, there is necessarily an odd number of passes employed. In order to eliminate the disadvantages above mentioned of running the material through an idle stand, I make provision for bodily removing intermediate stands from the mill. This is not possible in the mills now employed because invariably two or more stands are connected together and passes cannot be arranged in proper sequence. In my improved mill the several intermediate stands are connected back to their respective power sources independently of the other intermediate stands, whereby a given intermediate stand may be bodily removed.

I preferably operate the mill so that each stand reduces the same volume of material in a given time. In other words, the product of area of section times speed is a constant for all stands. This means that for a given finishing speed the reduction in each stand is effected at the lowest possible speed and therefore with the least power.

In the accompanying drawings illustrating a present preferred embodiment and showing the various set-ups thereof,

Figure 1 is a plan view, largely diagrammatic, showing my improved mill;

Figures 2 to 4 inclusive are diagrams showing the use of the mill in the production of rounds of different sizes and illustrating and dropping out of intermediate stands, and

Figures 5 to 7 inclusive are similar views showings the use of the mill in rolling flats of various sizes.

Figure 1 shows a heating furnace F from which billets are supplied to a roughing train indicated generally by the reference character 2. This train comprises five stands, each driven through spindles 3, pinions 4 and bevel gears 5 from a motor 6. The stands and roughing train form a continuous mill and produce an intermediate product which is to be worked on by a varying number of additional mills depending on the final size of the product desired.

As the material issues from the roughing train it is cropped by a flying shear 7 and passes through a trough 8 to a pair of intermediate stands 9 and 10. These stands are driven from a motor 11. It will be noted, however, that each stand is connected back to the power source independently of the other, so that either stand can be bodily removed without affecting the driving connection to the other stand. After the material has been reduced in the stands 9 and 10 it passes along a trough 12 and through a repeater 13 to mill stands 14 and 15. From the stand 15 it travels through a trough 16 to a finishing stand 17 in alinement with the stands 14 and 15. After the material has been rolled in the stand 17 it passes through a repeater 18 to finishing stands 19, 20 and 21.

It will be noted that the stands 9 and 10 are in alinement with the roughing train 2, that the stands 14, 15 and 17 are in alinement with one another and parallel to the line of the mills 9 and 10, and that the mills 19, 20 and 21 are also in alinement with one another and parallel with the other two lines of mills.

Considering the mills in the order 2, 17, 9—10, and 15—14, it will be seen that they are in staggered relationship, and the mill may be considered as comprising first, second, third and fourth units. A repeater 22 is placed so as to deflect material from the trough 8 into the trough 16. If this repeater is thrown into operation, the material is routed around the stands 9, 10, 14 and 15. In other words, after leaving the roughing train the material passes through only the finishing stands. Another repeater 23 is placed so as to deflect material from the trough 12 into the trough 16, thereby dropping out the stands 14 and 15. When the repeater 23 is in operation the material passes through two intermediate stands after leaving the roughing train. Under these conditions the mill 2 may be considered as forming the first stand, the mills 9—10 as forming the second stand and the mill 17 as forming the third stand.

The main problem in a mill of this character is to supply to the finishing train stock of the size required for forming the desired product. The following examples will illustrate the flexibility of my improved mill and will show how the sizes of the stock supplied to the finishing train may be varied depending on the size of the product desired.

Assume that the furnace F is charged with 2½" square billets and that it is desired to roll rounds in the range from ⅜" to ¾". The roughing train 2 will reduce the billet to a 1—1/32d inch square, having an area of 1.04 square inches. The delivery speed will be 187.5 feet per minute. The stands 9 and 10 will be effective for reducing this bar to a 45/64 inch square bar, having an area of .497 square inches. The delivery speed at the stand 10 will be 393.7 feet per minute. The stands 14 and 15 will further reduce the bar to a 17/32d inch square, having an area of .274 square inches and at a delivery speed of 717.8 feet per minute. This bar will then be reduced in the stands 17, 19, 20 and 21 and issue as a ⅜ths inch round at a speed of 1800 feet per minute.

This arrangement is shown in Figure 2. The bar is rolled automatically from a square or diamond to an oval as indicated diagrammatically by the cross-hatched sections adjacent each stand. The parting lines of the rolls are indicated on these sections.

Figure 3 shows the mill as it will be arranged for the manufacture of ½" rounds, for which rolling the stands 14 and 15 will be dropped out. The setting of the roughing train and the stands 9 and 10 will be the same but they will be speeded up so that as the material leaves the roughing train it will be travelling at a speed of 332 feet per minute, and when it leaves the stand 10 will be travelling at a speed of 695 feet per minute. The stands 17, 19, 20 and 21 will take the 45/64 inch square bar and reduce it to ½" rounds which issue at 1800 feet per minute.

For the manufacture of ¾" rounds, the stands 9 and 10 are also dropped, as diagrammatically illustrated in Figure 4, so that the 1—1/32d inch square, issuing from the roughing train, will go direct to the stand 17. For ¾" rounds the roughing train will be further speeded up so that the material issues at 419 feet per minute.

The three sizes corresponding to the above examples, as well as intermediate sizes, can thus be handled without any change of rolls. It will be understood that by the time the material reaches the roll stand 17 it is sufficiently small so that grooves covering the desired range of sizes can be cut in the rolls for the stands 17, 19, 20 and 21, and that it is only necessary to guide the material into the proper groove. However, it is undesirable to cut a large number of grooves of different sizes into the rolls of the roughing stands or of the intermediate stands, because to do so would require too much roll width and would weaken the rolls. With my improved mill, therefore, it is only necessary to drop out intermediate stands as desired in order to supply stock of the proper size to the finishing train. The rolls in the finishing train will have a series of grooves of different sizes and a set up for the rolling of a given size product can be effected in a few minutes.

Figures 5 to 7 show the rolling of flat products. In such rollings a series of flat and edge passes is required. Figure 5 shows the rolling of small flats. The stand 15 is bodily removed and the trough 15—T is put in its place. This can be readily done because of the fact that the stand 15 is independently driven. Figure 5 shows the set-up which will be employed for narrow flats.

Where rolling wide, thin flats the arrangement of Figure 6 is employed. In this case the stand 10 is also dropped out and a trough 10—T is substituted therefor.

With the arangement of Figure 5 stock in square or rectangular fom is taken from the stand 10 whereas with the arrangement of Figure 6 square or rectangular stock is taken from the last stand of the roughing train.

Figure 7 shows the arrangement employed for wider and thicker flats. The repeater 23 is employed in this case, the mills 10, 14 and 15 all being idle. Square or rectangular stock is taken from the last stand of the roughing mill for this operation.

It will be seen from the foregoing that the roll stands following the roughing train will be dropped out one at a time, that there is no necessity of passing the material through idle stands, and that all products will be finished through the stands 17, 19, 20 and 21.

I have shown motors 6 and 11 for driving the roughing train and the stands 9 and 10. It will be understood that another motor is used for driving the stands 14 and 15, and that independent motors are used for the stands 17, 19, 20

and 21. All of these motors are preferably variable speed motors so that they can be adjusted as desired.

There is no necessity for driving an idle stand and repairs can be effected or the rolls replaced at the convenience of the mill crew and without danger to them.

I have illustrated and described the present preferred embodiment of the invention, but it will be understood that it is not limited to the form shown as it may be otherwise embodied within the scope of the following claims.

I claim:

1. A rolling mill comprising a roughing train, a mill stand in substantial alinement with said train but spaced therefrom, a second stand arranged for the travel of material therethrough from the first mentioned stand, and a repeater arranged to direct material from the roughing train to the second mill stand without going through the first-mentioned mill stand.

2. A rolling mill comprising staggered mill stands arranged in a pair of spaced rows and staggered an amount sufficient to permit of the placing of repeaters between the rows so as to direct material travelling through the mill stands in the first row to a mill stand in the second row and without going through intermediate mill stands.

3. A rolling mill comprising staggered mill stands arranged in a pair of spaced rows and staggered an amount sufficient to permit of the placing of repeaters between the rows so as to direct material travelling through the mill stands in the first row to a mill stand in the second row and without going through intermediate mill stands, the several mill stands being arranged to effect successive reductions and to each reduce substantially the same volume of material in the same time.

4. A rolling mill comprising a roughing train, a first mill stand in alinement therewith but spaced therefrom, a third mill stand ahead of the first stand but out of alinement therewith a second mill stand spaced beyond the first stand and in alinement with the third stand, a repeater ahead of the first stand arranged to supply the third stand, and a repeater beyond the first stand arranged to supply the third stand.

5. A rolling mill comprising a roughing train, a first mill stand arranged to receive material direct from the roughing train but spaced therefrom, a third mill stand placed ahead of the first stand but out of alinement therewith, a second mill stand spaced beyond the first stand and arranged to receive material from the first mill stand and supply material to the third mill stand, a repeater ahead of the first stand arranged to supply the third stand, and a repeater beyond the first stand arranged to supply the third stand.

6. A rolling mill comprising a roughing train, a first mill stand arranged to receive material direct from the roughing train but spaced therefrom, a third mill stand placed ahead of the first stand but out of alinement therewith, a second mill stand spaced beyond the first stand and arranged to receive material from the first mill stand and supply material to the third mill stand, a repeater ahead of the first stand arranged to supply the third stand, a repeater beyond the first stand arranged to supply the third stand, and a finishing stand beyond the third stand.

7. A rolling mill comprising a roughing train, a first mill stand arranged to receive material direct from the roughing train but spaced therefrom, a third mill stand placed ahead of the first stand but out of alinement therewith, a second mill stand spaced beyond the first stand and arranged to receive material from the first mill stand and supply material to the third mill stand, a repeater ahead of the first stand arranged to supply the third stand, a repeater beyond the first stand arranged to supply the third stand, and finishing stands arranged in general parallelism with the roughing train and having a repeater adapted to supply material from the third stand.

8. A rolling mill comprising substantially parallel troughs, spaced repeaters connecting the troughs, and roll stands between the repeaters.

9. A rolling mill comprising two spaced troughs, repeaters spaced along the troughs and connecting the same, and roll stands between the repeaters and alternately in alinement with the different troughs.

10. A rolling mill comprising a roughing train, a finishing train, a plurality of intermediate stands, the several intermediate stands being conneeted back to their respective power sources independently of the other intermediate stands, whereby a given intermediate stand may be bodily removed, and means for guiding material through selected intermediate stands.

11. A rolling mill comprising a roughing train, a finishing train, and a plurality of intermediate stands, the intermediate stands and the roughing train being arranged in two rows, the several intermediate stands being connected back to their respective power sources independently of the other intermediate stands, whereby a given intermediate stand may be bodily removed, and repeaters between the rows arranged to supply material from a stand in the first row to a stand in the second row.

12. A rolling mill comprising a plurality of roll stands lying in generally parallel lines, the several stands being in zigzag relation, there being intermediate stands in the mill, which intermediate stands are connected back to their respective power sources independently of the other intermediate stands, whereby a given intermediate stand may be bodily removed, and repeaters in front of the several stands adapted to guide material from one of said lines to the other.

13. A rolling mill comprising a roughing train with a plurality of stands, the rolls in the roughing stands forming passes for the production of successive bars of like cross section, a plurality of intermediate stands, means for guiding bars from the roughing train in different desired paths so that in different cases the bars pass through different numbers of intermediate stands, whereby bars of different size are supplied from the intermediate stands, and a finishing train with a plurality of stands, the stands in the finishing train providing a plurality of passes adapted to accommodate the different sizes of bars supplied from the intermediate stands and produce the desired range of final sizes, and means for independently driving the several finishing stands at different adjusted speeds.

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