

July 3, 1934.

W. ROHN

1,964,893

ROLLING MILL

Filed April 30, 1931

4 Sheets-Sheet 1

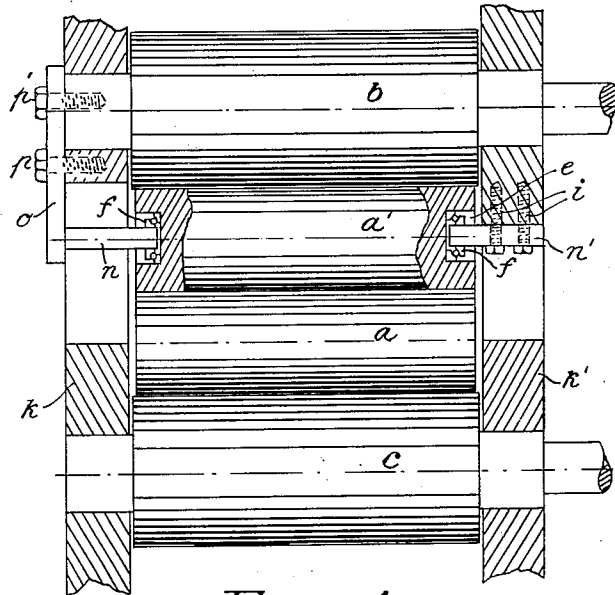


Fig. 4

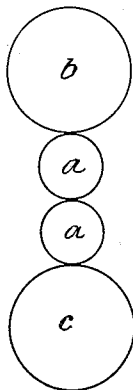


Fig. 1
(OLD FORM.)

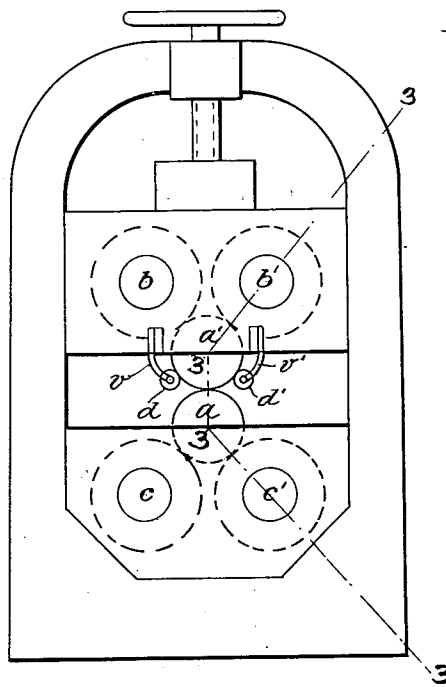


Fig. 2

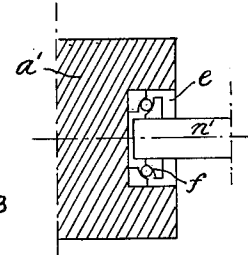


Fig. 4a

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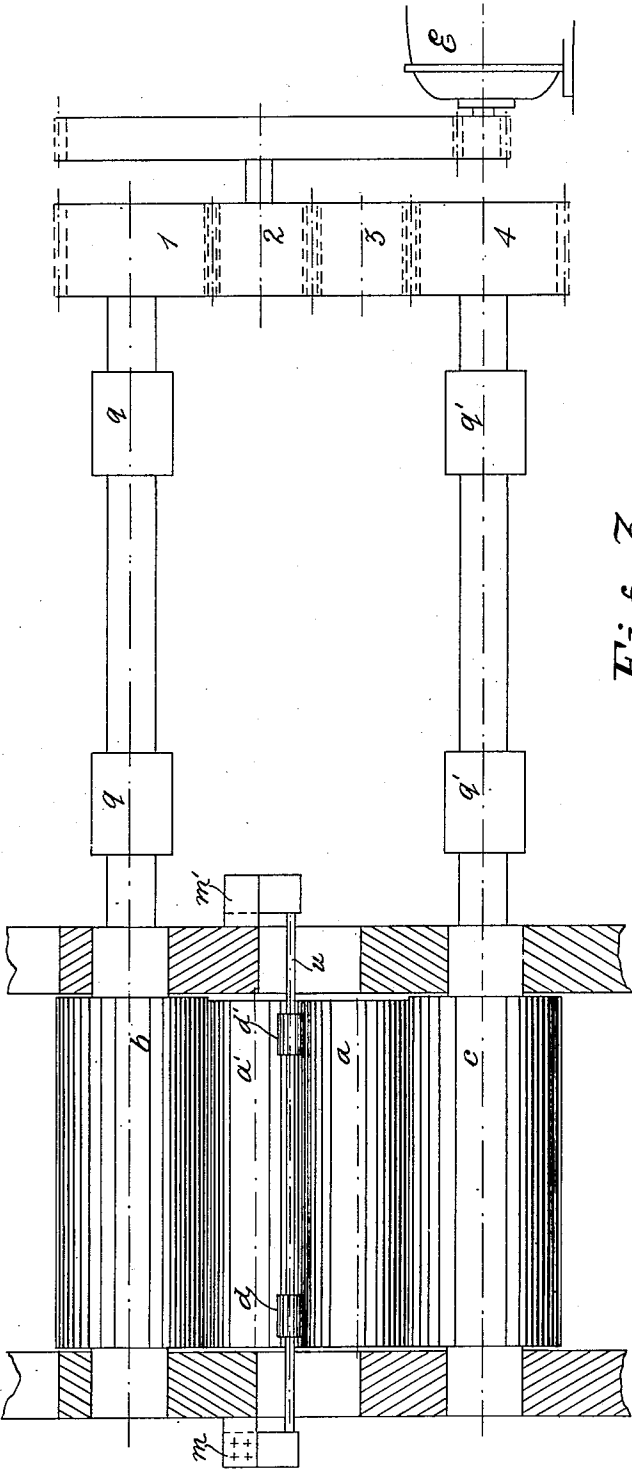


Fig. 3

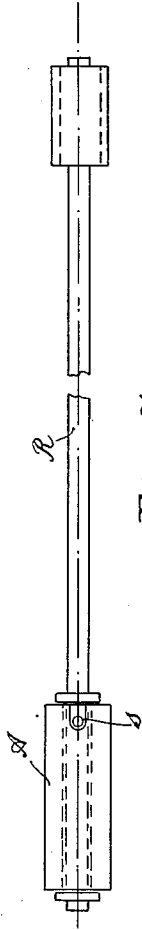


Fig. 7

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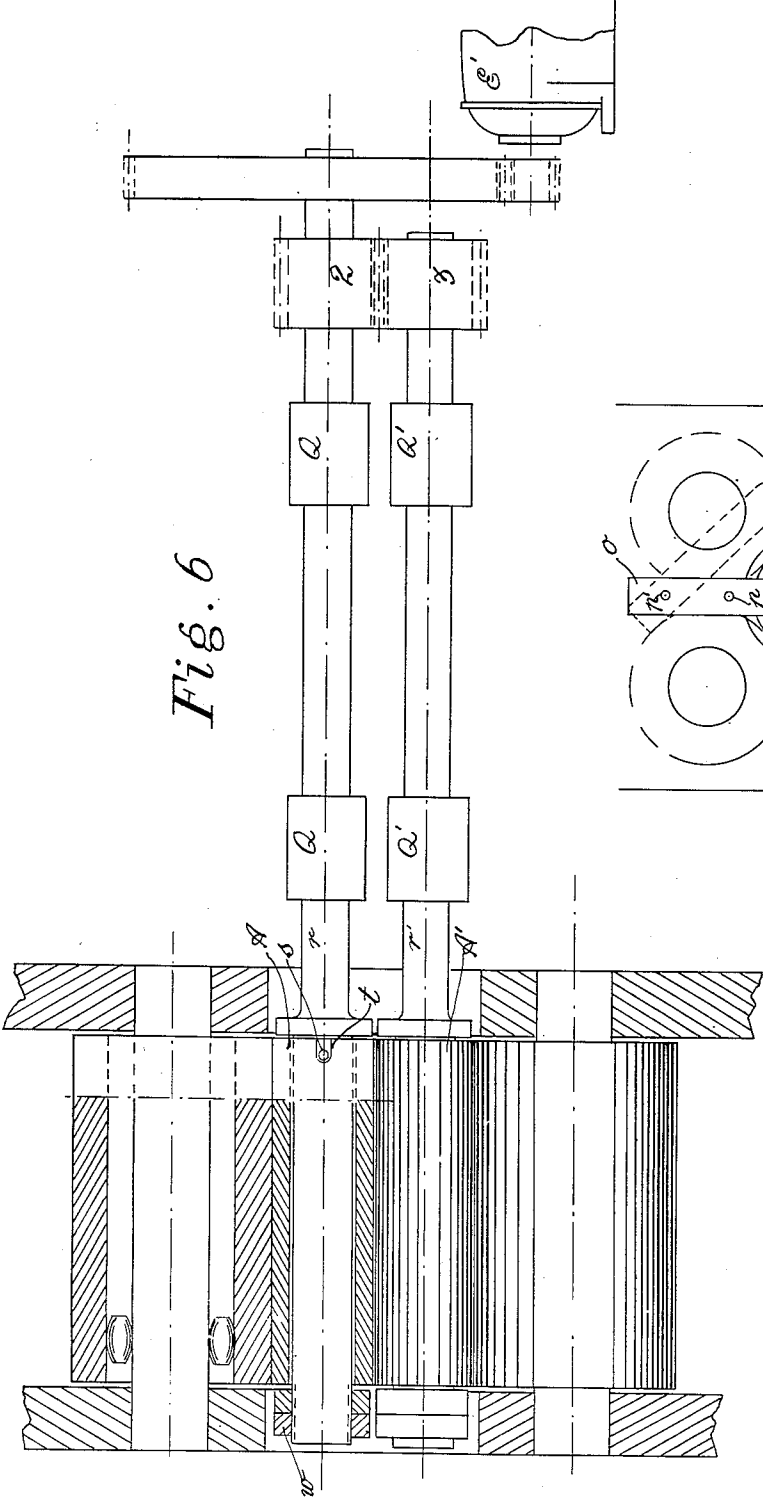


Fig. 6

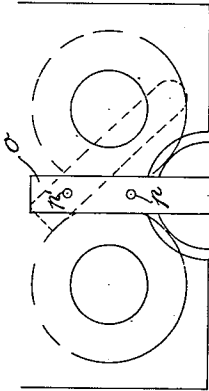


Fig. 5

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Fig. 8

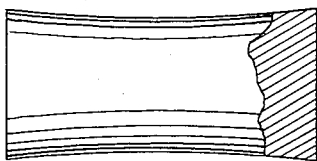


Fig. 9

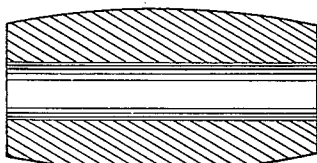


Fig. 10

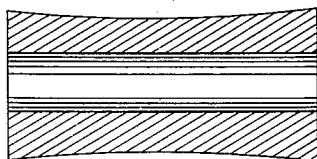


Fig. 11

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UNITED STATES PATENT OFFICE

1,964,893

ROLLING MILL

Wilhelm Rohn, Hanau-on-the-Main, Germany

Application April 30, 1931, Serial No. 534,085
In Germany January 28, 1929

3 Claims. (Cl. 80—38)

This invention relates to improvements in rolling mills.

For the purpose of rolling strips there have been introduced to an increasing extent rolling mills having six rolls with driven operating rolls, the operating rolls being provided with bearing pivots and coupling pivots. It would be possible to increase the economy in such rolling mills if it were possible to reduce the cost of the operating rolls which are subjected to wear and to shorten the time necessary for changing these rolls. These results are obtained by the invention hereinafter described.

The present invention comprises a rolling mill with two-pivotless operating rolls consisting of simple plain solid or hollow cylinders and two pairs of thicker rolls supporting the said operating rolls. The use of pivotless operating rolls has been proposed in connection with four roll rolling mills (Figure 1), wherein the axes of all the four rolls are located in the same or substantially the same plane. In Figure 1 *a*, *a* indicate the operating rolls, *b* and *c* the supporting rolls. In connection with four roll rolling mills the use of pivotless operating rolls has led to an absolute failure. In this connection it is necessary to arrange in front of and behind the central operating rolls bearing bush-like supports in order to prevent the operating rolls from moving in the direction of rolling or in the opposite direction thereto. Between these bearing bush-like supports and the operating rolls unallowable high friction is set up which under circumstances may even cause the operating rolls to stop, whereby the supporting rolls slip on the operating roll and thus damage this. This friction is considerably increased if the strip when entering or leaving the rolls is tightly tensioned which, as is well known, is of the greatest importance for obtaining a smooth and straight strip. These tensions also render it impossible to prevent the operating rolls from moving in the rolling direction or oppositely thereto by the provision of small supporting rolls in front of and behind the operating rolls, as these supporting rolls can only be made very small and are, therefore, not capable of withstanding the high strains.

Applicant has found that these difficulties are immediately eliminated if pivotless operating rolls are used in combination with supporting pairs of rolls as in this case the operating rolls are simultaneously prevented automatically from moving in the rolling direction or opposite thereto and this without any disadvantages, so that even the strongest pulling efforts applied to the

entering or outgoing strip do not produce any disturbances.

By reason of the pressure components and the bearing of each operating roll against two supporting rolls, the driving action exerted by the supporting rolls on the operating rolls is so great that the liability of a stopping of the operating rolls is practically entirely obviated.

The invention will now be described with reference to the accompanying drawings wherein

Figure 1 shows diagrammatically a known four high rolling mill which is being referred to for the purpose of comparison with the rolling mill according to the present invention.

Figure 2 is a diagrammatic end view of a six high rolling mill according to the invention.

Figure 3 is a section of a rolling mill taken along the line 3—3—3 of Figure 2.

Figure 4 is a side view partially in section of a similar rolling mill.

Figure 4a is a detail of Figure 4 on an enlarged scale.

Figure 5 shows by end view a detail of the upper part of Figure 4.

Figure 6 shows a six roll rolling mill provided with a special kind of rolls.

Figure 7 shows a special design of rolls of a six high rolling mill as illustrated in Figure 6.

Figures 8 and 9 show two forms of supporting rolls and Figures 10 and 11 illustrate two forms of operating rolls.

The arrangement of a six roll rolling mill is illustrated diagrammatically in Figure 2 wherein *a*, *a'* indicate the operating rolls, *b*, *b'* the upper supporting rolls and *c*, *c'* the lower supporting rolls.

As will be seen from this figure the use of pivotless operating rolls, as already suggested in four roll rolling mills, but inoperative therein, is capable of being used with an efficient result by the addition of pairs of supporting rolls.

These plain pivotless rolls, however, only cost one-fourth to one-sixth of the price of rolls of the same size provided with pivots. The subsequent regrinding of worn rolls is also considerably cheapened as it is unnecessary to regrind pivots which have become rough. In some cases the regrinding may even be carried out by the centerless method.

It is unnecessary to provide any further bearing for the lower operating roll. During idle running the upper operating roll should be held in loose contact with the upper supporting rolls when these are raised. This can be effected in various ways. For example, in the end surfaces of the

roll a' there are provided recesses e (Figure 4) in which are mounted center point bearings or auxiliary ball bearings f . The shaft n' of the bearing may be fixed to the block k' by means of bolts i .

15 To enable the withdrawing of the upper operating roll through the block k , a part of the frame is cut out and the shaft n is screwed to the part o . This part o is fixed to the block k by screws p and p' . After unscrewing the screw p the part o may

20 be swung outside and then around the screw p' into the position indicated in Fig. 5 by dotted lines whereupon roll a' may be withdrawn. In order to prevent lateral movement of the operating rolls a, a' the ball bearings f may be constructed so as to form at the same time axial thrust bearings

25 (Figure 4), the pivotless operating rolls having in their axial direction a certain clearance between these thrust bearings so that the end surfaces of the recesses e of the operating rolls only come into

30 contact with the thrust bearings when the operating roll tends to move laterally.

Another arrangement for holding the upper operating roll in contact with the supporting rolls consists, for example, in mounting in the upper

25 framework at both ends of the operating roll a' at the right and left hand thereof, small trailing rolls d and d' (Figure 3) which may be fixed upon rods u connected by springs v, v' (Figure 2) to joints m and m' and being capable of being bent

30 outwardly for the purpose of enabling the operating roll to be changed.

The driving mechanism consists of a motor E driving, for instance, the gear 2 which meshes with a pair of gear 1 and the gearing roll 3, meshing with a pair of gear 4. The pairs of gearing

35 rolls 1 and 4 are coupled with the supporting rolls b, b' and c, c' by coupling devices q and q' . In addition to the low cost of these simple operating rolls, a rolling mill according to the invention also

40 has a further and very important advantage, namely that the operating rolls (which substantially solely are liable to wear, whereas the supporting rolls are hardly exposed to any wear) can be exchanged in less than five minutes.

Should it be desirable in exceptional cases to operate, instead of employing driven supporting rolls as described, in the manner hitherto usual with six roll rolling mills, that means with driven operating rolls, the coupling devices q and q' between the supporting rolls b, b' and c, c' and the corresponding pairs of gearing rolls 1 and 4 for effecting the drive of the supporting rolls are simply removed. The pivotless plain cylindrical operating roll may then be replaced by operating

55 rolls provided with pivots. These can be driven directly by the provision of coupling devices between the gearing rolls 2 and 3 and the operating rolls. By this construction allowing to change pivotless operating rolls and operating rolls provided with pivots it becomes possible to carry out the greatest part of the rolling work, for instance,

60 $\frac{1}{10}$ of the total work in the new manner with pivotless operating rolls while only $\frac{1}{10}$ of the total work may be carried out if necessary, with operating rolls provided with pivots.

Another modification of the subject of the invention is obtained by replacing the solid pivotless operating rolls as shown in Figures 3-5 by hollow cylinders, serving as pivotless operating rolls which are simply loosely fitted on driving shafts as shown in Figures 6 and 7. There is no need to machine the internal bores accurately and the rolls shall not fit closely on the driving shafts as the guiding and supporting

75 thereof is solely effected by the supporting rolls.

In Figure 6 the motor E' drives the gearing 2 which meshes with the gearing 3. The shafts of the gearings 2 and 3 are coupled by the coupling devices Q and Q' , driving the shafts r and r' connected with the hollow rolls. These driving shafts r and r' and the hollow operating rolls A and A' may be coupled together by any suitable coupling device, for instance bolts s fixed to the shafts r and r' . Corresponding to these bolts the ends of the rolls A and A' are grooved at t . The more movable the hollow rolls remain relatively to the driving shafts the less the driving shocks and spindle vibrations will be capable of acting on the material which is being rolled so that a simplified driving train is sufficient. It has been previously proposed to mount rolls with square holes fitting exactly on square or non-circular shafts. This arrangement does not, however, lead to any reduction in expense as the production or formation of non-circular holes causes considerable expenses whereas hollow rolls with non-machined bores cost only one-third to one-fifth of corresponding rolls provided with pivots. The proposal referred to above was in respect of two roll rolling mills so that a complicated and expensive mounting of the pivotless rolls would be necessary, as well as an exact coincidence of the axis of the surface of the roll with the axis of the hole. The use of hollow rolls fitting only loosely on the shafts has the further advantage that the rolls can be exchanged in a fraction of the time required for changing pivoted rolls. In the selected constructional example it is only necessary to release the nuts w (Fig. 6) whereupon the hollow rolls which are loosely mounted on the driving shafts can be stripped off by two grasps. The securing of the rolls on the driving shafts can be effected in various ways and it is only necessary to provide for rapid detachability.

It may also be mentioned that the hollow rolls are only slightly liable to defect when hardening and acquire a better hardness. A simplification of the constructional arrangement of the rolling mill itself is also obtained by using hollow rolls, as in many cases coupling spindles and coupling sleeves may be omitted as the rolls loosely mounted on the driving shafts already possess sufficient resiliency which must otherwise be obtained by the interposition of coupling sleeves.

For smaller or lighter rolling mills the driving shafts may be made somewhat longer and thinner so that they can bend directly. Such a device is illustrated in Figure 7 wherein A again indicates a hollow operating roll, s a coupling or lost-motion device consisting of a slot in the roll A and a pin in the shaft R and R a comparatively long and thin driving shaft.

An essential improvement in the rolling industry is obtained when using pivotless operating rolls in six roll rolling mills as only a comparatively short time is required for exchanging the rolls. This circumstance is of particular importance when it is desired to roll in the rolling mill a material which has very different degrees of hardness, that is to say that the material to be rolled alternately consists of different materials or by reason of previous annealing has acquired different degrees of hardness. In such cases it is desirable for each material to be rolled or for each separate condition of the material to be rolled to use rolls having an arched surface (Fig. 8), that is to say having a longitudinal curvature deviating from a true cylindrical

der, which corresponds with the actual hardness of the material under consideration. Hitherto an exchange of rolls between two successive operations was too tedious and the rolls provided with pivots were too expensive to permit of a frequent exchange of the rolls. When using pivotless rolls consisting of solid or hollow cylinders it is directly possible to effect two directly succeeding rolling operations with rolls of different longitudinal curvature. It is well known that incorrect or unsuitable longitudinal curvature is the cause of the greatest portion of the scrap and waste occurring during cold rolling. In spite of this it was not possible to utilize this knowledge hitherto as the exchange of rolls lasted too long and the high cost of rolls provided with pivots prevented the keeping in stock of a large number of rolls of different longitudinal curvature. The present invention enables the rolls to be exchanged within a few seconds and to use the roll having the desired longitudinal curvature when passing from the first to the second and third operations after annealing or when passing from one kind of material to another with a different hardness or from one thickness of material to another thickness.

In the above circumstance lies a further commercial improvement of great importance, which it has only been possible to render useful by the present invention.

Finally, it is also possible in the case of six roll rolling machines, wherein always the same work is to be carried out, to give the supporting rolls the desired longitudinal curvature (Figs. 8 and 9) whilst the pivotless operating rolls are made without longitudinal curvature as exact cylinders.

I claim:

1. A rolling mill comprising a housing with two pairs of supporting rolls, these rolls supporting two simple pivotless working-rolls of smaller diameter than the supporting rolls, the working-rolls consisting of hollow cylinders with unmachined inner surface and being put with some clearance on driving shafts entirely penetrating the hollow cylinders and bearing removable abutments at their ends, and loose couplings between the shafts and the hollow rolls to permit of a certain flexibility between the driving means and the hollow roll.

2. A rolling mill comprising a housing with two pairs of supporting rolls, these rolls supporting two simple pivotless working rolls of smaller diameter than the supporting rolls, the working rolls consisting of hollow cylinders with unmachined inner surface, and further comprising driving shafts entirely penetrating the hollow cylinders and bearing removable abutments at their ends on which the said working-rolls are put with some clearance, and a lost-motion device for coupling the said hollow working-rolls to said driving shafts.

3. A rolling mill comprising a housing supporting two pairs of rolls, these rolls supporting two simple pivotless working-rolls of smaller diameter than the supporting rolls, the working-rolls consisting of hollow cylinders with unmachined inner surface, driving shafts entirely penetrating the hollow cylinders and bearing removable abutments at their ends on which the said operating rolls are mounted loosely, the driving shafts being so long and thin, that they are capable of substantial bending.

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75	150