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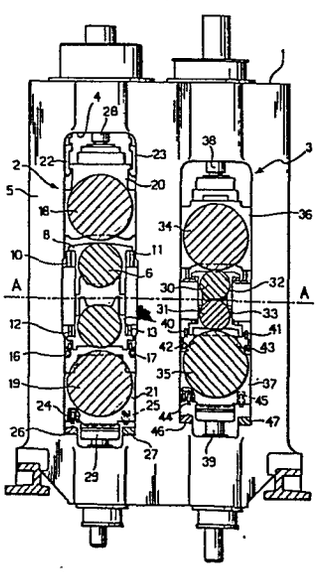
(54) Limited-capacity reversible rolling mill, particularly for the hot-rolling of special steels and non-ferrous metals.

(57) A reversible hot-rolling mill is described which is constituted essentially by a rolling stand (1) including a roughing unit (2) and a finishing unit (3) arranged in line, the work-rolls (6, 7; 30, 31) of these units (2,3) being displaceable between an operative position and an inoperative position spaced from the rolling line (A) of the rolling stand (1). The rolling mill is particularly suitable for the hot-rolling of special steels and non-ferrous metals.

FIG. 1



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Limited-capacity reversible rolling mill, particularly for the hot-rolling of special steels and non-ferrous metals

The present invention relates to a reversible rolling mill particularly, but not exclusively, for the hot-rolling of special steels and non-ferrous metals.

It is known that, in hot-rolling processes, the metal is subjected to multiple passes between the work-rolls of one or more rolling stands until it is transformed into a product having the desired form and dimensions.

It is also known that, when the metal to be rolled is a special steel, such as, for example, stainless steel, silicone steel, and the like, or a non-ferrous metal, a reversible rolling mill of reduced capacity is widely and advantageously utilised because there is only a limited demand for rolled products of such materials.

A rolling mill of this type is essentially constituted by two reversible rolling stands, one having roughing rolls (roughing stand) and one having finishing rolls (finishing stand), which can be arranged in line or side-by-side. In the aligned arrangement, the two rolling stands are separated by a material conveyor, usually formed by a roller table, which has a length greater than the length of the material leaving the roughing stand. In the side-by-side arrangement of the rolling stands, the rolling mill is equipped with transverse conveyors for transferring the material coming from the roughing stand to the working plane of the finishing stand.

The reversible rolling mills of the type considered have significant technical disadvantages which have not yet been overcome. Thus, for example, the necessity of having conveyors of considerable length (roller tables) both aligned with and transverse the rolling stands, as well as the equally considerable dimensions of the system, entails a significant cooling of the material while it is on the conveyors between the roughing

and finishing stands. Consequently, bearing in mind that the rolling must be completed while the material is still at a temperature lying within a well-defined range of admissible temperatures, it has been necessary to equip the rolling mill with furnace winders positioned upstream and downstream of the finishing stand. To reduce the heat loss in rolling mills with aligned stands, it has been proposed that the intermediate conveyor be of reasonably reduced length. Consequently, the starting material, for example, a bloom, must be rolled on the reversible roughing stand to a thickness such that the length of the rough billet is still less than the distance between the rolling stands. The cooling of the intermediate billet (or intermediate product) and its limited length define the maximum dimensions of the starting bloom (thickness and length) and, consequently, the maximum elongation which can be effected on the reducer stand. Generally, the rolling time on the finishing stand is very much longer than on the roughing stand, so that the roughing stand is only partially utilised.

The problem behind the present invention is that of devising and providing a reversible hot-rolling mill having structural and functional characteristics which will completely overcome the disadvantages of the prior art discussed above.

This problem is resolved, in accordance with the invention, by a reversible rolling mill for the hot-rolling of special steels or non-ferrous metals, which is characterised by the fact that it includes a rolling stand supporting a roughing unit and a finishing unit arranged in line, each unit including two work-rolls and actuator members for displacing the rolls in the rolling stand from an operative position to an inoperative position spaced from the rolling line of the rolling stand.

In the inoperative position, the working rolls of the

roughing and finishing units may be lowered completely below the rolling line, or raised completely above it. In a preferred embodiment, the work-rolls of the roughing and finishing units are open in the inoperative position, that is to say, spaced apart on opposite respective sides of the rolling line of the rolling stand by respective distances such that they allow the free passage of the material to be rolled through the rolling stand.

In addition to the work-rolls, each of roughing and finishing units may, of course, include one or more back-up rolls arranged in any known configuration.

The main advantage of the rolling mill of this invention is due fundamentally to the elimination of the conveyor between the roughing and finishing units, which has been absolutely necessary until now. Consequently, the costs of the installation are reduced and savings are gained on the movement of the material with an implicit saving of time in the working cycle, but above all the loss of heat and associated cooling of the material is reduced in a considerable and substantial manner.

Further characteristics and advantages of the invention will become clearer from the detailed description of an embodiment of a reversible hot rolling mill according to the invention, which follows, by way of non-limiting example, with reference to the attached drawings in which:

Figure 1 shows schematically a rolling mill according to the invention, and

Figures 2 and 3 show schematically a roughing or finishing unit in an operative position and an inoperative position respectively.

With reference to the drawings, a reversible rolling mill according to this invention is constituted essentially by a rolling stand 1 which supports a roughing unit 2 and a finishing unit 3 in line with one

another. The rolling line of the rolling stand 1 is indicated by A.

The roughing unit 2 is of the so-called "four-high" type and includes two work-rolls 6, 7 which are supported in a conventional manner with associated roll chocks 8, 9 in the opening 4 of a support housing 5 of conventional type. The roll chocks 8, 9 are subjected to the action of respective back up rolls and equilizing actuators, of which only the vertical rods 10, 11 and 12, 13 respectively, are shown in the Figures. The bearing block 9 is also provided with wheels 14, 15 for engagement on support rails 16, 17 carried by the housing 5.

There are two back-up rolls 18, 19 respectively, having respective roll chocks 20, 21. The roll chock 20 is supported and equalized from above by means of conventional hydraulically-operated devices represented schematically by hook members 22, 23. The roll chock 21 is provided with wheels 24, 25 for engagement with respective supporting guide rails 26, 27 carried by the housing 5.

In Figure 2, the roughing unit 2 is shown in a working condition, that is, with the work-rolls 6, 7 close to one another and maintained at a rolling distance by actuator devices, schematically indicated 28, 29, positioned respectively in the upper part and the lower part of the housing 5. These devices 28, 29 may be of any conventional type, for example, interrupted screws, hydraulic cylinders, wedges, eccentrics or any combination of these.

In Figure 1, the roughing unit 2 is shown in its inoperative condition. In this position, the work-rolls 6, 7 are spaced from one another by a predetermined distance on each side of the rolling line A so as to allow the material in the roughing stage to pass without interference. In particular, to achieve this inoperative position, the work-roll 7 and its associated

back-up roll 19 are lowered simultaneously by means of the adjustment device 29. This simultaneous lowering continues until the roll chock 9 of the work-roll 7 abuts the rails 16, 17 by which it is stopped positively. From this point, it is advantageous to continue the lowering of the back-up roll 19 and the associated roll chock 21 until the back-up roll 19 is spaced by a predetermined distance Z_1 from the corresponding work-roll 7.

An identical operation is carried out for the upper work-roll 6 and its associated back-up roll 18. The raising of these rolls is effected by means of the adjustment device 28 which acts on the roll chocks 20, 8 by operation of the equalizing devices 22, 23 and 10, 11 respectively. Moreover, in this case, the raising of the rolls 6, 18 is effected in a "differential" manner so that, at the maximum displacement, the back-up roll 18 is spaced by a predetermined distance Z_2 from the corresponding work-roll 6.

The finishing unit 3, which is shown in the working position in Figure 1, is constructed in exactly the same way to the roughing unit 2. In fact, the finishing unit 3 includes a pair of work-rolls 30, 31 with respective roll chocks 32, 33, and a pair of back-up rolls comprising an upper roll 34 and a lower roll 35 each with associated roll chock 36, 37. These rolls are displaceable relative to the rolling line A by means, for example, of upper and lower interrupted screws 38, 39 and hydraulic equalizing devices of which only a pair of vertical rods are shown.

The roll chocks 33, 37 of the lower rolls 31, 35 are provided respectively with wheels 40, 41 and 44, 45 for resting on corresponding guide rails 42, 43 and 46, 47.

In Figure 3, the finishing unit is shown in an inoperative position which can be achieved in an identical manner to that described in respect of the

roughing unit 2. It should be noted that the arrangement of the rolls of each of the units in the inoperative condition is particularly advantageous when the working rolls 6, 7 and 30, 31 are controlled by a single drive. In fact, upon reversal of the direction (the rolling mill being of the reversible type), only the driven work-rolls rotate, while the corresponding back-up rolls remains stationary. Consequently, the inertia of the rotating parts of the unit which do not take part in the rolling is considerably reduced.

The rails 16, 17 and 42, 43 are already used in rolling stands to allow the removal and replacement of the work-rolls. It is advantageous,therefore, to use these rails as positive stops against the downward displacement of the lower work-roll when it is carried to its inoperative position. It must be understood, however, that for particular working requirements the rails can be replaced by proper abutment stops fixed rigidly to the support structure, or mounted adjustably with respect thereto by means which are themselves conventional.

Moreover, it should be understood that, although the particular solution described above is the preferred one with respect to the arrangement of the rolls in the inoperative condition (the back-up rolls being spaced from the respective work-rolls which are, in turn, spaced apart on opposite respective sides of the rolling axis A), this inoperative arrangement could be achieved by displacing both the work-rolls beneath the rolling axis or above it, provided only that they are always at a distance from the axis A such as to allow the free passage of the material rolled by whichever of the roughing unit or the finishing unit has its rolls in the operative position.

CLAIMS:

1. A reversible rolling mill of limited capacity, particularly but not exclusively for the hot-rolling of special steels and non-ferrous metals, characterised in that it includes a rolling stand (1) supporting a roughing unit (2) and a finishing unit (3) arranged in line, each unit (2,3) including two work-rolls (6,7;30,31) and actuator members (28,29; 38,39) for displacing the rolls (6,7;30,31) in the rolling stand (1) between an operative position and an inoperative position spaced from the rolling line (A) of the rolling stand (1).

2. A reversible rolling mill according to Claim 1, characterised in that, in the inoperative position, the work-rolls (6,7;30,31) are spaced apart by predetermined distances on opposite respective sides of the rolling line (A).

3. A reversible rolling mill according to Claim 2, characterised in that the work-rolls (6,7;30,31) of the roughing unit (2) and the finishing unit (3) are operated by a single drive.

4. A reversible rolling mill according to Claim 3, characterised in that at least one of the work-rolls (6,7;30,31) has associated therewith at least one back-up roll (18,19;34,35) which, in its inoperative position, is spaced by a predetermined distance from the work-roll (6,7;30,31).

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FIG. 1

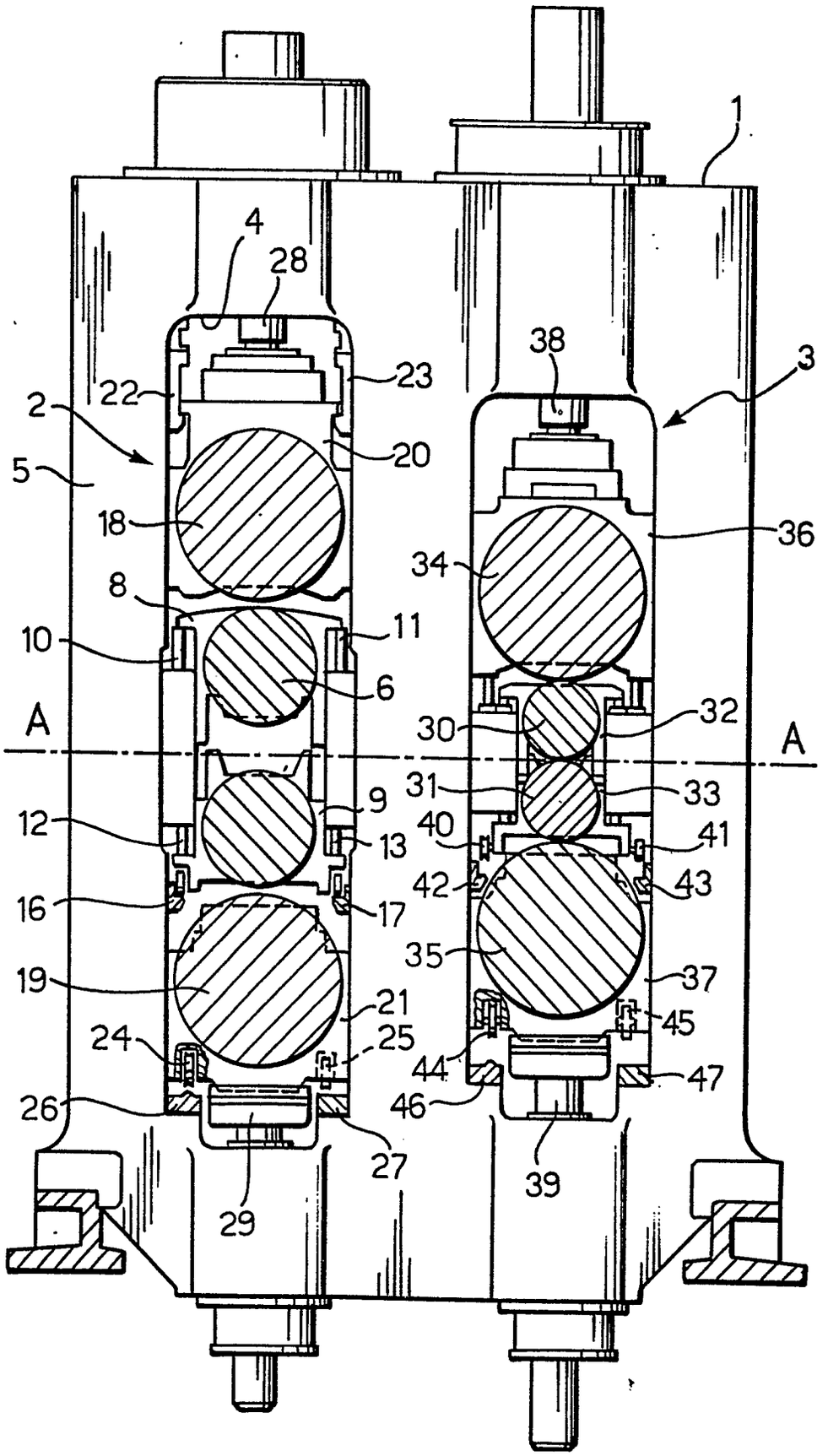
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FIG. 2

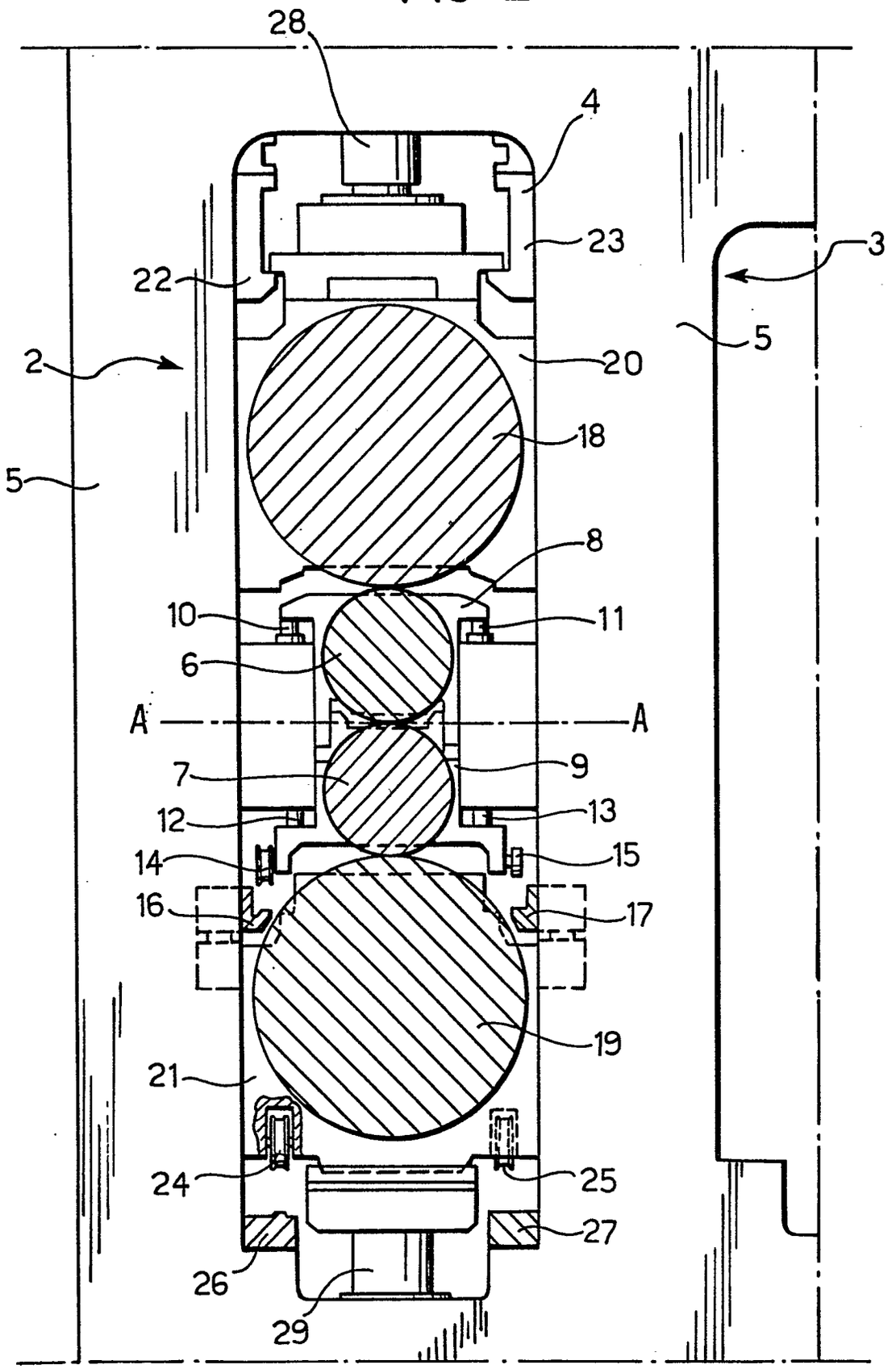
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FIG. 3