April 15, 1969 D. A. L. ELTON 3,438,235

PRE-STRESSED ROLLING MILL

Filed Sept. 15, 1966 Sheet 1 of 4

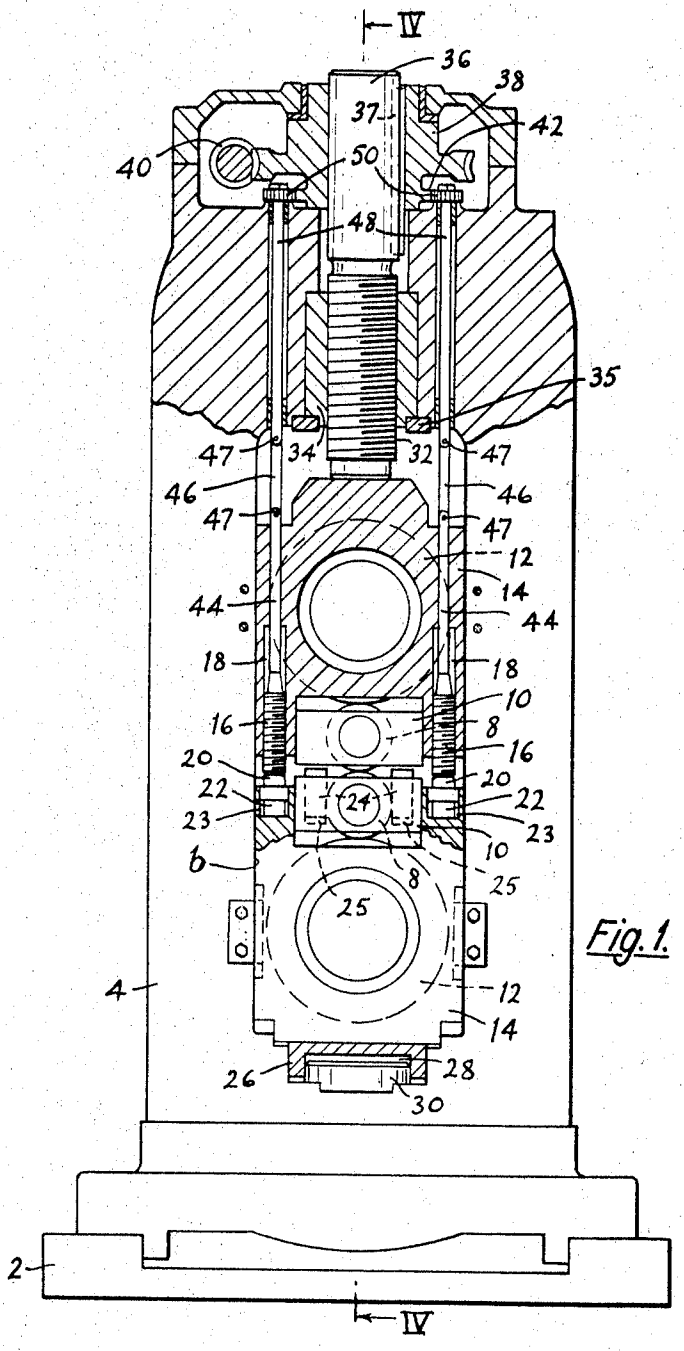

Fig. 1.

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April 15, 1969 D. A. L. ELTON 3,438,235

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Filed Sept. 15, 1966 Sheet 2 of 4

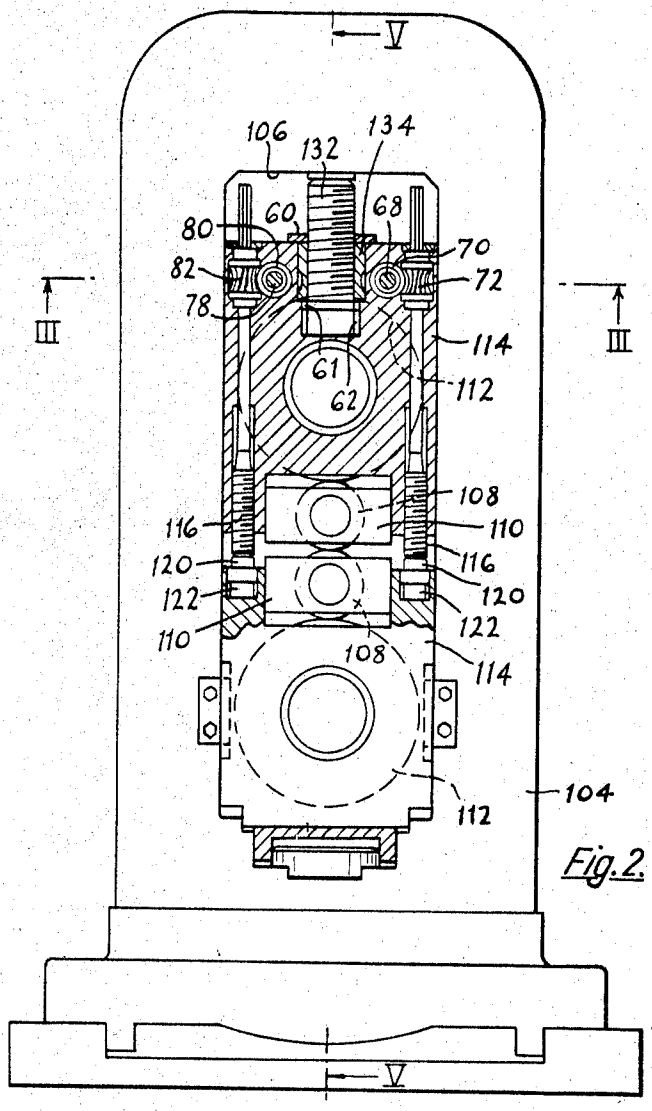

Fig. 2.

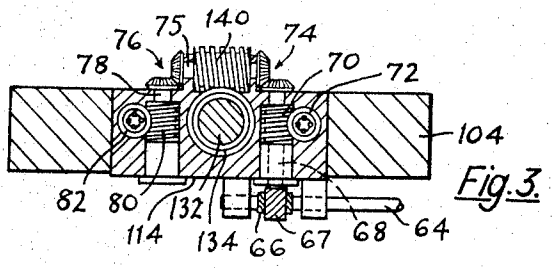

Fig. 3.

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April 15, 1969 D. A. L. ELTON 3,438,235

PRE-STRESSED ROLLING MILL

Filed Sept. 15, 1966 Sheet 3 of 4

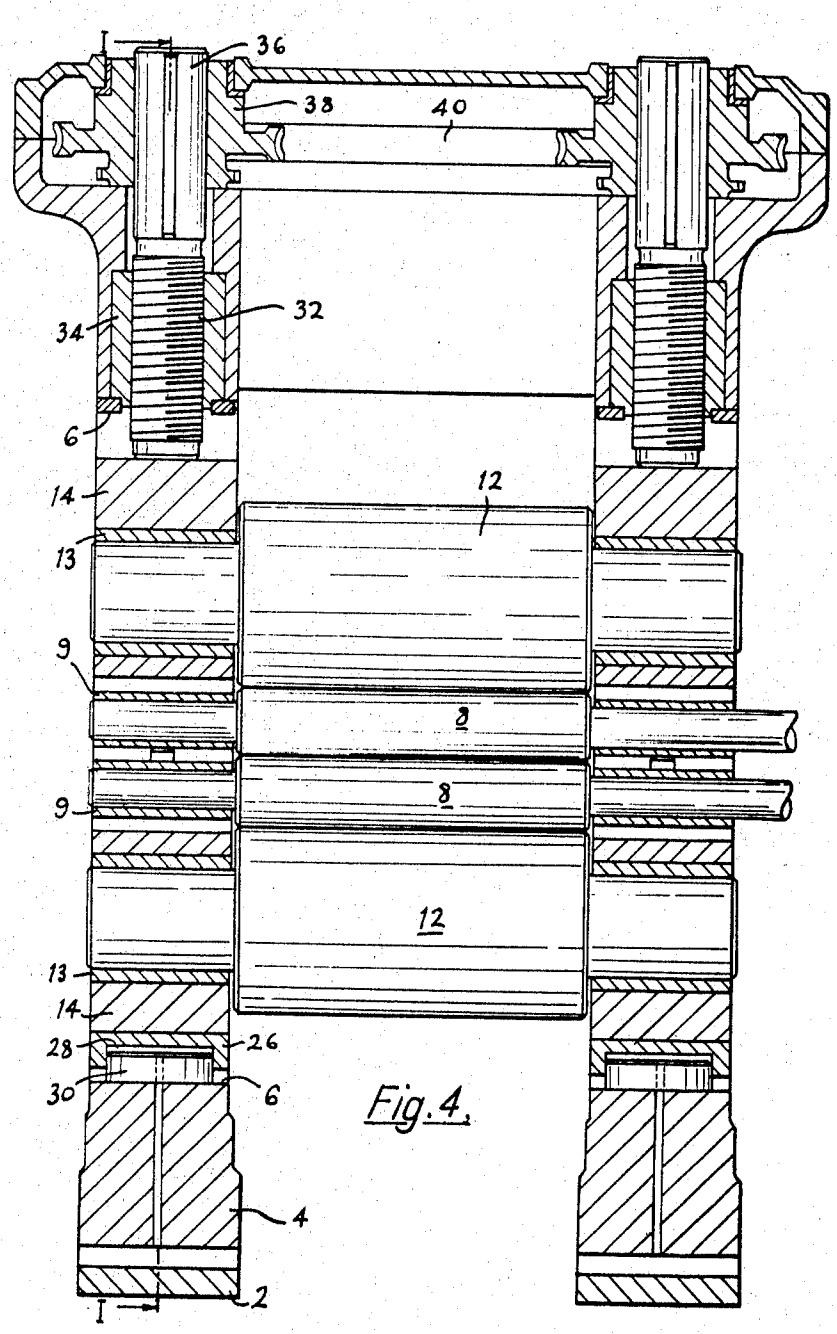

Fig. 4.

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April 15, 1969 D. A. L. ELTON 3,438,235

PRE-STRESSED ROLLING MILL

Filed Sept. 15, 1966 Sheet 4 of 4

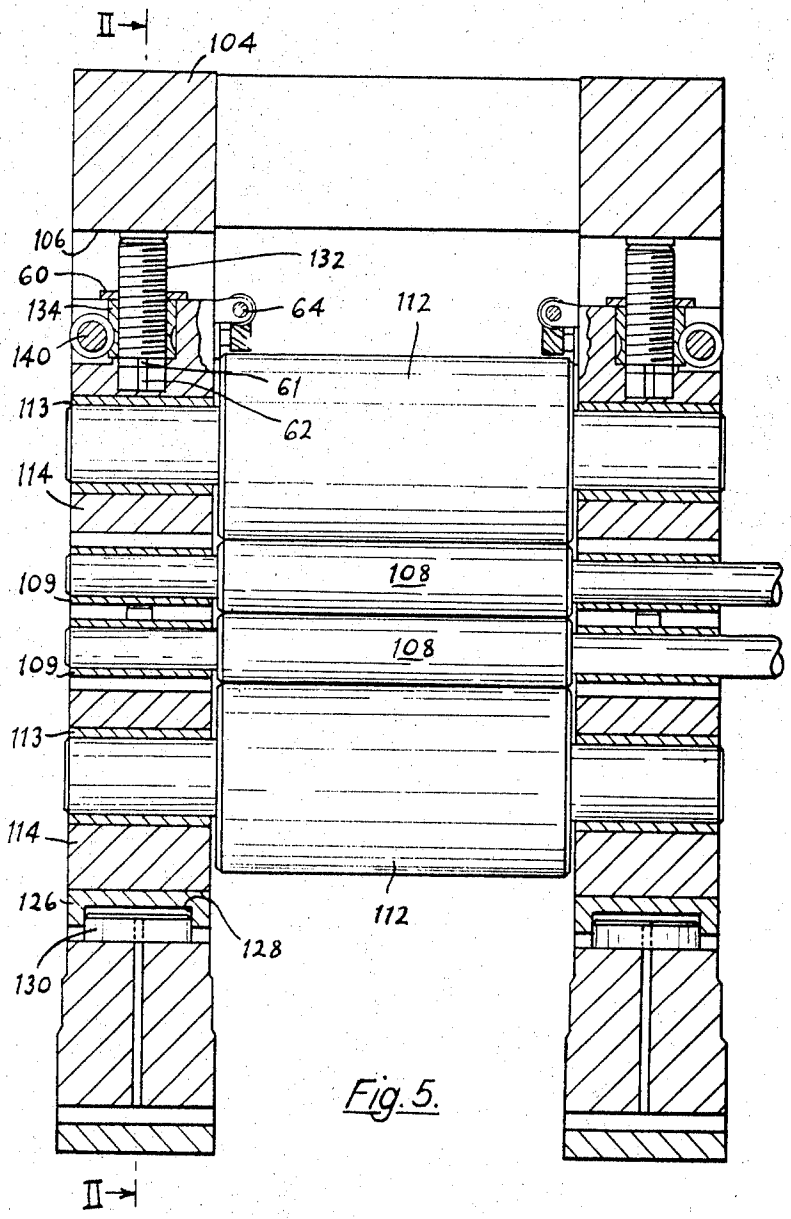

Fig. 5.

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PRE-STRESSED ROLLING MILL

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Int. Cl. B21b *31/20, 31/24*
U.S. Cl. 72—240 4 Claims

ABSTRACT OF THE DISCLOSURE

A rolling mill having screwdown means arranged between the mill housings and the chocks of a roll for the adjustment of the pass-opening between said roll and another roll, spacing means projecting into the chocks and resting on the chocks of another roll, a drive for said screwdown means, and movement-reversing means operatively associated between said screwdown means and said spacing means whereby the chocks of the first roll and the spacing means are displaced by the same distance but in opposite directions.

This invention relates to rolling mills in which the roll-bearing chocks of one of two superposed rolls are supported on the bearing chocks of the other roll by spacing means. The spacing means may be arranged between the chocks of either the working rolls or the back-up rolls of the mill, if provided, and they may be adjustable so that the distance between these rolls, and thereby the roll-pass opening, can be varied.

In one mill of this type, the spacing means between the rolls chocks are formed by relatively slender screw spindles threaded at one end into the chocks of a mill roll and resting with their other ends on the chocks of another roll, with the roll-pass opening between both rolls. A rotary drive is provided for the spindles, whereby the chocks of the first roll can be lifted or lowered as required when the setting of the roll-pass opening has to be changed. This design has been adopted for rolling mills whose housings are pre-stressed, e.g., by hydraulic means.

It has been found that in such mills, the pre-set roll-pass opening can be kept constant throughout rolling and a rolled article of uniform thickness produced only if the adverse influence of elastic deformations which are bound to occur during rolling in the rolls and in their chocks are eliminated or at least greatly reduced. To this end, the load on the spacing means during rolling is measured by load-meters, and the output of these load-meters fed into electric control circuits which vary the pre-stressing force in such a manner that the desired result is obtained, as described in the British Patent No. 955,124, the load-meters there being formed by cells which are in contact with screw spindles acting as spacing means for the chocks. It is essential for exact measurement of the loads and effective control of the pre-stressing force that close contact be maintained between the spindles and the load-meters throughout rolling.

It is an object of the present invention to provide a rolling mill which is equipped with conventional screwdown means for the adjustment of the roll-pass opening, and also with the afore-described arrangement of chock-spacing means, so that load-meters may be used in the manner described above for the control of a pre-stressing force.

According to the present invention, a rolling mill having screwdown means arranged between the mill housings and the chocks of a roll for the adjustment of the pass-opening between said roll and another roll, spacing means in the form of screw spindles threaded into these chocks and resting on the chocks of the other roll, and a drive for said screwdown means, is provided with movement-reversing means between the screwdown means and said spacing means, whereby the chocks of the first roll and these spacing means are displaced by the same distance but in opposite directions, so that the spacing means remain stationary relative to the chocks of the second roll during displacement of the chocks of the first roll by the screwdown means. Thus, in the case of load-meters being placed between said spindles and the chocks of said second roll, the contact between the spindles forming the chock-spacing means and the load-meters will not be affected in any way by the displacement of the chocks of the first roll during adjustment of the roll-pass opening.

The mill according to the invention may be provided with pre-stressing means for the housings and the pre-stressing force be controlled by the load-meters so as to eliminate or greatly reduce the adverse influence of elastic deformations of the chocks or rolls on the setting of the roll-pass opening as described in the British Patent No. 955,164.

In a preferred embodiment of the invention, the screwdown means and the chock-spacing means are drivably connected to each other by a set of reversing gears which, upon the chocks of the first roll being lowered by the screwdown means, raises the spindles relative to said chocks by the same distance, and vice versa, so that the position of the spindles in space remains unaltered.

The screwdown means may be of any known design and may consist of heavy rotary spindles threaded into the housings and resting on the top of an upper or the bottom of a lower roll. Alternatively, the spindles may be screwed into wedges acting on the chocks, so that upon rotation of the spindles, the chocks are lifted or lowered. In either case, the setting of the roll-pass opening is effected by the spindles of the screwdown means.

The screwdown means and the chock-spacing means may be driven by the same motor or motors and a reduction gear provided between the motor or motors and either means. The reversing gear provided according to the invention may then be combined with that reduction gear.

Alternatively, the screwdown means and the spacing means may be driven from separate motors, the motors being automatically controlled so that they start and stop simultaneously, the drives of the motors being so laid out that the chocks and spacing means are moved by the same distance, but in opposite directions.

The mill according to the invention may have either working rolls only or working rolls supported by back-up rolls, and the screwdown means and the spacing means may accordingly act either on the chocks of working rolls or of the back-up rolls.

Several embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a side elevation of a rolling mill according to the invention, partly in section, along the line I—I of FIG. 4.

FIG. 2 is a side elevation, again partly in section, along the line II—II of FIG. 5.

FIG. 3 is a section along line III—III of FIG. 2.

FIG. 4 is a section through the rolling mill of FIG. 1 along the line IV—IV of FIG. 1.

FIG. 5 is a section through the rolling mill of FIG. 2 along the line V—V of FIG. 2.

The rolling mill shown in FIGS. 1 and 4 comprises a base 2 and two housings 4, of which only one is shown,

each housing having a window **6**. Two roll-assemblies are mounted in the housings, each assembly comprising a working roll **8** mounted at its end in bearings **9** supported in chocks **10**, and a backing roll **12** mounted at its ends in bearings **13** supported in chocks **14**. The upper chocks **14** are spaced apart from the lower chocks **14** by supports **16** in the form of screw spindles threaded into recesses **18** formed in the lower part of each of the upper chocks **14**, the lower ends of the supports abutting against pressure pads **20**. A load meter **22** in the form of a load cell is inserted between each pressure pad and the top of the lower chocks **14**. The pads and the load meters are accommodated together in recesses **23** formed in the upper part of the lower chocks **14**. Plungers **24** displaceable in hydraulic cylinders **25** are arranged between the chocks **10** of the upper working roll and those of the lower working roll whereby these two rolls are maintained in contact with their respective backing rolls **12**.

Each of the lower chocks **14** is mounted on a thrust block **26** in which a hydraulic cylinder **28** is formed, the cylinders being displaceable over rams **30** secured to the lower wall of the windows **6**. The pressure of the hydraulic fluid in the cylinders **28** acts both on the upper and the lower parts of the housings **4**, whereby the latter are pre-stressed.

The mill so far described is similar to that of British Patent 955,164, the output of the load meters **22** being utilised for controlling the pre-stressing forces in such a manner that the load taken by the supports **16** remains constant during a rolling operation. However, whereas in the mill according to the above-mentioned patent adjustment of the roll-pass opening is effected exclusively by the screw spindles which act as supports for the upper roll assembly, no other roll-pass adjusting means being provided in the earlier mill, the rolling mill according to FIGS. 1 and 4 of the present invention is provided with roll-pass adjusting means in the form of screwdown spindles which pass through the upper parts of the housings **4** and bear with their lower ends against the upper chocks **14**. Each spindle **32** is threaded into a bush **34** secured to a housing **4**, for instance, by a retaining ring **35**. The spindle **32** has further a smooth upward extension **36** which is slidably keyed at **37** to a worm wheel **38**. The latter is driven by a worm **40** from a motor, not shown.

As will be clear from the foregoing, the upwardly directed pressure produced in the hydraulic cylinders **28** is taken partly by the spindles **16** and partly by the roll-assemblies **10**, **12**, the two pressure components being transmitted to the upper chocks **14** and from there through the spindles **32** to the upper parts of the housing **4**. During a rolling operation, the load on the spindles **16** is therefore the difference between the pre-stressing force and the roll-separating force, as is also the case with the rolling mill according to British Patent No. 966,164.

In the rolling mill according to FIGS. 1 and 4, the adjustment of the roll-pass opening is effected in a well-known manner by the screwdown spindles **32** which lower or raise the upper chocks **14** by the required amounts. In order to maintain the spindles **16** in contact with the pads **20** during a rolling operation, irrespective of any adjustments of the roll-pass opening, the spindles **16** are raised relative to the upper chocks **14** by the same distance as that by which these chocks are moved towards the lower chocks **14**; conversely, the spindles **16** are lowered relative to the upper chocks **14** by the same distance as the latter chocks are moved away from the lower chocks **14**. To this end, the worms **40** are integral with or secured to spur gears **42** which are in mesh with pinions **50** provided on shafts **48** which extend freely from the upper parts of the housings **4** and are connected to upward extensions **44** of the spindles **16**. The connection is effected by means of links **46** pivoted to the shafts **48** and extensions **44** by pins **47**, whereby assembly and dismantling of the spindles **16** from the shafts **48** is facilitated.

The threads on the spindles **32** and **16** and the ratio of reduction of the gear drive between the two spindles are so selected that the spindles **16** move by the same distance relative to the upper chocks **14** as these chocks are displaced in the opposite direction by the spindles **32**. Thus, the spindles **16** remain stationary in space and the contact between the spindles **16** and the pressure pads **20** is not affected by the movement of the upper chocks **14**.

The rolling mill shown in FIGS. 2, 3 and 5 is to some extent identical with that of FIGS. 1 and 4, and corresponding parts have been marked in FIGS. 2, 3 and 5 with the same reference numbers as have been used in FIGS. 1 and 4, increased by "1––." The mill of FIGS. 2, 3 and 5 has accordingly two housings **104** with windows **106**, working rolls **108** with bearings **109** and chocks **110**, backing rolls **112** with bearings **113** and chocks **114**, supports **116** in the form of threaded spindles, pressure pads **120** and load cells **122**, all arranged as described with respect to the rolling mill of FIGS. 1 and 4. Screwdown spindles **132** are threaded into sleeves **134**, the latter being housed in recesses of the upper back-up chocks **114**. The sleeves are formed at their outsides with worm teeth for rotation by worms **140** (FIGS. 3 and 5) and are prevented from axial movement with respect to the upper chocks **114** by retaining rings **60**. Rotation of the screwdown spindles **132** is prevented by keys **61** which are slidable in grooves **62** in the upper chocks **114**. Rotation of the sleeves **134** will therefore cause vertical displacement of the spindles **132** and thereby also of the upper roll assembly.

As shown in FIG. 2, the spindles **132** abut against the upper ends of the windows **106**.

The drive of the spindles **132** is here combined with the drive for the spindles **116**, as will now be described in more detail with reference to FIG. 3. The horizontal shaft **64** supported on the upper part of upper chock **114** carries a helical gear wheel **66** which drives a pinion gear wheel **67** on a stub shaft **68**. A worm **70** mounted on shaft **68** drives a worm wheel **72** mounted on the upper extension of one of the spindles **116**. Rotation of shaft **68** is transmitted through bevel gears **74**, shaft **75** and bevel gears **76** to another stub shaft **78** which latter has a worm **80** driving a worm wheel **82** mounted on the upper extension of the other spindle **116**. Both spindles **116** can therefore move together.

The shaft **75** carries also the afore-mentioned worm **140** which drives sleeve **134**. The threads on the spindles **132** and **116** and their ratio of rotation is so selected that the spindles **116** move by the same amount relative to the upper chocks **114** as these chocks are displaced in the opposite direction by the spindles **132**. Here again, the spindles **116** will remain stationary in space irrespective of any movement of the upper chocks **114** for roll-pass adjustment purposes, so that the contact between the spindles **116** and the pads **120** remains unaffected.

In an alternative embodiment (not shown) the shaft **64** is extended as far as the second stub shaft **78** and provided with a further set of gear wheels for driving the second stub shaft. The worm **140** can then be arranged between the two sets of gear wheels. This makes the shaft **75** and the gear wheels **74**, **76** unnecessary.

The shaft **64** may be driven through articulated spindles (not shown) from an electric motor.

As will be clear from FIGS. 4 and 5, the arrangement shown in FIGS. 1, 2 and 3 is duplicated in respect of each housing. A separate motor may be provided for driving the screwdown spindles in each housing, and means may be provided for synchronizing the speed of each motor so that the spindles of both housings move by equal distances. For this purpose, the output shafts of both motors may be connected, if desired, by a clutch.

The provision of screwdown means makes it possible to displace the upper roll assembly relative to the lower roll assembly by any desired distance, so that the mill according to the invention can be used for reducing

relatively thick rolled articles, such as slabs or plates. At the same time, it is possible with the mill according to the invention to effect accurate control of the pre-stressing force as described in British Patent No. 955,164 and in British application No. 24519/63.

I claim:

1. A rolling mill having housings, rolls mounted in said housings, chocks for mounting said rolls in said housings, screwdown means arranged between said housings, and said chocks for the adjustment of the pass-opening between said rolls, spacing means in the form of screw spindles threaded into these chocks and resting on the chocks of the other roll, a drive for said screwdown means and movement-reversing means between said screwdown means and said spacing means, whereby the chocks of the first roll and these spacing means are displaced by the same distance but in opposite directions, so that the spacing means remain stationary relative to the chocks of the second roll during displacement of the chocks of the first roll by the screwdown means.

2. A rolling mill according to claim 1, in which the movement-reversing means consist of reversing gears which drivably connect to each other the screwdown means and the chock-spacing means and which upon the chocks of one of the mill rolls being lowered by the screwdown means relative to the chocks of another roll, raise the chock-spacing means relative to the chocks of the first roll by the same distance as these chocks have been lowered, and vice versa.

3. A rolling mill according to claim 2, in which the reversing gear is arranged between the screwdown means and the chock-spacing means and drivably connected to both.

4. A rolling mill according to claim 2, in which the reversing gear is drivably connected to a reduction gear arranged in the drive of the screwdown means.

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U.S. Cl. X.R.

72—248