March 18, 1969 A. I. WILSON 3,433,045

ROLLING MILL APPARATUS

Filed Feb. 1, 1966 Sheet 1 of 5

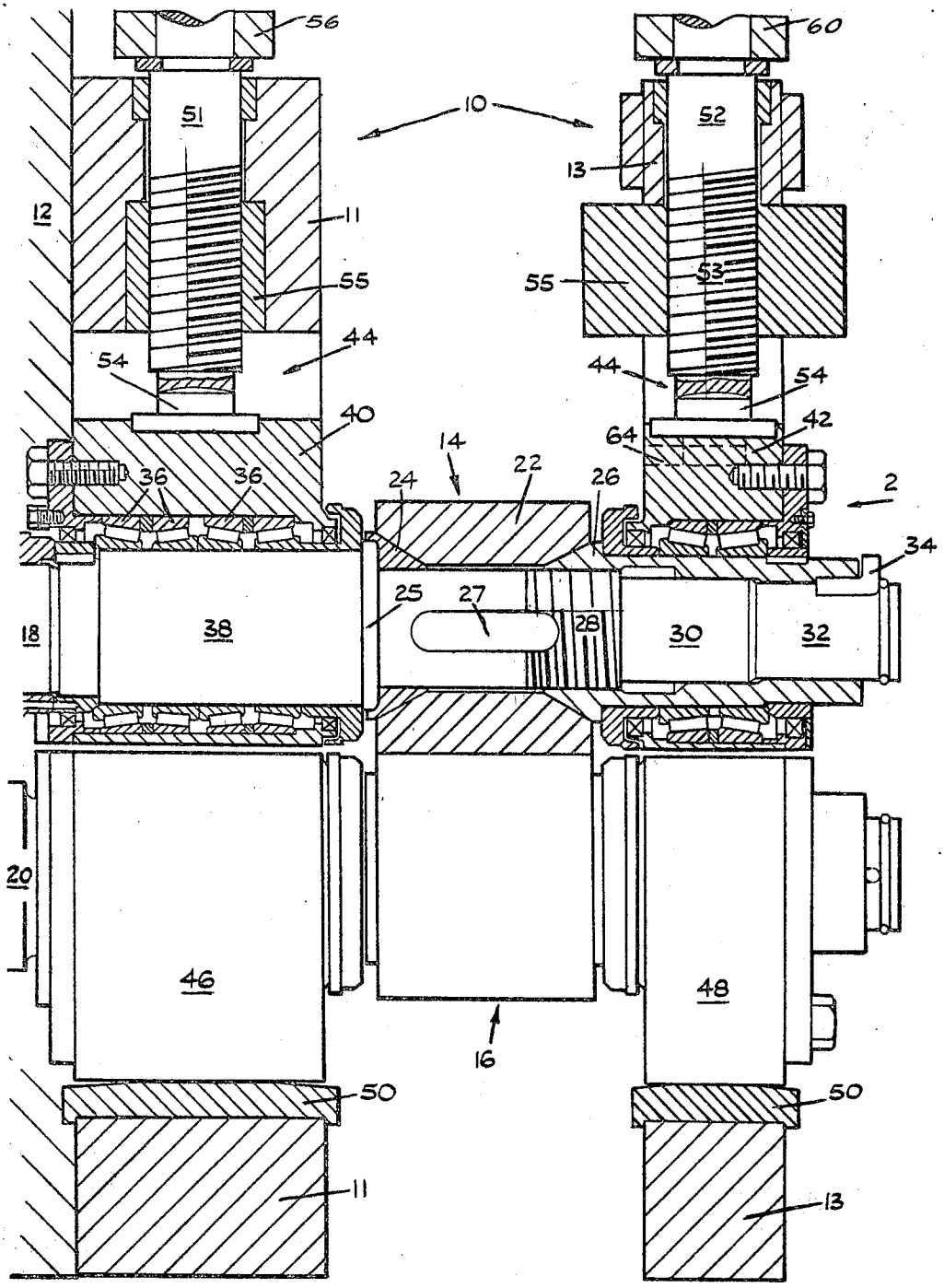

FIG. 1

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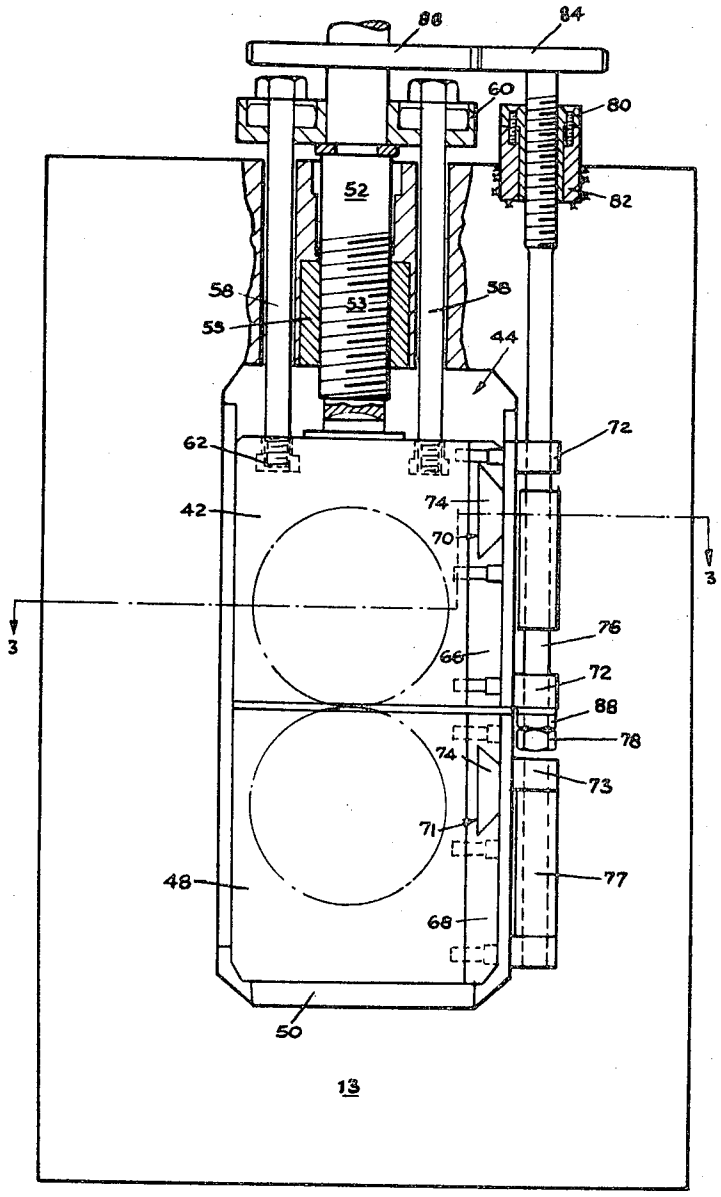

FIG. 2

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ROLLING MILL APPARATUS

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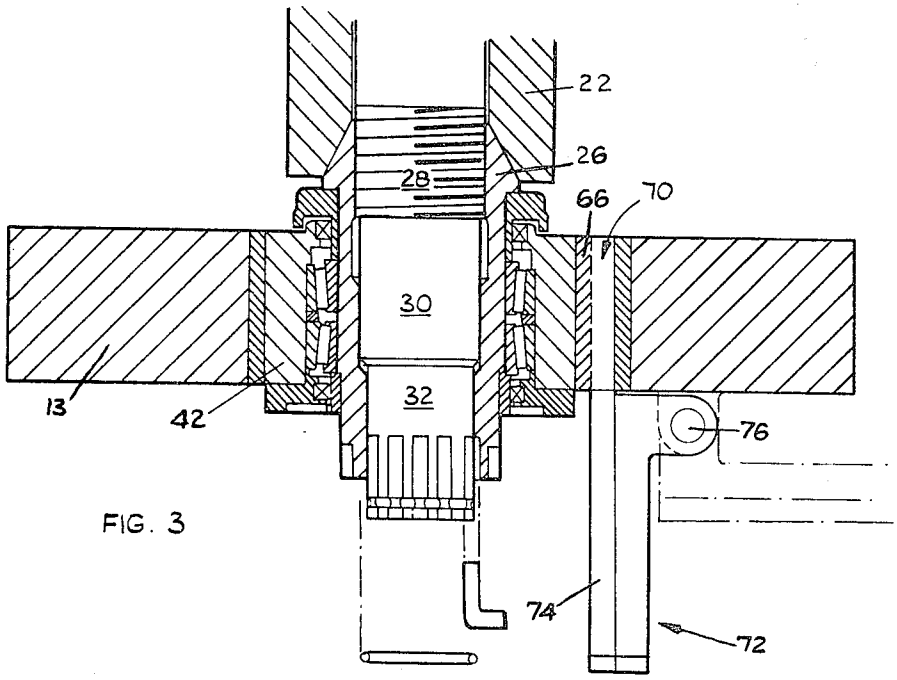

FIG. 3

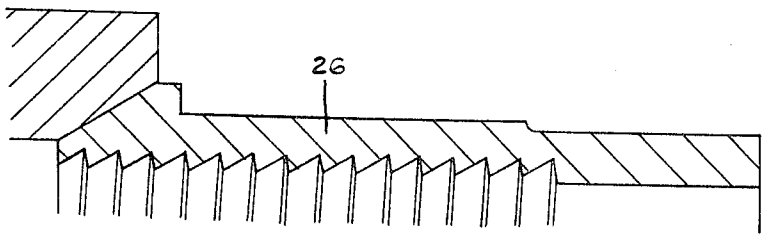

FIG. 7

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ROLLING MILL APPARATUS

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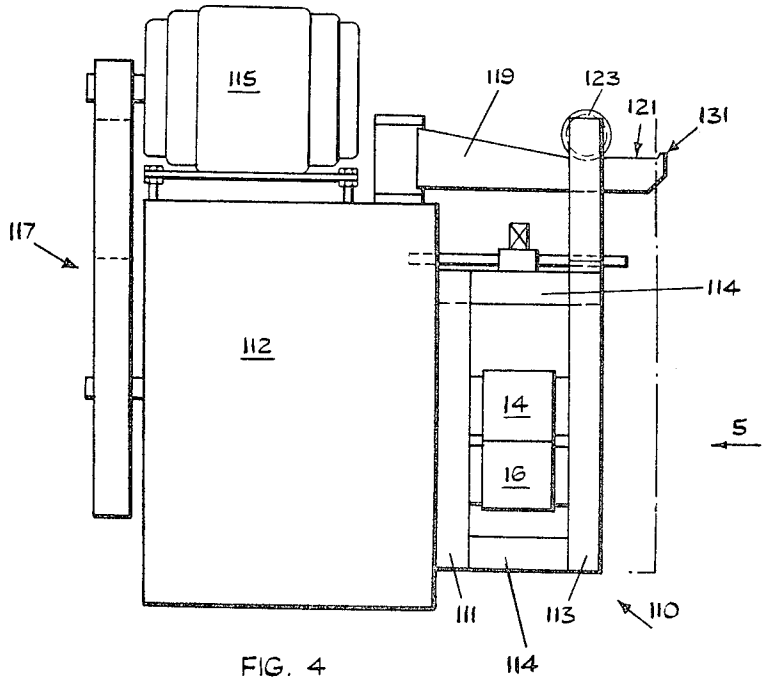

FIG. 4

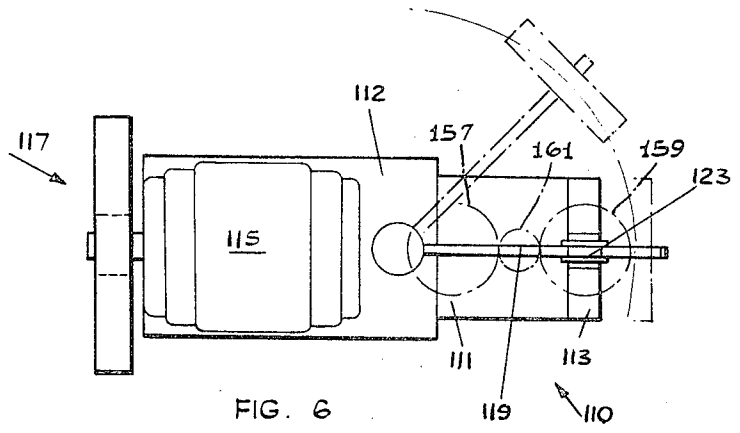

FIG. 6

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ROLLING MILL APPARATUS

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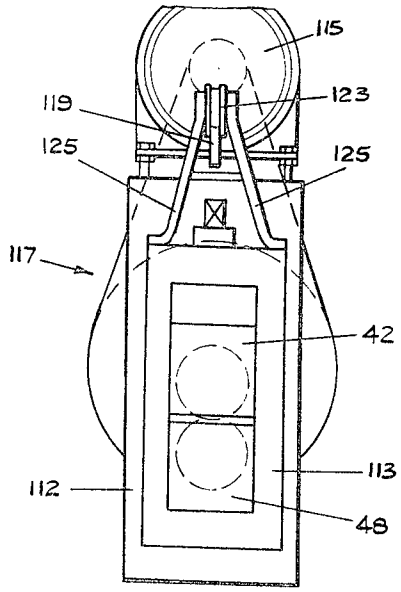

FIG. 5

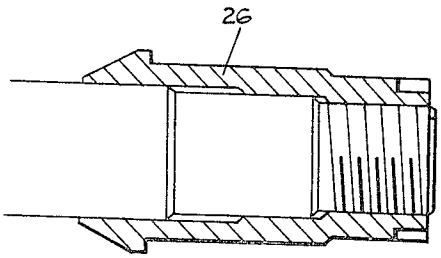

FIG. 8

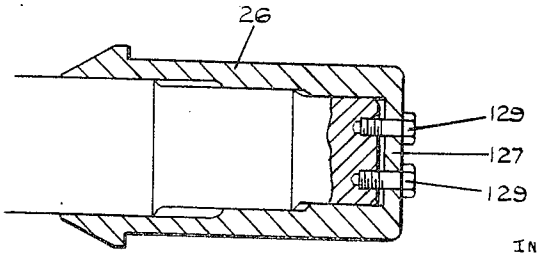

FIG. 9

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3,433,045

ROLLING MILL APPARATUS

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Claims priority, application Great Britain, Feb. 4, 1965, 4,907/65
U.S. Cl. 72—239 8 Claims
Int. Cl. B21b 31/10

ABSTRACT OF THE DISCLOSURE

The invention is concerned with rolling mills having at least two rolls. The rolls comprise sleeves mounted on intermediate portions of roll shafts. A bearing forming part of an end mounting is mounted on each roll shaft. One end mounting of each roll shaft is carried by a movable structure. That structure is movable axially of the roll shaft to enable the end mountings to clear the ends of the shafts. Means is provided to support the movable structure during such axial movement. And means is provided for moving the structure away from the ends of the shafts to enable the sleeves to be withdrawn from the shafts without having to remove the shafts themselves. This makes it possible very conveniently and very quickly to remove a roll sleeve and replace it by another, e.g., when the sleeve has become worn or, e.g., when it is desired to roll a product of a different shape or thickness.

The invention relates to rolling mill apparatus.

The object of the invention is to provide rolling mill apparatus in which shut-down time between different rolling operations is reduced to a minimum, that is to say, in which sleeves which constitute working lengths of the rolls can very easily and quickly be removed for replacement by new or alternative sleeves when worn or when it is desired to roll a different cross-section of rolling mill product.

According to the invention, rolling mill apparatus includes at least one pair of rolls mounted at their opposite ends in respective bearings, a working length of each roll between said bearings being surrounded by a sleeve which is removable from the roll, for replacement by a new or alternative sleeve, when it has become worn or when it is desired to roll a different cross-section of rolling mill product, one of the bearings being removable from the roll and at least a portion of associated structure carrying said bearings being movable to allow the sleeve to be removed from the roll without the necessity for said roll to be removed from the mill. The other of the bearings is preferably capable of supporting the roll during the replacement of the sleeve when said one of the bearings has been removed therefrom. Alternatively, means for supporting the roll when said one of the bearings has been removed may be constituted by a supplementary bearing encircling an extension of the roll at its end remote from the bearing which is removable, or may be constituted by an abutment member capable of acting downwardly on said extension to limit downward movement of the unsupported end of the roll. The bearing which is removable when the sleeve is to be replaced preferably encircles a portion of a clamping collar which abuts against the end of said sleeve so that when the clamping collar has been released from the roll said collar together with said bearing and structure in which the latter is mounted can be moved clear of the roll shaft simultaneously. The clamping collar is preferably provided with an internally screwthreaded length for engagement with a screwthreaded length of the roll shaft,

and the screwthread is preferably of special form, its opposite flanks having unlike angles of inclination. Preferably, also, the ends of the bore of the sleeve are flared for co-operation with a conical portion of the roll shaft (or a bush mounted thereon) and a conical nose portion of the clamping collar respectively. Preferably, the portion of the bearing mounting structure associated with the bearing which is removable from the roll is initially movable axially of the roll for a distance to ensure that the clamping collar can clear the end of the roll, and is then movable to one side or the other, preferably suspended from a hinged member. Said hinged member is preferably a guide rail on to which the removable structure carrying the clamping collar is slidable as the initial movement is effected. Alternatively, the portion of the structure which is removable is suspended from a jib pivotally connected to the apparatus and, to allow the initial axial movement, the movable structure is suspended from the jib by means of a roller which rides on a horizontal track adjacent the free end of the jib. In the latter case, the bearing mounting structure associated with the bearing which is removable from the roll may be movable in its entirety prior to the sleeve being replaced, so that, when the apparatus is re-assembled, said structure is preferably bolted to fixed structure in which the other bearings are housed, separated therefrom by spacer members. In a different construction embodying the invention, the removable structure may comprise a housing containing a window for the reception of a pair of roll chocks, said housing being capable of being bolted to an apertured frame member through the aperture of which the sleeves can be passed. In a preferred construction, however, the removable structure includes only a pair of roll chocks, the upper one of which is provided with T-slots for the connection of suspension rods for holding it in abutment with a clamping screw. The sleeves are preferably keyed on the roll shafts.

In order that the invention may be fully understood and readily carried into effect, a preferred embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:

FIG. 1 is a part-sectional front elevation of rolling mill apparatus embodying the invention,

FIG. 2 is a part-sectional view in the direction of the arrow **2** in FIG. 1, and

FIG. 3 is a sectional view on the line **3—3** in FIG. 2,

FIG. 4 is a front elevation of further rolling mill apparatus embodying the invention,

FIG. 5 is a view in the direction of the arrow **5** in FIG. 4,

FIG. 6 is a plan view, and

FIGS. 7–9 are sectional views which will hereinafter be referred to.

Referring now to FIGS. 1–3 of the drawings, rolling mill apparatus includes frame structure generally indicated **10**, an inner housing **11** of which is bolted to one side of a so-called cabinet **12** and an outer housing **13** of which is spaced from the inner housing by spacer members (not shown). Said frame structure contains a pair of rolls **14**, **16** and the cabinet **12**, into which respective roll shafts **18**, **20** of said rolls extend, contains driving gear (not shown) for transmitting drive to said rolls from a motor (not shown).

Since the construction of the two rolls is identical, the construction of the roll **14** only will now be described. A working length of the roll shaft of the roll **14** is surrounded by a sleeve **22** the bore of which is flared at each end for co-operation with a conical bush **24** mounted on the shaft (in abutment with a flange **25** integral with said shaft) and with a conical nose portion of a clamping collar **26**. A key prevents rotation of the sleeve on the shaft.

The clamping collar **26** has an internally screwthreaded inner length for engagement with a screwthreaded length **28** of the roll shaft, and also an internally plain intermediate portion which is a close running fit on a plain portion **30** of said shaft. An outer length **32** of the roll shaft is provided with means including a key **34** whereby the clamping collar can be secured non-rotatably on the roll shaft after it has been screwed tightly into abutment with the sleeve.

The roll shaft **18** of the roll **14** is mounted in roller bearings **36**, four of which are carried in a roll chock **40** mounted in the housing **11** and embrace a portion **38** of the shaft and two of which are carried in a roll chock **42** mounted in the housing **13** and embrace the sleeve **22**. The roll chocks **40** and **42** (hereinafter termed upper roll chocks) are slidably disposed in so-called windows **44** in the housings **11** and **13**, and the lower roll chocks **46** and **48** are also disposed in said windows, being seated on respective blocks **50**.

Respective clamping screws **51** and **52**, screwthreaded lengths **53** of which engage respective nuts **55** "let into" the housings **11** and **13**, act upon the upper roll chocks through the intermediary of respective dome-headed bearing pads **54**, and conventional screw-down gear (not shown) is provided for rotating said screws. A pair of bolts (not shown) depend from a yoke **56** which is rotatably connected to an upper part of the clamping screw **51** and, extending freely through the upper portion of the housing **11** into the window therein, engage the chock **40** to suspend it in known manner in abutment with the lower end of said screw. A similar pair of bolts **58** depend from a yoke **60** which is rotatably connected to an upper part of the clamping screw **52** and said bolts extend freely through the upper portion of the housing **13** into the window therein. At their lower ends, said bolts **58** engage special nuts **62** which are slidably accommodated in T-slots **64** in the chock **42** and suspend the latter in abutment with the lower end of the screw **52**.

Respective guide blocks **66** and **68** are bolted to the roll chocks **42** and **48**, said guide blocks being provided with dovetail guides **70** and **71**, and respective hinged members **72** and **73**, provided with dovetail guiderail sections **74**, are pivotally connected to the housing **13** about respective pivot pins **76** and **77**.

The arrangement is such that said hinged members can be swung from a stowed position in which they lie alongside the housing **13** (as shown in chain-dotted lines in FIG. 3) to the position shown in full lines wherein said guide-rail sections are aligned with the dovetail guides in the guide blocks. The means whereby the clamping collars **26** of the rolls are secured non-rotatably on their respective roll shafts can then be released as shown in FIG. 3 so that, after the tension in the bolts **58** has been released, said collars can be unscrewed, simultaneously displacing the roll chocks **42** and **48** from the window **44** of the housing **13** as the guide blocks engage and slide along the hinged members **72**. It will of course be understood that as the chocks are displaced from the window **44**, the nuts **62** slide out from the T-slots **64** in the upper chock **42**.

When the collars **26** have been fully unscrewed from the screwed portions **28** of the roll shafts, the chocks can be manually displaced along the hinged members for a distance to ensure that the clamping collars can clear the ends of the roll shafts and can then be swung aside suspended on said hinged members which once again assume their stowed positions. When the clamping collars and their removable associated structure have thus been moved aside, the sleeves **22** can easily be removed from the exposed ends of the roll shafts through the window **44**, for replacement by new or alternative sleeves depending upon whether the sleeves have become worn or whether it is desired to roll a different cross-section of rolling mill product. It will, of course, be understood that the four bearings which surround the portion **38** of each roll shaft are quite capable of supporting said shaft and the sleeve **22** which it carries without any additional support. The removable structure is replaced as soon as the sleeves have been changed and the mill is thus ready to resume working after the very minimum of "down" time.

The hinged member **73** associated with the lower roll chock **48** is maintained at a constant height in alignment with the dovetail guide **71** in said chock. The hinged member **72**, however, is suspended so that, as roll gap adjustments cause the upper roll chock to move up or down, said hinged member is maintained in alignment with the dovetail guide **70**. The means by which the hinged member associated with the upper roll chock **42** is suspended include an internally screwthreaded bush **80** which is secured within a boss **82** welded to the housing **13** and with which a screwthreaded length of the pivot pin **76** is engaged. A pinion **84** is secured to the upper end of said pivot pin and meshes with a gear wheel **86** secured on the clamping screw **52**.

The lead of the screwthread of the pivot pin **76** is slower than the lead of the screwthread **53** of the clamping screw **52** in the ratio between the pinion **84** and gear wheel **86**, so that when the clamping screw moves up or down, the pivot pin moves with it by the same amount. The lower end of the pivot pin **76** is provided with a nut **78** and locknut **88** which abut against the underside of the hinged member **72**.

Referring now to FIGS. 4–6 of the drawings, in further rolling mill apparatus embodying the invention frame structure generally indicated **110** is constituted by an inner housing **111** and an outer housing **113** spaced apart by spacer members **114**, the housing **113** being releasably connected to the spacer members. The frame structure is bolted to one side of a cabinet **112** containing gearing (not shown), and said gearing is drivably connected to an electric motor **115**, mounted on the cabinet **112**, by means of a belt pulley drive **117**.

The frame structure contains a pair of rolls **14** and **16** which are identical to those of the previously described embodiment and so do not need to be described in detail. The rolls are also mounted in the identical manner previously described in respective roll chocks (not shown) in the housing **111** and respective roll chocks **42** and **48**, in the housing **113**. As in the previously described arrangement, clamping screws (not shown) act upon the chocks in which the upper roll is mounted and conventional screw-down gear, including respective gear wheels **157** and **159** meshing with a common pinion **161**, is provided for adjusting the roll gap.

In the present case, however, the removable structure comprises the entire housing **113** complete with the chocks and the parts of the screwdown gear mounted therein. For the purpose of facilitating the removal of this structure, a jib **119** is pivotally connected to the cabinet, and a horizontal track **121** adjacent the free end of the jib carries a roller **123** which is freely rotatable between the upper ends of a pair of brackets **125** bolted on the housing **113**.

The arrangement is such that when the housing has been released from the spacer members and the collars have been fully unscrewed from the roll shafts, the removable structure can be withdrawn (as shown in chain-dotted lines in FIGS. 4 and 6) axially of the rolls until the collars are clear of the roll shafts. (The track **121** is provided with a raised end **131** constituting a stop to limit the extent of withdrawal.) The removable structure can then be swung aside to allow the sleeves of the rolls to be removed for replacement by new or alternative sleeves.

Various modifications may be made without departing from the scope of the invention. For example, the way in which the clamping collars are urged into abutment with the sleeves may be modified in a number of ways, but a modification which is thought to be particularly advantageous is shown in FIG. 7.

Referring now to FIG. 7, the clamping collar **26** is shown to be screwthreaded on the roll shaft by means

of a screwthread of special form which extends substantially for the full effective length of said collar, that is to say, it extends through the bearings which encircle the collar.

The special form of screwthread has opposite flanks of unlike angles of inclination as shown in the drawing. Thus the flanks of the thread facing towards the sleeve have angles of inclination of thirty degrees to the axis of the roll shaft, that is to say, the same angle as the conical end of the collar. The flanks of the threads facing away from the sleeve on the other hand are almost radial to the axis of the roll shaft. The thread is very similar in appearance to the well-known buttress thread but, unlike the buttress thread, when the clamping collar is tightened and the thread is under load, the compressive forces are applied to the flanks which are inclined at a relatively shallow angle to the axis of the roll shaft. For this reason it is thought that the forces which are applied to the sleeve during a rolling operation, and transmitted to the roll shaft by way of the clamping collar, will be transmitted to the shaft through a much improved bearing surface. The sleeve is therefore likely to be held concentric with the axis of the roll shaft in a much more effective manner than is the case when the screwthread is of conventional form. The flanks of the thread which are inclined at a relatively shallow angle can of course be ground to improve accuracy even further. It will of course be understood that the flanks facing the sleeve need not be inclined exactly at the angle of inclination of the conical end of the clamping collar, and it may be found advantageous to make the screwthreads on the two roll shafts of opposite hand so that during a rolling operation the clamping collars tend to tighten against the sleeves. Means will, of course, be provided for locking the clamping collar in position and the thread will preferably be provided with a relatively "fast" thread. It may even be a multi-start thread.

Other modifications which could be made are shown in FIGS. 8 and 9. In FIG. 8, the previously described arrangement has been modified by the screwthreaded length of the roll shaft being located adjacent the end of the shaft. The nose portion of the clamping collar **26** is a sliding fit on the part of the shaft which is surrounded by the sleeve.

In FIG. 9, the clamping collar **26** is provided with an outer transverse wall **127** and is urged tightly into abutment with the sleeve by means of two set screws **129** which extend through said wall and engage screwthreaded holes in the end of the roll shaft. The nose portion of the clamping collar is again a sliding fit on the part of said shaft which is surrounded by the sleeve.

Varius other modifications may be made without departing from the scope of the invention. For erample, the clamping collars could be urged into abutment with the sleeves by means of cotters. Furthermore, the housing **13** could be replaced by an apertured frame member, said frame member being provided with a subhousing containing a window for the reception of the chocks **42** and **48**. The removable structure would then comprise the sub-housing together with said chocks and the clamping collars rotatably mounted therein, and the sleeves would be passed through the aperture in the frame. In a further modification, means for supporting the rolls when one of the bearings has been removed from each roll may be constituted by supplementary bearings encircling extensions of the roll shafts at their ends remote from the bearings which are removable, or may be constituted by abutment members capable of acting downwardly on said extensions to limit downward movements of the unsupported ends of the rolls.

It will of course be understood that the invention can equally well be applied to a 3-high or a 4-high mill.

What I claim is:

1. A rolling mill comprising a frame; at least a pair of co-operating roll shafts; sleeves surrounding intermediate lengths of said roll shafts; an end mounting including a bearing mounted on each end of said roll shaft; and movable structure carrying one of the end mountings of each roll shaft; means for supporting said movable structured during movement in the direction of the axis of said roll shaft for said end mounting to be removed from the roll shaft; and means for moving said movable structure away from the end of said roll shafts to permit the sleeves to be withdrawn without the necessity for said roll shafts to be removed from the mill.

2. A rolling mill as claimed in claim **1** comprising in addition camping collars abutting against ends of said sleeves; each end mounting carried by said movable structure surrounding one of said clamping collars.

3. A rolling mill as claimed in claim **2** comprising in addition co-operating screw threads on said roll shafts and interiorly of said clamping collars for screwthreaded connection therebetween, unscrewing of said clamping collar causing movement of said end mounting in the direction of the axis of said roll shaft.

4. A rolling mill as claimed in claim **3** comprising in addition flanks upon said screwthreads, opposite flanks of said screwthreads having unlike angles of inclination and the flanks which are operative to urge said clamping collars into abutment with said sleeves having angles of inclination substantially the same as those of conical nose portions of said clamping collars.

5. A rolling mill as claimed in claim **2** comprising in addition an outer transverse wall at an end of at least one of said clamping collars remote from the end thereof in abutment with said sleeve; and at least one screw extending through said transverse wall and engaging a screwthreaded hole in said shaft for urging said collar into abutment with said sleeve.

6. A rolling mill as claimed in claim **1** also comprising positioning means associated with said means for moving said movable structure away from the end of said roll shaft, said positioning means being for permitting the last mentioned means to move said movable structure sideways relative to the axis of the roll shaft.

7. A rolling mill as caimed in claim **6** comprising in addition a jib from which said movable structure is suspended for permitting said movement of the movable structure in the direction of the axis of said roll shaft and for moving said structure sideways relative to the axis of said roll shaft.

8. A rolling mill as claimed in claim **7** comprising in addition pivot means for mounting said jib above the frame; and a roller riding on a horizontal track on said jib and from which said removable structure is suspended.

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U.S. Cl. X.R.

29—123, 129; 55—19