Oct. 19, 1965 M. P. SIEGER 3,212,314

BEAM AND PLATE ROLLING MILL

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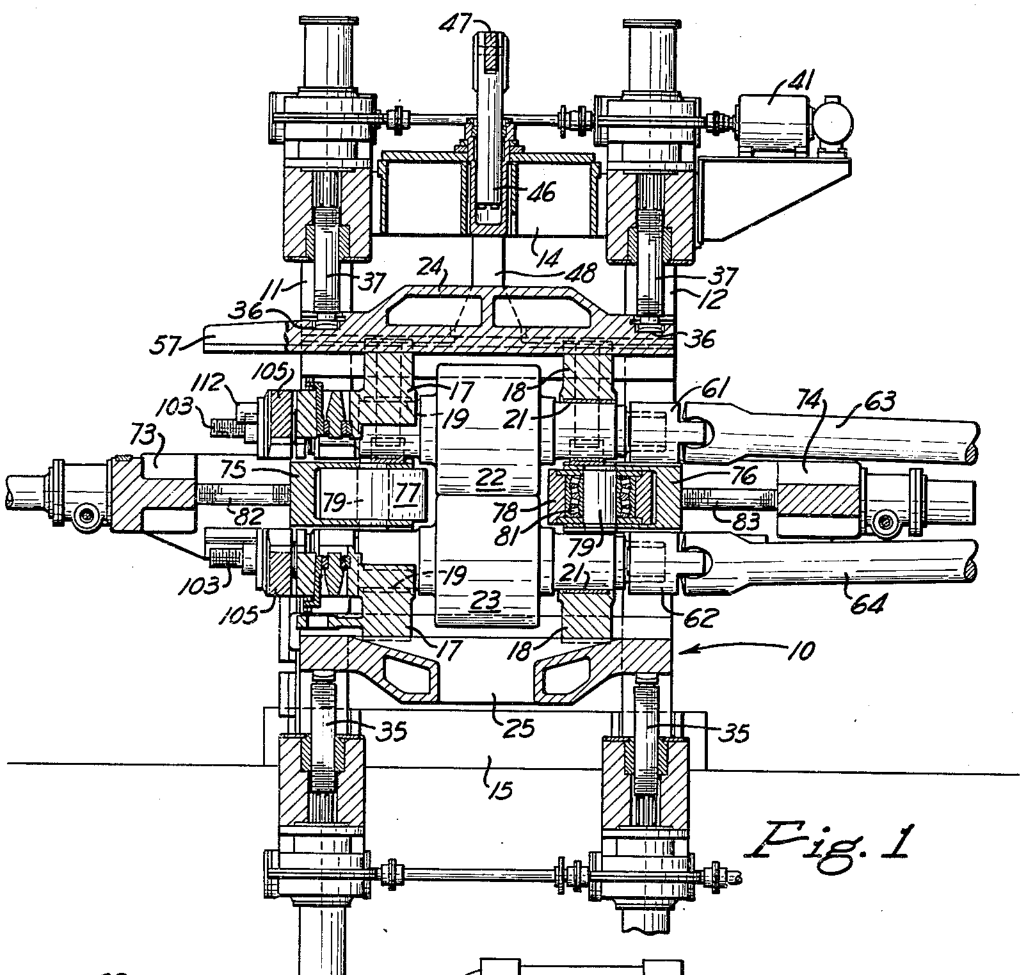

Fig. 1

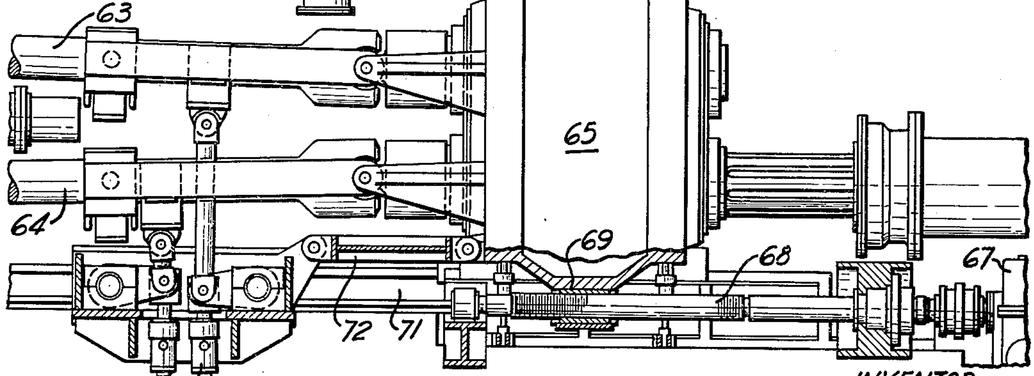

Fig. 1a

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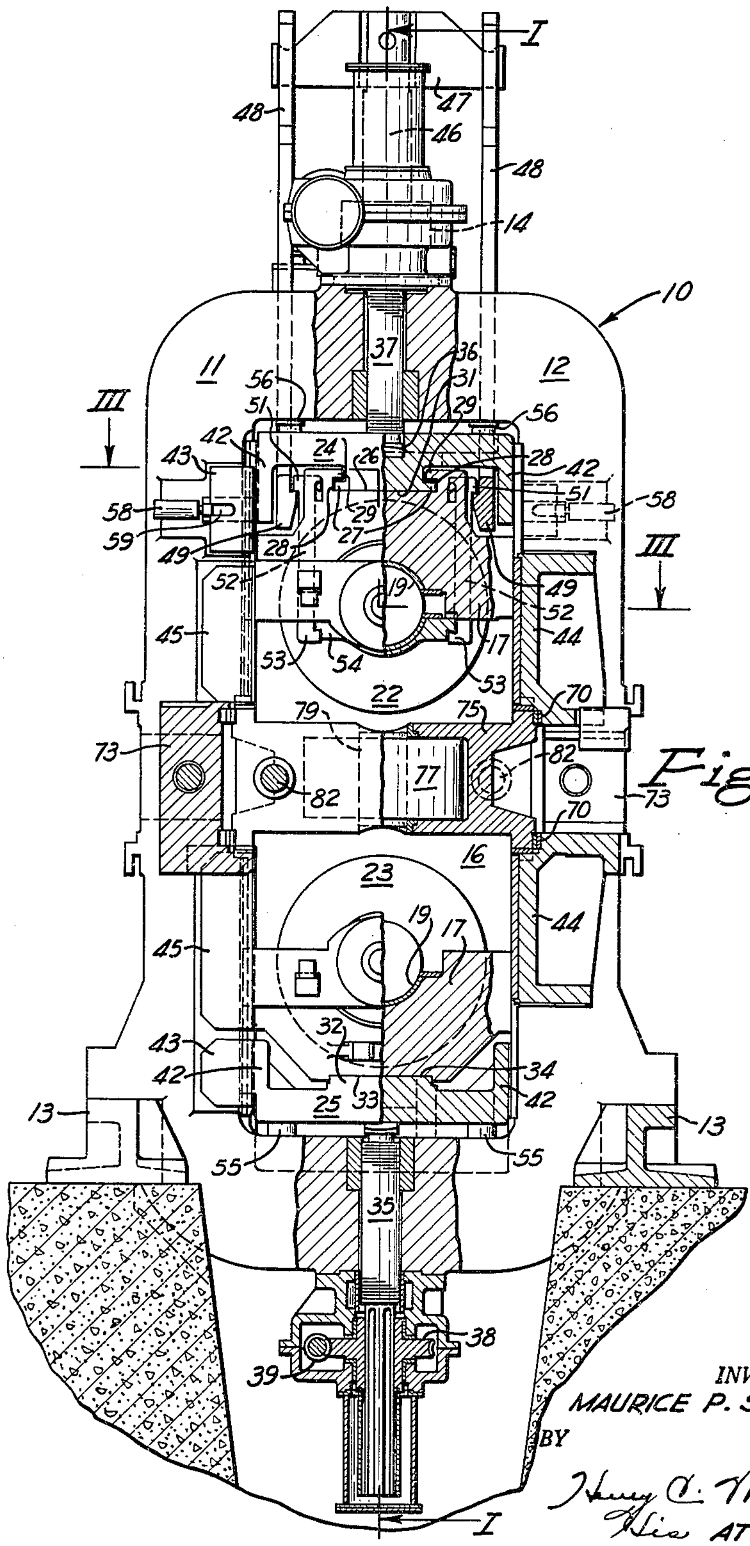

Fig. 2

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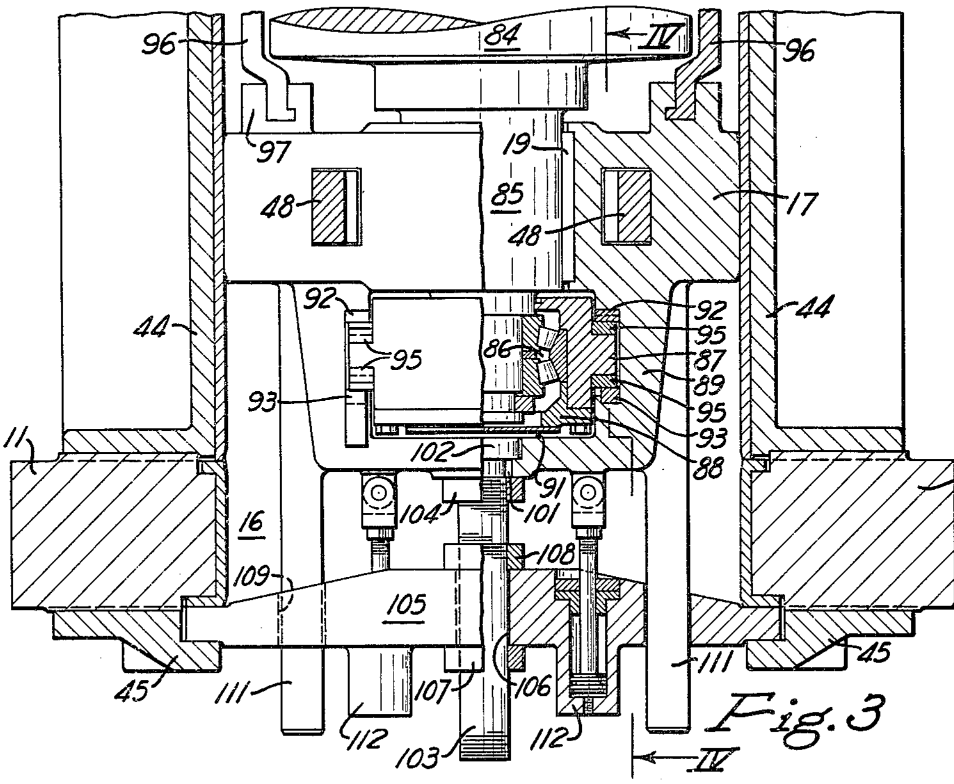

Fig. 3

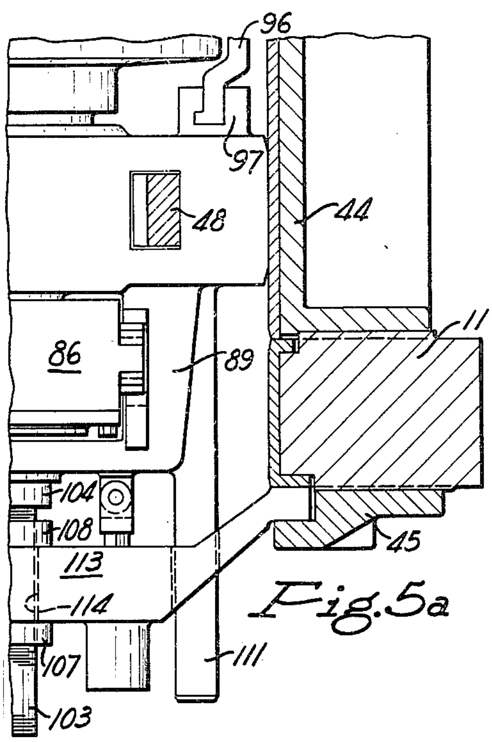

Fig. 5a

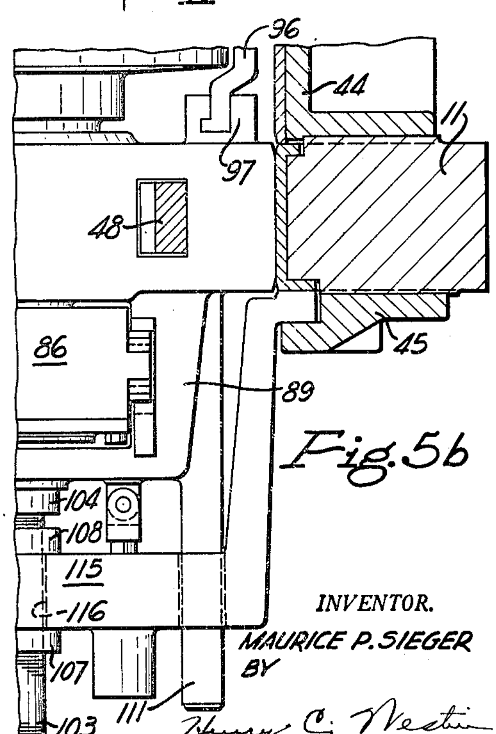

Fig. 5b

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BEAM AND PLATE ROLLING MILL

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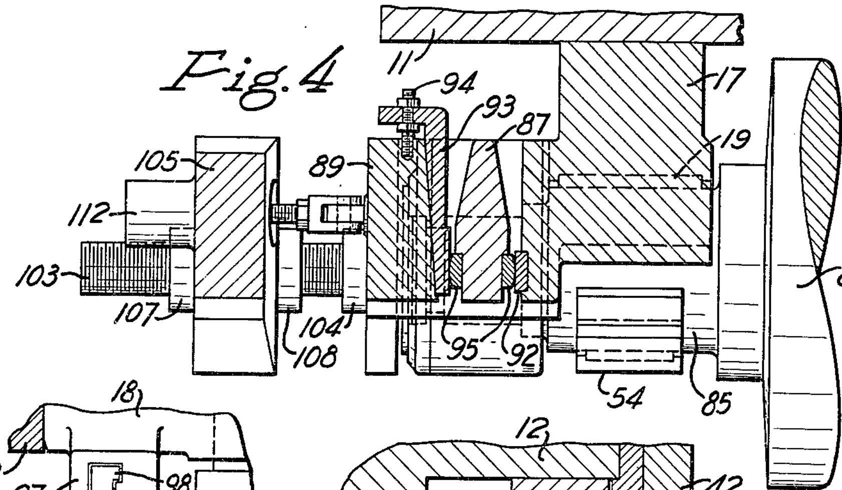

Fig. 4

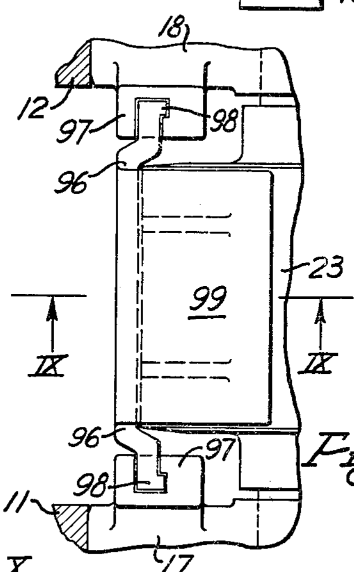

Fig. 10

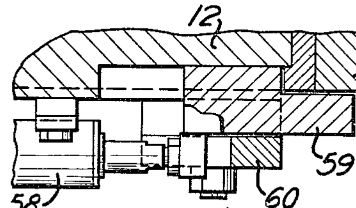

Fig. 7

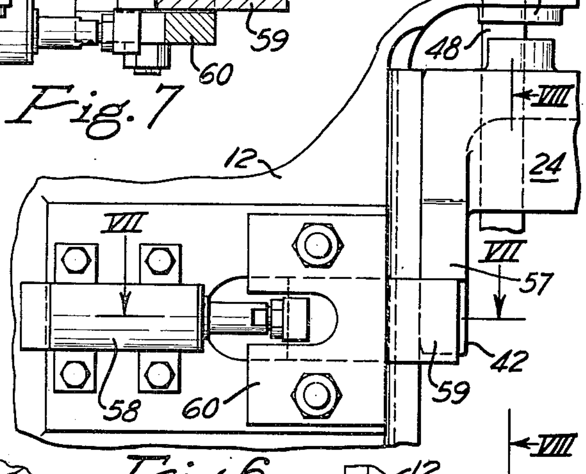

Fig. 6

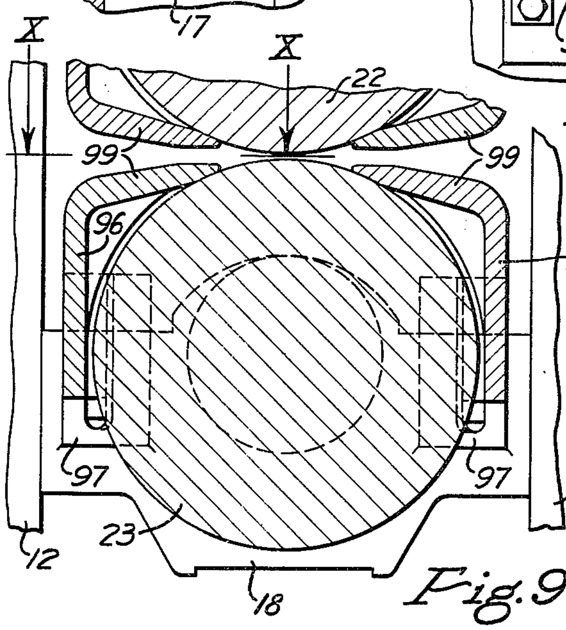

Fig. 9

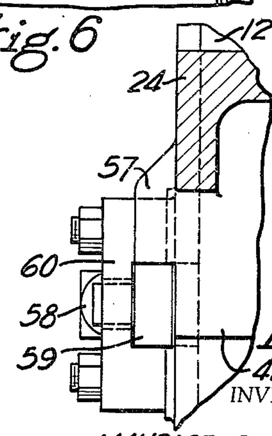

Fig. 8

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Fig. 11a

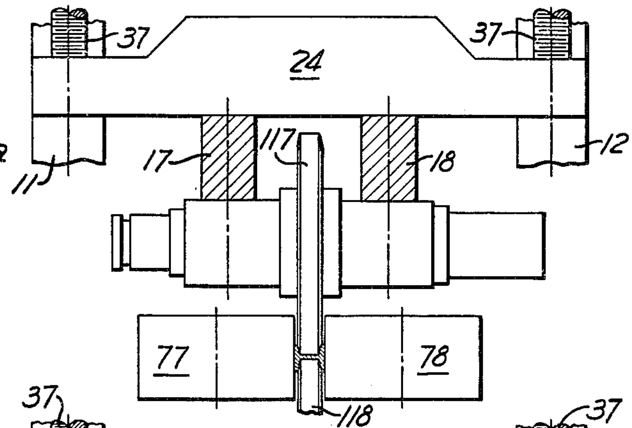


Fig. 11b

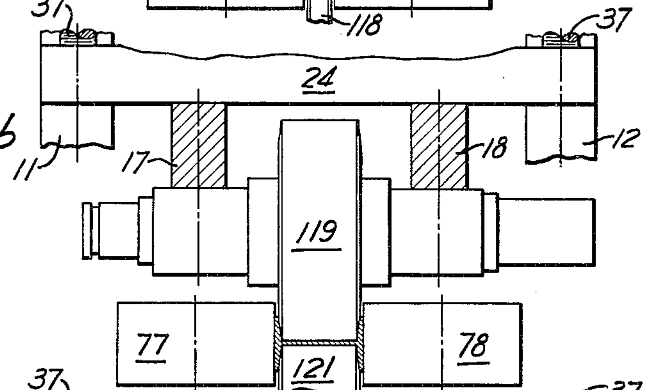


Fig. 11c

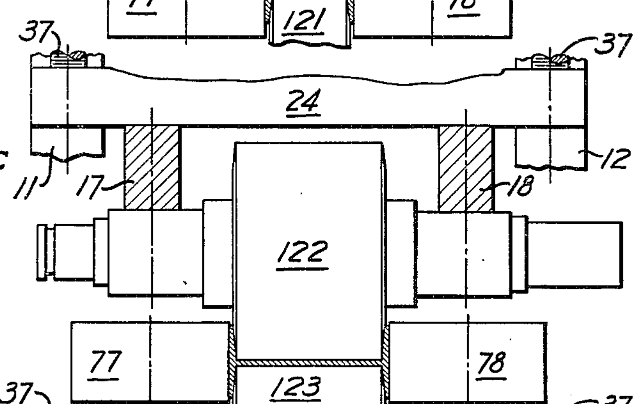
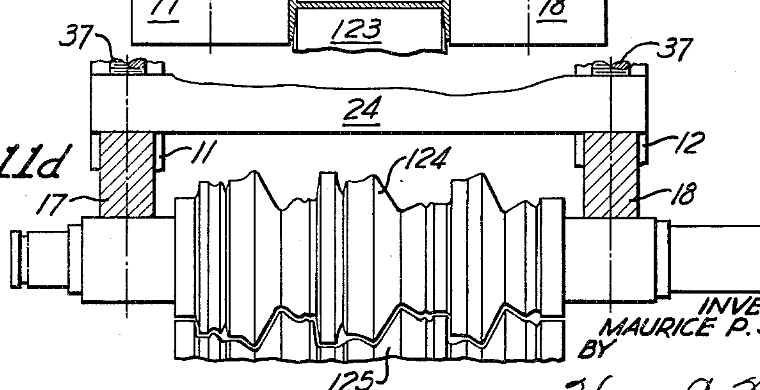


Fig. 11d



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United States Patent Office

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3,212,314

BEAM AND PLATE ROLLING MILL

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11 Claims. (Cl. 72—225)

This invention relates to an improved rolling mill and, particularly, to a mill adapted to produce workpieces having varying characteristics, which mill, dependent upon the workpiece desired to be produced, contains rolls of the length required for the operation and being so constructed as to support adequately rolls of minimum lengths.

In the design of present-day rolling mills such as, for example, mills for producing plates and beams of greatly varying widths, in view of the great variation in the width of the products rolled, it is economical and in other cases absolutely necessary to provide rolls with varying roll-body portions. This is particularly true with respect to a universal beam mill for producing wide-flange beams. Present-day beam mills of this type may be classified as mills having fixed, movable, or set-up housings.

In the fixed housing type of mill, as the name implies, the housings are rigidly secured to a foundation so that all of the rolls for the various size products must be made of the same length, notwithstanding the fact that only relatively short portions of the rolls are utilized for rolling narrower web beams. While this type of mill has the advantage of being very rigid thus assuring that the desired tolerances of the beam can be more readily realized, since the housings thereof are stationary, it has one very serious disadvantage in that the rolls are unnecessarily long thus resulting in a substantial unnecessary capital outlay.

In an attempt to avoid this economical loss, some mills have been constructed with movable housings, that is to say, the housings are transversely adjustable relative to the mill's pass line. In this manner, since the housings can be moved relative to each other, the length of the rolls can be made commensurate with the actual length necessary to produce a given size beam. However, this advantage is rather questionable in that considerable time is lost in non-productive effort, in view of the fact that the mill must be rendered inoperative in order to adjust the housings to accept a new set of rolls having a different length from those embodied in the previous operation. There is also a substantial labor factor involved in accomplishing the roll-changing operation in a mill of this type. Moreover, on this type of mill, the tolerances of the rolled beam are not as readily attainable as in the case of a mill having fixed housings.

It is because of the aforesaid limitations and disadvantages that set-up mills have been provided on occasion. These set-up mills constitute an exact duplicate of an operating mill, except that a different set of rolls is inserted therein at a place remote from the operating mill. When it is desired to change the rolls of the operating mill, the operating mill, including its rolls is bodily removed from the operating position and replaced by the set-up mill. While this operation has the significant advantage of reducing losses in productive time incident to changing the rolls to a minimum in comparison with the two other types of mills hereinbefore discussed, this advantage again is offset by the initial capital outlay required which is substantial. In addition to the added expense represented by the set-up mill itself, in order to be able to remove and replace the entire mill, a heavy mill crane is needed, thereby greatly increasing the size of the entire mill building. The overall effect of the aforesaid economic factors reduces considerably the significance of the advantage realized from the use of the set-up type of mill.

It is an object of the present invention to provide a rolling mill, which, in addition to being free from each and every one of the aforesaid limitations and deficiencies, has certain other significant advantages that make it substantially more economical to construct and operate than present-day mills. This object is attained by providing a novel manner for supporting the rolls of the mill so as to permit at all times the employment of rolls having lengths that are precisely commensurate with the length characteristic of the workpiece being produced.

The rolls, according to the teaching of the present invention, are engaged by a roll-supporting means which is interposed between the bearing-chock assemblies of the rolls and the mill screws or housings. Consequently, the bearing-chock assemblies are freely positioned along the length of the supporting means, which, depending on the length of the rolls, may be located directly under the mill screws or spaced relatively thereto. In this manner not only can the lengths of the rolls be maintained at the very minimum with a substantial resulting economic saving, but the need of set-up mills is completely eliminated, with the added feature that the housings thereof need not be movable relative to each other.

It is another object of the present invention, incident to the roll-supporting means herein disclosed, to provide a construction whereby the rolls can be quickly and efficiently removed from and inserted into the mill.

It is a further object of this invention to provide a novel arrangement for securing the bearing-chock assemblies and thrust-bearing assemblies of the varying length rolls to the housings and for providing means for quickly adjusting the rolls axially relative to each other.

It is still a further object of this invention to provide an improved thrust-bearing arrangement, whereby the bearing will be rendered free from the vertical forces caused by wearing on the radial bearing and which arrangement will have means for maintaining the thrust-receiving elements of the thrust bearing in tight engagement with each other.

In one application of the present invention as involved in a universal beam mill, it was made possible to roll not only a full range of wide-flange beams but also standard size beams with each and every one of the aforesaid advantages being fully realized.

These objects, as well as the other novel features and advantages of the present invention, will be more fully understood when the following description is read in light of the accompanying drawings of which:

FIGURE 1 is a front elevational sectional view taken on lines I—I of FIGURE 2 of a combination universal wide-flange and structural beam mill illustrating certain features of the present invention,

FIGURE 1*a* is a continuation of FIGURE 1, partly in section, illustrating the spindles and driving arrangement of the mill,

FIGURE 2 is an end elevational view, partly in section, of the mill shown in FIGURE 1, but with the horizontal rolls separated from each other,

FIGURE 3 is a horizontal-sectional view taken on lines III—III of FIGURE 2, but with different length rolls being shown, illustrating, along with other features of the present invention, the horizontal roll-retaining means employed for one range of roll lengths,

FIGURE 4 is a vertical sectional view taken on lines IV—IV of FIGURE 3,

FIGURES 5*a* and 5*b* are partial horizontal sectional views similar to the left-hand side of FIGURE 3 of two other horizontal roll-retaining means employed for two different ranges of roll lengths,

FIGURE 6 is an enlarged partial elevational view of a portion of the mill shown in FIGURE 2, illustrating the roll-carrying beam latching device employed on the drive side of the mill and showing the top roll-carrying beam in the roll-changing position,

FIGURE 7 is a partial horizontal sectional view taken on lines VII—VII of FIGURE 6,

FIGURE 8 is a partial vertical sectional view taken on lines VIII—VIII of FIGURE 6,

FIGURE 9 is an enlarged horizontal sectional view of a portion of the mill illustrated in FIGURES 1 and 2 taken on lines IX—IX of FIGURE 10, showing the workpiece guides and bars for interconnecting the chocks,

FIGURE 10 is a vertical sectional view taken on lines X—X of FIGURE 9 and,

FIGURES 11*a*, 11*b*, 11*c* and 11*d* are vertical schematic views, illustrating several of the pairs of various length rolls which are employed in the mill illustrated in the earlier figures and, particularly, the relative positions that certain major parts of the mill assume for the particular length rolls shown.

The mill and the horizontal roll components thereof

With reference to FIGURES 1, 2 and 3 of the drawings there is illustrated a combination wide-flange and structural beam mill **10** incorporating the features of the present invention, comprising a pair of vertically arranged spaced-apart mill housings **11** and **12** rigidly secured at their lower ends to bed plates **13** and connected together both at their upper and lower ends by horizontally disposed separators **14** and **15**, the separators being only shown in FIGURE 1. The housings are provided with elongated windows **16**, having bearing liners mounted therein, into which there are received chocks **17** and **18**, including their babbit bearings **19** and **21**, respectively, for supporting a pair of horizontal rolls **22** and **23**. The particular rolls shown in FIGURES 1 and 2 are designed to roll one of the larger size wide-flange beams.

Extending horizontally between the housings **11** and **12**, at the top and bottom of the windows **16**, are rigid beams **24** and **25**. As best shown in FIGURE 2, the upper beam **24** is formed with a central downwardly extending portion which in addition to having a relatively wide flat-load receiving surface **26** has two horizontal projections **27**, both the surface and projections extending over the entire length of the beam. The upper chocks **17** and **18** have indented slots **28** formed on their upper ends, each including two horizontal projections **29**, which in certain instances slide over and are carried by the upper surfaces of the projections **27** of the beam **24**. It will be noted that the lower surface of the slots **28** form load-transferring surfaces **31**, which during the rolling operation engage with the surface **26** of the beam **24** and transfer the vertical rolling load thereto.

With respect to the lower beam-chock construction, with further reference to FIGURE 2, the beam **25** has a raised central portion **32**, the top surface **33** thereof being of a substantial width and constituting a load receiving surface which is engaged by complementary surfaces **34** formed by centrally located recesses provided at the bottom of the lower chocks **17** and **18**. The vertical walls of the recesses serve as guiding surfaces for the chocks when they are moved axially along the beam.

In the case of the lower beam **25**, and as best shown in FIGURE 1, the lower outer surfaces thereof are engaged by a pair of adjusting screws **35**, provided for vertically adjusting the lower roll **23** and which are mounted in the bottoms of the housings **11** and **12**. With respect to the upper beam **24**, the two opposite upper ends thereof are provided with recesses **36** into which are received for engagement with the bottom surfaces thereof enlarged portions of a pair of screws **37** vertically arranged in the tops of the housings **11** and **12** and provided for adjusting the upper roll **22**. The upper and lower ends

of the screws **37** and **35**, respectively, are splined and connected to gear wheels **38** which mesh with gear worms **39**, these elements being only shown at the bottom of FIGURE 2. The worm-wheel sets, in the customary manner, are driven by electrical motors **41**, one of which is shown at the top right-hand side of FIGURE 1.

With further reference to the beams **24** and **25**, and as best illustrated in FIGURE 2, it will be noted that they are provided with parallel vertically extending legs **42** which protrude through the windows **16** of both of the housings **11** and **12** and engage the vertical adjacent surfaces thereof. In this manner the beams are guided and restrained in their vertical travel. Keeper plates **43**, shown at the left-hand side of FIGURE 2 are provided for preventing the beams from moving axially relative to the rolls **22** and **23**.

In order to prevent the chocks **17** and **18** from moving to the left and right in the planes containing their horizontal axes and as one views FIGURE 2, two pair of rigid cross members **44** are connected to and extend between the inner vertical walls of the housings **11** and **12** above and below mill pass line. These members, best shown on FIGURES 2 and 3, are provided with vertical lined surfaces which are made of sufficient height so as to provide an adequate supporting surface for the entire surfaces of the vertical walls of the chocks **17** and **18**. As will be observed in FIGURE 3, only the chocks of the rolls provided for rolling the smaller beams will be in total engagement with the members **44**, since the chocks of the rolls for the larger size beams will at least extend partly into the windows **16** and as a result be in engagement with the housings **11** and **12**. By this construction, the chocks of all length rolls are adequately supported against the horizontal components of the rolling load.

As shown only on the left-hand side of FIGURE 2, a pair of keeper plates **45** is provided for each roll **22** and **23**, being secured to the outside vertical faces of only the housing **11** and which extend beyond the windows **16** for engagement with a part of the roll retaining means to be explained later and by which means the chocks are restrained from moving axially in the direction containing the axes of the rolls.

With reference still to FIGURES 1 and 2, connected to and supported by the top separator **14** is a centrally arranged piston cylinder assembly **46** having its outer piston end extending toward the top of the mill. To the outer end of the piston there is secured an arm **47**, as shown in FIGURE 2, extendable in a horizontal direction parallel to the two housings **11** and **12**. To each end of the arm **47** there are connected vertically extending bars **48**. The bars **48** pass through both the top separator **14** and the upper beam **24** and are formed with projections **49** at their lower ends, which projections extend toward each other. In engagement with the projections **49** of the bars **48** are complementary projections **51** formed at the upper ends of links **52**. The lower ends of the links **52** are provided with additional projections **53** which engage the lower surface of the bearing caps **54** of the upper bearings **19** and **21** provided for the upper horizontal roll **22** of the mill.

It will be appreciated in this construction that when fluid is admitted to the piston cylinder assembly **46** to urge its piston in an upward direction, the upward force imposed on the bars **48** and links **52** will not only assure that the bearings **19** and **21** of the upper horizontal roll **22** are maintained in their proper operating positions, but will also urge upwardly the upper roll **22** thereby bringing the load transfer surface **31** of the chocks **17** and **18** into engagement with the load receiving surfaces **26** of the beam **24**. Hence, the beam will be urged into tight contact with the bottom of the screws **37**. By reason of this construction, not only are the rolling loads transferred to the housings **11** and **12** but accurate adjustment of the upper roll **22** is assured.

With respect to the lower horizontal roll **23**, the surfaces **33** and **34** of the beam **25** and of the chocks **17**, **18**, respectively, are urged into contact with each other by virtue of the weight of the roll assembly **23** and the rolling loads, thus the rolling loads in the downward direction are transferred to the housings **11** and **12** and accurate adjustment of the roll **23** is assured.

In addition to the feature of the beams **24** and **25** providing a novel way of positioning of the chocks **17** and **18** along its length depending of the particular length of the horizontal rolls being employed in the mill, it is also a feature of the beams to enhance the speed and efficiency at which the horizontal roll can be removed from and replaced into the mill. In this connection and with respect to the lower roll **23**, a pair of stops **55**, shown only in FIGURE 2, are provided at the bottom of each of the windows **16** of each housing **11** and **12** against which the lower surface of the beam **25** engages when the screws **35** are retracted. In this way the beam can be made to register itself with a roll-changing device, not shown, which is positioned at the operating side of the mill. Once the vertical rolls have been removed, the keeper plates **45** are retracted and the various other elements disconnected, such as, the lubrication lines, etc., the roll with its chocks **17** and **18** can be slid over the beam **25** onto the awaiting roll-changing device. The raised central portion **32** will guide the roll assembly during this travel.

With respect to the upper roll **22**, as best shown in FIGURES 2, 6, 7 and 8, a pair of stops **56** are provided at the top of each of the windows of the housings **11** and **12** which are engaged by the upper surface of the beam **24**. On portions of each outer face of the legs **42** of the upper beam **24** that extends through the housing **11** and at the lower ends thereof projects **57** are provided. These projections extend in the same direction as the axis of the roll **22**. To the outside faces on each side of the housings **11** and **12**, piston cylinder assemblies **58** are provided. By way of illustration reference will be made to one of the cylinder arrangements located on the housing **12** which is shown on FIGURES 6, 7 and 8. To the outer end of the piston, there is secured a slidable block **59** which, on operation of the cylinder in one direction, is caused to extend beyond the window **16** of the housing and constitutes a latching device. As shown in FIGURES 6 and 8, a C shaped plate **60** serves to guide the block **59** in its reciprocal movement. In the roll changing of the upper roll **22**, the screws **37** are operated to raise the roll until the projections **57** of the beam **24** pass above the upper surfaces of the blocks **59** connected to the piston cylinder assemblies **58** until the beam engages the stops **56**. Once this occurs the piston cylinder assemblies **58** can be operated to cause the blocks **59** to extend beyond the windows **16**, after which the beam **24** can be lowered and caused to engage the blocks **59**. In this manner, since in the roll-changing operation the pressure of the balance piston cylinder assembly **46** is interrupted, the load represented by the weights of the beam **24** and roll assembly is taken off the screws **37**. In addition, the latching devices will serve to position the beam **24** at a predetermined elevation whereby it can be automatically aligned with a roll-changing device, not shown.

The driving arrangement for the horizontal rolls

With reference to FIGURES 1 and 1*a*, it will be noted that on each of the driving ends of the horizontal rolls **22** and **23** couplings **61** and **62**, respectively, are provided. These couplings are connected to spindles **63** and **64** by universal joints, the other end of the spindles being connected in driving relationship to the pinions of a pinion stand **65** as shown in FIGURE 1*a*. The usual spindle balancing spindle supporting mechanism **66** is provided for adjusting the vertical positions of the spindles. In view of the fact that pairs of different length rolls are employed in the mill **10**, the distance between the ends of these rolls and the spindles **63** and **64**, should the latter not be adjusted, would change. Therefore, means are provided for adjusting the spindles relative to the housing **12**, whereby the couplings **61** and **62** can be brought into their proper operating positions with respect to the ends of different length rolls.

This means includes a motor-gear unit **67** provided for driving a shaft **68**, the shaft having a threaded portion which is received in a non-rotatable nut **69** located at the bottom and constructed as a part of the pinion stand **65**. The pinion stand is mounted on and slidable over a pair of parallel rails **71**. These rails also serve to support the spindle balancing mechanism **66**, the latter being connected to the pinion stand by a pair of parallel links **72** and by virtue of which these two elements move together on rotating of the shaft **68**. In the employment of the aforesaid means, when a new set of rolls is inserted into the mill, having a length different from the replaced rolls, the motor-gear unit **67** is operated to move the spindles **63** and **64** relative to the mill thereby to bring their couplings **61** and **62**, respectively, into their proper operating positions.

The vertical roll assembly of the mill

With reference to the vertical roll assemblies of the illustrated universal beam mill **10**, the vertical housings **11** and **12** thereof are provided with integral wings **73** and **74** which project horizontally outward from the opposite sides of the vertical housings, this construction being best shown in FIGURE 1. These wings are provided with rectangular shaped vertical openings which have formed on their parallel vertical walls upper and lower bearing lined ledges **70**, shown only in FIGURE 2, for supporting and guiding the rectangular shaped horizontally disposed chocks **75** and **76** of the vertical non-driven rolls **77** and **78**. The bearing lined ledges **70** of the wings **73** and **74** are continued through the housings **11** and **12** for the total distance of the lateral travel of the rolls **77** and **78**. Each vertical roll is mounted on non-rotative shafts **79** to which there are secured bearings **81**, these elements being only shown on the right-hand side of FIGURE 1.

The necessary lateral travel for the vertical rolls **77** and **78** is obtained by providing for each roll a pair of separate screws **82** and **83** which are received in the wings **73** and **74**. The two pairs of screws **82** and **83** are driven in the customary manner and may be mechanically tied together to insure synchronization in the movements of the rolls **77** and **78**. The description of the components of the vertical roll assemblies has been purposely made brief and reference to certain other elements has been entirely omitted in view of the fact that the design and operation of the assemblies follows well-known technology and, therefore, a full description thereof is not deemed necessary to understand the present invention.

Thrust bearing arrangement

With reference to FIGURES 3 and 4 of the drawings, there is illustrated the mill bearing arrangement provided on the operating side thereof for the upper roll. The roll **84** shown in these figures differs from the upper roll shown in FIGURES 1 and 2 in that it is designed to roll a narrower size beam. It is to be understood that a similar bearing arrangement is provided for the lower roll. The previously referred to radial bearing **19** of the chock **17** is received on the journal **85** of the roll **84**. On the extreme end of the roll a thrust bearing **86** is secured thereto by means of a bearing housing **87** and retainer ring **88**.

It is a feature of this invention to provide a bearing construction that will permit the thrust bearing to be tightly retained against axial movement by the chocks **17** but yet allow it to move vertically relative thereto. This action is necessary since otherwise on wear of the babbit bearings **19** and **21**, the roll **84** would be allowed to move vertically thereby to cause objectionable vertical forces to be imposed upon the thrust bearing. To obviate this condition, the chock **17** is formed with an extending portion **89** which is provided with a rectangularly shaped opening **91** on its upper outer surface for receiving the entire thrust-bearing assembly **86**. The opening **91** is indented at two of its opposite sides into which indented portions there is provided on the one side of the chocks vertically extending fixed bearing blocks **92**. On the other side, adjustable bearing blocks **93** are provided. As shown in FIGURE 4, the adjustable bearing blocks **93** consist of wedges, their upper ends being formed with right angle portions through which bolts **94** pass to connect the blocks to the extended portion **89** of the chock **17** and by which means the wedges are adjusted to assure that the various cooperative elements of the thrust bearing and chock will always be in positive contact with each other.

Again as shown in FIGURE 4, in engagement with the bearing blocks **92** and **93** of the chock are complementary bearing blocks **95** secured to vertical surfaces formed on the housing **87**. These blocks differ from the blocks **92** and **93** in that their surfaces are tapered in their vertical planes so as to make only line contact with the blocks **92** and **93**. This line contact between the bearing blocks is designed to permit the thrust bearing **86** to move vertically with the roll on the experience of wear of the babbit bearings **19** and thus relieve the thrust bearing from any vertical forces incident thereto.

On the drive side of the mill, the horizontal rolls are not provided with thrust bearings but have only radial babbit bearings, similar in construction to the bearings **19**. Nor is it necessary to provide roll retaining means for the rolls at the drive side of the mill. This is because the chocks **17** of the operating side of the mill **10** are rigidly connected to the chocks **18** of the drive side by bars **96** arranged on each side of the pass line, two for each pair of chocks. By this construction only the thrust bearings and roll-retaining means employed on the operating side of the mill hold the rolls against axial movement.

As best shown in FIGURES 9 and 10, on the inner opposite sides of the chocks **17** and **18** there are provided projections **97** including vertically formed slots **98** into which are received the ends of the bars **96** and by which means the pairs of chocks are interconnected. In this manner the chocks on the drive side of the mill need not be directly secured to the adjacent housing **12**; instead they are held in their operative position by virtue of the fact that they are directly connected to the chocks on the operating side of the mill which, in turn, are connected to the housing **11**. It is to be pointed out that the bars not only eliminate the need of incorporating retaining means on the drive side of the mill, but, in addition their employment also makes it possible for the chocks to be preassembled on the roll journals at their exact operating positions prior to placement of the rolls in the mill. Another feature incident to the use of the bars **96** is that the work piece stripper guides **99**, shown only in FIGURES 9 and 10, can be constructed to be carried by the bars, whereby these guides can be removed with the rolls and arranged in the proper operating position prior to insertion of the rolls into the mill. These advantages assist in keeping at a minimum the lost time otherwise required for roll changing.

Horizontal roll-retaining means

With reference again to FIGURE 3, it will be noted that the outer extreme of the extendable end portions **89** of the chock **17** are formed with a stepped circular opening **101** concentrically arranged with respect to the axis of the roll **84**. Into the enlarged circular portion of the opening **101** an enlarged end portion **102** of a screw **103** is received, the inner surface of the end portion **102** of the screw tightly engaging with the collar formed by the reduced portion of the opening **101** and against which it is held by a nut **104** carried by the adjacent portion of the screw **103**. Once assembled, the nut **104** is rigidly secured to the screw and will rotate with it, thereby assuring that the tight connection between the chock **17** and screw **103** will always be maintained. The screw **103** is carried by a roll-retaining arm **105** for which purpose the arm is provided with an opening **106** through which the screw unrestrictedly passes. Nuts **107** and **108** are provided on the screw **103** and arranged to engage the opposite sides of the arm **105**, by which construction the screw is held in its proper position.

The roll illustrated in FIGURE 3 represents one of the shorter lengths employed in the mill. This being the case, the ends of the roll will fall between the inner faces of the housings **11** and **12**. As a result, the configuration of the arm **105** is made straight, the length of the screw **103** being sufficiently long to bridge the distance between the end of the chock and the arm. When longer length rolls are to be employed in the mill, as will be discussed later, the arm shown in FIGURE 3 will be replaced by another arm designed to extend out from the housing **11** thereby providing for the necessary allowance for the increased roll length while at the same time permitting a single given length screw to be employed.

The opposite ends of the arm extend beyond the inner surfaces of the housing **11** and are secured thereto by the previously mentioned keeper plates **45** which are secured to the housing. The arm **105** is provided with two horizontally arranged square shaped holes **109** through which pass parallel projections **111** formed as an integral part of the chock **17**. These projections are provided to prevent any tendency of the arm to rotate relative to the screw **103**. It will be observed that the projections **111** are made sufficiently long so as to enable the projections to extend through the arm **105** for the entire range of roll lengths.

On either side of the screw **103**, the arm **105** has formed thereon integral piston cylinder assemblies **112**, which construction is best shown on the right-hand side of FIGURE 3. The outer ends of the pistons are connected to the chock **17** so that once the nuts **107** and **108** are rotated away from the arm **105**, the chock **17** and roll **84** including the screw **103** can be quickly moved in an axial direction. In this manner any necessary adjustment of the roll **84** relative to the lower roll can be quickly and automatically accomplished. Once the adjustment has been made, either or both of the nuts **107** and **108** will be tightened to connect the screw **103** rigidly to the arm **105** and thus assure that any axial displacement of the roll will be prevented.

With reference now to FIGURES *5a* and *5b*, there is illustrated two other roll-retaining arm assemblies provided for use with the remainder of the pairs of varying length rolls employed in the mill. In FIGURE *5a* it will be noted that the configuration of the arm **113** provided for this arrangement is not straight as in the case of the arm **105**, but the portion of the arm in which the opening **114** is provided for supporting the screw **103** is arranged farther away from the housing **11** than in the case of the arm **105**. Arm **113** is designed to be used with the length of rolls for rolling the middle range of beams.

In FIGURE *5b* the arm **115** is formed in the shape of a U having its opening **116** for supporting the screw **103** much farther away from the housing **11** than either of the arms **105** or **113**. The arm **116** is designed for use with the length of rolls for rolling structural beams. It will thus be appreciated that by employing the replaceable arms **105**, **115** and **113**, the screw **103** may be kept at a single given length and still be effective for the extremely wide range of different length rolls.

Now with reference to the diagrammatical drawings of FIGURES 11*a*, *b*, *c* and *d*, there is illustrated in these figures, in connection with several different length rolls, the relative positions of the major components of the mill in relation to the roll-supporting beams **24**. Each drawing illustrates schematically a universal finishing mill designed to roll both wide-flange and structural beams and in each case only the top horizontal roll, a portion of the bottom roll, the chocks of the top roll **17** and **18**, the vertical rolls **77** and **78**, the upper beams **24** and the upper mill screws **37** are shown. Certain center lines of some of the elements are indicated in order to aid in illustrating the relative positions of the elements.

FIGURE 11*a* illustrates horizontal rolls **117** and **118** designed to roll one of the smallest size wide-flange beams. As indicated, the length of the rolls in this case can be maintained at a very minimum since the chocks **17** and **18** thereof can be positioned along the beam **24** and yet be adequately supported.

With reference to FIGURES 11*b* and 11*c*, horizontal rolls **119** and **121** of FIGURE 11*b* and rolls **122** and **123** of FIGURE 11*c* are designed to roll the intermediate and full width wide-flange beams, respectively. Here, again, the minimum length rolls are shown employed with their chocks **17** and **18** positioned along the beam **24**.

In considering FIGURE 11*d*, the greatest significance of the present invention can be appreciated with respect to providing a mill wherein minimum length rolls can be employed. This drawing shows the employment of the relatively long structural rolls **124** and **125** in the same mill for rolling wide-flange beams. In this rolling operation, it will be noted that the chocks **17** and **18** are positioned directly beneath the mill screws **37** and within the housings **11** and **12**.

In each of these schematic figures, in addition to serving to exemplify the feature of the present invention wherein minimum length rolls can always be utilized, they also demonstrate the fact that the present invention permits the elimination of the need of moving the housings or alternatively employing of set-up mills.

FIGURES 11*a*, *b*, *c* and *d* also serve to point out the improved roll changing features of the present invention. In this connection it will be noted that the beam **24** will support the rolls while they are being withdrawn from and inserted into the mill from the time their ends pass into the windows. As indicated earlier, this feature greatly increases the speed at which the horizontal roll can be changed. While for the purpose of illustration, the invention has been related to a rolling mill, it will be appreciated that it may just as readily find utility in other apparatuses.

In accordance with the provisions of the patent statutes, I have explained the principle and operation of my invention and have illustrated and described what I consider to represent the best embodiment thereof. However, I desire to have it understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. In a rolling mill comprising a pair of housings adapted to alternately receive a first roll arrangement consisting of a pair of rolls of a given length or a second roll arrangement consisting of a pair of rolls of a length different from said given length,

windows in said housings into which said two roll arrangements are alternately received,

bearing-chock assemblies secured to the ends of the rolls of each pair, wherein the distance varies between the assemblies of each pair of the different length rolls,

a first supporting member extending through the windows of each of said housings and engageable by the bearing-chock assemblies of one of the rolls received in said housings of an alternate pair of rolls, in a manner that the assemblies thereof can be located axially along one of said first supporting members as determined by the length of the roll,

a second supporting member extending through the windows of each of said housings and engageable by the bearing-chock assemblies of the other roll of the pair of rolls received in said housings, in a manner that the assemblies thereof can be located axially along said second supporting members as determined by the length of the roll,

means for maintaining said bearing-chock assemblies of the pair of rolls received in said housings in their operative positions along said first and second members,

said first and second supporting members comprising rigid beams connected to said housings, and

means for slidably connecting said bearing-chock assemblies of the pair of rolls received in said housings to at least one of said beams.

2. In a machine according to claim **1**:

wherein the means for slidably connecting the bearing-chock assemblies to said beam comprises;

members having guiding and supporting surfaces;

said surfaces extending through the windows of said housings, thereby serving to support said bearing-chock assemblies and rolls when they are removed from and inserted into the mill.

3. In a machine according to claim **1**:

in which said beams have portions engageable with said bearing-chock assemblies for resisting in one direction the rolling forces imposed thereon; and

means provided for resisting in another direction the rolling forces imposed on said assemblies.

4. In a machine according to claim **1**:

a pair of screws arranged in said housings for adjusting one of said rolls relative to the other; and

one of each of said beams engaged by and movable with said screws.

5. In a machine according to claim **4**, including

means for supporting said adjustable roll, the bearing-block assemblies thereof and the beam engaged thereby and for urging said bearing-chock assemblies into contact with said beam and said beam into contact with said screws.

6. In a machine according to claim **4**; including

means for causing said bearing-chock assemblies of the adjustable roll to separate themselves from said engageable portions of said beam, whereby the assemblies will be supported and movable freely along the said beam.

7. In a machine according to claim **4**, including

a latch mounted on one of said housings and operable to engage with and support said beam when the adjustable roll is to be removed from and inserted into the mill.

8. In a rolling mill comprising a pair of housings adapted to alternately receive a first roll arrangement consisting of a pair of rolls of a given length or a second roll arrangement consisting of a pair of rolls of a length different from said given length,

windows in said housings into which said two roll arrangements are alternately received,

bearing-chock assemblies secured to the ends of the rolls of each pair, wherein the distance varies between the assemblies of each pair of different length rolls,

a screw connected to one of said bearing-chock assemblies of each roll of the pair received in said housings for axially adjusting the rolls with which it is associated,

replaceable yokes for each screw having a portion connectable to one of said housings and another portion connectable to its screw, in which for a given length of screw the distance varies between the portions connectable to the housing and the screw dependent upon the length of the alternate pair of rolls,

means for securing said screws to said yokes, and

means for quickly moving said screws.

9. In a machine according to claim **8** in which,

said yokes are provided with openings;

projections on said chocks adjacent to said yokes extending through said openings thereby to connect said yokes to said chocks.

10. In a machine for rolling workpieces requiring cooperative pairs of rolls of different lengths;

a pair of housings;

windows in said housings;

a cooperative pair of rolls alternately received in said windows and establishing a rolling pass;

bearing-chock assemblies secured to the ends of each of said rolls;

two bars, one arranged above and one arranged below said rolling pass, one of said bars being secured to and connecting together the bearing-chock assemblies of one roll, and the other pair secured to and connecting together the bearing-chock assemblies of the other roll;

means for securing the bearing-chock assemblies, at one end of said rolls, to one of said housings;

upper and lower guides for directing a workpiece into the pair of cooperative rolls; and

said guides mounted on said bars in such a manner that the rolls, bearing-chock assemblies and upper and lower guides can be inserted into and removed from the machine as a unit.

11. In a rolling mill comprising a pair of housings adapted to alternately receive a first roll arrangement consisting of a pair of rolls of a given length or a second roll arrangement consisting of a pair of rolls of a length different from said given length,

windows in said housings into which said two roll arrangements are alternately received,

bearing-chock assemblies secured to the ends of the rolls of each pair, wherein the distance varies between the assemblies of each pair of the different length rolls,

a first supporting member extending through the windows of each of said housings and engageable by the bearing-chock assemblies of one of the rolls of a pair of rolls, in a manner that the assemblies thereof can be located axially along said first supporting member as determined by the length of the roll,

a second supporting member extending through the windows of each of said housings and engageable by the bearing-chock assemblies of the other roll of a pair of rolls, in a manner that the assemblies thereof can be located axially along said second supporting member as determined by the length of the roll,

means for maintaining said bearing-chock assemblies in their operative positions along said first and second supporting members,

means for driving the rolls of the alternate pairs received in said housings,

means for connecting the rolls received in said housings to the driving means, and

means for positioning the connecting means to bring the connecting means into a driving relationship with the alternate pair of rolls received in said housings, thereby compensating for the difference in length thereof.

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