Sept. 25, 1962 A. I. WILSON 3,055,242

ROLLING MILLS

Filed July 5, 1960 3 Sheets-Sheet 1

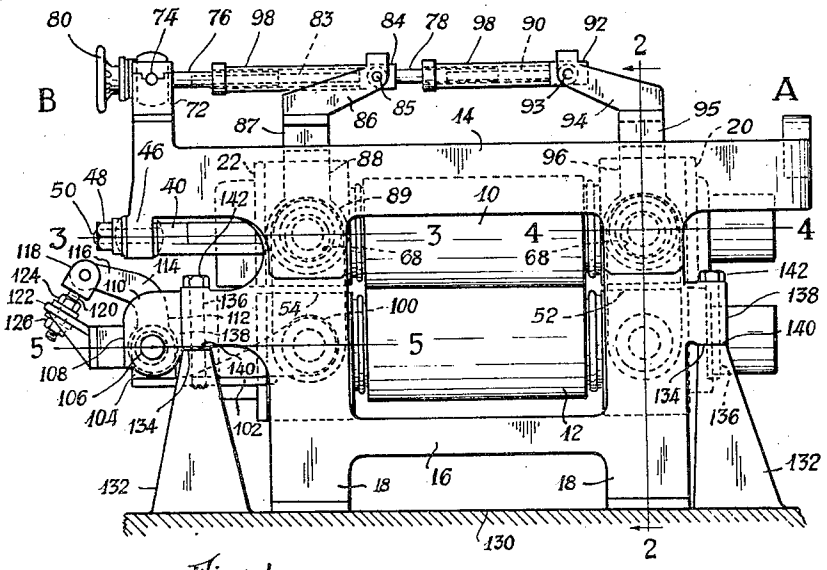


Fig. 1.

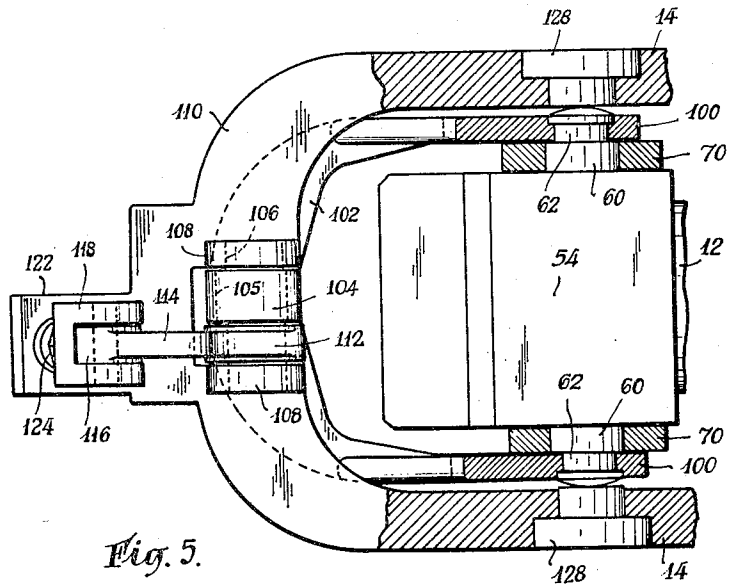


Fig. 5.

INVENTOR.
Alexander I. Wilson
BY
Albert L. Jacobs
ATTORNEY

Sept. 25, 1962 A. I. WILSON 3,055,242

ROLLING MILLS

Filed July 5, 1960 3 Sheets-Sheet 2

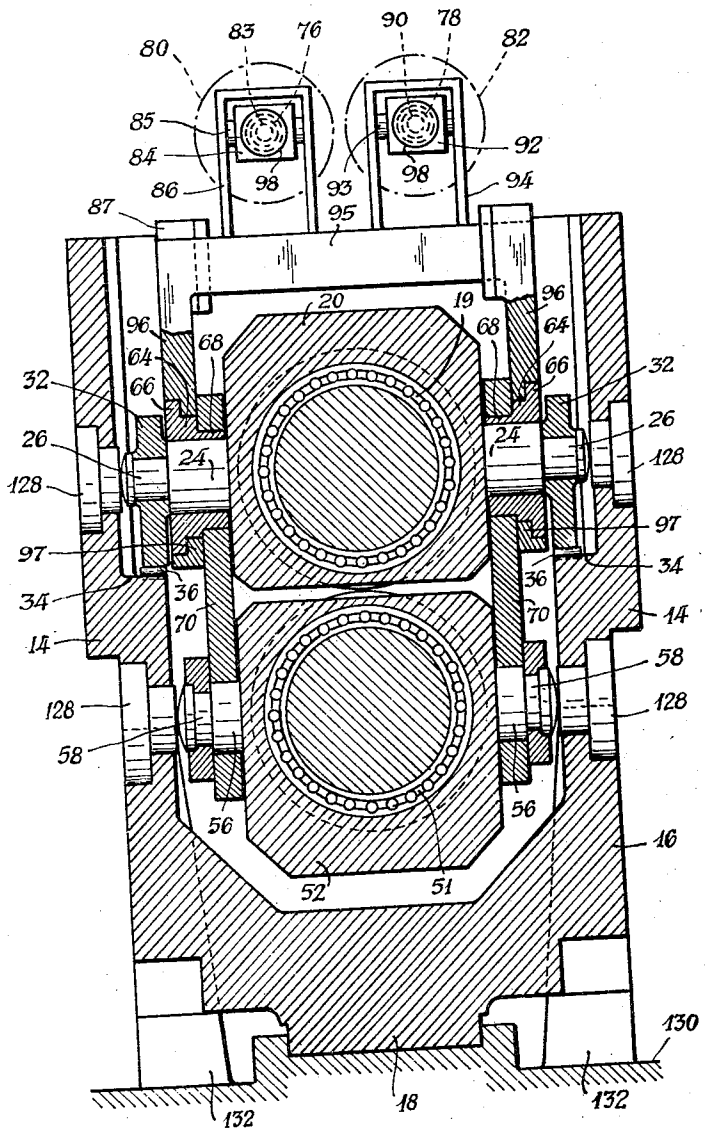


Fig. 2.

INVENTOR
Alexander I. Wilson
By Albert L. Jacobs
ATTORNEY

Sept. 25, 1962 A. I. WILSON 3,055,242

ROLLING MILLS

Filed July 5, 1960 3 Sheets-Sheet 3

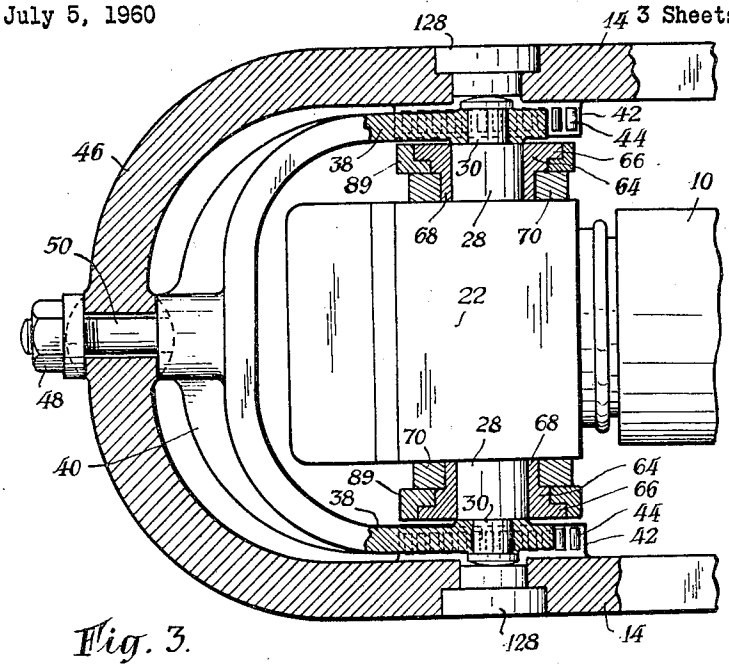


Fig. 3.

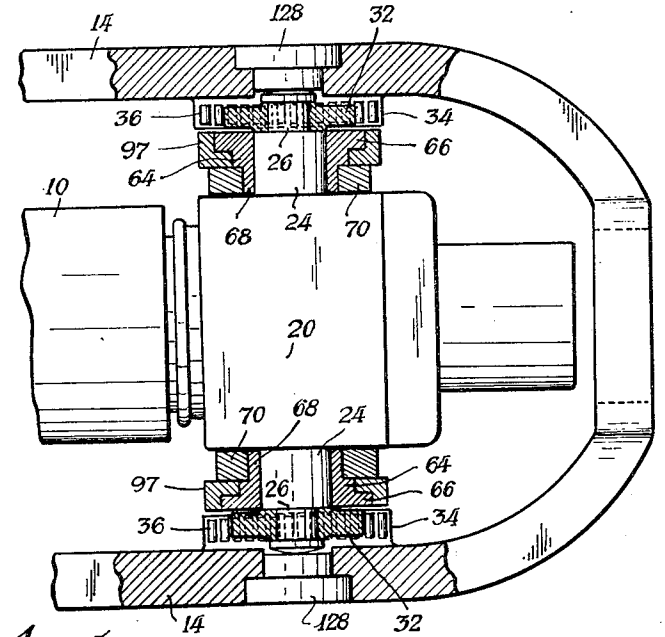


Fig. 4.

INVENTOR
Alexander I. Wilson
BY Albert L. Jacobs
ATTORNEY

United States Patent Office 3,055,242 Patented Sept. 25, 1962

3,055,242

ROLLING MILLS

Alexander Ian Wilson, High Green, near Sheffield, England, assignor to Morgan Construction Company, Worcester, Mass., a corporation of Massachusetts

Filed July 5, 1960, Ser. No. 40,696
9 Claims. (Cl. 80—31.1)

This invention relates to a rolling mill and more particularly to apparatus arranged to reduce in size and to elongate rod or bars of metal by means of roll deformation.

The conventional rolling mill consists of housings in which the rolls are mounted in bearings and, in the past, difficulty has been encountered in maintaining accurate settings of the rolls in relation to another after the rolling operation has begun. Consequently, the gap between the rolls, which should remain constant in order to obtain accurate rolling, is liable to vary as the rolling proceeds. This inconsistency in the roll gap has apparently arisen from changes in the rolling pressure; this pressure changes when the section of the billet, rod, slab, strip, or the like varies in size, temperature, or hardness. It also occurs in the case of continuous mills when the material being rolled is subjected to tension within the roll gap. During rolling, stresses are set up in such a manner that a cycle of stresses occurs which, starting at the roll gap, travels through the rolls and through the various components back to the gap again; the strain resulting when the circle is completed cause the gap to open by an amount depending on the rolling load. This opening of the gap is spoken of as the "spring" in rolling practice and this term is used hereinafter where the context requires.

The rolling mill housing and the components in which the rolls are mounted and held together necessarily have joints or interfaces which add considerably to the amount of spring, particularly at low loads before the slack in the housings is taken up. The amount of this spring due to the interfaces is dependent not only on the number of such interfaces but also upon their nature. The rolling mill operator endeavors to remove the disadvantages set forth above by tightening the bolts and nuts of the roll stand in order to take up any slack and by making the components more compact and rigid so as to induce the desired rigidity or stiffness in the mill. This tightening up of the bolts and nuts, however, is more likely to create other faults, one of the most serious being that the self-aligning characteristics of the chocks is impaired; this results in reduced bearing life and in difficulty with the adjustment of the rolls. Also, in order to obtain rigidity and stiffness in the mill, it is customary to use massive housings and components not so much to increase the structural strength, but in order to limit the deflection. As a consequence, such mills are often cumbersome, difficult to adjust, and in many cases involve more joints or interfaces in the stress cycle than is desirable. Furthermore, it is important, particularly in high speed continuous rolling mills, that the roll changing should be carried out as quickly as possible in order to reduce the "shut-down" time of the rolling operations to the lowest possible value.

It is, therefore, an outstanding object of the invention to provide a rolling mill having improvements which will result in a very stiff mill, particularly at the lower load ranges, without the necessity for using conventional roll housings and other massive components for mounting the rolls.

Another object of this invention is the provision of a rolling mill in which the length of the stress cycle is reduced as compared with conventional mills and the number of interfaces in the stress cycle also reduced, the interfaces which remain being of such a type that they can be accurately machine and fitted to reduce looseness.

A further object of the present invention is the provision of a rolling mill which has no roll mounting components which are subject to bending.

It is another object of the instant invention to provide a rolling mill which can be accurately adjusted both vertically and axially with considerable precision, the adjustments being made in such a way that the self-aligning features of the chocks are not affected, thus allowing for perfect bearing conditions as near as possible.

It is a further object of the invention to provide a rolling mill such that the rolls, chocks and guides may be set up remote from the position the mill is to occupy during rolling and then can be taken to its required position, readily lifted and located in position, thus facilitating rapid roll changing and reducing mill shut-down time to a minimum.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

The character of the invention, however, may be best understood by reference to certain of its structural forms as illustrated by the accompanying drawings in which:

FIG. 1 is an elevational view of one form of a rolling mill constructed in accordance with the principles of the present invention;

FIG. 2 is a vertical sectional view drawn to an enlarged scale on the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary horizontal sectional view drawn to an enlarged scale of the invention on the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary horizontal sectional view drawn to an enlarged scale of the invention on the line 4—4 of FIG. 1;

FIG. 5 is a fragmentary horizontal sectional view drawn to an enlarged scale of the invention on the line 5—5 of FIG. 1.

In general, the present invention consists in providing a rolling mill in which the rolls and their chocks and bearings, along with means adjustably connecting together adjacent upper and lower chocks by links supported and suspended from trunnions on the chocks of the upper mounting, make up a unit which is adapted to be removably supported at the tops of exterior pillars suitably supported on the floor of the steel mill.

In the rolling mill shown in the drawings, upper and lower rolls 10 and 12, respectively, are held longitudinally between and substantially parallel with upstanding side members 14 of an open ended supporting frame 16. The side members are open at the entrance and exit sides of the rolls and the frame is mounted on supporting base parts 18.

The upper roll 10 is supported at the drive end A of the stands in bearings 19 which, in turn, are mounted in a chock 20, and at the work end B in similar bearings (not shown) which are mounted in a chock 22. The upper roll chock 20 at the drive end of the roll stand is provided with a pair of trunnions 24 having reduced extensions 26 and intersecting the axis of the roll 10. In a similar manner the upper roll chock 22 at the work end of the roll stand is provided with trunnions 28 and reduced extensions 30 which intersect the axis of the roll 10.

The trunnion extensions 26 of the chock 20 at the drive end of the stand are accommodated for rotation in blocks 32 which are freely slidable on inwardly-directed horizontal support surfaces 34 provided therefor on the side members 14 of the frame 16. It will be obvious, therefore, that the chock 20 is mounted so as to permit swiveling in a vertical plane by means of its trunnions 26 as well as to be slidable horizontally because of the

slidable blocks **32**. Rollers **36** are interposed between the blocks **32** and the support surfaces **34** to provide for easy sliding movement of the blocks.

At the work end B of the roll stand the trunnions **30** of the upper roll chock **22** are rotatably accommodated in co-axial eye ends **38** formed on an adjustable yoke **40**, the said eye ends **38** being slidably supported on inwardly-directed horizontal support surfaces **42** provided on the side members **14** of the frame **16**. These are similar to and are in horizontal alignment with the support surfaces **34** on the frame at the drive end of the roll stand, there being rollers **44** interposed between the surfaces **42** and the eye ends **38** of the yoke **40**.

The yoke **40** is connected for swiveling to an upper arcuate cross member **46** of the frame **16** for a very limited amount of horizontal swiveling movement; it is also adjustable axially of the roll **10** to permit adjustment of the latter and is secured by means of a tightening nut **48** which engages a screw-threaded stem **50** of the yoke.

The lower roll **12** is supported in bearings **51** which, in turn, are mounted in chocks **52** and **54** at the drive and work ends, respectively, of the roll stand. The chock **52** at the drive end is provided with trunnions **56** having co-axial reduced extensions **58**, the axes of the said trunnions intersecting the axis of the lower roll **12**. The chock **54** at the work end is provided with trunnions **60** having reduced extensions **62** which also intersect the axis of the lower roll **12**. The lower roll **12** is freely and adjustably suspended at both ends from the upper roll, as will be described hereinafter.

Mounted on each of the trunnions **24** and **28** of the two upper roll chocks **20** and **22**, respectively, is a flanged bushing **64** having an outer end flange **66** and a reduced inner end providing externally thereof an eccentric **68**. Suspended from the eccentric of each bushing **64** closely adjacent to the adjacent chock is a depending link **70**, such that a pair of such links is suspended from the upper roll chocks at each end of the upper roll and the trunnions of the lower roll chocks are accommodated in the lower ends of the links **70**, as is clearly shown in FIG. 2.

It will be appreciated, therefore, that the lower roll **12** is freely suspended from the upper roll **10** through the medium of the chocks and the suspension links **70** engaging the trunnions of the chocks.

In order that the axis of the lower roll **12** may be adjusted relative to the axis of the upper roll **10** for determining the depth of gap therebetween, the bushings **64** on the trunnions **24** and **28** of the upper roll chocks are adapted to be rotatably moved, so that the eccentrics **68** of said bushings may turn within the upper end of the links **70** and thereby raise and lower said link, bringing about similar movement to the chocks of the lower roll, according to the direction of rotation of the eccentrics.

In order to mechanically turn the eccentric **68** overhead screw operating means are provided which comprises an upstanding bracket **72** at the upper end of the frame **16** at the work end B. The bracket **72** supports the two side-by-side bearings **74** for two internally screw threaded hollow rotatable spindles **76** and **78** which are separately operable by handwheels **80** and **82**.

Engaging the hollow screw threaded spindle **76** is the end of a screw-threaded rod **83** carried by a block **84** to which is pivotally connected at **85** a stirrup **86** carried on the cross head **87** of a pair of levers **88** which straddle the upper roll chock **22**. The levers are provided with eye ends **89** encircling the bushings **64** which in turn, are disposed on the trunnions **28** of the chock **22**, said lever eye ends **89** being connected for driving to the flanges **66** of said bushings.

Similarly engaging the hollow screw threaded spindle **78** is the end of a screw threaded rod **90** carried by a block **92** to which is pivotally connected at **93** a stirrup **94** carried on the cross head **95** of a pair of levers **96**. These levers straddle the upper roll chock **20** and are

provided with eye ends **97** encircling the bushings **64** on the trunnions **24** of the chock **20**. The lever eye ends **97** are connected for driving to said bushings at the flanges **66** thereof.

A protecting outer sleeve **98** is carried by each block **84** and **92** around the screw threaded rods **83** and **90** for telescoping the hollow spindles **76** and **78**, respectively.

Rotation of the handwheels **80** and **82** will, therefore, bring about movement of the pair of levers **88** and **96**, rotatably moving the eccentric bushings **64** and raising or lowering the links **70** so as to adjust the axis of the lower roll **12** with respect to the upper roll **10**.

To provide for axial adjustment of the lower roll **12** the trunnion extensions **62** of the lower roll chock **54** at the work end of the roll stand are accommodated in the co-axial eye ends **100** of a slidable yoke **102**. The yoke has an upstanding eye lug **104** by which it is supported on the eccentric **105** of a pivot pin **106** mounted in a pair of co-axially spaced eye lugs **108** mounted on an arcuate cross member **110** of the frame **16**. Fixedly mounted on the pin **106** adjacent the eye lug **104** of the yoke **102** is one end **112** of a bent lever **114**. The other end **116** of the lever **114** is connected to the bifurcated head **118** of a screw threaded stud **120**. This stud is slidably extended through a supporting bed **122** which is attached to the arcuate cross member **110** of the frame **16**, the screw-threaded stud **120** being slidably adjustable by means of upper and lower adjusting nuts **124** and **126**.

When adjusting the lower roll axially, adjustment of the bent lever **114** will bring about longitudinal movement of the yoke **102** by means of the eccentric **105** of the pin **106** which rotates within the eye of the lug **104** of the said yoke.

Stainless steel plugs **128** are provided in the frame **16** to abut the ends of the trunnion extensions of the four roll chocks and thereby serve to locate the chocks at the sides thereof.

It can be seen that the upper and lower rolls with the chocks in which they are rotatably mounted and the means for adjusting each roll wtih respect to the other make up, together with the frame, a stand unit. This unit can be assembled at a position remote from the working position and transported thereto as required. It can then be erected upon supports which are secured to the mill floor. For this purpose a bedplate **130** carrying four roll stand supporting pillars **132** is provided. The upper ends of the pillars **132** are provided with seating faces **134** and strong screw-threaded studs **136** projecting therefrom. The frame **16** is provided with four end eye lugs **138** and seating faces **140** on the underside thereof complementary to and intended for fastening to the seating faces **134** of the pillars **132** by means of securing nuts **142**.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

1. A rolling mill, comprising a frame, an upper roll, a lower roll, an end mounting including a bearing mounted on each end of each roll, means on the frame for supporting the upper roll mountings, and adjustable means pivoted with respect to both the upper and lower roll end mountings for suspending the lower roll mountings from the upper roll mountings substantially independently of the frame.

2. A rolling mill, comprising a frame, an upper roll, a lower roll, end mountings including bearings therein for each roll, means supporting the upper roll mountings in said frame, means pivoted respect to both the upper and lower roll mountings and suspending the lower roll mountings from the upper roll mountings substantially independently of the frame, all of the said mountings

being swivelable in a vertical plane parallel to the roll axes, means operable upon the suspension means for the lower roll mountings for adjusting the lower roll with respect to the upper roll, means for axially adjusting the upper roll, and means for axially adjusting the lower roll.

3. A rolling mill, comprising a frame, an upper roll, a lower roll, end mountings including bearings for each roll, means slidably adjustable in a horizontal direction on the frame and supporting the upper roll mountings, adjustable means suspending the lower roll mountings from said upper roll mountings substantially independently of the frame, and means slidable horizontally on the frame for adjusting the lower roll.

4. A rolling mill, comprising a frame, an upper roll, a lower roll, an end chock for each end of each roll, trunnions on the upper roll chocks having a common horizontal axis intersecting the plane containing the axes of the upper and lower rolls at a right angle thereto, means slidably adjustable horizontally on the frame and supporting said upper roll chocks by said trunnions, said means being operable for adjusting the upper roll, trunnions on the lower roll chocks having a common horizontal axis intersecting the plane containing the axes of the lower and upper rolls at a right angle thereto, eccentric bushings on each upper roll chock trunnion, links suspended from said eccentric bushings and supporting the lower roll chock trunnions, means mounted on the eccentric bushings for turning the bushings in order to raise or lower the links, and means slidable in a horizontal direction on the frame and engaging the lower roll chock trunnions for axially adjusting the lower roll.

5. A rolling mill, comprising a frame, an upper roll, a lower roll, an end chock mounted on each end of each roll, trunnions on the upper roll chocks having a common horizontal axis intersecting the plane containing the axes of the upper and lower rolls at a right angle, means slidably adjustable in a horizontal direction on the frame and supporting the upper roll chocks by the trunnions, the said means being operable for adjusting the upper roll, trunnions on the lower roll chocks having a common horizontal axis intersecting the plane containing the axes of the lower and upper rolls at a right angle thereto, eccentric bushings one on each upper roll chock trunnion, links suspended from said eccentric bushings and supporting the lower roll chock trunnions, means separately mounted on the eccentric bushings at opposite ends of the upper roll for turning the bushings at one end in unison in order to raise or lower the links at said one end together, and means slidable in a horizontal direction on the frame and engaging the lower roll chock trunnions for axially adjusting the lower roll.

6. A rolling mill, comprising a frame, an upper roll, a lower roll, an end mounting including a bearing mounted on each end of each roll, means on the frame supporting the upper roll mountings, means in the form of pairs of links pivotally attached to opposite sides of said end mountings and swingable only in vertical planes parallel to the axes of said rolls, said links suspending the lower roll mountings from the said upper roll mountings substantially independently of the frame, and means for adjusting each pair of said links with respect to at least one of said end mountings whereby the space between said rolls may be varied.

7. A rolling mill, comprising a frame, an upper roll, a lower roll, an end mounting including a bearing mounted on each end of each roll, means on the frame supporting the upper roll mountings, and adjustable means suspending the lower roll mountings from the said upper roll mountings substantially independently of the frame, said adjustable means comprising links pivotally connected to the said end mountings and swingable about their pivots in vertical planes only.

8. A rolling mill, comprising a frame, an upper roll, a lower roll, an end mounting including aligned trunnions and a bearing mounted on each end of each roll, means on the frame acting through the trunnions for supporting the upper roll mountings, adjustable means in the form of links extending between corresponding upper and lower mounting trunnions thereby suspending the lower roll mountings from the said upper roll mountings substantially independently of the frame.

9. A rolling mill comprising a frame, an upper roll, a lower roll, an end mounting including a bearing mounted on each end of each roll, aligned trunnions on opposite sides of each mounting, means on the frame supporting the two upper roll mountings by the trunnions, links pivotally connected to the upper mounting trunnions at a position between the said supporting means and the mounting, the said links also pivotally connected to the lower mounting trunnions whereby the lower roll is suspended by said links, and means on said frame slidingly engaging the ends of said trunnions to prevent movement of said mountings in the direction of the pass line of the rolls while permitting movement of said mountings in a direction parallel to the axes of said rolls.

References Cited in the file of this patent

UNITED STATES PATENTS

1,773,737	Lindquist	Aug. 26, 1930
1,972,158	Moreland	Sept. 4, 1934
2,072,831	Solenberger	Mar. 2, 1937
2,240,362	Backhaus	Apr. 29, 1941
2,506,681	Norlindh	May 9, 1950

FOREIGN PATENTS

200,426	Germany	July 18, 1908
505,252	Germany	May 14, 1932
834,387	Germany	Mar. 20, 1952
923,362	Germany	Feb. 10, 1955
1,235,591	France	May 30, 1960