United States Patent

Amend

[15] **3,702,557**

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[54] **APPARATUS FOR SUPPORTING YOKES FOR A ROLLING MILL HAVING ROLL CONTOUR CONTROL**

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[52] **U.S. Cl.** **72/238**

[51] **Int. Cl.** **B21b 31/08**

[58] **Field of Search** 72/237–239

[56] **References Cited**

UNITED STATES PATENTS

3,373,588	3/1968	Stone	72/237
3,364,715	1/1968	O'Brien	72/241
3,526,118	9/1970	O'Brien	72/243
3,373,589	3/1968	O'Brien	72/237

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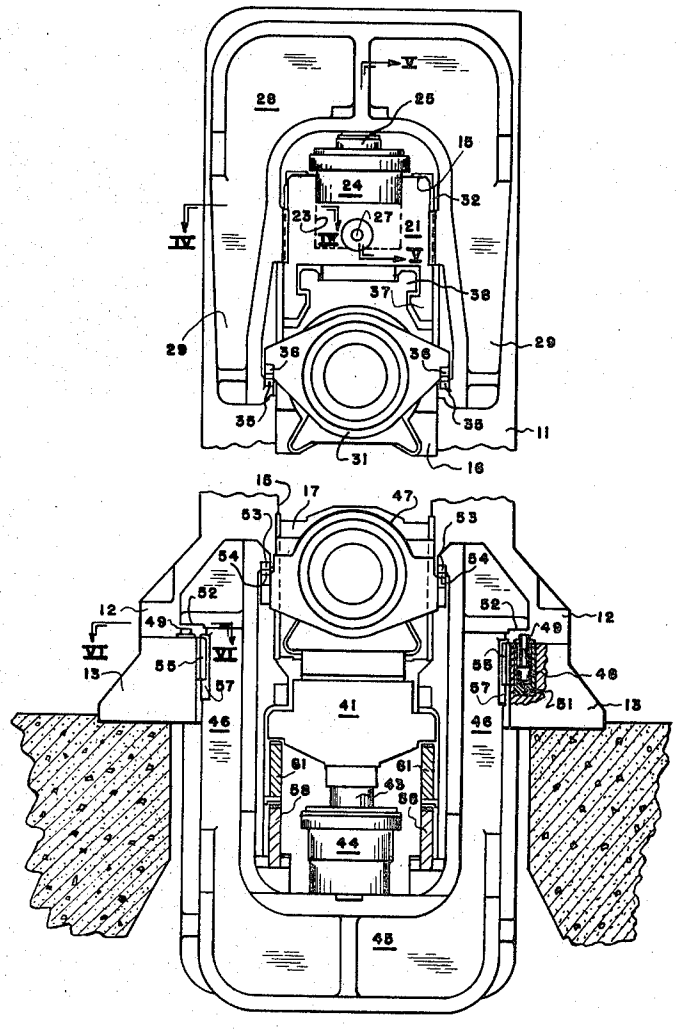
[57] **ABSTRACT**

This disclosure relates to an improved 4-high rolling mill construction which is particularly useful to facilitate backup roll changing. The rolling mill includes piston and cylinder assemblies employed to develop a roll bending force which is transmitted by yokes to outboard bearing chocks mounted on the backup rolls. A beam is provided between each backup roll and the top and bottom of the housings for absorbing the reaction force to the roll bending force. The yokes for the upper backup roll are guided and horizontally supported by the beam. The yokes for the bottom backup roll are guided and horizontally supported by the housing bed plates which further include piston and cylinder assemblies for vertically supporting these yokes during replacement of the bottom backup roll.

11 Claims, 6 Drawing Figures



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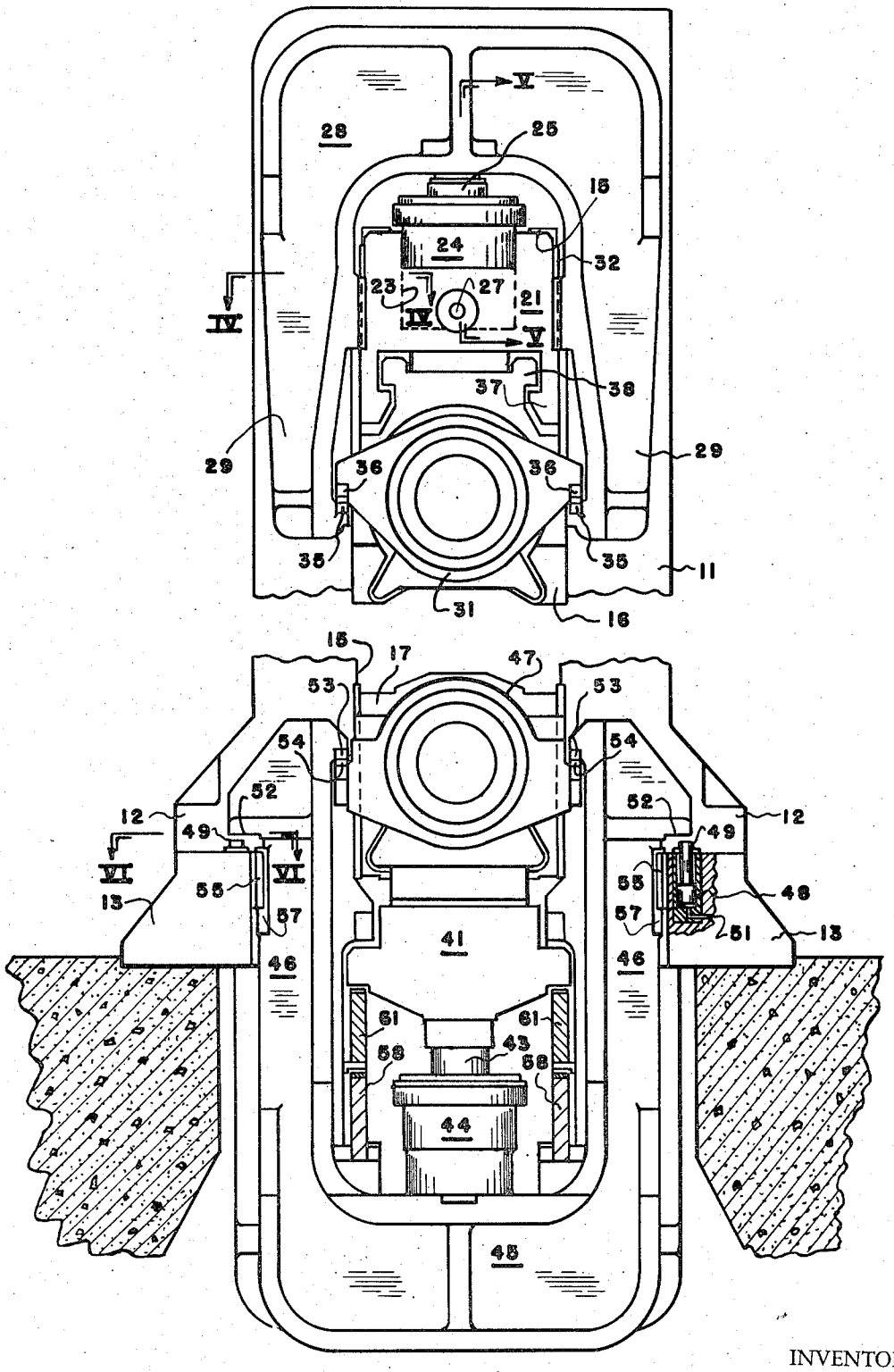

FIG. 1

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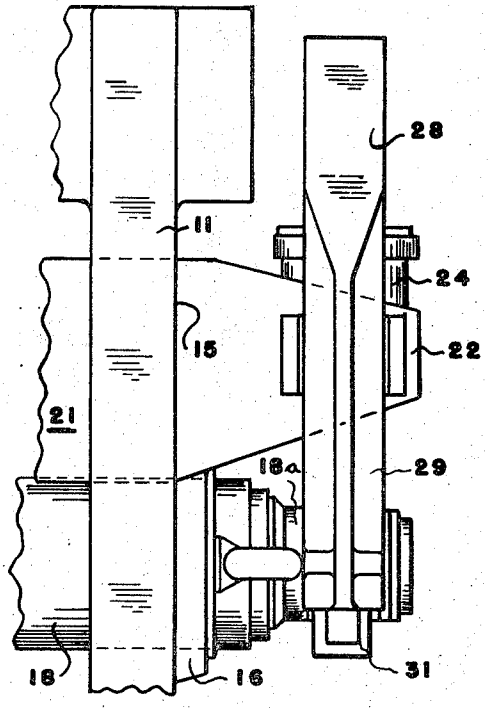

FIG. 2

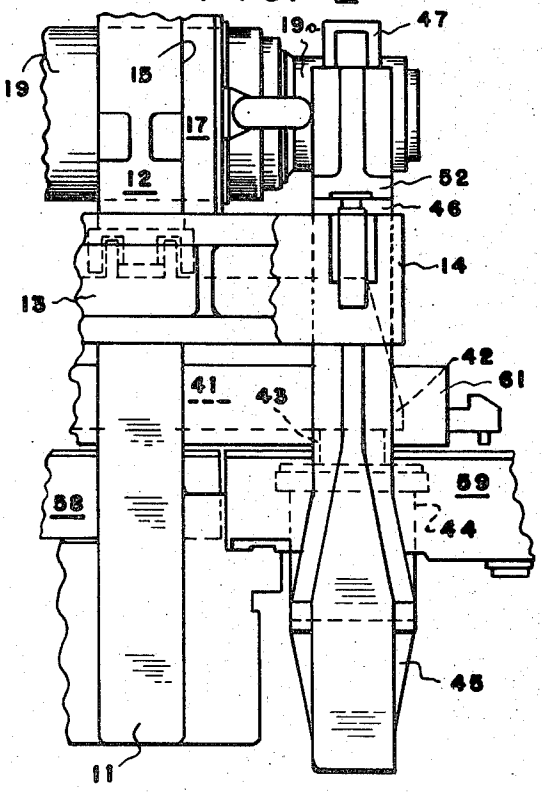

FIG. 3

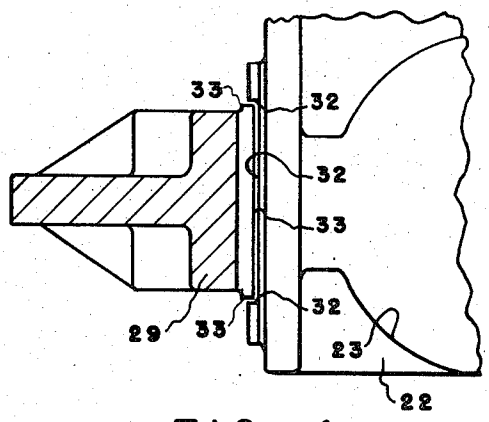

FIG. 4

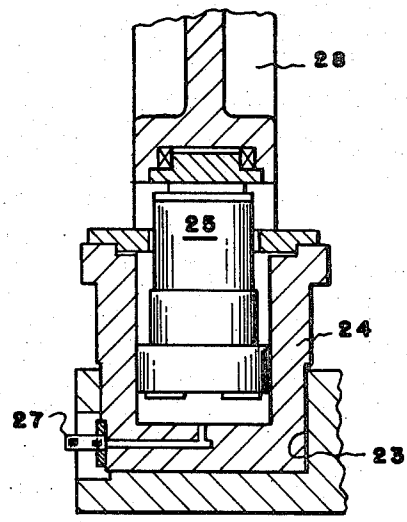

FIG. 5

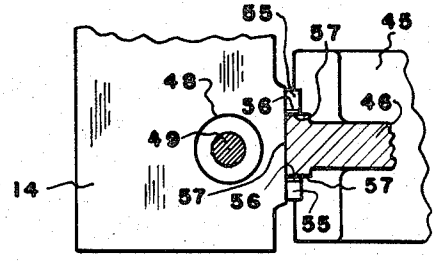

FIG. 6

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APPARATUS FOR SUPPORTING YOKES FOR A ROLLING MILL HAVING ROLL CONTOUR CONTROL

The present invention relates to an improvement in rolling mills employed to process strip, sheet or plate, and, more particularly, to such rolling mills which are provided with means for applying crown or contour controlling bending moments to the journals of the backup rolls in the case of a 4-high rolling mill and to the journals of the work rolls in the case of a 2-high rolling mill.

A valuable and successful control has been added to rolling mill technology through the use of force generating means for applying contour control bending moments to certain of the rolls of a rolling mill. The actual design and arrangement of parts provided for enabling such control has presented certain problems and disadvantages, particularly with respect to replacement of the rolls in the mill. In present-day rolling mills, great attention continues to be focused on minimizing lost mill production brought about by the time required for replacing the rolls in the mill. The weight and cumbersomeness of the roll assemblies, particularly, large plate mill backup rolls having additional bearings on their outboard ends for contour control, makes slow and careful movement necessary during their replacement in the mill housing. Moreover, prior to and after the actual roll replacement, apparatus forming part of the roll contour control means and directly associated with each such roll must be handled in some manner since, when in its operative location, such apparatus obstructs necessary access to the housing window for the replacement of the rolls.

One form of contour control apparatus designed to overcome the foregoing disadvantages during roll changing is disclosed in U.S. Pat. No. 3,373,589 and consists of carrying by a pivotal mounting on the mill housing, the piston and cylinder assemblies which engage the additional outboard bearing chocks on the rolls, which assemblies are used to impose the contour-controlling bending forces on the roll. During roll changing, these piston and cylinder assemblies are swung about their pivotal mounting to a remote position for enabling access to the housing window for replacement of the mill rolls.

Another rolling mill construction utilizing roll contour control via the outboard ends of the rolling mill rolls is described in U.S. Pat. No. 3,364,715, which features the provisions of beams arranged in the mill housings for absorbing the reaction forces to the bending forces generated incident to roll contour control without transferring such forces to the mill housings or through the conventional roll gap adjusting screws. Piston and cylinder assemblies are used to develop the roll bending force between the beam and the outboard bearing chock on the roll end via links and cross members. Prior to the present invention, known prior art has failed to provide adequate facilities to handle and guide these links and cross members or similar mill parts during operation of the mill and during the time when servicing operations are performed, such as roll changing.

It is an object of this invention to provide an improved construction and arrangement of parts in a rolling mill having apparatus for applying contour control bending moments to at least certain of the rolls thereof.

It is a further object of this invention to provide a rolling mill having means for applying bending moments to outboard ends of certain of the rolls thereof. The rolling mill is characterized by a compact construction and arrangement of parts including bending force transferring yokes and means for supporting and positioning them during roll replacement and during servicing of parts in the mill, such as load cells, piston and cylinder assemblies, and the like.

It is another object of this invention to provide a compact mill construction requiring a minimum of parts to bring about guided support and positioning of force transferring yokes forming part of an apparatus for applying bending moments to certain rolls outboard of their main bearing chocks for controlling the contour of the rolling mill rolls.

These features and advantages, as well as others, will be better appreciated when the following description is read along with the accompanying drawings, of which:

FIG. 1 is a partial elevational view of the operating side of a 4-high rolling mill incorporating the features of the present invention, the work roll assemblies being removed for clarity,

FIG. 2 is a partial front elevational view of the upper portion of the rolling mill shown in FIG. 1,

FIG. 3 is a partial front elevational view of the lower portion of the rolling mill shown in FIG. 1,

FIG. 4 is a sectional view taken along line IV—IV of FIG. 1,

FIG. 5 is an enlarged sectional view taken along line V—V of FIG. 1, and

FIG. 6 is an enlarged sectional view taken along line VI—VI of FIG. 1.

With reference to FIGS. 1, 2 and 3, there is illustrated a 4-high rolling mill which includes a pair of housings 11, only the housing at the operator's side being shown in the drawings. It is to be understood that the housing and its component parts at the drive side are the same as hereinafter described with respect to the operator's side of the mill, unless otherwise noted. Each housing has as an integral part thereof horizontally projecting feet 12 by which the housings are secured in a spaced-apart relation on bed plates 13 that are supported on a foundation and have extensions 14 projecting beyond each of the mill housings, the purpose of which will be explained in detail hereinafter. The housing 11 is formed with a window 15 into which there is received an upper bearing chock 16 and a lower bearing chock 17 for rotatably mounting upper and lower backup rolls 18 and 19, respectively, that support in the usual manner a pair of work rolls, not shown. While not shown in the drawings, piston and cylinder assemblies are located in the bottom of the housings for adjusting the elevation of the lower backup roll and, thus, controlling the separation between the work rolls.

The top portion of the housing 11, as shown in FIGS. 1 and 2, includes a horizontally disposed beam 21 that is urged by a piston and cylinder assembly, not shown, against a force transferring surface located in the top of the housing. The beam extends through the mill in a parallel relation with the upper backup roll 18 such that its chock 16 contacts the lower surface of the beam in a force transmitting relationship. The beam 21 has a projecting end 22 extending beyond the housing and into which there is formed a circular recess 23 for

carrying a cylinder **24** having a piston **25**. As shown in FIGS. **1** and **5**, a conduit line **27** receives liquid under a controlled pressure to urge the piston **25** upwardly and apply a roll contour-controlling bending force to a yoke **28** having two downwardly extending arms **29** which transmit this force to an outboard bearing chock **31** mounted on an extended journal **18***a* of the backup roll **18**.

Referring to FIGS. **1**, **2** and **4**, the projecting end **22** of the beam at each side thereof has U-shaped guide surfaces **32** for receiving in a guiding relationship complementary guide surfaces **33** formed on the arms **29** of the yoke **28**. According to the features of the present invention, this guiding relationship between the yoke and beam not only stabilizes the yoke's movement during operation of the mill, but also supports it in the horizontal plane of the beam to facilitate roll replacement or other servicing operations without necessitating the disassembling of the yokes from the beam. Preparatory to the replacement of the upper backup roll by any suitable well-known procedure, the fluid pressure in conduit line **27** is reduced, thereby allowing the piston **25** to come to rest on the bottom of the cylinder **24** under the weight of the yoke **28** which is guided in the vertical direction by the mating guide surfaces **32** and **33**. The piston in this position will establish an air gap between rocker plates **35** secured on the arms **29** and rocker plates **36** secured on the outboard chock **31**. The establishment of this air gap is also made possible by the upper backup roll **18** being held in position by hooks **37** projecting from the beam and engaging hooks **38** formed on the backup chock **16**.

As shown in FIGS. **1** and **3**, the lower backup roll chock **17** is supported on a horizontally disposed beam **41** which is arranged parallel to the backup roll **19**. Between the beam **41** and the bottom of the window **15** there is located the previously mentioned piston and cylinder assembly for adjusting the elevation of the lower backup roll to control the gap between the work rolls. The beam **41** has a projecting end **42** extending beyond the housing. In contact with the bottom surface of the beam's extended end is a piston **43** which is received in a cylinder **44** carried by a yoke **45**. This yoke has two upwardly extending arms **46** which transmit the roll contour-controlling bending force generated by the piston **43** and cylinder **44** to an outboard bearing chock **47** mounted on an extended journal **19***a* of the backup roll **19**.

According to the features of the present invention as shown in FIGS. **1**, **3** and **6**, there is constructed in the bed plate extensions **14** cylinders **48** for receiving pistons **49** employed to position and support the yoke **45** during roll replacement or other servicing operations. A conduit port **51** transmits fluid under pressure to the cylinder for displacing the piston **48** into supporting engagement with wings **52** that project from each arm **46** of the yoke **45** causing the latter to be displaced upwardly to a predetermined position where an air gap is established between rocker plates **53** secured on the arms **46** and rocker plates **54** secured on the outboard chock **47**.

To both maintain the position of the yokes **45** with respect to the horizontal plane of the beam and provide vertical guiding therebetween, each bed plate extension **14** has spaced parallel gibs **55** defining U-shaped guide surfaces **56**. Complementary shaped guide surfaces **57** are machined on the arms **46** of the yokes.

For removing the lower backup roll from the rolling mill illustrated in FIGS. **1** and **3**, there are employed spaced parallel rails **58** located in the bottom of the housing window. Arranged in an abutting relation with the rails **58** are other similarly spaced parallel rails **59** located at the operator's side of the mill. Supported in the mill on the rails **58** is a roll changing sled **61** which is constructed and arranged for displacement along the rails **58** and **59** while it supports the beam **41** and backup roll **19**, including the bearing chocks **17** and **47**, incident to replacing the backup roll and servicing of the mill parts, such as load cells and piston and cylinder assemblies, in the lower portion of the mill housing. It will be readily apparent to those skilled in the art that suitably dimensioned spacers inserted between the backup roll chocks **16** and **17** will enable the employment of the sled **61** to simultaneously replace the upper and lower backup rolls along with their chocks and including, if desired, the work rolls and their bearing chocks. It is to be appreciated that, preparatory to such roll replacement, the yokes **28** and **45** will have been repositioned, as previously described, to establish the air gaps between the rocker plates **35** and **53** on the yokes and the rocker plates **36** and **54** on the outboard bearing chocks **31** and **47**.

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.

I claim:

1. In rolling apparatus including a pair of housings for supporting a pair of rolls subject to deflection under the rolling load developed incident to reducing the thickness of the material being rolled,

each housing having a window for receiving said rolls,

bearing chock assemblies mounted on the ends of the rolls for rotatably supporting the rolls in said housing,

at least one of said rolls having journals extending outward of said bearing chock assemblies,

a beam member including a projecting portion extending outwardly of said housing,

said beam member arranged parallel to said roll and disposed between the housing and the bearing chock assembly of said roll,

force exerting means developing a roll contour-control bending force resisted by said beam member independently of said housing,

displaceable yoke means arranged in a force-transmitting relationship between said force-exerting means and said journals for imposing roll contour-control bending forces to said journals to control the deflection of said one roll, and

support means on said displaceable yoke means having at least two restraining surfaces for positioning said yoke relative to said housing independent of said one roll.

2. A rolling apparatus according to claim **1** further comprising:

guide surfaces formed on said projecting portion of said beam member, and

said support means including guide surfaces constructed and arranged to mate in a guiding relationship with the first-mentioned guide surfaces.

3. A rolling apparatus according to claim 2 wherein at least one of said guide surfaces is constructed and arranged to define a U-shaped configuration.

4. A rolling apparatus according to claim 1 further comprising:

guide surfaces projecting from said housing and fixed in relation thereto, and

said support means including guide surfaces constructed and arranged to mate in a guiding relationship with the first-mentioned guide surfaces.

5. A rolling apparatus according to claim 4 further comprising:

bed plates for supporting said housing,

said bed plates having extended portions projecting from said housing and having surfaces defining said guide surfaces projecting from said housing and fixed in relation thereto.

6. A rolling apparatus according to claim 5 wherein at least one of said guide surfaces is constructed and arranged to define a U-shaped configuration.

7. A rolling apparatus according to claim 1 further comprising:

bed plates for supporting said housings in a spaced-apart relationship,

said bed plates having extensions projecting away from said housings, and

displaceable power means supported in said extensions for engaging said support means.

8. A rolling apparatus according to claim 7 wherein said support means includes wings projecting from said yokes for engagement with said power means.

9. In a 4-high rolling mill having a pair of work rolls adapted to deflect away from the material being rolled under the rolling loads,

a housing having windows for receiving the pair of work rolls,

a pair of backup rolls received in said windows wherein each one of said backup rolls supports one of the work rolls,

bearing chock assemblies mounted on the ends of said backup rolls for rotatably supporting the backup rolls in the housing,

said backup rolls having journals extending outward of said bearing chock assemblies,

outboard bearing chock assemblies mounted on said journals,

yoke means connected with each of said outboard bearing chock assemblies,

a beam member at each backup roll arranged parallel thereto and between said bearing chock assemblies and said housing,

said beam member having extensions projecting outward of said bearing chock assemblies,

force exerting means operatively connected between said yoke means and said extension of said beam member for imposing roll contour-control bending moments on said journals to control the deflection of said backup rolls, and

support means on said yoke means having at least two restraining surfaces for positioning said yoke means relative to said housing independent of said backup rolls.

10. A rolling mill according to claim 9 wherein said support means includes guide surfaces constructed and arranged to mate with other guide surfaces fixed in relation to said mill housing.

11. A rolling mill according to claim 9 further comprising:

bed plates for supporting said housings in a spaced-apart relationship,

said bed plates having extensions projecting from said housings, and

displaceable power means supported in said extensions for engaging said support means.

* * * * *