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(54) **SIZING ROLL STAND FOR A STEEL MILL**

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(52) **U.S. Cl.** **72/250**; 72/227

(58) **Field of Search** 72/78, 224

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(57) **ABSTRACT**

An assembly for producing a finished shape for a rod after the last rolling stage of a multi strand steel mill. This apparatus provides an operation for correcting minor surface irregularities and shape distortion of the rod as it exits from the finishing roll stand. The apparatus consists of four rollers mounted in an assembly which resembles a roller entry guide except that the rollers are capable of producing changes in shape of a work product passing therethrough. The orientation of the roller axis is slowly and constantly changed to prevent wear distortion of the rollers which may result when the rollers are required to roll a malformed product from fixed roller axes. The rollers may be driven in some circumstances.

14 Claims, 3 Drawing Sheets

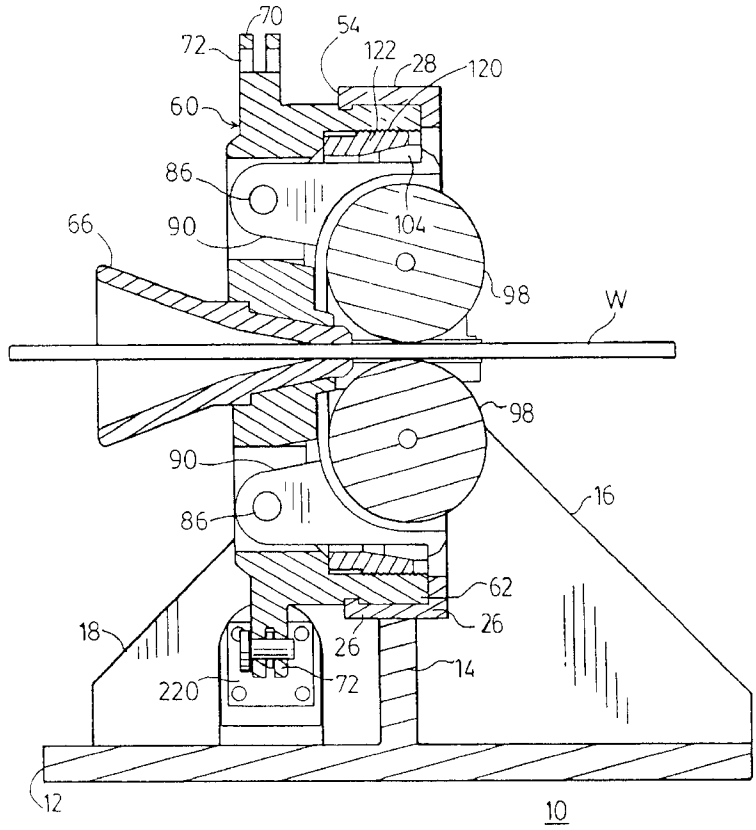
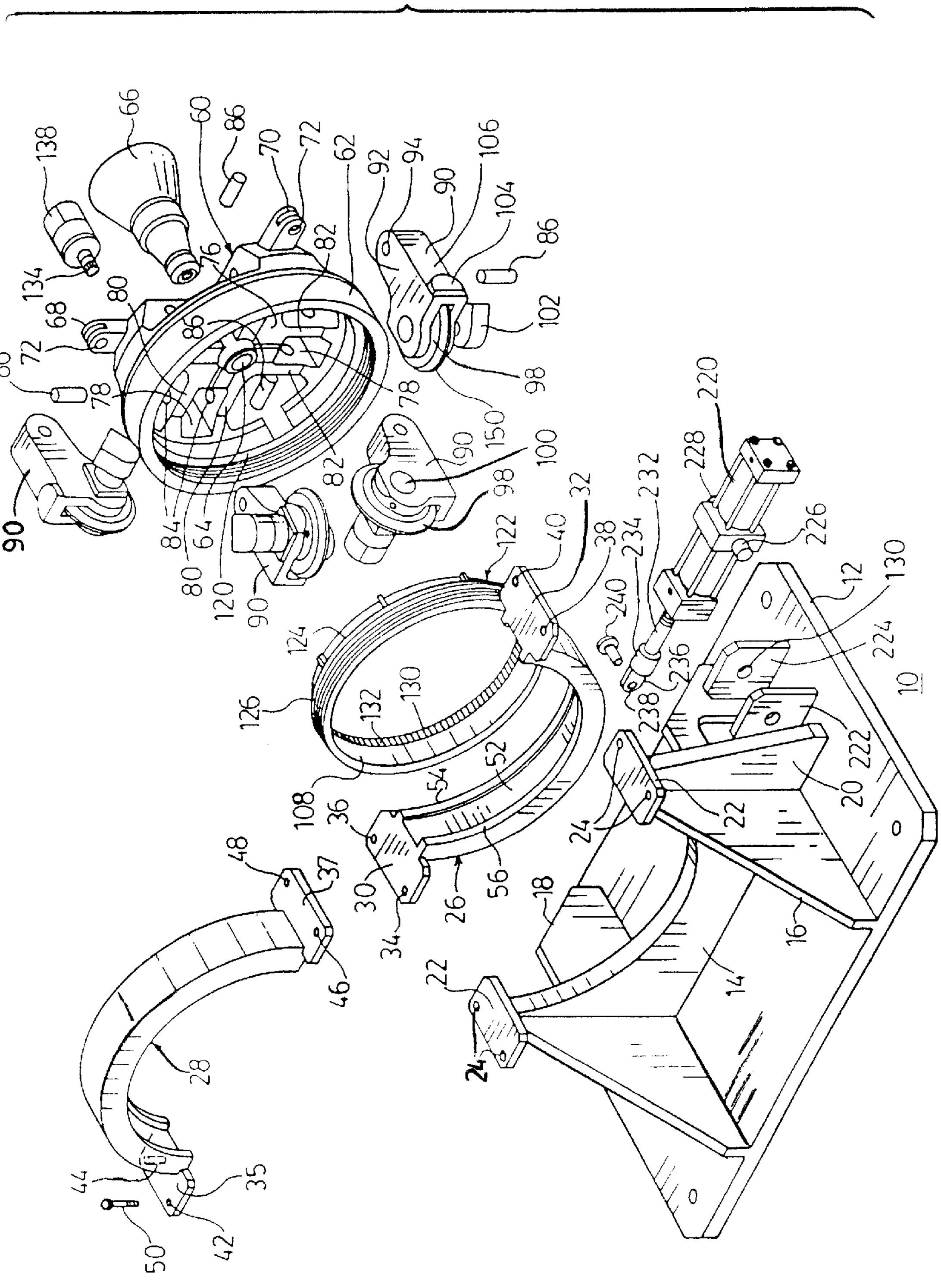


FIG.1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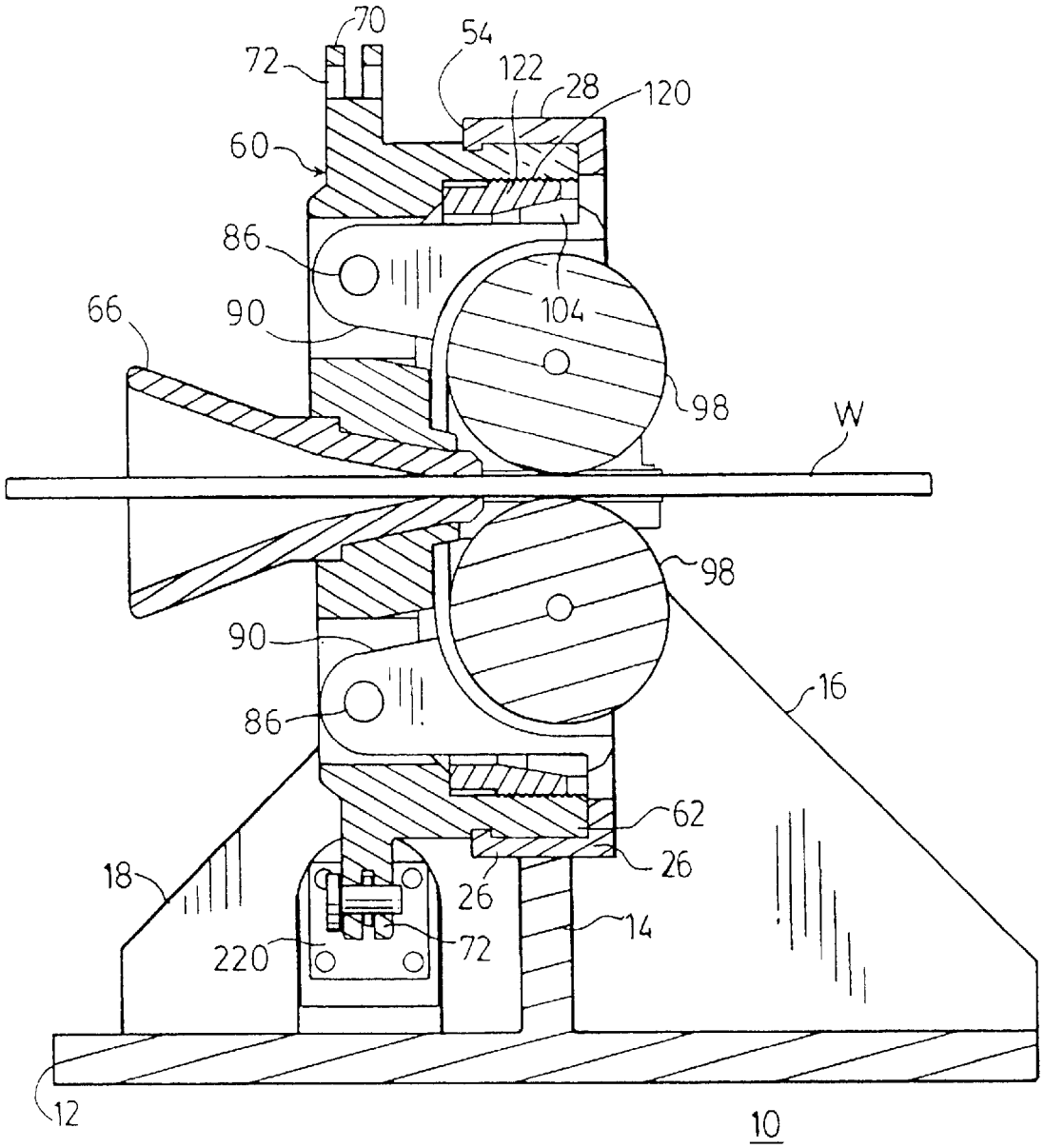
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FIG. 2

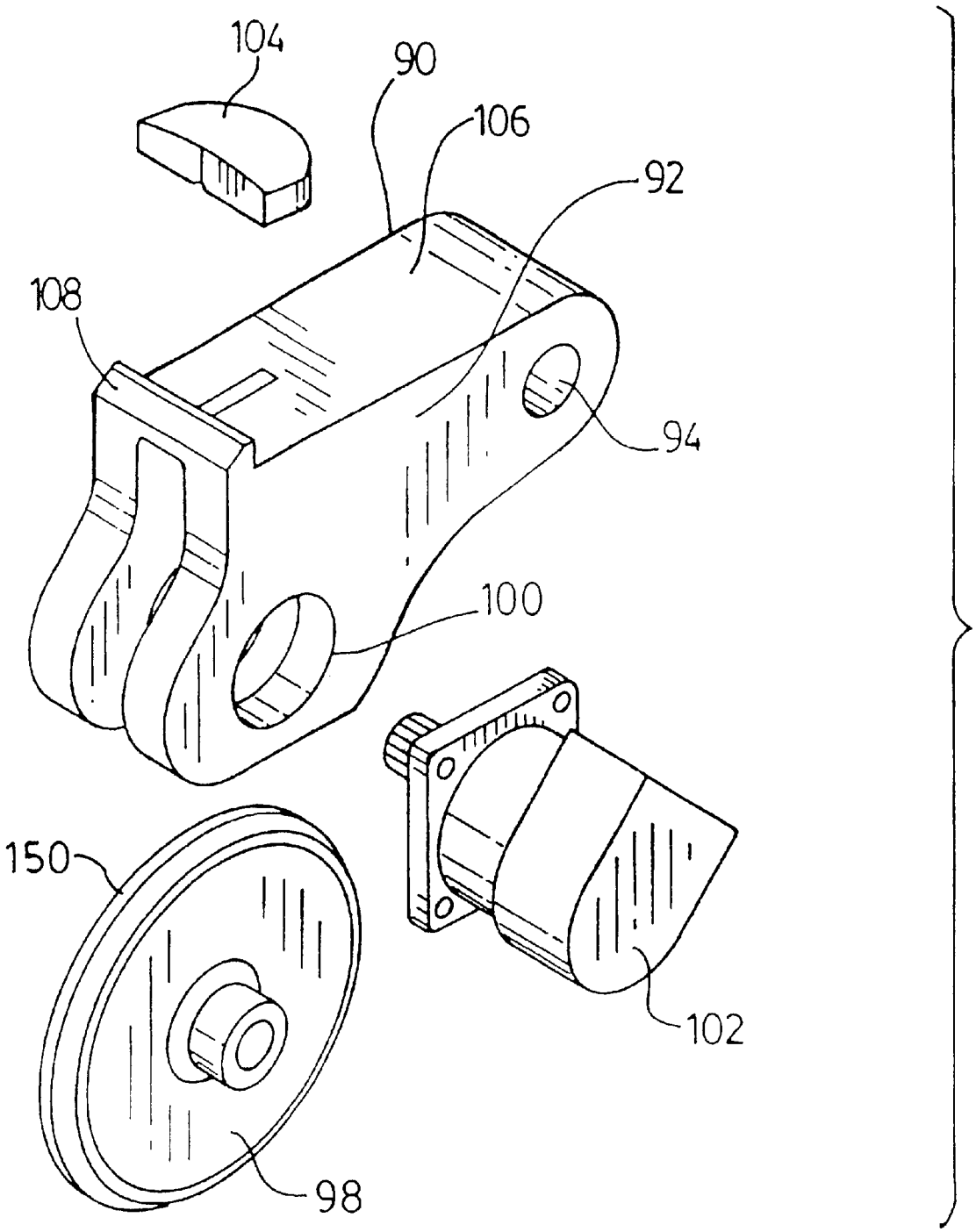

FIG.3

SIZING ROLL STAND FOR A STEEL MILL

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

Modern steel mills are required to produce a finished product which must meet critical size requirements within a very small tolerance. Most rod mills are capable of producing a finished product within a given tolerance range until the steel work product wears the contours of the forming rolls so that the finished product has a shape which is not acceptable to a customer. To correct minor irregularities in shape, the steel mill industry has, at times, employed a process known as peeling, wherein a finished rod is pulled through a die to remove portions of the surface of the rod to restore the shape of the finished product to one that is now acceptable to a customer and the surface is now true and free of imperfections. The peeling process is capable of correcting for only small deviations in the gauge of the finished product.

SUMMARY OF THE INVENTION

This invention provides a rolling assembly in which at least three and preferably four equally spaced rollers are mounted in a housing about an axis through which a steel rod or wire passes. The rollers are mounted in a robust assembly which can exert substantial pressure on the rollers to change the shape of the work to compensate for minor shape deviations in the shape of the work product caused by wear of the rollers in the reducing mill. The assembly is provided with a roller positioning device which moves the rollers in the roller assembly in concert toward and away from the axis of the work piece passing between the rollers.

At the same time, the roller assembly in which the rollers are mounted is pivotable through a predetermined angle (say 45°) to change the orientation of the entire roller assembly with respect to the workpiece passing therethrough. In this instance, premature wear of the roller surfaces of the rollers of the sizing guide is minimized because the rollers of the sizing guide are constantly changing position with respect to the surface of the work product.

The cross sectional shape of a work product exiting from a finishing stand of a multi stand steel mill is dependent upon the accuracy of the profile existing in the rollers of the mill stand. When the rollers of the mill have worn to the extent that the work product has a gauge or shape which lies outside the acceptable tolerance range and no further corrective actions involving roller adjustment are capable of restoring the work product to an acceptable gauge, the rollers in the mill must be replaced because the surface contours of the reducing rollers have undergone wear and abrasion by the constant passage of the work product between the reducing rolls.

Some wear patterns in the rollers are predictable, depending on the rolling process to which the mill stand rollers are subjected and most operators of modern steel mills instinctively known that shape distortion of the finished product will inevitably result. At times, the distortion in work product shape may be corrected by further processing the work product to remove such distortion after passage through the final mill stand (if the distortion is not too great). The worn rolls in the mill may then continue to be used to produce a useful work product beyond the usual wear period

due to the correction applied to the work product. In the past this correction has usually been accomplished by "peeling" some metal from the surface of the malshaped workpiece using a die such that small shape deformations may be removed by this process.

The sizing roll stand of this invention is capable of restoring the exterior shape of a malformed work product exiting from a steel mill to an acceptable size and shape. The apparatus of this invention is capable of providing corrections for the same shape distortions as the "peeling" process to which reference has been made, but at a very high speed. The rollers of the sizing roll stand may or may not be externally driven.

PERTINENT PRIOR ART

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of the device of FIG. **1**.

FIG. **2** is a sectional elevation of the sizing roller device of this invention.

FIG. **3** is a perspective view of an exploded roller assembly of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. **1** and **2**, a sizing device **10** is shown having a supporting base **12** having a rigid semicircular flange **14** secured thereto by means of gussets **16, 18, 20**. A pair of faceplates **22** are welded to the flange **14** at the intersection of gussets **16** and **20**. Each faceplate has a pair of holes **24** for mounting the pair of stationary split half rings **26, 28** therein.

Split rings **26** and **28** have a pair of faceplates **30, 32** and **35, 37** formed therein to permit mounting the pair of split half rings **26, 28** on supporting base **12** and faceplates **35, 37** have holes **42, 44** and **46, 48** formed therein. The split rings **26, 28** are made to be joined together at the faceplates **30** and **35** and **32** and **37** and the complete assembly is bolted onto faceplates **22** of base **12** with four bolts (such as **50**) passing through holes such as **42, 34** and **24** to hold split rings **26** and **28** together and firmly in place on base **12**.

The assembled split rings provide a captive cylindrical recess **52** formed between the annular flanges **54** and **56** for receiving the somewhat circular housing **60** therein. (Note that flange **56** has substantially more depth than flange **54**.) Housing **60** has a somewhat cylindrical boss **62** which is made to cooperate with split rings **26** and **28** which form a housing in recess **52** in which the cylindrical boss **62** may rotate.

The housing **60** is provided with a central bore **64** to which guide **66** is frictionally mounted.

Housing **60** is shown with 2 extending arms **68** and **70** protruding therefrom (two more identical arms are located opposite arms **68** and **70** on the housing **60**). The exterior portion of each of the arms **68** and **70** is formed into a clevis type device which is provided with a bore **72** therein.

Housing **60** is provided with a cruciform shaped inner structure **76** at the center of which is bore **64**. The cruciform structure comprises **4** substantially identical recesses **78** formed by parallel walls **80, 82** arranged in orthogonal relationship about bore **64**. Each pair of walls **80, 82** houses a bore **84** for receipt of pins such as **86**.

Each recess **78** is of a size and shape to receive a roller assembly **90** (of which there are four) in a restrained

pivoting relationship. Each assembly **90** comprises a pivot arm **92** having a bore **94** in one end thereof. At the opposing end of pivot arm **90** is a sizing roller **98** mounted for rotation (in this instance driven) about an axis determined by bore **100**. Suitable bearings are provided in assembly **90** to withstand the heavy pressures applied to roller assembly **90** during a sizing operation.

A drive motor **102** is applied to rollers **98** (in this instance) to assure that rollers **98** are rotating when the work product makes its entry to the bight formed by the wheels **98**. Each roller assembly **90** fits into its respective recess **78** with a precise fit to avoid slopiness, and to prevent unnecessary lateral motion of each assembly **90** along the axes of pins **86**. Each roller assembly **90** is provided with a bearing pad **104** which is applied to the flat surface **106** of assembly **90**. An abutment **108** provides a guide for mounting pads **104** on the wheel assemblies **90** (see FIG. **3**).

The housing **60** is provided with an internal thread **120** for receiving collar **122** which has a cylindrical outer portion **124** of which **126** is threaded to mate with thread **120**. An opposing conical surface **128** is provided in the interior of collar **122**. Conical surface **128** is shaped to mate with pads **104** of the roller assemblies **90**.

A second internal surface **130** of collar **122** is provided with a set of gear teeth **132**. Gear teeth **132** are provided for engagement of toothed pinion **134** of gear motor **136**. Gear motor **136** is mounted on housing **60** so that the gears **134** and **132** are in constant engagement.

A hydraulic cylinder **220** is mounted in mounting plates **222, 224** on base **12**. Cylindrical bosses **226, 228** of cylinder **220** are mated in bore **130** of plates **226, 228**. Piston rod **232** of cylinder **220** terminates in fitting **234** which has a projection **236** bearing a bore hole **238** therein.

The projection **236** is provided to fit into one of the clevis members **68** of arms **70** of housing **60** and receive a pin **240** through apertures **72** and **238** to secure piston rod **232** to one of the arms **70** of housing **60**. As piston rod **232** is moved in and out of cylinder **220**, the housing **60** rotates within recess **52** of housing **56** formed by the split rings **26** and **28**.

The sizing guide **10** functions as follows: A work product (rod, wire, etc.) is fed into funnel shaped guide **66** and passes into the bight between the four rollers **98** mounted in roller assemblies **90**. The rollers **98** have a predetermined external contour **150** to produce the desired shape of the work product passing therebetween. Collar **122** is rotated by drive motor **138** to move the collar **122** axially in housing **60** along the threaded surface **120** to bear on bearing pads **104** of roller assemblies **90** to wedge the rollers **98** inwardly into a contacting relationship with the work product.

If for some reason the shape of the work product has deviated from the preset gauge required, the sizing device **10** may be used to bring the work product back to a size that is within an acceptable tolerance by applying substantial pressures to the wheel assemblies **90**. The conical surface **108** of collar **122** serves to wedge the wheel assemblies in an inward direction.

Usually the rolls of a mill stand wear in a predictable manner over a period of time, depending on the deformation being produced by the mill rolls in the work product passing therebeween. The work product usually exits from the last mill stand having a peculiar and consistent shape which has a particular orientation with respect to the mill stand. Because of this, any deviation from the desired cross sectional shape of the workpiece tends to be continuously passed from the mill stand with a consistent physical orientation, into the sizing device of this invention.

Depending on the deviation of the workpiece from the desired gauge, the sizing device of this invention will provide correction to the shape of the workpiece exiting from this device and prolong the life of rollers **98** of the sizing guide **10**. Because the finished product of a steel mill exits with any shape deformation of the work product always in the same orientation with respect to the direction of travel of the work product, this device is made to rotate the entire roller assembly (encased in housing **60**) through an angle of about 45° during operation. This assures that the rollers **98** of the roller assemblies **90** continuously contact different surface configurations of the moving work product so that the rollers **98** wear evenly. The working life of rollers **98** is significantly increased as a result.

While changes and deviations from the disclosed device will no doubt occur to those skilled in the art, the applicant prefers to limit the scope of this invention by the ambit of the following claims.

I claim:

1. A roller sizing guide having a **[**set**]** *plurality* of *guide* rollers mounted in a housing *to form a guide roller assembly* for contacting *and guiding* a workpiece traveling through said guide along a central axis of said housing,

said housing *and roller assembly* being rotatably supported on a suitable support means to permit said housing *and roller assembly* to rotate about said central axis,

[said rollers**]** *said roller assembly comprising a plurality of levers pivotally* being mounted *on pivots located at one end of each lever* in said housing, *each lever having a roller mounted in the end remote from the pivot, said pivoted levers serving* to permit said rollers to move *in an arc* toward or away from said central axis,

a pressure bearing pad for each lever located at the roller end of the roller assembly over the point of contact of each roller and workpiece,

roller positioning means for said rollers *mounted in said housing* to *apply a* force *to* said rollers *at said pressure bearing pad* to move *said rollers* in concert to contact said workpiece to alter the shape of said workpiece at is travels through said guide.

2. A roller sizing guide as claimed in claim **1** wherein said roller positioning means includes a common wedging **[**means**]** *ring surrounding said guide roller assembly* for producing simultaneous and equal *pivotal* movement of said rollers in said housing toward said workpiece.

3. A roller sizing guide as claimed in claim **1** wherein a housing drive means is mounted on said structure to produce **[**rotation**]** *oscilliatory motion through a predetermined arc* of said housing *and said roller assembly* during passage of said workpiece therethrough.

4. A roller sizing guide as claimed in claim **3** wherein said roller positioning means includes a common wedging means for producing simultaneously and equal movement of said rollers in said housing toward said workpiece.

5. A roller sizing guide as claimed in claim **4** wherein *all of* said rollers are mechanically driven.

6. A roller sizing guide as claimed in claim **5** which includes a funnel shaped guide for feeding said workpiece along said axis to said set of rollers.

7. A roller sizing guide for producing shape changes in a workpiece passing along a central axis of said guide,

said guide having a rotatable housing mounted in a suitable framework supported by a base,

said housing having a cylindraceous outer surface,

said framework including means to contact said cylindraceous outer surface and permit said housing to rotate in a plane orthogonal to said axis,

said housing having means to mount at least three roller assemblies in said housing,

said roller assemblies comprising lever means having a suitable roller mounted for rotation at one end thereof, pivot means in said lever means at an end remote from said roller, said pivot means being mounted in said housing to provide for pivotally mounting said rollers at equally spaced intervals about said axis, *bearing pads mounted on said lever means at a location on said lever means remote from said pivot means,*

adjustable pressure lever contacting means *applying pressure to bearing pads on said lever means* causing said **[**levers**]** *lever means* to exert pressure on said roller assemblies *at points above said roller* to cause said rollers to contact said workpiece and produce surface changes to said workpiece.

8. A roller sizing guide as claimed in claim **7** wherein housing rotation means is connected to said housing to cause continued rotational oscillation of said housing within predetermined limits.

9. A roller sizing guide as claimed in claim **8** wherein said adjustable pressure lever contacting means comprises a pressure ring having an exterior threaded surface for threadably engaging a threaded surface in said housing, said pressure ring being provided with a conical inner surface to engage pressure pads on said roller assemblies for adjustably applying pressure to said pressure pads of said roller assemblies as said pressure ring rotates in said housing.

10. A sizing guide assembly for guiding and contacting a workpiece passing through said guide assembly to produce minor shape changes in said workpiece as it passes through a central axis of said guide assembly,

said guide assembly comprising:

a stationary support for mounting a rotatable housing within said stationary support to permit said housing to rotate about said central axis,

said housing comprising a pair of cooperating members for mounting and adjusting the position of a plurality of guide rollers in a roller assembly in said sizing guide,

a first member of said pair having an external cylindrical surface which cooperates with said stationary support to permit said first member to rotate in a controlled manner within said support member,

said first member having means to mount a plurality of pivot arms therein, each pivot arm having a guide roller mounted thereon for contacting said workpiece, said pivot arms and guide rollers being moved in concert by a second member which is mounted within said first member so as to permit said second member to execute translational motion within said first member along said central axis in the presence of a suitable stimulus,

said second member having a conical interior surface which simultaneously engages said pivot arms to move said pivot arms and said rollers toward said workpiece as said second member translates.

11. A sizing guide assembly as claimed in claim 10 wherein said second member is of a ring shaped configuration and has a threaded peripheral surface opposite said conical surface, wherein said threaded peripheral outer surface of said second member engages a corresponding mating threaded interior surface in said first member.

12. A method of producing minor changes to a steel rod or wire as it passes through a sizing guide comprising:

providing said guide with a housing for mounting a plurality of rollers therein for contacting said rod or wire as it passes through said guide,

providing pressure means for urging said rollers in concert toward said rod or wire as it passes therethrough,

providing a support means to capture said housing within said support means in such a manner as to constrain said housing to rotational movement about said rod or wire as it passes therethrough,

driving means associated with said housing for causing oscillatory rotational motion of said housing and rollers about said rod or wire as said rod or wire passes through said guide.

13. A method as claimed in claim 12 in which each roller is mounted within said housing on a pivot arm, and said pressure means comprises a pressure ring mounted in said housing, wherein said pressure ring is provided with an internal conical surface which engages each pivot arm simultaneously.

14. A method as claimed in claim 13 in which said pressure ring executes translational motion upon suitable stimulation to change the pressure on said pivot arms and said rollers.

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