Oct. 14, 1969 W. J. H. CHANG 3,472,053

TUBE MILL

Filed Feb. 10, 1967 4 Sheets-Sheet 1

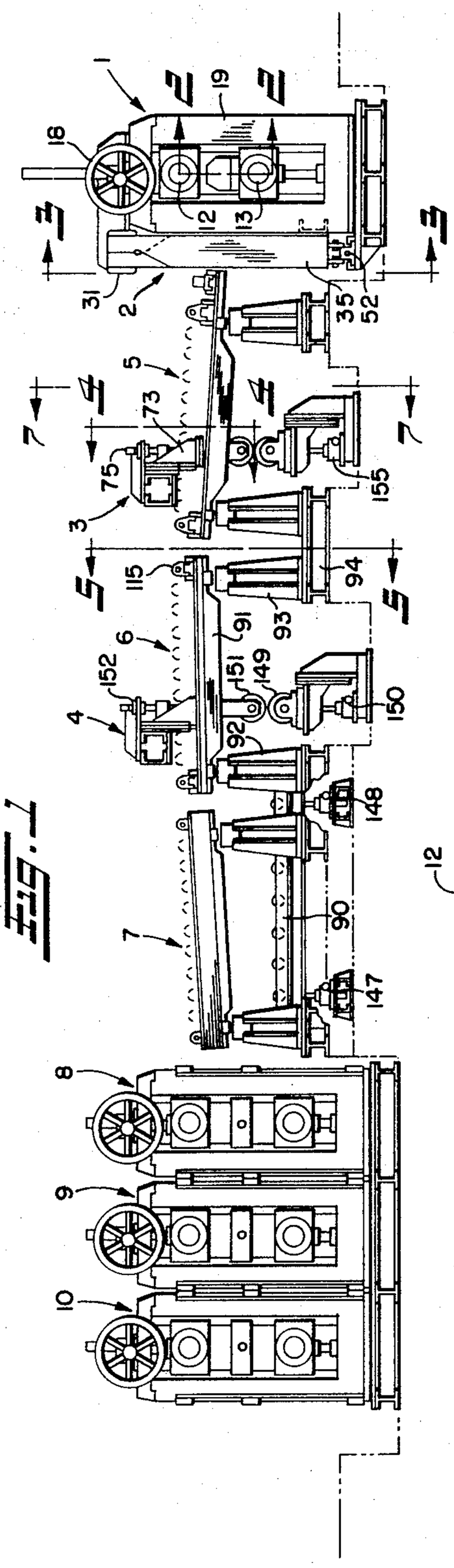

FIG. 1

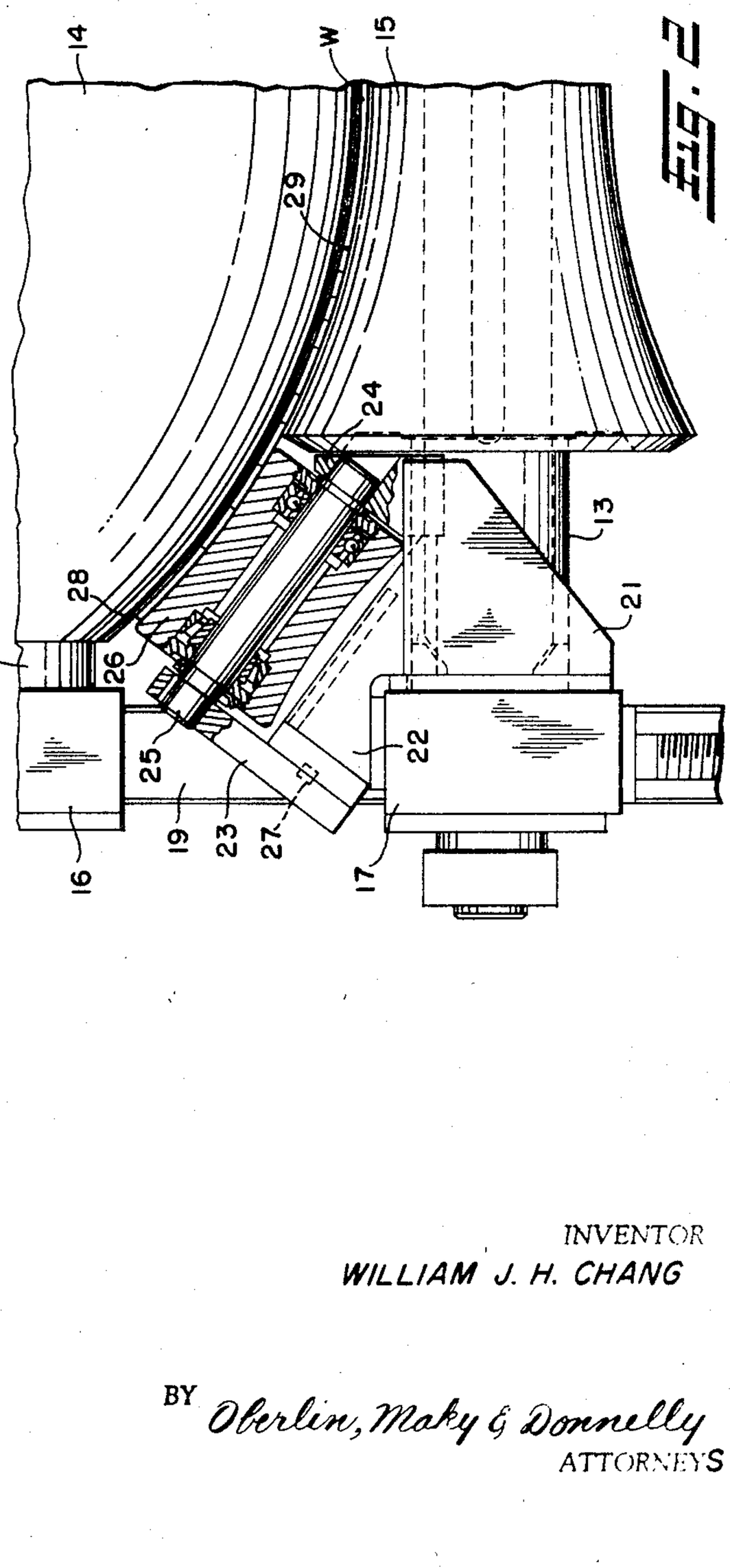

FIG. 2

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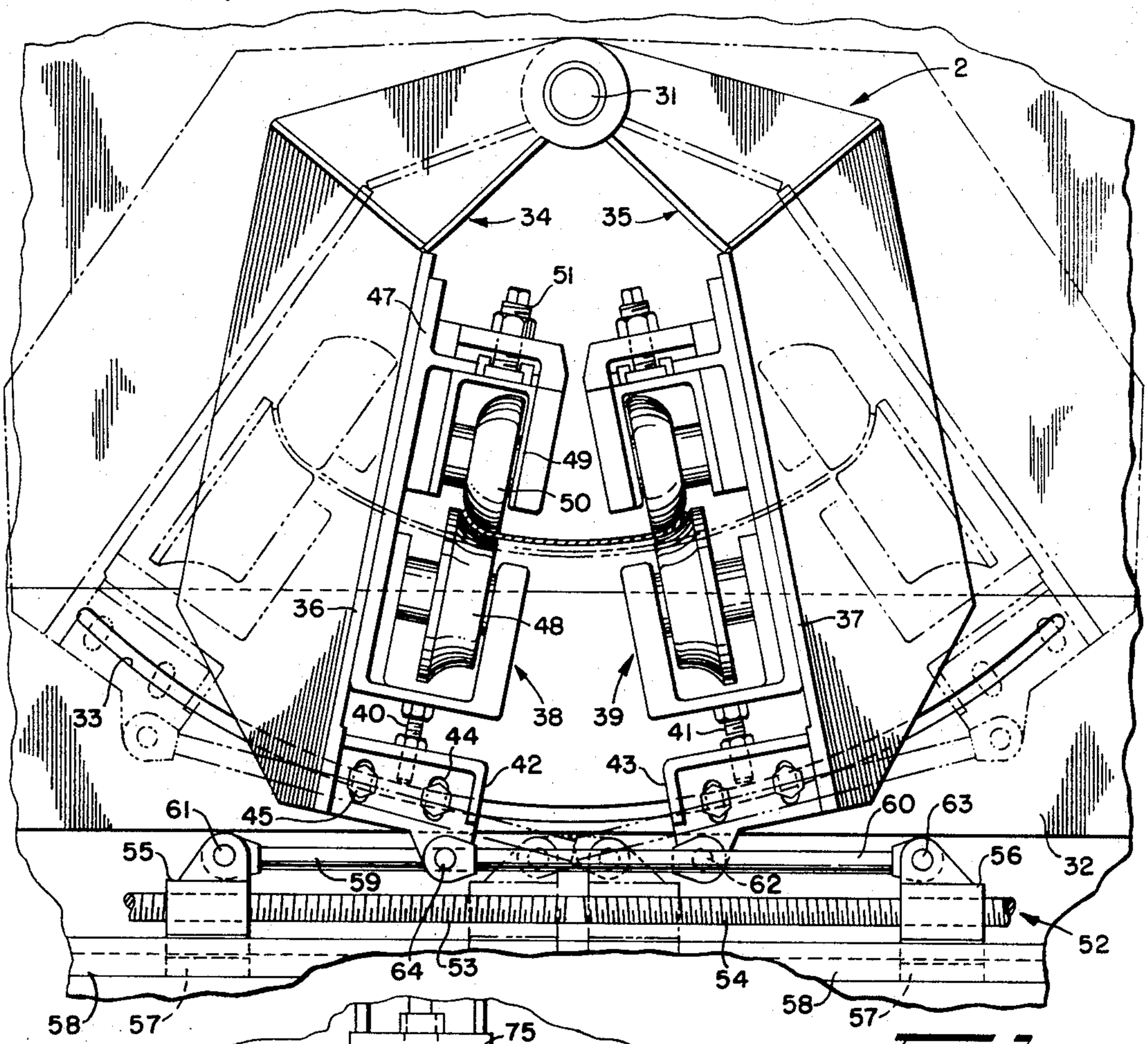

Fig. 3

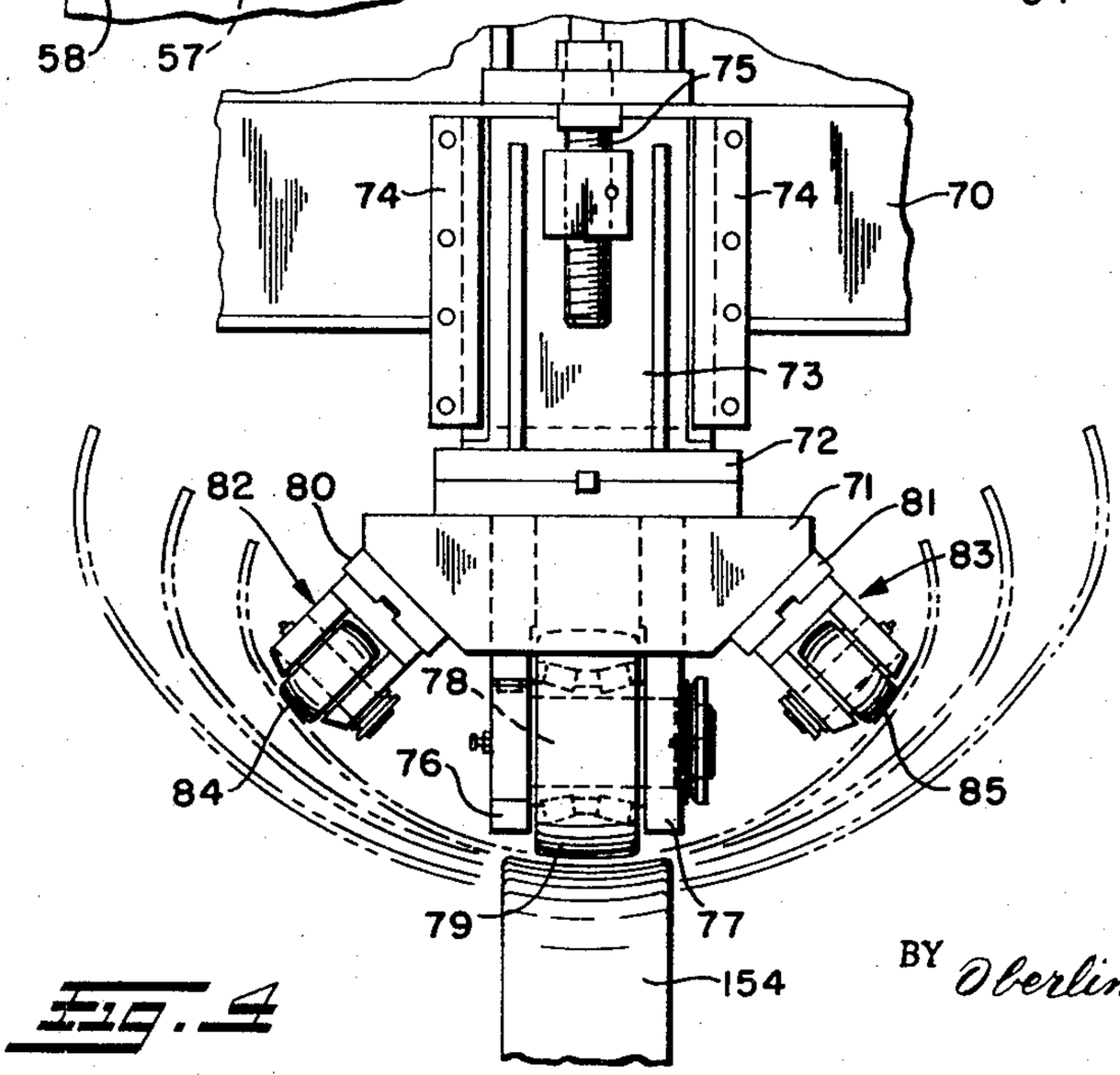

Fig. 4

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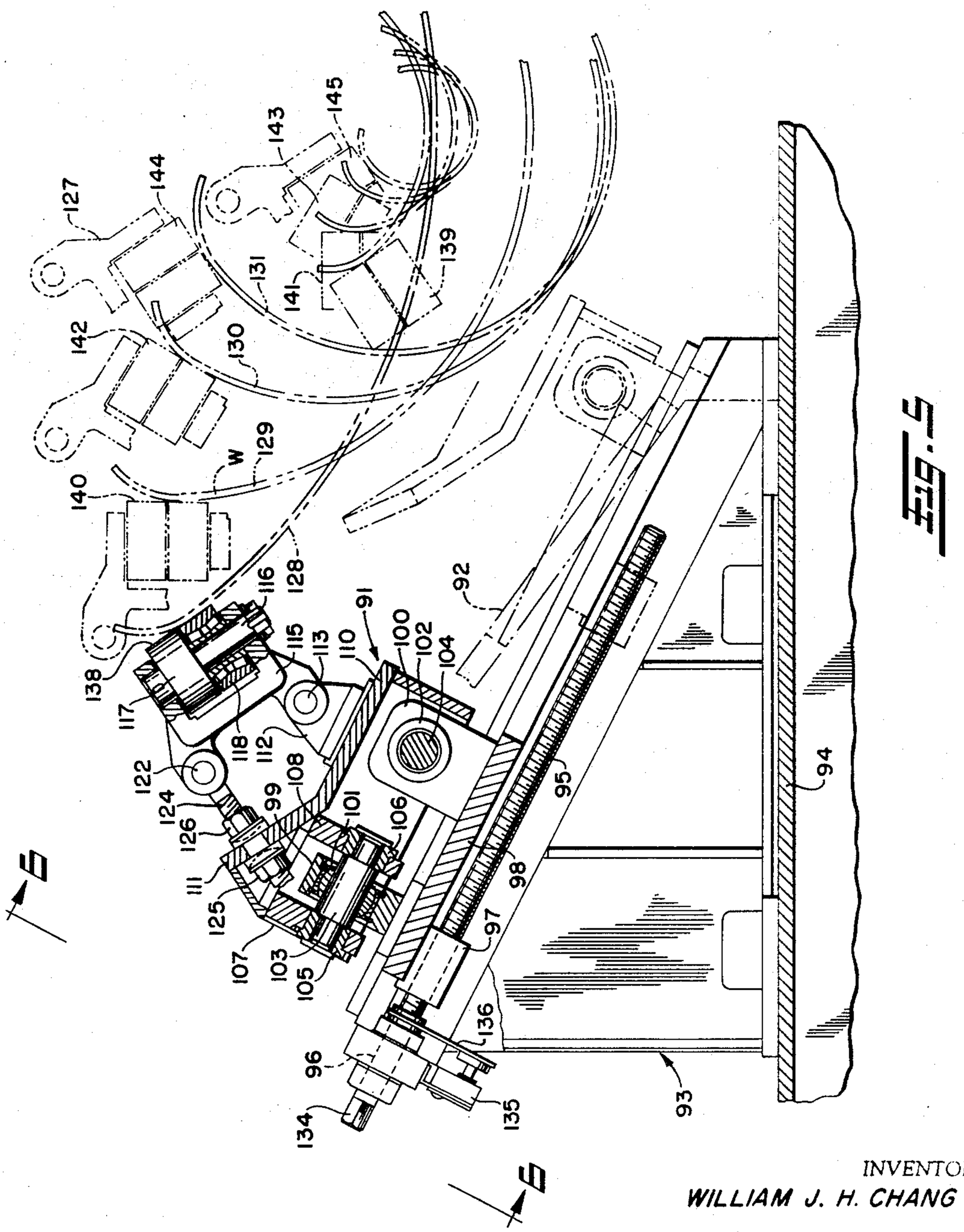

FIG. 5

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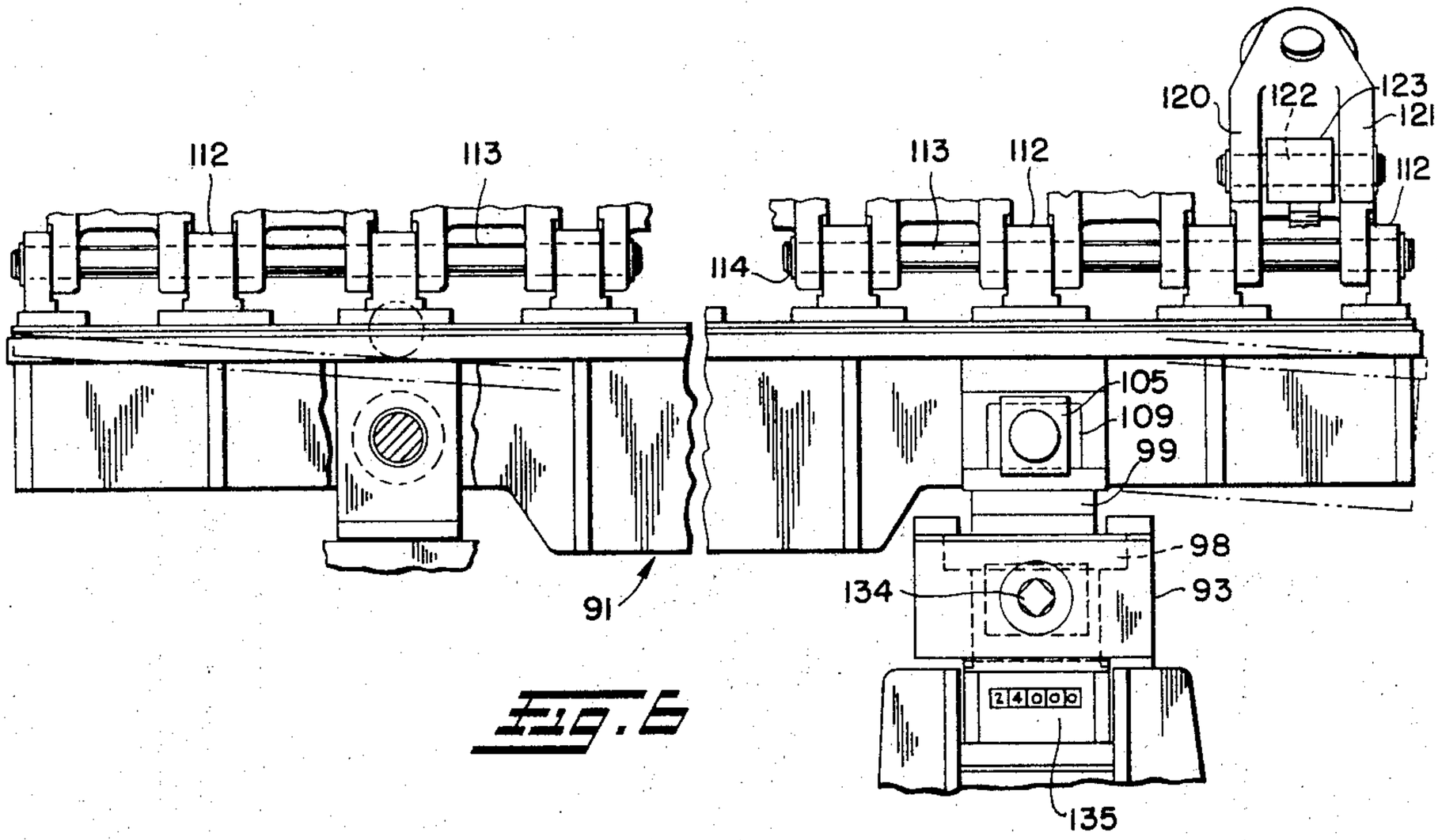

Fig. 6

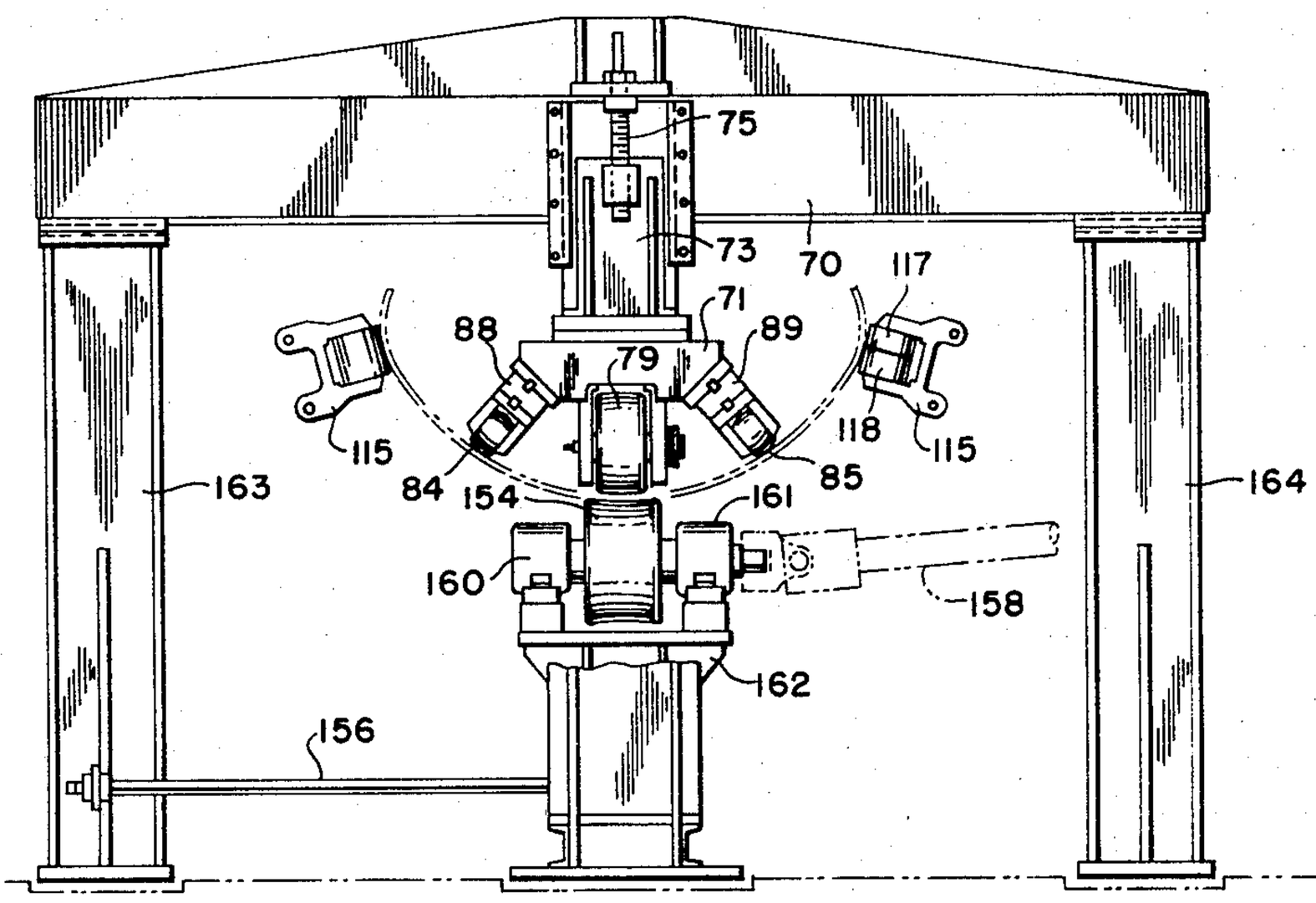

Fig. 7

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3,472,053

TUBE MILL

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Filed Feb. 10, 1967, Ser. No. 615,159
Int. Cl. B21d 5/12
U.S. Cl. 72—178 25 Claims

ABSTRACT OF THE DISCLOSURE

A tube or pipe mill of the cage type having improvements in the breakdown and cage roll supports so that the mill may readily be converted to produce tubes or pipes of different sizes and which may readily be converted to or from single or double radius forming.

This invention relates generally as indicated to a tube mill and more particularly to a tube or pipe mill having improvements in the support and adjustability of the multiple forming rollers whereby they can be repositioned quickly and conveniently for the formation of tubes or pipes of different size.

Single radius forming is standard for making tubing from good quality soft steel strip in medium gauges. Double radius or edge forming is preferred for stock likely to be stiff and difficult to form, including the very light and the very heavy gauges. However, in conventional mills, when double radius or edge forming, the forming rolls of the first pass or initial breakdown generally have to be changed for each different size of tube or pipe to be made. The initial breakdown rolls are fairly massive and this is especially true with larger diameter pipe so that the job of changing such rolls can be difficult and time consuming. Moreover, large breakdown rolls have a tendency to scuff the edges of the stock because of the different surface speeds along the contour of the rolls.

With the edge forming device of the present invention, the initial breakdown rolls need not be changed for each pipe size, but only the edge forming rolls on the edge forming device. The edge forming rolls on the edge forming device may be preassembled and quickly replaced to form tubes or pipes of different sizes. The edge forming roll assemblies are readily adjustable in a symmetrical manner so that once the proper roll assemblies are in place, single point adjustment is all that is required to position the rolls for different size tubes or pipes.

Improved support and adjustment of the multiple rollers of the cage between the breakdown passes is also provided ensuring in an economical construction a minimal amount of time required to convert the mill to different sizes or from single radius forming to double radius or edge forming.

A principal object of the present invention is to provide an improved tube or pipe mill of the type shown in my copending application, now Patent No. 3,323,341.

Another principal object is the provision of an edge forming device adjacent the initial breakdown which can easily be converted to form tubes or pipes of different sizes without requiring replacement of the rolls of the initial breakdown.

Still another principal object is the provision of an improved initial breakdown roll assembly not requiring extremely massive rolls and minimizing the scuffing of the edges of the stock normally inherent in the initial breakdown.

A further principal object is the provision of an improved roll support and adjusting mechanism for the rolls of the cages between breakdowns permitting quick adjustment for different work sizes while yet providing firm and adequate support.

Another object is the provision of an edge forming device having but single point adjustment for conversion to different work sizes.

A still further object is the provision of a pendulum type edge forming device which can be positioned adjacent the exit side of the first breakdown stand and used optionally to obtain a double radius or edge forming.

A further object is the provision of a beam type support for the cage rolls of a tube or pipe mill wherein the beam is mounted in a manner to obtain a practically infinite variety of positions to form tube or pipe of different sizes and with a single or double radius forming.

A yet further object is the provision of a cage roll assembly wherein the cage rolls have a wide range of adjustment.

A still further object is the provision of a tube or pipe mill of low cost and wide utility wherein the smaller forming rolls do the work normally required by massive conventional rolls.

Yet another object is the provision of a less costly breakdown roll assembly for driving the work which cooperates with the cage roll assemblies.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

In said annexed drawings:

FIG. 1 is a schematic partial side elevation of a mill in accordance with the present invention;

FIG. 2 is an enlarged fragmentary elevation partially in section of the initial breakdown pass taken substantially on the line **2—2** of FIG. 1;

FIG. 3 is a fragmentary vertical section of the edge forming device on the exit side of the first breakdown as taken substantially on the line **3—3** of FIG. 1;

FIG. 4 is a fragmentary section of the second breakdown as seen from the line **4—4** of FIG. 1;

FIG. 5 is a fragmentary vertical section of the cage forming roller assembly with a "flower" diagram of the work shown in phantom lines;

FIG. 6 is a fragmentary end elevation of the cage roll assembly as seen from the line **6—6** of FIG. 5; and

FIG. 7 is a vertical section of the entire second breakdown illustrating the cooperation between the cage forming rollers and the breakdown as seen substantially on the line **7—7** of FIG. 1.

Referring now to the annexed drawings and more particularly to FIG. 1, there is illustrated the forming portion of a tube or pipe mill which comprises reading from right to left, which is the direction of stock travel, a first breakdown roll stand **1**, having an edge forming device **2** on the exit side thereof, a second breakdown roll stand **3**, a third breakdown roll stand **4**, cage roll assemblies **5** and **6** associated with the second and third breakdowns **3** and **4**, a cage roll assembly **7**, and three fin passes **8**, **9** and **10**. Ahead of the first breakdown **1** or to the right as seen in FIG. 1, there may be positioned a coil box or uncoiler for the strip stock, a starting table and a feed pass, all not shown. Beyond the fin passes **8**, **9** and **10** will be the squeeze roll assembly and seam welder, followed generally by a cooling system, a sizing stand, and finally a tube or pipe cut-off.

The first breakdown or roll stand **1** comprises vertically spaced power driven spindles **12** and **13** on which the main breakdown rolls **14** and **15** are keyed. The spindles

are journalled in vertically adjustable blocks **16** and **17**, at each end, with adjustment being obtained in conventional manner by the hand wheel **18** seen in FIG. 1. The blocks are mounted for vertical movement in the window openings in the side frames **19** of the stand.

As seen more clearly in FIG. 2, the bottom initial breakdown roll **15** is foreshortened and a saddle **21** extending over the spindle **13** is secured to the inner side and top of the block **17**. The saddle includes an inclined portion **22** extending over the top of the block and the outer end thereof is provided with a stanchion **23**. A somewhat shorter stanchion **24** is provided at the inner end of the saddle and roll shaft **25** extends between such stanchions at the inclination shown. Roll **26** is journalled on such shaft with a thrust bearing being provided at the outer upper end. Elongated key **27** is provided between the stanchion **23** and the portion **22** of the saddle to absorb some of the thrust load. It will be understood that a similar idler roll **26** will be provided at the opposite end of the roll **15**. In this manner, a more massive lower roll **15** is avoided and scuffing of the work W at the edges is avoided. This breakdown roll assembly can accommodate work extending to the point **28** for pipes having an O.D. of 24" or to the point **29** for pipes having an O.D. of 6⅝". A variety of intermediate sizes may also be accommodated on the same initial breakdown roll assembly.

Referring now more particularly to FIGS. 1 and 3, the edge forming device **2** is mounted on the exit end of the first breakdown and is supported at the top by a large hinge pin **31** mounted on the top of the housing cap of the first breakdown. At the bottom, the pendulum type frame of the edge forming device is clamped tightly on a cross beam **32** having arcuate slot **33** therein. The pendulum frame includes two symmetrical frames **34** and **35** each pivoted at its top to the hinge pin **31**. As seen in FIG. 1, the frame **34** is offset forwardly of the frame **35** at the hinge pin. Each symmetrical frame comprises a fabricated structure having a principal mounting plate as indicated at **36** and **37**, respectively. On each mounting plate there is secured a roll mounting subassembly as indicated at **38** and **39**, respectively. The subassemblies may be secured to the mounting plates by clamping bolt and slot connections so that the vertical position of the subassemblies may be adjusted by the screws indicated at **40** and **41**, respectively. Such screws are mounted in inward extensions **42** and **43** at the lower ends of the frames **34** and **35**, each of which include a pair of vertically oriented slots **44** through which clamping bolts **45** extend so that the frames may be secured at their lower ends to the cross beam **32** at any adjusted position.

Each roll assembly comprises a main frame **47** with the lower end being U-shaped and supporting bottom roll **48**. The upper end is also U-shaped but encloses a U-shape yoke **49**, between the legs of which is journalled the upper roll **50**. The yoke **49** is vertically adjustably movable within the upper U-shape portion of the frame **47** by means of the adjusting screw **51** extending through the top of the upper portion of the frame **47**. The screws **40** and **41** can accordingly be employed to position accurately the bottom rolls **48** while the screws **51** at the top of the frames control the position of the upper rolls **50** and, of course, the pass size.

An adjusting screw **52** having left and right hand thread portions **53** and **54** is employed to maintain the frames **34** and **35** in a symmetrical relation about a plane passing vertically longitudinally of the mill axis. Such symmetrical movement is obtained by nuts **55** and **56** having threaded engagement with the screw portions **53** and **54**, respectively. Each of the nuts includes flanges **57** retained by gibs **58** to prevent rotation of the nuts upon turning of the screw and also to guide the nuts for sliding movement. The nuts **55** and **56** are connected to the frames **35** and **34**, respectively, by links **59** and **60**. The link **59** is pin connected to the nut **55** at **61** and to the extension **43** of the frame **35** at **62**. The link **60** is pin connected to the nut **56** at **63** and to the extension **42** at **64**. The link **59** and its connections are offset rearwardly from the link **60** and its connections.

To adjust the edge forming device for a different size pipe, the operator may simply replace the roll subassemblies **38** and **39** with rolls of different size as seen in the phantom line position. The sets of rolls for the various sizes may be preassembled and maintained in stock as tooling. The entire subassembly is removed simply by loosening the clamping bolts and dropping a new subassembly in place. The adjustments may then be made for the pass dimension.

The clamping bolts **45** are then loosened and by single point adjustment with the screw **52** the frames **34** and **35** may be moved symmetrically either closer together or further apart. A counter with digits may be provided on the screw to indicate to the operator the exact position for a new pipe size. The clamping bolts **45** are then tightened so that the load of edge forming during operation of the mill will be taken by such bolts and will not be reflected to the links **59** or **60** or the adjusting screw **52**.

Referring now to FIG. 4, there is illustrated the second breakdown roll stand **3**. The upper tooling is mounted on a cross beam **70** and comprises a three faced block **71** which is secured to plate **72** at the lower end of a slide **73** mounted in gibs **74** on the beam **70**. A screw adjustment **75** vertically moves the slide **73** and accordingly the block **71** with the rollers mounted thereon. The center facet of the block has extending therefrom projections **76** and **77** between which is mounted a roll spindle **78** having breakdown roll **79** journalled thereon. The two inclined side facets of the block **71** are provided with mounting plates as indicated at **80** and **81** to which roller assemblies **82** and **83** are secured, respectively, each having diagonally projecting idler rolls journalled therein as indicated at **84** and **85**. Each of the rolls **84**, **79** and **85** are not driven but bottom roll **86** may be power driven as indicated more clearly in FIG. 7. Massive forming rolls in the subsequent breakdowns are thus not required and to change pipe size, shims are indicated at **88** and **89** in FIG. 7 may be added or removed as required.

As indicated in FIGS. 1 and 7, the second and third breakdowns cooperate with cage roll assemblies, the detail of the mounting structure of which is shown in FIGS. 5 and 6. Referring first to FIG. 1, it will be seen that there are three such cage assemblies with the assemblies **5** and **6** cooperating with the second and third breakdowns, respectively. It will also be appreciated that each cage assembly includes two separate assemblies, one on each side of the mill. The assemblies **5** and **6** each comprise two beams supporting a multiplicity of rollers, one beam being on each side of the mill. The assembly **7** also comprises two such beams with a third beam being adjustably positioned beneath the work as indicated at **90** in FIG. 1. Each of the other six beams may be substantially identical in form and accordingly only one will be described in detail.

The beam **91** is mounted on inclined guide tables **92** and **93** at opposite ends thereof. As indicated in FIG. 5, with the guide table **92** being shown broken away and in phantom lines, the supper surfaces of the guide tables being inclined at different angles. Opposed tables are supported on a stand **94** and such tables include adjacent the upper surface thereof an adjusting screw **95** journalled at its upper end at **96**. The screw **95** has threaded engagement with nut **97** secured to the bottom of slide plate **98** which is slide guided along the incline table top. The plate or platform **98** is provided with stanchions **99** and **100** which are positioned at right angles to each other. Each stanchion includes a spherical bushing or sleeve bearing as indicated at **101** and **102** and stub shafts **103** and **104**, respectively, project therethrough. The shaft **103** is supported at each end

by slide blocks **105** and **106** which are mounted for slight floating movement toward and away from the viewer in FIG. 5 in supporting plate members **107** and **108** forming part of the beam **91**. Slightly elongated windows **109** are provided in such plates for such floating purpose as seen more clearly in FIG. 6. This permits the shaft **103** to cant slightly with respect to the beam **91**. The opposite end of the beam is supported in similar manner on guide table **92**.

The top of the beam **91** comprises a platform **110** having a rearwardly inclined portion **111**. The forward part of the platform supports a plurality of shaft supports **112** through which a plurality of shafts **113** extend, such shafts being held in place by snap rings indicated at **114**. Mounted on such shafts between the supports **112** are a series of U-shape roller supports **115** having roll shafts **116** extending between the legs thereof as seen more clearly in FIG. 5. Journalled on such shafts are a pair of small diameter rollers as seen at **117** and **118**.

The upper end of the roller housing or support **115** includes two projections **120** and **121** between which extend pin **122**. A collar **123** is mounted on the pin between the extensions and an adjusting screw **124** extends from such collar through the inclined portion **111** of the platform **110**. The adjusting screw is of substantial length so that by proper positioning of the nuts **125** and **126**, seen in FIG. 5, the pivotal position of the roll housing or support **115** about the axis of the shafts **113** can be controlled. Accordingly, the attitude of the rollers **117** and **118** closely spaced along the beam **91** can be adjusted widely, as for example, from the full line position of FIG. 5 to the phantom line position indicated at **127**. It will be appreciated that the position **127** would be obtained in the cage assembly **7**, seen in FIG. 1, and that the beam position would be changed accordingly. In the initial cage assembly **5**, the work W would be shaped from the position shown at **128** to that at **129** and in the assembly **6**, to the shape shown at **130**. In the final cage assembly **7** the position shown at **131** may be obtained and final shaping will occur in the fin roll stands **8**, **9** and **10**. The various positions of the cage rollers **117** and **118** are obtained by supporting the beams **91** on stands having different inclinations. Then, when it is desired to convert the mill to shape pipe or tube of different size, the operator will then apply a turning tool to the end of the adjusting screws **95** as indicated at **134** moving the beams along the inclined supports to preselected positions. Such preselected positions can readily be ascertained by the counters **135** driven from the screws as indicated at **136**. The operator simply turns the screw until the proper predetermined number appears on the counter.

As seen in FIG. 5, the rollers in the full line position **138** may be shifted to the phantom line position **139**. The rollers in the phantom line position **140** may be shifted to the phantom line position **141**. The rollers in the phantom line position **142** may be shifted to the phantom line position **143** and the rollers in the phantom line position **144** may be shifted to the phantom line position **145**. This change of size adjustment may be accomplished without resetting the screws **124** for the individual roll assemblies and accordingly only six adjustments need be made on each side of the mill at the cage roll assemblies to reposition the cage rollers as seen in FIG. 5. However, additionally in the final cage roll assembly **7**, the lowermost beam **90** will have to be elevated through the adjustment features shown in **147** and **148** in FIG. 1.

In addition to the above adjustments, in the third breakdown **4** seen in FIG. 1, the bottom driven roll **149** will be vertically adjusted through the mechanism shown at **150**. Shim spacers may be removed in the upper tooling **151** of the second breakdown and vertical adjustments made through the mechanism **152**. The same adjustments may be made in the second breakdown **3** with the bottom driven roll **154** by jack **155** through shaft **156** seen in

FIG. 7. The shims **88** and **89** may be removed or new upper roll tooling may be secured in place.

FIG. 7 illustrates how the cage rollers cooperate with the breakdowns **3** and **4** and it is noted that only the bottom roll **154** of the breakdown roll assembly will be driven bearing against the main backup roll **79** of the upper tooling. The two outboard rollers of the upper tooling of the breakdown assembly are idler rollers as, of course, are the rollers **117** and **118** of the cage assembly. The bottom roll may be driven through drive shaft **158** shown in phantom lines in FIG. 7, and the spindle of such roll is journalled in pillow blocks **160** and **161** supported on slide **162** moved vertically by jack **155**. Widely spaced supports for the cross beam **70** permit a full range of adjustment for the cage rollers inside the structure of the breakdown passes.

The tooling of the double radius or edge forming device seen in FIG. 3 may readily be replaced and the position of the tooling quickly symmetrically repositioned by the single point adjustment of the screw **52**. Initial breakdown tooling need not be changed.

It can now be seen that there is provided several improvements in tube or pipe mills which reduce the cost of the mill and enable the mill to be converted to produce different sizes of pipe in much less time.

Other modes of applying the principles of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. A mill for producing pipe and the like comprising a breakdown, cage roll assemblies following said breakdown to shape the work passing therethrough, and an edge forming device on the exit side of said breakdown between said breakdown and said cage roll assemblies, said edge forming device comprising two frames coaxially pivotally mounted on said breakdown.

2. A mill as set form in claim **1** including single point adjustment for the frames of said edge forming device operative to pivot said frames symmetically on each side of the pivot support.

3. A mill as set forth in claim **2** including edge forming roll subassemblies readily removably mounted on said frames, and means operative firmly to clamp said frames in adjusted position.

4. A mill as set forth in claim **1** wherein said breakdown comprises a power driven top roll, and a power driven bottom roll having inclined idler rolls at opposite ends thereof, the idler rolls and bottom roll cooperating with said top roll to form the breakdown pass.

5. The mill as set forth in claim **4** wherein the bottom roll and two idler rolls of said breakdown are vertically adjustably movable as a unit.

6. The mill as set forth in claim **5** wherein said idler rolls are mounted on saddles supporting said idler rolls over the spindle of said bottom roll laterally beyond the latter.

7. The mill as set forth in claim **1** including additional breakdowns each comprising a vertically movable power driven bottom roll, and a vertically adjustable top idler roll having idler rolls projecting diagonally on each side thereof, and means operative to adjust the position of the diagonally positioned rolls.

8. In a mill for producing pipe and the like including a cage roll assembly, the improvement comprising beams supporting the cage rollers of said assembly, a plurality of rollers on each beam, pivot means for said rollers mounted on the top of each beam, and means to adjust and support each said roller about said pivot means.

9. A mill as set forth in claim **8** including two point support means at each end of each beam supporting the latter for movement along inclined linear paths of different inclination.

10. A mill as set forth in claim 9 including inclined stands, tables vertically adjustably movable on said stands, said two point support means comprising spherical bearings normal to each other, support shafts on said table extending through said bearings, and one of said shafts floating at both ends.

11. In a mill for producing pipe and the like including a cage roll assembly, the improvement comprising beams supporting the cage rollers of said assembly, and two point support means at each end of each beam supporting the latter for movement along inclined linear paths of different inclination.

12. A mill as set forth in claim 11 including inclined stands, tables mounted on said stands for movement therealong, stanchions on said tables, spherical bearings in said stanchions extending normal to each other, and support shafts on said table extending through said bearings providing said two point support at each end of the beam.

13. A mill as set forth in claim 12 wherein one of said support shafts is floatingly mounted at each end in said beam.

14. A mill as set forth in claim 13 including a plurality of rollers on each beam, pivot means for said rollers mounted on the top of each beam, and means to adjust and support each said roller about said pivot means.

15. A mill as set forth in claim 14 including breakdowns cooperating with said cage roll assembly, each of said breakdowns comprising a vertically adjustable power driven bottom roll and a vertically adjustable idler top roll with the latter having idler rolls projecting on each side thereof, and means to control the extent of projection of said idler rolls.

16. A mill as set forth in claim 15 wherein the top idler roll of said breakdowns is mounted on a cross beam having spaced supports accommodating said cage roll assembly therebetween.

17. A mill as set forth in claim 16 wherein the power driven bottom roll is journalled on a separate smaller stand between the supports for said cross beam.

18. A mill for producing pipe and the like comprising a breakdown roll stand having a power driven top roll, a power driven bottom roll having inclined idler rolls at opposite ends thereof, the idler rolls and the bottom roll cooperating with said top roll to form the breakdown pass, an edge forming device mounted on the exit side of said breakdown, said edge forming device comprising two frames coaxially pivotally mounted on said breakdown, and single point adjustment for said frames operative to pivot said frames symmetrically on each side of the pivot support.

19. A mill as set forth in claim 18 including edge forming roll subassemblies readily removably mounted on said frames, and means operative firmly to clamp said frames in adjusted position on said breakdown.

20. In a mill for producing pipe and the like an edge forming device, edge forming roll subassemblies, frame

means supporting said subassemblies, single point adjustment for said frame means operative to convert the edge forming device to pipe and the like of different size, and a common pivot axis for said frame means.

21. A mill as set forth in claim 20 wherein said single point adjustment for said frame means includes means to maintain symmetry of said frame means about said pivot axis.

22. A mill as set forth in claim 20 wherein said frame means comprises two frames, said single point adjustment being operative to adjust said frames and including an adjusting screw having opposite hand thread portions, and a nut on each such thread portion, each nut being connected to one of said frames.

23. A mill for producing pipe and the like comprising a first breakdown, cage roll assemblies following said first breakdown to shape the work passing therethrough, an edge forming device on the exit side of said first breakdown between said first breakdown and said cage roll assemblies, beams supporting the cage rollers of the cage roll assemblies, a plurality of cage rollers on each beam, pivot means for said rollers mounted on the top of each beam, and means to adjust and support each said roller about said piovt means.

24. A mill for producing pipe and the like comprising a first breakdown, cage roll assemblies following said first breakdown to shape the work passing therethrough, an edge forming device on the exit side of said first breakdown between said first breakdown and said cage roll assemblies, beam supporting the cage rollers of said cage roll assemblies, and two point support means at each end of each beam supporting the latter for movement along inclined linear paths of different inclination.

25. A mill for producing pipe and the like comprising a first breakdown, cage roll assemblies following said first breakdown to shape the work passing therethrough, an edge forming device on the exit side of said first breakdown between said first breakdown and said cage roll assemblies, beams supporting the cage rollers of said cage roll assemblies, two spherical bearings at each end of each beam supporting the latter for movement along inclined linear paths of different inclination, said bearings at each end being normal to each other, and support shafts on said beam passing through said bearings, one of said shafts floating at each end in said beam.

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