Jan. 7, 1969 G. L. BEARER 3,420,082

LEVELER

Filed June 2, 1966 Sheet 1 of 6

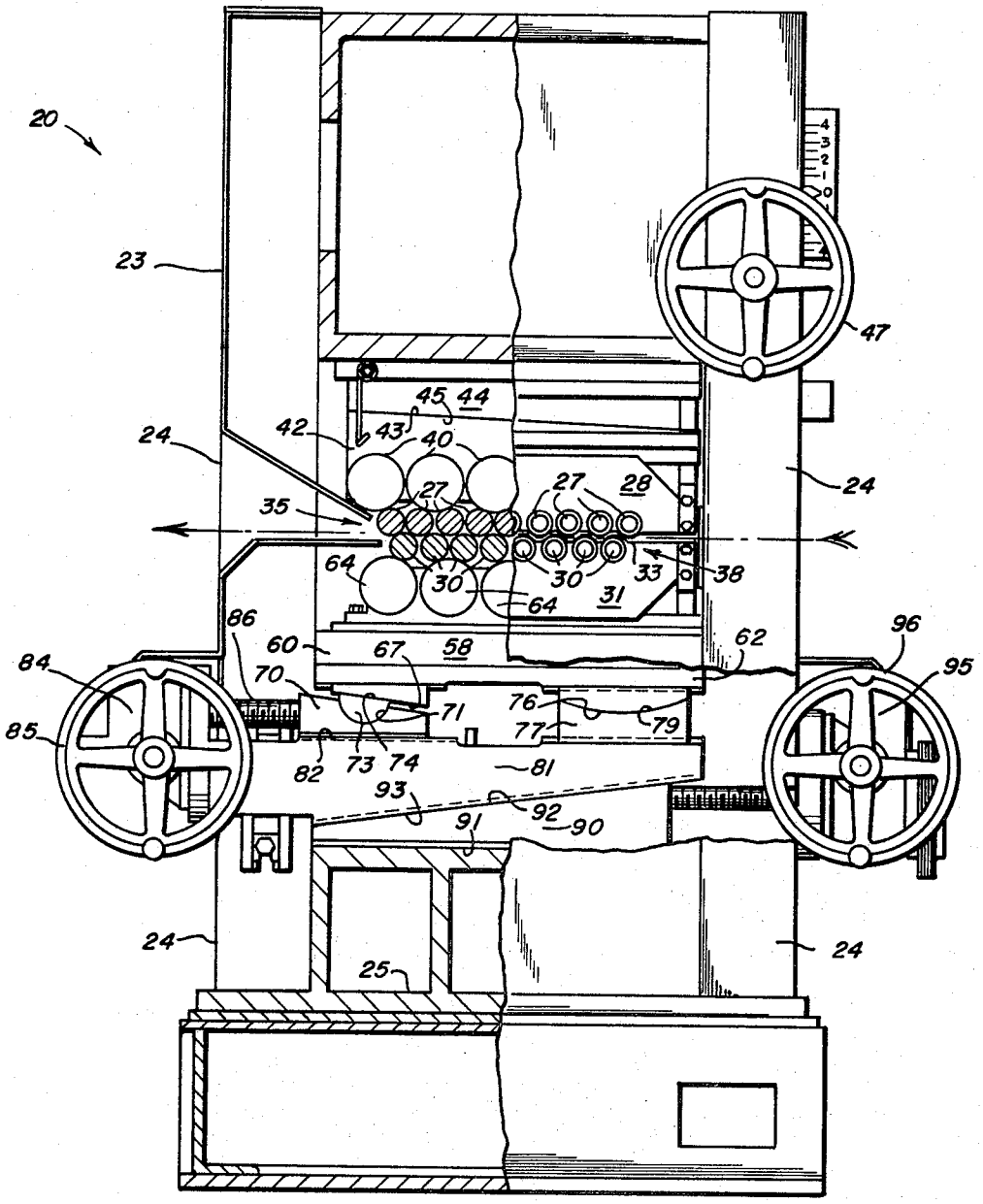

FIG. 1

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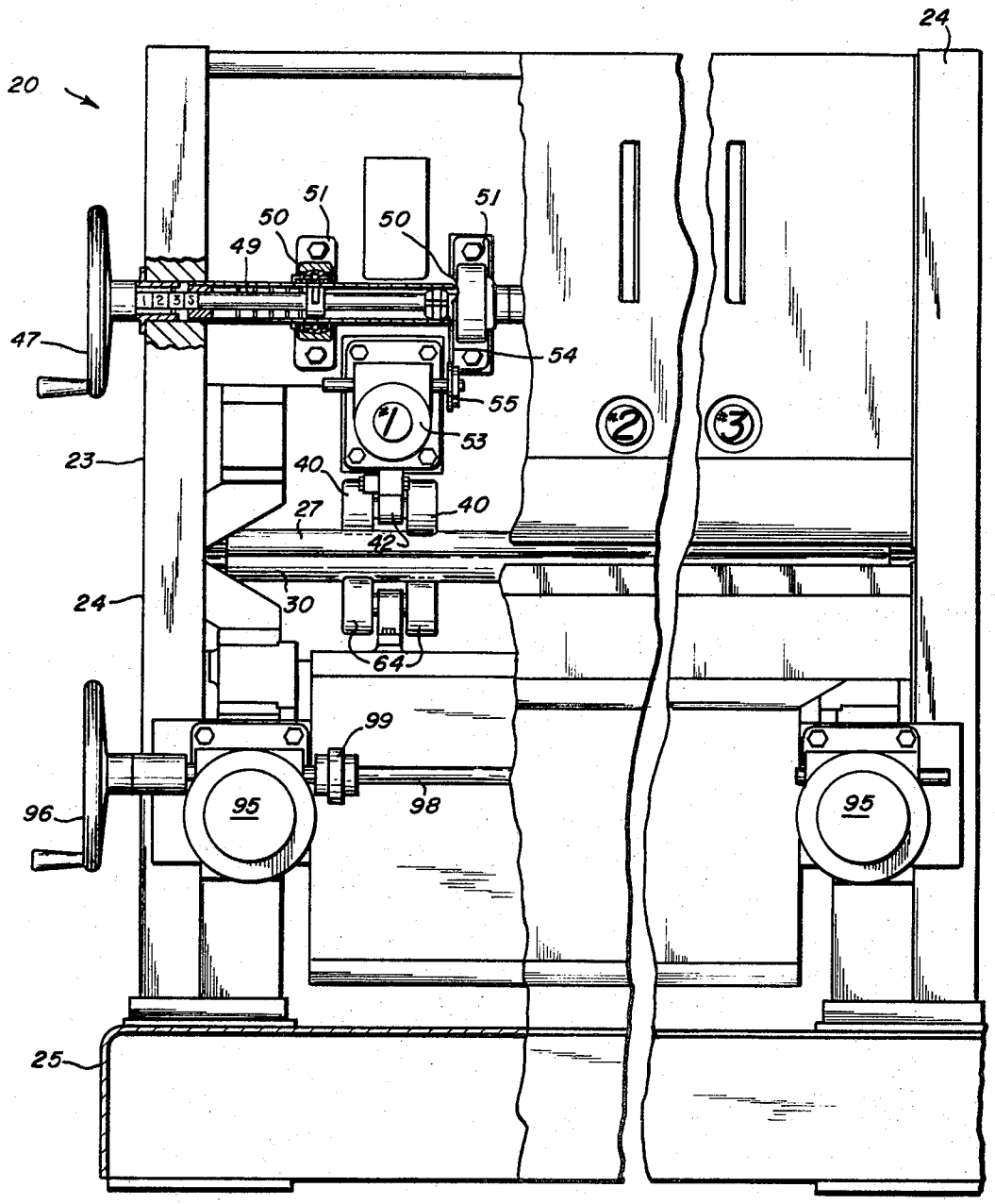

FIG. 2

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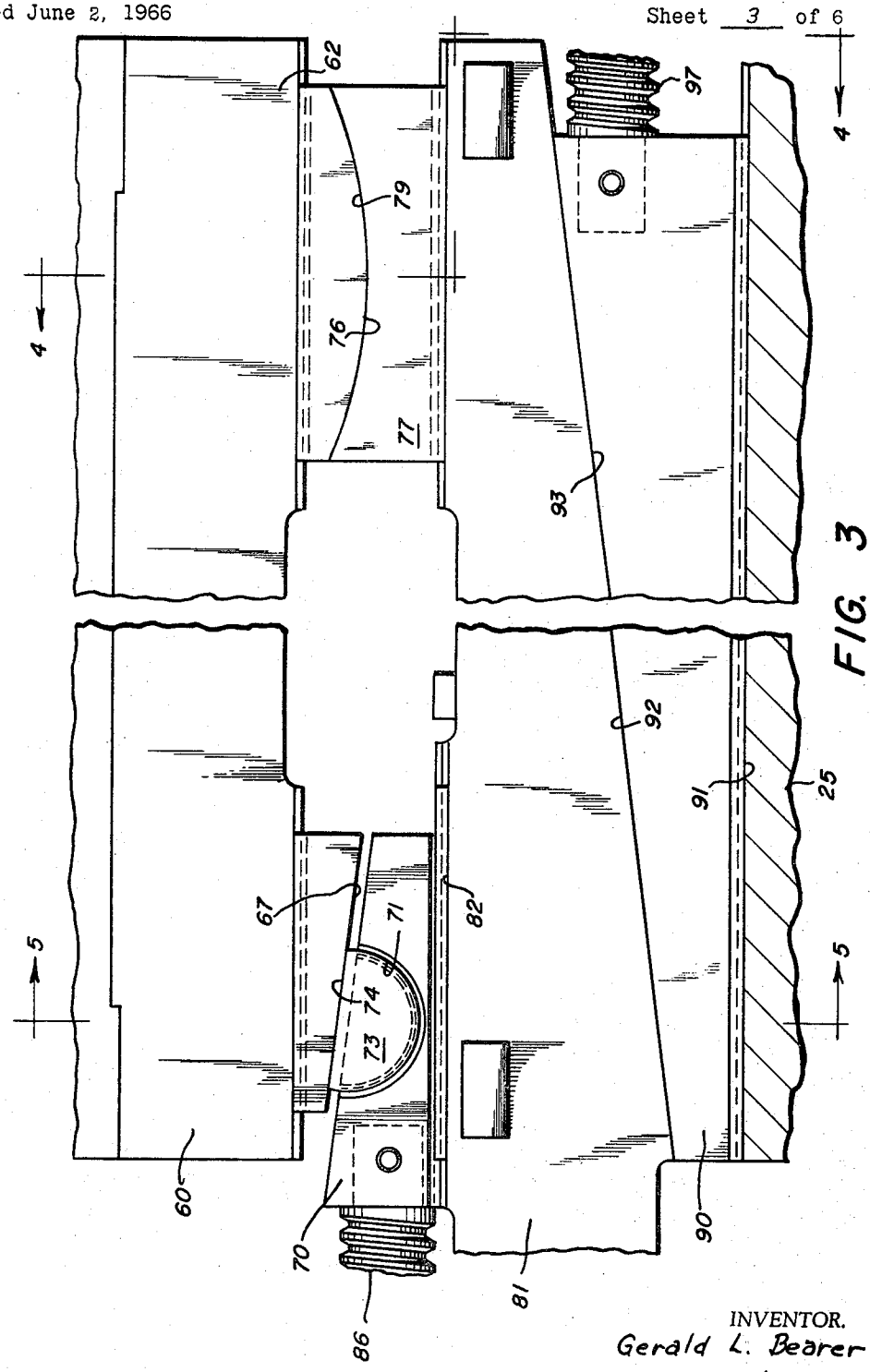

FIG. 3

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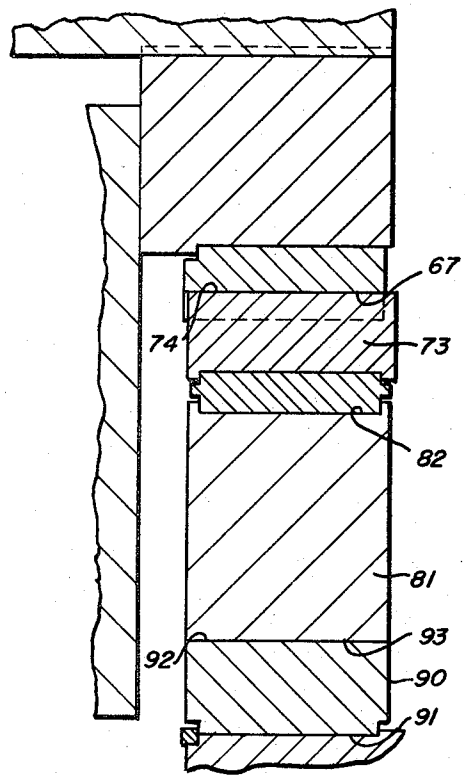

FIG. 5

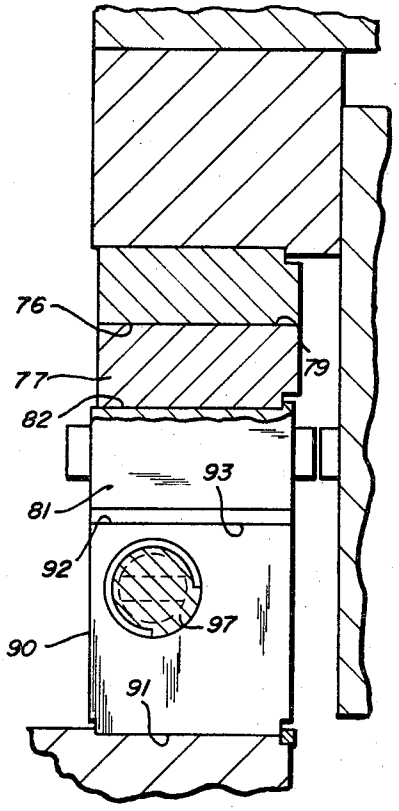

FIG. 4

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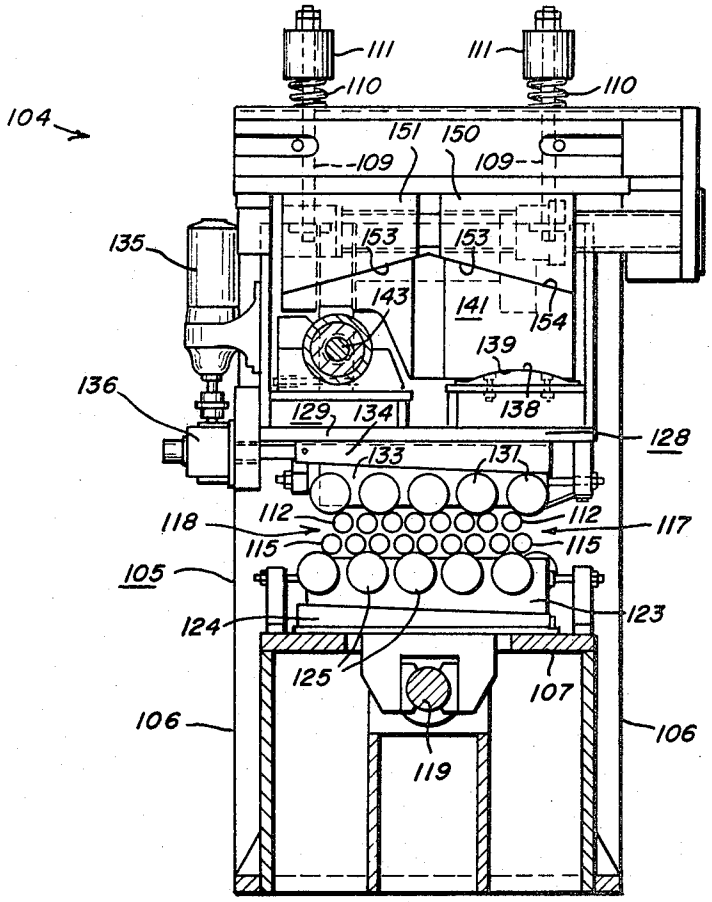

FIG. 6

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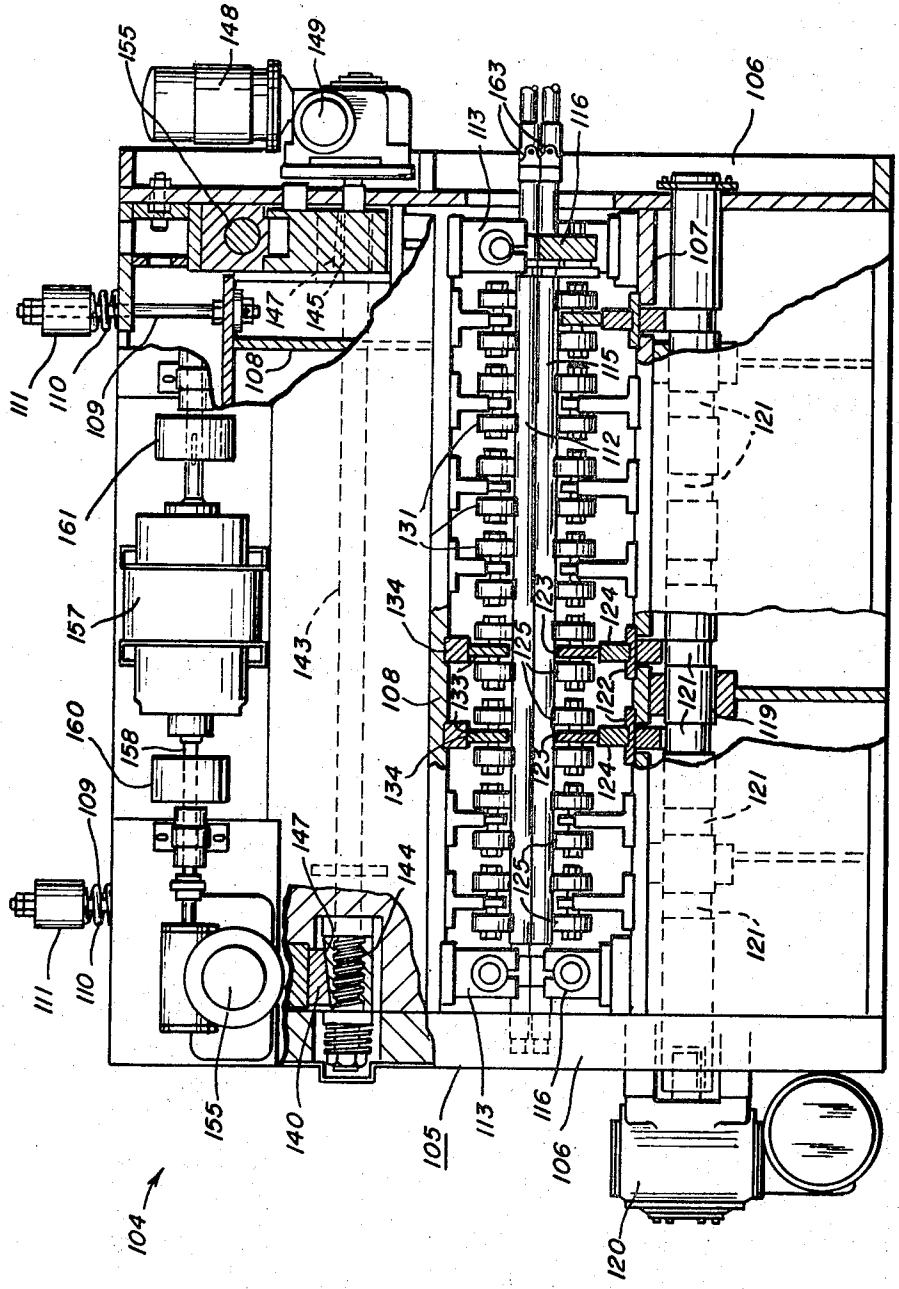

FIG. 7

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United States Patent Office 3,420,082 Patented Jan. 7, 1969

3,420,082

LEVELER

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Filed June 2, 1966, Ser. No. 554,875
U.S. Cl. 72—163 12 Claims
Int. Cl. B21d 1/02

ABSTRACT OF THE DISCLOSURE

The disclosure relates to a machine to work a web such as a metal sheet by progressively bending it between first and second pluralities of work rolls. One plurality may be tilted relative to the other and the greatest separating force exerted by the metal sheet on the work rolls occurs at either the entrance or exit end. A large arcuate journal surface is located vertically in line with that end of the machine having the largest separating force to support such force and permit easy adjustment of the tilt angle without materially changing the height adjustment.

The present invention relates in general to apparatus for working a web by bending, such as straightening or rendering relatively flat, a continuous sheet of metal by passing the same between first and second spaced pluralities of work rollers and more particularly to such apparatus wherein the work rollers of one plurality may be tilted relative to the other plurality to adjust the spacing between the work rollers of the two pluralities at the entrance or exit end of the apparatus.

A primary object of the present invention is to provide a tilting mechanism in a metal straightening or leveling apparatus, to tilt a first plurality of work rollers relative to a second plurality of work rollers to vary the separating force exerted by a metal sheet at either the entrance or exit end of the apparatus, with a primary support mechanism which is vertically in line with the end where the greatest separating force is exerted as distinguished from the middle and the control mechanism for actuating the tilting mechanism about the primary support mechanism is located vertically in line with the end opposite the primary support mechanism.

Another object of the present invention is to provide a tilting mechanism for the above mentioned type of machine which rotates about a support by way of a surface which comprises at least a portion of the surface of a cylinder.

Another object of the invention is to provide an apparatus having a plurality of rolls for working on a web or sheet of material wherein the plane of one plurality of work rolls may be tilted relative to the plane of another plurality of work rolls without any substantial change in the relative height or separation between the two planes, to thereby simplify adjustment and setup.

Another object of the invention is to provide an apparatus for working on sheet material between first and second pluralities of work rolls with a separating force therebetween established by the back pressure of the work, wherein this main separating force is at one end or the other of the plurality of work rolls and is carried by a large bearing surface, the central area of which is in a plane perpendicular to the plane of the work rolls so that the same size bearing surface will provide a greater load capacity than the prior art machines.

Another object of the present invention is to provide a tilting mechanism in a leveler wherein the tilting support mechanism and the actuating control mechanism therefor may be located either above or below the pass line, which is the location of a metal sheet when it passes through the leveler.

Another object of the present invention is to provide an apparatus of the above mentioned type wherein the tilting mechanism permits adjustment of the delivery side of the same or the entrance side as the case may be, independently, that is, adjustments to the tilting mechanism do not influence the basic height of the apparatus.

Another object of the present invention is to provide an apparatus of the above mentioned type wherein means are provided wherein adjustments may be conveniently made for work roll height, cant, synchronous, and individual work roll crown, as well as for work roll tilt.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is an elevational view partially in section of a leveler constructed in accordance with the teachings of the present invention;

FIGURE 2 is an elevational view partially in section taken from the right end of FIGURE 1 and 90° from the direction of FIGURE 1;

FIGURE 3 is an enlarged view of a portion of the structure seen in FIGURE 1;

FIGURE 4 is a view taken generally along the line 4—4 of FIGURE 3;

FIGURE 5 is a view taken generally along the line 5—5 of FIGURE 3;

FIGURE 6 is an elevational view of a modified form of a leveler of the present invention; and,

FIGURE 7 is an elevational view partially in section taken from the left end of FIGURE 6.

FIGURES 1 through 5 embody the teachings of the present invention in an apparatus **20** for leveling a sheet of metal and may otherwise be referred to herein as a leveler. The function performed by the present device is to work a web by bending and one specific use is to render a continuous sheet of metal, such as steel relatively flat across its width by the action of spaced pluralities of work rolls which bend the metal back and forth as it travels between the work rolls. The metal which is to be leveled or made of uniform thickness is unsatisfactory in this respect as it is received from the rolling mills where it is initially formed, because in traveling through the rolling mills different portions across the width of the sheet of steel are caused to travel different distances with resultant warping across the width of the sheet.

The leveler shown and described in FIGURES 1 through **5** includes in combination a main frame **23** which comprises a plurality of posts **24** which extend upwardly from a base **25**. A first plurality of generally horizontally disposed work rollers **27** are journalled in bearings located in plates **28** (only one of which is shown) which in turn are fixedly secured to the posts **24** which form a part of the main frame. A second plurality of horizontally disposed work rollers **30** are similarly journalled for rotation in plates **31** and are vertically spaced from and horizontally offset with respect to the first plurality of work rollers **27**. The plates **31** may be considered a first or movable frame, and the plates **28** may be considered a second frame, part of the fixed main frame **23**. Means are provided for rotatably driving the work rollers **27** and **30**, however, in the embodiment of the invention this means has not been specifically shown. Because of the spacing of the work rollers **27** and **30**, they are adapted to receive a web or sheet of metal **33** therebetween and these work rollers serve to define an exit portion **35** of the leveler and an entry portion of the leveler **38** at the pass between the two planes of pluralities **27** and **30** of work rollers. A first plurality of

back up rollers **40** are carried or supported by the upper portion of the main frame **23** and are engageable with the upper or rear portion of the first plurality of work rollers **27** at a plurality of places along their axial length. As will be noted from viewing FIGURE 2, there are three banks of these back up rollers **40** located at positions **1**, **2** and **3**, however, only the construction at position **1** has been shown since the back up rollers are of the same construction at all positions. Engagement of the back up rollers with the work rollers is best understood from viewing FIGURES 1 and 2. It will be noted that back up rollers **40** are rotatably journalled on a support block **42** which has an upper tapered surface **43**. An adjusting wedge **44** is positioned vertically above the support block **42** and has a tapered surface **45** in mating engagement with surface **43**. It will be understood that as wedge **44** moves horizontally to the left as seen in FIGURE 1 the block **42** will be caused to move downwardly bringing back up rollers **40** into engagement with work rollers **27** to maintain or increase the force on the metal sheet **33**. As the wedge **44** is moved to the right the pressure of the metal sheet will cause the support block **42** as well as back up rollers to move vertically upwardly. This adjustment is commonly known in the art as synchronous roll crown adjustment since all three banks of back up rollers at positions **1**, **2** and **3** are moved at the same time and this adjustment is brought about by an operator of the leveler manipulating, in the proper direction, a hand wheel **47**. A shaft **49** is rotatably supported on bearings **50** which are in turn secured to the leveler by brackets **51**. A screw type jack **53** is located at position **1** and of course a similar construction is provided at positions **2** and **3**, and this screw type jack is operatively connected to the right end of the wedge **44** as viewed in the direction of FIGURE 1, so that actuation of the jack **53** in appropriate directions causes the wedge **44** to move back and forth as above described. The jack **53** is driven from the shaft **49** by way of a chain **54** driving a jack shaft **55**.

A movable frame member **58** is located below the metal sheet **33** and has a first end portion **60** generally vertically below the exit portion **35** of the leveler and has a second end portion **62** generally vertically below the entry portion **38** of the leveler. The plates **31** which mount the second plurality of work rollers **30** are carried by the movable frame **58** so that they move together as a unit and additionally a second plurality of back up rollers **64** are rotatably carried by the movable frame **58** and are engageable with the lower plurality of work rollers **30** at a plurality of places along their axial length. There are three banks of the second plurality of work rollers, one being shown in FIGURE 2 and two of these banks not being shown because they are all identical but being located vertically below stations **2** and **3** shown in this figure.

A first cam surface **67** is provided on the underside of the first end portion of the movable frame member **58** and a similar cam surface (not shown) is provided at the opposite side, or far end, of the movable frame member. A tilt wedge member **70** is positioned beneath the first cam surface **67** and is provided with bearing means **71** in the form of a portion of the surface of a cylinder and a semicircular insert **73** is carried in the bearing means **71** and has a flat surface **74** in engagement with the first cam surface **67**. An arcuate bearing surface **76** is provided on the underside of the second end portion **62** of the movable frame member **58** and forms at least a portion of the surface of a cylinder. A saddle member **77** is provided beneath the bearing surface **76** and has a mating support bearing surface or journal surface **79** positioned beneath and receiving the bearing surface **76**. This journal surface **79** has a relatively large radius with the center of the arc or axis substantially in the plane of the axes of the lower work rollers. In this case it is at the entry portion **38** because

the largest load on the machine **20** is at this entry portion. Also the central area of the journal surface **79** is vertically below this entry portion **38** in order to better support these large loads, which may be in the order of several hundred tons.

A first vertical movement wedge **81** is provided which has an upper horizontal surface **82** which slidably supports the tilt wedge member **70** and also serves to support the saddle member **77** which carries the journal support surface **79**. Means are provided for moving the tilt wedge member **70** back and forth (as well as another tilt wedge member which engages the referred to and not seen cam surface at the opposite side, or far end, of the movable frame member) in a horizontal direction with the flat surface **74** of the semi-circular insert **73** engaging the first cam surface **67** which causes the movable frame member **58** to move angularly about the center of rotation of the mating bearing surfaces **76** and **79**. This angular movement serves to change the tilt angle of the plane of the work rollers **30** with respect to the plane of the work rollers **27**. This means comprises a jack **84** operated by a hand wheel **85** and the jack **84** is operatively connected to the tilt wedge **70** by a threaded member **86**. The construction of the jack **84** is conventional in nature and further details of construction of the same will not be discussed herein.

A second vertical movement wedge **90** is provided and has a lower horizontal surface **91** slidably supported by the base **25** and has a wedge surface **92** in mating engagement with the wedge surface **93** on a bottom portion of the first vertical movement wedge **81**. Means are also provided for moving the second vertical movement wedge **90** back and forth in a horizontal direction to properly vertically position the components carried thereby and this means comprises another jack **95** operatively actuated by a hand wheel **96** and the jack is mechanically connected to the wedge **90** by means of a threaded member **97**. An identical jack **95** is operatively connected to an identical second vertical movement wedge **90** on the opposite side, or far end, of the leveler and these two jacks **95** operate identically and at the same time because of their interconnection by means of a shaft **98**.

As mentioned hereinabove, the combination of the two vertical movement wedges **81** and **90** serves to determine the vertical positioning of all of the elements carried thereby which includes the elements below the metal sheet **33** and in order to assure that the first vertical movement wedge **81** moves in the correct vertical direction, guide means may be provided, not shown.

A clutch **99** in shaft **98** may be disengaged for separate actuation of only the jack **95** on the left side of FIGURE 2, in order to provide cant adjustment of the work rollers **30**.

In the leveler shown in FIGURES 1 and 2 and described in detail hereinabove, the greatest separating force exerted by the metal sheet **33** which travels between the first and second plurality of work rollers, is exerted at the entry portion **38** of the apparatus. This separating force may be varied, relative to the exit portion, by tilting or rotating the movable frame member **58** about the mating bearing surfaces **76** and **79** so as to vary the vertical spacing between the work rollers at the entrance portion relative to the exit portion of the leveler. In any event, it will be noted that the bearing surfaces **76** and **79** are located vertically below the entry portion **38** of the leveler and this asymmetry serves to support more directly and more conveniently this main separating force. This results in many advantages, only one of which is that there is less twist in the bottom frame. By moving the primary support for the main separating force of the leveler to this side there is provided more space at the exit end of the leveler for location of the camming mechanism which is used to actuate tilting of the movable frame member **58**.

In leveling machines the main separating force is at the entrance portion **38** because of the greater bending of the

metal sheet 33 at this area. Accordingly, the central area of the journal surface 79 is in a plane perpendicular to the plane of the work rolls at the entry portion 38. Also the center of the arcuate journal surface 79 is established at this entry portion 38. This has several advantages, the first of which is that with the large journal surface 79 vertically below the entry portion 38, whereat the main separating force is located, this force is readily supported in the machine 20. If this large journal surface 79 of the same radius and of the same surface area were located on the center line of the machine, vertically below the center of the work rolls 27 and 30, then the main separating force would be an off-center load and such journal surface 79 would not be able to support this separating force nearly as well. Accordingly, the capacity of the machine is substantially increased.

A second advantage obtains when or if the center of the arcuate journal surface 79 is moved to the exit portion 35. Then changes in the tilt angle do not change the height adjustment of the work rollers. By the height adjustment is meant the vertical separation between the plane of the work rollers 27 relative to the plane of the work rollers 30. This materially aids and speeds the set up of the machine for a particular working condition. It means that the height and tilt adjustment are independent of each other instead of being interdependent as they would be were the center for the journal surface 79 to be located on the vertical center line through the work rolls 27 and 30. Accordingly slight adjustments in the tilt may be made and it will not be necessary to make a corresponding compensating adjustment in the height adjustment. This makes the setup for each particular work operation much more rapid and accurate.

It is also possible, when the main separating force is at the entrance end of the leveler, to move the main support to a position vertically above or below the entrance portion of the leveler, which creates more space at the exit portion of the leveler for the cam actuating mechanism. A construction in acordance with this discussion will be shown and described more thoroughly hereinafter.

As mentioned hereinabove, the wedges 81 and 90 serve to properly vertically locate the work rollers 30 and by disconnecting the clutch 99 in shaft 98 it is possible to provide, what is commonly referred to in the art as "cant" to the rollers 30. This is accomplished by vertically moving a wedge 81 on only one side of the machine which causes the axes of the rollers 30 to be located at an acute angle with respect to the horizontal. The roll crown adjustment has been discussed hereinabove and it will suffice to say that by rotating the hand wheel 47 and shaft 49 the crown on work rollers 27 may be either increased or decreased.

FIGURES 6 and 7 illustrate a variation in construction of an apparatus made in accordance with the teachings of the present invention. The leveler of FIGURES 6 and 7 has been indicated generally by the reference numeral 104 and also includes a main frame 105 which comprises vertically extending posts 106 which extend from a base 107. The construction of this leveler also comprises a first frame or suspended movable frame 108 which is capable of vertical movement within limits. The suspended frame 108 is supported by rods 109 threadably secured thereto and extending through a cross member of the main frame 105 which extends between posts 106. A spring 110 surrounds a respective rod 109 and engages a cap 111 which is carried on an end portion of rod 109. This apparatus also comprises a first plurality of work rollers 112 rotatably journalled at their opposite ends in journal boxes 113 which journal boxes are suspended on the lower portion of suspended frame 108. A second plurality of work rollers 115 are provided and are journalled by journal boxes 116 at their opposed ends, which journal boxes are supported by the main or second frame 105 in the manner indicated in FIGURE 7. These work rollers are related to each other in a manner similar to the work rollers 27 and 30 described in conjunction with the apparatus of FIGURES 1 and 2. The work rollers 112 and 115 serve to define an entrance portion 117 of the leveler and an exit portion 118 of the leveler. In other words, in the leveling operation performed, the sheet of metal enters the leveler at the entrance portion 117 and leaves at the exit portion 118.

The base of the leveler journals a shaft 119 for rotation which shaft is adapted to be rotatably driven by motor 120. The shaft 119 is provided with a plurality of eccentric portions 121, specifically eight in number as seen in FIGURE 7, and secured to each of the eccentric portions 119 is in effect a crank arm 122. Each of the crank arms 122 operatively engages a respective wedge member 124 each of which engages a respective support block 123 each of which in turn rotatably journals a second plurality of back up rollers 125. As noted from viewing FIGURES 6 and 7, the back up rollers 125 serve to engage the work rollers 112 in a manner similar to that described in conjunction with the leveler of FIGURES 1 and 2. It will therefore be apparent that as shaft 119 is rotated the engagement of the back up rollers 125 with work rollers 112 will be varied and as a result the crown on the work rollers 112 will be changed. The eccentricity is greatest at the center eccentric portions and is less toward the ends or sides.

The suspended frame 108 has a first end portion 128 which is vertically in line with the entrance portion 117 of the leveler and has a second end portion 129 vertically in line with the exit portion 118. A first plurality of back up rollers 131 are positioned in rotatable engagement with the first plurality of work rollers 112 and are supported and journalled by a plurality of support blocks 133. Positioned between each of the support blocks 133 and the bottom of the movably suspended frame 108 are a corresponding number of crown adjustment wedges 134, each of which are adapted to be individually driven in a horizontal direction as viewed in FIGURE 6 by means of a separate drive motor 135 and appropriate gear reduction 136. It will be apparent therefore that depending on the position of the wedge 134, the crown of the work rollers 115 at these particular points will be controlled and of course the work pressure between the first and second plurality of work rollers.

The first end portion 128 of the movably suspended frame 108 is provided with an arcuate bearing surface 138 which forms at least a portion of a surface of a cylinder which in turn is rotatably received in a complementary journal bearing surface 139 of a saddle member 141. The second end portion 129 of the movably suspended frame 108 is provided with a camming mechanism for causing the movably suspended frame to rotate about the center of rotation of the complementary bearing surfaces 138 and 139. This center of rotation is at the entrance portion 117 of the work rollers. This in turn causes tilting of the back up rollers 131 and associated work rollers 112 with respect to the plane of the work rollers 115. This camming mechanism comprises a rotatable shaft 143 which is provided at opposed ends with oppositely threaded portions 144 and 145, respectively. Wedge members 147 are threadably connected to the threaded portions 144 and 145 and as a result when shaft 143 is rotated the wedge members 147 either move outwardly away from the central portion of the leveler or inwardly toward the central portion of the leveler. The threaded portions 144 and 145 are left and right hand threads, respectively, so that the hereinabove movement of the wedge members 147 can be accomplished. The wedge members 147 are in operative engagement with wedges 140 at the second end portion 129 of the movably suspended frame 108 and as a result vertical movement is transmitted to this end 129 of the frame 108 as desired. The shaft 143 is caused to be rotated by means of a tilt motor 148 through appropriate gear reduction 149 and this tilt motor and gear reduction are mounted on and travel with the suspended frame in all of its movement.

In order to provide a vertical positioning for the movably suspended frame 108 there are provided vertical ad-

justment wedges **150** and **151** at both sides of the leveler which at their upper portions are supported by a fixed part of the main frame **105**. These vertical adjustment wedges on their lower sides are provided with a cam surface **153** which mates with a corresponding cam surface **154** on the upper side of the saddle member **141**. A jack **155** is operatively connected to wedges **150** and **151** at either side of the machine and actuation of the jacks **155** at either side of the leveler will cause wedges **150** and **151** to travel toward each other or away from each other as the case may be. The jacks **155** are operatively driven from a drive motor **157** through the medium of a shaft **158**. Electric clutches **160** and **161** may be energized to render inoperative either one of the jacks **155**. When this is done only one side of the movably suspended frame **108** is caused to be raised or lowered as the case may be, thereby providing to the leveler what is commonly known in the art as "cant." When the work rollers are canted, they are caused to be moved into a position where their axes are moved out of a horizontal plane and into a position which is at an acute angle with respect to a horizontal plane.

It will be noted from viewing FIGURE 7 that universal joints **163** are provided to connect each of the work rollers to driving shafts.

In operation, a continuous or intermittent metal sheet is fed into the entrance portion **117** of the leveler and leaves the same at the exit portion **118** and by action of the driven work rollers the metal sheet is worked, in this case worked to uniform thickness across its width. The primary separating force exerted by the metal sheet is at the entrance portion **117** of the leveler and because of the positioning of the complementary bearing surfaces **138** and **139** vertically in line with the entrance portion, the primary separating force is supported in an appropriate and most convenient position. By locating the primary support surfaces at this position there is appropriate room vertically in line with the exit portion **118** for location of the cam mechanism which serves to tilt the movably suspended frame **108**. When it is desired to adjust the tilt position of the two pluralities of work rollers relative to each other, the cam mechanism is actuated by rotation of the shaft **143** in the manner hereinabove described. Vertical positioning and canting of the movably suspended frame **108** is accomplished by way of the wedges **150** and **151** and synchronous roll crown adjustment of work rollers **112** is accomplished by shaft **119** and associated mechanism. Individual roll crown adjustment is accomplished on work rollers **112** by way of the separately actuated crown adjustment wedges **134** through the medium of drive motor **135** and gear reduction **136**. It will otherwise be seen that the hereinabove stated objects are carried out by means of the structure hereinabove described.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be restored to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. Apparatus for operating on a web including, in combination, a base,

a saddle,

first means mounting said saddle on said base,

first and second frames,

second means mounting said first frame on said saddle, means carrying said second frame on said base,

a first plurality of work rollers journalled relative to said first frame and disposed generally parallel and in a first plane,

a second plurality of work rollers journalled relative to said second frame and disposed generally parallel and in a second plane,

said first and second planes of work rollers being spaced apart to receive a web therebetween and defining an entrance portion and an exit portion of said work rollers,

said mounting means including an arcuate journal surface on said saddle and having the axis of the arcuate journal surface at a location closer to the work rolls than said journal surface,

a bearing surface on said first frame engaging said journal surface,

the central area of said journal surface being in a third plane passing through one of said entrance and exit portions of said work rollers and said third plane being substantially perpendicular to said first plane,

and said mounting means including adjustment means displaced from said journal surface on said saddle and when actuated rotating said first frame about the axis of said arcuate journal surface to change the tilt angle of the plane of said first plurality of work rollers relative to the plane of said second plurality of work rollers.

2. Apparatus as defined in claim **1** including establishing the axis of said arcuate journal surface substantially at one of said entrance and exit portions of said work rollers.

3. Apparatus as defined in claim **1** wherein said first and second pluralities of work rollers are disposed generally in horizontal planes,

said third plane passing through the central area of said journal surface being a substantially vertical plane,

means to adjust the vertical height of the plane of one of said first and second pluralities of work rollers to vary the vertical spacing between said first and second planes of work rollers,

said arcuate journal surface being a substantially cylindrical journal surface of large radius relative to the radius of said work rollers,

and means establishing the axis of said cylindrical journal surface substantially at one of said entrance and exit portions of said work rollers whereby a change in the tilt angle between said first and second planes has substantially no effect on the height adjustment between said first and second planes.

4. Apparatus as defined in claim **1** including wedge means as said adjustment means to adjust the tilt angle of said first plane relative to said second plane of work rollers,

and a semi-circular insert in said wedge means to maintain a surface contact between said wedge means and said semi-circular insert despite changing tilt angle of said first and second planes of work rollers.

5. An asymmetric tiltable leveler for leveling a continuous metal sheet including in combination a fixed frame,

a first plurality of work rolls each journalled for rotation about a horizontal axis,

a first plurality of backup rolls each journalled for rotation about a horizontal axis and rotatably engageable with given work rolls of said first plurality,

a first support member mounting said first plurality of backup rolls for said journalled rotation,

a second plurality of work rolls each journalled for rotation about a horizontal axis and being spaced from and alternately offset with respect to corresponding work rolls of said first plurality,

a second plurality of backup rolls each journalled for rotation about a horizontal axis and rotatably engageable with given to work rolls of said second plurality,

a second support member mounting said second plurality of backup rolls for said journalled rotation,

means for rotatably driving said first and second plurality of work rolls to drive a continuous metal sheet therebetween in a direction at right angles to the axes of said work rolls,

said first and second plurality of work rolls defining an entrance end portion and an exit end portion on opposite sides of a middle portion of said leveler,

a tiltably movable frame connected to said first support member which mounts said first plurality of work rolls,

said movable frame have an arcuate bearing surface substantially vertically in line with one of said entrance and exit end portions with the axis of said arcuate bearing surface being closer to said work rolls than said bearing surface,

a saddle member having a mating support bearing surface complementary to said bearing surface on said movable frame and receiving the same for permitting angular movement of said movable frame relative thereto,

and means operably connected to an end portion of said movable frame at an end opposite said bearing surface substantially vertically in line with the other of said entrance and exit end portions and when actuated causing said movable frame to move angularly about said mating support bearings surface.

6. A leveler as claimed in claim **5** wherein said bearing surface comprises at least a portion of the surface of a cylinder.

7. A leveler as claimed in claim **6** wherein said saddle member is provided with a cam surface opposite said mating support bearing surface which engages a cam surface on a longitudinally movable height wedge which when longitudinally moved vertically adjusts the position of said movable frame.

8. A leveler as claimed in claim **5** wherein said means for causing said movable frame to move angularly about said mating support bearing surface comprises cam means.

9. A leveler as claimed in claim **5** wherein said bearing surface of said movable frame and said mating support bearing surface of said saddle member are substantially vertically in line with said entrance end portion and said means for causing said movable frame to move angularly about said mating support bearing surface is substantially vertically in line with said exit end portion.

10. A leveler as claimed in claim **5** wherein said bearing surface of said movable frame and said mating support bearing surface of said saddle member are substantially vertically in line with said exit end portion and said means for causing said movable frame to move angularly about said mating support bearing surface is substantially vertically in line with said entrance end portion.

11. Apparatus for leveling a sheet of metal including in combination a main frame and a base,

a first plurality of horizontally disposed work rollers journalled for rotation,

a second plurality of horizontally disposed work rollers journalled for rotation and being vertically spaced from and horizontally offset from said first plurality of work rollers,

means for rotatably driving said work rollers,

said first and second plurality of work rollers adapted to receive a sheet of metal therebetween and defining an entrance portion and an exit portion of said apparatus,

a first plurality of back up rollers carried by the upper portion of said main frame and engageable with the upper portion of said first plurality of work rollers at a plurality of places along their axial length,

adjustable means for urging said first plurality of back up rollers into engagement with said first plurality of work rollers with varying force,

a movable frame member having a first end portion substantially vertically in line with said entrance portion and having a second end portion substantially vertically in line with said exit portion,

a second plurality of back up rollers carried by said movable frame member and engageable with a lower portion of said second plurality of work rollers at a plurality of places along their axial length,

a first cam surface on the underside of said first end portion of said movable frame member,

a tilt wedge member positioned beneath said first cam surface,

bearing means in the upper surface of said tilt wedge member,

a semi-circular insert carried in said bearing means and having a flat surface in engagement with said first cam surface,

a bearing surface on the underside of said second end portion of said movable frame member and forming at least a portion of the surface of a cylinder,

a saddle member having a mating support bearing surface positioned beneath and receiving said bearing surface,

a first vertical movement wedge having an upper horizontal surface which supports said tilt wedge member and said mating support bearing surface,

means for moving said tilt wedge member back and forth in a horizontal direction with said flat surface of said insert engaging said first cam surface to angularly move said movable frame member about the center of rotation of said mating support bearing surface to change the angular position of said plurality of work and back up rollers carried by said movable frame member relative to the other plurality of work and back up rollers,

a second vertical movement wedge having a lower horizontal surface slidably supported by said base and having a wedge surface in engagement with a mating wedge surface on a bottom portion of said first vertical movement wedge,

means for moving said second vertical movement wedge back and forth in a horizontal direction thereby adjusting the vertical position of said movable frame member and the elements carried thereby,

and guide means acting between said main frame and said first vertical movement wedge to assure vertical movement of the same.

12. Apparatus for leveling a sheet of metal including in combination a main frame and a base,

a movable frame secured to said main frame and adapted for limited vetrical and angular movement,

a first plurality of horizontally disposed work rollers journalled for rotation and carried by said movable frame,

a second plurality of horizontally disposed work rollers journalled for rotation in said main frame and being vertically spaced from and horizontally offset from said first plurality of work rollers,

means for rotatably driving said work rollers,

said first and second plurality of work rollers adapted to receive a sheet of metal therebetween and defining an entrance portion and an exit portion of said apparatus,

a first plurality of back up rollers carried by said movable frame and engageable with the upper portion of said first plurality of work rollers at a plurality of places along their axial length,

a second plurality of back up rollers carried by said main frame and engageable with said second plurality of work rollers at a plurality of places along their axial length,

adjustable means for urging said second plurality of back up rollers into engagement with said second plurality of work rollers with varying force,

means suspending said movable frame from said main frame,

a saddle member having a support bearing surface,

said movable frame having a first end portion substantially vertically in line with said entrance portion and a second portion substantially vertically in line with said exit portion,

an arcuate bearing surface on said first end portion of said movable frame engaging said support bearing surface and having the axis of said arcuate bearing surface closer to said work rolls than said arcuate bearing surface,

cam means at the second end portion of said movable frame and when actuated rotating said movable frame about the center of rotation of said support bearing surface to change the angular position of said first plurality of work rollers relative to said second plurality of work rollers,

first and second vertical adjustment wedges supported by said main frame and having cam surfaces cooperating with corresponding cam surfaces on said saddle

member for vertically adjusting the position of said suspended frame.

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