Nov. 5, 1946. P. P. M. DUBOSCLARD 2,410,603

FORMING ROLL

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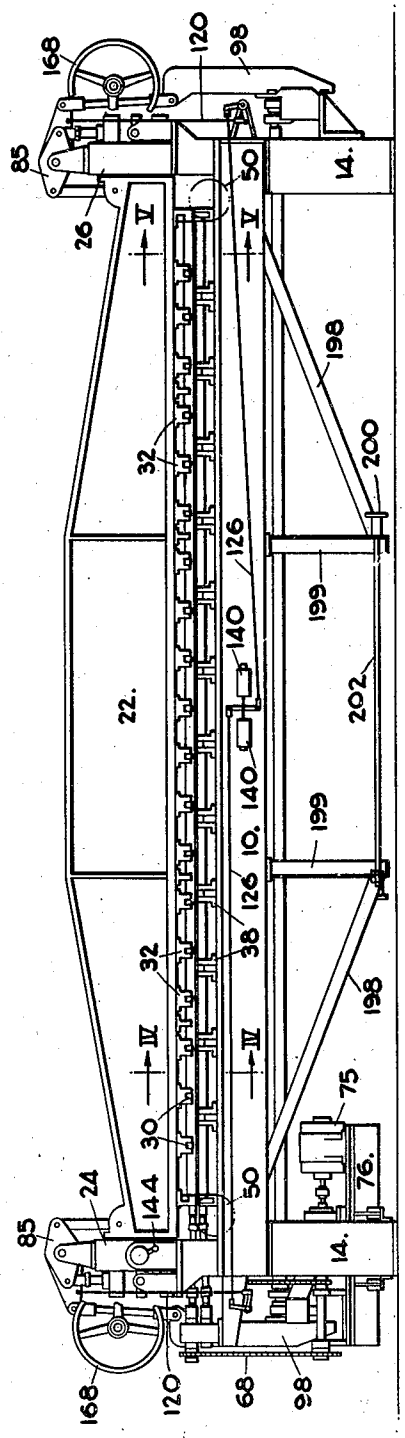
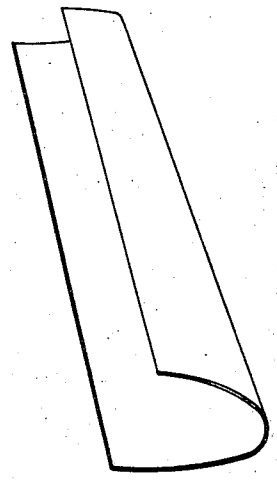


Fig. 1.

Fig. 10.



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Nov. 5, 1946. P. P. M. DUBOSCLARD 2,410,603

FORMING ROLL

Filed Sept. 1, 1944 6 Sheets-Sheet 2

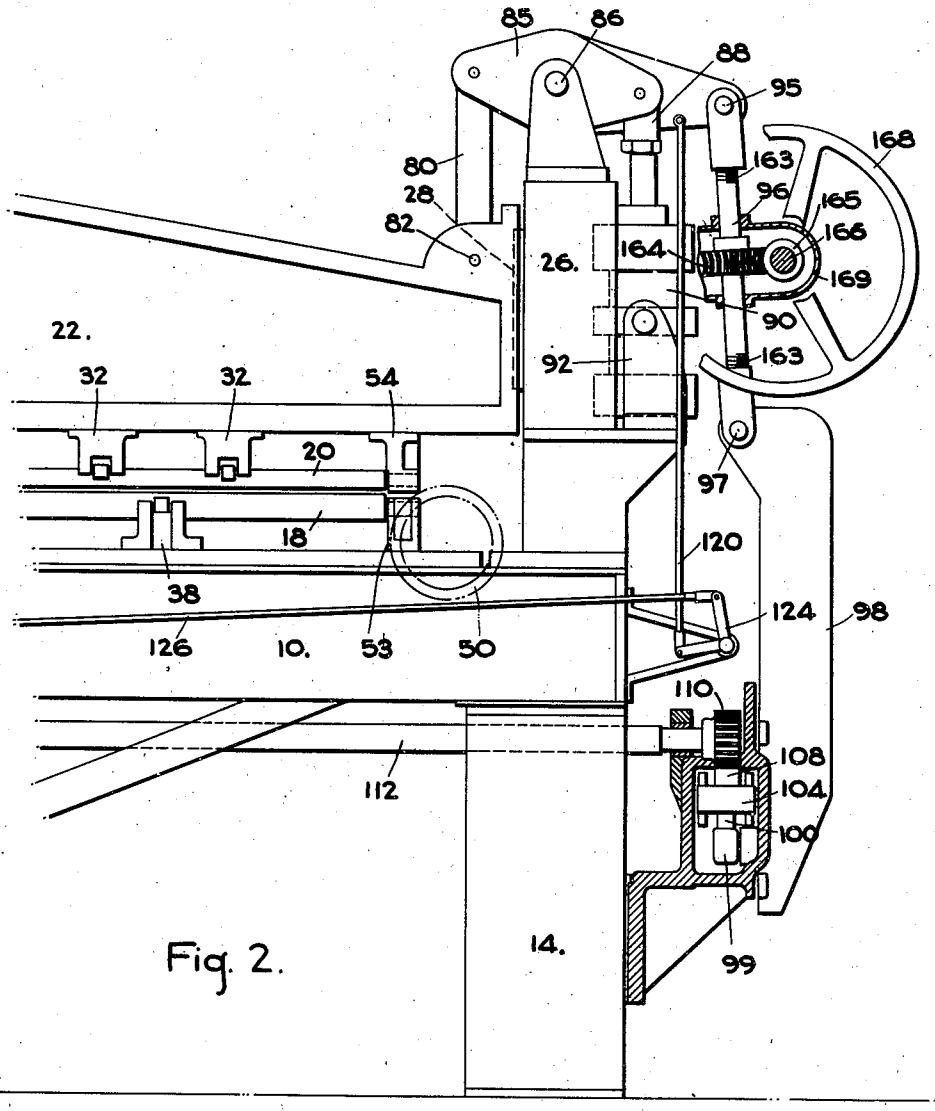


Fig. 2.

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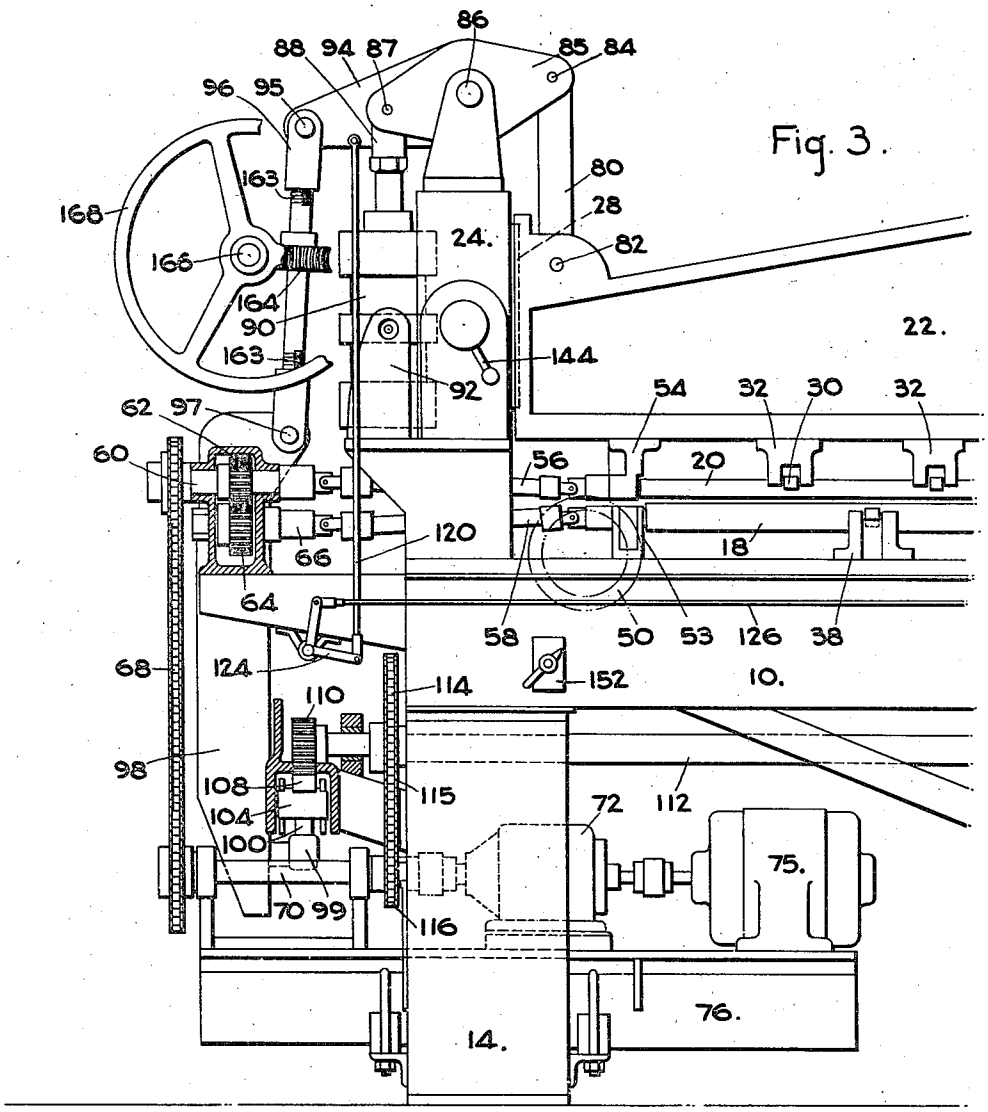
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Nov. 5, 1946. P. P. M. DUBOSCLARD 2,410,603

FORMING ROLL

Filed Sept. 1, 1944 6 Sheets-Sheet 3

Fig. 3.



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Nov. 5, 1946. P. P. M. DUBOSCLARD 2,410,603

FORMING ROLL

Filed Sept. 1, 1944 6 Sheets-Sheet 4

Fig. 4.

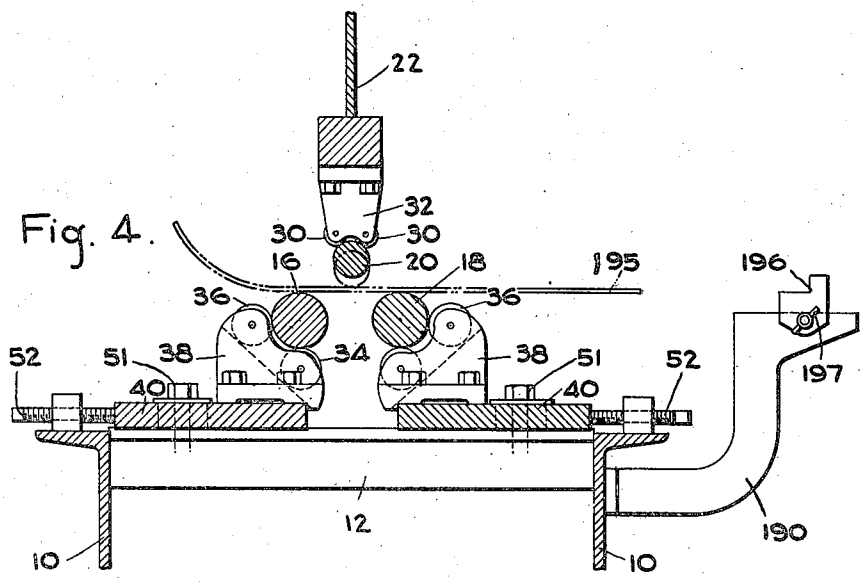
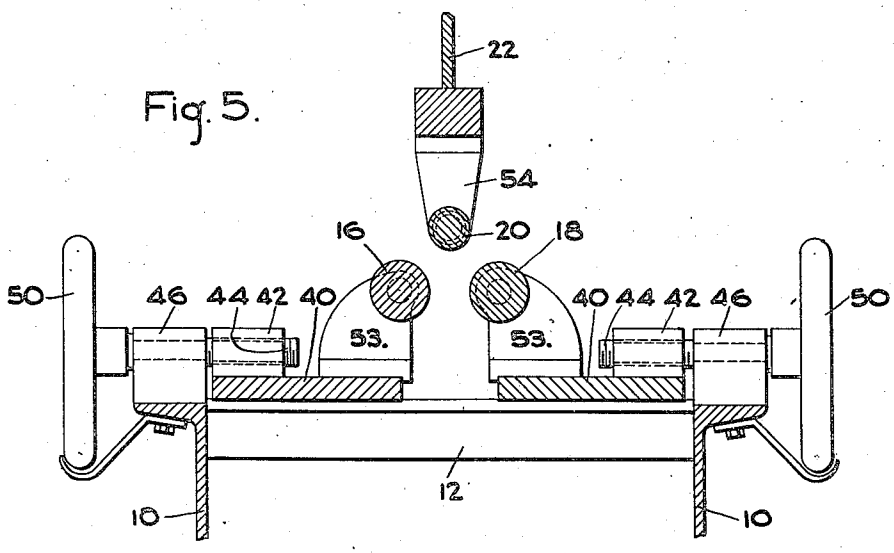


Fig. 5.



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FORMING ROLL

Filed Sept. 1, 1944 6 Sheets-Sheet 5

Fig. 6.

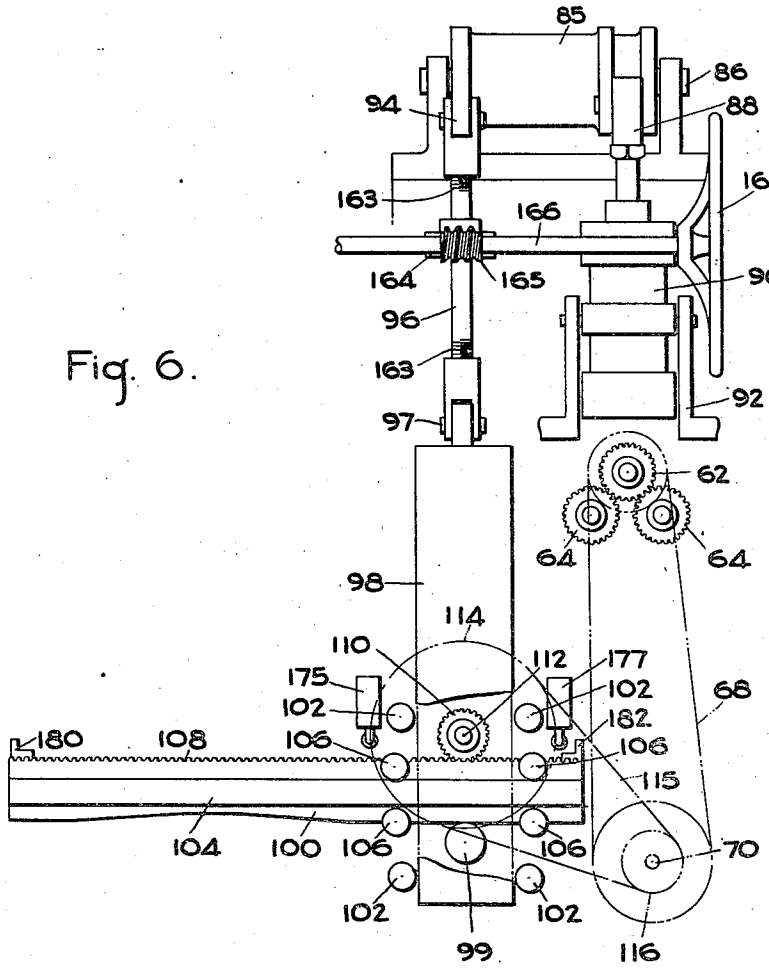


Fig. 7.

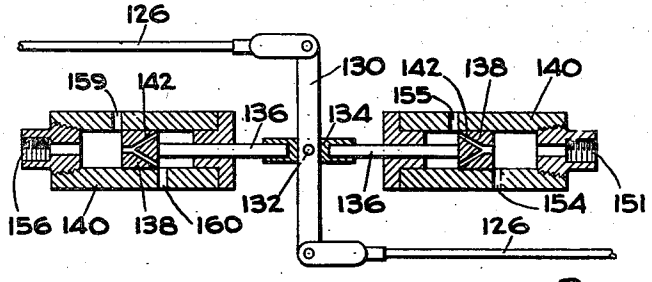
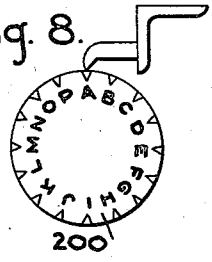


Fig. 8.



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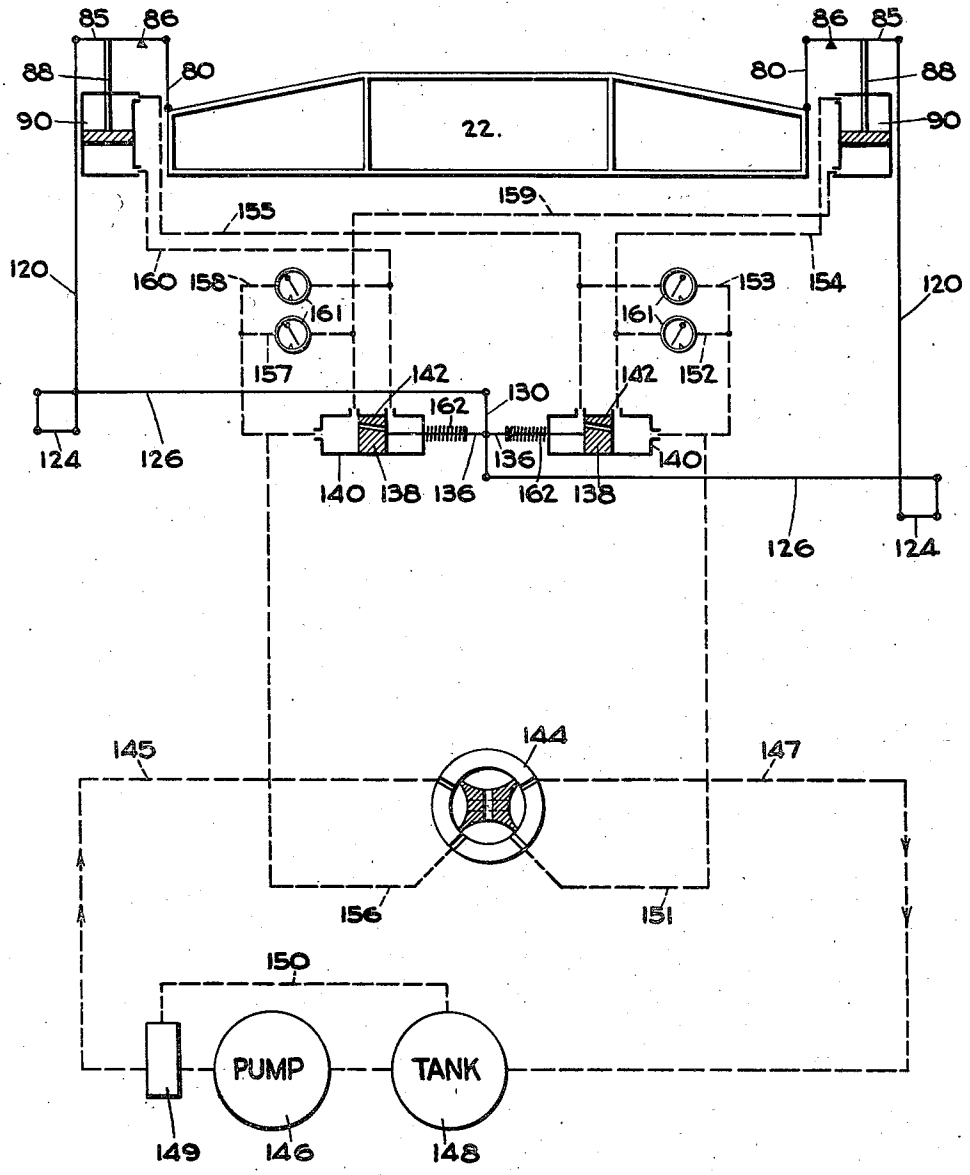
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Nov. 5, 1946. P. P. M. DUBOSCLARD 2,410,603

FORMING ROLL

Filed Sept. 1, 1944 6 Sheets-Sheet 6

Fig. 9.



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2,410,603

UNITED STATES PATENT OFFICE

2,410,603

FORMING ROLL

Paul P. M. Dubosclard, Buffalo, N. Y.

Application September 1, 1944, Serial No. 552,291

13 Claims. (Cl. 153—54)

1

This invention relates to forming rolls, and more particularly to improvements in forming rolls for processing sheet metal stock and the like into varyingly curved sectional shapes.

One of the objects of the invention is to provide a powered sheet rolling mill of improved form which is capable of handling relatively large size stock sheets and imparting thereto in improved manner variously curving sectional forms. Another object of the invention is to provide an improved forming roll which is adapted to form a flat stock sheet automatically into a prescribed varyingly curving contour during a single pass through the machine. Another object of the invention is to provide a machine of the character described which is adapted to operate in improved manner to form stock sheets into chordwise sectionally curved forms, either tapering or non-tapering in spanwise directions.

Another object of the invention is to provide an improved machine of the character aforesaid which is adapted to single-pass a stock sheet therethrough to form such stock sheet to curve sectionally to varying degrees chordwise of the sheet without requiring operator-attention to the roll settings of the machine intermediately of the rolling pass. Another object of the invention is to provide a forming roll for the purpose aforesaid which is adapted to roll flat sheet stock into relatively sharply curved shapes with improved facility.

Another object of the invention is to provide an improved forming roll of the character aforesaid which is adapted to more uniformly process stock sheets accurately into curved shapes and at increased speed when attended by only relatively unskilled operating personnel, compared to other manual or mechanism-controlled machines of the prior art. Another object of the invention is to provide a forming roll of the character aforesaid which is adapted to be set to automatically process, in improved manner, a flat sheet stock into a variously curved sectional form during a single pass of the stock sheet through the machine.

Another object of the invention is to provide an improved automatic operation control mechanism in rolling mills and the like whereby a positionally adjustable roll element thereof is automatically controlled to maintain substantially equidistant spaced relations at opposite ends thereof with respect to a positionally fixed roll element of the mill. Another object of the invention is to provide a forming roll of the character aforesaid which incorporates adjustable and automatically operating cam and stock sheet positioning devices for accurate control and synchronization of the cam and stock sheet actuating operations.

A more specific object of the invention is to provide an improved sheet metal forming roll which

2

is adapted to be operated by relatively unskilled workmen to produce large quantities of variously curved sheet metal pieces such as airplane wing leading edge skin sheets or fuselage skin sheets or the like in improved manner.

In the drawings:

Fig. 1 is a front elevation of a forming roll of the invention;

Fig. 2 is an enlarged view of the right hand end portion of the mill of Fig. 1, with portions broken away to show operative mechanism in section;

Fig. 3 is an enlarged view of the left hand end portion of the machine of Fig. 1, with portions broken away to show operative mechanism in section;

Fig. 4 is a fragmentary section, on an enlarged scale, taken along line IV—IV of Fig. 1;

Fig. 5 is a fragmentary section on an enlarged scape taken along line V—V of Fig. 1;

Fig. 6 is a fragmentary end elevation of the mechanism of Fig. 3;

Fig. 7 is an enlarged view, partly in section, of an automatic roll levelling and control device located centrally of Fig. 1;

Fig. 8 is an end elevation of a manual control device portion of the machine;

Fig. 9 is a diagrammatic illustration of the hydraulic control system of the mill; and

Fig. 10 is a perspective of a typical curved sheet product formed upon the mill of the invention.

The invention is illustrated by the drawings to be embodied in a forming roll comprising a bed constructed of parallel side beams 10—10 and spacers 12 extending transversely therebetween at intervals longitudinally of the beams. The bed is supported above the floor line for convenient operator feeding of stock sheets to the mill by means of pedestals 14. The stock contacting roll system of the machine comprises a group of three rolls disposed in parallel relation and extending lengthwise of the bed at a position generally centrally thereof. The rolls are grouped so as to comprise a pair of spaced bottom rolls 16—18 and an upper roll 20 carried at a position above and intermediately of the positions of the bottom rolls.

The upper roll 20 is carried by a beam 22 which is in turn suspended at its opposite ends from posts 24—26 extending upwardly from the bed of the machine. The beam 22 is keyed to the posts 24—26 by means of vertical key slides 28—28, and its vertical disposition is controlled by adjustable link mechanisms which will be described in detail hereinafter, whereby the elevational positions of opposite ends of the roll 20 are selectively controlled by adjustments of the suspension link devices, as will also be explained in detail hereinafter.

The upper roll 20 is supported by the beam 22 by means of a plurality of paired roller bearing

devices 30—30 which are carried by brackets 32 extending along the bottom edge of the beam 22 at intervals longitudinally thereof so as to support the roll 20 against undesirable deflections during stock rolling processes.

The bottom rolls 16—18 are similarly mounted upon paired roller bearings 34—36 carried by brackets 38 bolted to top plate members 40—40 at intervals longitudinally thereof, whereby to support the rolls 16—18 against undesirable deflections under the stresses of sheet stock rolling operations. The top plates 40—40 are slidably mounted upon the cross bars 12 of the bed so as to be adjustable in directions transversely of the bed to vary the distance between the rolls 16—18. To control such adjustments of the positions of the rolls 16—18 the top plates 40—40 are provided with threaded bosses 42 (Fig. 5) engaged by screws 44 which are journaled as at 46 upon the bed and arranged to be manually controlled by calibrated hand wheels 50—50. Thus, it will be understood that manipulations of the hand wheels 50 will produce corresponding lateral adjustments of the top plates 40—40 carrying the bottom rolls 16—18, and that the plates 40—40 may thereby be selectively adjusted relative to the bed at either or both ends thereof to procure any desired plan view alignment of the bottom rolls 16—18 relative to the mill bed. Thus, not only may the distance between the rolls 16—18 be adjusted, but also the directional alignments thereof relative to the bed may be selectively adjusted as required for proper processing of variously contoured stock sheets. Locking bolts 51 are provided to extend from the bed through lateral slotted portions of the plates 40—40, and backing up screws 52 are provided to bolster the plates 40—40 at positions intermediately of the positions of the hand wheels 50.

The rolls 16—18 are arranged adjacent their extreme end portions to be journaled upon their corresponding top plates 40—40 by means of bearing blocks 53—53 (Figs. 2—3—5), and the top roll 20 is similarly journaled upon the top beam 22 at the extreme opposite end portions of the roll 20 by means of stirrup blocks 54—54. In order to insure even pulling away from the work between sheet rolling operations the top roll 20 may be additionally suspended from the beam 22 intermediately of the bearing blocks 54—54 by means of straps or magnetic devices, as preferred. The top roll 20 is arranged to be power driven by a universally jointed intermediate shaft 56 (Fig. 3), while the lower rolls 16—18 are arranged to be driven by similar universally jointed intermediate shafts 58—58. The shaft 56 connects through a stub shaft 60 to a spur gear 62 meshing with corresponding spur gears 64—64 carried by stub shafts 66—66 connecting to the corresponding intermediate shafts 58—58 of the lower rolls. The upper stub shaft 60 is fitted with a sprocket and chain drive device 68 which engages a countershaft 70 (Fig. 3) coupled to the output shaft of a speed reducer gear device 72 which in turn is driven as by an electric motor 75. The motor and gear box and drive shaft devices are all firmly mounted upon a base plate 76 which is carried by pedestal portions 14 of the machine frame.

Thus, it will be understood that operation of the motor 75 will cause the rolls 16, 18, 20 to be individually driven so as to drive a stock sheet inserted therebetween as shown in Fig. 4 to pass over the lower rolls and below the upper roll. The gears are so arranged and selected as to drive the rolls against the stock sheet in the same direction and at approximately the same peripheral speeds. Thus, it will be understood that whenever a stock sheet is placed in position between the rolls, and the upper roll is lowered so as to bend the stock sheet into the space between the bottom rolls, the rolls will thereupon pull the stock sheet through the machine while imparting a curved sectional contour to the sheet throughout its length and width.

To adapt the machine to roll stock sheets to relatively short radii the upper roll 20 is provided to be of as small diameter as possible while still being sufficiently rigid against deflection intermediately of its supporting brackets 32. However, the diameters of the bottom roll 16—18 are not as critical in relation to the problem of forming stock to short radius curves, and it is therefore usually practicable to provide the bottom rolls 16—18 to be of larger diameters so as to provide therein larger factors of safety against undesirable deflection intermediately of their supporting brackets 38.

To control the elevation of the upper roll 20 throughout its length relative to the bottom rolls 16—18 and to thereby regulate the depth of pressing of the stock between the bottom rolls which in turn regulates the sectional contour of the finished stock piece, the roll carrying beam 22 is suspended at its opposite ends from the support posts 24—26 by means of separate elevation-adjusting linkage devices. For example, as shown in Figs. 3 and 6, the beam suspension linkage at the left hand end portion of the machine as viewed in Fig. 1 includes a suspension link 80 pivotally connected by a pin 82 at its lower end to the beam 22 and by means of a pin 84 at its upper end to one arm of a rocker 85. The rocker 85 is pivotally mounted at 86 upon a bracket extending from the frame post 24, and a second arm of the rocker 85 pivotally connects at 87 to the piston rod 88 of a hydraulic cylinder 90. The cylinder 90 is carried by a rocker bracket 92 extending from the frame post 24 so as to be automatically adjustable into proper directional alignment with the pivot connection 87 at all positions of the rocker.

A third arm 94 of the rocker 85 pivotally connects at 95 to a link 96 which extends downwardly therefrom into pivotal connection at 97 to the upper end of a pitman 98 which is mounted to be vertically slidable upon the machine frame and to carry a roller 99 disposed to bear upwardly against the underneath surface of a cam plate 100. Paired rollers 102—102 (Fig. 6) are carried by the machine frame to guide vertical motions of the pitman 98; and the cam track 100 is detachably mounted upon a carrier bracket 104 which is disposed between paired horizontal guide rollers 106—106 for mounting the carrier and cam 100 upon the machine frame to be freely slidable in horizontal directions transversely of the end view of the machine. The cam carrier is also formed with a toothed rack portion 108 which meshes with a spur gear 110 carried by one end of a drive shaft 112 which is journaled upon the machine frame and extends substantially from one end to the other thereof. The drive shaft 112 carries a sprocket 114 engaging a drive chain 115 which is geared to a sprocket 116 carried by the motor drive shaft 70, whereby it will be understood that whenever the motor 75 is started to drive the rolls 16, 18, 20, for passing a stock sheet therethrough, the cam 100 will be simultaneously driven to move horizontally and in the

same general direction as the movement of the stock sheet, and in synchronism therewith.

As illustrated by Fig. 2, a top roll suspension linkage and elevation control cam and cam displacing mechanism identical to the mechanisms of Fig. 3 at the left hand end of the machine are furnished in conjunction with the right hand end portion of the roll carrying beam 22; and like reference numerals are employed in Fig. 2 to designate operative elements corresponding to the hereinabove described operative elements of Fig. 3. As in the case of the driving pinion 110 in Fig. 3, the cam driving pinion 110 at the right hand end of the machine is keyed to the drive shaft 112 which extends to both ends of the machine frame as explained hereinabove, whereby it will be understood that the cam devices at both the right hand and left hand ends of the machine are arranged to be simultaneously driven to be displaced horizontally in directions corresponding to the direction of stock sheet movements through the machine, and in synchronism therewith.

The hydraulic cylinders 90—90 are arranged to be controlled by a hydraulic system as illustrated in Fig. 9, and the control system includes an automatic upper roll levelling feature which insures that whenever the machine is opened up to receive a new stock sheet the upper roll is elevated throughout its entire length substantially equidistantly relative to the bottom rolls. For this purpose a push-pull member 120 pivotally connects to an arm of each of the rockers 85—85 and extends vertically therefrom into corresponding pivotal connections with bell-cranks 124—124 carried by the machine frame. The opposite ends of the bell-cranks 124—124 pivotally connect to push-pull members 126—126 which extend, respectively, into pivotal connections with opposite ends of a differential lever 130 (Figs. 7–9) which is fulcrumed at 132 upon a block 134. The block 134 is keyed to a pair of oppositely directed rods 136—136 which carry valve heads 138—138 slidably mounted within cylinders 140—140. Each of the valve heads 138—138 is formed with a bifurcated fluid port 142 (Fig. 7) therethrough to permit equalization of fluid pressures at opposite sides of the valves.

The top roll elevational control system of the mechanism of the invention is arranged to be operator-controlled by any suitable four-way valve as indicated at 144 (Figs. 1, 3, 9). As shown in Fig. 9, the inlet port of the valve 144 is connected to a fluid conduit 145 leading from the output side of a pump 146. A fluid return port of the valve 144 is connected to a return conduit 147 leading to an oil reservoir 148 which is in turn connected to the intake side of the pump 146. A pressure relief valve 149 is installed in the conduit 145, and the overflow port thereof connects to a return conduit 150 leading back to the reservoir 148. Thus, it will be understood that whenever the control valve 144 is in "off" position as indicated in Fig. 9, the pump 146 will simply circulate fluid through the conduits 145—147 and the reservoir and pressure relief connecting devices.

The valve 144 is so arranged that upon manual turning of the control handle, such as for example to rotate the valve core clockwise as viewed in Fig. 9, the pressured fluid traveling through the conduit 145 will be diverted into a conduit 151 leading into open communication with paired conduits 152—153 which connect respectively into cylinder feeding conduits 154—155. The valve 144 is

also so arranged that upon turning of the control handle thereof so as to rotate the valve core away from the "off" position thereof and in counterclockwise direction as viewed in Fig. 9, the pressured fluid traveling through the supply conduit 145 will be diverted into a conduit 156 leading into open communication with paired conduits 157—158 which in turn connect respectively to cylinder feeding conduits 159—160. Check valves as indicated at 161—161 are provided in each of the conduits 152—153—157—158, and spring devices as indicated at 162 are coupled to the valve carrying block 134 for biasing the latter toward a central position between the cylinders 140—140.

Thus, it will be appreciated that whenever it is desired to raise or lower the upper roll 20, the control valve 144 is simply manually turned either clockwise or counterclockwise away from the "off" position thereof shown in Fig. 9. For example, if the valve is so rotated as to divert the pressured fluid from the conduit 145 into the conduit 151, the fluid will then force through the check valves 161 of the conduits 152—153 and into the cylinder feeding conduits 154—155 which are shown to connect into the upper ends of the cylinders 90—90 at the opposite ends of the roll support beam 22. Simultaneously with such rotation of the control valve 144, the conduit 156 will be brought into open communication with the pumping system return conduit 147, whereby it will be understood that the pressures under the pistons of the cylinders 90—90 will be relieved. The fluid below the piston in the right hand cylinder is permitted to drain through the conduit 159 and into the left hand cylinder 140 and thence into the return conduit 156, and at the same time the fluid under the piston of the left hand cylinder 90 drains through the conduit 160 and thence into the other end of the cylinder 140 which is to the left of the differential lever 130. Under such conditions the check valves 161—161 in the conduits 157—158 will automatically close upon commencement of such drainage operations so as to prevent the draining fluid from passing therethrough.

As long as the beam 22 moves so as to remain substantially level relative to the lower rolls 16—18 the orifice 142 through the valve heads 138 in the left hand cylinder 140 permits the fluid draining from the conduit 160 to join the fluid draining from the conduit 159 and to pass into the return conduit system 156—147. Therefore pressure differentials are established at opposite sides of the pistons in the cylinders 90—90 which operate to lower the pistons and to raise both ends of the roll support beam 22. If however the beam 22 tends to move faster at one end than at the other, the automatic leveling feature of the device will function to retard the excess motion so as to bring the opposite ends of the beam 22 back into leveled relation.

For example, if the right hand end portion of the beam 22 tends to rise faster than the left hand end, the linkage and bell crank system comprising the elements 80—85—120—124 at the right hand end of the machine will displace the corresponding push-pull member 126 at a rate greater than the coincident displacement of the opposite member 126, and this differential action will rock the central lever 130 toward the left about its pivotal connection to the left hand link 126 as a fulcrum. Thus the block and valve unit 136—138—138 will be displaced to the left as viewed in Fig. 9 against the action of the centralizing springs 162—162. Such movements to the

left of the valves 138—138 will throttle the port of inlet into the left hand cylinder 140 from the conduit 159 without disturbing free passage of draining fluid through the conduit 160. Thus, the downward motion of the piston in the right hand cylinder 90 will be automatically retarded relative to the rate of motion of the left hand cylinder piston until such time as the two ends of the roll support beam 22 return to relatively level positions, whereupon the leveling mechanism will be automatically returned to a neutral position, as illustrated in Fig. 9. This leveling mechanism permits the beam to deviate slightly from perfectly level relation, such as may be necessary to allow the upper roll to follow different cam shapes at opposite ends of the beam; but the "leveling" device in any case prevents the upper beam from "cocking" to such degree as would result in its jamming between the end posts.

Whereas, the description herein has so far been limited to reference to operations of the hydraulic control system to provide raising of the upper roll 20, it will be understood that manual turning of the control valve 144 in opposite direction away from its "off" position will provide reverse direction operation of the entire system; and that drainages of the cylinders 90—90 will then take place through the upper ports of the cylinders and into conduits 154—155 and thence through the valve cylinder unit 138—140 at the right hand side of the differential lever 130; and that the automatic leveling feature of the mechanism will under such circumstances be adapted to function in a similar manner.

To provide for relative adjustments of the beam suspension devices at opposite ends of the upper roll 20, the cam supporting links 96—96 are provided to be oppositely threaded at their ends as indicated at 163 (Figs. 2—3). Each link 96—96 has keyed thereon a worm wheel 164 which meshes with a worm gear 165 carried by a shaft 166 which is keyed to a corresponding hand wheel 168 and journaled in a bearing 169 which is carried by the link 96. Thus, manual rotations of the hand wheels 168—169 will provide corresponding selective adjustments of the lengths of the links 96—96 so that the upper roll can be finally adjusted relative to the work in conjunction with each new work setup while the wheels 99—99 are against the cams 100—100. Also, the hand wheels 168 may be employed if desired for manual control of the upper roll setting during work sheet forming processes, in lieu of cams or the like as explained hereinabove. Micrometer switch devices adapted to open the circuits to the motor 75 are mounted as indicated at 175—177 (Fig. 6), and each of the cams 100—100 is provided with positionally adjustable stop devices 180—182 (Fig. 6) for cooperation with the actuating finger portions of the micrometer switches.

A work sheet trailing edge support bracket as at 190 (Fig. 4) is preferably arranged to extend from the feed side of the machine frame 10 to support in approximately level position the work sheets to be processed, as indicated at 195. An adjustable stop device 196 is preferably mounted upon the bracket 190 and arranged to be detachably clamped thereto as by a wing nut 197; whereby preparatory to similarly processing a series of identical work sheets the stop 196 may be initially set at proper position and successive work sheets may then be rested upon the bracket so as to register their trailing edges against the stop in proper starting position.

To commence the work sheet forming operation the switch controlling the pump motor is closed and the control valve handle 144 is then rotated to "down" position, whereupon the pressure cylinders 90—90 will operate to lower the upper roll into pressing relation against the leading edge of the work sheet and to simultaneously raise the cam following rollers 99—99 up against the cam tracks 100—100. The pressure exerted by the upper roll against the work sheet is regulated by the pressure within the hydraulic system as controlled by the setting of the pressure relief valve 149. The hand wheels 168—168 may then be adjusted if necessary, to provide the prescribed degree of work sheet deflection at each station on the cams; and the sheet forming operation will then proceed immediately upon manual rotation of the motor control switch 152 into operative position. The rolls 16—18—20 will thereupon be driven to pull the work sheet through the machine while the cams 100—100 will be simultaneously driven to move in synchronism with the work sheet to control the cam following rollers 99—99 for regulating the elevation of the upper roll 20 at the opposite ends thereof in accordance with the contour change prescription for the curved sheet article to be produced. Thus, it will be understood that it is the hydraulic pressure forces within the cylinders 90—90 that force the upper roll downwardly relative to the work sheet to deflect the latter to varying degrees such as are permitted by the profile changes of the cams 100—100 corresponding to the opposite ends of the work sheet. Therefore, the cams need only be preformed to produce suitable separate elevational adjustments of the opposite ends of the upper roll 20 so as to cause the work sheet to be bent as prescribed throughout the chordwise and spanwise extents thereof.

As the rear edge of each work sheet passes through the roll elements of the mill the sheet is freed to be removed by an attendant, and the micrometer switch 177 is thereupon actuated by the limit device 182 to open the circuit of the drive motor 75 so as to prevent the cam carriers 100—100 from being driven off the machine. The operator will then turn the motor control switch 152 to "reverse" and the hydraulic roll elevation control valve 144 to "open" position. The motor will then drive the cam carriers to return toward starting position and the upper roll 20 will be lifted to make room for feeding the next work sheet into starting position between the rolls. During this process the automatic leveling mechanism described hereinabove operates to insure that the roll 20 rises equally at both ends. Upon return of the cams 100—100 to their starting positions the limit device 180 actuates the micrometer switch 175 so as to open the reverse operation circuit of the motor 75, whereupon the machine is fully prepared to receive another work sheet and to repeat thereon the hereinabove recited forming operation.

Because it is impracticable to build the relatively long roll supporting beam elements of the machine to be absolutely rigid against bending, it is preferred in connection with flat-rolling operations to provide means for oppositely deflecting to a metered degree one of the opposed roll supporting beam elements when it is unloaded. Thus, when the working load forces are applied they are employed to realign the roll supporting elements and their rolls into perfect straight-line forms so that the machine will produce finished rolled sheets which are perfectly straight

in spanwise directions. For this purpose an adjustable truss arrangement may be provided to comprise diagonal struts 198—198 extending from opposite ends of the frame beams 10 into connection with vertical struts 199—199 extending from intermediate positions on said beams. A manually adjustable and calibrated hand wheel 200 (Figs. 1 and 8) is keyed to a screw bar 202 which extends between the free ends of the struts 198—199 to regulate the distance therebetween upon manual adjustment of the hand wheel 200; whereby it will be understood that the machine frame may be caused to arch slightly under unloaded conditions so as to be prepared to flatten out under stock rolling loads so as to produce perfectly straight leading edge type products as illustrated for example by Fig. 10.

A particular feature of the forming roll of the invention is that all of the stock-contacting roll elements thereof are power driven in mutual synchronism. Hence, it its unnecessary to arrange for pinching the work sheets between the rolls in order to obtain sufficient driving action of the rolls against the work sheets. Because of this "triple-grip" holding and driving action of the rolls against the stock sheet when inserted therebetween, the rolls are enabled to obtain sufficient frictional holds upon the stock piece to drive it in accurate synchronism with corresponding displacements of the cams without excessive pinching of the stock between any two of the opposed roll elements. This enables the work sheet to be permitted to slip relative to the rolls in such manner as to provide the requisite differentials of displacement motions of the work sheet relative to the rolls at opposite ends of the work sheet in connection, for example, with the forming of a spanwise tapered curved product such as the tapered airplane leading edge sheet illustrated by Fig. 10.

It will be understood that in order to form an article as illustrated in Fig. 10, either the lower roll elements 16—18 will be first adjusted to be closer spaced at one end of the machine than at the other, or the cam track devices at opposite ends of the machine will be shaped so as to force the upper roll 20 to move downwardly between the rolls 16—18 to a greater depth at one end of the machine than at the other intermediately of the stock forming operation. In any case, since the opposite ends of the roll elements are rotating at equal speeds some slippage of the work sheet relative to the roll elements must be permitted to accommodate the "tapered" forming operation referred to hereinabove. If, for example as in the prior art, only one or two of the roll elements were arranged to be power driven it would be necessary to provide the powered rolls to more firmly grip or "pinch" the work sheets therebetween in order to get sufficient driving connections between the roll elements and the work sheet; and such a "geared" type connection between the roll elements and the work sheet would interfere with the differential slippage required to form tapered articles as explained hereinabove.

Although only one form of the invention has been shown and described in detail it will be apparent to those skilled in the art that the invention is not so limited but various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a machine having a long bed and press

actuated by fluid means at opposite ends thereof, wherein it is normally desired to provide said press to remain substantially equidistant from said bed at opposite ends thereof; an automatic levelling control comprising a single fluid pump and conduit means extending parallel into connection with said fluid means, return conduits leading from said means into a cylinder at longitudinally spaced ports therein, a piston within said cylinder normally positioned therein between the position of said ports so as to avoid closing thereof, said piston being perforated to provide metered passage of fluid therethrough and connected to a control rod extending exteriorly of said cylinder, a differential lever pivoted to said control rod intermediately of its ends and pivotally connected at its opposite ends to push-pull members linked to opposite ends of said press so as to be differentially displaced upon movements of said press relative to said bed to unequally spaced relation at opposite ends thereof, whereby said control lever will be automatically shifted to move said piston so as to throttle one of said ports whereby to retard fluid drainage from one of said fluid means and to thereby provide a press-level restoring force.

2. In a forming roll machine of the class described and having a long bed and press actuated by fluid means at opposite ends thereof, wherein it is normally desired to provide said press to remain substantially equidistant from said bed at opposite ends thereof, power means for actuating said press at opposite ends thereof to move relative to said bed, and an automatic leveling device associated with said power means to control the latter so that any motion of one end of the beam to advance ahead of the other end thereof will automatically reduce the forces creating such advance motion.

3. In a forming roll machine of the class described and having a long bed and press actuated by fluid means at opposite ends thereof, wherein it is normally desired to provide said press to remain substantially equidistant from said bed at opposite ends thereof, power means for actuating said press at opposite ends thereof to move relative to said bed, and an automatic leveling device associated with said power means to control the latter so that any motion of one end of the beam to advance ahead of the other end thereof will automatically reduce the forces creating such advance motion, said automatic leveling control comprising a single fluid pump and conduit means extending parallel into connection with said power means, return conduits leading from said power means into a cylinder at longitudinally spaced ports therein, a piston within said cylinder normally positioned therein between the position of said ports so as to avoid closing thereof, said piston being perforated to provide metered passage of fluid therethrough and connected to a control rod extending exteriorly of said cylinder, a differential lever pivoted to said control rod intermediately of its ends and pivotally connected at its opposite ends to push-pull members linked to opposite ends of said press so as to be differentially displaced upon movements of said press relative to said bed to unequally spaced relation at opposite ends thereof, whereby said control lever will be automatically shifted to move said piston so as to throttle one of said ports whereby to retard fluid drainage from one of said power means and to thereby provide a press-level retoring force.

4. In a forming roll having stock contacting

roll elements at opposite sides of the position of the stock to be rolled, means for regulating the relative positions of said roll elements, said means comprising pressure means tending to force one of said roll elements toward the other, cam means positively limiting the effects of said pressure means, and means synchronizing said camming effects with the movements of stock through said roll elements.

5. In a forming roll having stock contacting roll elements at opposite sides of the position of the stock to be rolled, means for regulating the relative positions of said roll elements, said means comprising cam devices positioned at opposite ends of one of said roll elements, guide means linked to opposite ends of one of said roll elements and associated with said cams respectively for shifting the positions of the corresponding end portions of said roll element in response to movements of said guide means relative to said cam devices, and means automatically operable in response to driving rotation of said roll elements to provide relative camming movements between said guide and cam devices.

6. In a forming roll having stock contacting roll elements at opposite sides of the position of the stock to be rolled, means for regulating the relative positions of said roll elements, said means comprising pressure means tending to force opposite ends of one of said roll elements to move independently toward the other of said roll elements, and cam devices controlling the extent of movements of said roll element ends, said cam devices being controlled by the rotation of the roll elements.

7. In a forming roll having stock contacting roll elements at opposite sides of the position of the stock to be rolled, means for regulating the relative positions of said roll elements, said means comprising pressure means tending to force opposite ends of one of said roll elements to move independently toward the other of said roll elements, and cam devices controlling the extent of movements of said roll element ends, said cam devices being controlled by the rotation of the roll elements and in synchronism with passage of the stock through the machine.

8. In a forming roll having stock contacting roll elements at opposite sides of the position of the stock to be rolled, means for regulating the relative positions of said roll elements, said means comprising pressure means tending to force opposite ends of one of said roll elements to move independently toward the other of said roll elements, and cam devices controlling the extent of movements of said roll element ends, said cam devices being controlled by the rotation of the roll elements, said press means including means normally providing approximate synchronism of motion of opposite ends of said roll supporting element.

9. In a forming roll having stock contacting roll elements at opposite sides of the position of the stock to be rolled, means for regulating the relative positions of said roll elements, said means comprising pressure means tending to force opposite ends of one of said roll elements to move independently toward the other of said roll elements, and cam devices controlling the extent of movements of said roll element ends, said cam devices being controlled by the rotation of the roll elements, said press means including means normally providing approximate synchronism of motion of opposite ends of said roll supporting element except as overcome by operations of said cam means.

10. In a forming roll machine of the character described, a bed, a pair of stock forming rolls mounted upon said bed, a frame disposed above said bed, a third roll carried by said frame so as to be adapted to rollingly engage and press upon the upper surface of a stock piece rested upon said lower rolls, an adjustable support device mounted at each end of said bed and extending therefrom to provide suspension mountings for the opposite ends of said frame relative to said bed, and support adjustment control means comprising guide devices carried by said suspension means and cam devices mounted upon said bed to be displaceable thereon in synchronism with stock-driving rotations of said rolls and thereby operable to actuate said guide devices to independently adjust the frame suspension means at opposite ends thereof.

11. In a forming roll machine of the character described, a bed, a pair of stock forming rolls mounted upon said bed, a frame disposed above said bed, a third roll carried by said frame so as to be adapted to rollingly engage and press upon the upper surface of a stock piece rested upon said lower rolls, all three of said rolls being power-driven at approximately the same surface speed, an adjustable support device mounted at each end of said bed and extending therefrom to provide suspension mountings for the opposite ends of said frame relative to said bed, and support adjustment control means comprising guide devices carried by said suspension means and cam devices mounted upon said bed to be displaceable thereon in synchronism with stock-driving rotations of said rolls and thereby operable to actuate said guide devices to independently adjust the frame suspension means at opposite ends thereof.

12. In a forming roll machine of the character described, a bed, a pair of stock forming rolls mounted upon said bed, a frame disposed above said bed, a third roll carried by said frame so as to be adapted to rollingly engage and press upon the upper surface of a stock piece rested upon said lower rolls, a positioning device at each end of said bed and extending therefrom to provide mountings for the opposite ends of said frame relative to said bed, and position adjustment means comprising cam means carried by said bed to be displaceable thereon in synchronism with stock-driving rotations of said rolls and thereby operable to independently adjust the frame positioning means at opposite ends thereof.

13. In a forming roll having stock contacting roll elements at opposite sides of the stock motion passageway therethrough, means for regulating the relative positions of said roll elements, said means comprising separate cam devices corresponding to opposite ends of one of said roll elements, separate guide means linked to said opposite ends of said one of said roll elements and guided by said cams for adjusting the positions of the end portions of said roll element in response to relative movements between said guide devices and said cam devices, and means automatically operable in response to driving rotation of said roll elements to provide relative movements between said guide and cam devices.

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