April 5, 1949. H. C. COGAN 2,466,653

BARREL BENDING MACHINE

Filed Feb. 14, 1947 5 Sheets-Sheet 1

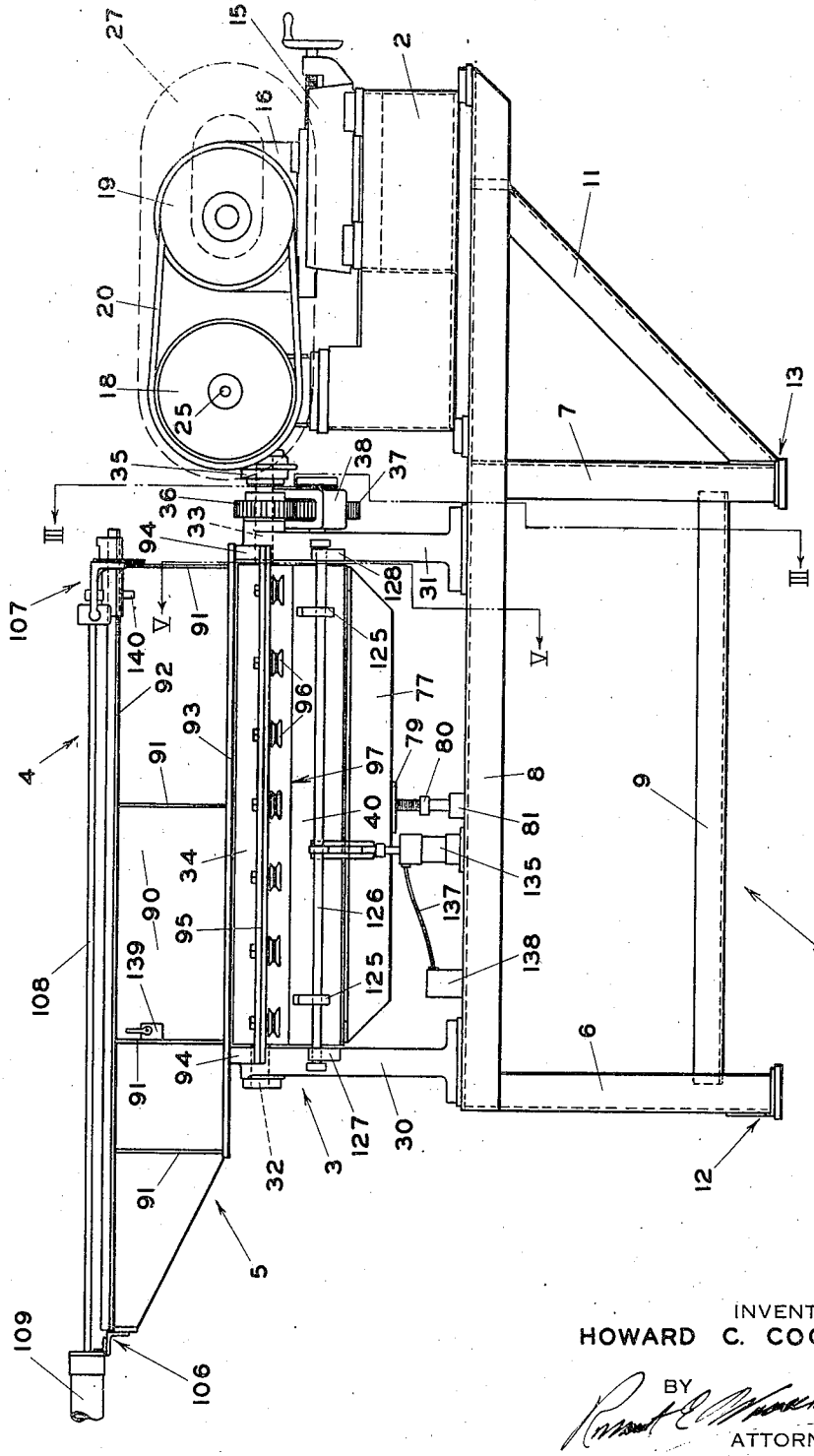


FIG. 1

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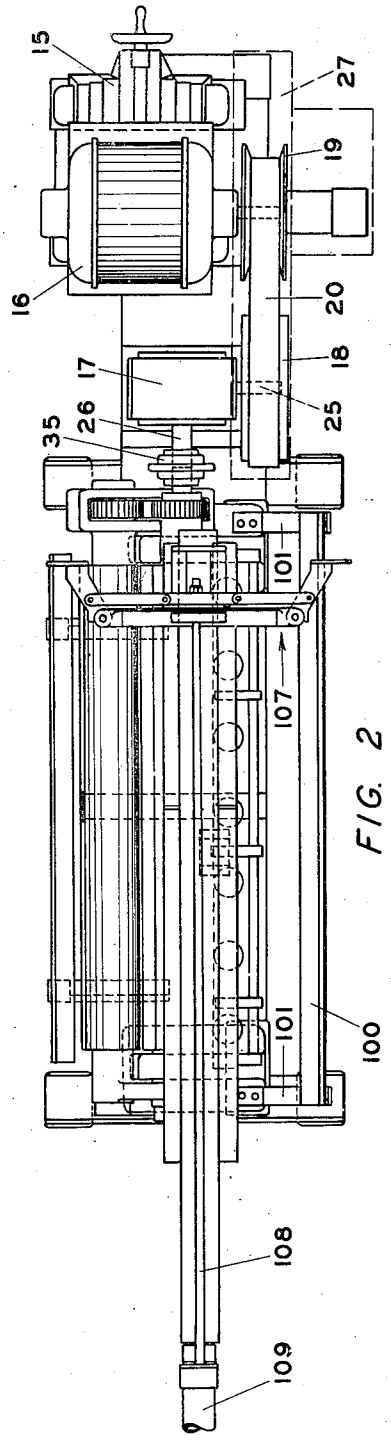


FIG. 2

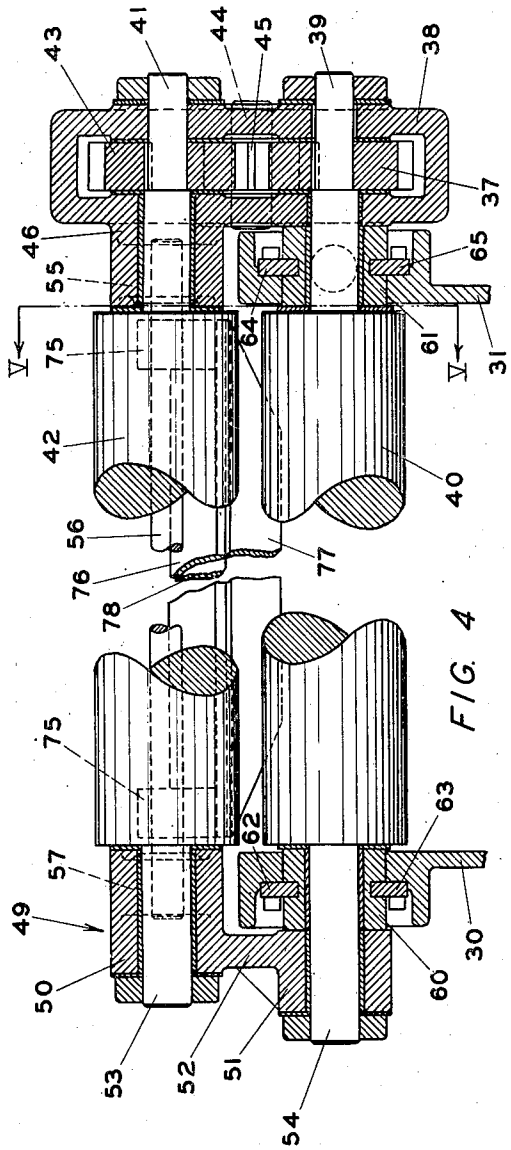


FIG. 4

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BARREL BENDING MACHINE

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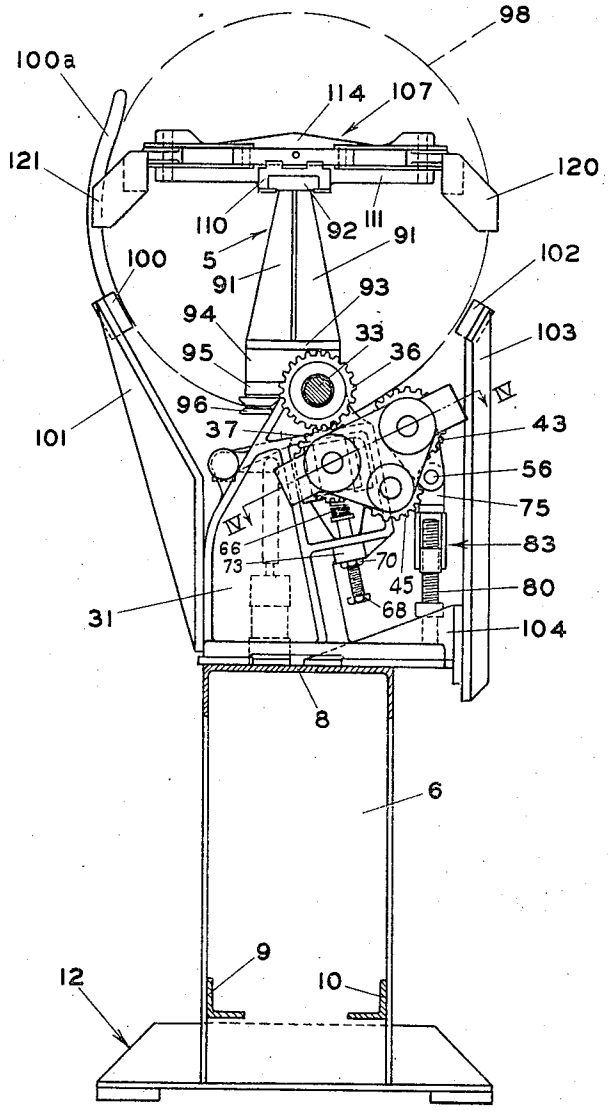


FIG. 3

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BARREL BENDING MACHINE

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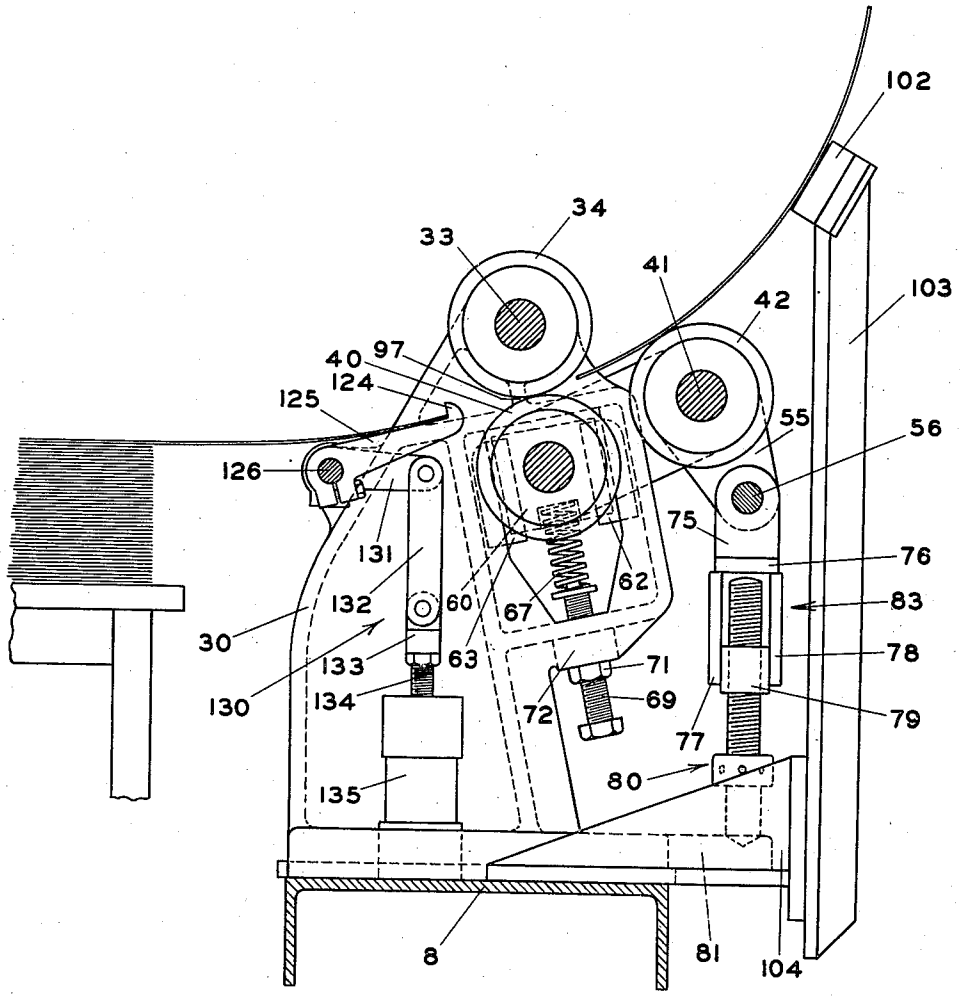


FIG. 5

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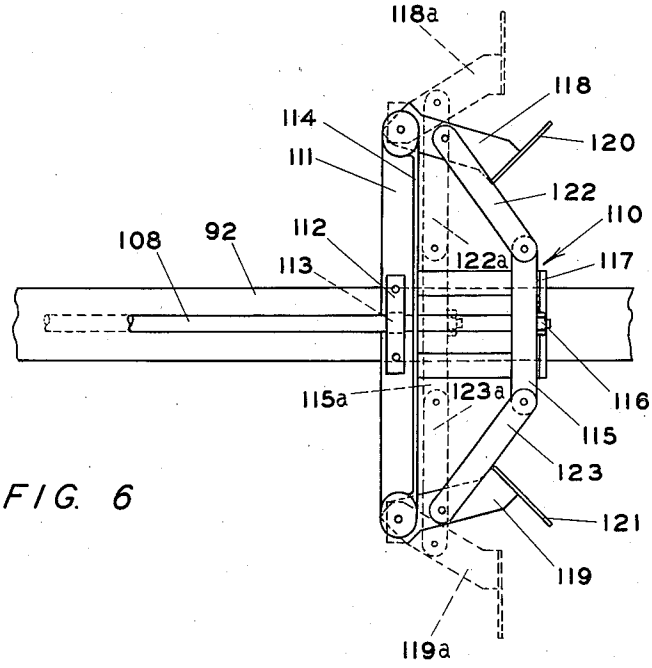


FIG. 6

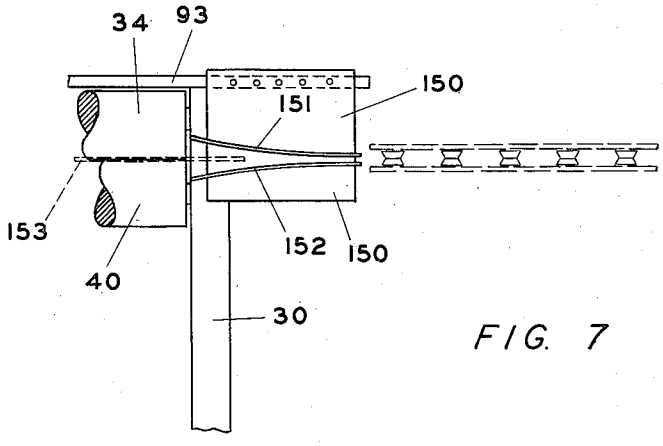


FIG. 7

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Patented Apr. 5, 1949

2,466,653

UNITED STATES PATENT OFFICE

2,466,653

BARREL BENDING MACHINE

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Application February 14, 1947, Serial No. 728,662

8 Claims. (Cl. 153—54)

1

This invention relates to a power driven bending machine for producing cylindrically shaped articles from sheet stock, and more specifically to a type thereof which will deliver the articles being rolled to means which then effect other operations on said articles.

It is the general purpose of the invention to provide improvements in a bending machine which will render such machine adaptable to automatic cooperation with another machine which will receive the article or material formed in such bending machine and then fasten together certain selected portions thereof. However, inasmuch as the particular bending machine, here utilized to illustrate the invention, has been designed specifically for cooperation with an automatic seam welding machine for cylindrical articles, the hereinafter appearing description of the invention will be of a machine for rolling sheets of suitable material into cylindrically shaped articles, hereinafter referred to as preforms, which may be welded by such welding machine into the side walls of a container, such as a barrel.

It is recognized that there are numerous machines and methods in existence for rolling suitable sheet stock into cylindrically shaped preforms which may then be welded to form containers, such as barrels. However, since the present method of producing sidewalls for such containers, whose diameter is relatively large in proportion to the thickness of the side walls, involves two separate machines and two separate operations, as the material is first rolled into the proper form and then welded, it becomes apparent that a machine which reduces these two operations to a single operation would be highly advantageous. It is further obvious that a machine of the type disclosed eliminates the need for additional floor space in which to store or stack the rolled articles between the rolling and welding operations. It will also be noted that a bending machine coordinated automatically with a welding machine will operate more efficiently than could the two machines operating separately by its elimination of the manual transfer of the rolled cylindrically shaped articles from said bending machine to said welding machine.

Accordingly, it becomes apparent that a major object of this invention is to provide a power driven bending machine for automatic cooperation with a welding machine whereby stock shaped on said bending machine will be automatically transferred therefrom to said associated welding machine.

A further object of this invention is to provide

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a bending machine as aforesaid which is readily adjustable to the handling of a variety of sizes and gauges of sheet material.

A further object of this invention is to provide a bending machine as aforesaid which will preform the cylindrical side walls for barrels made from sheet material.

A further object of this invention is to provide a bending machine as aforesaid which may be quickly and readily adjusted to control the amount of curvature imposed upon a piece of sheet material being shaped thereby.

A further object of this invention is to provide a bending machine as aforesaid which will affect a substantial reduction in the overall cost of producing cylindrically shaped articles from sheet stock which are to be welded, after shaping, into solid cylindrical surfaces.

Other objects and purposes of this invention will be apparent to persons familiar with this type of equipment upon referring to the accompanying drawings and upon reading the following specification.

In order to meet the objects and purposes mentioned above, as well as others incidental thereto and associated therewith, I have conceived the provision of a bending machine having, among other things, three rolls comprising two driving rolls and a bending roll suitably driven and mounted so that the degree of curvature induced by said rolls upon sheet stock run between them may be altered easily and quickly. The operable length of said rolls will be such that it will meet the maximum requirements in axial length of cylindrically shaped articles to be formed thereby.

In conjunction with said rolls and disposed in a line adjacent to and parallel with said rolls is a series of equally spaced, grooved guide rollers for reception of that edge of the sheet stock which, having entered and passed through the driving rolls, has described a substantially complete circle above said rolls and has returned to a position approximately adjacent to and parallel with the point of entry between the said rolls.

A suitable ejection device, including means imparting appropriate reciprocable motion thereto, is operably timed with the rolling mechanism so as to transfer the cylindrically shaped articles from said bending machine, for example, to a conveniently located welding machine associated therewith.

It will be understood that the said ejection device is not limited to use associated with a welding machine as just described. The said cylin-

drically shaped articles may be discharged from the bending machine by said ejection device onto a conveyor or other means properly positioned with respect to the point of ejection. It will be further understood that said ejection device is not limited in principle to cylindrically shaped articles. Either in its present form or by means of simple modification, said device may be adapted to eject other articles shaped by this or similar machines.

The bending machine, its prime mover and the ejecting device may be mounted on any suitable platform, but will be positioned preferably so that sheet stock may be readily and easily fed into the machine by a workman occupying a normal position of posture. It must also be kept in mind that said machine, illustrating a preferred embodiment of the invention, has been adapted for cooperation with a welding machine but is not limited thereto.

For illustrations of the embodiment of the invention hereinafter disclosed, reference is made to the drawings in which:

Figure 1 is a side elevation view of the bending machine including the prime mover, the ejection device and the supporting structure.

Figure 2 is a top plan view of the machine shown in Figure 1.

Figure 3 is a section taken along the line III—III of Figure 1.

Figure 4 is a cross-sectional view taken along the line IV—IV of Figure 3.

Figure 5 is a sectional view taken along the line V—V of either Figure 1 or Figure 4.

Figure 6 is a top plan view of the ejecting mechanism head in a collapsed position, including a phantom view of the head mechanism in the extended position.

Figure 7 is an elevation of a fragment of the machine on the side opposite to that shown in Figure 1 showing a convenient form of discharge guide.

Construction

The bending machine, as illustrated in Figure 1, is comprised of a sub-base support frame, indicated as **1**, upon which is mounted a combination prime mover and drive pedestal **2** and the rolling mechanism **3**, which in turn supports the ejection device **4** by means of the ejection device support **5**.

For the sake of clarity, the end of the bending machine which supports and includes the prime mover and its pedestal will be referred to as the "right" end and that end of the machine which supports and includes the rolling mechanism will be hereinafter referred to as the "leftward" end of the machine.

The sub-base support frame **1** may be constructed in any convenient, conventional manner, but as illustrated in Figures 1 and 3 is comprised of the vertical members **6** and **7** which support the horizontal platform member **8** at their upper extremities and are braced near their lower extremities by the cross-members **9** and **10**. The horizontal platform member **8** extends beyond the rightward vertical member **7** for the purpose of supporting the prime mover and drive pedestal **2**, and is therefore additionally braced at a point near its overhanging extremity by means of the overhanging support brace **11** which is connected at its lower end to the lower extremity of the vertical support member **7**, as by welding. Two foot members **12** and **13** secured at the base of the vertical support members **6** and **7**, respectively, provide added lateral stability to the sub-base frame.

The individual elements and members comprising the sub-base support frame are secured to each other, where required, by any suitable means or method, as by welding, bolting or riveting. Although the cross-members **9** and **10** are shown as angle iron and the vertical members **6** and **7** and horizontal platform member **8** are illustrated as shaped pieces of fabricated steel plate, it will be understood that such structure is not intended to limit the construction, but merely to provide one example thereof.

The prime mover and drive pedestal **2** supported as aforesaid on the rightward or overhanging end of the horizontal platform member **8** may, as illustrated, be a fabricated steel structure which supports a conventional type of adjustable prime mover base **15** upon its rightward end. Said adjustable base **15** in turn mounts a suitable prime mover **16** hereinafter referred to as an electric motor for illustrative purposes only. The leftward end of the combination motor and drive pedestal **2** supports a suitable differential gear box viewed more clearly at **17** in Figure 2. Said gear box **17** is operably associated with the motor **16** by means of the pulleys **18** and **19** mounted on the gear box and motor shafts, respectively, and which are mutually engaged by the belt **20**. It will be understood that the belt and pulley arrangement used as a transmission means between the motor **16** and the gear box **17** is one of several means for transmitting such power and therefore is described for illustrative purposes only. It will also be noted that the pulley **19** mounted on the motor **16** is of the variable pitch type for the purpose of speed adjustment, and may be of any conventional, convenient type. Although the gear box **17** may be of any conventional type, it will preferably be of the worm and pinion type by which a reduction of speed may be accomplished between the driving shaft **25** and the driven shaft **26**. The gear box and adjustable motor base may be secured to the motor and gear box pedestal **2** in any convenient manner, such as by bolting. The said pedestal **2** may be secured to the said extended portion of the horizontal platform member **8** also by any suitable means, such as bolting. The gear box and motor, hence the pedestal **2** supporting them, are preferably mounted with respect to said sub-base support frame so that the transmission means connecting the two, here pulleys and a belt, are radially in line longitudinally of said sub-base support frame. Such alignment of said pulleys **18** and **19** permits their easy enclosure within the drive guard shown in phantom at **27** in Figure 1.

The rolling mechanism **3**, appearing in Figures 1 and 2, is supported on either end by means of the support brackets **30** and **31**. As illustrated in Figures 3 and 5, said brackets **30** and **31** are substantially mirror images of each other. In the region of the upper extremities of said brackets **30** and **31** are suitable integral means provided with suitably bushed openings therein, for rotatable reception of the end shafts **32** and **33** which support the upper initial roll **34** as shown in Figures 1 and 5. The roll **34** is the top roll in a group of three parallel rolls, advantageously, but not necessarily, of similar lengths and diameters, which are directly or indirectly supported at their extremities by means of brackets **30** and **31**.

The end shaft **33** is flexibly coupled with the

driving shaft 26 (Figure 2) of the gear box 17 by means of any conventional type of flexible coupling 35 presently in use. Secured to the end shaft 33, between the bracket 31 and the flexible coupling 35, is a pinion 36 (Figure 1), engaged by another geared pinion 37, which latter geared pinion is rotatably mounted, within one side of the semi-gear housing 38, on the end shaft 39 of the lower initial roll 40. The other side of said semi-gear housing 38 rotatably supports the end shaft 41 of the roll 42. Said end shaft 41 mounts the pinion gear 43 (Figure 4) rotatable therewith, but without directly engaging the gear 37. Also rotatably mounted within the semi-gear housing 38 on the shaft 44 is the geared pinion 45 which engages both the gear 37 and the gear 43 and effects driving of the said gear 43 from the said gear 37.

At the opposite end of the said rolls 42 and 40 from the gear housing 38 is a bearing support member 49 (Figure 4) comprising the bearing housings 50 and 51, which are held in fixed relationship with respect to each other by the web 52. Said bearing housings 50 and 51 are provided with suitable bearings for appropriate support of the end shafts 53 and 54, respectively, of the rolls 42 and 40, respectively. The semi-gear housing 38 is on the rightward end of the rolling mechanism whereas the bearing support member 49 is on the leftward end of said rolling mechanism. The bossed arm 55, which may be an integral part of the bearing housing 46 which in turn may be an integral part of the semi-gear housing 38, fixedly supports the shaft 56 at its rightward extremity. The bossed arm 57 which may be an integral part of the bearing housing 50, supports the leftward extremity of said shaft 56.

As will be noted in Figures 3, 4 and 5 the principal support of the assembly shown in Figure 4 is provided by the end brackets 30 and 31 through the adjusting blocks 60 and 61 which rotatably support the end shafts 54 and 39 of the roll 40. The adjusting blocks 60 and 61, as illustrated in Figures 4 and 5, are held in slidable relationship with said end brackets 30 and 31, respectively, by means of the slides 62 and 63 associated with the block 60, and slides 64 and 65 associated with block 61. Said slides 62, 63, 64 and 65 are affixed to said support brackets 30 and 31, respectively, by any suitable means, such as bolting. Blocks 61 and 60 are held in resilient adjustment by suitable means, such as the coiled springs 66 and 67, respectively (Figures 3 and 5), which are associated with the adjustment screws 68 and 69, respectively, which screws are in turn held in their respective proper positions by means of the nuts 70 and 71. By means of said adjusting block, adjusting slides, resilient means, set screws, and locking nuts, it is possible to maintain or readily change the desired pressure between the engaging peripheral surfaces of the said parallel rolls 40 and 34. The adjustment screws 69 and 68 are threaded through suitable bosses 72 and 73 in the support brackets 30 and 31, respectively.

Inasmuch as the assembly illustrated in Figure 4 is rotatably supported on the support brackets 30 and 31 in the manner just described, other support means are necessary to hold the curvature roll 42 in position for proper engagement with the sheet material which is fed through the rolls.

In order to accomplish this and as illustrated in Figures 3, 4 and 5, the shaft 56 rotatably supports a plurality of brackets 75 which are secured, as by welding, to a plate 76 which is in turn secured as by welding to two vertical plates 77 and 78. As shown in Figures 1, 3 and 5, there is disposed between said vertical plates, preferably midway of their extremities, a suitable block 79 for threaded relationship with an adjusting screw 80. Said adjusting screw 80 is pivotally seated in a block 81 which may be secured to the horizontal platform member 8, as by bolting. The block 79 is securely held in position with respect to plates 77 and 78 by bolting, welding or other suitable means.

It may be observed from the foregoing, that by proper adjustment of the screw 80 with respect to the block 79, as illustrated in Figures 1, 3 and 5, a raising or lowering of the adjusting assembly 83 including the brackets 75, the plate 76, the vertical plates 77 and 78 and the blocks 79 will be effected. Since the brackets 75 rotatably support the shaft 56 which is, as aforesaid, affixed to the rocker arms 55 and 57, movement upward or downward of the adjusting assembly 83 will produce a movement of the curvature roller 42 in a generally upward or downward direction along the arc of a circle whose center is coincident with the center of the lower initial roll 40. The assembly 83 and the adjusting screw 80, which provides the support thereof, thus constitute the other support required for the assembly shown in Figure 4, and at the same time provide a means for adjusting the curvature of the sheet material which is fed between the rolls 34 and 40 and thence over the roll 42.

Mounted on the top of said brackets 30 and 31, conveniently as required, is an ejecting mechanism support 5 (Figures 1 and 3) which may be fabricated or cast in any conventional manner, of any convenient material, but, preferably and as illustrated, is constructed in this particular embodiment of the invention of plate steel elements secured together by welding. Such elements comprise a central vertical member 90 braced at convenient intervals by webs 91, topped by a steel plate slide rail 92 and mounted on the bottom thereof by another piece 93 of steel plate of a generally rectangular shape and sufficiently wide and long to completely contact the lower edges of the said web members 91 and the central vertical member 90.

Supported on the underside of said steel plate 93 are a plurality of brackets 94 to which is mounted the roller supporting strip 95, as illustrated in Figures 1 and 3. Pivotally supported on said roller supporting strip 95 is a plurality of suitably grooved rollers 96 whose grooves are substantially radially in line and whose axes are also along a single line which line is perpendicular to said axes of said rollers, substantially parallel with said rolls 40, 34 and 42, and longitudinally disposed with respect to the bending machine. Said rollers 96 are suspended from the forward edge of the steel plate 93, as appearing in Figure 3, for the purpose of engaging the leading edge of the sheet material, as shown in phantom at 98 in Figure 3, after said sheet material has been fed through the rolls, as heretofore described, has been cylindrically curved thereby up, over and around the ejection support 5, and is about to return to its initial position of feeding. Said cylindrically shaped material, having gone through the rolls, may be guided into contact with the said grooved rolls 96 by means of a suitable guide member 100 which is supported by a plurality of guide support brackets 101, which may be adjustably mounted on the forward side of said

support brackets 30 and 31. The guide member 100 may conveniently, but not necessarily, be a strip of steel bar, supplemented, if desired, by the fingers 100a. The brackets 101 may be constructed of fabricated steel members secured together as by welding. A suitable guiding means, as illustrated in Figures 3 and 5, may also be provided along the rear of said rolling machine. This may comprise the guide bar 102 which is substantially parallel with the said bending machine, as is the guide bar 100, and suitably secured as by bolting to a plurality of suitable support members 103 fabricated similarly to the support members 101.

As illustrated in Figures 3 and 5 the support members 103 may in turn be adjustably held in position with respect to the machine by means of the brackets 104.

Figure 7 illustrates one convenient form of guide 150 for receiving the trailing edge of sheet material as it is being ejected axially from the bending machine to receiving means, here shown in phantom as guide rollers on the conveyor feed for an automatic welder. This guide is mounted to the frame in any convenient manner, is aligned to receive between its flared flanges 151 and 152 the sheet to be guided, the position of whose edge is indicated by the broken lines 153.

It will be understood that the guide bars 100 and 102 as well as their supporting members 101 and 103 are described in detail for the purpose of illustrating one possible means of construction. However, said bars, as guide members, may in some cases advantageously be replaced by rollers, rolls or any of a variety of guiding means, or in other cases it may be found that such guides will be inadvisable or unnecessary.

An ejection device 4 which may be viewed in Figures 1, 2, 3 and 6 is located above the rolls and within the zone which will be circumscribed by the sheet material during the bending operation. It comprises a head 107, which is secured to the operating end of a piston rod 108 operatively associated with an actuating cylinder 109. Said actuating cylinder may be supported in any convenient manner, but as illustrated in Figure 1 is mounted at its rightward end, by means of the fastening members 106, on the leftward extremity of the ejection device support 5. The leftward end of said cylinder may be supported by the associated welding machine or by means of an independent pedestal, not shown. Said ejection head is slidably associated with the slide rail 92 for reciprocable motion therewith by means of said piston rod 108 upon the actuation of said cylinder 109. Reciprocable actuation of the piston rod 108 within the cylinder 109 may be effected by means of any suitable fluid, such as air which is introduced and exhausted by conventional means in any conventional manner. The timing and control of said cylinder 109 may be by any conventional means, such as directly by an operator or by any conventional automatic means.

As will be noted in Figures 3 and 6, the ejection head is comprised of a sliding base 110, a cross-member 111, either integral therewith or separably secured thereto, which in turn supports the guide block 112. Said guide block 112 is provided with a suitable opening 113 for slidable reception of the piston rod 108, which rod also penetrates the flange 114 of the cross-member 111, through an ample opening therein, for fixed relationship with the sliding bar 115 by means of the nut 116. The sliding bar 115 is substantially free to slide reciprocably, longitudinally of the sliding base 110 within the limits of the flange 114 and the stop 117 whose function will be described hereinafter in more detail. The fingers 118 and 119 are pivotally attached to the extended ends of the cross-member 111 at their one end, and securely attached to the contactors 120 and 121 at their other ends, respectively. Pivotally affixed to each of said ejection fingers 118 and 119, between said extremities thereof, are one end of the links 122 and 123, respectively. Said links are pivotally attached, at their other respective ends to opposite ends of the sliding bar 115. Thus, it will appear that, since the sliding bar 115, the links 122 and 123, the fingers 118 and 119 and the cross-member 111 are all pivotally associated, a movement of the piston rod 108 in a rightward direction, as appearing in Figure 6, urging the sliding bar 115 across the top of the sliding base 110 until said bar strikes said stop 117, will cause the contactor ends of the fingers 118 and 119 mutually to collapse towards the centerline of the sliding base 110. After said sliding bar 115 has contacted the stop 117, as just described, continued motion of said piston rod 108 in a rightward direction will cause said sliding base 110 to slide along the slide rail 92. If, on the other hand, the piston rod 108 is caused to move in a leftward direction, as appearing in Figure 6, said sliding bar 115 will take a position indicated in phantom at 115a, and the links 122 and 123 will take the positions 122a and 123a, also shown in phantom, thereby causing the fingers 118a and 119a to be extended as shown. The purpose of this collapsing feature in the ejection device head will be described in detail hereinafter in connection with the operation of the entire bending machine.

A plurality of hooked restrictors, indicated as 125 in Figures 1 and 5 are secured as by bolting to the shaft 126 which in turn is rotatably supported within appropriately bushed openings in the bossed ears 127 and 128, which ears may be an integral part of the support brackets 30 and 31. The oscillatory rotation of the shaft 126 and the attached restrictors 125 is determined by the control assembly indicated in Figure 5 at 130.

The said control assembly 130 comprises a rocker arm 131, linkage members 132, a turnbuckle 133, a piston rod 134 and associated control cylinder 135. Said rocker arm is secured at its one extremity, as by bolting, to the shaft 126 preferably, but not necessarily, about midway of the ends of said shaft. The other extremity of said rocker arm 131 is pivotally secured to the upper end of linkage member 132, whose lower end is pivotally secured to the said turnbuckle 133. Said turnbuckle is threadedly associated with the piston rod 134 of the control cylinder 135, which may be, for example, a cylinder actuated by a suitable pressure fluid, such as air. Said cylinder 135 is mounted on the horizontal platform member 8 in any suitable manner as by bolting. In this particular embodiment of the invention, the piston within the cylinder 135 is actuated by the pressure fluid in a downward direction only. When the pressure is released on said fluid, a suitable resilient means, such as a spring (not shown), causes said piston, hence said piston rod 134, to return to the top of its stroke. Referring either to Figure 3 or to Figure 5 it will be observed that, if the piston and associated piston rod are forced in a downward direction by the introduction of pressure fluid, as aforesaid, the linkage comprising 133, 132 and 131 will be caused to move in

a downward direction thereby effecting a clockwise rotation of the restrictors 125. When the fluid pressure into said cylinder 135 is cut off, said resilient means within said cylinder will cause said linkage and said restrictors 125 to return to the restricting position shown in Figure 5. It will be noted that when said hooked restrictors are in a position as shown in Figure 5, their hooked ends 124 will prevent the entry of sheets of stock between the rolls 34 and 40. Said hooked ends 124 will also eliminate the possibility for the leading edge of the sheet being rolled to pass over and around the ejection device support 5 in a circular path and re-enter at 97 between the rolls 34 and 40, in the event that said leading edge should overshoot the rollers 96.

The flow of pressure fluid to said cylinder 135 through the conduit 137 is controlled by means of the electrically energized valve 138, shown in Figure 1, which may be mounted on the horizontal platform member 8 in any convenient manner such as bolting. The electrical release mechanism in the valve 138 is remotely controlled by means of a conventional type limit switch 139, conveniently, but not necessarily, mounted on the central vertical member 90 or attached web members 91 of the ejection device support 5. The limit switch 139 is positioned with respect to the slide rail 92 of the ejection device support 5 so that a suitable finger 140, depending from the underside of said ejection device head 107, will trip the said limit switch 139 as said ejection device head 107 is urged to move along said slide rail 92 either leftwardly or rightwardly past the position of said limit switch. A conventional arrangement of contactors within the limit switch 139, which are electrically connected with the valve 138, will initiate and maintain a suitable synchronization between the hooked restrictors 125 and the ejection device 4 with respect to feeding new sheets of stock into the roll mechanism. Since control and adjustment by means of limit switches, electric valves for pressure fluid systems, and their associated assemblies are part of a well known and much used art, detailed description regarding the exact means and method of control will be omitted. It is sufficient to say that the reciprocation of the ejection device head 107 along the slide 92 past the position of the limit switch 139, when properly regulated and adjusted, will cause the hooked restrictors 125 to permit or impede the entry of sheet stock between the rolls 34 and 40 in proper synchronization with said ejection device.

Operation

A description of the operation of the said bending machine may be followed most readily by reference to Figures 1, 2 and 3. The electric motor 16 may be energized by means of any suitable, conventional starting switch, not shown, thereby rotating the pulley 19 which is secured to the shaft thereof. Rotation of said pulley 18, hence the driving shaft 25 of the gear box 17, will be induced by means of said pulley 19 through their mutual association with said belt means 20. A suitably geared mechanism within said gear box 17 will produce a differential in rotational speeds, here a reduction, between the driving shaft 25 and the driven shaft 26, which is flexibly coupled with the end shaft 33 of the top roll 34.

Hence, a rotation of the end shaft 33, upon which is mounted the geared pinion 36, will directly effect a rotation of the geared pinion 37, hence the end shaft 39 of the bottom roll 40. The pinion 37 will also effect rotation of the geared pinion 43 and through it the associated shaft 41 of the curvature roll 42. All three of the said rolls 34, 40 and 42 will advantageously, yet not necessarily insofar as this invention is concerned, be rotated at approximately the same rate of peripheral speed. The basic determination of the relationship between the rotational speed of said rolls and the pulley 18 will be determined by the ratio between driving shaft and driven shaft of the differential gear box 17, and may be selected from conventional equipment to suit the specific requirements of the job. Small, more precise adjustments, in the rotational speed of said rolls may be controlled by means of the variable speed pulley 19 mounted on the motor shaft. The adjustable base 15 is provided to take up any slack in the belt 20 produced by a variation in the pitch diameter of the variable speed pulley 19. Such base 15 and pulley 19 may also be selected from conventional equipment so, therefore, will not be described in further detail.

After the rotational speed of the rolls 34, 40 and 42 has been properly adjusted, a related adjustment must then be made in the ejection device mechanism 4, so that the actuating cylinder 109 will not urge the ejection head to move in a leftwardly direction, as appearing in Figure 1, until the sheet stock being rolled through the machine has completed its rolling cycle and its leading edge is resting in the grooved rollers 96. A further adjustment must be made between the limit switch 139 and the hydraulic cylinder 135 so that the hooked restrictors 125 will remain in their restricting position until the ejection device head has moved the cylindrically rolled preform clear of the rolling area. The mechanism is also preferably adjusted so that the ejection device head will not return rightwardly until the next sheet to be rolled is partly through the rolls. This will prevent the leading edge of such sheet from striking the ejection head and fouling.

The bending roll 42 is adjusted so that the radius of curvature of the sheet being rolled is a little less than that which would effect an easy encircling of the parts encircled and only a light engagement of the leading and trailing edges, respectively, with the rollers 96 and the discharge side of the initial rolls 34 and 40. Thus the bent sheet will grip the guides tightly and will thereby remain in proper position for ejection from said bending machine.

These adjustments and corrections having been made, the bending machine is now ready for operation. The operator energizes the various moving parts of the entire machine and awaits the timed reciprocation of the ejection device head 107 thereby causing the hooked restrictors 125 to rotate momentarily away from a position impeding access to the entry 97 between the initial rolls 34 and 40. Thereupon, said operator introduces a suitably sized and shaped sheet of stock between said rolls 34 and 40 at the entry point 97, as appearing on the forward side of the machine in Figure 1. The gears 36, 37, 43 and 45, by means of inter-relationship as described, will drive the rolls to draw said sheet stock through said initial rolls, and against the curvature roll 42 by which to impose the desired curvature onto said sheet stock. The sheet stock will continue to move between said rolls, while being supported by said guide bar 102, and follow a circular path over and around the ejection device mechanism and support 4 and 5, respectively, where it may be supported and guided by the guide bar 100 and associated frame so that, and until, the said leading

edge thereof engages the grooved pulleys **96**, as shown in Figure 3. The trailing edge of said sheet will then ride on the discharge side of the initial rolls **34** and **40** and may be slid axially therealong.

The cylinder **109** is now actuated, as above described, to move the piston rod **108** leftwardly as appearing in Figure 1, whereby to pull the ejection head **107** to the leftward end of the machine. The contactors **120** and **121** of said ejection head will contact the rightward edge of the cylindrically shaped preform and draw said preform towards the leftward end of the machine where it may be discharged onto an appropriate conveyor mechanism for transporting it to a stock pile, or where said preform may be ejected upon the suitable conveyor system of an associated welding machine, as in the specific embodiment of the invention here illustrated. As said ejection head moves past the position of the limit switch **139**, the hydraulic cylinder **135** will be actuated to rotate the hooked restrictors **125** from a position blocking the entry **97** between the rolls **34** and **40**. The operator is thereby provided with an adjustable period of time to feed another sheet of stock between said rolls. When this sheet is partly, as one-third, through the rolls, said actuating cylinder **109** will then return the ejection head to the rightward end of the rail **92** in a collapsed condition, as described heretofore and illustrated in Figure 6, so that said contactors **120** and **121** will pass the newly forming sheet and be ready to eject it as soon as it is finished.

The desired pressure between said rolls **34** and **40** may be adjusted and maintained by means of said set screws **68** and **69** either before said bending machine is set into motion, or after it is in operation. Likewise, proper adjustment of the curvature roll by means of the curvature roll adjusting assembly **83** may be accomplished either before or after the said machine has been placed in running operation. By means of the two aforementioned adjusting devices proper curvature of the sheet stock being preformed is under constant control, thereby insuring the most efficient possible operation of said bending machine.

It may be readily observed that the speed with which the subject bending machine can produce preformed, cylindrically shaped articles, may vary over a wide range and is substantially limited only by the speed with which the associated conveyor or welding machine means can handle the articles preformed on this bending machine.

Although a particular embodiment of the invention has been selected for illustrative purposes and although many specific details have been disclosed for the purpose of clarity during the course of illustration and description, it will be evident that a wide variety of modifications may be incorporated into the machine illustrated without departing from the scope of the invention. Furthermore, it will be understood that although a rolling machine of the type herein disclosed may handle and preform sheets as shown in a wide variety of diameters, the embodiment herein selected for illustrative purposes has been designed especially to roll sheet stock into relatively large cylindrical shells suitable for the side walls of barrels having a diameter of approximately 10 inches or larger.

It will also be understood that the means for actuating the various cylinders, valves and gears, although specifically stated for illustrative purposes, may be of any conventional type convenient in the specific application of the invention.

Finally, although the above mentioned drawings and descriptions may apply to one particular preferred embodiment of the invention it is not my intention, implied or otherwise, to eliminate other variations or modifications which do not depart from the scope of the invention, unless specifically stated to the contrary in the hereinafter appended claims.

I claim:

1. In a bending machine for uniformly curving sheet material, the combination comprising: a frame, a plurality of bending rolls rotatably supported by said frame and means effecting rotation thereof, two of said rolls constituting initial rolls receiving sheet stock to be bent, and means cooperating with said initial rolls effecting such bending; stop means close to and parallel with said initial rolls for arresting the movement of stock being bent as the free edge thereof reapproaches said initial rolls near the end of a bending cycle, and ejection means supported by said frame above said rolls within the zone circumscribed by said sheet material during the bending procedure for removing said bent sheet in a direction parallel to the axes of the rolls after the bending operation has been completed.

2. In a bending machine for sheet material the combination comprising: a frame, a plurality of bending rolls rotatably supported by and substantially above said frame, and means effecting rotation thereof, two of said rolls constituting initial rolls receiving sheet stock to be bent, and a third roll cooperating with said initial rolls for effecting the bending thereof by curving a sheet of such stock upwardly, stop means close to and parallel with said initial rolls for arresting the movement of stock being bent as the free edge thereof reapproaches said initial rolls near the end of a bending cycle, and reciprocable ejection means supported by said frame above said rolls within the zone circumscribed by said sheet material during the bending procedure for removing said bent sheet in a direction parallel to the axes of the rolls after the bending operation has been completed.

3. In a bending machine for uniformly curving sheet material the combination comprising: a frame, a plurality of bending rolls rotatably supported by said frame, two of said rolls constituting initial rolls receiving sheet stock to be bent, and a third roll cooperating with said initial rolls comprising means effecting such curving of said sheet material; stop means close to and parallel with said initial rolls for arresting the movement of stock being bent as the free edge thereof reapproaches said initial rolls near the end of a bending cycle; retractable means obstructing entry of sheet material into said initial rolls; ejecting means supported by said frame above said rolls within the zone circumscribed by said sheet material during the bending procedure for removing said bent sheet in a direction parallel to the axes of the rolls after the bending operation has been completed; means relating the operation of said retractable means to the operation of said ejecting means whereby said retractable means will be in sheet obstructing position during the ejection of a given sheet, and in sheet passing position during at least a part of the remainder of the operational cycle including that part immediately following said ejection.

4. In a bending machine for sheet material the combination comprising: a frame, a plurality of bending rolls rotatably supported by said frame, two of said rolls constituting initial rolls receiving sheet stock to be bent; stop means close to

and parallel with said initial rolls for arresting the movement of stock being bent as the free edge thereof reapproaches said initial rolls near the end of a bending cycle; and means supported by said frame above said rolls within the zone circumscribed by said sheet material during the bending procedure for removing said bent sheet in a direction parallel to the axes of the rolls after the bending operation has been completed; guard means adjacent the initial rolls adjustable to two positions in one of which positions said guard means prevents the introduction of sheet material into said initial rolls and in the other of said two position said means permit the entry of sheet material into said initial rolls; control means relating the action of said guard means to the operation of said ejection means by which said guard means will be in obstructing position when said ejection means is in one position and may be in open position when said ejection means is in another position.

5. In a machine for uniformly curving sheet material said machine having a frame and a plurality of bending rolls above said frame and rotably supported thereby and means rotatably driving said rolls, the improvement comprising: a horizontally disposed slide rail above and substantially parallel with the axes of said rolls supported by said frame within the zone circumscribed by a sheet of said sheet material during the bending process; a sliding base slidably supported on said rail; collapsible arms supported on said sliding base extending laterally of the direction of such sliding; means effecting reciprocation of said sliding base and said slide rail and including means by which the laterally extending parts are collapsed in one direction of reciprocation and extended in the other direction of reciprocation.

6. In means for bending sheet material, the combination comprising; a supporting frame, a pair of rolls rotatably supported on said frame at the upper side thereof and a bending roll adjacent thereto; said rolls bending said sheet material upwardly and around a cylindrical zone having its axis above and spaced from said rolls retractable means intermittently blocking entry of sheet material between said pair of rolls; reciprocal means located at least partially within, and operably parallel to the axis of, said zone of ejection of said sheet material and means responsive to the position of said reciprocable means for controlling the position of said retractable means.

7. In a machine for uniformly curving sheet materials, said machine having a frame and a plurality of bending rolls above said frame and rotatably supported thereby, and means rotatably driving said rolls, the improvement comprising: a horizontally disposed slide rail above and substantially parallel with the axes of said rolls supported by said frame within the zone circumscribed by a sheet of said sheet material during the bending process; a sliding base slidably supported on said rail; collapsible arms supported on said sliding base extending laterally of the direction of such sliding; a reciprocable rod having one end adjacent said sliding base and reciprocably movable with respect thereto; spaced means on said base engageable by said rod in each direction of reciprocation for reciprocably moving said sliding base with the reciprocation of said rod but permitting lost motion between said rod and said base, said lost motion occurring between the end of movement of

both thereof in one direction and the beginning of the movement of said base in the other direction; linkage connecting said rod and said collapsible arms operable by said rod during said lost motion period for collapsing said arms as said base is moved along said rail in one direction and for extending said arms as said base is moved along said rail in the opposite direction.

8. In a machine for bending sheet material into a substantially cylindrical form and having a supporting frame, a pair of initial feeding rolls cooperating with each other and rotatably supported on said frame, a bending roll adjacent and parallel to said feeding rolls for bending said sheet material upwardly and around a substantially cylindrical zone, means rotating said rolls, stop means close to and parallel with the feeding rolls for arresting movement of sheet material being bent as it reapproaches said feeding rolls near the end of a bending cycle, and means controlling the feeding of sheet material into and effecting the ejection of curved sheet material out of said machine; the improvement in said last named means comprising: guard means retractably obstructing the entry of sheet material between said feeding rolls; a horizontal slide rail above and substantially parallel with the axes of said rolls, supported by said frame within said zone and extending out from one end thereof; a sliding base supported on said rail and reciprocably slidable thereon through the full length of said zone and out therefrom in bent-sheet-ejecting direction and back into said zone in non-ejecting direction; collapsible arms on said base extending therefrom sufficiently when in extended position to engage the edges of said sheet material after same has assumed a fully curved shape and when in collapsed position capable of moving axially through said zone without contacting said sheet material; driving means reciprocating said sliding base; linkage means associated therewith effecting extension of said arms as said driving means moves in bent-sheet-ejecting direction for engaging and moving a bent sheet axially off said rolls, and effecting collapsing of said arms as said driving means moves in non-ejecting direction for permitting return of said arms to a position for engaging the next sheet without contacting such sheet if it is then being bent; and control means responsive to movement of said sliding base effecting positioning of said guard means in sheet arresting position during an ejecting stroke of said ejection means to prevent feeding of a new sheet into the machine before the previous one is fully removed therefrom and effecting movement thereof into non-arresting position in other positions of said ejecting means whereby a new sheet may be fed through said rolls for bending during at least a part of the return stroke of the ejecting mechanism.

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