June 25, 1929. L. E. MILLER 1,718,753

METHOD AND APPARATUS FOR FORMING PIPE

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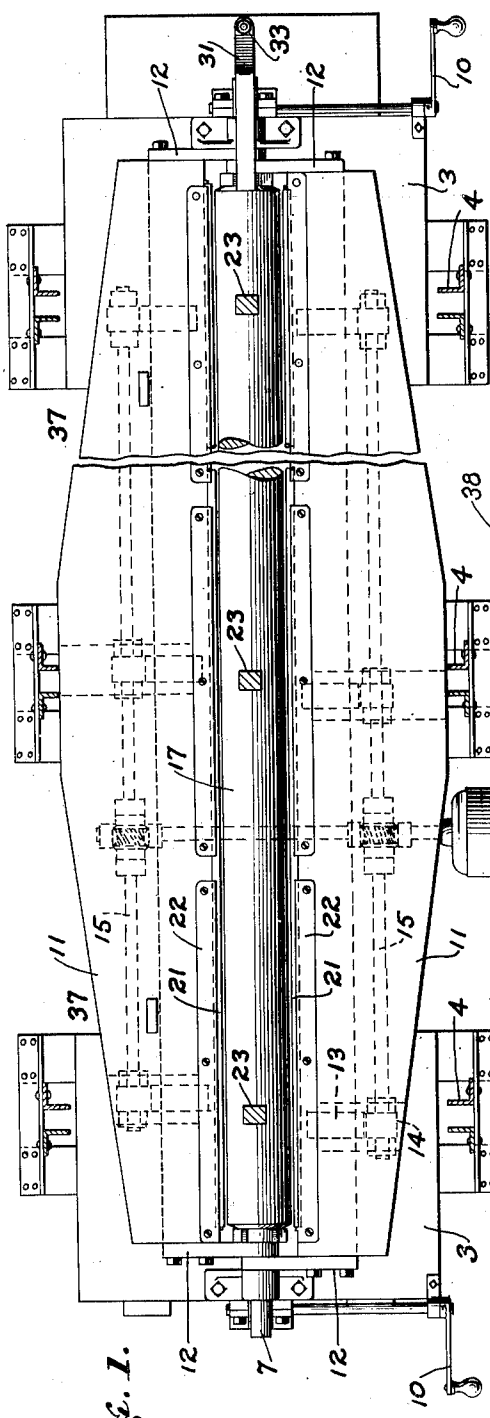


Fig. 1.

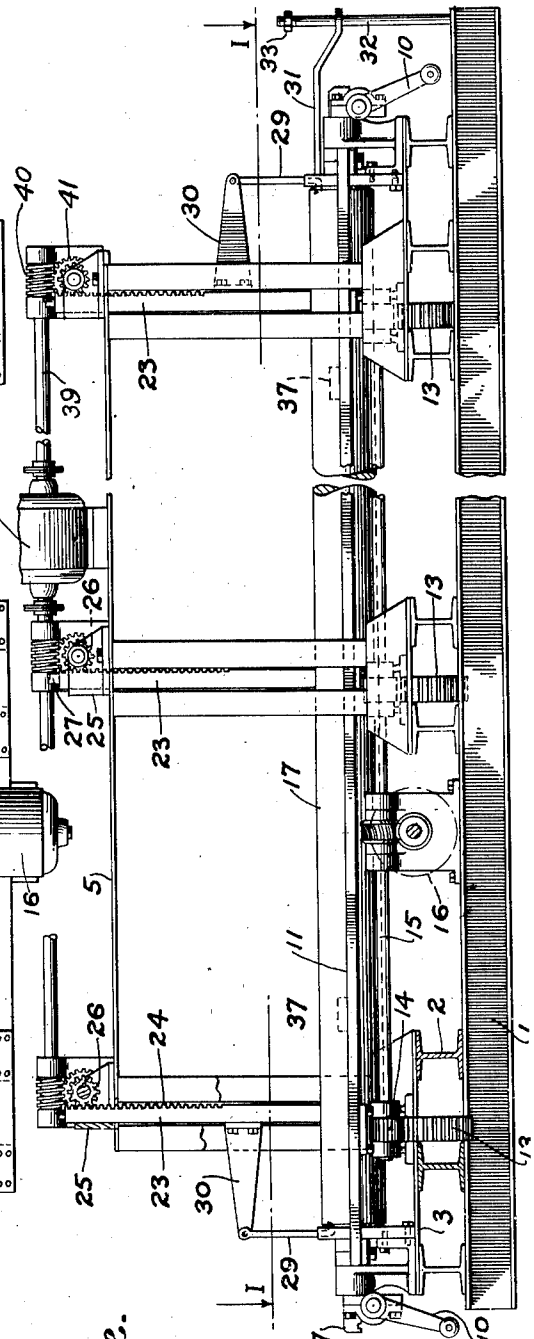


Fig. 2.

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Fig. 3.

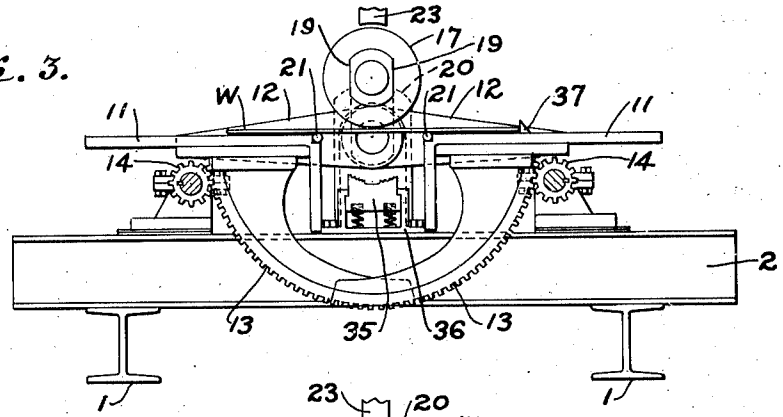


Fig. 4.

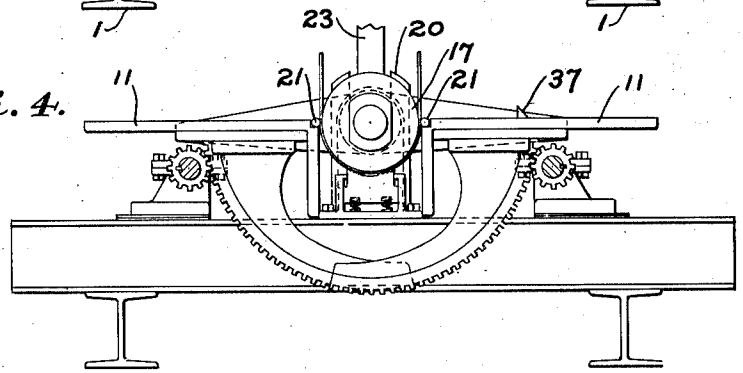
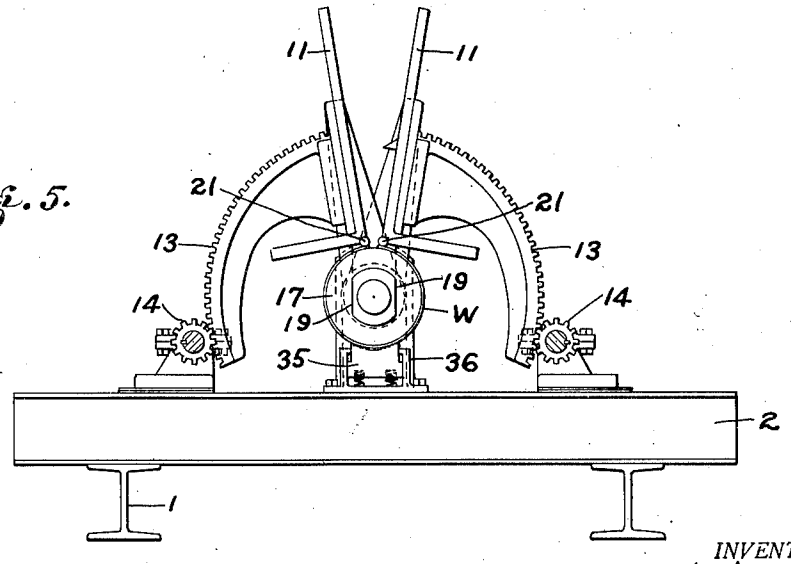


Fig. 5.



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Fig. 6.

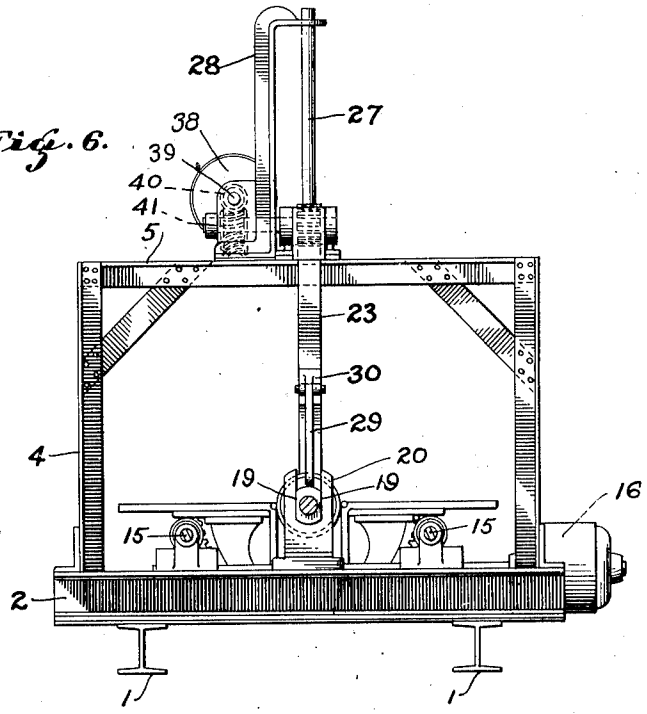
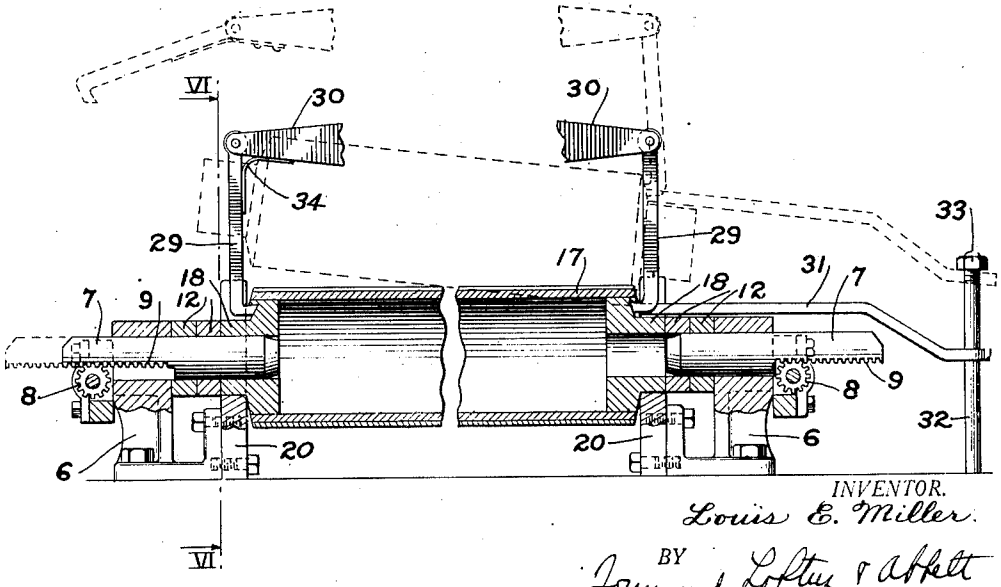


Fig. 7.



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UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR FORMING PIPE.

Application filed November 22, 1926. Serial No. 149,960.

This invention relates to an improved method and apparatus for forming pipes by bending metal sheets into tubular form. I am aware that machines of various kinds have heretofore been devised for performing this operation, but as far as I know all of these machines have failed to form the sheets into perfect cylinders which may be welded together along the edges of the sheets without further straightening or bending operations thereon. In the machines heretofore known, the greater portion of the sheet intermediate the ends thereof has been bent into tubular form but the bending operation has not been continued to the ends of the sheet and these ends have therefore been left in an upstanding position necessitating the manual shaping thereof before they can be welded together. This incomplete bending operation therefore not only necessitates a considerable amount of manual labor on each sheet, but, since this manual operation is performed by hammering the ends into place, the ends are very crudely and irregularly shaped. The ends of the sheet in such shape do not meet along a continuous line and therefore the welding thereof is imperfect and the sheet in its finished form falls far short of being a true cylinder.

I am also aware that other machines have been developed for taking the sheets after they have been bent into substantially cylindrical shape and giving them a final shaping operation. However, these machines are very complicated and expensive and also do not leave the sheet in a true cylindrical shape.

Also these cylinders are ordinarily formed in compartively short sections and welded together to form sections of pipe of the desired length. Since the sections are not in the form of a true cylinder, the ends thereof do not accurately co-operate and the welding of the same together therefore is also imperfect.

It is the object of my invention herein to provide an improved method and apparatus for bending metal sheets into perfect cylindrical shape in one machine and at one bending operation thereon, the entire sheet, including the ends thereof, being uniformly bent to the shape of a cylinder and the ends of the sheet meeting along a continuous line in a manner adapting the same to a perfect weld. My invention also is adapted to form these cylindrical pipes of any desired length, thus eliminating the necessity of welding two or more sections of pipe together to form a pipe of the desired length. It may furthermore be mentioned that pipes formed by my improved method are so perfectly cylindrical that two or more such pipes may be welded together end to end with a perfect joint should such operation become necessary or desirable.

In the accompanying drawings, I have illustrated one specific embodiment for carrying my invention into practice, but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended hereto being relied upon for that purpose.

Referring to the figures of the drawings:

Fig. 1 is a sectional plan view of a machine embodying my invention, the same being taken on line I—I of Fig. 2.

Fig. 2 is a side elevation thereof partly in section.

Fig. 3 is an end view thereof with a piece of work in place and before any bending thereof.

Fig. 4 corresponds to Fig. 3, but shows the work partially performed.

Fig. 5 shows the same at the end of the bending operation.

Fig. 6 is a fragmentary end view taken on line VI—VI of Fig. 7.

Fig. 7 is a fragmentary sectional view, vertically and longitudinally, through the machine.

Referring more specifically to the drawing by reference characters, the base of my machine is illustrated as comprising a pair of longitudinally extending rails 1 and three sets of transversely extending rails 2 thereon. A platform 3 is provided on each set of rails 2. A superstucture comprising uprights 4 and connecting top irons 5 is mounted on the rails 2. The working parts of my machine are supported on and secured to the platforms 3 and superstructure 5. It will be understood, however, that any suitable supporting base may be used.

Mounted on each outer platform 3 over the two outer sets of rails 2 is an upright 6 within each of which is slidably mounted an axle 7. These axles are movable axially within the uprights, by means of pinions 8

engaging rack teeth 9 and operated by handles 10.

A pair of relatively long members 11 have arms 12 at their outer ends pivotally mounted on the inner ends of the axles 7. Secured to the lower side of each of these members are segmental racks 13 each engaged by a driving pinion 14. The three pinions on each side of the machine may be mounted on a single shaft 15 and driven by a motor 16. These pinions are adapted to pivotally move the members 11 from the position shown in Figs. 3 and 4 to the position shown in Fig. 5.

The machine is adapted to bend the metal sheet to be formed about a mandrel 17. This mandrel is received in an opening between the two members 11 as shown in Figs. 1 and 4. The intermediate portion of the mandrel is cylindrical and the hubs 18 at the ends thereof have diametrically opposite flats 19 slidable vertically in guiding brackets 20 secured to the bearing uprights 6. Centrally disposed holes are also provided in the mandrel ends for receiving the axles 7.

Anti-friction means are preferably provided at the inner edges of the members 11 for engaging the work. This means in each member preferably comprises a single rod 21 held in place by plates 22, this rod constituting a long anti-friction roller adapted to engage and bend the work sheet as hereinafter described.

As a means for forcing the mandrel downwardly from the position shown in Fig. 3 to that shown in Fig. 4, I illustrate three vertically movable plungers 23 disposed directly above the mandrel. These plungers are provided with rack teeth 24 and are movable vertically through housings, 25, having pinions 26 therein engaging the rack teeth. The pinions can be operated by any convenient power. Guide rods 27 carried by the upper ends of the plungers are movable through guiding and supporting brackets 28. These brackets and the housing 25 are mounted on the superstructure 5 as illustrated in Fig. 6.

As a means for lifting the mandrel from the position shown in Figs. 4 and 5 to the position shown in Fig. 3 and for holding the same in a position permitting the removal of a formed pipe therefrom, I may use the following mechanism: Hooks 29, pivoted to the outer ends of brackets 30, secured rigidly to the outer plungers 23, are adapted to engage within notches in the ends of the mandrel as shown in Fig. 7. Thus the mandrel may be raised by moving the plungers 23 upwardly. A bar 31 has its outer end slidable on a bolt 32 secured rigidly to the base and provided with a nut 33 at the top end. The inner end of the bar is secured rigidly to the adjacent end of the mandrel. A spring 34 is adapted to disengage the outer hook 29, as shown in dash lines in Fig. 7, when the bar engages the nut 33 and prevents further upward movement of the adjacent end of the mandrel.

The frictional contact between the mandrel and the work sheet W will ordinarily be sufficient to prevent any movement of the work on the mandrel. However, in order to positively prevent any such movement, I preferably mount one or more spring pressed dogs 35 in a housing or housings 36 beneath the mandrel. The portion of the dogs engaging the work is serrated in a manner gripping the work piece and preventing rotation thereof on the mandrel.

The operation of my machine as illustrated is briefly as follows:

In Figs. 1 and 3 the several parts of the machine are shown in the position ready to receive the work piece W. The members 11 are open to a horizontal position and the mandrel 17 is supported above the members sufficiently to permit the sheet W to be placed on the members beneath the mandrel. Stops 37 may be provided on one of the members for properly locating the work piece.

The plungers 23 are thereafter moved downwardly against the mandrel in a manner forcing the same to the position shown in Fig. 4. It will be understood that during this movement the mandrel is accurately guided by the flats 19 in the brackets 20. As the mandrel moves downwardly the sheet is wrapped securely about the lower half of the mandrel, by its engagement against the rolls 21. As shown in Fig. 4, the intermediate portion of the sheet is forced into a true semi-cylinder about the lower half of the mandrel and the bottom of the sheet is engaged against the holding dogs 35. The pinions 8 are then rotated to move the axles 7 inwardly to engage the ends of the mandrel as shown at the left-hand end of Fig. 7.

The motors 16 are thereafter operated to move the members 11 from the position shown in Fig. 4 to that shown in Fig. 5. This operation moves the rollers 21 along a true circle about the upper half of the mandrel in a manner securely wrapping the two ends of the sheet thereabout. The members are moved to a position bringing the rollers 21 nearly into engagement and over the work to the extreme ends thereof. As shown in Fig. 5, the entire sheet W, including the extreme ends thereof, has been formed into a perfect cylinder and these ends are in perfect alignment ready for the welding operation.

It will be understood that during the operation performed between Figs. 3 and 4 and that performed between Figs. 4 and 5 no uncompensated lateral thrust or strain is placed on the mandrel. The strain or thrust on one side of the mandrel is always exactly

balanced and compensated by the opposing strain on the opposite side.

After the work is formed as shown in Fig. 5, the same is removed as follows: The members 11 are dropped back to the position shown in Fig. 4. The plungers 23 are then lowered and the hooks 29 engaged with the mandrel. The plungers and hooks are then raised in a manner raising the entire mandrel vertically until the bar 31 engages the nut 33. Continued upward movement of the plungers thereafter tilts the outer end of the mandrel upwardly and the outer hook is automatically disengaged by means of the spring 34. The cylindrical work may then be removed from the free end of the mandrel as will be understood, this position of the parts being shown by dash lines in Fig. 7.

While, as heretofore stated, the plungers 23 can be operated by any convenient power, I have in Figures 2 and 6 illustrated a convenient means for operating these pinions. A motor 38 mounted on the superstructure 5 is connected to a shaft 39 having a plurality of worms 40 thereon engaging worm wheels 41 connected to the pinions 26. By this mechanism the pinions 26 are all operated simultaneously and with great power.

I wish to particularly emphasize the fact that by the use of my invention very long pipes can be manufactured from a single sheet of metal, the only operations necessary being the bending of the sheet to cylindrical form and the welding of the ends of the sheet together. Heretofore these long pipes have had to be made in sections, this being a very expensive and tedious operation since all the sections must be welded end to end to form a long pipe. Obviously such a pipe also is not as strong as a pipe made in one piece. It will be obvious that one piece pipes of any desired length can be made by my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. The method of bending a metal sheet into tubular form about a mandrel consisting of placing the sheet on a base having a mandrel opening therein, forcing the sheet into the opening by means of the mandrel whereby the intermediate portion of the sheet is bent about that portion of the mandrel forced into the opening, and thereafter swinging a pair of rollers over the ends of the sheet so as to bend the ends over the outer portion of the mandrel.

2. The method of bending a metal sheet into tubular form about a mandrel consisting of placing the sheet on a base having a mandrel opening therein, forcing the sheet into the opening by means of the mandrel whereby the intermediate portion of the sheet is bent about that portion of the mandrel forced into the opening, and thereafter simultaneously swinging a pair of rollers over the ends of the sheet so as to bend the ends over the outer portion of the mandrel, the rolling force being exerted on the two sheet ends at points opposite each other for the purpose of balancing each other and thereby eliminating any strain on the mandrel.

3. A pipe forming machine, comprising the combination of a pair of relatively long members pivoted at their opposite ends on a common axis, the members in their separated position having a mandrel opening therebetween, a mandrel movable vertically into and out of the opening and in its outer position permitting a metal sheet to be placed on the members beneath the mandrel, means for forcing the mandrel into the opening for the purpose of bending the sheet about the lower half of the mandrel and bringing the mandrel into a position coaxial with the said common axis, and means for swinging the members upwardly about their pivots for the purpose of rolling the ends of the sheet about the upper portion of the mandrel.

4. A pipe forming machine, comprising the combination of a pair of relatively long members pivoted at their opposite ends on a common axis, the members in their separated position having a mandrel opening therebetween, a mandrel movable vertically into and out of the opening and in its outer position permitting a metal sheet to be placed on the members beneath the mandrel, anti-friction roller means mounted on the inner edge of each member adjacent the opening, means for forcing the mandrel into the opening for the purpose of bending the sheet about the lower half of the mandrel and bringing the mandrel into a position coaxial with the said common axis, and means for swinging the members upwardly about their pivots for the purpose of moving the said anti-friction roller means over the sheet and about the mandrel whereby the ends of the sheet are rolled about the upper portion of the mandrel.

5. A pipe forming machine, comprising the combination of a pair of relatively long members pivoted at their opposite ends on a common axis, the members in their separated position having a mandrel opening therebetween, a mandrel movable vertically into and out of the opening and in its outer position permitting a metal sheet to be placed on the members beneath the mandrel, guiding means engaging the ends of the mandrel and guiding the same in said movement, means for forcing the mandrel into the opening for the purpose of bending the sheet about the lower half of the mandrel and bringing the mandrel into a position coaxial with the said common axis, means for engaging the ends of the mandrel to hold the same

in such position, and means for swinging the members upwardly about their pivots for the purpose of rolling the ends of the sheet about the upper portion of the mandrel.

6. A pipe forming machine, comprising the combination of a pair of relatively long members pivoted at their opposite ends on a common axis, the members in their separated position having a mandrel opening therebetween, a mandrel movable vertically into and out of the opening and in its outer position permitting a metal sheet to be placed on the members beneath the mandrel, means for forcing the mandrel into the opening for the purpose of bending the sheet about the lower half of the mandrel and bringing the mandrel into a position coaxial with the said common axis, means for swinging the members upwardly about their pivots for the purpose of rolling the ends of the sheet about the upper portion of the mandrel, and means for thereafter lifting the mandrel out of the opening and supporting the same with one end free for the removal of the tubular work thereon.

7. A pipe forming machine, comprising the combination of a base, a pair of relatively spaced coaxial bearing members supported thereby, a pair of axially movable supporting axles respectively supported in the bearing members, a pair of relatively long members pivoted at their opposite ends on the said axles, the members in their separated position having a mandrel opening therebetween, a mandrel movable vertically into and out of the opening and in its outer position permitting a metal sheet to be placed on the members beneath the mandrel, means for forcing the mandrel into the opening for the purpose of bending the sheet about the lower half of the mandrel and bringing the mandrel into a position coaxial with the said axles, means for moving the axles axially to engage the ends of the mandrel and hold the same in such position, and means for swinging the members upwardly about their pivots for the purpose of rolling the ends of the sheet about the upper portion of the mandrel.

8. A pipe forming machine, comprising the combination of a pair of relatively long members pivoted at their opposite ends on a common axis, the members in their separated position having a mandrel opening therebetween, a mandrel movable vertically into and out of the opening and in its outer position permitting a metal sheet to be placed on the members beneath the mandrel, means for forcing the mandrel into the opening for the purpose of bending the sheet about the lower half of the mandrel and bringing the mandrel into a position coaxial with the said common axis, means for swinging the members upwardly about their pivots for the purpose of rolling the ends of the sheet about the upper portion of the mandrel, and means engaging the work on the mandrel and preventing its movement thereon.

9. A pipe forming machine, comprising the combination of a pair of relatively long members pivoted at their opposite ends on a common axis, the members in their separated position having a mandrel opening therebetween, a roller journaled in each member at opposite sides of the mandrel opening, a mandrel movable vertically into and out of the opening between the rollers and in its outer position permitting a metal sheet to be placed on the rollers beneath the mandrel, means for forcing the mandrel into the opening between the rollers for the purpose of rolling and bending the sheet about the lower half of the mandrel and bringing the mandrel into a position coaxial with the axis of the roller carrying members, means for swinging said members upwardly about their pivots for the purpose of rolling the ends of the sheet about the upper portion of the mandrel, and means for supporting the mandrel in its lowered position and for preventing movement of the sheet about the mandrel.

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