J. FARMER.

BENDING MACHINE.

APPLICATION FILED SEPT. 12, 1919.

1,351,472. Patented Aug. 31, 1920.

FIG. 1

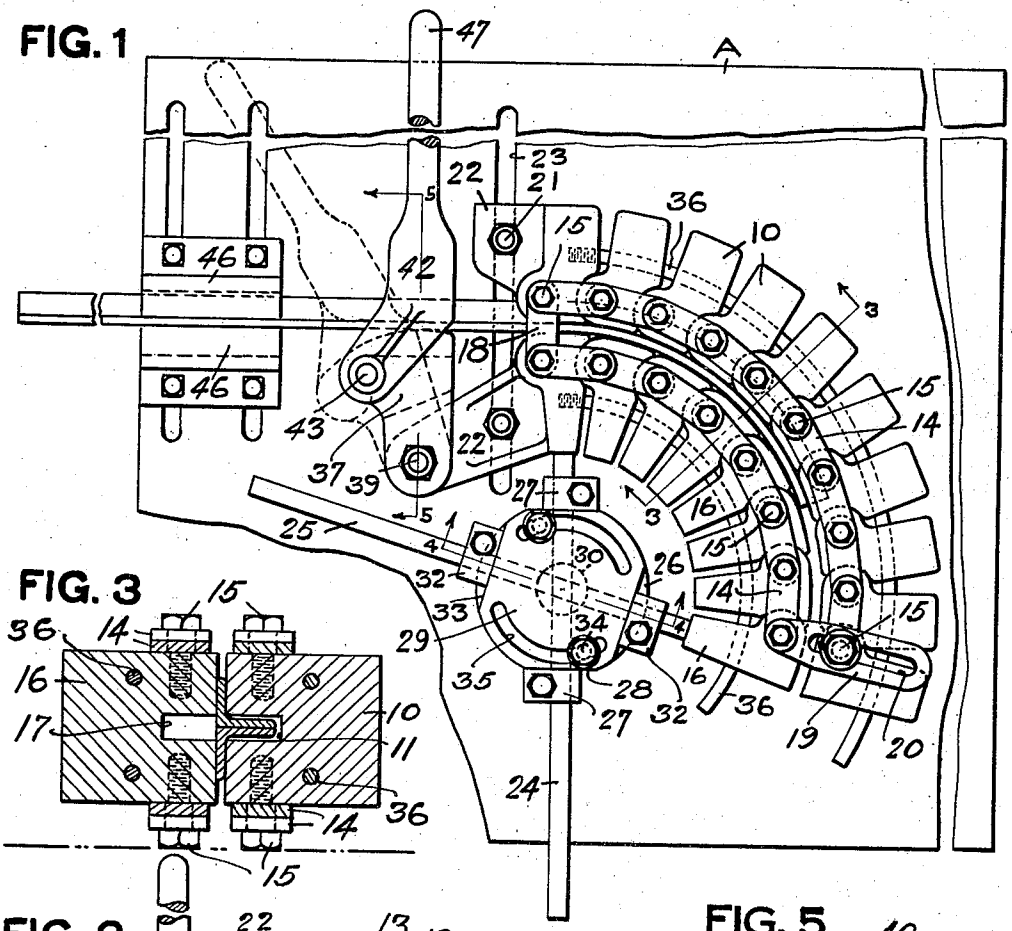



FIG. 3




FIG. 2

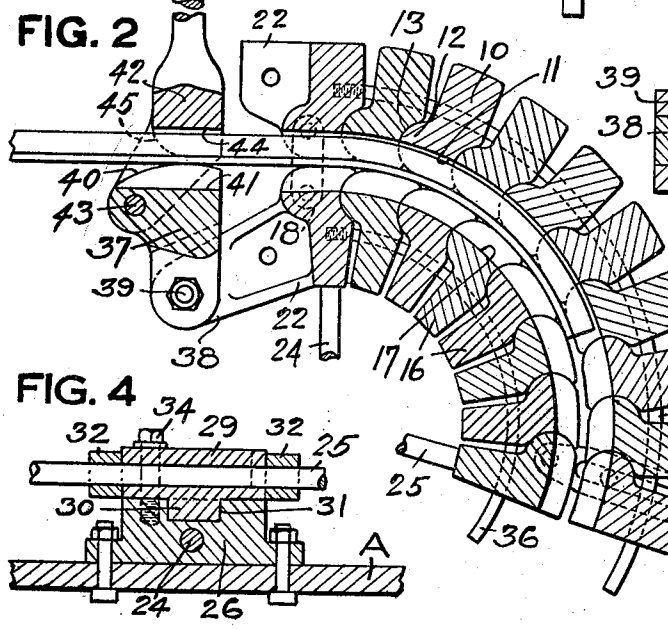



FIG. 5

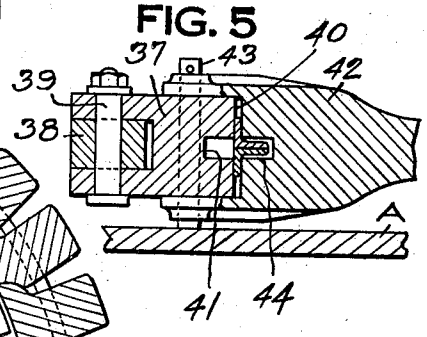



FIG. 4




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# UNITED STATES PATENT OFFICE.

JAMES FARMER, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR OF ONE-THIRD TO JAMES E. CONWAY, OF PITTSBURGH, PENNSYLVANIA.

## BENDING-MACHINE.

1,351,472. Specification of Letters Patent. Patented Aug. 31, 1920.

Application filed September 12, 1919. Serial No. 323,338.

*To all whom it may concern:*

Be it known that I, JAMES FARMER, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Bending-Machines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to bending apparatus.

Heretofore machines for bending strips of metal, angle, channel or T-irons, and pipes have been arranged to bend such material to a fixed arc, generally as near to a true arc as possible, and if, for example, two pieces of material are to be bent to arcs of respectively different radii, two separate bending machines were necessary, because each machine will impart only a constant arc to the material.

In such former machines, the die usually comprises a roll or wheel stationarily journaled on a suitable support and having its periphery shaped to conform to the inner face of the particular kind of material to be bent. Associated with such die is a lever pivoted on the journal about which the die turns, and having a gripping face adapted to contact the material and press it against the rotatable die. Rocking the lever causes it to press the material against the die and turn the latter, the material being drawn through a stationary guide so located as to cause it to conform to the shape of the die.

Besides being non-adjustable, a disadvantage of the former mechanism is that the flanges of an angle or T-iron are often cracked due to the excessive speed at which the machine is operated, and to the pull exerted on the material by the lever.

One object of the present invention is the provision of a machine adjustable to enable metal strips, angle, channel and T-irons, piping and the like, to be bent to any desired curvilinear shape, either on a true arc or on the arc of a parabola or ellipse.

Such adjustability permits the bending of material on arcs of any desired radii within the scope of adjustment of the machine.

Another object is to feed the material into the machine by a pushing rather than a pulling action, whereby the material is caused to assume the desired curvature without being subjected to as much strain or stress as in the machines of the prior art.

A further object is to provide a strong and durable bending machine, quickly adjustable to its various positions, and readily operated to impart the desired curvilinear form to the material passing through the machine.

Other objects and advantages will be referred to hereinafter and particularly specified in the claims.

In the accompanying drawings, Figure 1 is a top plan view of one embodiment of my invention, adapted to bend angle-iron, Fig. 2 is a horizontal sectional view through the forming dies and feed lever; Fig. 3 is a detail cross-sectional view, on line 3—3 of Fig. 1, through a pair of co-acting bending dies. Fig. 4 is a detailed vertical cross-sectional view on line 4—4, Fig. 1, showing the means for adjusting the forming dies to impart the various curvilinear shapes to the material, and for maintaining the dies where adjusted; and Fig. 5 is a vertical sectional detail view on line 5—5 of Fig. 1, illustrating the feed lever.

A table or bed plate A (Fig. 1) supports the adjustable bending mechanism herein disclosed, and while I have shown a horizontal support, it is obvious that the mechanism may be mounted in a vertical plane.

Referring more particularly to Figs. 1 to 3, the bending mechanism selected to illustrate one form of my invention, includes an outer series of forming dies 10, each of which dies comprises a substantially rectangular die block, the inner or working face of which may be recessed, as at 11, if necessary, to accommodate the cross-sectional contour of the material to be bent.

The form herein selected discloses a machine arranged to bend a T-iron strip or two angle-iron strips, it being understood that the only change necessary to enable the machine to bend channel irons, piping, or other forms, would be to alter the shape or arrangement of the recesses in the working faces of the die blocks.

The die blocks 10 are arranged in tandem and each block is articulated relatively to its adjacent block, being provided with a semi-cylindrical boss or enlargement 12 adjacent its working face, the enlargement extending transversely of the block and fitting

into a similarly shaped socket 13 formed in the adjacent block.

Links 14, pivotally secured by studs 15 to the respective die blocks 10, connect the adjacent die blocks, on opposite sides thereof, to prevent separation of the blocks.

An inner series of forming dies 16 of similar design is arranged substantially concentric with the outer series of forming dies, the individual die members 16 being similarly articulated, and connected by links 14.

The working faces of the die members 16 lie opposite the working faces of the die members 10, and in the present instance, are similarly recessed as at 17, to accommodate one or the other flange of the angle-iron which is to be bent.

As so far described, it is apparent that each series of die blocks constitute a flexible chain adapted for arrangement in true arcs of varying radii, or in other curvilinear positions.

Retaining links 18 connect the foremost die blocks 10 and 16 of the respective series of die blocks, and maintain the working faces of the blocks in each series spaced apart to form a path traversed by the material to be bent, the retaining links 18 on opposite sides of the foremost die blocks being conveniently secured thereto by means of the same studs 15 which secure the forward ends of the connecting links 14 to the die blocks, as shown in Figs. 1 and 3.

A retaining link 19 connects the die blocks of the inner and outer series, at the discharge end, but because of the necessity for permitting relative adjustment of the respective series of forming dies when assuming different curvilinear positions, I extend one end of this retaining link and provide it with a slot 20 through which the appropriate stud 15 passes. It will be noted that the inner series of forming dies contains a lesser number of die blocks than does the outer series, due to the smaller arc through which the inner series extends, and therefore, if the two series are brought nearer a straight line, the outer series of forming dies will extend past the inner series, thereby necessitating an angular adjustment of the retaining link 19.

Bolts 21 passing through ears 22 formed on the foremost die blocks 10 and 16 at the inlet end of the device, and through slots 23 formed in the support or bed plate A, anchor the die blocks fixedly in place.

By substituting retaining links 18 of a different length from that shown, and suitably adjusting the bolts 21 in their slots 23, the path between the working faces of the respective series of die blocks may be regulated to conform to the thickness of the material operated upon.

And in order to adjust the series of forming dies to various curvilinear paths, as well as to maintain the forming members where adjusted, I provide the adjustable brace rods 24 and 25 connected at their outer ends fast to the first and last die blocks of the inner series, respectively.

The brace-rod 24 is slidable in an opening extending through a step 26 (see Fig. 4) securely mounted on the bed plate A and is held in adjusted position by means of split collars 27 (Fig. 1) encircling the brace rod 24 on opposite sides of the step and bearing against flattened faces 28 conveniently formed on the step, to prevent accidental movement of the brace rod in either direction relatively to the step.

By loosening the spilt collars 27 and the securing bolts 21, the brace rod 24 may be slid rectilinearly in opposite directions relatively to the step plate 26, to shift the inlet end of the bending device, and thereby vary the distance between the inlet end and the center of the step plate with a consequent variation in the curvilinear path between the two series of forming dies.

The brace rod 25 connected to the last die block of the inner forming member, passes through a cap plate 29 (Fig. 4) having a trunnion 30 seated in a bearing 31 formed in the step plate 26, the two brace rods intersecting the axis of the trunnion in different parallel planes.

Split collars 32 encircle the brace rod 25 and bear against flattened faces 33 on opposite sides of the cap plate to adjustably retain the brace rod and the discharge end of the bending device in set position.

Studs 34 pass through arcuate slots 35 in the cap plate to secure it to the step 26, and to afford a rotary adjustment for the cap plate and brace rod.

By loosening the studs 34 and the split collars 32, the position of the discharge end of the bending device may be varied by shifting the brace rod 25 relatively to the cap plate. Obviously a gage may be provided on the bed plate, or the brace rods may bear indications whereby to enable the operator to determine the proper positions to which the inlet and discharge ends of the device should be adjusted for any desired curvilinear form which is to be imparted to the work passing along the path outlined by the working faces of the two series of flexibly connected die blocks.

And to preserve such path free from kinks and maintain the working faces of the die blocks in alinement so that the walls of the path shall remain smooth and even, I preferably pass resilient rods 36 through each series of die blocks 10 and 16, as shown in Figs. 1 and 3, the rods being slidable in the blocks and sufficiently flexible to enable the series of die blocks to conform to any of their adjusted positions, and yet retain them

against offsetting, which would form irregularities in the path formed between the two series of die blocks.

The end of the material to be operated on may be inserted between the opposed working faces of the two foremost die blocks of the inner and outer series, and advanced along the path between such working faces, in any suitable manner.

As one means, however, for effecting the feed of the material through the bending die blocks, I provide a pinch bar or lever, including a bifurcated lower jaw 37 embracing an extension 38 of the anchoring ear 22 projecting from the foremost block of the inner series of die blocks. A pin 39 fulcrums the lower jaw to the ear. The operating face of this lower jaw has a cam surface 40 adapted to bite against the inner surface of the work, and the cam face may be recessed, as shown at 41 (Fig. 5) to accommodate itself to the cross-sectional configuration of the work.

An upper jaw 42, formed to embrace the cam face 40 of the lower jaw, is pivotally connected at 43 to the lower jaw, and the crotch between the forked ends of the upper jaw, is provided with a recess 44 to accommodate the work and at its forward end, with a slight clearance 45 (see Fig. 2).

The material to be fed through the machine is first passed between a pair of gage plates 46 adjustably secured on the table or bed plate A, and then is led between the upper and lower jaws 42, 37 of the feed lever, with the leading end of the material inserted between the two foremost die blocks 10 and 16.

The feed lever has been rocked forwardly to its dotted line position, Fig. 1, by means of the handle 47 in which the upper jaw terminates, to open the jaws for the reception of the work, after which the handle is rocked to the right (in the drawing) to first cause the jaws to bite upon the material, and then, when the material is gripped, to force it along the path between the opposed working faces of the two series of forming dies, and cause it to take the flexure or bend for which the forming dies have been adjusted.

By alternately swinging the lever forwardly and backwardly, the material is fed step by step between the working faces of the dies.

Rocking the lever forwardly (to the left in the drawings) swings the upper jaw 42 in an anti-clockwise direction on its pivot 43, to release the upper jaw from the work, the clearance 45 facilitating such release, and similarly swings the lower jaw 37.

By rocking the lever to the right, the lower jaw swings on its fulcrum 39 until it bites on the lower surface of the material, whereupon the upper jaw swings on its pivot 43 to grip the material and force it ahead.

It will be noted that, while passing through the machine, the flanges of the material being bent are inclosed in the recesses formed in the opposed working faces of the respective series of die blocks to prevent crimping.

Changes may be made in the form and arrangement of the several elements set forth without departing from the spirit and scope of this invention.

What I claim is:

1. In a bending machine, the combination with a support, of a plurality of adjustably connected sets of bending dies, the dies in each set being flexibly connected one to another and means for feeding the work between the said sets of dies.

2. In a bending machine, the combination with a support, of a plurality of flexible trains of connected bending dies spaced apart from each other to form a path therebetween, means to variously adjust the dies and hold them where adjusted, and means to feed the work along the path between the dies.

3. In a bending machine, the combination with a suitable support, of a plurality of substantially parallel lines of forming dies spaced apart from each other to leave a path to be traversed by the work, and means to force the work endwise along such path.

4. In a bending machine, the combination with a suitable support, of two co-acting sets of connected forming members adjustable to impart various curvilinear shapes to the material to be bent, and means to advance the material between the forming members.

5. In a bending machine, the combination with a suitable support; of a plurality of co-acting series of connected forming members, adjustable to impart various curvilinear shapes to the material to be bent, and means to advance the material between the respective series of forming members.

6. In a bending machine, the combination with a suitable support; of a plurality of flexible series of forming members, spaced apart relatively to form a curvilinear path traversed by the material to be bent, means to adjust the series of forming members to vary the curvature to be imparted to the material, and means to advance the material along the path between the forming members.

7. In a bending machine, the combination with a suitable support, of a plurality of series of forming members, the respective series being arranged substantially concentrically to delineate a path traversed by the material to be bent, and means to feed the material along such path between the

series of forming members, whereby the material is caused to assume a shape conforming to the curvature of the path.

8. In a bending machine, the combination with a suitable support, of a plurality of series of forming members, the respective series being arranged substantially concentrically to delineate a path traversed by the material to be bent, means to adjust the series of forming members, to vary the curvature of the path, and means to feed the material along such path between the series of forming members, whereby the material is caused to assume a shape conforming to the curvature of the path.

9. In a bending machine, the combination with a suitable support, of a plurality of series of forming dies arranged substantially concentrically, and relatively spaced to leave a path to be traversed by the material to be bent, the respective dies in each series being flexibly connected for adjustment, means to adjust the series of dies to vary the curvature of the path, the respective dies of each series being relatively articulated to enable their working faces to form unbroken opposed walls, and means to advance the material between such opposed walls.

10. In a bending machine, the combination with a suitable support, of a plurality of series of flexibly-connected forming dies arranged substantially concentrically, the working faces of the die members of the respective series of dies being opposed to form a path traversed by the material to be bent, said working faces being recessed to accommodate the cross-sectional shape of the material, means to adjust the series of forming dies to vary the curvilinear path, and means to advance the material along such path.

11. In a bending machine, the combination with a suitable support, of a plurality of series of forming dies, the individual die members constituting each series, being flexibly connected and relatively articulated to enable the series to assume a variety of curvilinear positions, the working faces of the respective series of forming dies being opposed to constitute walls outlining a path traversed by the material to be bent, means to adjust the series of forming dies to conform to one or another curvilinear position, and means to cause the material to traverse the path between the opposed working faces of the forming dies.

12. In a bending machine, the combination with a plurality of series of forming dies, the die members of each series arranged in tandem, means to flexibly connect the die members of each series, the working faces of the die members of each series being opposed to form a path traversed by the material to be bent, means to adjust the respective series of forming dies to a variety of curvilinear positions, flexible means to hold the die members of each series in proper relation to maintain their working faces in an even line, and cause them to present a smooth wall to the material; and means to force the material along such path.

13. In a bending machine, the combination with a suitable support, of a plurality of series of forming dies, the individual die members of each series being flexibly connected, the working faces of the dies in one series being opposed to the working faces of the dies in another series, to form a path traversed by the material to be bent, retaining means to connect the co-acting series of forming dies against separation, adjustable means to maintain the respective series of forming dies in any curvilinear position within the scope of adjustment, and means to force the material along the path between the working faces of the dies of the respective series.

14. In a bending machine, the combination with a suitable support, of a plurality of series of forming dies, the dies of each series consisting of individual articulated members, flexible rods passing through said individual members, and a member adapted to feed the work between the said series of dies.

15. In a bending machine, the combination of a suitable support, of a plurality of series of forming dies, the dies of each series consisting of individual articulated members, flexible rods connected to the innermost of said members, and passing through openings in the other members, and a member adapted to feed the work between the said series of dies.

In testimony whereof I, the said JAMES FARMER, have hereunto set my hand.

JAMES FARMER.

Witnesses:
ROBT. D. TOTTEN,
JOHN F. WILL.