F. W. McARDLE.

BENDING PRESS.

APPLICATION FILED OCT. 29, 1920.

1,424,366.

Patented Aug. 1, 1922.

3 SHEETS—SHEET 1.

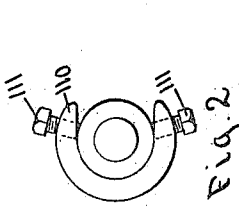


Fig. 2

Fig. 1

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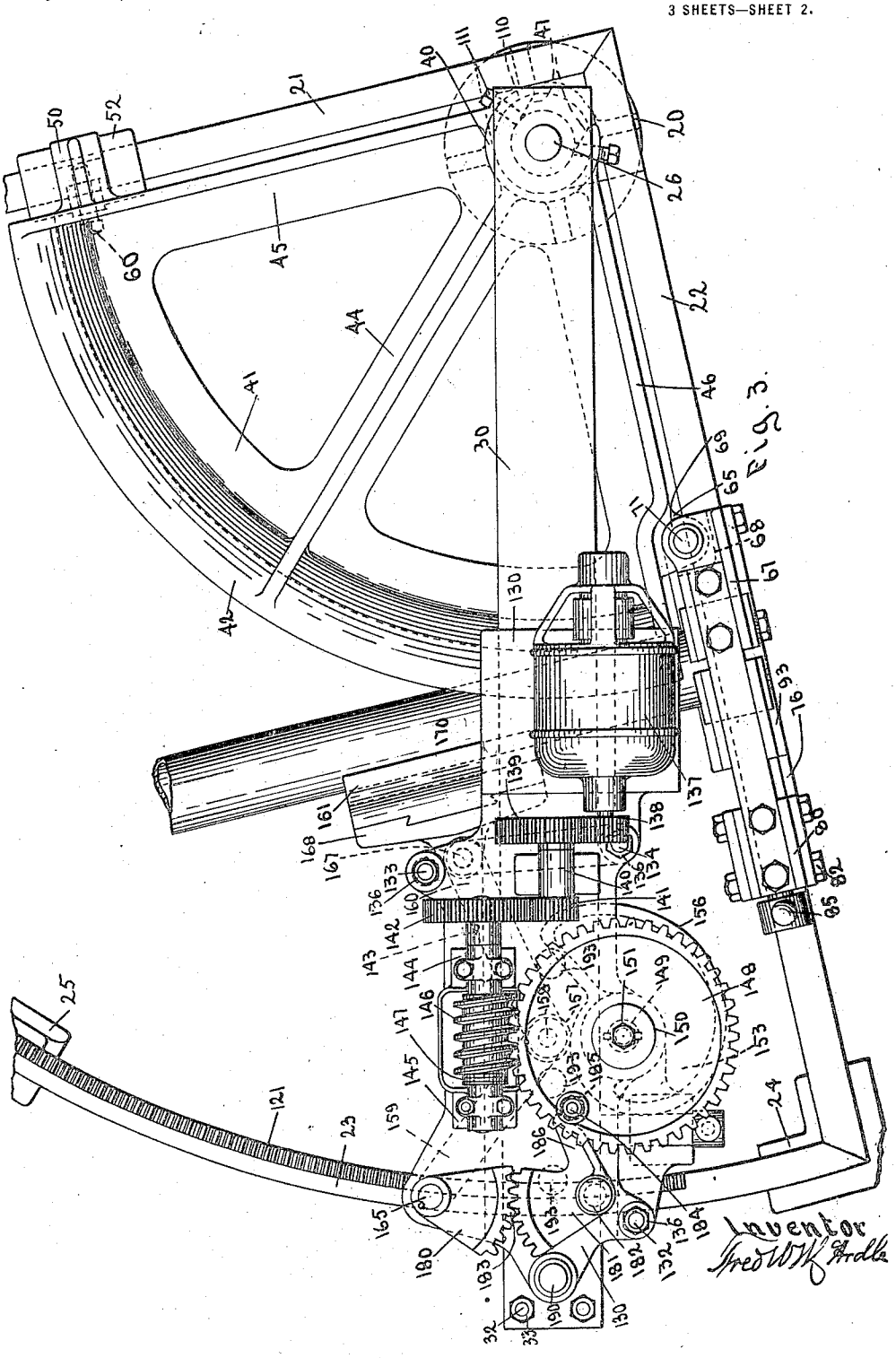


Fig. 3.

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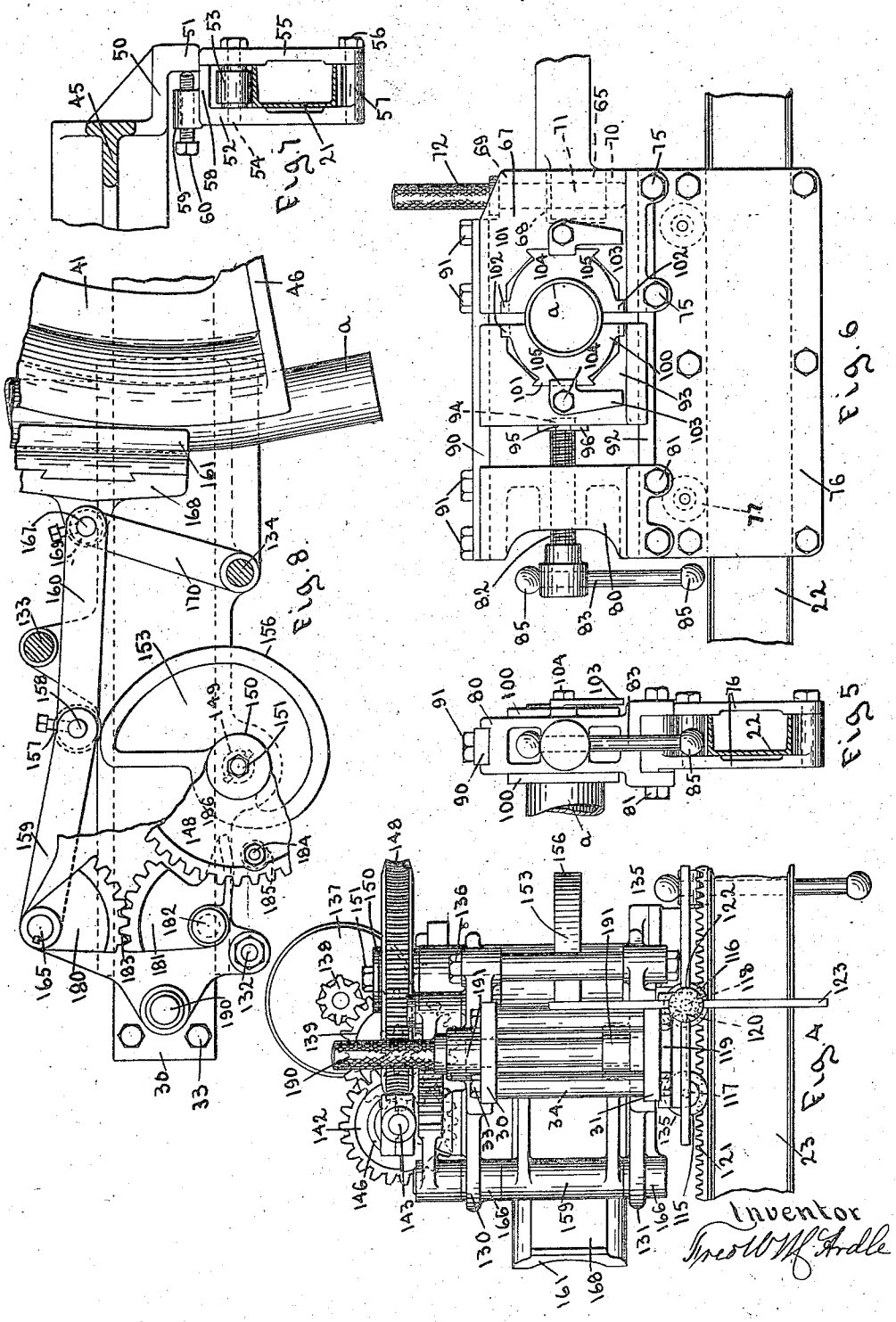
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3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

FRED W. McARDLE, OF BOSTON, MASSACHUSETTS.

BENDING PRESS.

1,424,366. Specification of Letters Patent. Patented Aug. 1, 1922.

Application filed October 29, 1920. Serial No. 420,520.

To all whom it may concern:

Be it known that I, FRED W. McARDLE, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Bending Presses, of which the following is a specification.

The object of my invention is to provide an improved machine for bending structural beams, bars, pipes and the like.

I am aware that the use of a segmental form with shoes coacting, is old in the arts, and that the method of bending step by step, is also old.

My invention consists in the novel construction and combination of well known elements, to accomplish my object economically. This, together with other features, will appear in the accompanying specifications and claims, and the drawings forming a part thereof. The drawings illustrate a preferred form of this invention, but other constructions and modifications may be used, without departing from the spirit and scope of the invention. In these drawings:—

Fig. 1 shows a side elevation of a machine embodying my invention.

Fig. 2 shows a clamp used in connection with the forming segments.

Fig. 3 shows a plan of the machine.

Fig. 4 shows an end view illustrating the carriage, carrying the bending mechanism.

Fig. 5 shows an end view of the holding clamp for a pipe, bar or beam.

Fig. 6 shows a side elevation of the same clamp.

Fig. 7 shows an end elevation of the forming segment support.

Fig. 8 shows a plan of the bending mechanism in extreme bending position.

In the drawings, 20 is a pedestal, 21—22 are side rails secured thereto, 23 is a rail segment, concentric with the post 26, which forms an integral part of the pedestal, 20.

Legs 24—25 form supports to which the outer ends of the rails 21—22, and the segment 23 are attached; the elements described forming a frame or bed to support the other parts of the machine, and to resist the reactions when the machine is operated. The bars 30—31, are journaled at one end, on the post 26, and near the other end are connected by means of the bolts 32 and nuts 33, the bushing 34 serving as a spacer for the bars. This construction forms a swinging arm, rotatable on the post 26, the bar 30 bearing on the shoulder portion 36 of the post 26, and the bar 31 resting on the top of the pedestal at 35, the members of the arm thus being parallel throughout their length. The bar 31 is bored sufficiently larger than the diameter of the post 26, to permit the use of a bushing 37, which projects through the bar for the purpose of supporting the hub 40 of the forming segment 41. The bushing 37 may be provided with the flange 38, to give a larger supporting surface for the hub, and in this case, sufficient clearance is allowed on the bottom of the flange to insure that the weight of the hub and segment shall not bear on the arm member 31, and thus interfere with the free rotation of the arm when the machine is operated. The segment 41, on which the pipe or structural shape is bent, consists of an outer rim 42, shaped to conform with the section of the shape or pipe as shown at 43.

Arms 44—45—46 connect this rim 42 with the hub 40, which is cut away at 47, to permit the ready removal of the forming segment, and the change to others of different radii or shape of forming groove. As these forming segments must be substantially rigid with the frame or base during the bending operation, means are provided to support and secure them rigidly in a predetermined relation to the pedestal and the frame, and a preferred method is shown in Figs. 3, 6, 7. The forming segment 41, is provided with a bracket 50 on the arm 45, which is formed with a downwardly extending rib 51, which is adapted to bear on the carriage 52. This carriage is mounted on the rail 21, and is provided with rolls 53 rotatable on the bolts 54, which also serve to secure the outside plate 55 to the main part of the carriage. Similar bolts 56 secure the plate below, the bosses 57 and the flange 58 serving to separate the plate and the carriage proper, to provide space for the rail 21, on which the carriage rides. A boss 59, extending upwardly from the flange 58, is tapped to receive the set screw 60, which is adapted to engage the inner side of the rib 51.

This secures the forming segment rigidly relative to the rail 21 and the carriage 52. Projecting outwardly from the arm 46, is a boss 65, through which extends the hole 66. This boss engages one member 67, of

a clamping device which is adapted to hold securely the pipe or bar which is to be bent. This member will hereafter be referred to as the rear clamp bracket.

This bracket is formed with a recess 68, into which the boss 65 extends, the upper wall of the recess 69, and the base of the bracket, at 70, being provided with holes adapted to align with the hole 66 in the boss 65. A coupling pin 71, through these holes, serves to secure the forming segment to the bracket 67, which in turn is supported by, and secured to a carriage 76.

This carriage is similar in character to the carriage 52, so far as mounting and general construction goes, but it is adapted to support the clamping device in addition to serving as a support for the forming segment. It is obvious that the forming segment secured as described is held substantially rigid, and yet may readily be released and replaced.

The rear clamp bracket 67 may be secured to the carriage in a variety of ways, and I have shown a satisfactory method, bolts 75 passing through ears formed on the bracket and through the carriage, to be fastened in place by nuts. This bracket is supplemented by a front bracket 80, secured to the carriage in a similar way as the rear bracket, by means of the bolts 81 and corresponding nuts. This bracket is tapped to receive the clamp screw 82, which is provided with a head, through which extends a hole in which the bar 83 is slidable.

This bar is provided with enlarged ends 85, which serve to limit the movement of the bar as it slides freely in the head 84. The brackets 67 and 80, secured to the carriage 76, are connected together, by the bar 90 which is rigidly secured to both by bolts 91. This bar, together with a flange 92, formed on the carriage 76, provide guides for a slidable clamp block 93, against the back of which, the clamp screw 82 bears. Near the end of this screw, it is grooved as shown at 95, and the projecting end 94 engages the bottom of a counterbore formed in the block 93, a plate 96, forked to fit into the groove 95, being fastened to the block, in order that the screw will act both to apply pressure to the block and to withdraw it, when turned in the other direction. The contiguous sides of the block 93 and the rear clamp bracket 67, are adapted to receive and hold the replaceable filler blocks 100, which may be secured in place in a variety of ways, but are here shown as engaging dovetailed recesses 101 formed in the block and in the bracket. These filling blocks shaped to conform with the pipe or structural section to be bent, are slid into engagement with the slidable block and the rear clamp block, projecting lugs 102 serving to limit the inward movement, as they abut the outer sides of the block and the bracket. Dogs 103, swiveled on the screws 104, are formed with projections 105, which swing out of the path of the filling blocks when they are slid into place, and which engage the backs of these blocks when the blocks are at the limit of their movement in the dovetailed recesses, the lugs 102 and the projection 105 on the dog 103, cooperating to secure the filler block 100 against movement lengthwise of the dovetailed recesses. In operating the machine, the block 93 together with its filler block, is retracted by the screw 82, permitting the insertion of the pipe or bar between the two filling blocks. The block 93 is then tightened on the pipe or bar which is thus held rigidly enclosed by the filling blocks 100. When secured in this way, the pipe or bar is in alignment with the groove in the forming segment 41, the part of the pipe or bar extending inwardly and adapted to conform to the groove in the segment as the operation progresses. Since the forming segment is secured, through the carriages 52 and 76 to the rails 21 and 22 and reacts on the post 26, it is held rigidly in position as the machine operates. It has been found that with some sections to be bent, the points of support for the forming segments are so disposed that they serve as fulcra, the preponderance in weight of the rim 41 tending to rotate the forming segment on these fulcra, and thus permit the formed groove to drop out of alignment with the axis of the pipe or structural shape. As it is advisable to leave a space between the bars 30 and 31, greater than the length of the hub 40, in order that the segments may be readily changed, the tendency noted is controlled by means of an open collar 110, which may be removed when the segments are changed, and which serves to hold the hub 40 down, the setscrews 111 securing the collar to the post 26 after the former is in place. It is obvious that other well known methods may be used to accomplish this purpose although this is a preferred form.

In this form of the invention, the bending mechanism is mounted on a carriage which is slidable on the swinging arm formed by the bars 30—31 and spacers 34, and this will be presently described. As above noted, the swinging arm is rotatable about the post 26, and the forming segment is concentric with the axis thereof, as is also the frame member 23. This member 23, serves not only as a part of the frame of the machine, but also, on its top surface, as a track on which the rollers 115—116 may ride. These rollers are secured respectively to the shafts 117—118 journaled in the truck 119, secured to the bar 31, of the swing arm, near its outer end, and which serves to support the weight of the outer end of the swinging arm and the weight of the mechanism carried thereby. Secured to the shaft 118, is a pinion 120, adapted to engage the segmental rack 121,

secured to the frame member 23, concentric with the axis of the post 26. The shaft 118 is extended outwardly to clear the end of the swinging arm, and secured to the outer end of this shaft is the hub 122, from which project the radial arms 123. By means of this construction, the swinging arm may be readily rotated in either direction about the post 26, to adjust the bending mechanism carried by the swinging arm to the radial position required for a bending operation. In machines for heavy service, a similar construction may be used to move the clamp carriage, but ordinarily it is unnecessary as the rollers 77 riding on the rail 22, permit the clamp carriage to be readily moved along the rail.

The bending mechanism is mounted on a carriage, slidable on the swinging arm, and this will hereafter be designated as the bending carriage. In this form of the invention, the bending carriage is constructed as follows:—A top plate 130, and a bottom plate 131, both with suitable projections adapted to support the mechanism required, are connected by spacer studs 132—133—134, the nuts 135—136 serving to secure the studs and plates together in a rigid construction. As here shown, the mechanism is operated by an electric motor 137, the pinion 138 being rigidly secured to the motor shaft, and meshing with the gear 139, on one end of an intermediate shaft with a bearing in the stand 140, secured to the top plate 130. Secured to the other end of the intermediate shaft is the pinion 141 meshing with the gear 142, secured to one end of the worm shaft 143.

It is obvious that the motor and gearing may be replaced by a belt driven worm shaft, the gear 142 being replaced by a pulley from which a belt may lead to a source of power. The worm shaft 143, is journalled at 144—145 and between these bearings, the worm 146 is rigidly secured to the shaft 143, a suitable thrust bearing 147, serving to reduce the end friction due to the reaction of the worm meshing with the worm gear 148. This worm gear is rigidly secured to one end of a shaft 149, a plate 150 secured by the bolt 151, tapped into the end of the shaft 149, providing added assurance against end movement, in case of loosened keys. The shaft 149 is journaled at 152 in the top plate and the bottom plate, and between these bearings, the cam 153 is keyed to the shaft 149, a pin 154, passing through the hub of the cam and the shaft, serving to prevent any upward movement of the shaft. It has been found advisable to use this form of construction on account of the practical difficulty in assembling the cam when a long key is used, but other ways for rigidly securing the worm gear and the cam may be used. The key in the cam and shaft is therefore depended upon to insure rotation of the cam and the pin to prevent possible end movement of the shaft in the hub of the cam as the worm gear is rotated by the worm, the action of which tends to lift the gear and shaft attached. This tendency causes a reaction between the top of the cam hub and the upper bearing 152, and to reduce the friction, the thrust bearing 155 is introduced between. The worm may be made left hand instead of right, and the gear made to correspond, in which case the reaction would be downward on the upper bearing 152, and in that case the thrust bearing 155 would be introduced between the bottom of the gear hub and the top of the upper bearing 152; the form illustrated and described is, however the preferred form. As the cam is rotated by the means described, the periphery 156 engages a roller 157, journaled on a shaft 158, which forms a hinge pin connecting the links 159 and 160, which constitute a toggle joint for the purpose of operating the bending shoe 161. These links, together with the shoe, are disposed in the following manner:—The link 159 is rigidly secured to a shaft 165, rotatably mounted in bearings 166 formed in both top and bottom carriage plates 130 and 131. The pin 158 connects the other end of the link 159, and the link 160, and serves as a hinge. The other end of the link 160 is hinged to the shoe holder 168 by the pin 167, rigidly held in a boss 169 formed on one end of a radius lever 170, journaled on the spacer stud 134. The hub of this radius lever is formed to extend between the carriage plates 130 and 131, and serve as a spacer, thus spacing the plates at 132, 133 and 134, and forming a rigid carriage on which the mechanism for bending, is mounted. Rigidly secured to the top of the shaft 165, is the segment 180 adapted to engage another segment 181, journaled on a stud 182, projecting from the top plate 130 of the carriage. Preferably engagement of the two segments is accomplished by intermeshing teeth 183, but it is obvious that the object may be attained by other commonly known mechanical means. A stud 184, projecting from the worm wheel 148, forms a journal for the friction roller 185, which is adapted to engage an arm 186, which extends laterally from the segment 181. As the worm wheel 148 is rotated, together with the cam 156, the periphery of the cam engages the roller 157, and the toggle joint above described, is straightened, which in turn causes the bending shoe to engage the pipe or bar to be bent about the forming segment 41; as the rotation of the worm gear and cam continues, the arm 186 is engaged by the roller 185, and the segment 181 is rotated on its bearing stud 182. Through the intermeshing teeth, the segment lever 180 is rotated, and the shaft to which it is at-

tached; the link 159, rotating with the shaft, acts to retract the shoe from its extreme bending position, and the swinging arm may be moved to a new position, preliminary to another bending cycle. I do not confine myself to this method for retracting the shoe, but may use other means for oscillating the link 159, for this purpose. As it is desirable to use forming segments of different shapes in the forming groove, and of different radii of bend, it is necessary that the carriage supporting the bending mechanism, be adjustable on the swinging arm, relative to the post 26. As the position of the carriage on the swinging arm is predetermined for any forming segment by its radius and sectional shape to be bent, the carriage may be anchored radially for any segment, by means of an anchor stud 190 which passes through aligned holes in the carriage plates 130—131 and plates 30—31 of the swinging arm, strengthening bosses being formed on the carriage plates.

A series of holes corresponding to the forming segments used, are provided in the swinging arm plates as indicated at 193.

In operating the machine, the proper forming segment is slid into place the hub engaging the post 26, and the supporting carriage and the clamp carriage secured to the segment as described. Collar 110 is then adjusted to bear on the top of the hub 40. With the carriage on the swinging arm anchored in the predetermined position for the segment used, and the swinging arm in a radial position near the clamp carriage, the motor is started, and through the mechanism above described, the pipe or bar is bent, to an extent depending on the position of the swinging arm radially. The continued rotation of the operating mechanism retracts the shoe, and during this interval in the cycle of bending, the swinging arm is moved to a new radial position relative to the post 26, preparatory to another bending operation. This proceeding is continued until the proper angle of bend in the pipe or bar is obtained.

It is obvious, that while no connections to the motor are shown wiring and switches may be used which are commonly used in similar cases, starting, stopping and reversing of the motor all being possible with apparatus commercially obtainable.

Having thus described my invention, I claim:—

1. In a bending press, the combination of a rigid former; a shoe adapted to coact therewith; a lever swivelled at one end to the shoe and at the other rotatable on a fixed axis; a link, hinged at one end to the shoe, and at its other end to a lever rotatable about a fixed axis; a rotatable cam, adapted to engage the hinge connecting the lever and link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; and means for rotating the cam, as and for the purpose described.

2. In a bending press, the combination of a rigid former; a shoe adapted to coact therewith; a lever swivelled at one end to the shoe and at the other rotatable on a fixed axis; a link, hinged at one end to the shoe, and at its other end to a lever rotatable about a fixed axis; a rotatable cam, adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; and means for rotating the cam, as and for the purpose described.

3. In a bending press, the combination of a rigid former; a carriage relatively adjustable therewith; a lever swivelled at one end to the shoe and at the other rotatable on an axis fixed relative to the carriage; a shoe adapted to coact with the former; a link, hinged at one end to the shoe, and at its other end to a lever, rotatable on an axis, fixed relative to the carriage; a cam rotatably mounted on the carriage and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; and means for rotating the cam, as and for the purpose described.

4. In a bending press, the combination of a rigid former; a carriage relatively adjustable therewith; a shoe, mounted on the carriage; means for controlling the movement of the shoe in a predetermined path in the direction of the former, for the purpose of coacting therewith; a link, hinged at one end to the shoe, and at its other end to a lever, rotatable on an axis, fixed relative to the carriage; a cam rotatably mounted on the carriage and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; and means for rotating the cam, as and for the purpose described.

5. In a bending press, the combination of a rigid former; a carriage relatively adjustable therewith; a shoe adapted to coact with the former; a lever swivelled at one end to the shoe, and at the other rotatable on a fixed axis; a link hinged at one end to the shoe and at its other end to a lever rotatable about a fixed axis; a cam rotatably mounted on the carriage and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact

with the former; and means for rotating the cam, as and for the purpose described.

6. A bending press, comprising a base; a post rigid therewith; interchangeable forming segments rigidly supported on the base, and substantially concentric with the axis of the post; an arm adapted to swing about the axis of the post; a carriage mounted on the arm and adapted to be secured thereto in different positions longitudinal of the arm; a shoe adapted to coact with the forming segment, and swiveled at one end to a lever rotatable at its other end on an axis fixed relative to the carriage; a link, hinged at one end to the shoe, and at its other end to a lever, rotatable on an axis, fixed relative to the carriage; a cam rotatably mounted on the carriage and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; and means for rotating the cam, as and for the purpose described.

7. In a bending press the combination of a rigid former; a carriage relatively adjustable therewith; a shoe holder; interchangeable shoes adapted to be secured thereto; a lever swiveled to the shoe holder, and rotatably mounted on the carriage; a link, hinged at one end to the shoe holder, and at its other end to a lever, rotatably mounted on the carriage; a cam rotatably mounted on the carriage and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; and means for rotating the cam, as and for the purpose described.

8. A bending press comprising a base; a post rigid therewith; interchangeable forming segments rigidly supported on the base, and substantially concentric with the axis of the post; a clamping device, supported by the base, and radially adjustable relative to the post, for the purpose of holding the pipe or bar to be bent in fixed relation to the forming segment; an arm adapted to swing about the axis of the post; a carriage mounted on the arm and adapted to be secured thereto in different positions longitudinal of the arm; a shoe adapted to coact with the forming segment, and swiveled to a lever rotatably mounted on the carriage; a link, hinged at one end to the shoe, and at its other end to a lever, rotatable on an axis, fixed relative to the carriage; a cam rotatably mounted on the carriage, and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the forming segment; and means for rotating the cam, as and for the purpose described.

9. A bending press comprising a base; a post rigid therewith; a clamping device supported by the base and radially adjustable relative to the post; interchangeable forming segments, substantially concentric with the axis of the post; means for securing the clamping device to the forming segment for the purpose of holding the pipe or bar to be bent in fixed relation to the forming segment; an arm adapted to swing about the axis of the post; a carriage mounted on the arm and adapted to be secured thereto in different positions longitudinal of the arm; a shoe adapted to coact with the forming segment, and swiveled to a lever rotatably mounted on the carriage; a link, hinged at one end to the shoe, and at its other end to a lever, rotatable on an axis, fixed relative to the carriage; a cam rotatably mounted on the carriage, and adapted to engage a friction roller journalled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the forming segment; and means for rotating the cam, as and for the purpose described.

10. A bending press comprising a base; a post rigid therewith; a clamping device comprising a carriage radially adjustable relative to the post; an extension from the carriage, adapted to coact with a block movably supported on the carriage, for the purpose of securely holding the pipe or bar to be bent; interchangeable forming segments, substantially concentric with the axis of the post; means for securing the clamping device to the forming segment in a fixed relation thereto; means for rigidly holding the pipe or bar between the extension and the movable block of the clamping device; an arm adapted to swing about the axis of the post; a carriage mounted on the arm and adapted to be secured thereto in different positions longitudinal of the arm; a shoe adapted to coact with the forming segment, and swiveled to a lever, rotatably mounted on the carriage; a link, hinged at one end to the shoe, and at its other end to a lever, rotatably mounted on the carriage; a cam rotatably mounted on the carriage, and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the forming segment; and means for rotating the cam, as and for the purpose described.

11. A bending press comprising a base; a post rigid therewith; a clamping device comprising a carriage, radially adjustable rela-

tive to the post; an extension from the carriage, adapted to coact with a block movably supported on the carriage, both the extension from the carriage, and the block being adapted to engage interchangeable shoes formed to hold the pipe or bar to be bent; interchangeable forming segments, substantially concentric with the axis of the post; means for securing the clamping device to the forming segment, in fixed relation thereto; means for rigidly holding the pipe or bar between the shoes engaged by the extension from the carriage and the block, of the clamping device; an arm adapted to swing about the axis of the post; a carriage mounted on the arm and adapted to be secured thereto in different positions longitudinal of the arm; a shoe adapted to coact with the forming segment, and swiveled to a lever, rotatably mounted on the carriage; a link, hinged at one end to the shoe, and at the other end to a lever, rotatably mounted on the carriage; a cam rotatably mounted on the carriage, and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the forming segment; and means for rotating the cam, as and for the purpose described.

12. A bending press comprising a base; a post rigid therewith; interchangeable forming segments substantially concentric with the axis of the post, and adapted to engage it; supports adjustably secured to the base; means for securing the forming segments to the support and to the post, for the purpose of holding the segments in a fixed position; an arm adapted to swing about the axis of the post; a carriage mounted on the arm and adapted to be secured thereto in different positions longitudinal of the arm; a shoe adapted to coact with the forming segment, and swiveled to a lever, rotatably mounted on the carriage; a link, hinged at one end to the shoe, and at the other end to a lever, rotatably mounted on the carriage; a cam rotatably mounted on the carriage, and adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the forming segment; and means for rotating the cam, as and for the purpose described.

13. In a bending press, the combination of a rigid former; a shoe adapted to coact therewith; a lever swivelled at one end to the shoe and at the other end rotatable on a fixed axis; a link, hinged at one end to the shoe, and at its other end to a lever rotatable about a fixed axis; a rotatable cam, adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; means for retracting the shoe from the former; and means for rotating the cam, as and for the purpose described.

14. In a bending press, the combination of a rigid former; a shoe adapted to coact therewith; a lever swivelled at one end to the shoe, and at the other end rotatable on a fixed axis; a link, hinged at one end to the shoe, and at its other end to a lever rotatable about a fixed axis; a rotatable cam, adapted to engage a friction roller journaled on the hinge pin connecting the lever and the link, for the purpose of rotating the lever, and thereby, through the link, causing the shoe to coact with the former; means, rotatable with the cam for causing the retraction of the shoe from the former; and means for rotating the cam, as and for the purpose described.

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