I. W. HOOVER.

METAL BENDING MACHINE.

APPLICATION FILED APR. 28, 1909.

986,713. Patented Mar. 14, 1911.

3 SHEETS—SHEET 1.

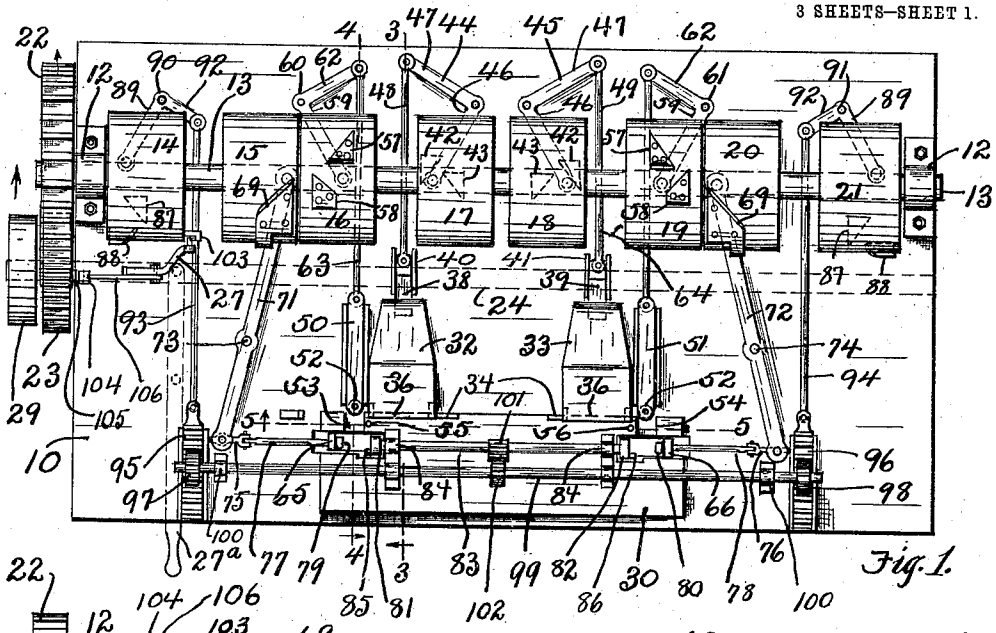

Fig. 1.

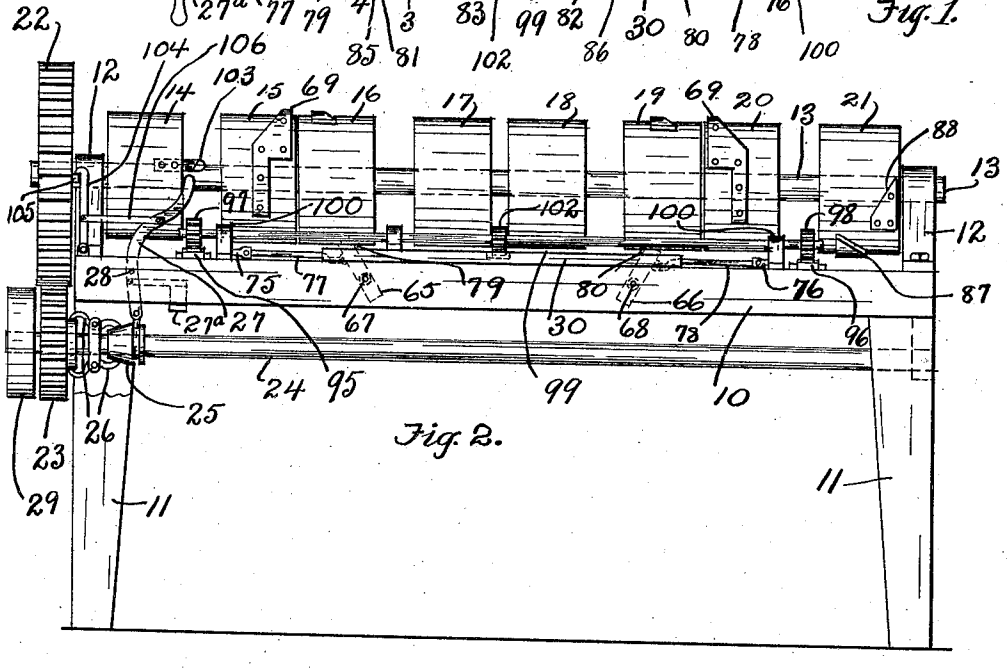

Fig. 2.

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3 SHEETS—SHEET 2.

Fig. 3.

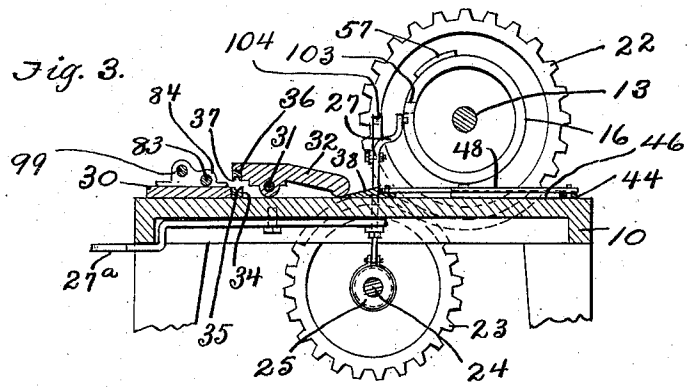


Fig. 4.

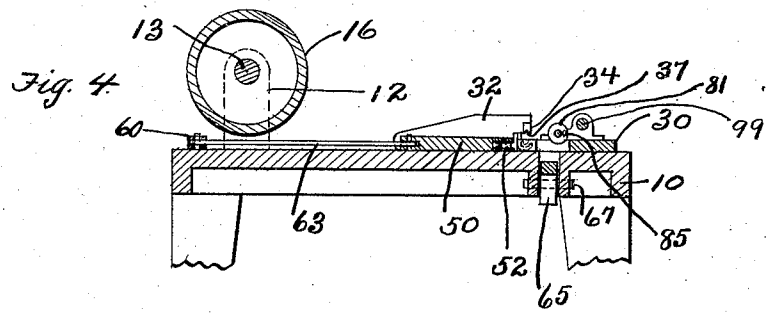
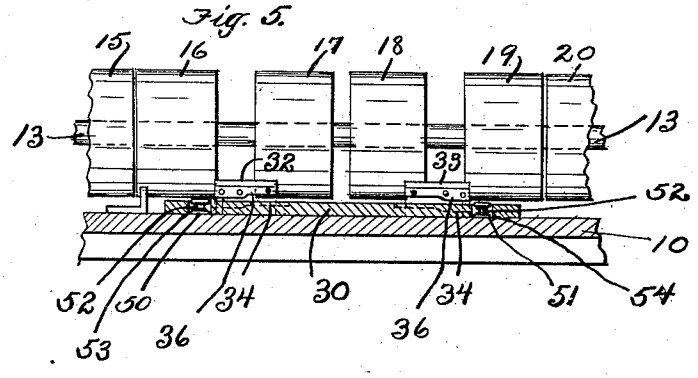


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 6.

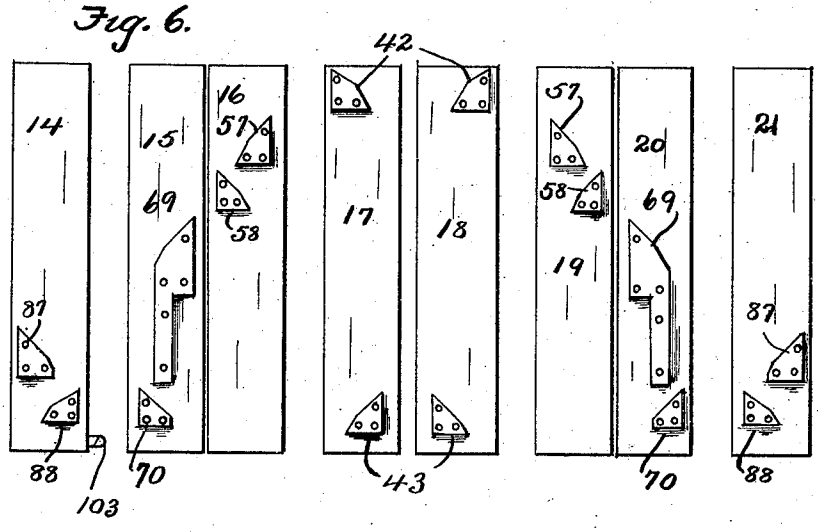

Fig. 7.

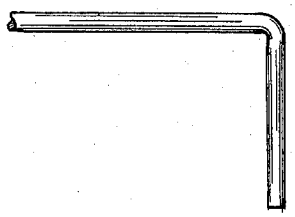

Fig. 8.

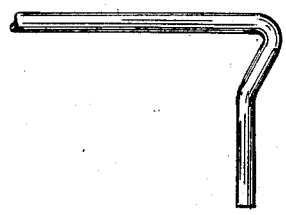

Fig. 9.

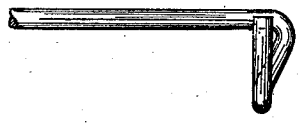

Fig. 10.

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UNITED STATES PATENT OFFICE.

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METAL-BENDING MACHINE.

986,713. Specification of Letters Patent. Patented Mar. 14, 1911.

Application filed April 28, 1909. Serial No. 492,751.

To all whom it may concern:

Be it known that I, ISAAC W. HOOVER, a citizen of the United States of America, residing at Avery, in the county of Erie and State of Ohio, have invented certain new and useful Improvements in Metal-Bending Machines; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to improvements in metal bending machines and particularly to those machines which automatically and successively perform several bending operations on the same metal stock.

The object of the invention is the provision of a machine which will receive and grip a rod, will thence quickly and effectively perform the necessary bending operations to produce an article or bar of the desired shape, and will again restore all the parts to the normal or initial positions so as to be capable of receiving another rod and of immediately repeating the cycle of operations.

The machine constructed in accordance with the present invention is intended particularly for forming from straight rods previously cut to the proper length, cross bars for endless conveyers, said cross bars having at their ends integral links or loops of a peculiar shape requiring several bending operations. The machine and particularly some of the novel features thereof may however be used for bending metal stock for other purposes and into different shapes, than that mentioned above.

The machine shown in the accompanying drawings and to be described presently in detail is of the semi-automatic type to the extent that the rods are fed by hand and the machine is started by hand prior to each series of bending operations, but after the machine receives a rod and is once started, the remaining operations are entirely automatic.

In the preferred embodiment of my invention, the machine is provided with a horizontal table or bed plate and on this table are arranged one or more clamping or gripping devices adapted to hold the stock or the rod when the bending operations are being carried out, and a plurality of bending devices arranged to bend the ends of the rod to cause the stock to assume the shape desired. All these members are actuated by suitable operating mechanism including properly arranged and properly shaped cams secured preferably to the surfaces of cylindrical drums or wheels which are mounted upon a shaft extending over the top of the table, which shaft, after having been started, will cause the various members to be actuated and will then be automatically stopped.

As will be explained presently, after the rod is gripped by the clamping devices, the machine performs three distinct bending operations upon each end of the rod. The ends of the rods are first bent laterally at substantially right-angles to the axis of the rod, by two longitudinally movable plungers which are actuated simultaneously, thence these laterally bent end portions are offset or bent in a direction of the axis of the rod by pivoted bending blocks, and thence the ends of the offset portions are bent or doubled so as to complete the links or loops, by means of rotating bending heads.

The invention may be further briefly summarized as consisting in certain novel details of construction and combinations and arrangements of parts which will be described in the specification and set forth in the appended claims.

For a better understanding of my invention, reference is had to the accompanying sheets of drawings, in which—

Figure 1 is a top or plan view of the metal bending machine constructed in accordance with my invention. Fig. 2 is a front elevation of the same. Fig. 3 is a transverse section taken substantially along the line 3—3, of Fig. 1, looking in the direction indicated by the arrow, and showing in detail the parts of the stock gripping or clamping mechanism. Fig. 4 is a transverse section substantially along the line 4—4, Fig. 1, looking in the direction indicated by the arrow, and showing in detail one of the plungers which performs the first bending operation on one end of the rod, and showing also part of the mechanism which performs the last bending operation upon the end of the rod. Fig. 5 is a partial longitudinal section substantially along the line 5—5, Fig. 1, showing particularly one of the pivoted or

swinging bending blocks which performs the second bending operation upon the end of the rod. Fig. 6 is a plan or development of the surfaces of the cam-carrying drums and showing the location and shapes of the various cams. Fig. 7 is a view of one end of the rod after having been acted upon by the first bending device. Fig. 8 is a similar view of a rod after having been acted upon by the second bending device. Fig. 9 is a similar view after having been acted upon by the third and last bending device. Fig. 10 is an end view of the article shown in Fig. 9.

Referring to the figures of the drawings, 10 represents the horizontal table which supports the mechanism of the bending machine and which consists preferably of a heavy metal plate supported on suitable legs 11. Extending horizontally over the table near the rear part thereof, and supported in suitable bearings 12 is a shaft 13 to which is secured eight cam-carrying drums or wheels designated respectively, 14, 15, 16, 17, 18, 19, 20 and 21. As will be explained presently the two drums 17 and 18 which are located on opposite sides of the center line of the table operate the rod or stock gripping or clamping mechanism; the drums 16 and 19 which are located next or adjacent to two drums 17 and 18 operate the plungers which perform the first bending operation; the drums 15 and 20 which are located next or adjacent to the drums 16 and 19, operate the mechanism for performing the second bending operation; and the two extreme drums 14 and 21 operate the mechanism which performs the third bending operation and the drum 14 also serves to break the driving connection between the shaft 13 and the power shaft after the last bending operations have been performed. At one end of the shaft 13 is secured a gear 22 which engages a gear 23 which is normally loose upon a shaft 24 supported by the table below the lower surface of the same, said gear being designed to be connected to the shaft 24 by suitable clutch mechanism which, as here shown, includes a spreading cone 25, clutch dogs 26, and an operating arm 27 which is pivoted at 28 to the table and has its lower end engaging the spreading cone and has its upper end projecting above the top of the table adjacent to the drum 14. The clutch may be operated manually by a lever 27^a connected to the arm 27 and projecting beyond the front of the table. The shaft 24 also has secured thereto a pulley 29 which is adapted to be engaged by a driving belt.

Secured to the upper surface of the table near the front thereof is a horizontal plate 30, the purpose of which will be explained presently. Pivotally mounted on the top of the table by means of separate transverse pins 31 are two gripping or clamping blocks 32 and 33 which, as will be explained, are designed to hold and clamp the rod or stock while the various bending operations are performed on the ends thereof. These two blocks 32 and 33 are located on opposite sides of the center of the table with their forward ends adjacent the rear edge of the plate 30 and are so constructed that the portion of the blocks at the rear of the pins have sufficient weight to cause the rear ends to be down and the front ends to be normally above or out of engagement with the rear portion of the horizontal plate 30, but when the rear ends of the block are forced upward the forward ends will be tipped downward so as to grip the rod. The rod is designed to be held between clamping dies or members 34, each having a substantially semi-cylindrical groove 35 (see Fig. 3) on its upper face, and dies or members 36 which are carried by the forward ends of the clamping blocks and are provided on their lower faces with substantially semi-cylindrical grooves 37 (see Fig. 3) which are located directly above and register with the grooves 35 in the lower clamping members 34 when the forward ends of the clamping blocks are tipped downward.

To cause the blocks 32 and 33 to grip or hold the rod when the latter is placed by hand or other means in the grooves 35 of the dies 34, and to hold the rod while the various bending operations are performed, I provide two wedge-shaped members 38 and 39 adapted to be inserted under the rear ends of the blocks 32 and 33 respectively so as to force the forward ends of the blocks downward. These wedges 38 and 39 which are arranged to slide transversely of the table toward and away from the blocks 32 and 33 and which are guided in their movements by suitable members 40 and 41, are actuated in the following manner:—Upon the periphery of each of the drums 17 and 18 are secured two cams 42 and 43 shown by dotted lines in Fig. 1 and by full lines in Fig. 6, the two cams on each drum being located adjacent each other. Pivoted on the top of the table and, in this case, just at the rear of the drums 17 and 18 and below the same are two bell-crank levers 44 and 45, each having an arm 46 which projects under the corresponding drums 17 or 18 and is provided with a friction roller adapted to be engaged by the faces of the two cams in a manner to be described and each bell-crank having an arm 47 projecting at substantially right-angles to the first-mentioned arm and extending to the rear of the corresponding drum, the free end of each of these arms 47 being at the rear of the corresponding wedge 38 and 39. The free ends of the arms 47 of the bell-crank levers 44 and 45 are connected to the wedges 38 and 39 respectively by means of two arms or

links 48 and 49. The cams 42 and 43 on each of the drums 17 and 18 are so arranged that when the shaft is rotated in the direction indicated by the arrow at the left of the gear wheel 22, or in a counter clockwise direction when viewed from the left of Fig. 1, the cams 42 will cause the arms 46 of the bell-crank levers to be swung toward each other, causing the free ends of the arms 47 of the two bell-crank levers to be moved forwardly and causing the links 48 and 49 to be moved forwardly and the wedges 38 and 39 to be forced under the clamping blocks 32 and 33. These wedges will remain in this position while the different bending operations are taking place and until the shaft makes almost a complete revolution when the wedges will again be withdrawn by the cams 43 which engage the rollers on the arms 46 of the bell-crank levers 44 and 45 causing the links 48 and 49 and wedges 38 and 39 to be moved rearwardly. It is to be noted that with the present construction of the clamping mechanism the portions of the rod which are gripped between the members 34 and 36 carried by the horizontal plate 30 and the bending blocks 32 and 33 respectively will be offset slightly with respect to the middle portion of the rod since the grooves in the members 34 extend a slight distance below the upper face of the horizontal plate 30 upon which the middle portion of the rod rests. This may be varied, however, so that the portions of the rods which are clamped are not offset.

Immediately after the rod is clamped by the mechanism just described, the ends of the rod are bent laterally or forwardly at right-angles to the axis of the rod by mechanism which will now be explained. This first bending operation is given to the ends of the rods by two plungers 50 and 51 located respectively adjacent the clamping blocks 32 and 33, each plunger having at its forward end a friction roller 52 (see Fig. 4). These plungers are adapted to be reciprocated or moved forwardly into slots 53 and 54 in the plate 30 and thence rearwardly, and when moved forwardly the rollers engage the ends of the rod and bend the same forwardly about two stationary upwardly projecting pins 55 and 56 located respectively near the outer corners of the two clamping blocks and adjacent the slots 53 and 54 into which the forward ends of the plungers enter. These plungers 50 and 51 are simultaneously reciprocated by the following mechanism:—Upon each of the drums 16 and 19 are located two cams 57 and 58 which are adapted to engage rollers on the free ends of arms 59 of bell-crank levers 60 and 61 respectively. These bell-crank levers being pivoted also on the top of the table and having arms 62 which project at right-angles to the arms 59, the free ends of the arms 62 being connected respectively by links 63 and 64 to the upper ends of the plungers 50 and 51. The cams 57 and 58 are so shaped and arranged on the drums 16 and 19 that immediately after the rod is clamped by the blocks 32 and 33 the cams 57 will engage the rollers on the bell-crank levers 60 and 61 shifting the latter and causing the links and plungers 50 and 51 to be moved forwardly, bending the ends of the rod at right-angles to the axis of the rod, and immediately after this is accomplished, the cams 58 will engage the rollers of the bell-crank levers causing the plungers 50 and 51 to be retracted or moved rearwardly to the position shown in Fig. 1.

As soon as the plungers 50 and 51 are retracted the laterally bent ends of the rod are offset or bent inwardly as shown in Fig. 8. This second bending or offsetting of the laterally bent ends of the rod is accomplished by two bending blocks 65 and 66 which are pivoted respectively on pins or bolts 67 and 68 as shown clearly in Fig. 2, and these bending blocks are simultaneously swung inwardly toward each other by the following mechanism,—Two cams 69 and 70 are arranged on the periphery of each of the drums 15 and 20, and these sets of cams are arranged to engage rollers mounted upon the rear ends of levers 71 and 72 which are pivoted intermediate their ends at 73 and 74, the rear ends of the levers being directly below the drums 15 and 20 respectively, and the forward ends being substantially in line with the bending blocks 65 and 66. The forward ends of the levers 71 and 72 are connected to the bending blocks by means of short links 75 and 76 which are pivoted to the ends of the two levers respectively and by two links 77 and 78 which are pivotally connected to the ends of the links 75 and 76 and to the bending blocks 65 and 66. The cams 69 and 70 on each of the drums 15 and 20 are so located and shaped that immediately after the retraction of the plungers 50 and 51, the cams 69 will engage the rollers on the ends of the levers 71 and 72 causing the levers 71 and 72 to be shifted and swinging the two bending blocks 65 and 66 inward so as to bend or offset the ends of the rod which, as was explained before, have already been bent laterally. The bending blocks are not retracted or swung back to the position shown in Fig. 1 until after the third bending operation is given to the ends of the rod. The cams 69 have rather long shanks which hold the levers 71 and 72 and the bending blocks in their forward positions until after the next bending operation takes place, and then the cams 70 engage the rollers on the ends of the levers 71 and 72 and shift the levers and the bending blocks 65 and 66 to the position shown in Fig. 1. The

two bending blocks have on their forward faces respectively pins 79 and 80, and the ends of the rods engage the bending blocks just below these pins, the free ends of the rod projecting forwardly beyond the pins before the third bending operation begins.

When the bending blocks and the pins 79 and 80 are in the position just described the free ends of the rod are then bent or doubled rearwardly over these pins 79 and 80 so as to form practically loops as is shown in Fig. 9, and this last bending is accomplished by means of rotating bending heads 81 and 82 on opposite ends of a shaft 83 mounted in suitable bearings 84 upon the upper face of the plate 30. These heads are provided with outwardly projecting pins having friction rollers 85 and 86 and these rollers are adapted to engage the free ends of the rod and to bend said ends upwardly and rearwardly when the shaft 83 is rotated. This shaft 83 is rotated by the following mechanism;—The drums 14 and 21 are each provided with two cams 87 and 88, the former being adapted to rotate the shaft 83 in one direction and the latter to rotate it in the opposite direction. These cams are adapted to engage rollers on the free ends of arms 89 of bell-crank levers 90 and 91 which are pivoted upon the top of the table 10 and these bell-crank levers have arms 92 which are at right-angles to the arms 89, and are connected by links 93 and 94 respectively to two racks 95 and 96 which engage pinions 97 and 98 secured to the ends of a shaft 99 which is parallel to the shaft 83 and is supported in suitable bearings 100 on the top of the table 10 and plate 30. The shaft 99 is connected to the shaft 83 by two gear segments 101 and 102, the former being secured to shaft 90, each segment being substantially a half gear. The cams are so arranged on the drums 14 and 21 and so shaped that as soon as the second bending operation is completed and while the bending blocks are in their forward positions, the cams 87 will engage the rollers of bell-crank levers 90 and 91 causing the bell-crank levers to be shifted and drawing the links 93 and racks 95 and 96 rearwardly, rotating the shafts 90 and 83 and causing the rollers carried by the bending heads 81 and 82 to perform the last or final bending operation. Immediately after the rollers on the bell-crank levers leave the cams 87 they are engaged by the cams 88 causing the links and racks to be moved forwardly and the shaft 90 and 83 to be rotated in the reverse directions. Simultaneous with or immediately after the last-mentioned movements of the racks 95 and 96 the friction rollers on the levers 71 and 72 will be engaged by the cams 70 causing the levers 71 and 72 and the bending blocks 65 and 66 to be restored to their normal positions. After these last-mentioned operations take place, the rod is now released from the clamp or rather the forward ends of the clamping blocks 32 and 33 are permitted to rise by means of the cams 43 on the drums 17 and 18 engaging the rollers on the bell-crank levers 44 and 45 and causing said levers to be shifted and the wedges 38 and 39 to be retracted or moved rearwardly.

Immediately after the wedges 38 and 39 are retracted the machine is stopped or rather the driving connection between the shaft 24 and the shaft 13 is broken by means of a cam-shaped lug 103 which projects laterally from the drum 14, said lug 103 engaging the upper end of a clutch lever 27 and causing the clutch cone 25 to be shifted inwardly or away from the clutch dogs 26. In order to prevent the momentum of the machine rotating the shaft 13 beyond the desired point the latter is brought to a dead stop by means of an arm 104 which has at its upper end a hook or projecting portion which engages a lug 105 on the inner face of the gear 22, the arm 104 being connected to clutch lever 27 by a link 106. The rod which has been operated upon or bent in the manner above described will now be taken from the machine and another rod can be placed between the jaws of the clamping mechanism and the machine again started when the same operations above described will be repeated.

What I claim is,—

1. In a metal bending machine, a support, a pivoted clamping block, and a movable bending member carried by said support, a shaft having secured thereto a plurality of drums, cams carried by each of said drums, a member adapted to be inserted under the end of the pivoted clamping block so as to cause the opposite end thereof to grip the stock, and actuating devices connected to said last-named member and to said bending member respectively and adapted to be actuated by the cams of said drum so as to cause the pivoted block to grip the stock, thence the bending member to bend the stock, and thence the clamping member to release the stock.

2. In a metal bending machine, a table, a pivoted clamping block, a plunger for bending the stock in one direction, a pivoted member for bending the stock in a different direction, a shaft, and actuating devices operatively connected to said clamping block, to said plunger and to said pivoted bending member respectively and adapted to be actuated by said shaft, so as to cause the stock to be gripped or clamped by said block, to be operated on successively by the plunger and by such pivoted bending member, and finally to be released from said clamping block.

3. In a metal bending machine, a table, a pivoted clamping block a plurality of bending members comprising a plunger, a pivot-

ed bending block and a rotatable bending member, all supported on said table, and means for operating said clamping block and said bending members successively comprising a shaft, cams carried by said shaft, and actuating devices operatively connected to said clamping block and to said different bending members respectively, and adapted to be shifted by said cams.

4. In a metal bending machine, a pivoted block for clamping the stock, means for swinging said block so as to cause the latter to grip the stock at its forward end, said means comprising a wedge adapted to be inserted under the rear end of said block, a plunger adapted to bend the stock in one direction a pivoted bending block adapted to bend the stock in a different direction, and a rotary bending member adapted to bend the stock in a still different direction, and means for successively operating said wedge and the different bending members comprising a shaft, a plurality of cams carried by said shaft, and operating devices connected to the wedge and to the bending members respectively, and adapted to be shifted by said cams.

5. In a bending machine, a table, a pivoted clamping block, adapted to grip the stock, a plurality of bending members, comprising a plunger, a pivoted bending block, and a rotary bending member, a shaft extending over said table, a plurality of drums carried by said shaft, one for operating the clamping block and one for operating each of the bending members, cams carried by each of said drums, and actuating devices operatively connected to the bending block and to each of the bending members respectively and adapted to be actuated by the cams of the different drums, the cams being so arranged and shaped that the clamping block first grips the stock, thence the different bending members are successively operated, and thence the clamping block releases the stock.

6. In a metal bending machine, a table, jaws for receiving and holding the stock, a pivoted bending block, a rotary bending member, said pivoted bending member having a projection about which the rotary bending member is adapted to bend the stock, a shaft, and actuating devices operatively connected to the shaft, and to the different bending members respectively for operating the pivoted bending member, thence for causing the rotary bending member to bend the stock about said projection and thence for restoring the bending members to the initial positions.

7. In a metal bending machine, a table, a shaft extending horizontally over said table and having a plurality of drums, a pivoted clamping block, means for swinging said clamping block so as to cause it to grip and thence release the stock, said means comprising a wedge adapted to be inserted under one end of said block and thence to be retracted, means for operating said wedge comprising a lever and a pair of cams on one of said drums and adapted to shift said lever, a plurality of bending members adapted to bend the stock successively, and means for operating said bending members comprising cams on the other of said drums and levers adapted to be operated by said cams and operatively connected to the corresponding bending members.

8. In a metal bending machine, a table, a shaft extending horizontally over said table, a plurality of drums mounted on said shaft and arranged along the length thereof, means for clamping the stock comprising a pivoted block adapted to grip the stock at its forward end, means for rocking said block so as to cause it to grip the stock and then release the same, comprising a wedge adapted to be inserted under the rear end of said block and then to be retracted, means for operating said wedge comprising a pair of cams carried by one of said drums, and a lever operatively connected to said wedge and adapted to be shifted by said cams, a plunger adjacent to said bending block and adapted to bend the stock in one direction, means for moving said plunger forwardly and thence rearwardly after the stock is clamped by the block comprising a pair of cams carried by another drum, a lever operatively connected to the plunger and adapted to be shifted by the corresponding cams, a pivoted bending block adapted to bend the stock after the latter has been operated on by the plunger, said bending block having a projection on the face thereof, means for swinging said block in one direction and thence in the other comprising a pair of cams on another drum and a lever operatively connected to said bending block and adapted to be shifted by said cams, a rotary bending member adapted to bend the stock about said projection after the stock has been operated upon by the said pivoted bending block, and means for operating said rotary bending member comprising a pair of cams on still another drum, a lever adapted to be shifted by said cams, a rack operatively connected to said lever, a shaft having a pinion engaged by said rack, and a shaft geared to said last-named shaft and carrying said rotary bending member.

9. In a metal bending machine, a table, a pivoted clamping block adapted to grip the stock, a plurality of bending members all carried by the table, a shaft, a plurality of drums carried by said shaft, each having cam faces on the periphery thereof, actuating devices operatively connected to the clamping block and to the different bending members respectively and adapted to be ac-

tuated by the cam faces on said drum, means for rotating said shaft, and means for automatically stopping said shaft after the stock has been operated upon by the said bending members and is released from said clamping block.

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses.

ISAAC W. HOOVER.

Witnesses:
VICTOR C. LYNCH,
N. L. MCDONNELL.