Dec. 3, 1935. O. H. JENSEN 2,022,915

METAL BENDING MACHINE

Filed Oct. 8, 1934 7 Sheets-Sheet 1

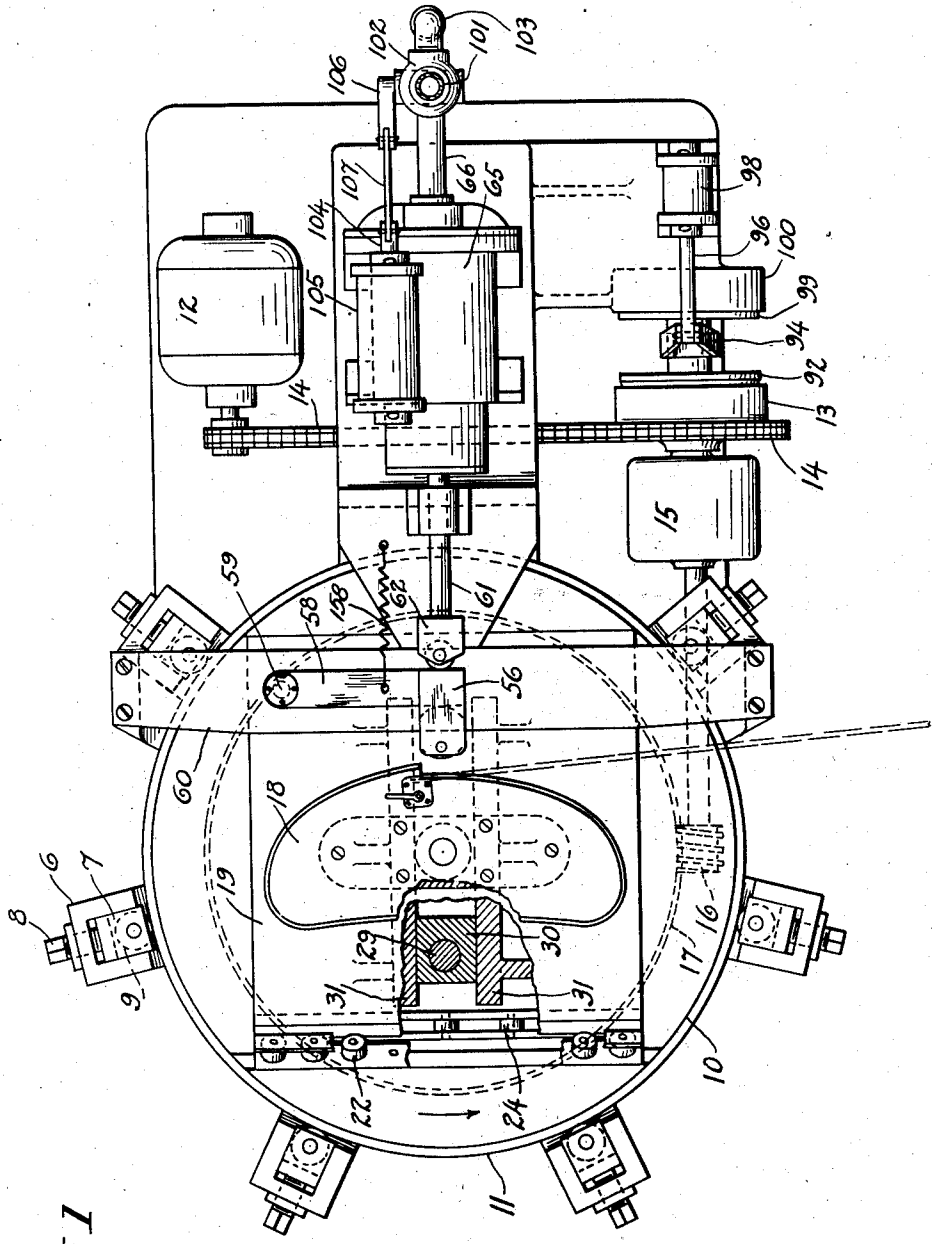


Fig. 1

INVENTOR.

OTTO H. JENSEN

BY

Barnes, Kisselle, Laughlin & Raisch

ATTORNEYS.

Dec. 3, 1935. O. H. JENSEN 2,022,915

METAL BENDING MACHINE

Filed Oct. 8, 1934 7 Sheets-Sheet 2

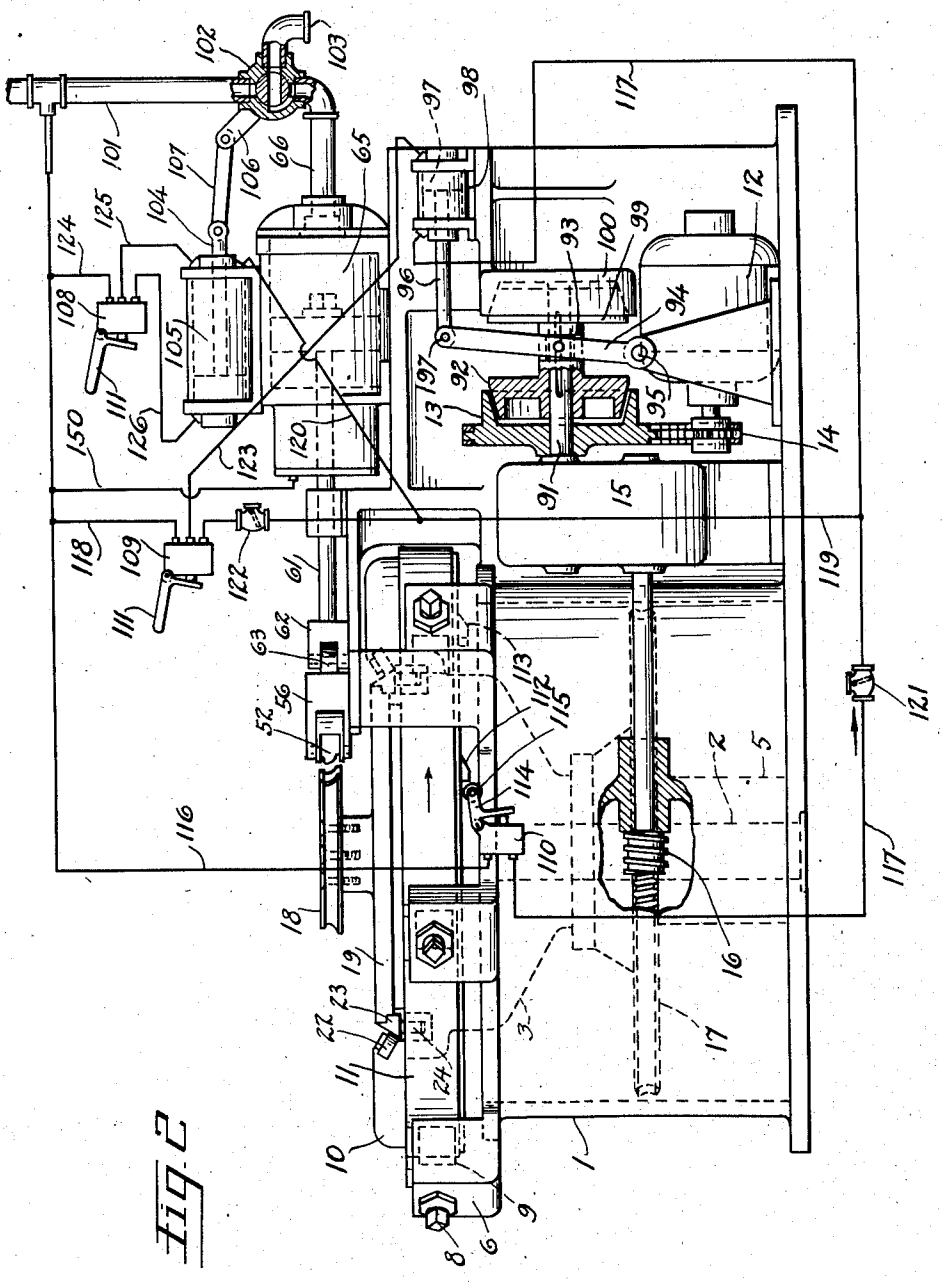


Fig. 2

INVENTOR.

OTTO H. JENSEN

BY

Barnes, Kisselle, Laughlin & Raisch

ATTORNEYS.

Dec. 3, 1935. O. H. JENSEN 2,022,915

METAL BENDING MACHINE

Filed Oct. 8, 1934 7 Sheets-Sheet 3

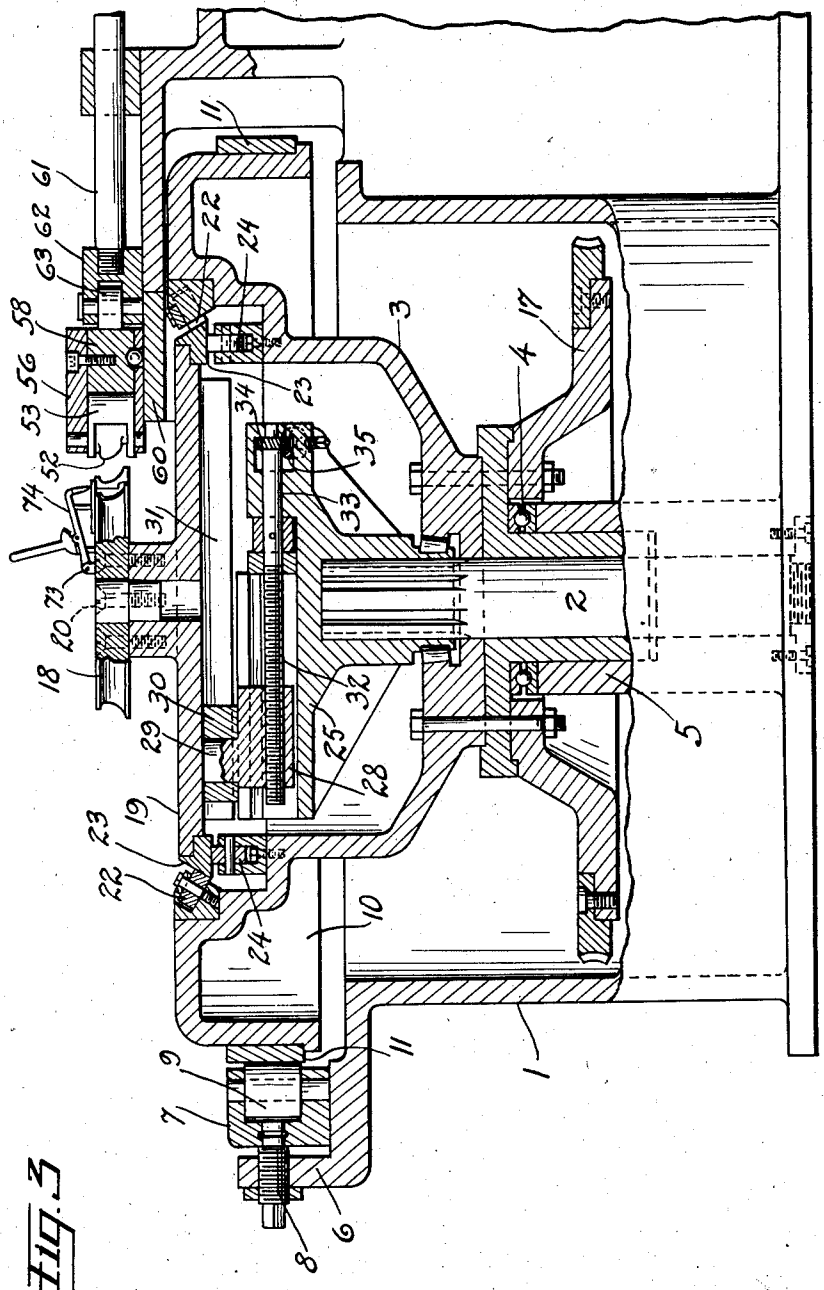


Fig. 3

INVENTOR.

OTTO H. JENSEN

BY

Barnes, Kisselle, Laughlin & Raisch

ATTORNEYS

Dec. 3, 1935. O. H. JENSEN 2,022,915

METAL BENDING MACHINE

Filed Oct. 8, 1934 7 Sheets-Sheet 4

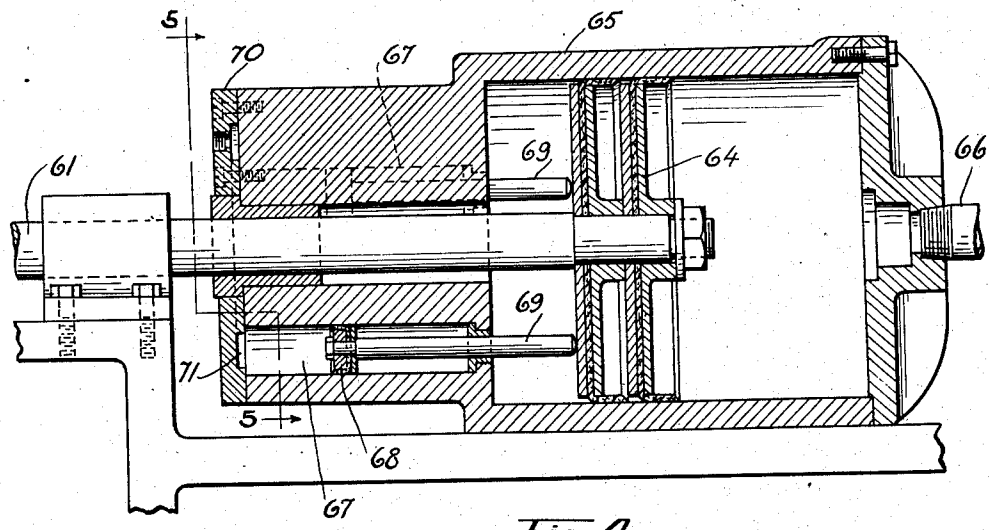


Fig. 4

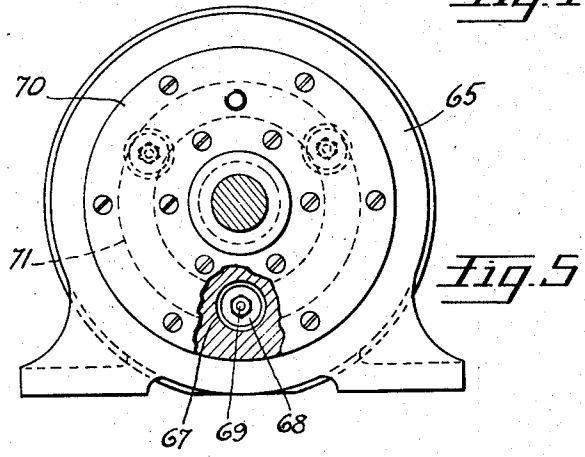


Fig. 5

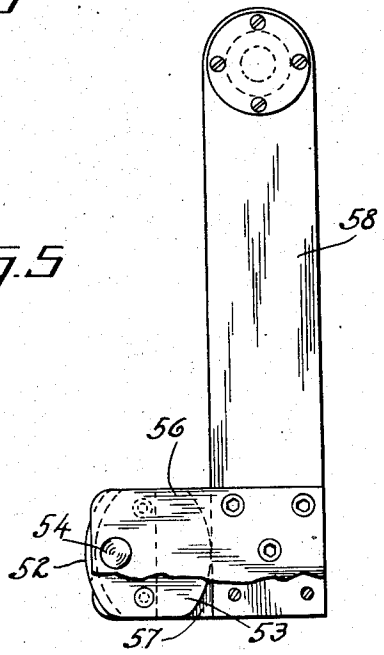


Fig. 6

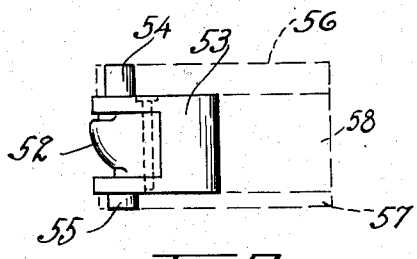


Fig. 7

INVENTOR.

OTTO H. JENSEN

BY

Barnes, Kisselle, Laughlin & Raisch

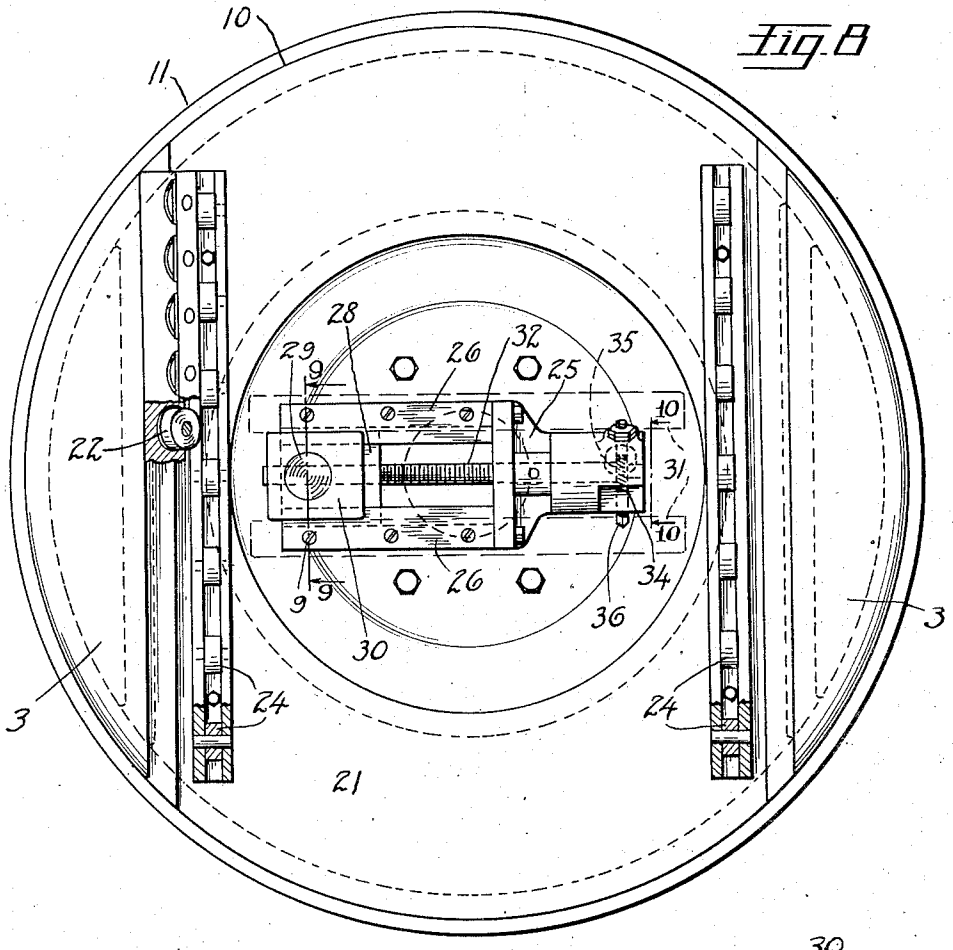
ATTORNEYS.

Dec. 3, 1935. O. H. JENSEN 2,022,915

METAL BENDING MACHINE

Filed Oct. 8, 1934 7 Sheets-Sheet 5

Fig. 8



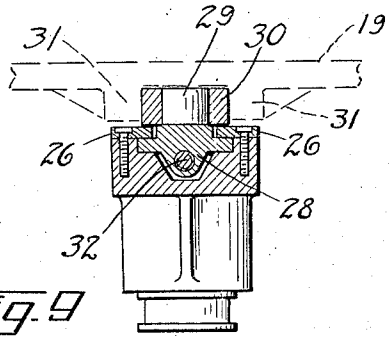


Fig. 9

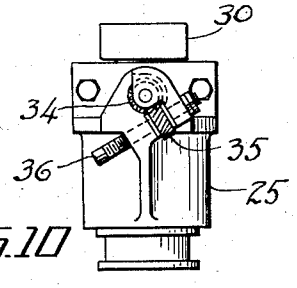


Fig. 10

INVENTOR.

OTTO H. JENSEN

BY

Barnes, Kisselle, Laughlin & Raisch

ATTORNEYS.

Dec. 3, 1935. O. H. JENSEN 2,022,915

METAL BENDING MACHINE

Filed Oct. 8, 1934 7 Sheets-Sheet 6

Fig. 11

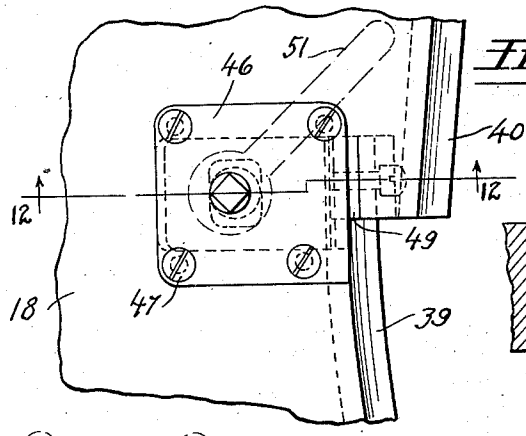


Fig. 12

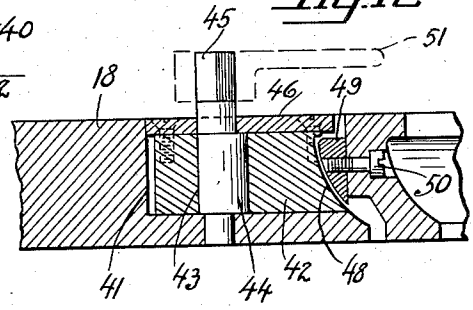


Fig. 13

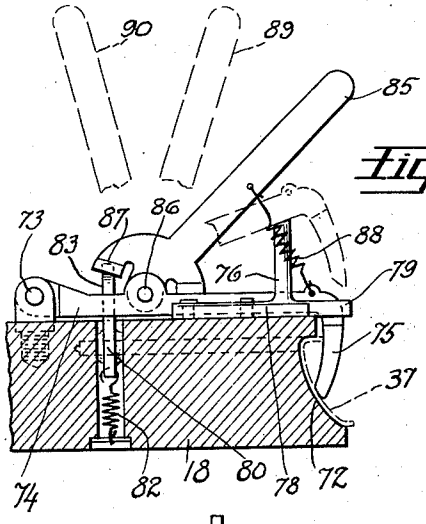


Fig. 14

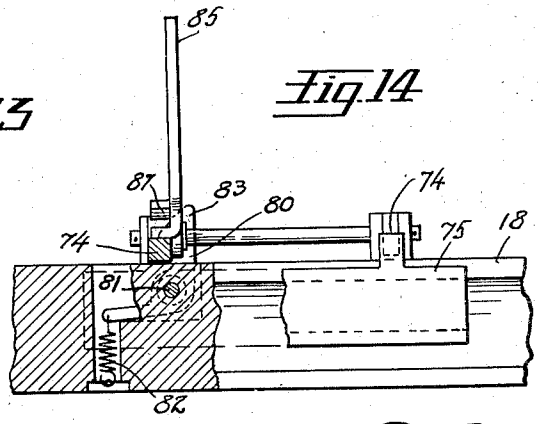


Fig. 15

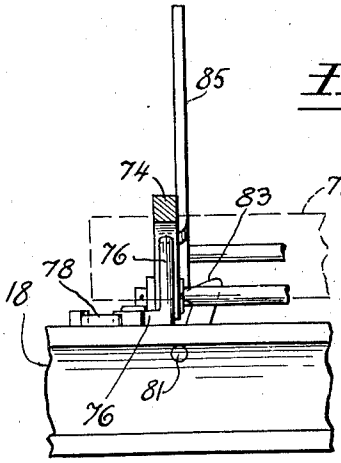
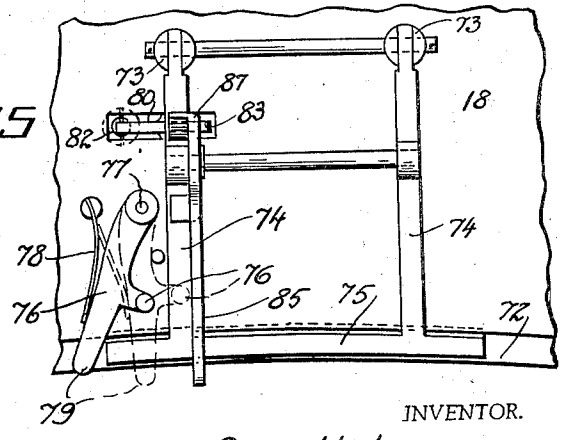


Fig. 16



INVENTOR.

OTTO H. JENSEN

BY

Barnes, Kiesselle, Laughlin & Raisch

ATTORNEYS.

Dec. 3, 1935. O. H. JENSEN 2,022,915

METAL BENDING MACHINE

Filed Oct. 8, 1934 7 Sheets-Sheet 7

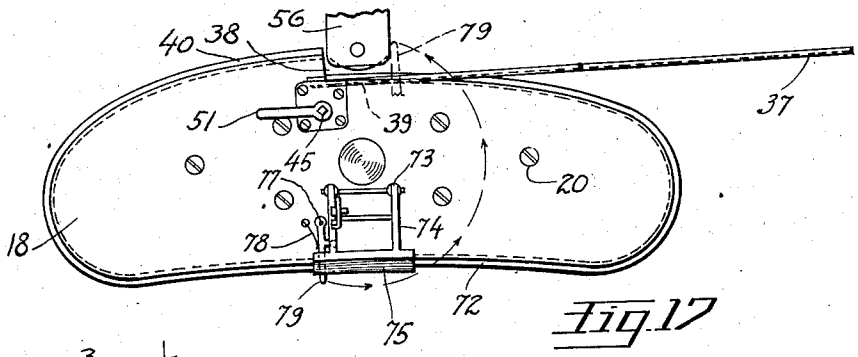


Fig. 17

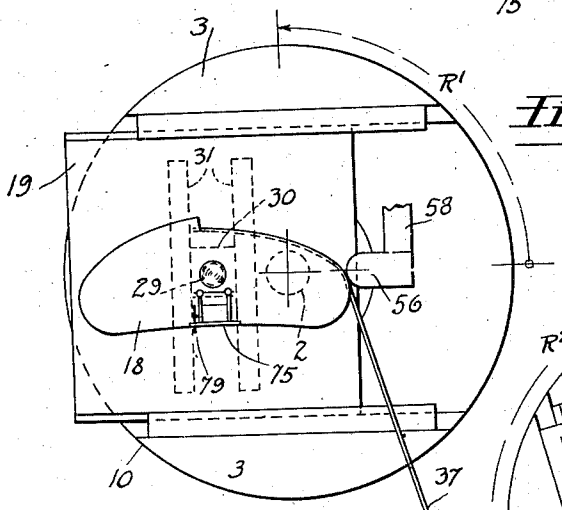


Fig. 18

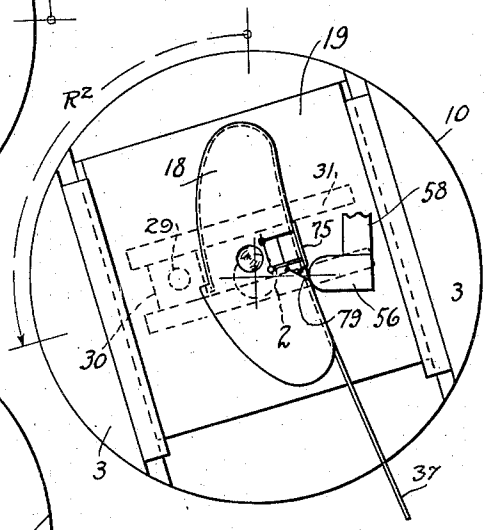


Fig. 19

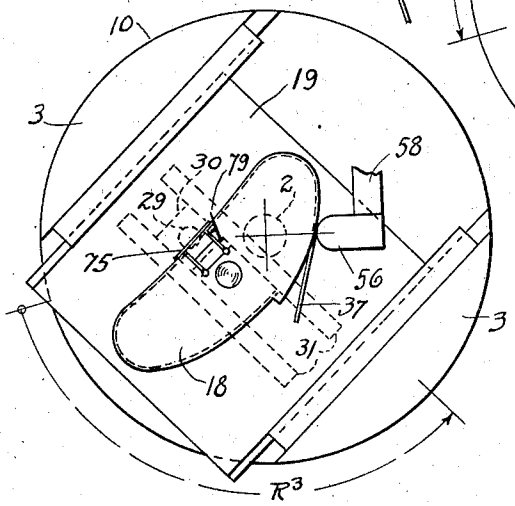


Fig. 20

INVENTOR.

OTTO H. JENSEN

BY

Barnes, Kisselle, Laughlin & Raisch

ATTORNEYS.

Patented Dec. 3, 1935

2,022,915

UNITED STATES PATENT OFFICE

2,022,915

METAL BENDING MACHINE

Otto H. Jensen, Detroit, Mich., assignor to Ternstedt Manufacturing Company, Detroit, Mich., a corporation of Michigan

Application October 8, 1934, Serial No. 747,366

11 Claims. (Cl. 153—40)

This invention relates to a metal bending machine and more particularly to a machine for bending a metal channel section such as that used for the frame for the window opening of an automobile commonly called the garnish molding.

It is old in the art to bend a metal strip or tube about a rotating die which rotates about a fixed center coincident with the geometrical center of the die to form a U-shaped frame. In such a case the die is formed so that all points along the working face along which the ironer travels are substantially equidistant from the center of the die or sufficiently close that as the die rotates the hill which the ironer is required to climb has a sufficiently low grade that the force component which acts tranversely of the ironer is insufficient to destroy the ironer or create enough friction between the ironer and the work to destroy the work.

In the case of a garnish molding for an automobile window opening, in particular those moldings which approximate a rectangle, a die is required for bending such moldings which has the corners of the working face, for example, spaced a much greater distance from the geometrical center of the die than the portion of the face midway of two successive corners.

In the bending of the rolled metal channel section to form the garnish molding, particularly in the case of the garnish molding for the front door, rear door and rear windows of the vehicle body which have relatively long sides compared with the garnish molding for the rear quarter window, this requires the ironer upon sliding along these long sides to climb a relatively steep hill. This causes a relatively large component of force to act transversely of the ironer which either breaks off the arm for the ironer or increases the friction between the ironer and the garnish molding to such an extent that the work or a large share of it is ruined. In such a case a die which rotates about a fixed center coincident with its geometrical center will not operate successfully.

It is an object of this invention to overcome this difficulty and produce a machine that will bend a garnish molding or equivalent metal strip about a rotating die where certain portions of the forming face of the die are spaced a relatively greater distance from the center of the die than other portions of the forming face of the die. This object has been attained by so constructing the machine that the rotating die upon presenting any of its face to the ironer which would require the ironer to travel a steep hill in case the die were rotated on a fixed center coincident with the center of the die, is backed away from the shoe to a sufficient extent to decrease the force component acting transversely of the ironer sufficiently so that neither the ironer nor the work is destroyed. More particularly this is achieved by mounting the die so that its geometrical center does not at all times coincide with the center of rotation of the die. The die is arranged so that its geometrical center recedes from the ironer whenever the ironer is required to climb up one of the long sides of the die, that is, required to travel from a point on the forming edge of the die which is close to the geometrical center of the die to a point which is more distant from the center of the die, and which travels toward the ironer whenever the ironer is required to travel down a long side of the die, that is, whenever the ironer travels from a point on the periphery of the die distant from the geometrical center of the die to a point less distant.

Another object of this invention is to produce a machine that will bend a single length of a metal, which may be in the form of a channel section, into a closed frame in a single operation.

It is also an object of this invention to produce a machine that will bend a metal strip which may be in the form of a channel section into a closed frame, one of the sides of which has a concave bend, that is, curves inwardly toward the geometrical center of the frame. This object has been achieved by providing a clamping device which is automatically set in operation during the rotation of the bending die to clamp the work against the concave edge of the die after a portion of the work has been bent and before the remaining portion of the work is bent.

A further object of this invention is the production of a machine that will bend a metal strip, which may be in the form of a channel section, into a frame so that the ends are overlapped thereby permitting the frame to be sprung outwardly with the ends of the frame in abutting relation to facilitate being welded or otherwise fixed together.

In the drawings:

Fig. 1 is a plan view of the bending machine showing the die in starting position.

Fig. 2 is a side elevation of the machine with a diagrammatic showing of the air lines.

Fig. 3 is a fragmentary longitudinal sectional view of the machine.

Fig. 4 is a detail section through the main air cylinder.

Fig. 5 is a view along the line 5—5 of Fig. 4.

Figs. 6 and 7 are details of the ironer and ironer support arm.

Fig. 8 is a top view of the rotating table with the die support plate removed.

Figs. 9 and 10 are detail sections along the lines 9—9 and 10—10 of Fig. 8.

Fig. 11 is a detail of the work clamp on the die.

Fig. 12 is a section along the line 12—12 of Fig. 11.

Figs. 13, 14, 15 and 16 are detail views of the clamping arrangement for holding the work against the face of the die opposite that where the work is clamped to the die.

Figs. 17 through 20 show the work being bent about the die and the relative positions occupied by the die during the bending operation.

Referring more particularly to the drawings the machine comprises a base 1 which supports a fixed post 2. The post 2 has rotatably mounted thereon a table 3. The rotating table 3 is mounted on the post 2 and supported by the thrust bearing 4 which rests upon the collar 5. The base 1 is provided with a plurality of circumferentially spaced brackets 6 each of which carries a yoke 7 each of which is adjustable radially inwardly and outwardly by an adjusting screw 8. Each yoke 7 carries a roller bearing 9. The rotating table 3 is provided with a depending circumferential flange 10 which carries a circular track 11. The roller bearings 9 have a rolling engagement with the track 11 and thus act as thrust bearings for the rotating table 3.

The rotary table 3 may be driven by any suitable power means such as the electric motor 12. The motor 12 is connected to a suitable clutch by a chain 14. From the clutch the power is transmitted through a suitable reduction gear arrangement 15 to the driving worm 16. The driving worm 16 meshes with the worm gear 17 which may be bolted or otherwise suitably secured to the rotary table 3.

Inasmuch as one of the objects of the invention is attained by having the die travel toward and away from the ironer during different periods of the rotation, to this end the die 18 is secured to a reciprocating support plate 19 in any suitable manner such as by the screws 20. The support plate 19 reciprocates diametrically of the rotating table 3 in a guideway generally designated 21. The parallel side edges of the guideway are provided with a plurality of inclined roller bearings 22 which have a rolling engagement with the beveled edges 23 of the die support plate 19. The engagement of the inclined roller bearings with the beveled edges 23 of the slide 19 takes up any side thrust and likewise retains the slide plate in the guideway 21. The rotating table is also provided along each edge of the guideway 21 with the rollers 24 which have a rolling engagement with the bottom face of the support plate 19 and support the same upon the table 3.

For reciprocating the slide 19 diametrically of the rotating table 3, the fixed post 2 has splined or otherwise fixed on its upper end a support member 25 provided with the parallel tracks 26 forming a guideway in which a block 28 carrying an upstanding pin 29 is adjustably mounted. A block 30 is swivelly mounted on the pin 29 and slidably engages in a guideway formed by two parallel tracks 31 depending from the bottom face of the slide 19. The block 28 may be adjusted along the tracks 26 by means of the adjusting screw 32. The adjusting screw 32 is journaled in the member 25 as at 33 and provided at the outer end with a worm gear 34. The worm gear 34 (Fig. 10) is meshed with the worm gear 35 carried on a shaft 36 having a square end. The square end of the shaft may be gripped with a suitable wrench and the worm gears 34, 35 turned; this rotates the screw 32 to adjust the block 28 and pin 29 toward and away from the center of rotation of the table 3 for purposes which will be explained below.

The die 18 is designed for the bending of a strip of metal of channel section into a garnish molding for the rear window of an automobile body, but it is understood that this die might be of a different shape and arranged to bend a strip of metal other than a channel section and into a frame having a periphery different from that shown. The garnish molding is formed from a single strip of metal 37 which initially is a single straight length having a channel cross section as indicated in the dotted lines Fig. 13. After the straight strip 37 has been bent into the form of a garnish molding frame, the ends of the strip are preferably welded or otherwise fixed together. To facilitate the welding of these ends together it is desirable that the spring tension in the bent garnish molding frame should be such as to urge these ends toward, rather than away from, each other. For this purpose, as well as for the purpose of permitting the single length of metal to be bent into a frame in a single operation, the die is formed so that at the end of the bending operation the adjacent ends of the frame overlap. To attain this result the die 18 is formed with a recess 38 so that the working face of the die, as at 39, at the beginning of the bending operation is inset from the working face of the die as at 40 at the end of the bending operation.

The arrangement for clamping the end of the work into the die is shown in detail, Figs. 11 and 12. The die 18 is provided with a recess 41 at the beginning of the working edge 39. This recess has slidably mounted therein a block 42 provided with an oblong opening 43 which is arranged to receive the eccentric or cam portion 44 of a pin 45 rotatably mounted in die 18 and in the cover plate 46. When the pin 45 is turned the engagement of the cam 44 in the oblong opening 43 causes the block 42 to move from the front to the back of the recess 41 or vice versa. The cover plate 46 covers the recess 41 and is secured to the die 18 by the screws 47. The outer edge 48 of the clamping block 42 is shaped to conform to the channel section of the garnish molding. The outer face of the recess 41 carries the block 49 which is shaped to correspond with the face 48 of the block 42. The block 49 is secured to the die 18 by any suitable means such as the screw 50. A suitable lever handle 51 is mounted on the square end of the pin 45. At the beginning of the bending operation the strip 37 is slid along the face 39 between the blocks 42 and 49 and the lever handle 51 turned. The turning of the handle 51, acting through the cam 44, moves the clamping block 42 outwardly towards the block 49 thereby clamping the end of the work 37 to the die.

As the die 18 rotates during the bending operation the work must be held against the edge of the die. To this end (Figs. 6 and 7) an ironer 52, the contour of which corresponds to the inner contour of the channel section of the garnish molding, is arranged to engage the inside face of the channel section strip. This ironer 52 is riveted or otherwise secured in the yoke 53. The yoke 53 is provided along its top and bottom faces with the pins 54 and 55 which are journaled in

the top and bottom plates 56 and 57 of the arm 58. The arm 58 is pivotally mounted as at 59 on a suitable support 60 carried by the base 1 of the machine. The pivoting of the arm 58 at 59 permits the ironer 52 to swing inwardly and outwardly as the die rotates. The arm 58 is backed up by a plunger 61, the end of which carries a yoke 62 on which is rotatably mounted a roller 63. The roller 63 is arranged to engage the arm 58. The plunger 61 (Fig. 4) is secured at one end to the piston 64 which is reciprocably mounted in the cylinder 65. The cylinder 65 is provided with an air line 66 through which compressed air is admitted into, and discharged from, the cylinder 65. The admission of compressed air into the cylinder 65 projects the plunger 61 causing the roller 63 to bear against the arm 58 and thus hold the ironer yieldably against the work which is held against the die by the ironer.

The end of the cylinder 65 through which plunger 61 passes is provided with a plurality of relatively small cylinders 67 having pistons 68. Each piston 68 has a piston rod 69 which yieldably engages the face of the piston 64. The cylinder housing 65 is provided with a suitable header 70 having a circumferential groove 71 which is continuously connected with the main air feed line described below by air line 150 and serves as a conduit for connecting the small cylinders 67 at all times with the main air line. Inasmuch as the small cylinders 67 are at all times connected with the main air line there is a constant air pressure exerted against the small pistons 68 which causes the rods 69 to exert a constant thrust against the main piston 64. Due to the fact that the cylinders 67 and pistons 68 are relatively small compared with the large cylinder 65 and large piston 64, the main piston 64, when compressed air is admitted through the inlet line 69, easily overcomes the small thrust of the pistons 68 and thus throws the plunger 61 to the left or toward the die. When the air is exhausted from the main cylinder 65 through the line 66, the small pistons 68 acting through the rods 69 move the main piston 64 toward the right thus withdrawing the plunger 61. This permits a suitable coil spring 158 to withdraw arm 58 and the ironer 52 from the die. The pistons 68 and cylinders 67 can be made fairly small because the only work they perform is overcoming the friction of the main piston 64 in the cylinder 65 and the friction of the plunger 61 in its supporting bearing.

It will be noted that the working face of the die 18 along one side as at 72 is concave, that is, curved inwardly toward the center of the die. The face 72 of the die is necessarily concave because it is desired to have the lower edge of the garnish molding frame, into which the work is bent, curved inwardly. This inward curve of the face 72 of the die creates a new problem, namely, that of maintaining the bent work against this face as the ironer travels from this face around the end of the die and back to the face 40 at the end of the bending operation.

To this end the die 18 has pivotally mounted thereon as at 73 a pair of arms 74 which carry at their outer ends a clamping bar 75. The clamping bar 75 is arranged to engage the inside face of the work 37, as shown in Fig. 17, to hold the work flush against the curved end 72 of the die. Since the ironer travels along the inner face of the work 37, obviously the clamping bar 75 must not be in lowered clamping position until the ironer has passed the clamping bar. Therefore the clamping bar 75 is held in raised position by a support member 76 pivotally mounted upon the die as at 77 and backed up by the spring 78. This support member 76, as shown in the dotted lines, Figs. 13 and 15, engages under an arm 74 to hold the clamping bar 75 in raised position. The outer end 79 of the pivoted support 76 projects beyond the edge of the die 18. After the ironer has passed beneath the clamping bar 75 and approaches the end of this bar, the ironer engages the projecting end 79 of the support 76 swinging it from beneath the arm 74 to the full line position, Fig. 15, thus permitting the clamping bar 76 to fall by gravity into clamping engagement with the work as shown in the full lines Fig. 13.

The bar 75 is held in clamping relation with the work by the latch 80 pivoted as at 81 to the die and held in latching engagement over the arm 74 by the spring 82. It will be noted, Fig. 16, that the upper face 83 of the latch 80 is inclined. The arm 74 of the clamping device has a handle 85 pivotally mounted thereon as at 86. The handle 85 has a projecting arm 87 extending over the cam face 83 of the latch 80. The handle 85 is normally drawn towards the arm 74 by the coil spring 88, Fig. 13. To retract the clamping bar the handle 85 is first drawn back to the dotted line position indicated at 89. At this time the arm 87 of the handle 85, through the cam engagement with the inclined face 83 of the latch 80, has thrown the latch to the disengaged position shown in Fig. 16. This permits the handle 85 to be drawn from the position shown in the dotted lines at 89 to the dotted line position 90, thus swinging the arms 74 upwardly and retracting the clamping bar 75 to the raised and fully retracted position shown in the dotted lines, Fig. 13. The spring 78 now throws the pivoted support 76 to the dotted line position, Fig. 15, beneath the arm 74 where it supports the clamping device in raised position. At this time the latch 80 is back in a position similar to that shown in Fig. 14 but beneath the arm 74 so that when the clamp 75 again falls down by the action of gravity the arm 74 will strike the cam face 83 of the latch 80 to throw it out temporarily and then permit it again to snap back into latching engagement with the arm 74 to latch it in clamping engagement with the work.

Although the power for running the machine may be supplied by an electric motor the machine is preferably air controlled. As shown in Figs. 1 and 2 the motor is connected to the driving member 13 of the clutch by the chain 14. The driving member 13 is freely rotatably mounted upon the shaft 91 which is operatively connected with the driving worm 16 through the gear reduction arrangement 15. The driven member 92 of the clutch is keyed or splined on the shaft 91 so that it is slidable axially of the shaft. The driven member 92 is operatively connected in the groove 93 with a lever 94. The lever 94 has its lower end pivoted to a suitable support as at 95 and its upper end pivoted to a piston rod 96 as at 197. The piston rod 96 is connected to a piston 97 reciprocably mounted within the cylinder 98. The driven member 92 may also be provided with a conical braking member 99 which is arranged to have a braking engagement with a stationary brake housing 100.

The air line 66 which connects the main cylinder 65 with the main air line 101 is controlled by a valve generally designated 102. As shown, the valve 102 has closed off the main air line

101 and has connected the line 66 from the main air cylinder 65 with the exhaust pipe 103. The valve 102 is controlled through the air cylinder 105. A piston rod 104 through link 107 connects the piston in air cylinder 105 to the lever 106 which operates the valve 102.

The air line arrangement is shown diagrammatically in Fig. 2. The air lines are provided with three valves of a type well known to the trade. These valves are numbered 108, 109, and 110. Valves 108 and 109 are manually controlled by lever handles 111 whereas valve 110 is mounted on the base 1 of the machine immediately below the depending flange 10 of the rotary table 3. The depending flange 10 carries the circumferentially spaced cams 112 and 113. These cams 112 and 113 may be spaced ten degrees apart for purposes described below. Valve 110 is provided with an operating lever 114 having a roller 115 at its outer end. During the rotating of the rotary table the cams 112 and 113 ride over the roller 114 thereby operating the valve 110.

The valve 110 is connected to the main air line 101 by a line 116 and with the cylinder 98 by line 117. The valve 109 is connected with line 116 by air line 118 and with line 117 by a line 119. A check valve 121 is mounted in line 117 between valve 110 and line 119 which permits the air to pass only in the direction of the arrow, that is, only from the valve 110 to the air cylinder 98. Line 119 is connected to cylinder 105 by line 120. Another check valve 122 is positioned in line 119 between the valve 109 and line 120. Cylinder 98 is also connected with the valve 109 by air line 123. Valve 108 is connected to line 116 by line 124 and to cylinder 105 by lines 125 and 126.

A valve, such as valves 108, 109, 110, is a well known article of manufacture and consequently will not be described in detail. Each of these valves is constructed so that air passes from the main air line and valve into any cylinder only when the handle is depressed. As soon as the hand is removed from the handle 111 or the cam passes over the lever 114, the handle returns to raised position and the valves shut off the main air line and exhause the cylinders to atmosphere.

The operation of the machine is as follows: The starting position of the die is shown in Figs. 1 and 17. At this time the work 37 is clamped to the die as above described. The operator then presses down on handle 111 which operates valve 108. This permits air to pass through line 126 to cylinder 105 which actuates the piston and throws the valve lever 106 to the right thus connecting main air line 101 with the line 66 permitting the compressed air to flow into the main air cylinder 65. This projects plunger 61 which in turn moves the ironer 52 against the work. The operator next presses down on lever 111 for the valve 109 which permits the air to pass through line 123 into cylinder 98 which, acting through piston 97 and clutch lever 94, engages the driven member 92 with the driving clutch member 13 thus causing the table 3 and the die to rotate. The operator only need momentarily depress the lever handles 111. As soon as the operator removes his hands from these levers the valve opens and permits cylinders 105 and 98 to exhaust to atmosphere. However, the pistons in these cylinders do not move back to their original position until compressed air is again fed into the opposite ends of the cylinders. This leaves the valve 102 in position so that the air line 101 is connected with air line 66 and the clutch is retained in engaged position by any suitable and well known locking arrangement, which may be a snap over center spring, until air is again admitted to the cylinder to disengage the clutch.

As the die rotates the work is bent by the ironer around the die 18 as shown progressively in Figs. 17, 18, 19 and 20. When the die has rotated approximately 350° the cam 113 engages roller 115 thus operating valve 110 momentarily. This momentarily permits air to pass from line 116 through 117, check valve 121 and into the other end of the cylinder 98 thus disengaging the clutches 13, 92. This also permits air to flow through lines 119 and 120 into cylinder 105 which returns valve 102 to the position shown with line 101 cut off and line 66 from cylinder 65 now becomes an exhaust line which in conjunction with valve 102 and line 103 exhausts cylinder 65 to atmosphere.

This permits the small pistons 68 and plungers 69, as above described, to return the main piston 64 and ironer to retracted position shown in Fig. 1. The rotation of the table is stopped after it travels approximately 350° or at any other point subsequent to the last bend around the end of the die and before it reaches the recess 38 because otherwise the ironer while still pressed by the plunger 61, would again reach the recess 38, jam into the work and destroy the work and injure the die.

After the ironer has been retracted with the table in the position shown in Fig. 20, the operator then depresses lever 111 for valve 109 which permits air to pass through line 123 into the cylinder 98 again engaging the clutch which rotates the table 3 and die 18. The cam 112 next engages the roller 115 opening valve 110 which permits air to flow through line 117 into cylinder 98 thereby disengaging the clutch and stopping the machine at its original position shown in Figs. 1 and 17. At this time the work can be removed and the machine is in position for reloading. Whenever the clutch is disengaged the brake 99, 100 stops the machine.

If, at any time during the operation of the machine, an emergency arises requiring the machine to be stopped immediately, the operator can throw handle 111 upwardly thus operating valve 109 so that the air passes through check valve 122 through line 119 into line 117 and then into cylinder 98 thereby disengaging the clutch. At this time the air also passes through line 120 into the cylinder 105 which throws the valve 102 to exhaust position permitting the air to exhaust from cylinder 65 through lines 66 and 103. Check valve 121 prevents the air from flowing from line 119 along line 117 to valve 110 where it would be exhausted. During the normal operation of the machine, check valve 122 prevents the air from flowing from line 117 into line 119 and then into valve 109 where it would be exhausted to atmosphere.

During the operation of the machine the table rotates as indicated by the arrows, Figs. 17 to 20. In Fig. 19 the ironer has just passed beyond the stop 79 and released the clamping bar 75 which thereafter holds the work tightly against the curved edge of the die.

As shown in Fig. 1 the geometrical center of the die 18 is concentric with the post 2 and the center of rotation of the table 3. At this time the support plate is entirely within the circumference of the table and the tracks 31 are aligned with the plunger 61. As the table 3 rotates this rotation is necessarily translated to the plate 19 and die 18. However, the slide 30, swiveled on the

stationary pin 29, remains stationary thus causing a relative movement between the rotating table 3 and the support plate 19, that is, the support 19 as it rotates also slides in the guideway 21 supported on the rollers 23 and guided by the rollers 22. The movement of the plate 19 for the first quadrant of rotation is shown in Fig. 18. It will be noted that as the die rotates counterclockwise the movement of the plate 19 in the guideway 21 causes the die to simultaneously recede from the ironer 52. This movement on the part of the die obviates the need for the shoe to travel up a steep hill during this first quarter rotation. In other words, this movement of the die away from the ironer as it rotates decreases the force component acting tangentially or perpendicularly to the radius of the die at the point of contact of the ironer with the work so that this component is not large enough to destroy the ironer and the work. It may also be said that the backing away of the die from the ironer makes it easy for the ironer to climb the hill presented by the face of the die along its long side.

As the die travels through the second quadrant, that is, from the position shown in Fig. 18 to that shown in Fig. 19, the ironer travels what may be termed "down-hill". At this time the stationary slide 30 operating between tracks 31 returns the plate 19 back to its original position within the circumference of the rotating table 3. During the third quadrant of rotation of the die, that is, from the position shown in Fig. 19 to that shown in Fig. 20, the ironer is again traveling up-hill and at this time the plate 19 is again drawn away from the ironer during the rotation as, and for the purpose, described above.

The machine is designed to operate with various dies, the working faces of which have different contours depending upon the size and the shape of the frame or article into which the metal is to be bent. The adjustability of the pin 29 and block 30 varies the length of the stroke of the plate 19 as it reciprocates across the rotating table 3. Through the adjustability of the pin 29 and slide block 30 the stroke of plate 19 can be lengthened to accommodate those dies which have longer faces and the stroke can be shortened to accommodate those dies which have short faces. In some instances it will be desirable to adjust the pin 29 so that it is concentric with the post 2, that is, the center of rotation of the table, thereby permitting the plate 19 to rotate with the table without any reciprocation transversely of the table in the guide 21.

I claim:

1. A metal bending machine comprising a rotatable table, a die movably mounted on the said table and arranged to rotate with the table, the said die having a working face about which the metal is bent during the rotation of the die, an ironer for yieldably holding the work against the working face of the die, and means for moving the die relative to the rotating table during the bending operation so that the geometrical center of the die travels toward and away from the center of rotation of the said table.

2. A metal bending machine comprising a rotatable table, a die reciprocably mounted on the said table and arranged to rotate therewith, the said die having a working face about which the metal is bent during the rotation of the die, some portions of said face being more distant from the geometrical center of the die than other portions, an ironer exerting a thrust toward the center of rotation of the table for yieldably holding the work against the working face of the die, and means for reciprocating the die relative to the rotating table during the bending operation so that the geometrical center of the die travels away from the center of rotation of the table as the ironer travels about the die from one working face portion of the die to another working face portion more distant from the geometrical center of the die whereby the travel of the ironer along the work and about the die is facilitated.

3. A machine for bending a single length of metal of channel or equivalent section into a frame in a single operation comprising a rotatable table, a die around which the metal is bent having portions of its working face spaced farther from the geometrical center of the die than other portions, the said die being supported on the said rotatable table and arranged to move relative to the table during the rotation of the table, an ironer for yieldably engaging the work and holding the same against the working face of the die during the bending operation, and means for moving the said die relative to its supporting table during the bending operation whereby the die retreats from the ironer as the ironer travels from one portion of the working face of the die to another portion of the working face of the die more distant from the geometrical center of the die.

4. A metal bending machine comprising in combination a rotatable table, a die carried by the said table and arranged to rotate therewith, the said die having a working face against which the work is held during the bending operation, an ironer for yieldably holding the work against the working face of the die, the working face of the die having one portion closer to the geometrical center of the die than another more distant portion thereby presenting a hill which the ironer must climb as it passes from the working face portion closer to the geometrical center of the die to the working face portion more distant from the geometrical center of the die, and means for shifting the said die bodily relative to the rotating table during the up hill travel of the ironer whereby the travel of the ironer along the up hill face of the die is facilitated.

5. A metal bending machine comprising in combination a rotatable table, a die carried by the said table and arranged to rotate therewith, the said die having a working face against which the work is held during the bending operation, an ironer exerting a thrust toward the center of rotation of the said table for yieldably holding the work against the working face of the die, the working face of the die having one portion closer to the geometrical center of the die than another more distant portion thereby presenting a hill which the ironer must climb as it passes from the working face portion closer to the geometrical center of the die to the working face portion more distant from the geometrical center of the die, and means for shifting the said die bodily relative to the rotating table and away from the said ironer during the up hill travel of the ironer whereby the travel of the ironer along the up hill face of the die is facilitated.

6. A metal bending machine comprising in combination a base, a table rotatably mounted on the said base, a guideway extending across the table, a die supporting plate reciprocably mounted in the said guideway, a die carried by the said support plate having a working face about which the metal is bent, an ironer for holding the work against the working face of

the die during the bending operation, and means for reciprocating the said support plate in the said guideway during the rotation of the table to facilitate the travel of the ironer along the working face of the die during the bending operation.

7. A metal bending machine comprising in combination a base, a table rotatably mounted on the said base, a guideway extending across the table, a die supporting plate reciprocably mounted in the said guideway, a die carried by the said support plate having a working face about which the metal is bent, an ironer for holding the work against the working face of the die during the bending operation, a fixed pivot offset from the center of rotation of the rotating table about which the support plate swings during the rotation of the table whereby as the table rotates the die supporting plate rotates with the table and also travels across the table in the said guideway to facilitate the travel of the ironer along the working face of the die.

8. A metal bending machine comprising in combination a base, a table rotatably mounted on the said base, a guideway extending across the table, a die supporting plate reciprocably mounted in the said guideway, a die carried by the said support plate having a working face about which the metal is bent, an ironer for holding the work against the working face of the die during the bending operation, the said die support plate having a guideway extending transversely of the guideway in the said rotatable table, a fixed pin operatively engaging the said support plate in the said guideway and offset from the center of rotation of the table whereby as the table rotates the die support plate reciprocates in the said guideway to facilitate the travel of the ironer along the working face of the die.

9. A metal bending machine comprising in combination a base, a table rotatably mounted on the base, a guideway extending across the table, a die support plate reciprocably mounted in the said guideway, a die having a working face about which the metal is bent carried by the support plate with its longer diameter positioned parallel to the guideway which extends across the table, an ironer for holding the work against the working face of the die during the bending operation, the said die support plate having a guideway extending transversely of the guideway in the said table, and a fixed pin having a block swiveled thereon which slidably engages the said support plate in the said guideway, the said pin and block being offset from the center of rotation of the table whereby as the table rotates the die support plate reciprocates in the said guideway to facilitate travel of the ironer along the working face of the die.

10. A metal bending machine comprising in combination a base, a table rotatably mounted on the base, a guideway extending across the table having a plurality of rollers, a die supporting plate reciprocably mounted on the said rollers in the said guideways, a die having a working face about which the metal is bent carried by the support plate with its longer diameter positioned parallel to the guideway which extends across the table, an ironer for holding the work against the working face of the die during the bending operation, the said die support plate having a guideway extending transversely of the guideway in the said table, and a fixed pin having a block swiveled thereon which slidably engages the said support plate in the said guideway, the said pin and block being offset from the center of rotation of the table whereby as the table rotates the die support plate reciprocates in the said guideway to facilitate travel of the ironer along the working face of the die.

11. A metal bending machine comprising in combination a base, a table rotatably mounted on the base, a guideway extending across the table having a plurality of rollers rotatably mounted in the bottom of the guideway and a plurality of rollers mounted with their axes inclined along the side of the guideway, a die supporting plate with inclined side faces reciprocably carried upon the said rollers in the bottom of the guideway and having the inclined side faces in rolling engagement with the rollers along the sides of the said guideways, a die having a working face about which the metal is bent carried by the support plate with its longer diameter positioned parallel to the guideway which extends across the rotatable table, an ironer for holding the work against the working face of the die during the bending operation, the said die support plate having a guideway extending transversely of the guideway in the said rotatable table, and a fixed pin having a block swiveled thereon which slidably engages the said die support plate in the said guideway, the said pin and block being offset from the center of rotation of the table whereby as the table rotates the die support plate reciprocates in the said guideway to facilitate the travel of the ironer along the working face of the die.

OTTO H. JENSEN.