May 11, 1948. S. E. KEAGLE 2,441,275

MACHINE FOR BENDING ARTICLES

Filed Oct. 14, 1944 4 Sheets-Sheet 1

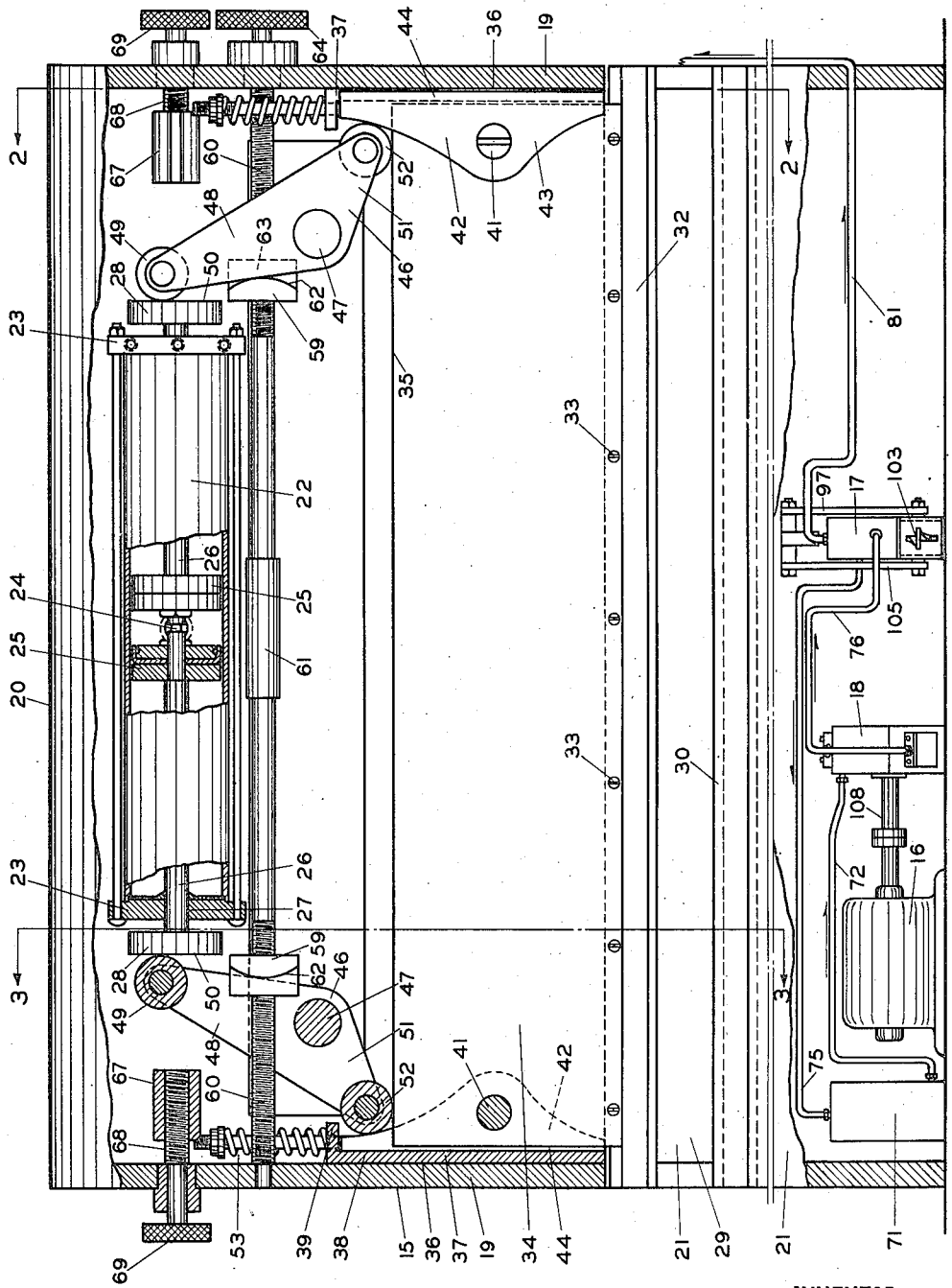


FIG. 1

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MACHINE FOR BENDING ARTICLES

Filed Oct. 14, 1944 4 Sheets-Sheet 2

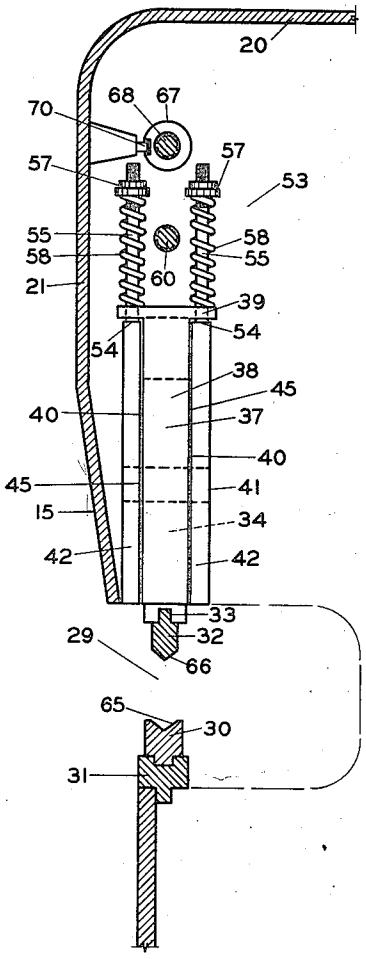


FIG. 2

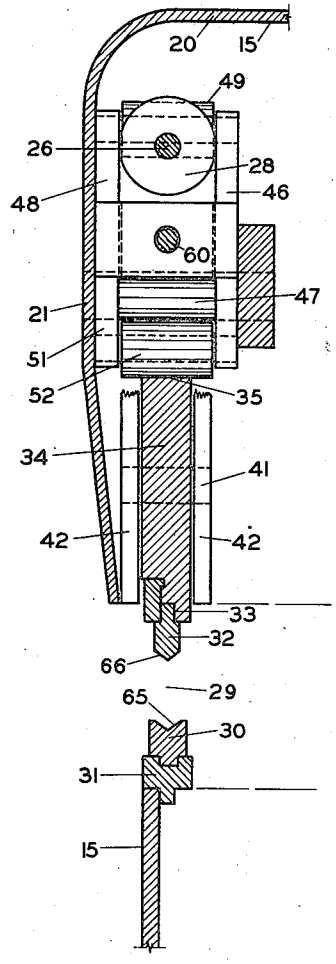


FIG. 3

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MACHINE FOR BENDING ARTICLES

Filed Oct. 14, 1944 4 Sheets-Sheet 3

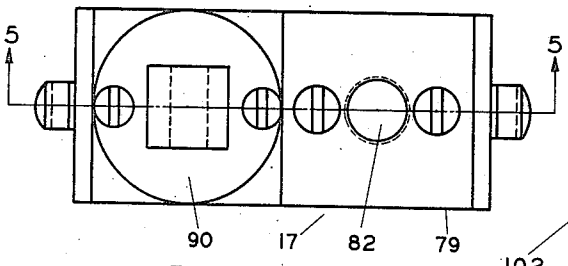


FIG. 4

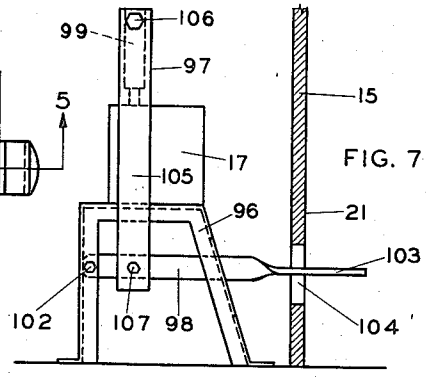


FIG. 7

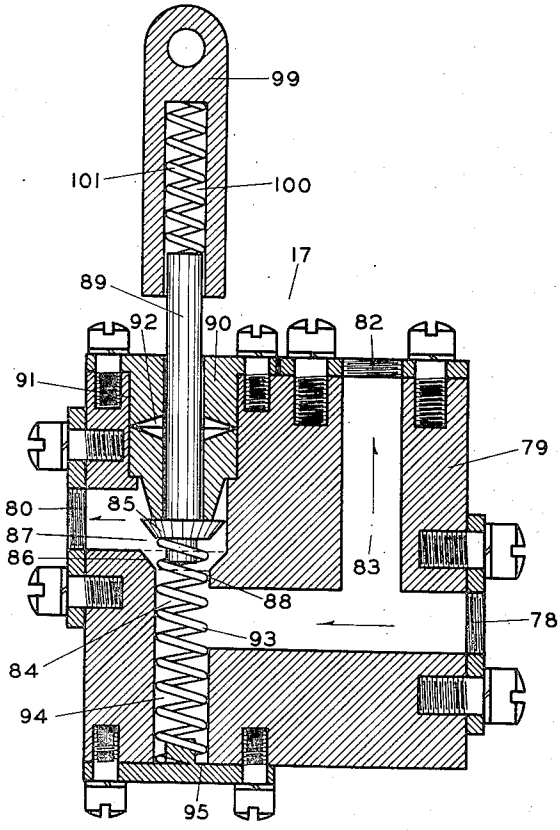


FIG. 5

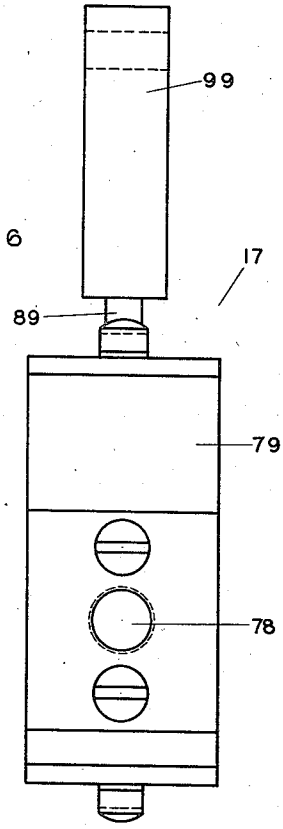


FIG. 6

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MACHINE FOR BENDING ARTICLES

Filed Oct. 14, 1944 4 Sheets-Sheet 4

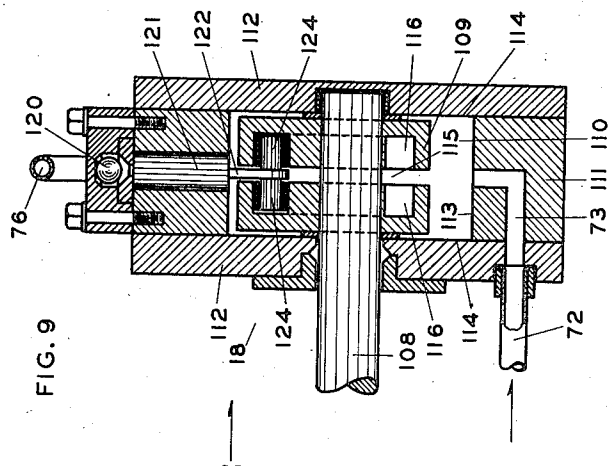


FIG. 9

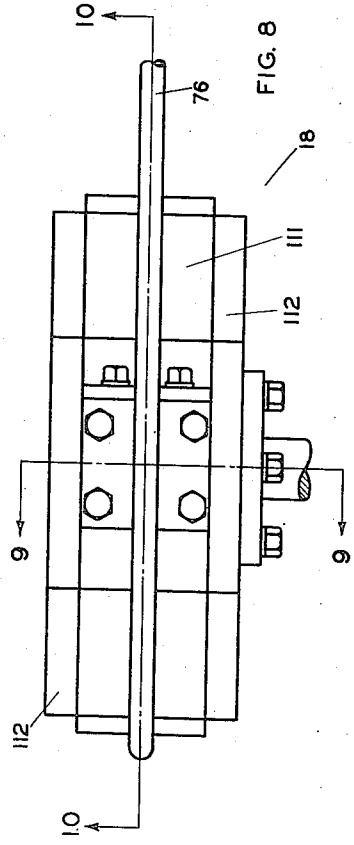


FIG. 8

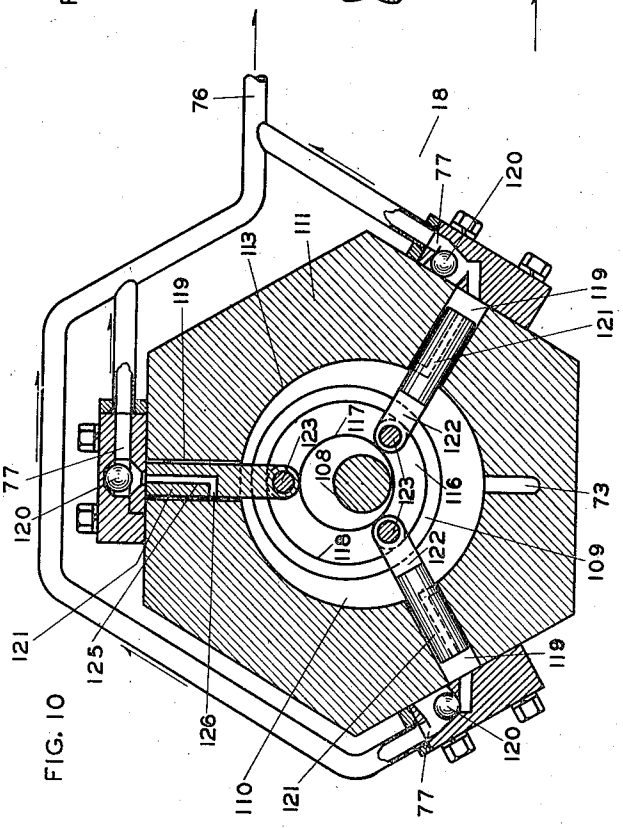


FIG. 10

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UNITED STATES PATENT OFFICE

2,441,275

MACHINE FOR BENDING ARTICLES

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Application October 14, 1944, Serial No. 558,778

11 Claims. (Cl. 153—21)

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This invention has relation to a machine for bending articles of a great many different varieties, and presents a machine including mechanism adapted to be operative upon articles to cause them to be shaped to any desired configurations suitable to their intended purposes. The word "bending" as employed herein is intended in a broad sense, as including twisting, shaping, straightening, etc.

An object of the invention is to provide a machine for bending articles which will be of novel and improved construction.

A further object is to provide a machine of the present character wherein will be incorporated various improved features and characteristics of construction novel both as individual entities of the machine and in combination with each other.

A further object is to provide an article bending machine which will be a vast improvement over machines for accomplishing the same general purposes.

And a further object is to provide a machine for bending articles which will incorporate features and characteristics of construction as hereinafter set forth.

With the above objects in view, as well as others which will appear as the specification proceeds, the invention comprises the construction, arrangement and combination of parts as now to be fully described and as hereinafter to be explicitly claimed, it being understood that the disclosure herein is merely illustrative and intended in no way in a limiting sense, changes in details of construction and arrangement of parts being permissible so long as within the spirit of the invention and the scope of the claims which follow.

In the accompanying drawings forming a part of this specification,

Fig. 1 is a front elevational view, partially in section and partially broken away, of a machine for bending articles made according to the invention.

Fig. 2 is a detail sectional view, taken as on line 2—2 in Fig. 1;

Fig. 3 is a detail sectional view, taken as on line 3—3 in Fig. 1;

Fig. 4 is an enlarged plan view of a valve housing with valve of the machine as when removed from the remainder thereof;

Fig. 5 is a sectional view of the disclosure of Fig. 4, taken on line 5—5 in said Fig. 4;

Fig. 6 is an end elevational view of the disclosure of Fig. 5 as it would appear from the right;

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Fig. 7 is a detail view disclosing the valve housing with valve in side elevation, a support and operating means for the valve of said valve housing, likewise in side elevation, and also disclosing, in section, a fragment of the frame at the front of the machine adjacent said valve housing with valve, said support and said operating means;

Fig. 8 is an enlarged end elevational view of a pump of the machine as when removed from the remainder thereof;

Fig. 9 is a transverse sectional view of the pump, taken on line 9—9 in Fig. 8; and

Fig. 10 is a longitudinal sectional view of said pump, taken on line 10—10 in said Fig. 8.

A frame 15 of the machine is adapted to be rested upon a floor or other supporting surface, and said frame desirably may enclose an electric motor 16, a valve housing with valve 17 and a pump 18 of said machine. As disclosed, the frame 15 includes spaced apart, vertical, parallel end walls 19, 19, a top wall 20, and spaced apart, substantially vertical, parallel front and rear walls 21, 21. Also as disclosed, the electric motor 16, the valve housing with valve 17 and the pump 18 are situated between the end walls 19, 19 and the front and rear walls 21, 21 and are rested upon the floor or surface supporting the frame 15. Said frame 15 is open at its lower portion. In the disclosure as made, the top wall 20 merges smoothly into the front and rear walls 21, 21, and said top, front and rear walls extend between and are rigid with the end walls 19, 19 thus to cause the frame to be stably situated in upright position.

A horizontal cylinder 22 is rigidly supported, in any suitable and convenient manner, within and upon the frame 15, between the ends walls 19, 19 and the front and rear walls 21, 21, and said horizontal cylinder is as shown beneath and adjacent to the top wall 20 and in considerably spaced relation to the electric motor 16, the valve housing with valve 17 and the pump 18. The horizontal cylinder 22 is disposed in perpendicular relation to the end walls 19, 19, and as disclosed said horizontal cylinder is spaced at equal distance from each of said end walls.

Closure heads for the opposite ends of the horizontal cylinder 22 are denoted 23, 23, and said horizontal cylinder includes an opening 24 at location intermediate its ends for permitting the passage of oil or other fluid into and out of the horizontal cylinder. Said opening 24 is desirably situated at the midlength of said horizontal cylinder 22, and the horizontal cylinder is closed save for the opening 24.

Each of a pair of pistons, snugly slidable within

the horizontal cylinder 22, is designated 25, and the construction and arrangement will be such that at all times the pistons 25, 25 will be at opposite sides of the opening 24, as said pistons are disclosed in Fig. 1 of the drawings. A connecting rod on each piston 25 is represented 26, and the connecting rods 26, 26 extend outwardly from the pistons 25, 25 and pass, as at 27, through the closure heads 23, 23. As shown, the connecting rods 26, 26 are of equal length. Said connecting rods are slidably disposed in the cylinder closure heads, and the outer end of each connecting rod rigidly supports a thrust member 28 situated in spaced relation to the adjacent end wall 19. The pistons 25, 25, the connecting rods 26, 26 and the thrust members 28, 28 are all in alined relation at the longitudinal axis of the horizontal cylinder 22.

The front wall 21 of the frame 15 is cut away to provide a longitudinal passage 29 extending horizontally from end to end of the machine, and a horizontal stationary die 30 at the rear of said longitudinal passage 29 is rigidly supported, as at 31, upon a lower portion of the front wall 21. The stationary die 30 is situated at location somewhat above the electric motor 16, the valve housing with valve 17 and the pump 18 and considerably below the horizontal cylinder 22, and as shown said stationary die is parallel with said horizontal cylinder.

A substantially horizontal movable die 32, complemental to the stationary die 30, is fixedly carried, as denoted at 33, by a substantially horizontal block 34 which spans the major portion of the distance between the end walls 19, 19 of the frame 15. The horizontal block 34 is of rectilinear configuration, and the movable die 32 is as disclosed below and vertically alined with said horizontal block. A flat, substantially horizontal upper surface of the horizontal block 34 is denoted 35.

The inner surfaces 36, 36 of the end walls 19, 19 rigidly support, in any suitable and convenient manner, oppositely disposed, stationary guide elements 37, 37, and each of said stationary guide elements 37 is constituted as an L-shaped piece including a relatively long, vertical leg 38 and a comparatively short, horizontal leg 39. The opposite side edges 40, 40 of the vertical leg 38 of each stationary guide element 37 are parallel with each other and are perpendicular to the horizontal leg 39 of the corresponding stationary guide element 37.

Each of the opposite end portions of the substantially horizontal block 34 is pivotally connected, as at 41, to oppositely disposed, movable guide elements 42, 42, including a movable guide element 42 of each set of movable guide elements at the front and a movable guide element 42 of each set at the rear of said substantially horizontal block 34. The movable guide elements 42, 42 of each set of movable guide elements are parallel, and each movable guide element 42 is retained by the corresponding pivotal connection, at 41, in contiguous relation with or closely adjacent relation to the substantially horizontal block 34.

Each movable guide element 42 is as shown a flat strip of material and includes a curvilinear inner portion 43 overlapping the adjacent end portion of the substantially horizontal block 34 and receiving the connecting means 41, which connecting means is situated at the midwidth of said substantially horizontal block and at the midlength of the corresponding movable guide element, and each movable guide element 42 also includes a guide portion 44 thereof which extends beyond the corresponding end of the substantially horizontal block. The inner surfaces 45, 45 of the guide portions 44, 44 are parallel with each other and with the opposite side edges 40, 40 of the vertical leg 38 of the stationary guide element 37 at the corresponding end of the frame 15.

The overall distance between the inner surfaces 45, 45 of the guide portions 44, 44 of each set of movable guide elements 42, 42 is a trifle greater than a measurement representing the width of the vertical leg 38 of each guide element 37, which vertical legs 38 are as disclosed of equal width, and the guide portions 44, 44 of each set of movable guide elements overlie the opposite side edges 40, 40 of the vertical leg 38 of the stationary guide element 37 at the corresponding end of said frame 15.

The construction and arrangement are such that when the stationary and movable guide elements are assembled, in the manner as before set forth, the substantially horizontal block 34 will be mounted upon the end walls 19, 19 of the frame for vertical sliding movement, as will be apparent. Said substantially horizontal block 34 is disposed in spaced, parallel relation to the horizontal cylinder 22, between said horizontal cylinder and the stationary die 30. Stated otherwise, the substantially horizontal block 34 is below and suitably spaced from the horizontal cylinder 22, and the movable die 32, carried by said substantially horizontal block, is above and suitably spaced from the stationary die 30.

As will be clear from Fig. 1 of the drawings, the overall length of the substantially horizontal block 34 is less than a measurement representing the distance between the vertical legs 38, 38 of the oppositely disposed stationary guide elements 37, 37, so that the machine includes provision for relative rocking or swinging movement between each of the opposite end portions of said substantially horizontal block and the movable guide elements 42, 42 at the corresponding end of the frame 15. That is to say, the substantially horizontal block 34 is mounted to be capable of having rocking or swinging movement in a vertical plane disposed longitudinally of said substantially horizontal block, as well as to be capable of having upward and downward movement in the machine.

Speaking generally, the substantially horizontal block 34 and the movable die 32 carried thereby are adapted to be depressed, or moved toward the stationary die 30, in response to pressure of oil or other fluid forced into the horizontal cylinder 22 by way of the opening 24, and to be elevated, or moved away from said stationary die, in response to resiliently actuated mechanism. And each of the opposite end portions of the substantially horizontal block 34 is adapted to be independently actuated both during depression and elevation of said substantially horizontal block.

To the end that the substantially horizontal block 34 can be depressed in response to pressure of oil or other fluid in the horizontal cylinder 22, a pair of rocker arms, each denoted 46, are suitably and conveniently mounted, as at 47, upon the frame of the machine for vertical swinging movement. As will be clear from Fig. 1, there is a rocker arm 46 adjacent and at the outer side of each thrust member 28. A longer, upper leg 48 of each rocker arm 46, above the pivotal connection 47, rotatably supports a roller 49 engaged

against the flat outer surface 50 of the thrust member 28 at the corresponding end of the machine, and a shorter, lower leg 51 of each rocker arm 46, below the pivotal connection 47, rotatably supports a roller 52 engaged against a portion of the flat upper surface 35 adjacent the corresponding end of the substantially horizontal block 34. The rollers 49, 49 are as shown disposed inwardly of the pivotal connections 47, and the rollers 52, 52 are disposed outwardly of said pivotal connections. Clearly, pressure within the hollow cylinder 22, by reason of oil or other fluid forced into said hollow cylinder through the opening 24 to location between the pistons 25, 25, will have tendency toward causing the thrust members 28, 28 to be moved outwardly, and outward movement of said thrust members will cause the upper legs 48, 48 of the rocker arms 46, 46 also to be swung or moved outwardly, thus to cause the lower legs 51, 51 of said rocker arms to be swung or moved downwardly, as well as inwardly. And, evidently, downward and inward movement of said lower legs 51 will cause the opposite end portions of the substantially horizontal block 34 to be depressed.

To the end that the substantially horizontal block 34 can be elevated in response to resiliently actuated mechanism, a pair of sets of resilient actuating devices, each denoted 53, are suitably and conveniently fixed, as at 54, upon the movable guide elements 42, 42 of the sets of movable guide elements. There is a set 53 of resilient actuating devices at each end of the frame 15. More explicitly, each set 53 of resilient actuating devices includes a pair of spaced apart posts 55 each rigid or integral with a movable guide element 42 and extending upwardly therefrom. Each upright post 55 passes upwardly from its corresponding movable guide element through an opening in the horizontal leg 39 of the stationary guide element 37 at the corresponding end of the machine and fixedly supports a limit piece 57 upon its upper end portion. As shown, the limit pieces 57 are nuts threaded upon the upper end portions of the upright posts 55. A coil spring 58 upon each upright post 55 and under compression between the corresponding limit piece 57 and the horizontal leg 39 at the corresponding end of the machine has potential normally to urge the limit pieces 57 upwardly, away from said horizontal legs 39, thus to cause the opposite end portions of the substantially horizontal block normally to be situated at elevated position. The coil springs 58, 58, 58, 58 will be of sufficient and substantially equal strength to cause the opposite end portions of said substantially horizontal block 34 to be elevated simultaneously when pressure in the horizontal cylinder 22 is relieved after depressing operation of the substantially horizontal block 34 by oil or other fluid under pressure is accomplished.

Evidently, the extent of upward movement permitted the substantially horizontal block 34 can be limited by engagement of the upper ends of the movable guide elements 42 with the lower surfaces of the horizontal legs 39, or by engagement of the thrust members 28 with the cylinder closure heads 23. But in practical operation of a machine of the present general character it is desirable that the extent of upward movement permitted the movable die be adjustable. In the disclosure as made, the extent of upward movement of the substantially horizontal block 34, and hence of the movable die 32, is limited by engagement of the upper legs 48, 48 of the rocker

arms 46, 46 with stops 59, 59 upon threaded members 60, 60. Outer end portions of the threaded members 60, 60 are rotatably mounted and fixed against longitudinal movement in the end walls 19, 19 of the frame 15, and inner end portions of said threaded members 60, 60 are rigidly connected as at 61. Each stop 59, 59 includes a curvilinear, outwardly facing surface 62 adapted to be engaged by the inner edge of the upper leg 48 of the rocker arm 46 at the corresponding end of the machine, and each stop 59, 59 also includes a surface 63 adjacent and at the outer side of the curvilinear surface 62 situated contiguous with a side surface of the corresponding rocker arm. A knurled head 64 upon one of the threaded members 60 and disposed to be accessible can be manually rotated thus to cause both threaded members 60, 60 to be rotated. One of the threaded members 60 has a right thread and the other threaded member 60 has a left thread. Both stops 59, 59 will be caused to move inwardly in response to rotation of the knurled head 64 in one direction, and both stops 59, 59 will be caused to move outwardly in response to rotation of said knurled head 64 in opposite direction. Outward adjustment of the stops 59, 59 will of course be accomplished against resilient action of the coil springs 58. The extent of upward movement permitted the substantially horizontal block 34 will be increased with inward adjustment of the stops 59, 59 and will be decreased with outward adjustment of said stops 59, 59.

In the illustrated embodiment of the invention, the working surfaces 65 and 66 of the stationary and movable dies 30 and 32, respectively, are complemental. Evidently, the extent of downward movement permitted the substantially horizontal block 34, and hence the movable die 32, will be limited by engagement of the working surface 66 against metal or material upon the working surface 65 when the metal or material becomes bent to the full extent dictated by the shapes of said complemental dies 65 and 66. But in practical operation it may be desirable that the extent of downward movement permitted the movable die be adjustable. In the disclosure as made, the extent of downward movement of the substantially horizontal block 34, and hence of the movable die 32, is limited by engagement of the outer edges of the upper legs 48, 48 of the rocker arms 46, 46 with stops 67, 67 upon threaded members 68, 68. Outer end portions of the threaded members 68, 68 are rotatably mounted and fixed against longitudinal movement in the end walls 19, 19 of the frame 15, and inner end portions of said threaded members 68, 68 carry said stops 67, 67. A knurled head 69 upon each threaded member 68 and disposed to be accessible can be manually rotated thus to cause the corresponding threaded member 68 to be rotated. The stops 67, 67, while free to move longitudinally along the threaded members 68, 68, are fixed, as at 70, against turning movement when said threaded members 68, 68 are rotated. Each stop 67 will be caused to move inwardly in response to rotation of the corresponding knurled head 69 in one direction and to move outwardly in response to rotation of the corresponding knurled head in opposite direction. The extent of downward movement permitted the substantially horizontal block 34 and the movable die 32 will be decreased with inward adjustment of the stops 67, 67 and will be

increased with outward adjustment of said stops 67, 67.

It will be apparent that the presence of mechanism for adjustably limiting the extent of downward movement of the movable die in a machine of the present character is provision whereby bending operations which need not necessarily be those dictated by the shapes of the complemental stationary and movable dies, such as 30 and 32, of said machine can be accomplished. That is to say, by causing the extent of downward movement of a movable die, such as 32, to be adjustably limited to different positions above the position where complemental stationary and movable dies, such as 30 and 32, would dictate the shapes of the bends, metal or material can be bent to varying degrees, extents or shapes. By way of explanation, metal or material bent by the working surfaces 65 and 66 of the stationary and movable dies 30 and 32 will, when said dies are brought together to accomplish the greatest possible bending of the metal or material, have a substantially right angular bend, but in instances where downward movement of the movable die 32 is checked short of position to accomplish a right angular bend, the metal or material will have a bend which is less than right angular.

The stops 67, 67 are alined with the horizontal cylinder 22 and are situated above and outwardly of the stops 59, 59. Evidently, said stops 67, 67, being separately and independently adjustable, can be situated so as to be equally spaced from the horizontal cylinder 22 or unequally spaced from said horizontal cylinder. In instances where metal or material to be bent to extent less than that dictated by the shapes of the working surfaces of the stationary and movable dies is of uniform thickness at its opposite end or side portions, the stops 67, 67 will be adjusted to be equally spaced from the horizontal cylinder 22, and in instances where metal or material to be bent to extent less than that dictated by the shapes of the working surfaces of the stationary and movable dies is of different thicknesses at its opposite end or side portions, said stops 67, 67 will be adjusted to be unequally spaced from said horizontal cylinder 22. The difference in spacing will correspond to the amount of difference between the magnitudes of the thicknesses at said opposite end or side portions of the metal or material, as will be understood. And, too, the stops 67, 67 will be unequally spaced from the horizontal cylinder 22 when it is desired to cause unequal bending of the opposite end or side portions of metal or material. Simply stated, the stops 67, 67 are adapted to be adjusted to positions intended to permit accomplishment of the bends desired.

A reservoir 71 for oil or other fluid is as disclosed situated within the frame 15 at location adjacent the electric motor 16. A pipe connection 72 leads from a lower portion of the reservoir 71 to an inlet 73 of the pump 18, and a pipe connection 75 leads to an upper portion of said reservoir. A pipe connection 76 leads from outlets 77 of said pump 18 to an inlet 78 of a valve housing 79 of the valve housing with valve 17, and the pipe connection 75 leads from an outlet 80 of said valve housing 79. A pipe connection 81 leads from an outlet 82 of the valve housing 79 to the opening 24 in the horizontal cylinder 22.

The valve housing 79 includes a fluid passageway 83 connecting the inlet 78 with the outlet 82 and a controlled fluid passageway 84 for selectively connecting the inlet 78 and the fluid passageway 83 with and disconnecting said inlet 78 and said fluid passageway 83 from the outlet 80. Mechanism for controlling the fluid passageway 84 includes a valve 85 adapted to be engaged with a valve seat 86 surrounding said fluid passageway 84 thus to disconnect the inlet 78 from said outlet 80 and to be removed from the valve seat 86 thus to cause said inlet 78 and the outlet 80 to be communicatively connected. The valve seat 86 is at the base of a concavity 87 of the fluid passageway 84 in surrounding relation to a port 88 of said last mentioned fluid passageway and at the side of said port 88 opposite the inlet 78 and adjacent the outlet 80. A valve stem 89 for the valve 85 is slidable in a closure plug 90 for the portion of the fluid passageway 84 which is constituted as the concavity 87. Said closure plug 90 is snugly fitted into an opening 91 in the valve housing 79 and is situated in alinement with the port 88, at the side of said port adjacent the outlet 80. The closure plug 90 consists of two pieces of material between which a gasket 92 is positioned in surrounding relation to the valve stem 89. A coil spring 93, situated in the fluid passageway 84 and in a pocket 94 of the valve housing 79 contiguous with said fluid passageway 84, is under compression between the bottom wall 95 of said pocket 94 and the valve 85 normally to retain said valve in open position and against the inner end of the closure plug 90, as the valve is disclosed in Fig. 5 of the drawings.

A support for the valve housing 79 is denoted 96, and operating means for the valve 85 includes a yoke 97 and an actuating lever 98. The base 99 of said yoke 97 includes a pocket 100 which receives the outer end portion of the valve stem 89, and a coil spring 101, stronger than the coil spring 93, is situated in said pocket and confined between the bottom wall of the pocket and the outer end of the valve stem. The inner end of the actuating lever 98 is pivotally connected, as at 102, to a portion of the support 96 situated below and in spaced relation to the valve housing 79, and the outer end portion 103 of said actuating lever 98 extends forwardly through an elongated slot 104 in a lower portion of the front wall 21 of the frame 15 to be conveniently accessible. Legs 105, 105 of the yoke 97 are pivotally connected, as at 106, to the base 99 of said yoke and are pivotally connected, as at 107, to an intermediate portion of the actuating lever 98. Said yoke 97 will evidently become depressed in response to downward swinging movement of the outer end portion 103 of the actuating lever 98, and depression of the yoke a sufficient distance will evidently cause the valve 85 to become seated under resilient pressure against the valve seat 89. The coil spring 93 will cause said valve 85 to be moved to open position, as in Fig. 5, immediately upon release of the yoke 97. In the disclosure as made, the outer end portion 103 of the actuating lever 98 is constituted as a pedal for foot operation.

The pump 18 is of rotary type. The electric motor 16 includes a shaft 108 for driving a rotor 109 of said pump 18 situated within a pump chamber 110 of the pump. When said pump 18 is operated, oil or other fluid will be caused to be drawn into the pump chamber 110 from the reservoir 71, through the pipe connection 72 and the pump inlet 73, and forced from said pump chamber into the valve housing 79, through the outlets 77, the pipe connection 76 and the valve housing inlet 78. When the valve 85 is in open

position, oil or other fluid forced by the pump will flow back to the reservoir 71, through the fluid passageway 84 and the pipe connection 75. When said valve 85 is in closed position, oil or other fluid forced by the pump will be driven under pressure into the horizontal cylinder 22, through the valve housing outlet 82, the pipe connection 81 and the opening 24. Return flow of oil or other fluid from the horizontal cylinder 22 back to the valve housing 79 will occur when the valve 85 is moved to open position. Said return flow will be through the outlet 24, the pipe connection 81 and the outlet 82, then serving as an inlet, of said valve housing 79. The coil springs 58, 58, 58, 58 are of sufficient strength both to cause the horizontal block 34 to be elevated when the valve 85 is opened and to cause oil or other fluid to be forced out of the horizontal cylinder 22. Evidently, oil returned to the valve housing 79 from the horizontal cylinder 22 will, when in sufficient amount, flow back to the reservoir 71, through the outlet 80 and the pipe connection 75.

The pump chamber 110 of the pump 18 is provided by a casing 111 having closure heads 112, 112 upon its opposite ends. As to its circumference, said pump chamber is defined or bounded by an internal cylindrical wall 113 which the casing 111 provides, and as to its depth, the pump chamber is defined or bounded by adjacent flat surfaces 114, 114 of the closure heads 112, 112.

The motor shaft 108 is mounted in said closure heads 112, 112 of the pump 18 and extends across the pump chamber 110 in concentric relation to the internal cylindrical wall 113 of said pump chamber. The rotor 109 of said pump is fixed upon said motor shaft 108 to rotate therewith, and said rotor 109 has diameter less than that of said internal cylindrical wall or surface 113 of the pump chamber 110. As disclosed, the rotor 109 consists of two separate pieces of metal each of which is fixed upon the motor shaft 108, and there is a radial slot 115 between the two separate pieces of said rotor. Said radial slot 115 is perpendicular to the motor shaft and is open at its outer portion to the pump chamber 110 throughout the whole of the circumference of the rotor 109.

Each of the two separate pieces of metal constituting the rotor 109 is interiorly cut away to provide a cylindrical slot 116 at either side of the radial slot 115 and eccentric to the motor shaft 108, as well as to the internal cylindrical wall or surface 113 of the pump chamber 110. The cylindrical slots 116, 116 face each other and are in alinement to together constitute a hollow cylindrical eccentric impeller of the rotor defined or bounded at its interior by external cylindrical surfaces 117, 117 defining or bounding the inner sides of the cylindrical slots 116, 116, and defined or bounded at its exterior by internal cylindrical surfaces 118, 118 defining or bounding the outer sides of said cylindrical slots 116, 116 and concentric to said external cylindrical surfaces 117, 117.

As disclosed, the pump 18 includes three pump cylinders 119 spaced at 120 degrees apart about the pump casing, although said pump could include a different number of cylinders. The pump chamber 110 is open to the inner ends of the pump cylinders 119, and the outer ends of said pump cylinders open to the outlets 77 from the pump. Each of said outlets 77 is controlled in ordinary or preferred manner by a check valve 120.

A pump plunger 121 is slidable in each pump

cylinder 119, and each pump plunger 121 rigidly or integrally supports an attachment piece 122. The attachment pieces 122 are situated at the inner ends of and alined with the pump plungers 121, and as disclosed each attachment piece 122 is disposed within the radial slot 115 to be capable of having reciprocatory movement in said radial slot. A cross pin 123 in the inner end of each attachment piece 122 supports a pair of rollers 124, 124 situated at opposite sides of the attachment piece. The rollers 124, 124 upon the different attachment pieces, or, more accurately, upon the cross pins 123 in the attachment pieces, lie in the cylindrical slots 116, 116 at the opposite sides of the radial slot 115. As will be clear from Figs. 9 and 10 of the drawings, the cylindrical slots 116, 116 are of equal width and each roller 124 is of diameter to substantially span the width of the cylindrical slot within which located. Evidently, the pump plungers 121 will be reciprocated in the pump cylinders 119 in response to rotation of the rotor 109 and its eccentric impeller, constructed and arranged as hereinbefore set forth.

A longitudinal slot 125 in the outer end portion of each pump plunger 121 is open at its outer end to the outer end of the pump plunger and merges at its inner end in a transverse slot 126 which extends outwardly to the side wall of said pump plunger. Each transverse slot 126 is in considerably spaced relation to the outer end of the corresponding pump plunger as disclosed, and the construction and arrangement are such that each transverse slot is situated to be in communication with the pump chamber 110 during each interval the corresponding pump plunger 121 is at and closely adjacent to the limit of its innermost position in the corresponding pump cylinder 119 during operation of the pump 18 and to be along the length of the wall of said corresponding pump cylinder, out of communication with said pump chamber 110, at all other times.

The inlet 73 to the pump 18 communicates with the pump chamber 110. As each pump plunger approaches its innermost position, its transverse slot 126 will become open to said pump chamber 110. Immediately, oil or other fluid will pass from the pump chamber into the portion of the corresponding pump cylinder beyond the outer end of the corresponding pump plunger. Upon outward movement of each pump plunger to extent causing its transverse slot 126 to be out of communication with the pump chamber 110, oil or other fluid in the portion of the corresponding pump cylinder beyond the outer end of the corresponding pump plunger will be trapped, and upon further outward movement of each pump plunger, trapped oil or fluid will be forced past the corresponding check valve 120 toward the pipe connection 75. The check valves 120 will of course be operative to cause the outlets 77 to be sealed off from the pump cylinders 119 while inward strokes of the pump plungers 121 occur and to cause said pump cylinders to be open to said outlets 77 while outward strokes of said pump plungers are being accomplished.

To the accomplishment of the bending of a piece of material, the operator will press down upon the actuating lever 98 thus to cause the valve stem 89 to be depressed and the valve 85 to be situated to disconnect the inlet 78 and the fluid passageway 83 from the outlet 80. Oil or other fluid under pressure from outlets 77 of the pump 18 will then flow by way of the inlet 78,

the fluid passageway 83 and the pipe connection 81 to the horizontal cylinder 22 thus to cause the substantially horizontal block 34 and the movable die 32 to be moved toward the stationary die 30. Upon completion of bending of the piece of material, the operator will release the actuating lever 93 thus to permit the coil spring 93 to elevate the valve 85 and cause it to be situated to connect the inlet 78 and the outlet 80. Pressure of oil or other fluid will then be relieved in the horizontal cylinder 22, and the coil springs 58 will cause the opposite end portions of the substantially horizontal block 34 and the movable die 32 to be moved away from the stationary die 30.

What is claimed is:

1. The combination with a cylinder, spaced apart pistons within said cylinder and a member to be actuated, of a connecting rod upon each of said pistons, rocker arms including a rocker arm adjacent each of said connecting rods, said member to be actuated having a working surface adjacent each of said rocker arms, a pivotal support for each of said rocker arms, each of said pivotal supports being situated at an intermediate portion of its corresponding rocker arm, a leg of each rocker arm at one side of its pivotal support having engagement with a portion of the connecting rod which is adjacent the rocker arm at location spaced from the corresponding piston and a leg of each rocker arm at the opposite side of its pivotal support having sliding engagement with a working surface of said member adjacent said rocker arm, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons, resiliently actuated mechanism and means for causing pressure of fluid within said cylinder to be relieved, pressure of fluid under pressure within said cylinder being adapted to cause said pistons to have tendency to be moved apart, the legs of said rocker arms engaged with said connecting rods to have tendency to be moved away from said cylinder in direction longitudinally thereof and the legs of said rocker arms engaged with the working surfaces of said member and said working surfaces to have tendency to be moved away from said cylinder in direction transversely thereof against action of the resiliently actuated mechanism and said resiliently actuated mechanism being adapted to cause said member and the legs of said rocker arms engaged against the working surfaces of said member to have tendency to be moved toward said cylinder in direction transversely thereof, the legs of said rocker arms engaged with said connecting rods to have tendency to be moved toward said cylinder in direction longitudinally thereof and said pistons to have tendency to be moved toward each other when pressure of fluid within said cylinder is relieved.

2. The combination with a cylinder, spaced apart pistons within said cylinder, a movable die and a stationary die, of a connecting rod upon each of said pistons, rocker arms including a rocker arm adjacent each of said connecting rods, a working surface rigid with said movable die and adjacent each of said rocker arms, a pivotal support for each of said rocker arms, each of said pivotal supports being situated at an intermediate portion of its corresponding rocker arm, a leg of each rocker arm at one side of its pivotal support having engagement with a portion of the connecting rod which is adjacent the rocker arm at location spaced from the corresponding piston and a leg of each rocker arm at the opposite side of its pivotal support having sliding engagement with a working surface rigid with said movable die and adjacent the rocker arm, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons, resiliently actuated mechanisms, a flexible operative conection between each of said resiliently actuated mechanisms and spaced apart portions of said movable die and means for causing pressure of fluid within said cylinder to be relieved, pressure of fluid under pressure within said cylinder being adapted to cause said pistons to have tendency to be moved apart, the legs of said rocker arms engaged with said connecting rods to have tendency to be moved away from said cylinder in direction longitudinally thereof and the legs of said rocker arms engaged with the working surfaces rigid with said movable die to have tendency to be moved away from said cylinder in direction transversely thereof against action of the resiliently actuated mechanisms and said resiliently actuated mechanisms being adapted to cause spaced apart portions of said movable die and the legs of said rocker arms engaged against the working surfaces of the movable die to have tendency to be moved toward said cylinder in direction transversely thereof, the legs of said rocker arms engaged with said connecting rods to have tendency to be moved toward said cylinder in direction longitudinally thereof and said pistons to have tendency to be moved toward each other upon relief of pressure of fluid within said cylinder.

3. In combination, a frame, a cylinder rigidly supported upon said frame, spaced apart pistons within said cylinder, a movable die, a stationary die, a connecting rod upon each of said pistons, an operative connection between each of said connecting rods and said movable die, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons to cause said pistons to have tendency to be moved apart and said connecting rods to be moved outwardly of said cylinder thus to cause said movable die to be moved in direction toward said stationary die, oppositely disposed stationary guides rigid with said frame, oppositely disposed movable guides adapted to be slid along said stationary guides, means pivotally connecting said movable die and said movable guides with each other for relative swinging movement in a plane extending longitudinally of the movable die, means for causing pressure of fluid within said cylinder to be relieved and a resiliently actuated mechanism urging said movable die in direction away from said stationary die.

4. The combination as specified in claim 3, means for adjustably limiting the extent to which fluid under pressure within said cylinder can cause said movable die to be actuated in direction toward said stationary die, and means for adjustably limiting the extent to which said resiliently actuated mechanisms can cause said movable die to be actuated in direction away from said stationary die.

5. The combination with a cylinder, spaced apart pistons within said cylinder and a member to be actuated, of a connecting rod upon each of said pistons, rocker arms including a rocker arm adjacent each of said connecting rods, said member to be actuated having a working surface adjacent each of said rocker arms, a pivotal support for each of said rocker arms, each of said

pivotal supports being situated at an intermediate portion of its corresponding rocker arm, a leg of each rocker arm at one side of its pivotal support having sliding engagement with a portion of the connecting rod which is adjacent the rocker arm at location spaced from the corresponding piston and a leg of each rocker arm at the opposite side of its pivotal support having sliding engagement with a working surface of said member adjacent said rocker arm, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons, resiliently actuated mechanism and means for causing pressure of fluid within said cylinder to be relieved, pressure of fluid under pressure within said cylinder being adapted to cause said pistons to have tendency to be moved apart, the legs of said rocker arms engaged with said connecting rods to have tendency to be moved away from said cylinder in direction longitudinally and transversely thereof and the legs of said rocker arms engaged with the working surfaces of said member and said working surfaces to have tendency to be moved away from said cylinder in direction longitudinally and transversely thereof against action of the resiliently actuated mechanism and said resiliently actuated mechanism being adapted to cause said member and the legs of said rocker arm engaged against the working surfaces of said member to have tendency to be moved toward said cylinder in direction longitudinally and transversely thereof, the legs of said rocker arms engaged with said connecting rods to have tendency to be moved toward said cylinder in direction longitudinally and transversely thereof and said pistons to have tendency to be moved toward each other when pressure of fluid within said cylinder is relieved.

6. The combination with a cylinder, spaced apart pistons within said cylinder, a movable die and a stationary die, of an operative connection between each of said pistons and spaced apart portions of said movable die, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons to cause said pistons to be moved apart and said spaced apart portions of said movable die to be actuated in direction toward said stationary die, means for causing pressure of fluid within said cylinder to be relieved, resiliently actuated mechanism for causing said spaced apart portions of said movable die to be actuated in direction away from said stationary die and said pistons to be moved toward each other upon relief of pressure of fluid within said cylinder after actuation of said spaced apart portions of the movable die in direction toward the stationary die in response to pressure of fluid under pressure within said cylinder, and means for adjustably limiting the extent to which fluid under pressure within said cylinder can cause said spaced apart portions of said movable die to be actuated in direction toward said stationary die.

7. The combination with a cylinder, spaced apart pistons within said cylinder, a movable die and a stationary die, of a connecting rod upon each of said pistons, rocker arms adapted to be actuated by said connecting rods to cause said movable die to be actuated, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons to cause said pistons to have tendency to be moved apart and said connecting rods to

actuate said rocker arms to cause said movable die to be moved in direction toward said stationary die, oppositely disposed stationary guides, oppositely disposed movable guides adapted to be slid along said stationary guides, means pivotally connecting said movable die and said movable guides to each other for relative swinging movement in a plane extending longitudinally of the movable die, and spaced apart, resiliently actuated mechanisms for urging said movable die in direction away from said stationary die.

8. The combination with a cylinder, spaced apart pistons within said cylinder and a member to be actuated, of a connecting rod upon each of said pistons, rocker arms including a rocker arm adjacent each of said connecting rods, said member to be actuated having a working surface adjacent each of said rocker arms, a pivotal support for each of said rocker arms, each of said pivotal supports being situated at an intermediate portion of its corresponding rocker arm, a leg of each rocker arm at one side of its pivotal support having sliding engagement with a portion of the connecting rod which is adjacent the rocker arm at location spaced from the corresponding piston and a leg of each rocker arm at the opposite side of its pivotal support having sliding engagement with a working surface of said member adjacent said rocker arm, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons, pressure of fluid under pressure within said cylinder being adapted to cause said member to have tendency to be moved away from said cylinder, and resiliently actuated means for causing said member to have tendency to be moved toward said cylinder.

9. The combination as specified in claim 8, wherein said resiliently actuated means is constituted as spaced apart, resiliently actuated mechanisms pivotally connected to said member.

10. In a machine of the character described, a movable die, a stationary die, spaced apart means engageable against said movable die for urging it toward said stationary die, oppositely disposed stationary guides, oppositely disposed movable guides adapted to be slid along said stationary guides, means pivotally connecting said movable die and said movable guides with each other for relative swinging movement in a plane extending longitudinally of the movable die, and spaced apart, resiliently actuated mechanisms for urging said movable die in direction away from said stationary die.

11. The combination with a cylinder, spaced apart pistons within said cylinder, a movable die and a stationary die, of a connecting rod upon each of said pistons, rocker arms adapted to be actuated by said connecting rods to cause said movable die to be actuated, means for causing fluid under pressure to be applied to said pistons at location within said cylinder and between the pistons to cause said pistons to have tendency to be moved apart and said connecting rods to actuate said rocker arms to cause said movable die to be moved in direction toward said stationary die, means for urging said movable die in direction away from said stationary die, and means for adjustably limiting the extent to which fluid under pressure within said cylinder can cause said movable die to be actuated in direction toward said stationary die.

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