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[45] **May 6, 1975**

[54] **DIE SET CLAMPING MECHANISM**

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[51] **Int. Cl.** **B21d 37/12**

[58] **Field of Search** 72/446, 462, 455, 456, 72/447, 448, 481; 29/1.5

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Primary Examiner—C. W. Lanham
Assistant Examiner—Robert M. Rogers
Attorney, Agent, or Firm—Townsend M. Belser, Jr.

[57] **ABSTRACT**

In a metal working apparatus having an upper bolster and a lower bolster arranged for supporting die components for relative movement, a die set clamping mechanism for securing the die components in operative position on the bolsters. The mechanism includes a pair of clamping plates arranged in planar relationship on each bolster with a central gap therebetween and die components secured thereto, opposing sets of releasable clamping devices mounted near opposite edges of each bolster and movable into clamping engagement with the outboard edge portions of each pair of clamping plates, and a central releasable clamping device disposed on each bolster within the central gap and movable into clamping engagement with the inboard edge portions of each pair of clamping plates. The lower clamping plates are supported for sliding movement into and out of the apparatus when the clamping devices are released by roller means recessed within the outer surface of the lower bolster.

14 Claims, 6 Drawing Figures

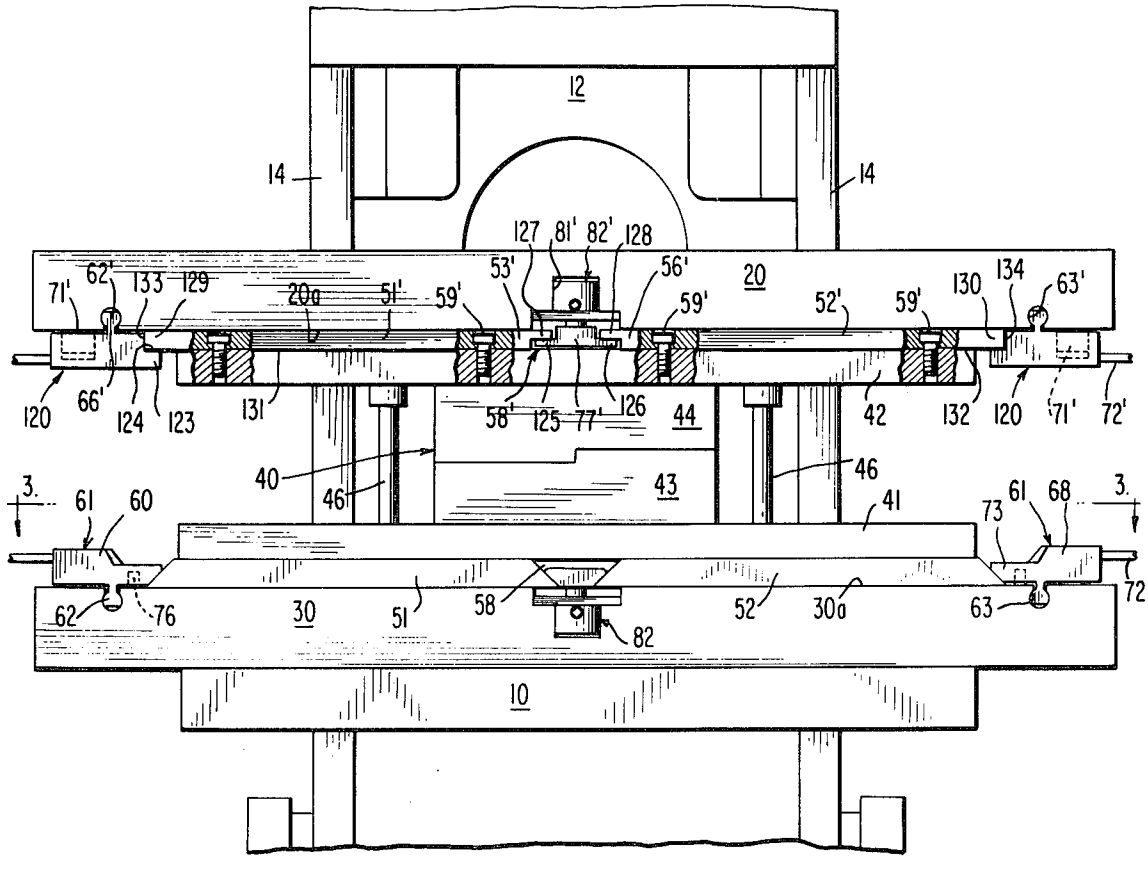


FIG. 1

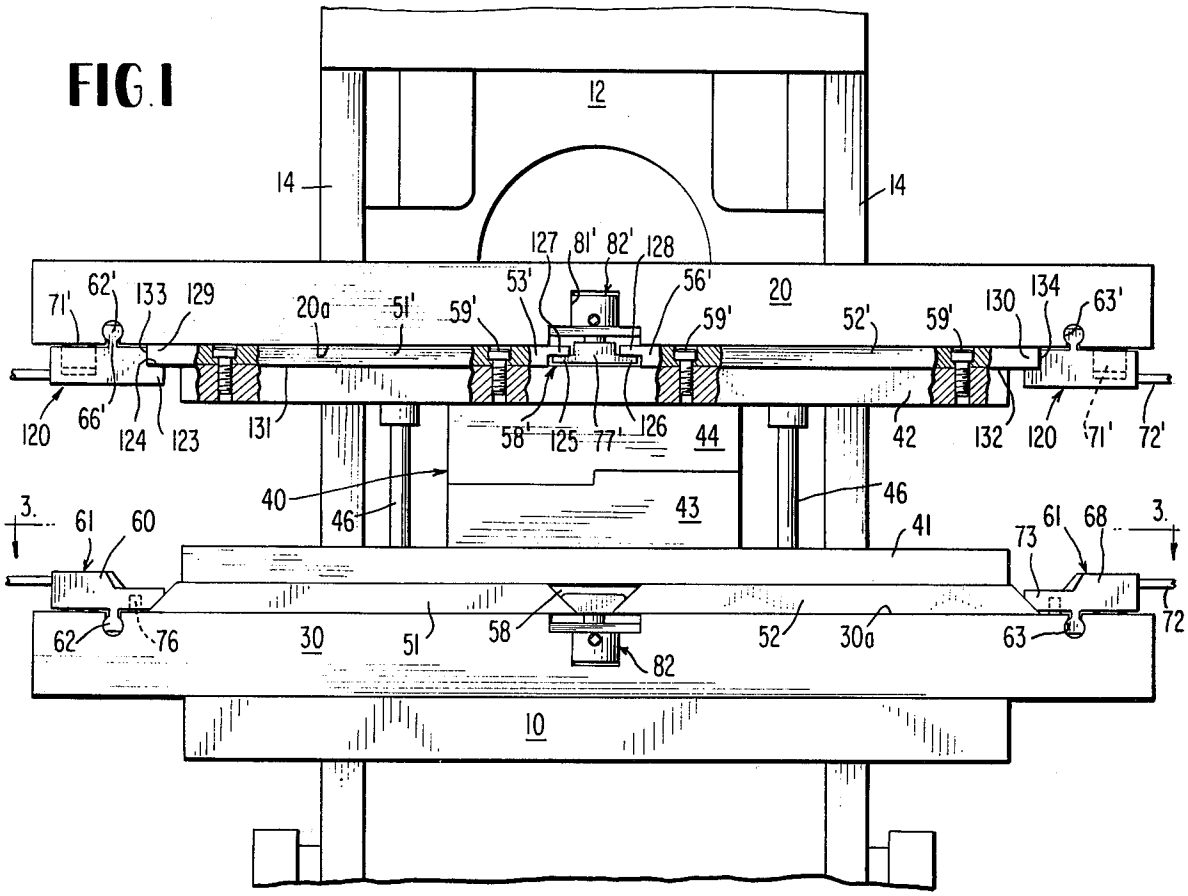
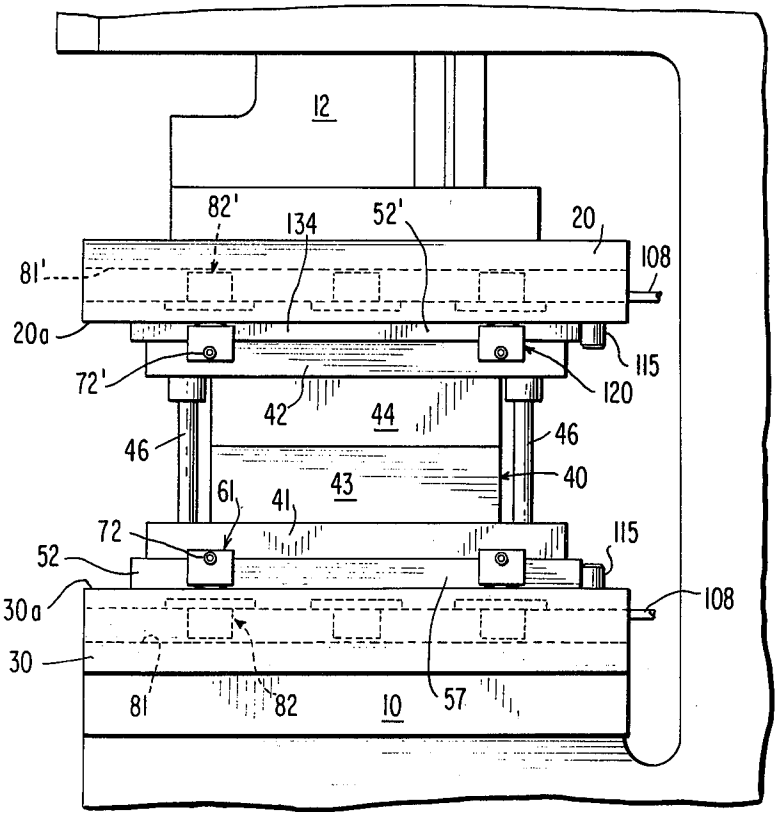

12
14
14
127
81'
82'
128
53'
56'
20
71'
62'
133
129
20a
51'
59'
59'
52'
59'
130
134
63'
120
66'
124
123
131
58'
125
77'
126
44
42
132
120
71'
72'
40
46
43
46
3.
61
60
41
73
61
68
3.
62
76
30
51
58
82
52
30a
63
72
10

FIG. 2


12
82'
134
52'
20
108
81'
20a
115
72'
120
42
44
46
46
43
40
61
41
72
115
52
108
30a
30
81
82
10
57

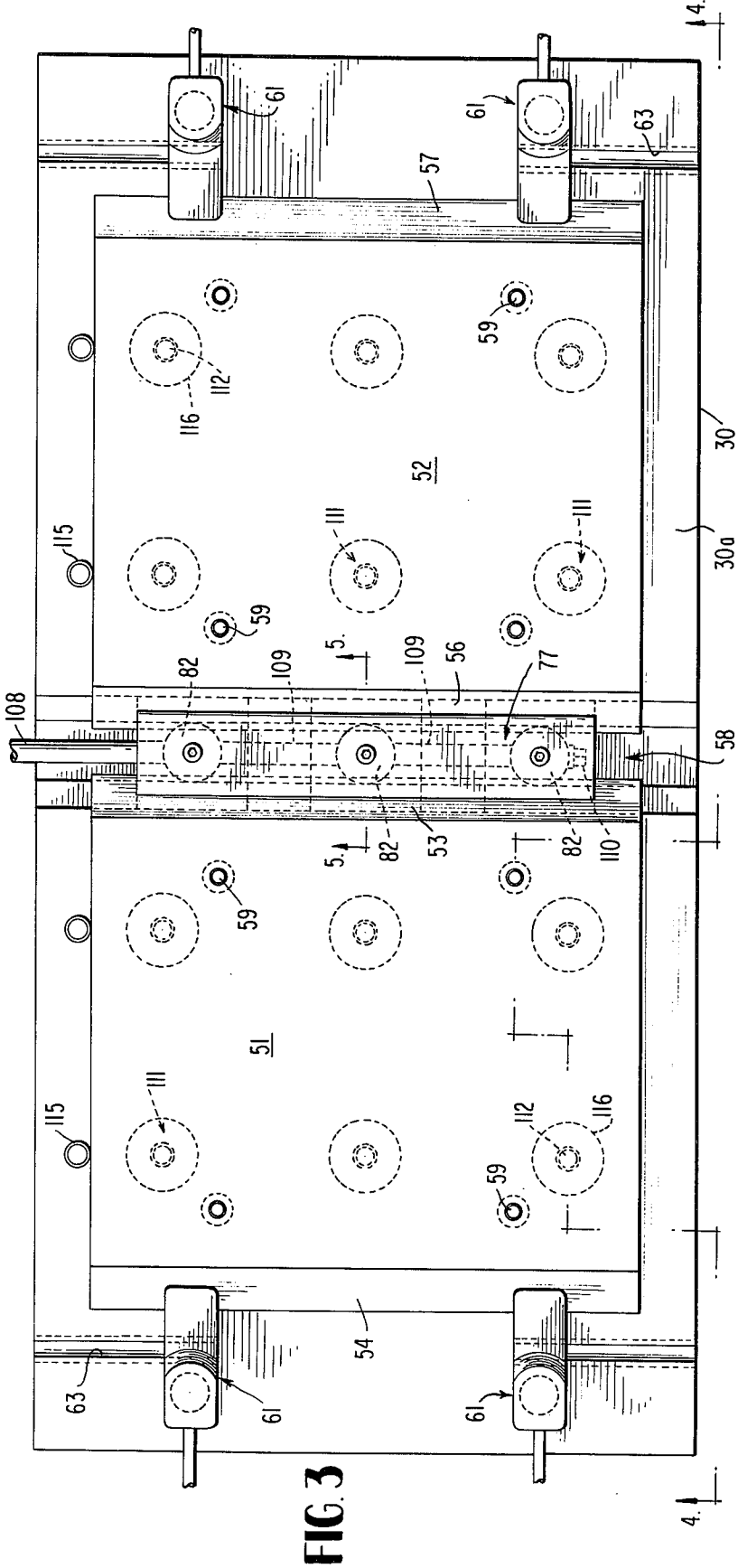


FIG. 3

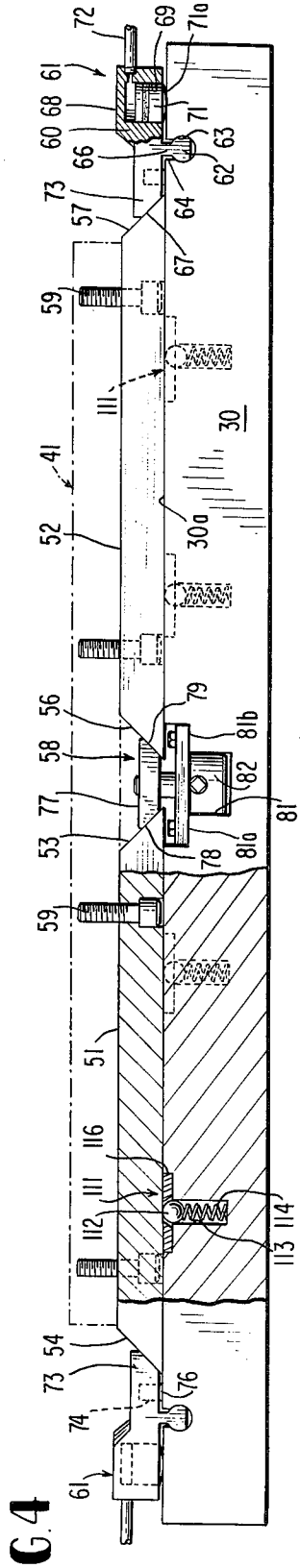


FIG. 4

FIG. 5

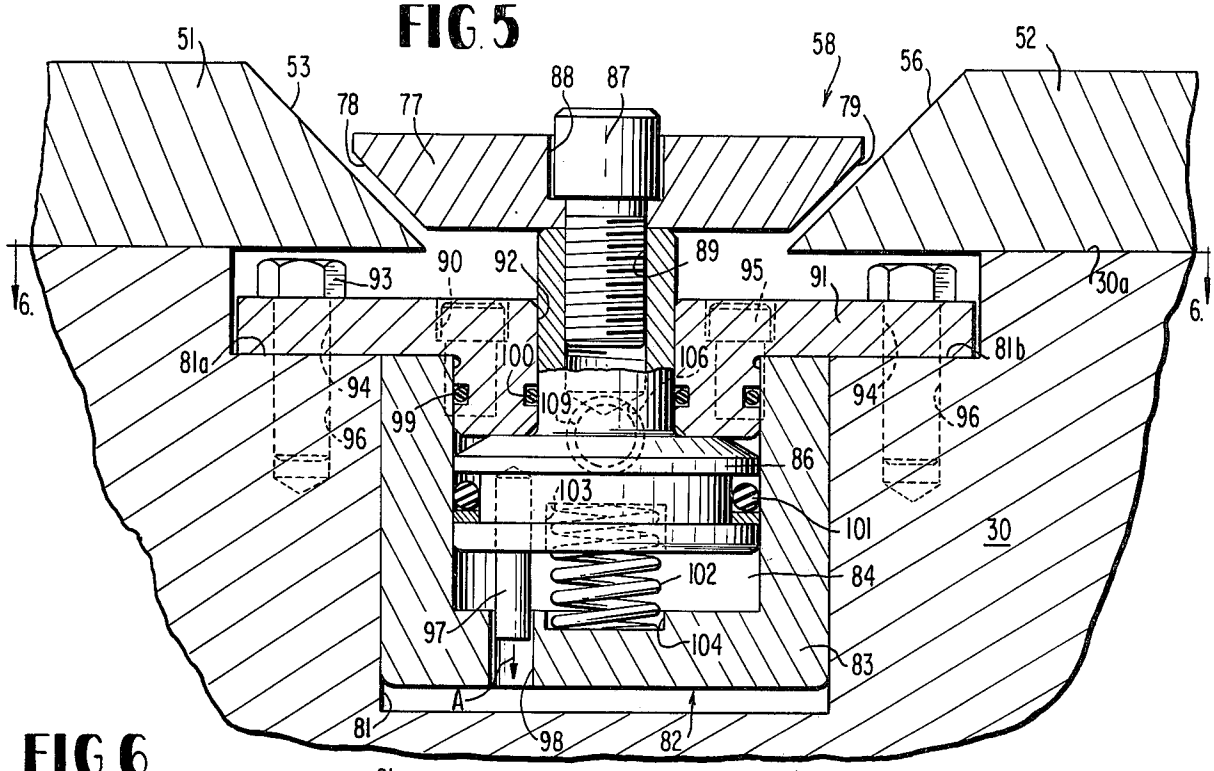
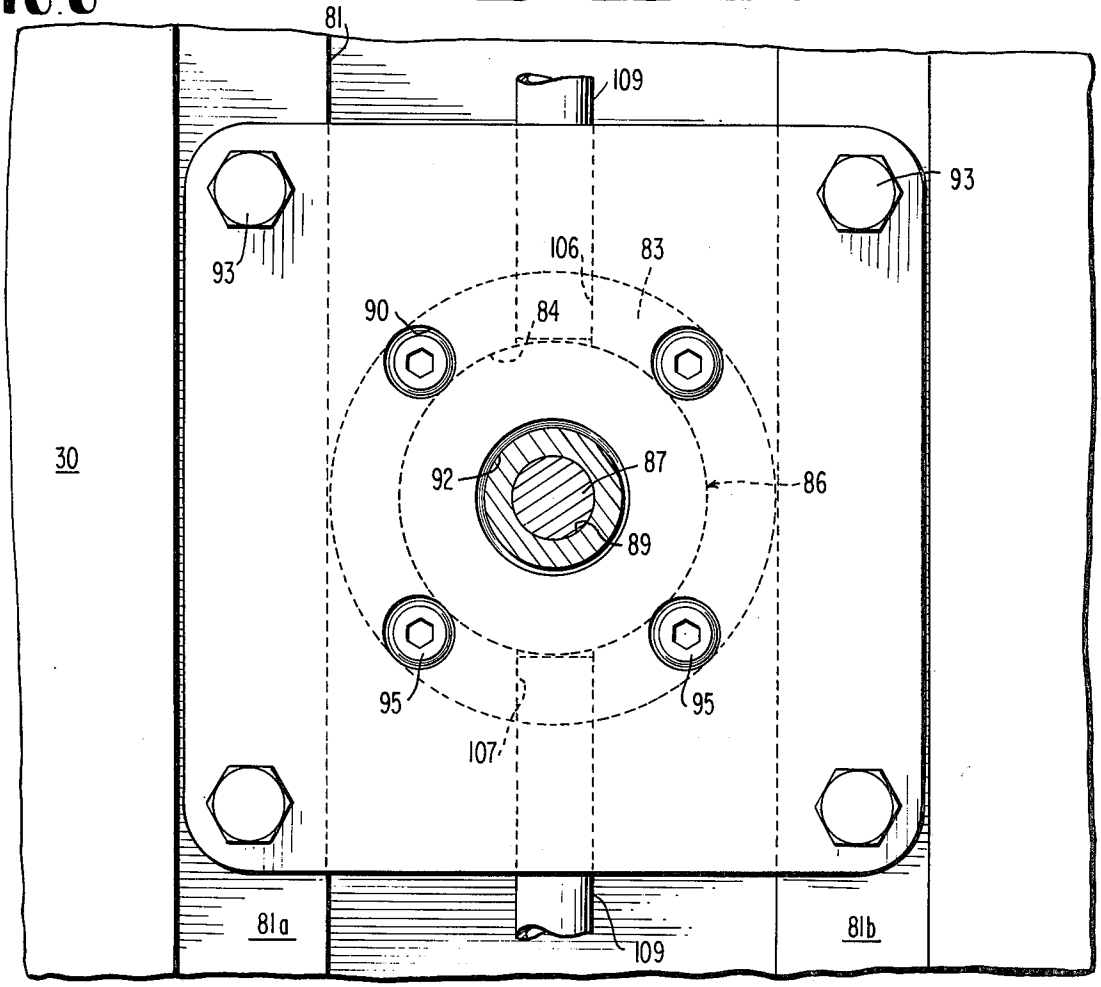

51
53
78
77
88
87
58
79
56
52
93
90
92
89
95
91
30a
6
6
81a
81b
94
96
100
106
99
109
94
96
86
103
101
30
102
84
97
104
83
A
81
98
82

FIG. 6


81
109
93
93
106
83
90
84
30
92
87
86
89
95
95
107
81a
81b
109

DIE SET CLAMPING MECHANISM

BACKGROUND OF THE INVENTION

The present invention is related to clamping devices for quickly changing die sets mounted between the bolsters of a stamping or other type of metal working press. The invention is particularly suitable for use in clamping standard die sets and associated die components in operative position on various types of equipment for shaping metal blanks.

In the metal working industry today, it is a common practice to utilize die sets in metal working apparatus such as a press for performing various metal working operations on metal blanks to produce articles or products of a specific shape. The wide variety of such articles, each with a different shape, requires frequent changes of the die sets used in production operations, not only for each production run but for maximum utilization of machine time. However, in most such metal working apparatus today, the setting up or changing of the die sets is a time consuming operation due to the weight of the die set and its associated components, the necessity of moving the die set and components horizontally between the bolsters of the press and then manipulating the lower and upper die plate components of the set into proper position in relation to their respective bolsters, and the tedious operation of maintaining proper alignment while clamping the die plates into operative position by conventional means, such as a series of individual bolts and securing nuts. Thus, the time required to change a die set in a press is usually quite long which adds to the down time of the press with attendant increases in manufacturing costs. Furthermore, present day clamping arrangements for die sets often produce misalignment of the die components causing increased wear and occasional jamming. One type of improved clamping mechanism which facilitates the quick changing and clamping of standard die sets in metal working presses and the like is that structure described and claimed in U.S. patent application, Ser. No. 389,592, now U.S. Pat. No. 3,834,217, entitled Pivotal Clamping Mechanism for Die Sets, previously filed on Aug. 20, 1973, by the present applicant.

The novel structure of the aforementioned patent application utilizes automated clamps to releasably engage the outboard edge portions of special clamping plates which are secured to the die set and permit it to be easily and quickly changed without misalignment of the die set components. Excellent results are obtained with the novel structure of the aforementioned patent application throughout a wide range of die set sizes. However, the major portion of the strain generated by metal working operations occurs in the central area of the die set, particularly during upstroke of the press, and with unusually large die sets, such as those used in large straight side presses, there is a tendency to deform or buckle the die plate component of the set.

SUMMARY OF INVENTION

The invention disclosed herein is directed to a novel clamping mechanism for mounting die sets in metal working presses and similar machines having a lower and an upper mounting bolster. In such machines, the upper bolster is usually driven in a reciprocating fashion by a hydraulically or mechanically actuated ram, slidably mounted on guide slots or tracks supported upon the foundation of the machine. With the foregoing background and prior art in mind, a principal object of the present invention is to provide a pair of clamping plates disposed in planar relationship with their inboard edge portions arranged in adjacent, spaced-apart relationship to define a clearance space, the plates being rigidly secured to die components and arranged to be clamped in operative position on the outer surface of a bolster in a metal working machine such as a press by a novel clamping mechanism. The clamping mechanism includes first clamping means mounted on the bolster adjacent each of the outboard side edges of the clamping plates, the first clamping means and outboard side edges being provided with coacting clamping surfaces, and second clamping means mounted on the bolster adjacent the inboard side edges of the clamping plates within the clearance space, the second clamping means and inboard side edges being provided with coacting clamping surfaces. Both the first and second clamping means are arranged to be actuated by actuating means for engagement of all of the clamping surfaces for clamping the pair of clamping plates securely between the clamping means in operative position flush upon the surface of the bolster along both the outboard sides and central area of the die set.

A primary object of the invention is therefore to provide a new and novel clamping mechanism for standard die sets wherein the die sets and associated components may be quickly and easily installed, changed or replaced on a metal working press.

Another object of the invention is to provide a new and novel fluid pressure operated clamping mechanism for securely clamping in operative position both the lower and upper die plate of a large die set while all of the associated die components are in place between said plates.

A further object of the invention is to provide a new and novel die set clamping mechanism for a metal working apparatus which clamps the central portion of a large die set from front to back to eliminate any deformation or buckling of the die plates and associated die shoes.

Still another object of the invention is to provide a new and novel mechanism for clamping a die set in operative position within a metal working press so that the die plates are held firmly against the bolsters of the press at all times during the metal working operation.

A still further object of the invention is to provide a new and novel die set clamping mechanism for metal working presses which is particularly advantageous for use with large die sets such as those employed in straight side presses.

Another object of the invention is to provide a new and novel mechanism for metal working apparatus which permits die sets to be clamped in operative position thereon in a simple and easy manner without the use of T-slot bolts, riser blocks or other complicated structural components.

A further object of the invention is to provide a new and novel mechanism for clamping die sets in metal working presses which offers no interference with the proper positioning of the die set, which is adapted for use with a variety of clamping devices and surfaces, and which rigidly and securely clamps the die set components in properly aligned position.

Another object of the present invention is to provide a quick change device for conventional die sets (which include an upper and a lower die plate) wherein a pair

of supplemental clamping plates is arranged to coact with novel clamping components on the press bolster and adapted to be secured to a corresponding die plate by recessed bolts or other means, such as welding, avoiding the remounting of associated die components and permitting an easy and inexpensive changeover from existing clamping devices to the present invention together with the utilization of valuable standard die sets already on hand.

Another object of the present invention is to provide a quick change clamping mechanism for the dies of a metal working press wherein proper alignment of the upper and lower die shoes is attained through the use of the conventional guide pins of standard die sets.

A further object of the present invention is to provide a quick change clamping mechanism which may be installed on the bolsters of existing metal working presses by machining appropriate channels and recesses therein for mounting the articulated clamps, the central clamps and the die assembly supporting rollers.

A still further object of the present invention is to provide a fluid pressure operated clamping device useable with a wide variety of metal forming and piercing die presses and having a simple and compact construction capable of producing ample clamping pressure to hold heavy mounting plates and associated die components accurately in position upon the press bolsters during metal working operations.

This invention further contemplates the provision of a new and novel mechanism for clamping die sets in operative position in metal working apparatus which is simple and inexpensive in construction, which is composed of a minimum of parts, which can readily be installed on existing apparatus, which may be hydraulically or pneumatically actuated for quick clamping and release, and which permits the utilization of a wide range of standard die set sizes and designs.

Still another object of this invention is to provide a new and novel clamping mechanism for die sets utilized in metal working apparatus wherein proper alignment of the die set in the apparatus is quickly and easily obtained so as to eliminate misalignment between lower and upper die components and avoid excessive wear of associated die shoes and guide pins.

In addition to the numerous advantages apparent from the foregoing discussion, the present invention has the further advantages of simplicity, ruggedness, durability and ease and economy of construction and manufacture. Although the clamps themselves are specialized parts, the mounting and actuating elements thereof can be constructed from standard parts which are commercially available and the entire mechanism can be assembled and installed with relatively few machinings with known machine tools. The exact nature of the invention as well as other objects and advantages thereof will be readily apparent from the annexed drawings and the following specific description of the preferred embodiment of the invention.

DESCRIPTION OF DRAWINGS

For a better understanding of the present invention, reference is made to the accompanying drawings in which:

FIG. **1** is a diagrammatic front elevational view of a metal working press employing a conventional die set and utilizing the clamping mechanism according to the present invention;

FIG. **2** is a diagrammatic side elevational view of the metal working press of FIG. **1** further illustrating the clamping mechanism according to the present invention;

FIG. **3** is a plan view of a portion of the apparatus of FIG. **1** showing the clamping mechanism of the invention and taken substantially along line **3—3** of FIG. **1** in the direction of the arrows;

FIG. **4** is a sectional view taken substantially along line **4—4** of FIG. **3** in the direction of the arrows;

FIG. **5** is an enlarged sectional view taken substantially along line **5—5** of FIG. **3** in the direction of the arrows;

FIG. **6** is an enlarged sectional view taken substantially along line **6—6** of FIG. **5** in the direction of the arrows.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

For purposes of illustration, the present invention has been shown in the drawings as mounted upon a conventional stamping press for forming sheet metal parts using a die set of standard design. However, the invention is adaptable for use with many other types of metal working machines, including lancing and piercing apparatus, and can be used to hold almost any plate supported tool or die component in operative position upon its associated bolster, platen, ram or equivalent support structure, utilization of the design features of the invention permitting quick replacement of a wide variety of such tools.

As illustrated in FIGS. **1** and **2**, the press to which the present invention is attached consists of the usual bed **10** and an upper head or ram **12**, the former being fixed and the latter being supported for up and down reciprocal movement along the posts **14** under the drive of a hydraulic or pneumatic actuator or other drive means. The particular drive means for the ram or upper platen is not shown, it being understood that the invention is not directed to the press itself or its operating drive.

Secured to the reciprocating ram **12** is an upper bolster **20** having an outer surface **20***a* and secured to the fixed bed **10** is a lower bolster **30** having an outer surface **30***a*. As will be explained hereinafter, the clamping mechanism of the invention is arranged to clamp a standard die set, designated generally in FIG. **1** by the numeral **40**, in an aligned operative position between the bolsters **20** and **30**, the die set **40** consisting principally of lower and upper die plates **41** and **42**, lower and upper die shoe components **43** and **44** and a pair of catercorner guide pins **46—46** mounted on the lower die plate **41** and arranged to guide reciprocating movement of upper die plate **42**. It is to be understood that the die set **40** and the related die components are of a standard commercial design in the preferred embodiment.

The description to follow will be directed to the clamping mechanism for clamping the die set components to the lower bolster **30**, many of the clamping elements for clamping the die set components to the upper bolster **20** being of similar construction, like numerals being used to identify like parts with the addition of a prime superscript.

As specifically illustrative of the invention and as shown best in FIGS. **3** and **4**, the clamping mechanism includes a pair of clamping plates **51** and **52** each having inboard and outboard side edges **53** and **54**, and **56**

and 57, respectively. The clamping plates 51 and 52 are disposed on the lower bolster 30 in planar relationship with the inboard edges 53 and 56 in adjacent, spaced-apart relationship to define a clearance space 58 as shown best in FIG. 3.

Means are provided for rigidly securing the die components to the planar clamping plates 51 and 52 and, in the illustrated embodiment, the lower clamping plates 51 and 52 are secured to the lower die plate 41 by a series of recessed bolts 59. Similarly, upper clamping plates 51' and 52' are secured to the upper die plate 42 by a series of recessed bolts 59'. It should be understood, however, that for a custom made die set, the lower die plate 41 and the lower clamping plates 51 and 52 could be made as a single integral unit which could then merely be referred to as a special "die plate". Similarly the equivalent upper components, including the clamping plates 51' and 52' and die plate 42, could be made as an integral upper "die plate".

The clamping mechanism of the invention also includes first clamping means mounted along opposite sides of the bolster 30 adjacent to each of the outboard side edges 54 and 57 of the pair of lower clamping plates 51 and 52. More specifically, in the illustrated embodiment, the first clamping means includes one or more articulated clamps 61 along opposite outboard sides of the bolster. Two of such clamps are provided on each side in the illustrated embodiment, with one pair arranged in spaced relationship adjacent to plate side edge 54 and the other pair in spaced relationship adjacent to plate side edge 57.

Each of the articulated clamps 61 includes a body portion 60 pivotally mounted on the associated bolster by means of a bulb-shaped projection or pivot knob 62 rotatably fitted within a transversely extending channel 63 of bulbous cross-section conforming to the shape of knob 62, the entrance sides 64—64 of the channel providing sufficient clearance for the neck portion 66 of the bulbous projection to permit tilting of the entire clamp body.

As described in the aforementioned patent application, the body 60 is provided with a clamping surface 67 which, in the illustrated embodiment, is an inwardly sloped or beveled surface that coacts with the adjacent outboard side edges 54 and 57 of the clamping plates 51 and 52, the outboard side edges 54 and 57 being outwardly sloped or beveled to mate with surfaces 67 as shown best in FIGS. 1 and 4. Preferably, both the beveled clamping surface 67 on the clamp body 60 and the bevel on the outboard edges 54 and 57 are formed at an angle of 45°.

Means are provided for actuating the first clamping means to move the clamping surface 67 on clamp 61 into frictional engagement with the beveled outboard side edges 54 and 57 of the clamping plates 51 and 52, respectively. More specifically, the clamp 61 has an integral actuating portion 68 which includes a cylinder 69 and a piston 71, the outer end 71*a* of the piston being provided with a rounded bearing surface adapted to act against the bolster outer surface 30*a*.

Pressurized fluid is applied to the cylinder 69 by means of a conduit or hose 72 connected at its other end to a source of hydraulic or pneumatic fluid pressure which is of conventional design and is not shown. The clamp 61 is also provided with an integral lever arm portion 73 which has the beveled clamping surface 67 previously referred to. Clamp 61 also includes a recess 74 in which there is disposed a spring loaded plug element 76 bearing against the outer surface 30*a* of the bolster to normally urge the clamp 61 in the opposite direction from the pivotal movement produced by actuation of piston 71.

The clamping mechanism of the present invention also includes a second clamping means mounted upon the bolsters 20 and 30 which is disposed within the clearance spaces 58 and 58' adjacent to the inboard side edges 53 and 56 and 53' and 56' on pairs of clamping plates 51 and 52 and 51' and 52', respectively. Coacting clamping surfaces similar to those on clamps 61 and on outboard plate edges 54 and 57 are provided between the second clamping means and the inboard plate edges. More specifically, the second clamping means comprises an elongated bar member 77 extending continuously along the major portion of the length of the clearance space 58, bar member 77' being provided for upper clearance space 58'. The clamping surfaces on the lower bar member 77 are preferably inwardly beveled surfaces 78 and 79 which are provided on opposite side edges of the bar member and coact with adjacent outwardly beveled surfaces 53 and 56 on the inboard side edges of the clamping plates 51 and 52.

As illustrated best in FIG. 4, the bolsters are each provided with a central recess 81 and 81' extending transversely in underlying relationship with the clearance space 58 and 58', respectively. The recess 81 is preferably formed with oppositely disposed shoulders 81*a* and 81*b* as shown. Means are provided for actuating the second clamping means to move the bar member 71 towards the outer surfaces of the bolster 30 for clamping engagement of the bar member surfaces 78 and 79 with the beveled inboard side edges 53 and 56 of the clamping plates 51 and 52, respectively.

More specifically, fluid pressure actuated means are provided which are disposed within the recesses 81 and 81' and, in the illustrated embodiment, comprise a plurality of cylinder-piston assemblies 82 positioned in longitudinally spaced relationship within the recesses 81 and 81' as illustrated best in FIG. 3. In the preferred embodiment, three of such cylinder-piston assemblies 82 are provided in each recess 81 and 81', each assembly including a cylinder 82 having an interior 84 in which a piston 86 is disposed for vertical reciprocating movement as shown in FIGS. 5 and 6.

Means are provided for connecting the pistons 86 in all of the cylinder-piston assemblies 82 in recess 81 to the bar member 77. This connecting means preferably includes a threaded bolt 87 extending through suitably provided openings 88 in bar member 77 and threadedly engaging recess 89 in the neck portion of each of the pistons 86. Each of the cylinders 83 is arranged to be closed by a top plate 91 having a central aperture 92 for accommodating the neck of piston 86 and four counterbored apertures 90 symetrically spaced and adapted to receive threaded bolts 95 which fasten said plate to the top edge of said cylinders. The assemblies 82 are secured to the shoulders 81*a* and 81*b* of the recess 81 by means of threaded bolts 93 extending through four spaced openings 94 in the plate 91 and threadedly engaging internally tapped recesses 96 in the shoulders 81*a* and 81*b*.

Each piston 86 extends through an aperture 92 in the top plate 91 and a guide pin 97, suitably attached to the piston 86, extends through opening 98 in the bottom

wall of cylinder 83 for guiding the vertical movement of the piston 86. O-rings 99 and 100 are preferably provided in top plate 91 and O-rings 101 in piston 86 for sealing purposes.

Means are provided in the cylinder 83 for yieldingly urging the piston 86 outwardly from the recess 81 to disengage the clamping surfaces on the bar member 77 and the clamping plates 51 and 52. More specifically, a spring 102 is disposed within the cylinder interior 84 with opposite ends received within suitably formed recesses 103 and 104 in the piston 86 and cylinder 83, respectively. Thus, the spring 102 urges the piston 86 outwardly from recess 81 to position the bar member 77 in spaced relationship from the inboard plate bearing surfaces 53 and 56 in the absence of fluid pressure above the piston.

Means are provided for communicating the cylinder-piston assemblies 82 with an associated source of fluid pressure (not shown). More specifically, each of the cylinders 83 is provided with a pair of ports 106 and 107 which communicate with that portion of the cylinder interior 84 above the piston head, port 106 on one of the outermost cylinders being connected by means of a conduit 108 to the associated source of fluid pressure and port 107 on the opposite outermost cylinder being closed by a plug 110. Interconnection between the cylinders 83 is obtained by means of conduits 109, the opposite ends of which are connected to corresponding ports 107 and 106.

The present invention also includes supporting ball roller mechanisms designated generally by the numeral 111 and disposed in spaced relationship only on the lower bolster 30 as shown in FIGS. 3 and 4. Any suitable number of such roller mechanisms may be employed, such as from four or more for each clamping plate. The number provided must be adequate to support the weight of all of the clamping plates and all of the intervening die set components, four rows of three rollers each as shown in dotted outline in FIG. 3 being preferred. Each of the roller mechanisms 111 include a ball roller 112 secured in a recess 113 in the lower bolster 30. The rollers 112 are yieldingly urged upward to project slightly above the bolster surface 30*a* by means of a spring 114 having sufficient tension for each individual bar roller to support its proportional share of the weight of the complete die assembly. The upward position of the ball roller 112 is limited by means of a apertured disk 116 so that the ball roller 112 projects a sufficient distance above the bolster surface 30*a* to normally raise the inner surface of the clamping plates 51 and 52 completely clear of the adjacent bolster when all clamping means are released.

Although the upper clamping means and associated clamping plates may be identical to those below, the preferred clamping arrangement for securing the upper die components to the upper bolster 20 is that shown in FIG. 1. In this embodiment, the articulated side clamps, the central clamping bar, and the pair of clamping plates are of a modified construction in which the beveled or tapered coacting surfaces found on the corresponding lower bolster components have been eliminated. Instead, each upper pivotal clamp 120 has a square shoulder 123 milled out of the clamp body at a 90° cut to produce a planar inner clamping surface 124. A bulb-shaped projection or pivot knob 62′ is attached to the clamp body 120 by neck portion 66′, the pivot knob 62′ being rotatably mounted within a conforming channel 63′ of bulbous cross section cut transversely through the upper bolster 20 in the same manner as for the articulated clamps 61 previously described. Similarly, articulated clamp 120 is activated by a fluid piston 71′ mounted within the clamp body so as to thrust against the upper bolster surface 20*a*. However, no reciprocating spring biased plug, similar to plug 76 of clamp 61, need be employed since the weight of the upper clamping plates and the die components mounted thereon provides sufficient force to tilt the pivotal clamp bodies in the reverse direction upon releasing fluid pressure acting on piston 71′. Similarly, upper clamping bar 77′ has squared shoulders 125 and 126 milled out of its elongated body along opposite sides thereof and is activated by a plurality of piston-cylinder assemblies 82′. Upper clamping plates 51′ and 52′ have square shoulders 127 and 128 milled out along their respective inboard edges 53′ and 56′. Squared outboard edges 129 and 130 are formed by the juncture of planar surfaces 131 and 132 and perpendicular side surfaces 133 and 134, respectively. As shown in FIG. 1, outboard plate edges 129 and 130 are arranged to be engaged by pivotal clamp shoulders 123 and inboard plate shoulders 127 and 128 are arranged to be engaged by clamping bar shoulders 125 and 126, respectively.

OPERATION OF INVENTION

In using the novel device of the present invention, a standard lower die plate 41 is mounted upon the pair of lower clamping plates 51 and 52 by means of the recessed threaded bolts 59 and a standard upper die plate 42 is mounted upon the pair of upper clamping plates 51′ and 52′ by means of recessed threaded bolts 59′. The other components of the die sets are assembled on each die plate and the lower and upper die assemblies are engaged with the upper die shoe resting in mating relationship upon the lower die shoe as guided into position by the guide pins 46—46.

The completed die assembly is then transported to the edge of a metal working press in which the upper slide or ram has been adjusted to a stroke-down position that provides sufficient clearance between the lower and upper bolsters for insertion of the die assembly. Prior to insertion of the die assembly, the associated source of fluid pressure is deactivated so that the bar member 77 is held in the elevated position by spring 102 as shown in FIG. 5 and the clamps 61 are pivoted to the open position by spring loaded plug elements 76. This permits the lower clamping plates 51 and 52 to move beneath the inwardly sloped pivotal clamping surfaces 67 and the beveled surfaces 78 and 79 of the bar member 77. At the same time, the upper clamping plates 51′ and 52′ move under the planar clamping surfaces 124 of the upper clamps 120 and the squared shoulders 125 and 126 of the upper bar member 77′. The absence of any metal work between the dies allows sufficient space for easy insertion and removal of the complete die assembly, which includes the clamping plates secured at the lower and upper extremes thereof.

When the bolsters of the press are properly positioned, the complete die assembly slides transversely into position between the lower and upper bolsters while resting upon and being slidably supported by the spring loaded ball rollers 112 in the lower bolster 30. The die assembly is inserted in the press by pushing it

transversely into the vertical space between the bolsters and the horizontal space between the opposing faces of the articulated clamps **61** adjacent the outboard side edges of the clamping plates. Transverse or rearward movement of the die assembly continues until the lower clamping plates **51** and **52** abutt a series of fixed posts or pins **115** along the rear edge of the lower bolster **30** as illustrated in FIGS. **2** and **3.** The die assembly is then in the correct transverse and longitudinal position for operation of the novel clamping mechanism of the present invention.

A clamping sequence is then employed wherein the lower articulated clamps **61** are actuated by fluid pressure from the associated pressure source through conduits **72** to pivot the clamps **61** in the inboard direction and engage the clamping surfaces **67** with the outboard beveled plate edges **54** and **57.** At the same time, fluid pressure is supplied to the lower cylinder-piston assemblies **82** through the conduits **108** and **109** which admit pressurized fluid into the cylinder chamber **84** adjacent to openings **106** and **107,** moving the pistons **86** downwardly in the direction of the arrow A against the action of springs **102** and causing the beveled clamping surfaces **78** and **79** on the lower bar member **77** to engage the inboard beveled surfaces **53** and **56** on the lower clamping plates **51** and **52.**

This initial wedging action may shift the entire die assembly sideways slightly toward one of the bolster edges, depending on the alignment of the lower clamping plates and all associated die components. It also brings the lower clamping plates flush with the adjacent lower bolster surface **30***a* as explained below. During any sideways (longitudinal) movement of the lower clamping plates, the usual guide pins **46—46** automatically keep the upper die components, together with the upper clamping plates **51′** and **52′**, in proper alignment with the lower die components. The upper articulated clamps **120** and upper clamping bar **77′** are then activated in unison to cause the clamping surface **124** of each clamp and bar clamping shoulders **125** and **126** to frictionally engage the outboard edges **129** and **130** and inboard shoulders **127** and **128,** respectively, of the upper clamping plates **51′** and **52′**, forcing them vertically upward into flush frictional engagement with the outer surface **20***a* of upper bolster **20** without any further shifting or misaligning movement. The upper articulated clamps **120** are thus arranged to exert only a vertical clamping force component upon the upper securing plates. The absence of any horizontal force component on the upper plates eliminates the tendancy for misalignment between the upper and lower clamping plates. Such misalignment could result in scraping and strain on guide pins **46—46,** causing them to wear excessively and unevenly with subsequent misalignment of the die components themselves.

Upon completion of the foregoing steps, each of the clamping plates is wedged between opposing clamping surfaces on the bar members **77** and **77′** and the clamps **61** and **120,** thereby clamping the die plates and associated die shoes to the face of the adjacent bolster both along the outboard plate edges and centrally from the front to the rear of the bolster. The wedging action between the beveled clamping surfaces of the lower mechanism has a vertical and a horizontal force component. The vertical component causes the lower clamping plates **51** and **52** to depress the spring loaded ball rollers **112,** the clamping pressure being sufficient to override both the roller spring tension and the clamp release plug spring tension and securely hold the clamping plates against the adjacent bolster surface in a flush, frictional relationship. The horizontal force component secures the die assembly to the lower bolster in proper transverse and longitudinal alignment for operation of the press. The corresponding wedging action of the upper clamping mechanism has only the vertical force component as previously described.

After insertion and clamping of the die assembly, the press ram is adjusted to proper operating height and the metal blank to be worked on inserted between the die shoes, with normal metal forming operations following thereafter. It should be understood that although articulated clamps **61** and **120** are utilized in the illustrated embodiment, it is within the scope of the invention to utilize other outboard clamping arrangements such as described in the aforementioned patent application, the novel features of the present invention being directed to the concept of clamping large die plates both centrally as well as at outboard locations on the bolster, thereby eliminating any deformation or buckling of the die plates and shoes during the metal working operation.

From the foregoing, it is apparent that the entire die assembly **40** may be quickly replaced by another die assembly accurately positioned for a new metal working operation. If a number of metal working operations are anticipated, the die assembly for each operation is made up as previously described. A change in die setups may then be performed within a period of several minutes whereas conventional die setup changes of this type take from between **30** minutes to several hours. In addition, the use of standard die sets with their associated guide pins in combination with the precision alignment afforded by the novel clamping mechanisms disclosed insure that both lower and upper components of the die set are accurately located and securely held in position for subsequent metal working operations of the press.

Although only a few embodiments of the present invention have been described, other embodiments and variations will occur to those skilled in the art. It is possible, of course, to use various features of the specific embodiments, either separately or in various combinations. Thus, it is possible to mount almost any combination of die assemblies or other tooling or metal working components upon a press bed using the clamping mechanisms of the present invention. Such uses are clearly within the contemplation of the present invention. Furthermore, many structural changes are possible and are intended to be within the scope of this disclosure. It is also to be understood that the attached drawings and the foregoing specification merely illustrate and describe the preferred embodiments of the invention and that other embodiments are contemplated within the scope of the appended claims.

Having thus described the invention, what is claimed is:

1. In a metal working apparatus having one or more bolsters for supporting metal shaping die components, a clamping mechanism for securing die components in operative position upon a bolster, comprising:

a. a pair of clamping plates disposed in planar relationship on the bolster with inboard side edges is adjacent, spaced-apart relationship to define a cen-

tral gap therebetween and outboard side edges directed toward opposite sides of the bolster;

b. means for rigidly securing die components to said pair of clamping plates;

c. first clamping means movable mounted on said bolster adjacent to each of the outboard side edges of said clamping plates, said first clamping means and said outboard side edges having coacting clamping surfaces;

d. second clamping means movably mounted on said bolster and disposed within said central gap adjacent to each of the inboard side edges of said clamping plates, said second clamping means and said inboard side edges having coacting clamping surfaces; and

e. means for actuating said first and second clamping means to move said coacting clamping surfaces into frictional engagement for clamping each of said clamping plates securely between said first and second clamping means and flush upon the surface of said bolster in operative position.

2. A clamping mechanism according to claim **1** mounted upon a first bolster of metal working apparatus and a second clamping mechanism according to claim **1** mounted upon a second bolster of the same apparatus in spaced relation to said first clamping mechanism; said bolsters being arranged for reciprocal movement toward and away from each other and said second clamping mechanism being adapted to secure die components on said second bolster in operative position to coact with die components secured in operative position on said first bolster during reciprocal movement of said bolsters, the coaction between said first and second die components producing metal shaping operations on metal blanks inserted therebetween.

3. A clamping mechanism according to claim **1** wherein the clamping surface on each of said inboard plate edges extends along a major portion of the length thereof; wherein said second clamping means includes an elongated bar member with clamping surfaces extending along the longitudinal sides thereof in coacting relationship with said inboard plate clamping surfaces; wherein said bolster has a recess in underlying spaced relationship with said central gap; and wherein said actuating means includes fluid pressure drive means mounted within said recess, means for connecting said drive means to said bar member, and means for supplying fluid pressure to said drive means to move said bar member toward the outer surface of said bolster and bring said bar clamping surfaces into frictional engagement with said inboard plate clamping surfaces.

4. A clamping mechanism in accordance with claim **3** wherein said fluid pressure drive means comprises a plurality of fluid piston and cylinder assemblies positioned in longitudinally spaced relationship within said bolster recess, and wherein the piston in each of said assemblies is connected separately to said bar member.

5. A clamping mechanism in accordance with claim **4** wherein each of said drive assemblies includes means within the fluid cylinder for yieldingly urging the associated piston outward from said recess to disengage bar clamping surfaces upon release of actuating fluid pressure.

6. A clamping mechanism in accordance with claim **3** wherein each inboard and outboard side edge of said clamping plates has an outwardly beveled clamping surface; wherein said first clamping means includes a plurality of clamp bodies each having an inwardly beveled clamping surface arranged to coact with said outboard clamping surface on the adjacent edge of the associated clamping plate; and wherein said elongated bar member has inwardly beveled clamping surfaces arranged along opposite longitudinal sides to coact with said inboard clamping surfaces on the adjacent edges of said pair of clamping plates to wedge each of said clamping plates between said clamping surfaces on the bar member and on the clamp bodies upon actuation of said first and second clamping means.

7. A clamping mechanism according to claim **6** wherein each clamp body of said first clamping means is pivotally mounted on said bolster; wherein said clamp actuating means is arranged to pivot said clamp body in one direction for clamping engagement between the coacting surfaces on said body and on said outboard plate edges; and wherein said first clamping means includes means for yieldingly urging said clamp body pivotally in the opposite direction from that produced by said actuating means to disengage said coacting surfaces for release of the outboard edges of said clamping plates.

8. A clamping mechanism according to claim **7** wherein said clamp actuating means includes a fluid piston and cylinder assembly within said clamp body and conduit means for supplying fluid pressure to said assembly, said piston being adapted to be moved by said fluid pressure into engagement with the outer surface of said bolster to pivot said clamp body in said direction for clamping engagement between said coacting surfaces.

9. A clamping mechanism according to claim **6** including a plurality of recesses within the outer surface of said bolster disposed in spaced-apart relationship adjacent to the inner surfaces of said clamping plates; roller means retained within said recesses for supporting a proportionate share of the total weight of the clamping plates and all associated die plates and components, said roller means having a freely rotatable bearing portion adapted to project a substantial distance above said bolster surface and spring means for yieldingly urging said bearing portion above said bolster surface with sufficient force to support said proportionate die assembly weight and maintain said clamping plates above the bolster surface for free translational movement when said first and second clamping means are deactivated.

10. In a metal working apparatus having a lower bolster to support the lower die plate of a die set and an upper bolster to support the upper die plate of a die set, a die set clamping device comprising a pair of lower clamping plates and a pair of upper clamping plates adjacent to the outer surface of said lower and upper bolsters respectively, the clamping plates in each of said pairs being disposed in planar relationship on the adjacent bolster with inboard side edges in adjacent, spaced-apart relationship to define a central gap therebetween and outboard side edges directed toward opposite ends of the bolster, and said inboard and outboard plate edges having outwardly beveled surfaces; means for rigidly securing said upper clamping plates to the upper die plate and said lower clamping plates to the lower die plate; first clamping means pivotally mounted on each of said bolsters adjacent to the outboard side edges of said clamping plates, said first clamping means including inwardly beveled surfaces

arranged for coacting clamping engagement with adjacent portions of the outwardly beveled surfaces on said outboard plate edges; second clamping means movably mounted on said bolsters within said central gap adjacent to said inboard plate edges, said second clamping means including inwardly beveled surfaces arranged for coacting clamping engagement with adjacent portions of the outwardly beveled surfaces on said inboard plate edges; means for actuating said first and second clamping means to pivot said first clamping means toward said plates for clamping engagement between said coacting surfaces on the first clamping means and on the outboard plate edges and to move said second clamping means toward the respective outer surfaces of said bolsters for clamping engagement between said coacting surfaces on the second clamping means and on the inboard plate edges.

11. A die set clamping device according to claim **10** which includes means for yieldingly urging said first clamping means away from said clamping plates and means for yieldingly urging said second clamping means away from said outer surface of the respective bolsters to release said clamping plates for translational movement relative to said metal working apparatus upon deactivation of said actuating means.

12. In a metal working apparatus having a lower bolster to support the lower die components of a die set and an upper bolster to support the upper die components of a die set, a die set clamping mechanism comprising:

a. a pair of lower clamping plates disposed in planar relationship on the lower bolster with inboard side edges in adjacent, spaced-apart relationship to define a central gap therebetween and outboard side edges directed toward opposite ends of the lower bolster, each of said lower plate edges having an outwardly beveled clamping surface;

b. lower clamping means including a plurality of outboard clamp bodies movably mounted on said lower bolster with at least one clamp body adjacent to each of said outboard plate edges, each clamp body having an inwardly beveled clamping surface arranged to coact with the clamping surface of said adjacent outboard plate edge, and an elongated central bar member movably mounted on said lower bolster and disposed within said central gap between the inboard side edges of the lower clamping plates, said bar member having inwardly beveled clamping surfaces extending along opposite longitudinal sides in adjacent coacting relationship with the clamping surfaces of said inboard plate edges, and actuating means arranged to bring said beveled clamp body surfaces and said beveled bar member surfaces into frictional engagement with said beveled plate surfaces to wedge the lower clamping plates into operative position upon the lower bolster between said outboard clamp bodies and said central bar member;

c. a pair of upper clamping plates disposed in planar relationship on the upper bolster with inboard side edges in adjacent, spaced-apart relationship to define a central gap therebetween and outboard side edges directed toward opposite ends of the upper bolster, each of said upper plate edges having a substantially planar outer clamping surface;

d. upper clamping means including a plurality of outboard clamp bodies movably mounted on said upper bolster with at least one clamp body adjacent to each of said outboard plate edges, each clamp body having an inner clamping surface arranged for normal clamping engagement with the clamping surface of said adjacent outboard plate edge, and an elongated central bar member movably mounted on said upper bolster and disposed within said central gap between the inboard side edges of the upper clamping plates, said bar member having inner clamping surfaces extending along opposite longitudinal sides and arranged adjacent to said inboard plate edges for normal clamping engagement with the clamping surfaces thereon, and actuating means arranged to bring said inner clamp body surfaces and said inner bar member surfaces into normal clamping engagement with said outer plate surfaces to secure the upper clamping plates into operative position upon the upper bolster between said upper outboard clamp bodies and said upper central bar member; and,

e. means for rigidly securing the lower die components to the lower pair of clamping plates and the upper die components to the upper pair of clamping plates.

13. A die set clamping mechanism according to claim **11** wherein means is provided for actuation of the upper clamping means after said pair of lower clamping plates has been wedged into operative position by prior actuation of the lower clamping means.

14. A clamping mechanism according to claim **12** wherein two series of at least four roller means each are recessed within the outer surface of the lower bolster, one series being located adjacent to the inner surface of each lower clamping plate and the roller means of each series being so spaced and arranged beneath the associated plate that each roller is in position to support a proportionate share of the total weight of all clamping plates and die components, said roller means having a freely rotatable bearing portion adapted to project a substantial distance above said bolster surface and a spring means biasing said bearing portion above said bolster surface with sufficient force to support said proportionate die assembly weight and maintain said pair of lower plates free of the lower bolster surface when said upper and lower clamping means are deactivated.

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