BLOCK AND DIE SHOE CLAMPING ASSEMBLY

Inventor: Howard J. McElroy, South Holland, Ill.
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Primary Examiner—Lowell A. Larson
Attorney—Hume, Clement, Hume & Lee

ABSTRACT

A die-clamping arrangement for a large forging press. The die-clamping arrangement includes a die-clamping assembly and a die shoe clamping assembly, each of which clamps a corresponding die or die shoe in place with great spring force effective through clamping means. To relieve the spring force, the springs are hydraulically loaded and compressed. Threaded adjustment pins or rods can then be turned. In the die-clamping assembly, this backs off the spring support, allowing the spring to expand freely when hydraulic pressure is relieved. In the die shoe clamping assembly, this unkeys the clamping heads.

9 Claims, 5 Drawing Figures
INVENTOR.
Howard J. M"Elroy

By Hume, Clement, Hume & Lee
Attorneys.
3,638,473

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BLOCK AND DIE SHOE CLAMPING ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates in general to forging presses and the like. It deals more particularly with the mounting and removal of dies and die shoes in a large forging press.

In the operation of a forging press, regardless of its size, it is frequently necessary to change the press setup for production of a new part. In the course of this changeover, the old dies are removed from the press and new dies mounted. Depending upon the size of the press, the changeover requires from a few to many man-hours of labor. The larger the press, ordinarily, the greater the number of man-hours required. It is an expensive operation not only for this reason, but also because the press is shut down and out of production during the changeover period.

The problem of die changeover is especially significant where a forging press of great size is involved. A press of this type is generally illustrated in the copending application of Eugene E. Grankowski et al. Ser. No. 55,467, filed July 16, 1970 and assigned to the same assignee as the present invention. This press, the largest mechanical press ever developed, is capable of forging parts such as crankshafts or the like with forging pressures up to and in excess of 16,000 tons. The press has an overall height of more than 50 feet. Approximately one-third of this overall height extends below the factory floor in a conventional installation. That portion of the press made up of dies and die holders is, in itself, approximately 7 feet high and 8 feet in depth, from front to back.

The immense size of the die and die shoe assemblies in a press of this size greatly magnifies the problems in die mounting and changeover. Because of the size of the large dies and corresponding die shoe assemblies, conventional die clamps and die shoe clamps have been found to be totally inadequate. The great weight and considerable expansion and contraction problems with the components necessarily make conventional wedge-type clamp assemblies, for example, virtually unusable.

SUMMARY OF THE INVENTION

The present invention is directed to a new and improved die-clamping arrangement for a large forging press or the like. The die-clamping arrangement includes a die-clamping assembly and a die shoe clamping assembly, each of which resiliently clamps a corresponding die or shoe with the great force necessary to properly mount and position these heavy components in a 16,000-ton press, for example. Nevertheless, both the die-clamping assembly and the die shoe clamping assembly facilitate simple and expedient relief of the clamping force to afford rapid die changeover capabilities.

Each locating clamp subassembly automatically sets itself up for receipt of the new die in "open-mouth" relationship when the old die is removed. When the locating clamp member of the subassembly is tightened down after receipt of the new die, the die is positively located and securely held by the locating clamp subassembly. The locating clamp subassembly is, in addition, readily adaptable to any one of plurality of die sizes.

Each thrust clamp subassembly is also adaptable to receipt of dies of a plurality of sizes. The thrust clamp subassembly resiliently grips the die with a thrust force of very high order, forcing the die against the locating clamp subassembly to properly position it. This resilience accommodates retraction or expansion of the die due to heating and cooling of the forging operation. At the same time, the thrust clamping subassembly operates to hold the die down against the die shoe in clamped relationship.

When it is desirable to remove the die from the die shoe, hydraulic means are effective to preliminarily relieve the high resilient thrust force against load release means and permit the load release means to be mechanically manipulated to relieve the thrust load on the die. The die is then easily removable from the die shoe for replacement by a new die. Release of the hydraulic pressure once a new die is positioned and a resilient clamping force setting established permits this great clamping force to become effective once again in clamping the die.

As has been pointed out, the die shoe is, in turn clamped to the bolster baseplate (or slide baseplate) with a die shoe clamping assembly embodying features of the present invention. In this light, each side of both the upper and lower die shoes is secured to a corresponding base plate by an identical shoe-clamping subassembly.

Each die shoe clamping subassembly includes a plurality of T-bolts disposed along a corresponding edge of a die shoe. In one rotational position, the heads of the T-bolts engage opposing shoulders formed in T-slots in the edge of the shoe and the opposite ends of the bolts are threaded into internally threaded piston nuts slideably mounted in a baseplate. The nuts hold extremely heavy springs against shoulders of the corresponding baseplate. The force of the springs hold the nuts and T-bolts down to firmly clamp the die shoe to the baseplate.

The force of the springs is so strong as to prevent turning the nut when spring force is exerted against them. According to the invention, to remove the die shoes hydraulic pressure is introduced to the chamber behind the piston nut. When sufficient hydraulic pressure is applied to move the nut against the springs, the T-bolts are rotated 90° in gang by a T-bolt rotating mechanism. The die shoe has thus been released and the entire die assembly can be moved outwardly from the press. A replacement die shoe is seated, the T-bolts rotated back 90° in gang, and hydraulic pressure released to bring the spring force to bear once again in clamping the die shoe in position.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention, together with its construction and method of operation, along with other objects and advantages thereof, is illustrated more or less diagrammatically in the drawings, in which:

FIG. 1 is a vertical sectional view taken through the fixed die and die holder portion of a large forging press, and illustrates the die and die shoe clamping assemblies embodying features of the present invention;

FIG. 2 is a front elevational view of the bolster baseplate, die shoe, and portions of dies, further illustrating the clamping assemblies;

FIG. 3 is a plan view of a thrust clamp subassembly for the dies;

FIG. 4 is an enlarged sectional view through a single die thrust clamp subassembly embodying features of the invention; and

FIG. 5 is an enlarged sectional view of a portion of a die shoe clamping subassembly embodying features of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and particularly to FIGS. 1 and 2, the die, die shoe, and baseplate arrangement of a large forging press is seen generally at 10. In the present illustration, the press has a 16,000-ton capacity, making it one of the largest, if not the largest, forging press in the world. As will be recognized, the die, die shoe, and baseplate arrangement 10 form the base of the press, and a die, die shoe, and slide plate arrangement (not shown) in the press cooperates with the unit 10 in a well-known manner to forge large components; crank shafts, for example.

The fixed die unit 10 includes a large, generally rectangular, steel baseplate 15 suitably mounted on the bed 16 of the forging press. Surrounding the bolster baseplate 15 is a generally
rectangular bolster nest plate 16. The bolster nest plate 16 is keyed into position on the baseplate 15 and has a large rectangular cutout 17 at its center in which the die knockout bar 20 of a knockout system is seated.

Surmounting the bolster nest plate 16, and thus overlaying the die knockout bar 20, is a die shoe 25. The die shoe 25 is clamped to the bolster baseplate 15, with the bolster nest plate 16 keyed therebetween, by a die shoe clamping assembly 26 along the front and back of the fixed die arrangement 10. Each die shoe clamping assembly 26 is identical in construction to the locating bodies features of the present invention. The clamping assemblies 26 firmly secure the die shoe 25 to the baseplate 15 during operation of the forging press, while permitting simple and expeditious removal of the die shoe 25 when such removal is required, all according to the invention.

Surmounting the die shoe 25, in side-by-side relationship, extending from the front to the back of the fixed die unit 10, are a series of dies 30. The dies 30 are essentially identical in external configuration. They are, of course, replaceable and interchangeable.

During operation of the forging press, each of the dies 30 is clamped to the die shoe 25 by a die locating and clamping assembly 31. Each die locating and clamping assembly 31, which includes a clamping subassembly 33 at the front of the fixed die arrangement 10 and a locating clamp subassembly 34 at the rear of the fixed die unit cooperate in clamping the die to, and positioning the die on, the die shoe while permitting simple and expeditious removal of the die block 30 from the die shoe immediately after a forging operation without concern for stresses developed by expansion of the die blocks 30, for example, due to heat developed during the forging operation.

The locating clamp subassembly 34 of the die-clamping assembly 31 for each die 30 comprises a locating block 40 which is generally rectangular in plan configuration. The locating block 40 has a transversely extending key 41 depending from its lower surface. The key 41 is adapted to be received in one of three key slots 42-44, depending upon the length of the die 30. In Fig. 1, the clock 40 is illustrated with the key 41 seated in the outermost key slot 42 to accommodate a die 30 of relatively large proportions.

The locating block 40 has a planar, front locating face 47 against which the corresponding, planar back surface 48 of the die 30 is adapted to be forced when the die is seated in properly positioned relationship on the die shoe 25. It is the opposing thrust clamp assembly 33 which urges the die 30 into engagement with the face 47 in a manner hereinafter described.

With the die 30 properly located on the die shoe 25, against the locating face 47, a pair of lips 50 (only one shown) on the locating block 40 above the locating surface 47 overlie a shoulder 51 formed into the planar back surface 48 of the die 30. These clamping lips 50 are urged against the shoulder 51 by a pair of large locking bolts 55 (only one shown) extending downwardly through the locating blocks 40 adjacent the locking lips 50 into suitably threaded bores 56 in the die shoe 25. With the bolts 55 turned down slightly against the locating block 40, as illustrated in Fig. 1, the clamping lips 50 securely clamp the rear end of the die block 30 against the die shoe 25.

When it is desirable to release the rear end of the die 30, the bolts 55 are merely backed off from engagement with the locating blocks 40 out of the corresponding bores 56. Four spring-loaded pins 60 disposed in suitable bores 61 extending downwardly through the locating block 40 then urge the locking lips 50 of the locating block upwardly a short distance, lifting the clamping lips 50 off of the shoulder 51. Coil springs 52 in the bores 61 urge the pins 60 downwardly in this fashion. The locating block 40 remains cocked upwardly at its front end while a die 30 is removed and, as will readily be recognized, facilitates the seating of a new die in such a position that the clamping lip 50 clearly extends over the shoulder 51 as the die is seated and forced rearwardly against the locating face 47.

A single thrust clamp assembly 33 urges each die 30 against the locating face 47 of the block 40 in the locating clamp assembly and clamps the front end of the die securely against the die shoe 25. As shown in FIGS. 1-3, each thrust clamp subassembly 33 includes a clamping block 70 which is generally rectangular in side elevation, front elevation and plan, respectively. Depending from the block 70 and extending transversely thereof is a key 71 adapted to seat in one of the three key slots 72-74, depending upon the relative dimensions of the die 30. In the present illustration, a relatively large die 30 is being employed and the key 71 is seated in the outermost key slot 72.

Four thrust pins protrude from the forward end of the thrust block 70 into engagement with the planar front surface 78 of the die 30. According to the invention, the thrust pins 77 urge the die 30 tightly against the locating face 47 on the corresponding locating block 40 of the locating clamp subassembly 34. Two clamping lips 80 protrude forwardly from the thrust block 70, immediately above the pins 77, and are adapted to overlie a clamping shoulder 81 formed in the front surface 78 of the die 30.

With the die 30 properly seated against the locating clamp subassembly 33, under the urging of the thrust pins 77, in a manner hereinafter discussed, the clamping lips 80 are clamped tightly down against the clamping block 70 by a pair of locking bolts 85 to hold the front end of the die 30 securely on the die shoe 25. The locking bolts 85 extend downwardly through the thrust blocks 70 between the thrust pins 77 immediately adjacent the clamping lips 80 into internally threaded bores 86 in the die shoe 25. The locking bolts 85 can readily be turned down to clamp the die 30 against the die shoe 25 or turned up to release clamping pressure on the die and permit its removal.

Referring now specifically to FIG. 4, it will be seen that each of the thrust pins 77 extends rearwardly inside the thrust block 70 into a corresponding spring chamber 90. An annular flange 91 is formed on the pin 77 intermediate its end and is disposed in the chamber 90.

The chamber 90 is defined in one end of a stepped bore 95 extending into the thrust block 70 from its outer face 96. A cylindrical plug 97 is threaded into the open end of the bore 95, adjacent the face 96. A conventional O-ring 99 provides a seal between the outer surface of the cylindrical plug 98 and the bore 95.

Threaded into the cylindrical plug 97, from its outer end, is a large thrust control screw 105. The inner end 106 of the thrust control screw 105 is adapted to freely engage the outer thread 107 of a piston stub rod 108 extending into an unthreaded section 110 inside the cylindrical plug 97 through a conventional O-ring seal 111.

Unitarily formed at the opposite end of the piston stub rod 108 from its end surface 107 is a cup-shaped piston head 115. The annular periphery of the piston head 115 carries an O-ring seal 116 which forms a seal between the head and the bore 95. A fluidtight expansion chamber 120 is, accordingly, defined between the cylindrical plug 97 and the cup-shaped piston head 115 around the piston stub rod 108.

The spring chamber 90 is actually defined between the cup-shaped piston head 115 and the closed end of the bore 95, and the thrust pin 77, bisected by the annular flange 91 in the chamber 90, extends through the chamber 90 into sliding engagement with a cup-shaped depression 121 in the cup-shaped piston head 115. Encircling the pin 77 in the chamber 90 between the piston head 115 and the flange 91 are a series of Bellevile springs 125 or the like. The springs 125 are partially compressed in their normal state, as illustrated in FIG. 4, and are seated against the piston head 115 which is, in turn, backed against the thrust control screw 105. The springs 125 urge the pin 77, through the flange 91, with great force against the die 30 to force the die tightly against the locating clamp subassembly 34 hereinafter described.

To remove the die 30 from the die shoe 25 and replace it with another die, the tremendous spring force of the Bellevile
springs 125 must be relieved, of course. Because of this tremendous spring force, it is virtually impossible to relieve it merely by turning the thrust control screw 105 outwardly and allowing the piston head 115 to back off in the bore 95 and, thus, lengthen the spring chamber 90. According to the invention, this retraction is made possible by hydraulically loading the chamber 120 to further compress the Bellville springs 125 with the piston head 115, thus relieving pressure against the thrust control screw 105 and allowing it to be backed off to a sufficient extent to permit substantial expansion of the Bellville springs after which pressure is relieved in the chamber 120 and the piston head 115 is allowed to retract.

To permit this retraction of the thrust control screw 105, the chamber 120 is hydraulically pressurized through the inlet port 126. A suitable check valve (not shown) in the inlet port 126 prevents the escape of fluid under pressure therefrom. An outlet port 127 with a suitable metering valve (not shown) therein is also connected to the chamber 120. Pressure builds up in the chamber 120 to force the head 115 to the right, as seen in FIG. 4, thus compressing the Bellville springs 125 to a greater extent and separating the surfaces 106 and 107 on the screw 105 and stub rod 108, respectively.

The thrust control screw 105 is screwed out for a predetermined length. The metering valve in the outlet port 127 is then opened to permit fluid under pressure to escape the chamber 120 at a predetermined slow rate. The piston 115 retracts and the Bellville springs 125 expand, relieving pressure on the thrust pin 77 and permitting the die 30 to be removed once the lock bolts 85 are backed off.

To reset a new die 30 in proper position on the die shoe 25, the reverse of the aforedescribed pressurization and thrust control screw 105 adjustment is made. First the chamber 120 is pressurized in the aforedescribed manner, compressing the Bellville springs 125 to exert a predetermined amount of force on the thrust pin 77 and, accordingly, the new die 30. The thrust control screw 105 is then turned inwardly until its outer surface 106 engages the outer surface 107 of the piston stub rod 108. Pressure is then relieved from the chamber 120 through the outlet port 127 and the spring force of the Bellville springs is maintained on the thrust pin 77 until the die 30 must be changed again or removed for some other reason.

As will now be readily understood, a die 30 can easily and quickly be removed from its seat on the die shoe 25 immediately after a forging operation. Even though the die 30 has expanded longitudinally due to the heat developed during the forging operation, against the heavy spring force of the Bellville springs 125, for example, this pressure can easily be relieved hydraulically and the thrust pin 77 permitted to back off.

Mounting a new die 30 is a simple and expeditious operation. The locating blocks 40 are all canted upwardly to a slight degree at their clamping lips 50 ends to easily receive the die 30. The thrust clamp subassemblies 33, which had been completely removed during die change, are quickly seated in place and both the thrust clamp subassembly and the locating clamp subassembly manipulated in the aforedescribed manner to seat the dies 30 securely on the die shoe 25.

The die shoe 25 is also easily and quickly removable from its seat on the bolster nest plate 16, according to the present invention. In this light, it should be recognized that it is sometimes necessary to remove and replace the die shoe 25, as well as the dies 30. The die shoe clamping assemblies 26 facilitate this simple and expeditious removal and replacement of the die shoe 25 after removal of the die 30.

A die shoe clamping assembly 26 is disposed along both the front and back faces of die arrangement 10, as seen in FIGS. 1 and 2. Each clamping assembly 26 is identical in construction and operation. Accordingly, only one die shoe clamping assembly 26 is described in detail, and corresponding reference numerals are applied to corresponding components of the others.

Each die shoe clamping assembly 26 includes a series of clamping units 135 spaced along the corresponding front or back of the fixed die unit 10. The clamping units 135 are connected in "gang" relationship to a hydraulic actuator motor 136 by an actuator 137. Each of the clamping units 135, in turn, identical in construction and operation, and, accordingly, only one is described in detail and corresponding reference numerals are applied to corresponding components of the others.

Referring to FIG. 5, a clamping unit 135 is illustrated in substantial detail. The clamping unit 135 includes a clamping rod 140 which extends vertically through a suitably shaped bore 141 in the bolster nest plate 16 in freely slidable relationship. The clamping rod 140 is generally T-shaped so as to have generally transversely extending head 142 (see FIG. 2) formed on its upper end.

The head 142 extends upwardly into a stepped slot 145 in the base, front edge of the die shoe 25. The slot 145 includes a relatively wide upper section 146 in which the head 142 is disposed and a narrower section 147 through which the rod 140 depends into the bore 141.

The rod 140 is rotatable on its axis in the bore 141 so that the head 142 is either aligned with the major axis of the narrow section 147 of the stepped slot 145 or extends transversely of it to seat on the sides of the wider section 146, as seen in FIG. 2. With the rod 140 and the head 142 in the latter orientation, it will be recognized that tension on the rod 140 will serve to clamp the die shoe 25 onto the bolster nest plate 16.

When the rod 140 is rotated 90° through alignment with the narrower section 147 of the slot 145, the die shoe 25 can readily be lifted off the bolster nest plate 16.

The rod 140 is rotatably mounted on its axis, in threaded relationship, in a cylindrical piston head 150 seated in the bolster base plate 115. The head 150 has a smaller diameter section 151 slidable in a bore section 152 in the bolster base plate 15, and a larger diameter head section 153 slidable in a larger bore section 154 in the plate. O-rings 160 and 161 encircling the larger and smaller diameter head sections 153 and 151, respectively, seal off a hydraulic pressure chamber 165 under the larger diameter head section 153.

Seated on the piston head 150, in surrounding relationship with the clamp rod 140 are a series of Bellville springs 170, disposed in a suitably sized cutout 171 in the base, front edge of the bolster nest plate 16. The Bellville springs 170 are compressed between the head 153 and a washer 175 encircling the rod 140 in the cutout 171 and seated against the roof 176 of the cutout. A sleeve 172 separates the Bellville springs 170 from the rod 140 itself, permitting free movement of the rod through the springs.

The Bellville springs 170 normally exert a great force on the piston head 150 to force the rod 140 downwardly in the bore 141. With the transversely extending head 142 of the rod 140 disposed as illustrated in FIGS. 2 and 5, the rod 140 thus clamps the die shoe 25 securely on the bolster nest plate 16. With all of the clamp units 135 arranged in this manner, it will be seen that the entire die shoe 25 securely and rigidly fastened.

When it is desired to remove the die shoe 25, the pressure of the Bellville springs 170 on the rod head 142 must be relieved, or the rod 140 cannot be rotated to bring the head 142 into alignment with the narrow section 147 of the stepped slot 145 whereby the die shoe 25 is freed. According to the invention, this is accomplished by introducing hydraulic fluid under pressure to the pressure chamber 165 below the larger diameter head section 153 of the piston head 150. This fluid under pressure raises the piston head 150 and, accordingly, the rod 140 against the large force of the multiple Bellville springs 170, lifting the head 142 upwardly in the larger slot section 146 of the stepped slot 145.

The rod 140 is then rotated 90°. To this end a rotating crank arm 180 is keyed onto a rectangular cross section extension 181 of the rod 140, on its lower end. A snapring 182 holds the lever 180 on the extension 181. The lever 180, and corresponding levers 180 for each of the clamping units 145, extends out to a pivotal connection 185 (see FIG. 2) with the
By actuating the conventional fluid motor 136, the gang bar 137 is moved to drive the levers 180 either to the left or the right, as seen in FIG. 2, thus twisting the rods 140 through 90° to either align the heads 142 of the rod with the narrow section 147 of the tapped slots 145 or place them in transversely extending relationship thereto. In the latter orientation, clamping of the die shoe is facilitated, while in the former orientation, the die shoe 25 can readily be removed. The manner in which a die shoe 25 can be removed and a new die shoe mounted should now be readily seen. This operation can be carried out simply and expeditiously, with minimal labor cost or "downtime."

1. In a metal forming press, a die locating and clamping assembly for securing a die to a die shoe or the like, comprising:
   a. a locating clamp member seated on the die shoe at one side of the die,
   b. a clamping lip formed on said locating clamp member and adapted to overlie a clamping shoulder formed on the die,
   c. holddown means for clamping said locating clamp member to the die shoe with said lip overlying said shoulder whereby said one side of said die is clamped to said die shoe,
   d. a locating surface on said locating clamp member for locating said die on said die shoe,
   e. a thrust clamp member seated on the die shoe at the opposite side of the die,
   f. a clamping lip formed on said thrust clamp member and adapted to overlie a corresponding clamping shoulder formed on the die,
   g. holddown means for clamping said thrust clamp member to the die shoe with said corresponding lip overlying said corresponding shoulder whereby said other side of said die is clamped to the die shoe,
   h. thrust means in said thrust clamp member normally urged by resilient means to force the die into engagement with the locating surface of said locating clamp member,
   i. and hydraulic means associated with said thrust clamp member for compressing said resilient means to permit mechanical adjustment of the force normally exerted by said resilient means in urging said thrust means to force said die against said locating surface.

2. The die locating and clamping assembly of claim 1 further characterized in that:
   a. said locating clamp member has a bore extending therethrough,
   b. said locating clamp member includes a pin movable in said bore and urged toward one end of said bore by said resilient means,
   c. said hydraulic means includes piston means movable in said bore and forming a compression member for said resilient means.

3. The die locating and clamping assembly of claim 2 further characterized in that:
   a. said hydraulic means further includes a hydraulic chamber in said bore formed by said piston means on one end and a bore closure means on the opposite end,
   b. and a thrust control screw threaded through said bore closure means and effective on said piston means to adjust the pressure exerted by said resilient means.

4. The die locating and clamping assembly of claim 1 further characterized in that:
   a. said locating clamping member has resilient means associated therewith which is effective to urge said locating clamping member to lift upwardly whereby when said holddown means is released said clamping lip moves upwardly from clamping position.

5. In a metal forming press, a die shoe clamping assembly for securing a die shoe to baseplate means, comprising:
   a. a clamping unit mounted on said baseplate means,
   b. said clamping unit including a clamping rod freely movable in said baseplate means and having head key means thereon normally disposed in key slot means in the die shoe,
   c. bore means in said base means,
   d. a piston head movable in said bore means and having said rod anchored in said piston head,
   e. resilient means on said baseplate means normally urging said piston head away from said die shoe so as to clamp the die shoe to said base means with said head key means seated in said key slot means,
   f. and a hydraulic chamber in the base means opposite said piston head from said resilient means,
   g. the introduction of fluid under pressure to said hydraulic chamber being effective to compress said resilient means and unseat said head key means in said key slot means to permit said head key means to rotate and be released from said head key slot means.

6. The die shoe clamping assembly of claim 5 further characterized in that:
   a. said rod is anchored in said piston head and rotatable relative thereto.

7. The die shoe clamping assembly of claim 6 further characterized in that:
   a. said rod is threaded through said piston head to anchor it against axial movement therein without rotation.

8. The die shoe clamping assembly of claim 5 further characterized by and including:
   a. actuator arm means connected to said rod for rotating it in said bore and having said head key means relative to said key slot means.

9. An arrangement for clamping die means on mounting structure of a metal forming press, comprising:
   a. clamping means,
   b. said clamping means including bolt means threadedly mounted in a member forming one end of a hydraulic chamber,
   c. said clamping means normally being thrust against said die means by resilient load means,
   d. means for relieving said resilient load means to relieve said thrust, and
   e. hydraulic means selectively effective upon the introduction of hydraulic fluid under a prescribed pressure to said hydraulic chamber to compress said resilient load means and make said relieving means operable.
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,638,473 Dated February 1, 1972

Inventor(s) Howard J. McElroy

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 40, change "clock" to --block--

Column 6, line 3, after "actuator" insert --bar--

Column 8, line 42, change "having" to --moving--
Line 47, change "threadly" to --threadedly--

Signed and sealed this 5th day of September 1972.

(SEAL)
Attest:
EDWARD M. FLETCHER, JR. ROBERT GOTTSCALK
Attesting Officer Commissioner of Patents