Aug. 27, 1963 R. H. CEDERLEAF 3,101,639

AUTOMATIC DIE CLAMPING MECHANISM FOR POWER PRESSES

Filed Sept. 28, 1959 2 Sheets-Sheet 1

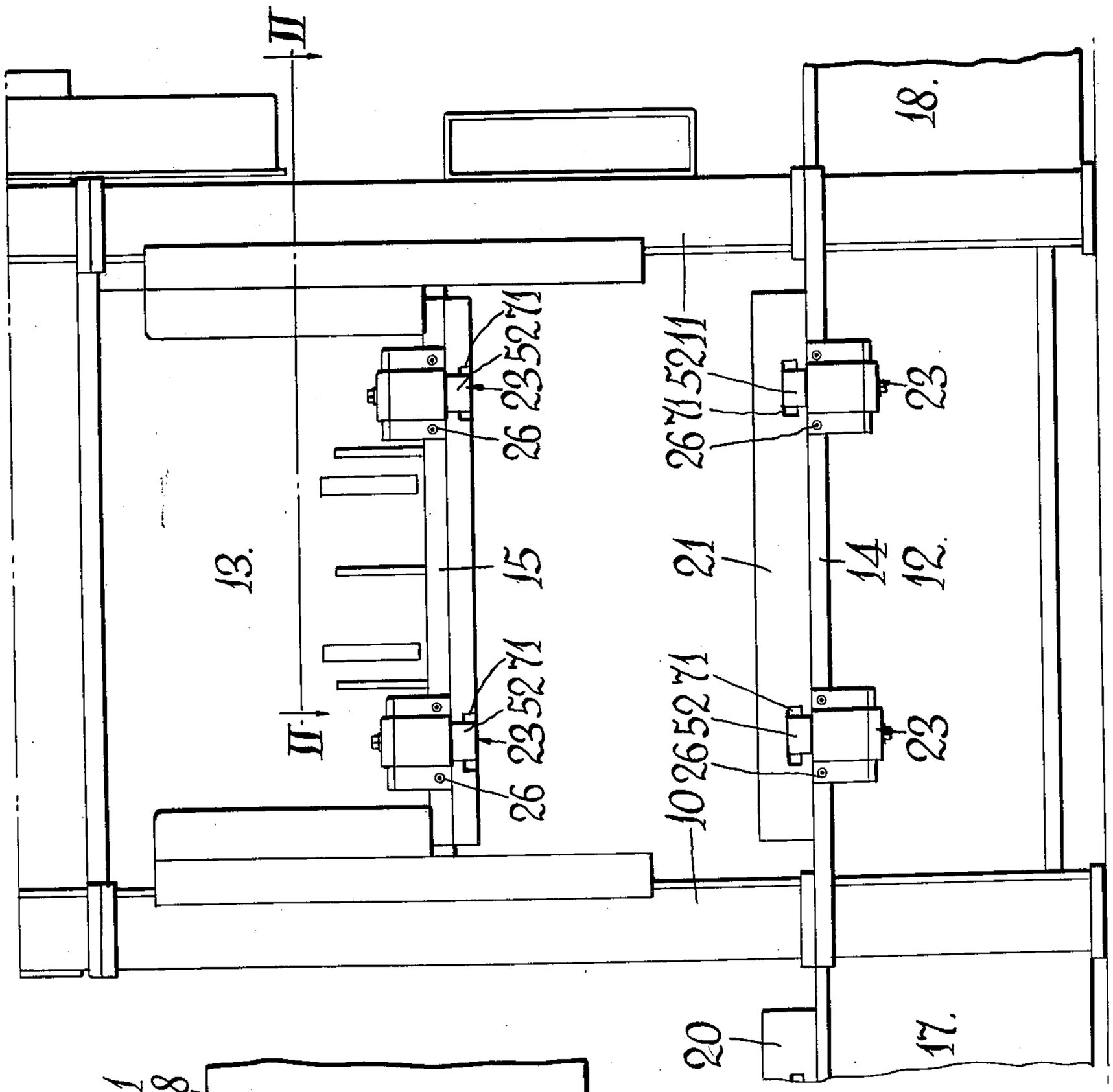

FIG. 1.

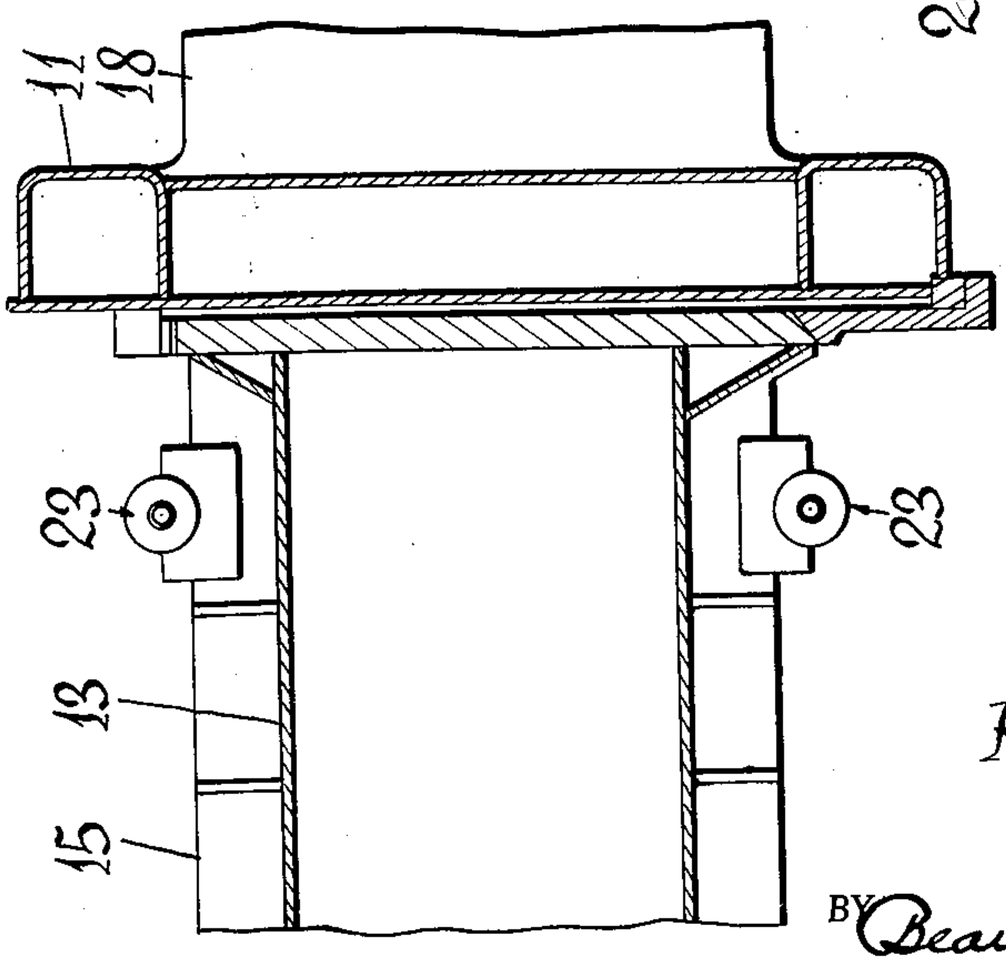

FIG. 2.

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AUTOMATIC DIE CLAMPING MECHANISM FOR POWER PRESSES

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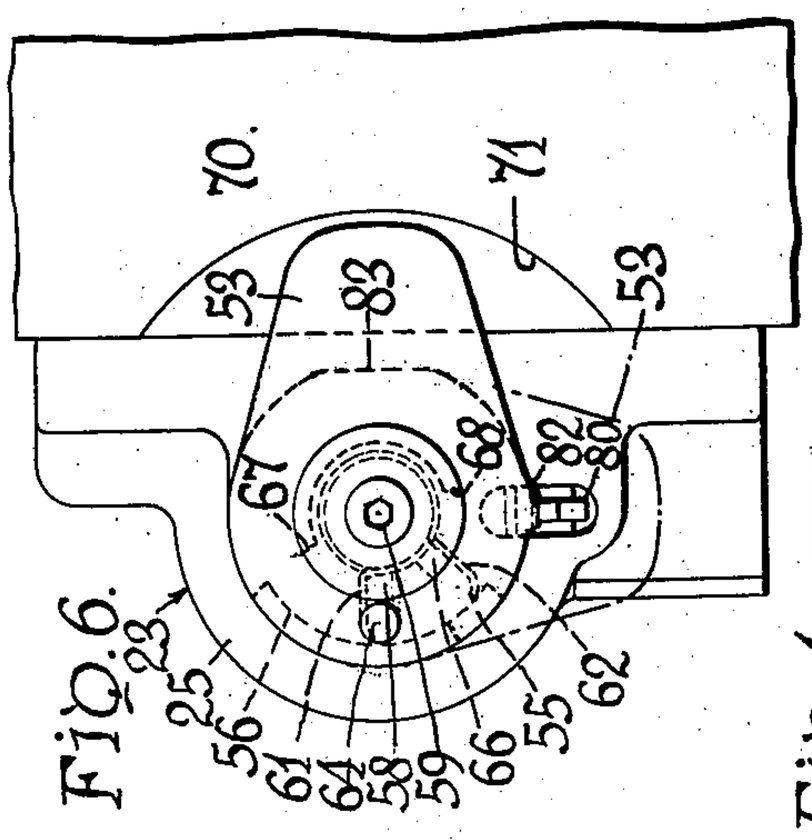

FIG. 6.

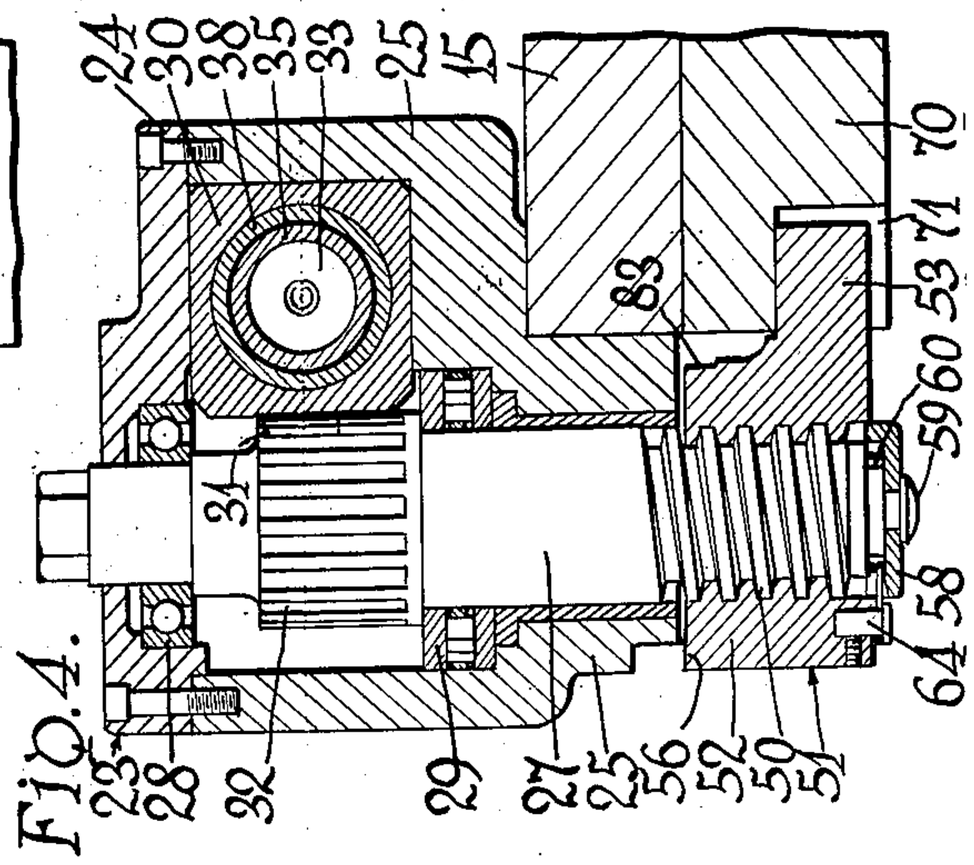

FIG. 4.

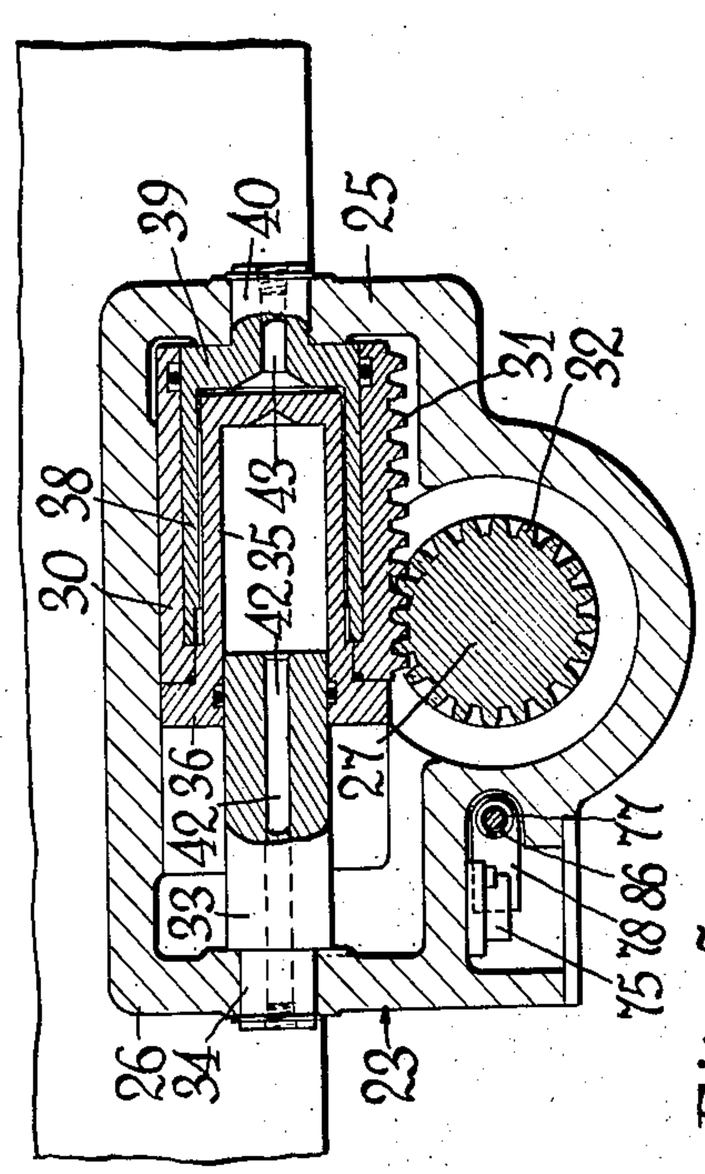

FIG. 5.

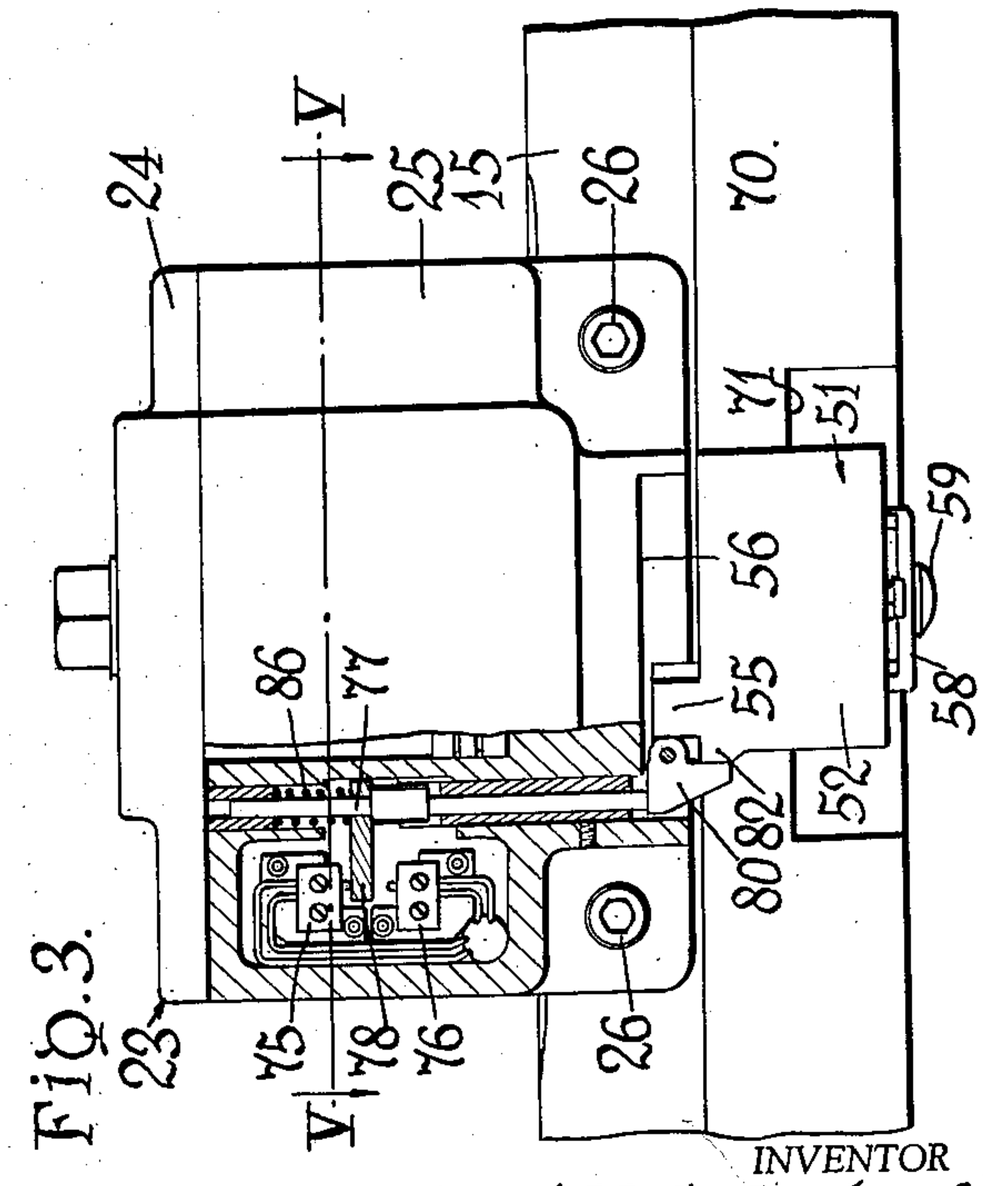

FIG. 3.

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AUTOMATIC DIE CLAMPING MECHANISM FOR POWER PRESSES

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6 Claims. (Cl. 83—698)

This invention relates to means for automatically clamping the relatively movable punch and die portions of conventional die mechanisms to the upper platens or slides of power presses and to the bolsters or bed members of such power presses, respectively.

In accordance with the present invention similar clamping means are provided in association with the bed or bolster of a press and the slide or upper platen, for similarly clamping the stationary and movable portions of a die mechanism to the bed and to the reciprocable slide of the press. The clamping means of the present invention may be employed in either or both of these cases.

In connection with the upper die or punch assembly, which is normally in association with and resting upon the lower die when the die mechanism is introduced to the press, the reciprocable slide of the press may be brought down by the usual "inching" operation to the top surface of the die assembly, that is the top surface of the punch unit or reciprocable portion of the die mechanism, and thence quickly clamped to the punch unit for subsequent reciprocation of the punch unit with the slide of the power press.

While not necessarily thus employed, the clamping mechanism of the present invention is particularly advantageous when used in conjunction with power presses having sliding bolster constructions whereby the entire die mechanism is placed upon a bolster while the same is laterally offset from the press proper, being supported by a lateral extension of the bed of the press.

After the die mechanism is thus positioned the bolster is moved to the bed proper of the press, beneath the slide mechanism thereof, and thereupon the clamping means of the present invention may be utilized to great advantage to clamp both the lower and upper portions of the die mechanism to the bed and the slide respectively of the power press. Such a sliding bolster arrangement is illustrated in Munschauer patent application, Serial No. 803,921, filed April 3, 1959, now Patent No. 2,940,384, dated June 14, 1960.

A die mechanism clamping arrangement of the general type here contemplated is illustrated and described in a pending patent application in the name of Frank J. Hohl, Serial No. 684,195, now Patent No. 3,027,792, dated April 3, 1962, and the clamping mechanism of the present invention presents substantial improvements in such mechanisms.

The present invention provides a novel fluid pressure piston and cylinder arrangement for motivating the clamping and unclamping operations which is incorporated directly and entirely within each clamp mechanism and which is so arranged as to require a minimum of length in an axial direction for accomplishing the desired result. Further, the fluid motor means is double acting and thus requires no springs or similar assist devices for operation in either direction. Furthermore, the arrangement is such that the movable member of the fluid motor means directly comprises a rack member for translating the rectilinear movement thereof to rotary movement of a clamp operating shaft member.

The clamp mechanism of the present invention embodies means for preventing unclamping movement of the clamping members unless proper unclamping clearance has first been established and further embodies

means to insure against unclamping movement of an upper die member when the same is not supported from beneath, so that dropping of an upper die member from the clamp mechanism is effectively prevented.

In addition to the foregoing, means are provided in conjunction with the clamping means of the present invention which cooperate with the control systems for initiating press operating cycles and for effecting bolster shifting operations such as are disclosed in the above identified Munschauer patent application. Accordingly, the control circuit for initiating working strokes of the power press cannot be energized unless all of the clamp members are fully closed and bolster shifting operation cannot be effected unless all of the clamp members are fully open.

A single specific embodiment of the principles of the present invention is illustrated in the accompanying drawings and described in detail in the following specification. However, it is to be understood that such embodiment is by way of example only and that the principles of the present invention are not limited thereto nor otherwise than as defined in the appended claims.

In the drawings:

FIG. 1 is a general elevational view of a power press provided with one form of the punch and die clamping means of the present invention;

FIG. 2 is a fragmentary cross-sectional view on the line II—II of FIG. 1;

FIG. 3 is an elevational view of one of the clamping units of the present invention viewed from the front or rear of the press, as the case may be, with a portion thereof broken away for added illustration;

FIG. 4 is a central vertical cross-sectional view through the clamping unit of FIG. 3, viewed as in side elevation;

FIG. 5 is a cross-sectional view on the line V—V of FIG. 3; and

FIG. 6 is a bottom plan view showing the clamping means per se of the clamping unit of FIGS. 3, 4 and 5.

Like characters of reference denote like parts throughout the several figures of the drawings and FIGS. 1 and 2 show a more or less conventional power press of the straight side type. The numerals **10** and **11** designate conventional side columns or side frame members, a bed is indicated at **12** and a reciprocable slide at **13**. The bed **12** has the usual top plate member **14** for receiving dies or bolster plates and slide **13** has the usual downwardly facing platen **15**.

In the present instance the bed **12** is shown provided with a pair of lateral extensions **17** and **18** which form continuations of the top surface of bed plate **14** and, as shown and described in detail in the above-identified Munschauer patent application, a pair of bolster plates **20** and **21** are connected for joint horizontal lateral movement along the bed plate **14** and extensions **17** and **18** so that either of them may be disposed in the working position on bed plate **14**, as bolster plate **21** is illustrated in FIG. 1, the other bolster being disposed on the top surface of extension **17** or extension **18**, as the case may be.

Clamping devices constructed in accordance with the present invention are associated with bed plate **14** and the platen **15** of slide **13** in the present instance, there being four clamps for each of these components and the same being designated generally by the reference numeral **23** in FIGS. 1 and 2.

The upper four clamp members **23** are secured to the platen **15** of slide **13** and the lower four are secured to bed plate **14** of the bed **12**. FIGS. 3 through 6 illustrate in detail one of the upper clamp members **23**, each of which comprises a main casing or housing member **25** which is attached to platen **15** by a pair of screws designated **26** in FIG. 3. A shaft **27** is journaled in casing **25**, and in a cover member **24** attached thereto, for rotation

on a veritcal axis, anti-friction bearings being provided for mounting shaft 27 as shown at 28 and 29 in FIG. 4.

Referring to FIG. 4 and more particularly to FIG. 5, a block 30 is mounted for horizontal sliding movement in casing 25 and is provided with rack teeth 31 meshing with a pinion 32 which is fixed to or formed on shaft 27.

As shown in FIG. 5, a piston member 33 is fixed at one end to casing 25 as at 34 and extends into a hollow cylindrical sleeve member 35. Sleeve 35 is provided with a flange 36 at its left-hand end as viewed in FIG. 5 and flange 36 is attached to the adjacent end of block 30 by screws (not shown).

A fixed sleeve member 38 is provided with an end wall portion 39 and a reduced right-hand end portion 40 which is fixed to the right-hand end wall of casing 25. The sleeve portion of sleeve member 38 telescopes over the outer periphery of the sleeve member 35 and fits slidably within a bore in rack block 30.

Fixed piston 33 is provided with an axial fluid pressure passage 42 and the end wall 39 of sleeve member 38 is provided with a fluid pressure passage 43.

From the foregoing, it will be seen that application of fluid pressure by way of passage 42, with the other fluid pressure passage 43 vented, moves the assembly comprising sleeve member 35 and rack block 30 to the right as viewed in FIG. 5 to the position there illustrated. Conversely, application of fluid pressure through passage 43 with passage 42 vented acts against the right-hand end wall of sleeve member 35 to move this member and the rack block 30 to the left as viewed in FIG. 5. These opposite reciprocations impart reverse rotative movement to shaft 27 through engagement of rack 31 with pinion 32.

The foregoing novel duplex piston and cylinder arrangement provides a positive double-acting fluid motor means for rotating shaft 27 in opposite directions without the use of springs and within a very short axial length. While the foregoing description and most of the descriptive matter which follows relates to the single clamping unit shown in FIGS. 3 through 6, it is to be understood that a number of clamping units will operate simultaneously by joint application of operating fluid pressure thereto by way of their respective fluid passages 42 and 43.

Referring particularly to FIG. 4, the lower end of shaft 27 is threaded as at 50 and a clamping member designated generally by the numeral 51 has a hub portion 52 which is internally threaded to fit the threads 50 of shaft 27 and has an offset toe portion 53 which performs the actual clamping function in a manner which will presently appear.

Speaking generally, if clamping member 51 is relatively unimpeded it will rotate with shaft 27, whereas if certain frictional or resilient restraints are imposed thereon, rotation of shaft 27 in opposite directions will produce relative threading and unthreading movements as between the threads 50 of shaft 27 and the threads of clamping member 51 which will result in vertical axial movements of clamp member 51, shaft 27 being restrained against vertical axial movement by the anti-friction bearings 28 and 29.

Hub portion 52 of clamp member 51 is provided with a lug or stop member 55 which rides in an arcuate peripheral groove 56 in casing 25, the length of groove 56 being such as to limit rotative movement of clamp member 51 to a 90-degree arc. Thus the toe portion 53 of clamp member 51 is limited to arcuate movement between the full line clamping position of FIG. 6 and the dotted line withdrawn position there shown.

A shallow cup-shaped cap member 58 is rigidly attached to the lower end of shaft 27 by a screw 59 and forms a chamber for receiving a torsion spring 60 which is wound around a reduced lower end portion of shaft 27. Torsion spring 60 has opposite terminal portions 61 and 62 which project radially outwardly and, as shown in FIG. 6, lie at opposite sides of a pin 64 carried by the hub portion 52 of clamp member 51 and a projection 66 formed on the inner side of the spring cap member 58. The annular

flange portion of cap member 58 is interrupted as indicated at 67 and 68 in FIG. 6 to permit certain relative rotative movements of the parts, as will presently appear, and the projection 66 of the cap member, which is in reality a separate arcuate portion of the interrupted flange of cap member 58, is disposed generally medially of the interruption in the flange.

The operation of this portion of the mechanism and the relative movements as between shaft 27 and clamp member 51 will now be described. As previously indicated, the clamp mechanism shown in detail in FIGS. 3 through 6 is an upper clamp mechanism secured to platen 15 of the slide 13 of a power press.

In FIGS. 3, 4 and 6 the numeral 70 designates a member which may comprise the actual punch holder of a die set but in the present instance comprises an adaptor plate secured to the top surface of such punch holder. Thus adaptor plates of a given uniform size to suit the locations of the clamping devices may be used on punch holders of various sizes and shapes. In the present instance adaptor plate 70 is recessed as at 71 to receive the toe portions 53 of clamping members 51.

In FIGS. 3 through 6 the rack and pinion mechanism and the clamping member 51 are all shown in their extremes of movement in a clamping direction. The parts are so arranged that when the clamping member reaches the full-line position of FIGS. 4 and 6, the shaft 27 continues to rotate in a counterclockwise direction as viewed in the bottom plan view, FIG. 6, the clamp being restrained against any further counterclockwise rotation by engagement of stop 55 against the lower end of arcuate notch 56 of casing 25, as viewed in FIG. 6.

This continued rotation of shaft 27 results in the clamp member 51 being drawn upwardly to securely clamp adaptor plate 70 to platen 15. This additional rotation of shaft 27 also moves stop 66 from a normal position of radial alignment with pin 64 to the position shown in FIG. 6 wherein leg 62 of spring 60 has been moved away from stop pin 64 of the clamp member to stress the torsion spring 60.

With the parts in the fully clamped position shown in FIG. 4 and in full lines in FIG. 6, if fluid pressure be applied to passage 43 to move rack block 30 to the left as viewed in FIG. 5 for unclamping movement, this produces an "unscrewing" rotation of shaft 27, that is a clockwise rotation as viewed in bottom plan in FIG. 6. At the very beginning of this rotation the clamp member 51 will not rotate with shaft 27 because of the clamping friction of toe portion 53 so that the clamp member 51 will begin to move downwardly, as viewed in FIG. 4.

As soon as toe portion 53 of clamping member 51 is relieved of its frictional engagement against adapter plate 70, the clamp member 51 will tend to rotate with shaft 27 toward the unclamped position shown in dot and dash lines in FIG. 6. The beginning of actual unclamping movement under these conditions would be somewhat unpredictable and haphazard and a more definitely defined pattern of operation is achieved by operation of spring 60.

The energy stored in spring 60 as described above insures that adequate vertical clearance will be established, in an unclamping operation, before the clamp member 51 swings away from the full line position of FIG. 6. As shaft 27 moves in a clockwise direction at the beginning of an unclamping operation, the leg 61 of spring 60 acts against stop pin 64 to urge the clamp member in a counterclockwise direction and thus restrains the clamping member against rotation with shaft 27 until the pin 64 and projection 66 are in radial alignment. This establishes the desired vertical clearance between the bottom of platen 15 and the top of toe portion 53 and clamping member 51 is now free to swing with shaft 27 to unclamping position unless other restraining conditions exist.

In normal operation unclamping movement of a die set should only be performed with the slide in its bottom dead center position or at least in a sufficiently lowered

position so that the upper movable portion of the die is resting downwardly upon the lower stationary portion thereof. In addition to the function just described, torsion spring 60 also serves to prevent inadvertent unclamping of the punch assembly or upper die set when the same is not resting down upon or supported by the lower die member.

If the punch assembly which is suspended from adaptor plate 70 is not fully resting upon the underlying die mechanism so that the punch assembly is resting upon or "hanging from" the toe portions 53 of the clamp members at the time that the unclamping movement of the clamp members is initiated, the clamp members might move out from under adaptor plate 70 and permit the punch assembly to drop down against the stationary portion of the die mechanism.

The operation of torsion spring 60 guards against this eventuality.

At this point in the unclamping operation described above, when projection 66 has moved into radial alignment with stop pin 64, if the adaptor 70 and the suspended punch mechanism is still resting upon the toe portions 53 of the clamp members 51, the clamp members will still be frictionally held against unclamping movement even though normally adequate vertical clearance has been established. In such case continued positive clockwise rotation of shaft 27 will move projection 66 against the other leg 61 of torsion spring 60 and move such leg in a clockwise direction until the shaft 27 reaches its extreme limit of clockwise rotation.

In this phase of rotation of the shaft 27, and under the stated conditions, leg 62 of torsion spring 60 will have engaged against the underside of pin 64 as viewed in FIG. 6, and will be arrested thereby, so that the torsion spring will again be wound in a direction to exert a clockwise force against clamp member 51 against the resistance offered by the friction of the adaptor plate resting on toe portion 53 of clamp member 51. Thus the adaptor plate and associated punch mechanism will continue to be supported even though the several shafts 27 have completed their unclamping movement.

If now the slide of the press is lowered to rest the punch mechanism on the lower portion of the die, and thus remove the frictional engagement between adaptor 70 and the toe portions 53 of clamp members 51, the force of the torsion springs 60 acting through their leg members 62 against pins 64 will rotate the clamp members 51 the full 90 degrees which the shafts 27 will have moved beyond the clamp members. At this point the projections 66 and pins 64 will again be in registry, and the stop lugs 55 will be against the top ends of the arcuate notches 56, as viewed in FIG. 6.

Clamp mechanisms constructed in accordance with the present invention further provide an arrangement which insures proper conditions of all of the clamp units preliminary to operation of the press to execute working cycles and also preliminary to operation of the sliding bolster mechanism which is employed in introducing dies to the working area of the press and removing them therefrom.

Specifically, the clamping mechanisms are so arranged that the electrical circuit which initiates operation of the power press to execute working strokes, as by engaging the clutch or by other means, cannot be operated unless all of the clamps are in a fully closed position and, secondly, the electrical circuit which initiates bolster shifting operations for moving dies to and from the working area of the press cannot be energized unless all of the clamps are in a fully released position.

Referring to FIG. 3, a pair of normally open microswitches 75 and 76 are mounted one above the other in casing 25 in such position that their operating buttons are in facing relationship. The microswitch 75 of each of the several clamp mechanisms is in series with the energizing circuit for engaging the clutch of the power press or other circuit for initiating press operation, and the microswitch 76 of each of the clamp mechanisms is in series with the electrical circuit which operates the bolster shifting means or initiates the operation thereof.

A rod 77 is mounted for vertical sliding movement in casing 25 and carries a laterally projecting plate member 78 which lies between the operating buttons of the microswitches 75 and 76. At its lower end rod 77 bears against a rocker member 80 which is pivoted to casing 25 adjacent to the upper peripheral portion of hub 52 of clamp member 51. This peripheral portion of hub 52 of clamp member 51 is provided with a lobe or projection 82 and at 90 degrees therefrom, with a depression 83.

Lobe 82 registers with rocker member 80 when the clamp member is in clamping position, as shown in FIG. 3 and in full lines in FIG. 6, and in this position rocker member 80 holds rod 77 in a raised position wherein the plate member 78 of rod 77 is in engagement with the operating button of microswitch 75, so that the circuit for initiating working strokes of the power press can be operated.

When the clamp member is in an intermediate position between its fully clamped and fully unclamped positions, the lower portion of rocker member 80 bears against the periphery of hub 52 and plate member 78 of rod 77 is in an intermediate position wherein both microswitches 75 and 76 are open.

When clamp member 51 reaches a fully unclamped position the depression 83 of hub 52 of clamping member 51 registers with the lower portion of rocker member 80 whereupon rod 77 is moved to its lowermost position under the impetus of a coil spring 86 which acts against the top of plate member 78, thus depressing the operating button of microswitch 76 to render the bolster sliding mechanism control circuit operable for bolster shifting operations.

I claim:

1. Die clamping means comprising a casing, an operating shaft journaled therein, and a clamp member associated with said operating shaft, a rack member guided for reciprocating movement in said casing and a meshing pinion fixed to said operating shaft, said rack member comprising a pair of coaxial, radially spaced sleeve portions, the inner sleeve portion being open at one end and closed at the other to form fluid chambers at opposite sides of said closed end, the outer sleeve portion being fixed to the inner sleeve at the open end of the latter and radially spaced therefrom at the other end to form an annular space, a piston fixed to one end of the casing and projecting into the open end of the inner sleeve portion and an annular piston fixed to the other end of the casing and projecting into said annular space, said pistons having fluid passages therethrough for selectively supplying operating fluid pressure to said fluid chambers to reciprocate said rack member in opposite directions.

2. Die clamping means comprising a casing and a clamp operating member guided for reciprocating movement therein, said operating member comprising a pair of coaxial, radially spaced sleeve portions, the inner sleeve portion being open at one end and closed at the other to form fluid chambers at opposite sides of said closed end, the outer sleeve portion being fixed to the inner sleeve at the open end of the latter and radially spaced therefrom at the other end to form an annular space, a piston fixed to one end of the casing and projecting into the open end of the inner sleeve portion and an annular piston fixed to the other end of the casing and projecting into said annular space, said pistons having fluid passages therethrough for selectively supplying operating fluid pressure to said fluid chambers to reciprocate said operating member in opposite directions.

3. Die clamping means comprising a casing, an operating shaft journaled therein, and a clamp member associated with said operating shaft, a rack member guided for reciprocating movement in said casing and a meshing pinion fixed to said operating shaft, said rack member

comprising a pair of coaxial, radially spaced sleeve portions, the inner sleeve portion being open at one end and closed at the other to form fluid chambers at opposite sides of said closed end, the outer sleeve portion being fixed to the inner sleeve at the open end of the latter and radially spaced therefrom at the other end to form an annular space, said two chambers being substantially coextensive in an axial direction, a piston fixed to one end of the casing and projecting into the open end of the inner sleeve portion and an annular piston fixed to the other end of the casing and projecting into said annular space, said pistons having fluid passages therethrough for selectively supplying operating fluid pressure to said fluid chambers to reciprocate said rack member in opposite directions.

4. Die clamping means comprising a casing and a clamp operating member guided for reciprocating movement therein, said operating member comprising a pair of coaxial, radially spaced sleeve portions, the inner sleeve portion being open at one end and closed at the other to form fluid chambers at opposite sides of said closed end, the outer sleeve portion being fixed to the inner sleeve at the open end of the latter and radially spaced therefrom at the other end to form an annular space, said two chambers being substantially coextensive in an axial direction, a piston fixed to one end of the casing and projecting into the open end of the inner sleeve portion and an annular piston fixed to the other end of the casing and projecting into said annular space said pistons having fluid passages therethrough for selectively supplying operating fluid pressure to said fluid chambers to reciprocate said operating member in opposite directions.

5. Die clamping means comprising a casing, a rotatable clamp member and a reciprocable clamp operating member guided for reciprocating movement in said casing, said operating member comprising a pair of coaxial, radially spaced sleeve portions, the inner sleeve portion being open at one end and closed at the other to form fluid chambers at opposite sides of said closed end, the outer sleeve portion being fixed to the inner sleeve at the open end of the latter and radially spaced therefrom at the other end to form an annular space, a fixed piston carried by one end of the casing and projecting into the

open end of the inner sleeve portion and a fixed sleeve piston carried by the other end of the casing and projecting into said annular space, said pistons having fluid passages therethrough for selectively supplying operating fluid pressure to said fluid chambers.

6. Die clamping means comprising a casing, a rotatable clamp member and a reciprocable clamp operating member guided for reciprocating movement in said casing, said operating member comprising a pair of coaxial, radially spaced sleeve portions, the inner sleeve portion being open at one end and closed at the other to form fluid chambers at opposite sides of said closed end, the outer sleeve portion being fixed to the inner sleeve at the open end of the latter and radially spaced therefrom at the other end to form an annular space, said two chambers being substantially coextensive in an axial direction, a fixed piston carried by one end of the casing and projecting into the open end of the inner sleeve portion and a fixed sleeve piston carried by the other end of the casing and projecting into said annular space, said pistons having fluid passages therethrough for selectively supplying operating fluid pressure to said fluid chambers.

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