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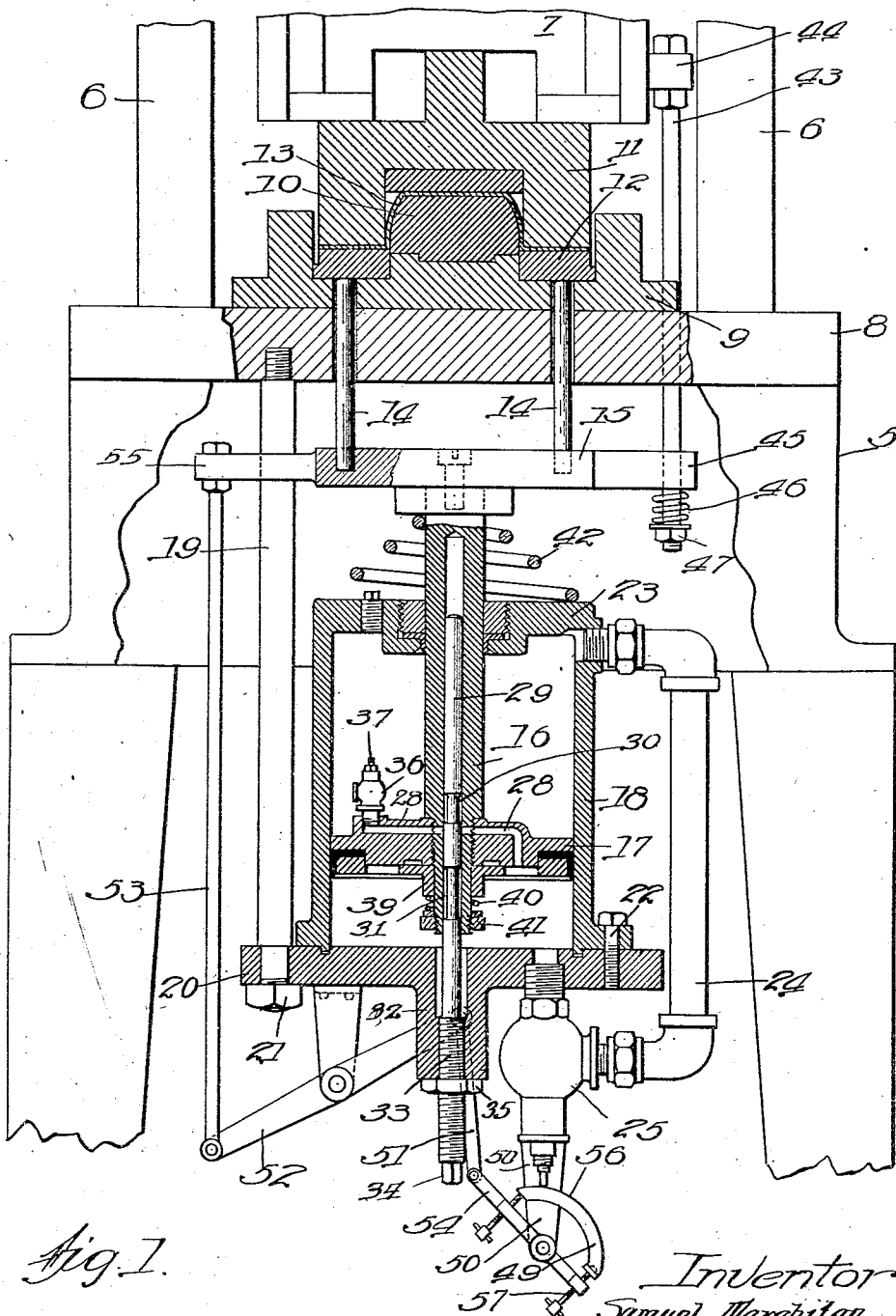
**S. MARGHITAN**

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# DIE CUSHION

Filed Feb. 16, 1928

2 Sheets-Sheet 1



Inventor:

Samuel Marghitan,

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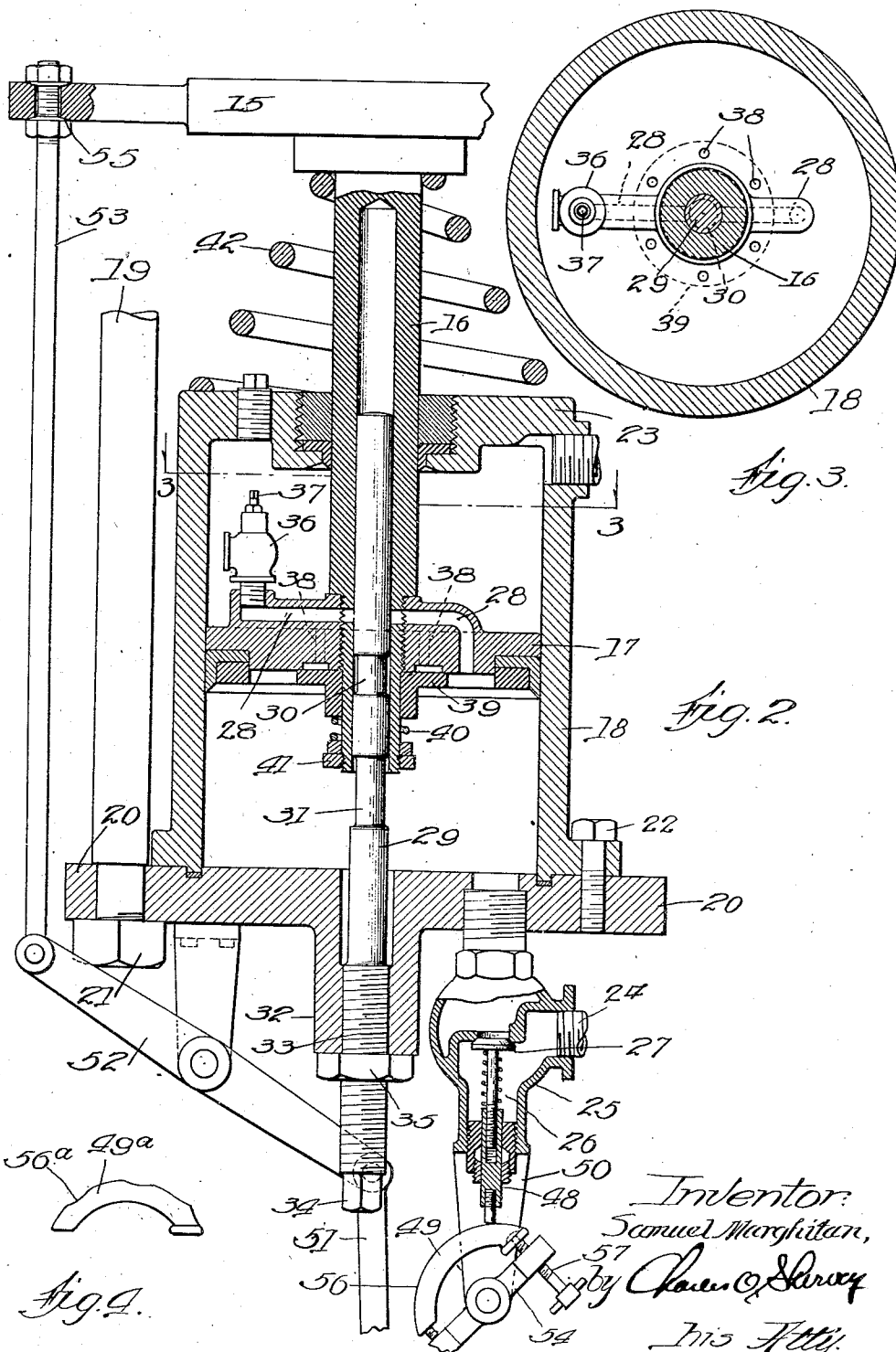
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## UNITED STATES PATENT OFFICE

SAMUEL MARGHITAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO NEL-MAR MFG. CO., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

## DIE CUSHION

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This invention relates to die cushions for power presses, and its principal object is to provide improved yielding means for holding a blank by resisting the pressure exerted by the ram during bending, forming or drawing operations. There are many situations where the desideratum is to obtain a maximum amount of resistance, against the work, during a portion of the down stroke of the ram, and at some place or places during the stroke, to reduce or increase the amount of resistance, more or less, and in some cases it is highly desirable that the amount of resistance vary at several places during the working stroke of the ram.

In many press operations it is essential that the work be firmly gripped between the dies or between one die and the draw ring, during the entire stroke of the ram, and in many drawing operations it is necessary that the grip on the work be released gradually or suddenly at spaced intervals as the ram makes its down stroke, and one of the objects of the present invention is to provide automatic means for varying the amount or degree of resistance offered against the pressure exerted by the ram while performing its work or entirely eliminating same. Another object is to provide means whereby the variable pressure or resistance may be regulated or eliminated to suit the particular character of work at hand.

Other objects and advantages will occur in the course of this specification, and with said objects and advantages in view, this invention consists in a die cushion having means whereby the resistance or pressure against the ram is capable of variation during the working stroke of the ram. It further consists in a die cushion in which the variable pressures may be regulated to suit the particular work at hand. It further consists in a die cushion in which the resistance or pressure against the ram may vary during the down stroke of the ram either through a gradual variation or through sudden changes from a maximum pressure to a reduced pressure. The invention further consists in the several novel features hereinafter fully set forth and claimed.

The invention is clearly illustrated in the drawings accompanying this specification in which—

Figure 1 is a central vertical section through a fragment of a power press and showing a simple embodiment of the present invention applied thereto;

Fig. 2 is a view similar to Fig. 1 with certain parts broken away, the operating mechanism being illustrated in a different position and the parts being shown upon a larger scale;

Fig. 3 is a detail horizontal section taken on the line 3—3 of Fig. 2; and

Fig. 4 is a detail side elevation of a slightly modified form of cam which forms part of the present invention.

Referring to said drawings, which illustrate one embodiment of the present invention, the reference character 5 designates a fragment of the frame of a power press having the usual uprights or standards 6 on which is guided the ram or plunger 7 as is customary. On the frame of the press is supported the usual bolster 8 on which is mounted a die shoe 9 carrying the lower die 10. The upper die 11 is mounted on the ram as usual. As is well understood, power mechanism is provided in the press for reciprocating the ram, but as this forms no part of the present invention, the power mechanism has not been illustrated.

In connection with certain drawing operations, a draw ring 12 is provided, which surrounds the lower die 10 and is adapted to engage with that part of the underside of the blank 13 which projects beyond the lower die 10. In some cases a cushion pad is employed for certain classes of work, as is well understood. The draw ring or cushion pad is yieldingly supported by elements of the die cushion, which forms the subject matter of the present application, and, as shown, the draw ring is mounted upon a number of draw pins 14 which project down through holes in the bolster 8 and are secured to and supported by a plate or block 15 that is mounted upon a piston rod 16 which has a piston or plunger 17 upon its lower end which is contained in the cylinder 18 of the die cushion.

The cylinder 18 is closed at both ends by cylinder heads 20 and 23 and may be supported from the bolster by rods 19 which are secured in the bolster and are connected to the cylinder head 20 by nuts 21. The cylinder 18 may be flanged upon its lower end and secured to the cylinder head 20 by bolts 22. Suitable packing is provided between the cylinder 18 and head 20 to insure a tight joint therebetween. The upper head of the cylinder may comprise an end wall 23 formed as a part of the cylinder.

Leading from the cylinder, at one side of the piston 17, is a conduit 24, which also communicates with the cylinder on the opposite side of the piston and forms a fluid passage around the piston. It will be understood that the cylinder is filled or partially filled with a fluid, such as liquid or compressed air, or the like, and during the down stroke of the piston the fluid is forced through said conduit from the lower side of said piston to the upper side thereof. Interposed in said conduit is a pressure regulating valve 25 or relief valve having regulatable means whereby the flow of the fluid through said valve may be governed.

While the exact form of pressure regulating valve or relief valve is not material to the present invention, broadly speaking, it usually embodies a compression spring 26 behind the valve proper 27, which spring operates to hold the valve seated against a pressure up to a predetermined point, and yields under pressure in excess thereof, the pressure required to compress the valve spring determining the flow of fluid therethrough. By properly adjusting the valve 25, the die cushion is made to resist a maximum or minimum amount of pressure exerted by the ram during the stroke so as to afford a maximum or minimum grip on the work operated upon which may be varied as required.

In order to provide for a multiple pressure or resistance to the ram, while moving through its working stroke, the piston 17 is provided with a by-pass or fluid passageway 28 extending between its opposite sides, which by-pass or passageway may be closed during a portion of the down stroke of the ram so as to provide a maximum amount of resistance to the under side of the piston during such portion of the stroke of the ram, and which by-pass or passageway is arranged to be opened at predetermined places along the stroke of the ram to thereby permit the fluid contained in the lower end of the cylinder to rapidly escape into the upper end thereof. Means are also provided in connection with said by-pass or passageway 28 to regulate or control the flow of liquid therethrough in order to obtain the required pressure or resistance in the die cushion. These means will now be described.

The piston stem 16 is made hollow, as

shown, and in the hollow of said stem is a stationary supported valve device 29 which, as shown, is in the form of a rod fitting in the bore of the piston stem 16 and having one or more circumferential grooves 30 and 31 formed therein with which the by-pass or passageway 28 may register during portions of the down stroke of the ram. The rod 29 is shown as adjustably supported in a boss 32 formed on the lower side of the cylinder head 20, whereby it may be raised or lowered to locate the grooves 30 and 31 at various positions along the axis of the cylinder 18. Conveniently, the rod 29 may be screw threaded as at 33 and threadedly connected with the boss 32, and it may be provided with a squared or non-circular end 34 for the reception of a wrench or other tool for adjusting the rod. A lock nut 35 may be secured upon the threaded portion of the rod 29 below the boss 32. The by-pass or passageway 28 opens downwards from the lower face of the piston 17 and its upper end extends radially to and beyond the valve device 29, where in certain positions of the piston, the by-pass is closed by the valve device. The passageway opens upwardly at its end into the upper end of the cylinder and preferably through a pressure regulating valve or relief valve 36 secured in the upper side of the piston.

As has been explained, the valve device 29 fits in the bore of the piston stem 16 and closes the passage through said by-pass 28, as is clearly seen in the drawings. When, however, one of the circumferential grooves 30 or 31 registers with the by-pass 28 communication is established between the lower end of the cylinder 18 and its upper end through said by-pass, thereby permitting fluid in the lower end of the cylinder to pass more freely to the upper end of the cylinder.

The relief valve 36 may be omitted entirely, if desired, whereby when the passageway through the by-pass 28 is opened by the valve device 29, the fluid may flow unrestricted through said passageway, but with certain classes of work, it may be found desirable to control or regulate the flow of fluid through the by-pass, and, for this reason, the relief valve 36 is provided in or at the end of said by-pass. The relief valve has regulating means whereby it remains closed against pressure up to a predetermined amount and is opened when subjected to the influence of pressure above said predetermined amount, and it has adjustment means for determining the amount of pressure required to open it, which means is usually controlled from a stem 37 which is accessible from the exterior of the cylinder. For instance, an opening may be provided in the upper head 23 of the cylinder through which a socket wrench may be inserted for engagement with the adjusting stem 37, and said opening may be closed by a plug threadedly

secured in the cylinder head. By properly setting the relief valve 36, it will remain closed until the pressure in the lower end of the cylinder unseats the valve, whereupon the fluid is permitted to pass through the by-pass 28 at a predetermined velocity.

In order to permit the piston to return rapidly during the up stroke of the ram, ports or passageways 38 are provided through the piston 17, which ports or passageways are arranged to be closed on the underside of the piston by a valve member 39, here shown as surrounding the lower end of the piston stem 16, and spring pressed against the lower face of the piston by a coiled compression spring 40 confined between the valve member 39 and a nut 41 threadedly secured on the lower end of the piston stem 16. The valve member 39 is kept closed during the down stroke of the piston 17, due to the pressure on the fluid, but opens to permit the fluid to freely pass through the ports 38 during the up stroke of the piston.

It is understood that the piston 17 is forced down upon the fluid, contained in the lower part of the cylinder 18, by the ram on its working stroke. Means are provided for returning the piston and the parts connected therewith to their upper position, while the ram is returning to the top of its stroke. Said means may be in the form of coiled compression springs interposed between the plate 15 and some stationary part, and, in the drawing, a coiled compression spring 42 is shown which is confined under compression between the plate 15 and the cylinder head 23.

In addition to the spring 42, or as a separate means for positively returning the piston 17 to its upper position, a plurality of connecting rods may be provided between some movable part, as, for instance, the ram 17 and plate 15, and one of such rods is illustrated at 43. Its upper end is connected to a lug 44 on the ram and its lower end extends through a lug 45 on the plate 15 and has a coiled compression spring 46 interposed between the lower side of the lug 45 and a nut 47 threaded on the lower end of the rod 43. When the rods 43 are employed for raising the piston and other parts supported by the plate 15, the rods 43 lift the plate 15 while the ram is moving to the upper end of its stroke and the springs 46 are provided to allow of lost motion between the rods 43 and the plate 15 in case the length of travel of the ram is slightly greater than that of the plate 15.

For obtaining a variable pressure on the lower side of the piston 17 independent of that furnished by the by-pass 28 and valve device 29, or as an auxiliary means operating in conjunction therewith, are means operated by a moving element, for instance, the plate 15, for controlling the flow of fluid

through the valve 25. In the simple form of means illustrated, the valve stem of the valve proper 27 has a part 48 which projects out through the casing of the valve 25 and rides upon a cam 49 which, as shown, is rotatably mounted upon a bracket 50 and is operatively connected to the plate 15, as, for instance, by a link 51, a lever 52, and a rod 53.

The link 51 is connected to an arm 54 which supports the cam 49, and the other end of the link is connected to one arm of the lever 52. The rod 53 is connected to the other arm of said lever and to a lug 55 on the plate 15. The cam 49 may be formed with a circular cam face 56 which is eccentric with respect to the axis around which the cam rotates, and the cam is adjustable with respect to its supporting arm 54, an adjusting screw 57 being provided in the arm and engaging with the cam.

By turning the adjusting screw 57 the relation between the circular cam face 56 and the axis of rotation of the cam may be varied so as to obtain any desired action of the cam on the valve stem. By lengthening or shortening the radius of the circular cam face 56 and by adjusting the cam, a variety of actions may be had upon the valve 27, with the result that the pressure in the lower end of the cylinder 18 may vary constantly during the entire working stroke of the ram. For instance, the pressure may be so regulated that the blank, to be operated upon, will be tightly gripped between the upper die and the opposition part below it, and during the working stroke of the ram the grip may be lessened and again increased, or the cam may be so set that at the commencement of the working stroke, the grip will not be so great, but during the course of the stroke the pressure will be increased, or the cam may be so set that at first the grip will not be so great, but during the course of the stroke the pressure will be increased and the grip tightened and later on reduced again. In Fig. 4 is illustrated a slightly modified cam 49<sup>a</sup>, this cam having an irregular cam face 56<sup>a</sup> whereby variable pressures may be obtained in the cylinder.

In the operation of the die cushion, the piston is normally held in its upper position with the draw ring or pressure pad held in its upper position. The blank being laid upon the draw ring or pressure pad, the ram is started on its working stroke and as the upper die encounters the blank, the blank is pressed against the draw ring or pressure pad and is gripped firmly between said parts inasmuch as the downward pressure of the ram is opposed by the fluid contained below the piston 17 in the cylinder 18. As the ram continues its downward movement, the piston 17 is forced downward through its connections with the draw ring or pressure pad and the fluid in the lower end of the cylinder is forced outward through the restricted

opening in the pressure regulating valve 25 and is discharged into the upper end of the cylinder 18.

When the by-pass or passageway 28 registers with a circumferential groove in the valve device 29 communication is established directly between the lower end of the cylinder and the upper end thereof through said by-pass and the fluid is permitted to flow more freely from the lower end of the cylinder to the upper end thereof, whereby the resistance or pressure in the lower end in the cylinder is decreased, and consequently the pressure of the die upon that part of the blank gripped between it and the draw ring or pressure pad is released somewhat depending upon the flow of fluid through the by-pass 28. The reduced pressure remains until the by-pass 28 is again covered by the valve device, whereupon the maximum pressure is again maintained.

As has been explained, the cam actuated pressure regulating device in the conduit 24 may operate in conjunction with the by-pass in the piston or independently thereof, or the grip on the blank may be controlled by the action of the cam on the valve 25.

More or less variation of the exact details of construction is possible without departing from the spirit of this invention; I desire, therefore, not to limit myself to the exact form of the construction shown and described, but intend, in the following claims, to point out all of the invention disclosed herein.

I claim as new, and desire to secure by Letters Patent:

1. In a die cushion for power presses, the combination of a cylinder adapted to contain fluid and closed at both ends, a piston therein, a conduit having a continuous passageway therethrough connecting one end of the cylinder with the other and having a restricted orifice whereby fluid may continuously flow from the lower side of the piston to the upper side thereof when the piston is depressed, press operated means for displacing the fluid in the cylinder, a closed passage through the piston, means controlled by the downward movement of the piston for opening said last mentioned passage whereby the pressure below the piston may be decreased at a predetermined point in the working stroke of the piston, and a second valve controlled passage through the piston through which the fluid may pass from the upper side of the piston to the lower side thereof when the piston is being raised.

2. In a die cushion for power presses, the combination of a cylinder adapted to contain a fluid and closed at both ends, a piston therein, a conduit having a continuous passageway therethrough connecting the lower end of the cylinder with the upper end and having a restricted orifice therein whereby the fluid may flow from the lower side of the

piston to the other when the piston is depressed, said piston having a restricted passageway therethrough leading from one side thereof to the other, a valve device extending through said piston and having means for opening and closing the restricted passageway through the piston on the working stroke of the piston, a valve controlled passage through the piston through which the fluid may pass from the upper side of the piston to the lower side thereof when the piston is being raised, and press operated means for displacing the fluid in the cylinder.

3. In a die cushion for power presses, the combination of a cylinder adapted to contain a fluid and closed at both ends, a piston therein, a conduit having a continuously open passageway connecting the lower end of the cylinder with the upper end and having a restricted orifice therein whereby fluid may flow from one side of the piston to the other when the piston is depressed, said piston having a restricted passageway therethrough leading from one side thereof to the other, a pressure operated relief valve in said restricted passageway of the piston, a valve device extending through said piston and having means for opening and closing the restricted passageway therethrough on the working stroke of the piston, a second passageway through the piston, a valve closing said last mentioned passageway and arranged to open on the up stroke of the piston, and press operated means for displacing the fluid in the cylinder.

4. In a die cushion for power presses, the combination of a cylinder adapted to contain a fluid and closed at both ends, a piston therein, a conduit having a continuous passageway connecting the lower end of the cylinder with the upper end and having a regulatable restricted orifice therein whereby the fluid may flow from the lower side of the piston to the other when the piston is depressed, said piston having a controllable restricted passageway therethrough, a stationary valve device extending through said piston and having means for opening and closing the passageway therein on the working stroke of the piston, a second passageway through the piston, a valve closing said last mentioned passageway and arranged to open on the up stroke of the piston, and press operated means for displacing the fluid in the cylinder.

5. In a die cushion for power presses, the combination of a cylinder adapted to contain a fluid and closed at both ends, a piston therein, a conduit having a continuous passageway connecting the lower end of the cylinder with the upper end thereof, a pressure regulating valve in said conduit, said piston having a restricted passageway therein extending from one side of the piston to the other, a valve device extending through said piston and cooperating therewith to open and close said restricted passageway in the piston on the work-

ing stroke of the piston, a second passageway through the piston, a valve closing said last mentioned passageway and arranged to open on the up stroke of the piston, and press operated means for forcing said piston against the fluid contained in the cylinder.

6. In a die cushion for power presses, the combination of a cylinder adapted to contain a fluid and closed at both ends, a piston therein having a restricted passageway extending from one side of the piston to the other, a valve device extending through said piston and co-operating therewith to open and close said restricted passageway in the piston on the working stroke of the piston, a second passageway through the piston, a valve closing said last mentioned passageway and arranged to open on the up stroke of the piston, a conduit having a continuous passageway leading from one end of the cylinder to the other, a pressure regulating valve in said conduit, said valve having a pressure regulating adjustment stem, press operated means for moving said piston against the fluid in the cylinder, and means actuated by said press operated means co-operating with said valve stem to control the passage of fluid therethrough.

7. In a die cushion for power presses, the combination of a cylinder adapted to contain a fluid and closed at both ends, a piston therein having a controllable restricted passageway therethrough, a conduit having a continuous passageway leading from one end of the cylinder to the other and having a regulatable restricted orifice therein, press operated means for moving said piston against the fluid, and yielding means for returning the piston to its normal position.

8. In a die cushion for power presses, the combination of a cylinder adapted to contain a fluid and closed at both ends, a piston therein having a controllable restricted passageway leading therethrough, a conduit having a continuous passageway leading from one end of the cylinder to the other and having a regulatable restricted orifice therein, press operated means for moving said piston against the fluid, and yielding means connected to said press operated means for returning said piston to its normal position.

9. In a die cushion for power presses, the combination of a cylinder closed at both ends, a piston therein, a hollow piston stem, draw ring supporting elements carried by said piston stem, there being a passageway leading through said piston from side to side, and a valve device fitting in the hollow of said piston stem and having a part arranged to close said passageway and a circumferential groove adapted to register with said passageway, whereby the passageway through said piston is opened.

10. In a die cushion for power presses, the combination of a cylinder, a piston therein,

a hollow piston stem, draw ring supporting elements carried by said piston stem, there being a passageway leading through said piston from side to side, and a valve device fitting in the hollow of said piston stem and having a part arranged to close said passageway and a passageway adapted to register with said passageway, whereby the passageway through said piston is opened, and a conduit leading from one end of the cylinder to the other and having a restricted orifice therein.

11. In a die cushion for power presses, the combination of a cylinder, a piston therein, a hollow piston stem, draw ring supporting elements carried by said piston stem, there being a passageway leading through said piston from side to side, and a valve device adjustably mounted in said hollow piston stem and having a part closing said passageway, and a passageway adapted to register with said passageway, whereby the passageway through said piston is opened.

12. In a die cushion for power presses, the combination of a cylinder, a piston therein having a passageway leading therethrough from side to side, a relief valve in said passageway, a hollow piston stem secured to said piston, draw ring pins connected to said piston stem, and a valve device mounted in the hollow of said piston stem for closing the passageway through said piston, said valve device having a cut away portion adapted to register with said passageway to thereby establish communication between the opposite sides of the piston.

SAMUEL MARGHITAN.

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