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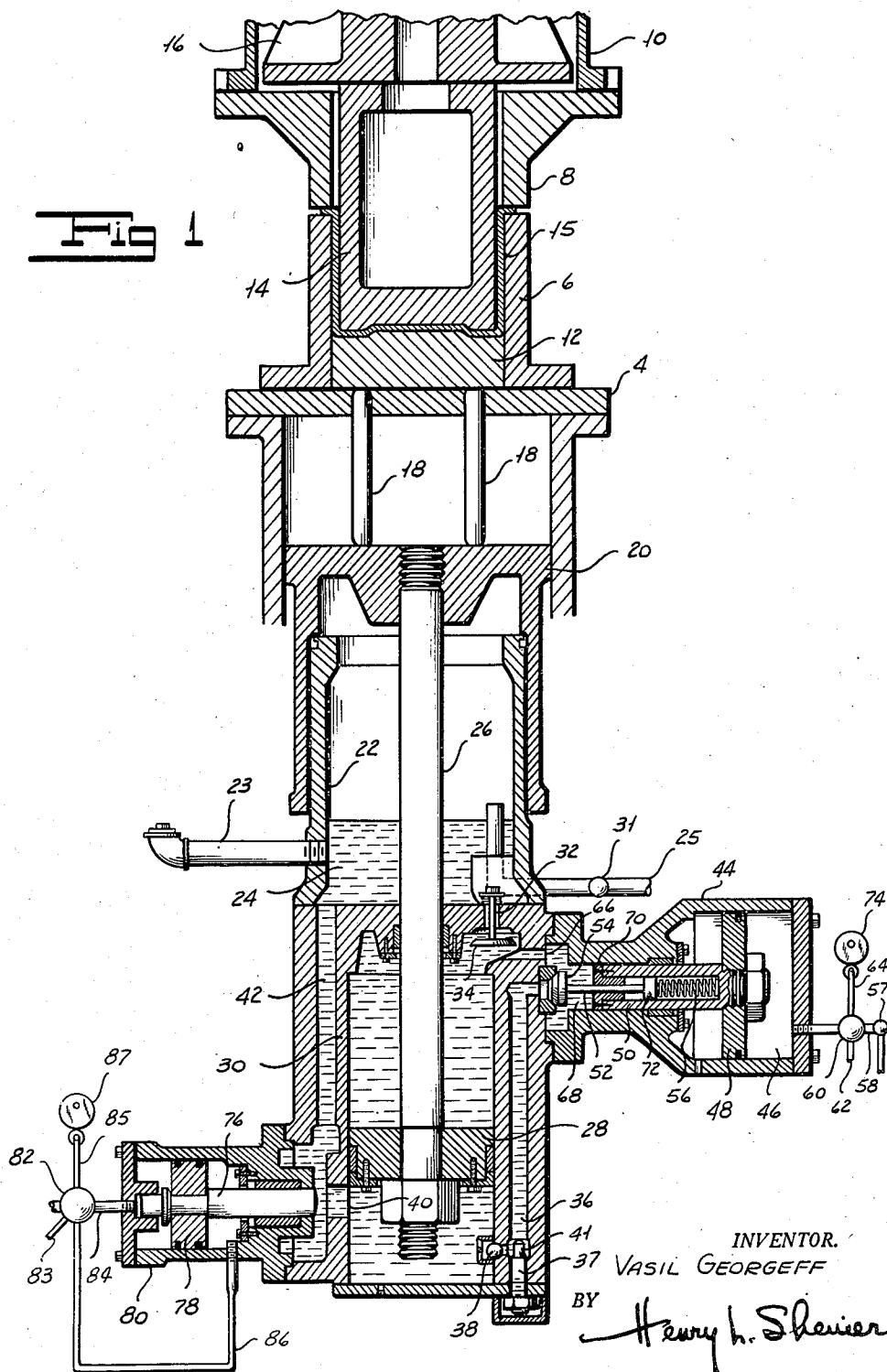
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HYDROPNEUMATIC LOCKING CUSHION FOR POWER PRESSES

Filed April 6, 1949

3 Sheets-Sheet 1

Fig 1



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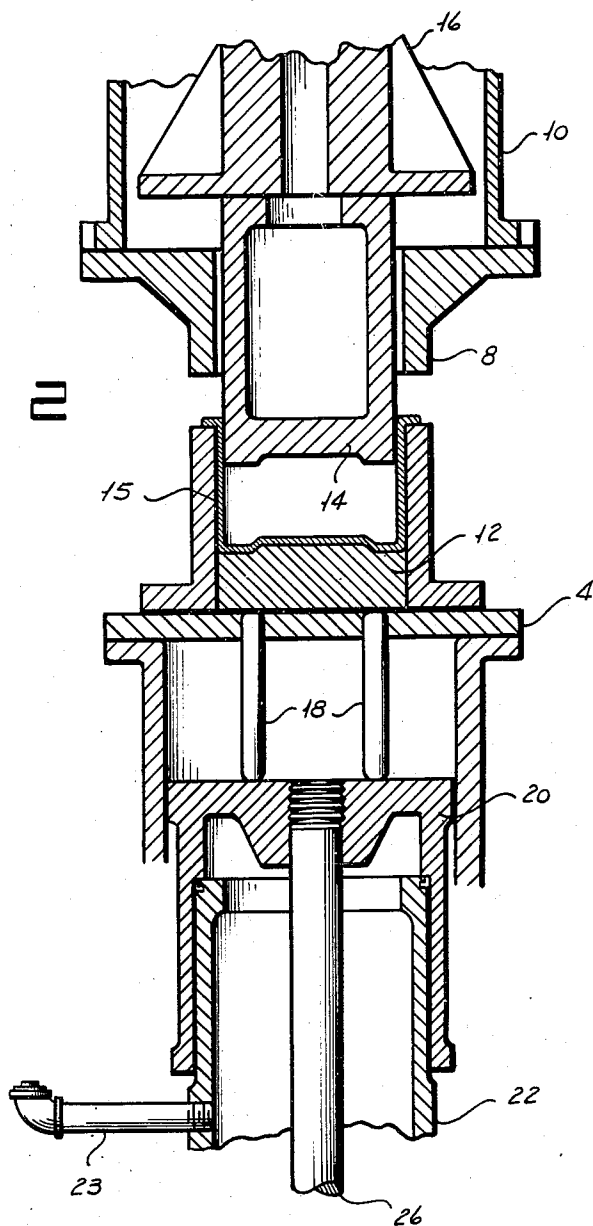
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Fig 2



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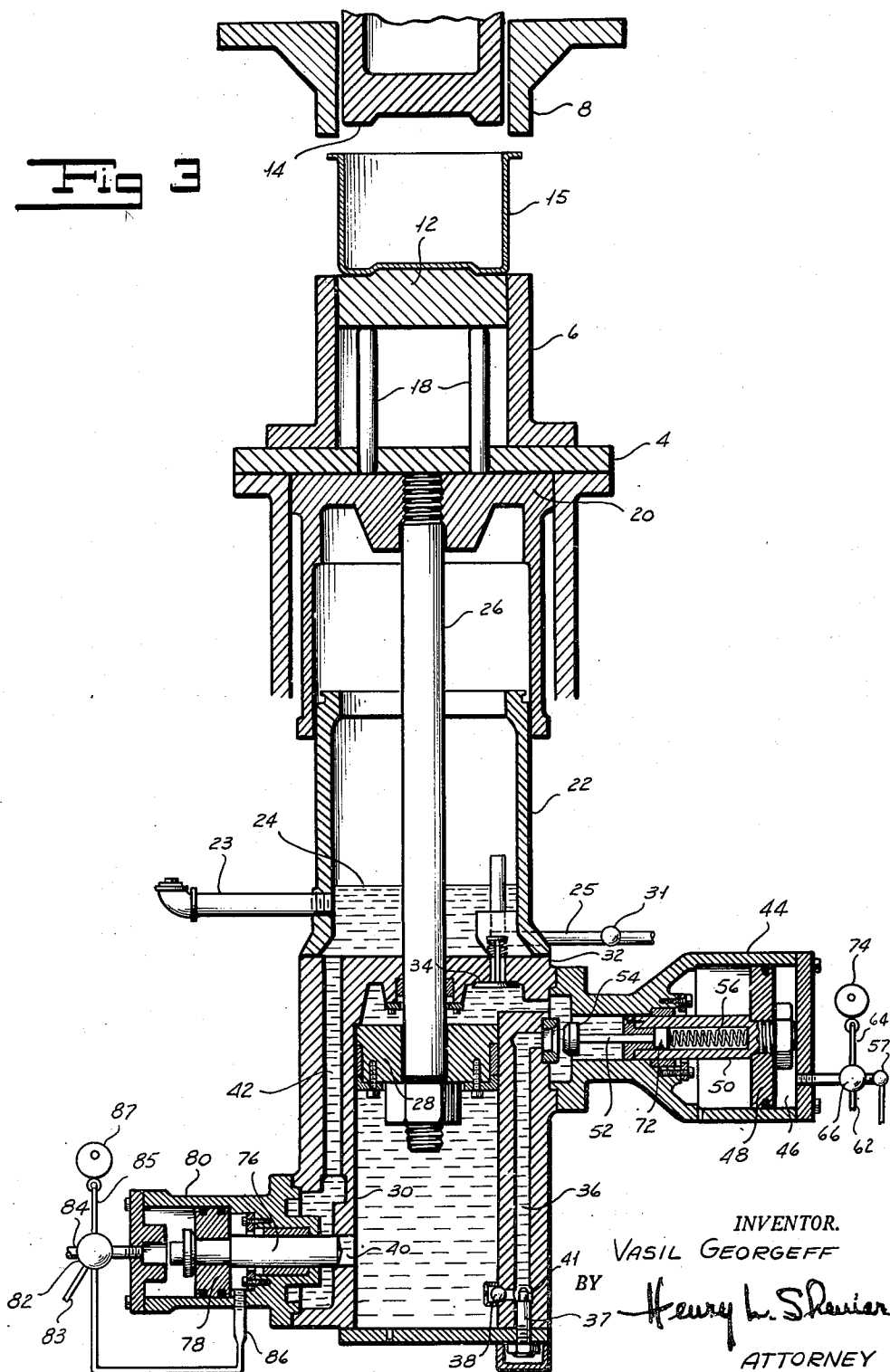
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UNITED STATES PATENT OFFICE

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HYDROPNEUMATIC LOCKING CUSHION FOR
POWER PRESSESVasil Georgeff, Chicago, Ill., assignor to Danly
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10 Claims. (Cl. 267—1)

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My invention relates to hydropneumatic locking cushions for power presses, and more particularly for double action power presses.

In a double action press, the metal to be worked is fed to the press and is first held in position between the dies by a blank holder. The press then moves to do its work while the blank is being held. After the work is finished, the blank holder moves away, followed by a more rapid action of the die holding ram. Die pins are used to push the work out of the die, in case that the formed metal is provided with a re-entrant portion. These die pins act against a die cushion or pressure pad. The arrangement is such that the pressure pad, which returns the die pins to their original position and at the same time moves the work out of the die, must be delayed until such time as the blank holder and upper die is moved clear of the work. This is usually accomplished by a locking arrangement, which holds the pressure pad from acting to return the die pins until the cycle of operations has brought the blank holder in the upper ram clear of the work. The resistance furnished by the pressure pad or cushion may be either pneumatic or hydraulic, or both. For some types of work a pneumatic cushion is most suitable, and for other types of work, where greater resistances are encountered during a shorter stroke, a hydraulic cushion is most suitable.

One object of my invention is to provide a flexible hydropneumatic cushion in which the same cylinder which cushions the die acts as a locking cylinder.

Another object of my invention is to provide a hydropneumatic locking cushion which may be employed as a simple pneumatic cushion or a hydropneumatic cushion with either locking or non-locking action, as may be desired.

Another object of my invention is to provide a flexible hydropneumatic locking cushion employing no auxiliary equipment and is a self contained unit.

Another object of my invention is to provide a hydropneumatic locking cushion which is cheaper to construct and easier to maintain than those of the prior art construction.

Another object of my invention is to provide a hydropneumatic locking cushion which may be shifted with facility to a simple pneumatic cushion, hydropneumatic cushion, a pneumatic locking cushion or to a hydropneumatic locking cushion, as desired.

In the accompanying drawings which form part of the instant specification and which are

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to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views:

Figure 1 is a sectional elevation through a hydropneumatic locking cushion showing one embodiment of my invention with the blank holder and the ram at the lowest position of their travel just after the completion of the working stroke, in which my invention is adjusted as a simple pneumatic locking cushion.

Figure 2 is a fragmentary view, similar to Figure 1, of the upper portion of my cushion, showing the position of the ram and the blank holder with the cushion in locked position.

Figure 3 is a view similar to Figure 1, showing the position of parts of a hydropneumatic cushion after the locking action has been released.

In general, my invention contemplates the provision of a pneumatic pressure pad, in which a piston is adapted to compress air within a cylinder, to provide for a pneumatic cushion. The air piston is connected by a piston rod to a second piston which is adapted to move fluid. The arrangement is such that the resistance to fluid motion creates a hydraulic resistance and acts as the hydraulic cushion. The motion of the hydraulic piston is adapted to draw liquid from a reservoir to the space above the hydraulic piston within the hydraulic cylinder past a check valve. The imprisonment of this liquid serves to lock the entire system, that is, both the pneumatic piston and the hydraulic piston. Timed means are provided for bleeding the liquid above the hydraulic piston back into the reservoir to release the locking action.

By removing the resistance between the bottom of the hydraulic piston and the reservoir, the hydraulic cushion is automatically eliminated and the hydraulic piston simply acts as a lock for the pneumatic cushion. By providing resistance to flow to the liquid below the hydraulic piston, I have a structure which becomes at once both a hydraulic and a pneumatic cushion. By releasing the constraint to the liquid above the hydraulic piston, I have been able to transform my assembly into a simple cushion with no locking features.

More particularly referring now to the drawings:

The bolster 4 of the press, which may be of any appropriate design, supports a die 6 adapted to cooperate with an upper die 8 attached to the blank holder 10 of the press. An inner die 12 cooperates with a punch die 14 attached to the press ram 16, as is well known in the art. The

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blank holder 10 is reciprocated in timed relation with the ram 16, such that the blank holder will contact the work first, followed by the press ram. On the up stroke the press ram moves away first, while the blank holder dwells and is then followed by the blank holder moving away. The position of the parts during the up stroke of the blank holder and the ram is shown in Figure 2. The die 12 acts against die pins 18 which are cushioned by a die cushion, the pressure pad 20 of which is shown in the drawing as an external piston around a cylinder 22. The downward motion of the piston 20 compresses the air beneath it within the cylinder 22. The cylinder 22 serves the additional function of acting as a reservoir for a liquid 24. The piston 20 is connected by a piston rod 26 to a hydraulic piston 28 lodged within a hydraulic cylinder 30. As the piston 20 moves downwardly, the hydraulic piston 28 will likewise move downwardly through the same distance. The cylinder 22 communicates with the cylinder 30 through a duct 32. This duct is controlled by a check valve 34, permitting liquid to flow through it from the cylinder 22 to the cylinder 30 only on the down stroke of the hydraulic piston 28. It will be observed that as fast as liquid is withdrawn from reservoir 22 to occupy the space above the hydraulic piston 28, liquid is replaced from below the piston 28 through duct 42 back into the reservoir, thus maintaining the effective level of liquid within the reservoir. The compression of the air between the upper surface of the liquid level and the piston 20 within the cylinder 22 will act as a pneumatic resistance for the pressure pad 20, when the die pins 18 move it downwardly under the action of the punch die 14. The piston 20, therefore, in conjunction with the cylinder 22 acts as a pneumatic cushion. A locking valve housing 44 is provided with a cylinder 46 in which I position a piston 48. The piston carries a housing 50, into which the valve stem 52 of a valve 54 is lodged. A spring 56 normally maintains the valve 54 in seated position, when the piston 48 is moved to the left under the action of air introduced through pipe 58 and controlled by the two-way valve 60. The pipe 52 is open to the atmosphere. The valve 60 is controlled by member 64 adapted to place the valve 60 in a position so that the cylinder 46 is either in communication with a source of compressed air through pipe 58 or with the atmosphere through pipe 62. The pneumatic pressure urging the piston 20 upwardly also urges the piston 28 upwardly. The check valve 34 prevents the liquid from flowing through duct 32, and this pressure is thus communicated through duct 66 into the space 68 within the locking valve housing 44. This pressure assists the spring 56 in holding the valve 54 on its seat. The pressure also acts upon the piston 70 formed on the housing 50 and tends to move the housing to the right against the action of the piston 48. When the cylinder 46 is vented this hydraulic pressure will move the piston to the right until the right hand end of member 70 contacts the valve unseating button 72 secured to the end of the valve stem 52. When this occurs, fluid is adapted to be transferred through duct 66 past the valve 54 which is now in open position, as shown in Figure 3, through duct 36 past check valve 38 into the area below the hydraulic piston 28, permitting the hydraulic piston to move upwardly under the influence of the pneumatic pressure behind the pneumatic piston 20. This upward motion of the piston 20 moves the die

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pins 18 upwardly and with them the die member 12 to a position shown in Figure 3, moving the formed work piece 15 out of the die 6.

The valve 60 is controlled by a cam 74 operated from any appropriate portion of the press mechanism in timed relation to vent the cylinder 46, when the blank holder die and the punch die have moved to position clear of the work. The construction so far described is that of a simple pneumatic locking cushion. By closing valve 57 governing the air supply to the cylinder 46, I may convert my structure into a simple pneumatic cushion. With the air supply in communication with the cylinder 46, we have a pneumatic locking cushion.

The opening 40 is adapted to be closed by a plunger 76 which is carried by a piston 78 positioned within a cylinder 80. A four-way valve 82 controls the supply of air from a source under pressure through a pipe 84 into the cylinder 80 to the left of piston 78 or through pipe 88 to the right of piston 78 depending upon the position of the four-way valve 82. When compressed air is on one side of the piston the other side of the piston is vented by the four-way valve through pipe 83. When air pressure is impressed to the left of piston 78 it will move to the right to the position shown in Figure 3. When the piston 20 and the hydraulic piston 28 move downwardly under the influence of the force exerted by the die pins 18 under the action of the punch die 14, the liquid beneath the hydraulic piston 28 must overcome the force exerted by the piston 78 before the liquid can escape through the port 40 and the duct 42. Since the area of the hydraulic plunger 76 is much smaller than that of the air piston 78, a comparatively small amount of air pressure will exert substantially high hydraulic pressure. A simple adjustment of the air pressure supplied through pipe 84 will accurately control the hydraulic pressure to be exerted by the hydraulic cushion. With the plunger 76 normally closing the port 40 of the hydraulic cylinder 30 the parts now act as a combined pneumatic and hydraulic cushion. The locking action remains the same and the pneumatic cushion serves to urge the hydraulic piston to its upward position as described above. The releasing action, however, when my cushion operates as a pneumatic-hydraulic cushion is somewhat different. It is complicated by the fact that the area below piston 28 is greater than the area above this piston by the cross-sectional area of the piston rod 26. When the valve 54 is opened by venting the cylinder 44 to the atmosphere through pipe 62 through the action of cam 74, the air pressure below piston 28 will move both piston 20 and connected piston 28 upwardly. The liquid displaced by the upper portion of piston 28 is smaller in volume than the area swept by the lower side of the piston 28. I must, therefore, make provision to feed additional liquid into the space below the piston 28. I do this by providing a second cam 87 operated in phase with the cam 74 in any suitable manner. It may, for example, be the same shaft as that to which cam 74 is attached. At the instant cam 74 operates the valve 60 to vent the compressed air behind piston 48, cam 87 through cam follower 85 will operate the valve 82 to move the piston 78 to the left to the position shown in Figure 1. This permits additional liquid from the reservoir 24 to flow downwardly through duct 42 through the now opened port 40 to supply the additional volume of liquid representing the

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differential in piston area above and below the piston 28. As soon as the piston 28 is moved to its upper position, air is again admitted behind the piston 78 and the plunger 76 again closes the port 40 so that the assembly may act as a hydropneumatic cushion.

It will be readily observed that when the piston 78 is moved to the left, that is, in the position shown in Figure 1, and the cylinder 44 is vented to the atmosphere, that is, when both port 40 is opened and valve 54 is off its seat, the device is a simple pneumatic cushion. When plunger 76 is operative and valve 54 is off its seat, my assembly acts as a hydropneumatic cushion. When port 40 is open and air pressure is behind piston 48 my assembly acts as a pneumatic locking cushion. When both the plunger 76 and the valve 54 are operative my assembly is connected to act as a hydropneumatic locking cushion.

The pipe 25 is normally connected to an air surge, the pressure of which determines the pneumatic pressure in the pneumatic system. In event it is not desired to employ die pins, as is sometimes the case with certain dies, piston 48 is positioned to the right by venting the cylinder 44 and piston 78 is moved to the left by applying air pressure through pipe 86 and the air in cylinder 22 is vented through bleeding the pressure by means of pipe 25 and its associated surge tank (not shown). When the parts are in this position all cushion effect is eliminated without any structural changes.

A drain pipe 23 is provided for removing oil or adding oil to the cylinder 22 as desired. The liquid may be drained from the cylinder 30 by removing the valve 37. This valve is also adapted to control the rate at which the piston 20 travels upwardly when the valve 54 is opened. If passage 36 were unobstructed, the piston 20 would travel upwardly at a speed which would be too great. The end 41 of the valve 37 is adapted to obstruct the passage 36 to provide a resistance to fluid flow and thus provide a time interval during which the piston 20 may move upwardly under the influence of air entrapped in cylinder 22.

It is believed that the operation of my hydropneumatic locking cushion will be clear from the foregoing description.

It will be seen that I have accomplished the objects of my invention. I have provided a flexible hydropneumatic cushion in which the same cylinder which cushions the die acts as a locking cylinder. I have provided a hydropneumatic locking cushion which may be employed as a simple pneumatic cushion or a hydropneumatic cushion with either locking or non-locking action, as may be desired. My hydropneumatic locking cushion employs no auxiliary equipment. It is a self contained unit and is cheaper to construct and easier to maintain than those of the prior art. I may condition my hydropneumatic cushion with facility to act as a simple pneumatic cushion, a simple hydropneumatic cushion, a pneumatic locking cushion or a hydropneumatic locking cushion, as may be desired.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is

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not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. A die cushion for power presses including in combination a first cylinder, a second cylinder, a piston coacting with the first cylinder, a piston in the second cylinder, means connecting said pistons in tandem, the first of the cylinders containing a quantity of hydraulic fluid below the piston partially filling the cylinder, the other of said cylinders containing hydraulic fluid positioned both above and below the piston, communication means between the first cylinder below its piston and the second cylinder above its piston, a check valve positioned to permit the flow of hydraulic fluid from the first cylinder to the second cylinder through said communicating means, a second communication means between the second cylinder below its piston and the first cylinder, intra-communication means between the upper portion of the second cylinder above its piston and the lower portion of the second cylinder below its piston, and controlling means for said intra-communicating means.

2. A die cushion for power presses including in combination a first cylinder, a piston coacting with the first cylinder, said first cylinder containing a quantity of hydraulic fluid partially filling the cylinder and positioned below the piston, a second cylinder, a second piston in the second cylinder, means for connecting the first and second pistons in tandem, said second cylinder containing hydraulic fluid positioned above and below the second piston, communication means between the first cylinder below its piston and the second cylinder above its piston, a check valve positioned to permit the flow of hydraulic fluid from the first cylinder to the second cylinder through said communicating means, a second communicating means providing communication between the second hydraulic cylinder below its piston and the first hydraulic cylinder below its piston, means for controlling the flow of hydraulic fluid through said second communicating means, means for varying the action of said controlling means, means providing intra-communication between the top of the second cylinder above its piston and the bottom of the second cylinder below its piston and means for controlling the intra-communicating means.

3. A die cushion as in claim 2 in which said controlling means for the intra-communicating means comprises a valve in the intra-communicating means and means for controlling the operation of the valve.

4. A die cushion as in claim 2 in which said controlling means for the intra-communicating means comprises a valve in the intra-communicating means and timed means for controlling the operation of the valve.

5. A die cushion as in claim 2 in which said means for controlling the intra-communicating means comprises a valve in the intra-communicating means, means for controlling the operation of the valve, and a check valve permitting the flow of fluid from above the second piston to below the second piston upon the opening of the first valve.

6. A die cushion as in claim 2 in which means for controlling the flow of hydraulic fluid through said second communicating means comprises a valve, and an elastic means for placing a predetermined pressure upon said valve.

7. A die cushion as in claim 2 in which means

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for controlling the flow of hydraulic fluid through said second communicating means comprises a cylindrical orifice, a plunger normally seated in said cylindrical orifice to close the orifice, and an elastic means for holding the plunger in the cylindrical orifice.

8. A die cushion as in claim 2 in which said means for controlling the flow of hydraulic fluid through the second communicating means includes a portion of the second cylinder formed with a cylindrical orifice, a plunger adapted to close said orifice, an air cylinder, a piston within the air cylinder, means for connecting the piston to the plunger and means for introducing compressed air under a predetermined pressure behind the air piston.

9. A die cushion as in claim 2 in which the means for controlling the intra-communicating means comprises a valve, an air cylinder, a piston within the air cylinder, a hydraulic cylinder, a piston in the hydraulic cylinder, means connecting the air piston and the hydraulic piston in tandem, said valve being adapted to be seated by

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hydraulic pressure, said hydraulic pressure biasing the tandem connected pistons to move the valve from its seat, means for counter-acting the hydraulic pressure by air pressure introduced into the cylinder behind the air piston and timed means for controlling the application and venting of air.

10. A die cushion as in claim 2 including means for introducing hydraulic fluid into the first cylinder below its piston, and controlled means for venting air from the first cylinder above the level of hydraulic fluid.

VASIL GEORGEFF.

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The following references are of record in the file of this patent:

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