D. STRAND.

DIE CUSHION.

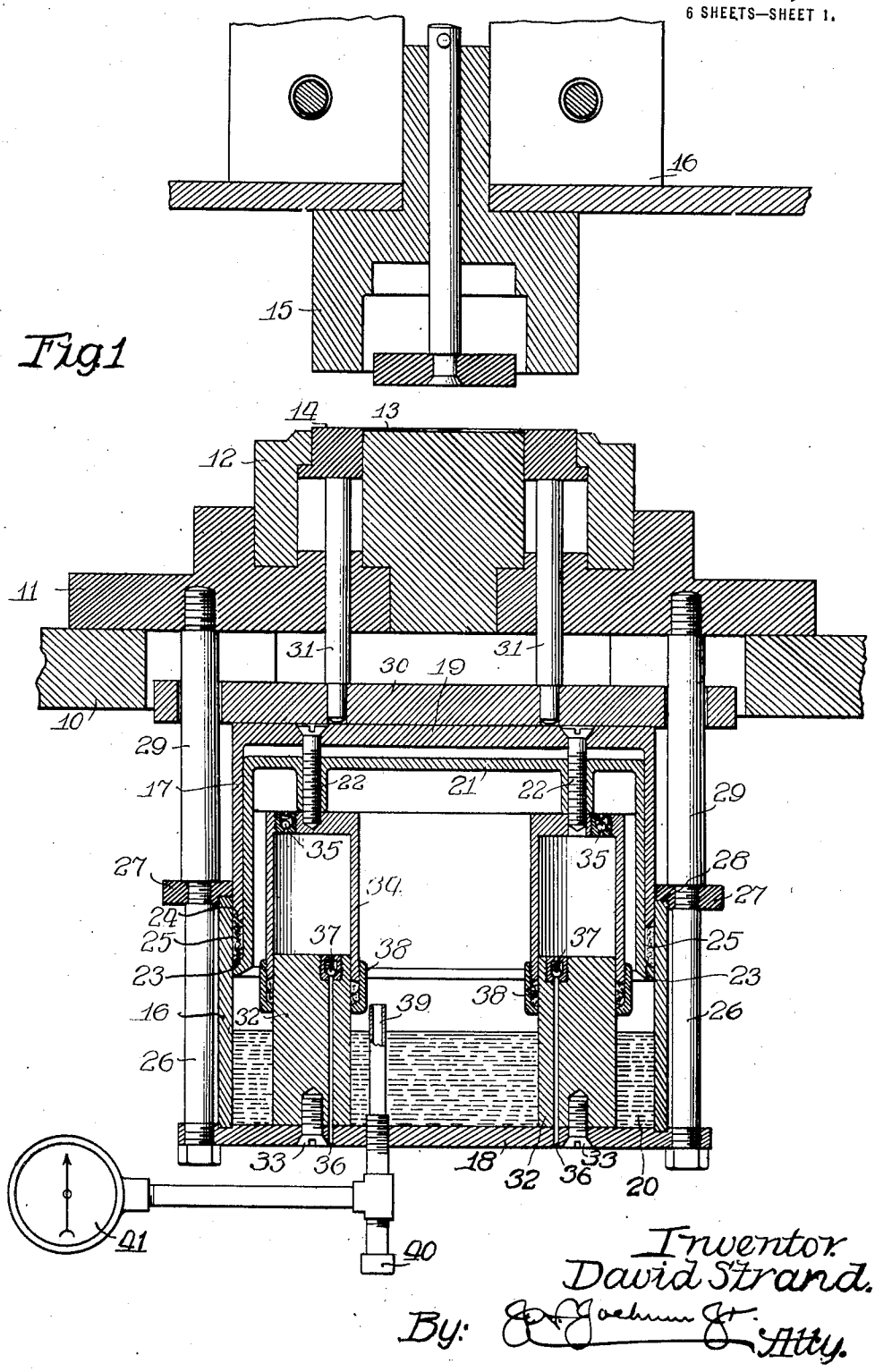
APPLICATION FILED MAY 7, 1918.

1,354,785.

Patented Oct. 5, 1920.

6 SHEETS—SHEET 1.

Fig 1



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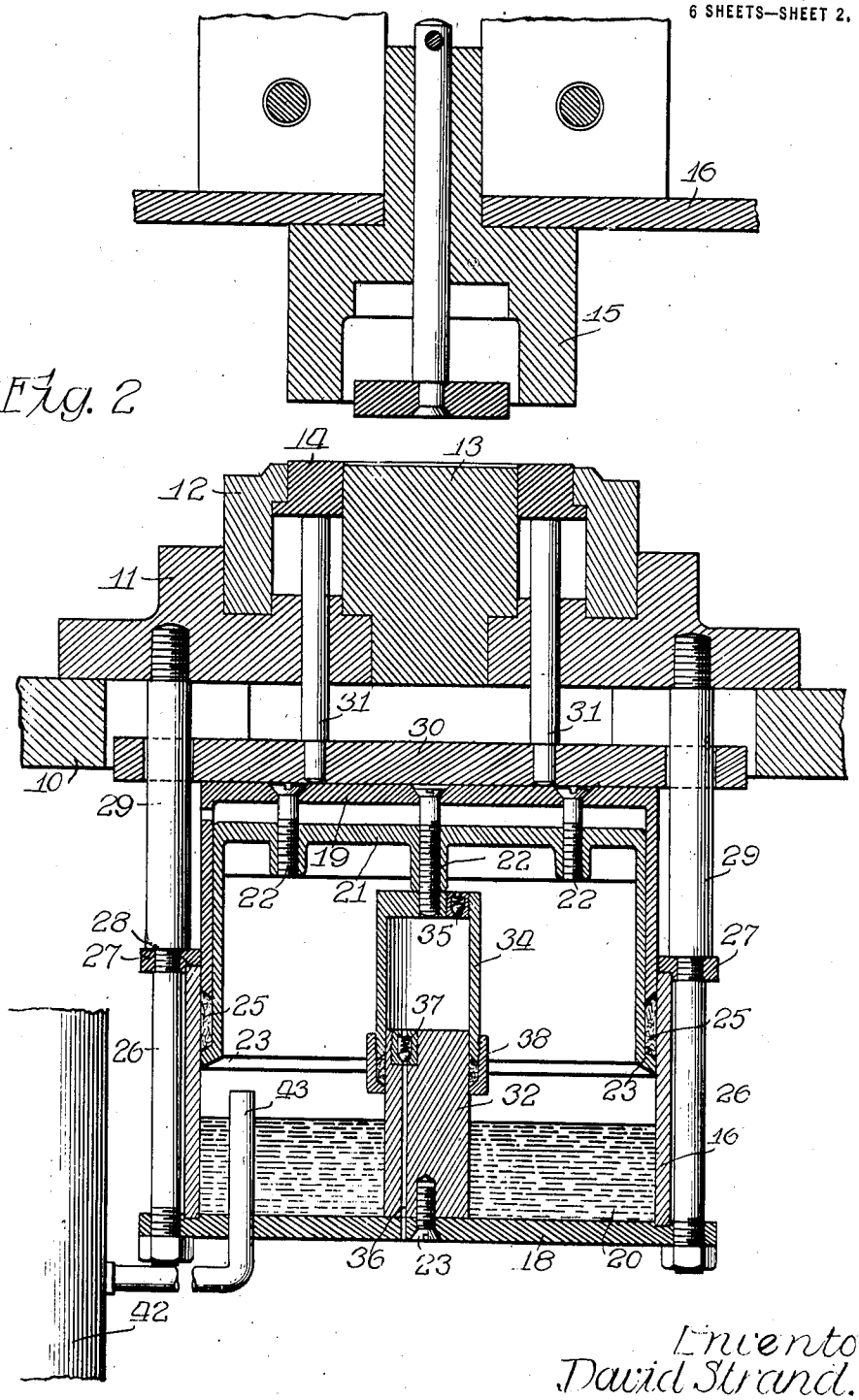
6 SHEETS—SHEET 2.

Fig. 2



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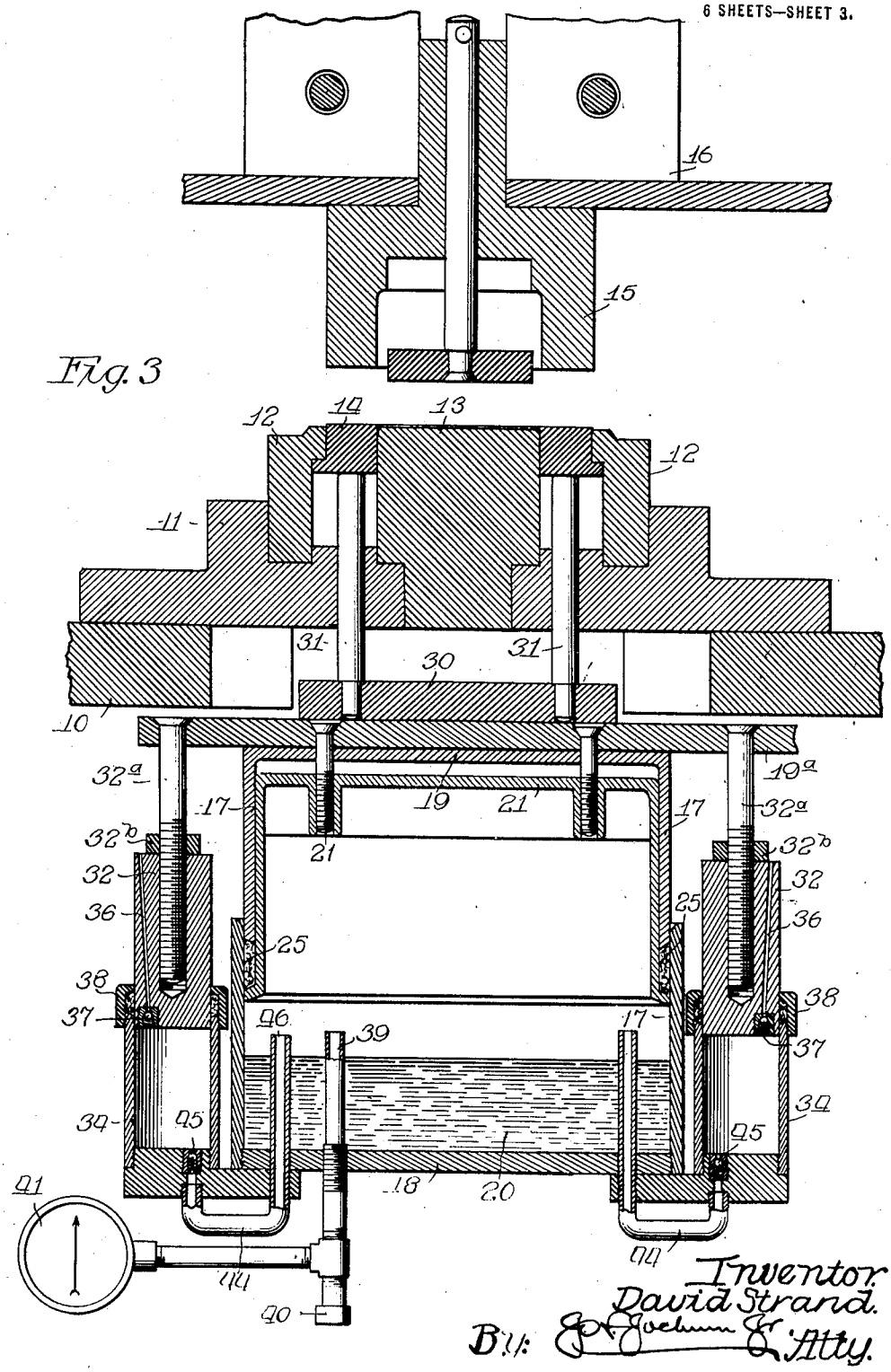
6 SHEETS—SHEET 3.

Fig. 3



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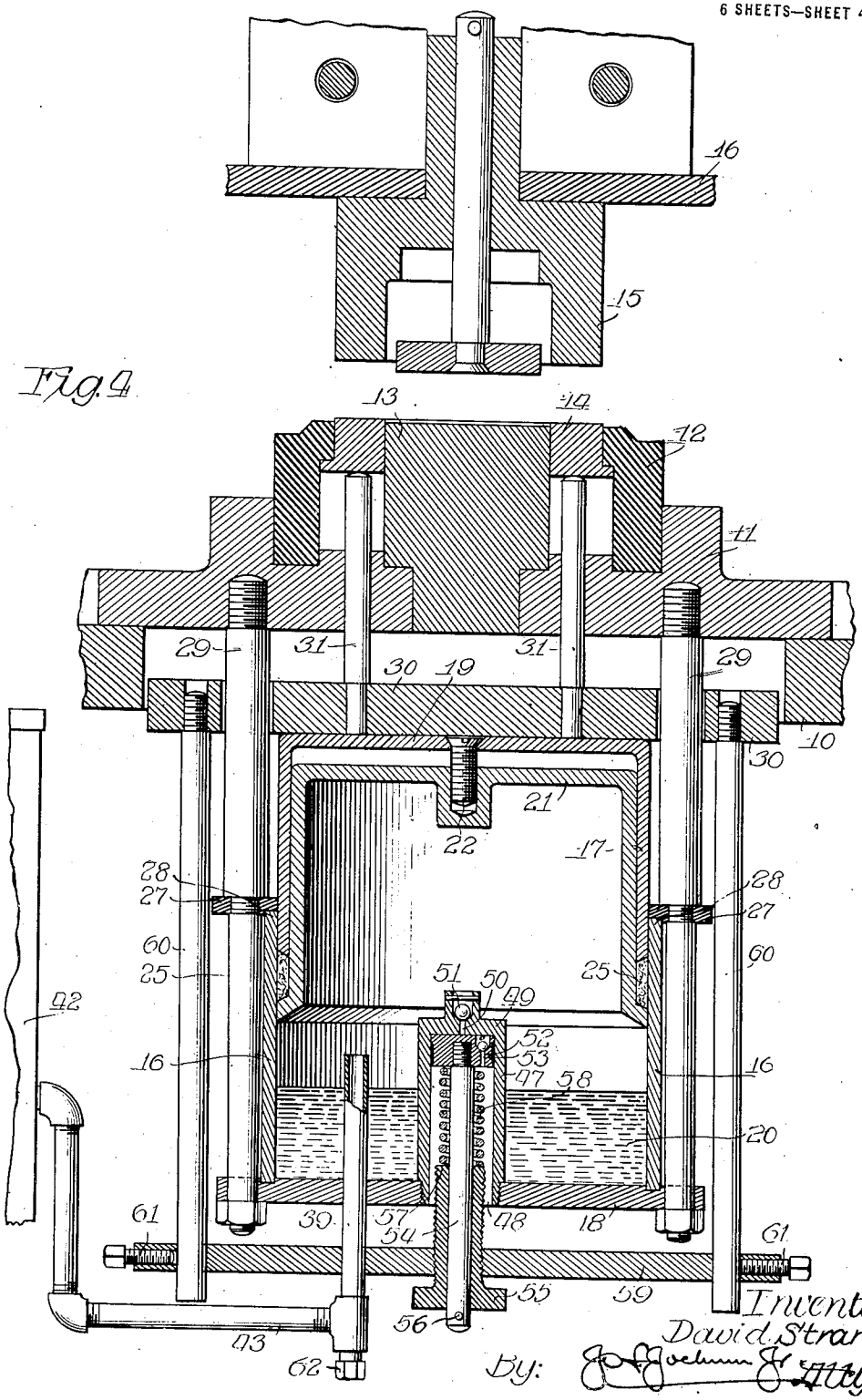
6 SHEETS—SHEET 4.

Fig. 4



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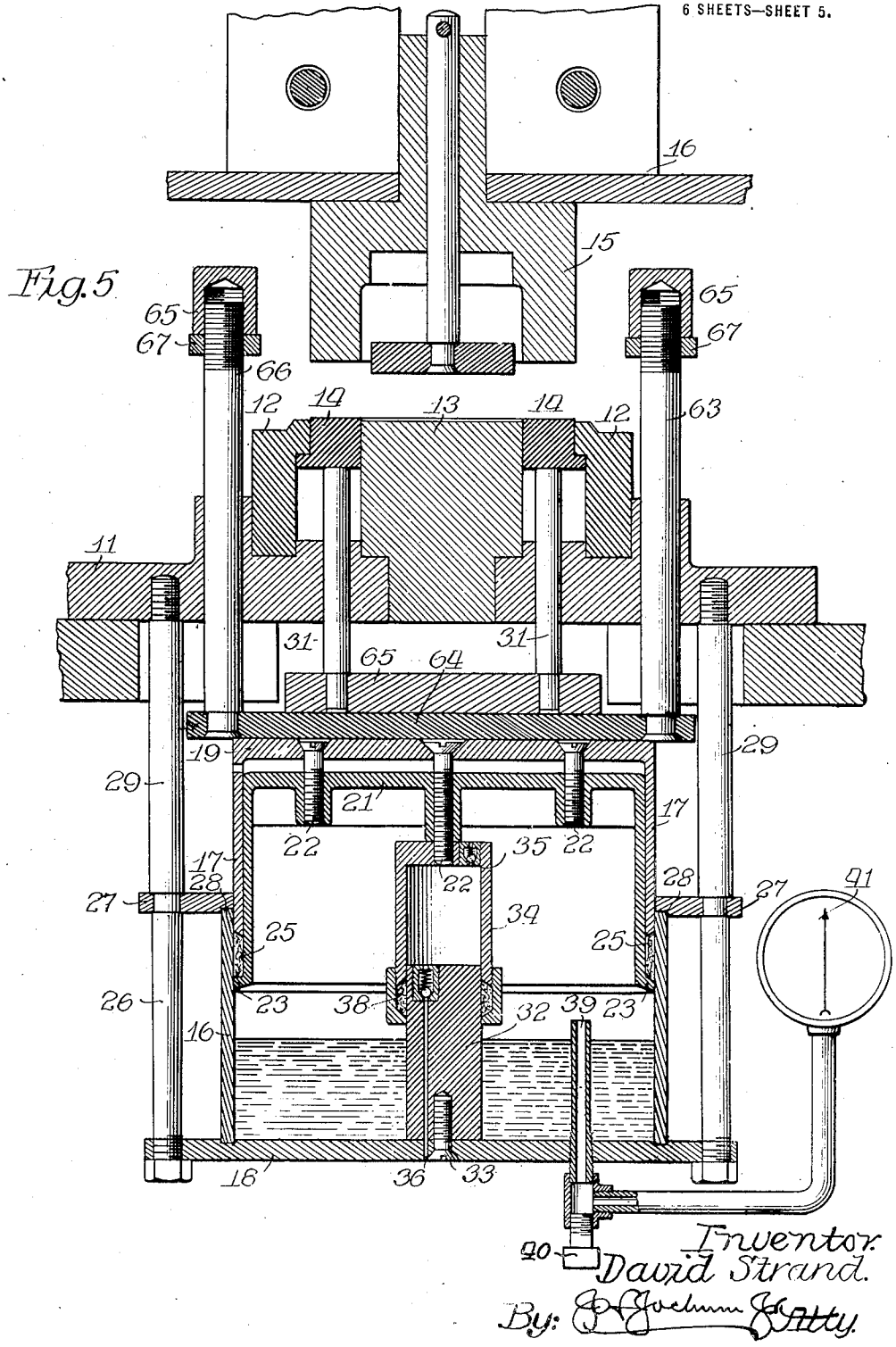
6 SHEETS—SHEET 5.

Fig. 5



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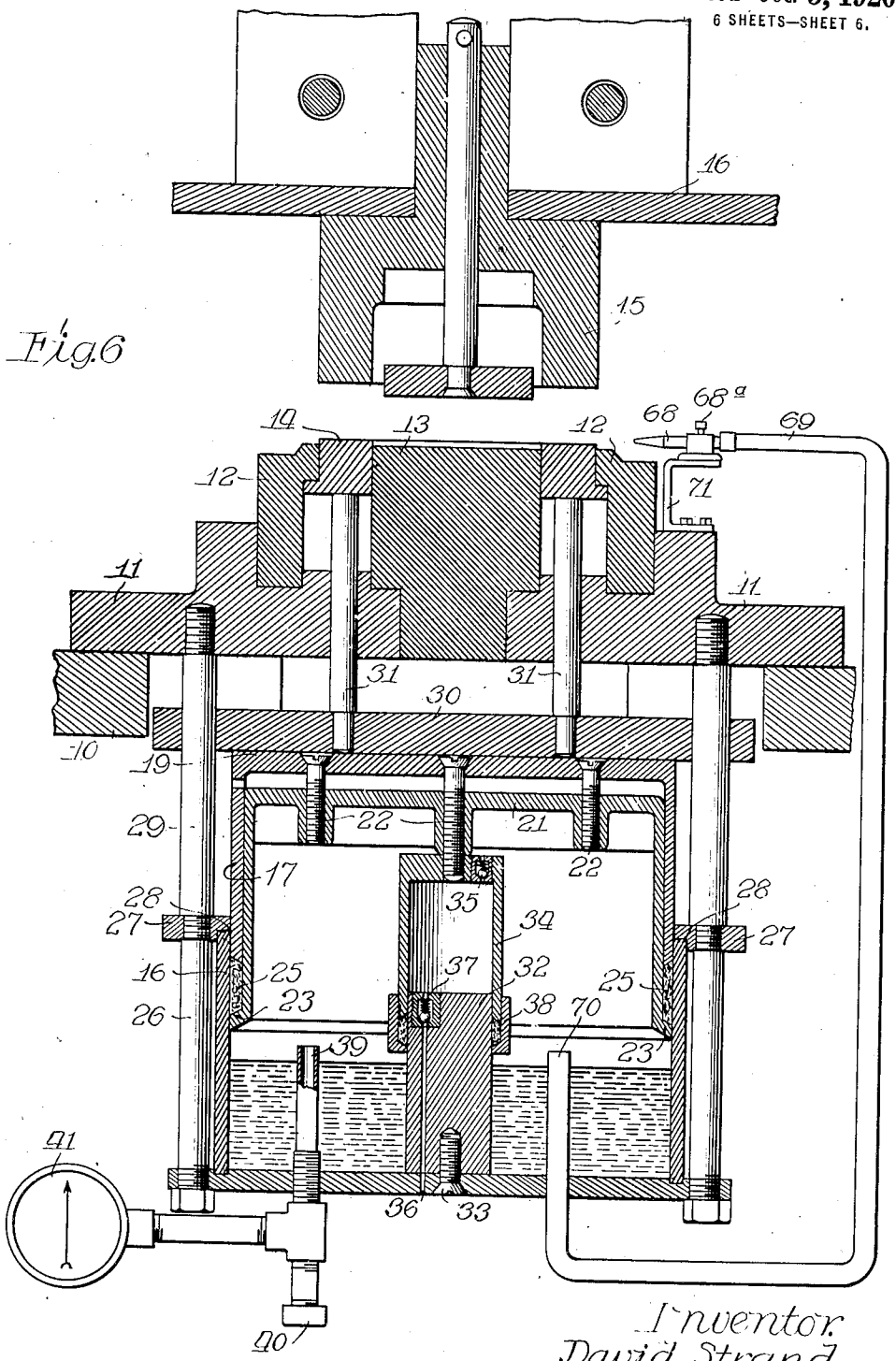
6 SHEETS—SHEET 6.

Fig. 6



Inventor.
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UNITED STATES PATENT OFFICE.

DAVID STRAND, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO RUDOLPH W. GLASNER, OF CHICAGO, ILLINOIS.

DIE-CUSHION.

1,354,785. Specification of Letters Patent. Patented Oct. 5, 1920.

Application filed May 7, 1918. Serial No. 233,084.

To all whom it may concern:

Be it known that I, DAVID STRAND, a citizen of the United States, residing at Chicago, in Cook county, State of Illinois, have invented certain and useful Improvements in Die-Cushions, of which the following is a specification.

This invention relates to improvements in die cushions of the fluid pressure type adapted to be secured to a die press, whereby the same may be readily attached to or detached from the machine as a single unit, and one of the objects of the invention is to provide an improved self-contained unitary device of this character embodying means constituting a self-pumping mechanism for supplying fluid to the cushion.

A further object is to provide an improved device of this character which will be simple, durable, and compact in construction and effective and efficient in operation.

To the accomplishment of these ends, and the equipment of other new and useful objects as will appear, the invention consists in the features of novelty in substantially the construction, combination, and arrangement of the several parts hereinafter more fully described and claimed and shown in the accompanying drawings, in which:—

Figure 1 is a vertical sectional view of a portion of a die press having a cushion attached thereto constructed in accordance with the principles of this invention.

Fig. 2 is a view similar to Fig. 1 of another form.

Fig. 3 is a similar view of another form of the invention.

Fig. 4 is a similar view of another form of the invention.

Fig. 5 is a similar view of another form of the invention.

Fig. 6 is a similar view of still another form of the invention.

Referring more particularly to the drawings, the numeral 10 designates generally a bolster plate of a die press having mounted thereon a die holding plate 11, in which is arranged a cutting die 12 which encompasses a forming block 13. A pressure ring 14 is preferably disposed between the forming block and the cutting die 12, which cooperates with a cutting die 15, the latter being mounted upon a reciprocating member or structure 16, as heretofore known in machines of this character.

Connected with the machine in a manner to coöperate with the pressure ring 14 is a fluid pressure cushion which preferably comprises two cylinder members 16, 17 having their respective outer ends 18, 19 closed with the adjacent ends open and telescoping with each other, so as to form a chamber or receptacle within the cushion and in which chamber of the receptacle a lubricant 20 is adapted to be held. The element 17 of the cushion preferably serves in the capacity of a piston element and may be constructed in any desirable or suitable manner, but preferably comprises a section 21 which telescopes with the elements 17, and the two are held together in any desired or suitable manner, such as by means of fastening devices 23 in the form of screws which pass loosely through the closed end 19 of the element 17, and then have engagement with the element 21 so that the parts may be relatively adjusted. The open end of the element 21 is preferably shaped to form a seat 23 which extends circumferentially of the element 21; and the free end 24 of the element 17 terminates short of the seat 23 so as to form a space for packing material 25 arranged therein, and which packing material is adapted to contact with the inner face of the wall of the element 16.

It will be manifest that with this construction, and when the lubricant 20 is held within the cushion, and when a reciprocating or relative movement is imparted to the members of the cushion, the packing will be moved into and out of the lubricant 20, and when it is desired, the elements 17, 21 may be adjusted relatively to each other so as to force the packing against the wall of the element 16.

The cushion thus formed is adapted to be secured to the machine in any desired or suitable manner, preferably by means of tie rods 26 which have engagement at one end with the closed end 18 of the element 16 and are connected by their other ends with an annular member 27 preferably provided with a shoulder 28 adapted to engage and rest upon the upper edge of the element 16. The ring or element 27 is connected with a stationary portion of the machine, by means

of suitable additional tie rods 29. It will thus be manifest that when it is desired, this cushion may be readily attached to or detached from the machine as a single unit.

Resting upon the closed end 19 of the element 17 is a pin plate 30 with which the pins 31 contact or have engagement, and which pins 31 coöperate with the pressure ring 14, so that when the pressure ring 14 is depressed, the element 17 of the cushion will also be depressed to cause a compression within the cylinder, and this is accomplished through the medium of the pins 31 and plate 30 disposed between the pressure ring 14 and the end of the element 17.

Air is supplied to the cushion in any desired or suitable manner, preferably by means of a pumping apparatus which, in the form of the invention shown in Figs. 1 and 2, comprise a stationary piston element 32 which is secured to any fixed portion of the cushion, preferably the end 18 of the element 16 by means of suitable fastening devices 33, and a cylinder element 34, preferably arranged within the cushion, is connected with the movable element 17 in any suitable manner such as by means of the fastening screws 22, so that when the elements 17, 16 are moved relatively with relation to each other, the cylinder element 34 will pass over the piston element 32 and any air which has been drawn into the cylinder 34 will be forced therefrom through the valved controlled outlet 35 into the cushion. The supply of air for the pump mechanism is drawn from the atmosphere through a suitable inlet opening 36 controlled by a valve 37 and a packing box 38 is provided between the cylinder 34 and piston element 32, as will be understood.

The pressure within the cylinder is maintained substantially constant and this is accomplished by means of a suitable outlet 39 which extends preferably through the closed end 18 of the element 16 and terminates at a point above the level of the lubricant 20 therein. Connected with this outlet 39 is a valve 40 adapted to be actuated under an abnormal pressure, and which valve may be of any desirable or suitable construction adapted to be set so as to maintain a predetermined pressure, but when the pressure is excessive, the valve will yield and the air or fluid will pass therefrom into the atmosphere. A pressure gage 41 may be provided, which is connected with the valve 40, and by means of which pressure gage the predetermined pressure may be determined.

In the form of the invention shown in Fig. 1, a plurality of pump devices are shown as being arranged within the cushion, but in the form of the invention shown in Fig. 2, a single pump apparatus is disclosed, and in this form of the invention the pressure within the cushion is maintained substantially constant by means of a suitable compressed air tank 42 which has communication with the interior of the cushion by means of a pipe 43, so that as the cushion is operated and as the pressure is created, the fluid will flow freely into and out of the cushion and out of and into the tank 42.

In the form of the invention shown in Fig. 3, the pump devices are disposed exterior of the cushion and have connection with the cushion through the medium of suitably connecting pipes 44, and which connections are controlled by a valve 45, the free end 46 of the connecting pipes 44 extend into the cushion and terminate at a point above the level of the lubricant 20 therein.

In the form of the invention shown in Fig. 4, the pumping apparatus consists essentially of a cylinder element 47, which is preferably arranged interior of the cushion and has an opening 48 through the closed end 18 of the element 16. The closed end 49 of the cylinder 47 is provided with an opening 50 controlled by a valve 51 and a piston 52 having a valve opening 53, which is arranged to reciprocate within the cylinder 47. This piston 52 is provided with a piston rod 54 surrounding which is an adjustable collar or nut 55; one end of the nut engages a stop device 56 on the piston rod 54 and the other end 57 terminates short of the piston 52 and against the end 57 of which nut 55 one end of a coiled spring 58 rests. This spring encompasses the piston rod 54 and the other end of the spring engages and rests against the face of the piston 52.

The piston is supported in any desirable or suitable manner, preferably by means of a bar or member 59 through which the nut or collar 55 is threaded and the bar or member 59 is itself supported, preferably by means of a suitable number of bars 60 which have an adjustable connection with the bar 59, preferably by passing loosely therethrough and which are held in position by means of suitable fastening devices 61, such as screws or the like. The other ends of the bars 60 are preferably detachably connected with the pin plate 30.

With this improved construction it will be manifest that when the pressure ring 14 is operated to depress the pin plate 30, the latter will, through the medium of the bars 60 and 59 move the piston 52 in the cylinder 46 and this will cause air to pass through the valved opening 53 into the space between the end 49 of the cylinder 47 and the piston 52, to be discharged therefrom through the opening 50 into the cushion to be compressed therein. The pressure may be maintained substantially constant in the cushion, in this form of the device, in any suitable manner, here shown as the compressed air tank 42, which has communication with the interior of the cushion through the pipe 43, and, if

desired, an automatically operating valve 62 may be also provided in this connection 43, by means of which a predetermined pressure in the cushion may be obtained.

By the provision of the adjustable nut 53 it will be manifest that by adjusting the same with respect to the bar 59, the relative movement of the piston 52 with respect to the cylinder 47 may be varied while the stroke or relative movement of the cushion elements will remain constant and by this means, it will be manifest that the pressure may be varied.

It is thought that the operation of this improved apparatus will be clearly understood from the above description, but briefly stated it is as follows:

Assuming that a metal sheet has been placed on the part 12, the member 16 and its associated elements descend, the coöperating cutting dies 15 and 12 acting to cut out a blank of the proper size and shape, the die 15 entering the die 12, as will be readily understood. As it does so, the marginal portion of the blank will be gripped or clamped between the pressure ring 14 and the lower face of the punch or die 15. During the continued descent of the part 16, the pressure ring 14, which is forced downwardly by it, is pressed upwardly, securely clamping the sheet metal blank by reason of the action of the compressed air in the cushion acting against the moving member 17 of the cushion, it being understood that the pressure, of course, is to be regulated either by the valve 40 when used or the compressed air tank 42 when that form is used. The downward movement of the pressure ring 14, of course, causes a relative movement of the cushion elements, one with relation to the other, and a portion of the air within the cushion, will be forced out of the outlet 39, when the pressure exceeds the predetermined pressure to which the valve 40 is set; and this, it will be manifest, will maintain the pressure substantially constant within the cushion.

The pressure around the ring, that is, around the forming block 13, is also substantially uniform. In thus pressing the sheet downwardly it is formed or drawn into shape around the fixed forming block 13, the co-acting descending part 15 and 14 during this operation, clamping the edge of the blank sufficiently to prevent its wrinkling or folding, but not sufficient, however, to cause the article being formed to tear or become severed.

It will also be obvious that, during the relative movement of the elements 16, 17 of the cushion, air will be pumped into the cushion by means of the pumping apparatus.

It is sometimes desirable, to slightly release the gripping movement of the pressure ring 14 and the die member 15, slightly in advance of the forming operation, so as to permit the blank to slip slightly. This may be accomplished in any desirable or suitable manner, but preferably by means of arms or bars 63 which latter are preferably connected by means of a bar or plate 64, that is adapted to rest upon the closed end 19 of the cushion and upon which plate or member 64 the pin plate 65 also rests. These bars or members 63 project upwardly and into the path of movement of the descending element 16, so as to be engaged by the latter at a point just before the cutting die 15 commences to enter the die 12, and when the element 16 engages the ends of these elements 63, the element 17 of the cushion will be slightly depressed, allowing the pressure ring 14 to recede slightly and thereby release the blank. An adjusting device 65 may be connected with the ends of the bars or members 63 for regulating the time at which this releasing movement will take place. These adjusting devices 65 may be in the form of nuts or collars screwed upon the threaded extremity 66 of the bars 63 and held in their adjusted positions by means of nuts or collars 67.

If desired, a portion of the air within the cushion may be employed as a means for cleaning or blowing off particles from the pressure ring 14 or the die 12, and to that end there may be provided a nozzle 68, with which is connected a tube or pipe 69, the free end of which extends into the cushion and terminates as at 70 at a point above the level of the lubricant therein, so that when the element 17 is forced into the element 16 of the cushion, a portion of the air will be forced through the pipe 69 to be discharged through the nozzle 68 against the work, and which nozzle may be supported by a suitable bracket 71 supported to a fixed portion of the machine.

While the preferred forms of the invention have been herein shown and described, it is obvious that various changes may be made in the details of construction and in the combination and arrangement of the several parts, within the scope of the claims without departing from the spirit of this invention.

What is claimed as new is:—

1. The combination of a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively one with relation to the other to cause the shaping of the blank over the block, and a fluid pressure cushion acting on said blank, gripping means during such relative movement of said gripping means and block, said cushion embodying relatively movable opposed coöperating cylindrical elements, each element having an open and a closed end, the open ends of the elements telescoping, one of said ele-

ments being fixed and the other of said elements being operatively related to the said gripping means, said cushion also embodying means whereby the relative movement of the cushion elements will supply fluid between the said elements.

2. The combination of a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively one with relation to the other to cause the shaping of the blank over the block, and a fluid pressure cushion acting on said blank-gripping means during such relative movement of said gripping means and block, said cushion embodying relatively movable opposed coöperating cylindrical elements, each element having an open and a closed end, the open ends of the elements telescoping, one of said elements being fixed, the other of the said elements being responsive in its operation to the operation of the said gripping means, and provisions whereby fluid will be supplied to the cushion by the relative movement of the said elements.

3. The combination of a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively one with relation to the other to cause the shaping of the blank over the block, and a fluid pressure cushion acting on said blank gripping means during such relative movement of said gripping means and block, said cushion being freely detachable and self-contained and embodying relatively movable opposed coöperating cylindrical elements having open telescoping ends, one of said elements being fixed, the other of said elements being responsive in its operation to the operation of said gripping means, and provisions whereby fluid will be supplied between the elements by the relative movement of the said elements.

4. The combination of a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively one with relation to the other to cause the shaping of the blank over the block, and a fluid pressure cushion acting on said blank gripping means and block, said cushion being freely detachable and self-contained and embodying relatively movable opposed coöperating cylindrical elements having open telescoping ends, one of said elements being fixed, the other of said elements being responsive in its operation to the operation of the said gripping means, provisions whereby fluid will be supplied between the elements by the relative movement of the said elements, and means whereby the pressure within the cushion will be automatically controlled.

5. The combination of a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively one with relation to the other to cause the shaping of the blank over the block, and a self-contained and freely detachable fluid pressure cushion acting on said blank gripping means during such relative movement of said gripping means and block, said cushion embodying opposed cylindrical elements having open telescoping ends, one of said elements being fixed, the other element being operatively related to the said gripping means, one of said elements forming an oil chamber into which the other element telescopes, means whereby the relative movement of the cushion elements will supply fluid between the cushion elements, there being an outlet for the fluid leading from between the elements, and means for controlling said outlet.

6. The combination of a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively one with relation to the other to cause the shaping of the blank over the block, and a fluid pressure cushion acting on said blank gripping means during such relative movement of said gripping means and block, said cushion embodying relatively movable opposed coöperating cylindrical elements, each element having an open and a closed end, the open ends of the elements telescoping, one of said elements being fixed and the other of said elements being operatively related to the said gripping means, said cushion also embodying means whereby the relative movement of the cushion elements will supply fluid between the said elements, the last recited means embodying a pump structure carried with the said cushion.

7. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylindrical elements having their outer ends closed and their inner ends open and telescoping, means for anchoring one of the said elements, one of the elements constituting an oil chamber into and out of which oil the other elements move, means whereby the relative movement of the said elements will supply fluid to be compressed between the said elements, there being an outlet for the fluid leading from between the elements above the level of the oil in the cushion.

8. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having their outer ends closed and their inner ends open and telescoping, means for anchoring one of the said elements, one of the elements constituting an oil chamber into and out of which oil the other element moves, means whereby the relative move-

ment of the said elements will supply fluid to be compressed between the said elements, and means for maintaining a substantially unvarying pressure in the cushion between said elements.

9. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer ends and open telescoping inner ends, means for anchoring one of the said elements, a pump structure carried with the cushion and adapted to supply fluid to the cushion by the relative movement of the said elements, and means for maintaining a predetermined pressure in the cushion.

10. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements, having closed outer and open telescoping inner ends, means for anchoring one of the said elements, means whereby the relative movement of said elements will supply fluid to the cushion to be compressed therein, means for maintaining a predetermined pressure in the cushion, one of said elements embodying telescoping sections, one of the sections having a packing seat, packing between the said sections and engaging said seat, and means adjustably securing the said sections together for holding and compressing said packing, said packing forming a fluid tight joint between the cushion elements.

11. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable telescoping cylinder elements having closed outer ends, means for anchoring one of the elements, said means embodying a tubular element secured to the end of one of the cushion elements and passing through the other cushion element and upon which the latter slides, a fastening device passing through the tubular element, one end of the fastening device extending beyond one end of the tubular element, said fastening device having a shoulder engaging the other end of the tubular element, and means whereby the relative movement of the cushion elements will supply fluid to the cushion to be compressed between the cushion elements.

12. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable telescoping cylinder elements having closed outer ends, means for anchoring one of the elements, said means embodying mechanism secured to one of the cushion elements and anchored to a fixed part of the machine, means whereby the relative movement of the cushion elements will supply fluid to the cushion to be compressed between the cushion elements, one of the cushion elements forming a lubricant receiver, there being an outlet leading from the cushion from above the lubricant, and means for controlling said outlet.

13. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer ends and open telescoping inner ends, means for anchoring one of the said elements, a pump structure carried with the cushion and adapted to supply fluid to the cushion by the relative movement of the said elements, and means for maintaining a predetermined pressure in the cushion, said pump structure being located within the cushion and being disposed between the said cushion elements.

14. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer ends and open telescoping inner ends, means for anchoring one of the said elements, a pump structure carried with the cushion and adapted to supply fluid to the cushion by the relative movement of the said elements, means for maintaining a predetermined pressure in the cushion, said pump structure embodying a cylinder and piston, said pump cylinder being connected with one of the cushion elements and said piston being connected with the other cylinder element whereby the relative movement of the cylinder elements will actuate the pump.

15. A sheet metal press embodying a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively to one another to cause the shaping of the blank over the block, in combination with a freely attachable and detachable fluid pressure cushion acting on said blank gripping means with substantially unvarying pressure during such relative movement of said gripping means and block, and means operating automatically to slightly relieve the pressure of the said gripping means upon the blank at a predetermined point in the shaping of the blank.

16. A sheet metal press embodying a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively to one another to cause the shaping of the blank over the block, in combination with a freely attachable and detachable fluid pressure cushion acting on said blank gripping means with substantially unvarying pressure during such relative movement of said gripping means and block, and means operating automatically to slightly relieve the pressure of

the said gripping means upon the blank at a predetermined point in the shaping of the blank, the said pressure relieving means being operatively related to the said cushion.

17. A sheet metal press embodying a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively to one another to cause the shaping of the blank over the block, in combination with a freely attachable and detachable fluid pressure cushion acting on said blank gripping means with substantially unvarying pressure during such relative movement of said gripping means and block, means operating automatically to slightly relieve the pressure of the said gripping means upon the blank at a predetermined point in the shaping of the blank, and means whereby the time of operation of the said pressure relieving means may be varied at will.

18. A sheet metal press embodying a forming block, means adapted to grip a sheet metal blank, means to move said gripping means and block relatively to one another to cause the shaping of the blank over the block, in combination with a freely attachable and detachable fluid pressure cushion acting on said blank gripping means with substantially unvarying pressure, during such relative movement of said gripping means and block, means whereby a portion of the fluid will be discharged from the cushion during such relative movement, and means for discharging a blast of fluid from the cushion adjacent the forming block.

19. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer ends and open telescoping inner ends, means for anchoring one of the said elements, a pump structure carried with the cushion and adapted to supply fluid to the cushion by the relative movement of said elements, and a compressed fluid tank having communication with the cylinder, whereby the pressure in the cushion and tank is always maintained substantially the same.

20. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer ends and open telescoping inner ends, means for anchoring one of said elements, and a pump structure adapted to supply fluid to the cushion, said pump being operable by the relative movement of the cushion elements.

21. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer ends and open telescoping inner ends, means for anchoring one of said elements, a pump mechanism responsive in its operation to the relative movement of the cushion elements, said pump mechanism operating to supply fluid to the cushion, and means operating automatically to maintain a substantially unvarying pressure in the cushion.

22. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer and open telescoping inner ends, means for anchoring one of said elements, and pump mechanism responsive in its operation to the relative movement of the cushion elements, and adapted to supply fluid to the cushion between the elements thereof, said pump mechanism receiving its supply of fluid from the atmosphere.

23. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cylinder elements having closed outer and open telescoping inner ends, means for anchoring one of said elements, and pump mechanism responsive in its operation to the relative movement of the cushion elements, adapted to supply fluid to the cushion between the elements thereof, said pump mechanism receiving its supply of fluid from the atmosphere, and means operating to automatically maintain a substantially unvarying pressure in the cushion.

24. The combination of a sheet metal shaping member, means coöperating with said member for shaping the material and embodying gripping means for the material, a freely detachable and self-contained fluid pressure means for maintaining a substantially unvarying pressure on the gripping means during the operation of shaping the material, said fluid pressure means embodying a piston and a cylinder element, means whereby the gripping means will be responsive in its operation to the operation of one of the parts of the cushion, and means embodying pump mechanism responsive in its operation to the relative movement of the cushion elements for supplying fluid between the cushion elements.

25. The combination of a sheet metal shaping member, means coöperating with said member for shaping the material and embodying gripping means for the material, a freely detachable and self-contained fluid pressure means for maintaining a substantially unvarying pressure on the gripping means during the operation of shaping the material, said fluid pressure means embodying a piston and a cylinder element, means whereby the gripping means will be responsive in its operation to the operation of one

of the parts of the cushion, means embodying pump mechanism responsive in its operation to the relative movement of the cushion elements for supplying fluid between the cushion elements, and means operating to maintain a substantially unvarying pressure in the said cushion.

26. The combination of a sheet metal shaping member, means coöperating with said member for shaping the material and embodying gripping means for the material, a freely detachable and self-contained fluid pressure means for maintaining a substantially unvarying pressure on the gripping means during the operation of shaping the material, said fluid pressure means embodying a piston and a cylinder element, means whereby the gripping means will be responsive in its operation to the operation of one of the parts of the cushion, means embodying mechanism responsive in its operation to the relative movement of the cushion elements for supplying fluid between the cushion elements, and means operating to maintain a substantially unvarying pressure in the said cushion, the said fluid supplying mechanism receiving its supply from the atmosphere.

27. The combination of a sheet metal shaping member, means coöperating with said member for shaping the material and embodying gripping means for the material, a freely detachable and self-contained fluid pressure means for maintaining a substantially unvarying pressure on the gripping means during the operation of shaping the material, said fluid pressure means embodying a piston and a cylinder element, means whereby the gripping means will be responsive in its operation to the operation of one of the parts of the cushion, and means embodying pump mechanism responsive in its operation to the relative movement of the cushion elements for supplying fluid between the cushion elements, the last recited means embodying mechanism whereby the operative stroke of the pump mechanism may be varied with relation to the said relative movement of the cushion elements.

28. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cushion elements, means for anchoring one of the cushion elements, mechanism to the operation of which the other cushion element is responsive to cause a relative movement of the cushion elements, pump mechanism for supplying fluid between the cushion elements, said pump mechanism embodying a cylinder and piston, the said cylinder and piston being one connected with the anchored cushion element, and the other having an operative connection with the first recited mechanism.

29. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cushion elements, means for anchoring one of the cushion elements, mechanism to the operation of which the other cushion element is responsive to cause a relative movement of the cushion elements, pump mechanism for supplying fluid between the cushion elements, said pump mechanism embodying a cylinder and piston, the said cylinder and piston being one connected with the anchored cushion element, and the other having an adjustable operative connection with the first recited mechanism whereby the operative movement of the pump mechanism with respect to the relative movement of the cushion elements may be varied.

30. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cushion elements, means for anchoring one of the cushion elements, mechanism to the operation of which the other cushion element is responsive to cause a relative movement of the cushion element, pump mechanism for supplying fluid between the cushion elements, said pump mechanism embodying a cylinder and piston, the said cylinder and piston being one connected with the anchored cushion element, the other having an operative connection with the first recited mechanism, and means for maintaining a substantially unvarying pressure in the said cushion.

31. A self-contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying opposed relatively movable cushion elements, means for anchoring one of the cushion elements, mechanism to the operation of which the other cushion element is responsive to cause a relative movement of the cushion elements, pump mechanism for supplying fluid between the cushion elements, said pump mechanism embodying a cylinder and piston, the said cylinder and piston being one connected with the anchored cushion element, and the other having an operative connection with the first recited mechanism, the said pump mechanism receiving its supply from the atmosphere.

32. A self contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying a cylinder and piston movable relatively one with relation to the other, means for anchoring one of the parts of the cushion, a pump structure carried with the cushion and adapted to supply fluid to the cushion by the relative movement of the cushion elements, and means for maintaining a predetermined pressure in the cushion.

33. A self-contained freely attachable and detachable fluid pressure cushion for sheet

metal die machines, said cushion embodying a cylinder and piston elements relatively movable, means for anchoring one of the elements, a pump mechanism responsive in its operation to the relative movement of the cushion elements, said pump mechanism operating to supply fluid to the cushion, and means operating automatically to maintain a substantially unvarying pressure in the cushion.

34. A self contained freely attachable and detachable fluid pressure cushion for sheet metal die machines, said cushion embodying a cylinder and piston, means for anchoring one of the parts of the cushion, and a pump structure adapted to supply fluid to the cushion, said pump being operable by the relative movement of the cushion elements.

In testimony whereof I have signed my name to this specification on this 2nd day of May, A. D. 1918.

DAVID STRAND.