

March 2, 1948.

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2,437,131

FLUID OPERABLE SHORT STROKE DEVICE

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2 Sheets-Sheet 1

Fig. 1

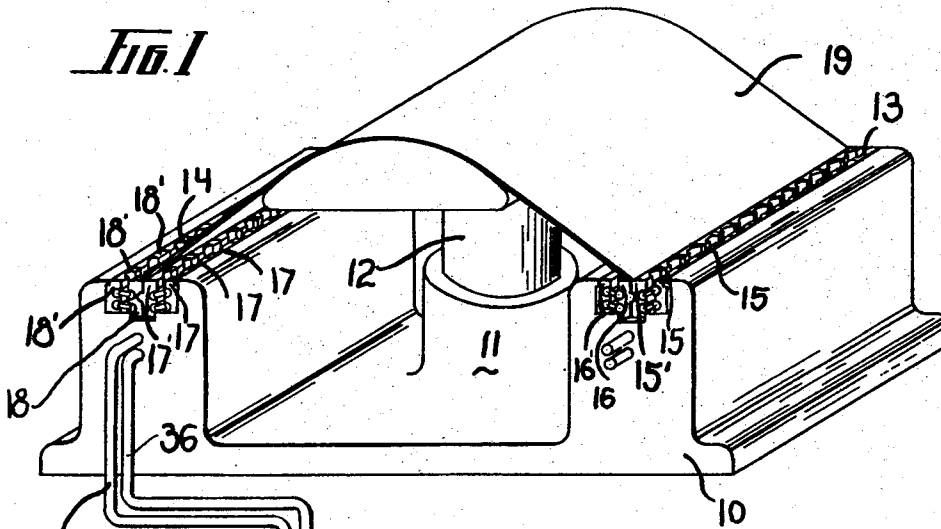
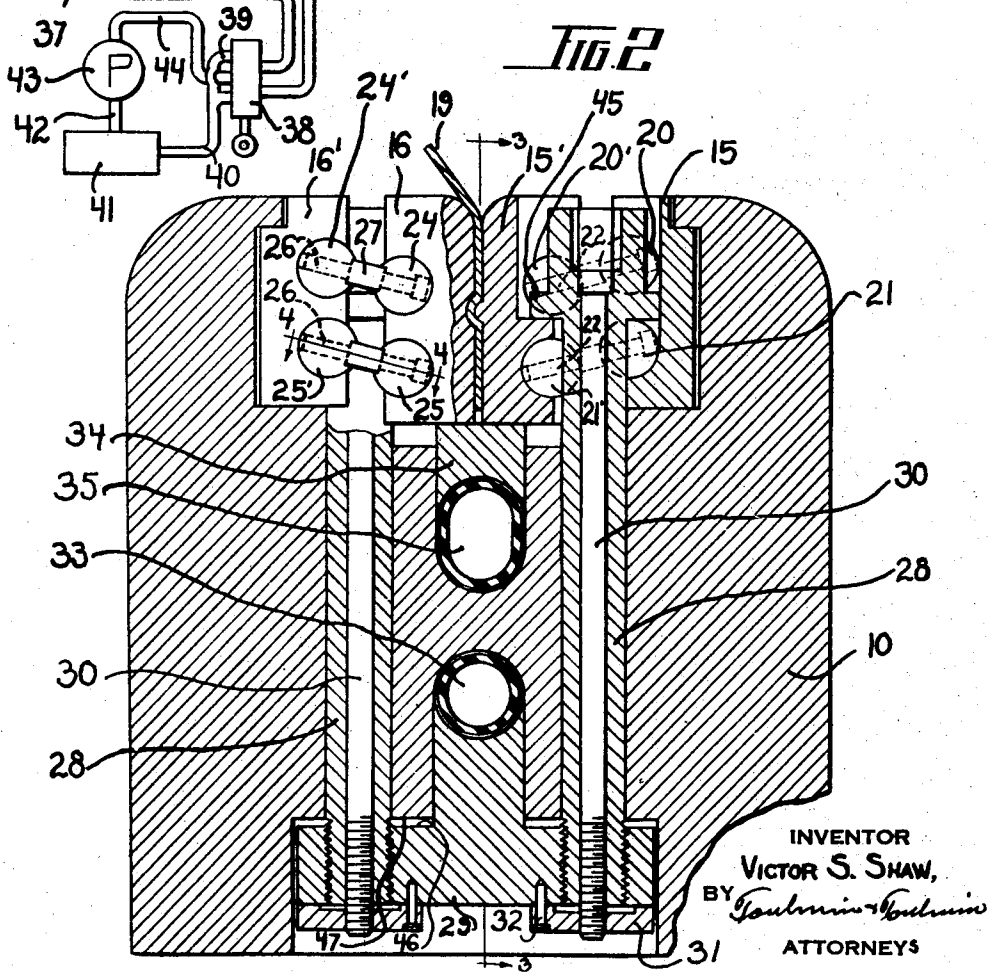


Fig. 2



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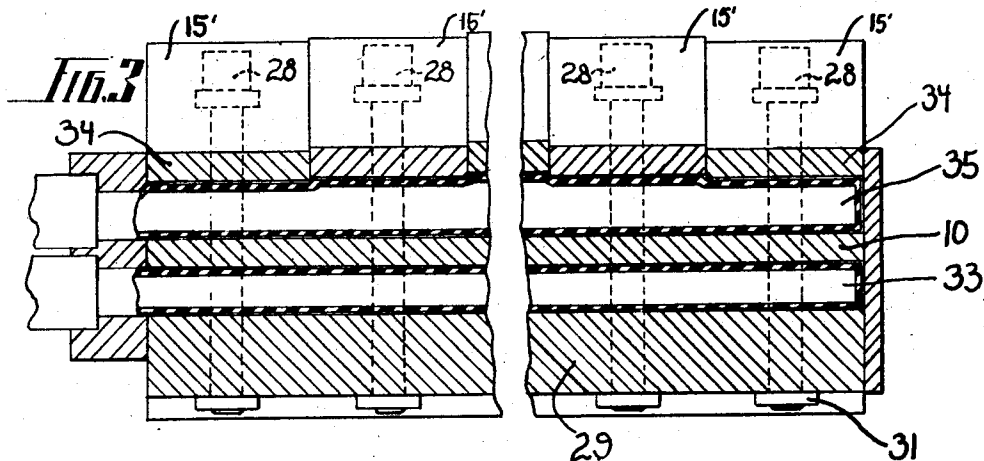
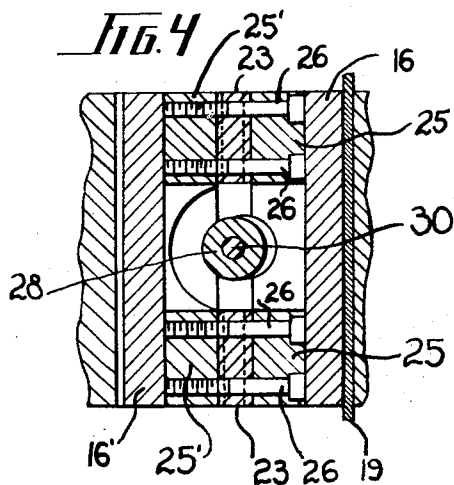
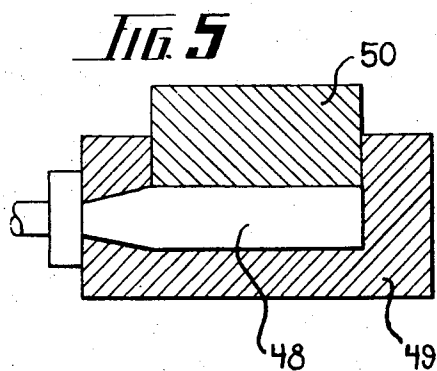
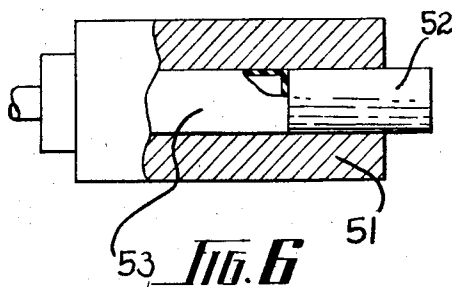
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FLUID OPERABLE SHORT STROKE DEVICE

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2 Sheets-Sheet 2



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FLUID OPERABLE SHORT STROKE DEVICE

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11 Claims. (Cl. 24-249)

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This invention relates to fluid operable means, and in particular, to fluid actuated elements with a short stroke.

It is an object of this invention to provide simplified fluid actuated means for use in connection with a reciprocable element to bring about a short stroke of said element.

Although by no means limited to clamping or gripping devices, the invention is of particular advantage in connection with such mechanism.

It is therefore, another object to create a clamping or gripping device, in which inflatable means is provided for actuating a clamping or gripping member.

Another object of this invention consists in the provision of a clamping or gripping device, in which the clamping or gripping means is actuated by the control of pressure in a flexible tube.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings in which Figure 1 is a view, in part perspective and in part diagrammatic, showing a device in connection with which the present invention may be used.

Figure 2 is a section on an enlarged scale, taken substantially on line 2-2, Figure 3, and showing the left hand clamping device in end elevation to more clearly disclose the relation of the parts.

Figure 3 is a section along the line 3-3 of Figure 2 on a smaller scale than the latter.

Figure 4 is a sectional detail view taken on the line 4-4 of Figure 2.

Figures 5 and 6 show simple applications of the principle of the present invention.

Referring now to the drawings in detail and the structure of Figure 1 in particular, this structure represents a stretching device comprising a bed or frame 10 with a cylinder 11 in which is reciprocably mounted a ram 12. The ram 12 is preferably operable by fluid pressure which may be supplied through suitable conduits (not shown) from pump 43. Also mounted in the bed 10 are clamping jaws generally designated 13 and 14. The jaw 13 may be termed the first clamping member and the jaw 14, the second clamping member. Each clamping jaw comprises a plurality of individual substantially

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aligned sections 15, 15' and 16, 16' pertaining to the clamping jaw 13 and similarly a plurality of clamping elements 17, 17' and 18, 18' pertaining to the clamping jaw 14. Figure 3 illustrates the arrangement of sections 15'; and it will be understood that the sections of each jaw are similarly arranged. The clamping elements 15, 15' and 16, 16' and also the clamping elements 17, 17' and 18, 18', each having suitable clamping faces, are movable relative to each other to clamp therebetween a metal sheet 19. As will be seen from Figure 2 illustrating a portion of the bed 10 with clamping elements 15, 15' and 16, 16', the elements 15 and 15' are interconnected by cylinders 20, 20' and 21, 21'. The members 15' and 16 may be termed the primary clamping elements, and the members 15 and 16' may be termed the secondary clamping element. These cylinders are located in corresponding recesses in the adjacent clamping elements and are interconnected by bolts 22, while the cylinders are held in a predetermined distance from each other by spacing members 23. Similarly the elements 16 and 16' are interconnected by cylinders 24, 24' and 25, 25'. These cylinders are interconnected by means of bolts 26 and are spaced from each other by spacing members 27. Hollow vertical bolts 28 pass between the elements 15, 15' and 16, 16' through the bed 10 and threadedly engage a T-shaped member 29. In order to lock the hollow bolts 28 with regard to the T-shaped member 29, bolts 30 pass through the hollow bolts 28, and their lower ends engage nuts 31. To prevent rotation of these nuts, pins 32 are provided which extend through the nuts 31 into the T-shaped member 29. The T-shaped member 29 extends into the bed 10 and defines with the latter a hollow chamber in which is located an expansible tube 33. Similarly the bed 10 defines with a reciprocable member 34 a chamber in which is located an inflatable tube 35. The reciprocable member 34 engages the adjacent clamping element 16 and 15'.

To supply fluid pressure to and exhaust fluid pressure from the tubes 33 and 35, these tubes are connected with two conduits 36 and 37 respectively which conduits lead to a 4-way valve 38. Also connected to the 4-way valve 38 are two interconnected conduits 39 and 40 leading to a fluid reservoir or tank 41. The tank 41 is

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connected by means of a suction line 42 to a fluid pressure source such as a pump 43, the pressure side of which is connected through a conduit 44 with the 4-way valve 38. While Figure 1 shows the fluid pressure supply system only for the clamping elements 17, 17' and 18, 18', it is, of course, understood that a similar pressure supply system is provided for the elements 15, 15' and 16, 16'.

The operation of the device will best be understood by reference to Figure 2. This figure shows the metal sheet 19 firmly clamped between the clamping elements 15' and 16, while the tube 35 is in its inflated condition. In order to release the metal sheet 19 from the clamping elements 15' and 16, the operator shifts the 4-way valve 38 so as to connect the tube 35 through the conduit 37 with the tank 41, while fluid pressure from the fluid source 43 is conveyed through conduits 44 and 36 into the tube 33. Due to the inflation of the tube 33, the T-shaped member 29 will move downwardly, thereby also moving the hollow bolts 28 downwardly. In view of the engagement of the shoulder 45 of the hollow bolt 28 with an adjacent shoulder on the clamping elements 15' and 16, these clamping elements move downwardly thereby reducing the projection of the axes interconnecting the cylinders 20, 20' and 21, 21'. Similarly the downward movement of the clamping member 16 reduces the projection of the axes pertaining to the cylinders 24, 24' and 25, 25'. Therefore, the pressure previously exerted by the clamping elements 15' and 16 on the metal sheet 19 is released so that the metal sheet 19 may now be removed from the clamping device.

On the other hand, if the metal sheet 19 is to be clamped between the clamping elements 15' and 16, the 4-way valve 38 will be shifted so as connect the tube 33 through conduit 36 with the tank 41, while fluid pressure from the fluid source 43 is conveyed through the conduit 37 into the tube 35. In this way the tube 35 will be inflated and move the reciprocable member 34 upwardly. As a result thereof the member 34 moves the clamping elements 15' and 16 upwardly thereby increasing the projection between the axes of the cylinders 20, 20' and 21, 21' and also of the axes pertaining to the cylinders 24, 24' and 25, 25'. Consequently, the clamping elements 15' and 16 are moved toward each other, thereby exerting clamping pressure upon the metal sheet 19. When the metal sheet 19 is stretched by upward movement of the ram 12, it will tend to move the clamping elements 15' and 16, thereby causing the same to exert further clamping pressure on the metal sheet. The upward movement of the clamping elements 15' and 16, and thereby the maximum clamping pressure exerted by these elements on the metal sheet 19 is dependent on the relative position of the hollow bolts 28 and the T-shaped member 29. In other words, as soon as the area 46 of the T-shaped member 29 engages the opposite area 47 of the bed 10, no further upward movement of the hollow bolts 28 is possible. Since bolts 28, by means of the shoulder 45, limit the upward movement of the clamping elements 15' and 16, the clamping pressure exerted by said elements on the metal sheet 19 is limited. It will, therefore, be clear that by screwing the bolts 28 out of the T-shaped member 29, greater clamping pressure can be exerted by the clamping elements 15' and 16 upon the metal sheet 19, while by screwing the hollow bolts 28 further into the

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T-shaped member 29, the maximum clamping pressure which may be exerted upon the metal sheet 19 will be reduced.

As will be clear from Figure 3, the hollow bolts 28 may be adjusted individually so that the various clamping elements 15' and 16 may exert different clamping pressure on the metal sheet 19 along the width thereof. This is clearly illustrated in Figure 3 in which the two end clamping elements 15' are held in a lower position than the next adjacent clamping elements 15' so that the latter are adapted to exert a greater maximum clamping pressure on the metal sheet 19 than can be exerted by the outer clamping elements 15'. The tubes 33 and 35 will automatically adapt themselves to the adjustment of the hollow bolts 28 for the individual clamping elements 15' and 16 pertaining thereto.

It will thus be apparent that element 15' is connected to element 15 for movement in an arcuate path thereabout and that element 16 is similarly connected to element 16'. Furthermore, it is clear that the two paths intersect so that, when urged upwardly by member 34 upon inflation of tube 35, elements 15' and 16 are positively moved or urged toward each other with a force that is, neglecting friction, equal to the upward thrust multiplied by the cotangent of the angle between a line vertical to the plane of the clamping surface and the axis of members 27. Thus by keeping the angle small, the clamping force may be greatly magnified over the thrust effected by member 34.

Figures 5 and 6 show simple devices using the principle of the present invention. In Figure 5 an expansible tube 48 is provided which is located in a member 49 and adapted to actuate a reciprocable member 50 as soon as pressure fluid is supplied to the tube 48. When the tube 48 is exhausted, the weight of the member 50 will return the latter to its initial or starting position.

Similarly, Figure 6 shows a cylinder 51 having reciprocably mounted therein a reciprocable member or plunger 52 which is engaged by an expansible member 53. It will be clear that as soon as pressure fluid is supplied to the expansible member 53, the member or plunger 52 will be actuated.

It will also be understood that the present invention is by no means limited to the particular structure shown in the drawings but also embraces any modifications within the scope of the appended claims.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a force-exerting device a bed having a wall, said wall having a first channel opening into one face of said wall, a second parallel channel opening into the opposite face of said wall, two plunger means each fitting a respective channel and forming chambers with the respective channels, a dilatable element in each chamber, pressure elements mounted on said bed for guided movement toward and from each other in intersecting paths away from said first channel, and positioned to be so moved in one direction along their paths by the plunger in said first channel, whereby to press a work piece between said elements, and means on said bed, connected to be operated by said second plunger to engage and move said elements in the opposite direction along their paths as said element in said second channel is dilated.

2. In combination, a plurality of oppositely lo-

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cated clamping units, each of said clamping units comprising a plurality of primary and secondary clamping elements arranged side by side, each primary clamping element being movably connected with an adjacent secondary clamping element, control means for individually controlling the maximum distance between the interconnected primary and secondary clamping elements, and a single inflatable member common to all of said clamping elements and operable simultaneously to act on all of said interconnected primary and secondary clamping elements to space said elements in accordance with adjustment effected by the respective control means.

3. In combination, a first clamping member, a second clamping member arranged opposite said first clamping member, said second clamping member comprising a primary and secondary element movably interconnected, adjustable control means for adjusting relative movement between the primary element and the first clamping member and for limiting the maximum movement of said primary element toward said first clamping member, and inflatable means in operative engagement with the clamping members and operable positively to bring about relative movement of said primary element and toward said first clamping member in accordance with the adjustment by said control means, said control means being adjustable independently of said inflatable means.

4. In combination, a plurality of oppositely located clamping units, each of said units comprising a plurality of individually adjustable clamping blocks, each of said blocks comprising a primary and a secondary clamping element, control means, means connecting said control means with said blocks and primary elements for actuating said blocks individually and for positively limiting the maximum movement of said primary elements toward each other, first inflatable means operable to bring about movement of said primary elements toward each other in accordance with the adjustment of said control means, and second inflatable means operable to bring about movement of said primary elements away from each other, said control means being adapted to be actuated independently of said first and said second inflatable means.

5. In a clamping device, first and second spaced parallel elements, a linkage connection between said elements limiting them to relative arcuate movement in planes transverse of said elements, first means having a clamp face lying in the path of arcuate movement of an opposing clamp face of said first element, means restraining said first means and said second element against separation, actuating means including an inflatable tube, said actuating means including means for engaging said first element and urging it in its path, whereby to clamp a work piece between said faces and means connecting said actuating means to each pair of first and second elements for adjustment independently of said actuating means for individually limiting the maximum clamping pressure of each pair of co-operating first and second elements.

6. In a clamp, a support means having a clamp face, first and second elements in said support, said second element being fixed relatively to said support, means connecting said first element to said second element for guided movement in a path angularly intersecting said face, an inflatable device enclosed in a chamber formed by parallel walls in said support, a member slidably fit-

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ting said walls, said member being positioned to engage and move said first element in said path whereby a work piece may be clamped between said face and said first element, and means adjustable independently of said inflatable device for limiting the movement of said first element toward said clamp face.

7. In a clamp device, a bed, a first pair of parallel clamping elements having adjacent coacting clamp faces, a second pair of parallel clamping elements restricted to a predetermined separation on said bed, linkage means between each element of said first pair and a respective clamping element of said second pair and constraining said clamp faces to intersecting angularly related paths, means including an inflatable device engaging and urge each element of said first pair to move in one direction along their respective paths, means including a second inflatable element engaging and adapted to move said first pair of clamping elements in the opposite direction along their respective paths, and means operable independently of said inflatable elements for individually limiting the maximum movement of each pair of coacting clamping elements.

8. In combination, a frame member, a plurality of oppositely located clamping members movably carried in said frame, a first inflatable means associated with said clamping members and responsive to a pressure created therein for moving said clamping members towards one another in order to clamp a workpiece therebetween, and a second inflatable means associated with said clamping members and responsive to a pressure created therein for moving said clamping members away from one another in order to release the said workpiece therefrom, and a plurality of individually adjustable elements operatively connected to said clamping members adapted to be actuated independently of said first and second inflatable means for limiting the clamping pressure of the respective clamping members, said adjustable elements also being adapted to be actuated by said first and second inflatable means for actuating said clamping members.

9. A work-clamping device comprising movable clamping means constituted by a plurality of separate elements, reaction means co-operating therewith for work clamping, a capsule embodying a flexible wall operatively associated with, and common to, a plurality of said separate elements of said movable clamping means, said capsule being distortable by flexure of a flexible wall of said capsule for outward flexure of said flexible wall effectually to expand said capsule means and load said movable clamping means toward said reaction means.

10. In a work-clamping member, embodying at least two clamping jaws, at least one of which is movable toward and away from the other for clamping work engaged between them; a hollow capsule having a flexible face for engagement with a pressure member operatively associated with the movable jaw means, and a pressure fluid flow connection communicating with the interior of said capsule for flexure of said flexible face outwardly, to urge said movable jaw means toward the co-operating clamping jaw means.

11. A work-clamping device comprising movable clamping means, reaction means co-operating therewith for work clamping, capsule means operatively associated with said movable clamping means and having a flexed wall distortable outwardly by internal pressure, and means to ap-

ply pressure internally of said capsule means for outward flexure of said flexible wall effectually to expand said capsule means and load said movable clamping means toward said reaction means.

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