Feb. 10, 1959 W. F. LONGFIELD 2,872,886

PRESS APPARATUS

Filed Sept. 16, 1954 4 Sheets-Sheet 1

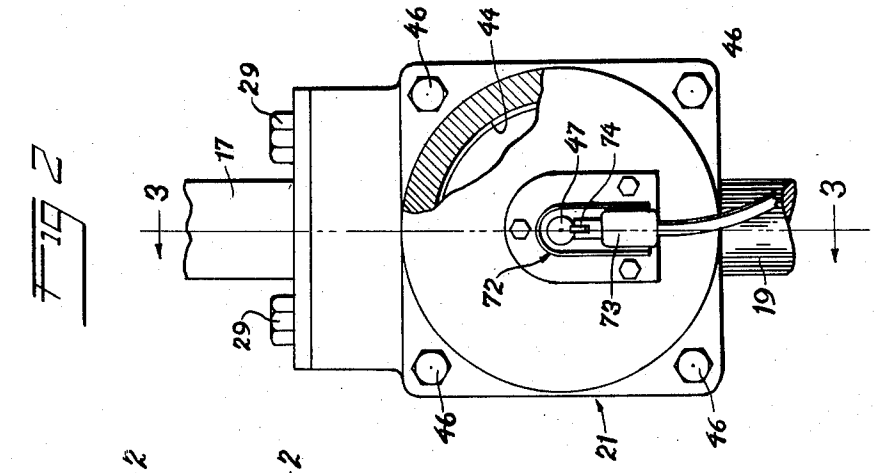


Fig 2

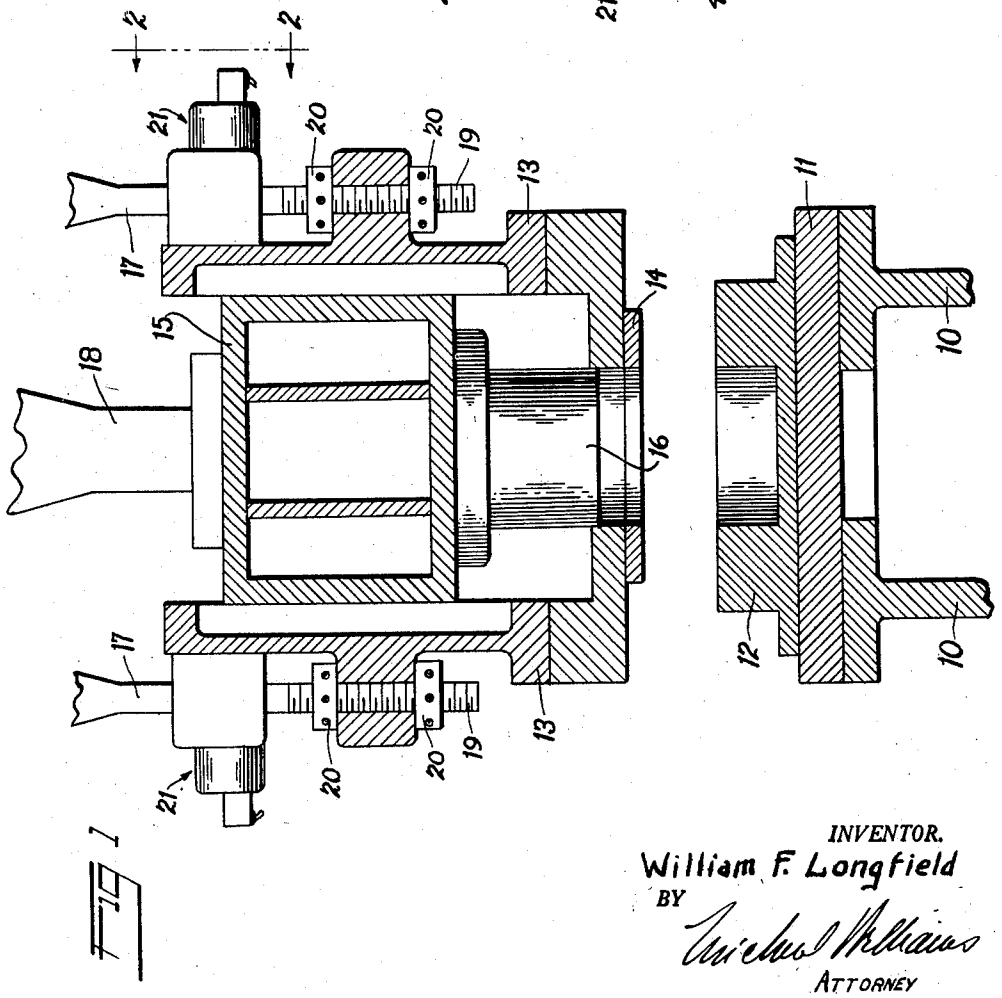


Fig 1

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Feb. 10, 1959 W. F. LONGFIELD 2,872,886

PRESS APPARATUS

Filed Sept. 16, 1954 4 Sheets-Sheet 2

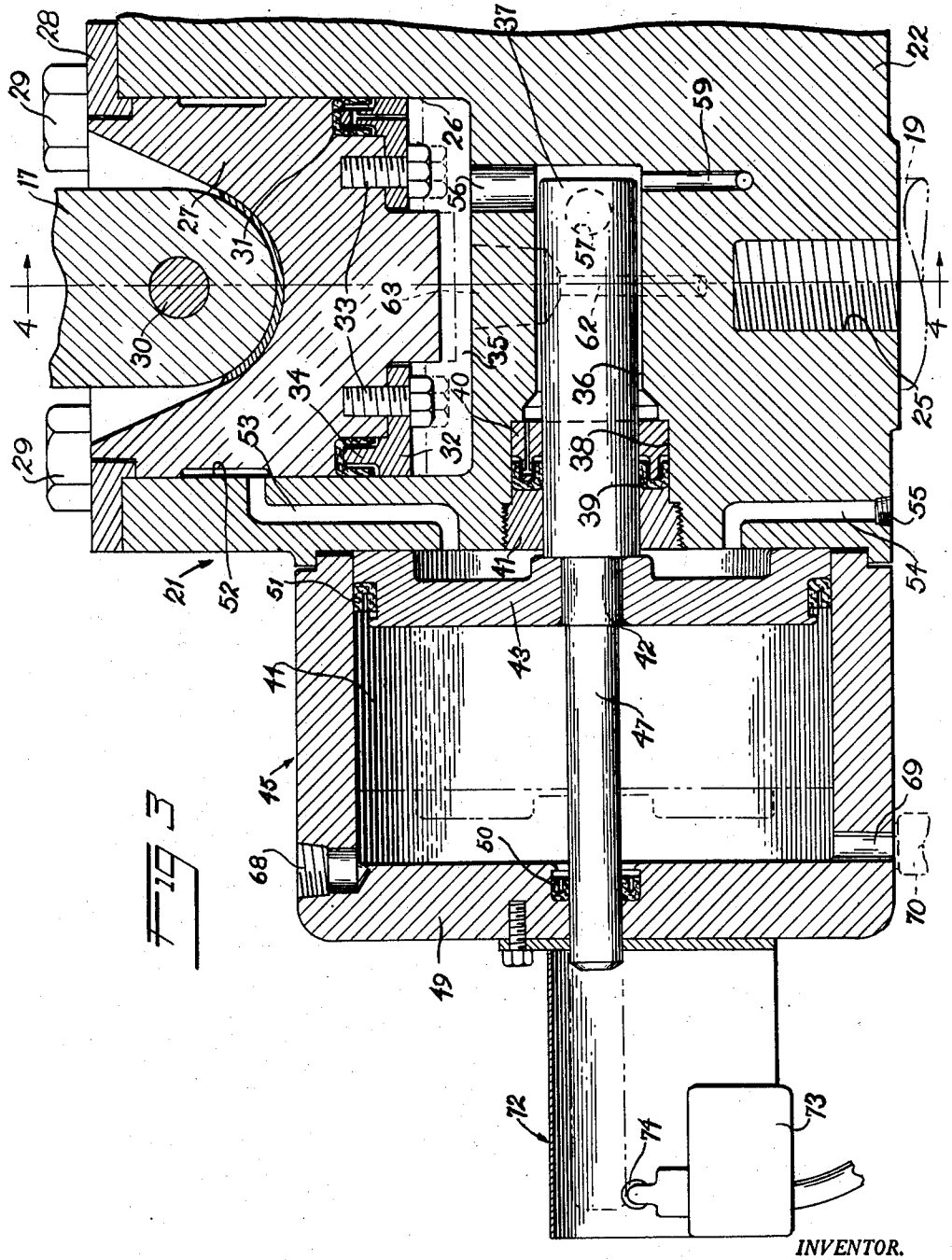


FIG 3

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Feb. 10, 1959 W. F. LONGFIELD 2,872,886

PRESS APPARATUS

Filed Sept. 16, 1954 4 Sheets-Sheet 3

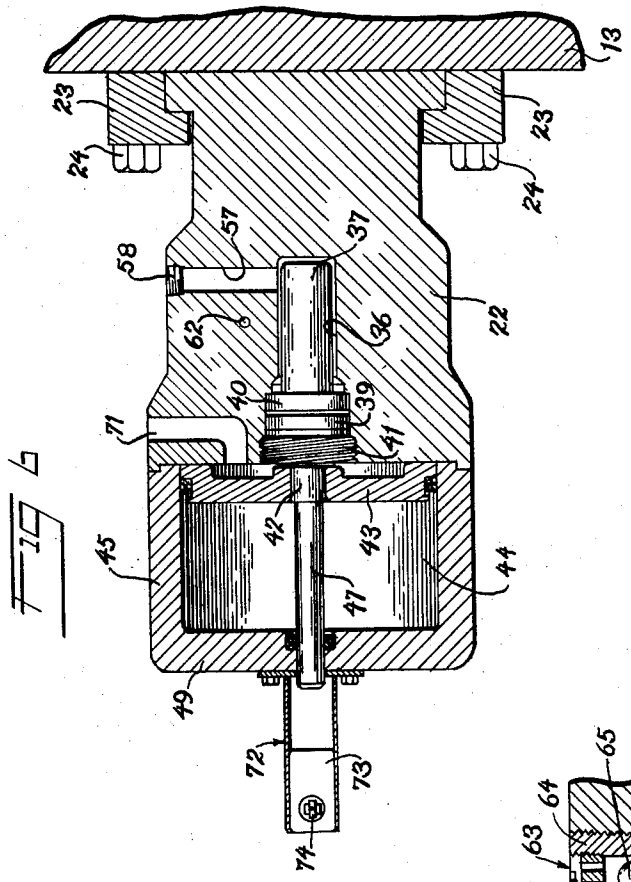


FIG. 5

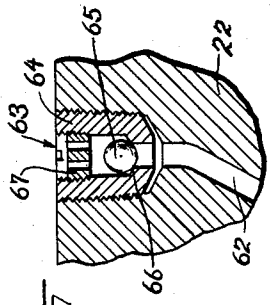
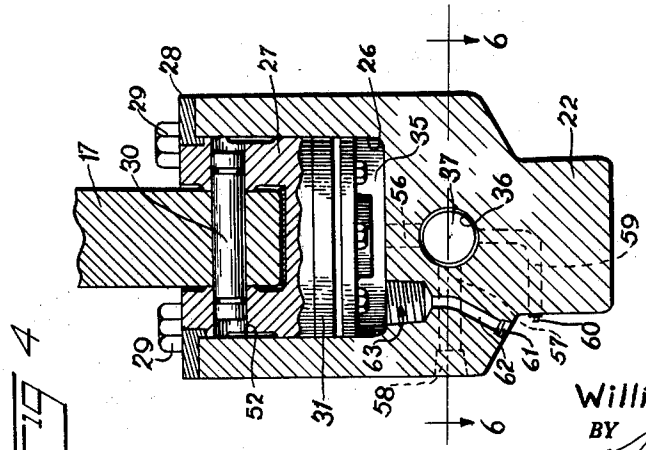


FIG. 4



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Feb. 10, 1959 W. F. LONGFIELD 2,872,886

PRESS APPARATUS

Filed Sept. 16, 1954 4 Sheets-Sheet 4

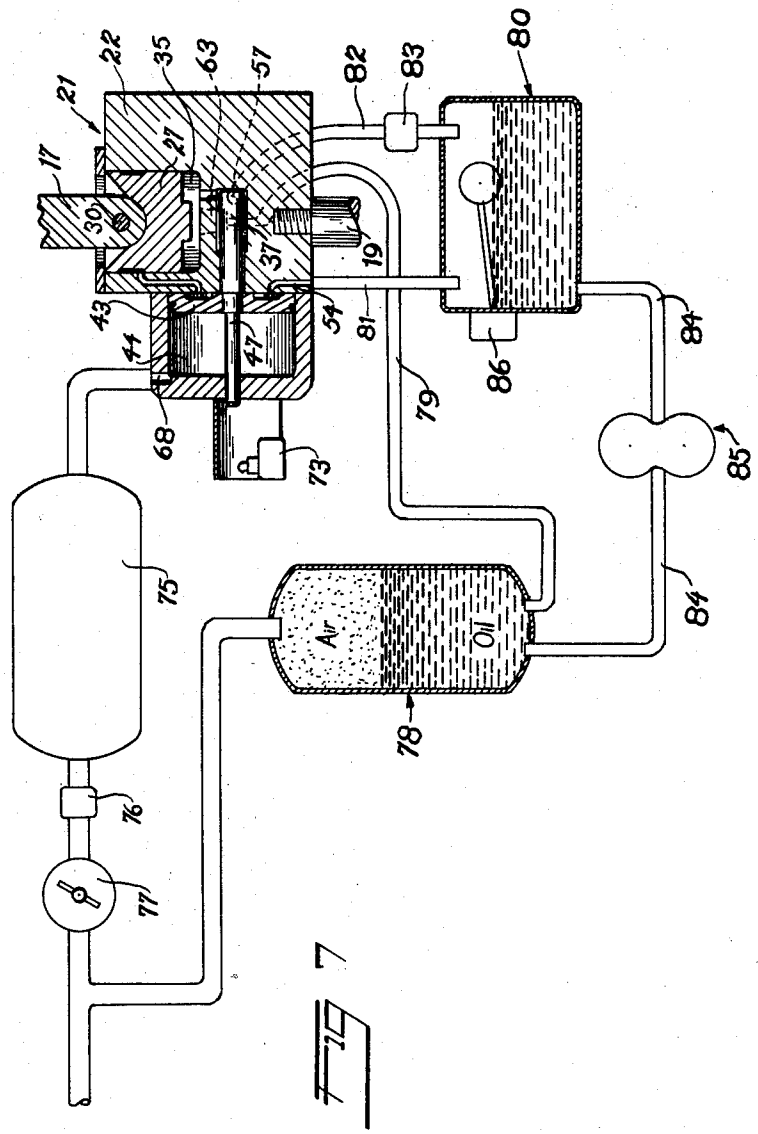


FIG 7

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United States Patent Office

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PRESS APPARATUS

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Application September 16, 1954, Serial No. 456,426

2 Claims. (Cl. 113—38)

The present invention relates to presses, more particularly to presses of the mechanical type having means associated therewith for selectively limiting or otherwise controlling the amount of pressure developed by the press, and the principal object of my invention is to provide new and improved devices of the character described.

In drawing material, particularly when relatively severe draws are to be made, it is usually necessary to employ what is known as a double action press. These presses have one slide which actuates the forming portion of the die being used and another slide which actuates a blankholder which exerts sufficient pressure upon the material being drawn to prevent the formation of wrinkles.

It has long been known that the pressure exerted upon the blank by the blankholder slide should be held to the minimum amount necessary for the specific job at hand. This is desirable since excessive blankholder pressure causes accelerated die wear and produces excessive stresses in the material which often makes annealing operations necessary on the drawn article.

With the conventional double action press, it is extremely difficult to determine and adjust blankholder pressure since this adjustment is performed by mechanically adjusting the space between the lower die and the blankholder. In view of the fact that the blankholder slide may travel only a few thousandths of an inch after it contacts the blank in order to build up the requisite pressure, it will be apparent that adjustment of this pressure is a very delicate operation. Moreover, even slight variations in the thickness of the material fed to the press will cause a great variance of the pressure exerted by the blankholder. Since the usual procedure is to adjust the press so that satisfactory pressure is obtained on the minimum thickness blank, it will be seen that excessive pressure is developed on the average and above average thickness blank with the attendant disadvantages mentioned.

While prior attempts have been made to limit the pressure exerted by the press to only that necessary, none of the devices employed for this purpose have been entirely satisfactory and therefore none have achieved a significant degree of commercial success. The failure of prior art devices has been due to the fact that most have either been too complicated and expensive or else so simplified that they lacked the necessary flexibility to satisfactorily perform the requisite functions.

The present invention provides apparatus which solves the problem of limiting the pressure exerted by a press to the precise amount required for a specific operation. This is accomplished by relatively simple, trouble-free apparatus which greatly simplifies and reduces press set-up time and which makes possible accurate predetermination of the results which will be obtained. These and other advantages will become apparent from a study of the following description and from the drawings appended hereto.

In the drawings accompanying this specification and forming a part of this application there is shown, for

purpose of illustration, an embodiment which my invention may assume, and in these drawings:

Figure 1 is a fragmentary sectional view of a press embodying my invention,

Figure 2 is an enlarged, elevational view of a detail generally corresponding to the line 2—2 of Figure 1, with a part broken away to show interior construction,

Figure 3 is a still further enlarged, sectional view generally corresponding to the line 3—3 of Figure 2,

Figure 4 is a reduced size view, partially in section, generally corresponding to the line 4—4 of Figure 3,

Figure 5 is an enlarged, fragmentary sectional view of a detail shown in elevation in Figure 4,

Figure 6 is a view partially in section and generally corresponding to the line 6—6 of Figure 4, and

Figure 7 is a reduced size, generally diagrammatic view of parts shown in Figure 3 and showing certain fluid circuits and certain parts associated therewith.

As shown in Figure 1, a press embodying my invention comprises the usual bed 10 which supports a bolster 11 which in turn supports a drawing die 12. Spaced above the die 12 and secured by any suitable means to a shiftably mounted member or slide 13 is a blankholder ring 14 which is adapted to cooperate with the die in the usual manner to clamp the blank, or material being formed, therebetween. A punchholder slide 15 is slideable within the slide 13 and carries a punch 16 which is cooperable with the die 12 to draw the blank to the desired configuration.

Each slide 13, 15 is adapted to be moved down (in the position of parts shown) to cooperative relation with the die by any suitable means. For example, the lower ends of links 17 may be connected to slide 13 and the upper ends of the links may have suitable connection to mechanism (not shown) which effects vertical movement of the links to effect corresponding movement of the attached slide. With respect to slide 15, a link 18 may have its lower end pivotally secured to the slide 15 and its upper end connected to a suitable mechanism (not shown) which will effect vertical movement of the link and corresponding movement of the attached slide.

While in the present embodiment four links 17 are employed (one at each corner of the slide 13), it is to be understood that the number herein disclosed is illustrative only and that such number may be varied in accordance with requirements. Furthermore, while only one link 18 has been shown, additional links may be employed if desirable.

Each link 17 is adapted to be secured to the slide 13 by means of a respective adjusting screw 19 which is adjustably secured to the slide by means of locking nuts 20, 20. For reasons later to be disclosed, the present invention employs devices 21 which are interposed between each of the links 17 and its adjoining adjusting screw 19. Since each of the devices 21 is similar, only one will be shown and described.

Referring now to Figure 3 wherein is illustrated an enlarged section through a device 21, it will be seen that the device presently comprises a main housing 22 which is positioned against the slide 13. For adjustment purposes later to be shown and as best seen in Figure 6, the housing 22 is slideable vertically of the slide 13 in gibs 23 which are secured to the slide by means of bolts 24. The lower portion of housing 22 is apertured at 25 and threaded internally to receive the reduced end of a respective adjusting screw 19.

The upper portion of housing 22 is formed with a downwardly extending recess or bore 26 in which a piston 27 is slideable. Means are provided for maintaining piston 27 in its bore and such means presently comprises a ring-like member 28 engageable with the piston in the

position shown and secured to the upper surface of the housing by means of bolts 29. The top of piston 27 is recessed to receive the lower end of a link 17, the link and the piston being pivotally secured together by means of a pin 30 (see also Figure 4).

The lower end of the piston 27 is formed to provide a shoulder for receiving a packing ring 31 of leather or the like which, in the present embodiment, is generally U-shaped in cross-section as shown. A retainer plate 32 is secured to the piston by bolts 33, this plate serving to hold the packing in place and having an annular upstanding ridge 34 which is adapted to seat in the bight formed by the U-shaped packing ring. A plurality of conduits are formed in the retainer plate 32 and in the ridge 34 forming a part thereof for venting pressure to the interior of the packing ring 31 from the chamber 35 formed between the bottom of the bore 26 and the piston 27 so as to effect expansion of the packing ring to reduce leakage therepast.

Housing 22 is also formed with a recess 36 in which a plunger 37 is shiftable, the recess preferably being enlarged at 38 to receive a packing ring 39, a retainer ring 40 and a compression member or nut 41 which is threaded into a further enlargement of the bore 36. Packing ring 39 is similar to packing ring 31 heretofore described and the retainer ring 40 is apertured in manner similar to retainer plate 32 in order to vent fluid pressure to the interior of the packing ring to reduce leakage therepast.

As herein disclosed, plunger 37 extends outwardly of the housing 22 and has a portion 42 to which is secured, by welding or other suitable means, an enlarged piston 43 reciprocable within a cylinder 44 provided by a cup-shaped member 45 which is secured to the housing 22 by means of bolts 46 (see also Figure 2). Plunger 37 also has a portion 47 which extends through an aperture 48 in the end wall 49 of the member 45 for a purpose to be disclosed. A packing ring 50 is carried by end wall 49 and a packing ring 51 is carried by piston 43 for sealing purposes as will be clear.

Still refering to Figure 3 and for a purpose later to be disclosed, piston 27 is provided with an annular groove 52 which is in communication with the portion of cylinder 44 on the right side (in the position of parts shown) of piston 43 through a conduit 53 formed in the housing 22. A conduit 54 also leads from the right-hand end of cylinder 44 to a threaded aperture 55 provided in the housing 22 for a purpose to appear.

Housing 22 is also provided with a conduit 56 which connects chamber 35 with recess 36; a conduit 57 which leads from recess 36 to a threaded aperture 58 (see also Figures 4 and 6); and, a drain conduit 59 which leads from recess 36 and is closed by a suitable plug 60 (see Figure 4).

As best shown in Figure 4, a threaded aperture 61 is provided in housing 22 and this aperture communicates with chamber 35 through a conduit 62 and a check valve 63. Check valve 63 may take any suitable form and it is herein shown to comprise (see Figure 5) a hollow casing 64 threaded into a recess in the housing 22 and containing a ball 65 which normally rests upon a seat 66. An apertured plug 67 is threaded into the casing 64 to prevent escape of the ball 65 from the casing 64.

Returning once again to Figure 3, member 45 is provided with a threaded aperture 68 which communicates with the left-hand end of cylinder 44 and also is provided with a drain aperture 69 which is adapted to be closed by a suitable plug, or drain cock, 70. For a purpose to become clear, a conduit 71 is formed in the housing 22 (see Figure 6) and such conduit establishes communication between the right-hand end of cylinder 44 and the atmosphere.

As illustrated in Figures 2, 3 and 6, a bracket structure 72 is secured to the end wall 49 of the member 45 by any suitable means and supports a limit switch 73 which has an actuator 74 so positioned that it will be engaged with portion 47 of plunger 37 when the plunger and its associated parts move to the dot-dash line position shown in Figure 3. Limit switch 73 is adapted to be electrically connected into the drive motor circuit or into the control of a clutch which effects operation of the press so as to stop the press when the limit switch is actuated by the plunger portion 47 when the latter is in the dot-dash line position shown in Figure 3.

Referring now to Figure 7 wherein a device 21 is generally diagrammatically shown connected with various circuits, it will be seen that compressed air from any suitable source is adapted to communicate with the left-hand side of cylinder 44 through aperture 68 via a surge tank 75, a check valve 76 and a pressure regulator valve 77. The volume of surge tank 75 will preferably be so proportioned relative to cylinder 44 that movement of piston 43 will not appreciably vary the pressure of the air within the tank.

Compressed air is also adapted to fill the upper portion of a tank 78 which has its lower portion filled with a suitable hydraulic oil or liquid. A suitable line 79 connects the lower part of tank 78 with chamber 35 through check valve 63, conduit 62 and aperture 61.

A drain tank, or sump, 80 is positioned below device 21 and a line 81 establishes communication between this sump and the right-hand end of cylinder 44 through conduit 54 and aperture 55. Additionally, communication between the interior of the sump and recess 36 in housing 22 is established via a suitable line 82 and through a pressure relief valve 83, aperture 58 and conduit 57.

The lower portion of sump 80 is connected with the interior of tank 78 through a line 84 in which is interposed a suitable pump 85. Pump 85 is adapted to be driven by an electric motor or the like whose operation is controlled by a suitable float switch 86 secured to the sump 80.

While Figure 7 illustrates but a single device 21 and its associated parts, it is to be understood that each device 21 will be similarly arranged. However, duplication of all the external circuit apparatus is unnecessary. While each device 21 will preferably have its own surge tank 75, check valve 76, regulator valve 77 and pressure relief valve 83, only one tank 78, pump 85 and sump 80 is required. It will be appreciated, however, that each device 21 will be connected in circuit as shown in Figure 7.

Setting up a press equipped with the present invention will be as follows: With tank 78 (or tanks if more than one is employed) connected to a suitable source of air pressure and with air pressure on the left side of piston 43 to hold it in the position shown, oil will be forced into each of the chambers 35 past the check valve 63 provided by the respective devices 21. Although not shown, a vent may be provided so that air may be bled from the lines to insure that all parts of the system are filled with oil.

The press will then be operated until slide 13, that is, the slide which carries the blankholder, is at its lowermost position. Each of the screws 19 will then be adjusted, by means of the nuts 20, so as to space the blankholder ring 14 from the die 12 a distance somewhat less than the thickness of the material or blank to be drawn. It it to be understood that this spacing should be less than the thinnest blanks to be drawn for a purpose to appear. It is also to be understood that the above described screw setting is not critical nor need each screw be set identically, it is only necessary that the spacing between the blankholder ring and the die be sufficiently less than the thickness of the material so that adequate pressure wil be developed on the blank when the slide descends.

After setting up the press in the manner described, the slide 13 will be retracted and each valve 77 set to admit

only enough pressure to the cylinder 44 to permit the minimum blankholder pressure to be attained. A blank will then be positioned on the die and the press then operated through a complete drawing cycle. Assuming that inspection of the drawn article discloses that the blankholder pressure is insufficient, valves 77 need only be readjusted to increase the air pressure admitted to each cylinder 44 until inspection of the drawn article discloses that the blankholder pressure is adequate to prevent wrinkling of the material. The requisite air pressure thus located by trial will then be noted on a suitable gauge (not shown) so that future setups can be quickly and accurately effected when it is desired to duplicate the job, without resorting to the trial procedure described.

In normal operation and with the parts positioned as shown in Figures 3 and 7, the blankholder slide will descend (with practically no relative movement of the parts comprising respective devices 21) until piston 27 develops sufficient pressure within the oil-filled chamber 35 and upon the plunger 37 to overbalance the air pressure exerted upon piston 43. When this point is reached, piston 43 will move to the left and piston 27 will move down an amount sufficient to permit the mechanism which operates the slide to reach its maximum down stroke. However, this overtravel of the press mechanism will not increase the pressure exerted upon the blank since the devices 21 absorb such overtravel.

It is to be understood that under normal conditions, piston 43 will move to the left from the position shown only a fraction of an inch. However, in the event an abnormally thick blank or more than one blank is fed to the press, piston 43 will be deflected further to the left and piston 27 will move down further in attempting to prevent excessive pressure from being exerted upon the blank. When piston 43 has been moved sufficiently far to the left to reach the dot-dash line position shown in Figure 3 (by the movement of piston 27 in reaching its dot-dash line position), portion 47 of the plunger 37 will engage the actuator 74 of limit switch 73. Movement of the actuator of switch 73 will immediately stop the press since the switch will interrupt the application of power thereto by disengaging the clutch through which the press is driven.

If for any reason switch 73 fails to operate and excessive pressure is exerted by the slide 13, relief valve 83 will operate to allow fluid to escape from chamber 35 to sump 80 and thus allow piston 27 to move down beyond its dot-dash line position. It is to be understood that each relief valve 83 is set to pass fluid when the pressure exerted by the slide is just below the point at which the die or the press will be damaged. Accordingly, valves 83 will not operate under normal conditions but will serve to protect both the press and the die in the event the press is operated improperly or carelessly and in the event an operator attempts to exceed the capacity of the press.

As soon as the blank has been pulled from between the blankholder ring and the die as a result of the drawing operation, the pressure within cylinder 44 will move piston 43 to the full line position shown in Figure 3 and such movement will cause piston 27 to move to the full line position shown. Additionally, in the event fluid has been lost from chamber 35 during the preceding press operation, the pressure of the oil in tank 78 will immediately force sufficient oil past check valve 63 and into chamber 35 to completely fill the chamber in preparation for the next cycle of the press.

From the foregoing it will be evident that since a device 21 is employed at each corner of the blankholder slide 13, each corner of the slide will exert an equal pressure upon the blank (assuming, of course, that each of the regulator valves is set to maintain the same pressure in each of the cylinders 44). Moreover, by simply varying the pressure between the cylinders 44, different pressures will be exerted at different portions of the blank (this is sometimes desirable when drawing certain shapes).

During prolonged operation of any high pressure hydraulic system, packing leakage is inevitable. Accordingly, means have been provided to accumulate any leakage and return it to the system. Any oil which leaks beyond packing 31 is collected in the annular groove 52 formed in the piston 27 from where it can flow through conduit 53 to the right side of piston 43. From here the oil can flow down conduit 54 to line 81 (see Figure 7) and to the sump 80.

Operation of the sump 80 and its associated parts is as follows: When the oil within the sump has been raised to a given level, either by leakage as before described or by release of fluid from chambers 35 past the pressure relief valves 83, the float contained within the sump will be raised and switch 86 thereby actuated to energize the drive motor (not shown) of pump 85. Operation of pump 85 will pump oil from the sump to tank 78 until the float drops sufficiently to once again actuate switch 86 to de-energize the pump drive motor.

In view of the foregoing it will be apparent to those skilled in the art that I have accomplished at least the principal object of my invention and it will also be apparent to those skilled in the art that the embodiment herein described may be variously changed and modified, without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described, hence it will be appreciated that the herein disclosed embodiment is illustrative only, and that my invention is not limited thereto.

I claim:

1. In a double action press, the combination of a press frame supporting a fixed part of a draw die, a blankholder slidably carried by said frame for reciprocation toward and away from said fixed die part, said blankholder being operable to clamp a work blank between it and said fixed die part during drawing operations of said press, a first liquid cylinder fixedly carried by said blankholder, drive means including a mechanical member for reciprocating said blankholder and carrying a first piston working in said cylinder for displacing fluid therefrom by movement of said piston relative to said cylinder when said blankholder exceeds predetermined pressure engagement with the work blank on said fixed die part, a second liquid cylinder in communication with said first cylinder for receiving fluid displaced from said first cylinder, a second piston within said second cylinder and moved therein by fluid displaced from said first cylinder, a third piston rigidly connected to said second piston and movable therewith, said third piston working in an air cylinder, an air storage tank, valve means for controlling delivery of air under pressure to said air storage tank, a conduit for delivering air from said air storage tank to said air cylinder, the volume of said air storage tank being considerably larger than the volume of said air cylinder whereby movement of said third piston in said air cylinder does not appreciably vary the pressure of air in said air storage tank, and control means operated when said third piston has moved a predetermined amount to stop operation of said drive means.

2. In a double action press, the combination of a press frame supporting a fixed part of a draw die, a blankholder slidably carried by said frame for reciprocation toward and away from said fixed die part, said blankholder being operable to clamp a work blank between it and said fixed die part during drawing operations of said press, a first liquid cylinder fixedly carried by said blankholder, drive means including a mechanical member for reciprocating said blankholder and carrying a first piston working in said cylinder for displacing fluid therefrom by movement of said piston relative to said cylinder when said blankholder exceeds predetermined pressure engagement with the work blank on said fixed die part, a second liquid cylinder in communication with

said first cylinder for receiving fluid displaced from said first cylinder, a second piston within said second cylinder and moved therein by fluid displaced from said first cylinder, a third piston rigidly connected to said second piston and movable therewith, said third piston working in an air cylinder, an air storage tank, valve means for controlling delivery of air under pressure to said air storage tank, a conduit for delivering air from said air storage tank to said air cylinder, the volume of said air storage tank being considerably larger than the volume of said air cylinder whereby movement of said third piston does not appreciably vary the pressure of air in said air storage tank, a rod connected to said third piston and extending outwardly of said air cylinder, and switch means for controlling operation of said drive means, said

switch means being engaged and operated by said rod to stop operation of said drive means when said second and third pistons have been moved a predetermined amount by fluid displaced from said first cylinder.

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