United States Patent

[11] 3,570,521

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[21] Appl. No. **796,344**
[22] Filed **Feb. 4, 1969**
[45] Patented **Mar. 16, 1971**
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[54] **DUAL PRESSURE RANGE VALVE**
1 Claim, 6 Drawing Figs.

[52] **U.S. Cl.** **137/113,** 91/32, 137/112
[51] **Int. Cl.** **G05d 16/04**
[50] **Field of Search** ..... 121/150; 137/108, 102, 113, 111, 112; 303/71 (310), 4—6; 91/31, 32 (X)

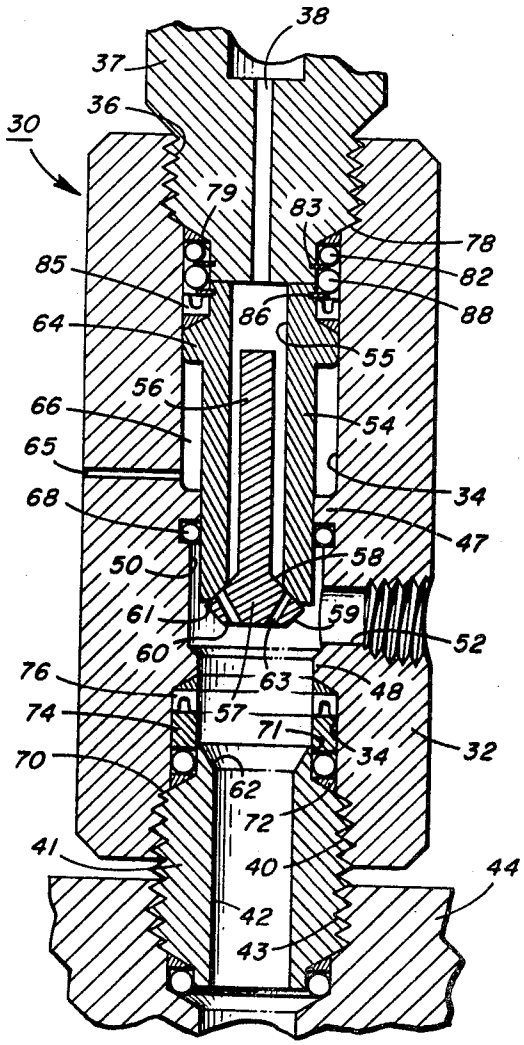
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ABSTRACT: Dual pressure range valve for alternately providing high pressure and low pressure fluid over a single line, the valve including a body having a high pressure fluid inlet port and a low pressure fluid inlet port, both the inlet ports being alternately communicable with a fluid outlet port. Communication of the fluid outlet port with the high pressure or low pressure fluid inlet port is established by the positioning of reciprocable means mounted within the valve body.



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2 Sheets-Sheet 1

FIG. 1

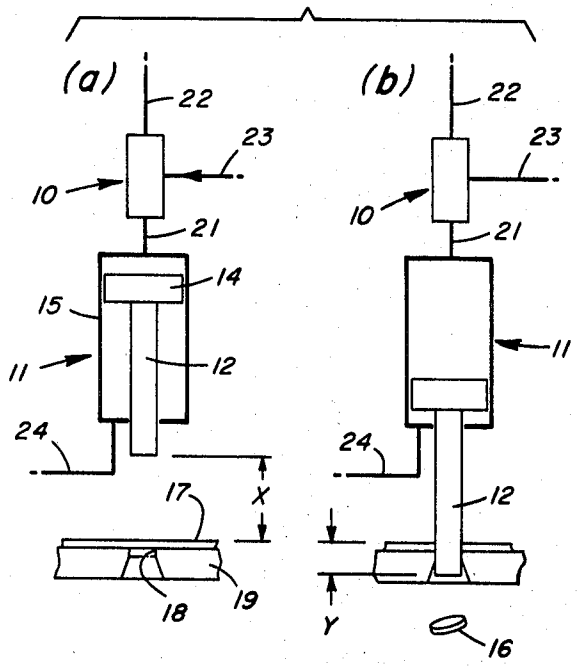
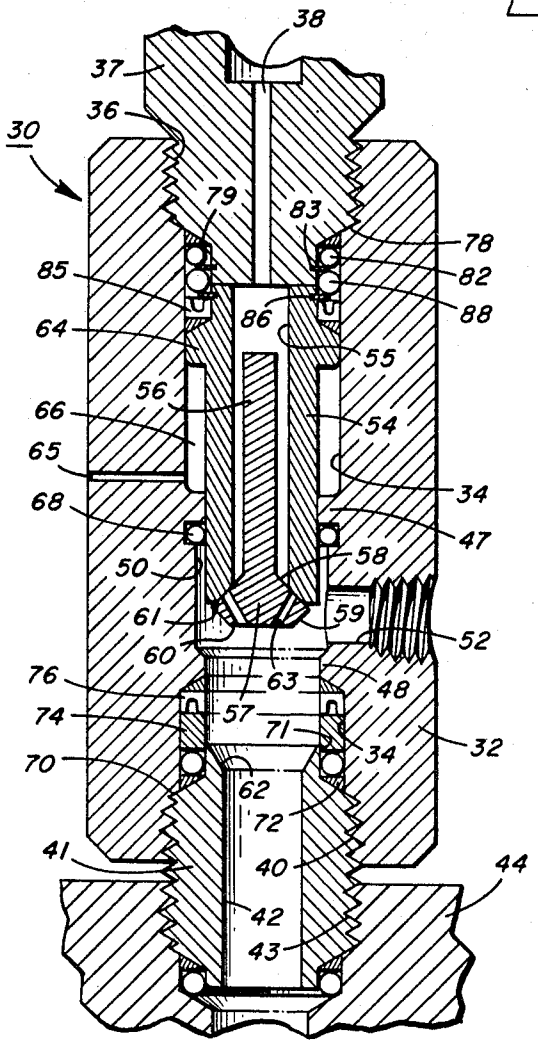


FIG. 2



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FIG. 3

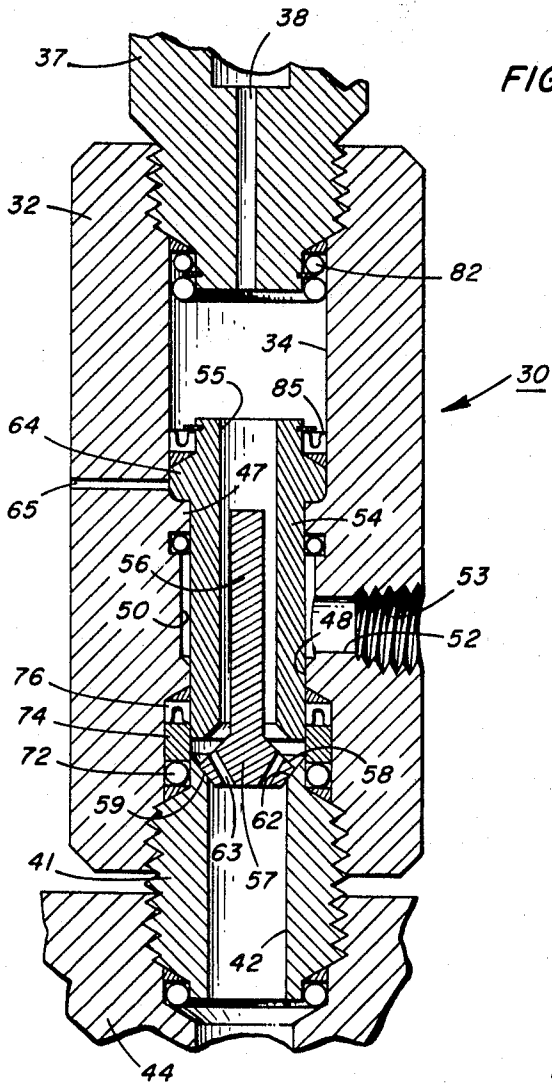
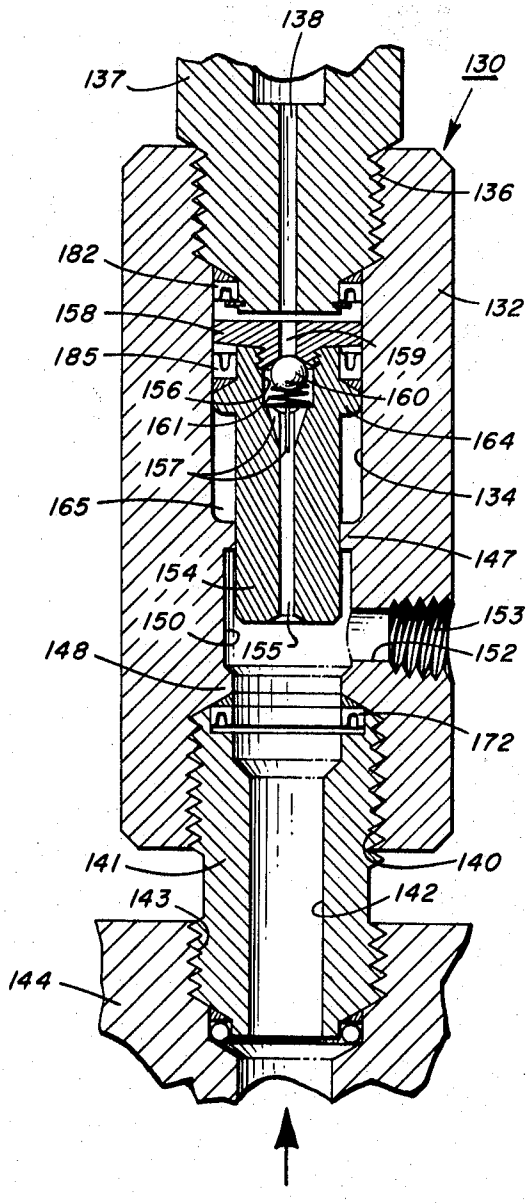

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FIG. 4


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DUAL PRESSURE RANGE VALVE

BACKGROUND OF THE INVENTION

It is often an operational requirement of various types of machinery that components thereof be moved, not under load, for relatively long distances and thereafter be moved, under load, for relatively long distances and thereafter be moved, under load, for relatively short distances. Typical of such machinery is a punch press for forming holes in a blank of material. Such a press ordinarily operates subject to a cycle which includes the steps of advancing a ram from a remote position to a punching position, accomplishing the punching operation, and retracting the ram to the remote position to facilitate removal of the punched blank and insertion of an unpunched blank for the next punching cycle. The advancing and retracting steps require the unloaded ram to be displaced relatively long distances under a relatively light load, whereas the punching step requires that the ram be displaced a relatively short distance, but under a relatively heavy load.

Conventional apparatus for powering such low load long distance and high load-short distance travel of machine components ordinarily comprise hydraulic systems which provide a high volume of low pressure fluid and low volume of high pressure fluid to the machinery being served. In some apparatus the high pressure and low pressure fluids are introduced to the served machinery through separate fluid systems. Other apparatus introduce a high volume of high pressure fluid to the served apparatus, whereafter the pressure of a great portion of the fluid is reduced for providing the necessary high volume of low pressure fluid.

The former approach, i.e. separately introduced high and low pressure fluids, has been found to be undesirable since the served machinery must be structured to accommodate each of the separately introduced high and low pressure fluids. The latter approach, i.e. the introduction of a large volume of high pressure fluid, also has been found to be undesirable in that the provision of such a large volume of high pressure fluid is fundamentally inefficient and difficult to accommodate, and the subsequent pressure reduction requires complex apparatus. Accordingly, those skilled in the art have directed their attention to providing fluid, at high or low pressures as required, to machinery being served through a single source line.

The provision of fluid, at high or low pressures from separate pressure sources to a common fluid line requires, at some point in the system, a valve which is capable of controlling the flow of fluid from the separate pressure source to the common fluid line in accordance with the needs dictated by the operating requirements of the machine to be served. The present invention embodies such a valve.

SUMMARY OF THE INVENTION

The present invention overcomes the aforementioned prior art problems by the provision of a dual range pressure valve which facilitates the alternate provision of high pressure fluid and low pressure fluid through a single fluid line to a machine being served, a dual pressure range valve embodying the present invention may include a body having a high pressure fluid inlet port and a low pressure fluid inlet port, which ports are alternately communicable with a fluid outlet port.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the dual pressure range valve of the present invention may be had from the following detailed description thereof, particularly when considered in the light of the attached drawings wherein:

FIGS. 1*a*, *b* and *c* are schematic views of the operation of a hydraulically operated press ram, fluid for the operation of which is provided through a dual pressure range valve according to the present invention;

FIG. 2 is a cross-sectional, elevational view of a dual pressure range valve according to the present invention, the valve elements being shown in alignment for low pressure fluid flow;

FIG. 3 is a cross-sectional, elevational view similar to that of FIG. 2, but showing the valve elements in alignment for high pressure fluid flow; and

FIG. 4 is a cross-sectional, elevational view similar to that of FIG. 2, but of an alternate embodiment of a dual pressure range valve structured in accordance with the teaching of the present invention.

DETAILED DESCRIPTION

The dual pressure range valve of the present invention may be used in any hydraulic system wherein high pressure fluid from one source and low pressure fluid from a second source must be provided alternately through a single fluid line. Many hydraulically operated machines have such a requirement, typical of such machines being punch presses which are used for punching holes in metal blanks. Accordingly, the dual pressure range valve of the present invention will be described below in use with such a machine for purposes of illustration, it being recognized that the valve may be used with many other machines having similar hydraulic fluid requirements.

Referring therefore to FIG. 1 1*a*, a dual pressure range valve, designated generally by the reference numeral **10**, is shown in use with a conventional punch press designated generally by the reference numeral **11**. The punch press **11** is provided with a punching ram **12** having a piston **14** mounted on one end thereof, the piston **14** being reciprocably received in a fluid pressure cylinder **15**. The lower surface of punch ram **12** serves as a punch for punching a circular disc **16**, FIG. 1*b*, from a blank plate **17**. The punching of disc **16** is accomplished through a suitable opening **18** formed in a die plate **19** which also serves to support the blank **17**.

Dual pressure range valve **10** is in fluid communication with vessel **15** through a connecting fluid line **21** which extends from an outlet port of valve **10**, as will be described in detail below, to the chamber of the vessel **15** which is above piston **14** as seen in FIG. 1. Thus, fluid passed through line **21** into vessel **15** will tend to displace piston **14**, and therewith punch ram **12**, downwardly. Valve **10** is also connected to a high pressure fluid line **22** which leads from a source of high pressure fluid (not shown), and a low pressure fluid line **23** which leads from a source of low pressure fluid (not shown).

In FIG. 1*a*, punch ram **12** is shown in a retracted position for facilitating the positioning of a blank **17** on die plate **19** prior to punching. Once the blank **17** is suitably positioned, a high volume of low pressure fluid is admitted through fluid line **23**, valve **10** and connecting line **21** to vessel **15** above piston **14** so as to rapidly advance punch ram **12** through distance *x* to a position of surface-to-surface contact with blank **17**. The punch ram **12** advances only to this surface-to-surface contact position since the pressure available in the low pressure fluid system, while adequate for rapidly displacing and positioning the punch ram when not under load, is not sufficient to accomplish the punching operation.

Punching, as shown in FIG. 1*b*, is accomplished by introducing a small volume of high pressure fluid from high pressure fluid line **22** through valve **10** and connecting line **21** into vessel **15** above piston **14**. The pressure of the fluid from line **22** introduced into vessel **15** is sufficient to generate the required force to punch the disc **16** from blank **17**, and the volume of high pressure fluid supplied is sufficient to displace ram **12** through a distance *y* to both punch and clear disc **16** through opening **18** in die plate **19**.

After punching is completed, punch ram **12** is retracted FIG. 1c, to facilitate removal of the punched blank. Retraction is accomplished by the introduction of low pressure fluid through a low pressure fluid line **24** which communicates with vessel **15** below piston **14**. Fluid pressure above piston **14** in vessel **15** is relieved by relieving the pressures in both the high pressure fluid line **22** and the low pressure fluid line **23** thereby allowing the piston **14** and therewith punch ram **12** to be displaced upwardly within vessel **15** through the distance *z* as shown in FIG. 1*c*. At this stage, punch press **11** is in position to repeat the punching cycle.

Clearly, therefore, a machine such as punch press 11 is a prime example of hydraulic equipment with which the dual pressure range valve of the present invention is particularly useful. One embodiment of such a valve is shown in FIGS. 2 and 3 and designated generally by the reference numeral 30. Valve 30 is shown in FIG. 2 with its components aligned for passing a high volume of low pressure fluid therethrough.

Dual pressure range valve 30 comprises a body 32 having a bore 34 extending longitudinally axially therethrough. One end of bore 34, the upper end as seen in FIG. 2, is provided with a threaded counterbore 36 for receiving a high pressure connector plug 37. Connector plug 37 is provided with an axially extending bore to define a first inlet port 38 through which high pressure fluid is introduced to valve 30 from a suitable source (not shown). The other end of bore 34, the lower end as seen in FIG. 2, is provided with a threaded counterbore 40 which is for threadedly receiving a connector 41. Connector 41 is provided with a longitudinally axially extending bore to define an outlet port 42 for accommodating the passage of high or low pressure fluids from valve 30. Connector 41 may be secured directly to the inlet orifice 43 of a machine 44 to be served, e.g. the punch press 11 of FIG. 1, or it may be secured to a suitable high pressure fluid line (not shown).

A pair of axially spaced, radially inwardly extending annular shoulders 47, 48 are formed on the inner surface of bore 34. Shoulders 47, 48 cooperate to define a central bore portion 50 from which a passage 52 extends radially through valve body 32. The outer end of passage 52 defines a second inlet port 53 (FIG. 3) to valve 30, and is provided with threads for accommodating the connection thereto of a suitable source of a high volume of low pressure fluid (not shown).

Slidably mounted within bore 34 is a check piston 54 having a bore 55 extending longitudinally axially therethrough. Axially slidably received within bore 55 is a check stem 56, the diameter of which is slightly smaller than the diameter of bore 55 so as to allow the free flow of fluid therebetween. The lower end of check stem 56 (as seen in FIG. 2) is provided with a flared plug 57 having an upper conical surface 58, a lower conical surface 59, a flat bottom surface 60 and a plurality of passages 63 extending therethrough from upper conical surface 58 to flat bottom surface 60. When valve 30 is aligned for low pressure, high volume flow, as shown, upper conical surface 58 is engageable with a complementary tapered surface 61 formed in the lower end of bore 55 thereby closing passages 63 so as to preclude the flow of fluid upwardly through bore 55. When valve 30 is aligned for high pressure, low volume flow, as shown in FIG. 3, the lower conical surface 59 of plug 57 is engageable with a complementary tapered surface 62 formed in the upper end of port 42 in threaded connector 41 thereby opening passages 63 so as to allow the flow of high pressure fluid downwardly through bore 55. Thus, check stem 56 with its associated plug 57 cooperates with tapered surface 61 of check piston 54 to define a stem check valve in check piston 54 for permitting the flow of fluid from the inlet port 38 to outlet port 42 during high pressure, low volume operation, while precluding a reverse flow of fluid from outlet port 42 to inlet port 38 during low pressure, high volume operation. Formed adjacent the upper end of check piston 54 is a radially outwardly extending shoulder 64. The diameter of shoulder 64 is substantially equal to the diameter of bore 34 so as to provide a surface-to-surface sliding fit therebetween. The chamber 66 defined by the outer surface of check piston 54, bore 34, the lower surface of shoulder 64 and the upper surface of shoulder 47 is vented to the atmosphere through a suitable passage 65 which extends radially outwardly through valve body 32 from a point just above shoulder 47. Such venting is provided to preclude a build up in pressure below shoulder 64, which build up would otherwise tend to retard the displacement of check piston 54 from low pressure, high volume alignment (FIG. 2), to high pressure, low volume alignment (FIG. 3).

As was noted above, check piston 54 is slidably mounted in bore 34 and is reciprocable between an upper position (FIG. 2) for accommodating high volume, low pressure fluid flow, and a lower position (FIG. 3) for accommodating low volume, high pressure fluid flow. Referring to FIG. 3, therefore, it can be seen that check piston 54 has been moved downwardly within bore 34 such that the lower surface of shoulder 64 of check piston 54 is in abutting engagement with the upper surface of shoulder 47 of bore 34. Additionally, stem 56 is shown as having moved downwardly within bore 55 of check piston 54 so that the lower conical surface 59 of plug 57 is in engagement with the tapered surface 62 of bore 42 in threaded connector 41. With the stem 56 and plug 57 in this position, passages 63 in plug 57 are uncovered so as to allow the free passage of fluid therethrough from bore 55 of check piston 54 to bore 42 of connector pipe 41.

The leakage of fluid from the desired fluid flow paths within valve 30 during the operation thereof is prevented by the provision of a series of seals mounted within the valve structure, some of which are operative during both high and low pressure operation of the valve, and some of which are operative only during high pressure operative of the valve.

Considering initially the alignment of elements and sealing arrangement for accommodating a low pressure, high volume flow of fluid (FIG. 2), check piston 54 is in its uppermost position so as to be in surface-to-surface contact with the lower surface of connector plug 37. Check stem 56 is also in its uppermost position such that the upper conical surface 58 of flared plug 57 is in surface-to-surface engagement with the complementarily tapered surface 61 on the lower end of bore 55 of check piston 54. With check stem 56 in this position, it can be seen that there is a sealing engagement between the flared plug 57 and check piston 54 so as to preclude the free passage of fluid through passages 63 in flared plug 57.

An annular channel for receiving a low pressure seal 68 is formed in central bore 50 immediately below annular shoulder 47. Low pressure seal 68 cooperates with the outer surface of check piston 54 to preclude the passage of low pressure fluid upwardly around check piston 54 into chamber 66.

Connector 41 is provided on its upper end with a conically tapered surface 70 which extends radially inwardly and upwardly from the threaded surface thereof to a reduced diameter portion 71. Tapered surface 70 and the reduced diameter portion 71 of connector 41 cooperate with bore 34 in body 32 to define an annular channel for receiving a high pressure seal 72 (FIG. 3) comprising a soft O-ring seal and a tapered antiextrusion ring which may be of any known suitable material such as beryllium copper.

Spaced axially above high pressure seal 72 by a cylindrical spacer element 74 is another high pressure seal 76 which comprises a soft U-shaped seal and a tapered antiextrusion ring. As will be recognized by those skilled in the art, the soft seal of high pressure seal 76 is U-shaped as distinguished from the soft O-ring seal of high pressure seal 72 in that high pressure seal 76 is subject to the reciprocation of check piston 54 therethrough while under load, which reciprocation is better accommodated by a U-shaped soft seal than by an O-ring soft seal. The tapered surface of the antiextrusion ring of high pressure seal 76 bears against the lower generally radially extending surface of annular shoulder 48, which surface is provided with a taper which complements that of the antiextrusion ring.

As can be seen from FIG. 2, therefore, when valve 30 is aligned for high volume low pressure flow, passage of fluid upwardly around check piston 54 is prevented by low pressure seal 68, passage of fluid downwardly around connector 41 is prevented by high pressure seal 72 (FIG. 3), and passage of fluid upwardly through bore 55 of check piston 54 is prevented by the firm seating of surface 58 (FIG. 2) of plug 57 against the tapered surface 61 of check piston 54.

In the same manner as described above with respect to connector 41, high pressure connector plug 37 is provided with a tapered surface 78 which extends radially inwardly and downwardly from the threaded surface of plug 37 to a reduced diameter portion 79 formed on the lower end of plug 37.

Tapered surface 78 and the reduced diameter portion 79 of plug 37 cooperate with bore 34 in body 32 to define an annular channel for receiving a high pressure seal 82 comprising a soft O-ring seal and a tapered antiextrusion ring. High pressure seal 82 is retained in position by a spring ring 83 which is mounted in a suitable annular channel formed in the reduced diameter portion 79 of plug 37.

The upper surface of radial shoulder 64 of check piston 54 is provided with a taper for receiving, in surface-to-surface engagement, the tapered surface of the antiextrusion ring of a high pressure seal 85, which also includes a U-shaped soft seal of the type used in high pressure seal 76. Seal 85 is secured in position by a spring ring 86 mounted in a suitable annular channel formed in the outer surface of check piston 54.

Between high pressure seal 82 and high pressure seal 85 there is provided an additional O-ring 88 which maybe made of any resilient material. O-ring 88 acts as a shock absorber between the two high pressure seals to soften the impact of check piston 54 rising from the lower volume, high pressure flow position of FIG. 3 to the high volume, low pressure flow position of FIG. 2.

Referring to FIG. 3, it can be seen that check piston 54 is in its lowermost position thus aligning valve 30 for low volume high pressure flow. In this configuration, the high pressure fluid which is introduced through first inlet port 38 of connector plug 37 into the bore 34 of valve body 32, is prevented from passing out of the valve around connector plug 37 by high pressure seal 82. Similarly, the leakage of high pressure fluid around the radial shoulder 64 of check piston 54 is prevented by high pressure seal 85. Thus, high pressure fluid passes into valve 30 through first inlet port 38, through bore 34 of body 32 into and through bore 55 of check piston 54. Thereafter the high pressure fluid passes through passages 63 in plug 57 into the bore of connector 41 for further passage to a machine to be served, It can be seen that during the flow of high pressure fluid through valve 30, cylindrical spacer element 74 is exposed to the high pressure fluid and that the leakage of high pressure fluid upwardly past check piston 54 or downwardly past connector 41 is prevented by high pressure seals 76 and 72 respectively. Thus, the entire path of high pressure fluid through valve 30 is sealed against leakage either out of the valve or into the low pressure fluid system through radial passage 52.

Considering now the operation of dual pressure range valve 30 in conjunction with a machine to be served 44, which may be the punch press 11 of FIG. 1, valve 30 is initially secure to suitable sources of high and low pressure fluid and to the machine to be served 44. Thereafter, a high volume flow of low pressure fluid is introduced into valve 30 through second inlet port 53 whereafter it passes downwardly through bore 34 in body 32 and outlet port 42 in connector 41 into the machine 44 to be served. If machine 44 is a punch press such as punch press 11 of FIG. 1, sufficient low pressure fluid will be provided to displace piston 14, and therewith punching ram 12 from the retracted position shown in FIG. 1*a* to the position (not shown) in which punching ram 12 is in surface-to-surface contact with blank 17, i.e. through a distance x as shown in FIG. 1*a*.

When the high volume of low pressure fluid passing through valve 30 has accomplished its function, e.g. the downward displacement of piston 14, high pressure fluid is introduced to valve 30 has accomplished its function, e,g, the downward displacement of piston 14, high pressure fluid is introduced to valve 30 through first inlet port 38 in high pressure connector plug 37 from a high pressure fluid source (not shown). The force of the high pressure fluid displaces check piston 54 and therewith check stem 56 downwardly from the position shown in FIG. 2 to the position shown in FIG. 3. More specifically, check piston 54 is displaced downwardly until the lower surface of radial shoulder 64 abuts the upper surface of annular shoulder 47. Check stem 56 is displaced downwardly until the lower conical surface 59 of flared plug 57 seats on the tapered surface 62 of connector 41. With the check piston 54 and check stem 56 in these positions, the upper conical surface 58 of flared plug 57 is axially displaced from the tapered surface 61 in the lower end of check piston 54 so as to allow the free passage of high pressure fluid therebetween.

With the dual pressure range valve 30 aligned as shown in FIG. 3, therefore, high pressure fluid passes into the valve through first inlet port 38 in plug 37, into bore 34 and through bore 55 in check piston 54, through passages 63 in plug 57 and out of valve 30 into the machine to be served 44 through outlet port 42 in connector plug 41.

If the machine to be served is the punch press 11 of FIG. 1, sufficient high pressure fluid is provided to displace piston 14 and advance punching ram 12 through the distance *y* as shown in FIG. 1*b* so as to cause the punching ram 12 to penetrate the blank 17 and punch out a disc 16 therefrom. Upon completion of the high pressure punching operation, low pressure fluid is introduced to the underside of piston 14 through low pressure fluid line 24. The high pressure then being relieved in the fluid above piston 14, the piston and therewith the punching ram is caused to retract, i.e. to be displaced upwardly through a distance z FIG. 1*c*, from the position shown in FIG. 1*b* to that shown in FIG. 1*c*. If the valve 10 in use with punch press 11 during the retraction of piston 14 is a dual pressure range valve 30 structured in accordance with the teaching of the present invention, the flow of fluid from the machine being served back through outlet port 42 in connector 41 causes check stem 56 to be displaced upwardly against check piston 54 so as to seal bore 55 against the passage of fluid therethrough. Thereafter, check stem 56 and check piston 54 are displaced upwardly together from the position shown in FIG. 1 to the position shown in FIG. 2 so as to uncover radial passage 52 to allow passage of the fluid from valve 30, through second inlet port 53 back into the low-pressure fluid system. With check piston 54 now in the upward position, valve 30 is again in proper alignment for commencing another cycle of the machine to be served.

Referring now to FIG. 4, there is shown another embodiment of a dual pressure range valve structured in accordance with the present invention and designated generally by the reference numeral 130. Valve 130 is substantially exactly the same as valve 30 of FIGS. 2 and 3 with three exceptions: first, valve 130 utilizes a ball check valve structure in place of the stem check valve structure used with the check piston 54 of valve 30; there is no low pressure seal to preclude the passage of low pressure fluid upwardly around the check piston of valve 130, into chamber 165; and, there is no provision for venting the bore of valve 130, which venting is accomplished by vent passage 65 of valve 30.

Considering the structure of valve 130 in greater detail, it can be seen to comprise a body 132 having a bore 134 extending longitudinally axially therethrough. One end of bore 134, the upper end as seen in FIG. 4 is provided with a threaded counterbore 136 for receiving a high pressure connector plug 137. Connector plug 137 is provided with an axially extending bore to define a first inlet port 138 through which high pressure fluid is introduced to valve 130 from a suitable source (not shown). The other end of bore 134, the lower end as seen in FIG. 4, is provided with a threaded counterbore 140 which is for threadedly receiving a connector 141. Connector 141 is provided with a longitudinally axially extending bore to define an outlet port 142 for accommodating the passage of high or low pressure fluids from valve 130. Connector 141 may be secured directly to the inlet orifice 143 of a machine 144 to be served, e.g. the punch press 11 of FIG. 1 or it may be secured to a suitable high pressure fluid line (not shown).

A pair of axially spaced, radially inwardly extending annular shoulders 147, 148 are formed on the inner surface of bore 134. Shoulders 147, 148 cooperate to define a central bore portion 150 from which a passage 152 extends radially through valve body 132. The outer end of passage 152 defines a second inlet port 153 to valve 130, and is provided with threads for accommodating the connection thereto of a suitable source of a high volume, low pressure fluid (not shown).

Slidably mounted within bore 134 is a check piston 154 having a bore 155 extending longitudinally axially therethrough. Bore 155 is provided at its upper end with a counterbore 156, the top portion of which is threaded and the bottom portion of which is provided with a plurality of radially oriented tapered slots 157 for communicating counterbore 156 with bore 155 as is discussed below. Threadedly received in the upper end of counterbore 156 is a flange 158, the major diameter of which is substantially equal to the diameter of bore 134. Flange 158 is provided with an axially extending bore 159 therethrough which cooperates with counterbore 156 to define a cage for containing a ball check 160. Ball check 160 is of a diameter greater than bore 159 but less than the diameter of counterbore 156 and is normally urged upwardly by the bias of a spring 161 mounted in counterbore 156 below ball check 160. This being the case, ball check 160 when positioned in its uppermost position as shown in FIG. 4 in solid lines, precludes the passage of fluid upwardly through bores 155 and 156 into bore 159. When ball check 160 is displaced downwardly against the bias of spring 161 to its lower position, (e.g., to a position located in the lower part of the counterbore 156) fluid is free to pass from bore 159 and through counterbore 156 into bore 155 through slots 157. Thus, ball check 160 defines a check valve which permits the passage of high pressure fluid through valve 130 to a machine to be served 144, and prevents the passage of fluid out of valve 130 through port 138 when high pressure is not being exerted thereon through port 138.

Formed adjacent the upper end of check piston 154 is a radially outwardly extending shoulder 164. The diameter of shoulder 164 is substantially equal to the diameter of bore 134 so as to provide a surface-to-surface sliding fit therebetween. The outer surface of check piston 154, bore 134, the lower surface of shoulder 164 and the upper surface of shoulder 147 cooperate to define a chamber 165.

In similar manner to that described above with respect to valve 30, a plurality of high pressure seals 172, 182 and 185 are provided in valve 130 to preclude the leakage of fluid from the valve around connector 141, high pressure connector plug 137 and radial shoulder 164 respectively. Each of these seals comprises a soft U-shaped seal and an antiextrusion ring as was discussed above with respect to seals 76 and 85 of valve 30. It is to be noted that distinguishably from valve 30 of FIG. 2 and 3, no low pressure seal is provided in central bore 150 of valve 130 adjacent annular shoulder 147 to prevent passage of fluid past shoulder 147 into chamber 165. Further, it is to be noted for reasons discussed below, that chamber 165 is not vented as is the case in valve 30.

As shown in FIG. 4, check piston 154 is in its uppermost position and is therefore aligned for high volume low pressure fluid flow. More specifically, during high volume low pressure flow, low pressure fluid is introduced to valve 130 through second inlet port 153 whereafter it travels through radial passage 152, central bore 150 and outlet port 142 into a machine to be served 144, e.g. the punch press 11 of FIG. 1. Low pressure fluid also passes upwardly within bore 155 in check piston 154 to urge ball check 160 upwardly against flange 158 so as to cover bore 159 to preclude the passage of fluid therethrough. Additionally, low pressure fluid passes between the outer surface of check piston 154 and the inner surface of annular shoulder 147 into chamber 165 so as to bear against the lower surface of radial shoulder 164 and maintain check piston 154 in its uppermost position.

When the cycle of the machine is to be served requires the introduction of high pressure fluid thereto, high pressure fluid is introduced to valve 130 through first inlet port 138 in high pressure connector plug 137 from a high pressure fluid source (not shown). The high pressure fluid is introduced against the upper support of flange 158 through a plurality of radially extending channels (not shown) which are formed in the lower surface of connector plug 137. The force of the high pressure fluid bearing against the upper surface of flange 158 displaces check piston 154 downwardly so as to preclude the passage of high pressure fluid out of valve 130 through radial passage 152 and second inlet port 153. During the downward displacement of check piston 154, ball check 160 is held seated against bore 159 by the action of spring 161. When check piston 154 has reached the limit of its downward displacement, however, i.e. when check piston 154 engages the upper surface of connector 141, ball check 160 displaced downwardly against the bias of spring 161, to seat against, without covering, slots 157. With the ball check so positioned, high pressure fluid passes through first inlet port 138 into bore 159, through counterbore 156, slots 157, and bore 155, and thereafter out of valve 130 through bore 152 in connector 141.

When the high pressure fluid-requiring function of machine 144 has been accomplished, the pressure from the high pressure fluid source is relieved and check piston 154 is displaced upwardly into high volume low pressure alignment as shown in FIG. 4 in either of two ways, viz by the action of fluid being passed into valve 130 through bore 142 as was the case with respect to valve 30 in use with the punch press 11 of FIG. 1, or by the introduction of additional low pressure fluid through second inlet port 153 into valve 130. In the latter case, the upward displacement of check piston 154 is caused by the passage of low pressure fluid between the outer surface of check piston 154 and the inner surface of annular shoulder 147 into chamber 165 so as to bear against the lower surface of radial shoulder 164 thereby causing upward displacement of check piston 154. This capability for self-realignment is particularly useful for situations where valve 130 is to be used in conjunction with machinery having requirements for a high volume of low pressure followed by a requirement for a low volume of high pressure, immediately followed by a further requirement for a high volume of low pressure without an intermediate phase wherein an element of the machine, e.g. piston 14 of punch press 11 of FIG. 1, is repositioned.

It will be understood by those skilled in the art that the above-described embodiments of dual pressure range valves may be manufactured by known processes and that they are representative of many dual pressure range valves which may be structured in accordance with the teaching of the present invention. Manifestly, many modifications and adaptations may be made in the present invention without departing from the spirit and the scope thereof.

I claim:

1. A dual pressure range valve comprising:

an elongated body having a first bore extending axially therethrough;

a first inlet port formed at one end of said first bore for accommodating the introduction of fluid at a first pressure into said first bore of said body;

an outlet port formed at the opposite end of said first bore for accommodating the discharge of fluid therethrough from said first bore of said body, said outlet port tapered conically outward toward the periphery of said first bore at its innermost end section;

said body having a second bore extending transversely therein one end of said second bore intersecting said first bore so as to communicate therewith;

second inlet port formed at the other end of said second bore for accommodating the introduction of fluid at a second pressure into said first bore of said body;

a pair of longitudinally displaced radially inwardly extending annular shoulders formed on said first bore of said body, said second bore communicating with said first bore at a point between said pair of annular shoulders;

an elongated reciprocable check piston slidably mounted for axial movement within said pair of shoulders of said first bore to alternately open and close said communication between said second bore and said first bore during the passage of fluid through said first bore, said piston having affixed thereto an outward extending annular sleeve situated externally of the outermost of said pair of shoulders on said first bore and engageable therewith to limit said axial movement of said piston having a longitu-

dinal bore therethrough, said bore of said piston tapered conically outward at its innermost end section; and

an elongated stem-check valve mounted within said bore of said piston, said stem check having a flared plug at its innermost end which protrudes from said bore of said piston, said plug having a first complementary conical surface adjacent said conical surface of said bore of said piston, a second complementary conical surface adjacent said conical surface of said outlet port, and a plurality of passages extending from said first conical surface through a third surface of said plug adjacent the bore in said outlet port, said stem check reciprocable within said bore of said piston during the reciprocal movement of said piston so that said first conical surface of said plug movably engages adjacent conical surface of said bore of said piston to preclude fluid passage from said first inlet port to said outlet port when said piston opens said communication between said second bore and said first bore, and said second conical surface of said plug is alternately movably engages with said adjacent conical surface of said outlet port to permit fluid passage from said first inlet port to said outlet port when said piston closes said communication between said second bore and said first bore.