June 6, 1944. W. ERNST 2,350,884

BLANKHOLDER AND DIE CUSHION CYLINDER HAVING SEPARATE ADJUSTABLE PRESSURES

Original Filed March 29, 1940 5 Sheets-Sheet 1

FIG. 1

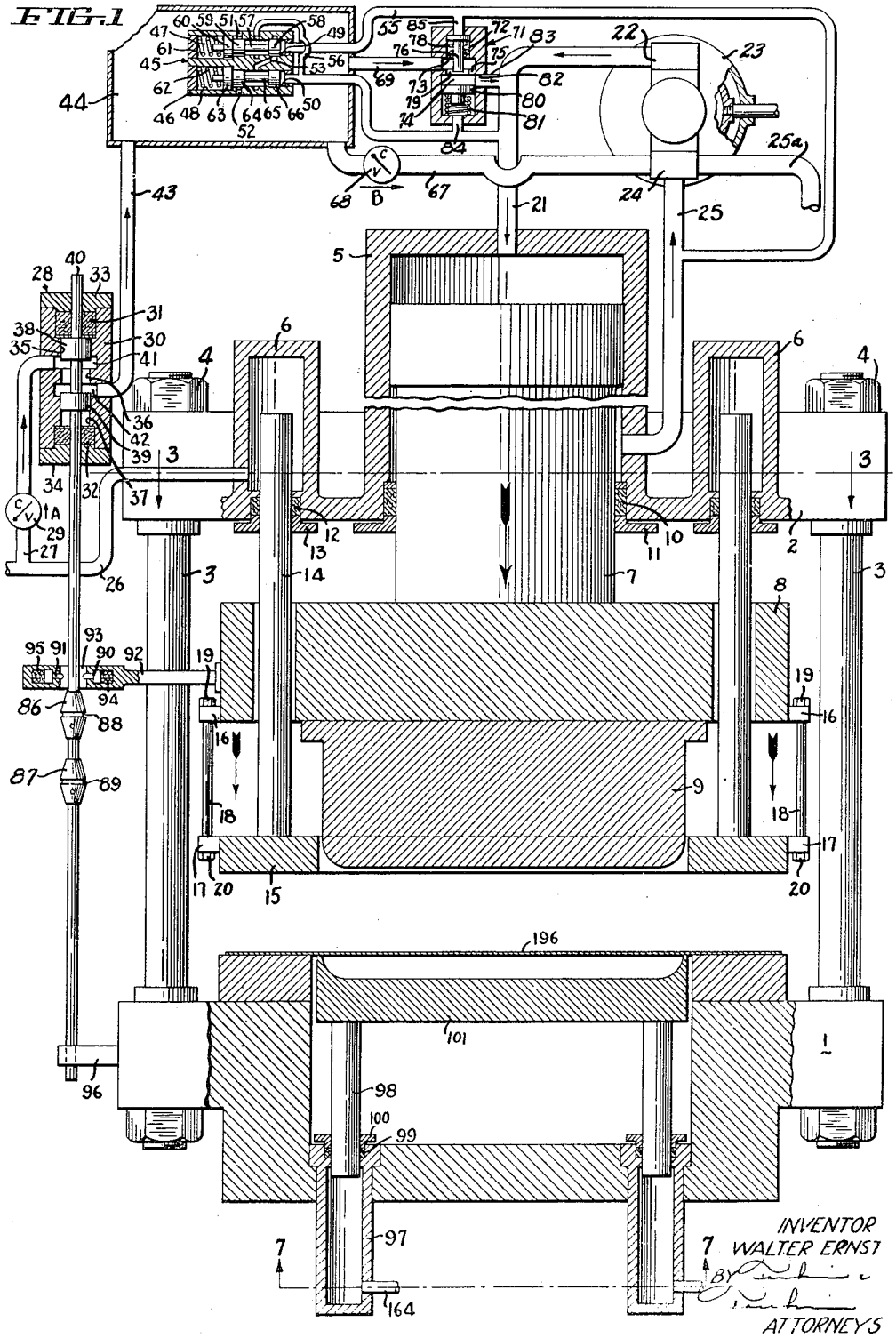

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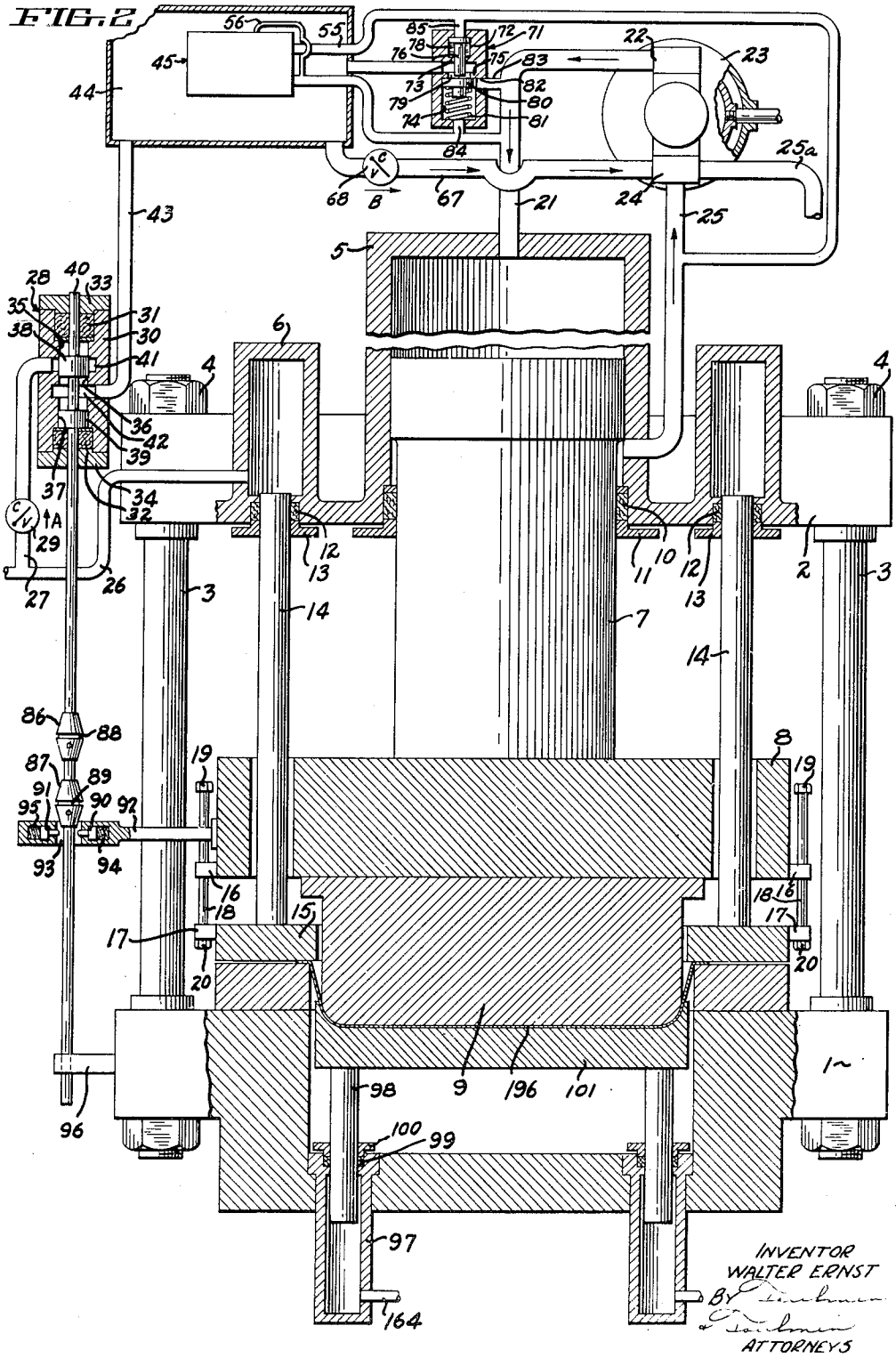
FIG. 2



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BLANKHOLDER AND DIE CUSHION CYLINDER HAVING SEPARATE ADJUSTABLE PRESSURES

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FIG. 3

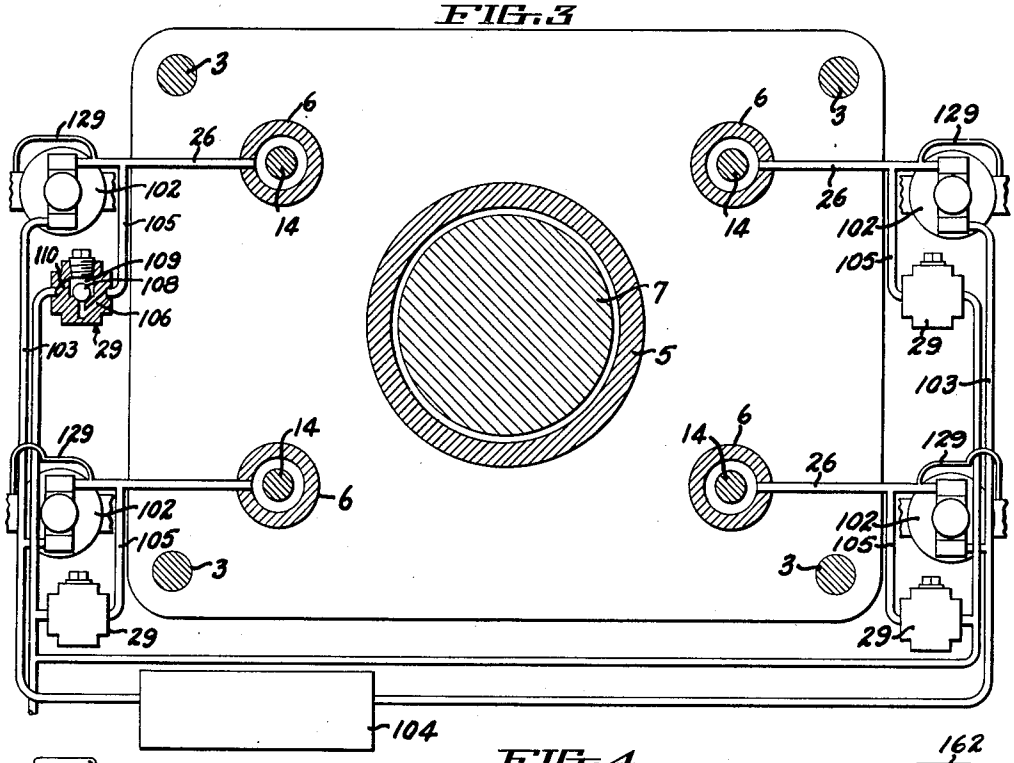
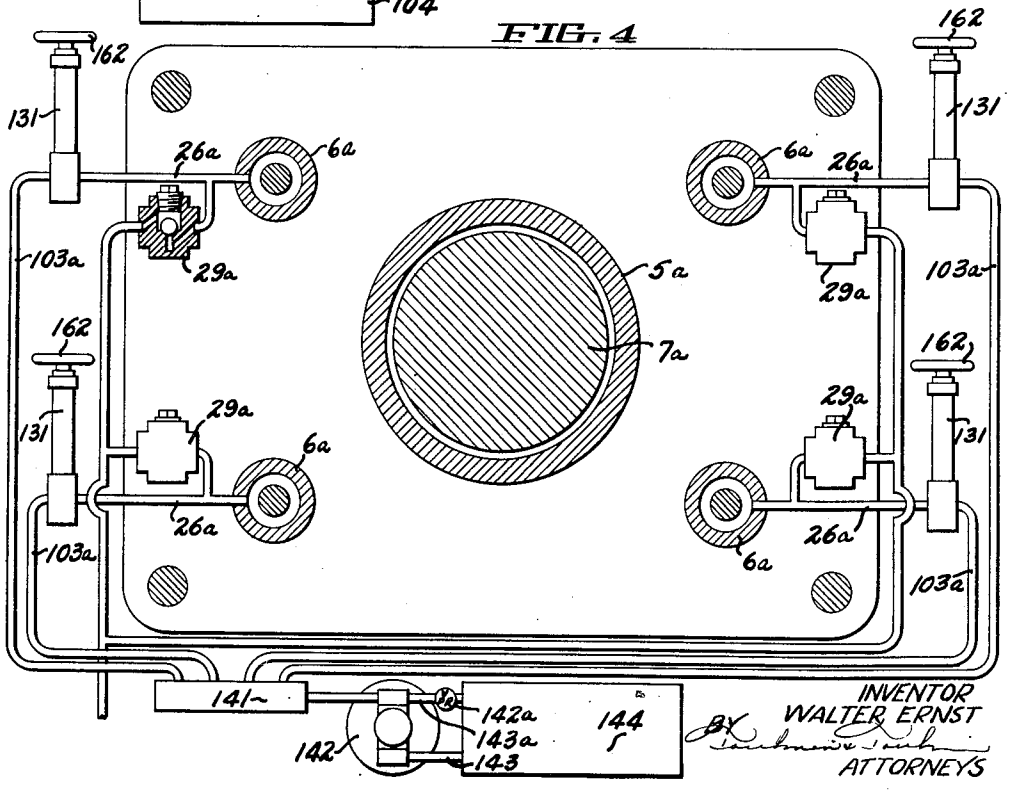


FIG. 4



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BLANKHOLDER AND DIE CUSHION CYLINDER HAVING SEPARATE ADJUSTABLE PRESSURES

Original Filed March 29, 1940 5 Sheets-Sheet 4

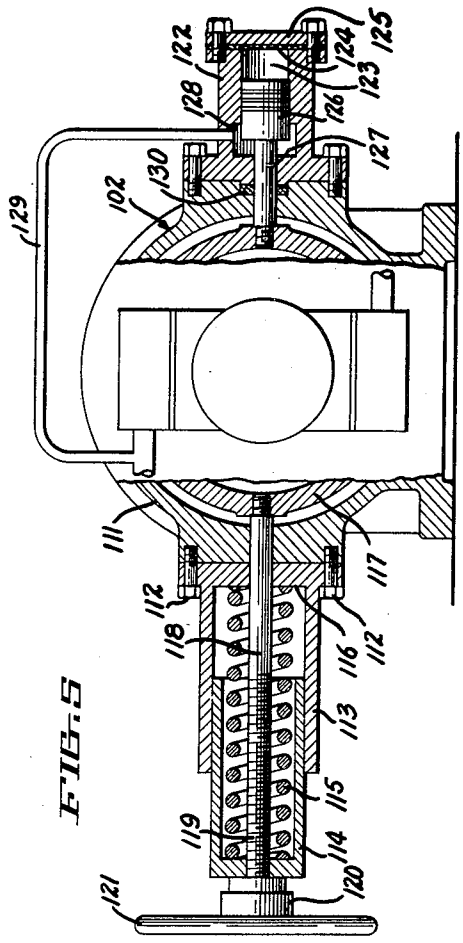

FIG. 5

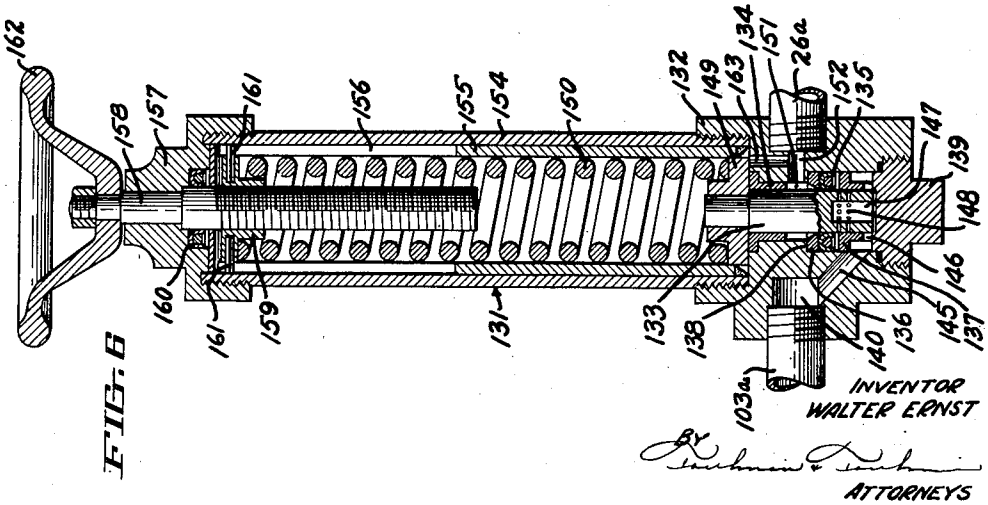

FIG. 6

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BLANKHOLDER AND DIE CUSHION CYLINDER HAVING SEPARATE ADJUSTABLE PRESSURES

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FIG. 8

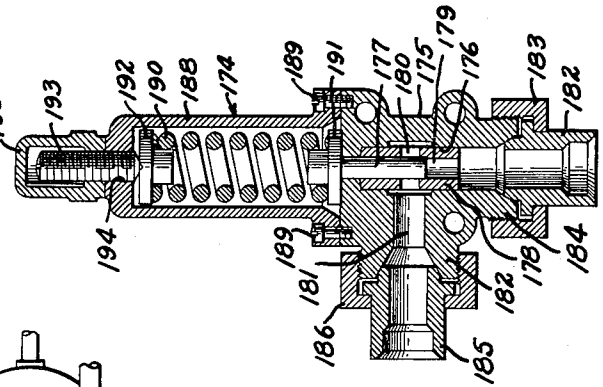
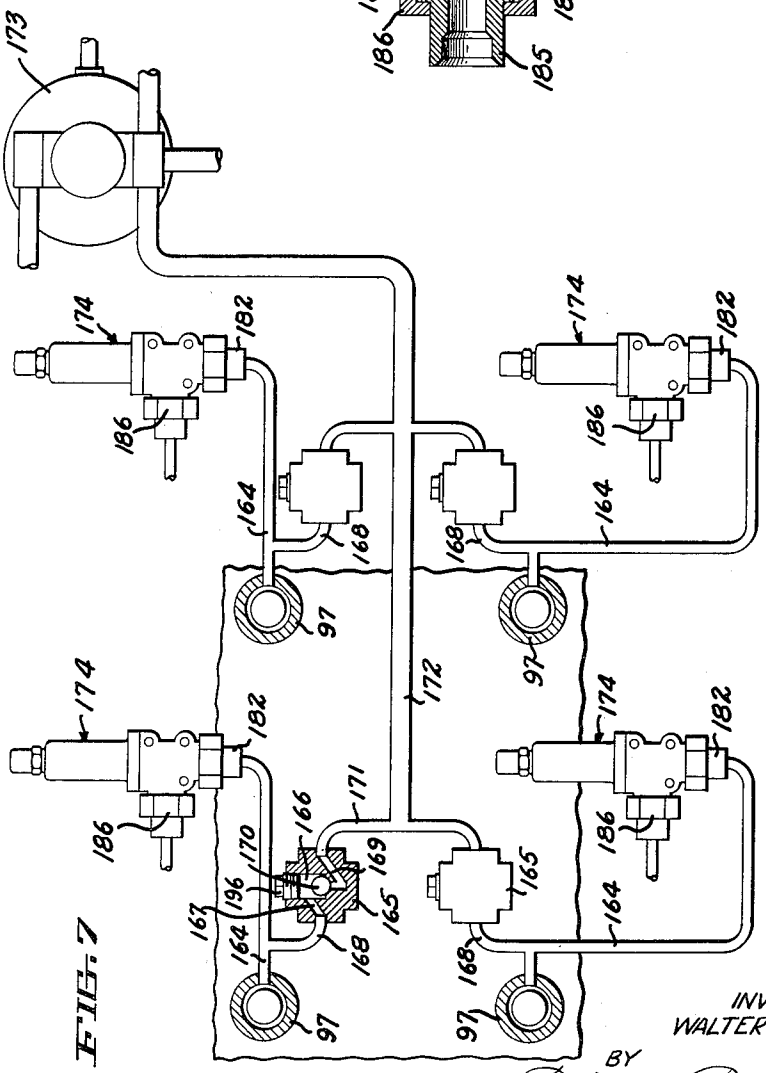


FIG. 7



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Patented June 6, 1944 2,350,884

UNITED STATES PATENT OFFICE

2,350,884

BLANK HOLDER AND DIE CUSHION CYLINDER HAVING SEPARATE ADJUSTABLE PRESSURES

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Original application March 29, 1940, Serial No. 326,709. Divided and this application November 27, 1940, Serial No. 367,447

6 Claims. (Cl. 113—45)

This invention relates to presses, and in particular to hydraulic presses having blank holding arrangements in association with drawing devices.

One object of this invention is to provide a hydraulic press having a drawing plunger and a plurality of clamping cylinders which will make it possible to exert and maintain different pressures in the clamping cylinders, and to vary the pressure in the individual clamping cylinders independently of each other.

It is another object of this invention to provide a hydraulic press having a drawing plunger and a plurality of clamping cylinders, in which the pressure in each clamping cylinder is individually controllable and automatically maintained by means associated with said clamping cylinders.

Another object of the invention consists in providing a hydraulic press having a drawing plunger and a plurality of individually controllable clamping cylinders in which the clamping cylinders receive their pressure fluid from a common fluid source, while each clamping cylinder has associated therewith individually adjustable pressure reducing means for automatically maintaining a desired pressure in each individual clamping cylinder.

It is a still further object of the invention to provide a hydraulic press having a drawing plunger, a plurality of clamping cylinders, and cushioning cylinders which will make it possible individually to vary and maintain the pressure in each clamping and cushioning cylinder.

These and other objects and advantages will appear more clearly from the following specification in connection with the accompanying drawings in which:

Figure 1 diagrammatically illustrates a press according to the present invention at the beginning of the downward stroke of the clamping plungers;

Figure 2 is a view similar to Figure 1, but showing the press at the end of the clamping stroke;

Figure 3 is a section along the line 3—3 of Figure 1;

Figure 4 is a section similar to Figure 3 with the exception that the pumps associated with the clamping cylinders are replaced by pressure reducing valves;

Figure 5 illustrates on a somewhat larger scale, a pump cooperating with the clamping cylinders;

Figure 6 shows a reducing valve in detail;

Figure 7 illustrates the hydraulic circuit for the cushioning cylinders; and

Figure 8 is a detail of the relief valve to be used in connection with the hydraulic circuit of Figure 7.

This application is a division of my application, Serial No. 326,709, filed March 29, 1940, which has become Patent 2,294,451, Sept. 1, 1942.

The press as illustrated in the drawings comprises a bed 1 and a head 2 spaced from and connected with each other by strain rods 3 and nuts 4. The head 2 carries a main cylinder 5 and clamping cylinders 6. The main cylinder 5 has reciprocably mounted therein a plunger 7 carrying a press platen 8 which, in its turn, supports an upper die 9. The lower end of the main cylinder 5 is provided with packing material 10 compressed by a gland 11 for preventing leakage from the main cylinder. Similarly, each of the clamping cylinders 6 is provided with packing material 12 compressed by a gland 13 for preventing leakage from the respective clamping cylinder.

Through each gland 13 and packing material 12 of the clamping cylinders is passed a clamping plunger 14 carrying a blank holder 15. The press platen 8 and blank holder 15 have lugs 16 and 17 respectively through which a rod 18 with nuts 19 and 20 is passed so that the blank holder 15 is lifted by the press platen when the latter has moved a predetermined distance away from the blank holder. The main cylinder 5 is connected at its upper end with a conduit 21 leading to one port 22 of a variable delivery pump 22, while the other port 24 of the pump 23 is connected with a conduit 25 leading to the lower end of the cylinder 5.

Each of the clamping cylinders 6 is connected by means of a conduit 26 with a conduit 27 leading to a two-way valve 28 and having mounted therein a check valve 29 which opens in the direction of the arrow A only. The two-way valve 28 comprises a cylinder 30 closed at its ends by packing material 31 and 32 and heads 33 and 34. The cylinder 30 has three aligned bores 35, 36 and 37 of a diameter corresponding to the diameter of pistons 38 and 39 connected with a push rod 40. The bores 35 and 36 are separated from each other by a chamber 41 having a diameter greater than those of the pistons 38 and 39. Similarly the bores 36 and 37 are separated by a chamber 42 which has a diameter likewise greater than those of the pistons 38 and 39.

A conduit 43 leads from the chamber 42 to a fluid tank 44, while the conduit 27 leads into the chamber 41. The fluid tank 44 has mounted therein a valve 45 for releasing the pressure in the upper portion of the main cylinder 5 at the beginning of the return stroke of the plunger 7. This valve 45 comprises a casing 46 having two spring chambers 47 and 48 and two cylinder bores 49 and 50. The cylinder bore 49 is adapted to communicate through an aperture 51 with the fluid tank 44, and similarly an aperture 52 is provided for effecting communication between

the cylinder bore 50 and the fluid tank 44. Furthermore, a channel 53 is provided for effecting a communication between the two bores 49 and 50. A conduit 54 leads from the bore 50 to the conduit 21, while a conduit 55 leads from the cylinder bore 49 to the conduit 25. A conduit 56 branches off from the conduit 54 and leads to the cylinder bore 49. Reciprocably mounted in the cylinder bore 49 is a valve member 57 with two pistons 58 and 59 which, in the position shown in Figure 1, close off the channel 53 and the aperture 51.

Connected with the piston 59 is an abutment 60 which is engaged by a spring 61 provided in the spring chamber 47 and urging the valve member 57 toward the right. Similarly, a spring 62 in the spring chamber 48 engages an abutment 63 connected with a piston 64 reciprocable in the cylinder bore 50. The piston 64 forms a part of the valve member 65 which carries a second piston 66. In the position shown in Figure 1, the piston 64 closes the aperture 52, while the piston 66 prevents communication between the conduit 54 and the channel 53. A conduit 67 leads from the fluid tank 44 to the port 24 of the pump 23 and has mounted therein a check valve 68 which opens only in the direction of the arrow B.

A further conduit 69 leads from the fluid tank 44 to a chamber 70 of a surge valve generally designated 71. The surge valve 71 has a cylinder bore 72 separated from the chamber 70 by a partition 73, and a cylinder bore 74 separated from the chamber 70 by a partition 75. The partition 73 is provided with a bore through which is passed a piston rod 76 carrying a piston 77. A spring 78 is mounted between the partition 75 and the piston 77 urging the piston 77 upward. The partition 75 is likewise provided with a bore 79 which has a diameter greater than the diameter of the piston rod 76. The cylinder bore 74 has also reciprocably mounted therein a piston 80 urged by a spring 81 to its uppermost position. In this uppermost position the piston 80 closes off a port 82 connected with the conduit 21 by a conduit 83. A conduit 84 leads from the lower part of the cylinder bore 74 to the conduit 54, while a conduit 85 leads from the upper portion of the cylinder bore 72 to the conduit 55.

The push rod 40 passing through the two-way valve 28 has adjustably mounted thereon two cams 86 and 87 having grooves 88 and 89 respectively. The cams 86 and 87 cooperate with pins 90 and 91 carried by an arm 92 connected with the press platen 8. The arm 92 has a bore 93 through which the cams 88 and 89 may pass. The pins 90 and 91 are urged toward the bore 93 by springs 94 and 95 provided in arm 92 so that the pins may engage the groove 88 or 89 as the case may be. The lower end of the push rod 40 is passed through a lug 96 connected with the bed 1. The bed 1 carries cushioning cylinders 97 having reciprocably mounted therein cushioning plungers 98 passing through packing material 99 compressed by a gland 100 and carrying the lower die 101.

According to the embodiment of Fig. 3, each of the clamping cylinders 6 is connected with the pressure side of a variable delivery pump 102 by means of the conduit 26. The suction side of each delivery pump 102 is connected by means of a conduit 103 with a fluid tank 104 which, if desired, may be connected with or form a part of the fluid tank 44. Branching off from the conduit 26 is a conduit 105 leading to a channel 106 of the check valve 29 (see also Fig. 1). The channel 106 is normally closed by a ball 108 arranged in a chamber 109 of the check valve 29. The chamber 109 communicates through a channel 110 with the chamber 41 of the two-way valve 28. As will be clear from the foregoing, the four check valves 29 prevent the pressure from equalizing in the four clamping cylinders 6, whereas the two-way valve 28 is adapted to open the clamping cylinders to exhaust.

The variable delivery pump 102, shown in detail in Figure 5, comprises a pump casing 111 having connected to one side thereof, for instance by means of screws 112, a hollow arm 113. Telescoped in the hollow arm 113 is a spring casing 114 engaged by one end of the spring 115. The other end of the spring 115 abuts the wall 116 of the hollow arm 113. Reciprocably mounted within the pump casing 111 is a flow-control member 117 adapted to vary the flow of the variable delivery pump by moving a secondary rotor relatively to a primary rotor. Moreover, a plurality of radial pistons and cylinders (not shown) are operatively connected with said rotors. The arrangement of these rotors and the interior of the pump is well-known to those skilled in the art and for more detailed description thereof, reference may be had to U. S. Patents Nos. 1,964,244 and 2,041,172.

Threaded into or otherwise connected with the flow-control member 117 is an adjusting rod 118 which passes through the pump casing 111 and the wall 116 of the hollow arm 113 and is provided with a threaded portion 119 passing through the spring casing 114. The threaded portion 119 is engaged by a nut 120 provided with a handwheel 121 so that by rotation of the handwheel 121 in one direction, the spring casing 114 may be moved into the hollow arm 113 thereby increasing the thrust of the spring, whereas the rotation of the handwheel 121 in the opposite direction allows the spring 115 to expand. Screwed to or otherwise connected with the opposite side of the pump casing is a cylinder 122 having a cylinder bore 123, closed at its outer end by a gasket 124 and a cylinder head 125. Reciprocably mounted in the cylinder bore 123 is a piston 126 connected with a push rod 127 threaded into the flow-control member 117. Adjacent the cylinder bore 123 and adapted to communicate therewith is a bore 128 having a diameter greater than the diameter of the cylinder bore 123 and communicating through a conduit 129 with the pressure side of the pump 102. Leakage from the bore 128 toward the interior of the pump casing 111 is prevented by packing material 130 provided between the pump casing 111 and the cylinder 122 and surrounding the push rod 127.

As will be clear from the foregoing, the spring 115 tends to hold the flow-control member in a position determined by the setting of the spring, thereby maintaining a predetermined flow of fluid of the pump 102. However, if the fluid pressure of the pump exceeds a predetermined value, this pressure will be conveyed from the pressure side of the pump through the conduit 129 into the bore 128 where it acts upon the piston 126 and moves the latter somewhat toward the right until equilibrium is established between the pressure acting upon the piston 126 and the thrust of the spring acting in the opposite direction. The movement of the piston 126 toward the right

causes the flow-control member to restrict the flow of fluid of the pump 102. In this way, the pump 102 automatically maintains the desired fluid pressure.

According to the embodiment of Figure 4, the pumps 102 are replaced by pressure reducing valves 131 which are supplied with fluid from a common variable delivery pump 142. Since this pump as shown in the drawings lacks the servomotor conduit 129 of the pump 102, provision is made for preventing excessive pressure in the conduits between the pump 142 and the pressure reducing valves 131. To this end a conduit 143a comprising a relief valve 142a connects the pump 142 with the tank 144. The relief valve 142a is so set that it opens towards the tank 144 at a pressure slightly higher than the desired pressure in the clamping cylinders. Aside from the above mentioned features the arrangement shown in Figure 4 corresponds to that of Figure 3 and the corresponding parts are designated with the same reference numerals, however with the additional letter *a*.

The pressure reducing valve 131 comprises a body member 132 (see Figure 6) having reciprocably mounted therein a plunger 133 guided by a guide ring 134 and by a packing 135 preferably of U-shaped leather mounted between rings 136 and 137. A shoulder 138 on the body forms a seat for the ring 136, and a screw plug 139 threaded into the body 132 presses the ring 137 against the packing 135.

The body 132 of each of the four pressure reducing valves shown in Fig. 4 is provided with an inlet 140 connected with a conduit 103a leading to a manifold 141 which is connected with the pressure side of the variable delivery pump 142. The suction side of the variable delivery pump 142 communicates through a conduit 143 with a fluid tank 144 which may be connected with or form a part of the fluid tank 44. The inlet 140 (see Fig. 6) communicates by an inclined passage 145 and openings 146 in the ring 137 with a central chamber 147 in the end of the plunger 133. A plurality of small ports 148 radiate from the chamber 147 and pass through the plunger. The inner end of the plunger 133 is provided with a shoulder which rests against a washer 149 which is forced outwardly by a spring 150 and therefore tends to resist the inward movement of the plunger. A chamber 151 within the body 132 communicates by means of an outlet 152 with a conduit 26a leading to the respective clamping cylinder 6a and check valve 29a. Since the clamping cylinder 6a and check valves 29a fully correspond to the clamping cylinders 6 and check valves 29 respectively, no further explanation is necessary. The ports 148 are adapted to communicate with the chamber 151 when the plunger is forced inwardly by a predetermined amount.

Screw threaded into the body 1 is a casing 154 which is welded or otherwise fastened to a sleeve 155 which is preferably of non-corrosive metal. The sleeve 155 has two diametrically opposite slots 156 extending through the walls thereof a considerable distance from the outer end. A cap 157 is screw threaded on the outer end of the casing 154, and through this cap passes a stem 158 which is screw threaded on its inner end to engage a nut 159. Suitable packing 160 is provided for the stem. Pins 161 carried by the nut 159 have their ends projecting into the slots 156 and thereby prevent relative rotation between the nut and the sleeve 155 connected with the casing 154. The upper end of the spring 150 rests against the nut 159 while the lower end of the spring abuts the washer 149. The stem 158 is provided with a handwheel 162 by which it may be rotated, and since the nut 159 cannot rotate with the stem 158 due to the engagement of its pins 161 with the slot 156, the rotation of the handwheel will cause the nut 159 to move longitudinally of the casing so as to vary the thrust of the spring 150. A passage 163 affords communication between the chamber 151 and the interior of the casing 154 when the plunger 133 is moved inwardly sufficiently to lift the washer 149 off its seat on the body and thus open the communication, it being understood that the interior of the casing 154 is always under more or less pressure by reason of the fluid entering between the washer 149 and the sleeve 155 and around the plunger 133.

The valve opens in the following manner:

The hydraulic pressure entering through the inlet 140 and the passage 145 is supplied to the plunger 133 within the chamber 147 and also at the end of the plunger 133. This pressure being greater than that of the spring 150 moves the plunger inward. As soon as the ports 148 pass beyond the packing 135 and open communication with the chamber 151, the fluid will pass therethrough and through the passage 163 into the spring chamber, thus affording a back pressure upon the plunger 133 in addition to the pressure of the spring 150. The pressure on the two sides of the plunger 133 will therefore tend to arrive at a balance, and it is evident that the pressure at the low pressure outlet 152 will be equal to the high pressure minus the pressure acting from the interior of the shell 155 upon the washer 149. When the pressure at the outlet 152 increases, this pressure will be conveyed through the passage 163 to the interior of the sleeve 155 and act therefrom upon the washer 149 so as to move the plunger 133 downwardly, thereby restricting the flow of fluid through the ports 148 into the chamber 151. In this way the desired pressure at the outlet 152 will be automatically maintained.

Referring now to Figure 7 illustrating the hydraulic circuit for the cushioning cylinders 97, it will be noted that each cushioning cylinder communicates through a conduit 164 with a check valve 165. This check valve 165 corresponds to the check valve 106 of Figure 3 and comprises a chamber 166 communicating through a channel 167 and a conduit 168 with the conduit 164. A further conduit 169 which may be closed by a ball 170 communicates with a conduit 171 leading into a conduit 172 which, in its turn, is connected with the pressure side of a variable delivery pump 173. The suction side of the variable delivery pump 173 is connected with a fluid tank not shown in Figure 7. The conduit 164 is also connected with a relief valve 174 shown in detail in Figure 8.

The relief valve 174 consists of a casing 175 having a bore 176 wherein reciprocates a valve plunger 177. Arranged between the valve plunger 177 and the bore 176 is a tubular member 178 having a longitudinal bore 179 and a cross bore 180, the cross bore 180 communicating with an annular chamber opening into a transverse bore 181 in the casing 175. The end connection 182 of the conduit 164 is held in communication with the bore 176 by means of a collar 183 engaging the threaded portion 184 of the casing 175, whereas a pipe connection 185

similar to the pipe connection 182 communicates with a fluid tank (not shown) and is held in communication with the transverse bore 181 by means of the threaded collar 186 engaging the threaded portion 187 of the casing 175.

Mounted on the upper portion of the casing 175 is a tubular cap 188 secured thereto by screws 189. Within the cap 188 is a coiled spring 190, one end of which engages an enlargement 191 upon the upper end of the valve plunger 177, whereas the opposite end engages a button 192 in contact with an adjusting screw 193 threaded through a bore 194 in the upper end of the cap 188. Surrounding and covering the adjusting screw 193 is a hollow nut 195 which serves to protect the adjusting screw 193 and also to lock it in its adjusted position.

As will be clear from the foregoing description, the spring 190 will normally hold the plunger 177 in such a position that the latter prevents communication between the bore 179 and the transverse bore 181. However, when the pressure in the bore 179 exceeds a predetermined value determined by the setting of the spring 190, the plunger 177 will be lifted to such an extent that pressure fluid from the respective cushioning cylinder 97 may pass through the conduit 164 and the bore 179 into the transverse bore 181 and from there to the fluid tank. The fluid expelled from the respective cylinder 97 cannot escape to the conduit 171 since the communication between the conduit 168 and the conduit 171 is closed by the ball 170.

The operation of the device is as follows:

If a drawing operation is to be effected, the workpiece 196 is placed on the bed 1 and the hydraulic pump 23 is started and its control set so that fluid pressure passes through the conduit 21. The plunger 7 first moves downwardly by gravity and the space above the plunger is filled by fluid from the pump 23 and from the tank 44 through the conduit 69, the surge valve 71 and the conduits 82 and 21. It will be understood that the suction effect in the conduit 21 and the conduits 54 and 84 causes the piston 80 of the surge valve to move downwardly so as to effect communication between the surge valve chamber 74 and the conduit 82 connected therewith. At the same time the clamping plungers 14 move downwardly by gravity and fluid from the variable delivery pumps 102 (Figure 3) or the variable delivery pump 142 (Figure 4) flows through the conduit 26 or conduits 103*a* and 26*a* respectively into the clamping cylinders. The cushioning cylinders 97 are assumed to have been filled with fluid during the previous retraction stroke, so that their cushioning plungers are in their upper position.

During the downward movement of the plunger 7 the liquid in the lower portion of the main cylinder 5 escapes through the conduit 25 to the suction side 24 of the pump 23. As soon as the upper die 9 contacts the workpiece 196, pressure starts to build up in the main cylinder 5 above the plunger 7 and acts through the conduits 21 and 54 upon the piston 66 of the valve member 65 thereby moving the valve member 65 against the thrust of the spring 62 toward the left so as to effect communication between the conduit 54 and the channel 53. Furthermore, the pressure in conduit 83 supported by the spring 78 moves the piston 77 upward while the spring 81 of the surge valve 71 moves the piston 80 engaged thereby likewise upward so as to close communication between the conduit 83 and the conduit 69. Just before the upper die 9 contacts the workpiece 196, the pins 90, 91 of the arm 92 engage the groove 88 of the cam 86 and move the rod 40 downwardly so as to shift the pistons 38 and 42 of the two-way valve 28 for interrupting the communication between the conduits 27 and 43. It will be understood that the rod 40 was previously held in its upper position by friction between the rod 40 and the packing material 31, 32 surrounding the same. When the pistons 38 and 42 have reached their lower-most position while the downward movement of the die 9 still continues, the pins 90 and 91 click out of the groove 88, slide over cam 87 and at the end of the pressing or drawing operation are below the cam 87. When the drawing operation proper starts, the die 9 presses the workpiece 196 into the lower die against the resistance of the liquid in the cushioning cylinders 97. Fluid from the cushioning cylinders 97 can escape only through the relief valves 165 and the pressure in each cylinder 97 can be controlled by the adjustment of its respective relief valve, i. e. by setting the screw 196 of the valve 165.

After the upper die 9 has moved the desired distance and completed its drawing operation the flow through the pump 23 is reversed by any desired means so as to initiate the retraction stroke of the plunger 7. When the pins 90, 91 during this retraction stroke engage the groove 89 of the cam 87, they move the control rod 40 and the pistons 38, 42 in the two-way valve 28 to their uppermost position indicated in Figure 1, thereby establishing communication between the conduits 27 and 43 so that liquid from the clamping cylinder 6 may escape through the conduits 27, the check valves 29, the two-way valve 28, and the conduit 43 into the fluid tank 44. When the retraction stroke of the plunger 7 is about to be started, pressure fluid is delivered by the pump 23 into the conduit 25. However, at this time the piston 80 prevents communication between the conduit 21 and the conduit 69 so that no fluid may escape through these conduits from the upper portion of the main cylinder 5. The pressure in the conduit 25 is therefore conveyed through the conduit 55 and moves the pistons 58 and 47 of the valve 45 toward the left. Since previously the piston 66 was moved toward the left, fluid from the upper portion of the main cylinder 5 may now escape through the conduits 21, 54 and 56 into the cylinder bore 49 from where it flows through the apertures 59 into the tank 44. Furthermore, liquid may escape from the conduits 21, 54 and 56 into the cylinder bore 49 and from there through the channel 53 and the aperture 52 into the tank 44.

The relief of pressure from the upper portion of the main cylinder 5 through the valve 45 enables the pressure in the conduit 55 to move the piston 77 of the surge valve 71 downwardly so as to push the piston 80 against the thrust of the spring 81, thereby effecting communication between the conduit 21 and the conduit 69 so that the liquid from the upper portion of the main cylinder 5 may now escape through the last-mentioned conduits into the surge tank. The pressure fluid delivered by the pump 23 through the conduit 25 into the lower portion of the main cylinder 5 now moves the plunger 7 upwardly. A portion of the pressure fluid also flows from the port 24 through the conduit 25*a* into the cushioning cylinders 97 so as to fill the latter and to raise the cushioning plungers 98 to the position

they occupy at the beginning of the drawing operation.

As previously mentioned, when the fluid pressure in the clamping cylinders 6 exceeds a predetermined pressure, the delivery of the pump 102 is automatically restricted so that the desired pressure is substantially maintained. If for some reason during the drawing operation the pressure in the clamping cylinders should still exceed a predetermined value, the respective check valves 29a come into operation so as to release the pressure until it again reaches the allowable value. As will be clear from the foregoing description, each clamping cylinder is individually controlled and may be individually adjusted according to the desired pressure in the respective clamping cylinder. A similar automatic control of the clamping cylinders is effected when the pumps 102 in the circuit of Figure 3 are replaced by the reducing valves 131 shown in Figure 4. In the latter case only one pump, viz. pump 142, supplies fluid to the clamping cylinders, and the pressure reducing valves 131 automatically maintain the desired individual pressures in the clamping cylinders 6a according to the setting of the respective springs 150 in the pressure reducing valves 131, as previously explained. The relief valves 188 associated with the cushioning cylinders prevent undue pressure in the cushioning cylinders, which pressure may be determined for each cushioning cylinder individually by the setting of the respective springs 190.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention. For instance, if desired, the check valves 29 and 29a may be replaced by check valves in which the closure member is normally held in closed position by a spring. Also a constant delivery pump may be substituted for the variable delivery pump 142 or, preferably, the pump 142 with the conduit 143a and check valve 142a may be replaced by the self-controlling variable delivery pump 102.

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

1. A hydraulic press comprising in combination a drawing plunger, means for actuating said drawing plunger, a plurality of clamping members operable by pressure fluid independently of each other for holding a workpiece clamped during the drawing operation of said drawing plunger, a fluid source, and means associated with said clamping members including an individual pump as the source of pressure for each clamping member and means for normally exhausting the discharge from the pump for automatically and independently of the travel of said drawing plunger to control the supply of pressure fluid from said fluid source to said clamping members so as to allow the creation of different predetermined pressures on separate clamping members at one and the same time.

2. A hydraulic press comprising in combination a drawing plunger, means for actuating said plunger, a plurality of fluid operable clamping members for holding a workpiece during the drawing operation of said drawing plunger, a fluid source, means respectively associated with said clamping members including an individual pump as the source of pressure for each clamping member and means for normally exhausting the discharge from the pump for automatically and independently of each other and of the travel of said drawing plunger to control the supply of fluid from said fluid source to the respective clamping member to create said predetermined pressures on different clamping members, and means adapted to prevent equalization of the fluid pressure on said clamping members.

3. A hydraulic press comprising in combination a drawing plunger, means for reciprocating said plunger, a plurality of fluid operable clamping members operable independently of each other to hold a workpiece during the drawing operation of said drawing plunger, a fluid source for supplying fluid to said clamping members including an individual pump as the source of pressure for each clamping member and means for normally exhausting the discharge from the pump for respectively and automatically to maintain predetermined different minimum pressures on said clamping members independently of the travel of said drawing plunger, fluid operable cushioning members adapted to cooperate with said drawing plunger, and means adapted to control the pressure on said cushioning members independently of each other.

4. A hydraulic press comprising in combination a drawing plunger, means for actuating said plunger, a plurality of fluid operable clamping members reciprocable in clamping cylinders, pressure reducing valves respectively associated with said clamping cylinders, said pressure reducing valves being adapted automatically to restrict the flow of pressure fluid to their respective clamping cylinders in response to a predetermined pressure in said cylinders, pumping means communicating with each of said pressure reducing valves for supplying fluid therethrough to said cylinders, and means associated with said pumping means and responsive to a predetermined pressure in said cylinders for preventing further supply of fluid to said pressure reducing valves.

5. A hydraulic press comprising in combination a main cylinder, a drawing plunger reciprocable in said main cylinder and carrying a control member, a variable delivery pump adapted to supply fluid to said main cylinder to actuate said drawing plunger, a plurality of fluid operable clamping members for holding a workpiece during the drawing operation of said drawing plunger, pumping means, independent of said variable delivery pump, for supplying fluid to said clamping members, and means respectively associated with said clamping members and adapted automatically and independently of each other and of the drawing action of said drawing plunger to vary the supply of pressure fluid to the respective clamping member and to maintain a predetermined minimum pressure thereon.

6. A hydraulic press comprising in combination a drawing plunger, a pump for supplying fluid to said drawing plunger for actuating the same, a plurality of fluid operable clamping cylinders, separate pumping means independent of said pump, one for each clamping cylinder, and adapted to supply fluid to said clamping cylinders, and means associated with said pumping means normally exhausting the discharge fluid therefrom and adapted respectively and at one and the same time to cause supply of different pressures to maintain the same in said clamping cylinders independently of the travel of said drawing plunger.

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