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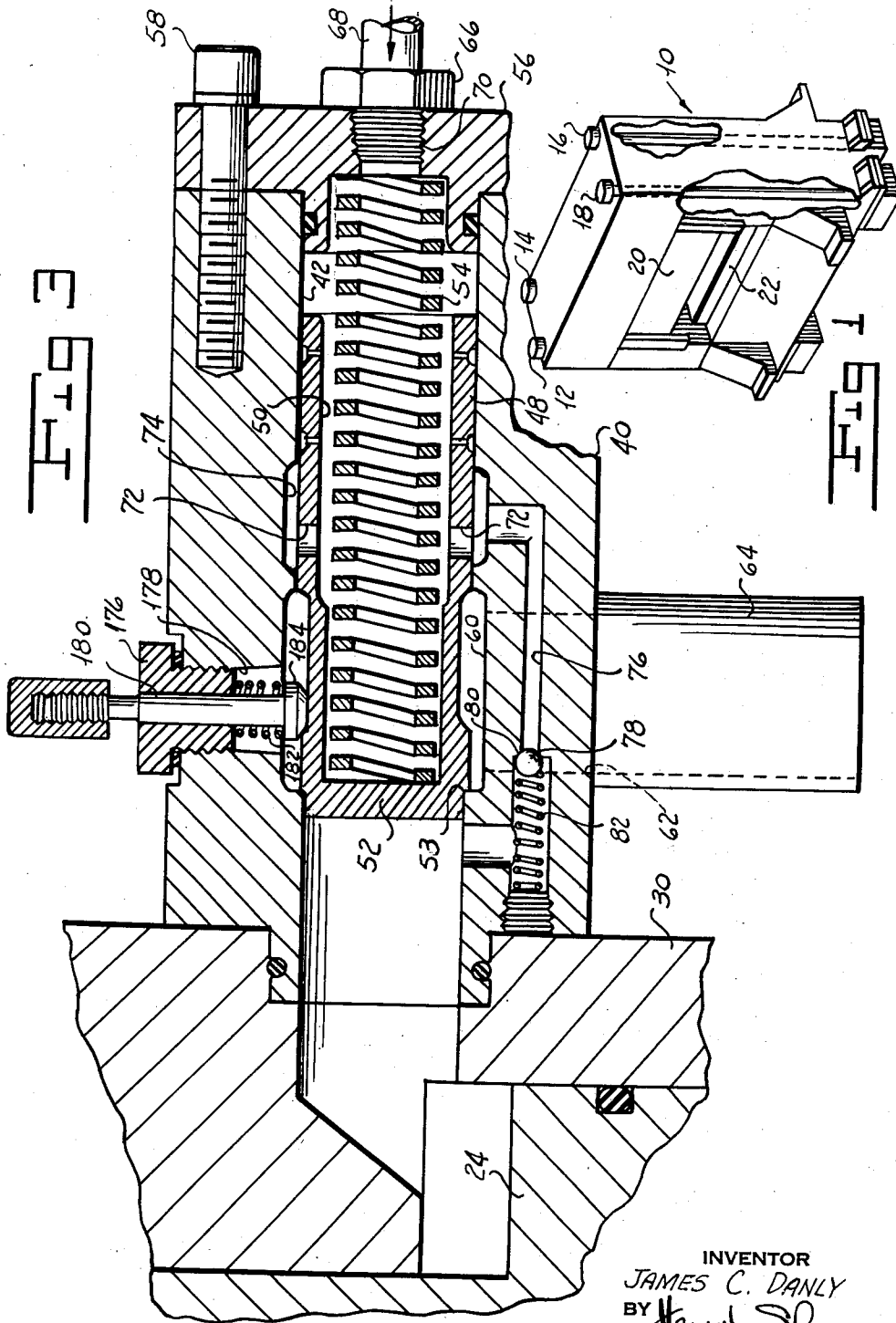
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2,937,733

OVERLOAD RELIEF ASSEMBLY FOR POWER PRESSES

Filed Oct. 31, 1956

3 Sheets-Sheet 1



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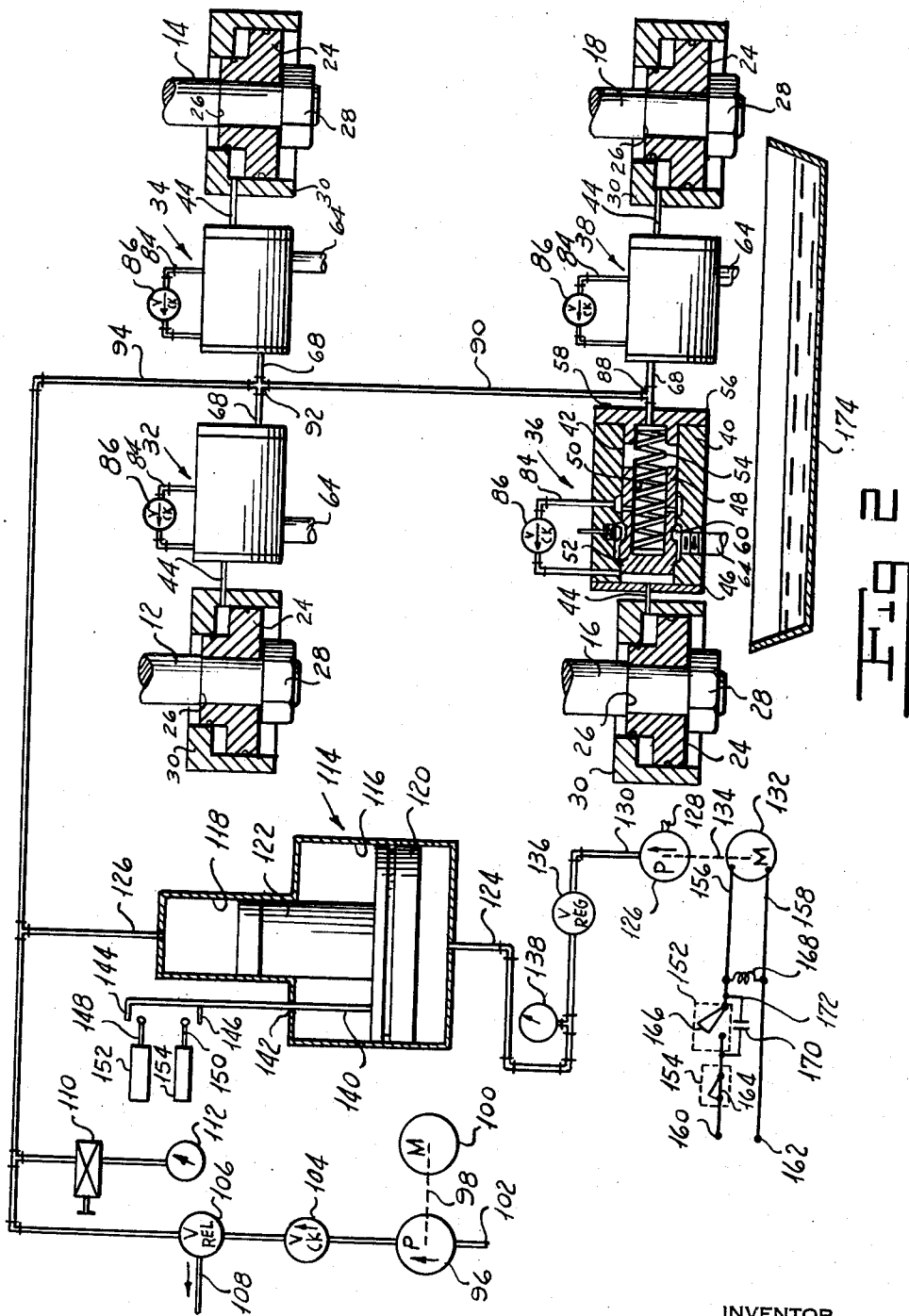
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OVERLOAD RELIEF ASSEMBLY FOR POWER PRESSES

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3 Sheets-Sheet 2



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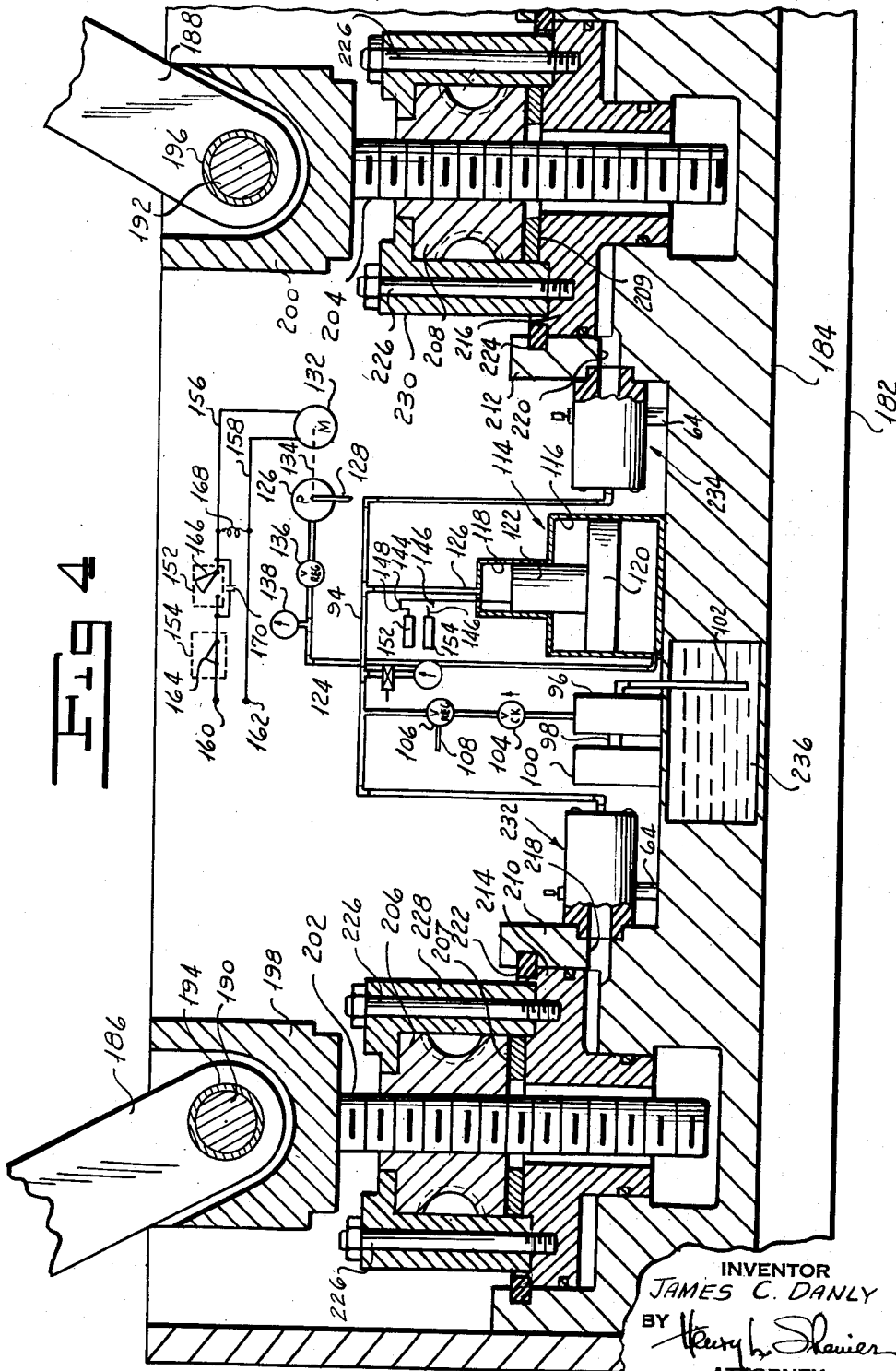
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3 Sheets-Sheet 3



1

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OVERLOAD RELIEF ASSEMBLY FOR POWER PRESSES

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8 Claims. (Cl. 192—150)

My invention relates to an overload relief assembly for power presses having one or more connections to the press working slide and more particularly to an overload relief assembly which relieves an overload occurring on one or more of the corners of the working slide either by relieving the load on the slide connections or by relieving the load on the press tie rods.

Overdrive presses are assembled with tie rods which are placed under a heavy predetermined tension. In operation of the press, if for any reason the press is overloaded, extreme damage such as bending of an eccentric shaft or rupturing or straining of the press tie rods is likely to result.

Patent No. 2,616,543, issued to Philo H. Danly on November 4, 1952, discloses a safety assembly for power presses which stops the press in the event of an overload on any one of the press tie rods. In the system disclosed in the said patent, fluid under pressure is fed to press tie rod cylinders carried by the press frame. This fluid acts on pistons carried by the tie rods to place the rods under the proper predetermined tension. When an overload occurs on a particular rod, the piston is displaced to relieve the tension on this rod and to stop the press.

One case in which a press is overloaded occurs when material of a thickness greater than the material thickness for which the press is set is fed into the press. If this increased thickness is uniform throughout the material, the system of the patent referred to hereinabove operates satisfactorily to relieve the increased tie rod tension and to stop the press. If, however, the material being fed to the press is not uniformly thicker with the result that not all the tie rods are placed under increased tension, the tension on only those rods which are overloaded is relieved. In the system described in the said patent, in the event such an unsymmetrical overload occurs, tension on all rods may be, but is not necessarily, equalized. It often happens that one rod is permitted to give in response to an unsymmetrical overload, but the other rods do not give since the fluid pressure to these rods is momentarily increased when the one rod is overloaded. It will be appreciated that if one or more rods, but not all rods, give, the resulting forces tend to cock-bill the press slide with resulting damage to press parts, such as the gibs.

In a first form of my invention I have provided an overload relief assembly for power presses which embodies an improvement on the safety assembly disclosed in the said patent. My system ensures that if any one of the press tie rods is overloaded, the tension on all the rods will be relieved. My system includes means for stopping the press in the event of an unsymmetrical overload. My assembly relieves tension on all the press tie rods in response to an unsymmetrical overload to prevent damage to press parts such as the drawing slide gibs.

In single action presses, a tie rod overload relief mechanism effectively relieves the overload applied to the press slide. In the case of overdrive multiple point suspension

2

presses, the tie rods are designed to have sufficient strength to withstand the load of both the inner slide and the blank holder. In most cases the load on the blank holder is considerably less than the load on the inner slide. As a result a relief system applied to these heavily loaded tie rods will not be sufficiently sensitive to respond to an overload on the relatively lightly loaded blank holder.

In a second form of my invention, I have provided an overload relief assembly which may be applied either to the press inner slide driving connections or to the press blank holder driving connections. In either case this system operates to relieve an overload imposed on the slide to which the system has been applied. As is the case with my tie rod overload relief system, overloading of any one of the driving connections of a slide results in relieving the load on the remaining slide connections in the event an unsymmetrical loading occurs.

One object of my invention is to provide an improved overload relief assembly for power presses which relieves the tension on all the press tie rods when any one of the rods is overloaded.

Another object of my invention is to provide an improved overload relief assembly for power presses which may be applied directly to the slides of the press.

Still another object of my invention is to provide an improved overload relief assembly for power presses which stops the press operation in response to an unsymmetrical overload.

A still further object of my invention is to provide an improved overload relief assembly for power presses which maintains constant the force acting on the press tie rods.

Still another object of my invention is to provide an improved overload relief assembly for power presses which prevents damage to the press in the event a sheet of stock of irregular thickness is fed to the press.

Other and further objects of my invention will appear from the following description:

In general the first embodiment of my invention contemplates the provision of an overload relief assembly for power presses in which a plurality of press tie rods carry pistons which are associated with cylinders to which fluid under a predetermined pressure is fed from a common source through respective valve assemblies.

If, owing to an unsymmetrical overload being applied to the press, the tension on any one of the rods exceeds the tension corresponding to said predetermined pressure, the associated piston drives fluid back into its valve assembly to actuate the valve to relieve the fluid pressure.

The construction and arrangement of the valve assemblies is such that actuation of any one of the valve assemblies relieves the pressure throughout the system to permit the other tie rod pistons to actuate their respective valves to relieve tension on all the rods. Means responsive to operation of any of the valve assemblies is adapted to stop the press.

The second embodiment of my invention contemplates the provision of an overload relief assembly for a multiple point suspension power press including a respective hydraulic cylinder and piston coupling each of the slide drive members to the slide. Fluid under a predetermined pressure is fed from a common source to respective valve assemblies connected to the cylinders. Upon the occurrence of an overload, the system of this second embodiment operates in the same manner as the tie rod relief assembly described above to relieve the pressure throughout the system. This form of my invention may be applied to the press inner slide, to the press blank holder or to both the press inner slide and blank holder.

In the accompanying drawings which form part of the instant specification and which are to be read in

conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

Figure 1 is a perspective view of a power press provided with my overload relief assembly with parts of the press broken away.

Figure 2 is a schematic view of the first form of my overload relief assembly for power presses.

Figure 3 is a sectional view of one of the tie rod cylinder supply valve assemblies of my overload relief assembly for power presses.

Figure 4 is a fragmentary sectional view of the second embodiment of my overload relief assembly for power presses.

More particularly referring now to Figure 1 of the drawings, a power press, indicated generally by the reference character 10, is assembled with a plurality of respective tie rods 12, 14, 16, and 18. These tie rods hold the press 10 assembled under a predetermined tension. The press 10 includes a slide 20 which reciprocates toward and away from the press bed 22.

Referring now to Figure 2, each of the respective rods 12, 14, 16, and 18 carries a piston 24 held against an annular shoulder 26 on the rod by means of a nut 28 threaded on the rod end. Each of a plurality of respective cylinders 30 associated with pistons 24 is supplied with fluid under pressure from one of a plurality of respective supply valve assemblies, indicated generally by the reference characters 32, 34, 36, and 38. The cylinders 30 are carried by or formed in the frame of press 10.

Referring now to Figures 2 and 3, each of the valve assemblies 32, 34, 36, and 38 has a body 40 formed with a bore 42. As shown schematically in Figure 2, a pipe 44 connects an opening in a first end plate 46 secured to the body 40 by any convenient means to an opening formed in the wall of the cylinder 30 with which the particular valve assembly 32, 34, 36, or 38 is associated. It will be appreciated that the pipes 44 provide communication between the respective bores 42 and the interiors of cylinders 30. As is indicated in Figure 3, in the actual construction of my assembly, the valve body of 40 may be secured to the wall of the associated cylinder 30 by means such as welding or the like with bore 42 communicating directly with the interior of the cylinder. I dispose a piston 48 provided with a bore 50, one end of which is closed by the piston head 52, within the bore 42 of the valve body. Springs 54 bear between heads 52 and end plates 56, which are secured to bodies 40 by any convenient means such as bolts 58, to urge the pistons 48 to the left as viewed in Figure 2. One edge of an annular enlargement 60 formed in bore 42 provides a seat 53 for head 52. A bore 62 in the wall of body 40 communicates with the enlargement 60 to permit any fluid in this enlargement to pass out of the valve and into a relief pipe 64.

A fitting 66 connects a supply pipe 68 to an opening 70 in wall 56, which opening leads into bore 42. I provide the wall of piston 48 with openings 72 communicating with a second annular enlargement 74 in bore 42. A passage 76 in the wall of body 40 bypasses enlargement 60 to permit fluid to flow from the enlargement 74 into the portion of bore 42 to the left of seat 53 as viewed in Figure 3. I dispose a check valve, including a ball 78 urged against a seat 80 by a spring 82, in passage 76. For purposes of clarity the passages 76 are shown as external pipes 84 in Figure 2. In this figure, the check valves including balls 78 are indicated schematically by the reference characters 86.

In a normal condition of any one of my valve assemblies 32, 34, 36, or 38, its spring 54 urges piston 48 to the left as viewed in Figures 2 and 3 to urge head 52 against seat 53. Fluid under pressure fed into bore 42 passes through openings 72 into enlargement 74, through passage 76, past ball 78 and into the portion of bore 42 to the left of seat 53. It is to be understood that in this condition of a valve, the wall of piston 48 engages the

portion of the wall of body 40 separating enlargements 60 and 74 to form a valve which prevents entry of fluid into enlargement 60. If, as will be explained hereinafter, the pressure in the portion of bore 42 to the left of seat 53 increases to urge head 52 to the right as viewed in Figures 2 and 3 against the action of spring 54, the piston 48 moves to permit communication between enlargements 60 and 74 to allow fluid being fed to the valve to be relieved through pipe 64.

T-fitting 88 connects the supply pipes 68 leading to the respective valve assemblies 36 and 38 to a pipe 90. A fitting 92 connects pipe 90 and the pipes 68 leading to the respective valve assemblies 32 and 34 to the main supply pipe 94. My hydraulic system includes a pump 96, the shaft 98 of which is driven by a motor 100. A pipe 102 connects the inlet of pump 96 to a source (not shown) of fluid such as oil. A check valve 104 connects the outlet side of pump 96 to a relief valve 106 connected to the main supply pipe 94. Check valve 104 permits fluid to be pumped into the system but prevents oil from returning to the pump. Relief valve 106 permits fluid to flow out of the system through a pipe 108 if the fluid pressure exceeds a predetermined value. A valve 110 connected to line 94 may be actuated to permit fluid to enter a pressure meter 112.

My system includes an accumulator, indicated generally by the reference character 114, which maintains the oil in the system at a predetermined pressure corresponding to the required tie rod tension. Accumulator 114 is made up of a first cylinder 116 and a second cylinder 118. Respective pistons 120 and 122 move together and cooperate with the respective cylinders 116 and 118. A pipe 124 communicates with the interior of cylinder 116 to supply air under pressure to the cylinder below the piston 120. A pipe 126 connects the interior of cylinder 118 over piston 122 to supply pipe 94 to permit oil to enter cylinder 118. A pump 126, the inlet side of which is connected to the atmosphere by a pipe 128, supplies compressed air to an outlet pipe 130. A motor 132 drives the shaft 134 of pump 126. A regulating valve 136 connects pipe 130 to pipe 124. A gauge 138 connected to pipe 124 indicates the air pressure within the system. Air pumped into the system by pump 126 passes through valve 136 and through pipe 124 into cylinder 116 below piston 120. This air tends to drive the piston 120 and the piston 122 upwardly as viewed in Figure 2 to exert a pressure on the oil in cylinder 118. The oil, being substantially incompressible, transmits this pressure to the pistons 24 through the respective valve assemblies 32, 34, 36 and 38. It is to be noted that the area of piston 120 on which the air under pressure acts is much greater than the area of piston 122 which acts on the oil in cylinder 118. Owing to this difference in the area of the pistons, a particular pressure per unit area applied to piston 120 results in a much greater pressure per unit area exerted on the oil by piston 122. Stated otherwise, my accumulator 114 provides a multiplication of pressure.

I provide motor 132 with a regulating system which ensures that the pressure exerted on piston 120 is within certain predetermined limits. A rod 140 carried by piston 120 for movement with it, passes through an opening 142 in the top of cylinder 116. Respective spaced fingers 144 and 146 on the rod are adapted to actuate limit switch arms 148 and 150 as piston 120 moves respectively down and up in cylinder 116. The limit switches 152 and 154 associated with arms 148 and 150 control the operation of motor 132. Respective conductors 156 and 158 connect motor 132 to the terminals 160 and 162 of a suitable source of electrical energy. Limit switch 154 has a normally closed contact arm 164 connected in series with a normally open contact arm 166 in conductor 156. With neither of the fingers 144 or 146 engaging an arm 148 or 150, the switches are in the condition shown in Figure 2 and motor 132 is not energized. If the

5

pressure under piston 120 drops below a predetermined pressure, finger 144 engages arm 148 to close the contact arm 166 of switch 152. This action completes the circuit of motor 132 which drives pump 126 to supply fluid under pressure to cylinder 114. As the pressure under piston 120 increases, the piston moves upwardly and arm 148 is released. In order to maintain the circuit of motor 132 after arm 148 is released, I connect a relay winding 168 between conductors 156 and 158. When arm 166 is closed, winding 168 is energized to close a normally open switch 170 through a linkage 172. I connect switch 170 across arm 166 to maintain the motor circuit after finger 144 releases arm 148 to permit arm 166 to open. As pump 126 continues to drive air into cylinder 114, piston 120 moves upwardly until finger 146 actuates arm 150. When this occurs, switch arm 164 opens to interrupt the circuit of motor 132 and the circuit of holding relay 168. The motor stops and its control circuit is returned to its initial condition.

When any one of the valve assemblies 32, 34, 36, and 38 is actuated, fluid is permitted to pass out of the system through relief pipes 46. It may pass from these pipes into any suitable means such as a sump tank or the like 174.

When an overload occurs owing to an irregular sheet of stock being fed to the press, it is desirable that the press be stopped. Referring to Figure 3, a plug 176 screwed into a bore in the wall of body 40 slidably supports a switch actuating pin 180. A spring 182 bears between plug 176 and a head 184 formed on pin 180. When piston 48 moves to the right as viewed in Figure 3, its head 52 cams pin 180 outwardly of bore 42 against the action of spring 182. The resulting movement of pin 180 is employed to actuate a suitable control (not shown) of a type known to the art to stop the press by unclutching the press drive from the flywheel. It is to be understood that I provide a switch actuating pin 180 for each of the valve assemblies 32, 34, 36, and 38.

Referring now to Figure 4, I have shown a second form of my overload relief assembly for a power press including a blank holder slide 182 mounted for reciprocation on a press frame (not shown) in a manner known to the art and an inner slide 184 also mounted for reciprocation on the press frame within the blank holder slide. The press, which may for example be a two-point suspension press, includes respective inner slide drive pitmans 186 and 188 which are driven in a manner known to the art to reciprocate inner slide 184. Respective pins 190 and 192 carrying bushings 194 and 196 pivotally connect pitmans 186 and 188 to the heads 198 and 200 of inner slide adjusting screws 202 and 204. Respective adjusting nuts 206 and 208 have threaded bores through which screws 202 and 204 pass. Worms (not shown) are driven in a manner known to the art to drive nuts 206 and 208 to adjust the position of slide 184 on the press frame.

Slide 184 carries a pair of cylinders 210 and 212 which house respective pistons 214 and 216. Respective passages 218 and 220 are adapted to admit fluid under pressure to the interior of cylinders 210 and 212 to force pistons 214 and 216 upwardly as viewed in Figure 4 against stop rings 222 and 224 carried by the cylinders. Bolts 226 secure respective housings 228 and 230 disposed over nuts 206 and 208 to the pistons 214 and 216.

I provide a hydraulic system, similar to that described in connection with the tie rod relief system shown in Figures 1 to 3, for supplying fluid under pressure to cylinders 210 and 212. This system includes respective valve assemblies indicated generally by the reference characters 232 and 234, the outlet ports of which are connected to cylinders 210 and 212. Valve assemblies 232 and 234 are of the same construction as the valve assemblies 32, 34, 36, and 38 of the form of my invention shown in Figure 2. The remainder of the fluid system of the form of my invention shown in Figure 4 is the same as that of

6

Figure 2. Accumulator 114 which may conveniently be carried by inner slide 184 operates to supply fluid such as oil under a predetermined pressure to pipe 94. The inlet ports of the respective valves 232 and 234 are connected to pipe 94. Pump 96 which supplies oil to the accumulator 114 over the piston 122 has its intake 102 disposed in a reservoir 236 formed in or carried by the inner slide 184. The system for supplying air under pressure to accumulator 114 under piston 120 is the same as that shown in Figure 2.

While in Figure 4 I have shown a two-point suspension press, it is to be understood that a four-point system may as well be used. Further, while I have shown a relief system for the press inner slide, it is to be understood that a similar system could be applied to the driving connections of blank holder slide 182. In any case, the operation of the system is the same.

In operation of the form of my improved overload relief assembly for power presses shown in Figures 1 to 3, the motor 100 drives pump 96 to supply oil to the system. Motor 132 is driven to supply air to cylinder 114 under piston 120 to exert a predetermined pressure on the oil in the system. The oil transmits this pressure to the respective pistons 24 carried by the press tie rods. In the normal condition of my system the tie rods are thus placed under a predetermined tension. When any one of the rods is overloaded, its piston 24 displaces fluid out of the cylinder 30 and into the bore 42 of the associated valve assembly 32, 34, 36, or 38. As a result of this action, the piston 48 moves to the right as viewed in Figures 2 and 3 to permit communication between enlargements 60 and 74 to permit the oil in the system to flow out of relief pipes 64 into sump 174. I construct piston 48 so that the valve formed by the engagement of the piston wall with the part of the bore between enlargements 60 and 74 opens slightly before head 52 is unseated to permit the system pressure to be relieved slightly before the pressure on the overloaded rod is relieved. When any one of the valve assemblies 32, 34, 36, or 38 is actuated, pressure throughout the system is relieved. Owing to the normal tension on the remaining tie rods of the system, these rods force fluid out of their associated cylinders 30 against the relieved pressure in the supply system to actuate their respective valve assemblies. It will be seen that actuation of any one of the valve assemblies results in operation of the remaining valve assemblies with the result that tension on all the tie rods is relieved. Motor 132 maintains the fluid pressure in the system through accumulator 114 in a manner described hereinabove. Any oil lost during an overload is replenished by the operation of pump 96.

In operation of the form of my invention shown in Figure 4, if the press inner slide 184 encounters a load over a predetermined load so that one of, or both of, the pitmans 186 or 188 is overloaded, the system operates to relieve the load on both pitmans. Assuming for example, that pitman 186 is overloaded, its associated piston 214 forces fluid back through passage 218 to valve assembly 232. In response to this fluid, the piston 48 moves to the right as viewed in Figure 3 to permit fluid entering the valve assembly to flow through ports 72 and from annular recess 74 to recess 60 and from recess 60 through relief pipe 64 back to the reservoir. After this connection is established, piston head 52 moves a slight distance to the right as viewed in Figure 3 to permit fluid from the cylinder 210 to flow out through relief pipe 64. It will be seen that in response to an overload on either of the pitmans 186 and 188 the fluid pressure throughout the entire system is relieved. The system as applied to a four-point suspension press or to the blank holder slide of a press functions in the same manner.

It will be seen that I have accomplished the objects of my invention. I have provided an overload relief assembly for power presses which relieves tension on all the

press tie rods in response to an overload imposed on any one of the rods. My system prevents damage to the press parts owing to an unsymmetrical overload applied to the press as when a sheet of material of irregular thickness is fed to the press. My system operates in response to an overload on any one of the press tie rods. It may be applied to press slides suspensions as well as to the tie rods.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is therefore to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. In a power press having a pair of elements subjected to stress and a member to which said elements are connected, respective piston and cylinder units for connecting said elements to said member, said units being adapted to transmit stress between the respective elements and said member when fluid under pressure is present in the cylinders, a common fluid system for supplying fluid to said units, and respective valve assemblies providing communication between said cylinders and said system, each of said assemblies comprising a valve responsive to a predetermined pressure difference between the associated cylinder pressure and the common system pressure resulting from an increase in cylinder pressure for relieving the common system pressure.

2. In a power press having a pair of elements subjected to stress and a member to which said elements are connected, respective piston and cylinder units for connecting said elements to said member, said units being adapted to transmit stress between the respective elements and said member when fluid under pressure is present in the cylinders, a common fluid system for supplying fluid to said units, and respective valve assemblies providing communication between said cylinders and said system, each of said valve assemblies comprising a first normally closed valve adapted to relieve the pressure in its corresponding cylinder and a second normally closed valve adapted to relieve the pressure in said system, each of said first and second valves being responsive to a predetermined increase in pressure in the corresponding cylinder to relieve the system and cylinder pressure.

3. Apparatus as in claim 2 in which each of said assemblies includes a check valve for connecting said system to the corresponding cylinder.

4. Apparatus as in claim 2 in which said first and second valves comprise a valve cylinder formed with a pair of respective valve seats, a piston disposed within said valve cylinder having a pair of valve heads for cooperation with the respective seats, a relief opening formed in said valve cylinder between said seats, means normally urging said piston to seat said heads, said piston urging means being responsive to a predetermined pressure to permit said piston to move to unseat said heads.

5. Apparatus as in claim 2 in which said first and second valves comprise a valve cylinder formed with a pair of respective spaced valve seats, a hollow piston disposed within said valve cylinder and having a pair of valve heads for cooperation with the respective seats, means providing communication between said system and one

end of said valve cylinder, means providing communication between the other end of the valve cylinder and the corresponding unit cylinder, means forming a relief opening in said valve cylinder between said valve seats, and means for urging said piston to seat said heads on said seats to prevent communication between said system and said relief opening and between said corresponding unit cylinder and said relief opening, said piston urging means being responsive to a predetermined increase in pressure in said corresponding unit cylinder to permit said piston to be displaced to relieve the pressure in said unit cylinder and in said system.

6. Apparatus as in claim 2 in which said first and second valves comprise a valve cylinder formed with a pair of respective spaced valve seats, a hollow piston disposed within said valve cylinder and having a pair of valve heads for cooperation with the respective seats, means providing communication between said system and one end of said valve cylinder, means providing communication between the other end of the valve cylinder and the corresponding unit cylinder, means forming a relief opening in said valve cylinder between said valve seats, means for urging said piston to seat said heads on said seats to prevent communication between said system and said relief opening and between said corresponding unit cylinder and said relief opening, said piston urging means being responsive to a predetermined increase in pressure in said corresponding unit cylinder to permit said piston to be displaced to relieve the pressure in said unit cylinder and in said system, and a check valve bypassing said first and second valves to connect said unit cylinder to said source.

7. Apparatus as in claim 2 in which said common fluid system comprises an accumulator having a first cylinder and a second cylinder, said first cylinder having a small diameter relative to the diameter of the second cylinder, respective first and second pistons disposed in said cylinders, means connecting said first and second cylinders for movement as a unit, means for supplying air under pressure to said second cylinder and means responsive to movement of said pistons for regulating said air supplying means.

8. Apparatus as in claim 2 including means for causing said second valve to operate slightly in advance of said first valve in response to said predetermined pressure increase in the corresponding cylinder whereby said system pressure is relieved slightly before said unit pressure is relieved.

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