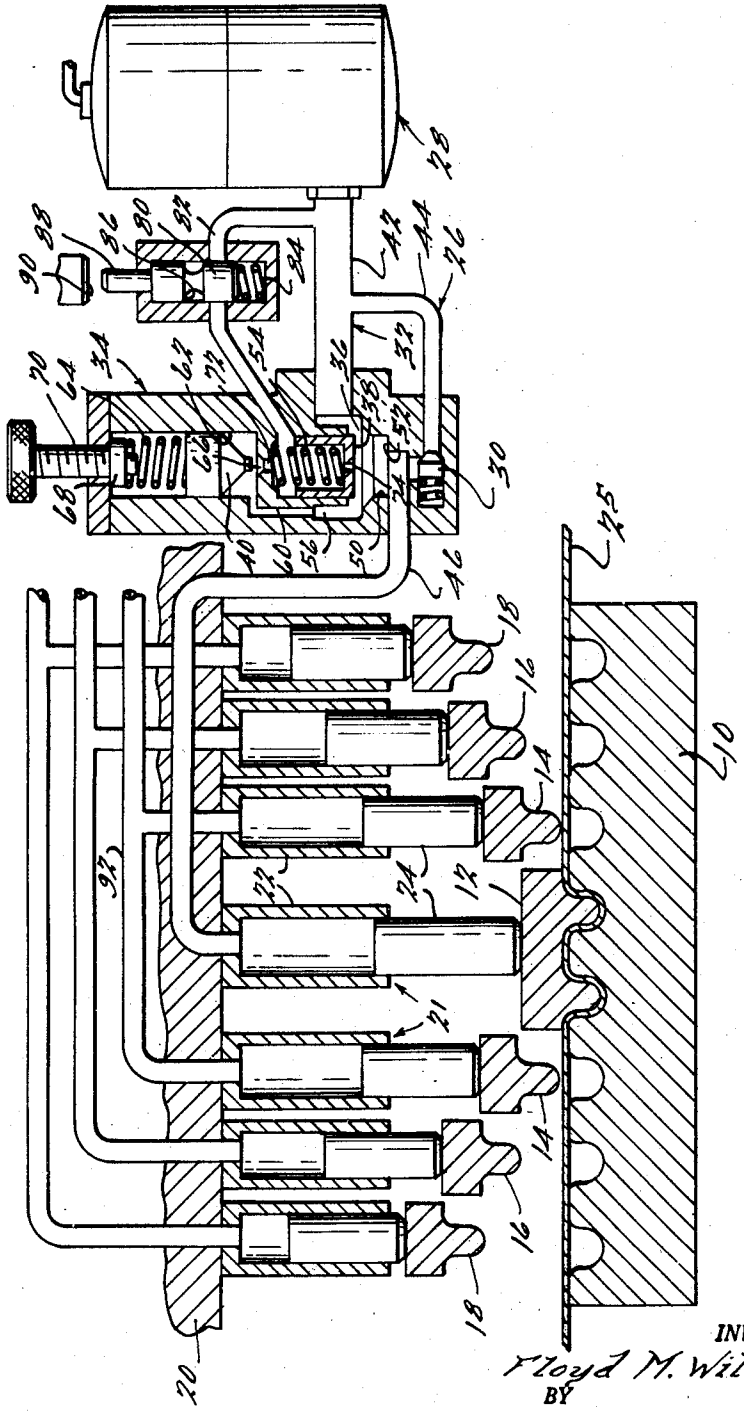
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HYDRAULIC CUSHIONS FOR DIE PADS OF RAM TYPE PRESSES

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HYDRAULIC CUSHIONS FOR DIE PADS OF RAM TYPE PRESSES

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This invention relates to hydraulic cushions for die pads of ram type presses and has particular reference to the hydraulic system for such cushions which makes it possible to dissipate the pressure of the cushion prior to the completion of the power stroke of the ram. The invention is particularly useful in connection with a ram type press having a set of dies operable for performing a plurality of operations in series upon a sheet of metal, such for example, as forming corrugations in the sheet.

A principal object of the invention is to provide a new and improved hydraulic cushion for die pads of ram type presses and more particularly a hydraulic system therefor which makes it possible to dissipate the pressure of the cushion prior to completion of power stroke of the press ram.

Another object of the invention is to provide a hydraulic system for controlling the dies of a set operable for performing a plurality of operations in series upon a sheet of metal.

Other and further objects of the invention will be apparent from the following description and claims and may be understood by reference to the accompanying drawing, of which there is one sheet, which by way of illustration shows a preferred embodiment of the invention and what I now consider to be the best mode of applying the principles thereof. Other embodiments of the invention may be used without departing from the scope of the present invention as set forth in the appended claims.

The drawings schematically and fragmentarily illustrate a hydraulic system embodying my invention associated with a ram type press having a set of dies operable for performing a plurality of operations in series upon a sheet of metal.

As illustrated in the drawings, a ram type press having a lower die 10 and a set of upper dies 12, 14, 16 and 18 is provided with a hydraulic cushion 21 between each of the dies of the set and the ram 20, each cushion including a cylinder 22 and a piston or plunger 24 and being arranged to react on a die such as the die 12. The dies 12, 14, 16 and 18 as schematically illustrated include an integral pad upon which the hydraulic cushion reacts for biasing the pad and die carried thereby to its extended position. A fluid connection indicated generally at 26 extends between a tank 28 of hydraulic fluid under pressure and the cylinder 22 of the cushion 21 for the die 12 whereby hydraulic fluid under pressure is supplied from the tank 28 to such cylinder 22 for biasing the die pad and die 12 to its extended position. Return flow through such connection is prevented by check valve 30. A second fluid connection indicated generally at 32 extends between the cylinder of the cushion 21 associated with the die 12 and the tank 28 and has a pressure relief valve indicated generally at 34 therein, whereby resistance to displacement of hydraulic fluid from such cylinder 22 is provided so as to form a hydraulic cushion for the die pad. A by-pass 36 is provided around the pressure relief valve and includes a normally closed unloading valve 38 which is disposed in

the fluid connection 32 between the pressure relief valve 34 and the cylinder 22 of the cushion 21. The unloading valve 38 opens in response to a predetermined pressure differential across the valve following the opening of the pilot or pressure relief valve 40. Such pressure relief valve arrangement is disclosed and claimed in my prior application Serial No. 815,832, filed May 26, 1959, now Patent No. 2,938,718 for "Hydaulic Cushion for the Die Pad of a Ram Type Press."

The valve indicated generally at 34 which includes the valves 38 and 40 is a pressure relief valve, as is the valve 40. The valve 38 is essentially an unloading valve, but it too may be considered as a pressure relief valve.

The fluid connection 26 from the tank 28 to the cylinder 22 of the cushion 21 for the die 12 whereby hydraulic fluid under pressure is supplied from the tank to such cushion, includes a part of conduit 42, line 44, the valve chamber in which the check valve 30 is disposed and line 46 which extends between the chamber of the check valve 30 and the cylinder 22 for the cushion of the die 12. The check valve 30 offers substantially no resistance to flow of fluid from the tank 28 to the cylinder 22 but does prevent return flow through such connection.

The line 46 communicates with the bottom of a valve chamber 50 in which the unloading valve 38 is disposed. The chamber 50 includes a cylinder bore in which the valve 38 reciprocates, which is biased to its seat 52 by a spring 54. The valve 38 is normally closed under the influence of the spring 54 and when closed shuts off the flow of hydraulic fluid from the line 46 to the end of the line 42 which opens into an annular space 56 surrounding valve chamber 50 and communicating therewith when the valve 38 is open. A conduit 60 affords communication between the space 56 and the valve chamber or bore 62 in which the pilot valve is reciprocal. A spring 64 biases the pilot valve 40 to its seat 66 and the spring 64 is backed up by a collar 68 on the end of a threaded stem 70 whereby the spring pressure reacting on the pilot valve 40 may be increased or decreased. The seat 66 for the pilot valve 40 comprises a frusto-conical surface surrounding one end of a passage 72 which extends between the valve chamber 62 and the upper end of the valve chamber 50.

The valve member 38 is provided with a restricted orifice 74 between the opposite sides thereof. As the press ram 20 moves downwardly and before the die 12 engages the sheet 25, the valves 40 and 38 will be closed and the cylinder 22 will be full of hydraulic fluid under the pressure to which it is subjected by the pressure of the tank 28. As the ram 20 closes the die 12 will engage the sheet 25 and the pressure relief valve 34 will resist displacement of fluid from the cylinder 22. As the ram continues its closing movement the pressure in the cylinder 22 and the line 46 will increase and react through the orifice 74 and the valve chamber 50 on the upper side of the valve 38 on the pilot valve 40 which will unseat as soon as pressure for which it is set is exceeded. On opening, the pilot valve 40 will reduce the pressure on the upper side of the valve 38 causing the same to open and permit the escape of hydraulic fluid under pressure from the line 46 through the valve chamber 50 and into the line 42, thus by-passing the valve 40, and relieving the excess pressure in the cylinder 22 and line 46. However, even though the valve 38 is open continued closing movement on the ram will be opposed by the resistance offered by the valve 34 after the die 12 has performed its intended operation on the sheet 25. No purpose is served by maintaining such resistance in the cushion 21 for the die 12. To dissipate such resistance I provide a by-pass around the unloading valve 38 which includes a normally closed valve 80 arranged in a fluid line 82

which extends between the upper part of the valve chamber 50 and the line 42. The valve 80 normally is positioned by a spring 84 so as to prevent flow of hydraulic fluid through the line 82. However, it is provided with an annular groove 86 which is adapted to be brought into registry with the line 82 when the valve 80 is shifted so as to bleed off the pressure in the upper part of the valve chamber 50, even though the valve 40 is closed, so as to permit the valve 38 to shift from its closed position to the position illustrated and dissipate the pressure in the line 46 and the cylinder 22 connected thereto. The valve member 80 is provided with a stem 88 arranged to be engaged by an abutment 90 movable with the ram 20 of the press for opening the valve 80 after the die 12 has completed its forming operation so as to dissipate the pressure in the line 46 and the cylinder 22 connected therewith.

The cylinders 22 of the cushion for the dies 14 are connected to a line 92 which is provided with a valve arrangement like that for the line 46 between the tank 28 and the cylinders connected to the line 92. Similar arrangements are provided for the lines connected to the cylinders of the hydraulic cushions for the other dies 16 and 18. As illustrated the valve 80 is arranged so as to be opened by the ram of the press during its closing movement; however I contemplate that the valve 80 may be manually opened if desired.

While I have illustrated and described preferred embodiments of my invention, it is understood that these are capable of modification, and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a ram type press having a die, a hydraulic cushion for said die including at least one hydraulic cylinder provided with a piston therein arranged to react on said die; a tank of hydraulic fluid under pressure, a fluid connection between said tank and said cylinder having a check valve therein whereby hydraulic fluid under pressure is supplied from said tank to said cylinder and piston for biasing said die to its extended position but return flow through such connection is prevented, a second fluid connection between said tank and cylinder having a pressure relief valve therein whereby resistance to displacement of hydraulic fluid from the cylinder is provided so as to form a hydraulic cushion for said die, a by-pass around said pressure relief valve and including a normally closed unloading valve in said second fluid connection between said pressure relief valve and said cylinder, said unloading valve opening in response to a predetermined pressure differential across said valve following the opening of said pressure relief valve, a second by-pass around said pressure relief valve and including said normally closed unloading valve and a normally closed valve, and means actuated by the press ram prior to the completion of the power stroke thereof for opening said last-mentioned valve for dissipating the resistance to displacement of hydraulic fluid from said cylinder provided by said pressure relief valve.

2. In a ram type press having a die, a hydraulic cushion for said die including at least one hydraulic cylinder provided with a piston therein arranged to react on said die; a tank of hydraulic fluid under pressure, a fluid connection between said tank and said cylinder having a check valve therein whereby hydraulic fluid under pressure is supplied from said tank to said cylinder and piston for biasing said die to its extended position but return flow through such connection is prevented, a second fluid connection between said tank and cylinder having a pressure relief valve therein whereby resistance to displacement of hydraulic fluid from the cylinder is provided so as to form a hydraulic cushion for said die, a by-pass around said pressure relief valve and including a normally closed unloading valve in said second fluid connection between said pressure relief valve and said cylinder, said unloading valve opening in response to a predetermined pressure differential across said valve following the opening of said pressure relief valve, a by-pass around said unloading valve including a normally closed valve, and means for opening said last-mentioned valve prior to the completion of the power stroke of the press ram for dissipating the resistance to displacement of hydraulic fluid from said cylinder provided by said pressure relief valve.

3. In a ram type press having a die, a hydraulic cushion for said die including at least one hydraulic cylinder provided with a reciprocating plunger therein arranged to react on said die; a tank of hydraulic fluid under pressure, a fluid connection between said tank and said cylinder having a check valve therein whereby hydraulic fluid under pressure is supplied from said tank to said cylinder and plunger for biasing said die to its extended position but return flow through such connection is prevented, a second fluid connection between said tank and cylinder having a pressure relief valve therein whereby resistance to displacement of hydraulic fluid from the cylinder is provided so as to form a hydraulic cushion for said die, a by-pass around said pressure relief valve and including a normally closed unloading valve in said second fluid connection between said pressure relief valve and said cylinder, said unloading valve opening in response to a predetermined pressure differential across said valve following the opening of said pressure relief valve, and means for dissipating the resistance to displacement of hydraulic fluid from said cylinder provided by said pressure relief valve prior to the completion of the power stroke of the ram.

4. In a ram type press having a die, a hydraulic cushion arranged to react on said die, a tank of hydraulic fluid under pressure, a fluid connection between said tank and said cylinder having a check valve therein whereby hydraulic fluid under pressure is supplied from said tank to said cushion for biasing said die to its extended position but return flow through such connection is prevented, a second fluid connection between said tank and cushion having a pressure relief valve therein whereby said resistance to displacement of hydraulic fluid from said cushion is provided, a by-pass around said pressure relief valve and including a normally closed valve, and means for opening said last-mentioned valve prior to the completion of the power stroke of the press ram for dissipating the resistance to displacement of hydraulic fluid from said cushion provided by said pressure relief valve.

5. In a ram type press having a die, a hydraulic cushion for said die including at least one hydraulic cylinder provided with a reciprocating piston therein arranged to react on said die, a tank of hydraulic fluid under pressure, a fluid connection between said tank and said cylinder having a check valve therein whereby hydraulic fluid under pressure is supplied from said tank to said cylinder and piston for biasing said die to its extended position but return flow through such connection is prevented, a second fluid connection between said tank and cylinder having a pressure relief valve therein whereby resistance to displacement of hydraulic fluid from said cylinder is provided so as to form a hydraulic cushion for said die, and means for dissipating the resistance to displacement of hydraulic fluid from said cylinder provided by said pressure relief valve prior to the completion of the power stroke of the ram.

6. In a ram type press having a die, a hydraulic cushion for said die including at least one hydraulic cylinder provided with a reciprocating piston therein arranged to react on said die, a tank of hydraulic fluid under pressure, a fluid connection between said tank and said cylinder having a check valve therein whereby hydraulic fluid under pressure is supplied from said tank to said cylinder and piston for biasing said die to its extended position but return flow through said connection is prevented, a

second fluid connection between said tank and cylinder having a pressure relief valve therein whereby resistance to displacement of hydraulic fluid from said cylinder is provided so as to form a hydraulic cushion for said die, a by-pass around said pressure relief valve and including a normally closed valve, and means for opening said last-mentioned valve for dissipating the resistance to displacement of hydraulic fluid from said cylinder provided by said pressure relief valve.

7. In a ram type press having a set of dies operable upon closing of the press for performing a plurality of operations in series upon a sheet of metal, a hydraulic cushion for each die, a tank of hydraulic fluid under pressure, a fluid connection between said tank and each cushion having a check valve therein whereby hydraulic fluid under pressure is supplied from said tank to each cushion for holding its respective die in its extended position but return flow through such connection is prevented, a second fluid connection between said tank and each cushion and having a pressure relief valve therein whereby resistance to displacement of hydraulic fluid from said cushion is provided, a normally closed by-pass around the pressure relief valve in each of said second fluid connections, and means for opening the by-pass around each pressure relief valve when the die whose resistance to displacement is provided by said pressure relief valve, has performed its operation.

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