Aug. 23, 1966 F. M. WILLIAMSON 3,267,715

HYDRAULIC CONTROL FOR DIES IN RAM TYPE PRESSES

Filed Oct. 16, 1961 4 Sheets-Sheet 1

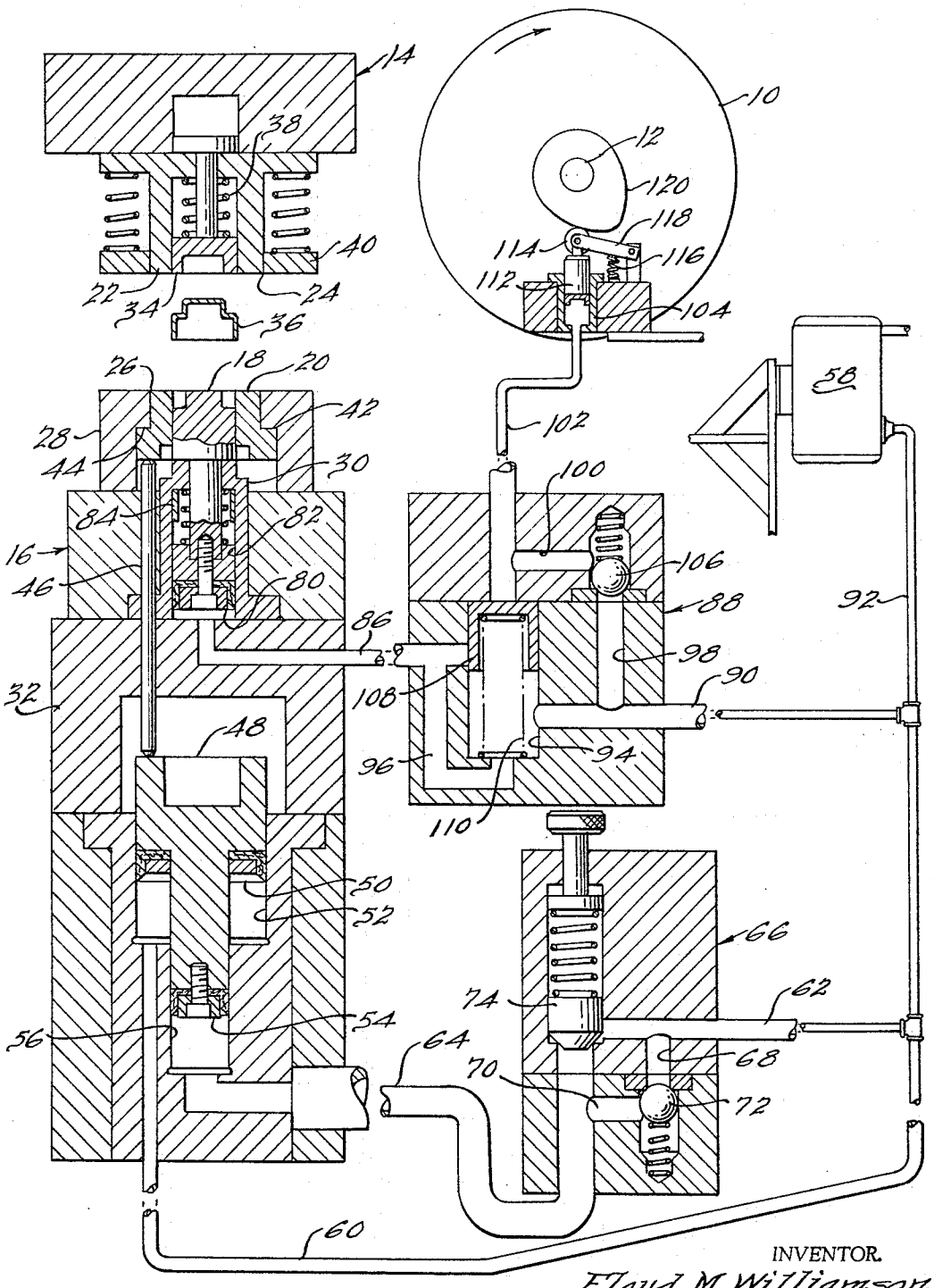

FIG. 1.

INVENTOR.
Floyd M. Williamson.
BY
Ballaff and McKinley
ATTORNEYS.

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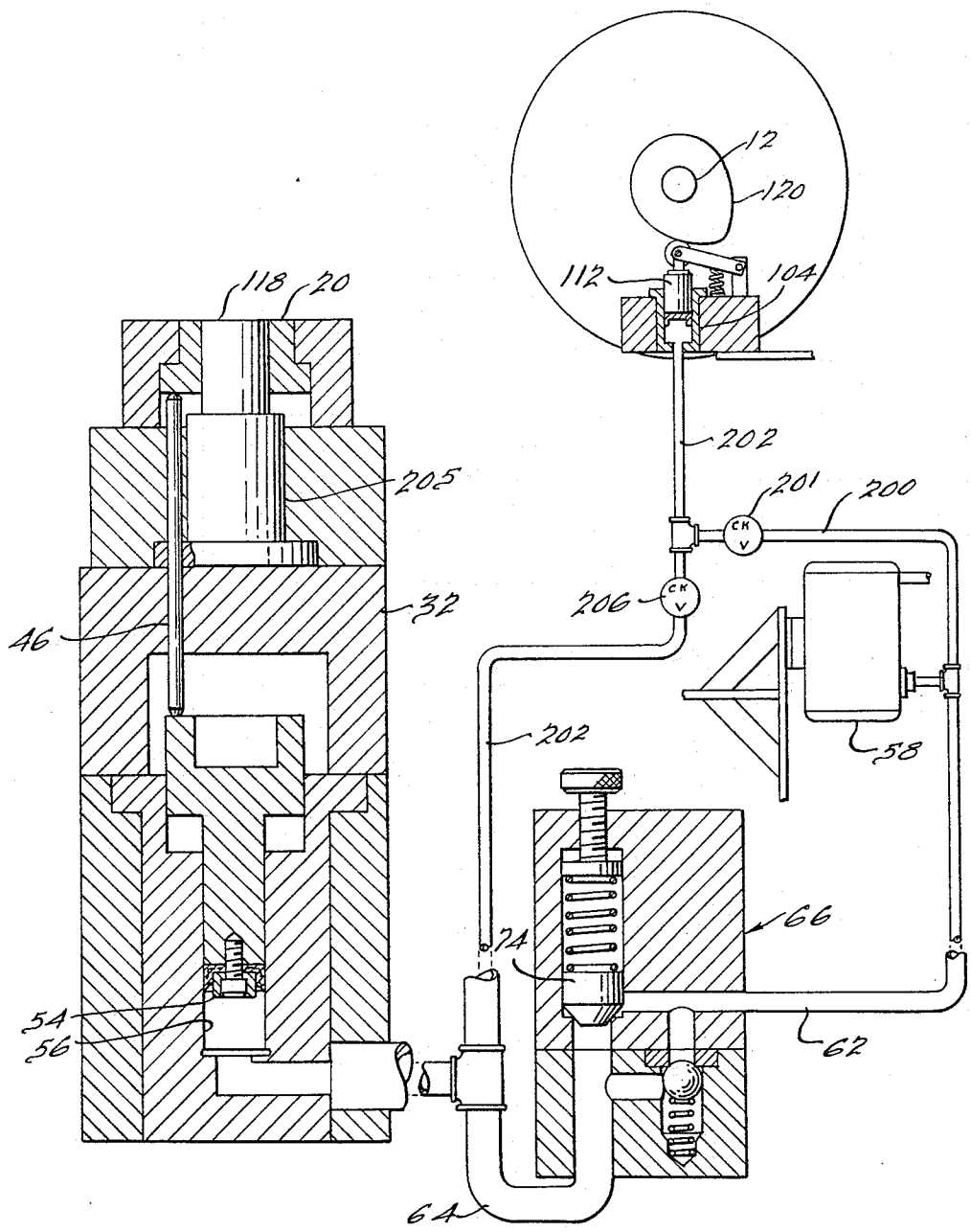

Fig. 2.

INVENTOR.
Floyd M. Williamson.
BY
Ballwff and McKinley
ATTORNEYS.

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HYDRAULIC CONTROL FOR DIES IN RAM TYPE PRESSES

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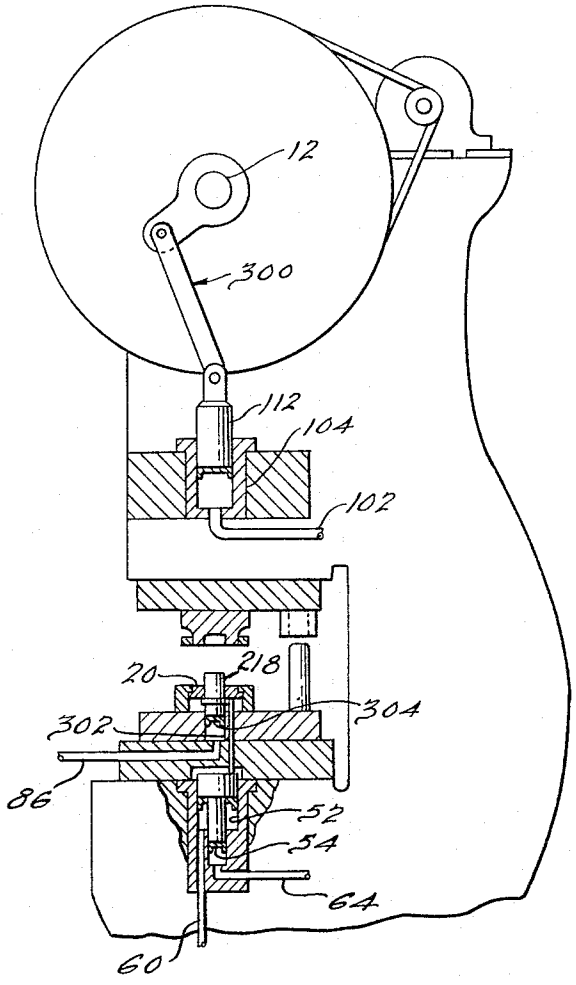

Fig. 3.

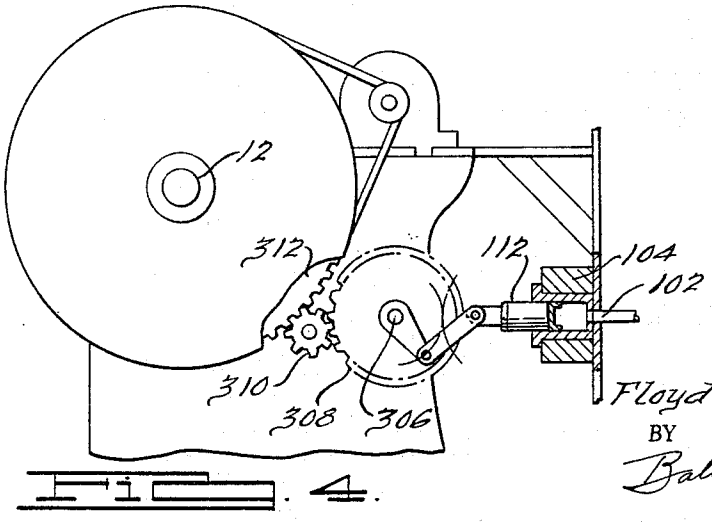

Fig. 4.

INVENTOR.
Floyd M. Williamson.
BY
Ballaff and McKinley
ATTORNEYS.

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HYDRAULIC CONTROL FOR DIES IN RAM TYPE PRESSES

Filed Oct. 16, 1961 4 Sheets-Sheet 4

FIG. 5.

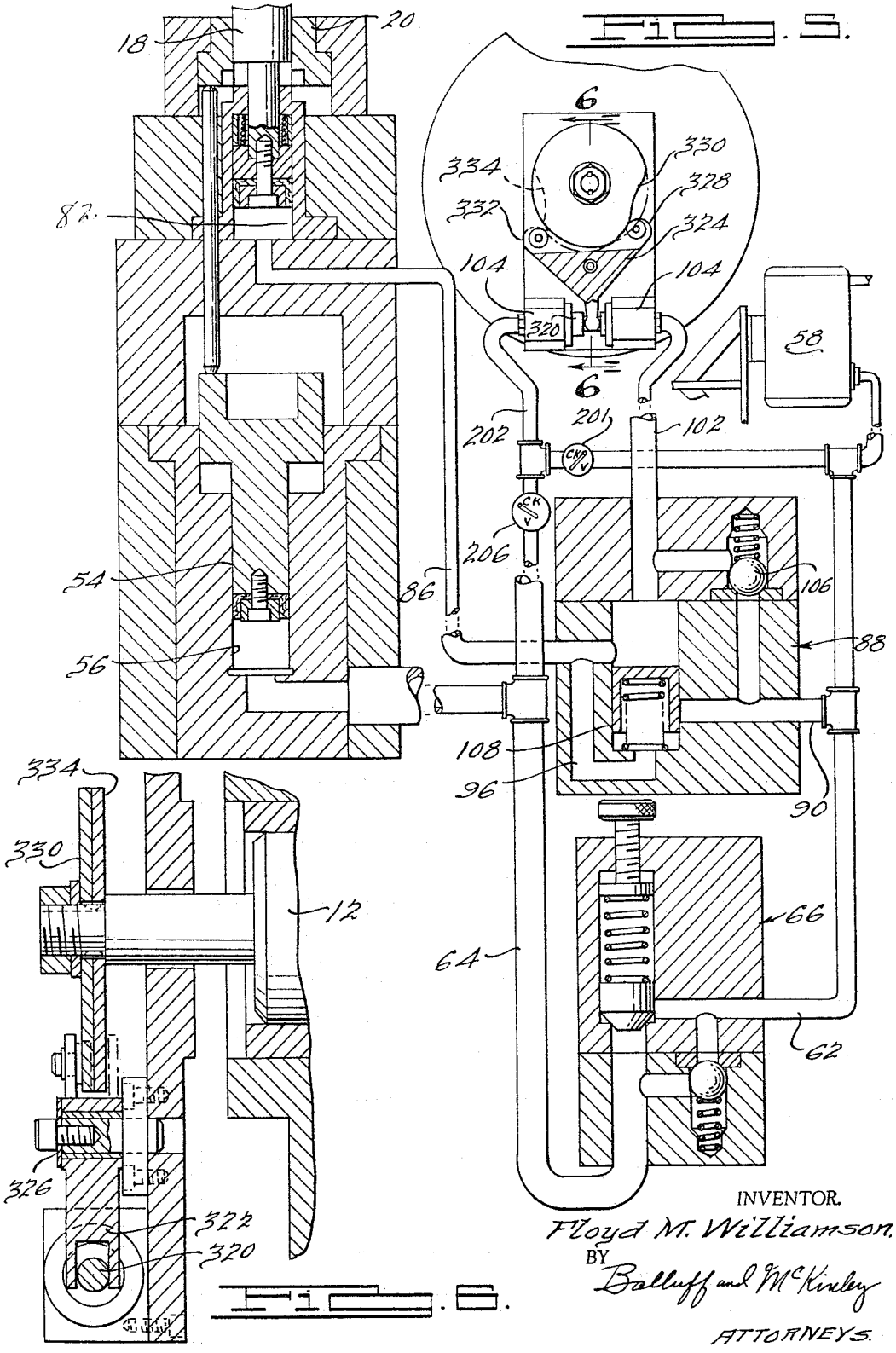

FIG. 6.

INVENTOR.
Floyd M. Williamson.
BY
Ballluff and McKinley
ATTORNEYS.

United States Patent Office 3,267,715 Patented August 23, 1966

3,267,715

HYDRAULIC CONTROL FOR DIES IN RAM TYPE PRESSES

Floyd M. Williamson, Detroit, Mich., assignor, by mesne assignments, to Di-Dro Engineering Company, Detroit, Mich., a corporation of Michigan

Filed Oct. 16, 1961, Ser. No. 145,297
6 Claims. (Cl. 72—351)

This invention relates to hydraulic controls for dies in ram type mechanical presses and has particular reference to certain improvements in hydraulic cushions for such presses of the type disclosed in my earlier Patents 2,901,238 and 2,938,718, and in my prior copending application Serial No. 114,264, filed June 1, 1961, issued as Patent No. 3,124,340, for "Hydraulic Control for Die Pads in Presses," the present application being a continuation-in-part of such prior copending application.

More particularly the present invention is directed to a hydraulic control system incorporationg means to advance or elevate a forming portion of a die in synchronism or in sequence with the movement of other movable sections of the die, or independently of movement of other sections of the die, during the cycle of press operation. This arrangement may be employed to expedite stripping of the work from the die as well as for work forming operations whereby a crank type press incorporating this invention may be operated at a substantially increased rate.

Accordingly, an object of the invention is to provide a new and improved hydraulic control for dies in ram type presses.

Another object of the invention is to provide a new and improved hydraulic die cushion for ram type presses.

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 drawings, of which there are four sheets, which by way of illustration show preferred embodiments 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.

In the drawings:

FIG. 1 is a schematic illustration of a crank type press embodying the invention;

FIG. 2 is a schematic view of the type shown in FIG. 1 and illustrating a modification of the invention;

FIG. 3 is a fragmentary side elevational view of a crank type press, partly in section, and showing a modified form of the invention;

FIG. 4 is a fragmentary view of a crank type press embodying a further modification of the invention;

FIG. 5 is a schematic view illustrating a further modification of the invention; and

FIG. 6 is an enlarged fragmentary sectional view taken along the line 6—6 of FIG. 5.

As illustrated in FIG. 1, a ram type mechanical press embodying the invention includes a flywheel 10 mounted on the crank 12 of the press to rotate therewith, a ram 14 which is reciprocated by the crank of the press, and a bolster 16 on which dies 18 and 20 are mounted. A punch 22 mounted on the ram 14 upon the descent of the ram is adapted to engage a sheet of metal positioned on the dies 18 and 20 and to clamp such sheet between the punch 22 and the die 20. The punch 22 is shown in its extended position and as it moves down during the closing movement of the press ram the outer peripheral edge 24 is cooperable with the inner peripheral edge 26 of the die block 28 to shear a work blank from the sheet and to frictionally clamp the periphery of such blank against the

upper surface of the die 20 as the die 20 moves down with the punch 22.

The die 18 as illustrated comprises a circular forming post which is disposed within the annular die 20. The die 18 is seated on the upper surface of a cylinder 30 which in turn is clamped by the bolster section 16 to the upper surface of the lower bolster section 32. As the punch 22 descends, a second punch 34 mounted on the ram 14 cooperates with the upper portion of the die 18 to form the blank into the desired form, such as the cup or cap 36. The punch 34 is movable relative to the punch 22 and is biased to its extended position by a spring 38. A spring pressed pressure plate 40 surrounds the punch 22 and is engageable with the sheet of material from which the blank is sheared to clamp the sheet against the upper surface of the block 28 during the opening and closing movement of the press ram.

The die 20 is reciprocably mounted in the die block 28 and is shown in its advanced or extended position which is determined by engagement of the shoulder 42 on the die 20 with the internal shoulder 44 on the die block 28. Under the pressure of the punch 22 the die 20 moves downward against a hydraulic cushion which biases the die 20 to its extended position and provides the pressure against which the punch 22 reacts during the closing of the press ram.

One or more rods 46 at their upper ends react on the die 20, and at their lower ends on a two-stage piston 48 which comprises a large diameter piston 50 which works in the hydraulic pressure cylinder 52 and a small diameter piston 54 which works in the high pressure hydraulic cylinder 56. A tank 58 containing hydraulic fluid under pressure is connected by a hydraulic fluid pressure transmitting connection 60 to the cylinder 52 whereby pressure of the fluid in the tank 58 is transmitted to the piston 50 so as to react on the rod 46 and bias the die 20 to its extended position. The tank 58 contains hydraulic fluid under a regulated pressure of the order of 100 lbs. per square inch. Hydraulic fluid pressure is also transmitted from the tank 58 through a hydraulic fluid pressure transmitting connection 62, 64 and a valve 66 to the high pressure cylinder 56 to react on the piston 54 therein for biasing the die 20 to its extended position. The hydraulic fluid pressure transmitting connection 62, 64 passes through a pressure relief valve indicated generally at 66 and includes intersecting passages 68 and 70 having a check valve 72 therein which permits the unrestricted flow of hydraulic fluid under pressure from the line 62 through the passage 68 past the check valve 72 and through the passage 70 into the line 64. This forms a by-pass around the normally closed pressure regulating valve 74 which will open when the pressure in the cylinder 56 and the line 64 rises above the pressure for which the valve 74 is set so as to permit the displacement of hydraulic fluid from the cylinder 56 under the control of valve 74.

From the foregoing it will be evident that the pressure in the tank 58 will react on the piston 50 to resist downward movement thereof, while the downward movement of the piston 54 will be resisted by the resistance created in the line 64 by the pressure regulating valve 74. This resistance will be substantially greater than the resistance afforded by the pressure in the tank 58. Thus the high pressure cylinder and piston 54, 56 provide the required resistance to retraction of the die 20 upon the closing of the press while the larger diameter piston 50 assists in returning the die 20 to its extended position to strip the work from the die Preferably the pressure regulating valve is of the type of construction illustrated in my prior Patent No. 2,938,718 or No. 2,901,238.

As above indicated, the die 18 is shown in its retracted position seated on the upper end of the cylinder 30. Integral with the die 18 is a piston 80 which works in the

cylinder bore 82 internally provided in the cylinder 30. A spring 84 confined between the piston 80 and a shoulder provided at the upper end of the cylinder bore 82 biases the die 18 to its retracted position as shown. The lower end of the cylinder bore 82 is connected by fluid pressure line 86 to a valve indicated generally at 88, which in turn is connected by fluid pressure line 90 to the manifold 92 that leads to the lower end of the tank 58. The line 90 communicates with a cylinder 94 in the valve 88, the lower end of which is connected by passage 96 to the line 86 whereby hydraulic fluid under tank pressure is supplied to the lower end of the cylinder bore 82 to react on the piston 80. However, the pressure thus provided is insufficient to overcome the spring 84 and hence the die 18 normally remains seated on the upper surface of the cylinder 30. The line 90 communicates with a passage 98 in the valve 88 which intersects a passage 100 which communicates with a line 102 that in turn communicates with a high pressure cylinder 104, whereby hydraulic fluid under tank pressure is supplied to the cylinder 104. A check valve 106 in the line 98 permits free flow from the line 98 into the line 100 while preventing reverse flow. The line 102 communicates with the upper end of the cylinder 94, as does the end of the line 86.

A piston type valve 108 slidable in the cylinder 94 is biased by a spring 110 so as to close the port through which the line 86 communicates with the cylinder 94, as well as the port through which the line 102 communicates with the cylinder 94. A piston 112 which works in the cylinder 104 carries a roller 114 which is biased by means of spring 116 and arm 118 against the outer surface of the cam 120 fixed to the crankshaft 12 to rotate therewith. As the press cycles, the high point on the cam reacting on the roller 114 will advance the piston 112 in the cylinder 104, thereby to discharge hydraulic fluid under high pressure to the line 102 and to valve 88. This will first shift the valve 108 so as to establish communication through the cylinder 94 between the lines 102 and 86 and then to close off the inner extremity of line 90, thereby forcing hydraulic fluid under high pressure into the cylinder bore 82 and advancing the die 18. The upward motion of the die 18 relative to the die 20 will strip the formed work 36 from the die 20. After the high point of the cam passes the roller 114, the high pressure in the cylinder 104 will be released and the pressure in the tank 58 will be effective to recharge the cylinder 104. The release of the high pressure in the cylinder 104 will permit the spring 110 to return the valve 108 to its position as illustrated, thus closing the port leading to line 86 and opening the port leading to line 90, thus permitting the discharge of hydraulic fluid from the cylinder bore 82 under the influence of spring 84 and retraction of die 18.

The cam 120 can be fixed at various positions on the crank shaft, depending upon when it is desired to elevate the die 18 to strip the work from the die 20 . The cam 120 may be set so as to advance the die 18 simultaneously with the closing of the press ram or prior thereto.

In the simplified arrangement schematically illustrated in FIG. 2 the large diameter cylinder and piston 52, 50, the valve 88, and the hydraulic pressure means operable by the crank of the press for moving the die 18 toward an extended position have been eliminated. Thus in the hydraulic control system of FIG. 2, hydraulic fluid under tank pressure is supplied through the line 200 past the check valve 201 to the line 202 which communicates with the high pressure cylinder 104 having a piston 112 therein operated by a cam 120 on the crankshaft 12, as per FIG. 1. The die 20 may be the same as in FIG. 1, whereas the central die 118 is fixed upon the upper end of a base 205 mounted upon the die block 32. The cylinder 56 and piston 54 in this case provide the hydraulic cushion for the die 20 and the cylinder 56 is connected through valve 66 with the tank of pressure fluid 58 in the same manner as in FIG. 1. However, in this case the high pressure cylinder 104 is connected by line 202 to the cylinder 56 via the line 64, a check valve 206 being included in the line 202 to prevent return flow of hydraulic fluid through the line 202 to the cylinder 104 when the piston 54 is subjected to pressure due to the closing of the press ram. Thus the high pressure cylinder 104 is employed to supply high pressure fluid to the cylinder 56 so as to apply pressure to the piston 54 for stripping purposes substantially in excess of the pressure supplied from the tank 58.

In the modification shown in FIG. 3 the piston 112 of the high pressure cylinder 104 is actuated by a crank and pitman indicated generally at 300 mounted on the crankshaft 12 instead of the cam 120 as shown in FIGS. 1 and 2. The line 102 communicating with the high pressure cylinder 104 is hooked up with the tank 58 by means of a valve 88 as shown in FIG. 1. In this modification the die 218 is movable relative to the die 20 but in a somewhat different fashion; that is, in FIG. 3 the die 218 is biased to its extended position as shown by a hydraulic cushion which includes the hydraulic cylinder 302 in which there is disposed a piston 304 which moves with the die 218. The cylinder 302 is connected to the valve 88 by a line 86 in the same way in which the cylinder 82 is connected to the valve 88 by the line 86 in FIG. 1. Thus the pressure normally reacting on the die 218 to maintain it in its extended position is the tank pressure, while the pressure developed in the high pressure cylinder 104 is supplied to the cylinder 302 to react on the piston 304 for advancing the die 218 for stripping purposes. The die 20 is backed up by a hydraulic cushion which is the same as that illustrated in FIG. 1.

In the arrangement illustrated in FIG. 4 the high pressure cylinder 104 is mounted on a bracket on the upper end of the press, and the piston 112 thereof is actuated by a crank and pitman arrangement like that shown in FIG. 3, but in this case the crank is mounted on a shaft 306 of a gear 308 which is driven through a pinion 310 from a gear 312 rotatable with the flywheel of the press. It will be understood that any of the arrangements illustrated in FIGS. 2, 3 and 4 may be employed for energizing the high pressure cylinder 104.

The arrangement illustrated in FIGS. 5 and 6 is in many respects like that illustrated in FIG. 1 except that the large diameter cylinder and piston 52, 50 have been eliminated and instead of having a single high pressure cylinder 104 energized by the rotation of the crank shaft, a double cylinder arrangement is employed, one to supply high pressure fluid to the cylinder 82 as in FIG. 1 and for advancing the die 18, and the other for supplying high pressure fluid to the small diameter piston 56 as in FIG. 2 for stripping purposes. Thus the die 18 is mounted and arranged as in FIG. 1 and the cylinder 82 thereof is connected to the tank 58 and to a high pressure cylinder 104 exactly as illustrated in FIG. 1. The axis of the cylinders 104, however, is oriented differently since it is a part of a double piston and cylinder arrangement which will be subsequently described.

The small diameter cylinder 56 which together with the piston 54 provides the hydraulic cushion for the die 20, as in FIG. 2, is connected to the tank 58 through the pressure regulating valve 66 and to a high pressure cylinder 104 exactly as illustrated in FIG. 2, whereby high pressure fluid from the second cylinder 104 may be supplied through the line 202 and the line 64 to the cylinder 56 for reacting on the piston 54 to provide additional pressure for stripping purposes.

Each of the high pressure cylinders 104 includes a piston like the piston 112, and such pistons are interconnected by a rod 320, a portion of which is straddled by a bifurcated arm 322. The arm 322 is carried by a rocker 324 arranged to pivot on pin 326. The rocker carries a roller 328 cooperable with a cam 330 and another roller 332 cooperable with a second cam 334, the cams 330 and 334 being mounted upon an extension

of the crankshaft **12** whereby the rocker **324** will energize the cylinders **104**. The cams **330** and **334** may be adjusted relative to each other, the object being to energize the high pressure cylinders **104** at the desired time to provide the high pressure fluid to the cylinder bore **82** and to the cylinder **56** so as to secure the desired movement of the dies **18** and **20**.

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 crank type press having a plurality of dies engageable with a work blank, one of said dies being movably mounted and disposed so as to be moved relative to the other die from an extended to a retracted position by a punch on the press ram upon the closing of the press ram, a hydraulic cushion for said one of said dies to resist such movement thereof and to effect return movement of said die to its extended position upon opening of the press ram, said hydraulic cushion comprising a hydraulic pressure cylinder having a piston therein movable with said one of said dies, a tank containing hydraulic fluid under pressure, a hydraulic fluid pressure transmitting connection between said tank and said hydraulic pressure cylinder whereby pressure of the fluid in said tank is transmitted to said piston so as to bias said one of said dies to its extended position, a normally closed pressure relief valve in said connection to provide a predetermined resistance, substantially greater than tank pressure, to flow of hydraulic fluid from said hydraulic pressure cylinder due to movement of said piston in said hydraulic pressure cylinder upon closing of the press ram, said other of said dies being positioned to engage and hold a portion of the work blank while the punch on the ram and said one of said dies draw the work blank thereover, and hydraulic pressure means operable by the crank of the press for generating hydraulic pressure substantially greater than tank pressure for moving one of said dies toward an extended position connected to said hydraulic pressure cylinder of said hydraulic cushion for supplying hydraulic fluid thereto at a pressure higher than that of the hydraulic fluid supplied through said connection from said tank.

2. In a press a die engageable with a work blank movably mounted and disposed so as to be moved from an extended to a retracted position by a punch on the press ram upon the closing of the press ram, a hydraulic cushion for said die to resist such movement thereof and to effect a return movement of said die to its extended position upon opening of the press ram, said hydraulic cushion comprising a hydraulic pressure cylinder having a piston therein movable with said die, a tank containing hydraulic fluid under pressure, a hydraulic fluid pressure transmitting connection between said tank and said hydraulic pressure cylinder whereby pressure of the fluid in said tank is transmitted to said piston so as to bias said die to its extended position, a normally closed pressure relief valve in said connection to provide a predetermined resistance to flow of hydraulic fluid from said hydraulic pressure cylinder due to movement of said piston in said hydraulic pressure cylinder upon closing of the press ram and hydraulic pressure means operable by the crank of the press for moving said die toward an extended position connected to said hydraulic pressure cylinder of said hydraulic cushion for supplying hydraulic fluid thereto at a pressure higher than that of the hydraulic fluid supplied through said connection for said tank.

3. In a press a die engageable with a work blank movably mounted and disposed so as to be moved from an extended to a retracted position by a punch on the press ram upon the closing of the press ram, a hydraulic cushion for said die to resist such movement thereof and to effect a return movement of said die to its extended position upon opening of the press ram, said hydraulic cushion comprising a hydraulic pressure cylinder having a piston therein movable with said die, a tank containing hydraulic fluid under pressure, a hydraulic fluid pressure transmitting connection between said tank and said hydraulic pressure cylinder whereby pressure of the fluid in said tank is transmited to said piston so as to bias said die to its extended position, and hydraulic pressure means operable by the crank of the press for moving said die toward an extended position connected to said hydraulic pressure cylinder of said hydraulic cushion for supplying hydraulic fluid thereto at a pressure higher than that of the hydraulic fluid supplied through said connection from said tank.

4. In a crank type press having a plurality of dies engageable with a work blank, one of said dies being movably mounted and disposed so as to be moved relative to the other die from an extended to a retracted position by a punch on the press ram upon the closing of the press ram, a hydraulic cushion for said one of said dies to resist such movement thereof and to effect return movement of said die to its extended position upon opening of the press ram, said hydraulic cushion comprising a hydraulic pressure cylinder having a piston therein movable with said one of said dies, a tank containing hydraulic fluid under pressure, a hydraulic fluid pressure transmitting connection between said tank and said hydraulic pressure cylinder whereby pressure of the fluid in said tank is transmitted to said piston so as to bias said one of said dies to its extended position, a normally closed pressure relief valve in said connection to provide a predetermined resistance, substantially greater than tank pressure, to flow of hydraulic fluid from said hydraulic pressure cylinder due to movement of said piston in said hydraulic pressure cylinder upon closing of the press ram, said other of said dies being positioned to engage and hold a portion of the work blank while the punch on the ram and said one of said dies draw the work blank thereover, and hydraulic pressure means operable by the crank of the press for generating hydraulic pressure substantially greater than tank pressure for moving said one of said dies toward an extended position connected to said hydraulic pressure cylinder of said hydraulic cushion for supplying hydraulic fluid thereto at a pressure higher than that of the hydraulic fluid supplied through said connection from said tank including a high pressure cylinder, a piston reciprocally received within said cylinder, a pivotally mounted lever, a roller rotatably secured to one end of the pivotally mounted lever in contact with said piston, a cam secured to the crank of said press engaged with said roller and resilient means operable on the lever for urging the roller into contact with the cam.

5. In a crank type press having a plurality of dies engageable with a work blank, one of said dies being movably mounted and disposed so as to be moved relative to the other die from an extended to a retracted position by a punch on the press ram upon the closing of the press ram, a hydraulic cushion for said one of said dies to resist such movement thereof and to effect return movement of said die to its extended position upon opening of the press ram, said hydraulic cushion comprising a hydraulic pressure cylinder having a piston therein movable with said one of said dies, a tank containing hydraulic fluid under pressure, a hydraulic fluid pressure transmitting connection between said tank and said hydraulic pressure cylinder whereby pressure of the fluid in said tank is transmitted to said piston so as to bias said one of said dies to its extended position, a normally closed pressure relief valve in said connection to provide a predetermined resistance, substantially greater than tank pressure, to flow of hydraulic fluid from said hydraulic pressure cylinder due to movement of said piston in said hydraulic pressure cylinder upon closing of the press ram, said other of said dies being positioned to engage and hold a portion of the work blank while the punch on the ram and said one of

said dies draw the work blank thereover, and hydraulic pressure means operable by the crank of the press for generating hydraulic pressure substantially greater than tank pressure for moving said one of said dies toward an extended position connected to said hydraulic pressure cylinder of said hydraulic cushion for supplying hydraulic fluid thereto at a pressure higher than that of the hydraulic fluid supplied through said connection from said tank including a high pressure cylinder, a piston reciprocally mounted in said cylinder and a crank and pitman connected between the piston and press crank for reciprocating said piston within said cylinder on actuation of said press.

6. In a crank type press having a plurality of dies engageable with a work blank, one of said dies being movably mounted and disposed so as to be moved relative to the other die from an extended to a retracted position by a punch on the press ram upon the closing of the press ram, a hydraulic cushion for said one of said dies to resist such movement thereof and to effect return movement of said die to its extended position upon opening of the press ram, said hydraulic cushion comprising a hydraulic pressure cylinder having a piston therein movable with said one of said dies, a tank containing hydraulic fluid under pressure, a hydraulic fluid pressure transmitting connection between said tank and said hydraulic pressure cylinder whereby pressure of the fluid in said tank is transmitted to said piston so as to bias said one of said dies to its extended position, a normally closed pressure relief valve in said connection to provide a predetermined resistance, substantially greater than tank pressure, to flow of hydraulic fluid from said hydraulic pressure cylinder due to movement of said piston in said hydraulic pressure

cylinder upon closing of the press ram, said other of said dies being positioned to engage and hold a portion of the work blank while the punch on the ram and said one of said dies draw the work blank thereover, and hydraulic pressure means operable by the crank of the press for generating hydraulic pressure substantially greater than tank pressure for moving said one of said dies toward an extended position connected to said hydraulic pressure cylinder of said hydraulic cushion for supplying hydraulic fluid thereto at a pressure higher than that of the hydraulic fluid supplied through said connection from said tank including a high pressure cylinder, a piston reciprocally mounted in said cylinder, a gear connected to be rotatable with the crank of the press, a pinion engaged with the gear, a second gear engaged with said pinion for rotation thereby and a crank and pitman structure connected between the second gear and the piston for reciprocating said piston in said cylinder on rotation of said second gear.

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CHARLES W. LANHAM, *Primary Examiner.*

NEDWIN BERGER, *Examiner.*

K. A. COCKS, R. J. HERBST, *Assistant Examiners.*