Feb. 29, 1944. W. W. CRILEY 2,342,645

CLUTCH CONTROL

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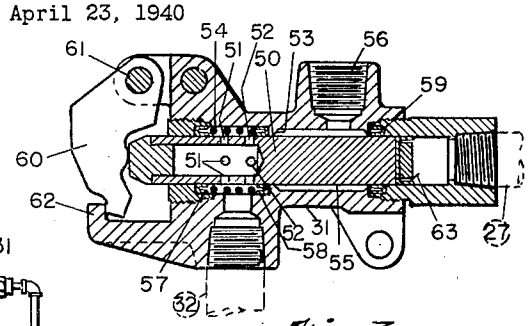


Fig. 3

Fig. 1

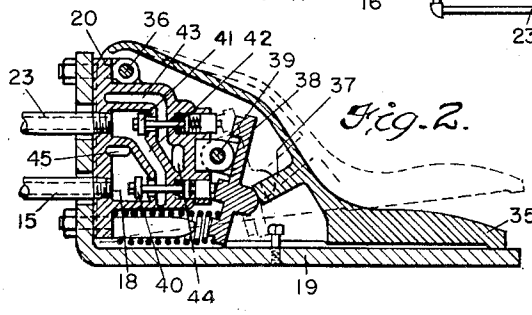


Fig. 2.

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CLUTCH CONTROL

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15 Claims. (Cl. 192—139)

The present invention relates to a mechanism for so controlling the operation of the driving elements of a metal working machine as to enhance its safety and to protect certain parts of the machine against wear and deterioration. The mechanism embodying the principle of my invention is particularly adapted to be used upon metal working machines of the character of forging machines and forging presses.

Generally outlined, the invention comprises two objectives: first, to prevent the machine from repeating its operating cycle without an intervening manipulation by the operator, and secondly, to control the maximum rate, e. g., the number of strokes per minute, at which the machine can be operated. The first of these objectives contributes to human safety in that the machine is definitely stopped at the end of each stroke and requires a distinct manipulation by the operator in order to repeat its cycle of operation, thus eliminating the hazard, for example, which heretofore has occurred when, even in automatically controlled machines, the drive shaft over-runs due to excess inertia, and re-trips the drive-engaging, actuating mechanism. The second of these objectives has for its major advantage, the prevention of over-heating and consequent deterioration of the dies by attempting a too rapid rate of operation of the machine.

Additional objects and advantages of the invention shall become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then consists of the means hereinafter fully described and particularly pointed out in the claims. The annexed drawing and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is an elevational view showing the mechanism embodying my invention as applied to the pertinent operative parts of a metal working machine, the latter, of course, merely being indicated in partial outline; Fig. 2 is a detailed, sectional view of the four-way manual valve employed in the control mechanism of Fig. 1; and Fig. 3 is a detailed, sectional view of the by-pass or exhaust valve employed in the control mechanism of Fig. 1.

Now referring more particularly to the drawing, there is shown therein the crank-shaft 1 of a metal working machine, such as a forging machine or a forging press. A cam 2 is carried on the crank-shaft 1, and as subsequently to be described, is adapted to contact certain actuating elements of my control mechanism. As is well-known to those skilled in the art, such a metal working machine comprises other major elements such as a drive motor, a clutch and brake, and possibly a high-speed shaft and gears, connecting the drive motor to the crank-shaft, and a connecting rod or pitman connecting the crank-shaft to the movable dies. Such component parts of the machine, and their assembly, being a matter of elemental knowledge to those skilled in the art, it is not deemed necessary to further describe or illustrate them herein.

A main control valve, indicated generally at 2 and preferably mounted upon the side frame of the machine, includes a clutch-actuating control valve 4, leading to the pressure line 5 and a brake-actuating control valve 6, leading to the pressure line 7. These two valves 4 and 6 are, in turn, connected to a piston rod 8 of the piston 9, reciprocable in the pressure cylinder 10. A latch pin 11 extends through the wall of the cylinder 10 and is adapted to engage in a stepped recess in the piston 9. An adjustable length connecting rod 12 connects the latch pin 11 to the bell-crank 13 which has a roller 14 on its opposite end and adapted to be contacted with the cam 2.

The last-described main or dual control valve mechanism constitutes the subject-matter of my co-pending application Ser. No. 192,956, filed February 28, 1938, and consequently, is not here described or illustrated in greater detail. Its detailed construction and mode of operation is accordingly herein incorporated by reference.

A pressure supply line 15, leading from a source of fluid pressure such as a compressed air tank (not shown) communicates with the line 16 leading to the intake manifold 17 on the main control valve 3. The pressure line 15 also connects with the inlet 18 of the four-way manually operated, or tread valve 19. The four-way valve 19 is suitably in the form of a standard foot treadle and comprises the outlets 20 and 21 and the exhaust outlet 22, in addition to the inlet 18. The outlet 20 connects through the line 23 to the valve cylinder 10. The outlet 21 connects through the line 24 to the parallel lines 25 and 26, by means of the T connectors, as shown, to the line 27. An adjustable throttle valve 28 is connected in the line 25 and includes the threadably mounted needle valve 29 which can be set to adjusted positions in order to regulate the amount of fluid flow through the line 25 and thence, to the line 27,

A check valve 30 is connected in the line 26 and so arranged as to prevent fluid pressure flow in a direction from the four-way valve 19 to the line 27, but not to prevent flow in the opposite direction.

The line 27 connects to the by-pass or exhaust valve 31, which is also mounted upon the side frame of the metal working machine and at a point adjacent the cam 2, whereby its mechanical parts are actuatable by the cam. A pressure line 32 connects the exhaust valve 31 to the cylinder 10. A shut-off valve 33 is connected in the line 32.

Fig. 2 is a sectional detail taken through two individual valves of the four in the foot treadle, four-way valve 19. The operating lever is in the form of a treadle 35 pivoted at the point 36, having an integral, projecting lug 37 adapted to contact with the rocker arm 38, which is pivotally mounted at 39. The rocker arm 38 contacts the projecting ends of the poppet valves 40 and 41. A passage 42 connects the seat side (righthand side) of the valve 40, with the head side (lefthand side) of the valve 41. A passage 43 connects the seat side of the valve 41 to the exhaust port 22 and also to the transverse passage 44. The transverse passage 45 also connects the space around the inlet 18 to the seat side of the corresponding poppet valve for the outlet 21. It is to be understood, of course, that there is a similar pair of poppet valves connected to the outlet 21 and the exhaust 22 and operated through the rocker arm 38.

The exhaust valve 31, shown in detail in Fig. 3, includes a movable valve member in the form of a piston 50, the lefthand portion of which is hollow and has a double series of ports 51 and 52 which are axially spaced apart a sufficient distance to bridge the partition wall 53. The partition wall 53 separates the larger diameter wall portions 54 and 55 of the cylinder in which the piston 50 reciprocates. The enlarged wall portion 54 is in communication with the line 32 and the enlarged wall portion 55 is in communication with the exhaust port 56. Suitable pressure seals are provided around the piston 50, such as indicated at 57, 58 and 59.

The lefthand end of the piston 50 is adapted to contact with the lever 60, which is pivotally mounted to the body of the valve 31 at 61. The outer end of the lever 60 is adapted to contact with the overhanging lip 62, and thereby to limit outward movement of the lever 60 and lefthand movement of the piston 50. As is shown in Fig. 1, the lever 60 is adapted to contact with the cam 2. The valve 31 is so mounted that the high spot, denoted 2' of the cam 2, when in contact with the lever 60, will move the piston 50 to its furthest righthand direction and thus place the line 32 in communication, through the ports 51 and 52, with the exhaust port 56.

The righthand end of the piston 50, carrying a cup washer 63, sealing it against pressure within its cylinder, is in communication with the end of the pressure line 27, so that pressure from the latter line is operable to move the piston 50 in a lefthand direction and to the position which it occupies as shown in Fig. 3.

The operation of the above-described mechanism is as follows: In order to start the metal working machine on its stroke or cycle of operation, the operator depresses the treadle 35, whereupon, pressure from the line 15 goes through the valve 40 to the outlet 20, to the line 23, to the cylinder 10, to move the piston 9 in a lefthand direction and to thus progressively open the valves 4 and 6. As the main control valves 4 and 6 are opened, they so control the introduction of pressure from the line 16 to the lines 5 and 7 as to release the brake and engage the clutch of the machine. At the same time, the latch 11 drops down into the recess in the piston 9, holding it in a lefthand position and the valves 4 and 6 in the position to which they have been so actuated. The crankshaft 1 then rotates in the direction of the indicating arrow, and through the majority of its working stroke, when the high spot 2' of the cam 2 contacts the cam lever 60 and moves the piston 50 in a righthand direction, or to its retarded position, where it remains for the time being.

Then, as the high spot 2' contacts the roller 14 the latch pin 11 is raised, permitting the piston 9 to move in a righthand direction under the pressure of the spring 65, whereupon, the valves 4 and 6 are closed, the clutch released and the brakes set, so that the machine stops.

If, during this last-described cycle of operation the operator holds the treadle 35 depressed, whether by mistake or intentionally, the machine will not repeat its stroke because any pressure introduced to the cylinder 10 will be inoperative to urge the piston 9 in a lefthand direction, since it is exhausted through the valve 31. Hence, in order to restart the machine, the operator must again release the treadle 35 (to a position shown in dotted lines in Fig. 2), whereupon, pressure from the pressure supply line 15 enters the line 24, to the line 25, through the throttle valve 28, to the line 27, to move the plunger 50 in a lefthand direction, closing the line 32 to exhaust, thus rendering the pressure cylinder 10 again operative when pressure is introduced to it. This, the operator does by depressing the treadle 35 and starting the machine on a repeat stroke or cycle of operation, as first described.

As the treadle 35 is depressed, the line 24 is placed in communication with the exhaust port 22, so that pressure from the line 27, through the line 26 and past the check valve 30, is relieved, and the plunger 50 thereby permitted to be moved in a righthand direction as the cam lever 60 is actuated from the cam high spot 2'.

It will be seen that the time required for resetting the exhaust valve 31, viz., moving the piston 50 in a lefthand direction, is dependent upon the rate at which pressure is built up or flows into the line 27 past the valve 28. This time interval can be varied from zero to infinity, dependent upon the setting of the needle valve 29. In this manner, the number of strokes per minute, or the rate of the operation of the machine, can be controlled to any desired amount, by setting the valve 28, since the operator will have to allow the treadle 35 to remain in its upward position for the required amount of time to re-set the valve 31 before he may again start the machine stroke.

The shut-off valve 33 is provided in the line 32 in the event that, for some particular reason, such as for test purposes, the above-described non-repeat and timing control operation is desired to be dispensed with. When the valve 33 is closed, the machine may then be run upon a repeated stroke operation merely by holding the treadle 35 in depressed position.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine, and another valve means actuated by said machine and connected to said pressure-actuated valve means for rendering the latter inoperative.

2. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine, and another valve means actuated by pressure from said manually actuated valve means and so connected to said pressure-actuated valve means as to require the intermediate manipulation of said manually actuated valve means between operating cycles of said pressure-actuated valve means to render the latter operative.

3. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine, another valve means actuated by pressure from said manually actuated valve means and so connected to said pressure-actuated valve means as to require the intermediate manipulation of said manually actuated valve means between operating cycles of said pressure-actuated valve means to render the latter operative, and means for adjustably regulating the rate of pressure transmission from said manually actuated valve means to said another valve means to vary the time interval of such intermediate manipulation.

4. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine, and another valve means connected to said pressure-actuated valve means and actuated by said machine in one direction to render said pressure-actuated valve means inoperative, said another valve means being also actuated by pressure from said manually actuated valve means in the opposite direction to render said pressure-actuated valve means inoperative.

5. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine, another valve means actuated both by said machine and by pressure from said manually actuated valve means, said another valve means being so connected to said pressure-actuated valve means as to require the intermediate manipulation of said manually actuated valve means between operating cycles of said pressure-actuated valve means to render the latter operative.

6. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine, another valve means actuated both by said machine and by pressure from said manually actuated valve means, said another valve means being so connected to said pressure-actuated valve means as to require the intermediate manipulation of said manually actuated valve means between operating cycles of said pressure-actuated valve means to render the latter operative, and means for adjustably regulating the rate of pressure transmission from said manually actuated valve means to said another valve means to vary the time interval of such intermediate manipulation.

7. In a control mechanism for a metal working machine, the combination of a pressure-actuated main control valve for controlling the operation of the driving mechanism for said machine, an exhaust valve connected to said main control valve, said exhaust valve being adapted to be opened by movement transmitted from said machine and to be closed by pressure actuation, the open position of said exhaust valve relieving pressure introduced to said main control valve to render the latter inoperative and the closed position of said exhaust valve preventing the relief of such pressure to render said main control valve operative, and a manual valve adapted to alternatively direct pressure to said main control valve and to said exhaust valve.

8. In a control mechanism for a metal working machine, the combination of a pressure-actuated main control valve for controlling the operation of the driving mechanism for said machine, an exhaust valve connected to said main control valve, said exhaust valve being adapted to be opened by movement transmitted from said machine and to be closed by pressure actuation, the open position of said exhaust valve relieving pressure introduced to said main control valve to render the latter inoperative and the closed position of said exhaust valve preventing the relief of such pressure to render said main control valve operative, a manual valve adapted to alternatively direct pressure to said main control valve and to said exhaust valve, and an adjustable throttle valve connected between said manual valve and said exhaust valve for variably regulating the rate of pressure flow to the latter.

9. In a control mechanism for a metal working machine, the combination of a pressure-actuated main control valve for controlling the operation of the driving mechanism for said machine, an exhaust valve connected to said main control valve, said exhaust valve being adapted

to be opened by movement transmitted from said machine and to be closed by pressure actuation, the open position of said exhaust valve relieving pressure introduced to said main control valve to render the latter inoperative and the closed position of said exhaust valve preventing the relief of such pressure to render said main control valve operative, a manual valve adapted to alternatively direct pressure to said main control valve and to said exhaust valve, an adjustable throttle valve connected between said manual valve and said exhaust valve for variably regulating the rate of pressure flow to the latter, and a check valve connected in parallel with said throttle valve for establishing unimpeded, one-way flow around the latter.

10. In a control mechanism for a metal working machine, the combination of a pressure-actuated cylinder and piston, control valves for introducing actuating pressure to the driving mechanism elements of said machine, said control valves being connected to and operated by said piston, a four-way, manually operated valve having an inlet, two outlets and an exhaust, a pressure supply line connected to said inlet, a second pressure line connecting one of said outlets to said cylinder, an exhaust valve adapted to be opened by movement transmitted from said machine, and to be closed by pressure actuation, a third pressure line connecting said cylinders to said exhaust valve, and a fourth pressure line connecting the other of said outlets of said four-way valve to said exhaust valve for pressure actuation of the latter, said four-way valve being adapted, in alternative positions of manipulation, to open said pressure supply line to either one of said outlets while connecting the other of said outlets, not so opened, to said exhaust.

11. In a control mechanism for a metal working machine, the combination of a pressure-actuated cylinder and piston, control valves for introducing actuating pressure to the driving mechanism elements of said machine, said control valves being connected to and operated by said piston, a four-way, manually operated valve having an inlet, two outlets and an exhaust, a pressure supply line connected to said inlet, a second pressure line connecting one of said outlets to said cylinder, an exhaust valve adapted to be opened by movement transmitted from said machine, and to be closed by pressure actuation, a third pressure line connecting said cylinders to said exhaust valve, a fourth pressure line connecting the other of said outlets of said four-way valve to said exhaust valve for pressure actuation of the latter, said four-way valve being adapted, in alternative positions of manipulation, to open said pressure supply line to either one of said outlets while connecting the other of said outlets, not so opened, to said exhaust, and an adjustable throttle valve connected in said fourth pressure line for variably regulating the rate of pressure flow therethrough to said exhaust valve.

12. In a control mechanism for a metal working machine, the combination of a pressure-actuated cylinder and piston, control valves for introducing actuating pressure to the driving mechanism elements of said machine, said control valves being connected to and operated by said piston, a four-way, manually operated valve having an inlet, two outlets and an exhaust, a pressure supply line connected to said inlet, a second pressure line connecting one of said outlets to said cylinder, an exhaust valve adapted to be opened by movement transmitted from said machine, and to be closed by pressure actuation, a third pressure line connecting said cylinders to said exhaust valve, a fourth pressure line connecting the other of said outlets of said four-way valve to said exhaust valve for pressure actuation of the latter, said four-way valve being adapted, in alternative positions of manipulation, to open said pressure supply line to either one of said outlets while connecting the other of said outlets, not so opened, to said exhaust, an adjustable throttle valve connected in said fourth pressure line for variably regulating the rate of pressure flow therethrough to said exhaust valve, and a check valve connected in parallel with said throttle valve.

13. In a control mechanism for a metal working machine, the combination of a pressure-actuated cylinder and piston, control valves for introducing actuating pressure to the driving mechanism elements of said machine, said control valves being connected to and operated by said piston, a four-way, manually operated valve having an inlet, two outlets and an exhaust, a pressure supply line connected to said inlet, a second pressure line connecting one of said outlets to said cylinder, an exhaust valve adapted to be opened by movement transmitted from said machine, and to be closed by pressure actuation, a third pressure line connecting said cylinders to said exhaust valve, a fourth pressure line connecting the other of said outlets of said four-way valve to said exhaust valve for pressure actuation of the latter, said four-way valve being adapted, in alternative positions of manipulation, to open said pressure supply line to either one of said outlets while connecting the other of said outlets, not so opened, to said exhaust, an adjustable throttle valve connected in said fourth pressure line for variably regulating the rate of pressure flow therethrough to said exhaust valve, a check valve connected in parallel with said throttle valve, and a manually operated shut-off valve connected in said third pressure line.

14. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine and another valve means connected to said pressure-actuated valve means for exhausting pressure therefrom and thereby rendering the latter inoperative.

15. In a control mechanism for a metal working machine, the combination of pressure-actuated valve means for initiating the operation of the driving mechanism of said machine, manually actuated valve means for controlling the introduction of pressure to said pressure-actuated valve means, machine actuated means connected to the latter for re-setting it to starting position at the end of one complete working cycle of said machine and another valve means actuated by said manually actuated valve means and so connected to said pressure-actuated valve means as to exhaust pressure therefrom and to require the intermediate manipulation of said manually actuated valve means between operating cycles of said pressure-actuated valve means to render the latter operative.

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