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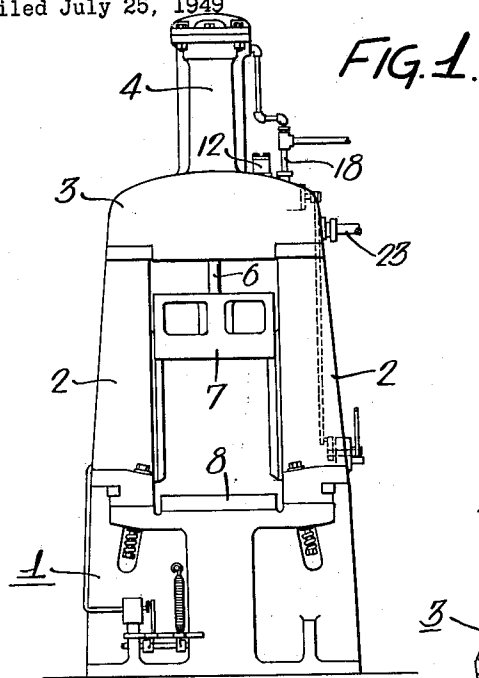
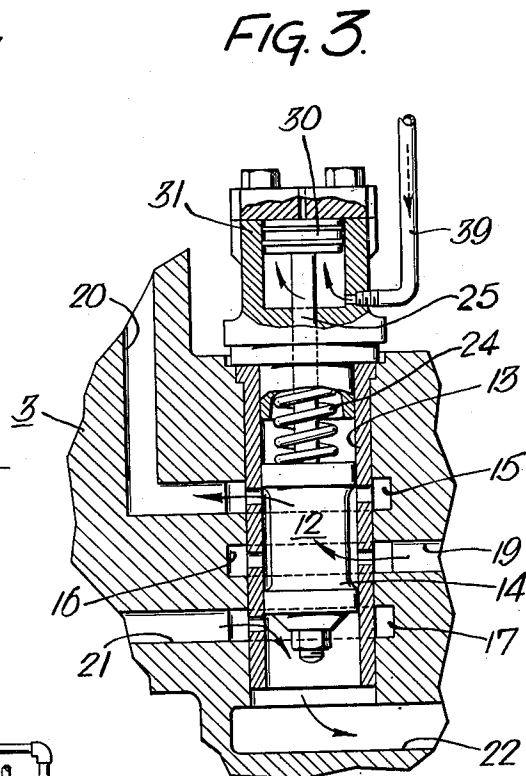
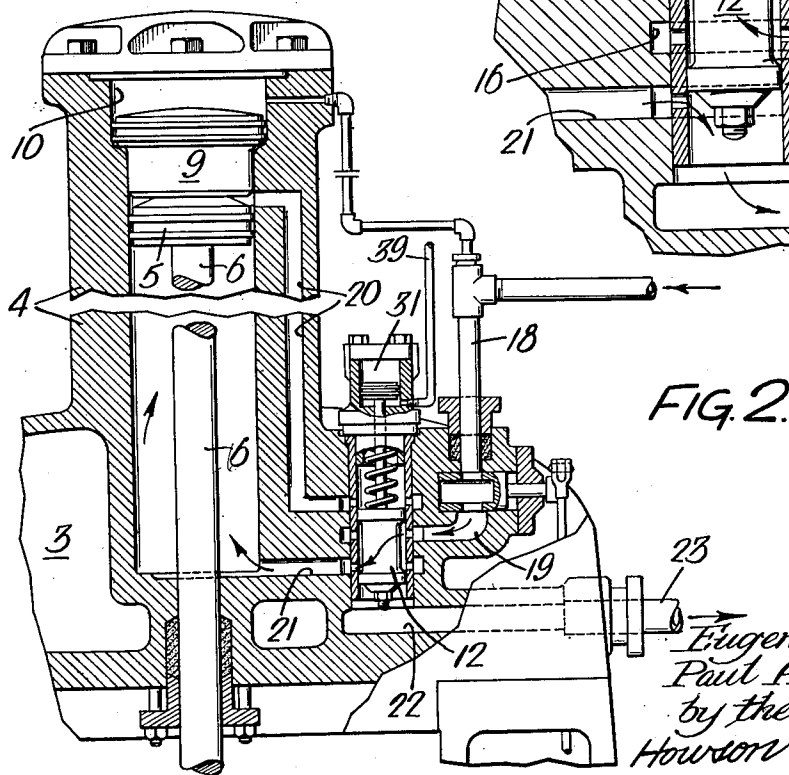
E. C. CLARKE, JR., ET AL

2,619,072

DROP HAMMER CONTROL

Filed July 25, 1949

2 SHEETS—SHEET 1



Inventors:
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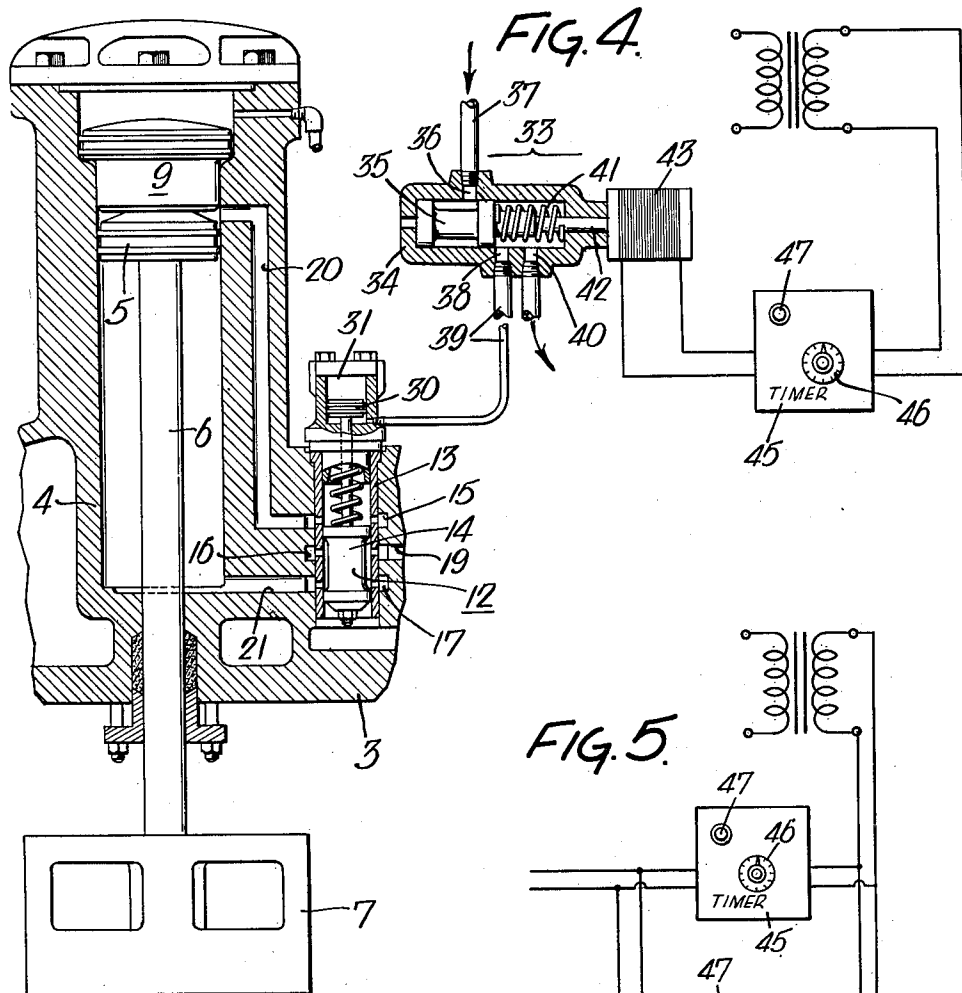
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2 SHEETS—SHEET 2



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UNITED STATES PATENT OFFICE

2,619,072

DROP HAMMER CONTROL

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11 Claims. (Cl. 121—20)

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This invention relates to new and useful improvements in drop hammers and more particularly to drop hammers of the elastic fluid power operated type.

It is known that the impact force of the hammer in an elastic fluid power operated drop hammer may be varied by controlling the interval of time that the elastic fluid is applied to actuate the hammer. However, prior to the present invention there has not been provided adequate mechanism for accurately and precisely controlling the time interval of application of the elastic fluid.

With this in mind, the present invention has for its principal object the provision for elastic fluid power operated drop hammers of normal means for effecting the very precise and accurate control of the impact intensity of the hammer through precise control of the time interval of elastic fluid application to the hammer.

Another object of the invention is to provide novel control mechanism for elastic fluid power operated drop hammers as set forth which may be operated to accurately pre-select the intensity of the impact before setting the hammer in operation.

Another object of the invention is to provide novel control mechanism for elastic fluid power operated drop hammers as described which affords a selective range of predetermined hammer impact intensities.

A further object of the invention is to provide novel drop hammer control mechanism which is comparatively simplified and entirely in the features and characteristics set forth foolproof and efficient in operation and use.

These and other objects of the invention and the various features and details of the construction and operation thereof are hereinafter fully set forth and described with reference to the accompanying drawings, in which:

Fig. 1 is an elevational view of a typical elastic fluid power operated drop hammer;

Fig. 2 is an enlarged fragmentary sectional view vertically through the operating piston of the hammer and the associated valve for controlling the flow of elastic fluid to the hammer piston, the said valve being shown in the position for admitting fluid to raise the piston;

Fig. 3 is an enlarged sectional view of the valve showing the latter in position for admitting elastic fluid to the hammer piston to actuate the same in the downward direction;

Fig. 4 is a view generally similar to Fig. 2 showing the control mechanism of the present invention; and

Fig. 5 is a schematic view of an alternate arrangement of the control mechanism.

Referring now to the drawings, the present invention is shown in conjunction with a con-

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ventional type elastic fluid power operated drop hammer which comprises the usual base 1, relatively spaced apart side frames 2 and a head or upper housing 3 which mounts a vertically arranged cylinder 4 containing a piston 5. A piston rod 6 has its upper end connected to the piston 5 and its other end is connected to a ram or hammer 7 which is mounted for vertical reciprocatory movement between the side frame 2 and adapted, when actuated downwardly, to cooperatively engage the usual anvil 8 supported upon the base 1 of the apparatus. In the drop hammer illustrated in the drawings an auxiliary piston 9 is mounted in an upper enlarged portion 10 of the cylinder 4 and functions to cushion the piston 5 on its upward or return stroke.

In accordance with the practice usually employed in elastic fluid pressure operated drop hammers, the ram 7 is caused to move downwardly on drop under the combined forces of gravity and elastic pressure fluid admitted to the cylinder 4 above the piston 5 therein, and elastic pressure fluid admitted to the cylinder 4 below the piston 5 is utilized to raise or return the latter and ram 7 to the elevated position after each drop.

To accomplish this, a suitable elastic fluid under pressure such as, for example, air or steam, is supplied to the cylinder 4 under the control of the main valve 12. In the drop hammer shown in the drawings, the main valve 12 comprises a cylindrical sleeve 13 which is mounted vertically in the head portion 3 of the hammer and has a valve element 14 slidable therein. Formed in the head or housing portion 3 and surrounding the sleeve 12 in axially spaced relation are a plurality of annular manifolds 15, 16 and 17, respectively.

The manifold 16 is arranged to receive elastic pressure fluid from the main fluid supply line 18 through a communicating duct 19 formed in the head or housing 3. A passage or duct 20 formed in the wall of the cylinder 4 communicates from the manifold 15 to the upper end of the cylinder above the piston 5, and another passage 21, likewise formed in the cylinder wall communicates between the manifold 17 and the cylinder 4 below the piston 5.

The valve element 14 is constructed so that in the lower limit position thereof shown in Fig. 2 the pressure fluid is caused to flow from the supply line 18 through the valve 12 and passage 21 to the lower end of the cylinder 4 below the piston 5 thus elevating the latter. Conversely, when the valve element 14 is in its upper limit position shown in Fig. 3 of the drawings, the pressure fluid is caused to flow from the supply line 18, through the valve 12 and the passage or duct 20 to the upper end of the cylinder above the piston 5 thereby augmenting the force of

gravity to actuate the piston 5 downwardly. In the upper limit position of the valve element 14 the passage 21 is placed in communication with an exhaust duct 22 which is vented to the atmosphere at 23.

In accordance with the present invention the valve element 14 normally is biased to its lower limit position (Fig. 2) by means of a coil spring 24 which surrounds the valve stem 25 and acts between the valve element 14 and a sleeve 13 that is secured in the head portion 3 of the hammer.

The valve element 14 is actuated to its upper position against the bias of spring 24 by means of a pilot piston 30 which is operatively mounted in a cylinder 31 that is secured in coaxial relation with reference to the valve element 14 and the sleeve 13. The valve stem 25 extends upwardly through the sleeve 13 into the cylinder 31 and has its upper end connected to the pilot piston 30 as shown in Fig. 3 of the drawings. Upward actuation of the pilot piston 30 is effected by means of elastic pressure fluid which is admitted to the cylinder 31 below said piston 30 under the control of a suitable control valve generally designated by reference numeral 33.

Referring to Fig. 4 of the drawings, the control valve 33 comprises a casing 34 in which is slidably mounted a valve element 35. Formed in the valve casing 34 is a pressure fluid inlet port 36 to which is connected an elastic fluid supply line 37 and a discharge port 38 having connected thereto one end of a pipe 39 that has its other end connected to the lower end of the pilot cylinder 31.

The construction of the valve element 35 and the location of the inlet and outlet ports 36 and 38, respectively is such that in the left-hand limit position of the element 35 shown in Fig. 4 the flow of elastic pressure fluid through the pipe 39 to the pilot cylinder is shut-off and the cylinder vented through said pipe 39, the valve casing and an exhaust port 40 directly to the atmosphere. On the other hand when the element 35 is in the right-hand limit position, the valve is open and elastic fluid flow takes place from the line 37 through the valve and pipe 39 to the cylinder 31 thereby actuating the pilot piston 30 upwardly to raise the main valve 14 and cause pressure fluid to be admitted through the duct 20 to the upper end of the hammer cylinder 4.

As shown in Fig. 4 the valve element 35 normally is biased to the left or closed position by means of a coil spring 41 which surrounds the valve stem 42 and acts between said element 35 and the adjacent end of the valve casing 34. The valve stem 42 extends endwise outwardly of the casing 34 and forms the core of a solenoid the coil 43 of which is mounted endwise of the said casing 34.

The construction and arrangement of the solenoid is such that when the coil 43 thereof is energized the stem 42 and valve element 35 are actuated to the right or open position against the bias of the spring 41 and remain in that position so long as the solenoid is energized. Upon de-energization of the solenoid the spring 41 will return the valve element 35 to its closed position and hold it there until the solenoid is again energized.

In accordance with the present invention energization of the solenoid is controlled by a timing device 45 which operates to effect energization of the control valve solenoid for a very precise, pre-selected interval of time. In the form of timer shown, the precise time interval may be pre-

selected by the operator manipulating the dial 46, and the device may then be placed in operation by momentary actuation of the switch 47. Any suitable timing device may be utilized to control energization of the solenoid and in the present instance the timer illustrated is an electronic timer constructed as shown in the copending application of R. L. Alcorn, Jr., Serial No. 118,536 filed September 29, 1949 and now Patent No. 2,586,592. However, any other suitable type or construction of timer may be employed.

In operation, it will be observed that with a pre-selected setting of the timer 45 when the switch 47 is actuated the solenoid will be energized thereby opening the control valve 33 and actuating the pilot piston 30 to open valve 14. Opening of the valve 14 will admit elastic pressure fluid to the top of the cylinder 4 thereby actuating the piston 5 and ram 7 downwardly. The elastic fluid will be supplied to the cylinder 4 as described for the precise interval of time for which the timer was set and at the end of such time interval the solenoid will be deenergized thereby closing in turn the control and main valves 33 and 14, respectively. For a given elastic fluid pressure and drop hammer construction the time interval of pressure fluid application to give a desired impact or blow intensity may be readily determined and the apparatus suitably calibrated.

As shown in Fig. 5 of the drawings, multiple arrangements of timers 46 may be provided and each timer set for a different time interval so that the operator simply by actuating the switch 47 of the appropriate timer 45 may selectively control the time interval of fluid application without the necessity of repeatedly resetting the timer between each operation of the drop hammer. In addition there may be employed with such a timer arrangement a conventional sequence and interval device, such as, for example, a series of rotating cam limit switches, which enable the operator to produce a predetermined sequence of blows of the hammer of different or equal intensity.

From the foregoing it will be observed that the present invention provides novel mechanism for effecting extremely accurate and precise control of the impact intensity of the ram of elastic fluid power operated drop hammers through precise control of the time interval of pressure fluid application to the hammer. The invention also provides novel mechanism as set forth which may be operated accurately to preselect the intensity of the ram impact before placing the hammer in operation. The invention further provides novel control mechanism for elastic fluid power operated drop hammers which affords the operator a selective range of predetermined hammer impact intensities. In addition, the invention provides novel control mechanism having the features and characteristics set forth which is of comparatively simplified construction and entirely foolproof and efficient in operation and use.

While certain embodiments of the invention have been illustrated and described herein, it is not intended that the invention be limited to such disclosures and changes and modifications may be made therein and thereto within the scope of the following claims.

We claim:

1. In an elastic fluid power operated drop hammer comprising a piston actuated vertically movable ram and an elastic pressure fluid system for

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actuating the piston, a valve in said system operable in one position to admit pressure fluid to actuate the piston downwardly, and mechanism to actuate the valve to said one position including a plurality of variable timing means selectively operable to effect actuation of the valve to said one position for a series of predetermined precise intervals of the down stroke only of the piston and thereby admit pressure fluid to the piston for each such interval and cause the ram to strike a succession of blows each of predetermined impact intensity.

2. In an elastic fluid power operated drop hammer comprising a piston actuated vertically movable ram and an elastic pressure fluid system for actuating the piston, a valve in said system operable in one position to admit pressure fluid to actuate the piston downwardly, pilot means operable to actuate said main valve to said one position, means to operate said pilot means including a control device, and means to actuate said control device to operate said pilot means including a plurality of variable timing means selectively operable to effect operation of said control device for a series of predetermined precise intervals of successive down strokes of the piston and thereby actuate said valve to admit pressure fluid to the piston for like intervals and cause the ram to strike a succession of blows each of predetermined impact intensity.

3. In an elastic fluid power operated drop hammer comprising a piston actuated vertically movable ram and an elastic pressure fluid system for actuating the piston, a main valve in said system operable in one position to admit pressure fluid to actuate the piston downwardly, pressure fluid actuated pilot means operable to actuate said main valve to said one position, means to supply pressure fluid to said pilot means including a control valve, and mechanism operable to actuate said control valve to open position including a plurality of variable timing means selectively operable to open said control valve for a series of predetermined precise intervals of successive down strokes of the piston and thereby actuate said main valve to said one position to admit pressure fluid to the piston for like intervals and cause the ram to strike a succession of blows each of predetermined impact intensity.

4. In an elastic pressure fluid operated drop hammer comprising a piston actuated vertically movable ram and an elastic pressure fluid system for actuating the piston, a main valve in said system operable in one position to admit pressure fluid to actuate the piston downwardly, spring means normally biasing said main valve to said other position, elastic pressure fluid pilot means operable to actuate said main valve to said one position, means to supply pressure fluid to said pilot means including a control valve, spring means normally biasing said control valve to closed position, and mechanism operable to actuate said control valve to open position including a plurality of timing means selectively operable to open said control valve for a series of predetermined precise intervals of successive down strokes of the piston and thereby actuate said main valve to said one position to admit pressure fluid to the piston for like intervals and cause the ram to strike a succession of blows each of predetermined impact intensity.

5. In an elastic fluid power operated drop hammer comprising a piston actuated vertically movable ram and an elastic fluid system for actuating the piston, a main valve in said system oper-

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able in one position to admit pressure fluid to actuate the piston downwardly, spring means normally biasing said main valve to said other position, elastic pressure fluid actuated pilot means operable to actuate said main valve to said one position, means to supply pressure fluid to said pilot means including a control valve, spring means normally biasing said control valve to closed position, solenoid means energizable to actuate said control valve to open position, and an elastic circuit for said solenoid including a plurality of variable timing means selectively operable to effect energization of the solenoid for a series of predetermined precise intervals of successive down strokes of the piston and thereby actuate said control valve to open position and said main valve to said one position for a like series of intervals and cause the ram to strike a succession of blows each of predetermined impact intensity.

6. In a drop hammer having a ram adapted to drop by gravity with the assistance of elastic fluid pressure and including a cylinder with a piston therein connected to the ram, an elastic pressure fluid system connected to the cylinder for actuating the piston in respectively opposite directions, a valve in said fluid system operable in one position to admit pressure fluid to the cylinder and raise the piston after each down stroke of the ram and in another position to admit pressure fluid to the cylinder to exert a positive downward force on the piston and assist the drop stroke of the ram, and mechanism including variable timing means operable to effect actuation of said valve to said other position during a preselected part of the drop stroke of the ram and admit pressure fluid to the cylinder for said part of the drop stroke of the ram thereby exerting a positive downward actuating force on the piston for at least a portion of its drop stroke and causing the ram to strike a blow of predetermined intensity.

7. In a drop hammer having a ram adapted to drop by gravity with the assistance of elastic fluid pressure and including a cylinder with a piston therein connected to the ram, an elastic pressure fluid system connected to the cylinder for actuating the piston in respectively opposite directions, a valve in said fluid system operable in one position to admit pressure fluid to the cylinder and raise the piston after each down stroke of the ram and in another position to admit pressure fluid to the cylinder to exert a positive downward force on the piston and assist the drop stroke of the ram, pilot means operable to actuate said valve to said other position, a control device for operating said pilot means, and mechanism including variable timing means selectively operable to actuate said control means and in turn the pilot means to actuate said valve to said other position during a preselected part of the drop stroke of the ram and admit pressure fluid to the cylinder for said part of the drop stroke of the ram thereby exerting a positive force on the piston and causing the ram to strike a blow of predetermined intensity.

8. In a drop hammer having a ram adapted to drop by gravity with the assistance of elastic fluid pressure and including a cylinder with a piston therein connected to the ram, an elastic pressure fluid system connected to the cylinder for actuating the piston in respectively opposite directions, a valve in said fluid system operable in one position to admit pressure fluid to the cylinder and raise the piston after each down

stroke of the ram and in another position to admit pressure fluid to the cylinder to exert a positive downward force on the piston and assist the drop stroke of the ram, pilot means comprising a pressure fluid actuated piston operable to actuate said valve to said other position, a control device for operating said pilot means, and mechanism including variable timing means selectively operable to actuate said control means and in turn the pilot means to actuate said valve to said other position during a preselected part of the drop stroke of the ram and admit pressure fluid to the cylinder for said part of the drop stroke of the ram thereby exerting a positive force on the piston and causing the ram to strike a blow of predetermined intensity.

9. In a drop hammer having a ram adapted to drop by gravity with the assistance of elastic fluid pressure and including a cylinder with a piston therein connected to the ram, an elastic pressure fluid system connected to the cylinder for actuating the piston in respectively opposite directions, a valve in said fluid system operable in one position to admit pressure fluid to the cylinder and raise the piston after each drop stroke of the ram and in another position to admit pressure fluid to the cylinder to exert a positive downward force on the piston and assist the drop stroke of the ram, said valve normally being disposed in said one position, pilot means operable to actuate said valve to said other position, a control device for operating said pilot means, and mechanism including variable timing means selectively operable to actuate said control means and in turn the pilot means to actuate said valve to said other position during a preselected part of the drop stroke of the ram and admit pressure fluid to the cylinder for said part of the drop stroke of the ram thereby exerting a positive force on the piston and causing the ram to strike a blow of predetermined intensity.

10. In a drop hammer having a ram adapted to drop by gravity with the assistance of elastic fluid pressure and including a cylinder with a piston therein connected to the ram, an elastic pressure fluid system connected to the cylinder for actuating the piston in respectively opposite directions, a valve in said fluid system operable in one position to admit pressure fluid to the cylinder and raise the piston after each drop stroke of the ram and in another position to admit pressure fluid to the cylinder to exert a positive downward force on the piston and assist the drop stroke of the ram, said valve normally

being disposed in said one position, pilot means comprising a pressure fluid actuated piston operable to actuate said valve to said other position, a control device for operating said pilot means, and mechanism including variable timing means selectively operable to actuate said control means and in turn the pilot means to actuate said valve to said other position during a preselected part of the drop stroke of the ram and admit pressure fluid to the cylinder for said part of the drop stroke of the ram thereby exerting a positive force on the piston and causing the ram to strike a blow of predetermined intensity.

11. In a drop hammer having a ram adapted to drop by gravity with the assistance of elastic fluid pressure and including a cylinder with a piston therein connected to the ram, an elastic pressure fluid system connected to the cylinder for actuating the piston in respectively opposite directions, a valve in said fluid system operable in one position to admit pressure fluid to the cylinder and raise the piston after each down stroke of the ram and in another position to admit pressure fluid to the cylinder to exert a positive downward force on the piston and assist the drop stroke of the ram, said valve normally being disposed in said one position, pilot means comprising a pressure fluid actuated piston operable to actuate said valve to said other position, means to supply pressure fluid to said pilot means including a control valve, spring means normally biasing said control valve to closed position, means to actuate said control valve to open position, and mechanism including variable timing means selectively operable to actuate said control means and in turn the pilot means to actuate said valve to said other position during a preselected part of the drop stroke of the ram and admit pressure fluid to the cylinder for said part of the drop stroke of the ram thereby exerting a positive force on the piston and causing the ram to strike a blow of predetermined intensity.

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