Jan. 11, 1938. E. G. EPPENS 2,105,074

FLUID ACTUATED HAMMER

Filed Aug. 26, 1937 2 Sheets-Sheet 1

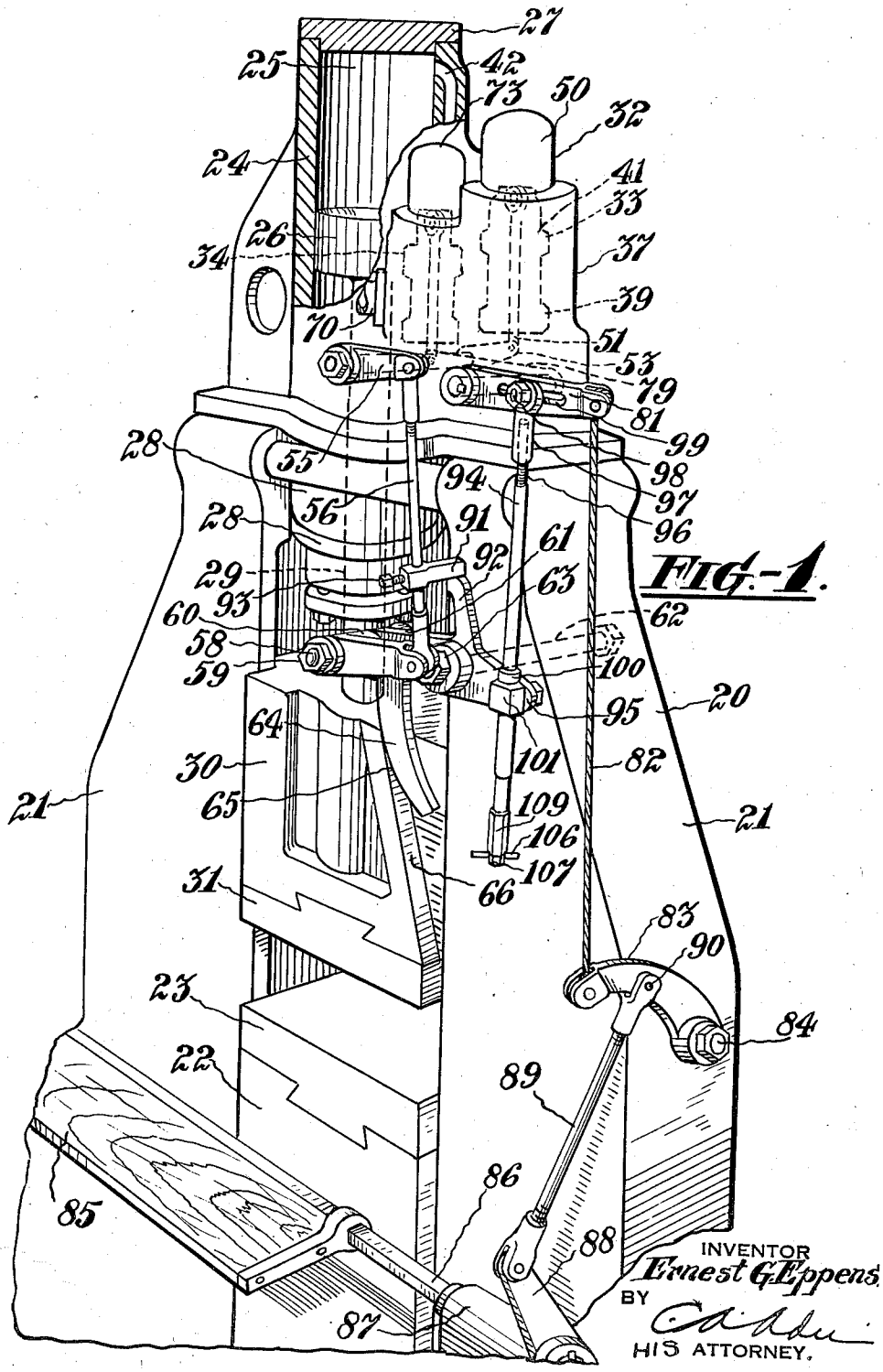


FIG.-1.

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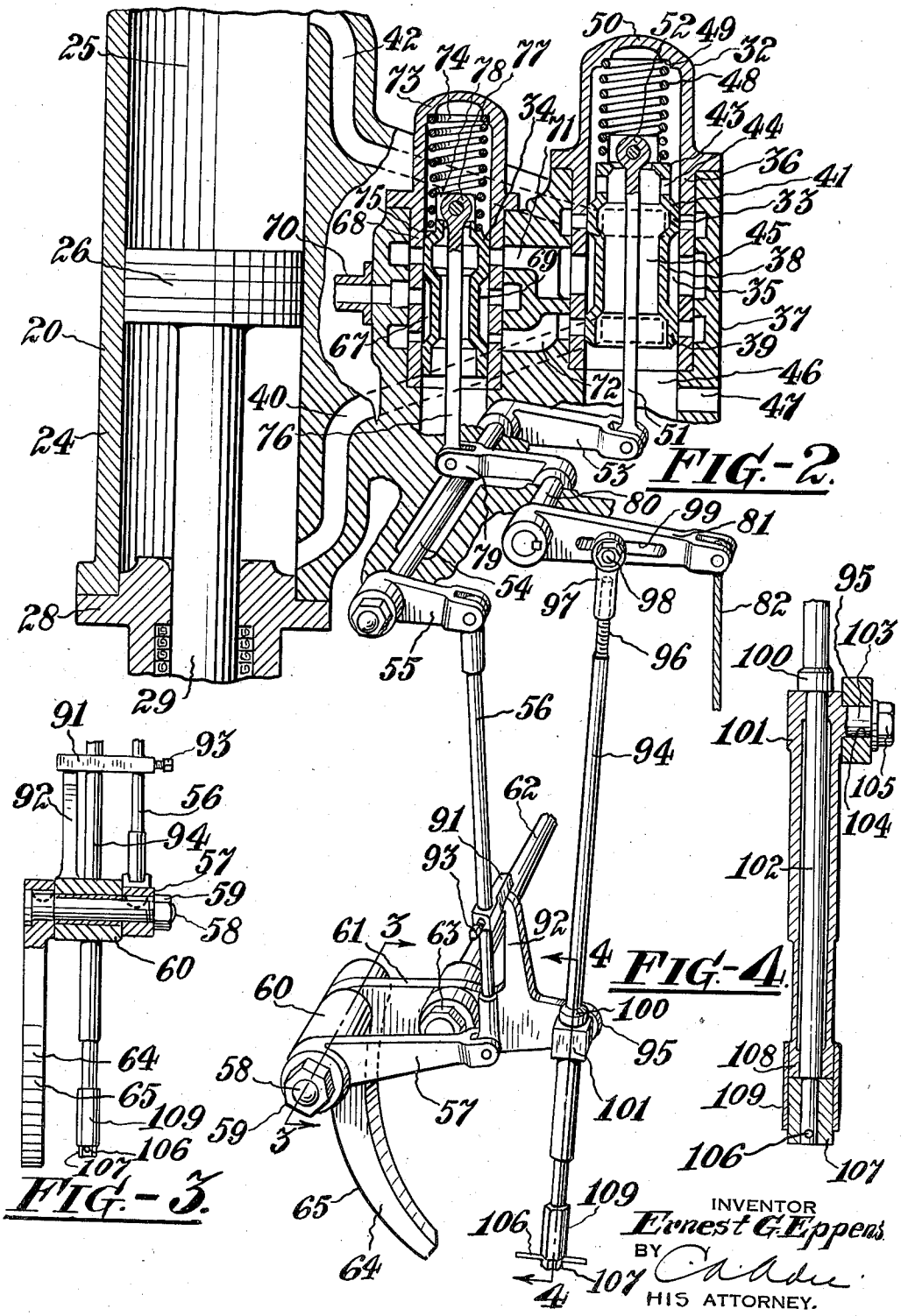


FIG.-2.

FIG.-4.

FIG.-3.

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Patented Jan. 11, 1938 2,105,074

UNITED STATES PATENT OFFICE

2,105,074

FLUID ACTUATED HAMMER

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Application August 26, 1937, Serial No. 160,958

7 Claims. (Cl. 121—30)

This invention relates to fluid actuated hammers, and more particularly to fluid actuated hammers of the type employed for drop forging and similar purposes.

One object of the invention is to limit the power consumption of the hammer to substantially that required for performing useful work.

Another object is to render the hammer readily responsive to the will of the operator.

Other objects will be in part obvious and in part pointed out hereinafter.

In the drawings accompanying this specification and in which similar reference numerals refer to similar parts.

Figure 1 is a perspective view in elevation, partly broken away, of a fluid actuated hammer constructed in accordance with the practice of the invention,

Figure 2 is an elevation, partly in section, of a portion of the hammer including the valve mechanism and the elements whereby the valve mechanism is controlled, the latter being shown in diagrammatic arrangement, and

Figures 3 and 4 are transverse views taken through Figure 2 on the lines 3—3 and 4—4, respectively.

Referring more particularly to the drawings, the hammer, designated in its entirety by 20, comprises the usual main frame consisting of a pair of columns 21 between which is interposed an anvil 22 to support a stationary die member 23.

Seated on the columns is a vertical cylinder 24 having a piston chamber 25 to accommodate a reciprocatory piston 26. Suitable closures 27 and 28 are provided for the upper and lower ends, respectively, of the cylinder, and that designated 28 serves the additional function of a guide for a piston rod 29 carrying a ram 30 which in turn carries a complementary die member 31.

The parts so far enumerated, their arrangement and mode of operation are well known. They form no part of the present invention which is concerned more particularly with the valve mechanism designated in its entirety by 32 whereby the action of the piston 26 is controlled.

The valve mechanism 32 is preferably arranged immediately adjacent the cylinder 24. It comprises a distributing valve 33 which effects the distribution of pressure fluid to the piston chamber 25 for actuating the piston 26 and a control valve 34 which serves, among other functions, to control the admission of pressure fluid from a source of supply to the distributing valve 33.

The distributing valve 33 is of the spool type and is reciprocable in a valve chamber 35 defined by a bushing 36 arranged in a valve chest 37 adjacent the cylinder 24. The valve 33 comprises a stem 38 and an end head 39 which controls communication between the valve chamber 35 and an inlet passage 40 in the valve chest 37 and the cylinder 24 and opening into the lower end of the piston chamber 25. The valve has a second head 41, intermediate its ends, to control communication between the valve chamber 35 and an inlet passage 42 leading to the upper end of the piston chamber 25.

The distributing valve may, as illustrated, be arranged in a vertical position and in the portion 43 of the valve lying above the head 41 are ports 44 to afford communication between the inlet passage 42 and the interior 45 of the valve through which fluid may exhaust from the upper portion of the piston chamber 25 to the atmosphere. In the structure shown such exhaust fluid flows from the interior of the valve into a bore 46 containing the bushing 36, thence to the atmosphere through a port 47 in the wall of the valve chest.

To the end that the valve 33 may be caused to assume the position necessary to establish communication between the upper portion of the piston chamber and the atmosphere a spring 48 is interposed between the upper end of the valve and the inner end surface 49 of a dome 50 at the top of the bushing 36. The spring 48 acts to depress the valve 33 for the purposes stated and to establish communication between the valve chamber 35 and the inlet passage 40 for admitting pressure fluid into the lowermost end of the piston chamber 25.

The force employed for moving the valve 33 upwardly to establish communication between the inlet passage 42 and the valve chamber 35 is, as is customary in mechanism of this character, supplied by the piston 26 and transmitted to the valve 33 through suitable linkage comprising a rod 51 having its upper end 52 pivotally connected to the corresponding end of the valve 33. The rod 51 extends through the valve and its lower end is pivotally connected to the free extremity of an arm 53 which is arranged in angular relationship with respect to the rod 51 and may be suitably affixed to a shaft 54 journalled in a casing part of a hammer, as for example the cylinder 24.

The shaft 54 carries a second fixed arm 55 which preferably bears the same angular relationship to the rod 51 as the arm 53. The outer or free end of the arm 55 is bifurcated to re-

ceive the end of a depending link 56 which is pivotally connected to the arm 55 and the other end is connected in like manner to the free end of an arm 57 arranged at substantially a right angle to the link 56. The arm 57 is keyed to a shaft 58 and held thereon by a nut 59.

The shaft 58 is freely rotatable in a bearing 60 carried by a rocker arm 61 pivotally mounted upon the projecting end of a shaft 62 supported by the adjacent column 21. The shaft 62 extends through an intermediate portion of the rocker arm 61 and a nut 63 threaded on the shaft 62 acts against the outermost surface of the rocker arm to retain it on the shaft.

The shaft 62 and, therefore, the elements which it supports is so arranged that the shaft 58 lies closely adjacent the path of movement of the ram 30 and to the shaft 58 is keyed a depending finger 64 having a convex surface 65 for engagement with an inclined surface 66 on the side of the ram 30. The arrangement is such that as the ram 30 is raised the surface 66 moves into engagement with the concave surface 65 and rocks the finger outwardly. This movement of the finger is transmitted through the arm 57 and associated linkage to the valve for actuating it in the direction required to communicate the inlet passage 42 with the valve chamber 35.

During the descending movement of the ram the inclined surface 66 is, of course, also lowered, thus permitting the finger 64 to move inwardly. The spring 48 will then depress the valve 33 and shift the linkage connected thereto to maintain the convex surface 65 of the finger 64 in contact with the inclined surface 66.

Structurally, the control valve 34 may be a replica of the distributing valve 33. It is reciprocable in a valve chamber 67 in a bushing 68 arranged in the valve chest 37. The control valve has an external annular groove 69 which, in one limiting position of the valve, affords communication between a supply conduit 70, attached to the valve chest, and a passage 71 connecting the valve chambers 67 and 35. The passage 71 opens into the valve chest 67 at a point above the supply conduit 70 and into the valve chamber 35 at a point intermediate the points of communication of the inlet passages 40 and 42 with the valve chamber 35. In another position of the valve 34 the annular groove 69 establishes communication between the supply conduit 70 and a supply passage 72 extending from the valve chamber 67 at a point below the supply conduit 70 and opening into the inlet passage 40.

On the upper end of the bushing 68 is a dome 73 forming a receptacle for a spring 74 which acts against a shoulder 75 on the valve 34 to actuate the valve to its lowermost limiting position for cutting off communication between the supply conduit 70 and the passage 71.

Extending through the valve 34 is a rod 76 of which the upper end 77 is pivotally connected to the upper end 78 of the valve 34 and the lower end of the rod 76 is connected in like manner to an arm 79 which may be affixed, in any suitable manner, to an end of a rocker shaft 80 journalled in the casing of the hammer. Keyed to the end of the rocker shaft 80 is a second arm 81 which lies in the same horizontal plane as the arm 79 but extends in an opposite direction. From its free end depends a cable 82 which is attached to the end of a rocker 83 mounted pivotally upon a bolt 84 seated in the column 21 that supports the rocker arm 61.

The rocker 83 and the elements connecting it with the valve 34 are actuated by manual force applied to a treadle 85 in front of the hammer. The treadle is mounted upon a rod 86 journalled in bearings 87, of which only one is shown, and affixed to the rod 86 is an arm 88 of which the free end is pivotally connected to an end of a link 89 having its other end connected to a pivot 90 seated in the rocker 83 at a point intermediate its ends.

The arrangement of the elements connecting the treadle 85 with the valve 34 is such that when the treadle 85 is tilted downwardly movement is transmitted through the various linkage to the valve 34 which is thereby raised to effect communication between the supply conduit 70 and the passage 71 and to compress the spring 74 which, upon the release of pressure against the treadle 85, will actuate the valve 34 downwardly and thus restore the linkage associated therewith, as well as the treadle 85, to their initial positions.

In addition to its function of effecting the distribution of pressure fluid to the ends of the piston chamber during the normal operation of the hammer the distributing valve 33, or more particularly the head 41, serves as a closure for the inlet passage 42 to seal the upper end of the piston chamber 25 during the time that the control valve 34 is in position to admit pressure fluid from the valve chamber 67 through the passages 72 and 40 into the lower end of the piston chamber.

In order to accomplish this the valve is held in an intermediate position in which the head 41 overlies the adjacent end of the inlet passage 42. The means serving to maintain the valve 33 in this intermediate position are preferably associated with the elements imparting movement to the valves 33 and 34 and comprises a pair of stop members 91 and 92. In the arrangement shown the stop member 92 is in the form of an upstanding finger on the rocker arm 61, and the stop member 91 consists of a bar arranged slidably and rotatably on the link 56 to which it may be locked by a set screw 93 threaded into the bar 91 and seating against the link 56.

The bar 91 may be shifted longitudinally of the link 56 or rotated with respect thereto to maintain it in position for engagement with the free end of the finger 92 of which the arc of oscillation varies with variations of the length of the stroke of the piston 26 as determined by the nature and proportions of the article being forged, and to which end the rocker arm 61 may require adjustment.

The means whereby such adjustment is effected comprises a rod 94 which connects the arm 81 with a wing 95 constituting the portion of the rocker arm 61 which carries the finger 92. An end 96 of the rod 94 is threadedly connected to a member 97 which may be secured in fixed position on the arm 81 by means of a bolt 98 extending through the arm 81. Preferably, the bolt 98 is arranged in a slot 99 in the arm so that the member 97 may be conveniently shifted longitudinally of the arm 81.

Intermediate the ends of the rod is an external shoulder 100 to seat upon the end of a bearing 101 through which the portion 102 of the rod 94 below the shoulder 100 extends. On the side of the bearing is an integral pivot 103 which extends through an aperture 104 in the free end of the wing 95 and a nut 105 threaded on the pivot 103 secures the bearing on the wing 95.

The rod 94 is freely rotatable in the bearing

101 and such movement may be imparted to the rod for purposes of adjustment through a grip portion or bar 106 extending transversely through the lower portion of the rod and through a collar 107 arranged on the adjacent portion of the rod. The exterior of the collar 107 is of hexagonal shape as is also the adjacent end 108 of the bearing 101, and arranged thereon is a hexagonal locking sleeve 109 to prevent unauthorized movement of the rod 102 with respect to the bearing 101.

The sleeve 109 has a slide fit on the collar 107 and the portion 108 and whenever it is intended to effect an adjustment of the rocker arm 61 the sleeve 109 may be drawn out of engagement with the collar 107, whereupon the rod may be rotated to increase or shorten the distance between the arm 81 and the wing 95 of the rocker arm.

Whenever it is intended to operate the device the operator depresses the treadle 85 and movement is thereby transmitted to the control valve 34, by the linkage connecting the two, for raising the control valve 34. In this position of the control valve the annular recess will communicate the supply conduit 70 with the passage 71 and pressure fluid then flows to the valve chamber 35 into the space between the heads 41 and 39 of the valve 33.

Inasmuch as the arm 81 is connected to the rocker arm 61 the position of the latter is also changed when the treadle 85 is depressed. In other words, the wing 95 of the rocker arm is drawn downwardly and the finger 92 is moved out of the plane of the bar 91. The spring 48 will then act to shift the valve 33 to its lowermost limiting position in which the space between the heads 41 and 39 affords communication between the passage 71 and the inlet passage 40 and pressure fluid flows from supply into the lower end of the piston chamber and drives the piston and its load upwardly.

During the up-stroke of the piston the air is expelled from the upper portion of the piston chamber 25 through the inlet passage 42, the ports 44, the interior 45 of the valve and the free exhaust port 47, also during such movement the inclined surface 66 engages the surface 65 of the finger 64 and rocks it outwardly. Being attached to the shaft 58, the finger will, therefore, rock said shaft and elevate the free end of the arm 57. This movement of the arm 57 is transmitted through the link 56 to the arms 55 and 53, thereby moving the valve 33 upwardly to a position in which the space between the valve heads establish communication between the passage 71 and the inlet passage 42.

In the new position of the distributing valve pressure fluid flows into the upper end of the piston chamber to impel the piston 26 on its working stroke and the head 39 will lie between the passage 71 and the inlet passage 40 so that the lower end of the piston chamber will be in communication with the atmosphere through the passage 40, the portion 46 of the valve chamber 35 and the exhaust port 47. The piston 26 may then move freely downwardly so that a forceful blow will be struck against the work, and as the ram 30 descends the finger 64 will be rocked inwardly toward the ram by the spring 48. The described cycle of operation may be repeated to apply the required number of blows against the work, and when the article has been correctly forged the operator releases the treadle 85. The spring 74 will then act to push the control valve 34 downwardly and shift the linkage attached thereto to its idle position. When the control valve reaches its lowermost limiting position the annular groove 69 will communicate the supply conduit 70 with the supply passage 72 and pressure fluid will flow directly from supply through these channels into the inlet passage 40 and into the lower end of the cylinder to raise the piston 26 and its load.

As the piston ascends the surface 66 will trip the finger 64 and raise the valve 33 to a position in which the head 41 overlies the inlet passage 42 where it will be held by reason of the engagement between the bar 91 and the finger 92, it being understood that the valve 33 may not complete its downward stroke until the finger 92 is against rocked out of engagement with the bar. With the head 41 in the position described air will be entrapped in the upper end of the piston chamber and the piston 26 will, therefore, move to an intermediate position in the piston chamber where it will be held immovable by the opposing forces acting against its ends until the control valve 34 is again raised to begin a new period of operation.

I claim:

1. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, valve means to effect the distribution of pressure fluid to the piston chamber for actuating the piston, and other valve means for controlling the supply of pressure fluid to the first said valve means and to admit pressure fluid to one end of the piston chamber to hold the piston stationary.

2. In a fluid actuated hammer, the combination of a casing having a vertical piston chamber and a reciprocatory piston therein, valve means to effect the distribution of pressure fluid to the piston chamber for actuating the piston, and other valve means movable independently of the first said valve means for controlling the supply of pressure fluid to the first said valve means and to admit pressure fluid into the lower end of the piston chamber to support and hold the piston immovable.

3. In a fluid actuated hammer, the combination of a casing having a vertical piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the piston chamber for actuating the piston and being itself actuated by the piston, and a manually operable valve movable to one position to admit pressure fluid to the first said valve and being movable to another position to valve pressure fluid into the lower end of the piston chamber to support and hold the piston immovable.

4. In a fluid actuated hammer, the combination of a casing having a vertical piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the piston chamber to cause reciprocation of the piston, means actuated by the piston for shifting the valve, a control valve, manually operable means for shifting the control valve to admit pressure fluid to the distributing valve, and means for moving the control valve upon release of the manually operable means to valve pressure fluid directly from supply into the lower end of the piston chamber for holding the piston immovable.

5. In a fluid actuated hammer, the combination of a casing having a vertical piston chamber and a reciprocatory piston therein, a valve chest having a valve chamber, inlet passages leading from the valve chamber to the piston chamber, a dis-

tributing valve in the valve chamber to control the inlet passages, and a control valve to selectively admit pressure fluid to the valve chamber for distribution by the first said valve and to admit pressure fluid directly into one inlet passage to raise the piston and hold it immovable in the piston chamber.

6. In a fluid actuated hammer, the combination of a casing having a vertical piston chamber and a reciprocatory piston therein, distributing and control valve chambers in the casing, inlet passages leading from the distributing valve chamber to the ends of the piston chamber, a distributing valve in the distributing valve chamber to control the inlet passages, a supply passage in the casing leading from the control valve chamber to an inlet passage, a control valve in the control valve chamber movable to one position to valve pressure fluid to the distributing valve chamber and being movable to another position to valve pressure fluid through the supply passage and the associated inlet passage into the lower end of the piston chamber to raise the piston and hold it immovable in the piston chamber, and means for maintaining the distributing valve in position to prevent communication between the distributing valve chamber and the piston chamber during the time the control valve occupies the last mentioned position.

7. In a fluid actuated hammer, the combination of a casing having a vertical piston chamber and a reciprocatory piston therein, a valve chamber in the casing, upper and lower inlet passages leading from the valve chamber to the piston chamber, a valve in the valve chamber, means for moving the valve to limiting position to effect the alternate admission of pressure fluid from the valve chamber to the inlet passages, means for selectively admitting pressure fluid from supply to the lower end of the piston chamber to raise the piston and hold it immovable in an intermediate position in the piston chamber, and means for maintaining the valve in position to seal the upper inlet passage to entrap cushioning fluid in the upper end of the piston chamber during the time the piston occupies such intermediate position.

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