July 29, 1941. E. G. EPPENS 2,250,449

FLUID ACTUATED HAMMER

Filed Feb. 24, 1941 2 Sheets-Sheet 1

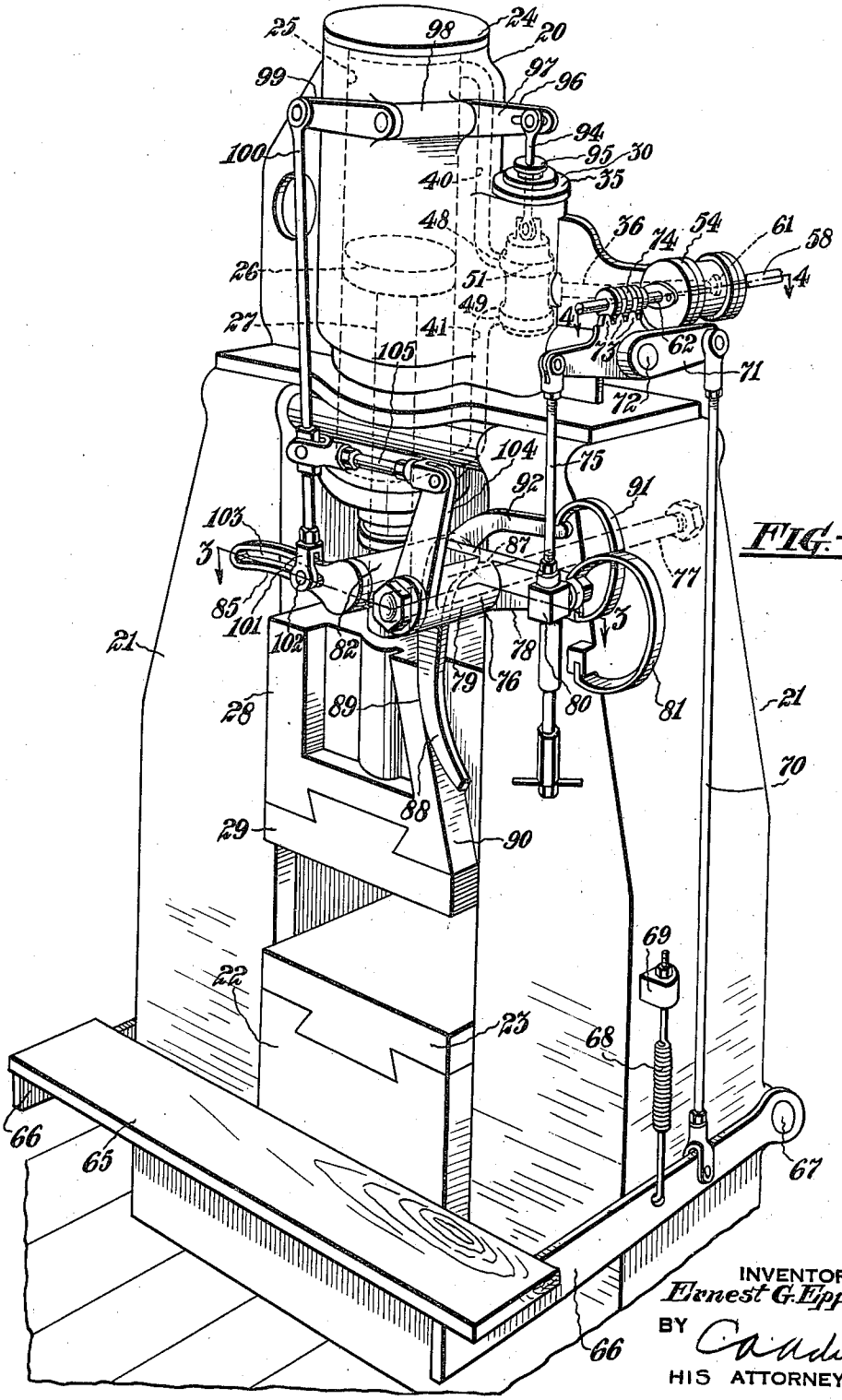


FIG.-1.

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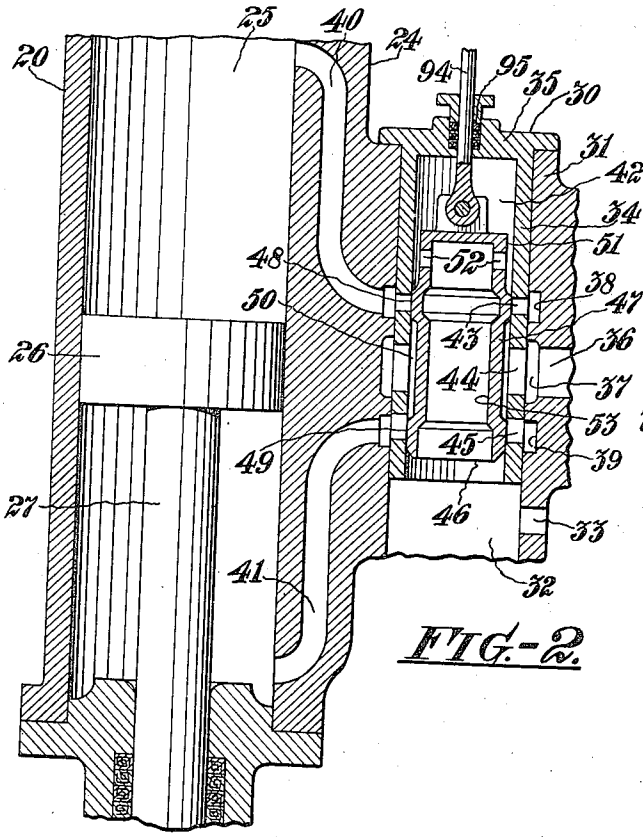


FIG.-2.

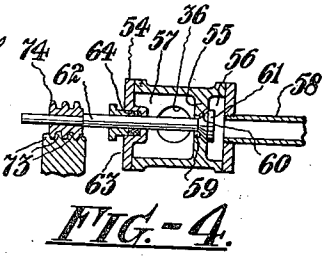


FIG.-4.

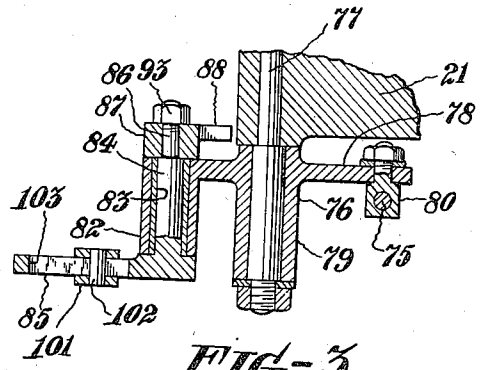


FIG.-3.

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Patented July 29, 1941 2,250,449

UNITED STATES PATENT OFFICE

2,250,449

FLUID ACTUATED HAMMER

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Application February 24, 1941, Serial No. 380,278

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 simplify the power controlling devices of the hammer.

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

A further object is to limit the power consumption of the hammer to substantially the amount required for performing useful work.

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, of a fluid actuated hammer constructed in accordance with the practice of the invention,

Figure 2 is an elevation, partly in section, taken through the cylinder and the distributing valve mechanism of the hammer, and

Figures 3 and 4 are transverse views taken through Figure 1 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 arranged on opposite sides of an anvil block 22 which supports a stationary die member 23.

The upper ends of the columns 21 serve as seats for a cylinder 24 that may be secured to the columns in any suitable manner. The cylinder 24 is suitably bored to provide a piston chamber 25 for the accommodation of a reciprocatory piston 26 having a depending rod 27 that is attached at its lower end to a ram 28 which in turn carries a complementary die member 29.

The cylinder 24 is provided with suitable distributing valve mechanism designated in its entirety by 30 and comprising a valve chest 31 having a bore 32 the lower end of which may communicate with the atmosphere through an exhaust port 33 in the valve chest. A bushing 34 is arranged in the bore 32 and has an end wall 35 to serve as a closure for the upper end of the bore.

The valve chest 31 is, moreover, provided with a supply passage 36 that opens into an annular groove 37 in the bore 32, said annular groove 37 lying between annular grooves 38 and 39 also formed in the surface of the bore 32 and communicating, respectively, with the upper and lower ends of the piston chamber 25 through inlet passages 40 and 41.

Communication is afforded between the grooves 38, 37 and 39 and the chamber 42 in the bushing 34 by ports 43, 44 and 45, respectively, in the wall of the bushing, and communication between the ports 44 and either the ports 43 or 45 is controlled by a distributing valve 46 arranged in the chamber 42.

The valve 46 is of the reciprocatory spool type. It accordingly comprises a stem 47 and upper and lower external flanges 48 and 49 that are separated by an annular groove 50 in the periphery of the valve. The groove 50 is of a length to effect communication between the ports 44 and either the ports 43 or 45, accordingly as the valve moves toward the upper or lower end of the chamber 42. In the reduced portion 51 of the valve above the flange 48 are ports 52 to afford communication between the upper end of the chamber 42 and a recess 53 within the valve and opening into the lower end of the bore 32.

The admission of pressure fluid to the supply passage 36 is controlled by suitable valve mechanism arranged adjacent the valve mechanism 30 and comprising a valve chest 54 having an internal wall 55 that divides the interior of the valve chest into a pair of chambers 56 and 57, the latter being in direct communication with the supply passage 36 and the chamber 56 being in constant communication with a source of pressure fluid supply (not shown) through a conduit 58. The wall 55 is bored to provide a port 59 for conveying pressure fluid from the chamber 56 to the chamber 57, and at the end of the port 59 confronting the chamber 56 is a bevelled seating surface 60 for a valve 61, of the poppet type, that controls the port 59. In the arrangement shown the valve 61 is preferably adjusted to be normally removed a slight distance from its seat and has a stem 62 that extends through the chamber 57 to the exterior of the valve casing and is sealed in the end wall 63 of the valve casing 54 by a gland-pressed packing 64.

As is customary in machines of the character to which the present invention pertains, the initial movements of the valves 46 and 61 required for setting the piston 26 in motion is effected by devices that act in response to force applied manually, in the present instance upon a treadle 65 positioned on the forward side of the hammer and below the die member 23. The treadle rests upon bars 66 extending along the sides of the columns 21 and having their rearward ends hinged on a pivot 67 seated in the columns 21. A

tension spring 68 having an end attached to an arm 66 and its other end attached adjustably to a lug 69 on the adjacent column 21 serves to normally maintain the treadle 65 in its uppermost limiting position and to return the treadle to such position when released from a controlling position.

The rocking movement of the treadle is transmitted from one of the arms 66 to the valve 61 by a rod 70 that is pivotally connected at one end to such arm 66 and at its other end to the extremity of a rocker 71 disposed adjacent the valve casing 54 upon a pivot 72 extending through the intermediate portion of the rocker, and on the upper surface of the rocker are teeth 73 that engage a rack 74 on the valve stem 62.

The opposite end of the rocker 71 is pivotally connected to a depending rod 75 serving to transmit movement from the rocker 71 to an oscillatory member 76 mounted pivotally upon a stationary shaft 77 seated in a column 21.

The oscillatory member comprises a plate 78 carrying on one side thereof and intermediate its ends a trunnion 79 which is bored to receive the stationary shaft 77. The plate 78 lies adjacent the front surface of the column 21 and carries a guide member 80 that is connected pivotally to the plate to receive the rod 75. The rod may be adjustably secured to the guide member for varying the effective portion of the rod 75 between the rocker 71 and the plate 78, in the manner illustrated and described with more particularity in my United States Patent No. 2,105,074 granted January 11, 1938.

Preferably, a spring 81 in the form of a single flat coil and having an end connected to a column 21 acts with its other end upon the plate 78 to normally depress said end of the plate 78 and thereby augment the force of the spring 68.

On the opposite end of the plate 78 is a second trunnion 82 which lies on the same side of the plate 78 as the trunnion 79 and has a bore 83 extending therethrough to accommodate a shaft 84 carrying on its foremost end an arm 85. The opposite or rear end 86 of the shaft 84 is of reduced diameter and extends through the hub 87 of a depending finger 88 having a convex surface 89 lying in the path of movement of the ram 28 for engagement with an inclined surface 90 on the side of the ram.

The finger 88 is urged constantly toward the inclined surface 90 by a spring 91 that is similar in all essential respects to the spring 81 and anchored with one end on the column 21 and with its other end on the extremity of an arm 92 carried by the hub 87 and extending in a direction approximately opposite to that of the arm 85. A nut 93 threaded upon the end 86 of the shaft 84 secures the hub fixedly to the shaft 84 so that the said shaft, the arms 85 and 92 and the finger 88 may be oscillated as a unit.

Suitable means are provided for transmitting movement from the shaft 84 to the valve 46 for effecting the distribution of pressure fluid to the piston chamber. To this end the valve is provided with a link 94 that is pivotally connected at one end to the valve and extends through the end wall 35 of the bushing 34 and through a packing element 95 in said end wall. The other end of the link 94 is pivotally connected to an arm 96 of a rocker 97 journaled in a bearing 98 on the side of the cylinder 24 and having its other arm 99 pivotally connected to a link 100 slidably interlocked with the arm 85.

In the arrangement shown the lower end of the link 100 carries a clevis 101 to receive the arm 85 and the pin 102 in the clevis extends through and is readily slidable in a slot 103, preferably of arcuate shape, in the arm 85 and terminating with its inner end near the shaft 84.

By reason of the slidable connection of the lower end of the link 100 with the arm 85 the range of movement of the valve 46 may be readily varied and in order to effect such shifting of the link in ready response to the will of the operator, the trunnion 79 is provided on its upper surface with a lateral projection or arm 104 having its free end pivotally connected to a link 105. The link 105 is adjustable for length and has its opposite end pivotally connected to the link 100 at a point approximately in the same horizontal plane as the point of connection of the link 105 with the arm 104.

Whenever it is intended to initiate a forging operation the treadle 65 is depressed. The downward movement of the treadle causes the throttle valve 61 to be opened for admitting a full supply of pressure fluid to the chamber 42 and, at the same time, the oscillatory member 76 will be rocked about the shaft 77 to move the finger 88 downwardly for engagement with the inclined surface 94. Movement will thereby be transmitted through the link 105 to the link 100 for moving the pin 102 to the outer end of the slot 103. The shifting of the link 100 to this position will have the immediate effect of raising the valve 46 to place the inlet passage 40 in communication with the ports 44 through the annular groove 50 in the valve. The lower flange 49 of the valve will then lie above the port 45 so that the lower end of the piston chamber 25 will be in direct communication with the atmosphere through the inlet passage 41, the ports 45, the bore 32 and the exhaust port 33. In this position of the valve pressure fluid will flow into the upper end of the piston chamber 25 and drive the piston downwardly on its working stroke.

During this, as in all movements of the piston, the finger 88 is held firmly in contact with the inclined surface 90 by the spring 91 and as the piston descends the finger will be rocked toward the ram and the arm 85 will, in consequence, be rocked upwardly. This swing movement of the arm 85, transmitted through the link 100 and the rocker 97, causes the valve to move downwardly to communicate the inlet passage 41 with the ports 44 and also to move the flange 48 below the ports 43. The pressure fluid in the upper end of the chamber will then escape to the atmosphere through the inlet passage 40, the ports 52 and the associated channels, including the exhaust port 33. At the same time pressure fluid flows into the lower end of the piston chamber to lift the piston.

The described cycle of operation may be repeated until the forging operation is completed and, of course, only while the treadle 65 remains depressed to maintain the linkage moved by the treadle in the positions hereinbefore described.

Upon completion of the forging operation the treadle is released. The springs 68 and 81 will then rock the treadle upwardly to its idle position and simultaneously with this movement of the treadle the end of the plate 78 upon which the spring 81 acts is rocked downwardly to elevate the shaft 84 and the associated arms. While this movement of the plate 78 is taking place the arm 104 will swing outwardly and move the pin 102 to the innermost end of the slot 103.

With the pin 102 in this position little, if any, movement may be transmitted from the arm 85

to the rocker 97 and the valve 46 will then occupy a position in which the flange 48 overlies the ports 43 to effectively seal the upper end of the piston chamber. The lower flange 49 will then partly uncover the ports 45, it being understood, of course, that said flanges are suitably spaced for this purpose, and pressure fluid will then flow into the lower end of the piston chamber and elevate the piston to an intermediate position where it will be held immovable by the fluid medium entrapped in the upper end of the piston chamber and the live pressure fluid flowing directly from supply into the lower end of the piston chamber.

I claim:

1. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the piston chamber for actuating the piston, a rocker, a cam carried by the piston for actuating the rocker, adjustable linkage for transmitting movement from the rocker to the valve, manually operable means for actuating the rocker relatively to the cam, and means acting in response to movement of the manually operable means for effecting adjustment of the linkage and thereby vary the range of movement of the valve.

2. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the piston chamber for actuating the piston, a rocker, a cam carried by the piston to actuate the rocker, adjustable linkage for transmitting movement from the rocker to the valve, manually operable means for actuating the rocker in one direction relatively to the cam, resilient means for moving the rocker in the opposite direction, and means to effect adjustment of the linkage for increasing the range of movement of the valve upon operation of the manually operable means and to effect adjustment of the linkage for decreasing the range of movement of the valve upon the release of the manually operable means and the subsequent operation of the resilient means.

3. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the piston chamber for actuating the piston, a rocker, a cam carried by the piston to actuate the rocker, adjustable linkage for transmitting movement from the rocker to the valve, manually operable means for actuating the rocker in one direction relatively to the cam, resilient means for moving the rocker in the opposite direction, and means to effect adjustment of the linkage for increasing the range of movement of the valve upon operation of the manually operable means and to effect adjustment of the linkage upon the release of the manually operable means and the subsequent operation of the resilient means to move the valve and hold it in position to prevent the passage of pressure fluid to and from one end of the piston chamber and to simultaneously admit pressure fluid into the other end of the piston chamber for holding the piston immovable.

4. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the ends of the piston chamber for actuating the piston, a rocker, a cam carried by the piston to actuate the rocker, means for transmitting movement from the rocker to the valve, manually operable means for moving the rocker in one direction to different operative positions relatively to the cam, resilient means for moving the rocker in the opposite direction relatively to the cam, and means for shifting the first mentioned means relatively to the axis of rotation of the rocker upon operation of the manually operable means and of the resilient means to vary the range of movement of the valve.

5. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, said casing having upper and lower inlet passages for pressure fluid leading to the upper and lower ends of the piston chamber, a valve to control the inlet passages, a rocker, a cam carried by the piston to actuate the rocker, adjustable linkage for transmitting movement from the rocker to the valve, manually operable means for actuating the rocker in one direction relatively to the cam, resilient means for actuating the rocker in the opposite direction, and means to effect adjustment of the linkage relatively to the rocker for causing movement of the valve to alternately admit pressure fluid to the inlet passages upon the operation of the manually operable means and to effect adjustment of the linkage relatively to the rocker for moving the valve to and holding it in position to seal the upper inlet passage and to simultaneously uncover the lower inlet passage for admitting pressure fluid into the lower end of the piston chamber for holding the piston immovable.

6. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the ends of the piston chamber for actuating the piston, a swinging bearing, a pivot on the casing for the swinging bearing, a shaft journaled in the swinging bearing and having an arcuate finger and an arm, a cam carried by the piston to engage the arcuate finger for rotating the shaft in one direction, a spring for rotating the shaft in the opposite direction, a link for transmitting movement from the arm to the valve and being slidably interlocked with the arm, manually operable means for rocking the swinging bearing and the arcuate finger relatively to the cam, and means associated with the swinging bearing and the link for shifting the link on the arm upon actuation of the manually operable means to vary the range of movement of the valve.

7. In a fluid actuated hammer, the combination of a casing having a piston chamber and a reciprocatory piston therein, a valve to effect the distribution of pressure fluid to the ends of the piston chamber for actuating the piston, a rocker, a cam carried by the piston to actuate the rocker, a swinging bearing on the casing for the rocker, manually operable means for rocking the swinging bearing and the rocker in one direction relatively to the cam, resilient means for rocking the swinging bearing and the rocker in the opposite direction, a link for transmitting movement from the rocker to the valve and being slidably interlocked with the rocker, a projection integral with and extending laterally of the swinging bearing, and a rod pivotally connected to the link and the projection to shift the link radially of the rocker for varying the range of movement of the valve upon actuation of the manually operable means and of the resilient means.

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