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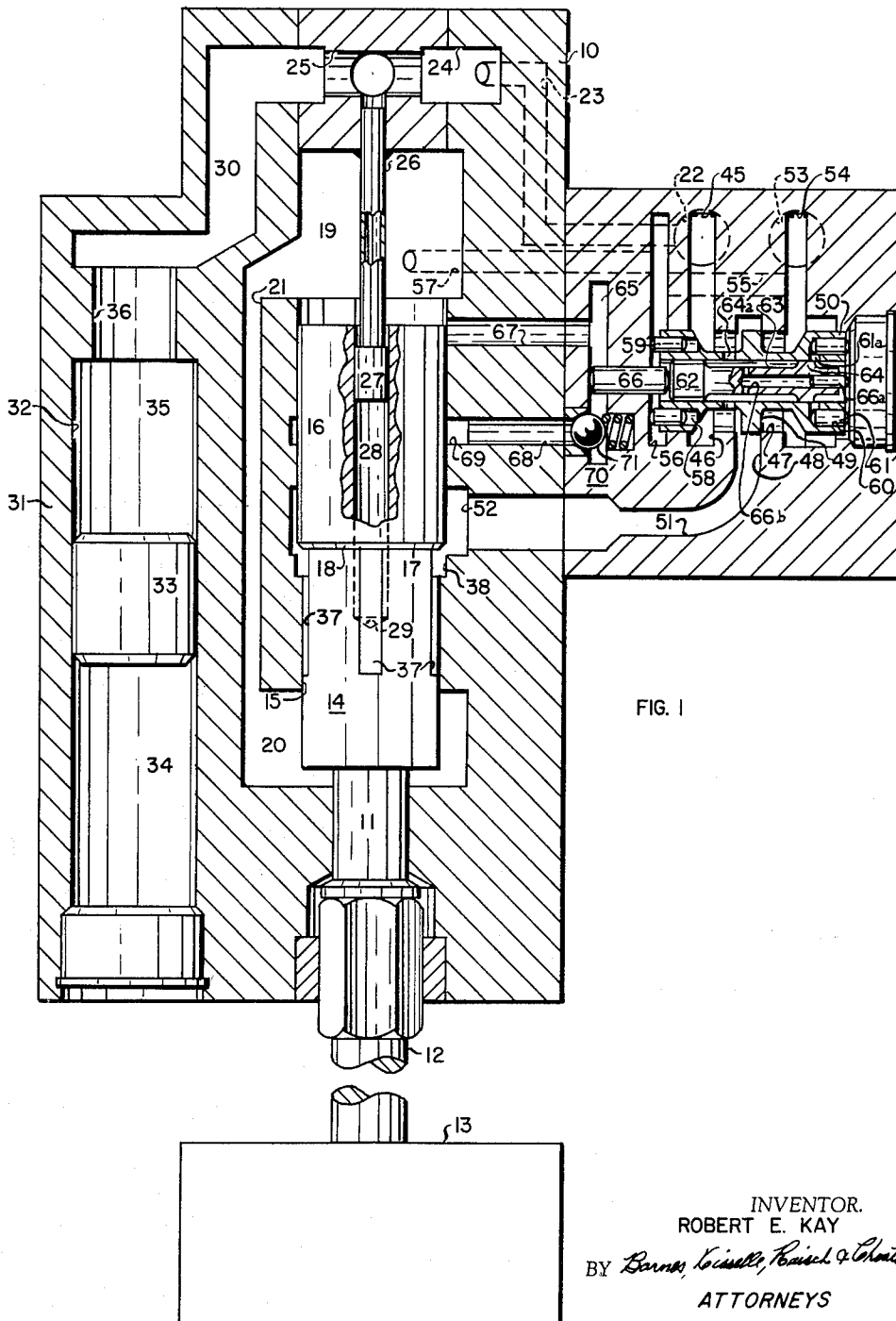
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HYDRAULIC HAMMER

Filed April 9, 1964

2 Sheets-Sheet 1



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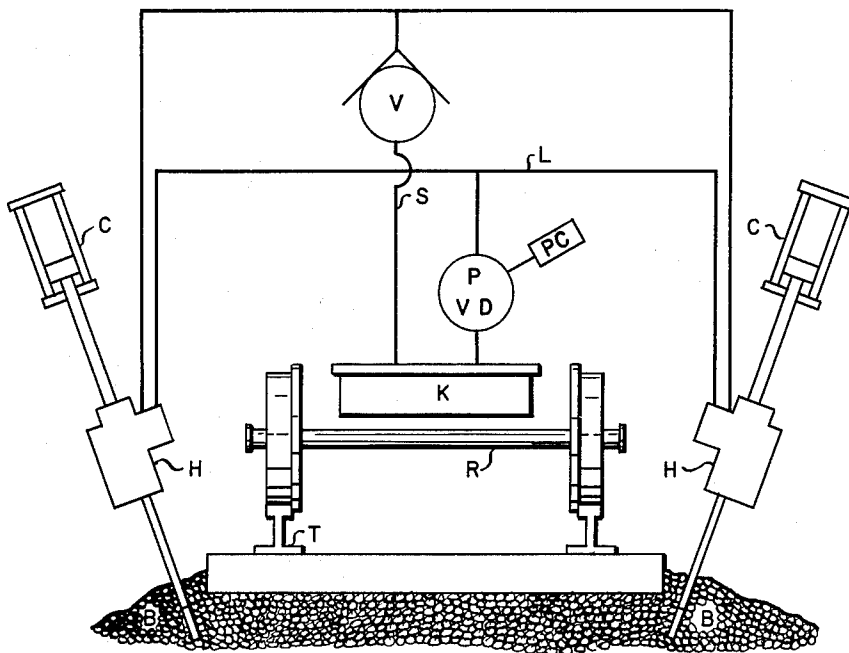


FIG. 2

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HYDRAULIC HAMMER

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This invention relates to power transmissions and particularly to hydraulic hammers that are intended for use in earth tamping operations such as tamping the road bed of a railroad.

In railroad construction, it is customary to re-level the railroad tracks and thereafter to fill in under the railroad ties that support the tracks with a ballast by tamping. It has also been customary to utilize a plurality of pneumatic hammers mounted on a car and movable along the track to tamp the track bed. Such hammers have necessarily been large, noisy and relatively inefficient and require large air compressors which are costly and inefficient.

It is an object of this invention to provide a hydraulic hammer which will obviate the disadvantages of a pneumatic hammer, which can be utilized singly or in banks.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

FIG. 1 is a partly diagrammatic sectional view of a hydraulic hammer embodying the invention.

FIG. 2 is a diagrammatic view of a railroad car embodying the invention.

Referring to FIG. 2, the hydraulic hammers of the present invention are particularly intended for use in the tamping of a road bed B alongside railroad track T. As shown, a plurality of hydraulic hammers H are mounted on the ends of the pistons of hydraulic cylinders C which in turn are mounted on a car R that is movable along the railroad track. The hydraulic hammers H are provided in banks on each side of the car R and are adapted to be moved into and out of tamping position by operation of the cylinders C. As shown in FIG. 2, hydraulic fluid under pressure is supplied to the hydraulic hammers from a variable displacement pump P. In the operation of the hydraulic hammers, the pump P is energized, causing fluid to flow through lines L through the hydraulic hammers H and which must return through a common tank return line S incorporating therein a back pressure valve V to the reservoir or tank K.

Each hydraulic hammer is of the same design such as shown in FIG. 1 and comprises a body 10 on which an anvil 11 is reciprocally mounted for engagement with the end of a shaft 12 that, in turn, supports the tamping tool 13. A reciprocating mass or hammer 14 is mounted in a stepped cylinder bore 15 formed in the body 10. Hammer 14 includes stepped portions 16, 17 separated by a shoulder 18, as presently described. The ends of the cylinder 15 are opened to areas 19, 20 that communicate with one another through a passage 21.

Hydraulic fluid under pressure is supplied to the body through an inlet 22 and passes through a passage 23 into an annular area 24 in one end of the body. Fluid under pressure passes through a diametral opening 25 across the annular area 24 and communicates with one end of a tube 26 that extends through the area 19 and has an enlarged cylindrical portion 27 thereon that is in sealing hammer 14. This provides fluid under pressure to area 29. The projected cross sectional pressure area of the shoulder 18 is greater, preferably twice as great, than the projected pressure across the cross sectional area of the area 29.

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The fluid under pressure from annular area 24 is also connected through a passage 30 to an accumulator 31 formed in the body by a cylindrical chamber 32 in which a piston 33 is positioned. The area 34 at the bottom of the piston 33 is charged with gas under pressure, preferably at half the system pressure, while the area 35 at the top of the piston 33 communicates with the passage 30 through an axial opening 36.

The fluid under pressure supplied to inlet 22 passes through a passage 45 to an annular groove 46 in a bore 47 in the body 10. Bore 47 is formed with a second groove 48 and the passage of fluid under pressure from groove 46 to groove 48 is controlled by the land 49 of a valve spool or sleeve 50 that is reciprocally mounted in the bore 47. In the position shown in FIG. 1, the fluid under pressure passes from groove 46 to groove 48 and thereafter through a passage 51 to an annular groove 52 formed along the inner surface of the cylinder 15.

The body 10 includes an outlet 53 through which the hydraulic fluid passes to the reservoir or tank. Outlet 53 communicates with a groove 54 surrounding the bore 47 and through passage 55 to a groove 56 at the inner end of the bore 47. The outlet is in turn connected to the area 19 through groove 54, passage 55, groove 56 and passage 57. Since the area 19 is connected to area 20 by passage 21, area 20 is therefore also connected to the outlet. Thus, both ends of hammer 14 are always subjected to tank pressure.

As shown in FIG. 1, the valve sleeve 50 has a plurality of circumferentially spaced axial holes 58 formed in one end thereof in which pins 59 are slidably positioned. Holes 58 open into groove 46 so that the pins 59 are always subjected to fluid under pressure. The reaction force acts on the sleeve 50, tending to drive the sleeve 50 outwardly. Similarly, the valve sleeve 50 is formed with axial holes 60 at the other end thereof in which pins 61 are positioned. The number of pins 61 is greater than the number of pins 59. A valve spool 62 is slidably positioned in the interior of valve sleeve 50. The valve spool 62 is formed with a groove 63 that communicates with the groove 46 through an opening 64a in the valve sleeve 50 adjacent the groove 46. Fluid under pressure is thereby provided to the groove 63 at all times. A land 64 on valve spool 62 controls the flow of fluid under pressure from the groove 63 to the left or inner ends of the pins 61. The inner ends of the holes 60 communicate with the interior of the sleeve 50 by means of ports 61a. In the position shown, ports 61a are connected to tank pressure. When the land 64 on spool 62 moves to the right or outwardly, communication of ports 61a with tank pressure is blocked and communication is made to fluid pressure.

As further shown in FIG. 1, body 10 is formed with a pressure area 65, and a pin 66 extends between the pressure area 65 and the left or inner end of the spool 62. The area 65 is connected to the enlarged portion of the surface of the cylinder bore 15 by a passage 67 and a passage 68, the latter extending to an annular groove 69. Inner valve spool 62 has a hole in the right or outer end thereof in which a pin 66a is positioned. The holes 66b communicate internally through a radial opening to the fluid pressure. The reaction force on the spool acts in a leftward direction on pin 66a, which is smaller in cross section than pin 66, preferably having an area ratio of one to two. A check valve 70 comprising a spring loaded ball 71 permits flow in one direction only from annular groove 69 through passage 68 to the end of pin 66 but not in the reverse direction.

The inner spool 62 thus acts as a pilot spool for the outer valve spool 50. Movement of the inner spool results in movement of the outer spool in the opposite direction.

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In the position shown in FIG. 1, the hammer 14 has just struck the anvil 11 and is beginning the return stroke. In this position, hydraulic fluid under pressure is being applied through the tube 26 to the area 29 and at the same time, is flowing through grooves 46, 48 and passage 51 to the groove 52 where it is applied to the shoulder 18. Since the projected area of the shoulder 18 is greater than the projected area of the area 29, the hammer begins to accelerate upwardly with uniform acceleration as shown in FIG. 1. As the piston accelerates, the upper end of the hammer closes the lower end of the passage 67. After the piston has traveled approximately one-half its stroke, the piston has moved further upwardly to uncover the groove 69 and the inner end of passage 68, permitting fluid under pressure to flow from groove 52 along the reduced portion 17 of the hammer 14 to the passage 68 through check valve 70 to the inner end of the pin 66. Since the area of the pin 66 is greater than the area of the pin 66a, the spool 62 will be shifted rightwardly, moving the land 64 and permitting fluid under pressure to flow from the groove 63 to the left ends of the pins 61. This causes a reaction force on the valve sleeve 50 moving it inwardly to move the land 49 inwardly and cut off communication between the grooves 46 and 48 and openings 48 to 54 and tank. This prevents further fluid from flowing under pressure through passage 51 to the shoulder area 18.

Removal of pressure from area 52 and shoulder 18 results in a resultant decelerating force caused by the pressure acting on area 29. The hammer 14 will thereafter decelerate as it moves upwardly. During the deceleration, the fluid being displaced from chamber 28 and the additional fluid being supplied to annular area 24 by the pump P passes through passages 30 and 36 to charge the accumulator 31. As the hammer 14 moves further upwardly and decelerates to a zero velocity and stops, the pressure of the fluid from the pump will begin to accelerate the hammer 14 downward. As the hammer 14 accelerates, the additional fluid from the accumulator 31 will insure continued acceleration. Just prior to the impact of the piston, the left end of passage 67 will be opened for communication to area 19 to shift the spool 62 inwardly and open the groove 61a to tank pressure.

As shown, the back pressure valve V reduces the pulsations in the tank line and prolongs tank line life. In the absence of the back pressure valve V, when pressure is applied to the area 18 to accelerate the piston toward the upper end of the device and the piston has traveled half its travel, it has reached a predetermined finite velocity. At that point, the switch to the valve groove 52 from the high pressure to tank pressure necessitates that atmospheric pressure force fluid into the differential area 18 at a rate which the fluid will follow the piston and prevent a void or cavitation. If the high velocity is encountered, atmospheric pressure is insufficient to supply this area with fluid. An instant reversal later, when the piston moves toward the point of impact the fluid is being driven from area 18 at a high rate. Thus, there are two extremes, at one instant, a tendency for cavitation occurs in the tank line and at the next instant, an effort is being made to force large volumes through the line, resulting in severe pressure pulsations. The presence of the back pressure valve V in the common tank return line S builds up a back pressure and maintains the hydraulic fluid in the outlet line of each hammer to prevent massive cavitation from occurring, only one back pressure valve being needed for the entire bank of hammers.

In order that the hammer 14 will be reciprocated only when the tamping tool 13 is in contact with the ground, the hydraulic hammer is constructed to operate only when the tamping tool 13 engages the ground and places a slight force on the hammer 14 tending to move the hammer 14 upwardly. Diametrically opposed longitudinally extending flat portions 37 extend from the step portion 38 of the bore 15 into which shoulder 18 extends along the length of the hammer, only one of which is

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shown in FIG. 1. The longitudinal extent of the flat portions 37 is such that when the tamping tool 13 is not in engagement with the ground, a leakage path is provided between the area of the step portion 38 and the area 20. As a result, pressure cannot be built up to cause operation of the hammer 14 until the tamping tool 13 moves the hammer 14 upwardly sufficiently to cut off communication between the lower end of flat portions 37 and area 20. Thus, when the hydraulic hammers embodying the invention are utilized in banks only those hammers which are in contact with the ground will be operated.

It can thus be seen that there has been provided a hydraulic hammer construction which can be utilized singly or in banks and which operates efficiently.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a hydraulic device, the combination comprising a housing, said housing having a bore, a member reciprocable in said bore, said reciprocating member having opposed pressure areas defining first and second pressure areas, said first pressure area having an effective cross sectional area less than said second pressure area, means for continuously applying fluid under pressure to said first pressure area, hydraulically controlled valve means for alternately applying fluid under pressure to said second pressure area, said housing having passage means extending between said bore and said valve means, said passage means being alternately connected by movement of said reciprocating member to operate said valve means and control the application of pressure to said second pressure area, said reciprocable member having an axially extending portion thereof spaced from the wall of said bore and providing communication between said second pressure area and the adjacent end of said member when the member is at one end of said bore whereby said member is maintained at said one end of said bore until axial external force is applied to said member in a direction tending to move said member toward the opposite end of said bore.
2. In a hydraulic device, the combination comprising a housing, said housing having a bore, a member reciprocable in said bore, said reciprocating member having opposed pressure areas defining first and second pressure areas, said first pressure area having an effective cross sectional area less than said second pressure area, means for continuously applying fluid under pressure to said first pressure area, hydraulically controlled valve means for alternately applying fluid under pressure to said second pressure area, said housing having passage means extending between said bore and said valve means, means for connecting the opposed ends of said bore to a fluid outlet, said housing having a passage therein extending between said bore and said valve means, said reciprocating member being adapted to open and close said passage as it reciprocates thereby alternately exposing said valve means to outlet pressure, whereby said valve means are caused to alternately operate and apply fluid under pressure alternately to said second pressure area, said reciprocating member having an axially extending portion thereof spaced from the wall of said bore

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and providing communication between said second pressure area and the adjacent end of said member when the member is at one end of said bore whereby said member is maintained at said one end of said bore until axial external force is applied to said member in a direction tending to move said member toward the opposite end of said bore.

3. The combination set forth in claim 1 including a second passage providing communication between said bore and said valve means, said reciprocating member being adapted to expose said second passage to fluid under pressure as it reciprocates in one direction, said member successively closing said first-mentioned passage to thereby cause an increase in pressure which causes said valve means to shift and terminate the application of fluid under pressure to said second pressure area.

4. The combination set forth in claim 1 including accumulator means adapted to be charged when the reciprocating member is moving due to the application of pressure to said second pressure area.

5. The combination set forth in claim 1 including a check valve in said second passageway permitting the flow of fluid through said passageway to said valve means in one direction only.

6. The combination set forth in claim 1 wherein said valve means comprises an inner spool having opposed areas of different size and a land,

an outer spool surrounding the inner spool and having a pair of spaced grooves,

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means for applying fluid under pressure to one of said grooves,

said land in said inner spool controlling the flow of pressure from one groove to the other groove,

said outer spool having an opening therethrough so fluid under pressure may flow to the area of the groove on the inner spool,

said outer spool having opposed pressure areas of different sizes,

means for applying fluid under pressure continuously to one of said areas,

said inner spool being shiftable by the application of fluid under pressure through said second passage means to apply pressure and in turn shift the outer spool which controls the flow of fluid under pressure to said second pressure area of said reciprocating member.

7. The combination set forth in claim 1 including accumulator means connected with said bore to be charged when the reciprocating member moves in one direction due to the application of pressure to said second pressure area.

References Cited by the Examiner

UNITED STATES PATENTS

709,067	9/02	Waugh	91—220
2,248,546	7/41	Morrison et al.	91—321
2,556,680	6/51	Davis	91—321

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