Aug. 7, 1928.

M. MACK

1,679,433

SAFETY APPLIANCE FOR HYDRAULIC ACCUMULATORS

Filed Oct. 27, 1925

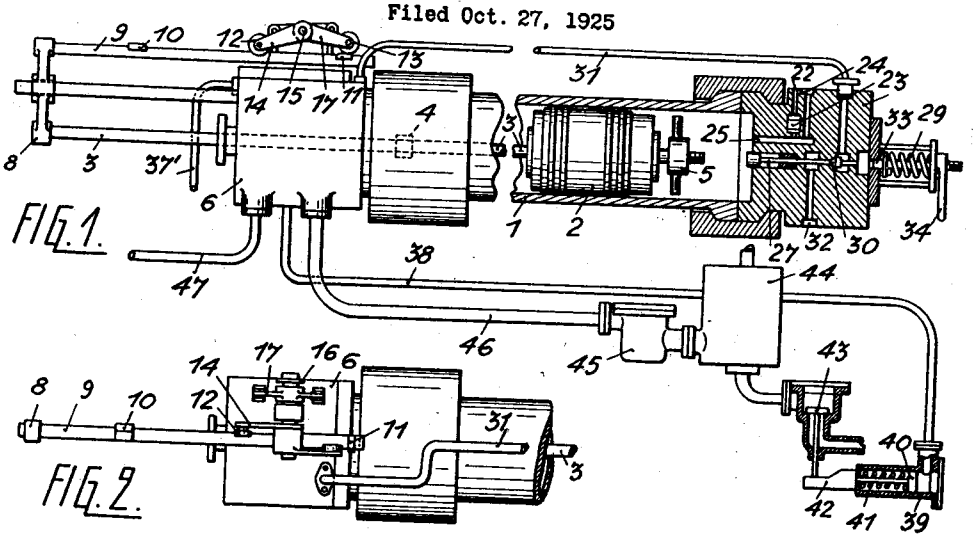


FIG. 1.

FIG. 2.

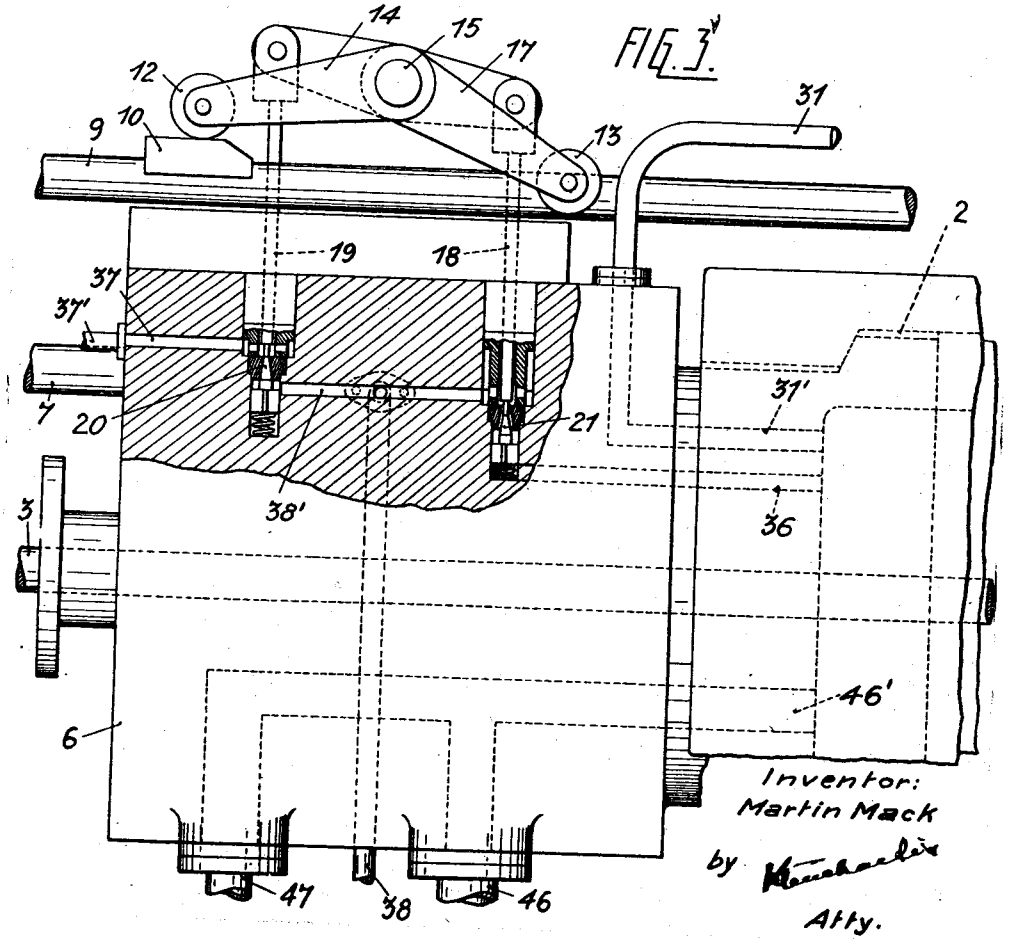


FIG. 3.

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Patented Aug. 7, 1928. 1,679,433

UNITED STATES PATENT OFFICE.

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SAFETY APPLIANCE FOR HYDRAULIC ACCUMULATORS.

Application filed October 27, 1925, Serial No. 65,170, and in Germany August 4, 1925.

My invention refers to safety appliance for hydraulic accumulators more especially to the kind in which the weight customarily employed in these devices is replaced by compressed air, a freely movable piston acting as a partition between the air and the liquid under pressure. By forcing liquid into the front end of the cylinder in which the piston is reciprocating the piston is moved to the rear and compresses the air in the rear end of the cylinder. The energy stored at this end is available after the delivery of liquid under pressure to the front end has been cut off and the liquid space at the front end of the cylinder has been connected to the system. It is an object of my invention to provide a safety appliance which automatically empties the water-filled part of the cylinder when the piston oversteps a certain limit on its inward stroke.

To this end I provide in the air-filled part of the cylinder, and preferably in its head at the air end, a valve which is operated by the piston when the piston oversteps the predetermined limit, thereby discharging the water in the water end of the cylinder so that the piston does not move further, and damage to the piston or the cylinder head by collision of these parts is prevented.

In the drawings affixed to this specification and forming part thereof an accumulator equipped with a safety appliance according to my invention is illustrated diagrammatically by way of example. In the drawings

Fig. 1 is an axial section,

Fig. 2 is a partial plan view,

Fig. 3 is an elevation, partly in section, of the front end of the cylinder on a larger scale.

Referring to the drawings, 1 is the working cylinder and 2 is the piston capable of free reciprocation within said cylinder. This piston is freely mounted on a governing rod 3 arranged axially in the cylinder, the piston being packed against the rod so as to prevent the passage of compressed air or liquid. On the rod is mounted near the front cylinder head 6 an adjustable check 4, on the rear end of the rod a check 5. Piston 2 is free to slide on the rod 3 between the two checks. The rod 3 extends across the cylinder head 6 and on its free end there is mounted a cross head 8 slidable on a slide bar 7 mounted in the cylinder head 6 and carrying on its free end a rod 9 carrying two laterally staggered cams 10 and 11 adapted to cooperate with rollers 12 and 13 mounted on the ends of a two-armed lever 14 which is keyed onto a shaft 15 mounted in a forked bearing 16. On the shaft 15 is further mounted the two-armed lever 17, to the end of which are pivoted the push rods 18 and 19 governing valves 20 and 21 which regulate the delivery of liquid to the front end of the cylinder from a pump indicated diagrammatically at 44 and operated by any suitable means, not shown, through the delivery valve chest 45, a pipe 46 and a passage 46′ in the cylinder cover 6. The front end of the passage 46′ is connected with the system, not shown, by a pipe 47.

As will appear from Fig. 3 the chamber of the valve 21 is connected with a cylinder 2 by a passage 36 in the cylinder head 6 and with a chamber of the valve 20 by a passage 38′ and the latter valve chamber, in turn, is connected with atmosphere by a passage 37 and a pipe 37′. 38 is a passage connecting the passage 38′ with a cylinder 39 in which a piston 40 is free to reciprocate against the pressure of a spring 41. 42 is a cam at the end of the piston rod, and 43 is the suction valve of the pump 44. It will appear that when liquid under pressure enters the cylinder 39 the cam 42 will lift the suction valve 43 so that the pump 44 becomes inoperative.

Instead of this cut-out device, a by-pass or any other suitable means, not shown, might be provided for interrupting the delivery of liquid to the pump.

The cylinder head 40 on the rear end of cylinder 1 is provided with means for distributing the compressed air. The cylinder head 40, while lacking the change-over valve customarily combined with these accumulators is provided with a safety device preventing the admissible pressure from being overstepped when the piston approaches the cylinder head. It is further provided with means for emptying the cylinder.

The admission of air is provided for by a channel 22 in the cylinder head 40, which opens into the atmosphere. The check valve 23 inserted in this channel serves for admitting atmospheric air into the cylinder whenever the accumulator is not in operation, so that the piston 2 is free to return to its

initial position at the front end of the cylinder. To a conduit 24 are connected steel tanks or other reservoirs (not shown) for increasing the air space of the accumulator. The conduit 24 as well as that part of the channel 22 which is governed by the check valve 23 communicate through channel 25 with the interior of the cylinder.

A push rod 27 movable in an axial boring of the cylinder head 40 and extending into the cylinder is adapted to cooperate with a valve 30 acted upon by a spring 29 and serving to control the connection of a pipe 31 which is in communication with the liquid space of the cylinder through a passage 31′ in the front cylinder head 6 with a discharge passage 32 in the cylinder head 48.

A spindle 33 mounted on valve 30 and which is secured against rotation by a spline or the like has mounted on its threaded end a nut carrying a handle 34 by means of which the valve 30 can be manually lifted off its seat against the action of spring 29 in order to empty the liquid-filled space of the cylinder by way of pipe 31 and discharge passage 32.

This accumulator operates as follows:—

As long as its working cylinder by the pump 44 is empty, the piston 2 abuts against the cylinder head 6. As soon as water is forced into the cylinder, the piston 2 will glide along rod 3 until it reaches the rear check 5, whereby rod 3 is drawn into the cylinder carrying along with it rod 9. As cam 10 mounted on this latter rod passes underneath roller 12, this latter is lifted thereby rotating lever 14. Lever 17 being forced to follow the rotation of the shaft 15 depresses the push rod 19 of the valve 20 and raises the push rod 18 of the valve 21. In consequence, valve 20 closes the passage 37 and valve 21 connects the passages 36 and 38′ so that liquid from the cylinder 2 enters the cylinder 39 and causes the suction valve 43 of the pump 44 to be raised so that the pump is rendered inoperative and the supply of liquid to the front end of the cylinder 1 ceases.

If owing to any irregularity in the control of the piston this latter should move beyond its normal end position, check 5 will lift spindle 27, thereby opening valve 30 which will cause liquid from the accumulator cylinder to flow back through pipe 31 and channel 32. This relieves the pressure in the water space in front of the piston 2 so that the piston ceases to move. If desired a connection, not shown, may be provided by which the liquid from 32 is returned to the pump. In consequence thereof the piston can never come in contact with the cylinder head 40, so that all undue pressure is obviated.

When the piston 2 moves in the opposite direction, the governing rod 3 being influenced by the pressure prevailing in the cylinder will follow its movement as far as the position of check 4 on this rod will permit it. When this check meets the cylinder head 6, the rod 3 is arrested but the piston 2 will continue its movement, gliding on the rod 3. Cam 11 on rod 9 is carried in time below roller 13 so as to rotate lever 14, push rod 18 will be lowered while push rod 19 is raised, whereby the accumulator is cut off from the pump control cylinder 39 by the valve 21 closing the passage 36 and the valve 20 opening the connection between the passage 38′ and 37, allowing the liquid from 39 to be discharged so that the spring 4′ is free to return the piston 40 to its initial position and the pump 44 is set operating again.

The accumulator has been shown in horizontal position. It may be arranged in vertical position if desired but since this accumulator is of the pneumatic and not of the gravity type, it is not limited to vertical arrangement. Horizontal arrangement has the advantage of being more convenient because generally more space is available in a building in horizontal than in vertical direction so that it is possible to arrange a horizontal accumulator without breaking through a wall, or several walls, of the building whereas with the accumulator in vertical position it will be inevitable to break through one floor or several floors of the building and the valve gear at the top of the accumulator is generally in a position which renders access thereto difficult, so that the gear and the mechanisms connected with the gear are liable to be neglected. With the accumulator arranged in horizontal position, on the other hand, there is no difficulty about getting at the valve gear and its mechanism for inspection and lubrication.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:—

1. A safety appliance for hydraulic accumulators comprising a cylinder, a piston axially movable in said cylinder, means for supplying said cylinder with water on one and with compressed air on the other side of said piston, means for emptying the water-filled part of said cylinder and means on the air-filled side of said cylinder adapted to be influenced by said piston for operating said emptying means.

2. A safety appliance for hydraulic accumulators comprising a cylinder, a piston axially movable in said cylinder, means for supplying said cylinder with water on one and with compressed air on the other side of said piston, means for emptying the water-filled part of said cylinder, means on the air-filled

side of said cylinder adapted to be influenced by said piston and separate manually operable means for operating said emptying means.

3. A safety appliance for hydraulic accumulators comprising a cylinder, a piston axially movable in said cylinder, means for supplying said cylinder with water on one and with compressed air on the other side of said piston, means for emptying the water-filled part of said cylinder and a valve on the air-filled side of said cylinder adapted to be influenced by said piston for operating said emptying means.

4. A safety appliance for hydraulic accumulators comprising a cylinder, a piston axially movable in said cylinder, means for supplying said cylinder with water on one and with compressed air on the other side of said piston, means for emptying the water-filled part of said cylinder, a valve on the air-filled side of said cylinder adapted to be influenced by said piston for operating said emptying means and separate means for actuating said valve by hand.

5. A safety appliance for hydraulic accumulators comprising a cylinder, a piston axially movable in said cylinder, a rod extending into said cylinder and arranged to be displaced by said piston, means for supplying said cylinder on one side of said piston with water, means connected with said rod for controlling said water supplying means, means for supplying said cylinder with compressed air on the other side of said piston, means for emptying the water-filled side of said cylinder and means on the air-filled side of said cylinder adapted to be influenced by said piston for operating said emptying means.

6. A safety appliance for hydraulic accumulators comprising a cylinder, a piston axially movable in said cylinder, means for supplying said cylinder with water on one end and with compressed air on the other end, two checks on said rod opposite either face of said piston and adapted to be engaged thereby, said rod projecting from the water-filled part of said cylinder, valve gear operatively connected with said water supplying and emptying means, and cam means operatively connected with the projecting end of said rod for controlling said valve gear.

In testimony whereof I affix my signature.

MARTIN MACK.