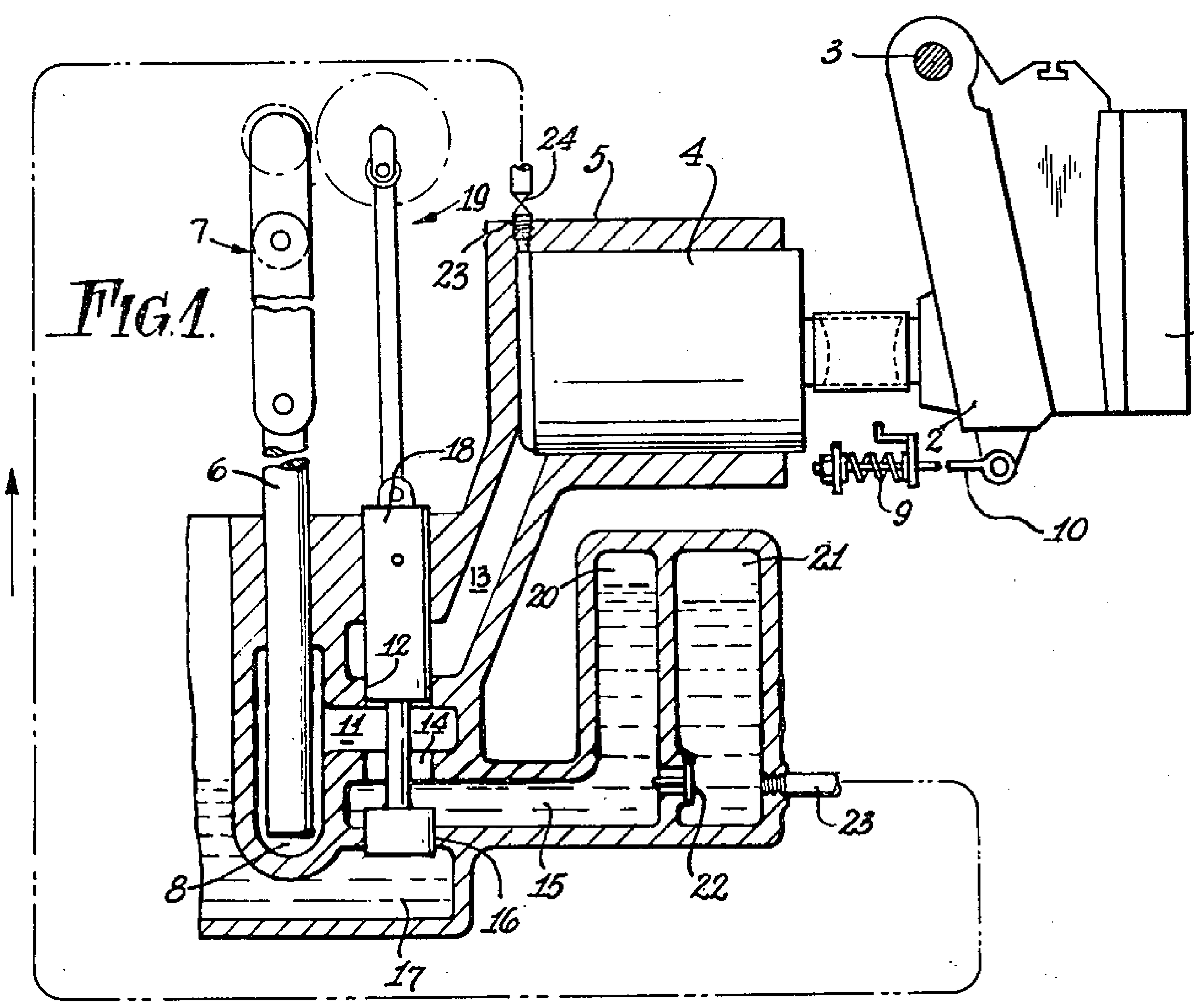
Aug. 8, 1961 K. GAULDIE 2,995,013

IDLE STROKE RECEIVER FOR HYDRAULIC DEVICES

Filed April 13, 1959

FIG. 1.



Make-up Liquid

FIG. 2.

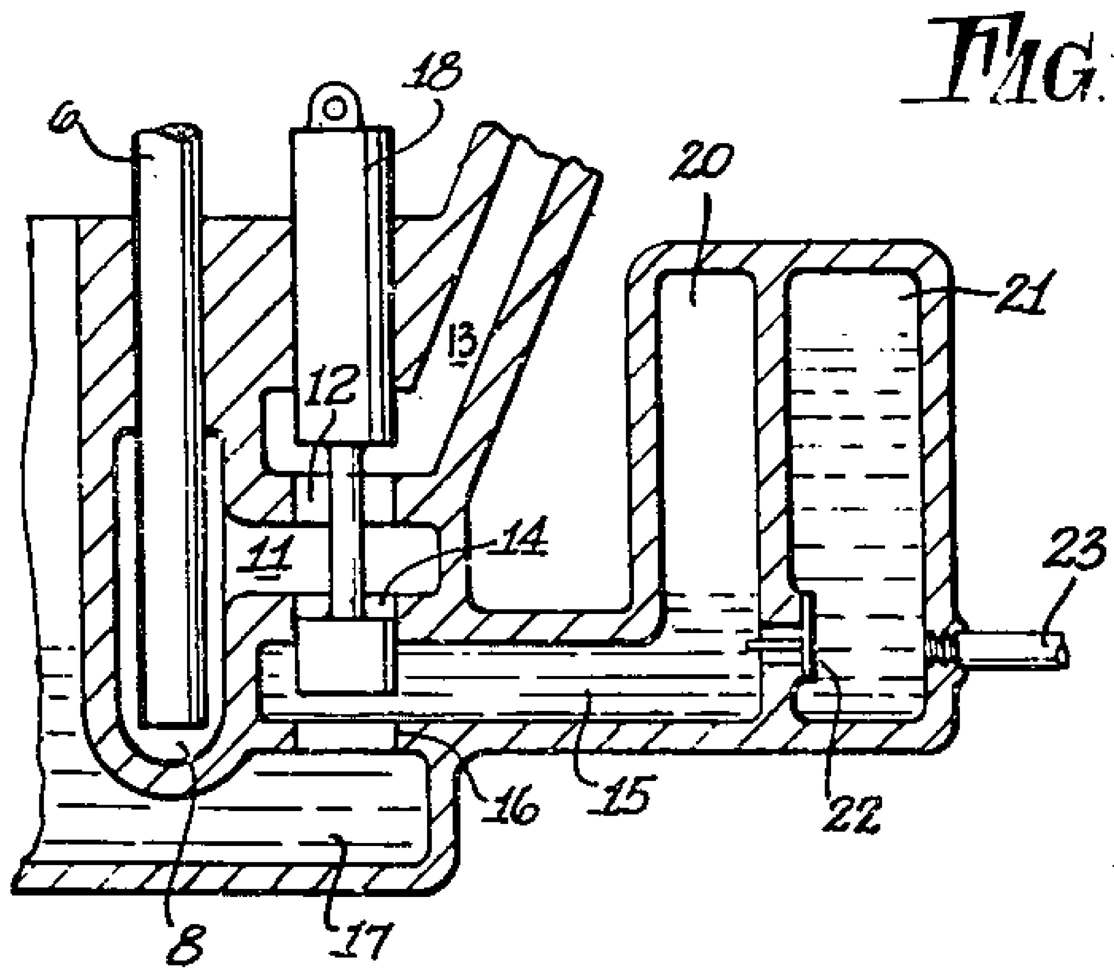
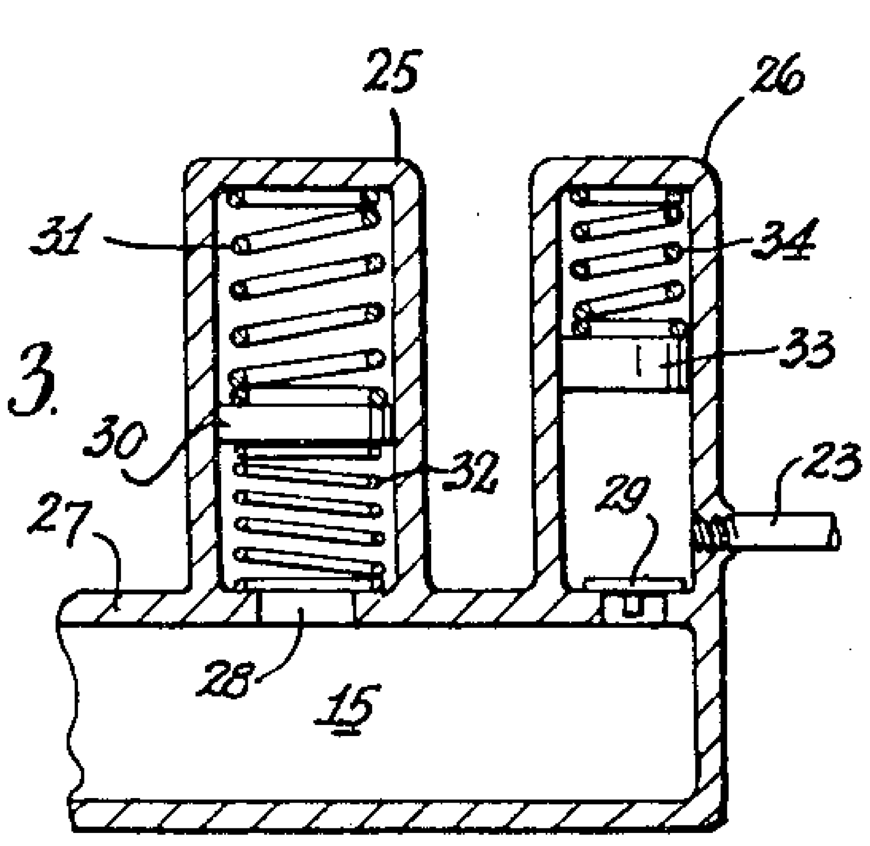


FIG. 3.



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IDLE STROKE RECEIVER FOR HYDRAULIC DEVICES

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The present invention relates to hydraulically operated jaw crushers of the kind described in my United States Patent No. 2,609,994, in which, during alternate oscillations, a reciprocating, power-driven plunger is hydraulically connected to and disconnected from a jaw-propelling ram. In that patent the plunger is described as delivering, during its non-active or "idle" strokes into a sump from which, by independent pump or otherwise, make-up liquid to compensate for leakage past ram and plunger is drawn. In such arrangement there would be violent turbulence in the sump during the discharge halves of the "idle" strokes of the plunger, likelihood of frothing or emulsification of oil with air in the sump and corresponding danger of air gaining access to the hydraulic system, with the make-up liquid.

At the high frequency and high velocities at which the plunger of a machine of this kind would operate the maximum velocities of the liquid in the passages communicating between it and the ram and elsewhere, would be relatively high; and the acceleration and frictional resistances to the movement of liquid in these passages could be very appreciable indeed. Were the plunger, during its "idle" strokes to be delivering to and drawing from the oil sump, the pressure in the plunger cylinder could be sub-atmospheric and might even fall to zero. That being the case, air leakage past the plunger during the return half of the "idle" stroke of the plunger would be inevitable; and that air would be associated with the ram in the succeeding "active" strokes of the plunger.

Air entering the hydraulic system during the operation of the machine becomes emulsified with the oil in the system and cannot, practically, be eliminated while the machine is in motion. And as practically complete freedom from air in the hydraulic system of the ram is essential to the proper working of the machine, it is important that means should be available to prevent its entry.

The primary object of the present invention is, then, to prevent entry of air into the hydraulic system of crushers of the kind described in the United States Patent 2,609,-994, by maintaining the hydraulic pressure at all times and at all points, such as ram, plunger and change-over valve, where inward or outward leakage may occur, above that of the atmosphere.

To that end a closed vessel is contemplated, into which, against a yielding resistance such as a cushion of air, or spring-loaded piston, the plunger delivers during its "idle" strokes.

In such "idle-stroke" receiver the maximum pressure that may be developed will depend on its design and is a matter of choice; and a secondary object of this invention is to associate with the receiver means whereby the pressure developed in it may be applied for injection of make-up liquid at rate equal to the rate of leakage from the system, in the general manner described in my previous United States Patent No. 2,620,629, thereby dispensing with need for any special make-up pump.

The invention will be described with reference to the accompanying drawings, in which

FIGURE 1 is a side elevation, partly in section of a jaw crusher with a leakage compensating device in accordance with the invention,

FIGURE 2 is a sectional side elevation of the leakage compensating device in another position thereof, and

FIGURE 3 is a sectional elevation of a somewhat modified form of leakage compensating device.

In the drawing, the jaw crusher illustrated comprises a fixed jaw **1**, a moving jaw **2** pivotally mounted on a shaft **3**, a ram **4** reciprocally mounted in a ram cylinder **5** to impart crushing strokes to the moving jaw, and a plunger **6** carried by means **7** for reciprocation in a chamber **8** communicating with the ram cylinder to develop hydraulic pressure therein for actuation of the ram. A spring **9** retracts the jaw **2** by means of a link **10**.

As shown, the plunger chamber **8** has a laterally extending portion **11** which has a port **12** leading to a passage **13** communicating with the ram cylinder and a port **14** leading to a passage **15**. Passage **15** has a port **16** leading to an oil or hydraulic liquid sump **17**. Ports **12**, **14** and **16** are in axial alignment for control by a piston valve **18** mounted for reciprocating movement as by means **19**. It will be observed that, in one position of the valve as shown in FIGURE 1, the valve closes ports **12** and **16** and opens port **14** to place the plunger chamber in communication with passage **15**. In a second position of the valve, as shown in FIGURE 2, port **12** is open and port **14** closed to place the plunger chamber in communication with the ram cylinder, port **16** being open for communication with passage **15**.

Passage **15** leads to an air vessel **20** which is connected in parallel with a second vessel **21** by means of a non-return valve **22** permitting flow from vessel **20** to vessel **21**. A make-up liquid delivery pipe **23** leads from vessel **21** to the ram cylinder. Pipe **23** may be provided with a valve **24**.

It will be understood that, in operation, valve **18** will be reciprocated to alternately place the plunger chamber **8** in communication with the ram cylinder (to effect a working stroke of the ram) and in communication with the passage **15** (during the "idle" stroke of the plunger). In FIGURE 1, the plunger is indicated at the end of its forward idle stroke and as having displaced liquid into the air vessel **20** and compressed the air in it.

It will be apparent that, towards the end of the idle forward stroke of the plunger the pressure developed in an air vessel of appropriate volume such as 20 would be high enough for delivery of make-up liquid therefrom into the cylinder **5** of the resting ram. However, that pressure would exist for only a small fraction of the operating time; and in order that a substantially steady pressure be maintained in the make-up system, the second vessel **21** is provided. In the operation of the system, the tendency is therefore for a substantially steady pressure, approximating the maximum developed in air vessel **20**, to be maintained in vessel **21**.

During the working strokes of the ram and plunger leakage occurs past them and elsewhere; and if, by appropriate means (such as the automatically controlled valve described in prior United States Patent 2,620,629) as much make-up liquid is allowed to enter the hydraulic system as leaks away from it past the ram and elsewhere then, at every idle stroke of the plunger there is a corresponding flow of liquid into vessel **21** through valve **22**. It follows therefore that, if leakage is occurring, part only of the displacement of the plunger in a forward idle stroke enters vessel **20** with the remainder passing into vessel **21**.

Because of loss of liquid from vessel **20**, it follows that a sub-atmospheric pressure is developed there towards the end of each idle return stroke of the plunger and that liquid may be drawn into the vessel **20** from the sump through the open port **16**.

FIGURE 3 illustrates a modification wherein spring-loaded pistons are employed instead of air cushions. As shown, vessels **25** and **26** (corresponding to vessels **20** and **21**) are mounted on the wall **27** of passage **15** which communicates with vessel **25** through an opening **28** and with vessel **26** through a non-return valve **29**.

The idle-stroke receiver or vessel **25** has a reciprocating piston **30** therein under the control of a combination of a relatively strong compression spring **31** above the piston and an opposing relatively weak compression spring **32** below the piston. The function of spring **32** is to give the main spring **31** some initial compression. Under the control of this combination the piston **30** is capable of movement in either direction from its neutral position when under atmospheric pressure. For that reason it is capable of reacting to a negative pressure and of drawing in make-up liquid from the sump in exactly the same manner as the air cushion in FIGURE 1. It will be apparent that, as an alternative to the compression spring **31**, a tension spring of like characteristics, extending through the main spring **30**, coaxially with it, may be employed.

The make-up vessel **26** has a piston **33** therein with a compression spring **34** acting on its upper face.

I claim:

1. A hydraulic fluid system for a power device having a cylinder, a ram in said cylinder, a plunger chamber, and a plunger reciprocally mounted in said plunger chamber, which comprises a closed vessel, a valve chamber, having a first port connecting said plunger chamber and said ram cylinder and a second port connecting said plunger chamber and said vessel, valve means movably mounted in said valve chamber and having a first position opening said first port and closing said second port to place said plunger chamber in communication with said ram cylinder, and a second position closing said first port and opening said second port to place said plunger chamber in communication with said vessel, said vessel having a resilient body therein compressible under the influence of fluid discharged into said vessel and constituting a yielding resistance for imposing a back pressure on fluid in said vessel.

2. A hydraulic fluid system as defined in claim 1, wherein said yielding resistance is an air cushion.

3. A hydraulic fluid system as defined in claim 1, wherein said yielding resistance is a spring-loaded piston.

4. A hydraulic fluid system as defined in claim 3, including two opposing springs of unequal strength acting upon said piston and permitting its displacement in both directions from its neutral position.

5. A hydraulic fluid system as defined in claim 1, including a second vessel, a passage leading from said first vessel to said second vessel, a non-return valve in said passage permitting passage of fluid from said first vessel to said second vessel, a hydraulic fluid sump having a port communicating with said first vessel, and a valve controlling said port to permit fluid to be drawn into said first vessel from said sump.

6. A hydraulic fluid system as defined in claim 5, said second vessel having a space therein variable under the influence of fluid discharged thereinto and comprising a yielding resistance for imposing a back pressure on fluid in said second vessel.

7. A hydraulic fluid system as defined in claim 6, including a duct for passage of hydraulic fluid leading from said second vessel to said ram cylinder.

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