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[54] **DEVICE FOR BUILDING-UP FLUID PRESSURE PULSES**

1 Claim, 1 Drawing Fig.

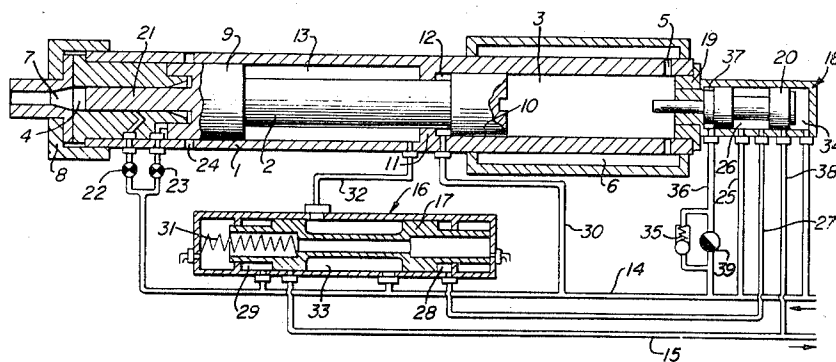
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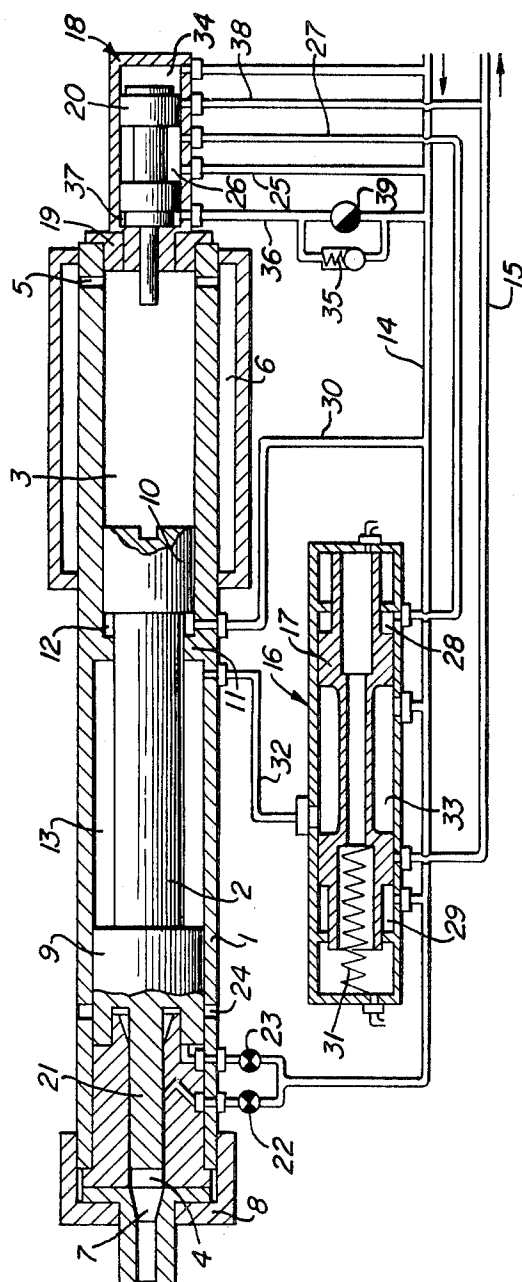
[56] **References Cited**

UNITED STATES PATENTS

- 3,412,554 11/1968 Voitsekhovskiy et al. **60/54.5 HA**

ABSTRACT: The invention describes a device for building-up fluid pressure pulses comprising a cylinder with a piston which divides the cylinder cavity into a high-pressure chamber and low-pressure chamber of which the first one has a hole and is filled with fluid while the second one communicates with a vessel containing compressed gas which accelerates the piston and the latter strikes the fluid contained in the first chamber so that said fluid is discharged under pressure through a hole in the chamber. The piston is of a differential design and its step of a larger diameter is located at the side of the first chamber while the step of a smaller diameter is located at the side of the second chamber, the cylinder between the steps being divided by a partition which, together with the piston steps, forms two hydraulic chambers. One of these chambers, located at the side of the step of a smaller diameter is in constant communication with the pressure line while the second one, located at the side of the step of a larger diameter is put periodically in communication with the first hydraulic chamber and simultaneously with the pressure line, and also with the drain line.





DEVICE FOR BUILDING-UP FLUID PRESSURE PULSES

The present invention relates to devices for building up ultrahigh pressures of fluid, so-called pulse monitors or giants in which a piston accelerated in the cylinder by compressed gas strikes the fluid inside the cylinder so that said fluid is thrown out through a discharge hole under pressure and is capable of doing work.

More specifically, this invention relates to the devices, wherein the piston is returned to the initial position by the fluid after the impact.

The present invention can be used for breaking up various materials, particularly rock, by the jets of fluid, or for hydraulic drop forging in which case pressurized fluid is fed into closed die holding a blank, or for pressing, forging and cutting of metals and other materials, in which case the jet of pressurized fluid actuates a progressively moving piston which carries a pressing, forging or cutting tool.

Known in the prior art are the devices for building up ultrahigh fluid pressure pulses said devices are described, in particular, in the USSR Pat. No. 142,237 granted to B. V. Voitzekhovskiy e.a.

The known device comprises a cylinder with a piston inside, said piston dividing the cylinder cavity into a high-pressure chamber and low-pressure chamber, the first chamber having a hole and being filled with fluid while the second one communicates with a compressed gas vessel (receiver) so that compressed gas accelerates the piston which strikes the fluid in the first chamber, thus building up pressure in it. The fluid is discharged under pressure from the hole in the form of a jet which is capable of doing work. After the impact piston returns to the initial position, when the fluid is fed into the cylinder cavity from the side of the first chamber, and compresses the gas in the second chamber.

During the subsequent acceleration of the piston for imparting to it a required velocity by the moment of impact, the cylinder cavity must be free of fluid therefore the device is provided with an automatic means which delays the piston for this period of time. It is just because of this that the piston of the known device can deal not more than 5 to 20 blows per minute.

It could be possible to dispense with this delay of the piston but then the energy of its movement would be spent unproductively for forcing out the fluid from the cylinder chamber before the piston.

An object of the invention consists in providing an improved device for building up fluid pressure pulses with the piston of such a shape and so located in the cylinder that the above-mentioned disadvantage would be nonexistent.

We hereby declare such a device for building-up fluid pressure pulses. It consists of a cylinder with a piston reciprocating inside, said piston dividing the cylinder cavity into a high-pressure chamber and low-pressure chamber of which the first one has a hole and is filled with fluid while the second one is in communication with a compressed gas vessel. Being acted upon by the compressed gas, the piston moves and strikes the fluid contained in the first chamber so that the fluid is discharged through a hole in the form of a jet. The essence of the invention consists in that piston is of a stepped design and its step with a larger diameter is located at the side of the first chamber whereas the step of a smaller diameter is located at the side of the second chamber, the cylinder cavity being divided between these steps by a partition which forms, together with the piston steps, two hydraulic chambers; one of these chambers at the side of a smaller step is in constant communication with the pressure line while the other one, located at the larger step side, is periodically put in communication with the first hydraulic chamber and simultaneously with the pressure line, and with the return line.

The claimed improvement makes it possible, in the first place, to dispense with the automatic means for delaying the piston, which allows an increase in the number of piston blows per unit of time.

This improvement also simplifies considerably the design and control of the device.

Given below is a detailed description of the device with reference to the accompanying drawing illustrating the device according to the invention.

The claimed device, as shown in the drawing, comprises a cylinder 1 with a piston 2 located therein, said piston divides the cylinder cavity into chambers 3 and 4. The chamber 3 communicates through holes 5 with a compressed gas vessel 6 the gas from which forces the piston 2 to move in the cylinder towards the chamber 4. Said chamber 4 is filled with fluid which is struck by the moving piston 2; this raises the fluid pressure and the fluid is discharged outward in the form of a jet through the hole 7 in the end wall 8 of the cylinder 1.

Since the fluid pressure in the chamber 4 is raised by the impact of the piston 2 high above the pressure of gas in the chamber 3, these chambers are classified, respectively as a high-pressure chamber and low-pressure chamber. Therefore, the walls of the cylinder 1 in the chamber 4 have a considerable thickness and consist of several layers.

The piston 2 is of a stepped design and its step 9 of a larger diameter is located at the side of the high pressure chamber 4 whereas the step 10 of a smaller diameter is located at the side of the low-pressure chamber 3. The cavity of the cylinder 1 is divided between the steps 9 and 10 of the piston 2 by a partition 11 which, together with said steps, forms two hydraulic chambers 12 and 13.

The hydraulic chamber 12 at the side of the step 10 of a smaller diameter is in constant communication with the pressure line 14 while the hydraulic chamber 13 at the side of the step 9 of a larger diameter communicates periodically with the hydraulic chamber 12 and a pressure line 14, and simultaneously with a drain line 15 by means of a slide valve 16 which comprises a movable member 17.

Operation of the slide valve 16 is controlled by a control valve 18 secured in the end wall 19 of the cylinder 1 and comprising a movable member 20 which enters partly into the chamber 3 and interacts with the piston 2 during its movement.

The step 9 of the piston has a rod 21 entering the chamber 4 and acting upon the fluid in it. Before each impact of the piston 2 the chamber 4 is filled with fluid from the pressure line 14 via a member 22, characterized by a constant hydraulic resistance. Simultaneously, part of the fluid from the same pressure line 14 is supplied via a member 23, characterized by a constant hydraulic resistance into the gap between the piston 2 and the end wall of the chamber 4 in order to prevent the piston 2 from striking against the wall.

The surplus fluid is discharged from the chamber 4 and from the said gap through the side holes 24 of the cylinder 1.

Let us consider the functioning of the claimed device from the moment when the rod 21 of the piston 2 is located in the chamber 4 after the impact, the chamber 13 will be filled with fluid and the member 20 of the control valve 18 will be at the wall 19 of the cylinder 1 as shown in the drawing.

In this case the fluid will start flowing from the pressure line 14 through a pipe 25 into the space 26 of the control valve 18 and further, through a pipe 27, into the space 28 of the slide valve 16. Simultaneously, the fluid flows from the pressure line 14 into the space 29 of the slide valve 16 and, through the pipe 30, into the hydraulic chamber 12.

The cross-sectional area of the member 17 of the slide valve 16 is larger at the side of the space 28 than it is at the side of the space 29, therefore the member 17 will move, compressing the spring 31, and the chamber 13 will be put in communication with the drain line 15 through a pipe 32 and the space 33 of the slide valve 16.

The piston 2 will start moving under the pressure of the fluid in the hydraulic chamber 12, thereby compressing the gas in the chamber 3. At the end of its stroke the piston 2 will move the member 20 of the control valve 18, forcing the fluid out of its space 34 and the fluid will flow from the pressure line 14 through a return valve 35 and pipe 36 into the space 37 of the control valve 18.

During the further movement of the member 20 the pipe 27 will be put in communication with the drain line 15 through the pipe 38 and the member 17 of the slide valve 16 will be moved by the pressure of fluid in the space 29 and by the spring 31 towards the space 28 to the initial position so that the chamber 13 will be connected with the chamber 12 and the pressure line 14. At this moment the piston 2 will start to be accelerated by the compressed gas in the chamber 3 and the fluid will flow from the chamber 12 into the chamber 13 thereby assisting in the acceleration of the piston 2. As the step 9 of the piston has a larger diameter than the step 10, the chamber 13 will be additionally filled with fluid from the pressure line 14 to make up for the losses of energy of the piston, required for moving the fluid from the chamber 12 during the piston acceleration. At the end of the stroke, the rod 21 of the piston 2 will strike the fluid in the chamber 4 and the member 20 of the control valve 18 will move to the initial position under the pressure of the fluid in the space 34 and the fluid will be forced from the space 37 into the pressure line 14 via the pipe 36 and a throttling orifice 39.

Then the cycle will be repeated over again. By adjusting the throttling orifice 39 one can change the number of blows of the piston 2 per unit of time on the fluid in the chamber 4.

The use of this device in industry has proven its advantages. The control of the device has been simplified considerably.

The number of piston blows on the fluid, the so-called "blow rate," has ranged from 60 to 130 blows per minute and the pressure of fluid in the chamber 4 has been about 5000 atm.

What we claim is:

1. A device for building-up fluid pressure pulses comprising a cylinder; a piston of a stepped design reciprocating in said cylinder and dividing its cavity into a high-pressure chamber and low-pressure chamber; a means for the supply of fluid into said high-pressure chamber; a compressed gas vessel communicating with said low-pressure chamber, the gas from which accelerates the piston in the cylinder towards the high-pressure chamber for striking the fluid contained in it, said chamber having a hole for discharging the fluid at the moment of the piston blow; a large-diameter step of said piston located at the side of the high-pressure chamber; a small-diameter step of said piston located at the side of the low-pressure chamber; a partition dividing said cylinder cavity between the steps of said piston and forming, together with these steps, two hydraulic chambers the first one of which at the side of the step of a smaller diameter is in constant communication with the pressure line while the second one located at the side of the step of a larger diameter is put periodically in communication with the first hydraulic chamber and simultaneously with the pressure line, as well as with the drain line.

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