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[54] **DEVICE FOR BUILDING-UP FLUID PRESSURE PULSES**
2 Claims, 1 Drawing Fig.

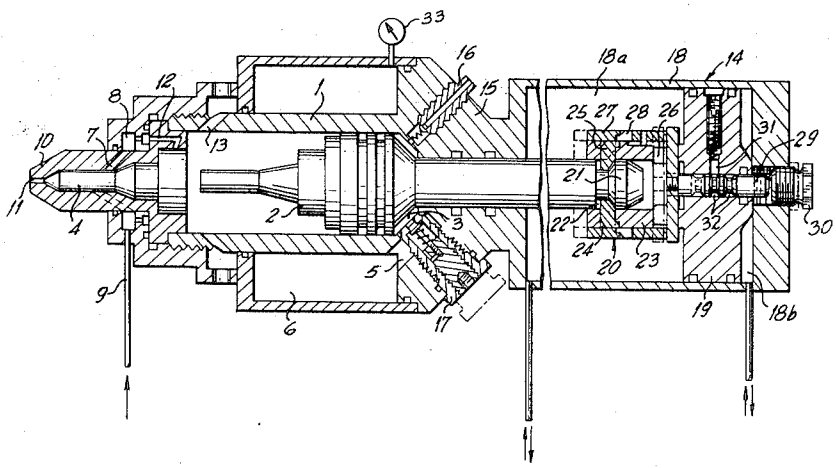
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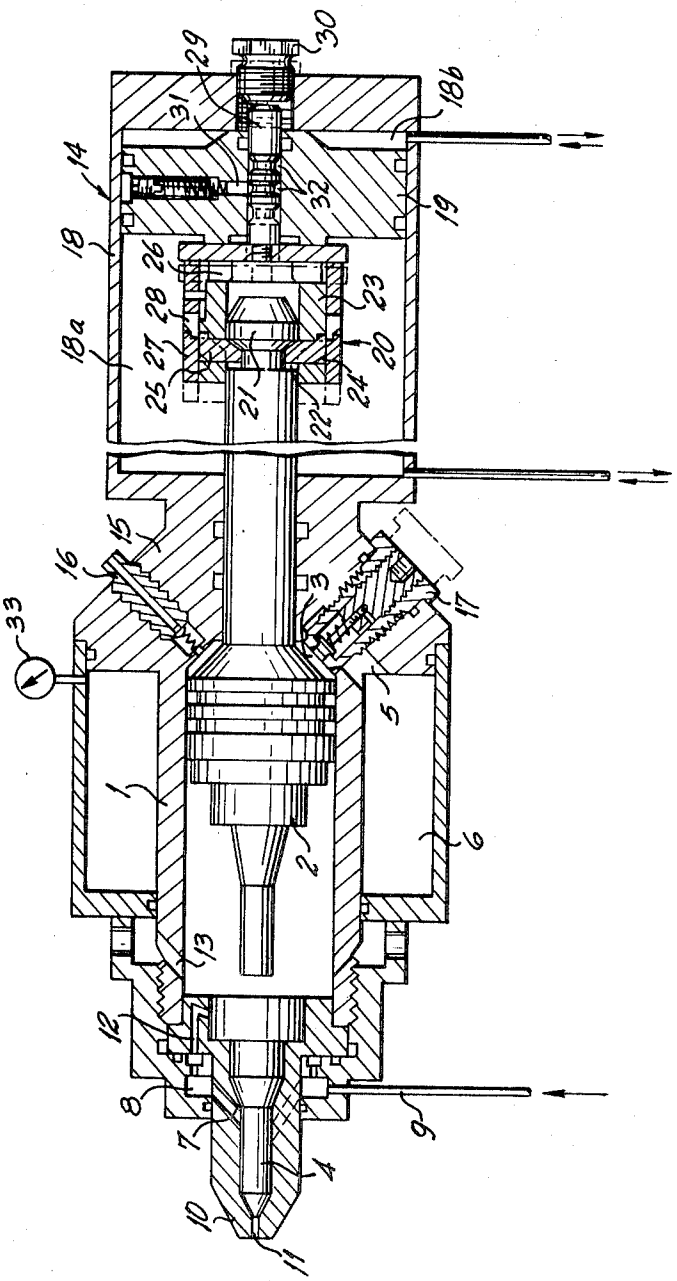
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ABSTRACT: The invention relates to a device for building up fluid pressure pulses, said device comprising a cylinder and a piston reciprocating inside said cylinder and dividing its cavity into two chambers. The first chamber is in communication with a compressed gas vessel whereas the second one is filled with fluid and has a hole for the discharge of the fluid under the pressure built up by the impact of the piston which is accelerated by the compressed gas contained in the first chamber. The device incorporates a means for replenishing the first chamber with gas (air) pumped from the atmosphere and for bypassing it into the compressed gas vessel during the progressive movement of the piston.




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DEVICE FOR BUILDING-UP FLUID PRESSURE PULSES

The present invention relates to devices for building up ultrahigh-pressure pulses of fluid produced by the impact of a piston on the fluid in the chamber, which latter is provided with a hole for discharging the fluid under pressure.

The invention can be used to advantage for rock breaking by the direct action of a jet of fluid under pressure, for hydraulic drop-forging in which the fluid discharged under pressure from the chamber is fed into a closed die holding a blank, as well as for forging, pressworking and cutting of metals in which case the pressurized fluid operates a movable piston carrying the working tool.

Known in the art are similar devices (see, for example, the USSR Pat. No. 142,437 granted to B. V. Voitsekhovsky et al.) incorporating a cylinder with a piston which divides the inside space of the cylinder into two chambers. The first chamber communicates with a compressed-gas vessel while the second one is filled with a fluid and has a hole for the discharge of the fluid under pressure, said discharge caused by the impact of the piston which is accelerated by the compressed gas contained in the first chamber, a means being provided for returning the piston to the initial position after the impact.

In these devices compressed gas is supplied into said vessel either by a compressor or from portable gas bottles.

In the course of operation, compressed gas is apt to leak out of the vessel so that the losses of gas must be made up for which calls for the provision of said compressor or gas bottles. Therefore, the use of the known devices has been limited to a certain extent.

An object of the invention is to provide such a device in which the motion of the impact piston would be utilized for filling the vessel with compressed gas from the atmosphere.

This object is achieved by providing an improved device for building up fluid pressure pulses comprising a cylinder with a piston inside, said piston dividing the cylinder into two chambers; the first chamber communicates with a compressed gas vessel while the second one is filled with fluid and has a hole for the discharge of the fluid under pressure, this pressure being built up by the impact of the piston which is actuated by the compressed gas in the first chambers.

According to the invention, the claimed improvement consists in that the end surface of the cylinder at the side of the first chamber is provided with a suction valve and a discharge valve, the suction valve communicating the first chamber with the atmosphere when the piston moves towards the second chamber and simultaneously pumps gas (air) from the atmosphere into the first chamber, whereas the discharge valve puts this chamber in communication with the compressed gas vessel during the return stroke of the piston for bypassing the pumped gas into said vessel, the channel between the vessel and the first chamber being shut-off by a special device in such a manner that the first chamber communicates with the compressed gas vessel periodically, as has already been stated, through the discharge valve during the return stroke of the piston.

In the preferable embodiment of the invention this device is constituted by the discharge valve proper, which is screwed for this purpose into the end wall of the cylinder and can move along the thread thereby shutting-off the channel between the vessel and first chamber.

An advantage of the invention lies in that this improvement makes the device more economical and accessible in operation.

Now the invention will be described in detail by way of example with reference to the accompanying drawing which illustrates a sectionalized view of the device according to the invention, in which the positions of its mechanisms during the impact and compressor operation are shown by dotted and continuous lines, respectively.

The claimed device comprises a cylinder **1** accommodating a piston **2** which divides the cavity of the cylinder **1** into two chambers **3** and **4**. The first chamber **3** communicates through a channel **5** with a compressed gas vessel **6**. The second chamber **4** is constantly in communication with a fluid supply line **9** through channels **7** and an annular chamber **8** and has a hole **11** in the end wall **10** of the cylinder **1** for the discharge of the fluid under pressure this pressure being built up by the impact of the piston **2** which is accelerated by compressed gas in the chamber **3**.

Therefore, the chamber **3** is a low-pressure chamber while the chamber **4** is a high-pressure one so that the walls of the cylinder **1** in this chamber are made of several layers and have a considerable thickness.

To prevent the piston **2** from striking against the walls of the cylinder **1** in the chamber **4**, the clearance between said walls and the piston **2** is filled with fluid through a channel **12** from said annular chamber **8**, said fluid being drained after the impact through a hole **13** in the sidewall of the cylinder **1**.

Before the impact, the surplus fluid is drained from the chamber **4** through the holes **11** and **13**.

The return stroke of the piston **2** to the initial position after the impact is effected by a cocking mechanism **14** which will be described hereinafter.

To allow the device to function at compressor duty, the end wall **15** of the cylinder **1** at the side of the first chamber **3** is provided with screwed-in suction valve **16** and discharge valve **17**. The suction valve **16** communicates the first chamber **3** with the atmosphere while the piston **2** is moving towards the chamber **4**, and pumping simultaneously the air from the atmosphere into the first chamber **3**. The discharge valve **17** bypasses the pumped-in air from the first chamber **3** into the vessel **6** during the return stroke of the piston **2** by means of the cocking mechanism **14**.

Everything that has been said with respect to the compressor operation of the claimed device will not be possible unless the channel **5** communicating the first chamber **3** with the vessel **6** is shut-off. This can be achieved, in particular, by moving the discharge valve **17** along the thread until it shuts off the channel **5**, or by the use of a plug (not shown) secured to a screw (not shown) extending through the wall of the vessel **6**.

The cocking mechanism **14** comprises a hydraulic cylinder **18** with a piston **19** inside, said piston dividing the cylinder into two chambers **18***a* and **18***b* and carrying a cam-type gripping device **20** which interacts with the head **21** of the extension of the piston **2**, said head having a circular recess **22**.

The gripping device **20**, in this turn, comprises a hollow member **23** receiving the head **21**, said hollow member being rigidly fastened to the piston **19** and being provided with ports **24** for the passage of cams **25**, and ports **26** accommodating a slide **27** installed movably with relation to the member **23**, said slide having ports **28**, and acting upon the cams **25** which move into or out of the recess **22** in the head **21** of the extension of the piston **2**.

The movement of the slide **27** in the ports **26** of the member **23** is controlled by a movable element **29** installed in the piston **19**, the extension of said element with relation to the piston **19** being determined by a plug **30** which can be set to different positions owing to its screwed joint with the cylinder **18**.

The movement of the slide **27** is changed to suit the impact or compressor operation of the device.

To prevent the gripping device **20** from being operated by the pressure of the fluid fed into the chamber **18***a* of the cylinder **18**, the element **29** is locked by a spring-loaded retainer **31** entering the recesses **32** of said element.

Let us consider the functioning of the device at compressor duty from the moment when the piston **2** is located in the first chamber **3** and the gripping device **20** of the cocking mechanism **14** is connected with the piston **2** as shown in the drawing.

For this purpose the plug **30** is set so that the element **29** does not bear against it, the gripping device **20** does not operate, and the pressure of the retainer **31** on the element **29** is increased as much as possible. Then the pistons **2** and **29** will work together, as an integral unit. The discharge valve **17**

will be moved all the way towards the chamber **3**, shutting off the channel **5**. These positions are shown with continuous lines in the drawing.

Then the fluid is fed into the chamber **18***b* of the cylinder **18**, the pistons **19** and **2** move towards the chamber **4**; the suction valve **16** operates and a portion of gas (air) is admitted from the atmosphere into the chamber **3**. Now the fluid is delivered into the chamber **18***a* of the cylinder **18** and the pistons **19** and **2** move back during which movement the discharge valve **17** operates and admits the portion of gas pumped from the chamber **3** into the vessel **6**.

The vessel **6** is filled with gas to a required pressure, as read by a pressure gauge **33**.

To step up the efficiency of the device at the compressor duty the piston **2** should be made so as to bring to a minimum the dead space in the chamber **3**.

After the vessel **6** has been filled with gas, the plug **30** is set to bear against the element **29**, the retainer **31** is released and the discharge valve **17** opens the channel **5**. This position is shown in the drawing by dotted lines.

The slide **27** will then move together with the element **29**, disengaging the cams **25** from the recess **22** of the head **21** of the piston **2**; the latter will be accelerated by compressed gas in the chamber **3** and strikes the fluid in the chamber **4** so that this fluid will be discharged through the hole **11** in the form of a high-pressure jet so that the device starts functioning at the impact duty.

For cocking the piston **2**, the fluid is fed into the space **18***b* of the cylinder **18**; this will move the piston **19** towards the piston **2** and the gripping device **20** will engage the head **21** of the piston **2**, said head being constantly located in the space **18***a* of the cylinder **18**.

This engagement will take place in the following way. The head **21** enters the hollow member **23** (because the cams **25** are pushed into the ports **28** of the slide **27**) after which the slide **27** bearing against the end wall of the cylinder **18** at the side of the space **18***a* moves in the ports **26** of the member **23** and shifts the cams **25** into the recess **22** of the head **21**. Then the piston **2** is cocked by the piston **19** to the initial position for the next impact.

As the piston **19** reaches its extreme position, the slide **27** bearing against the element **29** moves again and the cams **25** disengage from the head **21** of the piston **2**; the latter is again accelerated by the compressed gas in the camber **3** and strikes the fluid in the second chamber **4**. Then the impact operation of the device is continued in the same manner.

This description discloses only one of the embodiments of the invention. In some designs the cocking mechanism **14** may be omitted (when the piston **2** is made of a two-stepped shape and the cavity of the cylinder **1** between the steps of the piston **2** is divided into two cavities. Then the piston **2** is reciprocated during compressor operation of the device by delivering the fluid alternately into one or the other space of the cylinder **1** between the steps of the piston **2** as has been described in other Patent Applications by the same applicant.

The invention has passed industrial tests which have proved its advantages and high efficiency.

What we claim is:

1. A device for building up fluid pressure pulses comprising: a compressed gas vessel; a cylinder; a piston accommodated in said cylinder and dividing its cavity into two chambers of which the first chamber is in communication with said compressed gas vessel and the second one is filled with fluid and has a hole for the discharge of said fluid when it is struck by said piston which is accelerated by the compressed gas contained in the first chamber: a means for returning the piston to the initial position after it has struck the fluid; suction and discharge valves located in the end wall of said cylinder at the side of the first chamber, the suction valve communicating the first chamber with the atmosphere when the piston moves towards the second chamber, and the discharge valve communicating the first chamber with said compressed gas vessel during the return stroke of said piston; a device for shutting off the channel which communicates the compressed gas vessel with the first chamber when the latter is being filled with gas from the atmosphere.

2. A device according to claim **1** wherein the discharge valve is screwed into the end wall of the cylinder and, moving along the thread, serves as the means for shutting off the channel communicating the first chamber with the compressed gas vessel.