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HYDRAULIC IMPACT DEVICE

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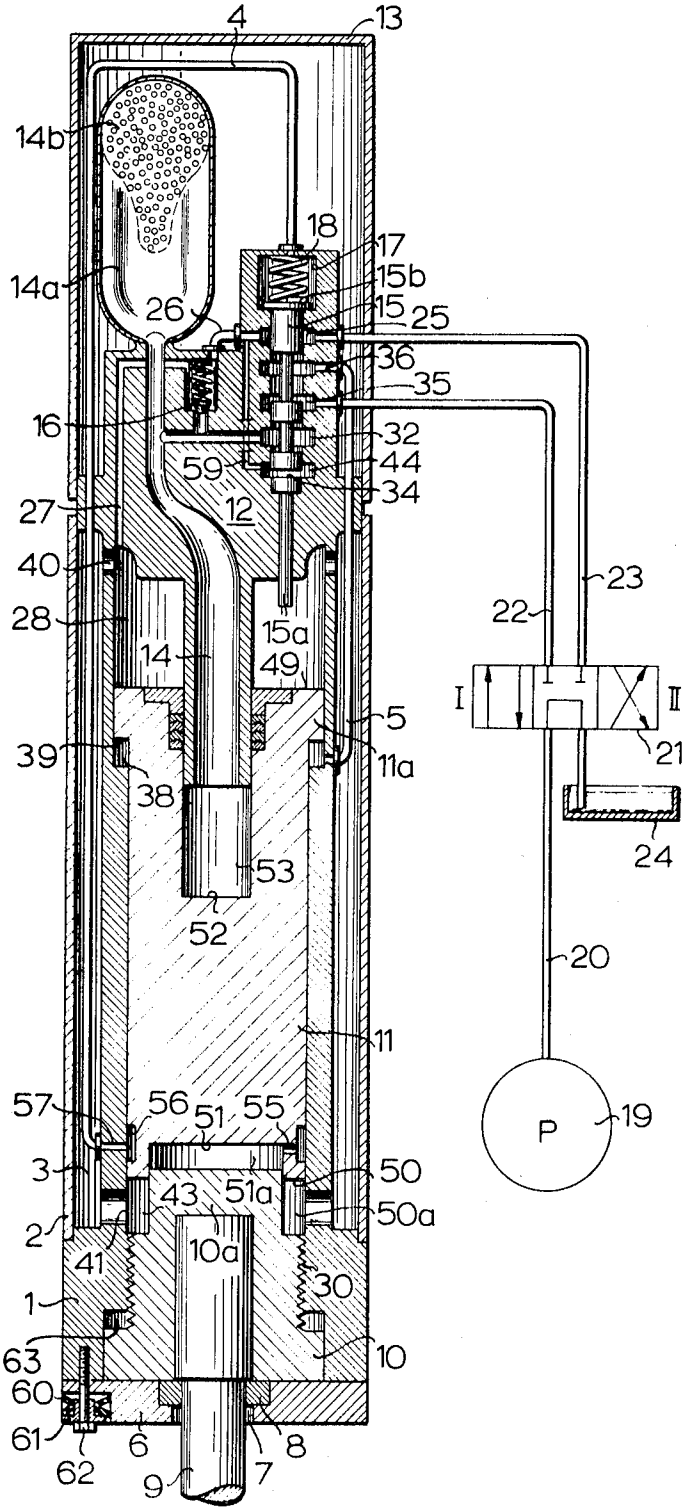

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HYDRAULIC IMPACT DEVICE

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ABSTRACT OF THE DISCLOSURE

A hydraulic impact device with an alternately pressure fluid actuated piston and with a control valve for controlling the impact and return stroke of the impact piston, and with an impact force storing hydraulic accumulator, in which the impact piston is provided with a central blind hole in fluid communication with a hydraulic accumulator adapted instantaneously to release stored fluid into said blind hole.

The present invention relates to a hydraulic impact device with a piston which is alternately subjected to pressure fluid and guided in a cylinder, said piston having a mass which is a multiple of the mass of the tool employed for crushing the rock. The device also comprises a control valve for controlling the impact stroke and the return stroke, and furthermore comprises a hydraulic accumulator for storing the impact energy.

Hydraulic impact devices have become known, such as compressed air hammers, for carrying out similar operations. In most instances, fast hammers are involved. With heretofore known hammers, for purposes of obtaining a great number of impacts, there are provided two rotary valves which are driven by a rotary motor which is likewise hydraulically operated. In addition thereto, two pneumatic pressure accumulators are provided for storing energy which is released when the piston moves downwardly while the volume above the piston increases. However, high impact energies as far as the individual impact is concerned, cannot be realized with such a device. Moreover, such device is rather expensive and the control of the rotary valve is liable to disorders.

According to a further heretofore known hydraulic impact tool, a higher impact force is intended to be realized by actuating a spring-loaded working piston by a further piston which is under the influence of an eccentric and which likewise acts upon a spring. Such a system, however, is expensive and, while realizing a fast impact sequence, does not permit a high individual impact energy as it is necessary for special operations, for instance, the crushing of large rocks.

It is, therefore, an object of the present invention to provide a hydraulic impact device with a high impact energy for each individual impact stroke, in which the device is actuated merely by the hydraulic energy available in a carrier vehicle.

This object and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing, illustrating in longitudinal section an embodiment according to the present invention.

The hydraulic impact device with an alternately pressure fluid actuated piston which is guided in a cylinder and has a mass representing a multiple of the mass of the chisel or tool for crushing the rock and with a control valve for controlling the impact stroke and return stroke, and with a hydraulic accumulator for storing the impact energy, is, in conformity with the present invention, characterized in that the piston is provided with a central axial blind bore for feeding the pressure medium through a pressure pipe while the impact stroke surface of the piston equals the annular return stroke surface, the annular end face of the piston which faces toward the hydraulic accumulator equalling the end face facing toward the inlet end for the tool to be inserted.

The advantage of the arrangement according to the invention is seen in the fact that the delivery of the pump is instantaneously released by means of a hydraulic accumulator and the precisely harmonized conditions of the end faces of the top and bottom side of the piston and the corresponding oil quantities. This release is effected by a positive actuation of the control piston, whereby a high impact force of the individual impact strokes will be realized.

Referring now to the drawing in detail, the cylinder housing **1** is surrounded by a cylinder pipe **2**. Between said cylinder housing **1** and said cylinder pipe **2** there is provided an overflow passage **3**, a control conduit **4**, a line **5** and further devices for conveying the pressure or control oil. The bottom of the cylinder housing **1** and cylinder pipe **2** are closed by a cover **6** which comprises a bore **7** with a tool holder **8**. The tool **9** is inserted through a cover **6** and the tool holder **8**. The inserted tool is held in the tool receiving piston **10**. Guided in the cylinder housing **1** is an impact piston **11** the head **11***a* of which has a larger diameter than the shank of said piston **11**. The upper end of the cylinder housing **1** is closed by an upper housing cover **12** and a covering hood **13**. In the upper housing cover **12** there are mounted a pressure pipe **14**, a valve spool **15**, a relief valve **16**, a return spring **18** in a recess **17**, and bores for conveying the pressure oil. Above the housing cover **12** there is arranged a hydraulic accumulator **14***a* which communicates with the pressure conduit **14**. The hydraulic pump **19** is through conduit **20**, control valve **21**, feeding line **22** and conduit **23** connected to the impact device. When turning the impact mechanism off, the oil is in a pressure-free manner conveyed to the reservoir **24**.

OPERATION

With the control valve **21** occupying the position shown in the drawing and with said control valve assembled in a supporting device together with pump **19**, the pump **19** feeds the pressure medium in a pressure-free manner through pump conduit **20** and control valve **21** to the reservoir **24**. In order to permit the device to operate, first all chambers have to be filled with oil. To this end, the control valve **21** is moved to the position II so that the pump line **20** connects with the reservoir line **23** and the feeding line **22** is connected with the reservoir **24**. Consequently, the oil delivery by the pump **19** can through passage **25**, discharge line **26** and compensating line **27** pass into the upper cylinder chamber **28** and through the upper overflow bores **40**, through the overflow passage **3** formed by the cylinder housing **1** and cylinder line **2**, and through overflow bores **41** into the annular passage **43**, and through grooves **30** also the annular chamber **41** can be filled. By lifting the relief valve **16** off its seat, the accumulator **14***a* and the cylinder chamber **53** communicating with the pressure pipe **14** are filled. The air present in these chambers and the excess oil may through passages **32** and **35**, feeding line **22** and control valve **21** flow to the reservoir **24** because the valve spool **15** is lifted by the pressure acting upon its end face **34**. After the filling operation has been completed, the relief valve **16** is closed. The device may then be brought into its working position, which means that the tool **9** is placed upon the rock to be crushed, whereby the piston **10** is lifted up to an abutments **63**.

The control valve **21** is then moved to the position I. The device is now in working position and the oil flow will be as follows: The oil delivered by the pump **19** passes through pump conduit **20**, control valve **21**, feeding line **22**, passage **35**, passage **36** and conduit **5** to the annular passage **38**. In view of the pressure acting upon the annular surface **39** of the impact piston **11**, the latter is lifted. The oil pressure in the upper cylinder chamber **28** is passed or forced through the overflow bores **40** and **41** and through the overflow passage **3** displaced into the lower cylinder chamber **50***a*, **51***a*. Inasmuch as the upper piston surface **49** of the impact piston **11** has nearly the same size as the lower piston surface consisting of the annular surface **50** and the top surface **51**, a nearly pressure-free oil exchange occurs. Since the two end faces **49** and **50**, **51** of the impact piston have nearly the same area, also the end face **52** of the working cylinder **53** must substantially equal the annular surface **39**. Since in the illustrated position of the valve spool **15** the passage **32** is blocked, the oil present in the working cylinder **53** may now be displaced into the accumulator **14***a*. As a result thereof, the gas in the bag **14***b*, e.g. air, of the hydraulic accumulator **14***a* is compressed. When the piston **11** has reached its upper end position, the valve spool **15** is lifted by the lifter **15***a* so that passage **36** communicates with passage **25**, i.e. annular passage **38** with the reservoir **24** on one hand and, on the other hand, passage **32** communicates with passage **35**, i.e., pump **19**, is connected with the working cylinder **53**. Since, however, in view of the fact that the surface **39** is nearly pressure-free, the gas volume in the gas bag **14***b* expands instantaneously and thus drives the impact piston **11** at very high speed in a downward direction until its pot-shaped recess **51***a* rides over the step-shaped extension **10***a* of the tool receiving piston **10** so that between the extension **10***a* and the impact piston **11** in recess **51***a* a closed oil cushion is formed. Since the oil column is to be considered as substantially non-compressible, the impact energy of the impact piston **11** is through the tool receiving piston **10** conveyed to the tool **9**. At the same time, however, a pressure simpulse is through bore **55**, annular passage **56**, bore **57**, control conduit **4** and recess **17** conveyed to the valve spool **15** so that the latter returns to the illustrated position, and the working cycle starts anew. In order to be sure that the valve spool **15** will remain in its lifted position during the downward movement of the impact piston **11**, passage **44** and thereby the lower end face **34** of the valve spool **15** communicates through conduit **59** and discharge line **26** as well as through passage **25** with the reservoir conduit **23**. Consequently, the damming up pressure prevailing in line **23** will hold the valve spool **15** in its lifted position and will establish communication between the passages **32** and **35**.

When the tool **9** during the crushing of the rock does not hit upon any resistance so that the tool receiving piston **10** impacts upon the cover **6**, the impact energy is absorbed or destroyed by springs **60** which latter are preloaded by means of spacer sleeve **61** and screws **62**. In this connection the annular passage **56** moves over the bore **57** so that the valve spool **15** cannot reverse instantaneously. The impact sequence, therefore, will become sufficiently slow to avoid any danger of disorders.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing but also comprises any modifications within the scope of the appended claims.

With regard to the opening and closing of the pressure relief valve **16** it may be added that these proceedings take place only for the initial starting of the apparatus and are necessary for the primary filling. By unscrewing of a screw (not represented in the drawing) the tension of the spring of the valve **16** will be released. To shut the valve the screw will be screwed down.

It may, furthermore, be added that the instantaneous expansion of the bag **14***a* is not interfered with by the pump pressure because the piston **11** is accelerated and the cylinder volume **53** increases, i.e. the cylinder is fed by oil from the bag **14***a* and from the pump.

What I claim is:

1. A hydraulically operable impact device which includes: a cylinder, a first cover closing one end of said cylinder, a second cover closing the other end of said cylinder, an impact piston reciprocable in said cylinder and having a blind hole substantially centrally located in that end face of said piston which faces toward said first cover, the bottom of said blind hole forming the impact stroke surface of said piston, said piston also being provided with a fluid operable piston return surface substantially equaling in area the area of said impact stroke surface, the other end face of said piston which faces toward said second cover having an area nearly equaling the area of said first mentioned end face of said impact piston, a hydraulic accumulator arranged outside said cylinder and in continuous fluid communication with said impact stroke surface, gas inflatable bag means within said accumulator, control valve means operable by said impact piston for controlling the supply of actuating fluid to and from said impact stroke surface and the end faces of said piston, said control valve means including a valve spool having an extension extending into the space between said first cover and the adjacent end face of said impact piston for actuation thereby, and that end face of said piston which faces toward said second cover being provided with a recess forming an auxiliary cylinder, said device also including tool holding means having an extension adapted slidably to be received in said auxiliary cylinder, and conduit means leading from said control valve means to said auxiliary cylinder.

2. A device according to claim **1**, in which said extension of said tool holding means has a diameter less than that portion thereof which is adjacent said second cover.

3. A device according to claim **1**, in which said impact piston includes surface means for closing off said conduit means with regard to said auxiliary cylinder.

4. A hydraulically operable impact device which includes: a cylinder, a first cover closing one end of said cylinder, a second cover closing the other end of said cylinder, an impact piston reciprocable in said cylinder and having a blind hole substantially centrally located in that end face of said piston which faces toward said first cover, the bottom of said blind hole forming the impact stroke surface of said piston, said piston also being provided with a fluid operable piston return surface substantially equaling in area the area of said impact stroke surface, the other end face of said piston which faces toward said second cover having an area nearly equaling the area of said first mentioned end face of said impact piston, a hydraulic accumulator arranged outside said cylinder and in continuous fluid communication with said impact stroke surface, gas inflatable bag means within said accumulator, control valve means operable by said impact piston for controlling the supply of actuating fluid to and from said impact stroke surface and the end faces of said piston, and means comprising spring means yieldably connecting said second cover to said cylinder.

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