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RAM WITH SUPPLEMENTING INTAKE MEANS

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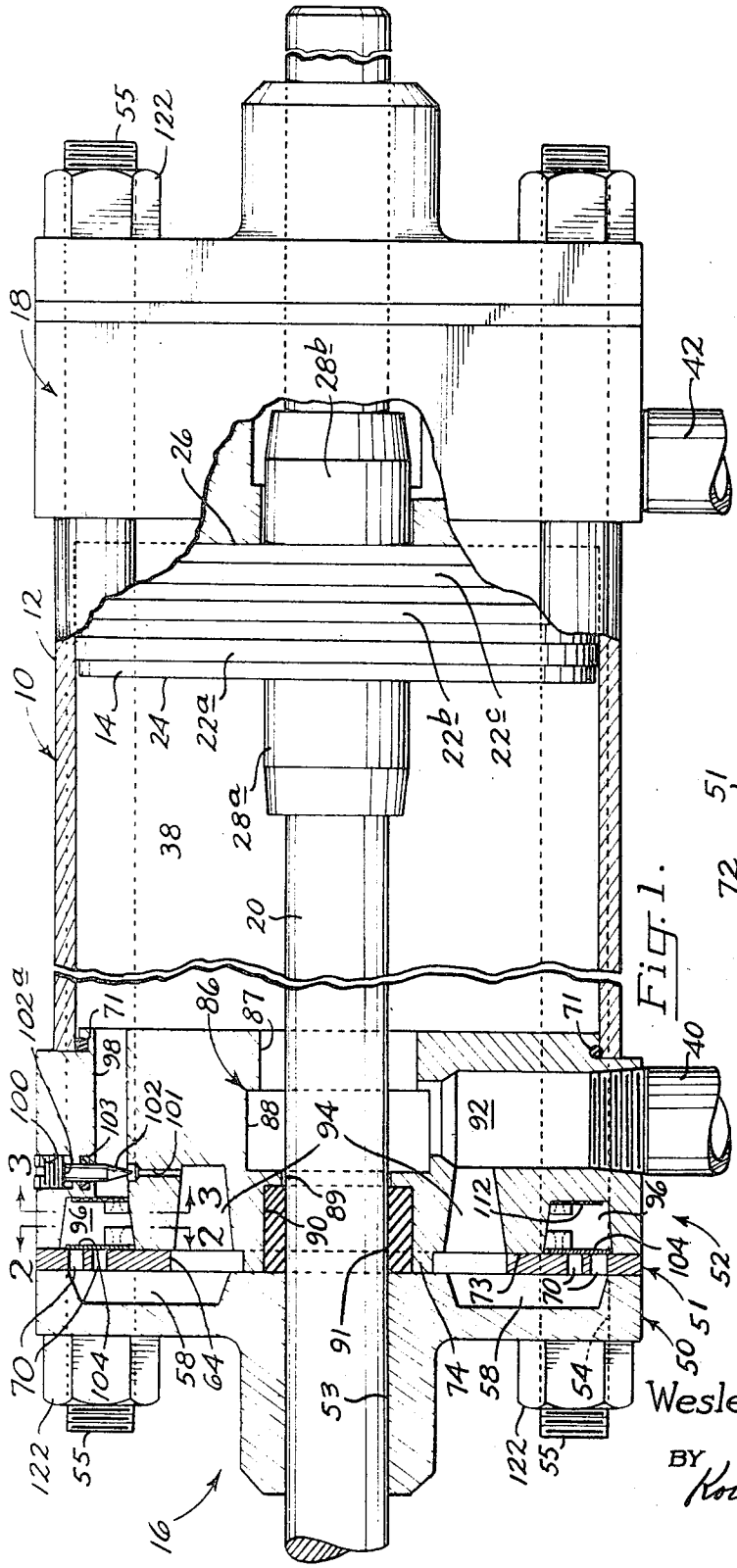

Fig. 1.

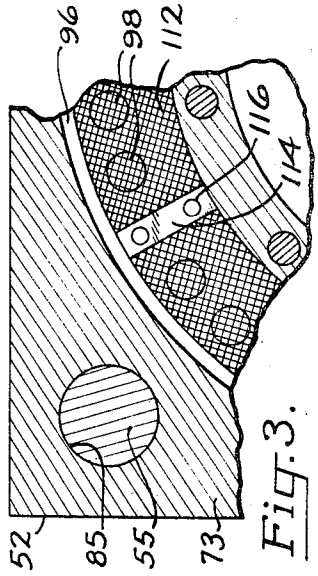

Fig. 3.

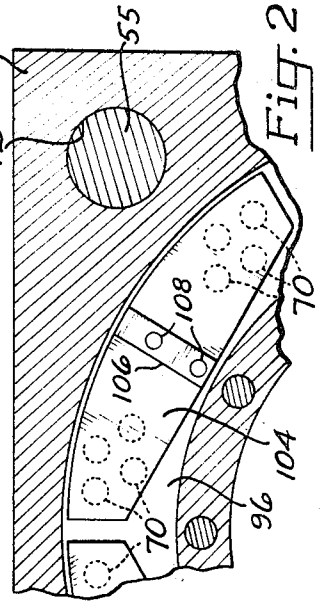

Fig. 2.

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RAM WITH SUPPLEMENTING INTAKE MEANS

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ABSTRACT OF THE DISCLOSURE

A ram cylinder, piston, and head assembly which provides relatively unrestricted inflow of working fluid at the start of a stroke and cushioning at the end of a stroke. The head assembly includes reed-type closure valves which open to provide relatively unrestricted inflow at the start of a stroke. The head assembly is formed of multiple block elements stacked against each other with the closure valves mounted on one of such elements.

This invention relates to a fluid-operated ram, and more particularly to such a ram with novel means for providing for relatively unrestricted inflow of working fluid at the start of a stroke, as well as providing for cushioning of the piston in the ram at the end of a stroke.

Rams where provision is made for cushioning the piston at the end of a stroke by controlling the exhaust of working fluid, are well known. A deficiency of such rams is that the means controlling exhaust resulting in cushioning tends to interfere with the inflow of working fluid at the start of a stroke increasing the response time of the ram. In an effort to overcome such a deficiency, by-pass passages providing for inflow of working fluid have been controlled by spring biased ball checks. Such a construction has several limitations. For one thing, it is difficult because of space limitations and for economic reasons to install a sufficient number to produce the high rate of inflow needed for truly fast response. Further, ball checks and spring biased poppet checks, on continued usage, tend to break down and are themselves somewhat slow in response by reason of considerable mass in the moving parts.

A general object of this invention is to provide improved means in a ram for achieving a high rate of inflow of working fluid whereby a short response time may be realized.

A related object is to provide means enabling relatively unrestricted inflow of working fluid to a ram cylinder, providing for inflow independently of the passage system which produces cushioning in the device.

The advantages of the invention are particularly apparent with relatively short stroke rams, wherein cushioning of the ram piston takes place over a significant part of the total stroke afforded the piston.

Other objects and features comprise the provision in a ram of a reed-type closure valve controlling fluid flow in a path or course leading to an end of the ram, which path supplements another supply passage for fluid to such ram end.

A still further feature and object is to provide a fluid operated ram having multiple passages providing such supplementing courses for flow fluid, which passages are hydraulically in parallel. Such multiple passages assure that a fast rate of inflow of operating fluid takes place on the start of a piston stroke.

A related object is to provide such a ram where such multiple passages are distributed circumferentially about the axis of the ram, and to provide a reed-type closure valve for each passage with such so organized as to make possible a compact structure for the ram.

Yet another object and feature is to provide multiple

block elements in a ram head assembly, which are stacked against each other in assembly. The organization permits simplification in the production of complex passages which are provided in the head assembly, and contribute to ease of maintenance.

Various other novel features and objects of the invention will become more apparent as the following description is read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side elevation of a ram constructed according to an embodiment of the invention, having a portion broken away better to illustrate the construction of the ram's head assembly and piston;

FIG. 2 is a cross-sectional view, taken generally along the line 2—2 in FIG. 1, and on a slightly larger scale, illustrating the positioning of a reed-type closure valve; and

FIG. 3 is a cross-sectional view, on the same scale as FIG. 2, taken generally along the line 3—3 in FIG. 1.

Referring now to the drawings, at **10** is indicated generally a double-acting fluid-operated ram. In the embodiment illustrated, such ram includes an elongated hollow cylinder **12**, a reciprocable piston **14** mounted within the cylinder, a left cylinder head assembly **16** secured to and closing off one end of the cylinder, a right cylinder head assembly **18** secured to and closing off on opposite end of the cylinder, and a piston rod **20** secured to piston **14** and extending outwardly from opposite faces **24**, **26** of the piston through opposing cylinder head assemblies **16**, **18**.

A fluid-tight seal sealing the piston and the interior wall of the cylinder is produced by a series of piston rings **22***a*, **22***b*, **22***c*, which encircle the piston. A pair of substantially cylindrical closure devices **28***a*, **28***b* are secured to and encircle the piston rod adjacent opposite faces of the piston. The cylinder and head assemblies **16** and **18** defiine a chamber **38** within which the piston, closure devices and portions of the piston rod may reciprocate.

Connected to cylinder head assemblies **16** and **18** are supply conduits **40**, **42**, respectively. Each conduit is connected at one end to a head assembly while an opposite end is connected through a valve means (not shown) to a suitable source of fluid under pressure, such as a compressed air supply (also not shown). By actuation of such valve means fluid under pressure may be admitted to either end of the ram, with an exhaust path for fluid provided the opposite end of the ram.

In the embodiment of the invention illustrated, head assemblies **16**, **18** are identically constructed, and are secured to cylinder **12** in an identical manner. In view of the above, only one head assembly will be described in detail.

In the embodiment illustrated, each head assembly (and referring to assembly **16**) comprises three stacked and separable block elements, detachably connected together. Specifically, such block elements comprise a first block element **50**, a second block element **51**, and a third block element **52**.

First or outer block element **50** forms the outside of the assembly, and has a bore **53** therethrough concentric with the cylinder axis which slidably receives piston rod **20**. Viewing an end of the ram, block element **50** has essentially the outline of elements **51**, **52**, which is square as can be seen with reference to FIGS. 2 and 3. Adjacent each corner of block element **50** is a bore **54** paralleling the cylinder axis receiving the end of a head retainer rod **55**.

An annular passage **58** is formed on the inner face of the outer block element. Passage **58** is concentric with bore **52**, and has an outer radius somewhat less than the radial spacing of bores **54** from the axis of the ram so

that the passage extends continuously around the head assembly without intercepting bores **54**.

The second or intermediate block element **51** abuts block element **50**. Bore **72** adjacent each of its corners receives a head assembly retainer rod **55**. Block element **51** has a bore **64** extending through it, which is concentric with the ram axis. The bore has a diameter greater than the inner diameter of annular groove **58** in the outer block element and thus overlaps inner marginal portions of such groove as best seen in FIG. 1. A series of ports **70** extend through block element **51** with axes paralleling about that axis of the ram with a set of ends communicating with annular passage **58**. These reports are shown in cross section in FIG. 1 and in dotted outline in FIG. 2.

Third or inner block element **52** abuts cylinder **12**. Sealing the two together is a seal **71**. Face **73** on the outer side of the element **52** abuts intermediate element **51**. An annular shoulder shown at **74** extends through bore **64**, and abuts the inner face of outer block element **50**. Adjacent each corner of element **52** is a bore **85** paralleling the ram axis receiving a head assembly retainer rod.

Block element **51** includes a hollow central region **86** formed of bores of varying diameters shown at **87, 88, 89, 90**. Bore **90** contains packing material **91** sealing the piston rod and head assembly. Bore **89** loosely receives rod **20**. Bores **87** and **88** are adapted to receive closure device **28***a* with movement of the piston to a position adjacent the head assembly. Bore **87** has essentially the diameter of device **28***a* so that a snug fit is produced with device **28***b* extending through the bore. Bore **88** has a somewhat larger diameter to permit the passage of fluid thereabout with device **28***a* extending into the bore.

A supply port **92** extends radially into element **52** and connects at its upper end with bores **87, 88**. Supply conduit **40** connects with the lower end of port **92**. An annular groove **94** is recessed inwardly from the left face of block element **52**, which is concentric with the ram axis, and interconnects with port **92**. The open side of the groove communicates with the outer margins of bore **64** in element **51**. A second annular groove **96** is also recessed in the left face of block element **52**, concentric with the ram axis, and this groove has an open side facing and communicating with a set of ends of circumferentially distributed ports **70** in blocks **51**.

A series of bores **98** are circumferentially distributed about the axis of the ram, extending from annular groove **96** to the right face of block element **52** in FIG. 1. Fluid flow is accommodated from one of the bores **98** described into annular groove **94** through radially extending passage **101** illustrated in the upper part of the figure in FIG. 1. As later brought out, this passage constitutes a by-pass channel in the invention. Controlling flow through the passage is a pin **102**, also referred to herein as a regulable metering valve, illustrated with its tapered lower end partially projecting into one end of the passage. Pin **102** has a threaded head **102***a* screwed into an internally threaded bore **100** extending inwardly from one side of element **52**. A seal **103** seals the pin in element **52** in a region outwardly from bore **98**.

Mounted on the right-hand face of block element **51**, and located within groove **96** with the block elements stacked together in a completed head assembly as shown in FIG. **1**, are a series of reed-type closure valves **104**. As is best shown in FIG. 2, each of these valves comprises an elongated, resilient, deformable blade element which is secured to block **51** by a bracket **106** and a screw **108**. The ends of each blade element rest flush against block element **51** and extend outwardly from bracket **106** to cover ports **70**. All of ports **70** in block elements **51** are so covered. The blade elements are deflected so as to move away from covering positions over the ports when the pressure of fluid on port **70** exceeds the pressure of fluid in groove **96**.

As is best shown in FIG. 3, an annular screen **112** is mounted within annular groove **96** which covers bores **98**. Mounting brackets **114** and screws **116** secure the screen to block **52**.

The entire head assembly **16** is secured to an end of the cylinder **12** by head assembly retainer rods **55** which extend the length of the ram and through bores such as those described at **54, 72,** and **85**. The ends of these rods are threaded to receive nuts **122**, which when advanced on the retainer rods clamp the head assemblies to the cylinder.

The grooves and ports within the head assembly define a fluid passage means comprising two courses for fluid flow which are hydraulically in parallel. A first course for the flow of fluid to the inside of the ram extends from the supply conduit **40** into supply port **92**, thence through annular groove **94**, outer margins of bore **64**, annular passage **58**, ports **70**, annular groove **96**, and finally through bores **98** into the ram. A second course for the flow of fluid to the inside of the ram is from the supply conduit **40**, through supply port **92**, and thence through bores **88** and **87** into the cylinder chamber.

Explaining the operation of the ram, it will be assumed that the piston is to be moved in a stroke to the left in FIG. 1. To move the piston, fluid under pressure is supplied through conduit **42** and permitted to exhaust through condiut **40**. Considering for the moment only how exhaust from the ram takes place, as the piston advances toward head assembly **16**, blade elements **104** are forced by fluid pressure into covering positions over ports **70**, and fluid leaves the ram primarily through the second course described, or through ports **87, 88**. A minor amount of exhaust flow is permitted through partially closed by-pass channel **101**. When the piston reaches the point at which closure device **28***a* enters bore **87**, bore **87** is substantially closed off, and at this point such exhaust of fluid as does take places occurs through the partially closed by-pass channel and by leaking past device **28***a*, at a sharply reduced rate. A mass of fluid tends to be entrapped within the left end of the ram providing a cushion absorbing the momentum of the piston, preventing it from striking the head assembly with full force.

In a return stroke, and describing how the supply of fluid to the ram takes place, fluid under pressure enters through supply conduit **40**, and thence is admitted to the inside of the ram by flowing through each of the two fluid courses described. Initially, and with the piston directly adjacent head assembly **16**, closure device **28***a* by closing off the bore **87** limits the effective area against which the fluid may act upon to an area equalling the cross-sectional area of bore **87** minus the cross-sectional area of the piston rod. The fluid course provided by grooves **94, 58** and bores **98**, however, accommodate a rapid inrush of fluid to the inside of the ram, whereby the fluid may act upon the full face of the piston. With fluid under pressure admitted to groove **94**, blade elements **104** are deformed with their ends moving off of ports **70**, to enable fluid to flow freely through bores **98**.

It will be seen from the above that the invention contemplates a ram with means for cushioning the piston near the end of a stroke, so constructed that this cushioning is not at the expense of sacrificing fast movement of the piston away from the head assembly of the ram in a subsequent return stroke. The construction described, providing as it does multiple bores **98** distributed circumferentially about the ram's axis, permits a relatively large volume of fluid under pressure to be admitted to the interior of the ram substantially immediately upon pressure fluid being supplied the head assembly at the end of the ram, and thus the full face of the piston is utilized substantially instantaneously as the effective area against which fluid under pressure acts upon in starting a stroke.

With the reed-type closure valve disclosed controlling flow through the ports or passages **70**, the ports open fully substantially instantaneously with fluid under

pressure admitted to the ports against the backsides of the blade elements which form the reed-type closure valves. The reed-type closure valves can take repeated cycling without disintegration of the blade elements or impairment of their operability. In the event that a blade element should break apart, fragments of such element are prevented from entering the ram by the screen described at **112**. With the blade elements providing closure of the ports **70** and occupying as they do a plane which extends generally perpendicularly to the ram axis, a compact organization is possible with the inclusion of a number of such ports and without excessive elongation of the ram.

With the head assemblies comprising separable block elements, block element **51**, which includes ports **70** and the blade elements for closing these ports, may readily be removed from that assembly for replacement of the blade elements should such be necessary. This also exposes screen **112**.

It is claimed and desired to secure by letters patent:

1. A fluid-operated ram comprising an elongated hollow cylinder, a relatively reciprocable piston mounted in said cylinder, a head assembly closing off one end of the hollow cylinder, fluid passage means connected to the interior of said cylinder for supplying fluid to and exhausting fluid from said cylinder comprising first and second courses providing parallel flow paths connecting with the cylinder, said first course comprises a passage formed in the head assambly extending about the axis of the ram and multiple ports distributed about the axis of the ram communicating with said passage, and reed-type closure valve means controlling flow through the first of said courses only, said closure valve means comprising plural deformable blade elements distributed about the axis of the ram adapted to close said ports during the exhaust of fluid from the cylinder and further adapted to open said ports during the supply of fluid to said cylinder.

2. The ram of claim **1**, wherein said ram further includes a closure device for closing said second course, said piston is adapted to reciprocate away from and toward said head assembly during the supply and exhaust of fluid, respectively, and said closure device precedes the piston in its travel toward said head assembly and closes off said second course on approaching the head assembly.

3. The ram of claim **1**, wherein said head assembly comprises at least two separable block elements detachably connected together, and one of said block elements has said deformable blade elements mounted thereon, which are exposed on seperation of the block elements.

4. The ram of claim **3**, wherein said passage is annular and the other of said block elements has an annular groove therein which is opened up on separation of the block elements, said annular groove overlying said deformable blade elements and forming part of said first course.

5. The ram of claim **4**, wherein multiple axially extending bores in said other block element connect said annular groove and the interior of said cylinder, said bores forming part of said first course, and which further comprises screen means mounted in said groove screening fluid flow into said bores.

6. The ram of claim **3**, wherein the block elements follow one another along the axis of the ram and the blade elements exposed on separation of the block elements occupy planes substantially normal to the axis of the ram.

7. The ram of claim **1**, wherein said first course further comprises a by-pass channel which by-passes said ports and a regulable metering valve for controlling the flow of fluid through said by-pass channel.

8. The ram of claim **1**, wherein said head assembly comprises at least two separable block elements detachably connected together, one of said block elements has said deformable blade elements mounted thereon with such disposed in a plane extending generally perpendicular to said ram which are exposed on separation of the block elements, the other of said block elements having an annular groove which overlies said blade elements with the block elements connected together and provides a space for receiving the blade element on such being deformed.

References Cited

UNITED STATES PATENTS

666,145	1/1901	Kennedy	137—525.5
1,299,761	4/1919	Nelson	137—525.5
2,610,064	9/1952	Goddard	137—525.5
3,033,169	5/1962	Norwood	91—26
3,218,934	11/1965	Daniels	91—26
3,303,746	2/1967	Schmoeger	91—26
3,267,815	8/1966	Ortman et al.	91—26

FOREIGN PATENTS

650,642	2/1951	Great Britain.

PAUL E. MASLOUSKY, *Primary Examiner.*

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91—396; 92—78, 164; 137—525.5