

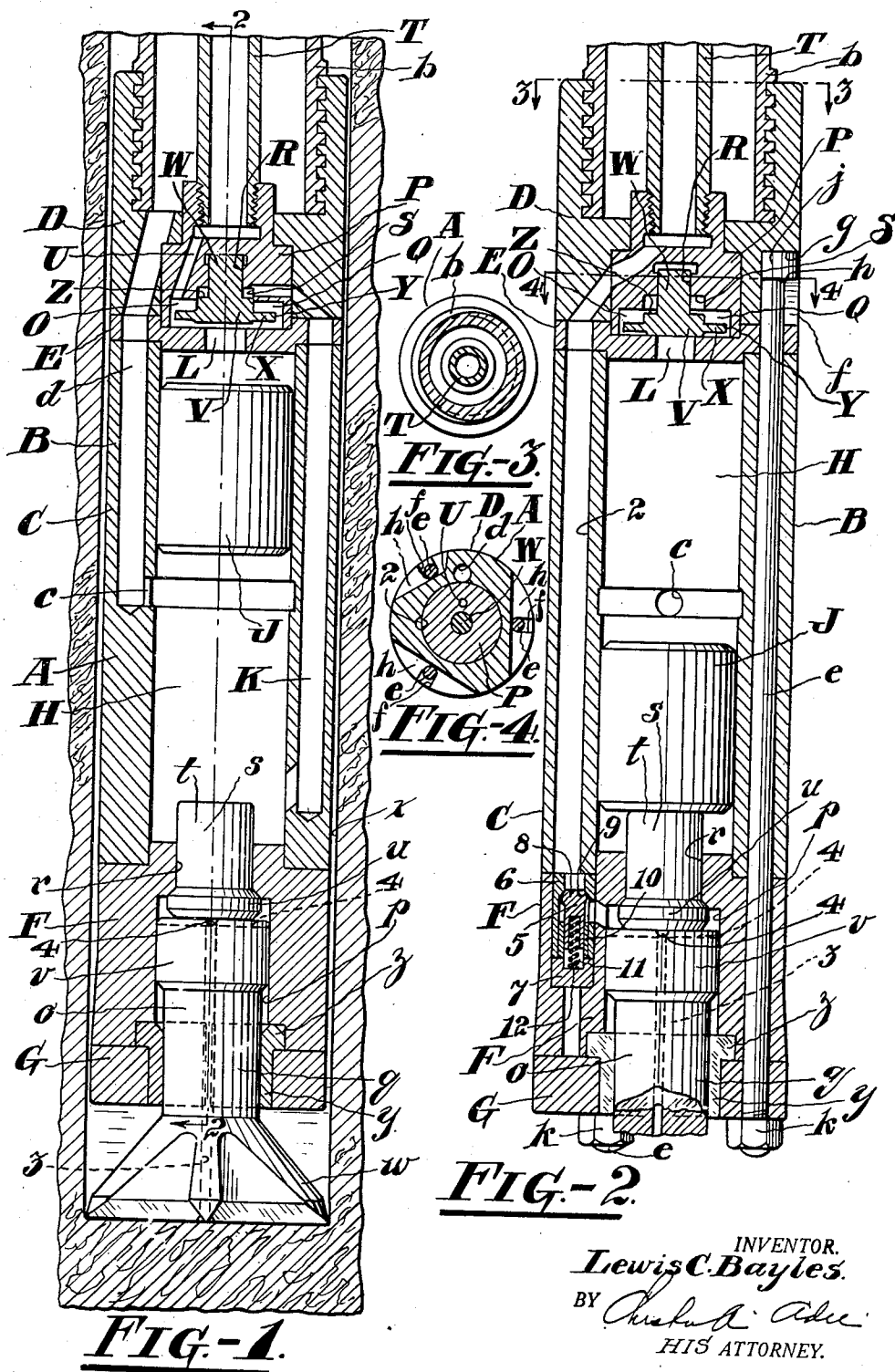
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PERCUSSIVE TOOL

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PERCUSSIVE TOOL

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This invention relates to fluid actuated percussive tools, but more particularly to tools of this type adapted to be used for sub-surface drilling, as for instance, where the work is inundated or in drilling holes of great depth where it would be impractical to employ working implements of such length as to enable the percussive motor or tool to be maintained above the surface.

One object of the invention is to enable the percussive tool to be maintained within close proximity of the work, irrespective of the depth of the hole being drilled, it being contemplated to provide a percussive tool having a plain cylindrical external surface without objectionable protuberances which would otherwise engage the work and thus hamper the free advancement of the percussive tool in accordance with the penetration of its working implement into the work and which would also hinder the free withdrawal of the percussive tool from the work.

Another object is to assure an abundant supply of cleansing fluid to the work when drilling under these conditions and at the same time to prevent the entrance of foreign matter into the tool through the cleansing fluid supply passages and other voids or spaces adjacent the advancing end of the percussive tool, both during the drilling operation and during the operation of inserting the tool into a drill hole of great depth and where therefore liquid, such as water or oil under considerable pressure, may be encountered.

Still another object is to prevent such injury as might otherwise be caused to the percussive tool by its hammer piston during the operation of inserting the percussive tool and its working implement into a deep hole and during which time, as during the operation of the tool, it is essential that certain portions of the tool be subjected to pressure fluid for the purpose of excluding foreign matter from the cooperating surfaces of the movable or working parts of the tool.

Other objects will be in part obvious and in part pointed out hereinafter.

In the accompanying drawing and in

which similar reference characters refer to similar parts,

Figure 1 is an end elevation in section of a percussive tool constructed in accordance with the practice of the invention and showing the movable parts thereof in certain limiting positions which they may assume in practice,

Figure 2 is a similar view taken through Figure 1 on the line 2—2 looking in the direction indicated by the arrows, and

Figures 3 and 4 are transverse views taken through Figure 2 on the lines 3—3 and 4—4 respectively looking in the directions indicated by the arrows.

Referring more particularly to the drawing, the percussive tool designated generally by A comprises a casing B which in the present instance consists of a plurality of casing sections, such as a cylinder C, a back head D with a back cylinder washer E interposed between these elements. At the front end of the cylinder C is arranged a front head F against the front end of which is seated a clamping plate G.

The several parts comprising the casing B are all formed with plain cylindrical outer surfaces. These parts are preferably of about the same external diameters so that the outer surfaces of the casing will be free from protuberances or enlargements which would render the free insertion or the removal of the tool into and from a drill hole difficult.

Within the cylinder C is a piston chamber H provided with a reciprocatory hammer piston J which is actuated by pressure fluid conveyed into the front and rear ends of the piston chamber H by inlet passages K and L respectively. The inlet passage L which may be termed the rear inlet passage is formed in the back cylinder washer E and in this instance opens directly into the front end of a valve chamber O formed within a valve chest P in the back head D. The valve chamber O shown, for the purposes of illustration, comprises a forward enlarged portion Q, a rearward reduced portion R and an intermediate portion S through which pressure

fluid may flow from the enlarged portion Q into the inlet passage K.

The pressure fluid used for actuating the hammer piston J and which is conveyed to the tool by a supply pipe T connected in this instance to the valve chest P as by threaded engagement, flows from the supply pipe to the enlarged portion Q of the valve chamber through a supply passage or passages U which are also preferably formed in the valve chest P. Such pressure fluid is distributed to the ends of the piston chamber by a distributing valve V of the reciprocatory type having a stem W which extends slidably into the rear reduced portion R of the valve chamber whereby the valve V is guided.

The valve is further provided with a flange X at its front end which is of smaller diameter than the enlarged portion Q of the valve chamber wherein it lies so that the pressure fluid may flow over and across the edge Y of said flange to the rear inlet passage L.

At the juncture of the stem W and the flange X of the valve V is a shoulder Z which, in the rearmost position of the valve, extends into the intermediate portion S of the valve chamber to cut off the flow of pressure fluid from the enlarged portion Q to the front inlet passage K.

The valve V may be of a well known type and is herein shown merely for the sake of including an effective means whereby the pressure fluid for actuating the piston J may be distributed.

Owing to the fact that the percussive tool is intended primarily for drilling operations of the nature hereinbefore described, that is, for drilling extremely deep holes of large diameter it would be impractical to permit the motive fluid utilized for actuating the piston J to exhaust directly into the drill hole. The tool is therefore provided with an exhaust eduction pipe b which may be secured to the back head D in any suitable manner.

The exhaust pipe b is preferably arranged exteriorly of the supply pipe T and, owing to its consequent larger diameter, may therefore be used as a means for manipulating the tool, such as rotating it relatively to the work or for removing the tool from or inserting it into the hole being drilled.

Inasmuch as the exhaust pipe b is of large diameter there will be a free passage for the exhaust motive fluid without causing any back pressure adjacent the exhaust port c which is preferably located intermediate the ends of the piston chamber H. The exhaust port c communicates with the exhaust pipe b through an exhaust passage d in the cylinder C, the back cylinder washer E and the back head D.

The casing parts, such as the cylinder C,

the back head D and the front head F and the plates E and G are in this instance securely clamped together by tie-bolts e which are disposed in suitably aligned apertures in the casing elements so that substantially the entire body portions of the bolts will be embedded within the casing. Preferably the back head D is provided at its front end with peripheral radial slots f into which the tie-bolts may be placed by lateral movement thereof, and at the rear end of said slots are slots g arranged transversely of the slots f thus forming shoulders h upon which the heads j of the tie-bolts e may seat.

The opposite or front ends of the tie-bolts e project beyond the corresponding end of the clamping plate G and may be suitably threaded to receive nuts k whereby the casing parts may be clamped tightly together. The entire arrangement is such that no part or parts of the tie-bolts e will extend beyond the peripheral surfaces of the casing parts.

The front head F, which in this instance forms a closure for the front end of the piston chamber H, also serves as a guide for a working implement o and is accordingly provided with a bore p into which the stem q of the working implement o extends. The rear end of the bore p is in the form of a reduced portion r to slidably accommodate the stem s of an anvil block t and which stem extends into the front end of the piston chamber H to receive the blows of the hammer piston J and which blows are transmitted to the working implement o by the anvil block t. At the front end of the anvil block t is an enlarged head u to seat against the adjacent end of the stem q of the working implement.

The rear end of the working implement o carries a head v and at the opposite or front end of said working implement is a cutting bit w, preferably of the cruciform type and of a diameter slightly in excess of the diameters of the casing parts. This arrangement will assure a drill hole of sufficiently larger diameter than the casing parts to permit the percussive tool to readily follow the progress of the cutting bit into the work and an annular space x will exist between the casing and the wall of the drill hole for the escape of cuttings and cleansing fluid from the working face.

The head v of the working implement o is slidably guided by the bore p and an additional guiding bearing is provided for the body portion of the working implement between the head v and the cutting bit w by a bushing y seated in the clamping ring g and having a flange z at its rear end to seat upon the rear end of the clamping ring g. When used in connection with working implements having enlargements at each end the bushing y is preferably split longitudinally, as illustrated more particularly in Figure 1, to form

two sections which may be readily placed about the body portion of the working implement and then inserted into the clamping ring *g*.

In drilling operations employing percussive tools of the character to which the present invention pertains it is essential that the working face upon which the working implement operates be maintained free of detritus to assure a satisfactory progress of the cutting bit *w* into the work. Means are accordingly provided to assure this favorable condition and to this end the percussive tool is provided with a cleansing fluid supply passage 2 which leads from the supply pipe *T*, wherewith it is in constant communication, and extends through the back head *D*, the washer *E*, the cylinder *C* and the front head *F* at which point it opens into the bore *p* and preferably at the rear end thereof. The pressure or cleansing fluid thus flowing into the bore *p* may pass therefrom through a passage 3 in the working implement *o* into the bottom of the hole being drilled.

In order to assure an abundant supply of cleansing fluid to the passage 3 the rear end of the working implement is provided with a series of grooves 4 which intersect adjacent the rear end of the passage 3 and extend with their outer extremities beyond the peripheral surface of the anvil block *t* so that a constant supply of cleansing fluid to the passage 3 will be assured.

In tools of this nature equipped with hole cleansing devices it is essential that means be provided to prevent a counter-flow of liquid and entrained solids from the drill hole through the cleansing fluid conveying passages. To this end the percussive tool *A* is provided with valve means in the form of a check valve 5 arranged in this instance in the front head *F* to assure against a return flow of fluid from the bore *p* into the passage 2.

For convenience of construction and maintenance, the valve 5 is provided with a valve chest in the form of a pair of hollow telescopically arranged members 6 and 7 which are seated in the front head *F* in line with the supply passage 2 which the valve 5 is intended to control. The member 6 forms a portion of or continuation of the passage 2.

The valve 5 illustrated comprises a head 8 which cooperates with a seating surface 9 in the member 6 to form a seal at this point, and at the forward end of the head 8 is a hollow stem 10 which extends slidably into a bore 11 in the member 7 and acts as a receptacle for a spring 12 which exerts a pressure in the direction necessary for closing the valve 5.

The operation of the device is as follows: Prior to or during the time of the operation of lowering the percussive tool into the drill hole the supply pipe *T* is opened to the source

of supply so that pressure fluid at full line pressure may be supplied to the supply passage 2. Such pressure fluid acting against the valve 5 will unseat said valve and thence flow into the bore *p* and through the passage 3 in the working implement *o* to prevent any foreign matter, such as liquids with entrained solid particles from entering the bore *p*.

It would obviously be inconvenient to provide a separate supply line for the distributing valve so that, when constructed as illustrated, pressure fluid will of course also flow from the supply pipe *T* to the valve chamber *O*. The presence of pressure fluid in the valve chamber *O* will set the valve *V* in operation and, in consequence, the piston *J* will also reciprocate in the chamber *H* during the lowering operation of the percussive tool.

During the time the percussive tool, together with the working implement, is being lowered into the drill hole however, the working implement will slide forwardly in the bore *p* and in the bushing *y* so that its head *v* will rest upon the rear end of the flange *z* of the bushing *y*.

The working implement *o* and the anvil block *t* will then lie in the opposite extremities of the bore *p* so that the cleansing fluid flowing through the bore into the passage 3 of the working implement will also serve as a cushioning medium for the anvil block *t*. This is made possible by the fact that the supply passage 2 together with the associated ports and passages leading to the bore *p* are of considerably larger area than the passage 3 in the working implement.

With the anvil block *t* thus held in retracted position by the pressure fluid in the bore *p* a considerable portion of the blow of the hammer piston *J* will be absorbed by such pressure fluid. This is extremely desirable as it prevents the piston from striking heavily against the element forming a closure for the front end of the piston chamber *H*, such as the front head *F*. Moreover, the working implement will be protected against the occurrence of unnecessary wear which might otherwise be caused thereto.

In the event that the supply of pressure fluid to the percussive tool should be interrupted so that, in the absence of a suitable checking device such as the valve 5, liquid from the drill hole might flow upwardly through the percussive tool and through the supply pipe *T* from whence it would flow to the valve chamber *O* and thence to the piston chamber *H*, the valve 5 will be pressed to its seat 9 by the spring 12. The pressure exerted by the spring 12 will be augmented by the pressure of the liquid in the drill hole so that an adequate seal may be maintained between the head 8 of the valve 5 and the seat 9 to prevent the admission of any liquid into the drilling apparatus.

Another advantage flowing from the pres-

ent invention is, that by maintaining an ample supply of pressure fluid within the rear end of the bore p liquid from the drill hole will be prevented from flowing along the cooperating surfaces of the working implement and the elements which form guides therefor.

Another very desirable advantage of the present invention is that it makes possible the use of very short working implements which may therefore be extremely rigid and, unlike drilling apparatuses intended for use only above the surface and in which case working implements of great lengths are necessitated, the working implement will not absorb a portion of the force of the blow of the percussive element.

The present invention has been found to be admirably adapted for subterranean drilling and is capable of rendering service for prolonged periods of time without necessitating frequent removal for the purposes of inspection and replacement of parts, it being merely necessary to add sections to both the supply line T and to the discharge pipe b as the working implement progresses into the work.

I claim:

In a percussive tool, the combination of a casing having a piston chamber and a hammer piston reciprocable therein, said casing having a bore in one end, a drill steel extending with its rear end into the bore and having a passage for conveying fluid under pressure from the bore to a hole being drilled, an anvil block for transmitting the blows of the hammer piston to the drill steel, a supply passage in the casing opening into the bore for conveying fluid under pressure thereto for supplying the first mentioned passage and for maintaining the anvil block and the drill steel apart and in opposite ends of the bore in the absence of external pressure against the cutting bit of the drill steel thereby cushioning the strokes of the hammer piston against the anvil block, and a check valve to control the supply passage for preventing the flow of foreign matter from the bore into the supply passage.

In testimony whereof I have signed this specification.

LEWIS C. BAYLES.

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