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C. A. HULTQUIST

FLUID OPERATED PERCUSSIVE TOOL

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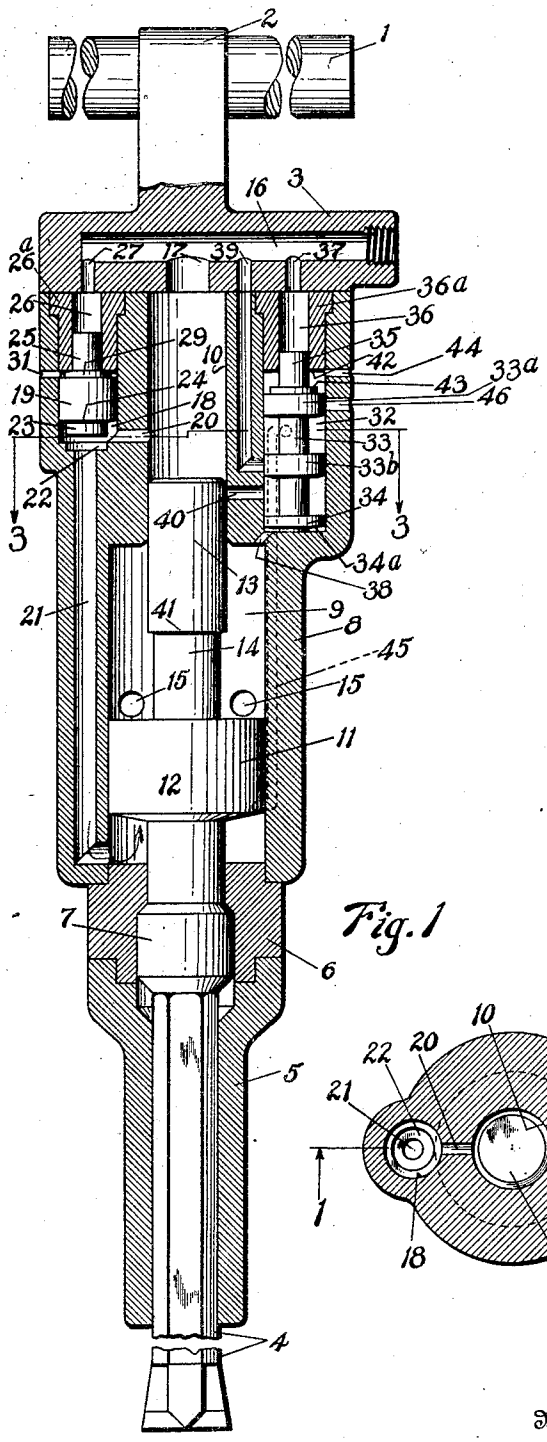


Fig. 1

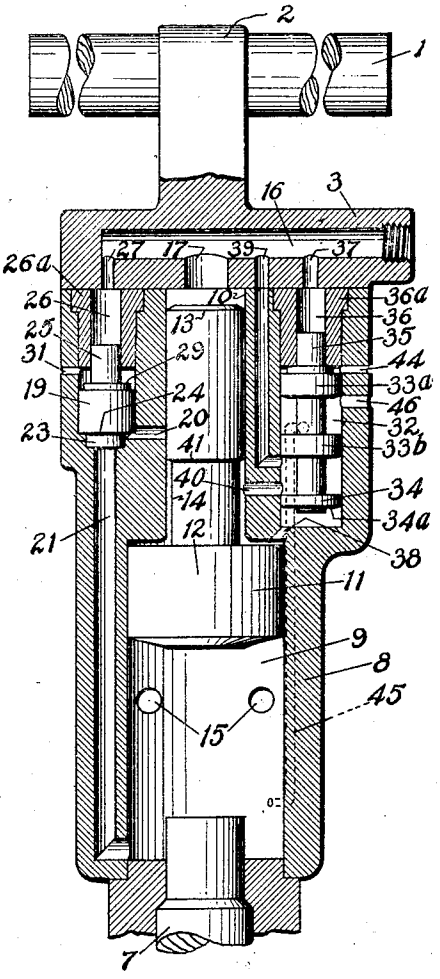


Fig. 2

Fig. 3

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FLUID-OPERATED PERCUSSIVE TOOL.

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My invention relates to fluid operated percussive tools and more particularly to that class of tools having a cylinder of differential bores and in which fluid under constant pressure is maintained in communication with one end of the hammer member while in operation.

In tools of this class now in use, there are large clearance spaces in the large cylinder bore for the reason that the admission of fluid is controlled by the hammer member. The admission of fluid into the large cylinder takes place too early, the fluid being admitted when the hammer is within about 35 per cent of the completion of its rearward stroke and the hammer cuts off the fluid at the same point on its forward stroke, therefore, in order to obtain a rearward stroke of the hammer of sufficient length, large clearance spaces are provided to provide space for a part of the fluid that enters into the cylinder by the early admission.

Slight benefit is derived from the expansion of the fluid in these clearance spaces, however, since the fluid is exhausted at about 73 per cent of the initial pressure, it is obvious that the construction is inefficient and that a large per cent of the fluid pressure is wasted. Also in this class of construction, there is a severe rearward shock or recoil of the tool which is produced by the early admission of fluid which is of great inconvenience to the operator and an excessive charge of fluid in the forward end of the cylinder is required to force the hammer backwardly against resistance occasioned by this early admission of the fluid.

The principal object of this invention, therefore, is to eliminate or reduce to a minimum the objectionable features referred to. Another object is to provide a tool of this class that is more efficient in every respect. Another object is to provide a tool of this class in which there is less vibration during operation, therefore, reducing the liability of crystallization. Another object is to provide a tool of this class which is simple and economical of construction, durable, easy to operate, efficient in its action and which will not readily deteriorate or get out of order.

With these and other objects in view as will appear hereinafter, my invention consists of certain novel features of construction, combination and arrangement of parts and portions as will be hereinafter described in detail and particularly set forth in the appended claims, reference being had to the accompanying drawings and to the characters of reference thereon, which form a part of this application in which:

Figure 1 is a longitudinal sectional view through 1—1 of Fig. 3, showing some of the parts and portions in elevation to facilitate the illustration and showing the movable parts in their certain correlation when the hammer member is at the forward end of its stroke. Fig. 2 is a similar view of a fragmentary portion of said tool, showing the operating portion only and showing the operating mechanism with the hammer member in its rearward position and Fig. 3 is a transverse sectional view through 3—3 of Fig. 1.

Similar characters of reference refer to similar parts and portions throughout the views of the drawings.

The handle grip member 1, supporting lug 2, head-end member 3, cutting tool member 4, front head member 5, anvil supporting member 6, anvil 7, main cylinder member 8, hammer member 11, valve member 19 and valve member 33, constitute the principal operating parts of my fluid operated percussive tool.

The cylinder 8 is provided with a relatively large diameter bore 9 at its forward end and a relatively smaller diameter bore 10 at its rearward end. The hammer 11 consists of a head member 12 which is adapted to reciprocate in the large bore 9, a shank portion 13 which is adapted to reciprocate in the small bore 10 and a reduced neck portion 14. Communicating with the bore 9 and with the atmosphere are exhaust ports 15 which are so positioned as to be covered and uncovered by the head 12 as the hammer 11 reciprocates. In the head 3 is provided an inlet port 16 which is adapted to connect with a source of fluid supply under pressure so that constant fluid pressure is maintained in this port 16, also in the port 17 and bore 10 which communicates therewith, when the tool is in operation. Extending parallel with the bore 10 in the wall of the cylinder 8 is a valve bore 18 and connecting the two bores 10 and 18 is a port 20. Reciprocably mounted in the cylinder 18 is a valve member 19 which is adapted to control admission of fluid to the forward end of the cylinder bore 9 through the port 20 and a delivery port 21 which extends longitudinally in the wall of the cylinder member 8 and commu-

nicates with the bore 9 at its forward end, the rear end communicating with a counter-bore 22. The valve 19 is provided with a reduced forward end 23 which is adapted to fit into the counter-bore 22 with the reciprocation of the valve member 19.

Fluid is supplied intermittently to the valve bore 18 through the port 20 from the cylinder bore 10. This valve 19 is provided with a pressure shoulder 24 against which the intermittent pressure acts through the port 20 as said port is covered and uncovered by the shank 13 with the reciprocation of the hammer 11. This valve 19 is also provided with a shank portion 25 at its rear end which is adapted to reciprocate in a bore 26 in a bushing 26ª fitted into the cylinder 8. Constant pressure is maintained on the face of the shank 25 through a port 27 which communicates with the port 16 and bore 26. The constant pressure on the end of the shank 25 forces the valve forwardly and the reduced portion 23 of said valve enters the counter-bore 22, thereby, cutting off communication between the supply port 20 and the delivery port 21, as shown best in Fig. 2 of the drawings. The pressure shoulder 24 being of larger area than the shank 25 when the shank 13 travels forward and uncovers the port 20, the fluid pressure supply to the bore 18 acts on the shoulder 24 and overcomes the resistance of the pressure against the shank 25 which causes the valve 19 to move rearwardly, as shown best in Fig. 1 of the drawings, which provides communication between the port 20 and the forward end of the cylinder 9, through the delivery port 21. This valve 19 is also provided with an abutment shoulder 29 which is adapted to abut against the end of the bushing 26ª and serve as a stop for the valve in its rearward stroke, as shown best in Fig. 1 of the drawings. Communicating with the rearward end of the bore 18 and with the atmosphere is a port 31 which is adapted to equalize the pressure at the abutment of the shoulder 29 with the end of the bushing 26ª. Positioned in the wall of the cylinder 8 alongside of and parallel with the bore 10 is another valve bore 32 in which is reciprocably mounted the valve 33 which is adapted to control the flow of the fluid to the rear end of the cylinder 9 and also control the compression in the forward end of said cylinder bore 9. This valve 33 has a plurality of heads 33ª, 33ᵇ and 34. The head 34 is provided with a pressure surface 34ª on its forward end and with an extended shank 35 on its rearward end. This shank 35 is adapted to reciprocate in a bore 36 in a bushing 36ª set in the rear end of the bore 32. Constant pressure is maintained on the face of the shank 35 through a port 37 communicating with the port 16 and bore 36. The constant pressure on the face of the shank 35 serves to force the valve 33 to a forward position, as shown best in Fig. 1 of the drawings. When the hammer 11 is on its rearward stroke and after the exhaust ports 15 are uncovered by the hammer head 12 the atmospheric air at the rear of the head 12 in the bore 9 is being compressed. This compressed fluid enters the valve bore 32 at its forward end through a valve port 38 and when the hammer is almost at the end of the rearward stroke the pressure acting on the surface 34ª is sufficient to overcome the resistance of the pressure on the shank 35, thus causing the valve 33 to move to its rearward position and uncovering the forward end of the supply port 39, which port communicates at its rear end with the inlet port 16, it being shown uncovered in Fig. 2 of the drawings. Fluid is now being admitted to the rear end of the cylinder bore 9 through the inlet port 16, port 39 valve bore 32 and delivery port 40 and the annular groove formed by the neck 14 for forcing the hammer forwardly. The fluid continues to flow into the rear end of said cylinder 9 until the neck shoulder 41 of the shank 13 covers the port 40 when the fluid is cut off, then the fluid in the cylinder expands until the head 12 passes over and uncovers the exhaust ports 15 at the rear of the head 12, as shown in Fig. 1 of the drawings, when the fluid is exhausted. The forward end of the bushing 36ª forms an abutment 42 and at the forward end of the shank 35 is an abutment shoulder 43 which forms a stop for the rearward movement of the valve 33. Communicating with the bore 32 and the atmosphere is a port 44 which is adapted to equalize the pressure at the abutments. Extending longitudinally in the wall of the cylinder 8 is a relief port 45 which communicates at one end with the bore 32 and at its opposite end with the cylinder bore 9 and communicating with the bore 32 and the atmosphere is a compression relief port 46 which is so positioned that it is covered by the valve when the valve is in its forward position and uncovered when in its rearward position.

The operation of my fluid operated percussive tool is as follows:

The fluid under constant pressure being admitted to the port 16 enters the cylinder 10, shank bores 26 and 36 and supply port 39 and maintaining pressure therein.

Assuming the operating parts of the tool to be in position as shown in Fig. 1, the hammer 11 having just completed its forward stroke by striking the anvil 7, the valve 19 having moved to its rearward position and opened communication from the shank cylinder 10 to the forward end of the cylinder bore 9 through the supply port 20, valve bore 18 and delivery port 21.

The fluid now acts on the front end of the hammer head 12 causing it to move back-

wardly until the end of the shank 13 passes over the port 20 when the supply of fluid is cut off from port 20, bore 18, port 21 and the front end of the bore 9 and the expanding air continues to drive the hammer backwardly until the head 12 passes over and uncovers the exhaust ports 15 which exhausts to atmosphere in front of the head 12. The fluid now being exhausted from the front end of the cylinder 9, port 20, valve bore 18 and port 21 and there being no pressure on the shoulder 24 to hold the valve 19 in its rearward position the constant pressure on the end of the shank 25 will cause the valve 19 to move forwardly and cut off communication between the ports 20 and 21, as shown in Fig. 2 of the drawings. The momentum of the hammer at this stage of the operation is considerable so that it continues on its rearward stroke compressing the atmospheric air in the rear end of the cylinder bore 9 but as the hammer approaches the end of its rearward stroke its momentum is checked by the constant pressure on the end of the shank 13 and accumulating pressure in the rear of the head 12, which pressure acts on the pressure surface 34 through the port 38 has now become sufficient to overcome the constant pressure on the end of the shank 35 and the valve 33 moves to its rearward position, as shown in Fig. 2 of the drawings. Communication, now, being established in the rear of the cylinder bore 9 through the inlet port 16 and supply port 39, valve bore 32 and delivery port 40 and around the reduced hammer neck 14 and admission of fluid to the rear of the hammer 12 is now taking place which, in addition to the constant pressure on the end of the shank 13 starts the hammer on its forward stroke and as it advances forwardly the neck shoulder 41 passes over the port 40 and cuts off the fluid delivery to the rear of the bore 9, however, the constant pressure on the end of the shank 13 and the expanding fluid in the rear of the head 12 continue to force the hammer forwardly until the hammer head 12 passes on to and covers the exhaust port 15 closing said ports, whereupon the relief ports 45 and 46 will prevent any compression taking place in front of the head 12. The hammer head 12 continuing forwardly and passes over the exhaust ports 15 and uncovers the same at the rear of the head 12. As the fluid from the rear end of the bore 9 is being exhausted, the fluid pressure on the surface 34, which holds the valve in the rearward position is also exhausted and the constant pressure on the end of the shank 35 will push the valve 33 forwardly to its original position, as shown in Fig. 1 of the drawings, and thereby cutting off communication between the supply port 39, delivery port 40 and between the relief ports 45 and 46. As the hammer approaches the end of its forward stroke the end of the shank 13 uncovers the port 20 and fluid from the shank cylinder bore 10 will now flow into the bore 18 and exert pressure on the shoulder 24 which has a larger area than the shank 25 causing the valve to start moving rearwardly and as the hammer at this period travels forwardly at its greatest speed, it will reach the anvil and deliver the blow thereon, at approximately the same time the valve 19 opens, communication between the ports 20 and 21 and the fluid again flows into the front end of the bore 9 and the operation is repeated as long as there is proper fluid pressure in the port 16.

Though I have shown and described a particular construction, combination and arrangement of parts and portions I do not wish to be limited to this particular construction, combination and arrangement but desire to include in the scope of my invention the construction, combination and arrangement substantially as set forth in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a fluid operated percussive tool, a cylinder having a relatively large forward bore and a relatively small rearward bore, a hammer provided with a head reciprocably mounted in the forward bore and a shank reciprocably mounted in the rearward bore, fluid conducting means to maintain constant pressure on the face of the shank, an exhaust port communicating with the large cylinder bore so positioned as to be automatically controlled by the head of the hammer, a valve bore, a valve in the bore for controlling the flow of fluid to the forward end of the large cylinder bore, a supply port from the small cylinder bore to the valve bore, a delivery port from the valve bore to the forward end of the large cylinder bore, a counter-bore in the rearward end of the delivery port, a reduced portion on the forward end of the valve adapted to enter the counter-bore, for the purpose of severing communication from the supply port and delivery port, a pressure shoulder on the valve for receiving intermittent pressure for moving the valve rearwardly and provided with a shank on the rearward end of the valve adapted to receive constant pressure on the face of the valve shank for moving the valve forwardly and means for maintaining constant pressure on the face of the valve shank.

2. In a fluid operated percussive tool, a cylinder having a relatively large forward bore and a relatively small rearward bore, a hammer provided with a head reciprocably mounted in the forward bore and a shank

reciprocably mounted in the rearward bore, fluid conducting means to maintain constant pressure on the face of the shank, an exhaust port communicating with the large cylinder more positioned so as to be automatically controlled by the head of the hammer, a valve bore, a valve in the bore for controlling the flow of fluid to the forward end of the large cylinder bore, a single supply port from the small cylinder bore to the valve bore, a delivery port from the valve bore to the forward end of the large cylinder bore, a counter-bore in the rearward end of the delivery port, a reduced portion on the forward end of the valve adapted to enter the counter-bore, for the purpose of severing communication between the supply port and the delivery port, a pressure shoulder on the valve for receiving intermittent pressure for moving the valve rearward, a shank on the rearward end of the valve for receiving constant pressure on the face of the shank for moving the valve forwardly, means for maintaining constant pressure on the face of the valve shank, an abutment shoulder on the valve at the forward end of the valve shank, a bushing with an abutment face on its forward end and an atmospheric equalizing port through the wall of the valve bore near the abutment face of the bushing.

3. In a fluid operated percussive tool, a cylinder having a relatively large forward bore and a relatively small rearward bore, a hammer provided with a head reciprocably mounted in the forward bore and a shank reciprocably mounted in the rearward bore, fluid conducting means to maintain constant pressure on the face of the shank, an exhaust port communicating with the large cylinder bore, positioned so as to be automatically controlled by the head of the hammer, a valve bore, a valve in the bore for controlling the admission of fluid to the rear end of the large cylinder bore, a supply port to the valve bore, positioned so as to be covered by the valve when in one position and uncovered when in another position, a delivery port from the valve bore to the small cylinder bore, positioned so as to be covered by the shank of the hammer when the hammer is on its forward stroke and uncovered when the hammer is on its rearward stroke, a valve operating port from the rear of the large cylinder bore to the forward end of the valve bore, a pressure surface on the forward end of the valve for receiving intermittent pressure for moving the valve rearwardly, a shank on the rearward end of the valve for receiving constant pressure on the surface of the shank for moving the valve forwardly.

4. In a fluid operated percussive tool, a cylinder having a relatively large forward bore and a relatively small rearward bore, a hammer having a head which reciprocates in the forward bore and a shank which reciprocates in the rearward bore, means to maintain constant pressure on the face of the shank, an exhaust port communicating with the large cylinder bore positioned so as to be automatically controlled by the head of the hammer, a valve bore, a valve in the bore for controlling the admission of fluid to the rear end of the large cylinder bore, a supply port, a delivery port, a valve operating port, a shank on the rear end of the valve, operating in a reduced portion of the valve bore, an abutment shoulder on the valve at the forward end of the shank, an abutment surface at the forward end of the reduced valve bore, and an atmospheric equalizing port through the wall of the valve bore near the abutment surface.

5. In a fluid operated percussive tool, a cylinder having a relatively large forward bore and a relatively small rearward bore, a hammer having a head which reciprocates in the forward bore and a shank which reciprocates in the rearward bore, fluid conducting means to maintain constant pressure on the face of said shank, an exhaust port in the large cylinder bore positioned to be automatically controlled by the head of the hammer, a valve bore, a valve in said bore, a supply port, a delivery port, a valve operating port, a compression relief port from the forward part of the large cylinder bore to the valve bore, a compression relief port from the valve bore to atmosphere, positioned to be covered by the valve when in forward position and uncovered when in the rearward position, a pressure surface on the forward end of the valve, a shank on the rearward end and means to maintain constant pressure on the face of the shank.

6. In a fluid operated percussive tool, a cylinder having a relatively large forward bore and a relatively small rearward bore, a hammer provided with a head reciprocably mounted in the forward bore and a shank reciprocably mounted in the rearward bore, fluid conducting means to maintain constant pressure on the face of the shank, an exhaust port communicating with the large cylinder bore so positioned as to be automatically controlled by the head of the hammer, a valve bore, a valve in the bore for controlling the flow of fluid to the forward end of the large cylinder bore, a shank supply port from the small cylinder bore to the valve bore, a delivery port from the valve bore to the forward end of the large cylinder bore, a counter-bore in the rearward end of the delivery port, a reduced portion on the forward end of the valve adapted to enter the counter-bore, for the purpose of severing communication from the supply port and delivery port, a pressure shoulder on the valve for receiving intermittent pressure for moving the valve rearwardly and provided with

a shank on the rearward end of the valve adapted to receive constant pressure on the face of the shank for moving the valve forwardly, means for maintaining constant pressure on the face of the shank, a second valve bore, a valve in said bore, a supply port, a delivery port, a valve operating port, a compression relief port from the forward part of the large cylinder bore to said second valve bore, a compression relief port from said second valve bore to atmosphere, positioned to be covered by the valve when in its forward position and uncovered when in its rearward position, a pressure surface on the forward end of said valve in the second valve bore and a shank on its rearward end and means to maintain constant pressure on the face of said shank.

7. In a fluid operated percussive tool, a cylinder having a relatively large forward bore and a relatively small rearward bore, a hammer provided with a head reciprocably mounted in the forward bore and a shank reciprocably mounted in the rearward bore, fluid conducting means to maintain constant pressure on the face of the shank, an exhaust port communicating with the large cylinder bore positioned so as to be automatically controlled by the head of the hammer, a valve bore, a valve in the bore for controlling the flow of fluid to the forward end of the large cylinder bore, a single supply port from the small cylinder bore to the valve bore, a delivery port from the valve bore to the forward end of the large cylinder bore, a counter-bore in the rearward end of the delivery port, a reduced portion on the forward end of the valve adapted to enter the counter-bore, for the purpose of severing communication between the supply port and the delivery port, a pressure shoulder on the valve for receiving intermittent pressure for moving the valve rearward, a shank on the rearward end of the valve for receiving constant pressure on the face of the shank for moving the valve forwardly, means for maintaining constant pressure on the face of the shank, an abutment shoulder on the valve at the forward end of the shank, a bushing with an abutment face on its forward end and an atmospheric equalizing port through the wall of the valve bore near the abutment face of the bushing, a second valve bore, a valve in said bore, a supply port, a delivery port, a valve operating port, a compression relief port from the forward part of the large cylinder bore to said second valve bore, a compression relief port from said second valve bore, to atmosphere, positioned to be covered by the valve when in its forward position and uncovered when in its rearward position, a pressure surface on the forward end of said valve in the second valve bore and a shank on its rearward end and means to maintain constant pressure on the face of said shank.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 18th day of April, 1925.

CHARLES A. HULTQUIST.