Feb. 12, 1952 R. BASSINGER 2,584,978

PERCUSSION TOOL

Filed Sept. 13, 1948 2 SHEETS—SHEET 1

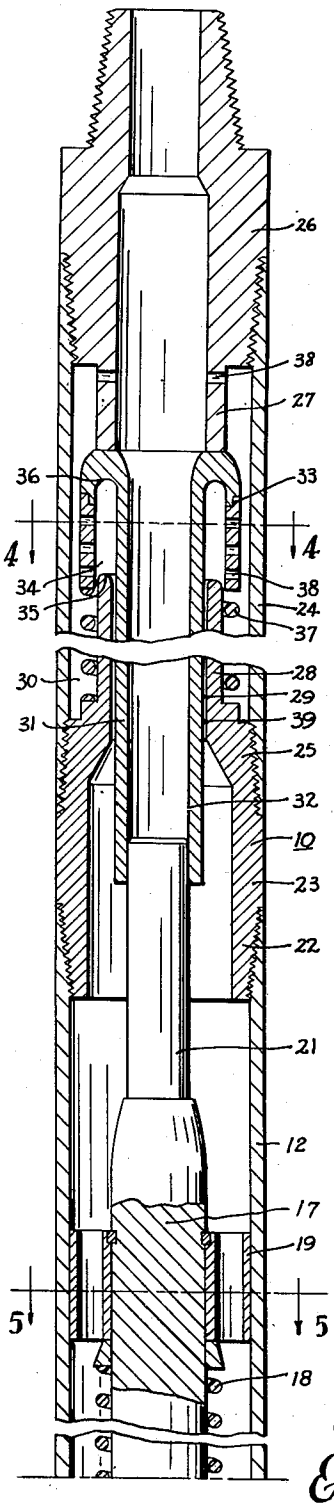


Fig. 1

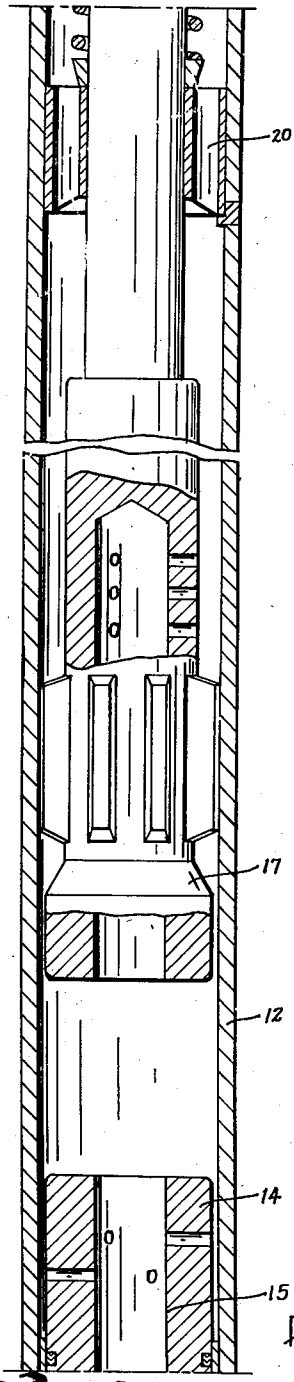


Fig. 2

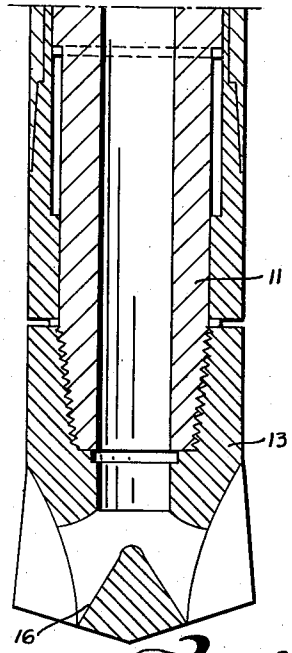


Fig. 3

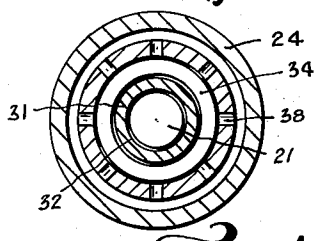


Fig. 4

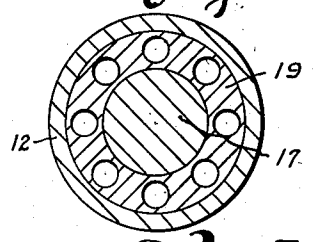


Fig. 5

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PERCUSSION TOOL

Filed Sept. 13, 1948 2 SHEETS—SHEET 2

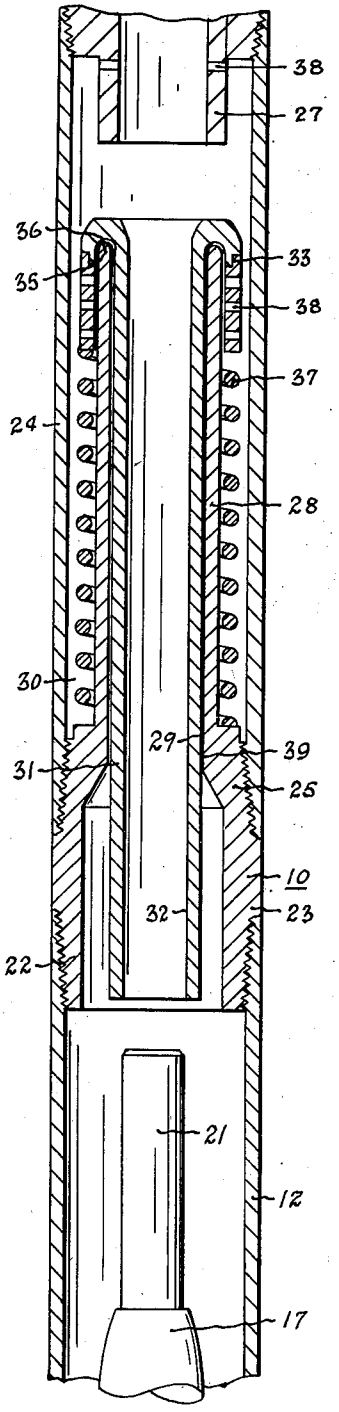


Fig. 6

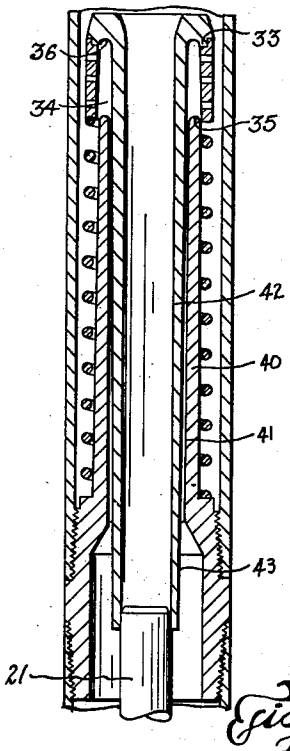


Fig. 7

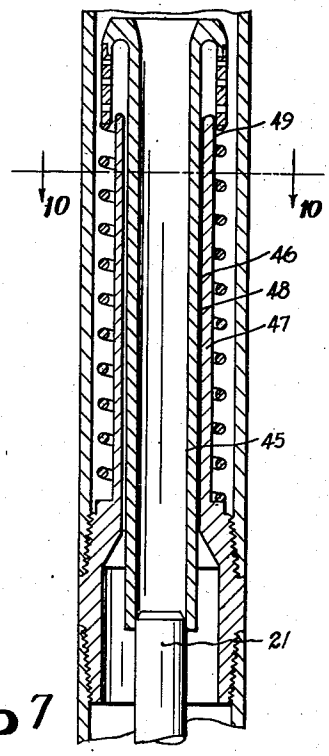


Fig. 9

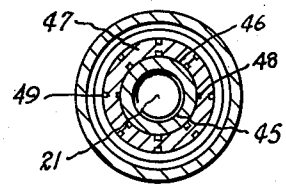


Fig. 10

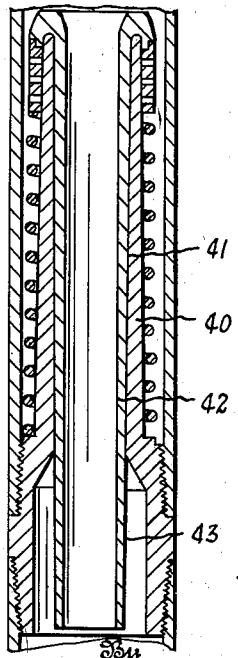


Fig. 8

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UNITED STATES PATENT OFFICE

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PERCUSSION TOOL

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4 Claims. (Cl. 255—4.4)

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This invention relates to new and useful improvements in percussion tools.

One object of the invention is to provide an improved percussion tool particularly adapted for use in oil wells and actuated by the drilling fluid employed in the drilling of such wells.

A particular object of the invention is to provide an improved percussion tool of the character described from which the drilling fluid may be drained in the course of its removal from the well bore.

Yet another object of the invention is to provide an improved percussion tool having a control sleeve for alternately applying and releasing the pressure of the drilling fluid upon and from a percussion hammer, with means associated with the sleeve for alternately trapping and by-passing the drilling fluid.

A still further object of the invention is to provide an improved percussion tool adapted to be run in a well bore upon a string of drill pipe and operated by drilling fluid passing downwardly through said pipe, and having means for automatically opening a drain passage for the drilling fluid when operation of the tool is ceased.

A pertinent object of the invention is to provide an improved fluid escape passage in various types of percussion tools, such as drills and jars, which will permit the drilling fluid to be drained from the drill pipe upon which the tools are carried.

A construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, wherein examples of the invention are shown, and wherein:

Fig. 1 is a longitudinal, sectional view of a percussion tool constructed in accordance with this invention, showing the control sleeve and hammer in their upper positions,

Fig. 2 is a continuation of Fig. 1,

Fig. 3 is a continuation of Fig. 2,

Figs. 4 and 5 are horizontal, cross-sectional views taken on the lines 4—4 and 5—5 of Fig. 1,

Fig. 6 is a view similar to Fig. 1, showing the control sleeve and hammer in their lower positions,

Fig. 7 is a longitudinal, sectional view of a modification of the invention as applied to a percussion tool control sleeve, showing the sleeve in its upper position,

Fig. 8 is a view similar to Fig. 7, showing the sleeve in its lower position,

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Fig. 9 is a longitudinal, sectional view of a further modification of the invention as applied to a percussion tool control sleeve, showing the sleeve in its upper position, and

Fig. 10 is a horizontal, cross-sectional view taken on the line 10—10 of Fig. 9.

There have been developed in the past a number of percussion tools for use in oil wells to implement the cutting action of the drill bit, to function as jars and the like. These tools are for the larger part actuated by the pressure of the drilling fluid or mud employed in drilling oil wells by the rotary drill method, and almost universally have the objection that no provision is made for draining the drilling fluid from the drill pipe. The drill pipe is full of a flowing column of fluid when the tools are in operation, and when drilling is terminated or interrupted and it is desired to remove the percussion tool from the well bore, the drill pipe remains full of the drilling mud because no avenue of escape is provided. This means the workmen must pull a string of "wet' pipe or pipe full of fluid, and the consequently hazardous and undesirable working conditions are encountered besides the necessity for special equipment if the drilling fluid is not to be lost. The present invention avoids these difficulties by providing for draining of the drill pipe when the percussion tool is not in operation.

Referring now to the drawings in which are illustrated several ways of applying the invention to one type of percussion tool, the numeral 10 designates a percussion tool of the general type disclosed in my co-pending applications, Serial No. 636,497, filed July 26, 1946, now Patent No. 2,507,585, issued May 16, 1950, and Serial No. 5,855, filed February 2, 1948. This tool includes a bit carrier 11 at its lower end splined to the housing 12 of the tool and carrying a suitable drill bit 13. An anvil 14 is provided upon the upper end of the carrier and extends upwardly within the housing 12. Fluid may flow downwardly through the axial bore 15 of the anvil and carrier and outwardly through the water courses 16 of the drill bit.

An elongate, heavy hammer 17 is reciprocably mounted within the housing 12 above the anvil, and is supported therein upon a heavy compression spring 18 which engages beneath a guide 19 secured upon a similar guide 20 secured to the inner housing wall therebelow. An elongate, reduced control piston 21 projects axially upwardly from the hammer above the upper guide 19.

Above the hammer and piston structure, the housing 12 screws onto the depending pin 22 of a

connection collar 23, and an upper portion 24 of the percussion tool housing is received upon the upstanding, screw-threaded pin 25 of said collar. A suitable tool-joint 26 is secured to the upper end of the portion 24 of the housing and is adapted to be coupled to the lower end of a suitable drill pipe (not shown). An annular skirt 27 depends from the tool-joint into the interior of the upper housing portion 24.

The connection collar 23 is formed with an integral, upstanding neck or guide 28 having an axial bore 29, and having its outer wall spaced from the housing portion 24 to provide an annular space 30 therebetween. An elongate, tubular control sleeve 31 is received within the bore 29 and extends therethrough projecting from each end of the bore. The sleeve is provided with an axial bore 32 of such diameter as to have a snug sliding fit over the hammer piston 21 whereby the latter may telescope such bore.

The upper end of the control sleeve is rounded and turned back upon itself to form an external, depending skirt or apron 33 outwardly spaced from and surrounding the upper portion of the sleeve so as to define an annulus or annular space 34 about said upper portion. The apron 33 is in vertical alinement with the annulus 30, while the annular space 34 is in vertical alinement with the upstanding neck 28 of the connection collar 23. With this structure, the control sleeve may reciprocate with a limited stroke within the bore 29, the upper limit of the stroke being established by the engagement of the upper end of the control sleeve with the lower end of the skirt 27, and the lower limit being defined by the abutting of the upper end 35 of the neck 28 with the upper end or bottom 36 of the annular space 34. To urge the control sleeve constantly upwardly, a suitable coiled spring 37 encompasses the neck 28 and is confined within the annulus 30 between the upper end of the connection collar 23 and the lower margin of the depending apron 33. Also, radial ports 38 are provided in said apron and in the skirt 27 to permit the relief of pressure fluid trapped therebehind.

The structure described up to this point is, in general, similar to that shown and described in my co-pending applications referred to hereinabove, and functions in substantially the same manner. This percussion tool is employed to deliver impact blows to the drill bit 13 through the anvil 14 and accomplishes this desirable result by rapid reciprocation of the hammer 17 within the housing 12 through the driving force and power of the drilling fluid flowing downwardly via the drill pipe to the percussion tool.

Beginning with the positions of the elements shown in Fig. 1, the rapidly moving column of drilling fluid flowing under the several hundred pounds pressure normally applied by the usual mud pumps (not shown) located at the surface of the well, will force the control sleeve downwardly to its lower limit of travel (Fig. 6), compressing the spring 37. The sleeve moves before the hammer because of its lesser mass and consequently smaller degree of inertia. However, when the sleeve can move no further, the full force of the drilling fluid if brought to bear upon the upper end of the piston 21 which is temporarily confined within the bore 32 of the sleeve, and the piston and hammer are driven rapidly downwardly (Fig. 6), compressing the spring 18 and delivering a sharp and heavy impact blow to the anvil 14 and drill bit 13. The splined connection of the carrier 11 to the housing 12 prevents the shock of this blow being transmitted to the housing 12 and through the latter to the drill pipe. However, this connection permits the bit to be rotated by the drill pipe at the same time as impact blows are being delivered thereto.

The strokes of the control sleeve and the hammer are so proportioned that the piston of the hammer is withdrawn from the sleeve (with the latter in its lower position) before the impact blow is delivered to the anvil. Thus, the pressure of the drilling fluid is relieved, and said fluid may flow downwardly around the hammer and through the fluid passages provided. At this point, the hammer is moving downwardly at great speed, and its momentum will carry it on to deliver a substantially undiminished impact blow. However, the relieving of the pressure upon the control sleeve eliminates the force holding it in its lower position and permits the spring 37 to return the sleeve to its upper position as shown in Fig. 1.

The hammer strikes the anvil 14 almost immediately following the disengagement of its piston with the control sleeve, and, the energy of the hammer being transmitted to the anvil, the spring 18 is free to return the hammer to its upper position. In returning to the upper position the piston of the hammer again engages within the bore of the control sleeve, and thus the cycle is repeated indefinitely. Under full flow of the drilling fluid, several hundred impact blows are delivered by the hammer each minute, and an effective and powerful percussion tool is provided.

The operation described is common to the present invention and to my co-pending applications which have been mentioned. However, this invention includes an additional feature in permitting the flow or draining of the drilling fluid when the percussion tool is not in operation. This is desirable in eliminating the necessity of pulling a "wet" string of pipe, or pipe full of drilling fluid, when the percussion tool is removed from the well bore for servicing or the replacement of the drill bit.

In order to achieve this desirable result, a flow passage around the control sleeve is provided in one of several ways, and means is incorporated in the tool for closing off the passage when necessary. In the form shown in Figs. 1–6, the upper end 35 of the neck 28 is rounded into a bead-like seating element, and the bottom 36 of the annular space 34 is curved to form an annular, concave seat. Also, the control sleeve is given a loose fit within the bore 29 to form an annular flow space 39 between the sleeve and the neck 28. With this structure, when the control sleeve is in other than its lower position, the drilling fluid may pass through the ports 38, or under the margin of the apron 33, across the annular space 34, and downwardly through the annular flow space 39. However, when the control sleeve is in its lower position and a pressure seal is desired, the upper end 35 of the neck 28 seats securely in the concave bottom 36 of the annular space 34, and such pressure seal is provided.

It has been found in the operation of this tool that there apparently occurs in the column of drilling fluid in the drill pipe a downwardly moving pressure wave or pressure front which strikes the upper end of the piston after the control sleeve has moved downwardly and just as the piston and hammer are commencing their downward movement. This pressure wave probably

originates as a reflection and amplification of a similar wave or front travelling upwardly from the piston as it enters the sleeve bore on its upward stroke and which results in slight compression of the drilling fluid (due to its occluded air content) and physical swelling of the drill pipe under the pressures applied. It is possible that the impedance of flow caused by the entry of the piston into the control sleeve area results in the "stacking up" of an increasing column of mud under increased pressure because of the following column of mud flowing under high velocity. Upon the ceasing of upward movement by the piston, there thus may be accumulated a considerable column of mud extending upwardly from the control sleeve and which is under greatly increased pressure. This body of fluid under high pressure acts as a stored pool of energy which continues to build up until the piston starts downwardly and which rapidly accelerates the piston to high speed after such downward movement has commenced.

In any event, the downwardly travelling pressure wave adds greatly to the impetus imparted to the hammer, and it is desirable to bring the pressures available as fully to bear on the piston as possible and with a minimum of loss due to leakage or blow-by. On a practical basis, the seal need not be absolute at any other point in the operating cycle, and some leakage may be desirable to provide a lubricant for the various moving parts. Of course, at the point where the utmost efficiency is desired in the utilization of the available pressures and pressure waves, the closing of the annular flow space **39** by the seating of the sleeve upon the upper end of the neck **28** provides an adequate seal and such efficiency. At other times, the flow space **39** is unobstructed, and upon the stopping of the flow of drilling fluid into the drill pipe, the column of drilling fluid within the drill pipe is free to drain from the pipe and will do so as the pipe is raised in the well bore.

It is, of course, apparent that many configurations and arrangements may be employed to effect the closing off of the flow space **39**. The upper ends of the control sleeve and the neck **28** may form the parts of a simple ring and seat valve, or such parts may be formed upon the side walls defining the flow space **39**. The essence of the invention resides in providing means for closing off or obstructing said flow space when the control sleeve is in its lower position and permitting flow when the sleeve is in its upper position.

The structure illustrated in Figs. 1–6 offers an additional advantage in that the annular space **34** may function as a dashpot to ease and lessen the shock occurring when the sleeve seats upon the upper end of the neck **28**. The clearances between the neck and the sleeve and the apron **33** may be slightly reduced if desired so as yet to remain adequate for drainage purposes, but to offer increased resistance to the flow of fluid therethrough as the control sleeve moves toward its lower position. This movement takes place at high speed, and a relatively large escape passage will still offer enough resistance and impede the flow of escaping fluid sufficiently to slow the movement of the control sleeve just before it seats upon the neck **28**. In this manner, the operating life of the sleeve and neck may be increased without materially affecting the operation of the tool as a whole or reducing the frequency of its impact blows. Of course, the dashpot structure is supplemental to the drainage feature and need not be employed at all.

A modified form of the invention is illustrated in Figs. 7 and 8. In this form, the same general structure is employed, but the upstanding neck **28** is replaced with a similar upstanding neck member **40** having a tapered, upwardly-divergent bore **41**. A control sleeve **42**, similar to the sleeve **31**, is received within the bore **41**, and is provided with a tapered, downwardly-convergent outer wall **43** complementary to the taper of the bore **41**. The other elements remain the same, the neck being provided with the annular, convex seating edge **35** upon its upper end, and the sleeve **42** carrying the annular, concave seat **36** at the bottom of its annular space **34**. In the upper position of the sleeve (Fig. 7), the drilling fluid may drain from the drill pipe, across the space **34**, and between the bore **41** and the wall **43**. However, when the sleeve moves downwardly (Fig. 8), the wall **43** moves into abutting relationship with the bore **41** because of the tapered structure of the two, and the flow space therebetween is cut off. At the same time, the engagement of the edge **35** and seat **36** preclude escaping of the pressure fluid and the full effect of the latter is brought to bear upon the piston of the impact hammer.

Another form of the invention is shown in Figs. 9 and 10. In this modification, the control sleeve **45** has a snug sliding fit with the bore **46** of the upstanding neck or guide **47**. Provision is made for the escape and drainage of the drilling fluid by a plurality of longitudinal drainage grooves or channels **48** cut in the wall of the bore **46** and extending the length thereof. The seating edge **35** at the upper end of the bore and the seat **36** carried by the sleeve **45** effectually prevent flow through the channels **48** when the control sleeve is in its lower position, but, when the sleeve is in its upper position, an adequate drainage flow space is had. If desired, similar grooves or channels **49** may be cut in the outer wall of the guide **47**, especially near the upper end thereof, to facilitate drainage flow from beneath the apron **33** of the control sleeve. It is also obvious that the drainage grooves may be cut in the outer wall of the control sleeve in place of, or in addition to, the grooves in the inner wall of the guide **47**.

In all the structures described and the alternative structures recited, the control sleeve in its lower position seats in some fashion upon a portion of the guide for said sleeve to shut off flow of the drilling fluid other than through the bore of the control sleeve. When the sleeve is in its upper position an escape passage is provided between the sleeve and its guide to permit drainage of the drilling fluid to take place. The same principles may be applied to percussion jars of various types and to percussion drills of types other than shown in the accompanying drawings. My co-pending applications illustrate and describe percussion tools having control pistons engaging collars on the hammer rather than control sleeves engaging pistons on the hammers, and it is to be noted that the present invention is equally applicable to those types of structures.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A well percussion tool that comprises a tubular housing including a high pressure chamber and a low pressure chamber, an opening into the high pressure chamber for the supply of high pressure fluid thereto, an opening from the low pressure chamber for the exhaust of fluid therefrom, means defining an axially directed opening between said chambers, two elements mounted for axial reciprocation within said housing, one of said elements having the form of a sleeve fitting slidably in the opening between the chambers, the other of said elements having the form of a piston fitting slidably in said sleeve, a hammer on one of said elements, the improvement that comprises an external skirt member depending in spared relation from said sleeve, a neck member fixed to said housing in a position to telescope with said skirt member, said skirt member having fluid ports therein to provide a fluid escape passage between the space between the skirt and sleeve and said housing, the neck member functioning to close off said fluid ports when said members are in telescoping relationship.

2. A well percussion tool as defined in claim 1, further characterized by a spring member mounted between the said means defining an axially directed opening and said skirt member and surrounding said neck member to return said sleeve to a position to reopen said fluid escape passages after said sleeve has reached the end of its stroke.

3. A well percussion tool that comprises a tubular housing including a high pressure chamber and a low pressure chamber, an opening into the high pressure chamber for the supply of high pressure fluid thereto, an opening from the low pressure chamber for the exhaust of fluid therefrom, means defining an axially directed opening between said chambers, two elements mounted for axial reciprocation within said housing, one of said elements having the form of a sleeve fitting slidably in the opening between the chambers, the other of said elements having the form of a piston fitting slidably in said sleeve, a hammer on

one of said elements, the improvement that comprises an external skirt member depending in spaced relation from said sleeve, a neck member fixed to said housing and extending along said sleeve to telescope with said skirt member, said skirt member providing a fluid port for fluid escape between the space between the skirt and sleeve and said housing, the adjacent walls of said neck member and said sleeve being tapered in the same direction for abutment when said members are in telescoping relationship.

4. In a well percussion tool wherein there is provided a housing having a high pressure chamber with an opening thereinto for supply of a high pressure fluid and a low pressure chamber with an opening therefrom for exhaust of fluid, means defining an axially directed opening between said chambers, two elements mounted for axial reciprocation within said housing, one of said elements having the form of a sleeve fitting slidably in the opening between the chambers, the other of said elements having the form of a piston fitting slidably in said sleeve, a hammer on one of said elements, the improvement which comprises a fluid passage between said chambers and means responsive to movement of said sleeve to close said passage when said sleeve moves towards said low pressure chamber.

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