

Filed Sept. 24, 1948

PERCUSSION TOOL

3 Sheets-Sheet 1



Feb. 12, 1952

R. BASSINGER
PERCUSSION TOOL

2,584,979

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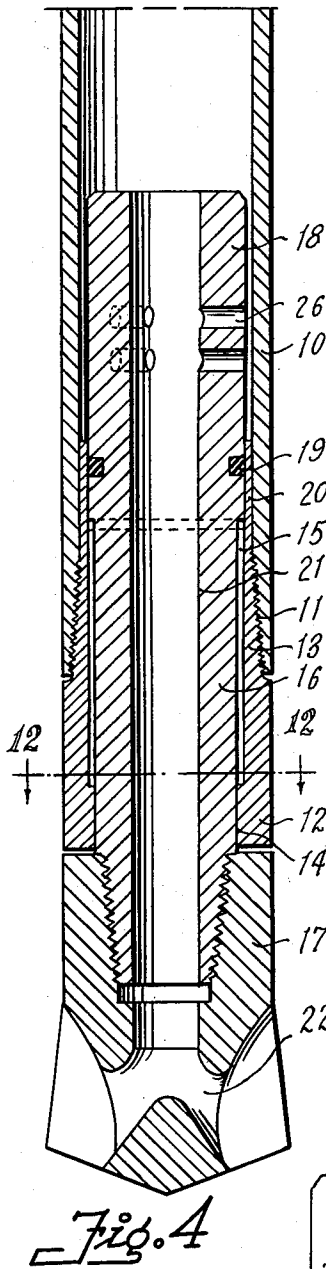


Fig. 5

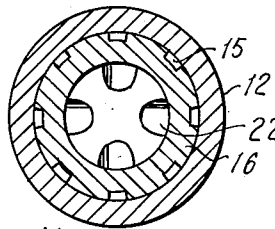
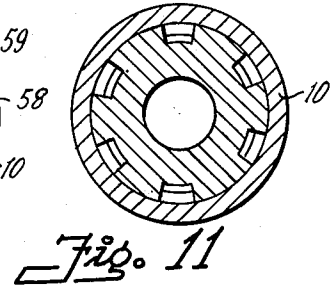
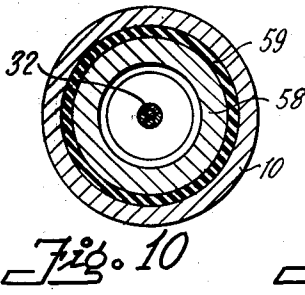
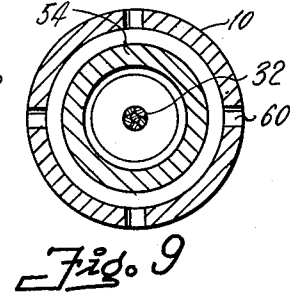
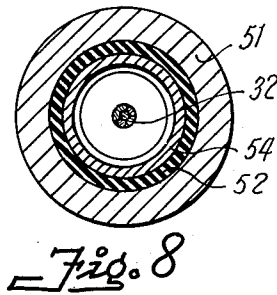
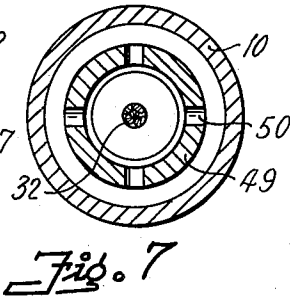
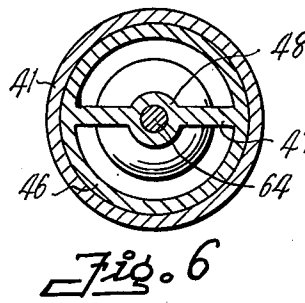
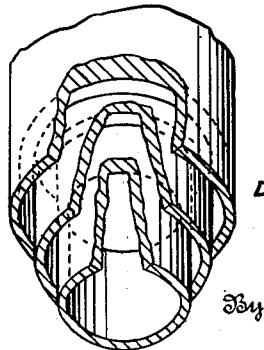


Fig. 12
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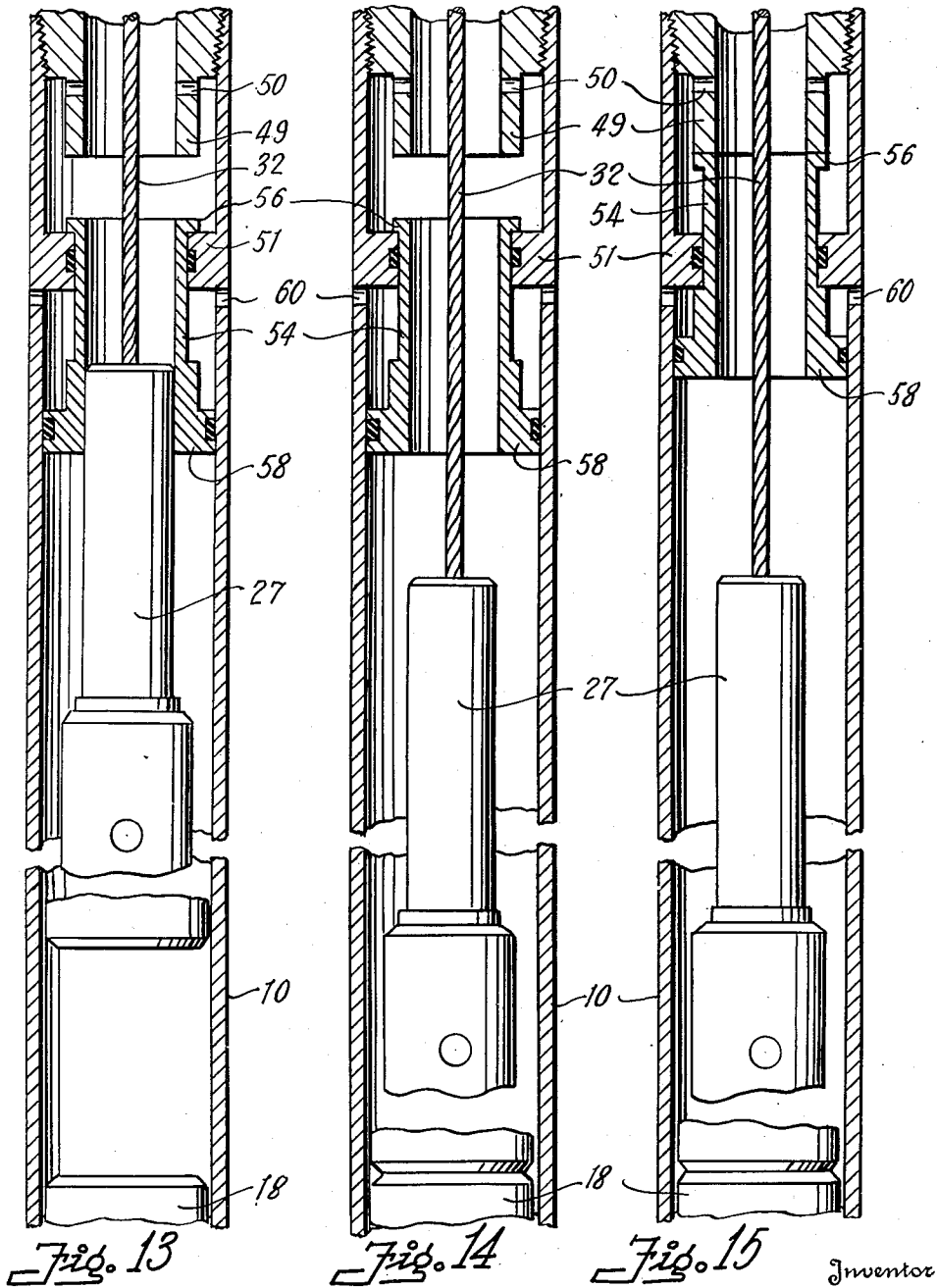
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UNITED STATES PATENT OFFICE

2,584,979

PERCUSSION TOOL

Ross Bassinger, Houston, Tex.

Application September 24, 1948, Serial No. 51,067

1 Claim. (Cl. 255-4.4)

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

The invention in some respects is a modification of the invention set forth in my co-pending application, Serial No. 686,497, filed July 26, 1946 now Patent No. 2,507,585, issued May 16, 1950, Serial No. 5,355, filed February 2, 1948, and Serial No. 20,470 filed April 12, 1948.

In the above identified applications, various structural features are set forth which constitute a new type of percussion drilling tool, the later application following the same general principle of operation, but including modifications and refinements of structure. The present invention again employs the same general method of operation as the first named application, and combines features from the remaining applications along with the addition of certain new structures not previously disclosed.

Each of the foregoing applications has been concerned with a structure in which at least one operating spring has been employed, and it is therefore one object of this invention to provide an improved percussion tool which is free of any spring elements.

A further object of the invention is to provide an improved percussion tool having a reciprocal hammer adapted to be moved in one direction by fluid under pressure, and in the opposite direction by the force exerted by an elongate, elastic element, which has an extensible rubber or rubber-like element.

Another object of the invention is to provide an improved percussion tool in which an element is provided, which, while placing a constant stress upon the hammer of said tool, is constantly in tension and thus free of columnar stresses and loading, and which includes a non-metallic, elastic member for applying such constant stress to the hammer.

A particular object of the invention is to provide an improved percussion tool in which the use of spring is eliminated and the fatigue and the crystallization characteristic of such springs when subjected to continuous operation or flexing, are thereby avoided.

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:

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upper portion of a percussion tool constructed in accordance with this invention,

Fig. 2 is a continuation of Fig. 1,

Fig. 3 is a continuation of Fig. 2,

Fig. 4 is a continuation of Fig. 3, showing the lower end of the tool,

Fig. 5 is a isometric view, partially broken away of the elastic element melting socket,

Figs. 6 through 12 are horizontal, cross sectional views taken upon the respective lines of Figs. 1 through 4,

Figs. 13 through 15 are longitudinal, sectional views of the percussion tool illustrating the operation thereof.

In the past, substantially all percussion tools have employed one or more springs to operate the various moving portions of such tools, it being a standard practice to employ a fluid under pressure for moving an element in one direction and a spring for moving or returning the element in the opposite direction. It has been found that such springs are subject to fatigue and crystallization, and that they possess a certain maximum degree of extension or an elastic limit beyond which they may not be extended without permanent damage. In the course of operation of such tools, the elastic limit of the springs is sometimes exceeded, and in addition, the rigorous and trying conditions under which the tools operate have resulted in a relatively short life for the spring being employed.

In the present invention, the applicant has overcome these difficulties through the employment of extendible, elastic element in the nature of a rubber rope, to replace the springs and thereby eliminate the undesirable features characteristic of such springs. The rubber rope functions in a highly efficient fashion to return the moving elements of the tool to their starting position and is not subject to fatigue and crystallization with the consequently foreshortened operating life.

A specific embodiment of the invention is illustrated in the drawings, wherein, the numeral 10 designates an elongate tubular housing having a screw-threaded box 11 upon its lower end. A collar 12 has its upstanding screw-threaded pin 13 received within the box 11 so as to depend from the lower end of the housing, and carry a plurality of inwardly directed splines 14 about its interior surface. The splines 14 engaged within matching longitudinal grooves 15 cut upon the periphery of a tubular bit-carrier 16. The bit carrier has a sliding fit within the collar 12, the lower end of the carrier being screw-threaded

Fig. 1 is a longitudinal, sectional view of the

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and projecting below the collar for receiving a suitable drill bit 17. The upper portion of the bit carrier projects upwardly within the housing 10 to provide an anvil 18 for receiving percussion blows and for transmitting said blows to bit 17. A suitable packing element 19 is recessed within the external surface of the bit carrier 16 and engages within a thin upstanding neck 20 provided upon the upper end of the collar 12 and extending above the pin 13 between the inner-wall of the housing pin and the outer surface of said bit-carrier. An axial flow passage 21 conducts fluid from the anvil 18 to the water courses 22 of the bit 17.

An elongate, heavy, tubular hammer 23 is reciprocally mounted within the housing 10 above the anvil 18 and carries a plurality of guide fins 24 at spaced points upon its exterior surface. The fins serve to center the hammer within the housing. The hammer carries an axial flow passage 25 in vertical alinement with the flow passage 21, and in addition, a plurality of ports 26 are provided at intervals in said hammer and in the anvil 18 to prevent the trapping of fluid between said elements and the wall of the housing 10.

An elongate reduced piston 27 projects axially from the upper end of the hammer, and is secured thereto by suitable locking pins 28. Radial ports 29 communicate between the bore 25 and the exterior of the hammer at the upper end thereof so that a continuous fluid passage is provided from the annulus surrounding the piston 27, through the lower portion of the tool, to the water courses of the bit 17. A hole 30 is drilled axially of the piston 27 and terminates in a suitable rope socket 31 at the lower end thereof. With this structure, the lower end of a steel cable 32 may be passed through the hole 30 and secured within the rope socket 31 in the usual manner. Thus, the entire hammer and piston structure is suspended within the housing 10 by or from the cable 32.

The housing 10 terminates a short distance above the upper end of the piston 27 in a screw-threaded box 33 which receives the depending, screw-threaded pin 34 of a coupling collar 35. An upstanding pin 36 is formed upon the upper end of the collar 25 and receives the lower end of an upper housing section 37 having substantially the same inside and outside dimensions as the housing 10. An inwardly-directed annular flange 38 is provided at the upper end of the upper housing section 37, and said section carries external screw-threads 39 at this point for engagement within a screw-threaded box 40 provided upon the lower end of a tubular connector 41. The inside and outside diameters of the connector 41 are substantially equal to such diameters of the housing section 37 whereby the inwardly-directed flange 38 forms an upwardly facing shoulder 42 within the lower portion of said connector. A screw-threaded pin 43 having an axial flow passage 44, is provided upon the upper end of the connector 41 to permit the assembly to be connected to the lower end of the usual tubing string (not shown).

A spider 45 is disposed within the connector 41, the spider including a circular ring 46 which rests upon the shoulder 42. A plurality of radial webs 47 extend inwardly from the ring 46 and support a central sleeve 48 from which the cable or wire rope 32 is suspended. A resilient supporting element is interposed in the connection between the spider 45 and the wire rope immediately below

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said spider as will be described more fully hereinafter, but it is to be noted that the structure described to this point is substantially that set forth in my co-pending application, Serial No. 5,855, filed February 2, 1948.

The coupling collar 35 is provided upon its lower end below the pin 34, with a reduced-diameter depending, annular skirt 49 having a plurality of radial ports 50. The outside diameter of the skirt 49 is somewhat less than the inside diameter of the housing 10, and the skirt projects into the upper end of the said housing a short distance above the upper end of the piston 27. Between the skirt and the piston is positioned a control sleeve structure as set forth in my co-pending application, Serial No. 20,470, filed April 21, 1948. The housing is provided with an internal annular flange 51 at a point spaced below the lower end of the skirt 49. The flange 51 is of considerable thickness whereby a set of suitable pressure-responsive, packing rings 52 may be recessed within the inner periphery of said flange. The inner periphery of the flange defines a bore 53 extending longitudinally within the housing 10, and the control sleeve 54 has a snug sliding fit within said bore. The control sleeve has an axial passage 55 through which drilling fluid flows, and carries an external annular lip 56 at its upper extremities. The lip 56 serves to engage the upper surface of the flange 51 and thereby limits the downward travel of the control sleeve within the bore 53. Upward movement of the sleeve is limited by the engagement of its upper end with the lower edge of the skirt 49, and also by the engagement with the underside of the flange 51 of an annular shoulder 57 formed externally upon the lower portion of said control sleeve. An external, annular flange 58 is provided at the extreme lower end of the control sleeve, said flange being of such diameter as to have a snug sliding fit within the bore of the housing 10. Similarly to the flange 51, the flange 58 is of such thickness as to permit the recessing in its outer periphery of a set of annular, pressure-responsive, packing rings 59 which seal off the space between the control sleeve and the inner wall of the housing 10. At the same time, the packing rings 52 seal off the space between the flange 51 and the central portion of the control sleeve.

A plurality of radial ports 60 are cut in the wall of the housing 10 immediately below the flange 51 so as to prevent the occurrence of a fluid lock between the underside of the said flange and the upper side of the flange 58. With this structure, the control sleeve is free to undergo longitudinal reciprocation within the housing 10, but at the same time, communication between these portions of the housing above and below the flange 51 is limited to the bore 55 of said sleeve. The piston 27 is of such diameter as to have a snug sliding fit within the bore 55 of the control sleeve, as illustrated in Fig. 2, and in the operation of said tool, said piston alternately engages within and retracts from the control sleeve bore as the hammer and the control sleeve reciprocate within the housing. The control sleeve structure described functions in the same manner as that described in my copending application referred to hereinbefore, and such operation will be brought out more fully hereinafter along with the operation of the complete tool.

The cable or wire rope 32 passes upwardly through the bore 55 and has its upper end received within a suitable rope socket 61 carried upon the lower end of a resilient element connec-

tor 62. A somewhat similar connector 63 is positioned within the upper housing section 37 a short distance above the connector 62, and carries an upwardly projecting shank 64 which extends through the sleeve 48 of the spider 45. The upper end of the shank 64 is screw-threaded, and a nut 65 is placed thereon to prevent downward movement of the shank and the connector 63 with respect to the spider 45. Thus, the spider serves as an anchor for said connector 63.

An elongate elastic or resilient element 66 extends between the connectors 62 and 63 and has its lower and upper ends suitably bonded or secured thereto. The element 66 thus forms the final link or connecting element between the spider 45 and the hammer 23 whereby the weight of said hammer as it hangs from the cable 32 is borne directly by the element 66, and the latter forms the only yieldable or resilient means between said hammer and the rigid support constituted by the spider 45.

The particular structure of the resilient element 66 is illustrated in detail in Figs. 1 and 5. The resilient portion of the element is in the form of an elongate cylindrical body 67 which may be formed of rubber, synthetic rubber, or any other suitable plastic and non-metallic material having the property of elasticity as exhibited in well-known fashion by rubber and similar materials. For securing the element 67 to the connector 62, said connector is formed with a plurality of annular, concentric upstanding ribs or flanges 68 having their axes alined with the axes of the element 67 and the connector 62. The material of the connector is cut away between the ribs of 68 to provide relatively large lateral surfaces upon said ribs, and in addition, a cylindrical opening 69 is drilled within the centermost rib to a considerable depth within said connector. This structure provides a quite large area of lateral surface extending parallel to the longitudinal axis of the element 67, and this feature is important in that it provides a large surface for bonding the element 67 to the connector 62. The ribs 68 may be arranged in an upwardly stepped relationship, progressing from the center to the outer edge of the connector, as illustrated by the connector 62 in Fig. 1, or the reverse arrangement may be employed as illustrated in the connector 63. In the latter structure, the concentric rings or ribs 70 are progressively downwardly stepped so that the bonding portion of the connector 63 has an overall convex outline. In contra-distinction, the bonding portion of the connector 62 has a generally concave outline but both modifications provide substantially the same amount of bonding area for securing the element 67 to said connectors. Either structure may be employed and are illustrated and described solely for the purpose of setting forth one of the permissible variations or modifications of structure.

The ends of the elastic element 67 are formed in a complementary fashion to the bonding portions of the connectors 62 and 63, and are securely fastened thereto by bonding and vulcanizing in the well-known fashion. Because of the large lateral surface or area provided by the connectors, such bonding results in a secure and strong joint between the elastic element and the two metallic connectors 62 and 63 and the equivalent of a unitary structure is had. With this structure, extreme longitudinal stresses may be placed upon the elastic element 67 without separation of said element from the connectors, and the element 67 completely replaces, in this man-

ner, the coil springs employed in my previous enclosures.

In the operation of this tool, the pressure and momentum of the column of drilling fluid or mud within the tubing string is employed to reciprocate the hammer 23 and deliver impact blows of considerable magnitude to the bit 17 with great rapidity, thereby increasing the drilling capacity or rate of the bit to a marked extent. The tool may also be employed as a jar, and the modifications illustrated and described in my copending applications employed in such use. It is not intended here to limit the use of the percussion tool to drilling alone since the tool has many uses and applications and since this disclosure is concerned solely with an improvement or modification in a certain portion of the tool, namely the resilient element employed for returning the hammer to its upper position. However, the operation of the tool will be described with reference to its use for drilling as a convenient method for clarifying such operation.

When the tool has been lowered into position within the well bore and before the flow of drilling fluid has commenced, the hammer will be in its upper position as illustrated in Figs. 2 and 3, while the control sleeve 54 may be at any point of its stroke since fluid pressure is relied upon for movement of the same. However, it is to be noted that even when the control sleeve is in its upper position as shown in Fig. 2, the piston 27 will be engaged in the lower portion of the bore 55 when the hammer is in its upper position. For the sake of convenience, it will be assumed that the control piston is in its uppermost position when the flow of drilling fluid is started.

In the aforementioned position, the first action achieved by the drilling fluid when its flow is started, is to drive the control sleeve downwardly over the piston 27 of the hammer. This occurs because the upper end of the control sleeve is exposed to the pressure of the drilling fluid while the lower end thereof is shielded from such pressure by the packing 52 and the engagement of the piston within the bore 55. Following downward movement of the control sleeve, the pressure of the drilling fluid is brought to bear upon the piston 27, and therefore the hammer 23, and moves the same downwardly when the control sleeve reaches the lower end of its stroke, as illustrated in Fig. 13. Upon engagement of the lip 56 with the upper surface with the flange 51, further downward movement of the control sleeve is prevented and the hammer and piston continue to move downwardly under the force and impetus of the column of drilling fluid flowing downwardly through the bore of the drilling string.

It will be noted that to this point, the underside of the flange 58 has been shut off from exposure to the pressure of the drilling fluid by the engagement of the piston within the bore 55 of the control sleeve. The annular space below the flange 58 and between the hammer and the inner wall of the housing is under nothing more than the static pressure of the column of drilling fluid present in the wall bore. This pressure is also exerted upon the upper end of the control sleeve, but, in addition, the pressure of the mud pumps (not shown) which are driving the drilling fluid downwardly through the bore of the drilling string, is also applied to the upper end of the control sleeve. Thus, although the upper end of said sleeve is smaller in diameter than

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the lower end, the predominance of pressure upon the upper end forces the same to move downwardly in a rapid fashion. However, as soon as the hammer has moved downwardly a distance sufficient to withdraw the piston from the bore 55, the pressure being exerted by the drilling fluid immediately comes to bear upon the underside of flange 58. Now, the predominant force created by the pressure of the drilling fluid tends to move the control sleeve upwardly. This is true because the pressure is acting downwardly on the sleeve only over an area equal to the cross-sectional area of the upper portion of the sleeve which is the cross-sectional area of the sleeve below the lip 56 less the cross-sectional area of the bore. On the other hand, the entire area of the flange 58 is exposed to this pressure, and since the latter area considerably exceeds the former area, the pressure of the drilling fluid immediately forces the control sleeve upwardly into its uppermost position, and the elements assume the position illustrated in Fig. 15.

The tool is so proportioned and the various elements so regulated that the separation of the piston and the control sleeve takes place immediately before the hammer strikes the upper end of the anvil 18. Thus, when the hammer strikes said anvil, it is still moving under considerable momentum and velocity imparted thereto by the pressure of the column of drilling fluid, and very little of its energy has been lost in the very short interval occurring between the cessation of application of pressure thereto and the moment of impact. Of course, in moving downwardly under the pressure of the drilling fluid, the hammer, by means of the wire rope 32, stretches or extends the elastic element 67. Therefore, when the hammer strikes the anvil and its energy is transferred thereto, the elastic 67 functions to return the hammer to its upper position wherein the piston 27 again moves into the bore 55 and causes the cycle to repeat. This entire operation requires only a fraction of a second for completion, and as many as 250 to 400 blows per minute may be obtained with this tool. Once the operation is started by the admittance of the fluid under pressure, the hammer assumes a vibratory action delivering impact blows of considerable magnitude to the upper end of the anvil 18 and thereby to the bit 17 while returning to its upper position between each blow. As before pointed out, immediately upon withdrawal of the piston from the bore 55, as illustrated in Fig. 14, the control sleeve is moved to its upper position as illustrated in Fig. 15. As the piston approaches the lower end of the control sleeve during the upward travel of the former the flow of drilling between the piston and the sleeve is gradually restricted so that a point is reached at which the pressure upon the flange 58 is insufficient to retain the sleeve at its upper position and the pressure upon the upper end of said sleeve becomes predominant. Thus, the sleeve may begin to move downwardly even before the piston has entered the bore 55. As soon as the piston does so engage within the bore, the upward movement of the hammer is not immediately checked and it may continue its upward travel in opposition to the tremendous ram action of the moving column of fluid present within the bore of the drilling string. This action is possible due to the small established compressibility of drilling fluid (because of occluded air) and the elastic expansibility of the tubing string. The piston, in moving upwardly, compresses the drilling

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fluid to some extent and also expands the tubing radially. These represent stored energies which are returned to the hammer as it begins its downward travel.

It is pointed out that the flow of drilling fluid through the drilling bit is never shut off or interrupted for a period of time long enough to result in physical damage. The control sleeve begins to move downwardly even before the piston engages therewithin, and thus, the sleeve is displacing fluid therebelow at the time the piston engages within the bore, and it is obvious that downward movement of the hammer will commence as soon as such engagement is completed. In this manner, although the piston shuts off communication momentarily through the bore 55, the downward movement of the various elements continues to displace fluid downwardly through the water courses of the bit 17, and flow therethrough is not seriously interrupted. Due to the relatively high frequency of impact blows delivered, there is only a slight plusation of the drilling fluid being discharged through the bit. The fluid thus continues to flow downwardly around the outside of the hammer and into the bore of the anvil, and thence downwardly through the drilling bit to flush cuttings upwardly in the well bore around the exterior of the tool.

The invention thus provides an improved percussion tool having a control sleeve which is entirely springless, and depends solely upon the pressure of the actuating fluid for its necessary reciprocation. At the same time, the spring formerly and usually employed to return the hammer to its upper position after it has struck an impact blow, is replaced by the elongate elastic element 67 which is non-metallic and is not subject to crystallization or fatigue. It is obvious that rubber may be used under certain circumstances, but that one of the several synthetic rubbers will be more preferable in the drilling of oil wells where hydrocarbons may readily be encountered. The increased swell resistance of certain of the synthetic rubbers makes their use preferable to the natural rubbers. In addition, other suitable or desirable materials may be employed which possess the necessary elastic qualities. The dead weight of the hammer 23 maintains the element 67 partially stretched or expanded at all times so that the failure of the synthetic rubbers and other materials to possess complete elasticity is not of serious consequence. When the hammer strikes the anvil 18, the energy stored in the element 67 during its stretching will immediately return the hammer to its upper position, and a frequency of operation may be achieved with this structure every bit as high as that achieved in structures employing metallic springs. Thus, there is no loss in operation efficiency, but the undesirable results inherent in the use of steel springs is avoided.

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

A well percussion tool that comprises a tubular housing, an inlet for the supply of mud fluid to said housing, a mud outlet from said housing, two elements in said housing mounted for axial reciprocation relative thereto, one of said elements having the form of a sleeve fitting slidably in an opening formed by an internal flange in said housing, said sleeve having upper and lower abutment means cooperating with said flange to limit the movement thereof in either

direction, the other of said elements having the form of a piston fitting slidably in said sleeve, said two elements forming a valve to control the flow of mud through said housing from said inlet to said outlet, a hammer attached to said piston for delivering impact blows to an anvil, an elastic means for urging said piston upwardly into closing engagement with said sleeve, said elastic urging means including an anchoring member mounted in the upper end of said housing, an upper connecting member suspended from said anchoring member, a solid non-metallic elastic element secured to said upper connecting means and having secured thereto at its lower end a lower connecting member, a cable connecting said piston with said lower connecting member, said elastic means acting in tension to return said piston to its initial position in engagement with said sleeve after said hammer delivers an impact blow to said anvil.

ROSS BASSINGER.

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