

No. 622,165.

Patented Mar. 28, 1899.

T. H. PHILLIPS.

IMPACT TOOL.

(Application filed Oct. 25, 1898.)

(No Model.)

4 Sheets—Sheet 1.

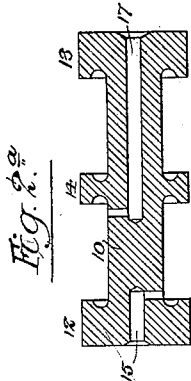


Fig. 1.

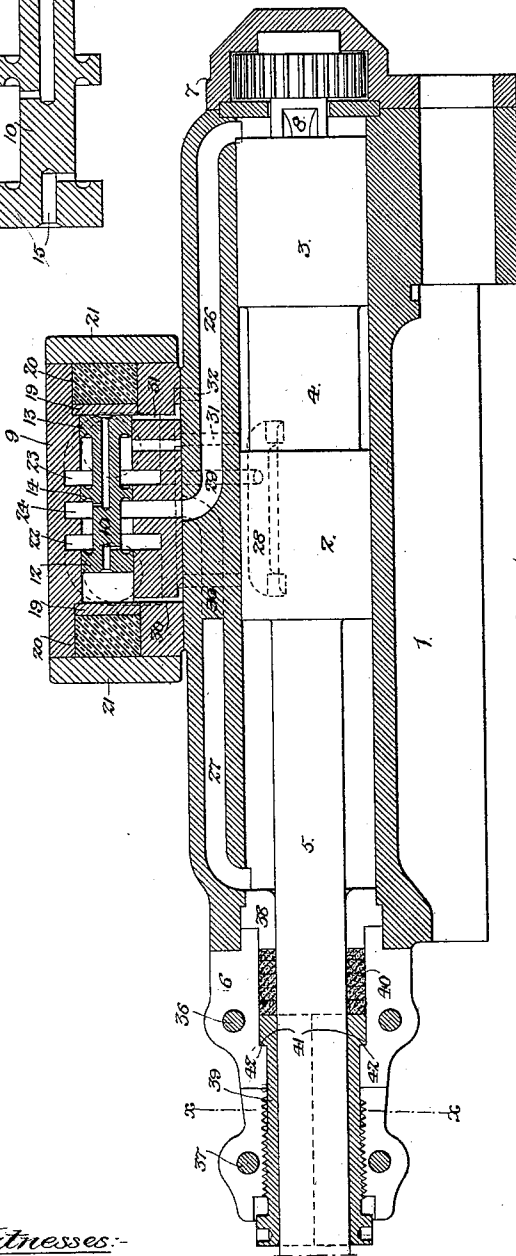
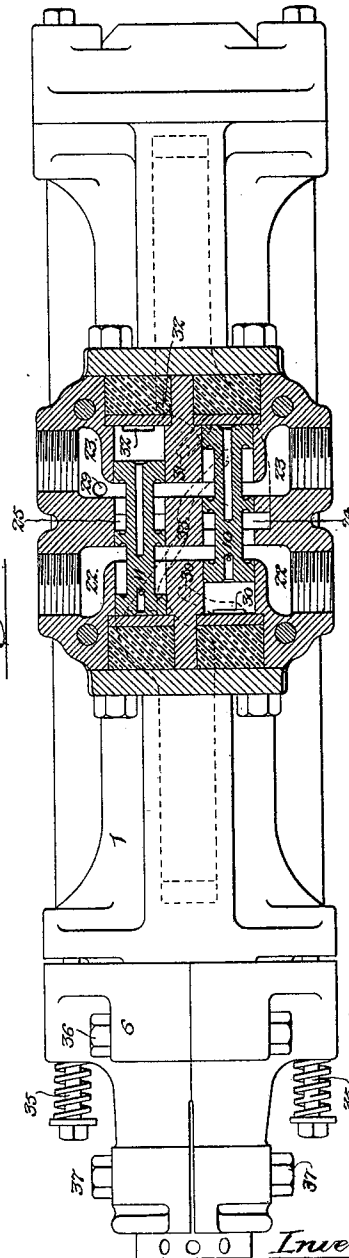


Fig. 2.



Witnesses:

Frank L. A. Graham
James C. Mayer

Inventor
Thomas H. Phillips
by his Attorneys
Howson & Howson

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Fig. 3.

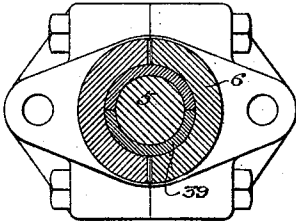


Fig. 4.

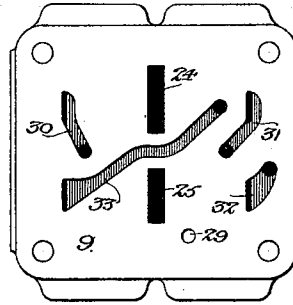


Fig. 5.

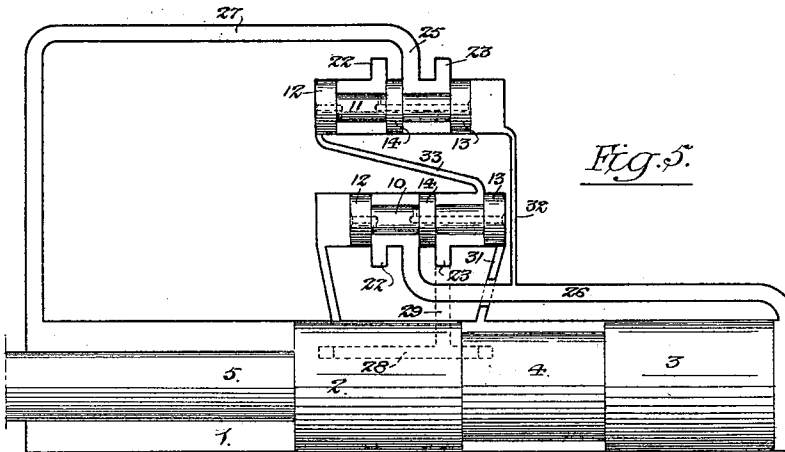
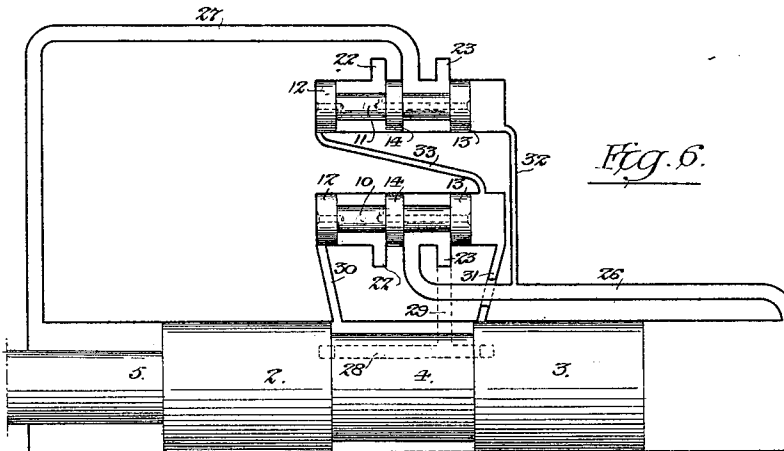


Fig. 6.



Witnesses:

Frank L. A. Graham
James C. Krayer

Inventor:

Thomas H. Phillips
by his Attorneys
H. W. Brown & H. W. Brown

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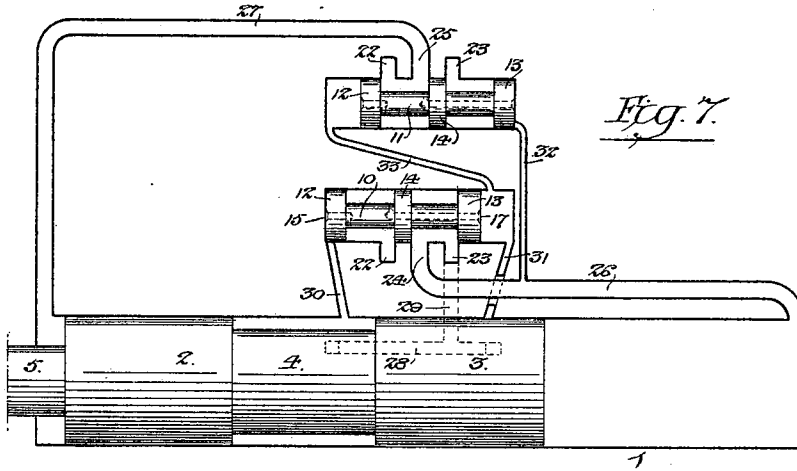


Fig. 7.

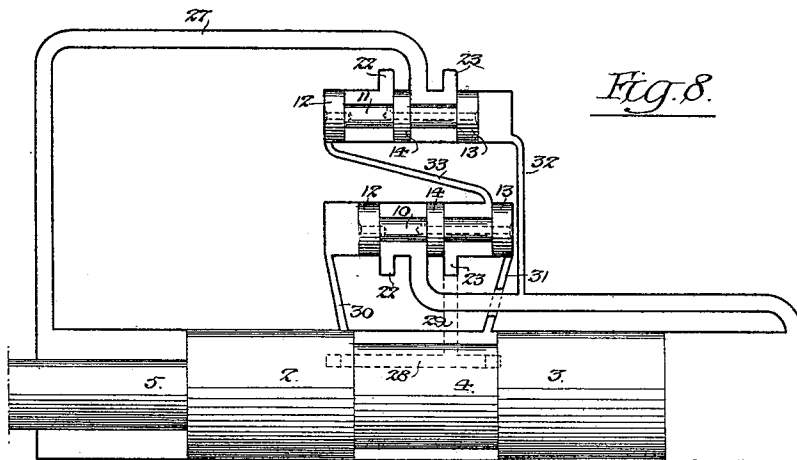


Fig. 8.

Witnesses:—

Frank L. A. Graham
James C. Kraybill

Inventor:—

Thomas H. Phillips
by his Attorneys

Howson & Howson

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Fig. 9.

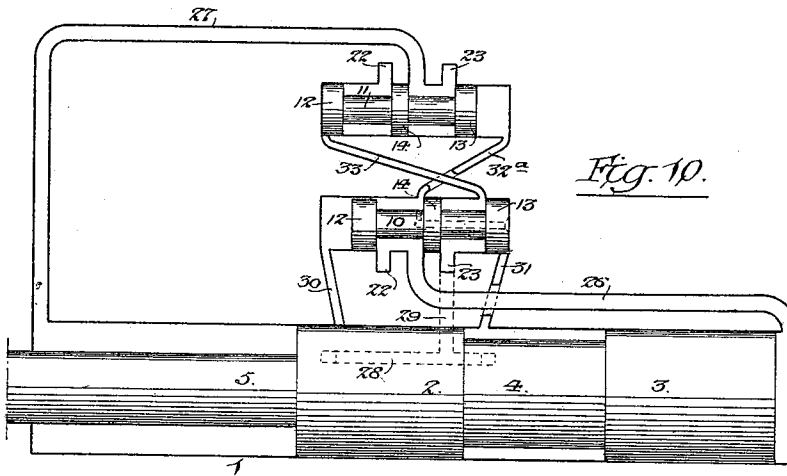
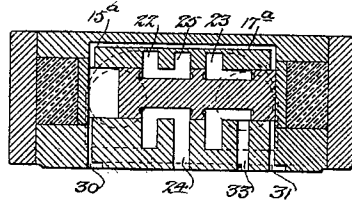


Fig. 10.

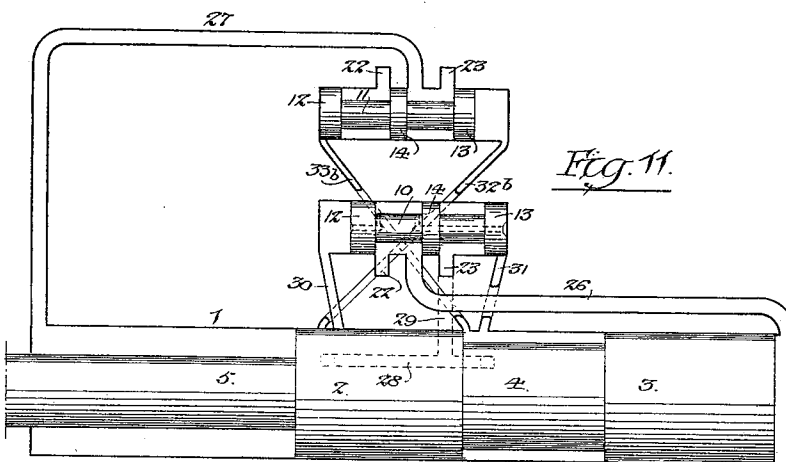


Fig. 11.

Witnesses:

Frederick L. A. Graham
James C. Gray

Inventor:

Thomas H. Phillips.
by his Attorneys
Howson & Howson

UNITED STATES PATENT OFFICE.

THOMAS H. PHILLIPS, OF ST. DAVIDS, PENNSYLVANIA.

IMPACT-TOOL.

SPECIFICATION forming part of Letters Patent No. 622,165, dated March 28, 1899.

Application filed October 25, 1898. Serial No. 694,531. (No model.)

To all whom it may concern:

Be it known that I, THOMAS H. PHILLIPS, a citizen of the United States, residing in St. Davids, Delaware county, Pennsylvania, have invented certain Improvements in Impact-Tools, of which the following is a specification.

My invention relates to impact-tools, such as rock-drills, my improvement being directed mainly to the valves and valve-controlled passages of the tool and to the rod-packing devices carried by the cylinder front head.

The objects of my improvements in the valve mechanism are to avoid excessive wear and friction in the steam-chest, to provide for a variable stroke of the piston, to overcome the inertia of a heavy single valve, and thereby insure a quicker and more sensitive action of the valve mechanism, to employ interchangeable valves, to cushion the rear stroke of the piston, so as to prevent it from coming into injurious contact with the back head, to prevent cushioning of the forward stroke, so as to insure an uncushioned blow, and to regulate the speed and time of travel of the valve governing the flow of motive fluid to and from the forward end of the cylinder without affecting the flow of motive fluid to and from the rear end of said cylinder.

The objects of the improvements in the rod-packing devices are to reduce the wear on the packing, to avoid the trouble and delay caused by the jarring loose of the nuts, such as are sometimes used to hold the gland in place, to prevent the gland from falling out of position, and to provide for drawing the gland up evenly, so as to uniformly compress the packing when desired.

In the accompanying drawings, Figure 1 represents a longitudinal sectional view of an impact-tool constructed in accordance with my invention. Fig. 2 is a plan view of the same with the valve-chest and valves in section. Fig. 2^a is an enlarged sectional view of one of the valves. Fig. 3 is a transverse section on the line *xx*, Fig. 1. Fig. 4 is a view of the under side of the valve-chest structure, showing the passages formed therein. Figs. 5, 6, 7, and 8 are diagrams illustrating successive positions of the piston and the position of the valves corresponding therewith,

and Figs. 9, 10, and 11 are diagrams illustrating modifications of part of the invention.

1 represents the cylinder of the tool, which contains an elongated piston comprising a forward head 2, a rear head 3, and an intervening grooved or chambered portion 4, the piston-rod 5 passing through a stuffing-box carried by the cylinder front head 6, to which reference will be made hereinafter.

The rear head 7 of the cylinder has the usual ratchet mechanism connected with a spirally-grooved bar 8, which engages with a nut or projection inside of the piston, so that the latter will be partially turned on its axis on each backward stroke. This mechanism forms no part of my present invention and may be similar to any of the forms ordinarily employed.

The valve-chest 9 is securely bolted to the top or side of the cylinder 1 and contains two valve-chambers disposed side by side, one of these chambers containing a valve 10 and the other a precisely similar valve 11. Each of the valves 10 and 11 is a spool-like structure consisting of a stem with projecting flanges or heads 12 and 13 at the opposite ends and a central flange 14 between the ends, the annular space between the heads 12 and 14 of each valve communicating with the forward end of the chamber in which said valve works through a passage 15 of contracted diameter in the valve-stem and said space also communicating with the rear end of the chamber in which the valve works through a like contracted passage 17 in the valve-stem.

Each end of each valve-chamber is enlarged in diameter for the reception of a washer 19, which closes the end of that portion of the valve-chamber in which the valve reciprocates, rubber or other elastic material 20 being interposed between this washer and the end cap 21 of the valve-chest, so as to provide an elastic backing for the washer.

The annular space between the heads 12 and 14 of each valve is in constant communication with a steam-inlet passage 22, which has a threaded opening at each side of the valve-chest, so that a steam-supply pipe can be connected to said chest at either side, and in like manner the annular space between the heads 13 and 14 of each valve is in constant communication with an exhaust-pas-

sage 23, which likewise has a threaded opening at each side of the valve-chest for the reception of an exhaust-pipe. The openings not in use are suitably plugged.

5 Between the inlet and exhaust passages of the valve-chest are located two passages 24 and 25, the passage 24 communicating with the chamber containing the valve 10 and the passage 25 communicating with the chamber
10 which contains the valve 11, and said passage 24 is in communication through a passage 26 with the rear end of the cylinder 1, while the passage 25 is in communication through a passage 27 with the front end of
15 said cylinder. In the cylinder is also formed a U-shaped passage 28, the ends of which communicate with the interior of the cylinder, and this passage is in constant communication with the exhaust-passage of the valve-
20 chest through a passage 29. The forward end of the chest containing the valve 10 is in communication with the interior of the cylinder through a passage 30, formed partly in the cylinder and partly in the valve-chest, and
25 the rear end of said valve-chest is also in communication with the interior of the cylinder through a passage 31. The rear end of the chamber containing the valve 11 is in communication with the passage 26 of the
30 cylinder through a passage 32, formed partly in the cylinder and partly in the under side of the valve-chest, and the forward end of said valve-chamber is in communication through a passage 33 on the under side of the
35 valve-chest with the chamber containing the valve 10, this communication being at a point in said chamber between the rear end of the same and the exhaust-passage 23.

The operation of the tool is as follows, the
40 motive fluid for convenience being considered to be steam: Supposing, in the first place, the parts to be in the position shown in Fig. 5—that is to say, the piston at the rear end of its stroke, the valve 10 at the rear end of its
45 stroke, and the valve 11 at the forward end of its stroke—steam is entering the rear end of the cylinder from the steam-inlet passage 22 through the forward space of the valve 10 and through the passages 24 and 26, and
50 steam is escaping from the forward end of the cylinder through the passages 27 and 25, the rear space of the valve 11, and the exhaust-passage 23. Steam can always enter each end of each valve-chamber from the
55 steam-passage 22 through the passages 15 and 17 in the valve-stem, and the movement of each valve in its chamber is caused by cutting off the escape of steam from one end of said valve-chamber and at the same time
60 permitting the escape of steam from the opposite end of said valve-chamber. The valves are retained in the position shown in Fig. 5, owing to the fact that there is full steam-pressure exerted on the front end of the valve 10,
65 because the passage 30 is closed by the forward head 2 of the piston, while the rear end of the chamber containing said valve 10 is

open to the exhaust through the passage 31, the central groove of the piston, and the passages 28 and 29, and the rear end of the chamber containing the valve 11 is open to the
70 full, pressure steam in the passage 26, as well as to that which enters through the passage 17 in the valve-stem, while the front end of said chamber is open to the exhaust through
75 the passage 33 and the rear space of the valve 10. This condition of affairs continues until the piston moves forwardly in the cylinder to the position shown in Fig. 6—that is to say, until its rear head 3 closes the passage 31 and
80 the front head 2 uncovers the passage 30. There being now a free escape of steam from the chamber in front of the valve 10 and the escape of steam from the rear end of said chamber being cut off, the valve 10 by the
85 accumulation of steam at its rear end is moved forwardly to the position shown in Fig. 6, so as to cut off the supply of steam to the rear end of the cylinder and open said rear end
90 of the cylinder to the exhaust, and at the same time the rear head of the valve 10 cuts off the exhaust of steam from the front end of the chamber containing the valve 11 by reason of the fact that said rear head of the
95 valve 10 is interposed between the opening of the passage 33 and the exhaust-passage 23. As the steam exhausts from the rear end of the cylinder the pressure in the passage 26 and in the rear end of the chamber containing the valve 11 is reduced and is finally
100 overcome by the pressure in the front end of said chamber, whereupon the valve 11 is moved rearwardly, as shown in Fig. 7, so as to open communication between the front end of the cylinder and the steam-inlet passage
105 22 through the front space of the valve 11 and the passages 25 and 27. Owing to the delay in the movement of the valve 11, however, the admission of steam to the forward end of the cylinder does not take place until
110 an appreciable time has elapsed after the opening of the rear end of the cylinder to the exhaust by the movement of the valve 10. Hence the piston has moved forwardly in the cylinder to the full extent neces-
115 sary to cause the tool to deliver its blow before steam enters the forward end of the cylinder. An uncushioned blow is the result and time has been allowed for the exhaust from the rear end of the cylinder and back
120 pressure is thus avoided on the retraction of the piston. As the piston moves rearwardly and the valves retain the position shown in Fig. 7 until said piston reaches the position shown in Fig. 8—that is to say, until the front
125 head 2 closes the passage 30 and the rear head 3 opens the passage 31. Escape of steam from the rear end of the chamber containing the valve 10 being thus permitted and escape of steam from the front end of said chamber be-
130 ing cut off, the valve 10 moves rearwardly again, admitting steam to the rear end of the cylinder and opening to the exhaust the front end of the chamber containing the valve 11,

so that the pressure of live steam against the rear end of said valve will immediately effect the forward movement of the same, thus opening the forward end of the cylinder to the exhaust, this admission of steam to the rear end of the cylinder and exhaust from the front end being effected at such a point in the rearward travel of the piston that ample cushioning of the rear stroke is provided for and injurious contact of the piston with the rear head of the cylinder is prevented. By thus using two valves, one controlling the flow of steam to and from the rear end of the cylinder and the other controlling the flow of steam to and from the front end of the cylinder and by making the movement of the latter valve dependent upon the previous movement of the former I positively insure the attainment of the uncushioned forward stroke and cushioned back stroke of the piston, the use of the two valves also enabling me to make each valve so light that it has less inertia, and thus is more sensitive than a single heavier valve. Each valve, moreover, being free to turn and perfectly balanced, excessive wear and friction are avoided, and both valves being precisely alike the substitution of one for the other by an ignorant or careless attendant cannot affect the working of the tool. Variable stroke of the piston is also provided for, since it will be apparent that the tool will be operative so long as the forward stroke permitted is sufficient to cause the forward head of the piston to uncover the passage 30 and the rear head to cover the passage 31, the back stroke in this case being correspondingly limited owing to the restricted volume of steam which is permitted to enter the forward end of the cylinder. Hence the piston will simply reciprocate with a short stroke in mid-position, a longer stroke being provided for by moving the cylinder rearwardly on its supporting structure.

Secured to the front end of the cylinder is a split and separable front head or casing 6, held together by transverse bolts 36 37 and having at the inner end a split and separable plug 38, which fits into the forward end of the bore of the cylinder, the forward end of the said casing being internally threaded for the reception of an external thread upon a gland or follower 39, which is likewise by preference split and separable, so that it can be readily applied to the piston-rod 5. A mass of packing 40 is interposed between the inner end of this gland 39 and the plug 38. Hence by screwing up the gland this mass of packing can be compressed to the desired extent, the pressure being exerted evenly throughout the mass instead of unevenly, as is sometimes the case when the gland or follower has projecting ears acted upon by independent tightening devices, one of which can be screwed tighter than the other. The forward end of the split casing 6 is slotted, as shown in Figs. 2 and 3, so that this portion can by the action of the bolts 37 be caused

to bind tightly upon the gland or follower 39, and thus lock the same in position after adjustment. In case, however, there should be any loosening or backing off of this gland the complete release of the same from the casing 6 is prevented by the engagement of an external shoulder 41 upon the gland with an internal shoulder 42 in the casing, so that under no circumstances can the gland drop from the casing and fall into the hole which is being drilled, an accident which sometimes happens when the ordinary gland with studs and nuts is employed and which is likely to cause such jamming of the drilling-tools in the hole as to make their withdrawal difficult and sometimes necessitate their abandonment.

It will be observed that the packing is disposed close to the joint between the cylinder and the front head—in other words, as close as possible to the piston, where there is the least vibration of the piston-rod, and consequently the least wear upon the packing. Hence the latter will remain in good condition for a longer time than packing disposed more or less in advance in the front head, where the vibration of the piston-rod is more appreciable.

When it is desired to repack the stuffing-box, this can be readily effected by removing the nuts from one or other of the ends of the longitudinal bolts 35, whereby the opposite heads are secured to the cylinder, and then sliding the head 6 forward on the rod 5 until the plug 38 can be freed from engagement both with the cylinder and head, the parts of the plug being then separated, so as to permit access to the interior of the stuffing-box. After the latter has been repacked the parts of the plug can be reapplied to the rod and the head 6 again secured in position.

The casing 6, plug 38, and gland 39 are made in split and separable halves, because it is preferable in this class of tools to forge from one piece of metal the piston, the piston-rod, and the chuck in which the shank of the drill-steel is clamped, the chuck, as well as the piston, being of greater diameter than the rod, so that the latter cannot be passed longitudinally through the plug or gland. When the rod is keyed or otherwise detachably secured to the piston or chuck, however, the split construction of the parts through which the rod passes need not necessarily be adopted.

The use of the passages 15 and 17 in the valves for maintaining constant communication of each end of each valve-chamber with the live-steam passage is not essential to the proper carrying out of my invention, as it is manifest that the same end can be attained by the use of passages in the valve-chest—as, for instance, the passages 15^a and 17^a. (Shown in Fig. 9.) In fact, the maintenance of constant live steam communicating with each end of the chamber containing the valve 11 is not necessary, as steam may, if desired,

be conducted to and from the opposite ends of said chamber solely through the medium of the passages 32 and 33 under control of the valve 10, and the entrance of live steam to the forward end of the chamber containing the valve 10 may be effected by permitting a slight clearance between the forward head of said valve and the chest instead of by a passage through the valve. These modifications are illustrated in Fig. 10. The construction shown in Figs. 1 and 2, however, is preferred, as it permits me to use snug-fitting valves and renders the valves interchangeable.

The rear end of the chamber containing the valve 11 may, if desired, like the front end, communicate directly with the chamber containing the valve 10—as shown, for instance, at 32^a in Fig. 10—instead of communicating indirectly through the medium of the passages 24 and 26, as shown in Figs. 5 to 8, the end to be attained being the placing of said passages 32 and 33 in communication with the live-steam and exhaust passages of the chest alternately or the alternate closing of each passage and the opening of the same to the exhaust and the construction shown in Figs. 1, 2, and 4 being adopted simply for convenience, as it avoids the formation of complicated passages in the valve-chest, which would otherwise be required.

The advantages of my invention, so far as they arise from the use of two light, independent, and easily-operated valves, one for controlling the flow of steam to and from the front end of the cylinder and the other for controlling the flow of steam to and from the rear end of the cylinder, may be attained, even if the movement of the front-end-controlling valve is not dependent upon the previous movement of the rear-end-controlling valve. In the structure shown in the diagram Fig. 11, for instance, the passages 32^b and 33^b lead directly to the cylinder, the termination of the passage 33^b being some distance in advance of that of the passage 31 and the termination of the passage 32^b being some distance in advance of that of the passage 30, so that both sets of passages will be controlled by the piston. If this construction is adopted, the movement of the valve 11 will follow that of the valve 10 on the forward stroke of the piston, so as to obtain the same results of uncushioned blow and free rear exhaust which arise from the preferred construction shown in Figs. 1 to 8; but the movement of the valve 11 will in this case precede that of the valve 10 on the back stroke of the piston. Hence as compared with the preferred construction there will be an earlier cut off of the steam from the front end of the cylinder and consequent lessened lifting power, decreased rear travel of the piston, and a lighter blow.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. The combination in an impact-tool, of a cylinder, a reciprocating piston contained therein, a valve-chest having inlet and exhaust passages for the motive fluid, and two valves each in its own chamber and each operated by the pressure of the motive fluid, one valve controlling the flow of motive fluid to and from the rear end of the cylinder and the other valve controlling the flow of motive fluid to and from the front end of the cylinder, substantially as specified.

2. The combination in an impact-tool, of a cylinder, a reciprocating piston contained therein, a valve-chest having inlet and exhaust passages for the motive fluid, and two valves, each in its own chamber, one valve controlling the flow of motive fluid to and from the rear end of the cylinder and the other valve controlling the flow of motive fluid to and from the front end of the cylinder, the movement of said front-end-controlling valve being governed by and following the movement of said rear-end-controlling valve, substantially as specified.

3. The combination in an impact-tool, of the cylinder, a reciprocating piston therein, a valve-chest having inlet and exhaust passages for the motive fluid, and two valves, each in its own chamber, one of said valves controlling the flow of motive fluid to and from the rear end of the cylinder and the other controlling the flow of motive fluid to and from the forward end of the cylinder, the movement of said rear-end-controlling valve being governed by the movement of the piston and the movement of said front-end-controlling valve being governed by and following the movement of the rear-end-controlling valve, substantially as specified.

4. The combination of the cylinder, a reciprocating piston therein, a valve-chest having inlet and exhaust passages for the motive fluid, two valves each in its own chamber, a passage leading from the first valve-chamber to the rear end of the cylinder, a passage leading from the second valve-chamber to the front end of the cylinder, each passage, by the movement of its controlling-valve, being placed in communication alternately with the inlet and exhaust passages of the chest, and passages for admitting motive fluid to and exhausting it from the opposite ends of each valve-chest, said passages being so disposed that on the forward movement of the piston in the cylinder, the first valve will be moved so as to open the rear end of the cylinder to the exhaust, and the second valve will be subsequently moved, so as to open the front end of the cylinder to the inlet, substantially as specified.

5. The combination of the cylinder, a reciprocating piston therein, a valve-chest having inlet and exhaust passages for the motive fluid, two valves, each in its own chamber, a passage leading from the first valve-chamber to the rear end of the cylinder, a passage leading from the second valve-chamber to

the front end of the cylinder, each passage, by the movement of its controlling-valve, being placed in communication alternately with the inlet and exhaust passages of the chest, and passages for admitting motive fluid to and exhausting it from the opposite ends of each valve-chest, said passages being so disposed that on the forward movement of the piston in the cylinder, the first valve will be moved so as to open the rear end of the cylinder to the exhaust, and the second valve will be subsequently moved, so as to open the front end of the cylinder to the inlet, and on the rearward movement of the piston in the cylinder, the first valve will be moved so as to open the rear end of the cylinder to the inlet, and the second valve will be subsequently moved so as to open the front end of the cylinder to the exhaust, substantially as specified.

6. The combination of the cylinder, a reciprocating piston therein, a valve-chest having inlet and exhaust passages for the motive fluid, two valves each in its own chamber, a passage leading from the first valve-chamber to the rear end of the cylinder, a passage leading from the second valve-chamber to the front end of the cylinder, each passage, by the movement of its controlling-valve, being placed in communication alternately with the inlet and exhaust passages of the chest, passages leading from the opposite ends of the first valve-chamber to the cylinder so as to be controlled by the piston, and passages leading from the opposite ends of the second valve-chamber to the first valve-chamber, so as to be controlled by the valve in said chamber, substantially as specified.

7. The combination of the cylinder, a reciprocating piston therein, a valve-chest having inlet and exhaust passages for the motive fluid, two valves each in its own chamber, a passage leading from the first valve-chamber to the rear end of the cylinder, a passage leading from the second valve-chamber to the front end of the cylinder, each passage, by the movement of its controlling-valve, being placed in communication alternately with the inlet and exhaust passages of the chest, passages leading from the opposite ends of the first valve-chamber to the cylinder so as to be controlled by the piston, passages leading from the opposite ends of the second valve-chamber to the first valve-chamber, so as to be controlled by the valve in said chamber, and passages whereby motive fluid is continuously admitted to the opposite ends of said first valve-chamber, substantially as specified.

8. The combination of the cylinder, a reciprocating piston therein, a valve-chest having inlet and exhaust passages for the motive fluid, two valves each in its own chamber, a passage leading from the first valve-chamber to the rear end of the cylinder, a passage leading from the second valve-chamber to the front end of the cylinder, each passage, by the movement of its controlling-valve, being

placed in communication alternately with the inlet and exhaust passages of the chest, and passages leading from the opposite ends of the first valve-chamber to the cylinder so as to be controlled by the piston, passages leading from the opposite ends of the second valve-chamber to the first valve-chamber, so as to be controlled by the valve in said chamber, and passages whereby motive fluid is continuously admitted to the opposite ends of each valve-chamber, substantially as specified.

9. The combination of the cylinder, a reciprocating piston therein, a valve-chest having inlet and exhaust passages for the motive fluid, two valves each in its own chamber, a passage leading from the first valve-chamber to the rear end of the cylinder, a passage leading from the second valve-chamber to the front end of the cylinder, each passage, by the movement of its controlling-valve, being placed in communication alternately with the inlet and exhaust passages of the chest, passages leading from the opposite ends of the first valve-chamber to the cylinder so as to be controlled by the piston, passages leading from the opposite ends of the second valve-chamber to the first valve-chamber so as to be controlled by the valve in said chamber, and passages in the valves, whereby each end of each valve-chamber is continuously in communication with the motive-fluid-inlet passage, substantially as specified.

10. The combination of the cylinder, piston and piston-rod of an impact-tool, with a stuffing-box casing having an internal shoulder, and a gland for compressing the packing, said gland having an external shoulder located inside of the shoulder of the stuffing-box and adapted to engage with the internal shoulder of the casing to prevent removal of the gland, substantially as specified.

11. The combination of the cylinder, piston, and piston-rod of an impact-tool, with a split and separable stuffing-box casing having an internal shoulder, and a gland or follower contained within said casing and having an external shoulder located inside of the shoulder of the stuffing-box and adapted to engage with that of the casing, substantially as specified.

12. The combination of the cylinder, piston, and piston-rod of an impact-tool, with a split and separable stuffing-box casing slotted at the forward end, a gland screwed into said casing, and transverse bolts whereby the slotted portion of the casing is confined to said gland, substantially as specified.

13. The combination of the cylinder, piston, and piston-rod of an impact-tool, with a split and separable stuffing-box casing having an internal shoulder, and a split and separable gland or follower fitted to said stuffing-box and having an external shoulder for engaging with that of the casing, substantially as specified.

14. The combination of the cylinder, piston, and piston-rod of an impact-tool, with a stuff-

ing-box casing having an internal shoulder,
a gland or follower having an external shoulder located inside of the shoulder of the stuffing-box for engaging with that of the casing,
5 and a plug located at the inner end of said stuffing-box casing, substantially as specified.

15 15. The combination of the cylinder, piston, and piston-rod of an impact-tool, with a stuffing-box casing having an internal shoulder,
10 a gland or follower having an external shoulder located inside of the shoulder of the stuff-

ing-box for engaging with that of the casing, and a split and separable plug located at the inner end of said stuffing-box casing, substantially as specified.

15 In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THOMAS H. PHILLIPS.

Witnesses:

WILL. A. BARR,

JOS. H. KLEIN.