(No Model.)

2 Sheets—Sheet 1.

A. J. SYPHER.

ROCK DRILL.

No. 485,721. Patented Nov. 8, 1892.

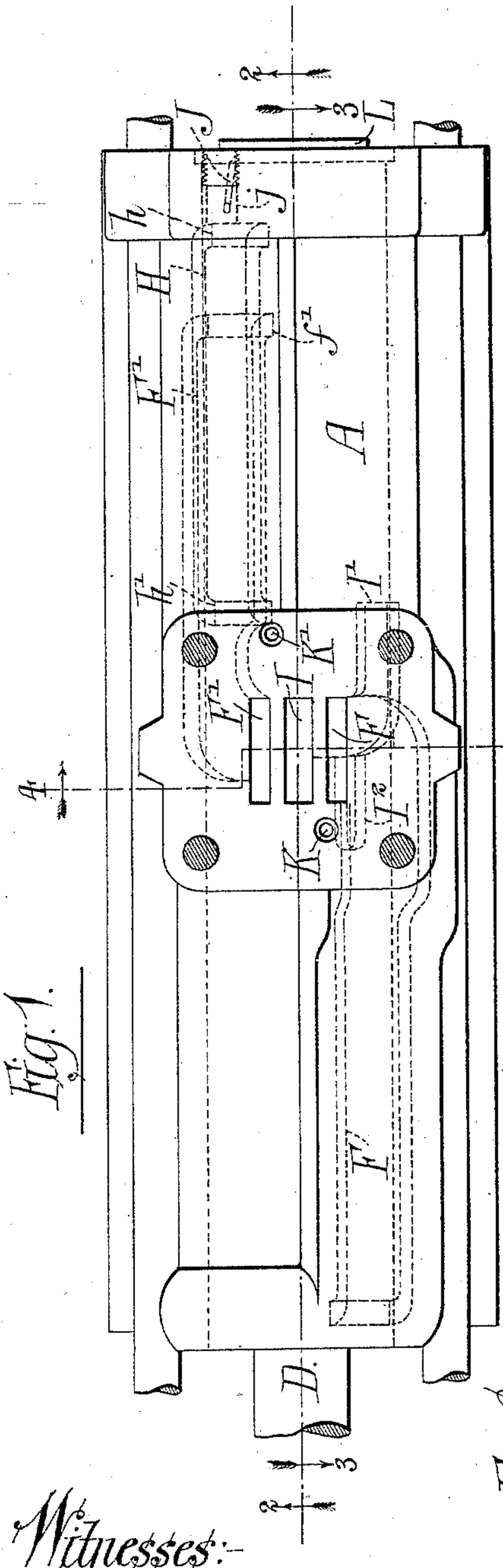


Fig. 1.

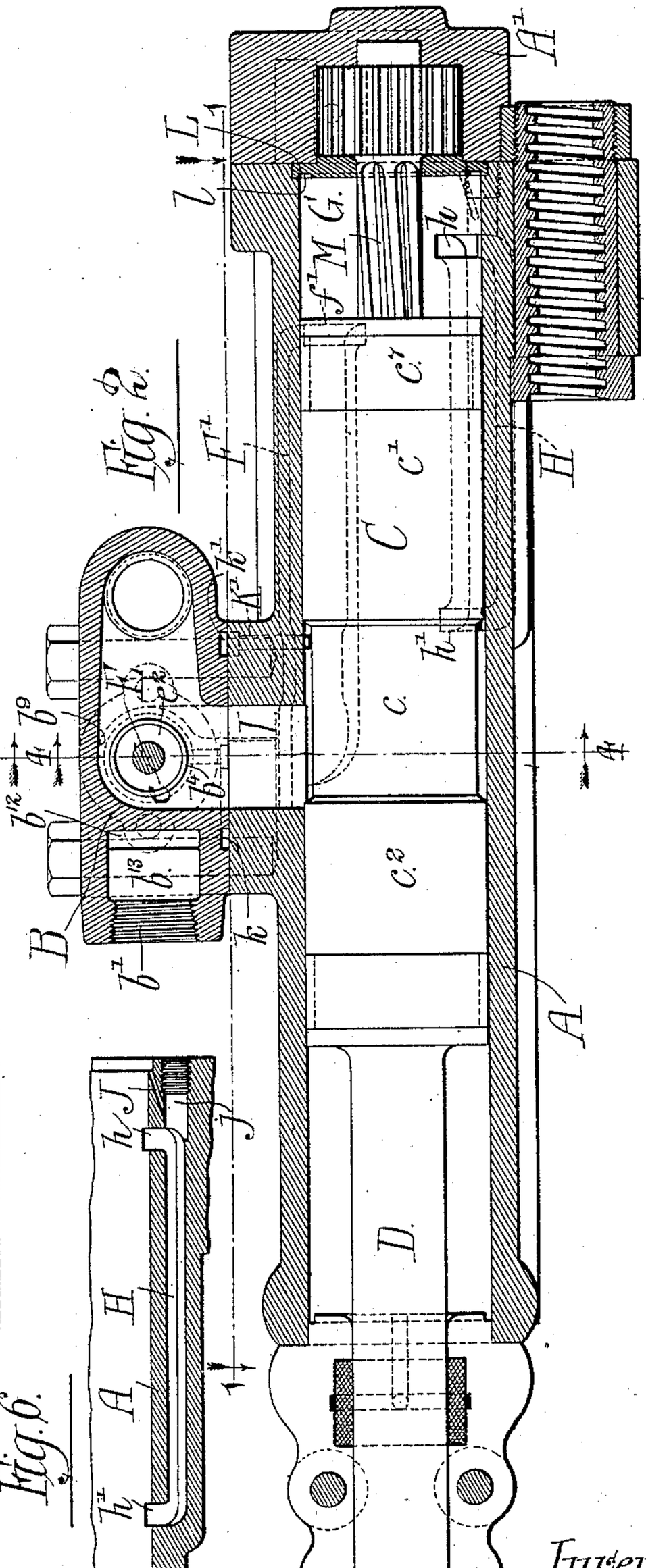


Fig. 2.

Fig. 6.

Witnesses:-
Louis H. Whitehead.
C. E. Tomlinson.

Inventor:-
Abraham J. Sypher.
by: Dayton Cooke & Brown
his Attorneys.

(No Model.) 2 Sheets—Sheet 2.

A. J. SYPHER.

ROCK DRILL.

No. 485,721. Patented Nov. 8, 1892.

Fig. 4.

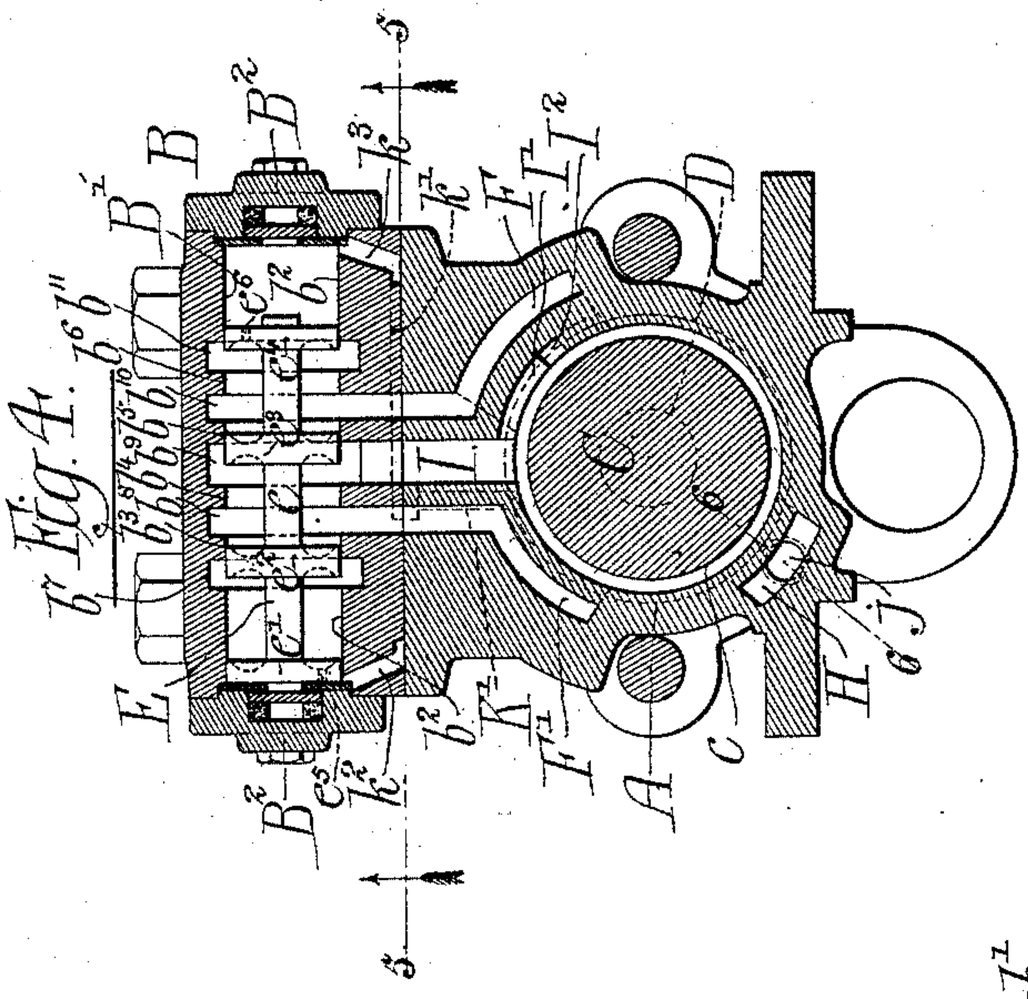


Fig. 3.

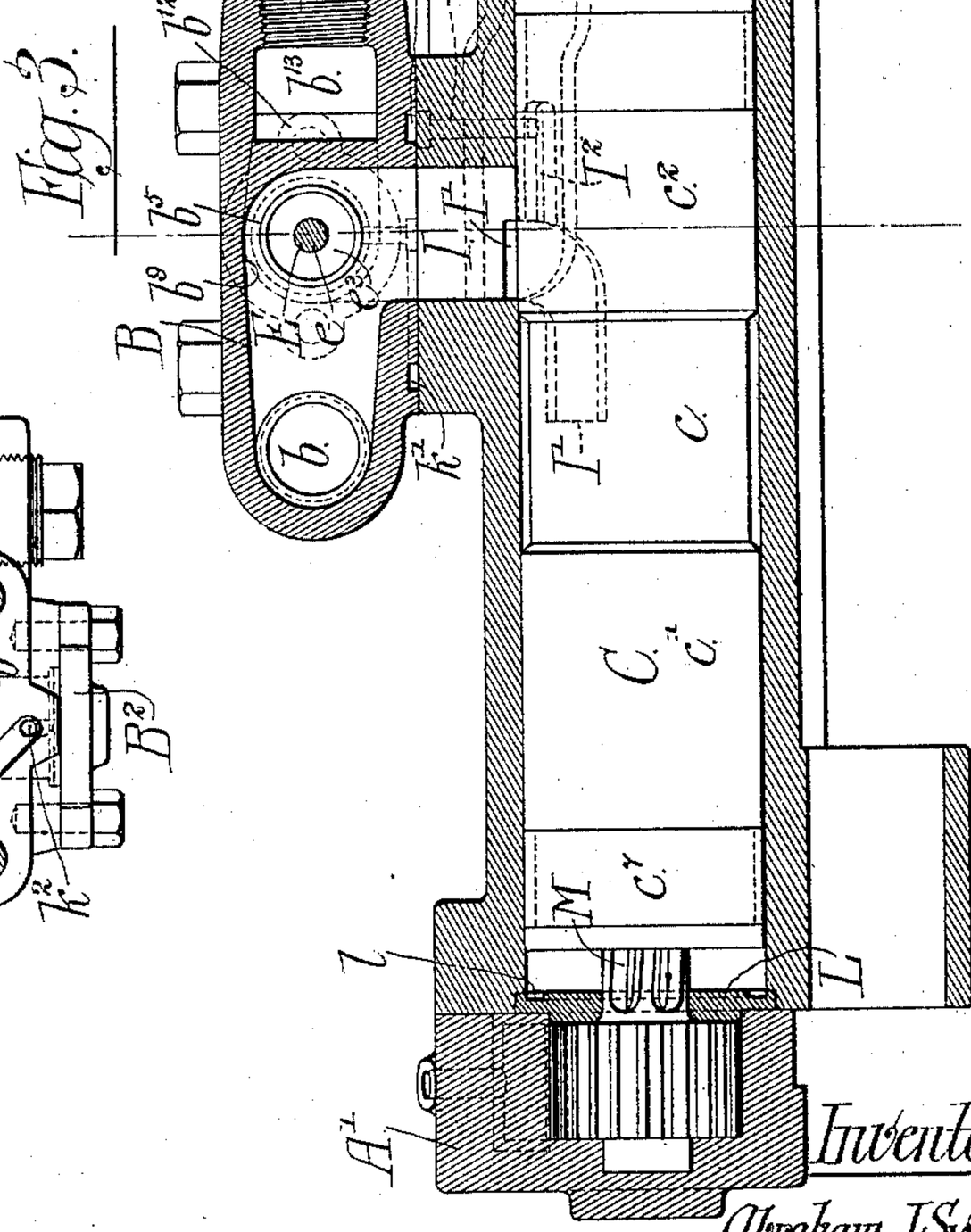
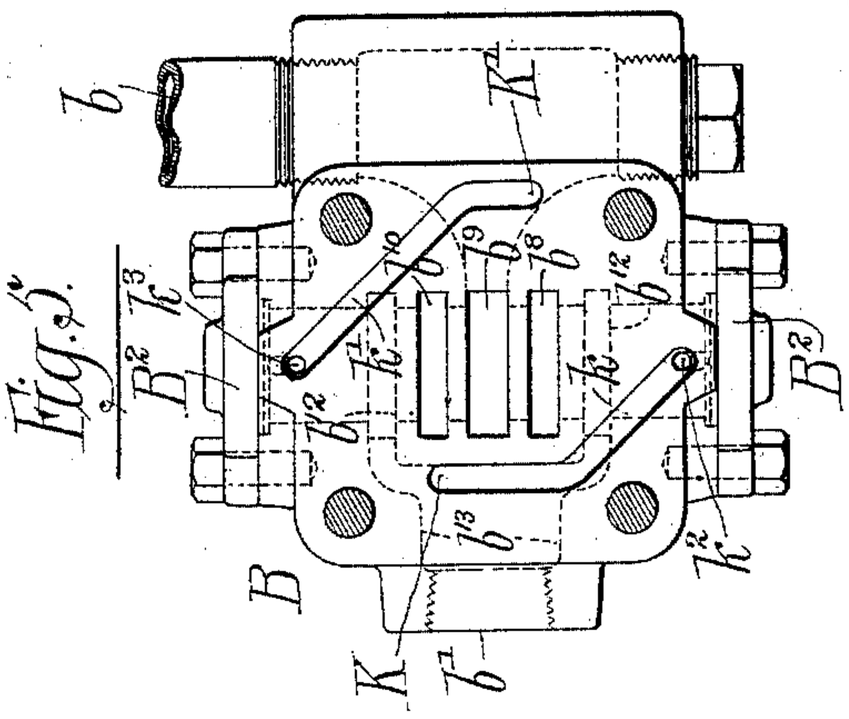


Fig. 5.



Witnesses:—

Louis M. T. Whitehead.

C. E. Tomlinson.

Inventor:

Abraham J. Sypher:

by:— Dayton, Porter & Brown

his Attorneys.

UNITED STATES PATENT OFFICE.

ABRAHAM J. SYPHER, OF CHICAGO, ILLINOIS.

ROCK-DRILL.

SPECIFICATION forming part of Letters Patent No. 485,721, dated November 8, 1892.

Application filed February 9, 1892. Serial No. 420,876. (No model.)

To all whom it may concern:

Be it known that I, ABRAHAM J. SYPHER, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rock-Drills; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in rock-drills of that kind shown and described in a prior patent, No. 403,496, granted to me May 14, 1889, wherein steam is supplied to the end of the cylinder for cushioning the piston through a steam-passage which is controlled by the piston and is independent of the steam-passages by which steam is admitted to the cylinder for actuating the piston.

The invention consists in the matters hereinafter described, and pointed out in the appended claim.

In the accompanying drawings, Figure 1 is a plan view of a drill-cylinder embodying my improvements, the valve-casing being removed to expose the steam-ports. Fig. 2 is a central longitudinal section of the cylinder and valve-casing as seen when looking in the direction of the arrows 2 2, applied to the section-line of Fig. 1. Fig. 3 is a similar section on the same line of Fig. 1, looking in the opposite direction, or as indicated by the arrows 3 3 of said Fig. 1. Fig. 4 is a transverse section through the cylinder and valve-casing, taken on lines of Figs. 1, 2, and 3. Fig. 5 is a sectional view taken on line 5 5 of Fig. 4. Fig. 6 is a detail section taken on line 6 6 of Fig. 4 and showing the auxiliary steam-passage.

As shown in said drawings, A indicates the steam-cylinder of the drill; B, a valve located at one side of the cylinder; C, a piston within the cylinder; D, a piston-rod which passes through one end of the cylinder and to which the drilling-tool is attached, and E a valve-piston located within the valve-casing B.

F F′ are steam-passages leading from the valve-casing to the opposite ends of the cylinder for the purpose of admitting steam to and exhausting it from the same.

G is a steam cushioning space or chamber at the inner or rear end of the cylinder; H, a steam-passage supplying steam to the cushioning-space, said passage being entirely separate from and independent of the steam-passages F F′ and the valve mechanism, and I a live-steam port leading from the valve-chest into the central part of the cylinder.

The piston C is provided at its central part with an annular groove or recess *c*, forming annular bearing-surfaces c' c^2 at the opposite ends of the pistons, adapted to fit the bore of the cylinder. The piston thus constructed operates in connection with ports and passages formed in the cylinder and valve-casing to afford steam-pressure alternately at opposite ends of the valve-piston E in a manner to actuate said valve-piston and thereby control the admission of steam to and its exit from the opposite ends of the cylinder for actuating the main piston, and also operates in connection with the independent steam-passage H to admit steam to the cushioning-space G of the cylinder for cushioning the piston, as will hereinafter fully appear.

The valve-chest is provided with a steam inlet *b* and outlet *b′*. The valve-piston E consists of a stem *e* and four disks e' e^2 e^3 e^4. The said valve-piston is fitted within a valve-seat B′, closed at its ends by heads B^2 B^2 and having cylindric end bearing-surfaces b^2 b^2 and intermediate narrow bearing-surfaces b^3 b^4 b^5 b^6, within which the several valve-disks are adapted to closely fit. Between the said several bearing-surfaces are formed annular recesses b^7 b^8 b^9 b^{10} b^{11}, of which the middle recess b^9 is in communication with the steam-inlet port *b* and also with the port or passage I and forms in effect the valve-chamber. The recesses b^8 b^{10} at either side of the central recess are in communication with the steam-passages F F′ of the cylinder, Fig. 4, and the external recesses b^7 b^{11} are in communication with the exhaust-outlet *b* by passages b^{12} b^{12}, extending at one side of the valve-seat, as seen in Fig. 5, and opening into said outlet *b*, Figs. 2 and 5.

K K′ are steam-passages leading from the interior of the cylinder outwardly through the wall of the same to the inner surface of the steam-chest, where they are connected with passages *k k′*, formed between the adjacent surfaces of the steam-chest and cylin-

der-casting and which lead to points adjacent to the ends of the valve-seat B′ and communicate with the spaces in said valve-seats outside of the end disks of the valve-piston by means of ports k^2 k^3. The passage K is located near the outer end of the cylinder and communicates by the passage k with the space behind the valve-disk, Fig. 4, while the passage K′ is located adjacent to the inner end of the cylinder and communicates with the space behind the disk e^4. Steam entering the valve-chest through the said ports k^2 k^3 acts upon the ends of the valve-piston to move the latter endwise in its seat.

At the inner end of the passage I is formed a recess I′, which extends along the inner surface of the cylinder toward the inner end thereof, said recess I′ being deflected laterally, as shown, so as to pass at one side of the passage K. A similar recess I^2, Figs. 3 and 4, extends from said passage I along the inner surface of the cylinder in the opposite direction, or toward the outer end of the cylinder, said recess being shown as forming a branch or extension of the recess I′.

The valve mechanism shown operates as follows: The valve-piston E being at the limit of its throw to the left, as seen in Fig. 4, live steam entering the passage b will pass from the recess b^9 through the recess b^8 and steam-passage F′ to the inner end of the cylinder. At this time steam is free to pass from the inlet b, through the port I, recess I′, and recess c, to the passage K′, which is nearest the inner end of the cylinder, and thence to the space at the end of the valve-chest, behind the valve-disk e^4, which is at the right-hand side of Fig. 4, and holds the valve piston in position for the delivery of steam to the inner end of the cylinder. While live steam is thus being delivered through the passage F′ to the inner end of the cylinder steam is exhausted from the opposite or outer end of the cylinder, through the passage F, the recesses b^{10} and b^{11}, and passages b^{13} and b^{12}, to the exhaust-outlet b'. As soon as the piston has moved outwardly such distance that its bearing surface c' at its inner end covers the passage K′ access of live steam to the end of the valve-chest behind the disk e^4 is cut off and the steam contained in that end of the valve-chest leaks through a small aperture e^6 in the disk e^4 to the exhaust-passage b^{11}. When the piston approaches the outward limit of its stroke, the bearing-surface c^2 at the outer end of the piston passes and leaves open the passage K and steam then passes from the port I through said recess c to the passage K and thence through the passages k and k^2 to the valve-chest behind the disk e', whereby the valve-piston E is lifted into position to admit steam through the passage F to the outer end of the cylinder. By reason of the longitudinal extension of the steam-passage I by means of the recesses I′ I^2 communication between the said passage I and the passages K K′ continues after the bearing-surfaces c' and c^2 have passed and covered the main port I.

The inlet opening or port h of the steam-cushioning passage H is so located, as seen in Fig. 2, as to be uncovered by the bearing-surface c^7 as soon as the piston reaches and covers the port or outlet f' of the passage F′ in its backward or inward movement, and the outlet h' of said passage H is located between the port f' and the end of the cylinder, so that it will be covered and closed by the piston shortly after the latter passes the port f'. The port f' is arranged at a less distance from the outlet h' than the length of the recess c, so that the inlet-opening h of the passage H will remain in communication with the port I through said recess during the movement of the piston past or over said outlet h'. As soon as the recess c comes opposite the inlet h live steam flowing into said recess from the port I passes from said recess c, through the passage H and outlet h' of said passage, into the steam-cushioning space G. As the piston continues to move inward the outlet h' will be closed as soon as the piston reaches the same, and all of the steam contained in the cushioning-space G will be locked or imprisoned in said space and will be utilized to cushion the stroke of the piston. Expansion of the steam thus confined operates to start the return-stroke of the piston, and as soon as the port h' is uncovered live steam will be admitted through the passage H from the recess c, so as to carry the piston outwardly to the port f', and when said port f' is subsequently uncovered steam entering through the passage F will complete the outward stroke of the piston.

The principal office of the recess I′ is to secure the admission of steam to the recess c after the port I is covered by the bearing-surface c^2 of the piston, so that live steam will fill the recess c and passage H and will promptly enter the cushioning-chamber as soon as the outlet h' is opened in the return of the piston, it being obvious that the back stroke of the piston would be but little aided by the steam entering the chamber G through said passage H unless the passage is in communication with the port I and filled with live steam in readiness to rush in behind the piston as soon as said outlet-port h' is opened. In the construction shown in said prior patent, No. 403,496, the piston is provided with two recesses or annular grooves—one near each end—and an independent passage similar to the passage H is employed to admit steam to the cushioning-space at the end of the cylinder. As shown in that patent, however, the outlet of said passage is arranged adjacent to the head of the cylinder and the outlet-opening of the passage is so located that it is covered by the annular bearing-surface at the end of the piston remote from the head when the piston reaches the usual limit of its stroke, so that the outlet-opening is not closed by the piston, but re-

mains constantly open in the usual operation of the drill. It follows that in the construction referred to the usual operation of the drill is accomplished by the steam confined within the cushioning-space added to that confined within the cushioning steam-passage. This construction has been found objectionable because the said passage forms a relatively-large space in addition to the cushioning-space within the cylinder, with the result that a relatively-small degree of compression is produced by a considerable movement of the piston. This may be better understood by the statement that if the area of the said steam-passage is equal to the area of the cushioning-space in the end of the cylinder, then the steam will be compressed during the movement of the piston through a space of one inch only half as much as it would be if the passage were not in communication with the cylinder at the time of compression, and if the impetus of the piston in its back stroke were sufficient to compress the steam into a space not larger than that afforded by the said passage, then all of the steam would be forced into the passage and the piston would strike the inner end of the cylinder. In the construction shown in said patent the outlet-opening of the cushioning steam-passage located near the head of the cylinder and at a point remote from the outer end or limit of the cushioning space or chamber, the length of which space in the construction shown in said patent is determined by the point at which the annular bearing-surface at the outer end of the piston closes the inlet-opening to the cushioning steam-passage. The construction herein described differs from that shown in said patent in the employment of a single central groove or recess only in the main piston, thereby affording a more simple and durable construction in the device as a whole and in the location of the outlet-opening of said cushioning steam-passage at the outer end or limit of said cushioning steam-space, so that the steam space or chamber is defined or its length determined by the position of the outlet-opening of the steam-passage instead of the inlet-opening thereof, as is the case in the construction shown in said prior patent.

In the improved construction described all of the steam within the cushioning-space is positively locked or confined therein as soon as the piston passes the outlet-opening of the cushioning steam-passage and the full cushioning effect of all of the steam is thus afforded to take up the impetus of the piston. In this construction, furthermore, the inlet of the said cushioning steam-passage being uncovered and in communication with the annular recess *c* during the time the outlet-opening therein is closed by the piston, the cushioning-passage remains in communication with the live-steam-supply passage I, and live steam therefore fills said passage and is in readiness to enter promptly behind the piston as soon as the said outlet-opening is uncovered in the return or out stroke of the piston.

J indicates a small passage leading from the passage H to the end of the cylinder, said passage J being unobstructed or without any check-valve and being so small as to have no effect upon the cushioning action of the steam confined in the cushioning space or chamber G of the cylinder. Its purpose is to start or lift the piston from contact with the inner head when first starting the machine in doing overhead work. The passage J is shown as connected with an annular groove *l*, formed in the plate L, which is secured between the head A′ of the cylinder and the end of the same and which holds in place the spirally-grooved spindle M, through the medium of which rotary motion is given to the drill, as heretofore common. A hole *j*, Fig. 6, is shown as being formed in the end of the cylinder in communication with the passage H, and into which the small passage J extends, said hole *j* being closed by a screw-plug in the manner shown.

While I have shown the cushioning device as applied to one end only of the cylinder, yet it is obvious that the same features of construction may be applied to the outer or forward as well as the inner end of the cylinder, so as to cushion the piston at the end of both of its out and in stroke or at the end of its stroke in either direction.

I have referred in the foregoing description to the use of steam for actuating the piston; but it will of course be understood that compressed air or other gaseous agent under pressure may be used with the same effect.

I claim as my invention—

The combination, with the cylinder provided with a live-steam port, steam supply and exhaust passages, and with a cushioning steam-chamber at one end and a piston provided with a single central annular recess and a main valve actuated by the passage of steam through said recess and controlling said steam supply and exhaust passages, of a cushioning steam-passage separate from the supply and exhaust passages, leading from the central part of the cylinder to the cushioning-chamber, the inlet-opening of said cushioning steam-passage being arranged in position to take steam from the said annular recess when the latter is in communication with the live-steam port of the cylinder, and the outlet-opening of said steam-passage being located at a distance from the end of the cylinder equal to the length of the cushioning-chamber, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

ABRAHAM J. SYPHER.

Witnesses:

C. CLARENCE POOLE,

TAYLOR E. BROWN.