(No Model.)

5 Sheets—Sheet 1.

J. B. RHODES.

IMPACT TOOL.

No. 604,480. Patented May 24, 1898.

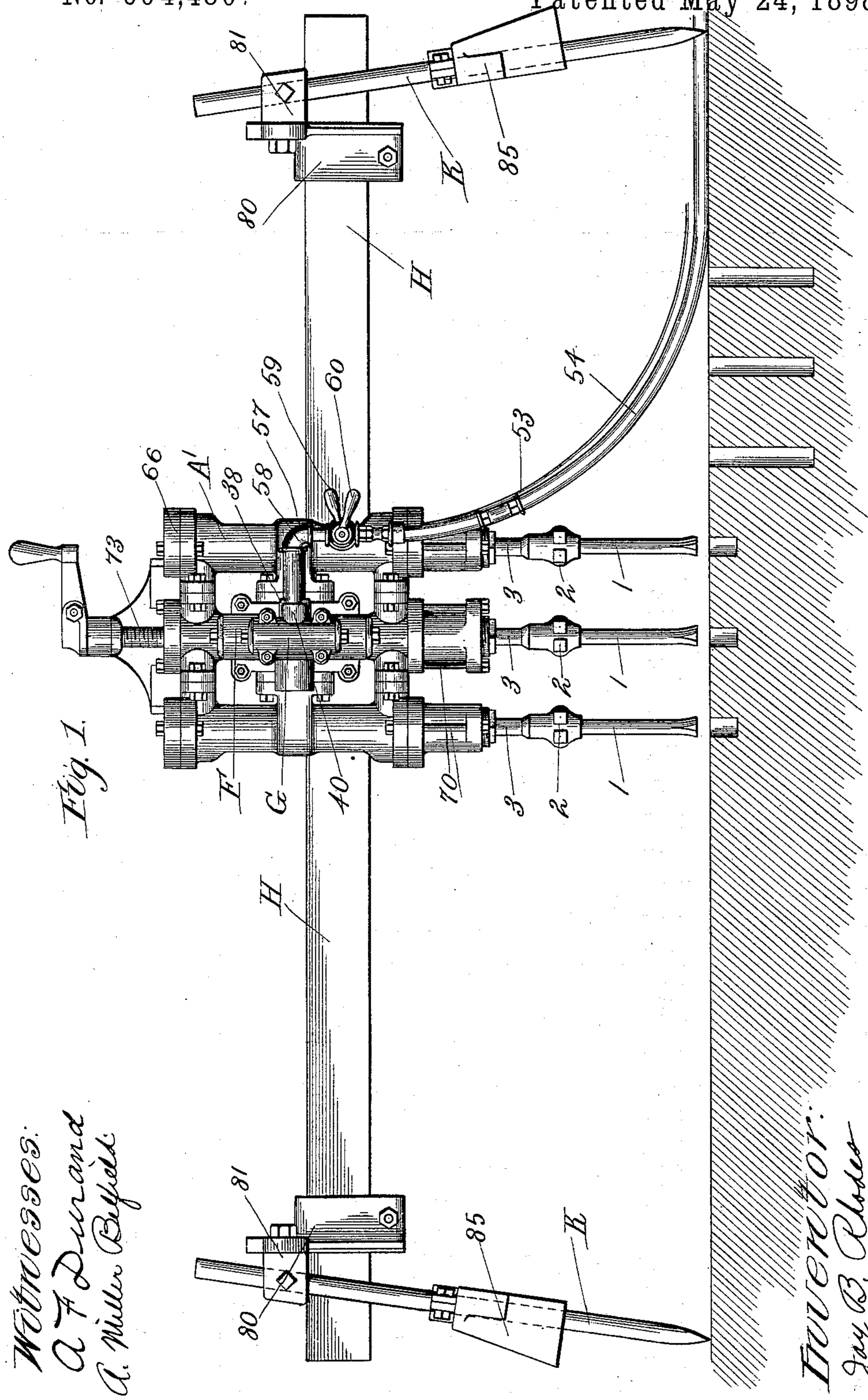

Fig. 1.

(No Model.) 5 Sheets—Sheet 2.

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Fig. 2.

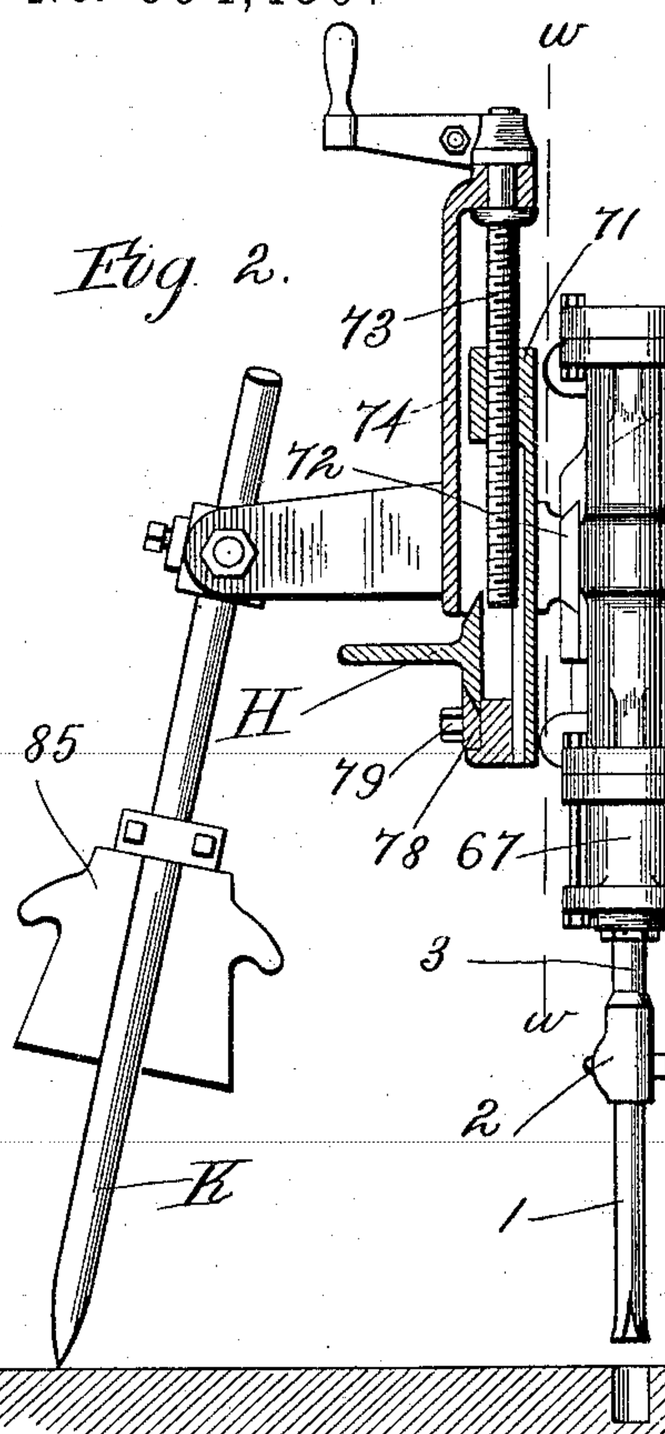


Fig. 3.

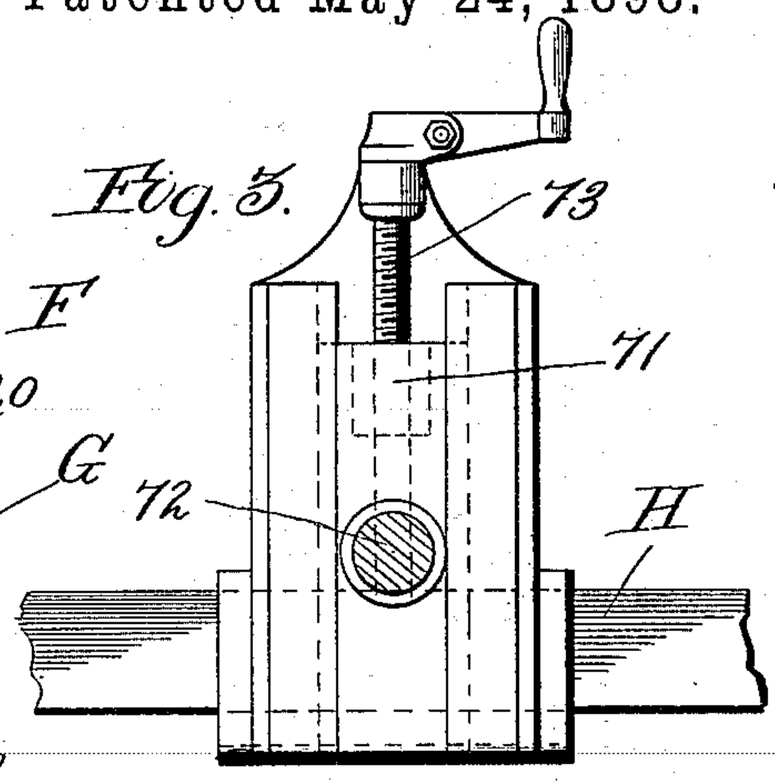


Fig. 4.

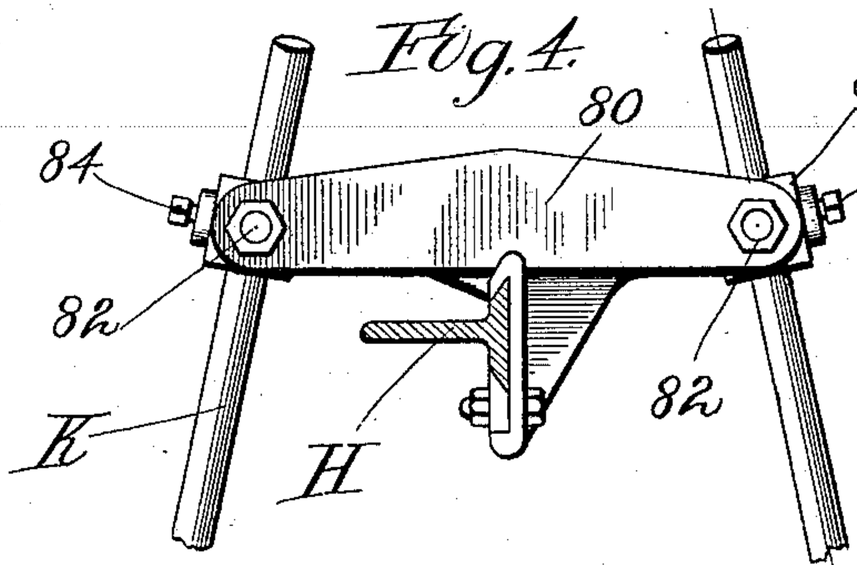


Fig. 5.

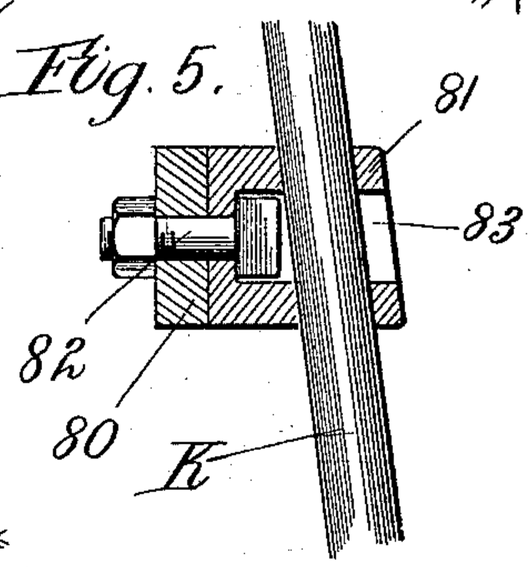
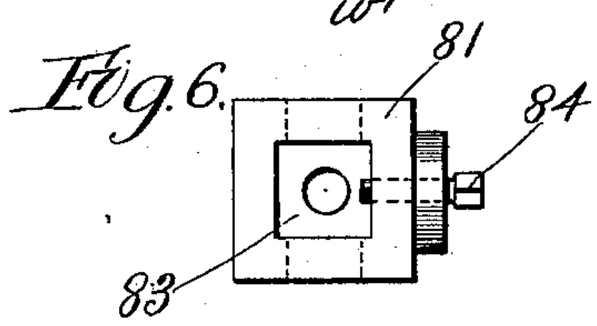


Fig. 6.



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(No Model.) 5 Sheets—Sheet 3.

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IMPACT TOOL.

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Fig. 7.

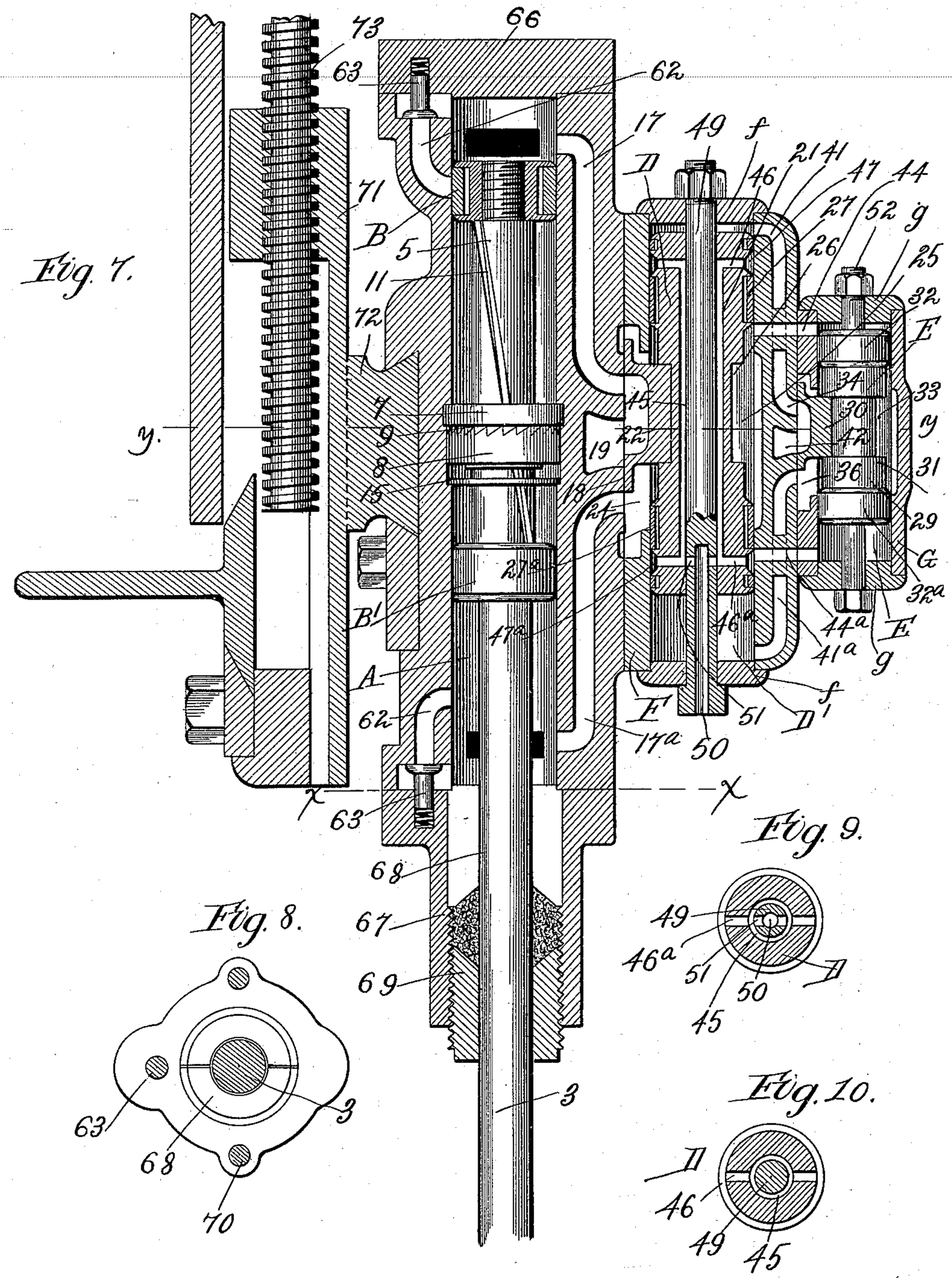

Fig. 8.

Fig. 9.

Fig. 10.

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(No Model.)

5 Sheets—Sheet 4.

J. B. RHODES.

IMPACT TOOL.

No. 604,480. Patented May 24, 1898.

Fig. 11.

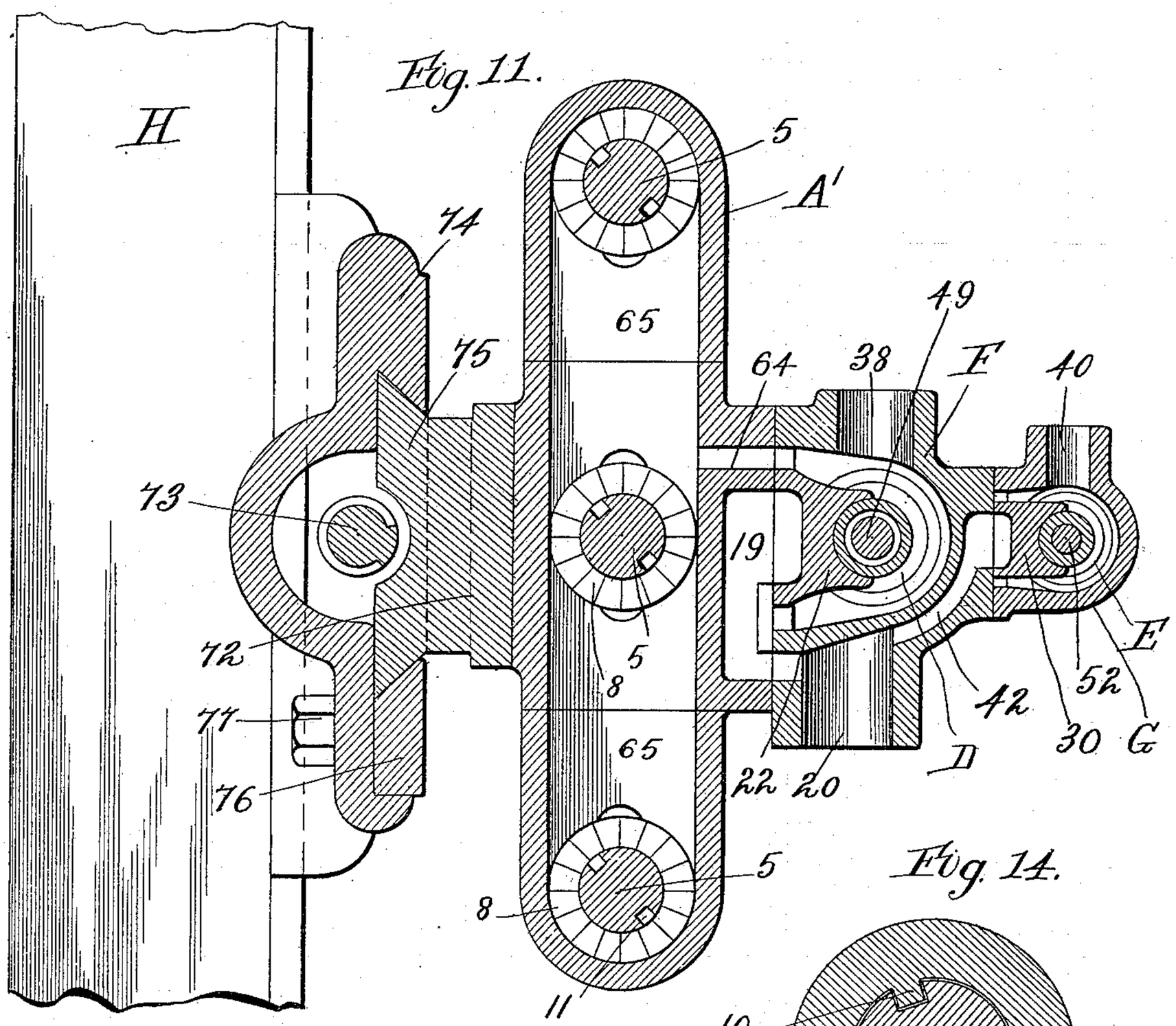


Fig. 13.

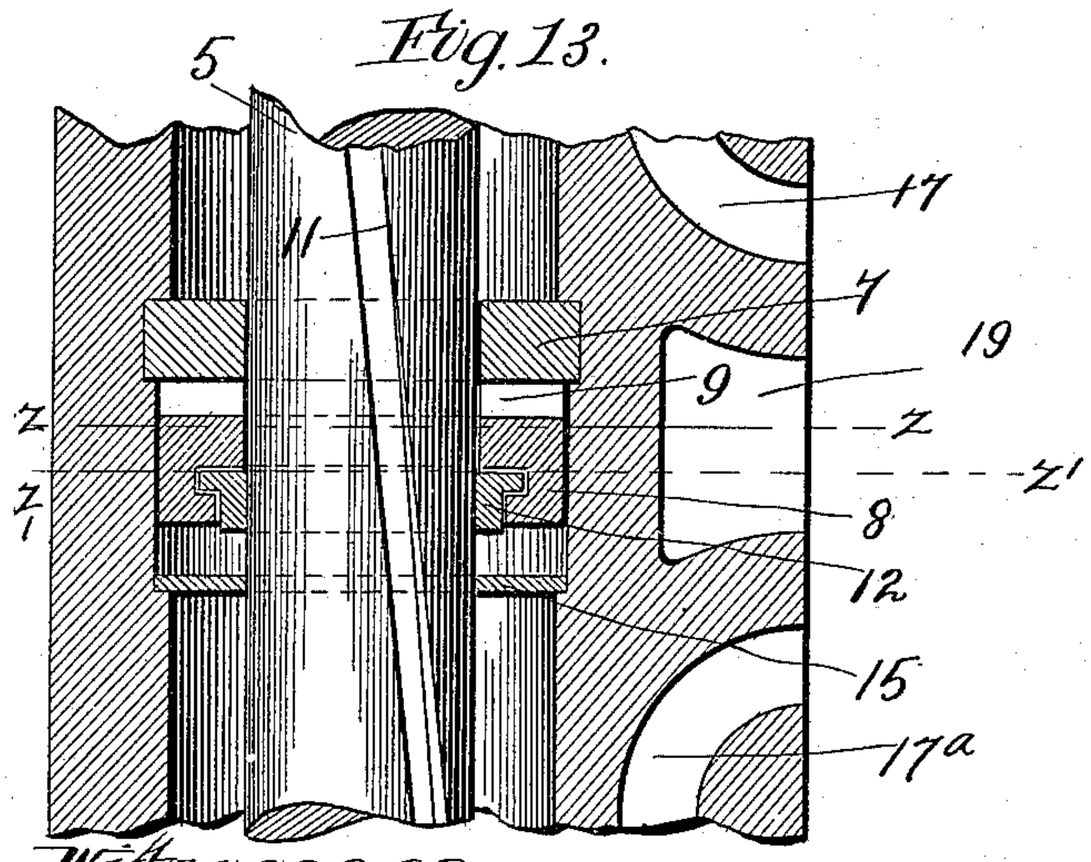


Fig. 14.

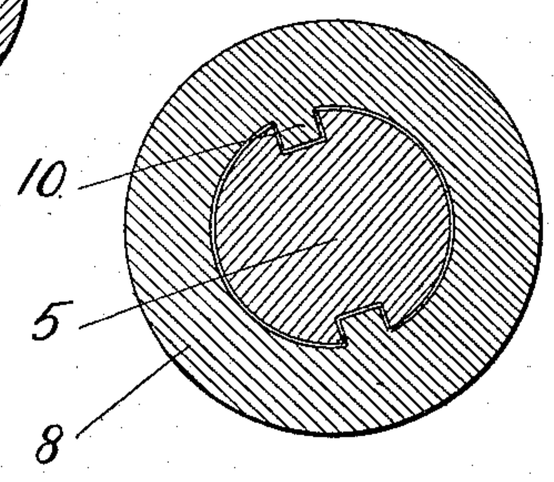
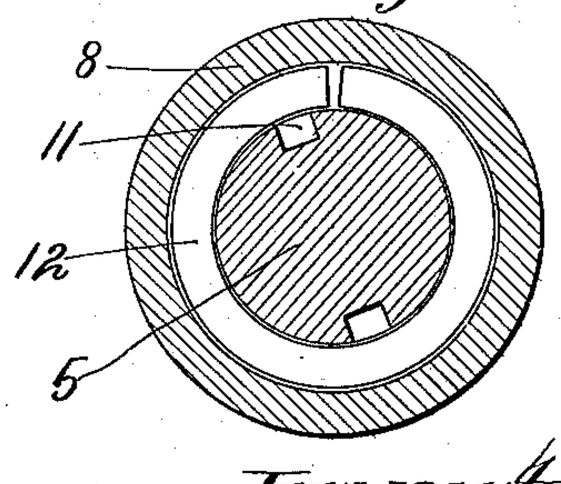


Fig. 15.



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(No Model.) 5 Sheets—Sheet 5.

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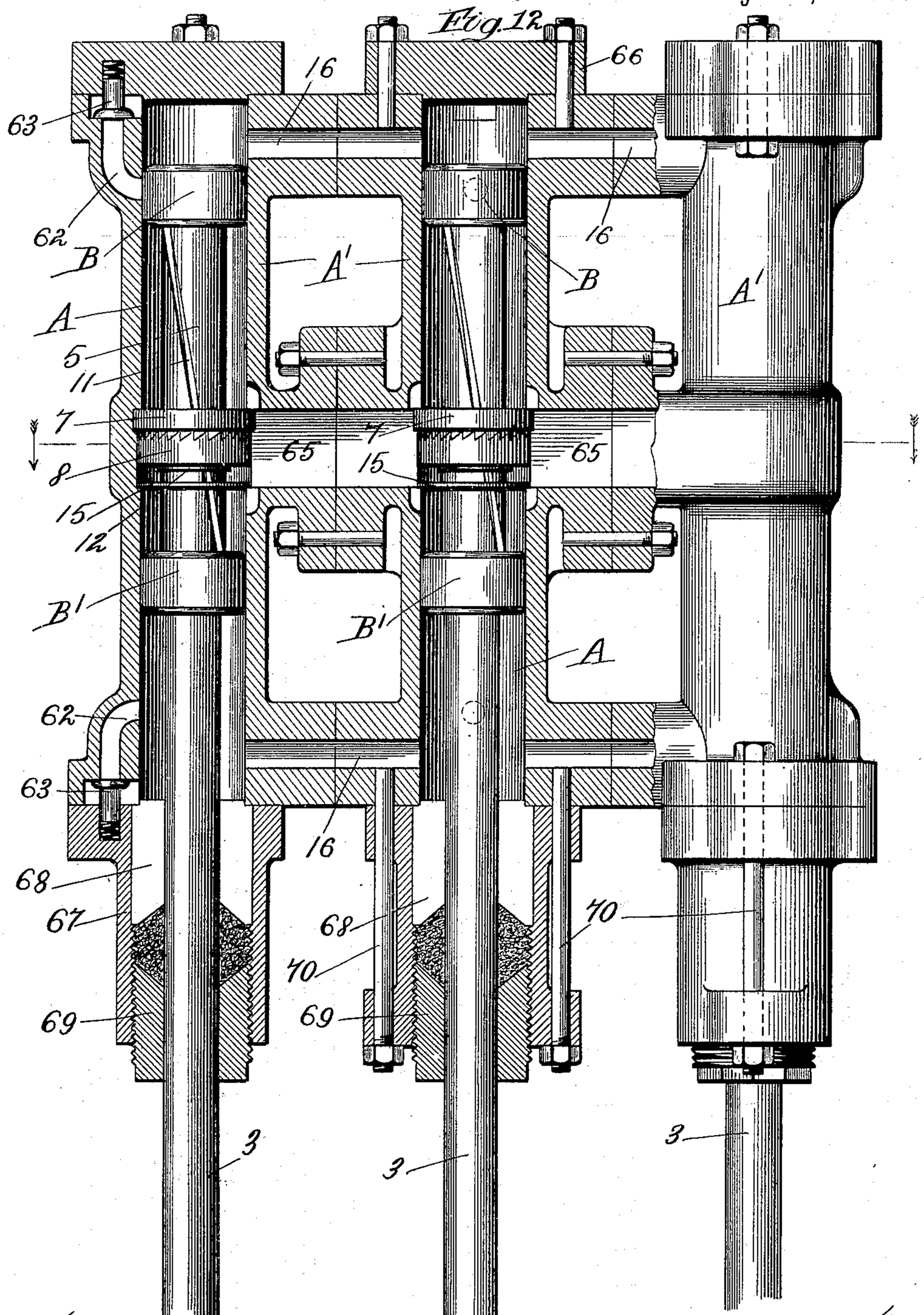
Fig. 12.



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UNITED STATES PATENT OFFICE.

JAY B. RHODES, OF CHICAGO, ILLINOIS, ASSIGNOR TO FREDERICK C. AUSTIN, OF SAME PLACE.

IMPACT-TOOL.

SPECIFICATION forming part of Letters Patent No. 604,480, dated May 24, 1898.

Application filed May 28, 1897. Serial No. 638,514. (No model.)

To all whom it may concern:

Be it known that I, JAY B. RHODES, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Impact-Tools, of which the following is a specification.

My invention relates in general to rock-drills or other impact-tools adapted for operation by means of steam, compressed air, or other motive fluid under pressure and having a piston-chamber inclosing a reciprocating piston which carries the drill or other implement; and it relates in particular to a construction of impact-tool in which the piston is reciprocated within its chamber by a valve mechanism operating independently of its movement, and comprising to such end a fluid-actuated reciprocating distribution-valve, or "piston-valve," as it may be termed, for distributing motive fluid to the piston-chamber and a fluid-actuated reciprocating valve which is reciprocated by motive fluid distributed to its chamber by the piston-valve and which when so reciprocated distributes motive fluid in turn to the piston-valve chamber, so as to reciprocate the piston-valve.

Prominent objects of my invention are to arrange for the independent variation either of the force of the blow of the implement operated by the reciprocating piston or of the rapidity of succession of such blows—that is to say, to allow the force of the blows to be varied irrespective of their rapidity of succession or to allow the rapidity of succession of such blows to be varied irrespective of their force; to cushion the piston against shock at the ends of its stroke; to successfully assemble a plurality of reciprocating implements and to arrange for the effective and economical operation of the same by means of a single independently-operating valve mechanism; to adapt the arrangement of such plurality of implements particularly for plug-and-feather work—that is to say, for work in which a series of holes are bored in alinement with one another in the rock for the purpose of allowing slabs of rock to be split off by the subsequent insertion of expansible plugs in such holes; to provide for the easy and ready adjustment of the tool, so as to permit of its implement or implements being applied as required by different varieties of work; to reduce the liability of such adjusting devices being broken as a result of repeated adjustments; to arrange for the easy, economical, and ready replacement of such devices should they finally be broken, and to otherwise increase the efficiency and general utility of such impact-tools.

In an impact-tool characterized by my invention the motive fluid distributed to the piston-chamber for reciprocating the piston enters the tool by way of one controllable supply-port, while that distributed to the piston-valve chamber for reciprocating the piston-valve enters by way of another or a second controllable supply-port. By such arrangement the force of the blows struck by the implement is dependent upon the pressure of motive fluid entering the first-mentioned or piston-chamber supply-port, while the rapidity of succession of such blows, as determined, of course, by the rate of travel of the piston-valve, is dependent upon the pressure of the motive fluid entering the second or piston-valve-chamber supply-port. As a result either the force of the blow or the rapidity of succession of the blows can be separately varied by varying the pressure of the motive fluid in one or the other of said supply-ports, and also both of such features can be varied at the same time by varying the motive-fluid pressure in both of said supply-ports.

In the accompanying drawings, Figure 1 illustrates in elevation an arrangement containing a plurality of drills, or, as it is commonly termed, a "gang" drill arrangement, embodying my invention and supported upon a suitable quarry-bar. Fig. 2 is a transverse vertical section of the same taken transversely of the quarry-bar intermediate of its ends, showing the piston and valve cylinders in elevation. Fig. 3 is a vertical section taken longitudinally of the quarry-bar on line *w w* in Fig. 2. Fig. 4 is a vertical section taken transversely of the quarry-bar at a point between the drills and one of the end-supporting legs for the bar, with the lower portions of such legs broken away. Fig. 5 is a sec-

tion taken longitudinally of the supporting-legs on line w' w' in Fig. 4, showing such leg in elevation. Fig. 6 is a side elevation of one of the adjustable connections for the supporting-legs. Fig. 7 is an enlarged vertical section taken centrally through the piston and valve cylinders and illustrating the piston, the piston-rod, and the supplemental valve in elevation and the piston-valve in section. Fig. 8 is a section taken horizontally across the end of the piston-cylinder on line x x in Fig. 7. Figs. 9 and 10 are sections taken transversely of the piston-valve, the former near one of its ends and the latter near its longitudinal middle. Fig. 11 is a horizontal section taken on line y y in Fig. 7. Fig. 12 is a vertical front view of the plurality of piston-cylinders, showing two of the same in central vertical section and a third in elevation. Fig. 13 is a sectional view of the middle longitudinal portion of one of the piston-chambers, on an enlarged scale. Figs. 14 and 15 are transverse sections taken on lines z z and z' z', respectively, in Fig. 13.

I have shown in the drawings three drills 1, connected by suitable connections 2 with piston-rods 3, which latter are reciprocated so as to effect the desired drilling operation by means of piston arrangements confined within piston-chambers which are conveniently provided by piston-cylinders A'. It will be understood, however, that the number of such drill-operating piston arrangements is immaterial, as such number may be more or less than three, as desired.

The piston-cylinders A' could be arranged with reference to one another in any desired manner; but as a preferred method the same are arranged in alinement with one another, so that holes bored by the drills are situated in a substantially straight line, as shown in Fig. 1, it being observed that such placing of the drill-holes is desirable for work commonly known as "plug-and-feather" work—that is to say, work in which slabs of rock are quarried by expanding a series of expansible plugs in a series of alined holes.

The drills 1 are desirably twisted or rotated between their successive blows, so as to present the drills in a different position for each blow. To such end either the piston arrangements or the piston-rods are desirably connected with devices whereby they are intermittently twisted or turned as a result of their reciprocation, such intermittent rotation being of course transmitted to the drills by means of the piston-rods. While any suitable or well-known arrangement for this purpose could be employed, I have illustrated an arrangement fully described and claimed in another application of mine filed contemporaneously with this one. In such arrangement each piston comprises a couple of separated piston-heads B and B', connected with one another by a spirally-grooved connecting-rod 5, and an intermittently-twisting device is inclosed within the piston-chamber and is arranged to engage the connecting-rod 5 between the piston-heads B and B', so that the reciprocation of the latter in the piston-chamber A operates to automatically turn the connecting-rod 5 and consequently the drills.

The device for intermittently twisting the connecting-rod 5 comprises a couple of collars 7 and 8, inclosing such connecting-rod and provided, respectively, with oppositely-arranged coöperating ratchet-teeth 9, adapted to engage those of one another, so that when such teeth are in engagement the collars are locked against relative rotation in one direction, but can rotate in the opposite direction. The upper collar 7 is secured within the piston-chamber against rotary motion and sliding movement longitudinally of said chamber and fits loosely over and is disconnected from the connecting-rod 5, so as to allow the latter to work freely within it. The lower collar 8, on the contrary, fits loosely within the piston-chamber, so as to allow of its being rotated therein and also so as to allow of its being slid longitudinally thereof into and out of engagement with the upper fixed collar 7, and also it engages the connecting-rod 5 by means of one or more, but preferably a couple, of inwardly-projecting tongues 10, with which it is provided, and a corresponding number of grooves 11, formed longitudinally in said connecting-rod 5 and adapted to receive the tongues 10, said grooves 11 being so inclined that the connecting-rod 5 tends during its rise to turn the collar 8 in the direction against which it is locked when in engagement with the upper fixed collar 7 and to turn said collar 8 in the opposite direction during its descent; also, the loose collar 8 has a friction connection with the connecting-rod 5—as, for instance, by means of a friction clasp-ring 12, inclosing the connecting-rod and inclosed in turn within a suitable annular chamber formed internally in said collar 8, whereby the latter is slid automatically into and out of engagement with the upper fixed collar 7 by the rise and descent of the connecting-rod 5—and it is provided with a stop adapted to limit its descent when it has been moved downward by the connecting-rod sufficiently to cause it to become disengaged from the upper fixed collar 7. By such arrangement the lower loose collar 8 is slid automatically upward and into engagement with the upper fixed collar 7 by the initial rise of the connecting-rod 5 and is held there against rotation during the remaining portion of the upstroke of said connecting-rod, thereby causing the latter, and consequently the drill, to turn or rotate, and by the initial descent of the connecting-rod said collar 8 is slid automatically out of engagement with the upper fixed collar 7 and is rotated thereby during the remaining portion of the downstroke, thereby allowing the connecting-rod, and consequently the drill, to descend without rotating.

The collar 7 can be conveniently fixed

tightly within the piston-chamber A by embedding it in an annular recess or chamber formed in the piston-cylinder, as shown in Fig. 13, and the stop for limiting the downward movement of the loose collar 8 can conveniently be provided by a disk 15, inclosing the connecting-rod 5 and held against a shoulder formed in the bore of the piston-chamber below said loose collar 8.

Motive fluid could be distributed to each of the piston-chambers A by means of separate independently-operating valve mechanisms, if desired; but as a preferred arrangement the corresponding ends of said chambers A are connected with one another by means of ports 16, and motive fluid is distributed to one of said chambers by means of such an independently-operating valve mechanism, by which arrangement a plurality of valve mechanisms are dispensed with and the cost and complexity of the tool greatly reduced, it being observed that an independently-operating valve mechanism is particularly advantageous for distributing motive fluid to a plurality of piston-chambers, for the reason that the failure on the part of any one of the pistons to operate properly does not affect the proper distribution of motive fluid to the other piston-chambers. Motive fluid could be thus primarily distributed to any one of the three piston-chambers by the valve mechanism; but in the arrangement illustrated it is distributed to the middle one of the three, whereby all three chambers are supplied more quickly and effectively than if motive fluid were admitted primarily to one of the end chambers. The independently-operating valve mechanism for thus distributing motive fluid to the middle piston-chamber A comprises a fluid-actuated reciprocating piston-valve and a fluid-actuated reciprocating supplemental valve E, confined, respectively, in suitable valve-chambers D′ and E′. The piston-valve D distributes motive fluid to said middle piston-chamber A by means of inlet-ports 17 and 17ª, extending from its valve-chamber D′ to the opposite ends of said piston-chamber and terminating in its valve-seat 18, and an exhaust-port 19, extending from its valve-chamber D′ to a suitable exhaust-outlet 20, Fig. 11, and likewise terminating in the valve-seat 18, Fig. 7. While the supplemental valve E distributes motive fluid to the piston-valve chamber D′, so as to reciprocate the piston-valve D, and is reciprocated in turn by motive fluid distributed to its valve-chamber E′ by the piston-valve D, such coöperation is effected by means of suitable ports connecting the two valve-chambers, it being understood, however, that motive fluid distributed to said middle piston-chamber A by the piston-valve D is supplied by way of one supply-port, whereas that distributed to the piston-valve chamber by the supplemental valve for reciprocating the piston-valve is supplied by way of another or a second supply-port.

In carrying out my invention it is of course quite possible to vary within wide limits the arrangement of the valve-chambers and distribution-ports and the construction of the valves. I wish it understood, therefore, that I consider the arrangement and construction herein described and illustrated merely as desirable types of the many different styles that could be employed.

In the arrangement illustrated the piston-valve D is constructed of a cylindrical body portion 21 and a flat-faced slide-valve 22. The cylindrical portion 21 is provided with a circumferential recess 25, formed between suitable cylindrical heads 27 and 27ª, so as to allow motive fluid supplied to the middle of its valve-chamber D′ to pass into the middle piston-chamber A. The said cylindrical heads 27 and 27ª, which can be conveniently provided by packing-washers or the like, fit closely within the valve-chamber D′, so as to prevent the escape of motive fluid from the recess 25 beyond either end of the valve D, it being observed that such an escape or leakage of motive fluid intended for the piston-chamber would interfere with the proper reciprocation of the valve D by a separate supply of motive fluid.

The recess 25 of the cylindrical portion 21 of the piston-valve D is provided with an annular depression 26, which is formed in the longitudinal middle portion of said recess 25 and is adapted to receive the rear portion of the slide-valve 22. The said slide-valve 22, forming a portion of the piston-valve D, fits upon the valve-seat 18 and is adapted to distribute the motive fluid admitted to the recess 25 of the cylindric portion 21 to the middle piston-chamber by way of the ports 17, 17ª, and 19, when it is reciprocated by said cylindrical portion 21 in an extension 24 of the piston-valve chamber D′. The supplemental valve E is similarly constructed of a cylindrical portion 29 and a slide-valve 30. The cylindrical portion 29 is constructed with a circumferential recess 31, formed between tightly-fitting cylindrical heads 32 and 32ª, whereby motive fluid admitted to the longitudinal middle of the supplemental-valve chamber E′ can pass into the piston-valve chamber for reciprocating the piston-valve and can be prevented from interfering with the proper reciprocation of the supplemental valve E by escaping beyond the ends of its cylindrical portion 29.

The recess 31 is provided with an annular depression 33, which is adapted to receive the rear portion of the slide-valve 30. Said slide-valve 30, forming a portion of the supplemental valve E, fits upon a suitable valve-seat 34 and is adapted to distribute the motive fluid admitted to the recess 31 of the cylindric portion 29 to the piston-valve chamber D′ for reciprocating the piston-valve D when it is reciprocated by said cylindrical portion 29 in an extension 36 of the supplemental-valve chamber E′.

The piston-valve chamber is conveniently provided by a cylinder F, having a side supply-port 38, Fig. 11, arranged to admit motive fluid to the recess 25 of the cylindric portion 21 of the piston-valve D for distribution to the piston-chambers by the slide-valve 22.

The supplemental-valve chamber E′ is conveniently provided by a cylinder G, fitted upon the front face of the cylinder F and having a side supply-port 40, Fig. 11, which latter is arranged to admit motive fluid to the recess 31 of the cylindric portion 29 of the supplemental valve E for distribution by the slide-valve 30 to the piston-valve chamber D′ for reciprocating the piston-valve D.

It will therefore be observed that while the pistons are actuated by motive fluid entering the supply-port 38 the piston-valve which controls the distribution of such motive fluid to the piston-chambers is actuated by motive fluid entering the supply-port 40, by which arrangement the force of the blows struck by the implements can be varied, independently of the rapidity of succession of such blows, by regulating the pressure of motive fluid entering by way of the piston-chamber supply-port 38, and also the rapidity of succession of the blows can be varied, independent of their force, by regulating the pressure of the motive fluid entering by way of the piston-valve-chamber supply-port 40.

As an arrangement for distributing motive fluid from the supplemental-valve chamber E′ to the piston-valve chamber D′ for reciprocating the piston-valve D the piston-valve cylinder F is provided with inlet-ports 41 and 41ª, extending from the supplemental-valve seat 34 to the opposite ends of the piston-valve chamber D, and also with an exhaust-port 42, extending from said valve-seat 34 to the exhaust-outlet 20, as best shown in Fig. 11; and as an arrangement whereby motive fluid is distributed by the piston-valve D to the supplemental-valve chamber E′ for reciprocating the supplemental valve E the adjacent walls of the valve-cylinders F and G are provided with ports 44 and 44ª, extending from the ends of the supplemental-valve chamber E′ to the piston-valve chamber D′ and adapted to admit motive fluid from the piston-valve recess 25 into the upper end of said valve-chamber E′ when the piston-valve D has risen sufficiently to place said recess 25 into communication with the port 44 and to the lower end of said valve-chamber E′ when the piston-valve D has descended sufficiently to place said recess 25 into communication with the port 44ª. Also the piston-valve D is constructed with an interior longitudinal exhaust-chamber 45 and with ports 46 and 46ª, extending from said exhaust-chamber 45 to a couple of circumferentially-formed recesses 47 and 47ª, respectively, which said recesses 47 and 47ª are arranged so that when the piston-valve recess 25 comes into communication with the port 44ª and also when said recess 25 and the port 44ª are in communication the recess 47 and the port 44 are also in communication, whereby when one or the other of the ends of the supplemental-valve chamber E′ is receiving motive fluid from the piston-valve recess 25 the opposite end of said chamber E′ can exhaust into the exhaust-chamber 45, formed in the interior of the piston-valve D.

The ports 44 and 44ª, extending between the valve-chambers D′ and E′, could be arranged so as to admit motive fluid to the latter valve-chamber E′ at any desired point in the stroke of the piston-valve D; but as a preferred arrangement said ports are so arranged as to admit motive fluid to the chamber E′ at a time when the piston-valve D is arriving at one or the other of the ends of its strokes, by which arrangement the time of actuation of supplemental valve E for reversing the piston-valve is delayed as long as possible, and thus the period of admission of motive fluid to the piston-chamber is prolonged to the greatest extent possible.

The motive fluid escaping from the ends of supplemental-valve chamber E′ into the exhaust-chamber 45 in the piston-valve D could be allowed to escape from said chamber 45 by means of any suitable arrangement. As a simple and convenient arrangement the piston-valve D is fitted for sliding movement upon a spindle 49, which extends beyond the ends of the valve-chamber D′ and is provided at one end with a bore 50 and with side ports 51, communicating with the bore 50, whereby motive fluid in the exhaust-chamber 45 can pass into the bore 50 and thence into the atmosphere or into any suitable exhaust arrangement.

In the operation of the tool when the piston-valve has descended to the lower end of its stroke motive fluid is admitted to the lower end of the supplemental-valve chamber and the supplemental valve rises, which rise of the supplemental valve operates to admit motive fluid to the lower end of the piston-valve chamber and causes the piston-valve to rise. When the piston-valve has risen to the upper end of its stroke, as shown in Fig. 7, motive fluid is admitted to the upper end of the supplemental-valve chamber and the supplemental valve descends, which descent of the supplemental valve operates to admit motive fluid to the upper end of the piston-valve chamber and causes the piston-valve to descend, and so on, as before.

With reference to the construction of the valve-cylinders F and G the same are conveniently constructed with detachable ends *f f* and *g g*, respectively, so as to permit the ready removal of the cylindrical portions of the valves D and E, it being observed that in order to permit such removal of the cylindrical portion of the supplemental valve E the cylinder G, providing its chamber, must

be removed from the cylinder F and its slide-valve portion detached, and also in order to permit the removal of the cylindrical portion of the piston-valve D the cylinder F, providing its chamber, must be removed from the middle piston-cylinder A and its slide-valve portion detached. The ends *f f* of the piston-valve cylinder F are desirably secured thereto by means of the spindle 49, while the ends *g g* of the supplemental-valve cylinder are conveniently secured detachably thereto by means of a similar spindle 52, upon which the supplemental valve is arranged to slide.

As a simple and convenient arrangement for supplying the tool with motive fluid while being moved from place to place I have shown in Fig. 1 flexible tubes or conductors 53 and 54, connected with the supply-ports 38 and 40 by means of suitable pipe connections 57 and 58, respectively, which latter are provided with separate valves 59 and 60, adapted to the pressure of motive fluid entering either of said supply-ports 38 and 40 to be independently varied at will.

As an arrangement for cushioning the pistons at the ends of their strokes live motive fluid is supplied to each piston-chamber between each pair of piston-heads B and B′ and is allowed to escape around one or the other of said piston-heads to the end of the piston-chamber, being approached by such piston-head when it is a short distance from the end of its stroke by way of by-pass or escape-ports 62, extending, respectively, from the end of each chamber to points within said end and provided with inwardly-opening spring-controlled check-valves 63—that is to say, check-valves arranged to allow the entrance of motive fluid into the piston-chamber ends, but to prevent the escape of the same therefrom. By such arrangement live motive fluid entering the ends of the piston-chambers before the arrival thereat of the piston-heads is compressed into cushions which form abutments in opposition to the further progression of the piston-heads and which at the same time provide for the return stroke of the piston-heads an initial motive-fluid pressure greater than the normal supply-pressure.

Motive fluid is conveniently supplied to the middle portions of the piston-chambers for such purpose by way of a port 64, Fig. 11, extending from the middle longitudinal portion of the piston-valve chamber D′ to the middle one of the piston-valve chambers A, and ports 65, Fig. 12, extending, respectively, from the longitudinal middle portion of said middle piston-chamber to the middle longitudinal portion of the end piston-chambers.

With reference to the construction of the piston-cylinders A′, providing the piston-chambers A, the same can be constructed in any suitable manner. The construction illustrated in the drawings, however, comprises certain features of advantage and improvement. In such construction the piston-cylinders A′ are constructed separately and bolted together at their end and middle portions, as shown in Fig. 1, whereby any cylinder can be separately inspected, repaired, or replaced, and they are respectively provided with detachable end pieces 66, conveniently bolted to their ends, whereby access can be gained to any piston-chamber without interfering with the others.

Each piston-cylinder A′ is desirably provided at its lower end with a piston-rod stuffing-box arrangement particularly illustrated and described by me in another application filed contemporaneously with the present application. As I have also claimed said arrangement in my other said application, I shall refer to same in this application only briefly. Said arrangement thus briefly considered comprises a detachable stuffing-box 67 and a couple of removable packing-glands 68 and 69, confined within the packing-box 67 and holding between them the requisite quantity of waste or packing. The stuffing-boxes 67 are conveniently secured detachably to the ends of the cylinders A′ by means of bolts 70, as shown in Fig. 12. The upper packing-glands 68 fit against the ends of the cylinders, while the lower glands 69 are desirably screw-threaded into the lower ends of the packing-boxes 67. Both of said glands 68 and 69 are desirably constructed of two longitudinal portions, as best shown in Fig. 8. The gang-drill thus constructed could be supported for adjustment in any suitable manner. As a matter of further improvement, however, the piston-cylinders are supported by an adjustable holder 71, having a projecting tongue 72, adapted to engage a suitable groove with which the middle piston-cylinder is provided, and the holder 71 is in turn suspended by a vertically-arranged adjusting-screw rod 73, whereby the drills can be adjusted vertically by an adjustment of the adjusting-screw rod 73.

The upper end of the screw-rod 73 is confined in a suitable socket formed in the bent or curved upper end of a sliding rest 74, which latter is conveniently provided with vertical guideways adapted to receive a rear tongued portion 75, with which the holder 71 is provided, as best shown in Fig. 11. One side of said guideways is conveniently provided by an adjustable clamping member 76, having an adjusting-screw 77 for the purpose of locking the holder 71 in its adjustments.

The sliding rest 74 is supported upon a quarry-bar H and is provided with guideways adapted to receive the quarry-bar, Fig. 7, so as to permit of the sliding movement of the sliding rest longitudinally of the quarry-bar, whereby the drills can be adjusted horizontally from side to side. The lower side of said guideways is conveniently provided by a clamping member 78, having an adjusting-screw 79, so as to allow the sliding rest 74 to be locked in adjustment upon the quarry-

bar H. Said quarry-bar H is supported by a couple of transversely-arranged legged sliding yokes 80, Figs. 1 and 4, having adjustable guideways adapted to permit their sliding movement longitudinally of the quarry-bar and adapted also to permit of their being removed from the latter. The yokes 80 are ordinarily placed upon opposite sides of the gang-drill, as shown in Fig. 1; but in case the ground to one side of the drill is incapable of affording a suitable support for the legs of one yoke said yoke can be removed from that side of the quarry-bar and placed upon the opposite side of the same.

The ends of the yokes 80 are provided with adjustable boxes 81 for the legs K. Said boxes 81 are pivotally connected with the yokes by means of suitable pivotal bolts 82, whereby the legs can be swung laterally of the quarry-bar, so as to give the drills any desired forward or backward inclination. The boxes 81 are constructed with open ends 83, adapted to allow the withdrawal of the heads of the pivotal bolts 82 for the purpose of replacing such bolts should they become broken off as a result of repeated adjustments, it being observed that when the pivotal connecting-bolt is separable or removable from the boxes 81 only the bolts need be replaced when they are broken, whereas if the bolts and boxes were integral with one another an entire new box would have to be substituted when its bolt became broken. Said boxes 81 are also constructed with apertures adapted to receive the legs K and to allow a sliding vertical adjustment of the same therethrough, and they are provided with adjusting-bolts 84, Fig. 6, extending through one of their sides and arranged to be screwed against the legs K, so as to lock the same in adjustment.

In the drawings the legs K are shown provided with weights 85, which are desirably attached thereto for the purpose of preventing the reaction of the drills from lifting the tool from the ground.

It will be understood that although I have shown my improved valve mechanism operating a plurality of drills the same can be used for operating a single drill without departing from the spirit of my invention.

What I claim is—

1. An impact-tool provided with a ported piston-chamber, a reciprocating piston moving therein, and a couple of coöperating fluid-actuated valves for distributing motive fluid to the piston-chamber independent of the piston movement; and constructed with separate ports for supplying motive fluid separately to the piston-chamber and to the chamber of one of said valves, as set forth.

2. An impact-tool comprising a ported piston-chamber, a reciprocating piston moving therein, a fluid-actuated piston-valve for distributing motive fluid to the piston-chamber, means for distributing motive fluid to the piston-valve independent of the piston movement, and a couple of supply-ports arranged to supply motive fluid separately to the piston-chamber and to the piston-valve chamber, as set forth.

3. An impact-tool comprising a ported piston-chamber; a reciprocating piston arranged therein; a fluid-actuated reciprocating piston-valve for distributing motive fluid to the piston-chamber; a fluid-actuated reciprocating supplemental valve arranged to distribute motive fluid for reciprocating the piston-valve, and arranged also to receive motive fluid from the latter upon the arrival of the same at the ends of its stroke; and a couple of supply-ports for supplying motive fluid separately to the piston-chamber and to the piston-valve chamber, substantially as described.

4. In an impact-tool, the combination of a couple of separated reciprocating piston-heads connected so as to reciprocate in unison and also so as to form a space between them; a piston-chamber therefor provided with a live-motive-fluid-inlet port which communicates with the space between the piston-heads during their reciprocation, and also provided with a couple of cushioning ports which serve to connect the space between the piston-heads with one or the other of the ends of the piston-chamber when the piston-heads are approaching that end of the chamber; and a couple of inwardly-opening automatic check-valves arranged respectively within one and the other of said cushioning ports, as set forth.

5. In an impact-tool, the combination of a plurality of independently-reciprocating pistons confined within a plurality of piston-chambers having their ends connected by ports; and a valve mechanism operating independently of the movement of any one of said pistons, and comprising a couple of coöperating fluid-actuated reciprocating valves, one of which distributes motive fluid to one of said piston-chambers, as set forth.

6. In an impact-tool, the combination of a vertically-adjustable leg; a support, such as the yoke 80, for the leg-holding box; a removable pivotal adjusting-bolt 82 extending through the leg-support; a hollow leg-holding box inclosing the head of the pivotal bolt 82 and having one of its ends closed and fitted between said bolt-head and the leg-support, and the other one open so as to permit the bodily removal of the bolt, and also having its upper and lower sides provided with apertures into which the leg can fit and through which it can slide; and a locking-bolt 84 which extends through one of the vertical sides of the box 81, and serves as a means of locking the leg in adjustment, substantially as described.

7. In an impact-tool, the combination with a couple of separated piston-heads and a spirally-grooved connecting-rod connecting the same, of a toothed collar secured tightly to the

walls of the piston-chamber and fitted loosely over the connecting-rod; a correspondingly-toothed and internally-tongued loose collar having a friction connection with the connecting-rod; and a disk also secured to the walls of the piston-chamber and arranged to afford a stop limiting the movement of the loose collar longitudinally of said piston-chamber, substantially as described.

JAY B. RHODES.

Witnesses:
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