

A. E. CHODZKO.
ROCK DRILLING MACHINERY.

No. 483,901.

Patented Oct. 4, 1892.

Fig. 1.

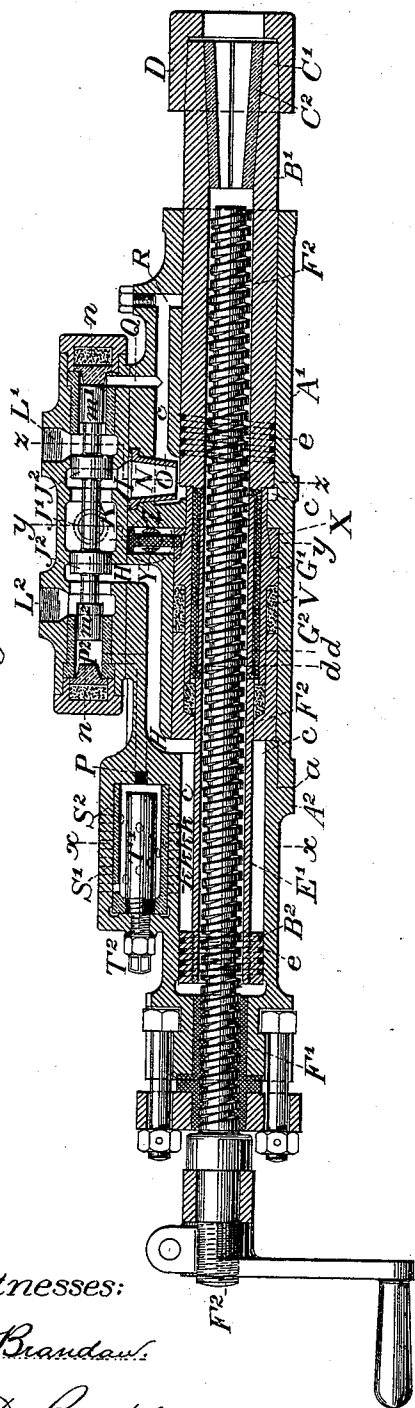
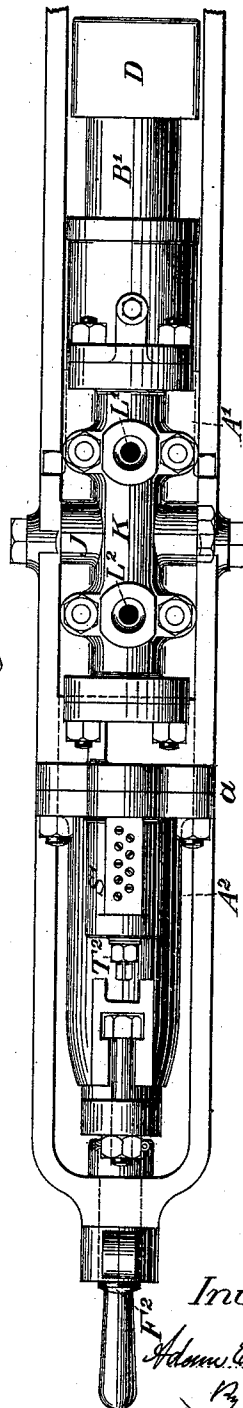


Fig. 2.



Witnesses:

E. A. Brandau.

W. D. Bentley.

Inventor:

Adam E. Chodzko.
John Richards,
Att'y

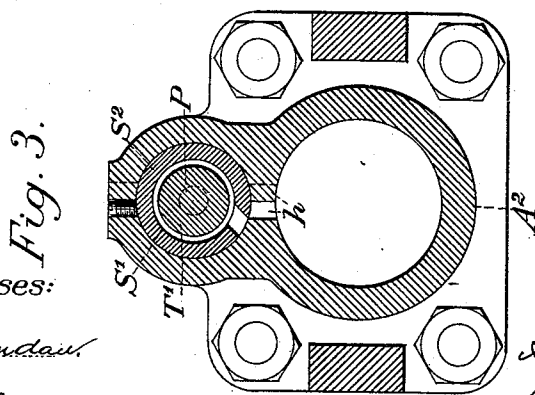
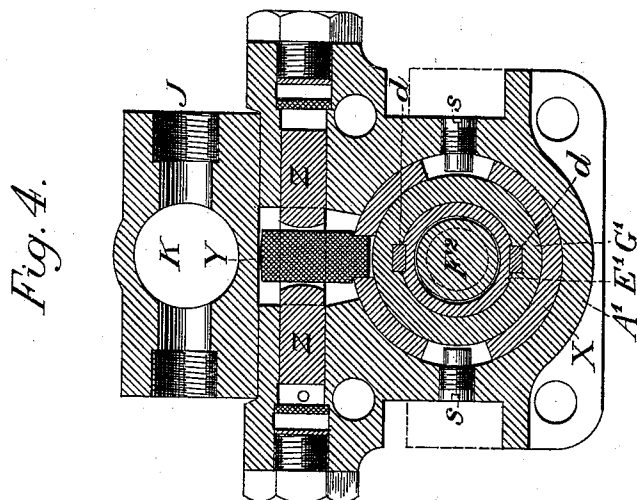
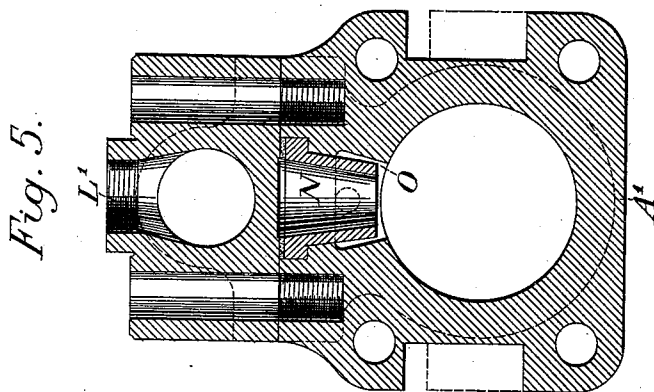
(No Model.)

2 Sheets—Sheet 2.

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By John Richards atty

UNITED STATES PATENT OFFICE.

ADAM E. CHODZKO, OF SAN FRANCISCO, CALIFORNIA.

ROCK-DRILLING MACHINERY.

SPECIFICATION forming part of Letters Patent No. 483,901, dated October 4, 1892.

Application filed September 10, 1891. Serial No. 405,303. (No model.)

To all whom it may concern:

Be it known that I, ADAM E. CHODZKO, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Rock-Drilling Machines; and I hereby declare the following specification and the drawings accompanying and forming part of the same to be a full, true, and exact description of my invention.

My invention relates to reciprocating drilling-machines to operate by either air or steam pressure; and it consists in so constructing such machines that the distributing-valves will operate independent of the main pistons, and thus permit a longer or shorter stroke, as the circumstances or requirements of the work may demand.

My invention also consists in placing the advancing or feeding screw of such machines in the axis of the main piston central with the moving mass and directly in the line of concussion or resistance, and also in providing a variable lead for the main valve for the return or back stroke of the piston, so that the action of the piston may be uniform when operating at various angles and whether its gravity falls on the forward or back strokes.

My invention further consists in dividing the main piston into two parts, the steam or air acting between them, so that the outer faces thereof are open to the air, thus dispensing with heads and glands for the main cylinder in which the pistons move; also, in placing between these pistons or parts of the main piston a partition or abutment, arranged with packing-glands secure from grit and dust and serving as a collar for rotating the main pistons and drills thereto attached, and also acting as an elastic buffer in case of overstroke of the pistons either way.

My invention also includes the manner of attaching the drills to the end of the piston-rod by means of conical surfaces and by friction alone and in other details that will be more fully explained in connection with the drawings.

Referring to the drawings, Figure 1 is a longitudinal section through the center of a rock-drilling machine constructed according to my invention. Fig. 2 is a plan view of the same machine. Fig. 3 is a cross-section on

the line *xx* of Figs. 1 and 2. Fig. 4 is a cross-section on the line *yy* of Figs. 1 and 2, and Fig. 5 is a cross-section on the line *zz* of the same figures.

Similar letters of reference on the different figures of the drawings represent corresponding parts of the machine.

I will first proceed to explain the nature and functions of such machines, as they have hitherto been constructed, so as to more clearly point out the nature and objects of my own invention.

In the class of implements called "reciprocating" rock-drilling machines, actuated either by steam or compressed air, a piston is moved back and forth in a cylinder, and has attached at the end of its rod a boring tool or drill, the impact of which against the rock disintegrates it, and thus gradually produces a hole of the required depth. Such a machine has three principal functions that may be described as follows: First, the motive agent, which, for convenience of language, I will hereinafter call "steam," must be in proper time admitted alternatively on the two opposite sides of the working piston and then exhausted after it has accomplished its work; second, the boring-tool must be partially turned at each blow, so as to insure a round or cylindrical hole, this being best adapted to the efficiency of explosives in blasting the rock, also preventing the tool from being jammed in the hole; third, the strength of the blow delivered on the rock by the cutting-tool must be varied at will, and the pressure on the piston being constant the required variation of force is attained by changing the length of the stroke; fourth, the stand, column, or carriage upon which the machine is fastened being stationary, the variation of stroke requires an adjustment of the cylinder, in which the piston moves in the direction of that movement. These being the main requirements, I will next revert to the various operations that must be performed in the present class of rock-drilling machines.

Distribution of steam.—The piston being on the upper end of the stroke or its remotest position from the rock, steam is admitted into the cylinder and drives the piston ahead until the impact takes place between the tool and the rock. Then the steam

must be exhausted and the other face of the piston put in communication with the steam-pressure, so as to bring the piston back to its former position. This is effected by means of a valve, similar in its principle to the valve of a steam-engine, and in all existing machines of that class, so far as I know, the motion of the valve is controlled by the motion of the piston. The way in which this interdependent action is established constitutes a special feature in the various kinds of rock-drilling machines in use, the valve being either of the flat or of the cylindrical kind; but the mechanism for that purpose is either by direct connection, in which the valve is actuated by a tappet, set in motion by the piston, which strikes it on its forward and backward strokes, or by indirect connection, in which the valve is actuated by two small single-acting pistons, one at each end, the steam being admitted and exhausted to and from these pistons either through ports covered and uncovered by the main piston or by means of an auxiliary valve actuated by the main piston. Now as the same machine may have to be worked either by steam or compressed air, and as the latter cannot be used expansively to any extent, it is customary to give no lap to the main valve—that is to say, the moment the exhaust begins on one side of the piston steam commences rushing in on the other side. Whichever of these two classes the valves belong to it requires a certain amount of movement of the main piston to effect the reversing of the main valve, and the simplicity of such machines, which is essential, leads to a construction which reverses the valve for the shortest stroke of the main piston. The result of this is that whenever the motion of the main valve is controlled by the motion of the main piston the reversing of that valve takes place continually at the same point of the stroke. Consequently for any longer stroke than this steam is acting on the wrong side of the piston during the latter part of its stroke, and the only force after the reversal of the main valve is the surplus momentum or *vis viva* of the piston. This is a necessary condition of the method of operating just described, causing the blows to be more or less impaired, or “cushioned,” as it is called, when they exceed the normal range or shortest stroke. Devices have been suggested to effect the reversal of the main valve after the blow has taken place, some devices consisting of a piece moving with the main piston and free to slide by its inertia in the direction of its motion, so that when the drill stops against the rock the momentum of that piece causes it to continue its forward motion and reverse the valve. The rotating motion of the piston commonly takes place during the backward or return stroke as the drill is withdrawn from the hole. The piston or the piston-rod is connected by means of helical grooves with a ratchet-disk free to turn one way, but locked the other way, either by spring-pawls or by a

small auxiliary piston under pressure acting on a lock of some kind. In some cases the helical grooves are replaced by straight slots, and then the ratchet must be actuated by pistons acting at proper intervals or points of the stroke. The first-named device imparts to the piston an amount of angular motion proportional to its stroke, and the second a constant amount of angular motion regardless of the stroke. The motion of the cylinder that regulates the range of the stroke is generally adjusted by means of a screw parallel to the piston's movement and operating either automatically by the piston or by hand, the latter being most common. These feeding or adjusting screws are commonly placed at one side of main cylinder, the thrust producing oblique strains. With these remarks, to enable me to more fully explain my invention, I will now proceed to describe the same with the aid of the drawings.

Referring to the different figures of the drawings and letters of reference thereon, the following is a detailed description of my machine:

A' A² is the cylinder, made in two parts, in which the pistons B' B² move backward and forward. At the extreme end of the piston B' the drill is held by a chuck D. The piston, with its connecting-rod or middle section E, is hollow and made in one piece, except the back head B², which is screwed on when the piston is in place. The cylinder is formed of two parts A' and A², the front piston-head B' sliding in the part A' and the back head B² in the part A². These parts A' and A² are bolted together at *a*, and to the part A² is attached the feed-nut F' of the feed-screw F². This feed-screw extends centrally through the bore of the piston B' B², as shown in Fig. 1.

Between the two heads of the piston B' B² and surrounding its central part E' is a partition or abutment G' G², fitting within and against the two parts of the cylinder A' A². Steam enters at the valve-chamber K and is introduced into A' and A² and exhausted therefrom through ports H and I. The distribution of steam through these ports is performed by a cylindrical valve J², which can be put in communication with either one of these ports H and I with the steam-chamber K, and also the exhaust-ways L' and L², performing the ordinary functions of an engine slide-valve.

The main valve J² is operated by two small detached pistons *m'* and *m*², pressing on its ends, as shown. These small pistons *m'* and *m*² can be formed integrally with the valve J²; but for constructive reasons are preferably made separate. The small pistons *m'* and *m*² are arrested at each end of the main valve's stroke by elastic buffers *n n*, as shown in Fig. 1. These small pistons *m'* and *m*² are in communication through the ports P and Q with the interior *c c* of the main cylinder A' A² and actuate the main valve J and the pistons B' B² in the following manner: Sup-

posing the piston B' to be at the outer extreme of its stroke, as shown in the drawings, Fig. 1, and also the valve J² at the extreme of its stroke, also as shown, communication is then established between the chamber c of A² and the exhaust-port I² through the port H on one hand and also with the chamber c of the cylinder A' and the steam-inlet chamber K through port I and nozzle N on the other hand. The steam thus rushes into the cylinder A' at c, driving forward the piston B², making a working stroke of the drill attached at D. The nozzle N is placed between the port I and cylinder A', so that its lower edge passes through an annular chamber O, communicating through the port Q with the back of the small piston m'. While the steam is rushing through the nozzle N into the cylinder A', and so long as the piston B' offers no resistance beyond its friction, there is no tendency for the steam to fill the chamber O, because its velocity through the nozzle N causes it rather to produce a suction from the chamber O around the nozzle N by an induced current, as is the case of an injector or ejector. This goes on as long as the piston B' is driven forward by the inrushing steam; but should the piston stop, either by delivering a blow or by other cause, then the steam in A' is confined, its inflow ceases, and the pressure immediately fills up the chamber O and port Q, pressing on the small piston m', consequently moving the valve J in the opposite direction. Steam is by this means admitted to the piston B² and the back stroke of the main piston B' and B² takes place, while the chamber A' is in communication through the ports N and I with the exhaust-port I'. In this manner it may be seen that the machine may make a forward stroke of any length and the main valve J² be reversed as soon as the piston is stopped. This same mode of action for reversing the valve J² at different points of the stroke of the main piston I have attained, also, by the use of a small supplementary valve which gave satisfactory results; but the construction here shown is preferable, being more simple and involving no moving parts. After the piston B' has traveled a certain distance on its back stroke the piston B² uncovers, successively, a series of holes h h h in the top of the cylinder A², communicating with a chamber S' and the shell S², thence passing through a port P and a channel at the back (shown in dotted lines) to the chamber P² behind the small piston m'. These holes h h h may be of any form and are disposed in such a way that the edge of each one of them corresponds to the edge of the next preceding one, thus constituting, in effect, a continuous slot. In the cylindrical-chamber S' the hollow sleeve S², has holes disposed helically around its bore, so that by turning it more or less either one of the radial holes can establish communication through the center of the valve or cylinder T' and the port P between the chambers S and c. This, with com-

munication through the port P to the small piston m², produces a variable lead of the main valve J² and admits steam to the piston B' sooner or later, according to the length of the stroke desired, and accommodates the position of the machine and consequent gravity of the pistons B' and B² in the line of their movement, so as to secure a full range and force of the blows, whether the machine be vertical, horizontal, or at any angle. For example, one of the end holes h is so arranged that the lead of the main valve J² is correct when the machine is drilling overhead vertically and the gravity of the parts falls on the back stroke. The other end hole h is arranged for drilling downward, so that the gravity of the moving parts is opposed to the back stroke, so that the action will be uniform in both cases. The intermediate holes h h correspond to intermediate positions and prevent impact of the piston B' on the cylinder A' by providing a cushion in the chamber A'. This change of lead for the valve J² is effected by loosening the screw-nut T², that holds the sleeve T' at the back of the chamber S, and turning this sleeve to the proper position and fastening the nut again, which operation can be performed when the machine is in motion.

The pistons B' and B² are packed with a steel wire shown at e e, Fig. 1, coiled in helical instead of annular grooves around the periphery of the pistons, forming a very simple packing, leaving no open or cross joints, as is the case with annular rings.

The partition, consisting of members G' and G², prevents communication between the chambers A' and A² of the main cylinder. This partition is formed of two parts overlapping each other, so as to form, in effect, two stuffing-boxes, as shown, compressing packing both around the piston-rod and against the walls of the inclosing cylinder. The ends of the piece G' and G² are solidly abutted against the shoulders in the cylinders A' and A², so that they cannot move apart, but may move toward each other as the elasticity of the packing will permit. The result of this is that during the forward stroke of the pistons and the drill the pressure of the steam acts upon the front part of the sleeve G' and squeezes the packings tighter as the pressure becomes greater, and on the backward stroke the same effect takes place, the outer part G² receiving from the steam reactive pressure equal to that on the piston B', thus constituting an automatic packing that does not require adjustment when in use. This partition also acts as a buffer both ways for the piston. The outside packing V of the shell is preferably made of india-rubber. The impact of the piston B² on the shell G² is also checked by the action of the steam through the port R, because as soon as the piston B' passes this port the steam is admitted through ports R and Q behind the small piston m' and reverses the main valve J² before the piston B² reaches the shell G², and thus cushions it. The shell or partition acts, also,

as a revolving ratchet for the piston and drill. On the piston-rod E' are two feathers or keys d d , fitting into two corresponding slots in the inner sleeve G'. These keys are long enough
 5 to engage the sleeve in all positions of the piston-rod E', so that by turning the sleeve the piston will be revolved accordingly or will maintain a rectilinear movement when the sleeve G² is fixed. Rotation of the sleeve G'
 10 is performed by means of a friction-clutch, as follows: A ring X fits on a taper portion of the sleeve G' and can turn freely around it as long as there is no pressure on the surfaces or between them, but when pressed together
 15 both revolve together. This ring X is kept from moving lengthwise in the cylinder by two set-screws s s , (shown in Fig. 4,) inserted in slotted holes cut through the sides of the collar X. This permits a partial rotation of
 20 the latter, which is actuated by the stud Y, and this again by the pistons Z Z, one of which communicates with the port I and the other end with the port P, connecting with the main cylinders A' and A². The result is that during
 25 the back stroke the clutch X and the shell G' is in contact ready to operate, but does not act until the port P is supplied with steam at the end of the back stroke and when there is little or no resistance to the rotation of the
 30 drill. In this way undue wear of the keys or feathers d d is avoided. If communication was made between the pistons Z and the port H instead of Z and P, then rotation would take place during the whole of the back stroke.
 35 From the construction of the partition G' G² it is seen that during the forward stroke the sleeve G', being pushed backward by the steam in chamber A' and the collar X being held by the set-screws s s , the clutch is open,
 40 and the ring X can turn without driving the sleeve G'. In other words, the clutch is put in gear during the back stroke by the pressure of the steam on the rear shell G² and on the taper surfaces of the ring X and is put
 45 out of gear during the forward stroke by the pressure of steam on the sleeve G'.

The feeding-screw F² is placed centrally through the axis of the pistons and in alignment with the drill, so that all reactive force
 50 or thrust is balanced on the screw and no diagonal strains exist. This construction is fully shown in the sectional view of the parts in Fig. 1 and also in Fig. 4 of the drawings.

The chuck D is made as follows: The end
 55 C' of the piston B' has a conical bore, into which is fitted a bushing made in halves to embrace the taper shank of the drill. The ends of both C' and C are split diametrically, so that a pressure applied around the two
 60 jaws thus formed grips the taper bushing and the drill-shank. The cap D is made slightly tapering to fit on the outside end of the piston C', and the bushing and bit being in position this cap D is driven on by blows of a
 65 hammer, securing all the parts firmly together.

When a machine commences to work, the first blows have a tendency to force the drill

into the bushing C² and expand it. This expansion increases the grip of the cap D and holds the drill more firmly. A blow on the
 70 back end of the cap D relieves the grip on the jaws, so that the drill can be removed.

Having thus described the nature and objects of my invention and the method of constructing and operating the same, what I
 75 claim as new, and desire to secure by Letters Patent, is—

1. In a rock-drilling machine, the combination of the main cylinder, a hollow piston therein consisting of hollow end members and
 80 a tubular connection between them, a feed-screw located within the central bore of the piston, a main valve alongside of the cylinder, and suitable ports and passages arranged so that the action of the steam may be between
 85 the end sections of the piston, substantially as described.

2. In a rock-drilling machine, the combination of the main cylinder consisting of two parts, a hollow piston therein consisting of the
 90 hollow end members and the tubular connection between them, a partition in said cylinder, which forms a tight steam-joint around the central tubular connection of the piston, a feed-screw located within the central bore
 95 of the piston, and a main valve which introduces steam to act between the piston-heads, substantially as described.

3. In a rock-drill, the combination of the main cylinder consisting of two parts, a hollow piston consisting of the hollow end members or heads and a central tubular connection
 100 between them, an adjusting or feed screw located within the central bore of the hollow piston, a partition in the main cylinder, said partition being provided with external and internal packing, so as to form an automatic
 105 steam-joint both around the central tubular part of the piston and also against the walls of the main cylinder, a main valve, and the ports and passages arranged so as to introduce the impelling-steam between the end
 110 members of the pistons and permit the action thereof, substantially as described.

4. In a rock-drilling machine, the combination of the main cylinder, the piston therein,
 115 the main valve and its chamber, and the ports H, I, and Q, together with the steam-passage connecting the ports I and Q, so that when the steam-current is arrested it will react on
 120 the main valve and reverse the piston at any point in its stroke, substantially as described.

5. In a rock-drilling machine, the combination, with the main valve J², of the conical nozzle N, placed in the principal port for the
 125 forward stroke and so arranged as to produce an induced current as the piston moves forward and a backflow of steam if the piston stops, thus reversing the main valve J² at any point of the main stroke where the pistons
 130 may stop, substantially in the manner described.

6. In a rock-drilling machine, the main valve J², and the piston m' and ports Q and R, the

latter opening into the main cylinder, so as to determine the extreme range of stroke for the pistons and drill and reverse the main valve J^2 at some predetermined point, substantially in the manner and for the purposes specified.

7. In a rock-drilling machine, the combination, with the main cylinder and the main valve, of the ports H, I, and Q and the annular chamber adjacent to the port I, the piston within the cylinder, and the piston m' , substantially as described.

8. In a rock-drilling machine, the combination of the main cylinder, a piston therein, the main-valve chamber, a valve therein having an auxiliary valve-piston, the passages leading to the small piston m' at each end, the steam-passages between the main-valve chamber and the cylinder, and a nozzle located in one of them through which steam may pass into the cylinder from the valve, with the result of producing an induced current as the piston moves forward and a back-flow when the piston stops for the purpose of reversing the main valve at any point of the main stroke where the piston may stop, substantially as described.

9. In a rock-drilling machine, the combination of the main cylinder, a piston therein, a main-valve chamber and its valve therein, another chamber communicating with the cylinder through a series of holes h , the in-

terior of said chamber communicating with the main valve through a suitable passage, and a hollow sleeve within the aforesaid chamber, having holes disposed helically around its bore, so that communication may be established through the center of the chamber and the other chambers of the machine, substantially as described.

10. In a rock-drilling machine, the combination of the main cylinder, a piston therein, a main-valve chamber with valve therein, a cylindrical chamber S' , communicating with the cylinder through the openings h , a port P between the chamber S' and the main valve, a hollow sleeve S^2 within the chamber S' , having holes disposed helically around its bore, so that by turning it more or less either one of the radial holes can establish communication through the center of the cylinder T' , port P, and other chambers, and the screw-nut T^2 , which holds the sleeve T' , which screw-nut is adjustable for the purpose of changing the lead for the main valve, substantially as described.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

ADAM E. CHODZKO.

Witnesses:

ALFRED A. ENQUIST,
WILSON D. BENT, Jr.