(No Model.)

2 Sheets—Sheet 1.

S. W. DOUGLASS.

EXPANSION ROTARY DRILL.

No. 274,740. Patented Mar. 27, 1883.

Fig. 1.

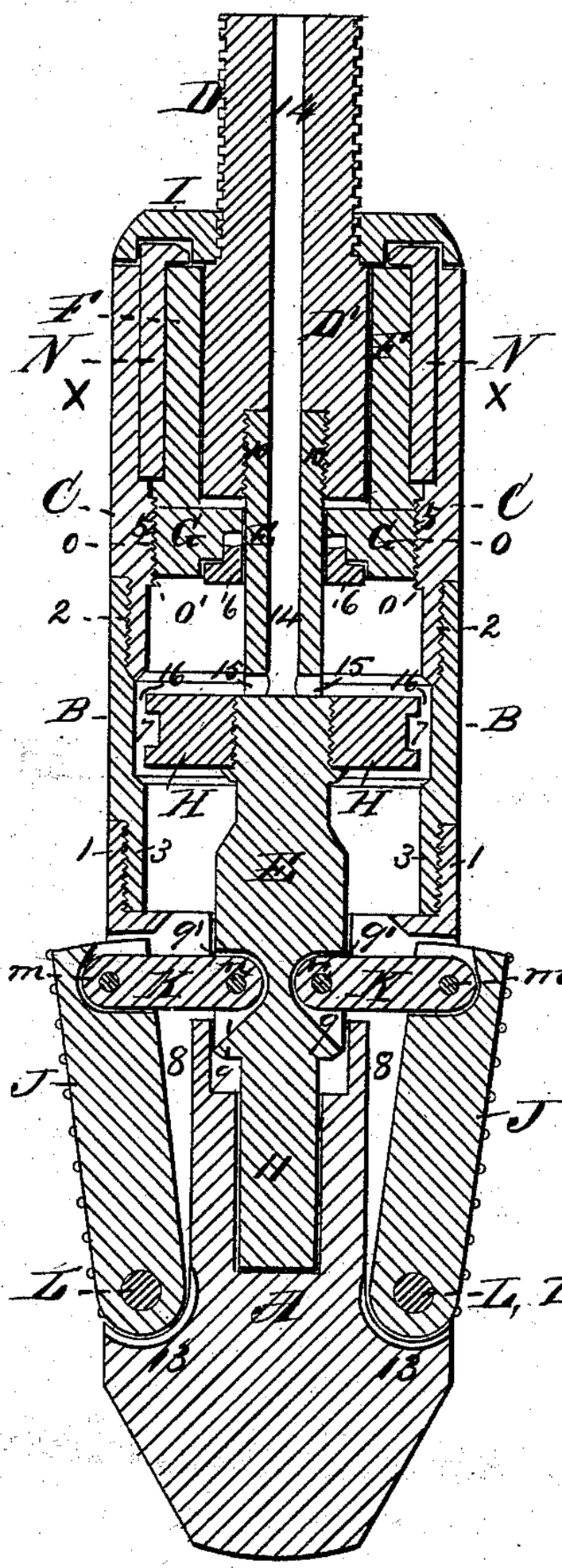
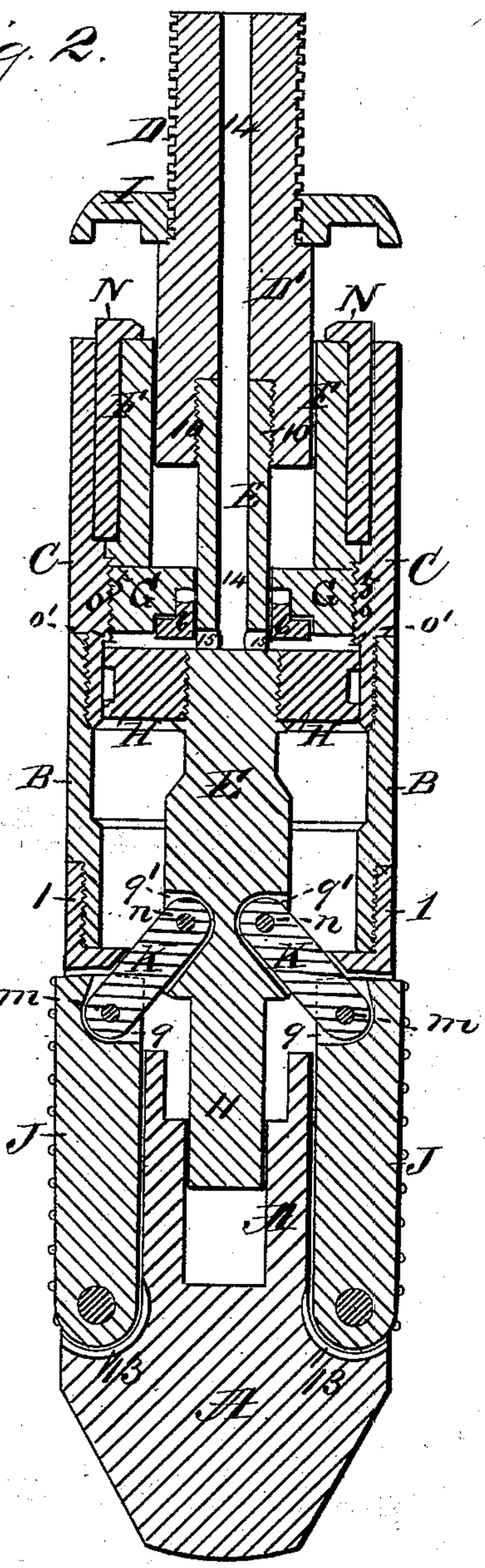


Fig. 2.



Witnesses.
John J. Cauldwell
John J. O'Brien

Inventor:
Samuel W. Douglass
by Wellington Jenner & Thompson
his Attorney

(No Model.)

2 Sheets—Sheet 2.

S. W. DOUGLASS.

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Fig. 3.

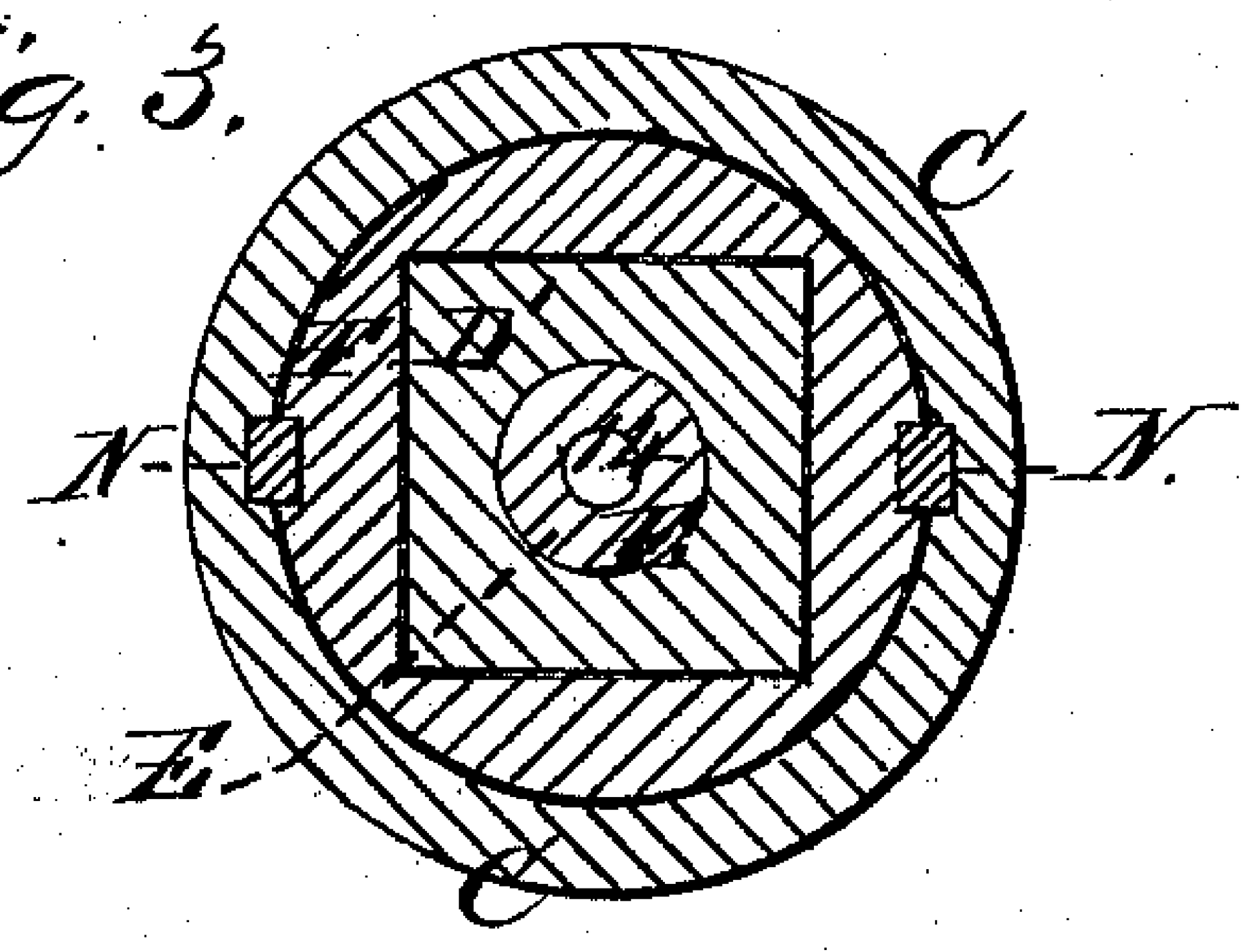


Fig. 4.

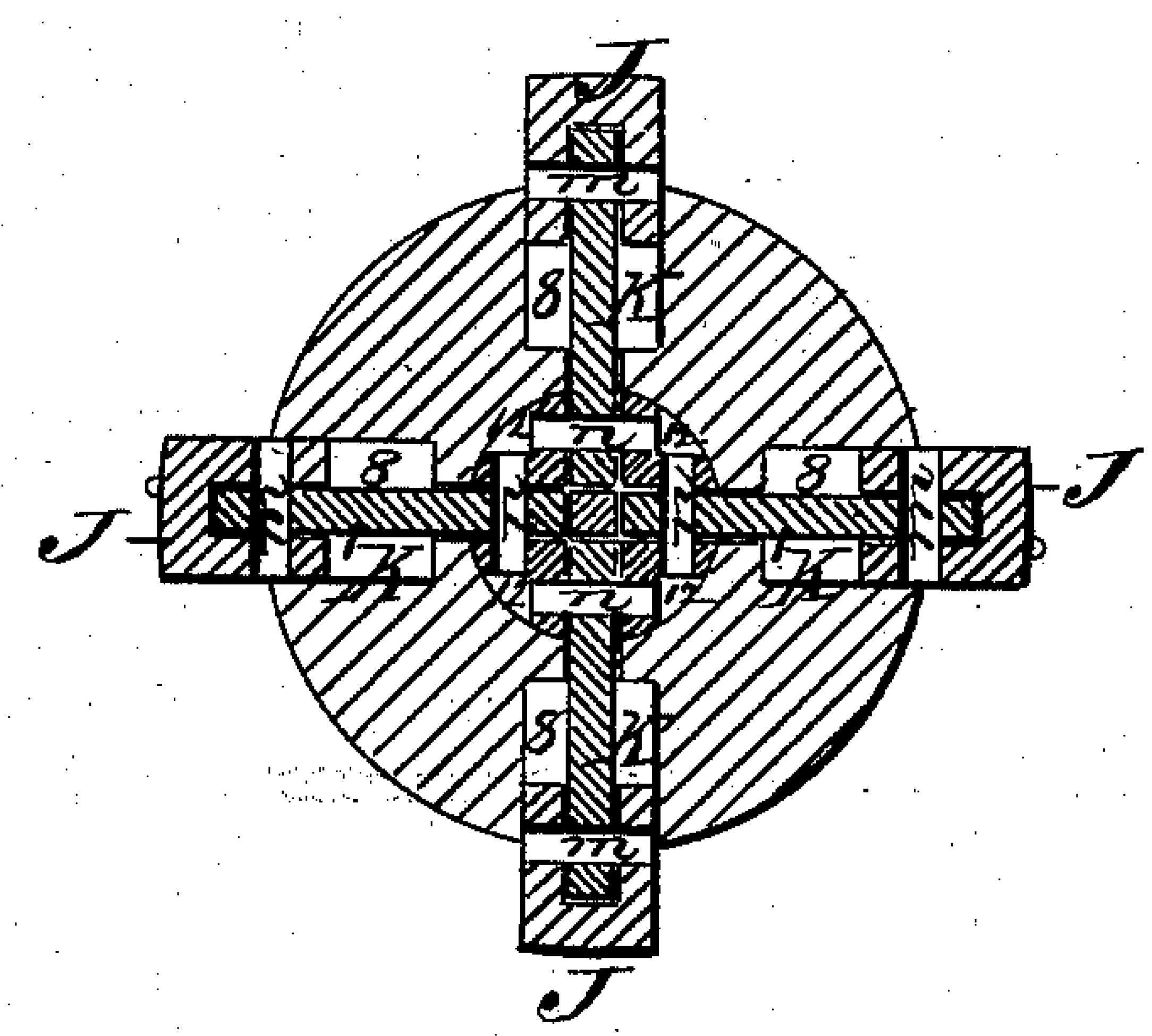
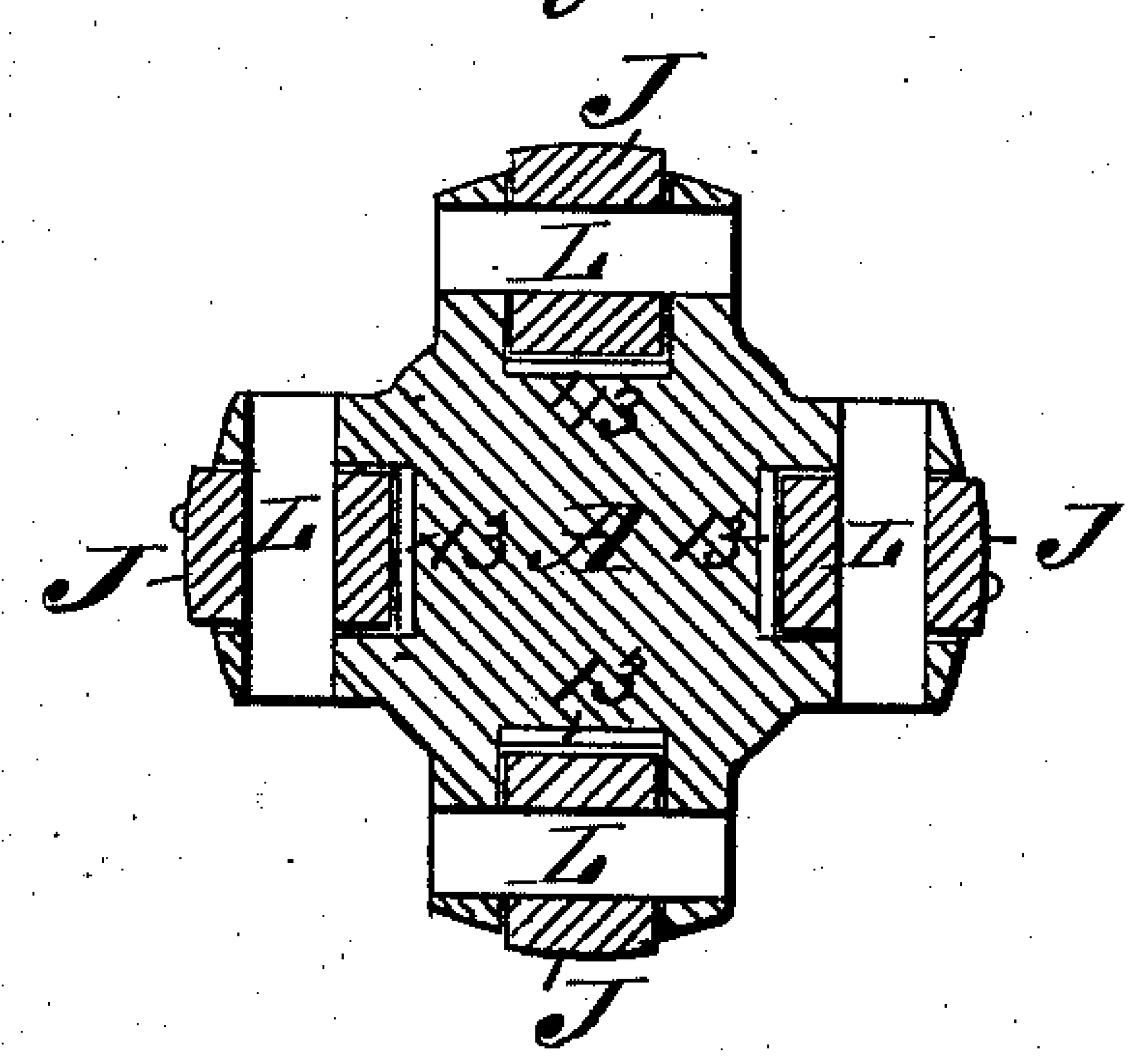


Fig. 5.



Witnesses:

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John J O'Brien

Inventor:

Samuel W. Douglass by Wetmore Jenner & Thompson his Attorney–

UNITED STATES PATENT OFFICE.

SAMUEL W. DOUGLASS, OF NEW YORK, N. Y., ASSIGNOR TO THE AMERICAN DIAMOND ROCK BORING COMPANY, OF SAME PLACE.

EXPANSION ROTARY DRILL.

SPECIFICATION forming part of Letters Patent No. 274,740, dated March 27, 1883.

Application filed December 2, 1882. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL W. DOUGLASS, of the city of New York, county and State of New York, have invented a new and useful Improvement in Expansion Rotary Drills, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, in which like letters indicate like parts.

Figure 1 is a longitudinal section of the expansion-drill, showing the cutting-bars extended. Fig. 2 is the same with the cutting-bars retracted. Fig. 3 is a cross-section through the line *x x* of Fig. 1. Fig. 4 is a cross-section through the line *y y* of Fig. 1. Fig. 5 is a cross-section through the line *z z* of Fig. 1.

This invention relates more particularly to rock-drills the cutting-faces of which are armed with diamonds, and through the drill-rod of which water is forced to keep the drill clear; but I do not limit myself to such drills, as my invention can also be used on any rotary expansion-drill. It frequently happens that it is desirable to enlarge the hole cut by the apparatus at some particular place below the surface, and this invention affords a means for so doing superior, as I believe, to any heretofore known.

In the following description I will assume that the boring apparatus is in a vertical position.

A is the lowermost portion of my expansion-drill, and it is a metallic head, preferably steel, of the shape shown in vertical section in Figs. 1 and 2 and in cross-section in Fig. 5; but at its upper part, at 1, it is cylindrical, and it may be cylindrical throughout, if preferred.

B is a coupling, also cylindrical, and of the same external diameter as A.

C is the uppermost section of my expansion-drill, and its lower part serves as a portion of the cylinder for the piston H, as hereinafter set forth. The section C is cylindrical, and of the same external diameter as both the coupling B and the head A. The coupling B is preferably connected with the section C by screw-threads 2, and with the head A by screw-threads 3; but, if preferred, it may be made in one piece with either of the other pieces. These three parts A, B, and C constitute the case of my improved drill, or that which, in the claims, I call the "drill."

D and D′ are an extension of the piston-rod proper, and D has upon the whole or part of it heavy screw-threads, by which it is connected with the drill-rod. The drill-rod is not shown.

E is the piston-rod proper, which passes through the cylinder-head G, and has the piston H fastened to it.

F is a circular piece of metal, square at top and bottom, and it fits tightly into the upper end of the section C, and is keyed to it by the keys N, which enter half and half into the section C and into this circular piece of metal, thereby preventing the same from turning in the section C. There is a square hole through this piece F, through which passes the square section of the extended piston-rod, (shown at D′.)

G is a cylindrical piece of metal, which is rigidly fastened in the section C by the screw-threads 5, and it serves as the head for the piston-cylinder. The threads 5 are cut on an inwardly-projecting circumferential portion of the section C, (shown at O.) Through the cylinder-head G the piston E works, as before stated, and it is provided with the usual packing-box used in such cases, (seen at 6.)

H is the piston, which is firmly attached to the piston-rod E, and it is provided, if desired, with the usual packing, 7.

I is a flat ring, of metal, rigidly fastened to the piston-rod D at the top of the square portion D′ thereof, and its diameter is not greater than the outside diameter of the section C. It has recesses on its under side for the accommodation of the heads of the keys N, if they have heads.

J are strong pivoted cutting-bars, made of steel. They are preferably four in number, and square in shape, except at the lower end, and are pivoted at or near their lower ends to the head A by the pins L. The shape of the head A, for the accommodation and convenient insertion of these bars and pins, is best seen in section in Fig. 5. These cutting-bars are armed with diamonds on their outer face, as usual, or other cutting devices, if desired, and they lie in recesses cut for them within the head A, (seen at 8.) These recesses are of sufficient size

and conform to the shape of these bars, so that the bars can be completely retracted within them.

K are toggle-arms, which are pivoted at one end to the upper end of the cutting-bars by the pins *m*, and at their other end to the piston-rod E by the pins *n*. A portion of the head A is cut away, as at 9, to allow of the swinging of these toggle-arms, and they are so pivoted to the piston-rod that when the cutting-bars are projected the toggle-arms shall lie substantially at right angles to the piston-rod. The piston-rod is also cut away, as at 9′, to allow the toggle-arms to swing in it. The piston-rod may be made in two sections, as shown in the drawings—one (the lower one) shown by E, and the other (the upper one) shown by D D′—and they are connected and made one continuous rod by the screw-threads 10. For the purpose of supporting, guiding, and giving greater strength to the piston-rod, the lower portion of E, as seen at 11, works into a recess made for it in the head A, and this portion 11 may be either round or square, preferably square, the recess in which it enters being made to correspond, for it then aids in turning the drill, as hereinafter set forth. The piston-rod E is cut away in triangular-shaped spaces, (seen at 12,) to allow the pins *n* to be easily put in place and fastened.

Around the lower end of the cutting-bars a water channel or passage-way (seen at 13) is cut out of the head A. Through this channel or passage the water can pass; and it can also pass between the cutting-bars and the walls of the recesses, in which they work. Through the extended piston-rod D D′, and also through that portion of it marked E, which is above the piston H, a water-passage is cut, (shown at 14 and clearly seen in Fig. 3.) Just at the upper side of the piston H this water-passage divides into a number of smaller passages, (seen at 15.) These may, as shown, run at right angles to the passage 14, and they discharge just above the piston H and between it and the head G; and in order that there may be a space between the piston and the head, so that the water may have an opportunity to exert its force, I extend the inwardly-projecting circumferential portion of the section C (seen at O) somewhat below the under side of the cylinder-head G, which thus presents a shoulder, O′, against which the piston brings up and cannot go any farther; and the adjustment of the parts should be such that the piston will not strike this shoulder until the cutting-arms J have been fully retracted and the diamonds on their outer faces are flush with the periphery of the drill-head A. If preferred, the toggle-arms K of the cutting-bars J may be so adjusted that they will bring up against some obstruction, and thus hold the piston from coming too near the stationary head G; or a stop may be put at any desired part of the apparatus to effect this end. The portion of the section C which is below the stationary head G is nicely turned out and fits the piston H, which works in it. The coupling B has slots or water-ways cut out from its inner periphery at the end of the piston-stroke, (seen at 16,) thus practically enlarging the internal diameter of the piston-cylinder, so that there will be a passage-way for water around the piston when it is at or near the end of its stroke. The drill-rod, which, as before stated, is screwed to the piston-rod by the threads on the portion D thereof, is provided with a continuous water-way through it, connected with the force-pump, through which the water is forced.

Having thus described my apparatus, I will now describe its method of operation.

Assuming that the hole to be acted upon is a vertical or practically vertical one, my improved drill is fastened to the end of the drill-rod by the threads on D, and is then passed into the hole till the drill lies at the upper part of the portion to be enlarged. During this insertion of the drill no water should be forced through the rod, and the weight of the head A, the coupling B, and section C causes the several parts of the apparatus to assume the position shown in Fig. 2, thus retracting the arms and allowing the apparatus to be easily introduced into the hole. When, as before stated, the drill has reached the part of the hole to be enlarged, the drill-rod is caused to revolve, which, acting through the square portion D′ of the piston-rod and the piece F, which is keyed by the keys N to the section C, causes the drill to revolve also, and at the same time the water is forced through the water-way in the drill-rod, as usual, and it passes in the water-way 14 through D and D′, and then, entering the upper end of E, it passes through it and out at the smaller passages, 15, and into the space between the piston-head G and the piston H. Here it can go no farther until, by the continued action of the pump or head of water, as the case may be, sufficient force is obtained to drive the cylinder-head G upward, which takes the drill with it, and as this takes place the piston-rod E, acting through the toggle-arms K, forces the cutting-bars J outwardly, as seen in Fig. 1, and the diamonds or other cutters on them, coming in contact with the substance to be removed, cut it away. The water presses the piston-head G upward until the water-ways (seen at 16) come opposite the piston, and when this takes place the water can escape around the piston through these water-ways; and further movement of the piston through the drill is stopped by the end of the piston E (seen at 11) reaching the bottom of its recess, or by some other suitable stop applied to any suitable portion of the apparatus. The water now passes through the lower part of the coupling B and through the spaces in which the toggle-arms work, and thence through the recesses in which the cutting-arms are, and out between them and the sides of the recesses and around their lower ends through the water-passages 13 to the outside of the

drill, where the cutting is being done, and thus cools the diamonds and cutting-bars and carries away the detritus. After the hole has been sufficiently enlarged the forcing of the water through the rod is stopped, the weight of the parts again causes them to assume the relative position shown in Fig. 2, and the drill can then be withdrawn from the hole. If the hole be a horizontal one or inclined upwardly from the machine, then the impingement of the cutting-arms J against the sides of the hole will force them into their recesses, so that the drill can be easily introduced into the hole.

If desired, the hole through the piston-head G may be squared, and that portion of the piston which works through it also squared. This will secure the revolution of the drill when the piston-rod is revolved, and will dispense with the square part D′ of the piston-rod and the piece F, through which is the square hole for D′; but the difficulty of packing a square piston-rod makes this undesirable. Also, if preferred, the lower extended end of the piston (shown at 11) may be squared, as before stated, and it, fitting into its square recess, will also effect the revolution of the drill. This may be the best method for small drills, and avoids the necessity for the squared portion D′.

If the expansion-drill be other than a diamond drill, so that the presence of water is not necessary at the place of the cutting, then there will be no necessity for the water-ways 16, nor for any water below the piston; but even in such drills I prefer to have the water pass, so as to keep the drill clean and to moisten and soften the earth or soft rock, and also to carry away the detritus.

My drills may be used with compressed air or steam as well as water, and my invention is applicable also to thread-cutting devices, the cutters being placed on the cutting-arms.

I claim as new—

1. The combination, in an expansion-drill, of a drill-rod, a piston-rod part of which is not cylindrical, and which part works through a corresponding and rigid part of the drill, the piston-rod also working through a cylindrical head within the drill, a piston attached to the piston-rod, which piston works through a part of the drill as its cylinder, the said drill-rod and piston having a water-passage through them down to the upper side of the piston, which there discharges between the piston and the cylinder-head, toggle-arms pivoted to the piston-rod at one end and to the cutting-bars at the other end, the cutting-bars themselves pivoted at one end to the toggle-arms and at the other end to the drill, and recesses in the drill for the reception of the cutting-bars, all combined substantially as and for the purposes set forth.

2. The combination, in an expansion-drill, of a drill-rod, a piston-rod a part of which is not cylindrical, and which part works through a corresponding and rigid part of the drill, the piston-rod also working through a cylinder-head within the drill, a piston attached to the piston-rod, which piston works through a part of the drill as its cylinder, the said drill-rod and piston having a water-passage through them down to the upper side of the piston, which there discharges between the piston and the cylinder-head, a water-passage around the piston at the farther end of the stroke to allow the water to pass beyond the piston, toggle-arms pivoted to the piston-rod at one end and to the cutting-bars at the other end, the cutting-bars themselves pivoted at one end to the toggle-arms and at the other end to the drill, recesses in the drill for the reception of the cutting-bars, and water-passages, so that the water can flow from below the piston to the cutting-faces of the cutting-bars, all combined substantially as and for the purposes set forth.

3. The combination, in an expansion-drill, of a hollow piston-rod, with openings from the outside to the inside of the piston-rod just above the piston and between it and the cylinder-head, and a piston fastened to it, and working in a suitable cylinder within the drill, the lower end of the piston-rod being connected with mechanism whereby cutting-bars may be projected and retracted from the face of the drill, all combined substantially as and for the purposes set forth.

4. The combination, in an expansion-drill, of a piston-rod and piston moving within the drill, toggle-arms attached to the piston-rod at one end and to cutting-bars at the other end, and the cutting-bars themselves attached at one end to the toggle-arms and at the other to the drill.

5. The combination, in an expansion-drill, of a rod and toggle-arms attached to the rod at one end and to cutting-bars at the other end, so that when the cutting-bars are in use the toggle-arms shall lie at substantially right angles to the rod, substantially as and for the purposes set forth.

6. The combination, in an expansion-drill, of a hollow piston-rod, with openings from the outside to the inside of the piston-rod between the piston and the cylinder-head, a piston fastened to the piston-rod and working in a suitable cylinder within the drill, a water-passage around the piston at the farther end of the stroke, the piston-rod being connected with mechanism whereby cutting-bars may be projected and retracted from the face of the drill, and water-passages from the space below the piston to the cutting-face of the cutting-arms, substantially as and for the purposes set forth.

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