

No. 807,826.

PATENTED DEC. 19, 1905.

F. G. IRVINE.  
UNDERREAMER.

APPLICATION FILED FEB. 11, 1904.

3 SHEETS—SHEET 1.

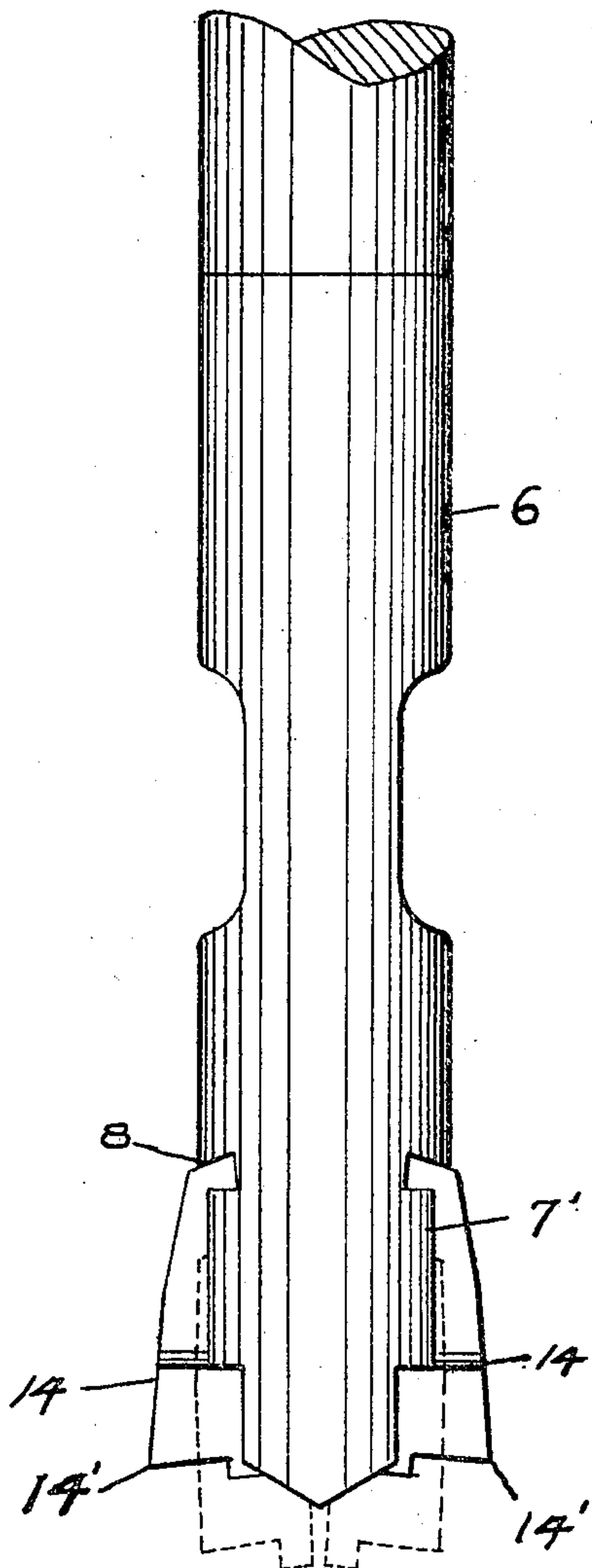


Fig. 1

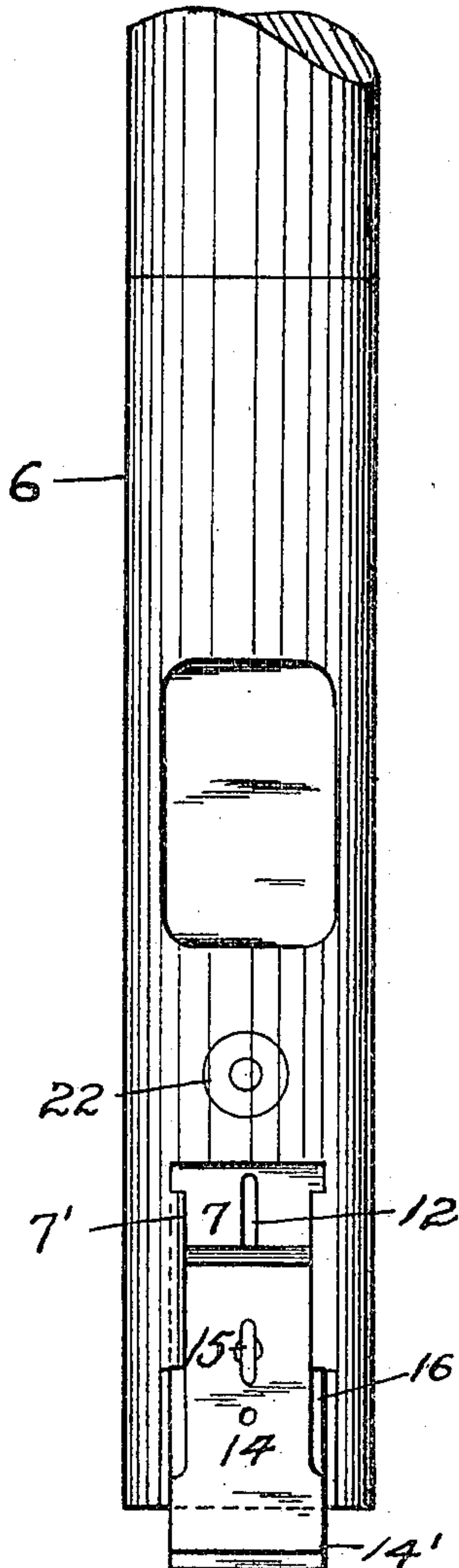


Fig. 2

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3 SHEETS—SHEET 2.

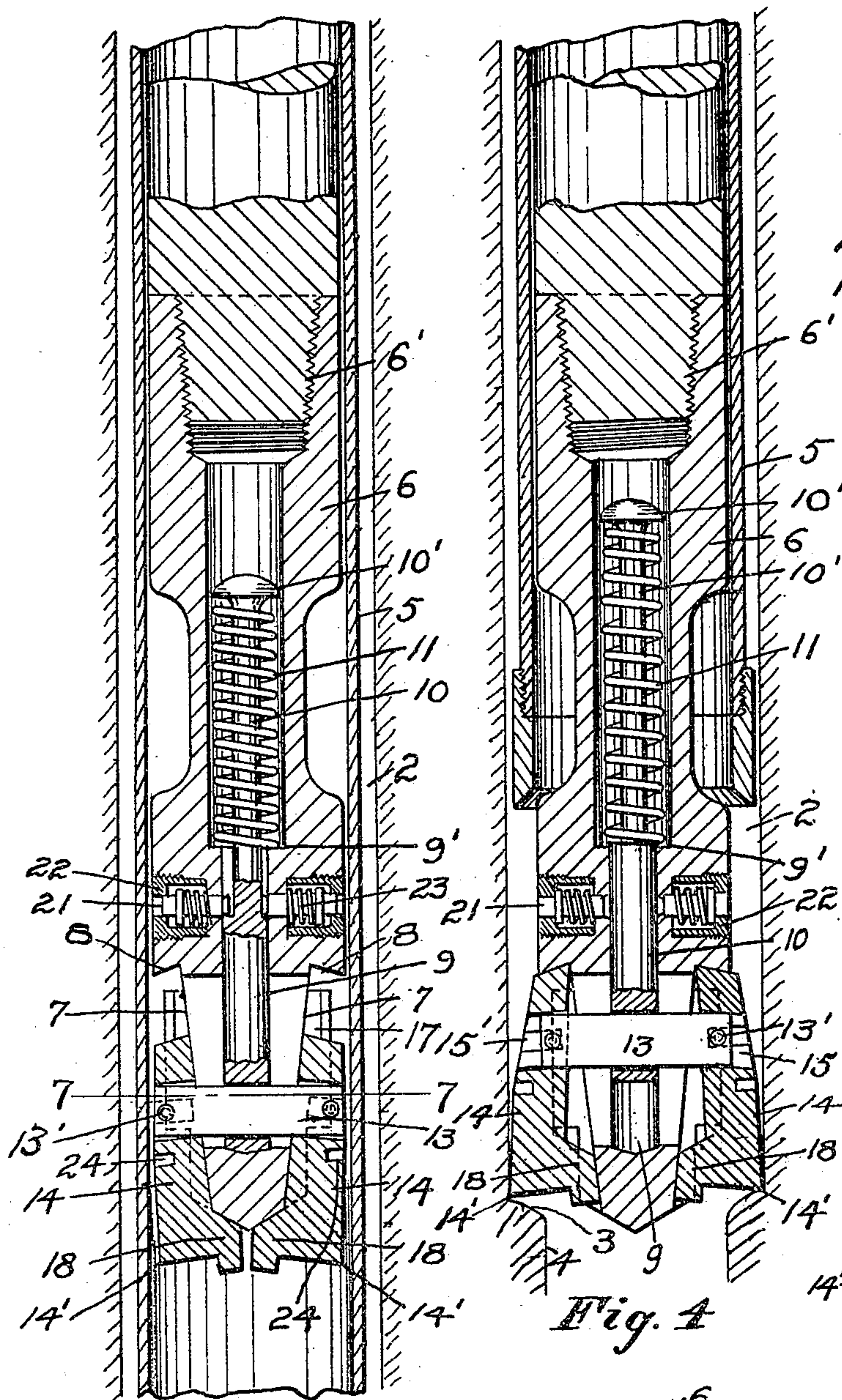


Fig. 3

Fig. 4

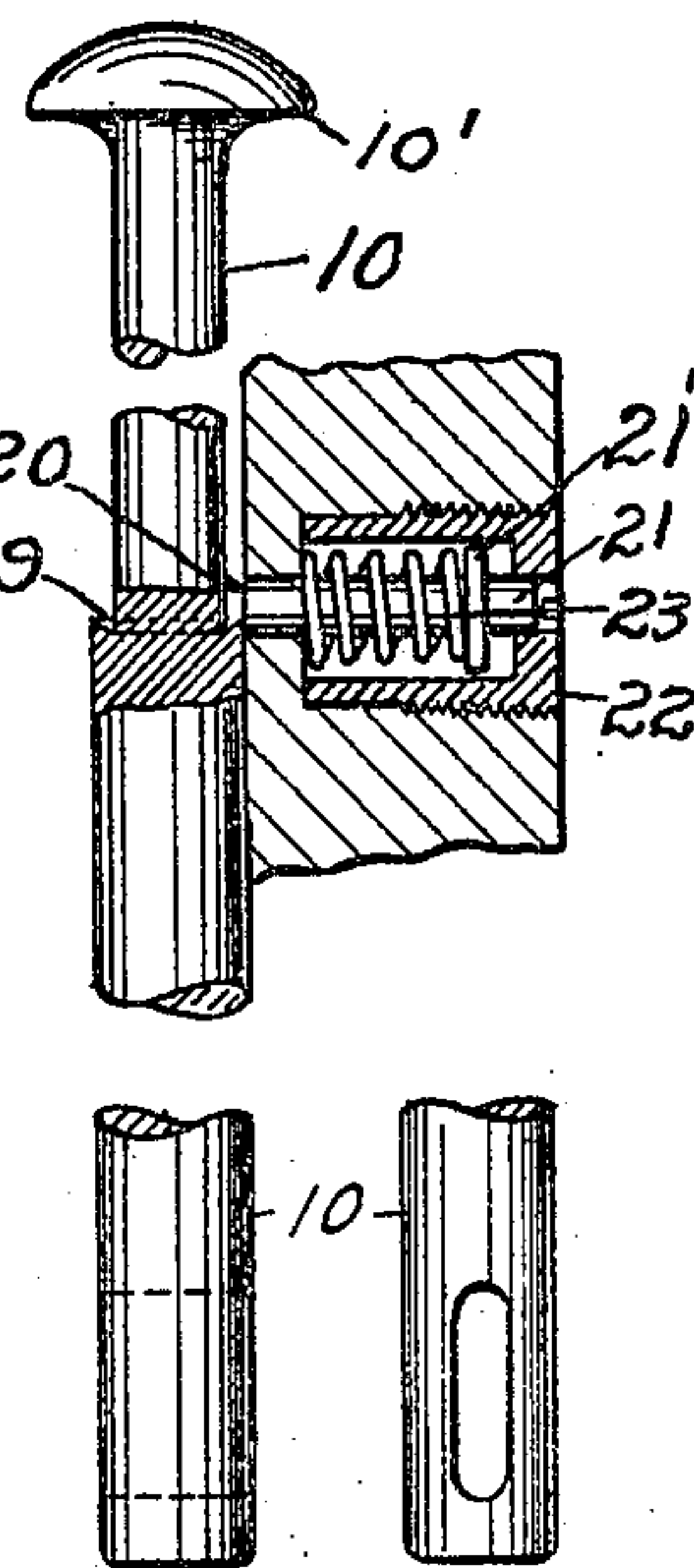


Fig. 6

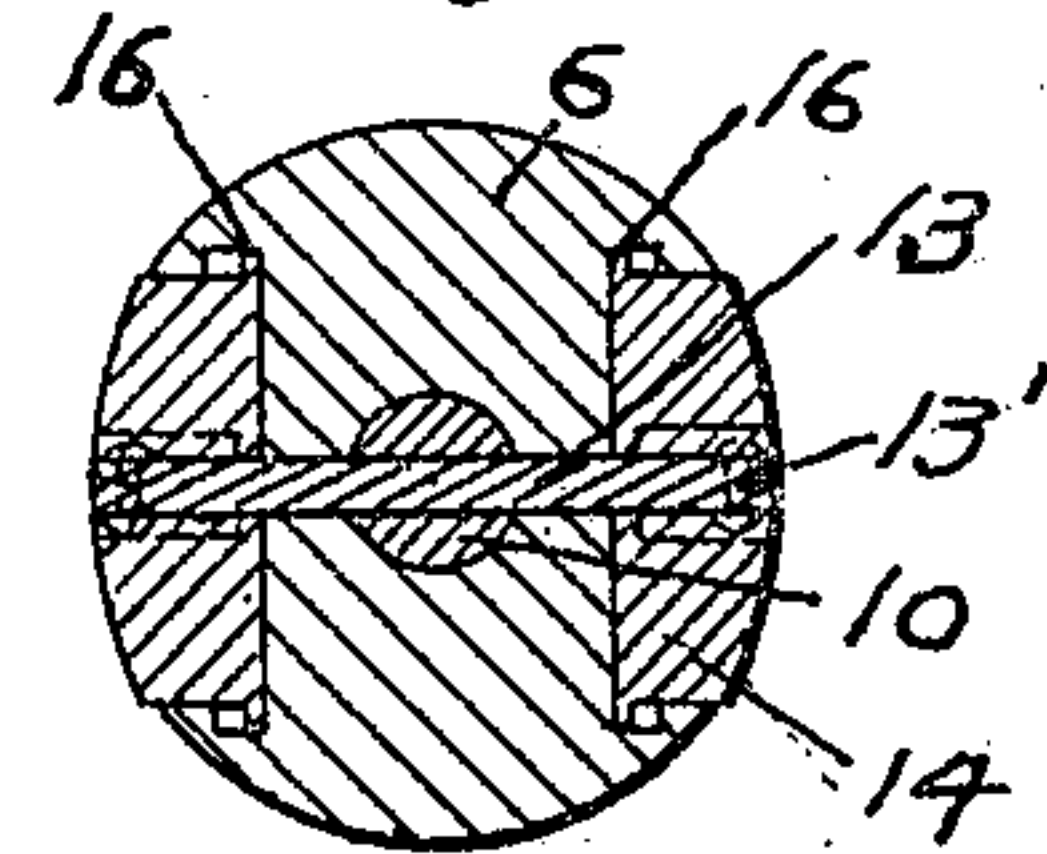


Fig. 7

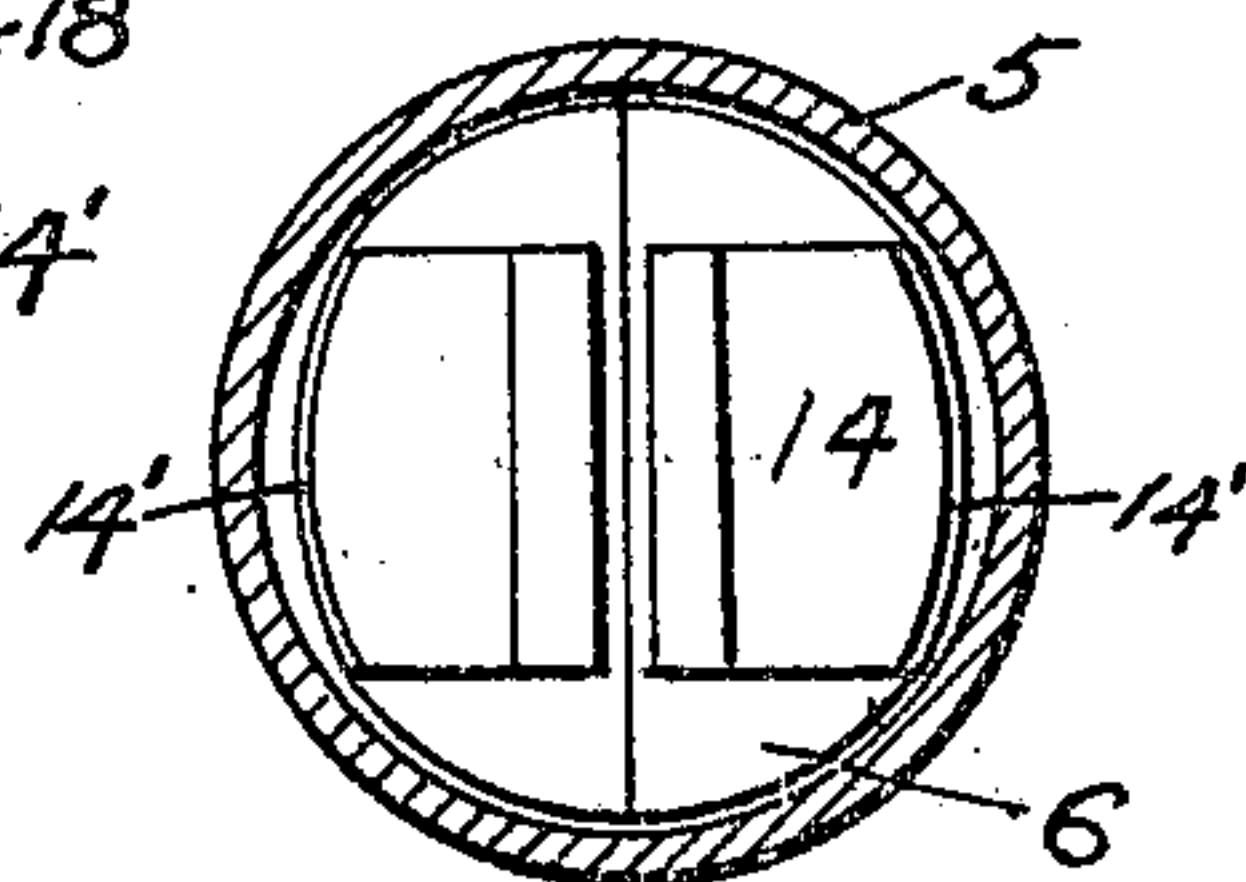


Fig. 8

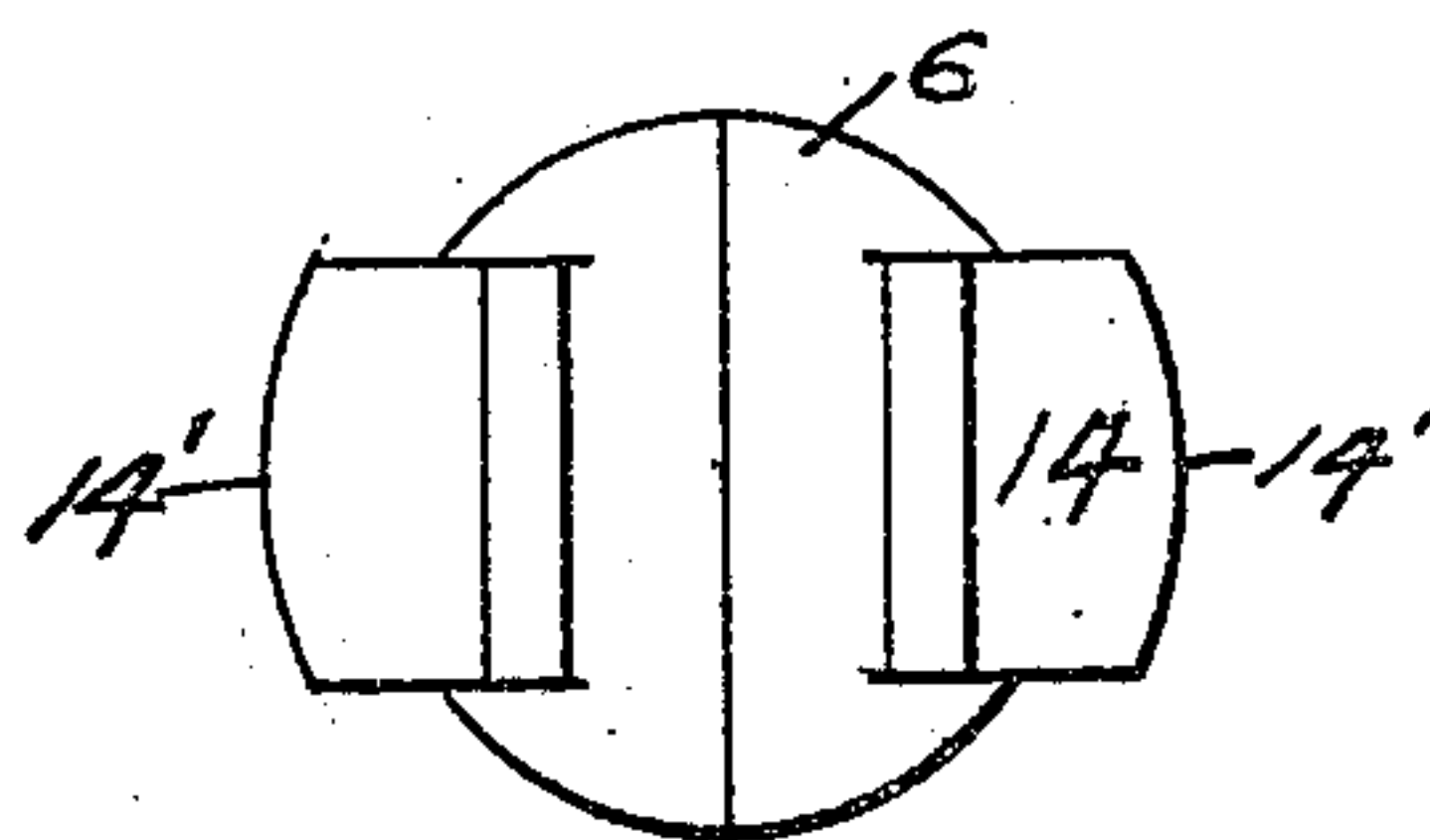


Fig. 5

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3 SHEETS—SHEET 3.

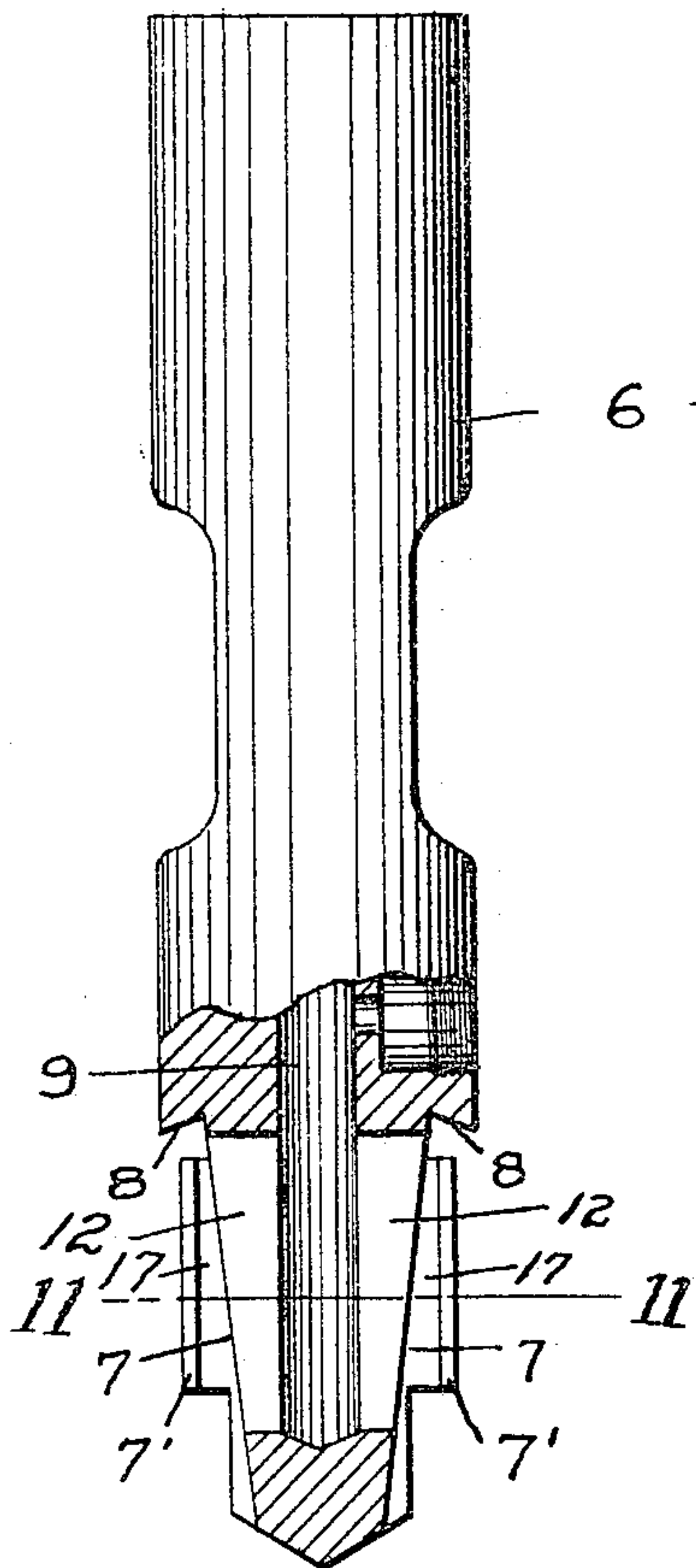


Fig. 9

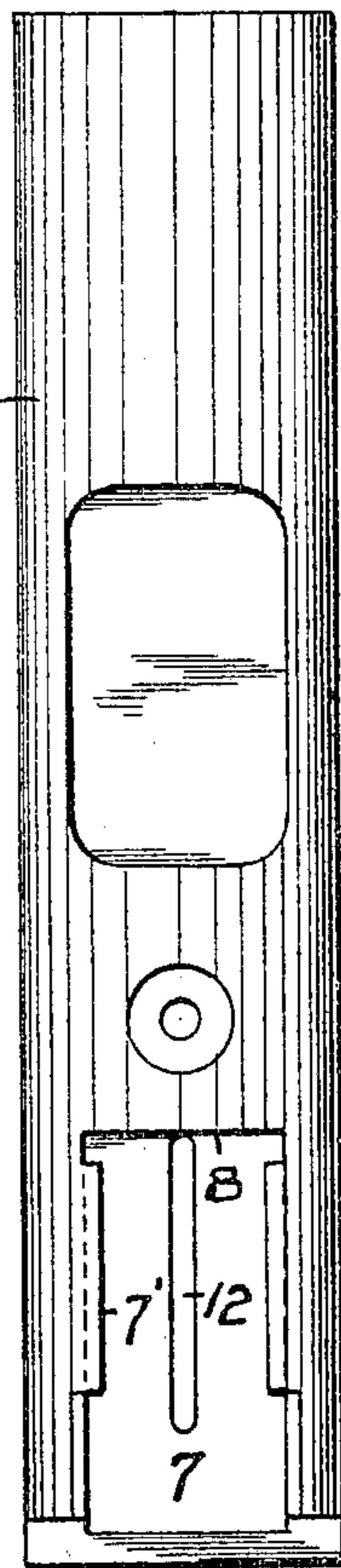


Fig. 10

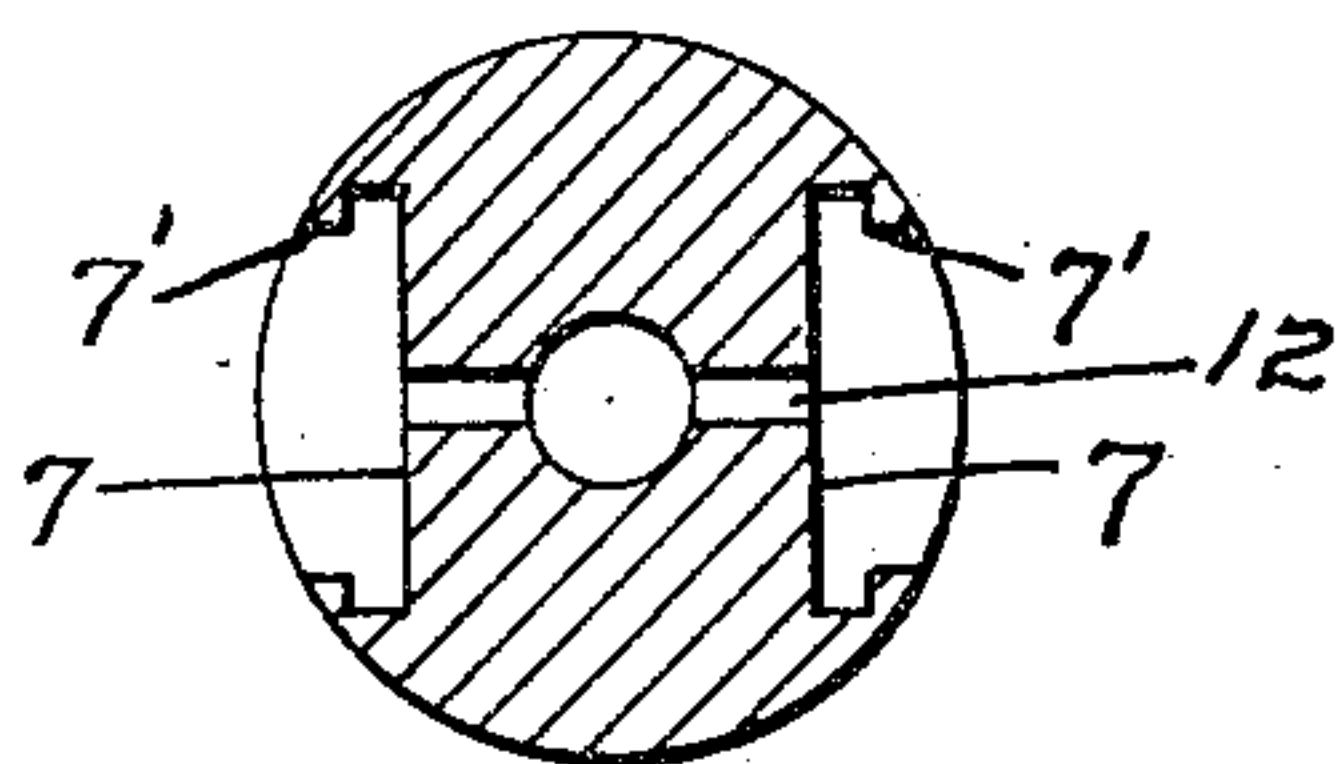


Fig. 11

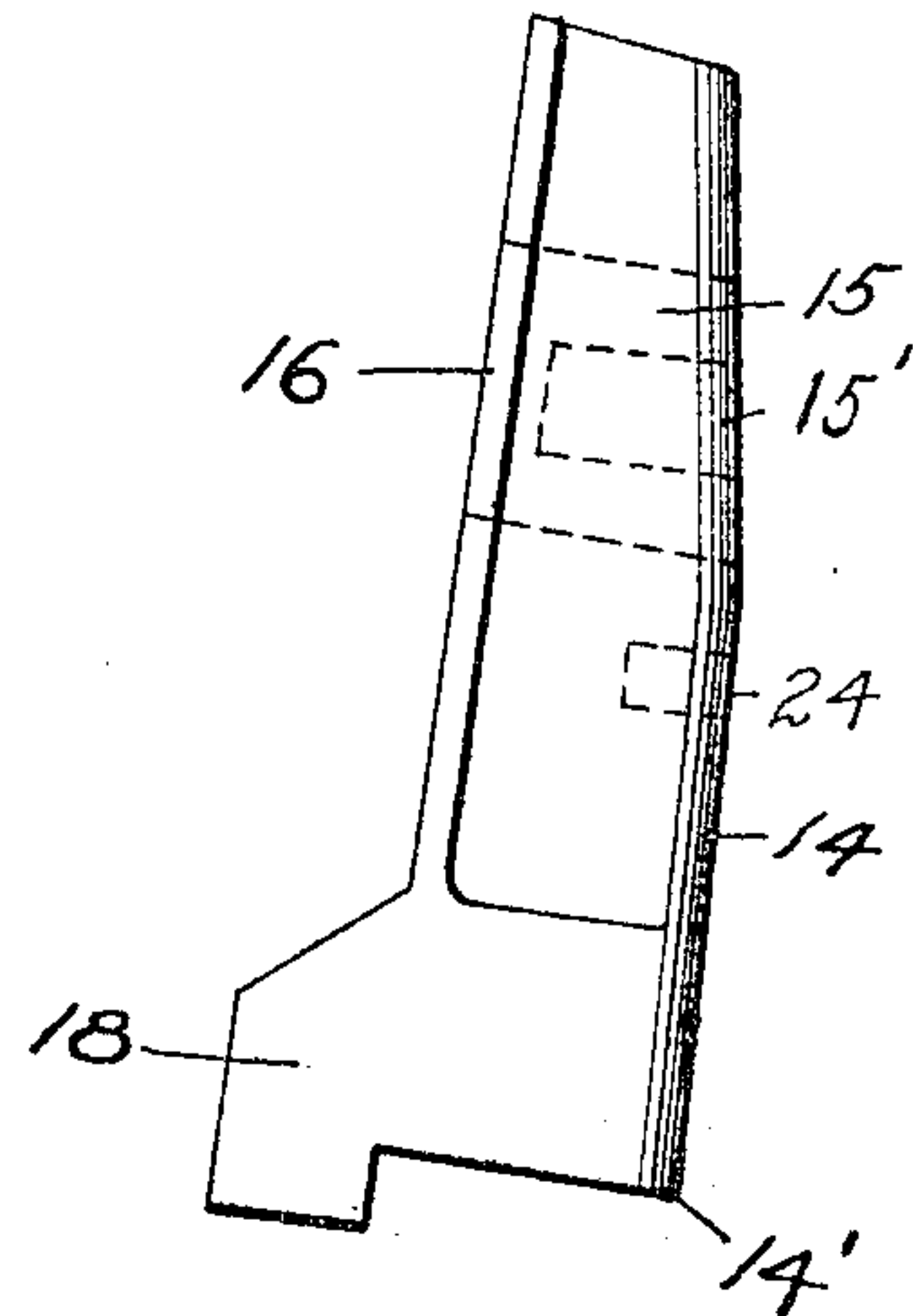


Fig. 12

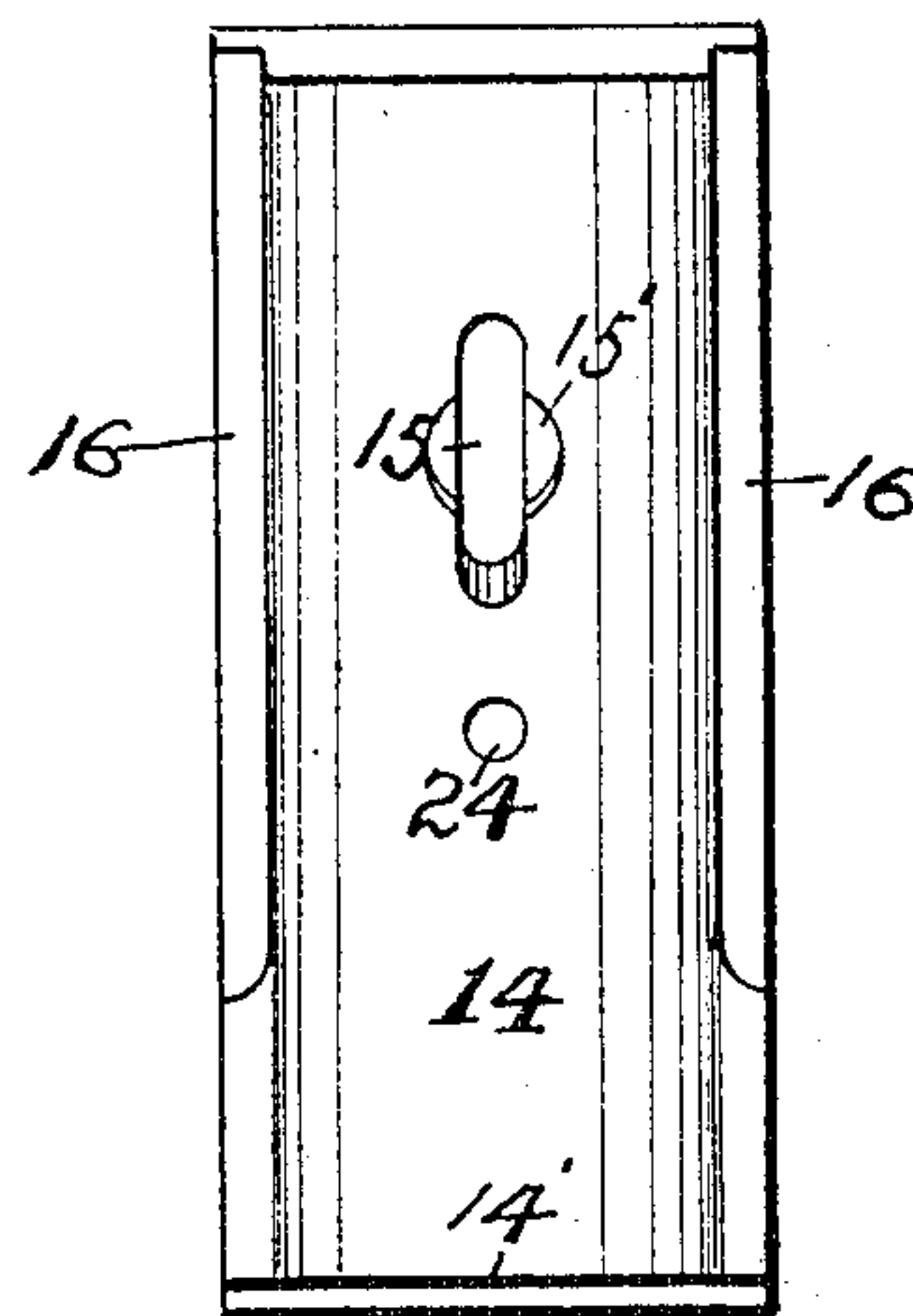


Fig. 13

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# UNITED STATES PATENT OFFICE.

FREDERICK G. IRVINE, OF MARIETTA, OHIO.

## UNDERREAMER.

No. 807,826.

Specification of Letters Patent.

Patented Dec. 19, 1905.

Application filed February 11, 1904. Serial No. 193,081.

*To all whom it may concern:*

Be it known that I, FREDERICK G. IRVINE, a citizen of the United States, residing at Marietta, in the county of Washington and State of Ohio, have invented certain new and useful Improvements in Underreamers, of which the following is a specification, reference being had therein to the accompanying drawings.

In the drilling of oil and gas wells when the hole has been sunk to a depth of several hundred feet, the distance varying in almost every well, it is necessary to insert a string of casing in order to shut off water, caves, &c. After the casing is in place the drilling proceeds therethrough, the tools being of smaller diameter than those first used, and the hole drilled thereby below the casing is of proportionately smaller diameter. In this second drilling water is often encountered or other causes present themselves which make it necessary to continue the casing to a greater depth. Instead of inserting a second string of casing through and necessarily of smaller diameter than the first, as was formerly done, the present practice is to enlarge the hole to the diameter of the initial drilling, so that the original casing may be lowered to the required depth. To accomplish this, an underreaming-tool is lowered through the casing and expanded after passing therethrough, the casing having been first raised a few feet in order that the reaming may start at the shoulder which originally supported the casing and which marks the juncture of the initial and second drillings. In this manner the hole is enlarged sufficiently to permit the casing to be lowered to any desired depth.

The present invention is here shown embodied in that type of underreamers wherein reaming heads or slips are slidable on inclined surfaces of the reamer-body and are thus spread sufficiently to ream the hole to the required diameter.

One object of the invention is to so construct the tool that the reaming-heads may expand to the diameter of the initial drilling and at the same time be rigidly supported or backed at their cutting edges, thus making the tool solid transversely at the point of greatest strain. It has been proposed heretofore to thus reinforce the reaming-heads; but with these prior constructions it has not been possible to obtain the desired maximum expansion or spread. In other tools preceding my invention the reaming-heads have been expanded as far as necessary; but this

has been accomplished only by so projecting said heads that their cutting ends or edges are without solid backing, with the result that the heads spring inward when working in sand-rock and other hard strata, and are thus caused to drill a funnel-shaped hole, and when a hole of this character is once started it is very difficult to get a tool to take hold for the purpose of enlarging it.

In the accompanying drawings, Figures 1 and 2 are elevations of opposite sides of a tool embodying my invention, in Fig. 1 the reaming-heads being shown expanded in full lines and contracted in dotted lines, while in Fig. 2 the heads are shown lowered or in contracted position in full lines and raised in dotted lines. Fig. 3 is a vertical sectional view showing the positions of the several parts while lowering the tool through the casing. Fig. 4 is a similar view illustrating the tool at the lower end of the casing with the reaming-heads expanded to operative position. Fig. 5 is a bottom plan view of Fig. 4. Fig. 6 is a detail view of the head-securing mechanism. Fig. 7 is a cross-sectional view on line 7 7 of Fig. 3, and Fig. 8 is a bottom plan view of the same figure. Figs. 9 and 10 are detail views of the reamer body or stock. Fig. 11 is a cross-section on line 11 11 of Fig. 9. Figs. 12 and 13 are detail views of one of the reamer-heads.

Referring to the drawings, 2 designates the upper portion of the hole of maximum diameter, and 3 is the shoulder in the well-wall at the upper end of the continuation 4 of the hole of smaller diameter.

5 is the casing, which prior to the underreaming operation rests on shoulder 3 and from which it is raised before the underreamer is inserted to afford room for the latter and so that the reaming may start at said shoulder.

6 designates the stock or body of the reaming-tool, which has the usual threaded box 6' at its upper end for uniting with the other tools of the string in manner well known in the art. On opposite sides of the lower portion of the stock are formed the inwardly-cut downwardly-converging faces 7, said faces extending from the lower extremity of body 6 and terminating at shoulder 8. The stock is formed with the central longitudinal bore 9, having offset 9', and operative therein is rod 10, headed at its upper end at 10', and confined on the rod between said head and offset 9' is the expansible coiled spring 11, which holds said rod normally raised. Formed



through faces 7 is vertical slot 12, which intersects bore 9, and movable in this slot is key 13, which loosely fits an opening in the lower portion of rod 10, as shown.

14 designates the cutting-heads of slips, which are movable on faces 7. The heads are slotted at 15 to receive the extremities of key 13, upon which the heads are movably confined by headed pins 13', carried by the key and playing in slot enlargements 15'. The opposite edges of each head are formed with tongues 16, and the walls 7' of stock 6, adjacent faces 7, are recessed to form the upwardly-tapering grooves or guideways 17, in which the tongues have a loose fit and by means of which the heads are held in proper position on faces 7.

The lower portions of heads 14 are enlarged at their inner sides, as shown at 18, the arrangement being such that when the heads are in lowered or contracted position said enlargements extend inward over the lower extremity of stock 6, the latter being beveled, as are also the corresponding surfaces of head enlargements, so that the heads may readily expand when drawn upward by spring 11. When the heads are contracted, as in Fig. 3, the curved cutting edges 14' thereof are drawn inward sufficiently to avoid contact with the casing while being lowered therethrough, thus preserving the edges in perfect condition for the reaming operation.

With the cutting-heads raised to operative position, as in Fig. 4, the cutting edges 14' are expanded to the full diameter of the initial portion 2 of the hole and start at shoulder 4 to enlarge the same. In this position the upper ends of the heads engage shoulders 8, and head enlargements 18 bear solidly and squarely against faces 7, with the heads reinforced laterally their entire length by walls 7', and with cutting edges 14' in line with said enlargements it will be seen that the heads are solidly supported their entire length, and it is absolutely impossible for them to yield or give save in downward direction.

For holding rod 10 depressed with the cutting-heads contracted the rod is formed with the countersunk or beveled shoulder 19, adapted to be engaged by the undercut inner ends 20 of the opposite horizontal bolts 21. The latter are projected through apertures which intersect bore 9, being arranged to move longitudinal in bushings 22, inserted in recesses of stock 6. Each bolt has an enlargement 21', against which bears an expansible spring 23, which holds the bolt normally drawn outward or away from bore 9.

The outer faces of reaming-heads 14 have depressions 24, and for setting the tool, as in Fig. 3, these depressions are engaged by an ordinary spanner-tongs or other suitable de-

vice, by means of which the heads and rod 10 are drawn downward against the pressure of spring 11 until shoulder 19 is below bolt-heads 20, when said bolts are forced inward by any suitable means against the pressure of springs 23, with their heads 20 projecting into the path of shoulder 19, and the bolts are so held until reaming-heads 14 have been released and permitted to start upward in response to the pressure of spring 11. This movement engages rod-shoulder 19 with bolt-heads 20, and owing to the peculiar formation of said parts the hold is positive and accidental disengagement impossible. Thus heads 14 are held depressed and contracted for the downward movement through the casing. After emerging from the latter, as in Fig. 4, a release is effected by giving the tool a sudden upward jerk, during which the inertia of cutting-heads is sufficient to appreciably lower rod 10 and release bolts 21, which are automatically retracted by their springs, leaving rod 10 and the cutting-heads free to respond to the pull of spring 11, thus raising the heads to expanded and operative position. It will be noted that the mechanism for holding the tool set is contained entirely within the tool and is not dependent on an engagement with the casing or any other device for its operation. The tool may be tripped at the pleasure of the operator and not necessarily the moment it emerges from the casing, as is the case with some tools heretofore used.

At the completion of the underreaming operation the tool is raised, and the upper ends of heads 14 come in contact with and are depressed by the lower extremity of the casing, and thereby moved downward and inward on faces 7 sufficiently to permit them to enter the casing and be drawn upward therethrough.

I claim as my invention—

An underreamer comprising a body having opposite inset faces extending upwardly from the lower extremity thereof, opposite slips slidable on said faces and having cutting edges at their outer lower extremities, the lower portions of the inner faces of the slips having lateral extensions in the plane of the cutting edges which bear against the lower portions of the opposite faces when the slips are in elevated position and operate to hold the slips with their cutting edges laterally projected, said slip enlargements underlapping the lower extremity of the reamer-body when the slips are in lowered and contracted position, and slip-actuating means.

In testimony whereof I affix my signature in presence of two witnesses.

FREDERICK G. IRVINE.

Witnesses:

CHARLES F. LEEPER,  
B. DEDMAN.