J. C. SWAN.

UNDER BIT AND REAMER.

APPLICATION FILED SEPT. 24, 1909.

973,993.

Patented Oct. 25, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

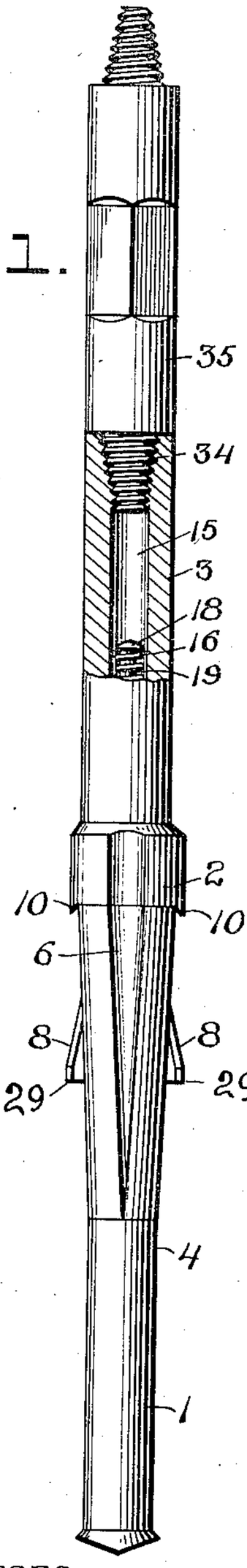


Fig. 6.

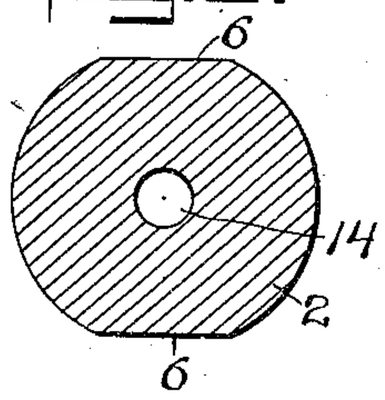


Fig. 7.

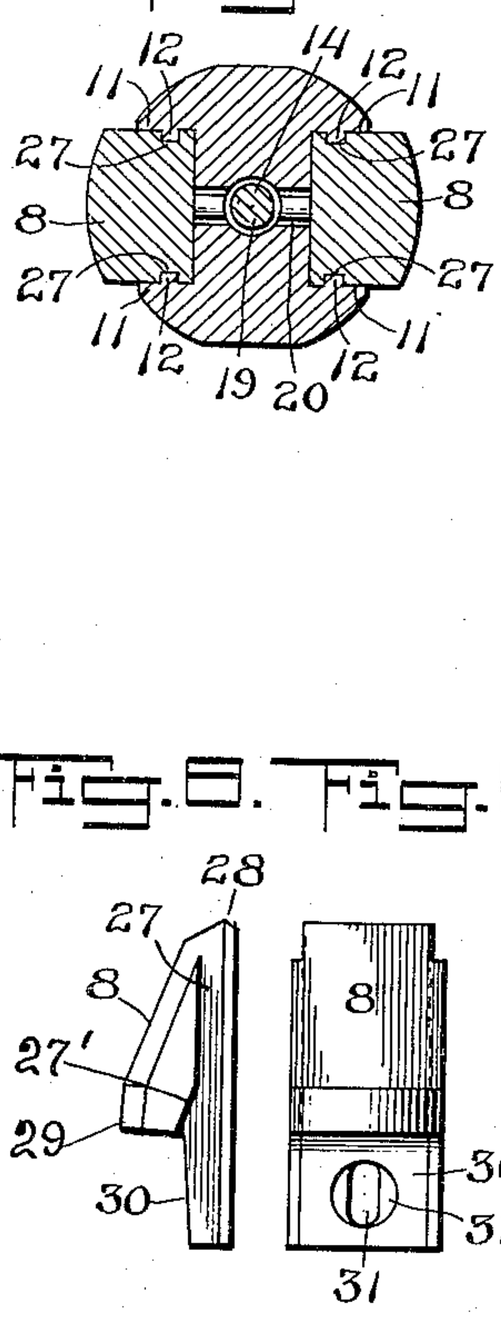
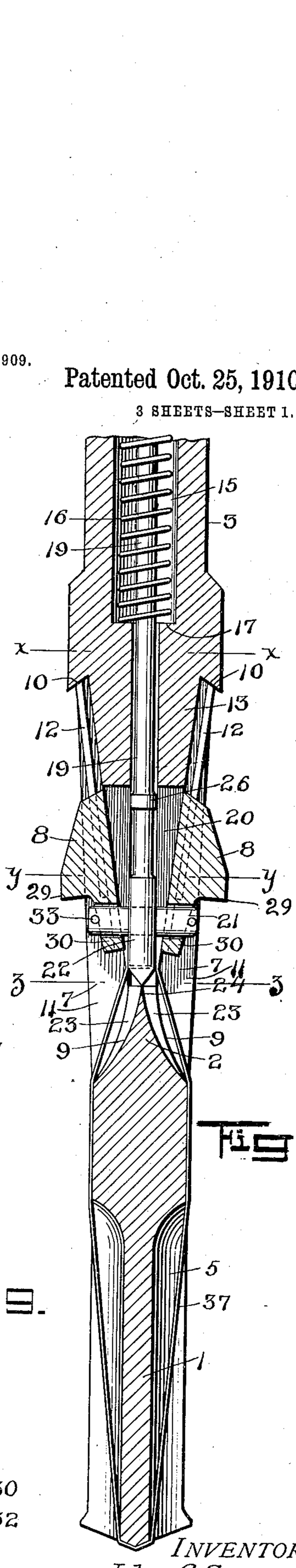


Fig. 8.

Fig. 9.

Fig. 2



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3 SHEETS—SHEET 2.

Fig. 3.

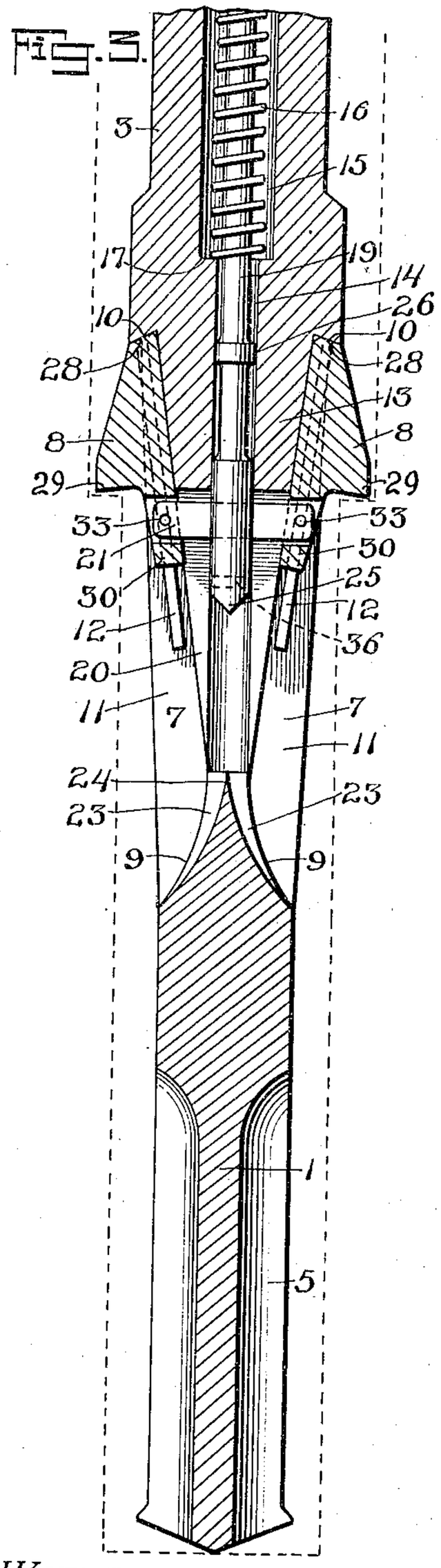


Fig. 5.

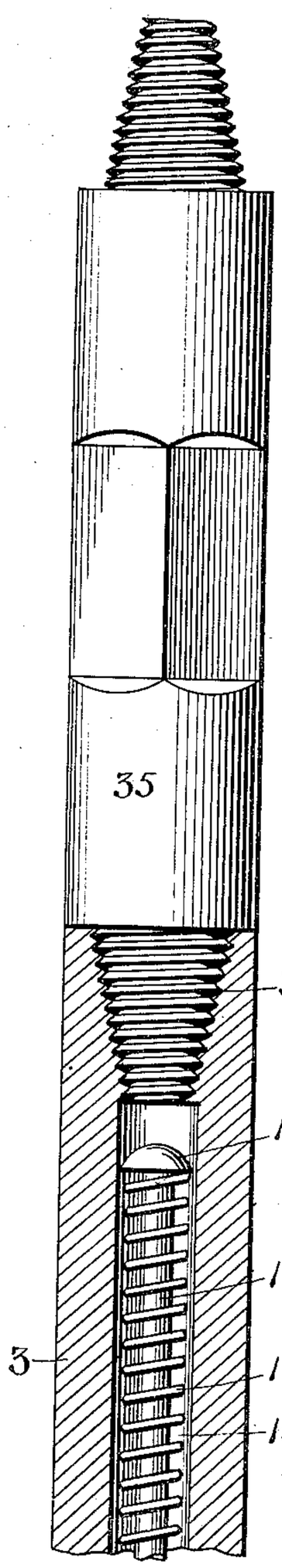
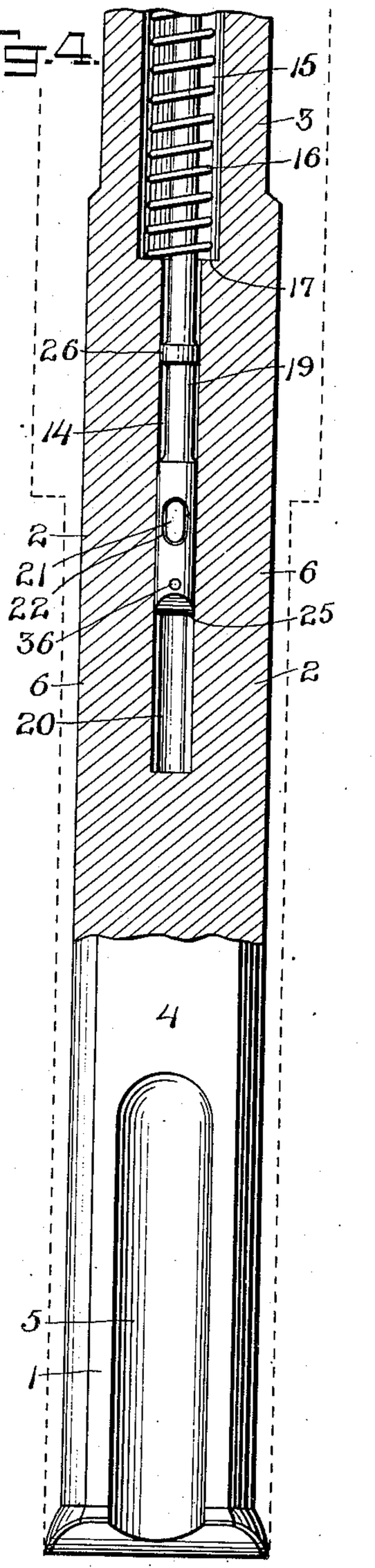


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 11.

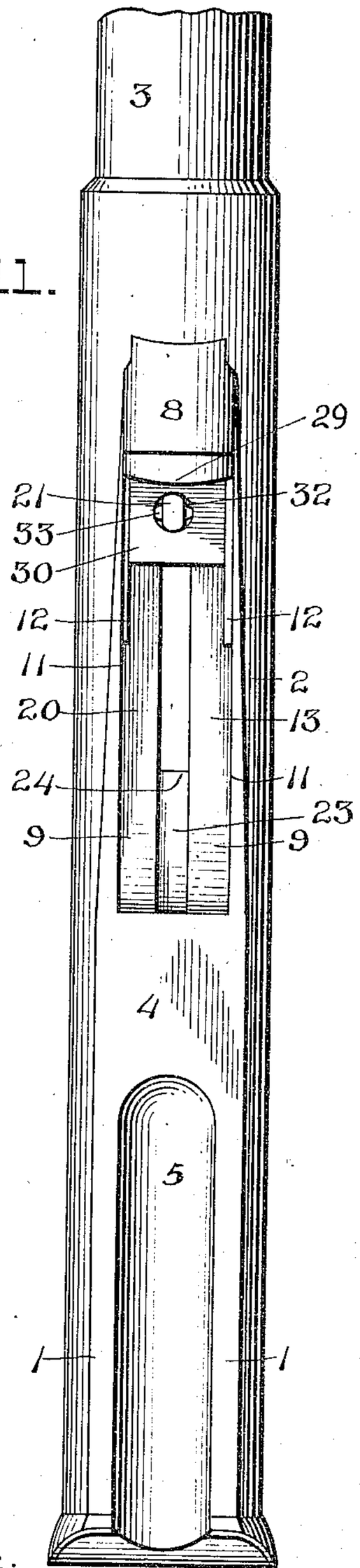


Fig. 12.

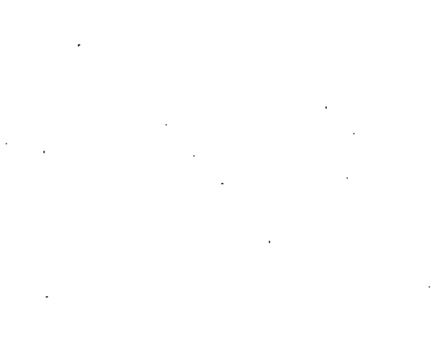


Fig. 10.

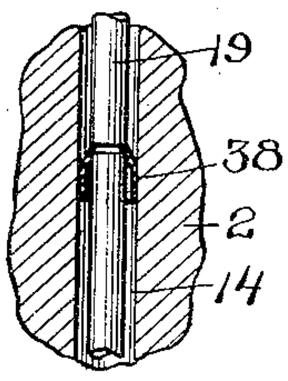


Fig. 14.

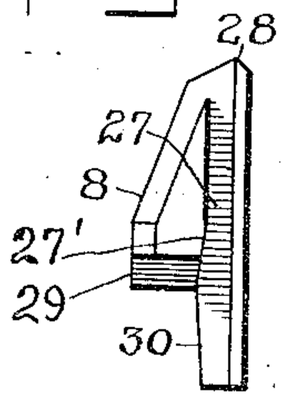
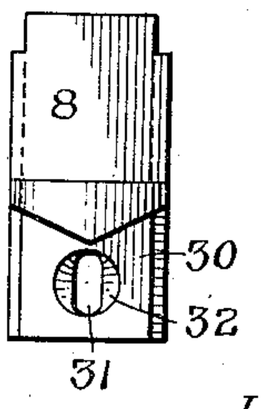


Fig. 13.



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UNDER BIT AND REAMER.

973,993. Specification of Letters Patent. Patented Oct. 25, 1910.

Application filed September 24, 1909. Serial No. 519,474.

To all whom it may concern:

Be it known that I, JOHN C. SWAN, a citizen of the United States, residing at Marietta, in the county of Washington, State of Ohio, have invented certain new and useful Improvements in Under Bits and Reamers, of which the following is a description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to drills for use below casing in drilling oil wells and similar wells for water or gas, and has for its object to provide a tool which will be capable of drilling a hole below casing and immediately enlarging the hole so drilled while it is still filled with the sediment composed of the detritus of the drilling together with soft material which may have fallen in from the walls of the hole.

A further object of the invention is to provide a tool in which the working parts and particularly the spring case will not become clogged or choked by disintegrated material, and will be capable of being readily freed from such material in solution and mechanical mixture which may work into the spring case or into the working parts.

With these and other objects hereinafter explained in view, my invention consists in the construction and combination of elements hereinafter described and shown and particularly pointed out in the claims.

The present invention is in some respects an improvement upon the underreamer described and claimed in U. S. Letters Patent No. 683,352 issued to me September 24, 1901, but is designed for use under somewhat different conditions than those under which the underreamer of my patent is intended to be used, the underreamer of my patent being intended to be used with an open hole beneath and so used being effective in all formations while the tool of the present invention is designed to be used where no open hole is present.

Referring to the drawings: Figure 1 is a side elevation partly in section showing the drill complete. Fig. 2 is a vertical sectional view of the drill on a plane passing through the reaming bits or slips showing the reaming bits or slips held in their lowermost or retarded position. Fig. 3 is a view similar to Fig. 2 but showing the reaming bits or slips in their upper or working position, Fig. 4 is a vertical sectional view of the drill on a plane at right angles to that on which Figs. 2 and 3 are taken, Fig. 5 is a vertical sectional view showing the spring case portion with the double pin substitute in position, the latter being shown in elevation. Figs. 6 and 7 are cross sectional views on lines *x*—*x* and *y*—*y* respectively of Fig. 2, Figs. 8 and 9 are respectively a side and a face view of a reaming bit or slip, Fig. 10 is a detail view showing a modification of the collar carried by the spring rod, Fig. 11 is an elevation of the tool showing the sides at right angles to that shown in Fig. 1, Fig. 12 is a cross-sectional view on line *z*—*z* of Fig. 2, and Figs. 13 and 14 show in front and side views a modified form of reaming bit or slip.

In the drawings, 1 is the bit portion of the drill, 2 is the central or reamer body portion and 3 is the spring case section. The bit portion 1 and the reamer body and spring case portions 2 and 3 are preferably formed of different qualities of steel, the bit portion being preferably of steel capable of being tempered to the degree of hardness desirable for a bit and united by welding to the reamer body portion 2 which, together with the spring case portion 3 is made of steel lower in carbon than the steel of the bit portion in order to secure toughness. The reamer body portion 2 and spring case portion 3 are preferably formed in one piece and in any case the three portions are integrally united to form a single body portion without joint.

The bit portion 1 is preferably of substantially the same width throughout having its lower end shaped to form the bit point of the usual form with the faces of its cutting edge dressed at such angle as may be found desirable, usually about 45°. The cutting end of the bit portion is also preferably upset on its sides to form the necessary clearance to permit of its working in the usual way in which bits are used in drilling. The bit portion is also preferably flattened to form sides parallel with the plane of the cutting edge as shown at 4 and clearance grooves 5 are preferably formed in these faces.

Any ordinary form of drilling bit may be followed in forming the bit portion 1 as the precise form of bit is not material.

The central or reamer body portion 2 is of gradually increasing diameter from the lower end at which it is integrally united to the bit portion 1 to its upper end at

which the spring case portion 3 begins. On its sides at right angles to the flattened sides 4 of the bit portion the central or body portion 2 is also flattened at 6 so as to form passages or ways for water and disintegrated material along it.

By forming the bit in one piece with the reamer body portion the increased diameter necessary to provide for the pin and box or socket usually employed for removably connecting one tool with another is avoided. This increase of diameter in a combined drill and reamer being below the reaming heads interferes materially with their proper operation.

On the sides of the central or reamer body portion at right angles to the flattened sides 6 are formed recesses 7 adapted to receive the reaming bits or slips 8. These recesses 7 are deepest near their lower ends, their lower ends terminating in curved faces 9 gradually approaching the exterior surface. At their upper ends these recesses terminate in shoulders 10 which are under-cut as shown preferably at an angle of about 26° to a plane at right angles to the axial line of the drill body.

The sides 11 of the recesses 7 are parallel and serve as guides for the reaming bits or slips 8, and each side 11 is provided with a guide rib 12 of such length as to guide the reaming bit or slip 8 in its reciprocation but terminating at such point short of the lower end of the recess as to permit of the removal of the reaming bits or slips when detached from the spring rod hereinafter described. These guide ribs 12 at their upper ends are preferably integral with the shoulders 10.

The bottoms of the recesses 7 from the points of the greatest depth of the recesses to the shoulders 10 form together the sides of a wedge 13 on which the reaming bits or slips 8 slide, this wedge being sufficiently thick at its upper end to cause the reaming bits or slips 8 when in contact with the shoulders 10 to be expanded sufficiently to bring their cutting faces to the outer periphery of a circle of the outer diameter of the casing which is to be lowered.

The recesses have their greatest depth at about the plane of the lower end of the wedge and at this point the curved faces 9 begin. The recesses are closed at their lower ends by the mass of metal forming the upper end of the bit the metal at this point being of the usual size in cross-section of the upper end of a bit of ordinary shape. The recesses being thus closed at their lower ends the tendency of disintegrated material to be forced into the working parts of the reamer, which is found to take place where the ways on which the reaming bits or slips move, are open at their lower ends, is avoided, it not being possible for the disintegrated material to be forced directly upward into the working parts as the tool descends to strike its blow in the drilling or reaming operation.

The recesses 7 being formed with parallel sides which are also, as shown, parallel with a plane passing through the axis of the reamer body at right angles to the faces of the wedge, the cross-section of the reamer body at the lower end of the wedge, which is the weakest point by reason of the fact that the recesses are deepest at this point, presents as is clearly shown in Fig. 12, a double T bar, thus securing the greatest possible strength for the mass of material.

The central or reamer body portion 2 and the spring case portion 3 are axially bored as shown at 14, 15 this bore extending throughout the spring case portion and extending in the central or reamer body portion 2 from its junction with the spring case portion to a point nearly down to the lower end of the wedge 13 at which point the recesses 7 have their greatest depth. The bore 15 of the spring case is made of sufficient diameter to receive the coiled spring 16 the lower end of which rests upon a shoulder 17 and the upper end of which bears against a shoulder 18 at the upper end of the spring rod 19. The lower end of this spring rod 19 extends into the bore 14 of the central or body portion 2.

The wedge 13 is centrally slotted at 20 parallel with the sides 11 of the recesses 7 to receive a cross bar 21 which extends through an opening 22 near the lower end of the spring rod 19 and on which the reaming bits or slips 8 are carried. This slot 20 extends upward only sufficiently far to permit the cross bar 21 to move freely to the position necessary to allow the upper ends of the reaming bits or slips to be brought against the shoulders 10. The slot 20 extends downward to the lower end of the bore 14 and in line with the lower end of the slot the material is cut away so as to form grooves 23 in the lower ends 9 of the recesses 7 of such shape that their bottoms come together at their upper ends to leave a wedge shaped or knife edge 24 and their lower ends merge with the curved lower ends 9 of the bottoms of the recesses 7.

The lower end of the spring rod 19 below the opening 22 is made wedge shaped as shown at 25 and at a point above the opening 22 the spring rod is provided with a collar 26 which fits the bore 14 closely enough to prevent the entrance of disintegrated material while permitting the passage of water. The lower end of the spring rod 19 is made of such diameter relative to the bore 14 as to fit therein with sufficient clearance to permit free movement and not to be readily choked by fine sand or the like which may be carried into the bore, but

does not fit the bore as closely as does the collar 26.

Between the lower end of the spring rod 19 and the collar 26 and also above the collar 26 the spring rod is reduced in diameter as shown so as to avoid a long bearing in the bore 14 which might be choked by sand carried in by the water which unavoidably enters the spring case through the bore 14 to a greater or less extent in the operation of the tool.

The reaming bits or slips 8 are formed of a width just sufficient to move freely between the parallel sides 11 of the recesses 7. They are provided on opposite sides with grooves 27 to engage the guide ribs 12. At the lower ends of these grooves the metal of the outer wall of the groove is cut away as shown at 27′ (see Fig. 8.) in order to avoid the pinching in of the metal at this point which might take place in the redressing of the reaming bits, it being a necessary part of the redressing operation to heat the reaming bit or slip and upset the metal to force it out to replace the metal worn away by use. In this upsetting of the metal there is a tendency to spread the metal inward as well as outward and consequently a tendency to reduce the width of the groove 27 on the plane of the cutting edge of the reaming bit or slip. Such tendency is effectually guarded against by cutting the metal away at 27′.

At their upper ends the reaming bits or slips 8 are each provided with an oblique face 28 adapted to engage the oblique abutment or shoulder 10 against which it rests when in expanded position. Below the cutting edge 29 the reaming bits or slips are each provided with a downwardly extending tail piece 30 having an opening 31 therethrough adapted to receive the end of the cross bar 21, the tail piece 30 being also provided in its outer face with a recess 32 to receive a pin or rivet 33 which extends through the end of the cross bar 21.

The tail piece being extended below the plane of the cutting edge of the reaming bit or slip serves to distribute the inwardly acting force of the blow of the reaming bit or slip upon the rock or other material to be cut away. All drilling or reaming tools as they strike their blow in the drilling or reaming operation tend to cut a tapering hole and to become wedged by the taper of the hole and to stick, this tendency to cut a tapered or pinched hole increasing as the metal of the cutting edge is worn away. The inward acting force of the blow tends to force the inner face of the reaming bit or slip into the face of the wedge and if the reaming bit or slip has its lower end in the same plane with its cutting edge the face of the wedge will be found to be cut into a considerable extent at the point at which the lower end of the reaming bit or slip is in contact with it when the blow is struck. By distributing this inward acting force by means of the tail piece injury to the face of the wedge is avoided. The tail piece 30 also serves to prevent any tilting of the reaming bit or slip as it comes in contact with the lower end of the casing in drawing out the tool.

The upper end of the bore 15 of the spring case portion 3 is tapered and screw-threaded to form a socket adapted to receive the pin 34 of a double pin substitute 35, by which the drill is connected to the auger stem.

The tail piece 30 being below the cutting edge of the reaming bit or slip, the main portion or body of the reaming bit or slip is solid and free from perforations thus securing the utmost strength possible. The sides of the recesses 7 and the guide ribs 11 extend to the shoulders or abutments 10 so that no space is left for expansion of the upper end of the reaming bit or slip thus preventing the lateral upsetting of this upper end by its striking the shoulder 10. As the slot 20 extends upward only far enough to permit the necessary movement of the cross bar 21 the wedge 13 will be without opening above the level of the cutting edge of the reaming bit or slip when it is in its expanded or working position and as the reaming bit or slip covers the slot when below its expanded or working position there will be no tendency of the reaming bit or slip as it moves to expanded position, (or as the wedge 13 moves downward between the reaming bits or slips in actual operation) to drive or force disintegrated material into the spring case.

In the downward movement of the tool as the reaming bits or slips strike the material which is to be cut away, they will be at the upper end of the wedge resting against the shoulders or abutments 10. At the same time the collar 26 will be in the bore 14 closing it against the entrance of any solid material except the very fine material which is carried by the water present in the well hole. The entrance of solid material into the bore 14 is further guarded against by the cross bar 21 which, when the reaming bits or slips are in operating position as above described, will be at the upper end of the slot 20 and nearly in contact with the upper end of the slot thus closing this upper end of the slot.

In the upward movement of the tool the relative movement of the reaming bits or slips will depend upon the rapidity of the upward movement and upon the extent to which the reaming bits or slips have been wedged against the walls of the well hole, but in any case as the tool is drawn upward the reaming bits or slips will move down-

ward on the wedge (or strictly the wedge will move upward between the reaming bits or slips) with the result that they will move inwardly sufficiently to free their cutting edges from contact with the walls of the hole and will tend to approach the lower end of the wedge to a greater or less extent dependent upon the strength of the spring 16. This relatively downward movement of the reaming bits or slips on the wedge will move the collar 26 downward in the bore 14 and if the movement is sufficient will carry the collar 26 below the lower end of the bore 14 permitting the escape of whatever liquid has entered the spring case. By raising the tool into comparatively clear water and raising and lowering it quickly so as to cause the reaming bits or slips to move up and down on the wedge and to cause the spring rod 19 with its collar 26 to move up and down in the bore 14 the spring case may be effectively washed out.

When the reaming bits or slips are at their lowermost position the cross bar 21 will be above the lower end of the slot 20 and will be capable of sustaining the reaming bits or slips so that even should the spring rod 19 be broken the reaming bits or slips cannot become detached from the tool and cannot swing outward by reason of the fact that even when the cross bar is at the lower end of the slot it will hold the reaming bits or slips at such elevation that their grooves 27 will still be in engagement with the guide ribs 12.

As the reaming bits or slips approach their lowest position the wedge shaped end 25 of the spring rod will approach the knife edge 24 so as to exert a splitting action upon any disintegrated material which may have lodged in the slot 20 and to force it downward against the knife edge 24 and cause it to be forced downward and outward along the grooves 23. The tool is thus not only so constructed as to be free from liability of being choked or clogged by disintegrated material but is also self cleaning as regards any such material which may have become lodged in the working parts.

It will be understood that the upper end of the spring case is closed by the pin 34 so that the only place at which anything can enter the spring case in the operation of the tool is through the bore 14.

In assembling the tool the spring rod 19 with the spring 16 in place on it is inserted through the bore 15 into the bore 14 until its end is below the upper end of slot 20, and the spring case is then closed by screwing the pin 34 into the socket in the upper end of the spring case. A wire or cord 37 is then inserted through the hole 36 in the lower end of the spring rod and the spring rod drawn downward the wire or cord being passed about the lower end of the bit as shown in Fig. 2 and secured. The reaming bits or slips are then inserted at the lower ends of the recesses 7 and are moved upward along the bottoms of the recesses until their grooves 27 engage the guide ribs 12. They are then slid upward until the openings 31 in their tail pieces 30 are opposite the opening 22 in the lower end of the spring rod. The cross bar 21 is then passed through and secured by the pins or rivets 33. The tool is then ready for use when connected up as a part of the usual string of drilling tools. The tool is then lowered through the casing. The point of the bit and the portion of the reamer body above the wedge are preferably of as nearly as possible the inner diameter of the casing allowing only for such clearance as is found necessary to allow unavoidable deformity of the casing. By reason of the flattening of the reamer body as shown at 6 it is possible to lower and raise the tool past deformities of the casing which would obstruct the passage of the tool if cylindrical as, if the tool strikes and is stopped by a deformity, it may be raised and rotated to bring a flat side in line with such deformity when it may be lowered past it. When the tool has been lowered below the lower end of the casing and the end of the bit strikes the bottom the wire or cord 37 will be severed. At most only one or two blows will be certain to sever it. As soon as this wire or cord is broken the reaming bits will be released and will be drawn up along the faces of the wedge 13 by the spring 16 acting through the spring rod 19 and cross bar 21 until they are in expanded position with their upper ends resting against the shoulders or abutments 10. The tool is then ready for operation to effect simultaneously both the drilling of a hole the size of the bit and the enlarging of this hole to the size necessary to receive the casing, it being necessary to withdraw the tool only for bailing out the disintegrated material it accumulates.

In withdrawing the tool, as the reaming bits or slips strike the lower edge of the casing, they will be forced downward along the faces of the wedge 13 until they are sufficiently contracted to pass into the casing. When so forced downward along the faces of the wedge the collar 26 will be brought below the upper end of the slot 20 so that whatever water may be in the spring case may run out.

While the reaming bits or slips will ordinarily have their cutting edges on the arc of the circle of the hole to be formed it is sometimes desirable in certain formations to use reaming bits or slips having their cutting edges as shown in Figs. 13 and 14 that is on the line of a diameter of the circle of

the hole to be cut. Instead of the solid collar 26 a cup 38 of leather or other flexible material may be used as shown in Fig. 10.

I am, of course, aware that drilling and under-reaming, as a simultaneous operation, has been heretofore attempted, and that tools for this purpose have been described but I am not aware that such tools have been satisfactorily successful for such purposes.

It will, of course, be understood that my invention is not intended to be limited to precise details of construction or proportion of parts as shown and described.

Having thus described my invention and explained the operation thereof, what I claim and desire to secure by Letters Patent is:

1. A reaming bit having a tail piece extending below the plane of the cutting edge and provided with a perforation, the portion above the plane of the cutting edge being imperforate.

2. In a tool for enlarging a drilled hole, a reamer body having a wedge shaped portion, reaming bits arranged to be movable on the faces of the wedge and having tail pieces extending below the plane of their cutting edges, a slot extending through the wedge parallel with the axis of the reamer body at right angles to the faces of the wedge, a cross bar movable in said slot engaging the tail pieces of the reaming bits and means for moving the cross-bar toward the upper end of the wedge.

3. In a tool for enlarging a drilled hole, a reamer body having a wedge shaped portion having abutments formed at the upper ends of the faces of the wedge, reaming bits arranged to be movable on the faces of the wedge each having a tail piece extending below the plane of its cutting edge, a slot extending through the wedge parallel with the axis of the reamer body at right angles to the faces of the wedge, said slot terminating at its upper end at a distance from said abutments not less than the distance from the upper end of a reaming bit to its cutting edge, a cross bar movable in said slot engaging the tail pieces of the reaming bits, and means for moving the cross bar toward the upper end of the slot.

4. In a tool for enlarging a drilled hole, a reamer body having a wedge shaped portion having abutments formed at the upper ends of the faces of the wedge, reaming bits arranged to be movable on the faces of the wedge each having a tail piece extending below the plane of its cutting edge, a slot extending through the wedge parallel with the axis of the reamer body at right angles to the faces of the wedge, said slot terminating at its upper end at a distance from said abutments not less than the distance from the upper end of a reaming bit to its cutting edge, a cross bar movable in and fitting said slot and engaging the tail pieces of the reaming bits immediately below the cutting edges so that when the reaming bits are against the abutments, the cross bar will close the slot against entrance of solid material present in the drilled hole, and means for moving the cross bar toward the upper end of the slot.

5. In a tool for enlarging a drilled hole, a reamer body having a wedge shaped portion, abutments at the upper ends of the faces of the wedge, reaming bits movable on the faces of the wedge each having its portion above its cutting edge imperforate, a central bore extending substantially to the lower end of the wedge, a slot extending through the wedge parallel with the axis of the reamer body and at right angles to the faces of the wedge and communicating wrtn said central bore, said slot terminating at its upper end at a distance from the upper end of the wedge not substantially less than the distance from the upper end of a reaming bit to the plane of its cutting edge, a spring rod movable in said central bore, a cross bar carried by said spring rod, fitting said slot and extending therethrough into engagement with the reaming bits below the plane of their cutting edges, said cross bar being adapted to close the upper end of the slot when the reaming bits are against the abutments.

6. In a tool for enlarging a drilled hole, a reamer body having a wedge shaped portion, a central bore extending substantially to the lower end of the wedge, a slot extending through the wedge parallel with the axis of the reamer body and at right angles to the faces of the wedge communicating with said central bore and terminating a substantial distance below the upper end of the wedge, a spring rod movable in said central bore, reaming bits movable on the faces of the wedge, means carried by the spring rod extending through the slot and engaging the reaming bits, and a collar on the spring rod fitting said central bore and so located that when the reaming bits are in their lowermost position said collar will be below the upper end of the slot.

7. In a tool for enlarging a drilled hole, a reamer body having a wedge shaped portion, a spring case above and integral with the reamer body, means for closing the upper end of the spring case, a central bore in communication with the interior of the spring case extending through the reamer body to substantially the lower end of the wedge, a slot extending through the wedge parallel with the axis of the reamer body and at right angles to the faces of the wedge terminating at its upper end a substantial distance below the upper end of the wedge, a spring rod movable in said central bore and extending into the spring case, a spring

in the spring case acting to draw the spring rod upward, reaming bits movable on the faces of the wedge, means carried by the spring rod engaging the reaming bits, and a collar carried by the spring rod and fitting the central bore, the collar being so located that when the reaming bits are at their lowermost position the collar will be below the upper end of the slot.

8. In a tool for enlarging a drilled hole, a reamer body having longitudinal recesses formed in opposite sides thereof the bottoms of said recesses forming the faces of a wedge, the lower ends of the recesses being curved downward and outward from the lower end of the wedge, guide ribs on the sides of the recesses parallel with the faces of the wedge and terminating above the lower end of the wedge, and reaming bits having side grooves adapted to engage the guide ribs, said reaming bits being of less length than the distance between the lower ends of the guide ribs and the lower end of the recesses.

9. In a tool for enlarging a drilled hole, a reamer body having longitudinal recesses formed in opposite sides thereof the bottoms of said recesses forming the faces of a wedge, the lower ends of the recesses being curved downward and outward from the lower end of the wedge, guide ribs on the sides of the recesses parallel with the faces of the wedge and terminating above the lower end of the wedge, reaming bits having side grooves adapted to engage the guide ribs, said reaming bits being of less length than the distance between the lower ends of the guide ribs and the lower end of the recesses, a slot extending through the wedge parallel with the axis of the reamer body and at right angles to the faces of the wedge, extending to the lower end of the wedge, and grooves formed in the lower ends of the recesses in line with the slot the grooves being of such depth at their upper ends as to leave between them a knife edge on the axial line of the reamer body.

10. In a tool for enlarging a drilled hole, a reamer body having longitudinal recesses formed in opposite sides thereof the bottoms of said recesses forming the faces of a wedge, the lower ends of the recesses being curved downward and outward from the lower end of the wedge, guide ribs on the sides of the recesses parallel with the faces of the wedge and terminating above the lower end of the wedge, reaming bits having side grooves adapted to engage the guide ribs, said reaming bits being of less length than the distance between the lower ends of the guide ribs and the lower end of the recesses, a central bore extending through the reamer body to the lower end of the wedge, a slot extending through the wedge parallel with the axis of the reamer body and at right angles to the faces of the wedge, extending to the lower end of the wedge, a spring rod movable in said central bore and having a cross bar extending through the slot into engagement with the reaming bits and having its lower end terminating in a cutting edge parallel with the faces of the wedge, and grooves formed in the lower ends of the recesses, in line with the slot, the grooves being of such depth at their upper ends as to leave between them a knife edge on the axial line of the reamer body in line with the cutting edge of the spring rod.

11. In a tool for enlarging a drilled hole, a reamer body having in opposite sides longitudinal recesses to receive reaming bits, the bottoms of said recesses forming the faces of a wedge on which said reaming bits are arranged to be movable, guide ribs on the side walls of the recesses extending from the upper ends of the recesses to a point above the apex of the wedge, a longitudinal slot extending through the wedge terminating at the apex of the wedge, a cross bar movable in said slot, reaming bits movable on the faces of the wedge having openings below the plane of their cutting edges for engaging the cross bar and provided with grooves for engaging the guide ribs, the length of the reaming bits or slips being such that when the cross bar is at the lower end of the slot the grooves will be in engagement with the guide ribs.

12. In a tool for enlarging a drilled hole, a reamer body having in opposite sides longitudinal recesses to receive reaming bits the bottoms of said recesses forming the faces of a wedge, reaming bits arranged to be movable on the faces of said wedge and provided with extensions below their cutting edges, a longitudinal slot extending through the wedge and terminating at its upper end at a distance below the upper end of the wedge corresponding to the length of the reaming bits above their cutting edges, whereby the upper portion of the wedge is left free from openings, and means movable in the slot engaging the extensions on the reaming bits.

13. In a tool for enlarging a drilled hole, a reamer body having in opposite sides longitudinal recesses, the bottoms of the recesses forming the faces of a wedge, abutments formed at the upper end of the wedge having faces arranged at an oblique angle to the axial line of the reamer body, guide ribs on the sides of the recesses parallel with the faces of the wedge extending up to and formed integral with the abutments, reaming bits movable on the faces of the wedge having grooves for engaging the guide ribs and having their upper ends adapted to contact with and bear against the abutments, and means for moving the reaming bits into contact with the abutments.

14. In a tool for drilling a hole and si-

multaneously enlarging the drilled hole, a reamer body having a wedge shaped portion, reaming bits arranged to be movable on the faces of the wedge and having tail pieces extending below the plane of their cutting edges, a slot extending through the wedge parallel with the axis of the reamer body at right angles to the faces of the wedge, a cross bar movable in said slot engaging the tail pieces of the reaming bits, means for moving the cross bar toward the upper end of the wedge, and a bit formed integrally with and extending below the reamer body the upper end of the bit forming an abutment at the lower end of the wedge.

15. In a tool for drilling a hole and simultaneously enlarging the drilled hole, a reamer body having a wedge shape portion having abutments formed at the upper ends of the faces of the wedge, reaming bits arranged to be movable on the faces of the wedge each having a tail piece extending below the plane of its cutting edge, a slot extending through the wedge parallel with the axis of the reamer body at right angles to the faces of the wedge, said slot terminating at its upper end at a distance from said abutments not less than the distance from the upper end of a reaming bit to its cutting edge, a cross bar movable in said slot engaging the tail pieces of the reaming bits, means for moving the cross bar toward the upper end of the slot, and a bit formed integral with and extending below the reamer body the upper end of the bit forming an abutment at the lower end of the wedge.

16. In a tool for drilling a hole and simultaneously enlarging the drilled hole, a reamer body having a wedge shaped portion having abutments formed at the upper ends of the faces of the wedge, reaming bits arranged to be movable on the faces of the wedge each having a tail piece extending below the plane of its cutting edge, a slot extending through the wedge parallel with the axis of the reamer body at right angles to the faces of the wedge, said slot terminating at its upper end at a distance from said abutments not less than the distance from the upper end of a reaming bit to its cutting edge, a cross bar movable in and fitting said slot and engaging the tail pieces of the reaming bits immediately below the cutting edges so that when the reaming bits or slips are against the abutments, the cross bar will close the slot against entrance of solid material present in the drilled hole, means for moving the cross bar toward the upper end of the slot, and a bit formed integral with and extending below the reamer body the upper end of the bit forming an abutment at the lower end of the wedge.

17. In a tool for drilling a hole and simultaneously enlarging the drilled hole, a reamer body having a wedge shaped portion, a central bore extending substantially to the lower end of the wedge, a slot extending through the wedge parallel with the axis of the reamer body at right angles to the faces of the wedge and communicating with said central bore, a spring rod movable in said central bore, reaming bits movable on the faces of the wedge, means carried by the spring rod extending through the slot and engaging the reaming bits, a collar on the spring rod fitting said central bore, and a bit formed integral with and extending below the reamer body the upper end of the bit forming an abutment at the lower end of the wedge.

18. In a tool for drilling a hole and simultaneously enlarging the drilled hole, a reamer body having longitudinal recesses formed in opposite sides thereof the bottoms of said recesses forming the faces of a wedge, the lower ends of the recesses being curved downward and outward from the lower end of the wedge, guide ribs on the sides of the recesses parallel with the faces of the wedge and terminating above the lower end of the wedge, reaming bits having side grooves adapted to engage the guide ribs, said reaming bits being of less length than the distance between the lower ends of the recesses, and a bit integral with and extending downward from the reamer body, the head of the bit forming the lower end of the recesses.

19. In a tool for drilling a hole and simultaneously enlarging the drilled hole, a reamer body having longitudinal recesses formed in opposite sides thereof the bottoms of said recesses forming the faces of a wedge, the lower ends of the recesses being curved downward and outward from the lower end of the wedge, guide ribs on the sides of the recesses parallel with the faces of the wedge and terminating above the lower end of the wedge, reaming bits having side grooves adapted to engage the guide ribs, said reaming bits being of less length than the distance between the lower ends of the guide ribs and the lower end of the recesses, a slot extending through the wedge parallel with the axis of the reamer body and at right angles to the faces of the wedge, extending to the lower end of the wedge, grooves formed in the lower ends of the recesses in line with the slot the grooves being of such depth at their upper ends as to leave between them a knife edge on the axial line of the reamer body, and a bit integral with and extending downward from the reamer body, the head of the bit forming the lower end of the recesses.

20. In a tool for drilling a hole and simultaneously enlarging the drilled hole, a reamer body having longitudinal recesses

formed in opposite sides thereof the bottoms of said recesses forming the faces of a wedge, the lower ends of the recesses being curved downward and outward from the lower end of the wedge, guide ribs on the sides of the recesses parallel with the faces of the wedge and terminating above the lower end of the wedge, reaming bits having side grooves adapted to engage the guide ribs, said reaming bits being of less length than the distance between the lower ends of the guide ribs and the lower end of the recesses, a central bore extending through the reamer body to the lower end of the wedge, a slot extending through the wedge parallel with the axis of the reamer body and at right angles to the faces of the wedge, extending to the lower end of the wedge, a spring rod movable in said central bore and having a cross bar extending through the slot into engagement with the reaming bits and having its lower end terminating in a cutting edge parallel with the faces of the wedge, grooves formed in the lower ends of the recesses, in line with the slot, the grooves being of such depth at their upper ends as to leave between them a knife edge on the axial line of the reamer body in line with the cutting edge of the spring rod, and a bit integral with and extending downward from the reamer body, the head of the bit forming the lower end of the recesses.

21. In a tool for drilling a hole and simultaneously enlarging the drilled hole, a reamer body having in opposite sides longitudinal recesses to receive reaming bits, the bottoms of said recesses forming the faces of a wedge on which said reaming bits are arranged to be movable, guide ribs on the side walls of the recesses extending from the upper ends of the recesses to a point above the apex of the wedge and terminating at a distance from the lower ends of the recesses, a longitudinal slot extending through the wedge terminating at the apex of the wedge, a cross bar movable in said slot, reaming bits movable on the faces of the wedge having openings below the plane of their cutting edges for engaging the cross bar and provided with grooves for engaging the guide ribs, the length of the reaming bits being such that when the cross bar is at the lower end of the slot the grooves will be in engagement with the guide ribs, and a bit integral with and extending below said reamer body, the upper end of the bit serving to close the lower ends of the recesses.

This specification signed and witnessed this 17th day of September A. D. 1909.

JOHN C. SWAN.

In the presence of—
A. M. PARKINS,
A. P. GREELEY.