

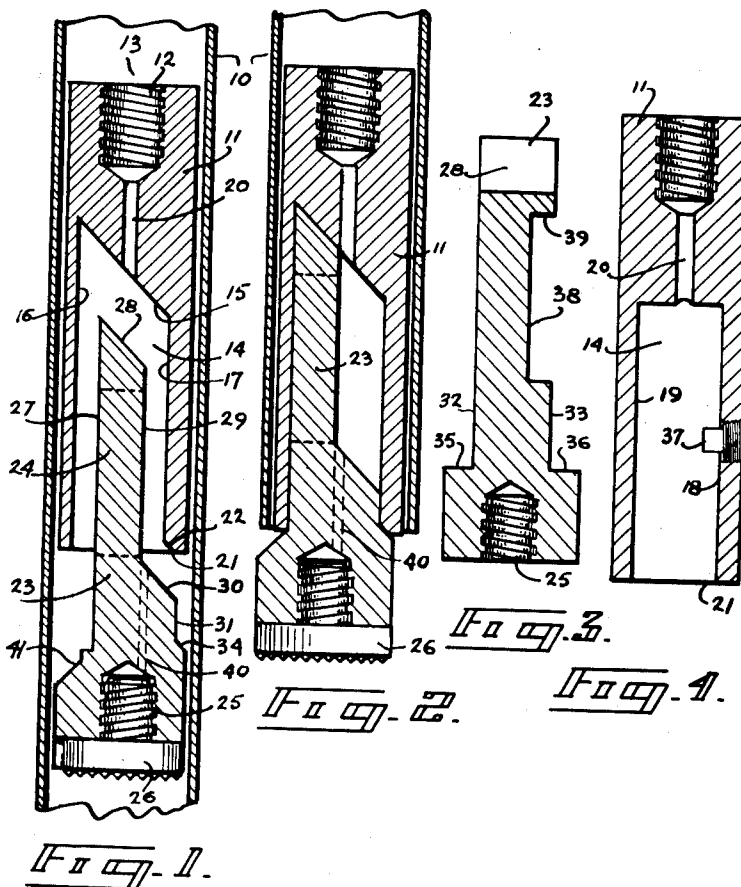
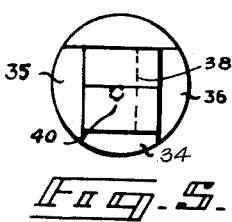
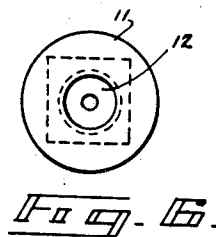
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UNDERREAMER

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UNDERREAMER

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1 Claim. (Cl. 255-75)

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This invention relates to a tool for drilling holes for casing or stand-pipe, through overburden or soft rock formations, and in particular to that type of tool known as an under reamer.

Under reamers are tools which carry a drill bit, or cutting blades and are themselves attached to drill rods which supply the rotative power for drilling. The purpose of the under reamer is to obviate the necessity of raising the casing every time the drill-bit or cutting blades must be changed. The function of the under reamer therefore, on being lowered to the bottom of the casing, is to expand and cause a hole to be drilled, which is of sufficient diameter for the casing to follow, and on the wearing out of the bit or blades, to contract so that the under reamer, and the attached cutting means may be raised through the casing. In order to effect this expansion and contraction, under reamers, have in the past been complex mechanisms with a large number of moving parts. The complexity and number of moving parts have made under reamers expensive to construct and susceptible to breakage and clogging.

This invention contemplates an under reamer constructed of two principal moving parts which performs the functions of expansion and contraction and drilling.

The reduction of the number of principal moving parts to two, and the consequent simplification of design reduces the likelihood of breakage or clogging and the expense of constructing the under reamer. Also since the number of parts is vastly reduced, and the space in the casing utilized by the tool is substantially the same, the individual parts are larger and therefore sturdier, further decreasing the likelihood of breakage.

The under reamer comprises two members, vertically disposed from one another, one attached to the drill rod and the other attached to the drill bit, both of which are substantially cylindrical in shape and which make a sliding fit with the casing, below which, a hole is to be drilled. The two members are so connected that when the force on the under reamer is tensile, the two members are semi-flexibly connected and, when both are contained in the casing, are coaxial, and so connected that when the force on the under reamer is compressive, the two members are rigidly connected and if the member attached to the drill bit is clear of the casing, are hetero-axial. When the under reamer is being raised or lowered through the casing, the upper member is held from above by the drill rod while

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the lower member is pulled downward by the force of gravity and the under reamer is in tension. When the drill bit is in contact with the bottom of the hole, the upper member is pushed downward by the drill rod while the lower member is pushed upward by the earth reaction at the bottom of the shaft and the reamer is in compression. Thus the two members each having the same external diameter are coaxial while passing through the casing and may be raised or lowered as desired, but on reaching the bottom of the casing the lower member projects below the lower extremity of the casing, and at the same time the drill bit contacts the bottom of the hole and the cylindrical members become hetero-axial and the lower member and the drill bit project laterally beyond the walls of the casing. With the drill bit in this eccentric position, rotation of the drill rods is carried through the now rigid connection between the upper and lower members, and causes the eccentric drill bit to rotate and drill a hole large enough for the casing to follow. When it is desired to raise the under reamer out of the casing, the drill rod is raised until the force on the under reamer is again tensile, and the two members are then therefore semi-flexibly connected, and on further raising the drill rod, the lower member slips back into the casing, and the whole under reamer may then be raised.

The two members are a body and a bit-holder, the body is cylindrical in shape and has a rectangular bore in its lower end and a means to attach a drill rod at its upper end, while the bit-holder is also cylindrical in shape and has a rectilinear tongue extending contiguously upwardly therefrom. Both body and bit-holder make a sliding fit with the casing and in the case of the body, it is essential that the fit be accurate. The tongue from the bit-holder projects into the bore of the body, a set screw seated in the body projects into the bore and into a recess in the tongue. When there is no upward pressure on the bit-holder, that is when the under reamer is being raised or lowered through the casing, the bit-holder hangs, suspended by the set screw bearing on the upper surface of the recess. When there is upward pressure on the bit-holder, due to the reaction of the bottom of the shaft on the bit holder, sloped surfaces on the tongue and in the bore co-operate to force the bit-holder to one side until it projects laterally beyond the outside wall of the casing, so that the drill bit, attached to the bit holder, will, on rotation of the drill rod, drill a hole large enough for the casing to follow.

In the drawings which illustrate embodiments of the invention:

Figure 1 is a vertical cross section showing the under reamer when passing through the casing.

Figure 2 is a vertical cross section showing the under reamer in position for drilling.

Figure 3 is a vertical cross section showing a view of the bit-holder at right angles to that shown in Figs. 1 and 2.

Figure 4 is a vertical cross section showing a view of the body at right angles to that shown in Figs. 1 and 2.

Figure 5 is a plan view of the bit holder.

Figure 6 is a plan view of the body.

The body 11 is cylindrical and makes a sliding fit with the interior of a cylindrical casing 10. The body 11 has in its upper end female threading 12 to receive drill rods 13, and in its lower end a rectangular bore 14 which terminates in a sloping bearing surface 15. The sloping surface 15 is from high end wall 16 to low end wall 17 and surface 15 is perpendicular to side walls 18 and 19. The female threading and the rectangular bore are connected by a water passage 20. The body 11 has a flat bottom surface 21 which meets the walls 16, 18, and 19 along right angled edges while the right angled edge which would be formed by the intersection of wall 17 and surface 21 is cut-off parallel to surface 15 to form chamfered surface 22.

The bit-holder 23 has a tongue 24 contiguously extending therefrom, and has female threading 25 in its lower face to receive a drill bit 26 while the tongue 24 has a stepped bevel shape defined by end walls 27, 29 and 31, parallel bevelled surfaces 28 and 30 and side walls 32 and 33.

The smaller tongue cross section is joined to the larger bit-holder cross section by means of chamfered surface 34 which is parallel to bevelled surfaces 28 and 30, base segments 35 and 36, shoulder 42 and chamfered surface 41.

The bit-holder 23 makes a sliding fit with the casing 10 and when in use, the bit-holder is disposed below the body, with the tongue 24 projecting into the bore 14. A set screw 37 projecting into the bore 14 through wall 18 ends in a rectangular recess 38 of the tongue. Therefore as long as there is no upward pressure on the bit 26 the bit holder hangs down from the body held by the set screw 37 which bears on the upper surface 39 of the recess 38. In this position, as shown in Figure 1 the under reamer is raised and lowered through the casing. When the under reamer has been lowered to a position such that the bit-holder projects below the casing, the bit comes into contact with the bottom of the shaft and the drill-rods press downward on the body while the earth presses upward on the bit-holder. The body and bit-holder are thus compressed. As this occurs the chamfered surface 22 rides up the bevelled surface 39 forcing the tongue over until it rests against end wall 16 of the bore. The bore continues to ride over the tongue until the chamfered surface 22 bears on chamfered surface 34 while at the same time bottom surface 21 bears on segments 35 and 36 and shoulder 42, halting the telescopic motion of the body and bit-holder, and at the same time wedging the tongue firmly in position.

The connection between the body and the bit-holder is now rigid and the bit holder now is ec-

centric with respect to the body, and projects laterally beyond the walls of the casing. If the drill rods are now rotated the bit will drill a hole large enough for the casing to follow. If it is desired to wash out the drillings a water passage 40 may be drilled through the bit-holder so that water may be pumped in from the surface to flush out the drillings.

When the drill-bit wears out, an upward movement on the drill rods, will pull the body upward until the set screw lifts on the upper surface of the rectangular aperture and the bit-holder is pulled upward, and is guided back into the casing by chamfered surface 41 and can then be raised to the surface.

While the body and bit-holder are described as cylindrical, it is obvious that any exterior shape which will conveniently rotate in the cylindrical casing and make a sliding fit during that rotation, may be used, for example a rectangular body might be used as long as the edges simultaneously touched the casing walls and kept the body from radial movement in the casing.

I claim:

In drilling apparatus, a hollow cylindrical casing, an under-reamer comprising a body slidably engaging the interior of said casing and having means for securing the body to the lower end of a drill rod within the casing, a bit holder slidably engaging the interior of said casing and having means for securing a bit to the lower portion of the bit holder, said body portion having a cylindrical bore open at its lower end and having an inclined upper end wall, said bit holder having an upwardly extending portion with an inclined upper surface opposed to said upper end wall, the inclined upper surface being adapted to slide along the upper end wall when the lower portion of the bit holder emerges from the casing and compressively engages the material being drilled bringing the body and bit holder into heteroaxial relationship, means being provided to prevent vertical rotation of the bit holder with respect to the body, said means for preventing vertical rotation of the bit holder with respect to the body portion comprising a shoulder portion of the bit holder slidably engaging a side wall of the bore of the body when a side of the upwardly extending portion of the bit holder slidably engages the opposite side wall of the bore, the upper surface defining said shoulder portion being inclined in the same direction as the inclination of the upper surface of the upwardly projecting portion so that it will be deflected by the lower edge of the body to assist in positioning the bit holder in heteroaxial relationship, and means semi-flexibly connecting the body and the bit holder in coaxial relationship when the under reamer is within the casing.

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