May 17, 1932. J. CHARLTON 1,858,263

ROTARY EXPANSION DRILLING TOOL

Filed April 13, 1929

Fig. 1.

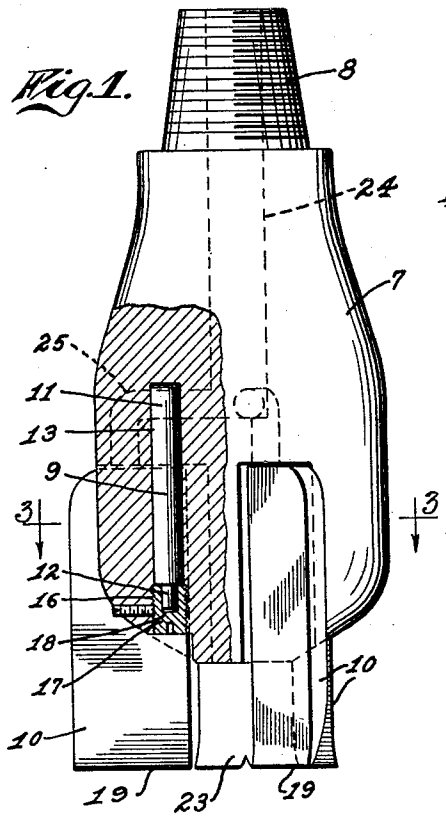


Fig. 2.

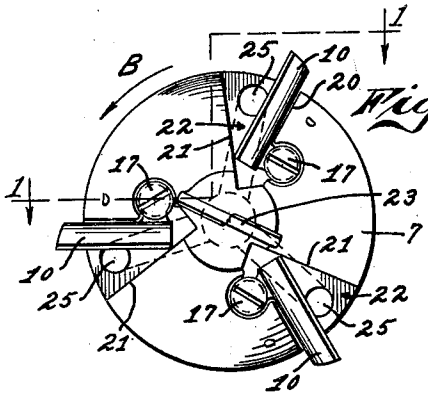


Fig. 3.

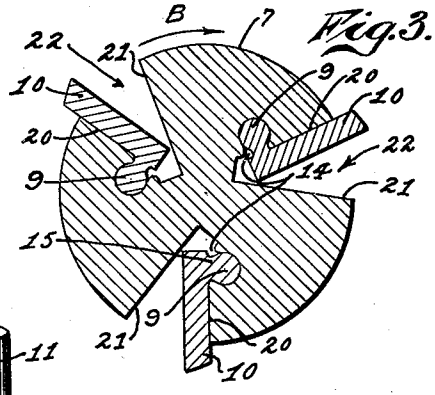


Fig. 5.

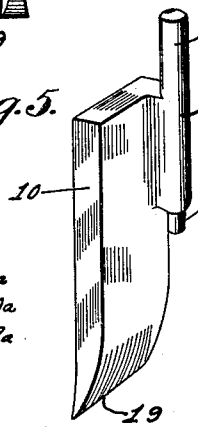
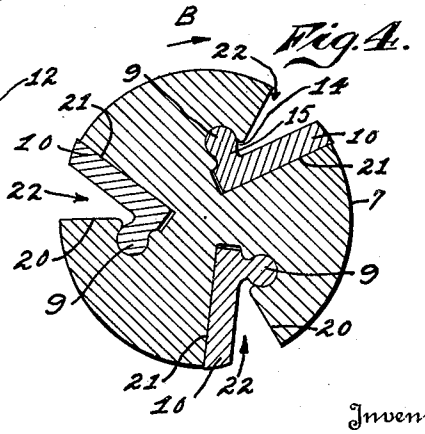


Fig. 4.



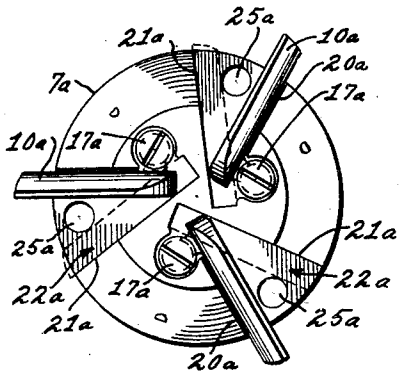


Fig. 6.

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UNITED STATES PATENT OFFICE

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ROTARY EXPANSION DRILLING TOOL

Application filed April 13, 1929. Serial No. 354,746.

This invention relates to rotary expansion drilling tools and, more especially, to that type of drilling tool provided with cutters adapted to be moved into expanded position and retracted by friction of the cutters upon the bottom of the hole being drilled.

A very important object of the invention is simplicity of construction.

Another important object of the invention is to obtain expansion of the cutters from retracted to working positions by eccentric motions of said cutters in relation to the longitudinal axis of the bit.

Another important object is to provide a construction of drilling tool that will drill a hole that need not be afterwards reamed, thus dispensing with a reaming operation.

Other objects and advantages will appear in the subjoined detailed description.

The accompanying drawings illustrate the invention.

Fig. 1 is a longitudinal view, partly in section on the irregular line indicated by 1—1 Fig. 2, of a rotary expansion drilling tool constructed in accordance with the provisions of this invention, the cutters being shown in their expanded positions.

Fig. 2 is an end view of Fig. 1 looking toward the end provided with the cutters.

Fig. 3 is a horizontal section on the line indicated by 3—3 Fig. 1.

Fig. 4 is a view similar to Fig. 3 excepting that the cutters are in their retracted positions.

Fig. 5 is a perspective view of one of the cutters.

Fig. 6 is an end view similar to Fig. 2 illustrating a slightly different form of the invention.

First referring to Figs. 1 to 5 inclusive of the drawings, the tool comprises a body 7 terminating at one end in a threaded pin 8 for engagement with the box of a tool joint, whereby the tool may be connected with the drill stem, in a manner well understood in this art.

Eccentric to the longitudinal axis of the body 7 are pivots 9 which carry cutters 10. The pivots 9 have portions 11 that project upwardly above the upper ends of the cutters and said pivots terminate at their lower ends in portions 12 of reduced diameter. Each of the pivots 9 is rotatably mounted in a bearing recess 13 provided in the body 7, there being a slot 14 opening into the lower portion of each recess 13 to accommodate the neck or web 15 that connects the pivot with the associated cutter 10. The lower end of each recess 13 is threaded at 16 to receive a threaded plug 17 that constitutes a bearing member for the pivot portion 12, each of said members 17 being provided with a bearing recess 18 in which the pivot portion 12 turns. The cutters 10 may be pivoted otherwise than illustrated and described, without departing from the scope of the invention.

The outer ends of the cutters 1 are sharpened to form cutting edges 19 and said edges may be variously shaped, in a manner well understood in this art, to entail uniformity of wear of the cutters.

It will be seen that the axes of the cutter pivots 9 are eccentric to the axes of the cutters, and this is important in order to secure movements of the cutters that will cause them to move from the retracted positions shown in Fig. 4 to the expanded positions shown in Fig. 3, and vice versa. Preferably, in their retracted positions the cutters project very slightly beyond the periphery of the body 7.

When the cutters 10 are in their expanded positions they engage shoulders 20 of the body 7, said shoulders, in this instance, being parallel with the longitudinal axis of the bit so that that portion of each cutter that lies within the body 7 will contact from end to end with a shoulder 20. When the cutters are in their retracted positions they stop against shoulders 21 of the body 7 and, in this instance, the shoulders 20, 21 constitute the opposite faces of vertical slots 22 that open to the periphery of the body 7. The slots 22 are segmental and are sufficiently wide at the periphery of the body 7 to secure the desired amount of projection of the cutters, when expanded, and to receive all of the cutters sufficiently into the tool body when said cutters are in their retracted positions.

In this instance, the cutters 10 are spaced a considerable distance from the longitudinal axis of the body 7 and, accordingly, to insure that when the tool is in operation an uncut core will not remain in the central space between the cutters, it may be advisable to provide in said space a small fish-tail bit 23 which may be formed from or inserted in the body 7, in any suitable manner.

In the form of invention illustrated in Fig. 6, the elements that functionally correspond to those described above are indicated by the same reference characters with the addition of the suffix "a". In Fig. 6 the cutters 10*a* are positioned closer to the axis of the body 7, thus making it improbable that a core would be left by the cutters and, accordingly, in this form of the invention the provisions of a bit corresponding to the bit 23 is unnecessary.

Assuming that the drilling tool is connected in the usual manner to a drill stem, the invention operates as follows: The cutters will be placed in the positions, as illustrated in Fig. 4, and the tool will be lowered into the well hole through the casing, if such casing has previously been installed, the body 7 being of slightly less diameter than the inside of said casing, thus enabling the cutters to pass through the casing to a position below the lower end of said casing. The drill stem will be lowered until the cutters engage the bottom of the hole, whereupon the driller will cause the drill stem to be turned clock-wise by the usual rotary table, in a manner well understood in this art. The friction of the cutters upon the bottom of the hole will hold said cutters against any appreciable rotary movement about the axis of the tool while the body 7 rotates through a sufficient number of degrees to bring the shoulders 20 into engagement with the cutters. While the body is rotating into this position, it carries the pivots 9 with it, thus causing the outer ends of the cutters to be thrust radially with respect to the axis of the tool, thereby expanding the cutters to the position illustrated in Figs. 2 and 3, which is the drilling position of said cutters.

The cutters being now expanded, the drill stem is continued in clock-wise rotation to cause the cutting edges of the cutters to cut away the material at the bottom of the hole, the cutters operating to cut a hole of a diameter somewhat larger than is required for the casing when said casing is subsequently lowered to case the newly bored portion of the hole. Thus an under-reaming operation, as is required when the usual drilling bit is employed, is not required when this tool is employed.

When it is desired to remove the tool from the well for repair or replacement of the cutters, the driller causes the drill stem to be reversely rotated, thus turning the tool body 7 counter-clockwise or in a direction opposite to that indicated by the arrow B in Figs. 2, 3 and 4. During this reverse rotation of the body the outer edges of the cutters are held against turning about the axis of the body by reason of their frictional engagement with the material at the bottom of the hole, while the pivots 9 are caused to rotate with the tool body, thereby causing the outer edges of the cutters to move radially inward until the cutters are retracted substantially within the slots 22, at which time the cutters will be in substantial engagement with the shoulders 21. The driller then elevates the drill stem by the mechanism usually employed for that purpose and well understood in this art, so as to withdraw the tool, through the casing that has been set, to the surface of the earth.

From the foregoing description it will be readily understood that the operations of expanding and contracting the tool are very simple and positive and do not rely upon any springs or other elements but simply upon engagement of the cutting edges of the cutters with the bottom of the hole.

It will be readily understood that if there is any tendency for the cutters 10 to leave an uncut core in alinement with the axis of the tool, the central cutter 23 will cut or break up the material between the inner edges of the cutters 10.

During the drilling operation described above, the drilling liquid or mud will be circulated through the tool in a manner well understood in this art, a duct 24 being shown extending axially of the body 7 from the upper end of said body downwardly to a level somewhat above the upper ends of the cutters, thence laterally in branches 25 that terminate at their outer ends in vertically extending portions that open into the slots 22 adjacent to the front faces of the cutters 10 when said cutters are in the expanded positions, thus entailing that the liquid or mud discharged downwardly along the front faces of the cutters so as to wash the detritus, produced by the cutters, away from the cutters and out of the slots 22, which detritus is then forced upwardly in the space between the tool body and the wall of the hole and caused to finally discharge out of the upper end of the casing, in a manner well understood in this art.

It is to be noted that when the cutters are in engagement with the formation that is to be drilled, assuming them to be in retracted position, and that the body is rotated clockwise, the outer longitudinal edges of the cutters will be caused to move substantially radially outward into their cutting positions. This is due to the relative positions of the pivots, the cutters and the longitudinal axis of the body. In the embodiments illustrated in the drawings and hereinbefore described, the pivots of the cutters are positioned ec-

centric to the longitudinal axis of the body and the cutters are eccentric to the axes of their pivots, but it is to be understood that the pivots may be otherwise positioned, within the scope of some of the appended claims, to cause the outer longitudinal edges of the cutters to move substantially radially, as mentioned above, so that said cutters may be caused to thrust outwardly beyond the periphery of the tool body, thus enabling the cutters to bore a hole of a diameter greater than the outside diameter of the casing, below which the tool operates and through which the tool must pass to reach its drilling position.

I claim:

1. A rotary expansion drilling tool comprising a body provided with bearing recesses in its lower end, cutters provided with pivots projecting above the upper ends of the cutters into the bearing recesses, plugs threaded into the lower ends of the recesses and provided with recesses engaged by the lower ends of the pivots, the cutters projecting below the lower end of the body and the outer ends of said cutters sharpened to form cutting edges.

2. A rotary expansion drilling tool comprising a body provided with bearing recesses in its lower end, cutters provided with outer longitudinal cutting edges and with pivots projecting above the upper ends of the cutters into the bearing recesses, plugs threaded into the lower ends of the recesses and provided with recesses engaged by the lower ends of the pivots, the body provided with vertical segmental slots opening to the periphery of the body to accommodate the cutters, the cutters projecting below the lower end of the body and the outer ends of said cutters sharpened to form cutting edges, the pivots being positioned relative to the cutters and to the longitudinal axis of the body so as to cause the longitudinal cutting edges to move outwardly when the body is rotated in one direction.

Signed at Houston, Texas, this 4th day of March, 1929.

JAMES CHARLTON.