ABSTRACT: A reamer for use in a drilling string for enlarging, scraping or smoothing a well bore, and having extensible and retractable cutting members operable by the pressure of the drilling fluid circulated through the string during the drilling operation. The cutting members may include a plurality of telescopically arranged elements movably positioned on the body of the tool for radial movement inwardly and outwardly thereof relative to window openings in the body and having seal forming means positioned to prevent leakage through the openings. The cutting members and body are formed with inwardly and downwardly sloping end faces positioned for coaction to allow the cutting members to move inwardly toward their retracted position, aided by gravity, when the internal pressure in the string is shut off, and the members are also formed with beveled external, upper end faces, positioned for engagement with irregularities in the well bore to move the members toward their retracted positions upon upward movement of the string during the removal of the same from the bore.
WELL REAMER WITH EXTENSIBLE AND RETRACTABLE REAMER ELEMENTS

BACKGROUND OF THE INVENTION

In the drilling of wells by the rotary drilling method, it is customary to make use of a tubular drilling string to whose lower end a drilling bit is attached whose diameter is substantially larger than that of the string. During the drilling operation a suitable drilling fluid, such as drilling mud, is circulated downwardly through the string and upwardly in the annulus of the bore about the string to carry away cuttings and lubricate the drill. The well bore produced by this method is almost never entirely vertical and frequently has curved or sloping portions, so that portions of the string are often in contact with the wall of the bore, which results in the formation of key slots at various locations in the bore, which slots are of substantially smaller diameter than the drilling bit and any drill collars employed therewith. Upon attempting to withdraw the drilling string from a well having such key slots, there is a tendency for the string to be straightened by the upward pull exerted on the string, thus tending to pull the string laterally into the key slots and causing the drill collars and bit to become stuck in the bore. Various devices have been employed to avoid the above difficulty, such as centralizers, key-seat reamers and breeching tools, and reamers adapted to drill the string. Tools of this character, may however, increase the difficulty by themselves becoming stuck in key slots, necessitating laborious and time consuming operations for the releasing and withdrawing of the string.

SUMMARY OF THE INVENTION

Briefly stated, the present invention comprises an expansible and retractable reaming tool comprising a tubular body adapted to be connected into a drilling string and formed with peripherally spaced window openings whose upper and lower ends are formed with radially inwardly and downwardly sloping faces. Extensible and retractable cutter members are movably mounted in the window openings for radial movement to extended positions to engage the outer extremities of the members with the surrounding wall of a well bore and retracted positions in which the members are substantially flush with the outer surface of the body. The cutter members are formed at their upper ends with beveled, external end faces positioned for engagement with irregularities in the bore, upon upward movement of the tool to urge the members toward their retracted positions. The members are also formed with upper and lower inwardly and downwardly sloping faces positioned for coaction with the end faces of the window openings to allow the members to be urged by gravity toward their retracted positions. The cutter members may be made up of a number of telescopingly arranged sections between which seal forming means is positioned and similar seal forming means is provided between the members and the body in the window openings to prevent leakage into or out of the string. The cutter members are adapted to be extended by the pressure of fluid in the string and are formed with means positioned for coaction with the internal surface of the body externally of the window openings to limit outward radial movement of the members. The invention has for an important object the provision of a reaming tool for use in a drill string embodying extensible and retractable cutter members extensible by the pressure of fluid in the string and having means to allow the retraction of the members under the influence of gravity when such pressure is removed. Another object of the invention is to provide a reamer of the kind referred to having extensible and retractable cutter members embodying means for causing the members to be moved toward their retracted positions in response to engagement of the members with irregularities in the well bore during removal of the string therefrom.
In making use of the well reamer, constructed as described above, the tool is connected into a string of pipe such as a drilling string, having a drilling bit attached to its lower end and lowered therewith into a well bore B, as seen in FIG. 3. During the drilling of the well, the pressure of the drilling fluid being circulated through the string and the annulus surrounding the same will exert a force on the cutting or reaming members of the tool tending to extend the cutters into engagement with the surrounding wall of the bore, and this force may be regulated by increasing or decreasing the pressure of the drilling fluid.

When the drilling string is to be withdrawn from the well, the pressure of the drilling fluid will be cut off so that the cutters may retract under the influence of gravity, and in the event that the cutters should engage any projections or irregularities in the bore, as the string moves upwardly therein, the cutters may slide freely along the downwardly and inwardly sloping end faces 26 and 29 of the window openings, thus allowing the cutters to retract to positions substantially flush with the outer surface of the body, whereby sticking of the tool in the well bore or damage to the cutters is effectively prevented.

A somewhat different form of the invention is illustrated in FIGS. 4 and 5, wherein the extendible and retractable reamer or cutter members are formed in a number of telescopingly arranged parts to enable the tool to be used in well bores of substantially different diameters.

In this form of the invention, each cutter member has inner and outer parts 28' and 30' similar or identical to the parts 28 and 30 previously described, and additional telescopingly arranged parts 60 and 62 by which the parts 28' and 30' are movably mounted in the window opening of the body. In this case the innermost one 60 of the telescoping parts 60 and 62 is formed with curved, sloping, external end faces 64 conforming to the shape of the curved end faces 26 and 29 of the window opening and is snugly but slidably fitted in the opening. The part 60 also has lateral projections 66 at its inner end positioned for engagement with the inner surface of the body adjacent the window opening to limit the outward movement of the part therein.

The parts 20 and 62 are formed with interengageable portions 68 and 70, respectively, positioned for engagement to limit relative movement of the parts and the part 62 has a portion 72 positioned for engagement with the inner end projection 48' of the part 28' to limit outward movement of the part 28' relative to part 60 and to cause the part 60 to be extended with the part 28' upon extension of the cutter.

Suitable seal forming means such as the O-rings 50', 74 and 76 are positioned to form fluid tight seals between the parts 28' and 62, between parts 60 and 62 and between part 60 and the body in the window opening, in all positions of the parts.

In other respects the form of the invention illustrated in FIGS. 4 and 5, is similar to that of FIGS. 1 to 3, and is similarly operated.

In assembling the cutter members with the body, the inner part 28, in the form of the invention shown in FIGS. 1, 2 and 3, may be inserted into the window opening through the bore of the body and the outer part 30 then attached to the inner part, while in the form of the invention illustrated in FIGS. 4 and 5 the inner parts 60 and 62 and inner part 28' may be similarly positioned one within another in the window opening and the outer part 30' then attached to the part 28'. It will also be apparent that the cutter members may be disassembled and removed from the body in an obvious manner by reversing the above described method of assembly.

It will thus be apparent that the invention constructed as described above, provides a reamer device for employment in well drilling strings which is of simple design and rugged construction, in which the cutter members may move readily toward retracted positions in response to engagement of the members with irregularities in a well bore and wherein the parts are easily replaceable for purposes of repair.

The invention is disclosed herein in connection with particular constructions and arrangement of the parts thereof, which are intended by way of illustration only, it being evident that various changes can be made therein within the spirit of the invention and the scope of the appended claims.

I claim:

1. A well reamer comprising a tubular body adapted to be connected into a well string for rotation and lowering with the string in a well bore, and having peripherally spaced window openings, cutter members movably mounted in the window openings for radial movement to extended positions projecting outwardly from the body under the influence of the pressure of fluid in the body and to retracted positions substantially flush with the external surface of the body, said body being formed with upper and lower downwardly and inwardly sloping end faces in said window openings, and said members being formed with end surfaces shaped for coaction with said end faces to cause the members to move radially inwardly and downwardly away from said wall upon movement of said members away from said extended positions.

2. The well reamer as claimed in claim 1 wherein each of said members includes an inner part and an outer part detachably secured together and means on said inner part positioned for coaction with said body to limit outward movement of the member in the opening.

3. The well reamer as claimed in claim 1 wherein each of said members includes telescopingly arranged parts slideable relative to each other radially of the body and means on said parts positioned for coaction to limit movement of the parts toward said extended position.

4. The well reamer as claimed in claim 3 including seal forming means for each of said parts positioned for coaction with the parts and body to prevent the outflow of fluid from the body through said window openings in all positions of the members.