

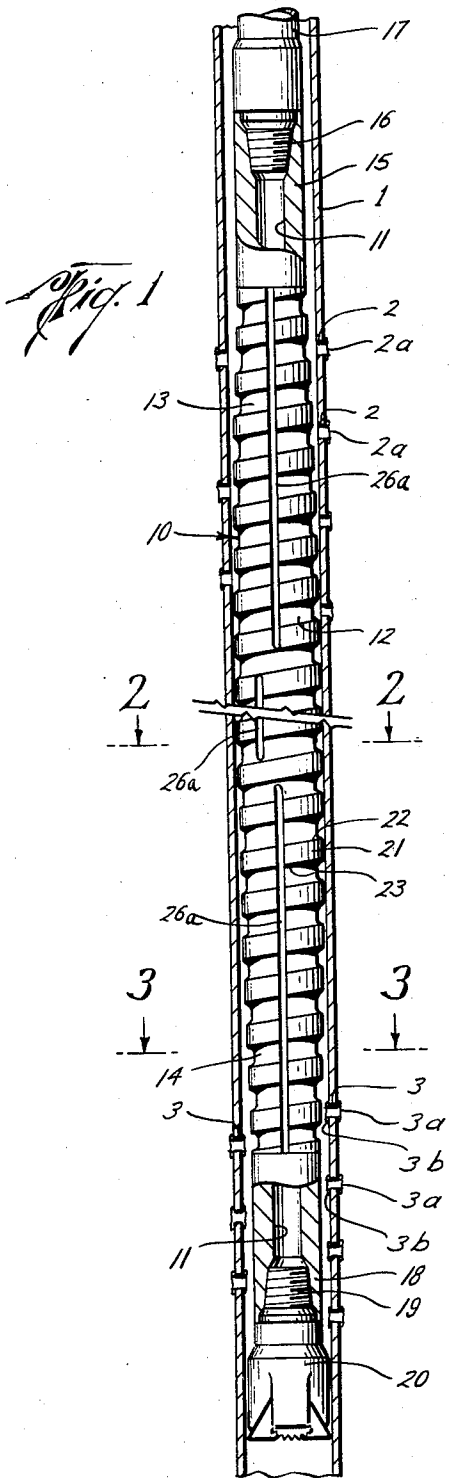
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J. McCLINTON

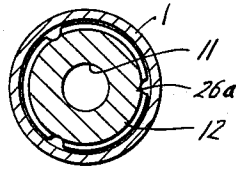
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COMBINATION BROACH AND DRILL COLLAR FOR USE IN WELL DRILLING

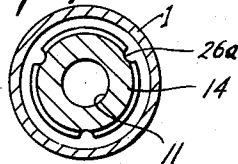
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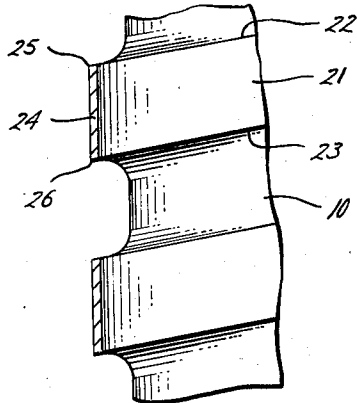
*Fig. 2*



*Fig. 3*



*Fig. 4*



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**COMBINATION BROACH AND DRILL COLLAR FOR USE IN WELL DRILLING**

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2 Claims. (Cl. 77-72)

This invention relates to well drilling apparatus and more particularly to a combination tool which I have termed a "combination broach and drill collar" which is adapted to perform several useful functions in well drilling as will be subsequently described.

In the course of drilling and completing oil and gas wells, the well casings are conventionally perforated by suitable means, such as bullets, shaped explosive charges, and other devices, in order to establish communication between the well bore and surrounding earth formations containing fluids to be produced by the wells. Perforation of the casings, particularly by bullets and explosive charges, generally results in the formation of metal burrs about the perforations which project into the bore of the casing and are usually of jagged and irregular conformation which form obstructions which may hinder the running of other tools, such as packers, squeeze tools, plugs and the like, into or through the perforated section and which, in particular, are likely to seriously tear and otherwise damage the rubber sealing elements of such tools and render them inoperative or ineffective for their intended functions.

The present invention, therefore, has for its principal object the provision of a tool, in the form of a broach, which is installed in, and forms a part of, an operating string, such as a well drilling string, and by means of which the internal burrs may be removed and the interior surface of the pipe effectively cleaned and smoothed.

Since, in many cases, one or more sets of perforations may be "squeezed-off" with cement and drilling resumed, the broach in accordance with this invention has been combined with a drill collar so that its wall scraping and cutting action may be combined with the weighting and guiding function of the drill collar in drilling and thus provide a composite tool which can be incorporated as a part of a regular rotary drilling string and which will be capable of performing several useful functions simultaneously.

Moreover, the combination tool in accordance with this invention is constructed with oppositely tapered ends and with a surface conformation such that it may be effectively employed to enlarge "key seats" in well bores and to remove obstructions of various types which may be formed in the well bore during drilling.

In accordance with a preferred embodiment of this invention, the combination tool is made from a drill collar to provide a heavy, thick-walled tubular body which has a generally cylindrical medial portion terminating at each end in an axially tapered portion, the end portions tapering oppositely to each other. The exterior of the body has formed thereon, by machining or in any other known manner, a coarse helical thread, the thread portions at each end decreasing in diameter in accordance with the taper of the ends of the body. The thread profile is preferably of the square or "Acme" form so as to provide sharp corners at the upper and lower edges of the thread to perform the desired cutting or scraping function. The

thread faces may be hardened by any suitable and known method and preferably by applying thereto one of the well-known hard facing alloys conventionally employed for cutting tools.

The foregoing and other objects and advantages of this invention will become more readily apparent from the following more detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with the present invention.

In the drawings:

Fig. 1 is an elevational view, partly in section, showing the combination tool in accordance with this invention, installed in a drilling string and inserted in a well casing;

Figs. 2 and 3 are cross-sectional views taken respectively along line 2-2 and 3-3 of Fig. 1; and

Fig. 4 is an enlarged detail showing the thread formation of the tool.

Referring to the drawing:

The combination drill collar-broach is designated generally by the numeral 10 and comprises a thick walled tubular body having an axial throughbore 11. The body includes a central or medial portion 12 which is generally cylindrical in its external configuration and terminates in each end in upper and lower conically tapered sections 13 and 14, respectively. The tapered portions will ordinarily be about one-fourth to one-half the length of medial portion 12. Upper tapered portion 13 terminates in a standard tool joint box 15 adapted to threadedly receive the pin 16 forming the tool joint member of the rotary drill string 17 to which the broach is connected. Lower tapered portion 14 similarly terminates in the tool joint box 18 which is internally threaded to receive the pin member 19 of a rotary drill bit 20 connected to the lower end of the broach. It will be understood, however, that one or more drill collars of more conventional form may be interposed in the tool string between the lower end of the broach and the drill bit. The degree of taper of the end portions 13 and 14 will vary, depending upon the diameter of the medial portion of the broach and the diameter of the tool joints at the ends thereof, the taper being such as to provide gradual reduction in diameter of the tool from its medial diameter to that of the tool joint at the ends of the body.

Formed on the external surface of broach 10 and extending from end to end thereof is a helical thread 21 of generally square profile shaped to provide sharp upper and lower edges 22 and 23, respectively, which form shearing edges adapted to cut and scrape surfaces engaged by the threads. As best seen in Fig. 4, the vertical face of the thread is provided with a hard facing material 24 applied in the form of a thin layer in any suitable and well-known manner to harden the surface of the thread and provide the hardened sharp corners 25 and 26 at the upper and lower edges of the thread. A series of longitudinal grooves 26a are cut at circumferential spaced points in the faces of the threads to provide passages for fluid circulating past the tool and to provide relief for scrapings or cuttings removed by the tool which can collect in the grooves and be washed out by circulating fluids.

The tool is shown installed as a part of the well string 17 which is inserted in a well casing 1 in which the tool is to be operated. Casing 1 is shown as having upper and lower sets of perforations through the wall thereof, the perforations in the upper set being designated by the numerals 2 and those in the lower set by the numerals 3. The latter are shown surrounded by external burrs 3a and internal burrs 3b formed respectively on the outer and inner walls of the casing by the perforating devices, as usually occurs in this type of operation. The upper set of perforations 2 are shown only with external burrs

2a, the internal burrs having been removed by operation of the tool, as will be described.

The operating string carrying the broach is run into casing 1 and operated therein in the usual manner. In this instance it is assumed that additional drilling is to be conducted through the casing as, for example, to remove excess cement which has set in the casing following squeezing of the perforations or the like. The string will be rotated as it is moved downwardly under the weight of the string, including the weight of the broach which also functions as a drill collar, as previously noted. The downward movement and rotation of the tool will cause the sharp edges of the thread 21 to engage the internal burrs surrounding the perforations and cut or grind them off as the broach moves past them. It will be understood that the diameter of the threads on the medial portion of the broach will be selected to be only slightly less than the internal diameter of the casing so that the internal burrs will be ground off sufficiently to render the interior wall of the pipe substantially smooth throughout its length.

In addition to the rotative operation of the tool the tapered conformation of the tool will be of assistance in permitting reciprocation of the string, which will also aid in removing the burrs and preventing the tool from sticking in the casing as it is operated.

It will be understood that drilling mud or other fluid may be circulated through the bore of the tool string, including bore 11, and out the usual openings in the bit (not shown) and thence upwardly along the outside of the string to lubricate the bit and wash out the cuttings. The scrapings removed by the thread from the pipe wall will move into grooves 26a and will either fall to the bottom of the well, or be washed out by the circulating fluid. The mud or wash fluid may also be circulated down the well bore exteriorly of the tool, grooves 26a forming additional passages for this flow, and the fluid will be returned through the bore of the tool string to the surface, this reverse circulation being a common expedient in drilling operations.

The double tapering conformation of the tool in accordance with this invention, is also useful in enabling the structure to enlarge key seats and similar obstructions or projections in the uncased portion of a well bore during drilling. Such a function will be performed in the manner such as described in my prior Patent No. 2,572,839, the double taper allowing the tool to be effectively reciprocated when necessary. The thread formation serves also as a screw by which the tool may be moved through or past constricted or obstructed passages of the well bore, the threads acting as broach cutters in removing or enlarging such obstructions.

By combining the broach with a drill collar member in the manner described, the tool will also serve the usual function of a drill collar in providing the weight desired near the bit in a drilling string. Thus, the combination

tool of the present invention may be installed as a part of the drill collar string in a drilling string and may function as a drill collar and when necessary perform the additional functions heretofore described, namely, removing burrs from the interior of a well casing, enlarging key seats, and removing obstructions from the uncased portions of the well bore.

In one example of a tool in accordance with this invention, namely, a combination broach and drill collar for use in 7 inch well casing, the medial portion of the tool is 48 inches in length and has an external diameter of 6½ inches. The tapered end portions are each 12 inches in length and taper from the diameters of the medial portion to the outside diameters of the tool joint boxes which, in this instance, is 4¾ inches. The nominal wall thickness will be about 2 inches.

It will be understood that various changes and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims, but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. A combination broach and drill collar for removing internal projections from the wall of a well bore, comprising, a heavy-walled tubular body adapted to be installed in a rotary drill string to form a part thereof, said body comprising a longitudinally extended cylindrical medial portion and conically tapered opposite end portions, and a coarse shearing thread on the exterior of said body extending throughout the length thereof including both tapered end portions, the length of each of said tapered end portions being between one-fourth and one-half that of said cylindrical medial portion, and said cylindrical medial portion having an external diameter closely approaching the diameter of the well bore and having a length such as to be simultaneously engageable with a plurality of longitudinally spaced projections on the wall of the well bore.

2. A combination broach and drill collar according to claim 1 having a plurality of circumferentially and longitudinally extending grooves intersecting said thread.

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