Jan. 20, 1959 J. McCLINTON 2,869,828

KEYSEAT TOOL

Filed May 7, 1956 2 Sheets-Sheet 1

Fig. 3

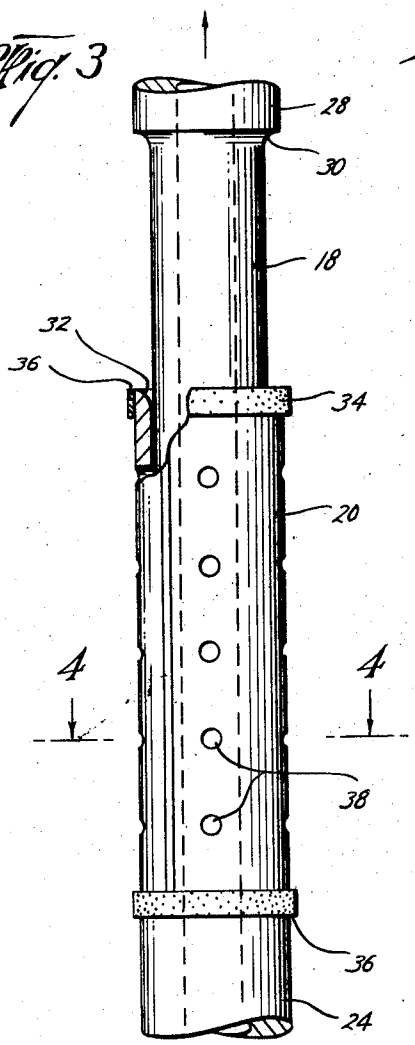


Fig. 1

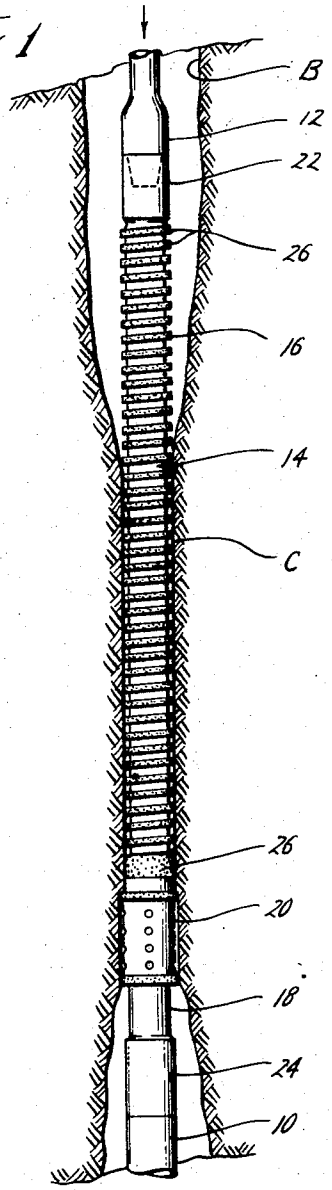
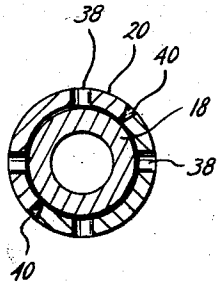


Fig. 4



John McClinton
INVENTOR.

BY

ATTORNEY

Jan. 20, 1959 J. McCLINTON 2,869,828

KEYSEAT TOOL

Filed May 7, 1956 2 Sheets-Sheet 2

Fig. 2B

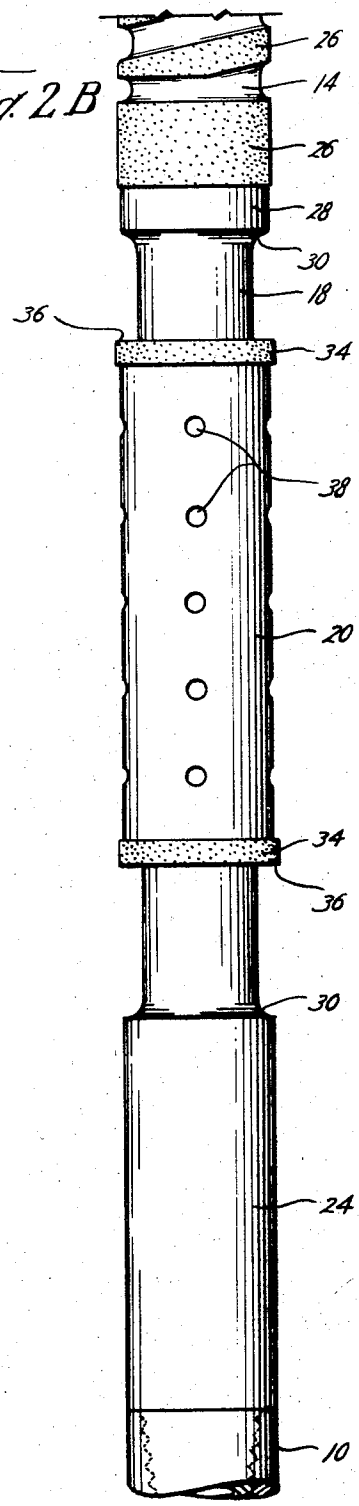
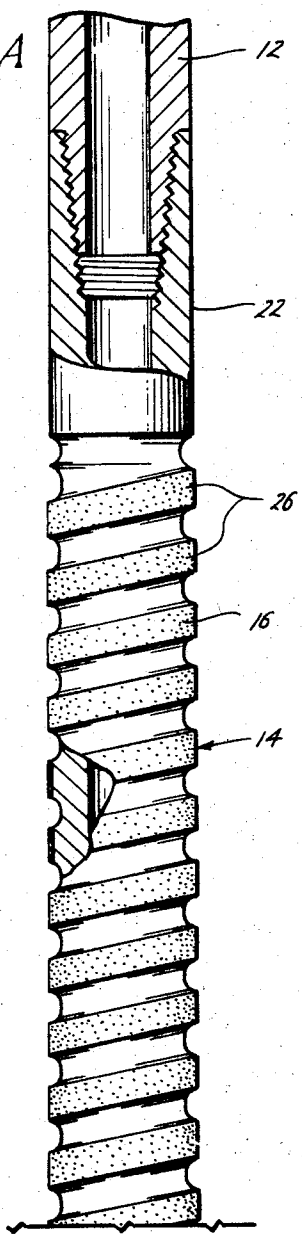


Fig. 2A



John McClinton
INVENTOR.

BY

ATTORNEY

United States Patent Office

2,869,828

Patented Jan. 20, 1959

2,869,828

KEYSEAT TOOL

John McClinton, Houston, Tex.

Application May 7, 1956, Serial No. 582,982

7 Claims. (Cl. 255—28)

This invention relates to a keyseat tool and more particularly to a tool for use in connection with the drilling of wells for the purpose of preventing the sticking of the drill collars of a drilling string in a keyseat or other irregular formation in a well bore.

In the drilling of wells and especially in the drilling of oil and gas wells, keyseats are often formed due to the contact of the drilling string with the wall of the well bore at curved portions, dog-legs, protruding hard ledges or other irregularities in the well bore. Such keyseats present a substantial hazard in the drilling operations in that they are of substantially smaller diameter than the bore of the well and the drill collars, which are of somewhat larger external diameter than the drill pipe above the collars often enter a keyseat and become wedged or stuck therein, particularly when the drill string is being withdrawn from the bore.

An important object of the present invention is to provide a keyseat tool for use in well drilling operations which is adapted to be inserted in a drill string to prevent the sticking of drill collars in a keyseat.

Another object of the invention is the provision of a keyseat tool which is designed to be easily released from a keyseat by manipulation of the drill string in the event that the tool should enter and become stuck in such a seat.

A further object of the invention is to provide a keyseat tool which may be operated to broach or enlarge a keyseat and which is also operable as a jar to release the tool from a keyseat in the event of sticking.

The invention also contemplates a keyseat tool having an upper tapered broaching portion which is constructed to ream or enlarge a keyseat by vertical reciprocating movement and which is also formed with means whereby the same may be released from a keyseat by an unscrewing action by rotation of the drill string, and having a lower portion which is constructed to prevent the sticking of a drill collar in a keyseat and which may be operated as a jar to effect release of the tool in the event that it should become stuck in the keyseat.

Other important objects and advantages of the invention will be apparent from the following detailed description thereof taken in conjunction with the accompanying drawings illustrating an operative embodiment of the same.

In the drawings—

Figure 1 is a side elevational view, on a somewhat reduced scale, illustrating the invention and showing the same in the bore of a well and the manner in which the tool is operated in a keyseat;

Figures 2A and 2B are fragmentary side elevational views illustrating the construction of the invention, Figure 2B being a downward continuation of Figure 2A and Figure 2A being partly broken away and partly in cross-section;

Figure 3 is a view similar to that of Figure 2B, illustrating one manner of use of the tool in performing a jarring action; and,

Figure 4 is a cross-sectional view taken along the line 4—4 of Figure 3 looking in the direction indicated by the arrows.

Referring now to the drawings in greater detail, the keyseat tool of the invention is illustrated herein in connection with its use in a well bore B wherein some form of obstruction is present, such as a bridged-over condition, or the like, indicated at C, whereby a portion of reduced diameter is formed in the bore in which there is likelihood that a drill collar may become stuck. Such obstruction may, of course, take the form of a keyseat, dog-leg, or other irregularity, by which the diameter of the well bore is reduced to an extent to prevent a hazard to the free passage therethrough of the drill collar and bit of the drilling equipment.

The tool of the invention is employed in a drilling string of conventional construction, having the usual drill collar 10, to the lower end of which a drill bit, not shown, is connected, and a tool joint 12, which is connected to the lower end of a drill stem extending upwardly to the surface.

The keyseat tool of the invention comprises a tubular body or mandrel 14, connected at its lower end to the upper end of the drill collar 10 and at its upper end to the tool joint 12, and having an upper externally threaded broach portion 16 and a lower reduced portion or stem 18, upon which a sleeve element 20 is mounted for relative longitudinal movement. At its upper end the body 14 has an unthreaded portion 22, which is internally threaded for connection to the tool joint 12, and whose external diameter is substantially the same as that of the lower end of the tool joint. The body has at its lower end a straight portion 24, whose lower end is externally threaded for connection to the drill collar 10, and whose external diameter is substantially the same as that of the drill collar. The drill collar is of larger diameter than the drill pipe, to provide weight and rigidity to prevent undue deflection of the bit.

The broach portion 16 is provided with an external thread and tapers upwardly, the thread at the lower end of the threaded portion being of slightly greater outer diameter than the other diameter of the drill collar 10, and thread at the upper end of the threaded portion having an outer diameter which is only slightly greater than the outer diameter of the upper end portion 22. The broach thread may conveniently be a thread of standard profile, such as an acme thread, and the outermost surface of the thread may be faced with a suitable wear-resisting material, such as hardened steel or other alloy 26. Below the lower end of the threaded portion the body may also be formed with a straight portion 28, whose outer diameter is substantially the same as the outer diameter of the lower end of the thread, and which may be provided throughout a substantial portion of its length with the same facing material 26.

The sleeve 20 is of substantially shorter length than the length of the stem portion 18 between the upper portion 28 and the lower portion 24, and has an external diameter substantially equal to the external diameters of those portions. The stem portion 18 preferably merges with the portions 24 and 28 by smooth curves or fillets 30, to avoid any sharp change in the external diameter of the body, and the sleeve 20, which constitutes an impact element, may be provided at its ends with rounded inner surfaces 32, positioned for engagement with the surfaces 30 of the body when the sleeve reaches the limits of its longitudinal movement relative to the body. The sleeve is also provided at its end portions with external facings 34, of similar material to the facings 26, and whose external diameters are somewhat greater than the external diameters of the portions 24 and 28, and which provide end faces 36, projecting laterally slightly beyond the external

surfaces of the body and the drill collar **10**. The hard facing material may be applied by conventional means, as by welding or the like. The internal diameter of the sleeve **20** is preferably slightly greater than the external diameter of the stem portion **18**, to allow free relative longitudinal movement between the sleeve and the stem, and the sleeve may be provided with a number of openings **38** extending from the interior to the exterior thereof, to permit the escape of fluid from within the sleeve.

The sleeve may conveniently be divided longitudinally, to form two sections, which may be assembled about the stem portion **18**, and welded together in assembling the tool, as indicated at **40**, in Figure 4.

The sleeve and the associated stem portion **18** and the upper and lower body portions **24** and **28** constitute jarring and keyseat wiping mechanism by which the drill collar **10** may be prevented from becoming stuck in a keyseat, and which may also be operated to release the tool in the event that the same should become stuck in a well obstruction. The body **14** may be of substantial length, to provide flexibility as a bridging connection between the drill collar and tool joint and because of the tapering configuration of the body the same serves as a means to provide a dampening effect on the stresses and strains transmitted upwardly between the drill collar and drill pipe. By this construction the tendency toward breakage of the drill string due to vibratory effects transmitted upwardly from the bit or the whipping action of the drill string is greatly reduced. These properties and functions of broach portion **16** are described in greater detail in my U. S. Patent 2,572,839.

In the operation of the invention to enlarge a keyseat or other obstruction in the well bore, strain is put on the drilling string at the surface of the well and the string is pulled upwardly. An increase in the drag on the string will then indicate that the broach portion of the tool has moved into binding contact with the keyseat. By applying an upward pull on the string and rotating the same the tool may in some cases be moved completely up through the keyseat without becoming stuck therein, the upward pull and rotation of the string causing the threads to shear or cut the formation to enlarge the keyseat. Cuttings formed by the threads may also pass downwardly about the threads into the well bore.

In the event that the broach portion should become wedged in the keyseat the pull on the string may be slackened off to apply weight to the tool, and the drill string will be rotated in addition to cause the threads to shear away the formation to permit the tool to move downwardly. The weight of the string, drill collar, and bit and rotation of the string will cause the broach portion to unscrew downwardly to release the tool from the formation. By successively pulling up on the string, rotating the same, and slackening off on the string to apply weight to the tool, together with rotation of the tool, and by repeating these operations a number of times the keyseat will be enlarged to an extent to permit the upward passage of the drill collar and bit therethrough.

Under some conditions the well obstruction may be of such character that when the broach portion has succeeded in cutting through the obstruction, an opening will be provided which, while substantially equal to the maximum diameter of the broach portion and, therefore, slightly larger than the diameter of the drill collar, may still not be large enough to permit the drill collar to pass freely therethrough. In such event the sleeve **20** because of the hardened facings **34**, which are of slightly greater external diameter than the external diameter of the drill collar will become stuck before the drill collar and by jarring action produced on the opposite ends of the sleeve by reciprocating the drill string, the sleeve may be employed to perform a wiping or enlarging operation on the formation to further enlarge the keyseat or other obstruction until the drill collar passes freely through the same.

It will also be apparent that drilling mud may pass around the body in the space between the broach threads to act as a lubricant between the broach and the keyseat formation, and may also pass through the sleeve in the event that the sleeve should become stuck. By repeating the steps of pulling the broach upwardly into the keyseat until it becomes stuck, rotating the broach to loosen it, and moving the broach up and down to shear away the formation. the keyseat may be enlarged, so that the sleeve, drill collar and bit may be worked upwardly therethrough.

The upper and lower surfaces **30** at the ends of the stem portion **18** of the body provide impact faces positioned for engagement with the respective ends of the sleeve **20**, in the event that it becomes necessary to carry out a jarring action by longitudinal movement of the string to release the sleeve and additionally enlarge the opening through the obstruction.

The invention has been disclosed herein in connection with a certain specific embodiment of the same, but it will be understood that this is intended by way of illustration only, and that various changes can be made in the construction and arrangement of the parts, within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A keyseat tool comprising a tubular body having a tapered, externally threaded end portion, a pipe connection at each end of the body to position the body in a drill pipe with the smaller end of the taper up, said body having a portion of reduced external diameter below said tapered portion forming abutments on the body at the ends of said reduced portion and a sleeve having annular cutting portions whose external diameter is larger than the maximum external diameter of the body surrounding and movable longitudinally on said reduced portion into and out of engagement with said abutments.

2. A keyseat tool comprising a tubular body having a tapered end portion, a pipe connection at each end of the body to position the body in a drill pipe with the smaller end of the taper up, a coarse shearing thread on the periphery of said tapered portion positioned to perform a cutting action in a restricted area in a well bore to enlarge said area upon rotation and longitudinal movement of said body in said area, said body having a portion of reduced external diameter below said tapered portion and forming upwardly and downwardly facing impact faces at the ends of said reduced portion, and an impact element including annular cutting portions having a larger external diameter than the maximum external diameter of said body mounted on said reduced portion for longitudinal movement into and out of engagement with said impact faces.

3. A keyseat tool comprising a tubular body having a tapered, externally threaded end portion, a pipe connection at each end of the body to position the body in a drill pipe with the smaller end of the taper up, said body having a portion of reduced external diameter below said tapered portion forming upwardly and downwardly facing impact faces on the body, and an impact element mounted on said reduced portion for longitudinal movement thereon and having upper and lower end faces positioned for engagement with said impact faces and of larger external diameter than said body.

4. A keyseat tool comprising a tubular body having a tapered, externally threaded end portion, a pipe connection at each end of the body to position the body in a drill pipe with the smaller end of the taper up, said body having a portion of reduced external diameter below said tapered portion forming upwardly and downwardly facing impact faces on the body, and an impact element mounted on said reduced portion for longitudinal movement thereon into and out of engagement with said impact faces and having an internal diameter larger than the external diameter of said reduced portion and including annular cutting portions having an external

diameter greater than the maximum external diameter of the body, said element having openings therethrough intermediate the ends thereof and in communication with the interior and exterior of the element.

5. A keyseat tool comprising a tubular body having a tapered, externally threaded end portion, a pipe connection at each end of the body to position the body in a drill pipe with the smaller end of the taper up, said body having a portion of reduced external diameter below said tapered portion forming longitudinally spaced, oppositely facing impact faces on the body, and an impact element mounted on said reduced portion for longitudinal movement thereon and having portions positioned for engagement with said impact faces to limit such longitudinal movement, said element having an external portion forming a cutting edge of greater diameter than the maximum external diameter of the body.

6. A keyseat tool comprising a tubular body having a tapered end portion, a pipe connection at each end of the body to position the body in a drill pipe with the smaller end of the taper up, a coarse shearing thread on the periphery of said tapered portion having a cutting face formed of hardened material positioned to perform a cutting action in a restricted area in a well bore to enlarge said area upon rotation and longitudinal movement of the body in said area, said body having a portion of reduced external diameter below said tapered portion and forming upper and lower impact faces on the body, and an impact element mounted on said reduced portion for longitudinal movement thereon into and out of engagement with said impact faces and having an external portion formed of hardened material whose external diameter is greater than the maximum external diameter of said body.

7. A keyseat tool comprising a tubular body having a tapered end portion, a pipe connection at each end of the body to position the body in a drill pipe with the smaller end of the taper up, a coarse shearing thread on the periphery of said tapered portion having an external face of hardened material positioned to perform a cutting action in a restricted area in a well bore to enlarge said area upon rotation and longitudinal movement of the body in said area, said body having an external surface portion of hardened material below said tapered portion whose diameter is substantially equal to the maximum diameter of said external face of said thread and also having a portion of reduced external diameter below said external surface portion forming upper and lower impact faces on the body, and an impact element mounted on said reduced portion for longitudinal movement thereon into and out of engagement with said impact faces and having an external portion formed of hardened material whose external diameter is greater than the external diameter of said external surface portion.

References Cited in the file of this patent

UNITED STATES PATENTS

2,572,839	McClinton	Oct. 30, 1951
2,620,164	Burris	Dec. 2, 1952
2,665,887	Shelton	Jan. 12, 1954
2,717,764	Cannon	Sept. 13, 1955
2,727,730	Crake	Dec. 20, 1955