Jan. 12, 1954 L. L. SHELTON 2,665,887

COMBINATION JAR AND KEY SEAT REAMER

Filed Aug. 3, 1951

Fig. 1

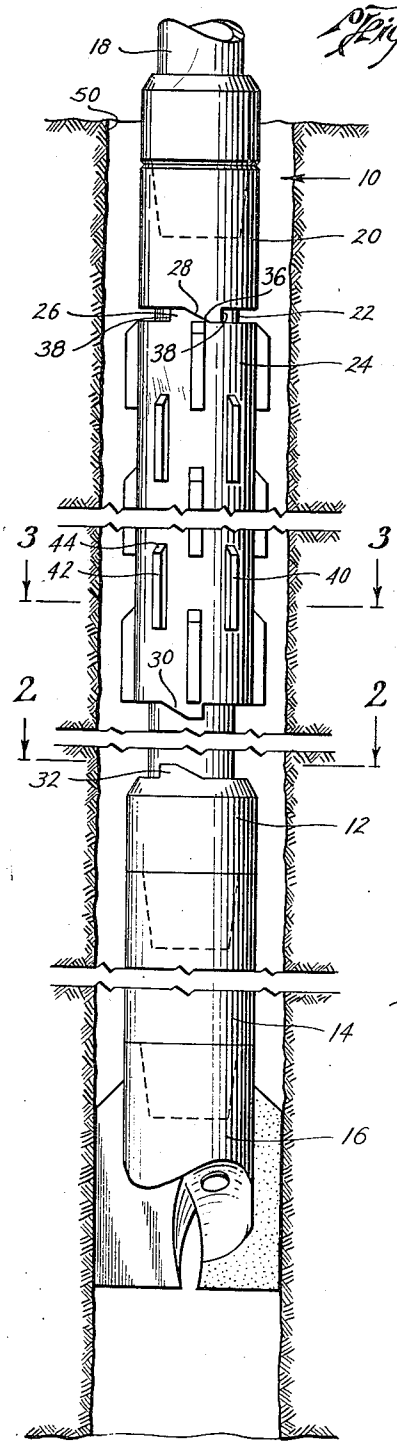


Fig. 2

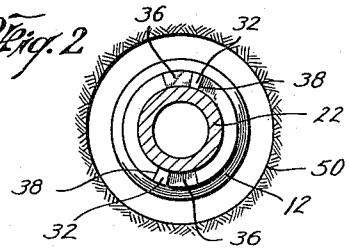


Fig. 3

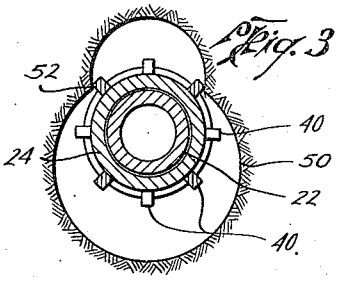
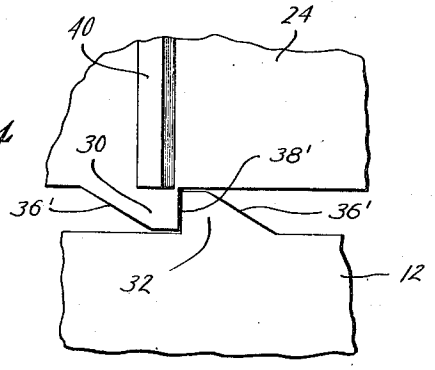


Fig. 4



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COMBINATION JAR AND KEY SEAT REAMER

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3 Claims. (Cl. 255—27)

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This invention relates to a device for jarring out or reaming out tight places or "key seats" in a well bore.

Frequently while drilling oil or gas wells the drill hole deviates from the true vertical either intentionally or accidentally. In these inclined holes the drill string while rotating imbeds itself in the wall of the previously drilled hole and results in what is commonly referred to in the art as a key seat. This key seat is smaller than the drill collar or collars to which the bit is secured and on withdrawing the drill string, in many instances, the drill collars will become lodged in the key seat and thereby effectively prevent the removal of the drill string from the bore hole.

Another common occurrence is the accumulation of a mud ring or filter cake on the wall of the bore hole which also results in a restricted portion and in many instances effectively prevents the removal of the drill string from the hole.

Accordingly, it is among the general objects of the present invention to provide a device for readily jarring out or reaming out these restricted portions or key seats in the well bore in order to freely withdraw the drill pipe and bit therefrom.

It is a further general object of the present invention to provide such a device which may be interposed in the drill stem above the drill collars and bit and which will not interfere with normal drilling operations but which will readily jar out or ream out any restricted portion or key seat in the well bore.

A main object of the present invention is to provide such a device which will remove the restricted portion or key seat in a well bore by either a jarring action or a reaming or scraping action or a combination of jarring and reaming.

A particular object and feature of the present invention is the provision of such a device in which the drill string is rotated to actuate the device and thereby provide the jarring and reaming action.

A feature of the present invention is the provision of such a device in which the jarring or reaming is provided by merely slackening or picking up the drill string while rotating in the same direction.

The drill pipe, collars or bit may become stuck or lodged in a well bore for many reasons and it is desirable to ascertain whether the sticking is due to a key seat or some other condition in

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the well bore in order to take appropriate steps to free and remove the drill stem therefrom. In conventional key seat wipers it is not possible to determine whether the sticking is due to a key seat or other conditions in the well bore inasmuch as the conventional key seat wipers are splined or keyed to the stem and it is not possible to rotate the drill string through the key seat wiper to determine whether the drill string, collars and bit are free to rotate and thereby indicate a key seat in the well bore.

It is, accordingly, an important object and feature of the present invention to provide a combination jar and key seat reamer through which the drill string may be rotated in order to ascertain whether or not a key seat or some other condition in the well bore is preventing removal of the drill string therefrom.

It is yet a further object of the present invention to provide a combination jar and key seat reamer through which the drill string may be rotated, but which may be actuated to jar or ream by rotation of the drill string.

A further feature of the invention is the provision of such a device which is of simplified construction, comprises a minimum of parts, is sturdy and strong, and which may be repaired easily and manufactured economically.

Other and further objects and features will be apparent from the following description of an example of the invention, for the purpose of disclosure, taken in connection with the accompanying drawing, where like character references designate like parts throughout the several views and in which:

Fig. 1 is a side elevation of a combination jar and key seat reamer constructed in accordance with the invention interposed in a drill string and shown in jarring position in a key seat formed in a well bore,

Figs. 2 and 3 are cross-sectional views taken along the lines 2 and 3, respectively, of Fig. 1, and

Fig. 4 is a fragmentary side elevation illustrating the lower clutch assembly in engaged position whereby the sleeve member is rotated to perform the reaming function.

Referring to the drawing and particularly to Fig. 1, the combination jarring and reaming or cutting tool 10 is threadedly interposed in the drill string and, as illustrated, is threaded by means of the pin member 12 to the upper end of the drill collar 14, the lower portion of the drill collars being threaded to the bit 16, and is threaded by means of the box member 20 to the

drill string 18 extending to the surface (not shown).

An elongate stem or axial support 22 is secured to the upper and lower couplings 20 and 12, respectively, and may be threaded to these couplings in order that the tool may be easily and quickly broken down into its respective elements and unserviceable parts quickly repaired or replaced. In many instances, however, it will be preferable to weld the stem 22 to the couplings 20 and 12 to provide a rugged and durable tool in use.

Slideably and rotatably secured about the stem or axial support 22 is a sleeve member 24 which is of less length than the extent of the stem or mandrel 22. Thus the sleeve 24 is freely rotatable about the stem or mandrel 22 and is free to move along the longitudinal axis thereof. Conversely, in the event the sleeve is stuck or lodged in the well bore the drill string and stem may be rotated relative to the sleeve as will be apparent later herein.

In order to actuate the sleeve member 24 clutch and rotary jar elements are provided on each end of the sleeve and the inwardly facing shoulder portions of the couplings 12 and 20, respectively. As illustrated, rotary jar elements 26 are positioned on the top annular surface of the sleeve 24 and are adapted to coact with the rotary jar elements 28 positioned on the downwardly facing shoulder of the upper coupling 20. The rotary jar elements 26 and 28 comprise projecting cam surfaces having the inclined or sloping back faces 36 and the substantially perpendicular front faces 38, the sloping back faces riding or ratcheting over one another when engaged and while the sleeve member 24 is stuck to provide a percussive jarring action to the sleeve member 24, as will be apparent later. Similarly, clutch elements 30 are secured to the lower annular face of the sleeve 24 and coact with the clutch elements 32 disposed on the upwardly facing annular shoulder of the lower coupling 12. As illustrated in Fig. 4, the clutch elements may have inclined or sloping back faces 36' and substantially perpendicular front faces or stop members 38'. Thus, it will be apparent that rotation in one direction upon engagement of the inclined surfaces 36 or 36', assuming the sleeve 24 is stuck and will not rotate, causes the cam surfaces to ride or ratchet over each other thereby providing a percussive jarring action or an up and down motion to the sleeve; whereas, rotation in the other direction upon engagement of the perpendicular front faces 38 or 38' will impart rotation from the drill string 18 to the sleeve 24. Preferably the clutch and rotary jar elements will be positioned in opposite directions at each end of the sleeve member 24, although any type clutch may be used at one end of the tool in combination with rotary jar elements at the other end of the tool. Thus, in the event the sleeve 24 is lodged in a key seat, rotation of the drill string 18 in one direction and thus rotation of the elongate stem 22 and couplings 12 and 20 in one direction will impart rotation or percussive reciprocation to the sleeve member or permit free rotation of the drill string relative to the sleeve member 24 depending upon the relative position of the sleeve member and the upper and lower couplings. While only two coacting clutch and rotary jar elements are shown at each end of the sleeve, respectively, any number may be utilized in practice.

A plurality of reaming or scraping elements 40 are disposed about the outer periphery of the sleeve 24. The reamers 40 are illustrated with a substantially flat outer surface 42 and upwardly and inwardly tapered surfaces 44 at their upper ends. It will be understood, however, that any preferred type of reamer or scraper blades may be utilized and these blades are preferably case hardened.

In operation the device is preferably threadedly interposed in the drill string immediately above the drill collars. During normal drilling operations the sleeve 24 will ordinarily fall or be in a lowered position and will not interfere with normal drilling operations. As illustrated, communicating axial bores extend throughout the drill pipe, the combination jarring and reaming tool and the drill collars and establish communication with the drill bit in order that drilling mud or fluid may be circulated through the drill pipe and out the bit in the usual manner. In the event the bore hole 50 deviates from the vertical, either intentionally, for example, in directional drilling, or accidentally, a restricted portion or key seat 52, see Fig. 3, may be bored in the side of the well bore 50. Thus, upon attempted withdrawal of the drill string from the well bore, the drill collars being larger in radial extent than the drill pipe may become lodged or stuck in the key seat and thereby effectively prevent the removal of the drill string, drill collars and bit from the well bore. In such an event the sleeve 24 will become stuck in the key seat and thus will be held against rotation. The drill stem may be rotated in conventional manner and tension in the string or drill pipe slackened or the string lowered. In the event the drill string will rotate freely the presence of a key seat in the well bore is indicated as only the sleeve member 24 will be stuck or fixed against rotation. Continued slackening of the tension in the drill string or lowering thereof, and, in the embodiment illustrated, rotation to the right will cause an engagement of the inclined faces 36 of the cam surfaces of the rotary jar elements 26 and 28 will cause them to ride or ratchet over each other to provide a percussive jarring action or reciprocating motion to the sleeve 24. By increasing tension in the drill string 18 or elevating the drill string, the front faces 38' of the clutch elements 30 and 32 will engage thereby causing rotation of the sleeve 24 and thereby providing a reaming or scrapping action to enlarge or ream out the key seat 52. Thus, while rotating the drill string in the single direction an indication of a key seat and a percussive jarring action or a reaming action or a combination of these actions is obtained by increasing or relaxing tension in the drill string to provide the desired function of the device.

Obviously, many changes in the present invention may be made within the scope thereof. For example, the upper coupling 20 may be considerably smaller in external diameter than the sleeve 24; however, it is preferable to have the sleeve 24 at least as large in external diameter as either of the couplings 20 or 12 in order that the sleeve will become stuck in the key seat and enlarge the key seat sufficiently for passage of the drill collars and bit. In addition, any type of reaming teeth or scraper blades may be utilized which would tend to give a cutting or scraping action upon jarring or rotation of the sleeve member 24.

If desired, the stem or axial support may be threaded directly in a string of pipe without

the upper and lower couplings, cooperating clutch and rotary jar elements being secured directly to the connecting members; however, it is manifest that the use of the couplings is preferred. While the present invention may be used in all drilling operations, it is particularly useful in directional drilling operations.

Broadly the present invention comprises a scraper or cutter assembly in which restricted portions of well bores, such as key seats, are readily determined and enlarged and in which a sleeve or reamer member is freely rotatable about a stem, the sleeve or reamer being operable to permit rotation of the drill string therethrough and to jar or ream by rotating the string of pipe to which it is connected and by merely decreasing or increasing the tension in the drilling string.

Thus, the prevent invention is not limited to the precise details of the example given for the purpose of disclosure, but is limited only by the spirit of the invention and the scope of the following claims.

What is claimed is:

1. A combination jar and key seat reamer for engaging and enlarging key seats formed in well bores by a string of pipe comprising, an elongate support, a sleeve member having reaming cutters on its outer surface, said sleeve member being rotatably and slidably mounted on said support, said sleeve member being of less length than that of said support, enlarged portions at each end of the support limiting upward and downward movement of said sleeve member, engageable clutch elements at one end of the sleeve and the enlarged portion adjacent thereto for transmitting rotation from said support to said sleeve upon engagement of such clutch elements, and cooperating rotary jar elements at the other end of said sleeve and the other of said enlarged portions, said rotary jar elements comprising engageable cam surfaces projecting from said other end of the sleeve and said other of said enlarged portions, respectively, so that while the sleeve member is lodged in the key seat relative longitudinal movement of the support and sleeve will engage said cam surfaces and relative rotation of the support and the sleeve member will cause the cam surfaces to ride over each other thereby percussively jarring said sleeve member.

2. A combination jar and key seat reamer for engaging and enlarging key seats formed in well bores by a string of pipe comprising, an elongate tubular support, a tubular sleeve member adapted to engage and enlarge said key seats, said sleeve member having scrapers on its outer surface and being rotatably and slidably mounted on said support, said sleeve member being of less length than that of said support, enlarged portions at each end of said support limiting upward and downward movement of said sleeve member, and coacting clutch elements on one end of said sleeve member and the enlarged portion adjacent thereto and coacting rotary jar

elements on the other end of said sleeve and the other of said enlarged portions, said rotary jar elements comprising engageable cam surfaces projecting from said other end of the sleeve and said other of said enlarged portions, respectively, said cam surfaces and clutch elements having sloping back faces and substantially perpendicular front faces so that while the sleeve member is lodged in the key seat relative longitudinal movement of the support and sleeve in a first direction will engage said cam surfaces and rotation of the support in one direction relative to the sleeve member will cause the cam surfaces to ratchet over each other thereby percussively jarring said sleeve member, and relative longitudinal movement of the support and sleeve in a direction opposite to that of said first direction will engage the clutch elements and rotation of the support in said one direction while the clutch elements are engaged will cause the front faces of the clutch elements to engage thereby imparting rotation from said support to said sleeve member.

3. A combination jar and key seat reamer for engaging and enlarging key seats formed in well bores by a string of pipe comprising, an elongate tubular support, a coupling member on each end of the support for connection in said string of pipe, said coupling members having upwardly and downwardly facing annular stop shoulders, respectively, a tubular sleeve adapted to engage and enlarge said key seats, said sleeve having scrapers on its outer surface and being slidably and rotatably mounted on said support, said sleeve being of less length than that of said support, a set of coacting clutch elements on the upwardly facing annular shoulder and the lower end of the sleeve for imparting rotation of said support to said sleeve upon engagement of said clutch elements, and a set of coacting rotary jar elements on the downwardly facing shoulder and the upper end of the sleeve, said rotary jar elements comprising engageable cam surfaces projecting upwardly from the upper end of the sleeve and projecting downwardly from the downwardly facing shoulder so that while the sleeve is lodged in the key seat downward movement of the support relative to the sleeve will engage said cam surfaces and relative rotation of the support and the sleeve will cause the cam surfaces to ride over each other thereby percussively jarring said sleeve.

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