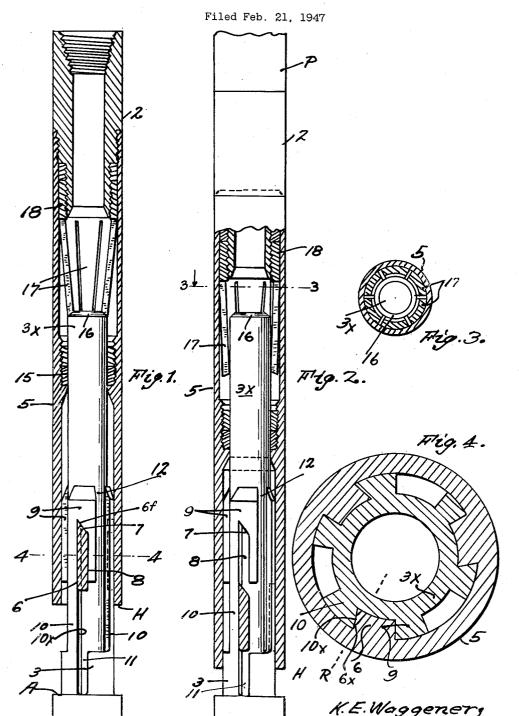
SAFETY SUB JAR ASSEMBLY



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SAFETY SUB JAR ASSEMBLY

Kenneth Edward Waggener, Brea, Calif.

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This invention is a sub for use in deep well drilling tool strings.

The current practice in deep well drilling is to make up a bit and drill collar assembly the latter being of desired predetermined weight to drive the 5bit down as fast as it cuts without weight of the suspended rotary tool string and the instant invention has for an object the provision of a safety sub or joint assembly to be incorporated in the tool string at a location preferably just above the 10 drill collar and which sub is adapted to be readily disconnected within itself to permit the string (of drill pipe) to be safely recovered from the well hole in event that the bit or the collar becomes frozen and is not pullable from the hole.

A further object of the invention is to provide a telescopic sub in which there is incorporated a device which automatically effects the relative jamming of the cooperative sub parts in such a a manner highly desirable in this form of joint

The invention has the additional object of providing a sub in which a mandrel and a complementary barrel are provided with cooperative interlocking features which enable the sub parts to be readily interconnected for suspension of the attached drill collar and rotational drive thereof without need of a screwing torque, and without setting up a reverse torque within the sub when 30 it is to be "broken" or disconnected to release the string from the collar for any reason, and which, particularly, will not unlock from the mandrel in event of back lash from a twisted drill string.

The invention has the further objective of providing a safe and reliable means for automatically latching the drive and suspending features of the sub in normal driving connected relation and for the increment of the drilling load up to a predetermined degree greater than the collar 40 weight so that the suspended collar can be pushed down past minor obstructions in a hole without the hazard of tripping open the sub joint, and in which increased load can be used on the drill while it is turning—still without unhitching the 45 drive feature in the sub. And in this connection it is an object to provide a yieldable latching means which will automatically give way when the string load on the drive element of the sub exceeds the additive load predetermined by the 50 latch means, and to provide a latching means which will repeatedly set itself as to the mandrel and will repeatedly give way in the manner

2 a trippable and self-acting latch means operative to allow the unlatched barrel to be bumped down repeatedly on an anvil part of the mandrel for jarring functions, at will; the sub having capacity for upwardly bumping the tool as may be needed at times.

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The invention resides in certain advancements in this art as set forth in the ensuing disclosure and having, with the above, additional objects and advantages as hereinafter developed, and whose constructions, combinations and subcombinations and details of means and the manner of operation will be made manifest in the following description of the herewith illustrative 15 embodiment; it being understood that modifica tions, variations and adaptations may be resorted to within the scope, spirit and principles of the invention as it is claimed in conclusion hereof.

Figure 1 is an axial section of the sub in its manner that these parts are rigidly stabilized in 20 normal drive position of the mandrel and its

> Figure 2 is a similar section, but showing the barrel lowered to the "breaking" or declutched position on the mandrel ready for left hand turn and barrel pulling operation for detachment from the mandrel.

Figure 3 is a cross-section on line 3—3; Fig. 2. Figure 4 is a cross-section, on larger scale, on line 4—4; Fig. 1.

The joint sub shown includes a box top 2 for attaching to the pin end of a portion of a drill pipe string P, and has a central mandrel 3 with a screw pin 4 attaching to the top end of a drill collar C; the weight of which is used to force down a bit not shown.

Usually the tool freezes at a level below the string sub and the instant invention provides for normal drive, that is righthand rotation, of the drill collar by the tool string, and in need to the right (looking down from the top), for the release of the string from the frozen collar.

Screwed onto the box 2 is the upper end of a barrel 5 whose lower end telescopes on the reduced, complementary body 3x of the sub mandrel and is adapted to bump down on an anvil forming shoulder A of the mandrel. The bore face of the barrel is provided with a set of longitudinal keys 6 having oblique top end cam facets 6f which are adapted to jam against complementary faces 7 presented at the top ends of relative clutching slots 8 in wide, top hooks 9 of elongate splines 10 which are rigid or integral with the body 3x of the mandrel 3. Therefore the barrel 5 can rotate the mandrel, if the keys 6 of Also an object of the invention is to provide 55 the barrel interlock in the slots 8. During nor

mal lowering or elevating operations of the mandrel and attached tool parts the keys suspend the load from the barrel.

If, during lowering of the mandrel, it should hang in the hole the barrel can be relatively lowered to set the keys 6 in complementary pockets II longitudinally below the slots 8 until the hammer end H of the barrel bumps the anvil shoulder A of the sub 3. This down bumping action may effect release of the mandrel from the wall of the 10 formation hole and lowering and drilling can proceed.

If for any reason the mandrel becomes frozen the barrel is elevated until the keys 6 reach an intermediate position and register with escape 15 channels 12; one for each key, formed along the sides of the splines 10 of the mandrel to their upper ends. This entirely disconnects the barrel from the frozen mandrel for free extraction from the formation hole. It will be seen that a slight 20 left hand rotation of the barrel to bring its keys laterally into the channels 12 can be accomplished without any danger of an unscrewing torque on the screw joints of the tool string.

Mandrel latching means

It is an object to maintain a desired additive degree of pressure on the bit in an amount somewhat greater than the weight of the drill collar and to provide for the automatic tripping of the 30 barrel when an excess additional pressure over that desired has been set on the collar and its bit.

For this purpose the mandrel body 3x is extended up through a joint packing device 15 provided with a low angle, conical rim shoulder 16 of the said body. A circle of heavy duty, spring-material latches 17 extend down from and are integral with a collar 18 fitting in the barrel and screwed onto the lower end of the top box 2 and these latches normally spring inwardly at their lower ends to abut the complementary shoulder 16 of the mandrel. The outward pitch of this shoulder determines the degree of load from the barrel string that can be added to the weight of the collar working on the cutting bit. Thus if an extra down pressure of fifteen tons be desired then the conic angle of the latch bearing shoulder 16 will be made to such pitch as will instantly press the spring latches outwardly enough to clear the body 3x and the barrel and its string will be free for down shift as to the mandrel. This detachment can be observed by the usual weight meter at the drill table.

The barrel can now be bumped up and down 55 on the mandrel, and the extra pressure will be put on the mandrel each time the latches automatically close on the shoulder 16. When it is found that the mandrel cannot be jarred loose for further down feed, or cannot be pulled from the hole under a safe string strain then the operator simply reverses normal righthand rotation and brings the keys into the escape channels 12 and elevates the barrel and strings; leaving the stuck mandrel for fishing operations.

Barrel stabilizing means

In joints of the sub type vibrations of the barrel and the mandrel, relatively, involve dangerous hazards and the instant invention pro- 70 vides for the effective elimination of such vibrations. Referring to Fig. 4 it will be seen that the side face 10x of the several splines 10 toward which the cam facets 6f incline, Fig. 2, are undercut at an ample angle, as to the radial plane 75 releasable locking means at the upper end of

R, and the coordinate face 6x of the adjacent key 6 is angled to snugly dove-tail with the spline face 10x. Therefore, when the top end face 6f jams on face 7 of the hook slot the dove-tail keys will be solidly wedged by the faces 10x and lost motions of the mandrel as to the barrel nullified.

What is claimed is:

1. A safety-joint well tool comprising, in combination, a cylindrical mandrel provided at its lower end with circumferentially spaced first splines each having at its upper end a downwardly extending smaller second spline attached thereto and spaced therefrom, the portion interconnecting said first and second splines having a downwardly extending transverse cam face formed thereon, a tubular barrel member telescopically and rotatively mounted on said mandrel and having key members formed on its lower end and projecting inwardly and slidably fitting in the spaces between the splines, whereby each of said key members is rotated by said barrel member into registry with the space between a first and a second spline, the upper surface of 25 said key members having a complementary cam face to engage with the said transverse cam face and suspend the mandrel from the barrel member during operation of the tool in a well hole, releasable locking means at the upper end of the mandrel yieldably urging said key members upwardly and releasably locking the barrel to said mandrel, said means comprising a collar fixedly connected to said barrel member and having a series of downwardly extending and mounted on the bore face of the barrel and is 35 inwardly converging spring latch members integral therewith, the lower ends of the latch members being bevelled downwardly and outwardly, said mandrel having on its upper portion a latch tripping cam face on which said latch ends engage, said mandrel and said barrel member having cooperative anvil and hammer faces respectively formed thereon, said hammer face impacting upon said anvil face when sufficient downward pressure is applied to said barrel member to overcome the resistance of the latch members on the latch tripping cam face of said mandrel and to move the latch members outwardly to allow for downward movement of said barrel member on said mandrel.

2. The tool of claim 1; and in which the collar connection to the barrel member consists of a box screwed into the barrel member and to which box the upper end of the said collar is affixed for insertion or removal by and with said box.

3. A safety joint jar assembly comprising, in combination; a cylindrical mandrel provided at its lower portion with circumferentially spaced, longitudinal, elongated, main splines each connected at its upper end to a downwardly directed, shorter spline laterally spaced from the upper portion of its respective main spline and forming therewith a slot which is closed at its top by a transverse land face at the connecting portion of the relative splines, a tubular barrel member telescopically and rotatively mounted on said mandrel and having peripherally spaced keys rigidly attached to its interior face and slidably meshing in the spaces between the main splines; whereby said keys are concurrently rotated by and with the barrel member into registry with the said slots so that the upper ends of the keys may be mutually engaged with the coordinate land faces at the tops of the said slots and suspend the mandrel during operation in a well hole,

the mandrel yieldably urging said keys against said land faces and thereby locking the barrel member to said mandrel; said means including a collar fixedly connected to the barrel member and having a series of downwardly extending 5 and inwardly contracting spring latch fingers integral therewith and whose lower ends are bevelled downwardly and outwardly, said mandrel having on its upper portion a latch tripping cam face on which said spring latch fingers engage, 10 file of this patent: said mandrel and said barrel member having cooperative anvil and hammer faces respectively formed thereon, said hammer face impacting upon said anvil face when sufficient downward pressure is applied to said barrel member to 15 overcome the resistance of the spring fingers on said cam face of the mandrel and to force the said fingers outwardly to allow for downward shift of said barrel member along the mandrel.

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4. The assembly of claim 3; the said land faces and the top end faces of the keys being inclined transversely to the axis of the barrel member whereby to exert a turning action as between the mandrel and the barrel member.

KENNETH EDWARD WAGGENER.

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