Dec. 24, 1957 F. L. LE BUS, SR 2,817,555

METHOD AND SYSTEM OF RETRIEVING STUCK PIPE JOINTS IN WELL BORES

Filed March 12, 1953 2 Sheets-Sheet 1

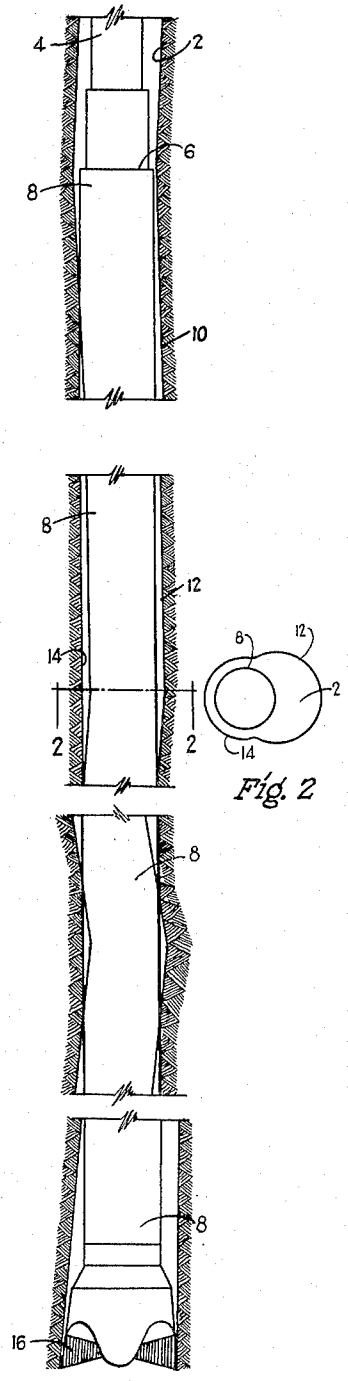


Fig. 1

Fig. 2

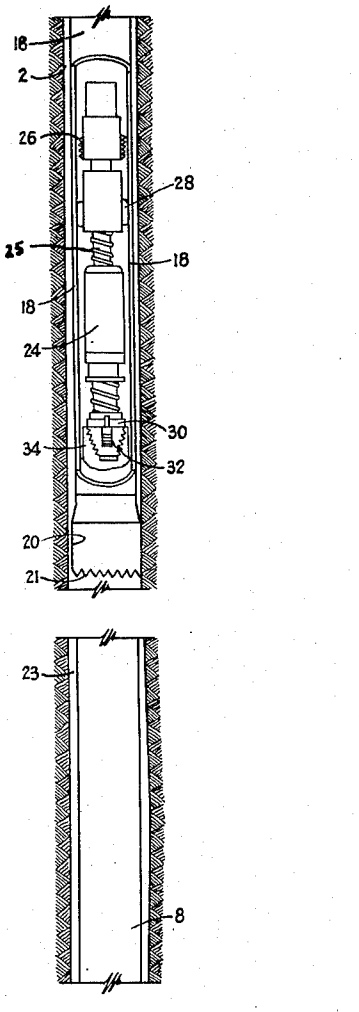


Fig. 4

Fig. 3

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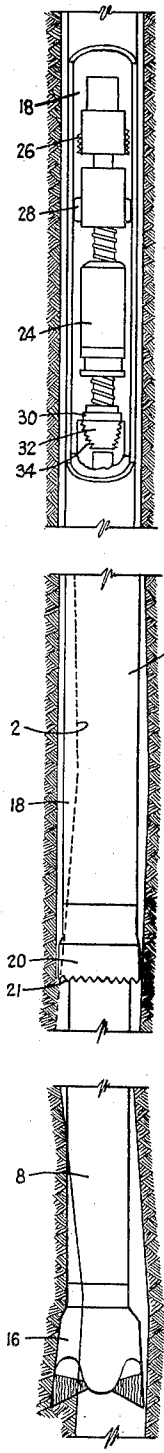


Fig. 5

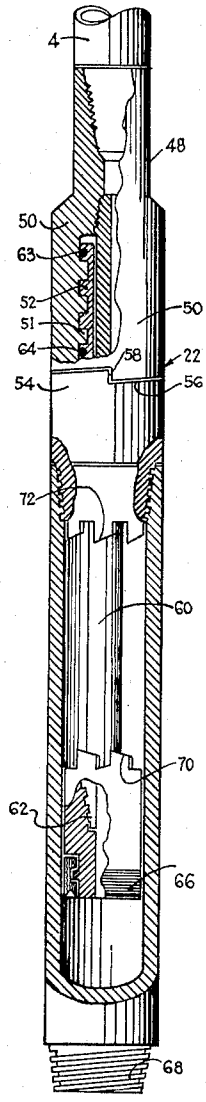


Fig. 11

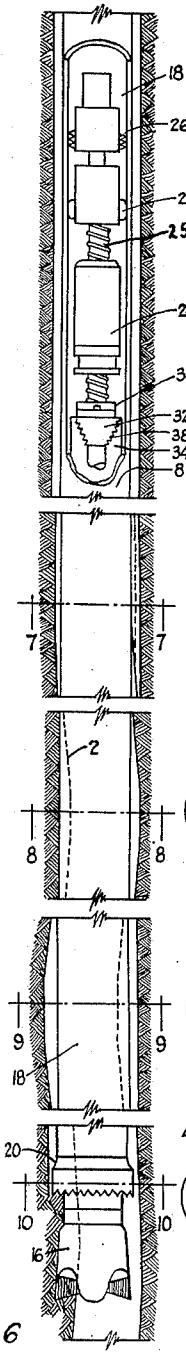


Fig. 6

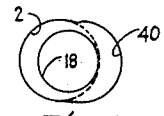


Fig. 7

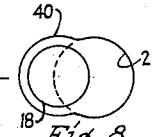


Fig. 8

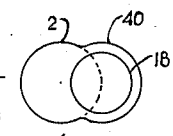


Fig. 9

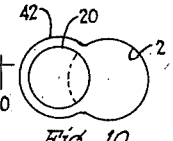


Fig. 10

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METHOD AND SYSTEM OF RETRIEVING STUCK PIPE JOINTS IN WELL BORES

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Application March 12, 1953, Serial No. 341,979

5 Claims. (Cl. 294—86)

This invention relates to a method of retrieving stuck drill collars from a well bore, and more particularly, but not by way of limitation, to a method or system of reaming out key seats in the well bore while simultaneously holding the stuck drill collars therein.

In the drilling of deep wells sometimes deviations from true vertical straightness of the well bore are apparent. These deviations are caused by successive variations of geological structure, and tilt as made by the drilling bit. In rotary drilling practice of deep wells, the drill bit constantly tends to shift laterally off the true vertical line of the bore, thereby providing what is known as crooked bores. A string of drill collars is usually interposed between the drilling string and the drill bit. A drill collar is a tubular link of steel having a substantial thickness to impose additional weight on the drill bit, and to lend rigidity or stiffness to the lower portion of the drilling string for the transmission of the torque. These drill collar strings usually are of a length of approximately four hundred to six hundred feet long, and with the additional weight and rigidity provided thereby, will tend to maintain a straighter bore during the drilling operation. The drill bit is larger in diameter than the drill collar, consequently leaving sufficient clearance or annulus between the string of drill collars and the well bore in order to receive a wash over pipe in the event the bit and the drill collar are lost or stuck in a "key seat" portion of the well bore.

Key seats are due to the variance of the drill collars from a true vertical having a tendency to drill a crooked bore, caused by the geological formation or too much weight applied at the surface of the well. When the drilling collars vary from the vertical, they rub against the well bore, thereby providing an off-set recess in the well bore which connects with, and is in alignment with the well bore itself. These off-set recesses are usually of much lesser diameter due to the smaller size of the drill collars than that of the drill bit, and are known as "key seats."

The key seat normally does not interfere with the drilling until a pulling job of the complete drill string is necessary, such as for example, when it is desired to replace a worn drill bit with a new one. In such instances, the operator will raise the drill string and the attendant drill collars out of the well bore until the drill bit is pulled upwardly into a key seat. Normally the drill bit is of a larger diameter than the key seat causing the drill bit to hang up, or become stuck therein. Unable to see what the condition is, most drilling operators have a tendency to throw the rig hoisting equipment at the surface of the well into low gear for hard pulling, which only causes the drill bit to stick or wedge up in the key seat much tighter, thereby necessitating a reaming and fishing operation for the stuck drill collar and bit.

In normal practice, the recovery of the stuck drill collar and bit is done by a string of wash over pipe having a reaming shoe at the lower end. Both the shoe and wash over pipe are of a diameter which will pass over the string of drill collars, and move downwardly in the annulus between the collar string and the well bore. The rotating wash over pipe coming in contact with the key seat will ream out the strata there-around, and thereby free the drill bit and the adjacent drill collar string.

After the key seat has been cut away, the drill collars become loosened in the well bore, and will drop or fall back to the bottom of the bore, which in most instances cause considerable damage to the drill bit, drill collars and the drill pipe. Consequently, loosened drill collars are dropped back into the bore, and another fishing job is usually necessary to remove the broken bits and the like out of the bottom of the well bore so the drilling operation can continue. It is apparent such extra fishing jobs are time consuming and costly.

This invention is primarily concerned with a method or system of reaming drill collars and bits that are stuck in an oil well bore key seat in such a manner that the drill collar and attendant drill bit are simultaneously secured to the wash over pipe to prevent the loosened drill collar string from falling down to the bottom of the bore after becoming unstuck by the reaming operation.

An important object of this invention is to retrieve stuck drill collars and the attendant rock bit from a key seated recess of an oil well bore in a manner to prevent dropping of the drill collar to the bottom of the bore upon becoming loosened from the key seated recess.

And still a further object of this invention is to provide a method of continuous reaming for loosening stuck drill collars from a key seated recess of an oil well bore while simultaneously assuring that the drill collar may be held in position when loosened from the key seated recess, and thereby prevent dropping to the bottom of the well bore.

And still another object of this invention is to retrieve stuck drill collars from a key seated recess of a well bore, and catching and holding the drill collars substantially in position as they are loosened during the reaming operation.

And still another object of this invention is to provide a system of retrieving a drill collar string stuck in a key seated recess of a well bore by a continuous reaming operation around the drill collars while simultaneously interconnecting the stuck drill collar with the reaming apparatus, yet permitting downward movement around the collar string.

And still a further object of this invention is to drill out a key seated recess in which is wedged a drill collar, and immediately catching the loosened drill collar upon completing the drilling of the key seat in order to prevent dropping of the drill collar back into the hole.

And still another object of the invention is to retrieve stuck drill collars from a key seated recess of a well bore by a fishing string providing a continuous reaming operation which contemplates an addition of extra joints of drill pipe to the fishing string without interruption of the reaming operation, and immediately catching and holding a loosened drill collar with the fishing string.

An additional object of this invention is to maintain a connection between a drill collar wedged in a key seat of a well bore during a reaming operation by a fishing string, in such a manner to catch and hold the loosened collar and prevent dropping to the bottom of the well bore, but permitting lowering of the held drill collar to the bottom of the well bore where the fishing string may be released from the collar and removed from the bore.

Other objects and advantages of the invention will be evident from the following detailed description, read in conjunction with the accompanying drawings, which illustrate my invention.

In the drawings:

Figure 1 is a broken elevational view of the well bore depicting a crooked bore drilling operation.

Figure 2 is a view taken on lines 2—2 of Fig. 1.

Figure 3 is a view similar to Fig. 1 depicting a drill bit moved upwardly into stuck relation with a key seat recess, and the wash over pipe disposed over the drill string with certain parts broken away for clarity.

Figure 4 is a view taken on lines 4—4 of Fig. 3.

Figure 5 is a view similar to Fig. 3 depicting downward movement of the wash over pipe over the stuck drill collar string.

Figure 6 is a view similar to Fig. 5 showing the wash over pipe substantially adjacent the drill bit and key seat.

Figure 7 is a view taken on lines 7—7 of Fig. 6.

Figure 8 is a view taken on lines 8—8 of Fig. 6.

Figure 9 is a view taken on lines 9—9 of Fig. 6.

Figure 10 is a view taken on lines 10—10 thereof.

Figure 11 is an elevational view partly in section of the slip joint interposed in the drill pipe string.

Referring to the drawings in detail, and more particularly Figs. 1 to 4, inclusive, reference character 2 designates a well bore in which is disposed a string of drill pipe 4 connected at 6 to a string of heavier drill collars 8. It will be understood that the drill collars are usually about thirty feet in length and are connected in vertical tandem relation in a suitable manner (not shown.) In Fig. 1, the upper portion 10 thereof shows a tendency of the drill collars to vary in one direction from the vertical, thereby providing a crooked bore 2. The intermediate portion 12 of Fig. 1 shows a substantial variation in a slightly different direction from the vertical of the well bore 2, and that the abrasive rubbing of the drill collars 8 have formed a key seat recess 14 (Fig. 2). At the lower end of the drill collars 8 is secured the usual drill bit 16. The lowermost portions of Fig. 1 show still a further exaggerated variance from the vertical in that the variation providing the crooked bore may be formed in an opposite direction from the variation upward therefrom.

When a key seat condition occurs in a crooked well bore, the drill bit 16 usually becomes stuck (Fig. 4) upon pulling the drill string upward. In such a situation it is then necessary to ream out the well bore 2 and the key seat 14. As is clearly shown in Figs. 3, 5 and 6, the drill string 4 is unjointed from the drill collars 8 at the connecting point 6, thereby permitting removal of the drill string to the surface of the well.

A wash over pipe 18 having a reamer 20 with teeth 21 at the lower-most end thereof is interposed between the drill string 4 and the stuck drill collars 8. It will be apparent that the diameter of the wash over pipe is greater than that of the drill string, or that of the drill collars in order to be disposed in the annulus 23 between the drill collars 8 and the well bore 2. A slip joint 22 for a purpose as will be hereinafter set forth is interconnected between the upper-most portion of the wash over pipe 18 and the bottom of the drill pipe string 4.

The lower-most interior portion of the wash over pipe 18 is adapted to receive a wall hanger overshot 24 carrying a plurality of circumferentially spaced slip members 26 for a purpose as will be hereinafter set forth. A plurality of circumferentially spaced friction dogs 28 are carried by the wall hanger 24 and with the slips 26 support the wall hanger 24 in the wash over pipe 18 during the lowering operation to the top of the collar string 8. The wall hanger 24 and cooperating slip members 26, as well as the friction dogs 28, are old and well known in the art and constructed generally in the manner shown in the prior patents to Costello, No. 2,190,442, issued February 14, 1940, or Lowry, No. 2,487,456 issued May 8, 1949. A joint spear 30 is removably connected with the wall hanger 24 in a manner not shown, and extends downwardly therefrom as shown in Figs. 3, 5 and 6. The spear 30 is provided with a tapered pin member 32 for threaded connection with the tapered box 34 at the top of the upper-most drill collar 8 from which the drill string 4 has been unjointed. The tapered pin members 32 and spear 30 are contractible and expandable and of the type old and well known in the art and constructed generally in the manner shown in the two prior patents to Wilson, No. 1,418,766, issued June 6, 1922, and Hindlerliter, No. 2,105,885, issued January 18, 1938.

Operation

With the upper drill string 4 removed, and the drill collars 8 and bit 16 stuck in the key seat recess 14, a fishing drill string including the wash over pipe 18 provided with the wall hanger 24 and joint spear 30 are lowered into the well bore. The wall hanger 24 and the removable connecting spear 30 are disposed in the lower-most portion of the wash over pipe 18 and are lowered therewith. The joint spear 30 and its tapered pin portion 32 are provided with a plurality of threads 38 for engagement with the threaded box of the upper drill collar 8 (Fig. 6). During the lowering operation of the wash over unit into the well bore, the wall hanger 24 is supported in the wash pipe 18 by engagement of the slips with the inner wall of the wash pipe simultaneous with the friction dogs 28. As soon as the joint spear 30 and its movable threaded dogs 32 make up in the drill collar box 34, the wall hanger is prevented from further downward movement due to the stuck condition of the fish 8. Continued rotation and downward movement of the wash pipe 18 after the make up connection will be against the friction hold of the dogs 28 with the inner wall of the wash pipe, yet providing sufficient friction therebetween, whereas the slips will be moved downwardly into a released or non-engaging position with the wash pipe 18. After the stuck fish or drill collar is loosened, it immediately starts to move downwardly and consequently will pull the freely movable inner stem portion 25 of the wall hanger 24 downwardly. The slips cooperate with a tapered body portion (not shown) connected with the inner stem portion, such as that shown in the patents to Costello, No. 2,190,442 and Lowry, No. 2,487,456. Such downward movement of the wall hanger will cause expansion of the slips outwardly into engagement with the wash pipe 18. The dogs 28 are supported loosely on the inner stem of the wall hanger by a helical spring 27 and have any suitable connecting means, such as links carrying the slips thereabove. Consequently, when the fish is loosened, the friction hold of the dogs is sufficient to support the slips in position until the freely movable inner stem 25 carrying the tapered portion (not shown) is moved into a position to cause outward expansion of the slips against the inner wall of the wall pipe 8 and thereby automatically engaging the loosened fish with the wall pipe 18 and thereby precluding any further downward movement thereof.

As soon as the joint spear 30 is threadedly engaged in the box 34 of the upper drill collar 8, the wash over pipe 18 continues its movement downward around the stuck drill collar string 8. It will be apparent that the joint spear provides a connection between the wall hanger 24 and the collar box 34, and yet the disengaged position of the slips 26 relative to the inside of the wash over pipe, until engagement is desired, permits movement of the wash over pipe 18 and the reamer 20 downwardly around the drill collar string 8 to provide a reaming action of the well bore and particularly, the key seat recess 14. The downward rotative movement of the wash over pipe 18 is sufficient to overcome the friction of the dogs 28 of the wall hanger 24 during the reaming operation. Furthermore, the vertical friction between the friction dogs 28 and the inside of the wash over pipe 18 is the only wear accountable during the lowering and rotating of the wash over pipe in the well bore 2.

During the continuous reaming operation of the downwardly moving reamer 20, the wall hanger 24 through the connecting joint spear 30 maintains a simultaneous engagement with the top of the drill collar string 8 at all times. A swivel connection (not shown) is provided between the wall hanger 24 and the spear joint 30 to permit rotation of the wall hanger after the threaded connection

of the spear with the drill collar. It will be apparent that with the joint spear **30** interconnecting between the wall hanger **24** and the drill collar string **8**, any engagements of the slip **26** with the inside of the wash over pipe **18** would immediately provide an interconnection between the wash over pipe and the drill collar string to hold any loosened drill collars **8** from falling into the bottom of the well bore.

As soon as the tool **20** reams out the key seat **14** the drill collar string **8** and bit **16** are loosened, and thus free to drop to the bottom of the well bore. However, the wall hanger **24** is so constructed and arranged in a manner not shown, that any downward movement of the connecting string **8** will cause actuation of the slips **26** outwardly into biting engagement with the inside of the wash over pipe **18**. In like manner any substantial upward movement of the wash over pipe **18** will cause an outward biting engagement of the slips **26** with the inside of the pipe **18**.

It will thus be seen as depicted in Figs. 6 to 10, inclusive, that as the reamer **20** and the wash over pipe **18** move downwardly over the collar string **8**, a new bore **40** (Fig. 7) is provided in order to substantially straighten out the crookedness of the old well bore **2**. Figure 8 depicts the reaming of the new bore **40** in one direction of the old crooked bore **2** from the vertical, while Fig. 9 discloses a similar situation for an opposite direction of variance for the old bore **2** with the vertical. The complete reaming of the key seat **14** by the reamer **20** to provide an enlarged bore **42** is set forth in Fig. 10.

It will be apparent that as soon as the key seat aperture or recess **14** is reamed sufficiently by the tool **20** to provide the new recess **42**, the string of drill collars **8** will become loosened, and under ordinary circumstances would fall to the bottom of the well bore **2** causing considerable damage to the rotary rock bit **16** and the drill collar string itself. In such instances the cones of the bit usually break off, and thereby necessitate an extra fishing job of these broken parts from the well bore before the drilling operations can continue.

The present method precludes any such dropping or falling of the drill collar string **8** upon becoming loosened from the key seat formation **14**. The connection provided by the joint spear **30** between the top of the drill collar **8** and the wall hanger **24** is such that when either a slight (only an inch or two) movement downward of the collars **8**, or a slight movement upward on the surface hoisting equipment for the wash over pipe **18**, the slips **26** are moved to biting engagement with the inside of the wash over pipe **18**, thereby firmly holding the loosened drill collar string **8** in suspension in the well bore and preventing it from falling to the bottom thereof. The wash over pipe **18** and the loosened drill collar string **8** and bit **16** may then be pulled from the well bore **2** to the surface, particularly if the bore **2** has been reamed clean.

Slip joint operation

It becomes apparent that during the reaming operation that the key seat recess **14** may be at a considerable distance downwardly from the top of the drill collar string **8**, consequently the length of the wash over pipe **18** rotating downwardly thereover is not sufficient to reach the key seat, thus it may become necessary to add additional joints of drill pipe in order to continue the downward movement of the wash pipe **18**. As is well known, in a rotary rig (not shown) the usual square kelly and rotary table (not shown) are utilized for rotating the drill pipe **4** in the drilling operation, and in this instance for rotating the drill pipe **4** and its connecting wash over pipe **18**. When it is desired to add a new joint of drill pipe so that the reaming operation can be continued downwardly, the square kelly of the drilling rig (not shown) at the surface of the well is moved upward, and this movement is permitted by the slip joint **22**. It becomes apparent that if the slip joint **22** was not interposed in the drill string

that the kelly could not be raised unless the spear **30** was disengaged from the top of the collar string **8**.

The slip joint for the purpose of the present invention may be any suitable type since the invention is not limited to the structural details of the slip joint **22**. In Fig. 11 a suitable slip joint member **22** is shown provided with a reduced upper neck portion **48** for connection to the lower joint of the drill pipe string **4**. An upper box **50** of the slip joint **22** is provided with female threads **51** loosely threaded to the threads **52** of the safety joint pin **54**. The pin and box are separated at **56** providing engaging shoulders **58** to prevent tightening of the threads **51** and **52** during the wash over operation of the pipe **18** and the reamer **20**. An inner mandrel **60** is secured at the top of the box **50** and extends downwardly through the joint **22** into connection at the bottom with a piston member **62**. Rubber packer members are provided at **63**, **64** and **66** to seal off the circulation and mud pressure from seeping through and contacting the inner threaded walls. The mud circulation passes through the mandrel **60**, wash over pipe **18** and to the reaming tool **20** in a well known manner.

The lower end of the slip joint **22** is provided with a tapered threaded portion **68** for engagement with the top (not shown) of the wash over pipe **18**. The slip joint **22**, and particularly the pin **54** and piston **62** are provided with clutch dogs **72** and **70**, respectively, which are adapted to be moved into engaging position (not shown) when the upper safety joint box **50** is unthreaded from the pin **54** and moved vertically upward into spaced relation to the safety joint pin **54**, thereby assuring that the wash over pipe **18** and the reamer **20** will still continue to rotate, if necessary.

When it is desired to add an additional joint of pipe to the drill string to provide for continuous reaming, it is not necessary to disengage the safety spear **30** from the drill collar **8**, thereby creating the possibility that the heavy drill collar may become loosened and drop to the bottom of the well bore. In adding the pipe joint, the spear **30** and its attendant wall hanger **24** in the wash over pipe **18** remain in engagement with the drill collar string **8**. The rotary kelly (not shown) at the surface of the well is raised out of the well bore and the slip joint **22** is unthreaded at the loosely threaded right hand threads **51** and **52**, and since all other joints in the drill pipe are tightly threaded, the slip joint body **22** will separate or disjoint at **56** to permit vertical movement upward of the box member **50** moving the lower clutch dog **70** into engagement with the upper clutch dog **72**. The upward movement of the slip joint **22** permits the insertion of the extra joint of drill pipe, after which the kelly is inserted therein and the rotary drilling operation is continued until the vertical spaced condition of the separated slip joint **22** is consumed, when it may be necessary to add another joint of drill pipe for continuing the reaming operation.

In most instances after the drill collar string **8** has been loosened and the slips **26** are set into engagement either by a pull upward on the wash pipe **18**, or the downward movement of the loosened collars **8**, the wash over pipe **18** and the attendant drill pipe string will fish or pull the loosened drill collars **8** and bit **16** from the well. This is particularly true since the previous reaming operation has straightened many of the crooked or vertical variations of the well bore **2**. In such instances the wash pipe string is merely pulled to the top of the well along with the drill collars **8** for replacement of the drill bit **16** or the like.

In some instances the bore may not be clean enough to warrant retrieving, or fishing of the loosened drill collars from the well bore by the wash over pipe string. The present invention contemplates removal of the loosened drill collars **8** by other suitable means, such as a releasing overshot (not shown). This is accomplished by downward movement of the loosened drill

collar string 8 to the extreme bottom of the well bore by the wash pipe 18, after which the removable joint spear 30 is disengaged by a suitable plug means in a manner not shown to release the wash over pipe 18, and the wall hanger 24 from any engagement with the joint spear 30 connected with the drill collar string 8. With the drill collars 8 resting on well bottom, and the wall hanger overshot 24 released therefrom, the wash string 18 is removed from the well bore, after which a suitable releasing overshot (not shown) provided on a drill pipe string may be inserted in the well bore 2 for engaging the top of the spear 30, thereby removing the drill collar string 8 from the well bore.

It will be apparent that the slip joint permits insertion of an extra section of pipe without vertical movement of the reaming tool 20 on the end of the wash pipe 18, thereby eliminating any possibility of cave-ins or loosened debris falling into the well bore which would be motivated by the vertical movement of the reamer.

It will thus be seen that the wall hanger changes its relationship respecting the wash pipe during the various cycles of the operation. In the lowering of the wash pipe, the wall hanger is in a floating or semi-rigid disposition in the lower end of the wash pipe. As soon as the joint spear connects with the upper end of the drill collar string, the wall hanger then is positively attached to the drill collar string with its attachment to the wash pipe remaining in the floating or semi-rigid condition in order to permit the downward and rotating movement of the wash pipe for the reaming operation. As soon as the key seat recess is removed sufficiently to unloosen the stuck drill collar, the slips of the wall hanger are moved to an engaging position to then provide a positive connection between the wall hanger and the wash over pipe, thereby eliminating the floating or semi-rigid condition previously set forth.

From the foregoing, it will be apparent that the present invention contemplates a method or system of reaming out stuck drill collars from key seat recesses in crooked well bores of oil wells. Simultaneous with the reaming operation, the disjointed and stuck drill collar is connected with the fishing tool providing the reaming operation so that upon loosening of the drill collar, the collar is immediately gripped or caught by the fishing string to prevent dropping of the collar to the bottom of the well bore, thereby creating considerable damage to the drilling tools and the like. Furthermore, the invention contemplates adding an extra joint of drill pipe during the fishing operation without disconnecting the connection between the fishing string and the stuck drill collar.

Changes may be made in the combination and arrangement of parts as heretofore set forth in the specification and shown in the drawings, it being understood that any modification in the precise embodiment of the invention may be made within the scope of the following claims without departing from the spirit of the invention.

I claim:

1. The method of retrieving a stuck drill collar of a drilling string from a key seated recess of an oil well bore which consists of unjointing the drilling string from the drill collars at a point above the key seat, lowering a fishing string into the well bore and providing a reaming action for enlarging the key seat to release the stuck collar, supporting a tool in the fishing string for connection between the tool and the stuck drill collar prior to the reaming action, releasing the tool from the fishing string after connection thereof with the stuck collar to permit lowering of the reaming string in the well bore to a point substantially below the key seated recess, rotating the reaming string with simultaneous movement downwardly through the key seated recess after connection of the tool with the stuck pipe for loosening the collars, preventing the loosened collar from a substantial dropping in the well bore by automatically engaging the connected tool with the fishing string.

2. In a method of retrieving stuck drill collars of a drill string from a well bore which consists of disjointing the drilling string from the collars at a point above the stuck position thereof, lowering a reaming string into the well bore, supporting a retrieving tool in the reaming string for connection with the stuck collars, releasing the tool after connection with the stuck collars to permit lowering of the reaming string in the well bore to a point substantially below the point of the drill collar connection, rotating the reaming string with simultaneous lowering thereof for reaming the well bore around the stuck position of the collars for loosening the collars therein, preventing the loosened collars from dropping a substantial distance in the well bore by automatically engaging the released tool with the reaming string.

3. In a method of releasing stuck pipe from cave-ins in a well bore which consists of lowering a reaming string and providing a reaming action around the cave-ins adjacent the stuck portion of the pipe, supporting a tool in the reaming string during the lowering thereof for connection with the stuck pipe, releasing the supported tool from the string after connection with the stuck pipe to permit lowering of the reaming string substantially below the connected position of the stuck pipe, rotating the reaming string with simultaneous movement downwardly through the cave-ins for loosening the collars, engaging the tool with the reaming string substantially instantaneous upon the pipe being loosened in the bore to prevent dropping of the pipe to the bottom of the well.

4. The method of retrieving a stuck drill collar of a drilling string from a key seated recess of an oil well bore which consists in unjointing the drilling string from the drill collars at a point above the key seat, lowering a fishing string into the well bore and providing a reaming action for enlarging the key seat to release the stuck collar, supporting a gripping tool in the fishing string for establishing a connection with the stuck drill collar, releasing the gripping tool from the fishing string to permit lowering of the fishing string in the well bore to a point substantially below the key seat recess, lowering the reaming string after the connection of the tool with the stuck collar for loosening the collars, automatically engaging the tool with the fishing string substantially instantaneous with a loosening of the drill collar in the well bore, providing an expansion drilling string above the stuck collars permitting telescoping of the drill string for addition of an extra joint of pipe during the reaming operation without breaking the connection with the drill collars.

5. In a system for retrieving stuck drill collars of a drilling string from a key seat recess of a well bore comprising unjointing the drilling string from the stuck collars at a point above the key seat, lowering a wash over pipe into the well bore above the stuck collars, supporting a retrieving tool in a substantially fixed position in the wash over pipe for positive engagement with the collars, releasing the fixed position of the retrieving tool in the wash pipe after connection with the collars to permit a continued downward movement of the wash pipe for loosening the stuck collars in the well bore, automatically re-engaging the retrieving tool into a fixed position in the wash pipe substantially instantaneous with the loosening of the stuck collar to prevent dropping of the collars a substantial distance in the well bore.

References Cited in the file of this patent

UNITED STATES PATENTS

1,767,286	Hinderliter	June 24, 1930
2,122,602	Beck	July 5, 1938
2,281,389	Shaffer	Apr. 28, 1942
2,416,613	Costin	Feb. 25, 1947
2,449,841	Claypool et al.	Sept. 21, 1948
2,647,008	Stewart et al.	July 28, 1953
2,762,438	Naylor	Sept. 11, 1956