Oct. 7, 1930. I. THOMAS 1,777,591

WELL TOOL AND JOINT

Filed June 24, 1929

Fig. 2

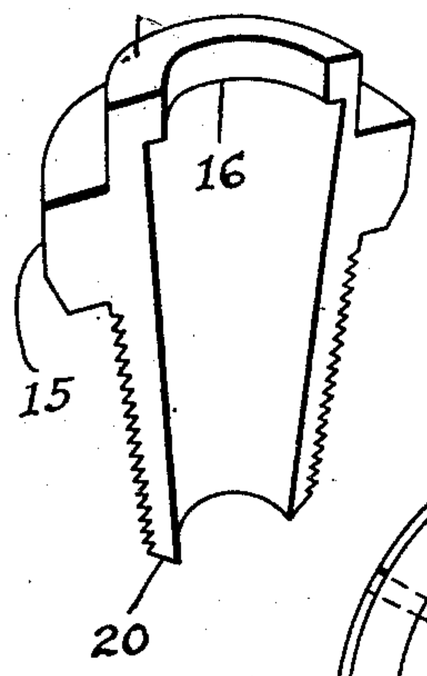


Fig. 3

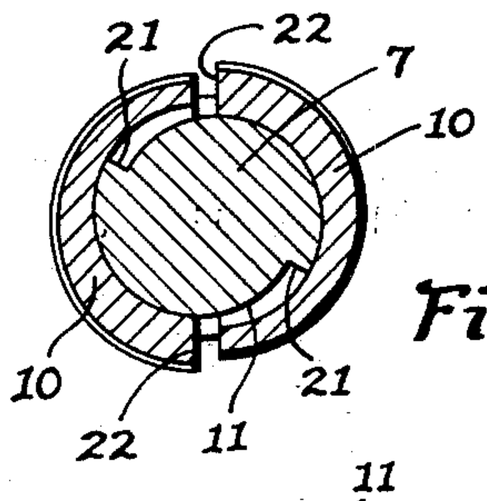


Fig. 4

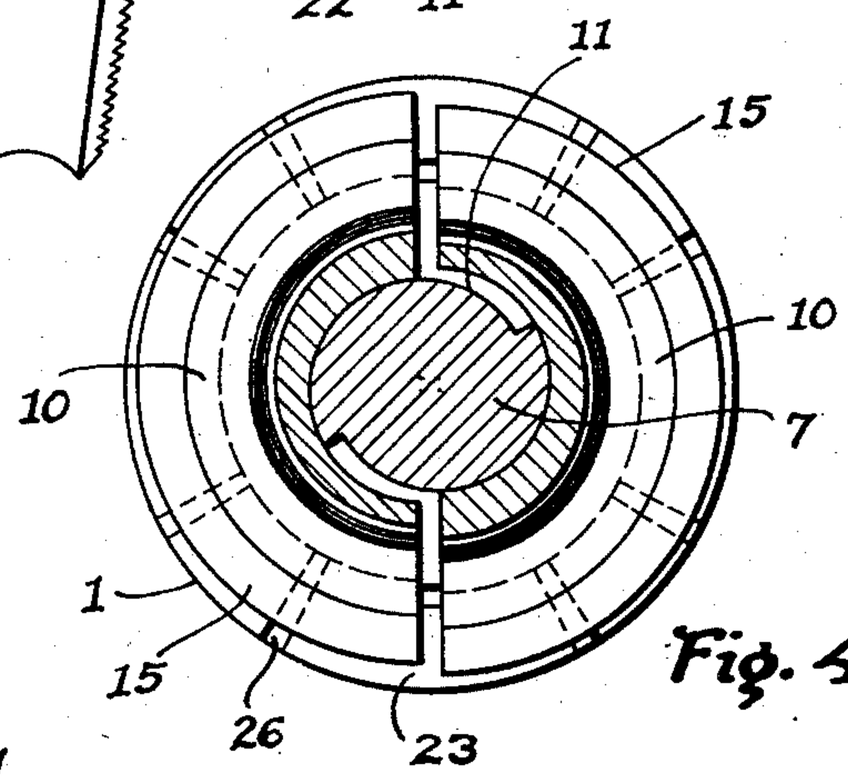


Fig. 1

Fig. 6

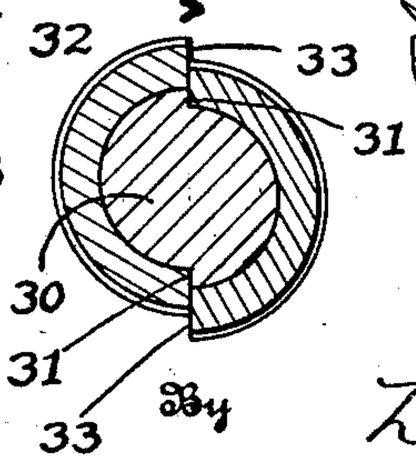
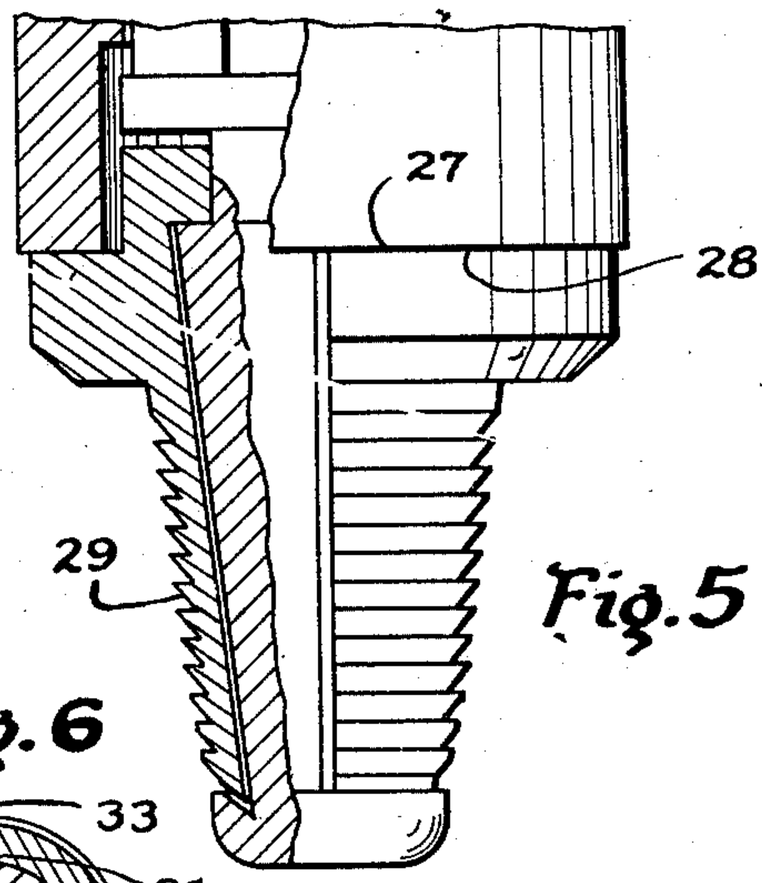


Fig. 5



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UNITED STATES PATENT OFFICE

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WELL TOOL AND JOINT

Application filed June 24, 1929. Serial No. 373,137.

This invention relates to deep well tools and the principles involved in the construction of the device enable it to have a wide range of usefulness in deep well tools. Features of the invention can be adapted to fishing tools and to produce a drill string joint of a safety type which can be released at will.

The general object of the invention is to produce a device of this nature having expanding slips controlled in such a way that when the slips are being set in a "fish" they can readily be released or expanded by rotation of the drill string, and also to provide means whereby, at will, the slips can be rotated with the casing of the tool.

A further object of the invention is to provide a simple construction for a tool or tool joint of this kind in which the tapered slips are carried on a mandrel which may have independent rotation of the slips, when desired, to expand or contract them, but which is so constructed as to enable the mandrel and slips to be rotatable in unison, when desired.

One of the objects of the invention is to provide a tool of this type which can be constructed so as to operate as a tap to cut its own thread in a twisted off casing or the like.

A further object of the invention is to provide an improved construction adaptable for embodiment in a back-off tool.

Further objects of the invention will appear hereinafter.

The invention consists in the novel parts and combination of parts to be described hereinafter, all of which contribute to produce an efficient well tool and joint.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

Figure 1 is a vertical section and partial elevation of a deep well tool embodying my invention.

Figure 2 is a perspective of one of the slips which constitute a feature of the invention.

Figure 3 is a cross-section taken on the line 3—3 of Figure 1, looking downward, and particularly illustrating the relation of the mandrel and slips.

Figure 4 is a view similar to Figure 3, but looking upward.

Figure 5 is a side elevation in partial section, showing another embodiment of the invention which is slightly different from that illustrated in Figure 1. The upper portion of this view is broken away.

Figure 6 is a cross-section illustrating the construction of the tool when it is adapted to be employed as a tap or die for cutting its own thread in the end of a twisted off casing or the like.

Before proceeding to a detailed description of the parts of the device, it should be stated that in its general construction the tool or joint includes a casing having means above for attaching the same to a drill string. The casing carries a mandrel which supports expansible and contractible slips, the construction being such that, when the mandrel is rotated, eccentric faces upon it operate to expand or contract the slips, depending upon the direction of relative rotation. In addition to this, the casing and slips are so constructed that the casing may be brought into direct contact with the slips so that rotation of the casing can be imparted to the slips. These features are very useful in a tool or joint of this kind and enable the tool to be readily disconnected from a lost casing or drill string which is being fished for in a well.

One of the features of the invention consists in a limited longitudinal relative movement between the mandrel and the casing, which movement is utilized to enable the casing to rotate the mandrel relative to the slips, or to come directly into engagement with the slips so as to rotate them directly by the casing. These features of the invention enable it to be adapted very readily for embodiment in back-off tools, fishing tools, or a special safety joint for drill strings which can be relied on to release itself if the tool string is properly manipulated at the mouth of the well.

Referring more particularly to the parts and especially to Figures 1 to 4, which illustrate an embodiment of the invention adapted to perform the functions of a back-off tool or

fishing tool, 1 represents the casing of the tool, which is preferably of tubular form. From the lower end of the casing a mandrel 2 extends downwardly, said mandrel being mounted in the casing for rotation by the casing and so that it is capable of a limited longitudinal movement within the casing. For this purpose the upper end of the body of the mandrel is formed with a threaded shank 3 passing through an annular collar 4 formed within the casing and in a position to be engaged by the lower end of a cap-nut 5 that screws down on the threaded end of the shank. The mandrel has a construction which will enable the casing to rotate it. For this purpose a key may be employed, but I prefer to construct the mandrel with an angular body 6. This body may be of hexagonal form and constructed integral with the shank 3 and integral with the lower portion 7 of the mandrel, which may be untapered, but is preferably tapered. The lower portion of the mandrel is connected by a reduced neck 8 to the upper portion. The shank 3 is of smaller diameter than the hexagonal body 6 so that a shoulder 9 is formed at the upper end of the body, and this shoulder is located below the lower face of the collar 4 when the mandrel is being supported on the upper face of the collar on the cap-nut 5. In other words, the cap-nut 5 and the shoulder 9 limit the longitudinal movement of the mandrel and the casing 1 with respect to each other.

The tapered portion 7 of the mandrel is constructed so as to carry a plurality of slips 10. There may be as many of these slips as desired. In the present instance I have illustrated two slips, which are of arcuate form and tapered in a circumferential direction (see Figure 3). These slips seat upon circumferentially disposed cam faces 11 formed on the tapered portion 7. The bodies 12 of the slips are tapered in their radius so that they virtually form two shells which co-operate to produce a collapsible pin 13, the said slips being preferably provided on their outer faces with threads 14 which would be standard threads for a regular pin of that diameter and taper.

The upper portion of each slip is formed into a relatively heavy collar 15 and this collar is undercut on its inner face (see Figure 2) to form an arcuate shoulder 16 that engages over a corresponding shoulder 17 formed at the upper end of the tapered portion of the mandrel by reason of the reduced diameter of the neck 8. The lower end of the casing projects over the upper end of the collar 15 so as to retain the slips and prevent their falling outwardly.

The lower ends of the slips are preferably retained by means of an integral button or head 18 formed on the lower end of the mandrel and having a deep inclined annular groove 19 at its upper edge which receives a correspondingly tapered nose 20 on the lower end of each slip.

By means of the rotary cam faces 11, two diametrically opposite longitudinally extending shoulders 21 are formed on the tapered portion of the mandrel. When the slips are in their collapsed condition, the wide ends 22 of the slips are located up against these shoulders. With this construction it will be evident that if a relative rotation of the mandrel takes place in an anti-clockwise direction (see Figure 3), the slips will be projected outwardly, due to the action of the cam faces 11. This action facilitates the use of the tool in order to make a connection with an open tapered box of the same diameter and taper as the pin 13 formed by the slips, and it also enables the pin to be introduced into the end of an open casing within a well and then expanded so as to cause the threads 14 to take hold of the mouth of the tubing. When the slips are introduced into a threaded box of the same pitch and thread, a very secure connection can be formed with the threads of the box by expanding the slips in the box. Having made such a connection to a lost drill string or tubing, this tool can be used as a back-off tool by rotating it in the proper direction to unscrew the lost tubing to which the tool has been secured. If the tubing to be backed off has right-hand thread, of course left-hand thread should be used in the string carrying the tool. The character of the cam faces illustrated in Figure 3 adapts the tool for performing this function.

The tool is constructed so that, at will, the slips can be rotated with the casing 1 instead of being permitted to be relatively stationary when the casing is rotated. In order to accomplish this, I utilize the relative longitudinal shifting movement of the mandrel within the casing and I provide the casing and the slips with engaging faces 23 and 24, respectively, which may come together if the casing is lowered down onto the slips. This movement may be merely a motion of translation without rotation; that is to say, rotation is unnecessary in effecting the connection. With the casing 1 lowered down onto the slips in this way, it will be evident that the rotation of the casing can be imparted directly to the slips. This rotation will enable the slips to be unscrewed from a box in which they may be anchored, and would also enable them to be unscrewed from open tubing within a well.

On account of the high friction that would be developed between the faces 23 and 24, it may not be necessary to provide any interlocking means to insure a positive connection between the casing and the slips to effect the rotation of the slips by the casing. However, for this purpose I prefer to provide a suitable interlocking connection which may

consist of notches 25 formed at different points around the periphery of the slips which will co-operate with tapered tongues 26, respectively, which project down from the lower end of the casing (see Figure 1).

In employing this invention in the construction of a safety joint to be used in a drill string, the construction is substantially the same as that described above and illustrated in Figure 1 except that the tongues 26 and notches 25 would be omitted. The pin 13 formed by the slips would be screwed into the box of the drill string section, with the mandrel in a position to maintain the slips expanded to the diameter of the box. With this arrangement, evidently by pulling up on the casing 1 and rotating it in the proper direction, the cam faces 11 would cause the release of the slips. By employing joints of this type at spaced intervals in a drill string, such joints could be made to release themselves, when desired, to facilitate the pulling of the drill string.

In Figure 5 I illustrate an embodiment of the invention in which I do not employ the notches 25 and tongues 26, but provide a plain lower edge 27 at the lower end of the tubular casing, which rests upon the plain upper face 28 on the upper end of the slip. In other respects the construction of the tool would be identical with that described in connection with Figure 1 except that, if desired, instead of employing threads 14, I may provide the slips with wickers 29 such as illustrated.

By employing slips of an abnormal construction, the tool may be transformed into a thread-cutting tap or die, adapted to cut its way into the open end of a lost casing or drill string. This is illustrated in Figure 6, which is a cross-section through the tapered portion of such a tool. In this view 30 represents the tapered portion of the tool formed with two driving shoulders 31 corresponding to the shoulders 21 of Figure 3. These driving shoulders drive arcuate slips 32 which are virtually cutting dies having projecting cutting shoulders 33 on the side of the tool opposite the shoulder 31 that drives that slip. It is evident that a tool of this kind, when introduced into an open tube or lost casing, can cut its own way into the wall of the lost casing and when it has been rotated sufficiently to engage sufficient metal in the wall, then the lost casing can be pulled.

To describe briefly the mode of operation and uses of the tool it should be understood that one important use would be that of a back-off tool. For example, in backing off a lost drill string having a right-hand thread, the thread on the collapsible pin or slips of the tool would be right-hand to fit the box of the lost drill string. The thread on the tool string would, of course, be left-hand as also would be the thread 34 at the upper end of the casing 1 which affords means for attaching the casing to the lower end of a tool string.

In backing off, the slips forming the collapsible pin 13 would be inserted in the box of the lost drill string and rotated in a right-hand direction to seat the pin easily in the box. In doing this, the threads on the slips would co-operate with the corresponding standard threads in the box. In seating the slips in the threads in this way, the weight of the casing 1 on the upper end of the slips would rotate them into the box. After they are seated in the box, the tool string should be pulled up slightly and then rotated slightly to the left to get the cam action of the cam faces 11 to lock the slips in the box. By reason of this cam action, it is not necessary that the threads on the slips should be of the same pitch as the thread of the box. The continued rotation of the tool string in an anti-clockwise direction, after tightening the slips in the box, will unscrew one or more sections of the lost drill string.

The casing 1 has means for encircling the slips in any position they can assume. In the present instance this function is performed by the lower end of the casing which always encircles the collars at the upper ends of the slips.

The neck 8 may be of cylindrical form, but I prefer to give it cam faces similar to the cam faces 11 of the tapered portion of the mandrel. When this is done, of course, the cam faces on the neck 8 should be in the same relative position as the cam faces on the tapered portion, in other words, the shoulders 21 on the tapered portion should be carried right up through the length of the neck 8.

It is understood that the embodiment of the invention described herein is only one of the many embodiments this invention may take, and I do not wish to be limited in the practice of the invention, nor in the claims, to the particular embodiment set forth.

What I claim is:

1. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel extending down from the casing, slips carried on the mandrel, said mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, said mandrel and said casing being capable of a limited relative longitudinal movement and having faces capable of engaging when the casing is lowered to enable the casing to rotate the slips.

2. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel extending down from the casing, slips

carried on the mandrel, said mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, said mandrel having means for supporting said slips and said casing having means for retaining the slips on the mandrel in any position they can assume, but permitting a limited radial movement of the slips with respect to the axis of the mandrel.

3. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel extending down from the casing, slips carried on the mandrel, said mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, said mandrel having means for supporting said slips and said casing having means for retaining the slips on the mandrel in any position they can assume, but permitting a limited radial movement of the slips with respect to the axis of the mandrel, said mandrel and casing being capable of a limited relative longitudinal movement and having faces capable of engaging when the casing is lowered with respect to the mandrel, to enable the casing to rotate the slips.

4. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel extending down from the casing, slips carried on the mandrel, said mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, said mandrel and said casing being capable of a limited relative longitudinal movement, the lower end of said casing and the upper end of the slips having interlocking means operating to engage when the casing is shifted downwardly relatively to the slips to enable the casing to rotate the slips.

5. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel mounted in the casing for limited longitudinal movement in the casing and capable of being rotated by the casing, said mandrel having a tapered lower portion and a reduced neck above the tapered portion whereby a supporting shoulder is formed, arcuate slips carried on the tapered portion of the mandrel and engaging over said shoulder, the tapered portion of said mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, the said casing and the slips having faces operating to engage when the casing is lowered with relation to the slips to enable the casing to rotate the slips.

6. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel mounted in the casing for limited longitudinal movement in the casing and capable of being rotated by the casing, said mandrel having a tapered lower portion and a reduced neck above the tapered portion whereby a supporting shoulder is formed, arcuate slips carried on the tapered portion of the mandrel and engaging over said shoulder, the tapered portion of said mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, the said casing and the slips having faces operating to engage when the casing is shifted downward with relation to the slips to enable the casing to rotate the slips, the lower end of the tapered portion of said mandrel having means for retaining the lower ends of the slips.

7. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel mounted in the casing for limited longitudinal movement in the casing and capable of being rotated by the casing, said mandrel having a tapered lower portion and a reduced neck above the tapered portion whereby a supporting shoulder is formed, arcuate slips carried on the tapered portion of the mandrel and engaging over said shoulder, the tapered portion of said mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, the said casing and the slips having faces operating to engage when the casing is lowered with relation to the slips to enable the casing to rotate the slips, the lower end of the tapered portion of said mandrel having means for retaining the lower ends of the slips in any position they can assume, the lower end of said casing operating to project over the upper ends of the slips for limiting their outward movement and retaining the same at their upper ends on the mandrel.

8. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel mounted in the casing for rotation and capable of limited relative longitudinal shifting movement in the casing, said mandrel having a tapered lower portion with slips carried on the same, the tapered portion of the mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, said slips and said casing having faces operating to engage when the casing is shifting downwardly with respect to the slips to enable the casing to rotate the slips.

9. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel mounted in the casing for rotation and capable of limited relative longitudinal shifting

movement in the casing, said mandrel having a tapered lower portion with slips carried on the same, the tapered portion of the mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, the lower end of said casing and the upper end of said slips having interlocking means for effecting a connection between them by a relative downward shifting movement of the casing, operating to enable the casing when lowered to engage the slips for rotating the same.

10. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel mounted in the casing for rotation and capable of limited relative longitudinal movement in the casing, said mandrel having a tapered lower portion, slips carried on the said tapered portion and having threads on their outer faces, the tapered portion of the mandrel having eccentric faces operating to project the slips outwardly when a relative rotation occurs between the mandrel and the slips, the thread on the slips having an opposite character with relation to the eccentric faces so that when the casing is moved down onto the slips to engage the slips and rotate the same in an unscrewing direction as regards their own threads, the slips will move in the same relative direction that would permit the slips to move inwardly.

11. In a deep well tool, the combination of a casing having means at its upper end for attaching the same to a tool string, a mandrel mounted in the casing for rotation and capable of limited relative longitudinal movement in the casing, said mandrel having a tapered lower portion, slips carried on the same and having threads on their outer faces, the tapered portion of the mandrel having eccentric faces operating when the mandrel is rotated relative to the slips in an anti-clockwise direction, to project the slips outwardly, the threads on the slips operating to advance the slips in a part engaged by the threads, by a rotation of the slips in a clockwise direction, the relative longitudinal movement of the casing and the mandrel enabling the casing to engage the slips for rotating the same.

12. In a tool of the kind described, a slip having a lower portion of arcuate form and tapering in a circumferential direction, said slip having a collar at its upper end presenting a substantially horizontal outer face and having an inwardly projecting flange forming a shoulder to support the slip on a mandrel.

Signed at Los Angeles, Calif., this 7th day of June, 1929.

IDRIS THOMAS.