June 26, 1928. 1,674,798

D. H. REED

DEVICE FOR UNSCREWING PIPE IN WELLS

Filed Jan. 31, 1924 2 Sheets-Sheet 1

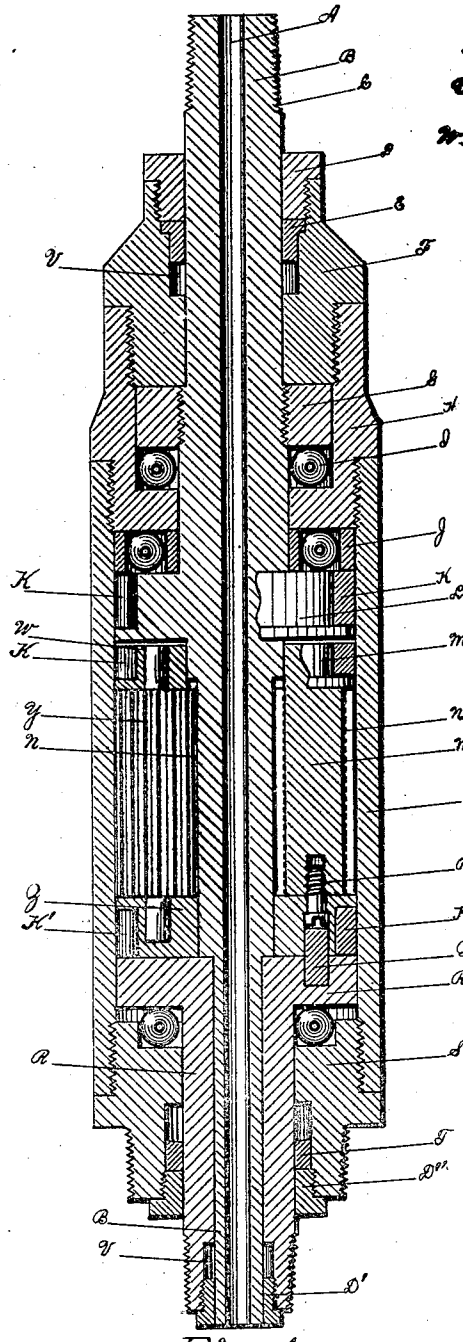


Fig. 1

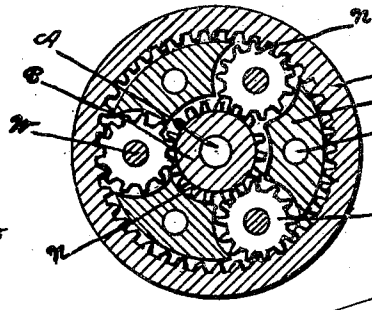


Fig. 2

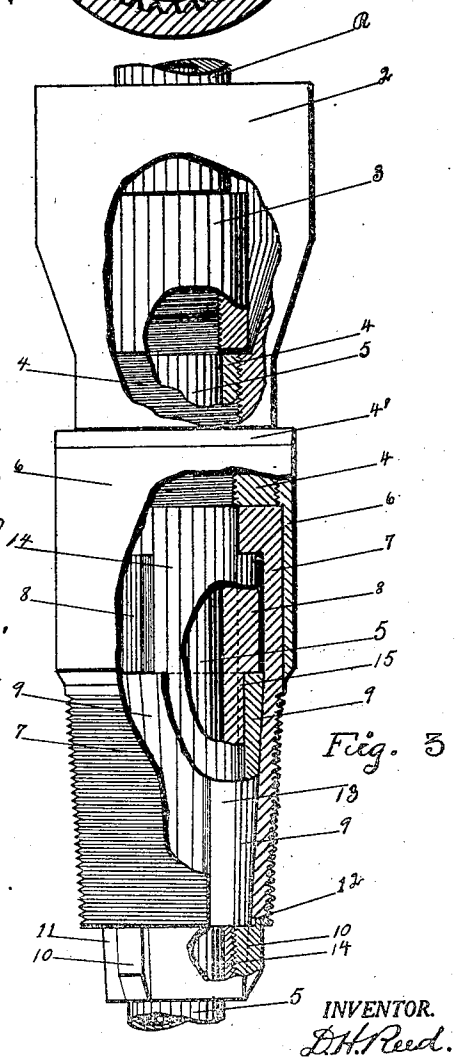


Fig. 3

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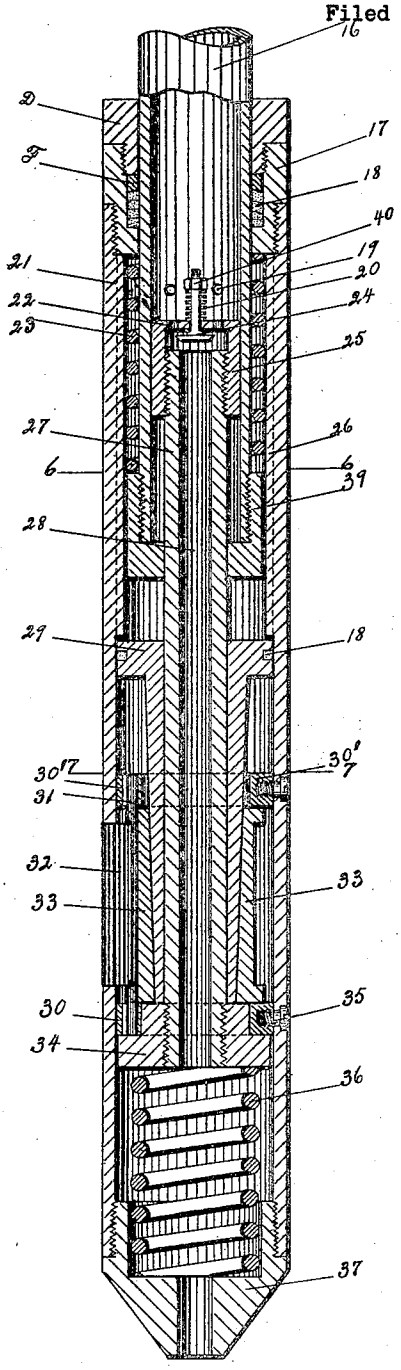


Fig. 5.

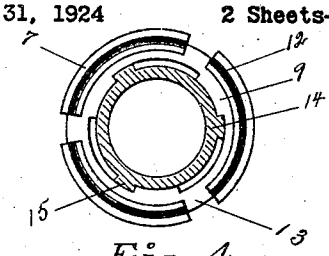


Fig. 4

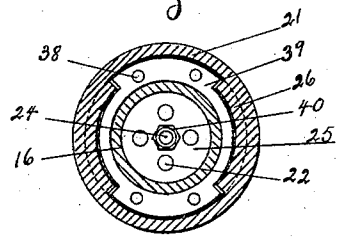


Fig. 6.

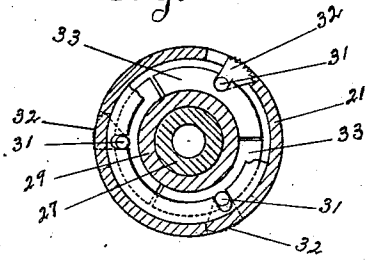


Fig. 7.

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UNITED STATES PATENT OFFICE.

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DEVICE FOR UNSCREWING PIPE IN WELLS.

Application filed January 31, 1924. Serial No. 689,837.

My invention relates to an improvement in unscrewing devices for operation in removing pipe from wells in drilling operations.

In well drilling it is common to use a drill stem for operating the bit. Said drill stem is made up in sections connected together at their adjacent ends by means of couplings into which the sections are threaded in a right hand direction. The casing and liner are also connected together at their couplings by the same right hand or clockwise threaded engagement. When it is desirable to remove a section or more of the casing from the well, or to unscrew sections of pipe which have fallen into the well, it becomes necessary to rotate the pipe engaging tool in a left hand or counter-clockwise direction. If the usual right hand threaded drill stem is employed, the stem itself will become unscrewed at the joints and difficulty at once arises.

It is an object of my invention to provide a device which may be connected at the lower end of a drill stem made of pipe sections coupled together in the usual manner, said device acting to convert a right hand rotation into a left hand rotation of the tool attached thereto.

Another object is to provide an unscrewing tool of this kind which may be employed without any means to anchor the same to the wall of the well hole. This will allow the invention to be employed in wells without the usual casing.

Another object is to provide means for engaging the pipe to be unscrewed in such manner that the tool may be released when desired.

Another object is to provide a positive means for connecting the unscrewing device with the pipe which is to be removed in such manner as to allow the desired number of sections at the upper end of the pipe so engaged to be unscrewed and removed in a most efficient manner.

Other objects and advantages of the invention will appear in a more detailed description which follows.

Referring to the drawing herewith, wherein like characters of reference are applied to like parts in all the views, Fig. 1 is a central longitudinal section through the upper portion of the mechanism whereby the direction of rotation is changed. Fig. 2 is a diagrammatic view illustrating the arrangement of the gears in the device shown in Fig. 1. Fig. 3 is a side elevation of the pipe engaging device, certain parts being broken away for greater clearness. Fig. 4 is a section taken on the lower end of Fig. 3 with the nut 11 removed. Fig. 5 is a central longitudinal section through the anchoring means employed with my invention. Fig. 6 is a transverse section approximately on the line 6—6 of Fig. 5; and Fig. 7 is a transverse section approximately on the line 7—7 of Fig. 5.

In the drawing I have shown a central mandrel or shaft for the unscrewing device indicated by the letter B; the upper end thereof is threaded at C for engagement with a drill stem of ordinary construction. The passage A through this mandrel furnishes a channel for the flushing fluid through the tool. As will be noted from the drawing, this mandrel extends throughout the length of the housing in which the reversing mechanism is enclosed. There is adjacent the upper end a plug or block F having a central stuffing box V therein surrounding the mandrel, said stuffing box having a packing gland E, and a gland nut D screwed into the upper end of the plug F, and fitting tightly about the shaft. The lower end of the plug F about the shaft B is threaded for engagement with a second block or collar H which extends downwardly from the plug F to include a flange G having threaded engagement with the shaft or mandrel. Below the said flange is a space providing an annular chamber to receive a series of roller bearings I, thus providing a ball race between the flange G and the lower inwardly projecting end of the collar H. This bearing tends to carry the downward thrust of the shaft upon the rotating housing.

The lower end of the collar H is threaded into engagement with a sleeve O which provides a housing for the gears constituting the reversing mechanism. It also serves to connect the outer rotating portion with the lower plug or block S below the gears.

Below the collar H and within the housing is a ball retainer J acting to secure in position a ball race bearing on the lower end of the collar H and between the said collar and a radial flange L on the shaft B. This bearing tends to provide a rolling friction between the collar and the shaft.

Spaced below the flange L upon the shaft,

the shaft is provided with longitudinal gear teeth N which are adapted to engage with a plurality of intermediate gears Y. I have shown three of these gears as indicated in Fig. 2; said gears are mounted in separate circular recesses in a gear retaining block M. This block is annular in form and fits about the central shaft B. At the upper ends of the recesses or pockets in which the gears Y are housed, there are a series of openings forming bearings to receive the reduced upper ends W of the gears. Outside of the bearing and adjacent the housing O are a series of roller bearings K fitting against the inner wall of the housing. The lower ends of the gears are seated upon a ring Z in which the reduced ends have a bearing. This ring is secured to the lower end of the gear retaining block by means of machine bolts or set screws P, the heads of which are countersunk from the lower side of said ring and fit within the lower face of said block. Roller bearings K′ are formed in a race provided in the outer face of the retaining ring Z in the manner shown in Fig. 1.

The gears Y are adapted to engage in teeth N′ on the inner face of the housing or sleeve O so that when the inner shaft B is rotated in a right hand direction, the engagement of the teeth N thereon with the teeth of the gears Y will cause the rotation of said gears in an opposite direction and this rotation of the gears will be communicated through the gear teeth N′ to the sleeve of the housing, thus rotating the same and the parts connected therewith in a left hand direction.

The plug or block S on the lower end of the housing serves to support a tubular shaft or collar R having a radial flange above said plug. Non-friction bearings are shown between the plug S and the flange R to take up the friction between these parts. The upper face of the shaft R is provided with a plurality of recesses to receive dowel pins Q which are so placed as to register with and fit into the openings in the retaining ring Z through which the bolts P are inserted. These pins will tend to prevent relative rotation between the gears and their retaining block and said shaft.

As will be seen from the drawing, the shaft R provides a bearing within which the shaft or mandrel B may rotate. The stuffing box D at the lower end of the tubular shaft R serves to provide a rotating but fluid tight fit between the shaft and mandrel. The space between the lower end of the plug S and the shaft R is also provided with a stuffing box D enclosing packing T which acts in the usual manner to maintain a fluid tight closure.

The lower end of the shaft R is threaded for engagement with a coupling 3 shown at the upper end of Fig. 3. This coupling serves to connect the said shaft R with the shaft 5 which extends downwardly through a pipe engaging tap with which the casing or other pipe to be unscrewed is connected. It will be noted therefore that the pipe 5 is rotatable within the tap and is independent thereof.

The tap consists of an upper coupling or nipple 2 which is adapted to be engaged with the threaded lower end of the plug or block S. Said nipple 2 is reduced in diameter at its lower end and threaded interiorly for engagement with a collar 4. This collar is rotatable on the shaft 5 below the coupling 3 previously referred to. It is increased in diameter to form a radial flange 4 below said nipple, and below said flange it is threaded externally for connection to a downwardly extending retaining skirt 6.

Below the flange 4′ the inner diameter of the collar is increased and threaded to receive a drive shaft 14 also rotatable upon the shaft 5. The said drive shaft is provided with a plurality of radially extending ribs 8. These ribs are three in number and extend downwardly to a point approximately even with the lower end of the outer skirt 6. At this point the ribs are reduced in height and as shown at 15 are extended downwardly along the lower end of the drive shaft to a point spaced somewhat from the end thereof. At this point the said shaft is reduced in diameter and threaded for engagement with a nut 11.

Between the drive shaft and the skirt 6 are a plurality of slips or jaws 7. The upper ends of these jaws are extended inwardly to fit above the ribs 8. Below said ribs the slips are inclined inwardly to fit against the outer face of a downwardly tapered sleeve or drive ring 9. The outer faces of the tapered portion of the jaws are toothed or threaded to engage within the casing or other pipe which is to be removed from the well. The ring or collar 9 is shaped to fit between the jaws of the slips, of which I have shown three, and the drive shaft 14. It furnishes a surface upon which the said jaws may find a firm support. The outer face of the said ring 9 has a plurality of projecting ribs 13 which are adapted to fit between the three separate jaws or slips 7, spacing them apart, and holding them against rotation under ordinary circumstances.

The nut 11 previously referred to is formed with three radially projecting ribs 10 thereon, and said ribs are formed with upwardly extending points thereon to fit within grooves 12 in the lower ends of the slips as shown in Fig. 3. These points are adapted to slide within the lower ends of the jaws on rotation, but, while operating, they serve to prevent outward movement of the slips relative to the ring 9. The nut 11

also serves to support the drive ring 9 in position upon the shaft 14.

The shaft 5 which extends downwardly through the tap described above may be of any desired length and it is contemplated that it will be connected by a coupling or nipple with a continuation thereof shown in Fig. 5, each shaft being tubular in form and extending downwardly within the housing 21. At its lower end within the housing it is connected with a cap 39 fitting within the housing.

The housing 21 may be formed of a section of pipe, the upper wall of which is thickened at opposite sides to provide ribs 26, which ribs extend longitudinally to a point approximately midway of the housing. Below this point the housing is cylindrical on its inner diameter and is connected at its lower end with a plug or cap 37. The upper end of the housing forms a close fit with the outer surface of the shaft 5 by means of stuffing box 17 having packing 18 therein held in position by the gland D. The cap 39 at the lower end of the shaft 5 is formed with radial ribs thereon to engage within the spaces between the opposite ribs 26 as shown in Fig. 6. The cap is perforated longitudinally as shown at 38 to allow the passage of water therethrough. Between the cap 39 and the lower end of the plug 17 of the stuffing box, is a coiled compression spring 23 tending to hold the shaft 5 downwardly within the housing. Centrally of the housing is a releasing shaft 27, tubular in shape, and having a central passage 28 therethrough. The upper end of the shaft fits within the lower end of the shaft 5, and has a cap 25 thereon fitting closely within the walls of the shaft 5 and having at its upper end a valve 40, the head of which, below the top of the cap, is adapted to fit within the upper end of the passage 28 through the releasing shaft. It is normally held out of said seat by a spring 20, bearing at its lower end upon the cap 25 and at its upper end against the nut at the upper end of the valve stem. The cap is perforated at various points 22 to allow the passage of water therethrough under normal conditions.

Above the normal position of the cap 25 the shaft 5 is perforated at 19 to allow the passage of water therefrom into the chamber about the spring 23. The lower end of the releasing shaft has thereon a nut 34 which has a radial recess therein to receive a retaining ring 30 for the pawls 32. The said ring is held against rotation in the housing by means of machine bolts or set screws 35 extending through the housing into said ring.

Below the nut 34 and the lower cap 37 is a compression spring 36 acting to resiliently hold the shaft 27 upwardly against said retaining ring 30. The cap 37 is provided with a central passage to allow an outlet for flushing water.

Surrounding the releasing shaft 27 below the ribs 26, is a piston 29 which has outer piston rings 18 therein to form a close fit with the inner face of the housing. Said piston is slidable to a certain extent upon the releasing shaft 27. Its outer face is tapered inwardly toward the lower end to form an expanding mandrel for a series of expanding members 33. These expanding members, as well as the piston, normally rest upon the upper face of the ring 35 and nut 34. Said expanding members or jaws 33 are three in number, and are shaped on their inner faces to fit the piston or mandrel 29. They are adapted to move radially outward as the piston is forced downwardly between them. They are limited in movement upwardly by a retaining ring 30′ held rigidly to the housing 21 by machine bolts as shown in Fig. 5.

Each of the jaws, or expanders 33 has mounted centrally therein a dog 32 which has upper and lower bearing shafts 31 to fit within openings in the two retaining rings 30 and 30′. These openings in the rings allow a lateral movement of the dogs as said dogs are forced outwardly into engagement with the pipe. As shown in Fig. 7 the said dogs are mounted somewhat eccentrically relative to the axis 31 and are toothed on their outer faces to engage with the pipe. When in normal position the dogs are housed within the outline of the housing 21, but the downward movement of the piston 29 relative to the expanding members will force the dogs outwardly, as will be later described.

In the use of my invention the shaft B of the unscrewing member is coupled to the lower end of the drill stem. The pipe engaging tap 7 is mounted below the unscrewing member, the nipple 2 being screwed to the lower end of the plug or collar S. The shaft R is connected to the pipe 5 which extends through the tap and is connected, at any desired distance beyond said tap, to a second pipe 5 which forms a part of the anchoring means shown in Fig. 5. When it is desired to unscrew a few upper sections of the pipe or casing for withdrawal, the anchoring device will be extended beyond the tap a sufficient distance to include the desired sections. The assembled device will be lowered into the well until the anchoring device projects down to the predetermined point in the pipe which is to be unscrewed and the tap 7 above the anchor comes into contact with the upper end of said pipe. The anchoring jaws 32 on the anchor will then be expanded to grip said pipe. This is done by increasing the pump pressure on the water flowing through the assembled device, thus tending to overcome

the tension of the spring 20 and seat the valve 40 over the passage 28. This will cause the said water to pass outwardly through openings 19 and downwardly around the cap 39 and through openings 38 therein to the piston 29 which will be forced downwardly with the releasing shaft 27 and expand the jaws 30 and pawls 32 against the pipe. Said pawls or dogs are arranged to grip the pipe more securely when rotated in the usual righthand direction. The jaws may be maintained in expanded position as long as desired by a continuation of pump pressure on the flushing liquid and again released by shutting off said pressure.

When the shaft R, pipe 5 is thus anchored, the shaft B may be rotated in a right hand direction, thus acting through gears Y to rotate the housing O in a left hand direction. This unscrewing rotation of the housing will turn with it the collar S and nipple 2, thus also rotating the drive shaft 14. When the rotation is in the left hand direction, as it usually is, the ribs 8 on the drive shaft will support the slips 7 in elevated position, and the ribs 15 will bear against the sides of longitudinal grooves in the drive ring 9, as shown in Fig. 4. The ribs 10 on the nut 11 will also support the slips at the lower ends thereof.

The tap formed by the slips 7 will therefore be screwed downwardly into the upper end of the pipe and cut threads therein to obtain a firm grip thereon. When the pipe has been thus engaged, the tap and pipe will be rotated further in a left hand direction to unscrew the pipe. When the upper pipe sections are thus unscrewed the anchor will be next released and the whole assembly with the pipe may be withdrawn from the well. This operation may be repeated if desired until the whole casing has been removed. If but a few sections of pipe are to be removed from the upper end of the casing, the anchor may be spaced the desired number of pipe lengths below the tap and serve to hold the lower sections stationary while the upper sections are unscrewed and released.

If the tap should be engaged within a pipe which for some reason could not be unscrewed or withdrawn from the well, the tap could be released from the pipe by rotating the drill stem one-sixth of a turn to the left, thus rotating the drive shaft 14 to the right bringing the ribs 15 into line with the spaces between the jaws of the slips 7. The ribs 8 will be moved from beneath the upper ends of the slips by the same movement and the ribs 10 will likewise move into the spaces between the jaws thus allowing the slips to drop down as the drive ring is moved upwardly and the inner shoulders of the jaws will hang on the upper ends of the ring 9. The slips will thus collapse and release the pipe so that the tap may be withdrawn from the well.

It will be noted that when the anchor is once set, it will not be moved until the pipe is caught by the tap and then unscrewed. To allow for the downward movement of the shaft 5 when the tap is screwed in place and the later upward movement of shaft 5 when the casing joints are unscrewed, the sliding of shaft 5 in the housing of the anchor is provided for in the manner previously described. This avoids any tendency to slide the anchor or to break the operating parts.

The advantage of this type of unscrewing device lies in the fact that it need not be anchored to the side of the hole to operate. The pipe engaging tap is simple and easily releasable if desired and the left hand mechanism simple to construct and operate.

Other objects and advantages will be apparent to one skilled in the art.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In a device of the character described, a drive shaft, a housing on said shaft, gear teeth on said housing and on said shaft, gears intermediate said shaft and housing cooperating therewith to communicate rotation from said shaft to said housing, a block in which said gears are mounted, a pipe engaging tap on said housing, and an anchor connected with said block and extending below said tap to anchor said block to the work.

2. In a device of the character described, a drive shaft, a housing on said shaft spaced therefrom to enclose a gear block, gear teeth on said shaft and on the inner surface of said housing, gears on said block engaging said shaft and housing, a pipe engaging tap below said housing and connected therewith, an anchor shaft connected with said block and extending downwardly through said tap and means to secure said anchor shaft to the work for the purpose described.

3. In a device of the character described, a drive shaft, a housing in which said shaft is rotatable, a gear block on said shaft in said housing, gears on said block engaging said shaft and housing to communicate rotative movement from said shaft to said housing, a pipe engaging tap on said housing, and anchoring means connected with said gear block and extending below said tap for detachable connection with a lower section of pipe.

4. In a device of the character described, a drive shaft, a housing in which said shaft is rotatable, a gear block between said shaft and housing, gears on said block positioned to engage gear teeth on said shaft and housing, a pipe engaging tap on said housing, a shaft connected with said gear block, and an

anchoring means on said last mentioned shaft below said tap, said anchoring means being expansible at any desired distance below said tap.

5. In a device of the character described, a drive shaft, a housing in which said shaft is rotatable, a gear block within said housing, gears mounted in said block and having operative engagement with said shaft and said housing, means connected with said housing for attachment to the work, and means between said gear block and said attaching means to engage therewith and prevent rotation of said block relative to the work.

6. In a device of the character described, a drive shaft, a housing rotatable on said shaft, gears on said shaft and said housing, intermediate gears engaging between said shaft and said housing, means to support said gears, means to connect said housing to a string of pipe and independent means extending through said pipe engaging means to anchor said intermediate gears against rotation with said shaft.

7. In a device of the character described, a drive shaft, a housing thereon, reversing means connecting said shaft and said housing for rotating said housing in a direction opposite to that of the shaft, a pipe engaging tap on said housing, and an anchoring means connected with said reversing means comprising a shaft, a sleeve thereon, a piston in said sleeve and expanding jaws operated by said piston in the manner described.

8. In a device of the character described, a drive shaft, a housing thereon, a reversing mechanism between said shaft and housing for rotating said housing in a direction opposite to that of the shaft, a pipe engaging tap on said housing, an anchoring device connected with said reversing mechanism below said tap, expanding jaws on said anchoring means, and means operatable through water pressure to expand said jaws when desired.

9. In a device of the character described, a drive shaft, reversing means mounted thereon including a housing, gears between said shaft and housing, pipe engaging means connected with said housing, anchoring means connected with said gears adapted to extend into the pipe to be engaged, said drive shaft and anchor having a water passage therethrough, and means operatable through the increase of pump pressure through said passage to engage the wall of said pipe below the said anchor to prevent relative rotation thereof.

10. In a reversing mechanism for operation in wells, an anchoring device comprising a hollow shaft or pipe, a housing on the end thereof, a releasing shaft slidable in said housing and pipe, said releasing shaft having a water passage therethrough, means to close said passage through water pressure, a piston on said releasing shaft, and jaws adapted to be expanded by said piston in the manner described.

11. In a reversing mechanism for use in wells, an anchoring device comprising a hollow shaft, a housing on the lower end thereof, a releasing shaft in said housing, a piston on said releasing shaft, expanding jaws on said piston, and means to move said piston to expand said jaws operatable through the increase in water pressure flowing through said device.

12. In a reversing mechanism for use in wells, an anchoring device comprising a hollow shaft, a housing on the lower end thereof, a tubular releasing shaft, movable in said hollow shaft and said housing, a valve at the upper end of said releasing shaft, a downwardly tapered piston on said releasing shaft, jaws in said housing adapted to be expanded by said piston, and resilient means between said hollow shaft and said housing.

13. In a reversing mechanism for wells, an anchoring means comprising a hollow shaft, a housing slidable on the lower end thereof, a downwardly tapered piston in said housing, pipe engaging jaws on said piston and hydraulically operated means to force said piston downwardly to expand said jaws.

14. In a device of the character described, an anchoring device comprising a hollow shaft, a housing thereon, pipe engaging jaws in said housing, a downwardly tapered piston between said jaws and hydraulically operated means to force said piston downwardly and expand said jaws when desired.

15. In a device of the character described, an anchoring means comprising a hollow shaft, a housing slidable on the lower end thereof, pipe engaging jaws in said housing, means to expand said jaws operable through water pressure and resilient means between said housing and said shaft to permit longitudinal movement of said housing on said shaft.

16. In a device of the character described, an operating shaft, a housing thereon, means between said shaft and said housing for rotating said housing in a direction opposite to the direction of rotation of said shaft, a pipe engaging tap connected with said housing comprising threaded slips, means to support said slips in operative position, said supporting means being adapted to release said slips when rotated, a partial rotation, whereby said slips may be allowed to collapse to release a pipe engaged thereby in the manner described.

17. In a device of the character described, a tap comprising a nipple, a collar thereon, a drive shaft connected with said collar, radial ribs on said drive shaft, slips sup-

ported on said ribs, said slips having downwardly tapered threaded ends thereon, a ring on said drive shaft to space said slips from said shaft, and ribs on said ring between said slips.

18. In a device of the character described a pipe engaging tap comprising a collar, a drive shaft thereon, radial ribs on said shaft, a downwardly tapered ring on said shaft below said ribs, slips supported on said ribs, and having downwardly tapered threaded ends thereon, said slips being spaced apart to allow release of the connection between said ribs and said slips, whereby said slips may move downwardly on said ring.

19. In a device of the character described, a pipe engaging tap comprising a collar, a drive shaft thereon, radial ribs on said shaft, a drive ring on said shaft below said ribs, a plurality of downwardly tapered threaded slips supported on said ribs, means to engage the lower ends of said slips and to support said ring, said slips being spaced apart to allow the upward movement of said ribs relative thereto, and means to retain the upper end of said slips against said shaft.

20. In a device of the character described, a pipe engaging tap comprising a drive shaft, downwardly tapered threaded jaws thereon, a drive ring between said shaft and the threaded ends of said slips, ribs on said ring spacing said jaws apart, means to support said jaws on said shaft, releasable by the rotation of said shaft, and means to retain said slips on said shaft.

21. In a device of the character described, a pipe engaging tap comprising a drive shaft, a plurality of downwardly tapered jaws thereon having means to engage a pipe, means to space said jaws apart, means to support said jaws on said shaft, releasable by the rotation of said shaft, and means to hold said jaws on said shaft.

In testimony whereof I hereunto affix my signature this 28th day of January, A. D. 1924.

DEMPSON HERBERT REED.