Feb. 22, 1949. C. R. EDWARDS 2,462,478

REVERSING TOOL

Original Filed May 13, 1940 2 Sheets-Sheet 1

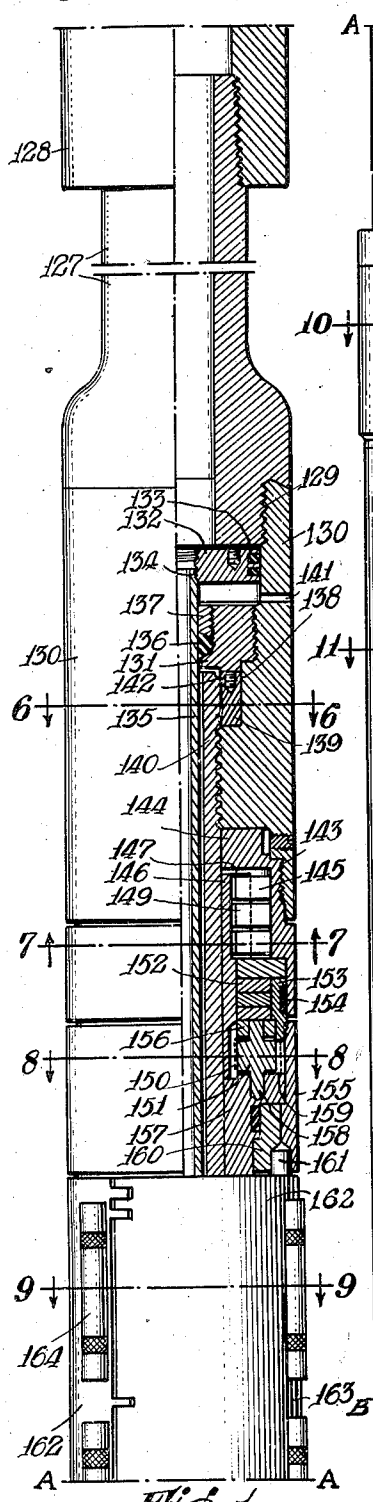


Fig. 1.

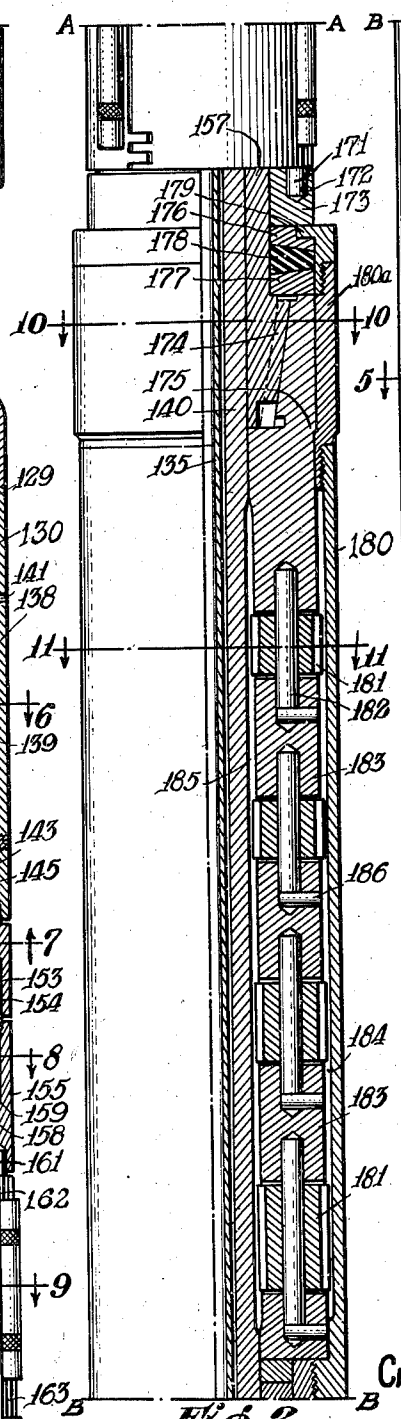


Fig. 2.

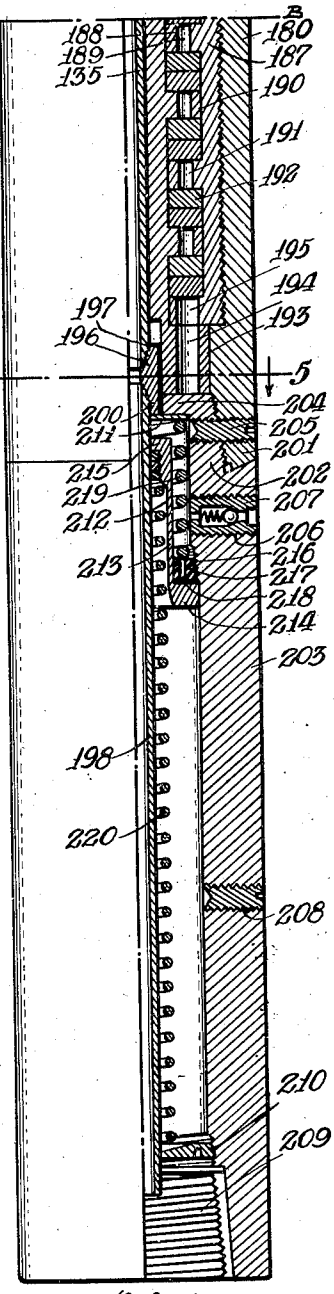


Fig. 3.

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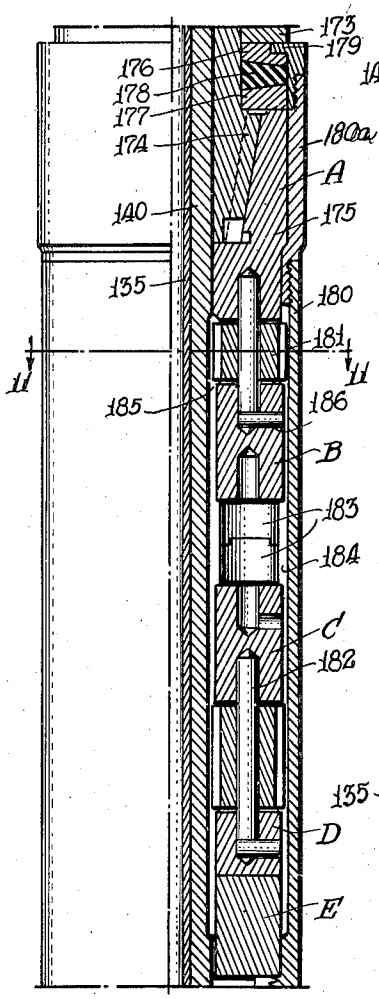


Fig. 4.

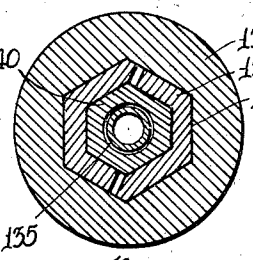


Fig. 6.

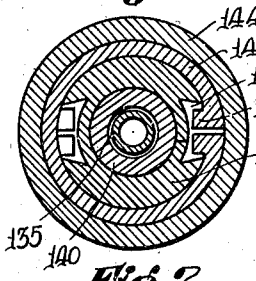


Fig. 7.

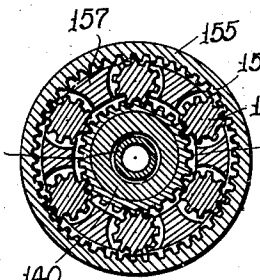


Fig. 8.

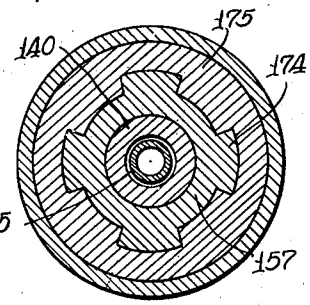


Fig. 10.

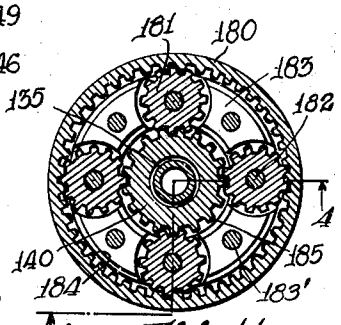


Fig. 11.

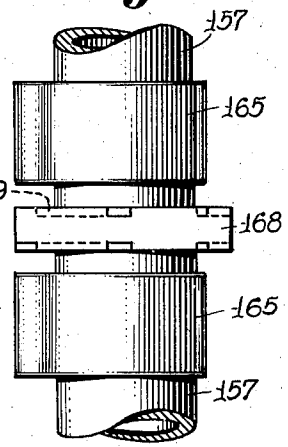


Fig. 12.

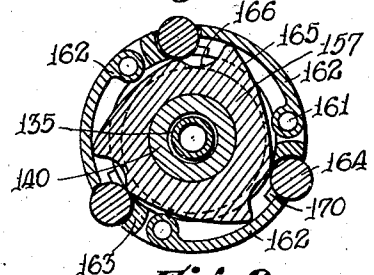


Fig. 9.

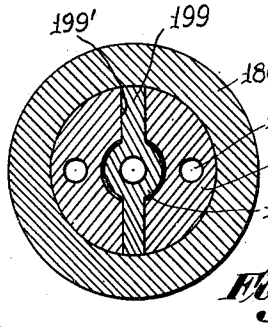
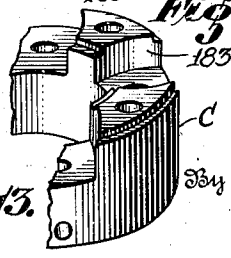


Fig. 13.



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UNITED STATES PATENT OFFICE

2,462,478

REVERSING TOOL

Charles R. Edwards, Houston, Tex.; Frances Robertha Edwards executrix of said Charles R. Edwards, deceased

Original application May 13, 1940, Serial No. 334,947. Divided and this application June 5, 1945, Serial No. 597,705

12 Claims. (Cl. 255—35)

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This invention relates to new and useful improvements in means for recovering elements from well bores.

In the well art, it is well known that in the drilling and completion of wells, pipe, in one form or another, is substantially at all times extending into the well bore. During the actual drilling, the drill stem or pipe, which is made up of sections connected by coupling collars, has the drill bit mounted on its lower end and is rotatable so as to rotate the bit and perform the drilling operation. After the well is drilled in, well tubing and casing are disposed within the well bore and, of course, remain therein so long as the well is producing. The pipe extending into the well bore may separate, collapse or for other reasons, may fall downwardly in the bore to the bottom thereof; or the wall of the bore may cave in and firmly lodge the pipe, or a portion thereof, within the bore. When any of the foregoing occurs, it is necessary that the pipe be removed or "fished out" from the bore before the well operations may continue and manifestly, such removal, particularly where the pipe is firmly lodged or stuck within the bore, creates quite a problem.

It has been found that the lodging or sticking of the pipe usually occurs during the drilling operation and although the present means may be employed for recovering or removing tubing, casing, or other objects or elements from the bore, said means will be described in connection with removing a portion of drill pipe which has become lodged in the bore due to a cave-in of the formation.

The reason that drill pipe is more apt to become lodged or stuck in the bore is because said pipe is usually rotated within an open hole, that is, there is usually no casing or the like surrounding at least the lower portion of the pipe and due to deeper drilling in recent years, the uncased part of the hole may be several thousand feet. It has often been experienced that the walls of the bore crumble or cave in and often the cuttings, which are normally circulated to the surface, settle back, thereby clogging the bore and binding, lodging, or sticking the pipe. This is caused by various formations, some of which are unstable, through which the drill pipe or stem passes. In extremely sandy strata and in shale beds, the sand or shale may crumble and even heave upwardly in the bore so that the pipe will become wedged in the hole.

It is therefore, one object of this invention to provide an improved means for recovering and removing pipe, tubing, casing and other objects

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which may have become lodged, or which may have fallen downwardly, within a well bore.

Still another object of the invention is to provide an improved means which includes, a suitable tool adapted to be lowered into the well bore, and connected to the lodged pipe through a rotative or other movement, after which the tool is rotated to impart a reverse rotation to the upper end of the pipe to uncouple a portion of the pipe from the remainder, whereby said uncoupled portion may be removed.

An important object of the invention is to provide a new and improved reversing tool for removing stuck pipe from a well bore, wherein a reverse rotation is produced at the bottom thereof.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Fig. 1 is a view, partly in elevation and partly in section, of the upper portion of a reversing tool constructed in accordance with the invention,

Fig. 2 is a vertical view, partly in elevation and partly in section of the central portion of the device shown in Fig. 1,

Fig. 3 is a vertical view, partly in elevation and partly in section of the lower portion of the device shown in Figs. 1 and 2.

Fig. 4 is an enlarged sectional view with parts omitted, taken on line 4—4 of Fig. 11,

Fig. 5 is a horizontal cross-sectional view taken on the line 5—5 of Fig. 3,

Fig. 6 is a horizontal cross-sectional view taken on the line 6—6 of Fig. 1,

Fig. 7 is a horizontal cross-sectional view taken on the line 7—7 of Fig. 1,

Fig. 8 is a horizontal cross-sectional view taken on the line 8—8 of Fig. 1,

Fig. 9 is a horizontal cross-sectional view taken on the line 9—9 of Fig. 1,

Fig. 10 is a horizontal cross-sectional view taken on the line 10—10 of Fig. 2,

Fig. 11 is a horizontal cross-sectional view taken on the line 11—11 of Fig. 2,

Fig. 12 is an enlarged view in elevation, of the anchor clutch of said device,

Fig. 13 is a partial perspective view of one of the pinion supporting blocks.

Often it is desirable to obtain a left-hand motion at the top of a piece of stuck pipe. For this

purpose, I have provided what is commonly called a "reversing tool," the upper end of which is turned to the right to produce a left-hand rotation at the lower end of said tool.

The reversing tool includes three main members: one, a driving member, or a driver which usually rotates in a clockwise direction; two, a holding or stationary member called the "anchoring member," or the "anchor"; and three, a turning member for rotating in a counterclockwise direction, called the "driven member" or the "reverse." While these three parts are present in most all reversing tools, a locking member called the "lock" is also a very desirable member in any reversing tool which is used to recover pipe and the like from well bores. Another useful member is one for storing and supplying lubricant under pressure to the bearing surfaces; this member is called the "lubricator." Still another very useful member is an anchor control used to control the position of the anchor engagement means.

The reversing tool consists of a plurality of sectional housings, the uppermost housing being formed to provide a nipple 127 which has its uppermost end externally screw-threaded so that an ordinary drill pipe 128 may be connected thereto. The nipple 127 has its outside diameter reduced so as to fit the ordinary elevators and rotary slips as are used to handle the string of pipe on the rig. The lower end of the nipple 127 is reduced and provided with screw-threads 129. A gland 131 is provided below the upper end of the housing 130, and said housing is screw-threaded to receive said gland. The gland 131 acts to retain a lubricant. As can be seen in the drawings (Fig. 1), a space is provided between the upper edge of the gland 131 and the lower exposed end of the nipple 127, thereby forming a chamber. Slidable in said chamber is a piston 132 which is provided with a plurality of packing rings 133 on its periphery. Screwed into the threads 134 is an elongated tubular pipe 135 which extends downwardly substantially the length of the tool, and which will be hereinafter explained. The gland 131 has its inner bore enlarged so as to receive a packing ring 136 and a retainer nut 137. Said packing ring 136 packs off between the gland 131 and the tubular pipe 135.

Below the gland 131, the housing 130 is provided with a hexagonal opening 138 (Fig. 6) which receives a double hexagonal lock ring 139 and also the upper end of an elongated mandrel 140, which latter member is formed with a hexagon upper end to fit inside of the double hexagon member 139. The object of these hexagonal parts is to lock the housing 130 securely to the mandrel 140 so as to prevent relative rotation between these parts. Below said hexagon-shaped portion of the mandrel 140, said mandrel is externally screw-threaded so that it may be attached to the housing 130. It is pointed out that the housing 130 is provided with a plurality of ports 141 located above the gland 131 and below the piston 132, which will be hereinafter explained. The double hexagonal lock ring 139 is provided with a plurality of screw-threaded openings 142 for the purpose of removing said ring. The mandrel 140 extends downwardly a considerable distance towards the bottom of the tool. The lowermost end of the housing 130 has its bore enlarged, and is internally screw-threaded at 143. Adjustably attached to the screw-threaded portion 143 is a friction clutch housing 144, which has its upper end slidably engaging the driving mandrel 140. The bore of said housing is enlarged so as to receive a plurality of frictional spring clutches 145.

A sleeve 146 (Figs. 1 and 7) rotatably surrounds the driving mandrel 140, and is provided with a pair of diametrically-opposite elongated slots 147. A plurality of split friction clutch springs 145 surround the member 146 and are provided with inwardly extending ears 149 on each of the exposed ends so as to form self-de-energizing clutches. Said ears extend into one of the slots 147. As the housing 130 and friction clutch housing 144 are rotated, the spring clutches 145 will frictionally engage the inner surface of the clutch housing 144, thereby rotating the sleeve 146. Said sleeve is provided with a plurality of teeth 150 on its lower periphery so as to form the center gear of a reverse motion gearing assembly, Fig. 8. Said teeth mesh with the teeth of a plurality of circumferentially spaced pinions 151. A plurality of bearing or thrust rings 152 are confined between a shoulder on the clutch housing 144 and the pinion bearing block 156. It is to be noted that said housing terminates above said gears. A packing retainer ring 153 surrounds the lowermost bearing ring and abuts the inner circumference of the lowermost end of the clutch housing 144. Said ring is provided with a packing ring 154 so as to prevent the passage of fluid therethrough. The retainer ring 153 has its lower end externally screw-threaded and attached to the upper end of the housing 155. The pinions 151 are provided with an upper bearing block 156 which is firmly secured to a lower bearing formed in the upper end of the hollow anchor body 157 that carries the pinions 151, so that a counterclockwise rotation may be transmitted to the housing 155 from the clockwise rotation of the friction-driven gear 150. For the purpose of assembly, the inner housing 160 is split longitudinally so as to permit assembly around two circular recesses on the anchor body 157. Each of said pinions 151 has a central axle 158 which rides in bearings in parts 156 and 157. Located near the upper end of the housing 155 is an internal gear 159; this, together with the gear 150 and the pinions 151, completes the reverse motion gearing assembly and which with the clutch forms the control for the anchor means.

The object of the anchor control is to provide a means for operating the holding means, and for maintaining operative contact, with the inner surface of a tubing or casing in a well bore, or the walls of a well bore, and for disengaging the holding means from such contact.

The lower ends of the housing 155 and the ring 160 are provided with recesses to rotatively receive the upstanding bosses 161 that are formed on the upper ends of the roller retainers 162. The roller retainers or wings 162 are arcuate in cross-section, (see Fig. 9) and have vertical pockets so that a roller 164 may be received in each of said pockets. Said rollers are placed in the pockets from the inside, and the outer portion of the opening of each of said pockets is reduced so as to prevent the rollers 164 from passing therethrough, but will allow a portion of said rollers to project beyond the outer surface of the retainers 162. The roller retainers 162 are pivoted on the pins 161, and each of said roller retainers has its unattached edge 163 free to swing and carrying a roller 164. The rollers 164 are free to rotate in said roller retainers, but cannot escape outwardly therefrom. Confined within the wings 162, and formed on the sleeve 157, are a plurality of cams 165, said cams being cut inwardly at 166

so as to receive the rollers within the circumference of the tool. Thus, when said rollers are in the grooves 166, they will not engage the casing surrounding said device; but, as they are moved up the inclined surface 165, they will begin to engage said casing until they have finally become wedged and will not rotate further, nor can the anchor 157 be rotated. The tool is now anchored against rotation of the holding means.

Lying between the cams 165 (see Fig. 12) is an outwardly-extending circular ring 168, which is also provided on the sleeve 157. Said ring is provided with a plurality of undercut grooves 169, formed parallel with the faces of the cams 165 and which receive flanges 170. Said flanges are provided on the inner surfaces of the roller retainer wings 162, and are located near the unattached edges 163 thereof. Thus, by the engagement of the flanges 170 in the grooves 169, the outer ends of said wings are prevented from swinging outwardly; this also acts to keep the rollers 164 in their respective pockets. The flanges 170 are free to slide in said grooves, and will move along with the wings and the rollers. It is to be observed that a portion of the outer surface of said rollers is knurled, thus providing a gripping surface for said rollers. Pins 171, similar to the pins 161, are provided at the lower end of the roller retainers or wings 162, and engage within openings 172 in a supporting block ring 173, which block is free to rotate as the wings move and for purpose of easy assembly is radially split. The sleeve 157 depends downwardly past the roller retainers or wings 162 and ring 173, and has its lower end enlarged and tapered inwardly to form a spline connection 174 which engages with a complementary spline in a corresponding opening in a pinion block 175. The upper end of the block 175 is terminated short of block 173. Confined between the block 173 and the block 175 is an upper junk ring 176 and a lower junk ring 177, so as to confine a packing ring 178 that lies between the two junk rings. The junk rings 176 and 177, and also the block 173, are separated vertically into sections so as to permit easy assembly. The sections of the block 173 are held rigidly together with cross-screws (not shown) in a well known manner for similar parts. The upper junk ring 176 is circumferentially cut so as to receive a flange 179 which is screw-threadedly attached to a small housing 180*a* connected to the upper end of the elongated housing 180. The flange 179 will ride on the ring 176, and its upper surface is rotatably confined by the block 173 (Fig. 2).

It will be noted that the driving mandrel 140 continues through a section of the tool shown in Fig. 2, as does the inner pipe 135. Operatively confined between the mandrel 140 and the housing 180 is a series of circumferentially spaced pinions 181 (see Figs. 4 and 11). Said pinions are supported by axles 182 which have their exposed ends confined in recesses formed in the lower and upper sides of a series of spacer blocks 183 (see Fig. 13) that support the axles and space the gears apart. The mandrel 140 is provided with a plurality of teeth, so as to form the elongated external gear 185, which meshes with the pinions 181. A plurality of retaining pins 186 are inserted in the spacer blocks 183 and contact the axles 182, thereby preventing said axles from rotating and allowing the gears to rotate on said axles. It will be noted that the upper pinion block A (Fig. 4) is vertically shorter than the upper pinion block 175 (Fig. 2). This is for the purpose of allowing the pinions 181, or a new set of pinions 181, to be moved up and down along the mandrel gear 185 and the internal gear 184 so that the teeth on the mandrel and in the internal gear, when a portion of them are worn, may be further utilized in unworn sections by moving the gears upwardly; whereby the member 175 (Fig. 2) will have to be shortened and a larger spacer block E below the last gear inserted thus, fully utilizing the entire length of the teeth of both the mandrel and the housing to their fullest extent. Obviously if the pinion blocks A and E are utilized first, then the block 175 will be substituted therefor and the pinions 181 moved downwardly to engage unworn sections of the teeth on the mandrel and in the internal gear.

The housing 180, below the last spacer block E, has its inner diameter slightly reduced and internally screw-threaded (see Fig. 3). Attached to the lower end of said housing by said threads is a radially split thrust nut or supporting rind 187 which is provided with a plurality of inwardly-extending thrust flanges 188. Said flanges are provided with a plurality of lubricant openings 189. The lower portion of the mandrel 140 is provided with a plurality of outwardly extending thrust flanges 190 which are provided with a plurality of lubricant openings 191. Lying between the flanges 188 and 190 are a plurality of radially split thrust rings 192, forming an anti-friction thrust bearing. The lowermost end of the mandrel 140 is provided with an enlarged foot 193, said foot being provided with a plurality of enlarged openings 194. The lowermost end of the ring 187 is provided with a corresponding opening 195, whereby a rod or other similar article may be inserted therein so as to unscrew the member 187 from the housing 180. The lowermost end of the pipe 135 is externally screw-threaded to receive a cross-lock key 196. Said lock key has an axial bore therethrough, the upper portion 197 of which is internally screw-threaded, as well as the lower portion.

Screwed into the lower portion of the lock key 196 is a tail pipe 198, which extends substantially to the bottom of the tool so as to carry the wash fluid through the tool. The lock key 196 has provided on its outer periphery a plurality of cross-locking arms 199 (see Fig. 5) which ordinarily lie in grooves 199' extending out from the central bore in the circular foot 193 of the driving mandrel 140. The lower portion of said lock key is formed to provide a circular collar 200. The lower portion 201 of the housing 180 is internally screw-threaded to receive an externally screw-threaded tap 202 of the lubricator body 203. The uppermost portion of the tap 202 of the body 203 is provided with an inwardly-extending flange 204, whose upper surface rotatably abuts the lower surface of the foot 193 of the mandrel 140, and also surrounds the circular collar 200 of the lock key 196. However, the flange 204 is provided with cross-keyway openings for alinement and similar to, but shallower than, the openings in the member 193 to receive only a part of the cross locking arms 199 of the lock key, 196. Thus, when the pipe 135 is moved downwardly, the lock key 196 will also be moved downwardly, and the locking arms 199 will move a part of the way into the cross-keyway openings (not shown) of the flange 204, thereby rotatably interlocking the flange 204 and the lubricator body 203 to rotate with the driving mandrel 140. The portion 201 of the housing 180 and the tap 202 of the member 203 are

locked together by a lock screw 205, thereby preventing their disengagement.

The lubricator body 203 is provided with an opening 206. Communicating with the interior of said body, and insertable in said screw-threaded opening, is a conventional check valve connection 207 for filling the lubricator chamber. Below the opening 206 is an inspection plug 208, the purpose of which is to observe if the lubricator chamber is full. The lowermost end of the body 203 is provided with internal screw threads 209 into which there may be connected a grapple, a tap, or other suitable fishing tool, such as a spear or an overshot. A keyway is provided in the threads 209 so as to prevent unscrewing by the use of a key (not shown). At the upper end of said screw-threaded portion, there is provided a collar 210 which is screwed into said threads and surrounds the lower end of the pipe 198.

Underlying the flange 204 and the collar 200 is a retainer washer 211. Slidable within the body 203, and surrounding the pipe 198, is a lubrication piston 212 which has a central vertical body 213 and also a flange 214 on its lower end which slidably engages the inner surface of the body 203. The vertical portion 213 does not contact with the pipe 198 or the body 203, however the upper end of the body 213 is provided with a fluid-packed, inwardly-extending flange 215 which slidably engages the pipe 198 so as to prevent fluid from escaping around said piston.

Above the flange 214, and engaging screw-threads 216 of the body 203, is a supporting ring 217 which is provided with a plurality of ports 218. Confined between the retainer ring 211 and the retainer nut 216 is a coil spring 219 which urges the retainer ring 211 upwardly. Surrounding the pipe 198, and confined between the flange 215 and the collar 210, is an elongated coil spring 220 which acts to urge said piston upwardly so as to supply lubricant to all the operative bearings in the entire tool.

In operation, a suitable lubricant is forced through the connection 207 and flows inwardly down through the ports 218, and forces the flange 214 of the piston 212 downwardly. The plug 208 is removed and when said flange can be seen through the port 208, the operator then knows that the lubricating chamber is full. Obviously, the spring 220 will be depressed and will maintain an upward pressure on the piston 212, and, as the lubricant is forced out of the lubricating chamber, the spring will move the piston upwardly. The lubricant is free to flow upwardly around the spring 219, up through cross-keyways, in the flange 204 around the retainer ring 211, and around the cross-lock key 196, upwardly to all parts of the device. It is also free to flow up through the opening 194 to the thrust bearing 192, and upwardly through the openings 189 and 191. Thus the device is completely lubricated by pressure lubricant at all times.

The method of operation of the reversing tool is to attach to its lower end a suitable fishing tool and to place a key in the threads 209. The tubing or drill stem 128 is attached to the upper end of the tool 127. When the fish or stuck pipe is engaged by the above described fishing tool (which may be a left hand tap, a spear, an overshot, or other grapple) in such manner as to exert a holding action so as to tend to prevent rotation of the part 203 and of the internal gear 180, the pipe 128 is rotated to the right, thus rotating the mandrel, including the member 127 and the housing 130. As the housing 130 is rotated, the nut 131, the double hex 139 the pipe 135, and the mandrel 140 will also rotate as a unit to the right. The lower end of the housing 130 is securely connected to the friction clutch housing 144 which will frictionally engage the clutches 145. Said clutches will rotate the gear sleeve 146, and, in turn, the gear teeth on the lower end of said sleeve will reversely rotate the gears 151. Said gears will rotate the housing 155 to the left, thereby moving the rollers 164 up the inclined surface of the cams 165 wedging said rollers between the inclined surface of the cams and a casing (not shown), which will hold the holding means of said device firmly against rotation within the well. The mandrel 140 will continue to rotate and the friction clutches 148 will slip on the housing 144, thus tending to continuously force the rollers further out along the cams 165 and thus securely anchoring the tool, but still allowing the inner driving mandrel 140 to rotate. Said mandrel will rotate the gears 181 counterclockwise and thereby rotate the outer housing 180 counterclockwise. This counterclockwise rotation will in turn be transmitted downwardly so as to unscrew one of the right-hand threads in the fish or stuck pipe below the tool. After the fish is separated into two sections, the unscrewed section can, if free, be withdrawn from the bore along with the tool. However, it is the practice to slightly rotate the pipe 128 and the driving mandrel 140 a little to the left so as to completely release the cams 165 from the inside of the casing or stuck pipe before pulling out with the tool and the released section of the fish. At times circulation is of service, the circulation fluid being passed through the pipes 135 and 198. These operations are repeated to suit the operator.

Long and continuous rotation will wear the teeth on the driving mandrel and in the driven housing; and in order to continuously use the device without complete disassembly, the gears 181 may be moved upwardly, as above indicated, a spacer block E placed under the lowermost block D, and the relatively short member A substituted for the member 175, as is shown in Fig. 4, thereby making the device adjustable. As is clearly illustrated in Fig. 4, the axial extent of the pinions 181 is decreased from the bottom to the top of the gear assembly. The axial length of the member D is substantially equal to the corresponding length of the lowermost and longest pinion 181 and the members B and C are substantially equal in length and are slightly longer than the axial length of the longest pinion 181. Hence it is obvious that when the pinions 181 are moved upwardly, unworn sections of the teeth on the mandrel gear 185 and the internal gear 184 are engaged thereby. However, the pinions and pinion axles will often become worn, and in this case these small inexpensive parts will be renewed and the very expensive, long gears will be the same as new at the new locations of the pinions.

The outer housing 180 will rotate, as hereinbefore described, and will impart such rotation to the body 203, the bottom of said body rotating the fishing tool attached thereto. The lower portion of the mandrel 140, through the flanges 190, will ride on the thrust rings 192, thereby supporting said mandrel. Thus, by a clockwise rotation at the top of said device, the operator is able to obtain a counterclockwise rotation at the bottom of the device, and at all times the spring 220 is pressed upwardly against the piston 212, and is

forcing lubricating fluid up through said structure.

As is indicated in Figs. 2, 11 and 13, it will be seen that the pinion pockets 183a are not each formed in its entirety in the end of any one of the pinion supporting blocks 183. This is also an important feature of the invention. As can be seen, if these pockets 183a where, as is the usual practice, formed in their entirety in the end of a single section of the pinion block 183, then the strength of the upstanding or downwardly-directed parts of the blocks 183 which are circumferentially located between the pinions 181, would be only about one half as great as if the joint was located as shown in Fig. 4.

However, it has been found in practice that with these pockets cut in both sections, even then in many cases there is such excessive deflections of these parts that the load wear is increased on the upper ends of the pinions and gears. In order to overcome this last condition, a new and useful improvement has been made by further shortening the depth of these pinion pockets by multiple decking of these pinions, and at the same time greatly lengthening the initial pinion tooth length, which is done by making said pinions much longer and then cutting each pinion up into short lengths. It will also be observed that the upper sections of these pinions have been cut shorter than the lower sections, the purpose being to shorten still further the length of the upstanding portion and downwardly extending beams between the upper section of these pinions where the load is the greatest. It is believed that that this is a novel construction, and, in practice, it is being found to be very useful where space prevents enlarging the size of the parts.

It is apparent that the total beam deflection with the old and usual construction, and with the pinions having equal total gear teeth, length, and load, is approximately several hundred times as great as is the beam deflection for the type of construction herein shown with similar total gear teeth, length, and load. This is the case without allowing for the great advantages obtained by having very short pinion axles 182, as in the present construction, over the long springy axles of equal total length in the usual construction now in use throughout many industries.

The gear block or gear assembly, shown most clearly in Fig. 4, comprises the annular members A, B, C, D and E and, of course, the pinions 181. The spacer block A is located immediately within the housing 180a. This spacer block is interchangeable with the vertically longer spacer block 175 shown in Fig. 2 when it is desired to vary the positions of the pinion 181 with respect to the gear 185. The pinion supporting block B extends around the interior of the housing 180 and is complementary to the pinion supporting block C which is partially shown in Fig. 13. The lowermost pinion supporting block D is similar to pinion supporting block C but is of slightly smaller axial extent in order to accommodate a larger pinion. The spacer block E forms the support for the various other blocks just enumerated. The entire assembly is maintained as a rigid unit by means of bolts 183' shown in Fig. 11 which extend upwardly into screw threaded recesses (not shown) in block A. These bolts are seated in counter-sunk recesses (not shown) in lower spacer block E and are threaded so that nuts may be engaged thereon to firmly unite all of the parts into a rigid assembly. One advantage of this is that the gear block can be moved as a unit and another advantage is that the pinions 181 are designed to bear against the vertical arcuate surfaces in the pockets 183a so as to lend support to the pinions during rotation in view of the tremendous stresses involved.

In the event the operator is desirous of releasing the fish, or for any other reason is desirous of obtaining a clockwise rotation at the bottom of the tool, he releases the anchor by a slight left-hand turn and builds a fluid pressure within the tool with the pumps; said pump pressure will act on the upper surface of the piston 132, moving said piston downwardly. As said piston is moved downwardly, the pipe 135 will also be moved downwardly, and the lower end of the pipe being connected to the lock key 196 said lock key will move down, depressing the retainer ring 211 and the spring 219. The cross arms 199 of said key will move down into the openings in the flange 204, thereby the body portion 203 must rotate with the pipe 135 and the driving mandrel 140. When the pump pressure is released from the piston 132, the spring 219 will move the retainer ring 211 upwardly, thereby moving the lock key 196 upwardly and also the pipe 135, whereby the device will be unlocked and will resume its original position. Movement of the piston 132 is facilitated by the openings 141 which function as breather openings.

It will be noted from the foregoing description that I have provided a reversing tool which may be easily operated within a well bore and which is provided with means to transmit the enormous strains normally encountered in uncoupling stuck pipe in a well. It will also be observed that I have provided means to lock the upper clockwise rotating housing to the lower counterclockwise rotating housing, this means being operated by fluid pressure of the circulating fluid. It is merely necessary to increase the pump pressure in order to engage both housings to rotate the same as a unit.

In addition to the foregoing it will be noted that the locking means also seals the various moving parts from the circulating fluid within the bore of the operating string. Fluid from without the tool is prevented from entering the various chambers containing the operating parts by packings.

The gearing used to transmit force from the driving mandrel 140 to the reverse housing is formed as a compact unit and has many advantages. For example, it can be removed as a unit and in addition, the pinions 181 which are supported by and bear against pockets 183a are capable of withstanding excessive strains since the pockets in combination with the gear on mandrel 140 and internal gear 184 on the reverse housing 180 support each of the pinions 181 throughout practically all of their circumferential extension. Finally, as stated above, by interchanging spacer blocks A and E of Fig 4, for block 175 of Fig. 2 the pinion 181 may be caused to contact different tooth surfaces on the sun gear and the internal gear.

This application is a division of my co-pending application, Serial No. 334,947, filed May 13, 1940, for Methods of and means for recovering elements from well bores, now matured into Patent No. 2,394,759, of February 12, 1946.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the

equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A reversing tool adapted to unscrew pipe in a well, said tool comprising a member rotatable in one direction, a second rotatable member and means to rotate said second rotatable member in a reverse direction to that of said first rotatable member, said members each including elongated teeth said means being actuated by rotation of said first member and including a plurality of superposed series of pinions in engagement with the gear teeth of each of said members, superposed pinion blocks supporting said series of pinions, means rotatably mounting said pinions of each said series in two adjacent pinion blocks, and an anchoring member supporting said pinion blocks and having externally expanding holding means.

2. A reversing tool adapted to unscrew pipe in a well, said tool comprising a member rotatable in one direction, a second rotatable member and means to rotate said second rotatable member in a reverse direction to that of said first rotatable member, said members each including elongated gear teeth said means being actuated by rotation of said first member and including a plurality of superposed series of pinions in engagement with the gear teeth of each of said members, superposed pinion blocks supporting said series of pinions, means rotatably mounting said pinions of each said series in two adjacent pinion blocks, and an anchoring member supporting said pinion blocks and having externally expanding holding means, said tool including a friction clutch connecting said first named rotatable member and said anchoring member for actuating said expanding holding means.

3. A reversing tool adapted to unscrew pipe in a well, said tool comprising a member rotatable in one direction, a second rotatable member and means to rotate said second rotatable member in a reverse direction to that of said first rotatable member, said members each including elongated gear teeth said means being actuated by rotation of said first member and including a plurality of superposed series of pinions in engagement with the gear teeth of each of said members, superposed pinion blocks supporting said pinions, complemental recesses in adjacent pinion blocks, and means rotatably mounting said pinions of each said series in the complemental recesses in two adjacent pinion blocks.

4. A reversing tool comprising an upper rotatable member, members each including elongated gear teeth, means connecting said rotatable members including a plurality of superposed series of pinions in engagement with the gear teeth of each of said rotatable members, superposed pinion blocks supporting said series of pinions, and means rotatably mounting said pinions of each said series in two adjacent pinion blocks, said anchoring member supporting said pinion blocks.

5. A reversing tool comprising an upper rotatable member, an anchoring member and a lower rotatable member, said rotatable members being connected by gearing, said anchoring member including a cam and roller, and means for actuating said cam to force said roller outwardly beyond the periphery of said anchoring member to engage a surface surrounding said tool.

6. A reversing tool comprising an upper rotatable housing, an intermediate rotatable housing and a lower rotatable housing, said intermediate housing being provided with holding means adapted to engage a surface surrounding the tool and to hold the intermediate housing stationary and means connecting said three housings whereby rotary movement of the upper housing produces reverse rotary movement of the lower housing, said intermediate housing containing a cam member, a wing pivoted to said intermediate housing, said wing rotatably mounting a contact roller and means actuating said cam to move said wing and roller outwardly.

7. A reversing tool adapted to unscrew pipe in a well bore, said tool comprising a rotatable member including an elongated mandrel, an anchoring means, a rotatable housing, said anchoring means including a tubular actuating member surrounding said mandrel, and a slip clutch connected to one of said members and in frictional contact with the other of said members whereby rotation of said first named member is permitted while said anchoring means remains stationary, said housing also surrounding said mandrel, and gearing connecting said housing to said mandrel whereby rotation of said first-named member produces reverse rotation of said housing, said gearing comprising superposed series of pinions and said pinions of one series varying in axial extent from the pinions of another series.

8. A reversing tool adapted to unscrew pipe in a well bore, said tool comprising a rotatable member including an elongated mandrel, an anchoring means, a rotatable housing, said anchoring means including a tubular actuating member surrounding said mandrel, and a slip clutch connected to one of said members and in frictional contact with the other of said members whereby rotation of said first named member is permitted while said anchoring means remains stationary, said housing also surrounding said mandrel, and gearing connecting said housing to said mandrel whereby rotation of said first-named member produces reverse rotation of said housing, said gearing comprising superposed series of pinions and said pinions of one series varying in axial extent from the pinions of another series, said pinions being rotatably supported by means connected to said anchoring means.

9. In a reversing tool, an inner tubular member, an outer tubular member, means connecting said inner and outer members for rotation relative to each other, said outer member including a portion extending below said inner member, a tubular pipe within said inner member and extending therebelow to form an annular lubricant storage chamber with the portion of said outer member extending below said inner member, an annular piston in said annular chamber, and means resiliently urging said piston upwardly to force lubricant between said members to lubricate said means.

10. In a reversing tool a tubular housing comprising three relatively rotatable sections, reverse drive gearing including a plurality of axially spaced series of circularly arranged pinions, one of said sections including a plurality of annular pinion blocks secured in abutting relationship and being of different length, said blocks being provided with longitudinal recesses for rotatably supporting said pinions, internal and external gears intermeshing with said pinions separately secured to the other two sections, said

gears having continuous teeth substantially longer than the over-all length of said pinions whereby upon interchange of said pinion blocks the pinions may be selectively shifted to mesh with unworn portions of said gears.

11. In a reversing tool, reverse drive gearing including a plurality of axially spaced series of circularly arranged pinions, a plurality of superposed annular pinion blocks secured in abutting relationship, said blocks being provided with upper and lower longitudinal recesses forming pockets for said pinions, and means rotatably supporting said pinions in said pockets.

12. A reversing tool adapted to unscrew pipe in a well bore, said tool comprising a rotatable member including an elongated mandrel, an anchoring means including externally expandable holding elements, means for expanding said holding elements, said anchoring means also including a tubular actuating member rotatably journaled on said mandrel, a driving connection from said tubular actuating member to said expanding means, and a split friction clutch spring connected to one of said members and in frictional contact with the other of said members whereby rotation of said first named member is permitted to continue after said holding elements have been expanded.

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