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B. ANDREWS

MAGNETIC SCREW

Filed May 4, 1925

Fig. 1.

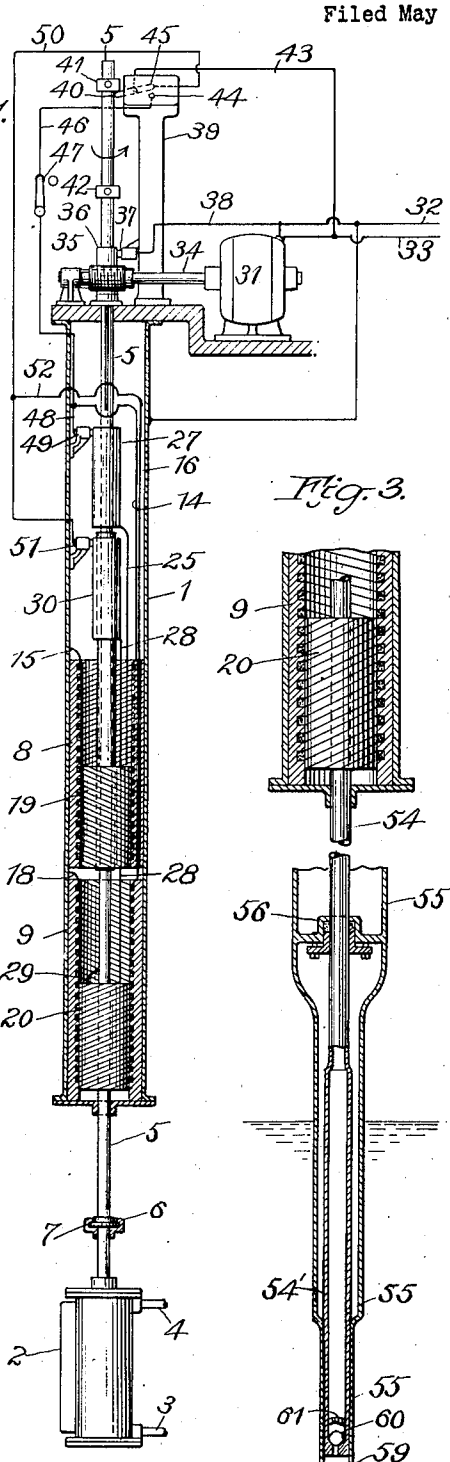
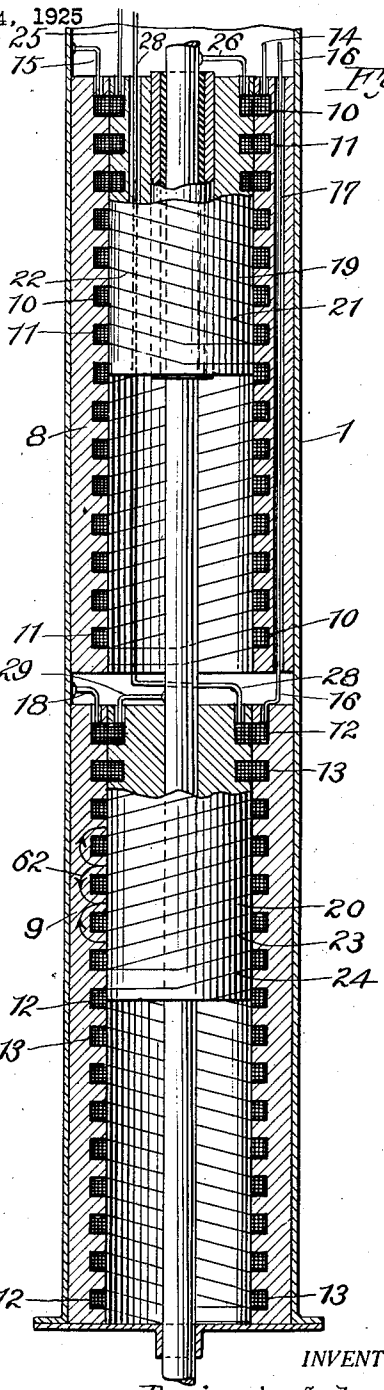


Fig. 3.

Fig. 2.



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HIS ATTORNEYS.

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UNITED STATES PATENT OFFICE.

BENJAMIN ANDREWS, OF HOUSTON, TEXAS.

MAGNETIC SCREW.

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To all whom it may concern:

Be it known that I, BENJAMIN ANDREWS, residing in Houston, county of Harris, State of Texas, have invented certain new and useful Improvements in Magnetic Screws, of which the following is a full, clear, concise, and exact description.

My invention relates to reciprocating devices which are controlled by a rotating member having helically arranged ribs similar to screw threads, but which are magnetized to form magnetic circuits with a similarly grooved stationary member whose threads are also magnetized to complete the magnetic circuit formed by the rotating member.

The main object of my invention is to produce a driving mechanism which, when operated to rotate the movable member, will cause a comparatively slow longitudinal movement of the driving member, but when the magnetism is discontinued by breaking the electric current, the discontinuance of the magnetization will allow the movable member to reciprocate freely, longitudinally. Such devices are applicable to various machines or apparatus where it is desired to produce the reciprocating motion through the rotation of the driving member, such as in the operation of pumps, hammers, drills, riveting appliances and so forth.

The magnetic screw is particularly adapted for the pumping of oil and similar liquids from driving wells when the pump is located at a considerable distance below the surface of the earth, and where it is necessary to supply the power for operating the pump from the surface of the ground. Under such conditions the magnetic screw driving mechanism may be lowered together with the pump through the well casing and operated at a point just above the liquid to be pumped from the well.

Various other applications of my improved magnetic screw will be apparent to those skilled in the art without specific reference thereto. A detailed description of two forms which I at present deem preferable is set forth in the following specification and accompanying drawings forming a part thereof, in which

Fig. 1 is a view in elevation of one form of my device showing the tubular casing therefor in cross section;

Fig. 2 is an enlarged view of the central portion of the device shown in Fig. 1; and

Fig. 3 is a cross-sectional view of a modified form of a device to which the screws may be applied.

Referring to the drawings, the numeral 1 indicates a casing which is adapted to contain the parts of the magnetic screw and a shaft or pipe communicating motion to the apparatus to be operated thereby. In the present instance, the numeral 2 indicates a pump provided with suitable inlet and outlet pipes 3 and 4. This is connected to the central operating rod or shaft 5 by means of a coupling 6 having a slip joint provided by a flange 7 which allows the shaft 5 to rotate without turning the plunger of the pump.

Referring now to Fig. 2, the numerals 8 and 9 indicate two sleeves of magnetic material, such as iron or steel, having formed therein two parallel helical grooves 10 and 11, and 12 and 13, respectively, the grooves in the sleeve 8 having a pitch opposite from the grooves in the sleeve 9. The windings in the groove 10 are connected with a lead 14 which passes downward through said groove to the bottom, whence they are then conducted to the groove 11, as indicated in Fig. 2 and pass upwardly through said groove until they emerge at the top as indicated by the conductor 15 in Fig. 2, said conductor being there grounded on the casing 1. Similarly, a conductor 16 passes through a hole 17 in the sleeve 8 and connects with the windings 12 in the sleeve 9. Said winding passes through said groove 12 until the bottom is reached whence the conductor is passed in to the the groove 13 and thence to the sleeve 9, whence it emerges as indicated at 18 where the conductor is grounded on the casing 1.

Adapted to reciprocate within the sleeves 8 and 9 are cylindrical cores 19 and 20 which have, respectively, pairs of grooves 21 and 22, and 23 and 24, also containing windings for magnetizing said cores. The windings in the grooves 21 and 22 are supplied with current through the conductor 25 in a similar manner to that previously described, the windings being connected together at the lower end of the cores so that the current passes downward through one groove and upward through the other. The conductor 25 is then grounded on the cen-

tral shaft 5, as indicated at 26. The conductor 25 is carried upward to an insulated sleeve 27. A conductor 28 passes through the core 19 and down to and into the core 20 where it connects with the windings in the groove 24. The windings 24 connect with the windings 23 at the bottom of the core 20, as indicated, and a conductor 29 emerges from the top of the core 20 and is connected with the central shaft 5. The conductor 28 is carried upward and connects with the insulated sleeve 30. Owing to the fact that the windings in successive grooves carry currents in opposite directions, the magnetic fields created thereby will be formed into closed circuits, half of which are in the sleeves and the other half of which are in the cores, as indicated in Fig. 2 at 62. Thus the magnetic circuits are made very short and will produce a strong attraction between the helical ribs formed on the sleeves and cores, respectively. When the central shaft is rotated causing the cores to rotate, this magnetic attraction will have the same effect as the engagement between interlocking threads of a screw and will cause the cores to move up and down according to the pitch of the ribs and the direction of rotation of the cores.

Referring now to the upper portion of Fig. 1, the numeral 31 indicates an electric motor or other guiding mechanism which in the case of a motor is supplied with current from the main leads 32 and 33. The motor shaft 34 carries a worm 35 which meshes with a corresponding worm wheel (not shown) on the shaft 5 to which it is slidably keyed. Thus the rotation of the shaft 34 will rotate the shaft 5 continuously in one direction which will be assumed to be the direction indicated by the arrow near the top of Fig. 1. The shaft 5 also has slidably carried thereon a contact ring 36, which is adapted to engage a brush or suitable contact 37. This contact is connected with one of the leads 32, as indicated by 38. On a suitable support 39 is carried a reversing switch 40 which is adapted to be operated by collars 41 and 42 on the shaft 5. The pivot of the switch 40 is connected with a lead 43 which is in turn connected with the main lead 33. The switch 40 is also provided with two contacts 44 and 45, the former of which is connected to lead 46 including a cut-out switch 47. The lead 46 is connected to the conductor 14 running to the winding of the upper sleeve 19 of the magnetic screw and also is provided with a branch conductor 48 running to the brush 49 in contact with the insulated sleeve 27. The contact 45 of the switch 40 is connected with a conductor 50 which runs to the brush 51 engaging the insulated sleeve 30, from which the conductor 28 runs to the windings in the core 20. A branch lead 52 connects with the lead 14 running to the windings in the sleeve 9. Thus the operation of this form of my device may be described as follows:

Assuming, as above stated, that the shaft 5 is turned in the direction of the arrow and that a contact has just been made at the point 45, the current will be conducted through the leads 33, 43 and 50 to the brush 51, sleeve 30, conductor 28, where it will pass through the windings of the core 20, emerge through the conductor 29, pass to the shaft 5, contact ring 36, brush 37, lead 38 and main supply lead 32. Thus said core 20 is energized. The branch 52 or the lead 50 conducts the current to the lead 16 which connects with the windings in the grooves 12 and 13 of the sleeve 9. From the windings of the sleeve it passes to the casing 1 at 18, through said casing to the conductor 53 by which it is connected to the main lead 32. Thus the grooved sleeve 9 and core 20 are energized. It being noted that the shaft is rotating in the direction of the arrow in Fig. 1, the core 20 will be correspondingly rotated which is in the same direction as when withdrawing a screw, as concerns the effect of the winding on the sleeve 9 and core 20, and, therefore, the core 11 and shaft 5 will be raised or drawn upward operating the pump 2 on an upward stroke. When the collar 42 comes in contact with the switch 40, said switch will engage the contact 44 thereby breaking the circuit in the sleeve 9 and core 20, but completing the circuit in the sleeve 8 and core 19, in which the grooves and windings are of opposite pitch from those in the sleeve 9 and core 20. Since the rotation of the shaft continues the same, as indicated by the arrow, the magnetic connection between the sleeve 8 and the core 19 will cause said core and shaft 5 to descend, thus causing the pump 2 to act on a downward stroke. At the end of the stroke the collar 41 again comes in contact with the switch arm 40 and the motion is reversed repeating the action first described. In the conductor 46 the switch 47 may be used to disconnect both the windings in the sleeve 8 and the core 9 from the source of supply of the electric current. When said switch is open, of course, the windings in said sleeve 8 and core 19 will become inactive, thus the rotation of the shaft 5 will cause the same to be raised when the windings in the sleeve 9 and core 20 are inactive, as indicated by the connection in Fig. 1. When the collar 42 strikes the switch arm 40 the current will be also disconnected from the windings in the sleeve 9 and the core 20, which will allow it to drop by gravity, thus producing a downward stroke of the pump more quickly than if released gradually, as above

described. This manner of operating the device may be used where a quick heavy blow or stroke is required instead of a steady reciprocating motion up and down.

Referring now to Fig. 3, the form of apparatus therein shown is similar to that of Fig. 1, except that the main shaft is made hollow and therefore constitutes a pipe 54 which passes through a casing 55 at the bottom of the well or projecting into a body of liquid to be pumped. The casing 55 is provided with a stuffing box 56 and at its extreme lower end with a check valve 57 of any suitable form, but in the present instance is shown as including a ball 58 which is retained in position by a web or retainer 59. The lower end of the pipe 54 is provided also with a check valve 60 and a retainer 61. The end of the pipe 54 makes a sliding contact with the lower end of the casing 55 and constitutes a plunger therein. It will thus be seen that when the pipe 54 is reciprocated by the core 20 and also by the core 19 connected as shown in Fig. 2, the lower end of the pipe 54 will act as a plunger of a pump and draw liquid into the casing 55 through which it passes to the valve 60 into the pipe 54, and thus upward to the surface of the ground or other point where the liquid is to be delivered.

It will thus be seen that I have produced a very efficient and simple apparatus for reciprocating two parts relatively to each other, and the principles involved in this device may be applied to a large number of uses, such as those above outlined.

What I claim and desire to protect by Letters Patent is:

1. In a device for producing a reciprocating motion, an inner cylindrical member having a pair of helical grooves therein, an outer cylindrical member enclosing said inner member and having internal helical grooves corresponding to those on the inner member, conductors located in one of said grooves to produce magnetization of opposite polarity on successive ribs between said grooves, and means for rotating one of said members relative to the other.

2. In a device for producing a reciprocating motion, an inner cylindrical member having a pair of helical grooves thereon, an outer cylindrical member enclosing said inner member and having internal helical grooves corresponding to those on said inner member, conductors located in the grooves in one of said members and connected to cause currents to flow in opposite direction in successive grooves, and means for rotating one of said members relative to the other.

3. A device for producing a reciprocating motion comprising an inner member having a pair of parallel helical grooves thereon, electric conductors contained in said grooves connected to carry the current in opposite directions in each of said grooves, an outer member having a similar pair of grooves, conductors contained therein and so connected as to carry the electric current in opposite directions therein whereby closed fields of force are successively produced in opposite directions between said grooves, and means for rotating one of said members relative to the other.

4. A device for producing a reciprocating motion comprising a plurality of inner rotatable members each having a pair of helical grooves therein, the grooves in adjacent members having opposite pitch, a rigid connection between said members, electric conductors in said grooves connected to carry current in opposite directions in adjacent grooves, a plurality of outer fixed members enclosing said inner members and provided with grooves and conductors corresponding to those in said inner members, means for rotating said inner members, suitable contacts for conducting electric current to said windings and switching mechanism for controlling the current in said windings through motion of said inner members.

Signed at Houston, Texas, this 28th day of April 1925.

BENJAMIN ANDREWS.