

May 17, 1927.

W. WERNER

MAGNETIC PUMP

Filed Sept. 5, 1925

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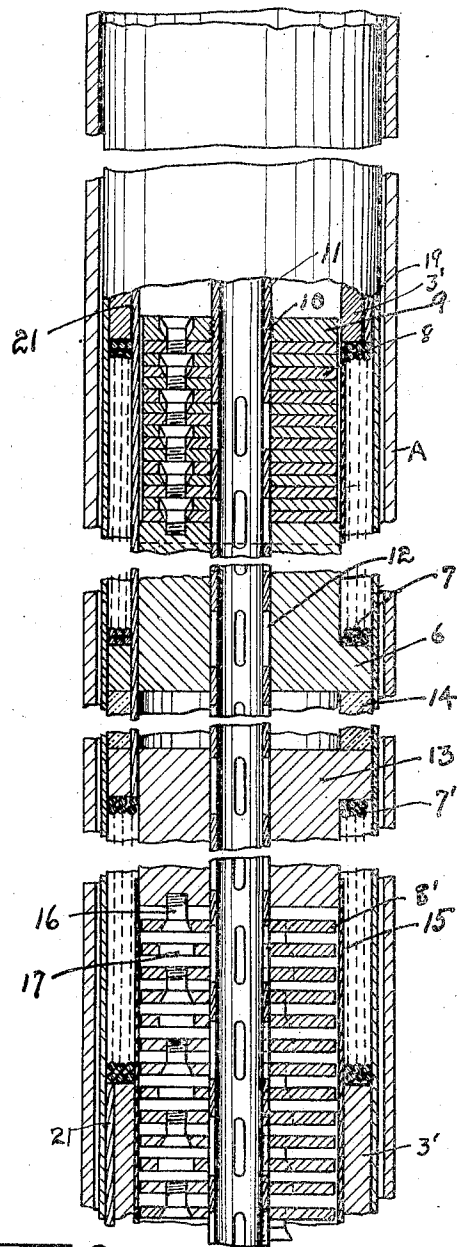
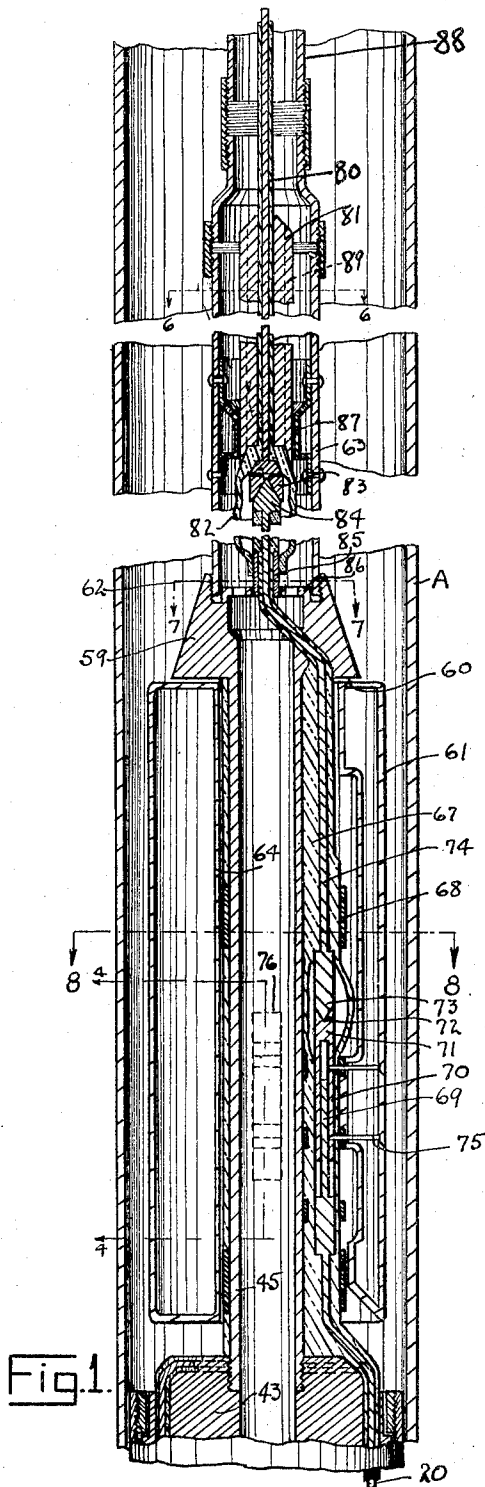


Fig. 2.

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May 17, 1927.

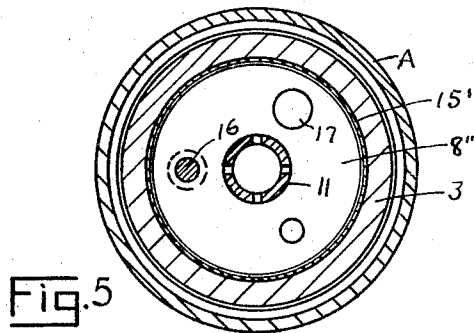
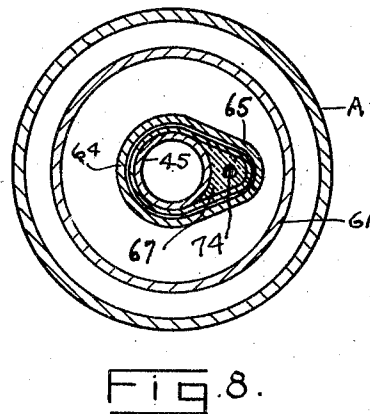
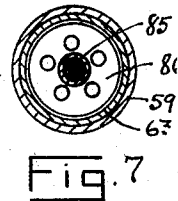
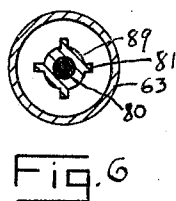
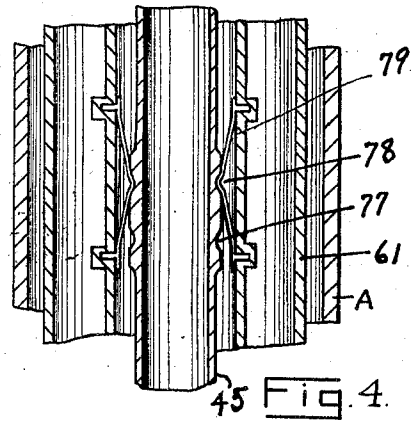
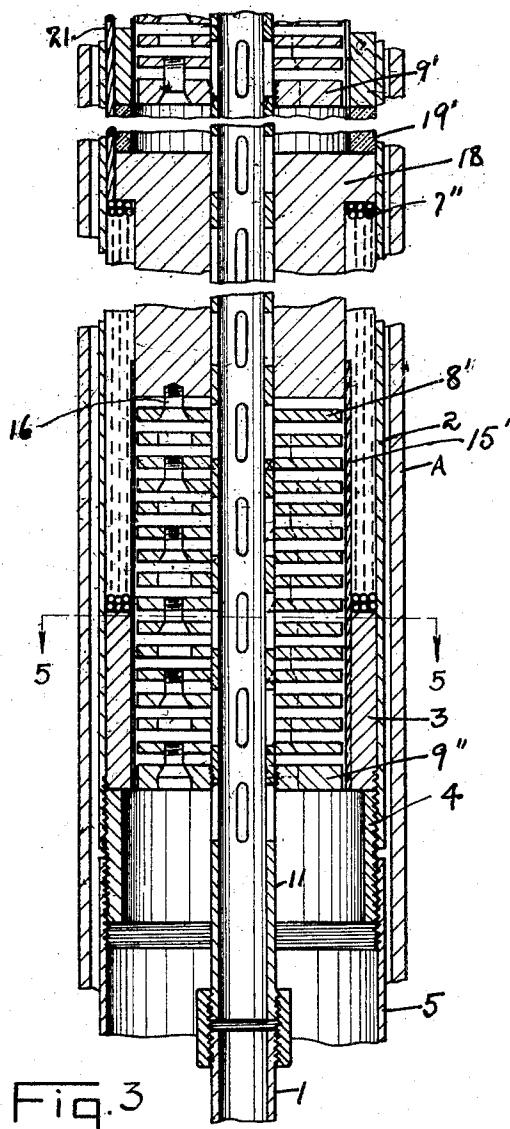
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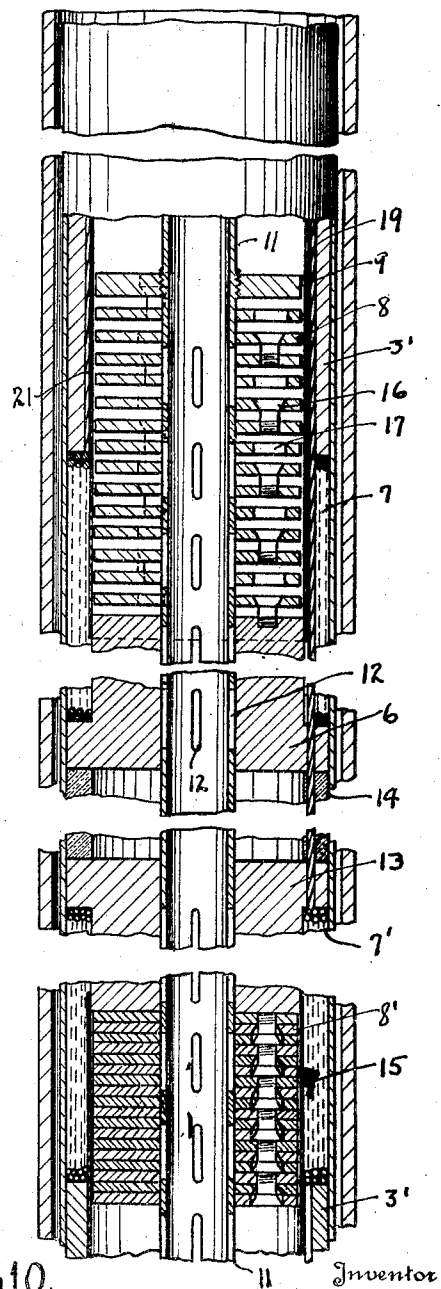
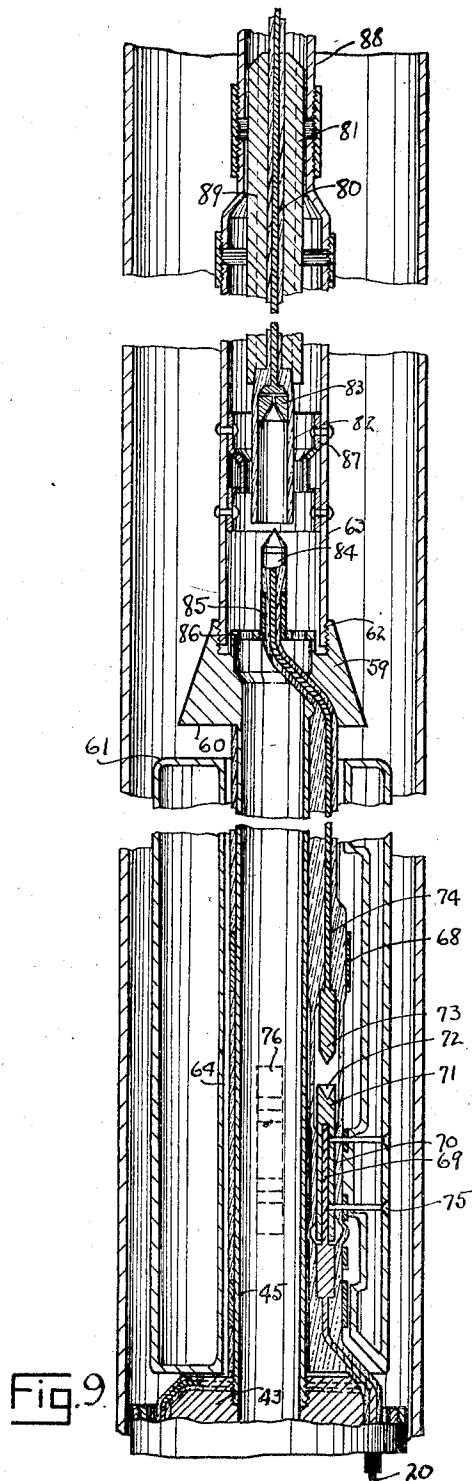


Fig. 10.

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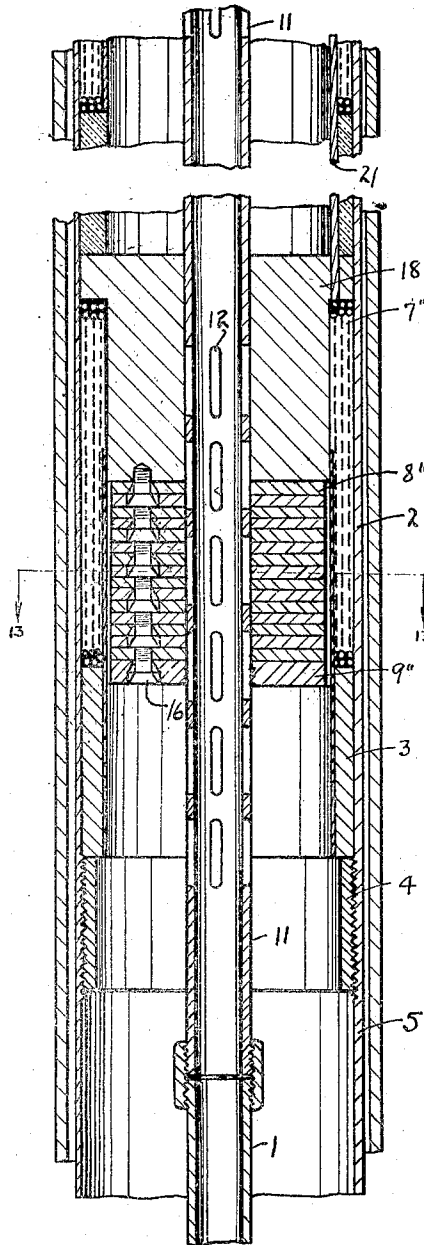


Fig. 11.

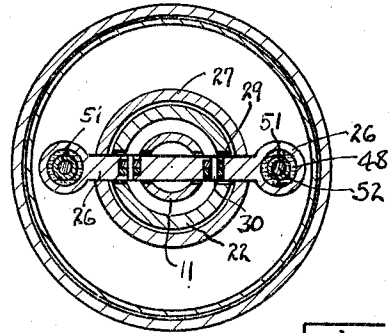


Fig. 12.

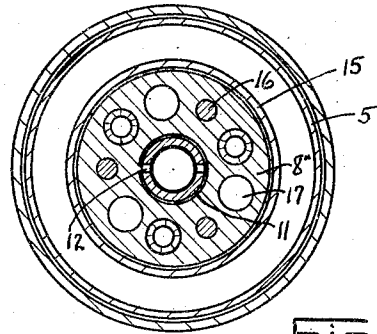


Fig. 13.

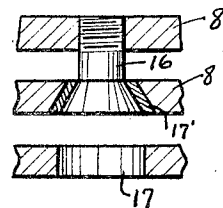


Fig. 14.

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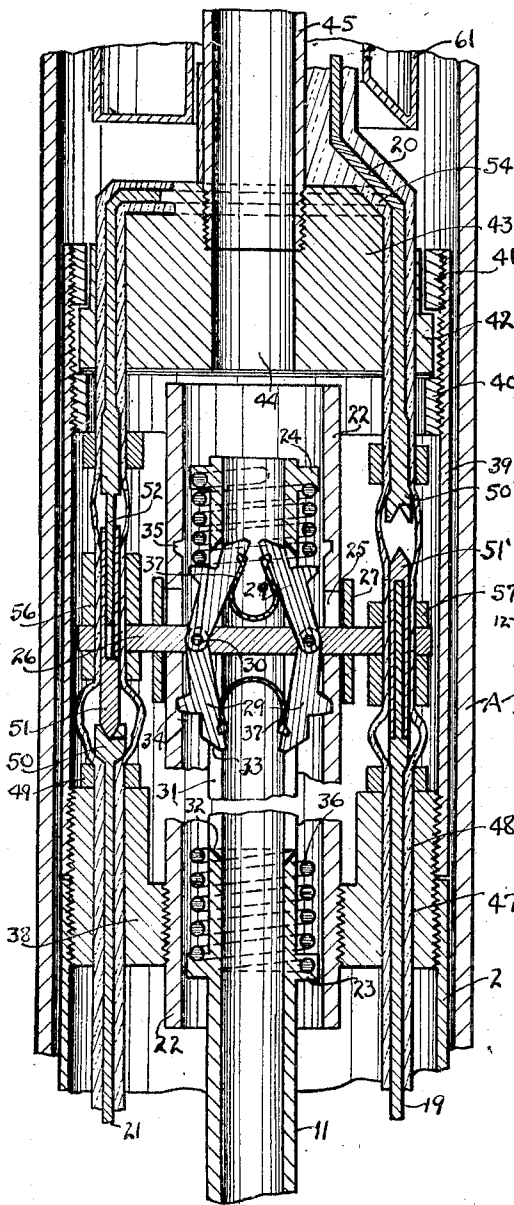


Fig. 15.

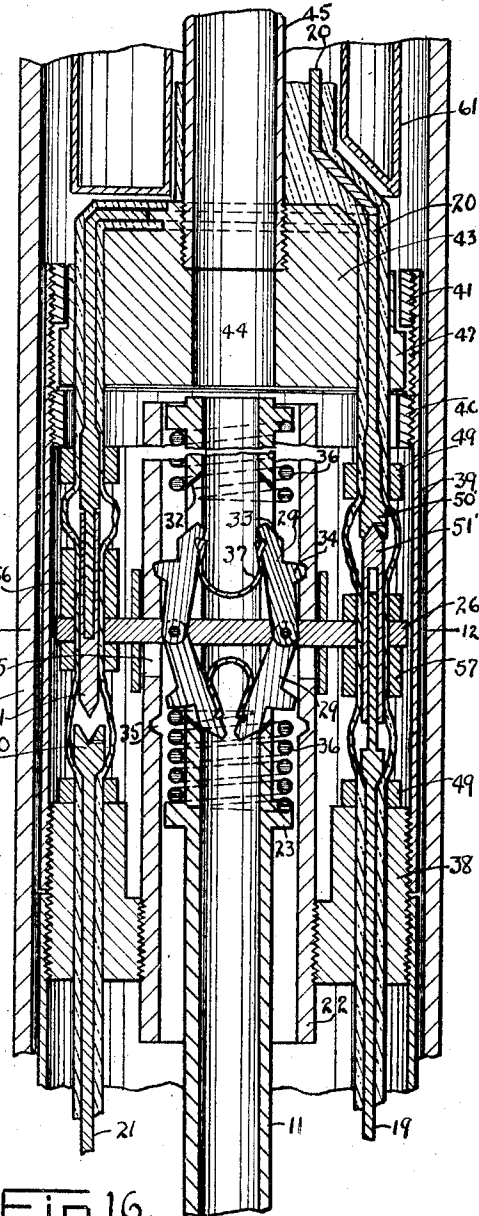


Fig. 16.

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UNITED STATES PATENT OFFICE.

WILLIAM WERNER, OF MEXIA, TEXAS.

MAGNETIC PUMP.

Application filed September 5, 1925. Serial No. 54,879.

My invention relates to means for operating a reciprocating pump in deep well pumping operations. It comprises a magnetically operated pump rod and the means by which the apparatus may be arranged in a well of small diameter, such as is found in oil well operations.

It is an object of the invention to use a magnetic lift for alternately raising and lowering a pump rod in the well, said device being constructed for operation adjacent a pump plunger and may even be submerged in the oil, or other fluid which is being pumped.

It is desired that the device be automatically operated so that it may cease operations when the oil level is below a certain predetermined point in the well, and to automatically start again when the oil has accumulated in the well to the desired point.

The invention lies largely in the particular construction and arrangement of the parts whereby the reciprocation of the pump rod is accomplished through an electromagnetic device and whereby the starting and stopping of the device, due to the change in the level of the oil in the well, may be regulated. These details of construction will more clearly appear in the detailed description which follows.

Referring to the drawing herewith, Fig. 1 is a transverse section through a well casing with my device therein, illustrating the upper end of said device in vertical section. Fig. 2 is a longitudinal section through the magnetic lift illustrating the upper portion thereof. Fig. 3 is a longitudinal section similar to that shown in Fig. 2, illustrating the lower end of the said magnetic lift. Fig. 4 is a detailed vertical section on the line 4—4 of Fig. 1. Fig. 5 is a transverse section on the line 5—5 of Fig. 3. Figs. 6, 7 and 8 are transverse sections on the lines 6—6, 7—7 and 8—8 respectively of Fig. 1. Fig. 9 is a sectional view similar to that shown in Fig. 1, illustrating the parts in different position. Fig. 10 is a view similar to that shown in Fig. 3 with the parts in different position, it being understood that Fig. 11 illustrates the lower end of the lift shown in Fig. 10. Fig. 12 is a transverse section on

the line 12—12 of Fig. 16. Fig. 13 is a view on the line 13—13 of Fig. 11. Fig. 14 is a broken enlarged detail illustrating the means by which the armature plates are secured loosely together. Figs. 15 and 16 are longitudinal sections illustrating the automatic switch for directing the current into the lifting magnets, the parts being in different position in the two views. Like numerals of reference are employed to designate like parts in all the views.

The magnetic lifting device employed with this type of pump is a modification of the arrangement shown in my co-pending application, No. 41,725, filed July 6th, 1925. It is illustrated best in Figs. 2, 3, 10 and 11, the device as shown in the views 2 and 3 being the same as that shown in Figs. 10 and 11, except that the parts are in different position in the two sets of views. Referring particularly to Figs. 2 and 3, the parts of the lifting device are shown in a position assumed where the pump rod 1 is at the lower end of its stroke. In this device there is a housing 2 of such size as to fit loosely within the casing of the well. The housing is secured at its lower end to a collar, or coupling, 4 by means of which it is connected to the pump barrel 5. Above the coupling 4, and secured at its lower end within the housing, is a sleeve 3. At the upper end of the housing 2 there is a similar sleeve 3', both said sleeves 3 and 3' being of magnetic material. Below the sleeve 3' a suitable distance is a core 6 of magnetic material, such as soft iron, said core being adapted to form an electro-magnet, and is therefore wound with a series of coils 7 of an electric conductor.

Above the core is a series of plates 8 of iron, or similar magnetic material, the upper of said plates 9 being of slightly increased thickness and having threaded engagement at 10 on its inner face with a tubular rod 11 which extends downwardly through a series of magnets and is secured at its lower end to the pump rod 1, as shown. This tube is perforated at 12, as shown in the different views, to allow the fluid to pass from the tube into the housing.

Spaced below the magnetic core 6 is a

similar magnetic core 13, the two cores being spaced apart by a collar 14 of electrical insulating material. The core is wound by a conductor 7', as in the other instance, and it will be noted that the windings extend beyond the end of the cores 6 and 13, the windings being separated from the plates 8 and 9 by a sleeve 15 of brass or some non-magnetic material. It will be noted that the plates 8 are secured loosely together by a series of pins 16 threaded at one end to engage within the end of the magnetic core or to the next adjacent upper plate. The said pins 16 are arranged in staggered relation on alternate plates so that they will not all be in the same plane, as shown in Fig. 13. The head of the pin is fitted loosely within an opening within the plate and the plate next adjacent the head of the pin is provided with an opening 17 to allow the pin to project therethrough when the plates are drawn together by the magnet. This arrangement is more particularly described in my co-pending application, previously referred to.

Below the series of plates 8, last described, is a third core 18 wound with a conductor 7'', as in the previous case, and having below the said core a series of plates 8'', said plates being separated from the windings by the sleeve 15'. The core 18 is separated from the plates of the magnet above by sleeves 19' of insulating material. Below the windings of the core 18 is the sleeve 3, previously described. A series of plates 8 below said magnet are suspended to the said core and to each other by a series of pins 16, as in case of the upper lifting device. It will be noted that the lowermost of the plates below the magnets 13 and 18 are in threaded engagement with the tube 11 so that when the plates are drawn into contact with each other the tube 11 will be raised. The windings 7 about the upper magnet 6 are connected by means of the wire 19 to a cable 20 in a manner which will be later described. The windings of the two lower magnets 13 and 18 are connected through the wire 21 to the same cable 20 through different connections. The two lower magnets which are the lifting magnets are hence adapted to operate together to lift the pump rod, while the upper series of plates connected with the magnet 6 are adapted to exert a downward pull on the pump rod to assist in its downward movement. It will be understood that when the current is directed through the wire 19 to the windings 7, the electro-magnet 6 will be energized, drawing the plates 8 into collapsed position, as shown in Fig. 2, thereby drawing the pump rod downwardly. At this moment the current through the wire 21 is disconnected and the plates 8' and 8'' below will drop apart, al-

lowing the rod to move downwardly. When the pump rod is to be lifted the current will be shifted into the wire 21 and released from the wire 19, thus energizing the two lower magnets 13 and 18, drawing the plates 8' and 8'' upwardly against the magnetic cores into the position shown in Figs. 10 and 11, thus serving to draw the tube and pump rod upwardly.

The automatic switch device by means of which the current is directed first through the wire 19 and then through the wire 21 alternately is shown in Figs. 15 and 16, it being understood that the two views illustrate the same construction with the parts in different position. In Fig. 15 the current is arranged to discharge through the wire 21. The tube 11 is extended above the magnetic lifting device and projects within the lower end of a tube 22, and within this tube 22, it has a radial flange, or ring, 23, and spaced above this flange adjacent the upper end of the tube 11 is a second radial flange 24. The tube 22 forms a casing within which the tube 11 is adapted to reciprocate for a limited distance in each direction. The said casing is provided with opposite vertical slots 25 between its ends to receive a transverse pin 26. A short collar 27 upon the casing 22 fits about the said casing and tends to close the slot 25 above and below the pin 26, which passes through an opening in said collar.

Within the casing 22 are two pairs of oppositely extending dogs 29. Said dogs are pivoted upon pins 30 extending through the cross pin 26. The central tube 11 is provided with an elongated slot 31 on a line with said dogs and the ends of said slots are beveled in such a manner that the slot is tapered outwardly, as shown at 32.

The dogs 29 are formed with beveled ends 33 and about midway of their ends each dog has an outwardly extending finger 34, adapted, when in the proper position, to fit within recesses 35 on the inner face of the casing 22. Above and below the transverse pins 26 upon which the dogs are pivoted, are coiled springs 36. Said springs normally extend to a point adjacent the end of the slot 31 in the tube and space the dogs from the adjacent flanges 23 and 24 against which they bear at their ends. Each set of dogs is normally held resiliently apart by means of a leaf spring 37, as clearly shown in the drawing.

The casing 22 has threaded engagement with a coupling sleeve 38 secured upon the upper end of the housing 2 and acting on its outer face to connect said housing with an upper housing 39 for the switch. Said housing 39 comprises a short length of pipe, the upper end of which is threaded internally to receive a ring 40 and a second upper ring 41 spaced somewhat from the lower

ring. Between the two rings 40 and 41 is the flange 42 of a block 43. Said block has a central passage 44 therethrough which furnishes a continuation of tube 11 for the passage of fluid. A tubing 45 is secured within the upper end of the block 43, serving to conduct the fluid upwardly toward the surface.

The two wires 19 and 21 are insulated as shown at 47 by a casing of rubber, or other non-conducting material, the tube forming the insulation extending through openings 48 in the block 38 on opposite sides of said block. Above the coupling 38 the wire 21 with its insulating tube passes through a small ring 49 and above said ring the wire 21 is formed into a head 50 having a V-shaped slot in its upper end. The insulating tube about the head is made flexible to receive a quantity of grease or other similar material to prevent the entrance of water thereto. Above the head 50 of the wire 21 is a co-operating part 51 which is provided with a pointed lower end to fit within the V-shaped slot in the head 50. This head 51 has an elongated recess in its upper end to receive the lower end 52 of the upper portion of the wire 21, said point 52 being adapted to telescope slidably within the recess provided in the head 51. The insulation about the telescoping joint thus formed is adapted to be filled with a thick grease to fill the space about the joint. Above the said joint the wire passes through the block 43 and is directed laterally around the said head and connected as shown in dotted lines at 54 with the cable 20.

The wire 19 is also provided with a similar slidable switch which may be opened or closed by means of adjacent transverse pin 26, the two switches differing in that the slotted head 50' is connected to the upper portion, forming a continuation of the cable 20, while the male member thereof is formed upon the sliding head 51 connected with the upper end of the wire 19.

It is to be noted that the joints thus formed between the ends of the two wires are so arranged that when one is connected the other will be disconnected, and this arrangement will be easily understood by referring to the two illustrations 15 and 16. The ends of the transverse pin 26 extend through collars 56 surrounding the wires 19 and 21 respectively, at its opposite ends, as shown best in Fig. 12. The collar 56 surrounding the member 51 is raised and lowered to move the point 51 of this member of the switch. The opposite collar 57 is arranged slightly lower than the switch formed at 51 on the member 26 and is connected with the point 51', which is arranged so that when the point 51' is down the opposite point 51 will be down, making a connection between the point 51 and the head

50, and breaking the connection between the parts 50' and 51'. In the operation of this device, the connection as shown in Fig. 15 will be through the switch between the points 50 and 51, and the current will pass downwardly through the wire 21 to the lifting portion of the magnet, thus raising the tube 11 and forcing the switch into position shown in Fig. 16. In Fig. 15 the switch at 50 is shown in the position which it assumes when the pump rod is at the lower end of its stroke and where the current is being directed into the windings of the two lower lifting magnets to draw the pump rod upwardly. In this position the upper magnet 6 will be de-energized and the two lower magnets 13 and 18 will be energized so as to draw upwardly the plates 8' and 8'' together with the armatures 9' and 9''. The tube 11, in moving to the low position shown in Fig. 15, has carried the spring 36 at the upper end against the fingers 34 of the dogs and has thereby compressed the spring. The upper ends of the dogs, having engaged the beveled end of the slot 31 are forced inwardly and released from the notches 35 in the casing 22. The spring 36 then acts to throw the dogs and the transverse pin 26 downwardly to the Fig. 1 position. This will throw the fingers 34 of the lower dogs into the notches 35, as shown in Fig. 15, and prevent further movement, after the switch is closed, until the upward movement of the pump rod 11 moves the lower spring 36 and the lower end 32 of the slot 31 is brought against the lower ends of the lower dogs. This upward movement of the pump rod will begin at once when the switch 50, 51 has been closed and the lifting magnets energized.

The lifting of the rod will, toward the upper end of the stroke, bring the parts into the Fig. 16 position, disconnecting the switch 50, 51 and connecting the switch 50', 51' and energizing the lowering magnet 6, as previously described. Thus the lowering and lifting magnets will be alternately energized and de-energized to cause the reciprocation of the pump rod in an automatic manner, which will be positive and accurate in its action.

The ordinary deep well pump employed in oil well pumping should preferably be worked intermittently. This is because the supply of oil which comes from the producing stratum into the well is not supplied to the well at such a rate as to necessitate the pumping of the well continuously. The ordinary operation of the pump at the most efficient speed will lower the level of oil in the well down to a point where the pump will no longer furnish liquid but gas and air will find entrance to the working parts of the pump. I, therefore, desire to provide a float operated means to automatically stop

the operation of the pump when the fluid level has been lowered to a predetermined point below which it may not go without exposing the valves at the lower part of the pump. This float operated means is placed in the pump barrel immediately above the automatic switch, which has just been described.

The tubing 45 at the upper end of the coupling block 43 is extended upwardly for a suitable distance and has a head 59, said head is provided with a lower shoulder 60 serving to limit the upper end of a float 61 mounted on said tube. The upper end is enlarged slightly and threaded internally at 62 for attachment to a nipple 63. Mounted slidably upon the tubing 45 is the float 61, previously referred to. Said float may be of some substance of light specific gravity, or may be of hollow metal, as shown in the drawing. It has its inner sleeve 64 which surrounds the tubing made with a lateral extension 65 thereon, as shown in Fig. 8, so as to provide means between the tubing and the float for a wire or cable 74 surrounded by insulating material 67. This wire and the insulation thereon is secured to the tubing by bands 68 which surround the tubing and the insulation at spaced intervals.

The cable 20 which extends upwardly from the switch below is provided with a float operated switch at a point slightly above the coupling head 43. The cable is provided with a point 69 which telescopes within a sleeve 70 of a head 71, which has a tapered recess 72 in the upper end thereof to receive the point of a co-operating member 73 of the switch above. Said member 73 forms the lower end of a cable 74 extending upwardly toward the surface. The sliding member 71 of the switch is connected by pins 75 to the float member. The insulation about the switch is preferably of flexible tubing, such as rubber, so as to provide a chamber about the switch which may be filled with cup grease, or similar material, to effect the water-tight connection about the switch. It will be noted that when the float 61 rises it will carry the member 71 upwardly into contact with the point of the member 73 to close the contact, as shown in Fig. 1. Thus, when the float is submerged, the pressure will tend to raise the float and close the switch.

In order that the movement between the opened and closed position of this switch may be abrupt, I provide on one side of the tubing 45 a resilient connection between the float and the tubing. This connection is shown at 76 in dotted lines in Figs. 1 and 9, and in full lines in Fig. 4. The wall of the tubing 45 is thickened at this point and provided with upper and lower notches 77 therein, which are adapted to receive the central point 78 of springs 79 secured at their ends within the inner wall of the float 61, thus tending to resiliently engage the notches 77

in the tubing. Engagement between the springs 77 and the tubing is sufficient to hold the float in either upper or lower position, as may be desired, until a predetermined force is exerted thereon, so as to move the float against the action of the spring. When the level of the fluid in the well exposes the float, the weight of the float itself will be sufficient to move the same down against the action of these springs. When this movement does take place, it will be an abrupt one, tending to snap the switch into closed position quickly. The same abrupt action takes place when the float has been submerged sufficiently to cause it to move upwardly against the action of the springs 79.

It is contemplated that the connection between the wire 74 and a cable 80 extending to the surface may be made after the tubing and the pump have been inserted into the well. To do this, I have provided a weight 81 at the lower end of the cable 80 to cause it to be drawn down by gravity into the well, and this weight is connected with the flexible tube 82 of insulating material which surrounds a member 83 of the switch. The tube extends beyond the member 83 and is adapted to receive a point 84 upon the upper end of the cable 74. This point is held erect by a support comprising a sleeve 85 of insulating material secured to a perforated disc 86, supported at the upper end of the head 59. A guide is formed to direct the upper portion of the switch centrally into position to receive the point 84, said guide comprising a collar 87 secured upon the inner portion of the nipple 63 and inclined inwardly to narrow the passage through the nipple, and thus serve to center the lower end of the cable as it is dropped downwardly into the well, tending to make it register with the upper end of the point 84 of the cable 74. The insulating tube 82 may be filled with grease and when the connection has been tightly made through the weight of the upper cable, the parts will assume the position shown in Fig. 1. The nipple 63 is secured at its upper end to the tubing 88 which will serve to carry the fluid upwardly to the surface and to provide a better passage about the weight 81. Longitudinal grooves shown at 89 in dotted lines are formed in the weight so as not to obstruct the flow of oil into the tube.

It is believed that the operation of my device has been made clear. The assemblage of the magnetic pump with its automatic switch above the same and the automatic means for stopping the pump when the level of the fluid in the well has reached a predetermined low position, all may be lowered into the well with the tubing from the surface and will serve to pump the oil from the well without the necessity of the usual sucker rods and operating means at the sur-

face of the well. It also is adapted because of its automatic control to operate only when there is sufficient oil for the pump, and hence the use of current will be economical. The working parts of the device have been made as simple and strong as possible so that there will be little danger of their getting out of order or failing to operate as desired. The advantages of this type of construction will be apparent to those skilled in the art without further description.

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

1. In a device of the character described, a hollow pump rod, electro-magnetic means to raise said rod, similar means to assist in lowering said rod, automatic means to alternately energize said raising and said lowering means, and means to automatically de-energize said electro-magnetic means when the fluid in the well reaches a predetermined level.

2. In a device of the character described, a hollow pump rod, electro-magnetic operating means to raise said rod, similar means to assist in lowering said rod, an automatic switch controlled by the movement of said rod to alternately energize said raising and said lowering means, and means to automatically de-energize said electro-magnetic means controlled by the low level of fluid in the well.

3. In a device of the character described, a hollow pump rod, electro-magnetic means connected therewith to raise said rod, said means having a conducting cable connected therewith, similar means to assist in lowering said rod, said lowering means having a cable connected therewith, and a switch with which said cables are connected, said switch comprising a cross pin on said rod connected with the said cables and operated through the movement of said rods to open the switch in one cable and close it in the other alternately in the manner described.

4. In a device of the character described, a hollow pump rod adapted for connection with a pump plunger, a plurality of magnetic cores on said pump rod, a series of plates adjacent each of said cores, electric conductors forming a winding about said cores, the plates on certain of said cores being suspended below said cores and on one of said cores, said plates being positioned above the same, and means to alternately energize the cores having the plates below the same and then the cores having the plates above the same for the purpose described.

5. In an electro-magnetic pump including a pump rod, electro-magnets having armatures comprising a series of spaced movable plates connected with said rod to raise said rod and similar electro-magnets having connection with said rod to lower said

rod, the combination of automatic means to alternately energize said lifting and said lowering magnets, and float operated means to start and stop said pump dependent upon the fluid level in the well.

6. In a device of the character described including a pump rod, and a plurality of oppositely directed operating electro-magnets, the combination of two opposite current-conducting wires leading to said electro-magnets, a sliding switch in each of said wires, and a cross pin on said rod engaging said switches to close one and open the other of said switches simultaneously at the upper and lower extremities of the stroke of said rod.

7. In a device of the character described, a pump rod, electro-magnets to raise said rod, a lowering magnet to lower said rod, opposite wires leading to said electro-magnets, sliding switches in each of said wires, a transverse pin slidable in a vertical slot in said rod, and means engaging said pin to said switches at each end, whereby one switch may be closed and the other opened simultaneously at the upper and lower limits of the stroke of said pump rod.

8. In an electro-magnetically operated pump, and an electrically conducting cable leading into the well, the combination of a switch in said cable comprising two inter-fitting parts in said cable, one of which is slidable into and out of contact with the other, and a float on said slidable part, adapted to be moved through the fluid level in the well to open or close said switch.

9. In an electro-magnetically operated pump, and an electrically conducting cable leading into the well for connection thereto, the combination of a switch in said cable, comprising a lower contact point slidable on said cable, an upper stationary contact member, and a float connected with said lower point and adapted to raise said point into contact with the stationary point to close the circuit in said cable when the fluid level reaches a certain point and to thereafter open said contact when the liquid level is lowered to a predetermined point.

10. In an electromagnetically operated pump, a housing containing the operating mechanism, an electric cable extending from said housing to the surface, a joint in said cable adjacent said housing, said joint comprising a terminal projecting upwardly from said housing; a co-operating terminal on said cable, a flexible tube of insulating material surrounding the upper terminal and projecting downwardly therefrom to telescope over the lower terminal, and a weight on said cable above said joint.

11. In an electromagnetically operated pump, a housing containing the operating mechanism, an electric cable extending from said housing to the surface, a joint in said

cable adjacent said housing, said joint comprising a terminal projecting upwardly from said housing, a co-operating terminal on said cable, a flexible tube of insulating material surrounding the upper terminal and projecting downwardly therefrom to telescope over the lower terminal, and a guide for said cable above said lower terminal.

In testimony whereof I hereunto affix my signature this 29th day of August, A. D. 1925.

WILLIAM WERNER.