

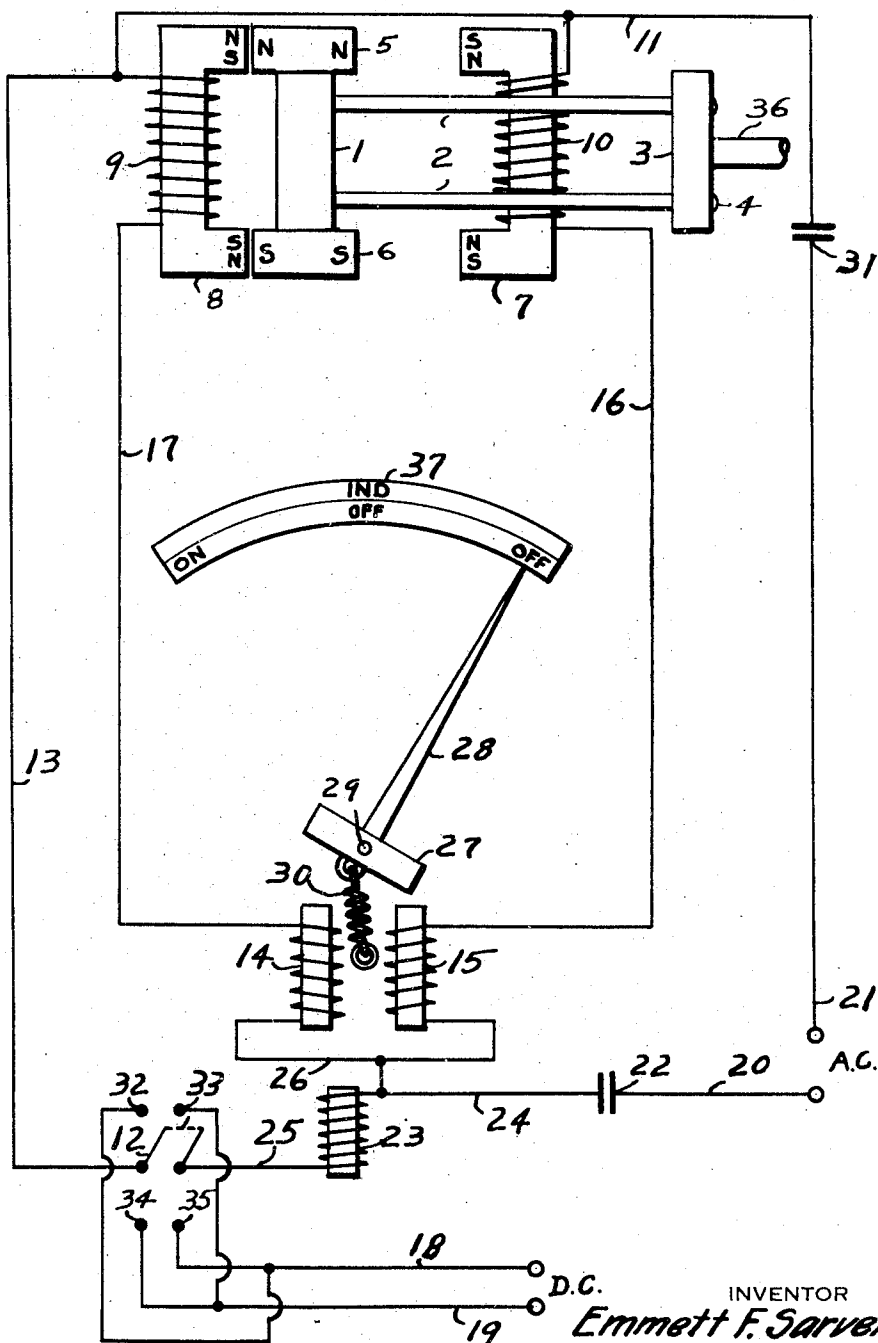
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POSITION INDICATOR FOR MAGNETIC ACTUATORS

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POSITION INDICATOR FOR MAGNETIC ACTUATORS

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1

This invention relates to a magnetic actuator, and more particularly to an electro-magnet mechanical actuator which can be utilized to operate valves, power switches and the like, from a remote control station.

It is well known that present type solenoid and magnetic valves are of two general types, one requiring a continuous flow of current to hold it in one position against a spring load to return it to its normal position which requires a great amount of electric energy for use in many places; the second type requiring a complicated mechanical locking arrangement which is costly to manufacture and subject to wear.

The principal objects of the invention are to provide a device of this character which requires power to operate the same only while in shifting position; to provide electro-magnetically operated means for operating a magnet through alternating currents, thus requiring direct current only momentarily while the power armature is changing position; to provide for reversal of movement of the magnet by reversal of polarity of electro-motive force applied thereto; to provide a device for holding a load in either position by magnetic force; to provide an indicator to show the position of the actuator from a remote control station; and to provide a device of this character of simple construction, economical to manufacture and efficient in operation.

In accomplishing these and other objects of the invention, I have provided improved details of structure, the preferred form of which is shown in the accompanying drawing, wherein the single figure represents a schematic view illustrating the electrical circuits, electro-magnets, and magnets embodying the features of the present invention.

Referring more in detail to the drawing:

1 designates an armature comprising a permanent magnet attached to connecting rods or other power transmission means 2 and having a cross head 3 mounted on the opposite ends of the rods by stud bolts or the like 4. While I have here shown the permanent magnet as slidably mounted, it will be obvious that it may be rotatably mounted or swinging, as desired, without departing from the spirit of the invention.

5 and 6 designate soft iron pole pieces rigidly attached to the magnet 1. The rods 2 are slidably mounted in suitable bearings through an electro-magnet 7 rigidly mounted on a suitable base (not shown). 8 designates a second electro-magnet also rigidly mounted on a suitable base (not shown) and facing the magnet 7. The rods are so arranged that the permanent magnet 1 is

2

free to move back and forth between the magnets 7 and 8. The electro-magnets 7 and 8 have windings 9 and 10 to which is attached an electric conductor 11.

12 represents a double pole throw switch and 13 an electric conductor connected to the conductor 11 and the double pole throw switch 12. 14 and 15 designate instrument magnets located at the remote station and are connected to electro-magnets 7 and 8 by conductors 16 and 17, respectively. 18 and 19 designate conductors connecting a source of direct current potential marked "D. C." on the drawing to a pole changing switch as shown.

20 and 21 represent a source of alternating current marked "A. C." on the drawing and located in the line 20 is a blocking condenser 22 connected to a choke coil 23 by conductor 24 which leads to the throw switch 12 through conductor 25. 26 designates a conductor connecting conductor 24 with the electro-magnets 14 and 15.

27 designates an armature rigidly secured to a pointer 28 by bolt 29 or other suitable means, and 30 represents a spring having one end connected between the magnets 14 and 15 and its opposite end to the end of the pointer 28 for urging the armature 27 to a normally balanced position equidistant from magnets 14 and 15.

The blocking condenser 22 will pass alternating current from the source 20 and 21 to the system and will prevent direct current from flowing from the system to said alternating current source. Located in the conductor line 21 is a blocking condenser 31 similar to and accomplishing the same purpose as blocking condenser 22. The double pole throw switch 12 is of conventional form and has contact points 32—33 and 34—35 for a purpose later described.

Operation of a device constructed as described is as follows:

Assuming that the cross head 3 is mechanically connected by suitable connection 36 to a load, such as a valve which it is desired to operate from a remote station, and the magnets 7 and 8 rigidly mounted on a suitable base, with the switch 12 and the indicating instruments 14, 15, 27, 28, and 30 located at the remote station, the switch 12 being open, a suitable direct current potential is applied to conductors 18 and 19 and an alternating current potential is applied to conductors 20 and 21. The alternating current flowing through conductor 20, condenser 22, and conductor 24 will be blocked by choke coil 23 where it will divide and flow through instrument magnets 14 and 15, conductors 16 and 17, and magnets 7

and 8, to conductor 11; thence through condenser 31 back to the source through conductor 21. It will be obvious that the alternating current circuit comprises an impedance bridge circuit with instrument magnet 14 and power magnet 8 in one leg of the bridge, and instrument magnet 15 and power magnet 7 in the other leg of the bridge. The impedance of instrument magnet 14 is equal to the impedance of instrument magnet 15 and the impedance of power magnet 7 is equal to the impedance of power magnet 8 when armature 1 is centrally located between the two power magnets 7 and 8.

It will further be obvious that permanent magnet 1 will always be contacting one or the other of magnets 7 and 8 due to magnetic attraction and due to the changed magnetic path of the magnet to which it is adhering, the impedance of that magnet will increase, thus causing less current to flow through that leg of the bridge.

I have here illustrated the armature magnet 1 as shown contacting magnet 8, and more alternating current will flow through magnets 7 and 15 than through magnets 8 and 14. Thus instrument magnet 15 is exerting a greater pull on instrument armature 27 than instrument magnet 14. Consequently armature 27 is moved toward magnet 15 causing pointer 28 to move to the right of the scale to the "off" position shown on dial 37. If the armature magnet 1 is moved into contact with power magnet 7, the bridge will be unbalanced in the opposite direction and the pointer will swing to the extreme left of the indicator to the "on" position. If the alternating current power supply fails, the pointer 28 will centralize on the "Ind. off" position due to the effort of spring 30 to hold it in that position.

When the switch 12 is closed momentarily to the 34-35 position, direct current will flow through conductors 18 and 19 through conductor 25 to choke coil 23 and there be blocked from the alternating current source by condenser 22. The current will then flow equally through instrument magnets 14 and 15 and through conductors 16 and 17 to power magnets 7 and 8.

It will be noted that the windings 9 and 10 of electro-magnets 7 and 8 are so arranged that unlike poles marked "N" and "S" are facing each other as shown, so that with the magnetizing effect of this new impulse of direct current, the poles will be reversed from the order shown. The permanent magnet 1 will retain its polarity and the poles 5 and 6 of magnet 1 will be facing like poles of magnet 8, thus causing a strong repulsion of magnet 1 forcing it to move away from magnet 8, and also due to a strong attraction of magnet 7 for magnet 1, the magnet 1 will move away from magnet 8 into contact with magnet 7. At this instance the indicator 28 will change position and the direct current switch which is preferably a push button self-opening type may be opened and the magnet 1 will be held to magnet 7 by the attraction of the permanent magnet 1 until a direct current impulse is caused to flow in the opposite direction. It will thus be obvious that the device requires direct current only momentarily while the power magnet position is changing. It will further be obvious that armature 1 which is a permanent magnet will always remain in either extreme position due to its magnetic action without the use of a mechanical locking device.

It will further be obvious that the indicator provided will show the position of the actuator to give a positive indication in case of failure of the indicator current supply. A very small amount

of power is required, approximately one milliwatt, to operate the indicator.

It will further be obvious that the power magnets can be made in any shape or size to satisfy various design requirements and the power magnet 1 may be slidably mounted, rotatably mounted, or swinging, as desired, without departing from the spirit of the invention, and it is further obvious that I have provided an improved magnetic actuator adaptable for use in aircraft fuel lines, refrigerator systems, water systems such as automatic valves, on washing machines, and in air pressure systems and the like.

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

1. A magnetic actuator of the character described comprising, spaced electromagnets, a permanent magnet movable between said electromagnets, the magnetic attraction of said permanent magnet effecting adherence thereof to the electromagnet with which it is in contact, an indicator, an alternating current circuit for energizing the electromagnets, means including a direct current circuit connectable in circuit with the electromagnets for changing the polarity of the electromagnets for moving the permanent magnet from one electromagnet to the other to change the inductive impedance in the electromagnetic circuits, and means for actuating the indicator in response to said change of inductive impedance in the electromagnetic circuits for indicating the position of the permanent magnet.

2. A magnetic actuator of the character described comprising, spaced electromagnets, an armature including a permanent magnet movable between said electromagnets, said electromagnets being arranged in parallel electric circuits having terminals between said magnets, an alternating current circuit connected to the terminals of said parallel circuits, a direct current circuit connected to the terminals of said parallel circuits, means in the alternating current circuit for stopping flow of direct current therein, means in the direct current circuit for stopping flow of alternating current therein, means in the direct current circuit for changing the polarity of the electromagnets for effecting movement of the armature to move the permanent magnet from one electromagnet to the other, said movement of the permanent magnet effecting an increase in the inductive impedance in the parallel circuit which includes the electromagnet toward which said permanent magnet is moved, and means between the electromagnets and movable in response to relative change of power thereof effected by movement of the permanent magnet for indicating the position of the armature.

3. A magnetic actuator of the character described comprising, parallel electric circuits, actuator electromagnets in each of said parallel circuits, other electromagnets in each of said parallel circuits, an indicator between said other electromagnets and movable in response to difference in power thereof, an armature including a permanent magnet slidable between said actuator electromagnets, an alternating current circuit connected to said parallel circuits, condensers in the alternating current circuit adjacent the parallel circuits, a direct current circuit connected to the parallel circuits, a choke coil in said direct current circuit, and a double throw pole changing switch in the direct current circuit for changing the polarity of the electromagnets for mov-

5

ing the armature from one actuator magnet to the other, said armature movement effecting a change in the inductive impedance in the parallel circuits reducing the comparative power of the other electromagnet in the parallel circuit which includes the actuator electromagnet toward which the armature is moved the indicator moving toward the more powerful of said electromagnets to show the position of said armature.

4. A magnetic actuator of the character described comprising, spaced electromagnets of equal inductive impedance, an armature including a permanent magnet movable between said electromagnets, other electromagnets of equal inductive impedance, said electromagnets being electrically connected to form an impedance bridge circuit with one of the first named electromagnets and said other magnets in each leg of the bridge circuit, an alternating current circuit connected to the bridge circuit between the first named electromagnets and between said other electromagnets for supplying alternating current to the bridge circuit whereby the inductive impedance in the leg of the bridge circuit which includes the electromagnets contacted by the permanent magnet is increased effecting a comparative reduction in the power of said other electromagnet in the same leg of the bridge circuit, an indicator actuated by said other elec-

6

tromagnets and movable toward the more powerful thereof to indicate the position of the armature, condensers in the alternating current circuit adjacent the bridge circuit, a direct current circuit connected to the bridge circuit between the first named electromagnets and said other electromagnets, a choke coil in said direct current circuit for stopping flow of alternating current therein, and a double throw pole changing switch in the direct current circuit for changing the polarity of the first named electromagnets for moving the armature from one of the first named electromagnets to the other, the position of the indicator being correspondingly reversed due to the change of inductive impedance in the legs of the bridge circuit.

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