United States Patent [19]

Pfeffer et al.

[11] **3,882,337**

[45] **May 6, 1975**

[54] **HALL PLATE CONTACT-LESS OPERATOR AND METHOD OF ITS ADJUSTMENT**

[75] Inventors: **Josef Pfeffer**, Amtszell; **Horst Schwäble**, both of Obermelsungen, Germany

[73] Assignee: **Rafi Raimund Finsterholzl Elektrotechn. Spezialfabrik**, Ravensburg-Vorberg, Germany

[22] Filed: **Nov. 13, 1973**

[21] Appl. No.: **415,335**

[30] **Foreign Application Priority Data**

Nov. 17, 1972 Germany 2256360

[52] **U.S. Cl.**... **310/273**; 310/DIG. 3; 317/157.5 PM; 324/45; 338/32 H; 338/200; 340/365 L; 29/593; 29/607

[51] **Int. Cl.** **H02k 35/02**

[58] **Field of Search** ..... 310/DIG. 3; 340/365 L, 340/174 HA, 174 PM; 338/32 H; 29/593, 607; 318/138, 254; 317/157.5 PM; 324/45, 28 R

[56] **References Cited**

UNITED STATES PATENTS

3,235,776	2/1966	Ireland	324/45 X
3,340,467	9/1967	Whan Ha	324/45 X
3,596,144	7/1971	Cunningham	317/157.5 PM
3,611,358	10/1971	Dalmasso	340/265 L

Primary Examiner—Mark O. Budd
Attorney, Agent, or Firm—Littlepage, Quaintance, Murphy & Dobyns

[57] **ABSTRACT**

In a contact-less operator, a Hall generator is carried in a plate. A pushrod member with a permanent magnet is arranged displaceable relative to the Hall generator against the force of a spring.

2 Claims, 2 Drawing Figures

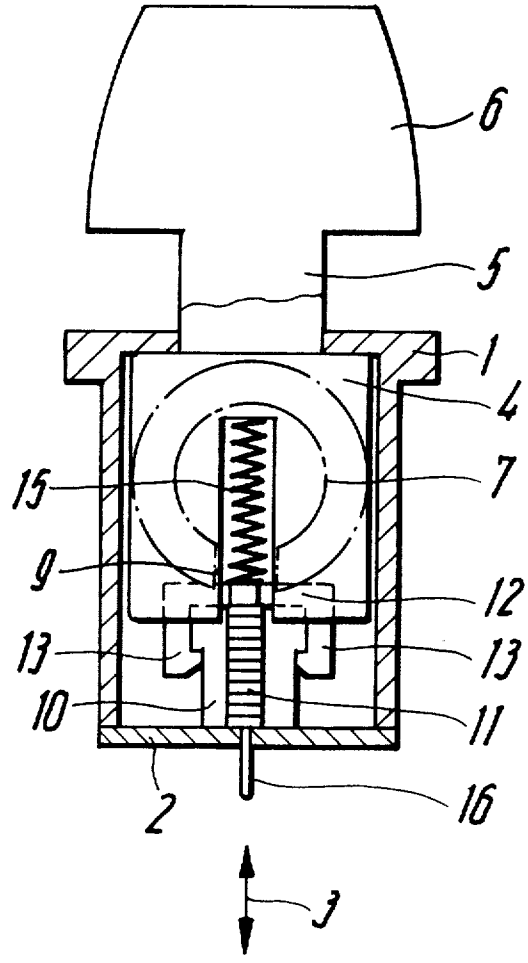
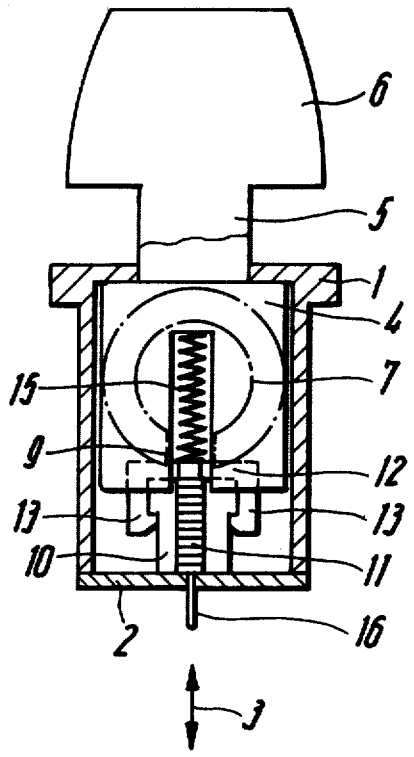


Fig. 1



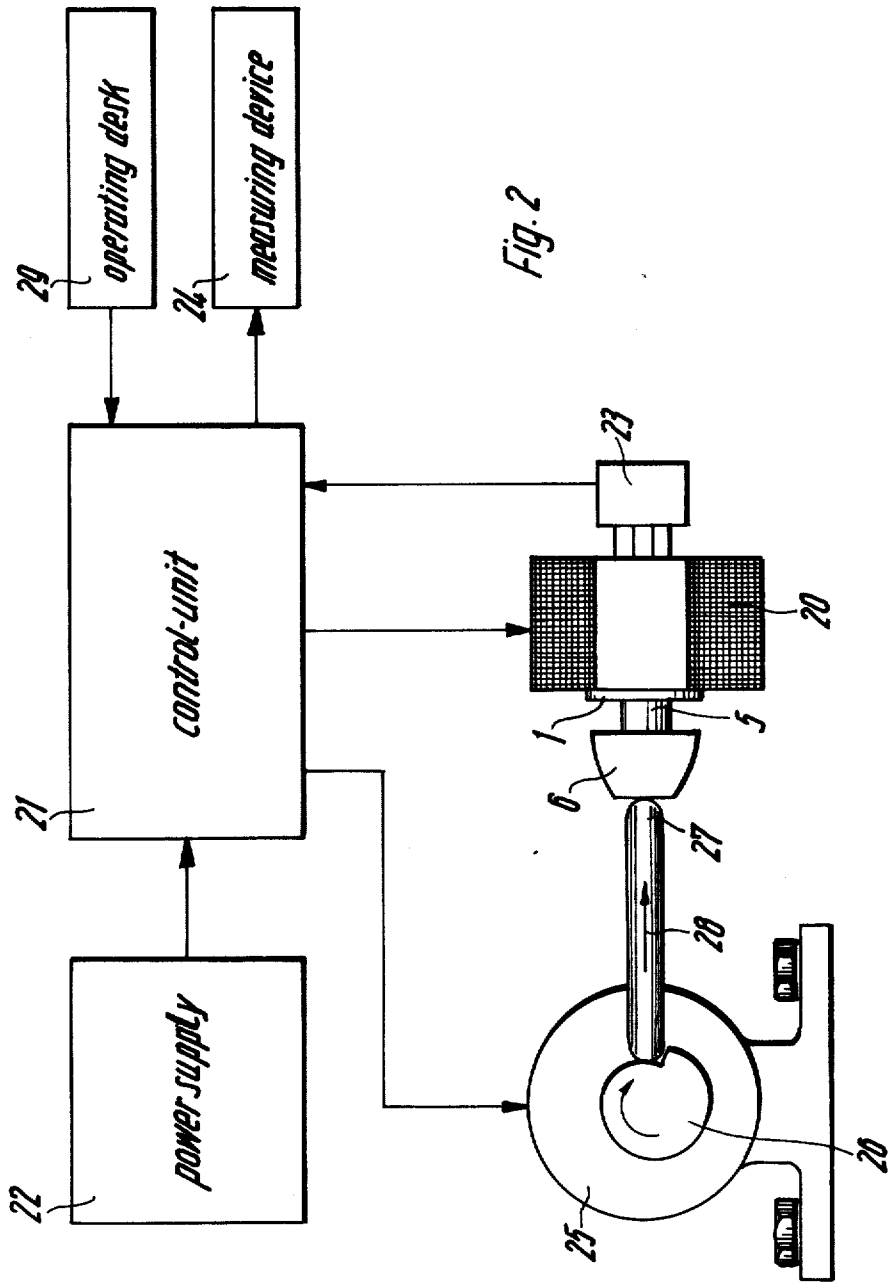

operating desk
29
measuring device
24
control-unit
21
power supply
22
23
20
1
5
6
27
28
26
25

Fig. 2

HALL PLATE CONTACT-LESS OPERATOR AND METHOD OF ITS ADJUSTMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from German Application No. P 2,256,360.6, filed Nov. 17, 1972.

BACKGROUND OF THE INVENTION

The invention relates generally to a contact-less operator or switch using a permanent magnet, and particularly to such an operator or switch for a path-responsive control of switching, whereby a permanent magnet is moved relatively to a member which is sensitive to magnetic forces for production of electronic control pulses.

It is known to arrange one or a plurality of current-fed field plates within the housing of a switch, together with one or a plurality of magnets, relative movable toward each other.

It is known that such contact-less switches, compared with such switches having mechanical contacts, have particularly advantageous characteristics, essentially chatter-free contact performance, long life, a transfer characteristic which remains constant resistance, to humidity and vibration, a high number of switching actuations in its life expectancy and low operating force.

These characteristics are particularly important in switches, whereby the following additional conditions are set: Reproduceability of the switching point, high switching exactness, and a switching speed which is independent of the operation of the switching-pushrod.

SUMMARY OF THE INVENTION

It is, therefore, one object of the present invention to provide a new type of a contact-less operator or switch, which has the characteristics of the known contact-less switches and beyond that also which fulfills the last mentioned conditions by making use of a Hall generator, which, in the normal condition of the operator, is outside the air gap of a permanent magnet, but which is between two pole surfaces of the magnet in the air gap after the displacement of the magnet against the force of a spring.

It is another object of the present invention, to provide a new method of adjusting the magnetic force of the contact-less operator by means of a demagnetizing coil.

It is a still further object of the invention to provide an automatic control of said demagnetizing coil by means of an electric pulse delivered by the operator when it is moved from one position into its other position.

With this principle it is possible, to fulfill the mentioned requirements, whereby depending upon the prevailing special structural and functional conditions, an embodiment of a contact-less operator and an apparatus for automatic control or adjustment of the magnetic force of the permanent magnet in said operator according to the present invention are provided.

BRIEF DESCRIPTION OF THE DRAWING

With these and other objects in view which will become apparent in the following detailed description, the present invention, which is disclosed by example only, will be clearly understood in connection with the accompanying drawings, in which:

FIG. 1 is a side view in partial cross-section of an operator according to the present invention,

FIG. 2 is a simplified diagram for explaining the method of adjusting the magnetic force of the permanent magnet in said operator.

DESCRIPTION OF A PREFERRED EMBODIMENT

The contact-less operator shown in FIG. 1 as side view in partial cross-section comprises a housing **1** with an end member **2** and a pushrod member **4**, which is displaceable in the housing **1** in the directions indicated by the arrow **3**, and which is integral with a pushrod **5**. The pushrod **5** carries a removable operating button **6**.

The pushrod member **4** incorporates an annular permanent magnet **7** which is indicated in the drawing by dash-dot lines. The magnet **7** has an air gap **9**, the surfaces of the magnet **7** which define the air gap **9** and which represent the poles being parallel to the direction of the arrow **3**. The pushrod member **4** has guide surfaces (not shown) on its outside which co-operate with guide surfaces (not shown) on the inside wall of the housing **1** to guide the pushrod member **4** parallel to a plane of symmetry of the magnet **7**.

The end member **2** of the housing **1** carries holders **10** which project into the interior of the housing **1** and between which is positioned a plate **11** which comprises a Hall generator.

A retaining loop bracket **12** with resilient limb portions **13** provided with inwardly projecting portions which engage behind corresponding projections on the holders **10**, holds the plate **11** with the Hall generator in position relative to the end member **2** and thus relative to the housing **1**. On its side remote from the Hall generator, the center portion of the bracket **12** also carries a projecting pin (not shown) for centering a coil spring **15**. The spring **15** extends into the central space of the magnet **7** within a passage which extends into the pushrod member **4** parallel to the direction of the arrow **3**.

The bracket **12** with its resilient limb portions **13** and the pin for centering the spring **15** is made in one piece from injection-molded plastics material. The magnet **7** is also fixed by injection molding in the pushrod member **4**, which comprises plastics material.

Disposed in the interior of the plate **11**, besides the Hall generator, are also other electronic components which form a so-called integrated-circuit or IC-chip. In the underside of the plate **11** are contact terminals **16** for connecting the IC-chip to associated external current sources and other external switching components which are to be controlled by the above-described contact-less operator.

When the button **6** is moved, the magnet **7** is displaced relative to the Hall generator. The Hall voltage which is produced by the magnetic field is amplified and controls a Schmitt trigger, the output signal of which passes by way of two equal-phase transistor outputs with open collector, to the output. By means of a voltage regular which also forms part of the IC-chip, it is possible for the operator to be used in a voltage range of from +4.5 volts to 30 volts.

The contact-less operator can be so constructed as to be either actuating or arresting, and either illuminated or unilluminated.

A particular advantage of the above-described construction of the operator is that, after the operator has been assembled, which assembly is very simple, precise

magnetic adjustment is possible. FIG. 2 shows an arrangement for such precise magnetic adjustment. First the operator is assembled using a permanent magnet which is too strong for the switch in which it is to be used. The assembled operator with housing 1 and operating button 6 is then brought into the field of a coil 20 which is fed with alternating current from a control unit 21 which is energized from a power supply 22. The coil 20 is used to permanently partially demagnetize the magnet. The operating button 6, together with pushrod 5 and attached magnet 7 (not shown in FIG. 2), is displaced into the required switching point position, and then the permanent magnet 7 is progressively and permanently de-magnetised by the alternating current field of the coil 20, until the transistor switch, which is connected to the Hall generator and which is linked by adapter 23 to a corresponding current source and a measuring device 24, switches over from one operating condition to the other. If, when this switch-over occurs, a switch is actuated to interrupt the flow of current through the coil, adjustment is effected automatically.

A precise displacement of button 6 can easily be achieved by means of a motor 25, associated gear (not shown) and a cam 26 which moves rod 17 in direction of arrow 28. The control unit 21 is operated from the operating desk 29.

The above described method may also be slightly modified. Let us assume that the operator should switch after the button has been displaced by 2 mm, but that it switches after a displacement of only 1 mm mm and a pulse is delivered through adapter 23 to the control unit 21. Now from the control unit there is delivered an alternating current to coil 21. The intensity of this demagnetising alternating current, in this modification, is controlled by the control unit 21 in relation to the angular position of the cam, and also the demagnetising time is controlled by the control unit. In this way it is possible to weaken the magnetic force of the permanent magnet of the operator to such an extend that the operator switches precisely after the desired displacement of, e.g., 2 mm.

Both above described procedures have the advantage that permanent magnets with greater tolerance in field strength can be used. By adjusting the switching point with a demagnetising electrical alternating current field, it is possible to adjust magnetically a large number of individual operators to the same switching point, and thereby to provide the necessary condition for the mass production of precision operators with relatively inexpensive components.

Many possible modifications will become apparent from the foregoing without departing from the spirit of the present invention. However, the foregoing disclosure is presented in an illustrative sense rather than a limiting sense and the appended claims are relied upon to define the scope of the present invention.

We claim:

1. A contact-less operator comprising: a housing, a Hall generator, a plate which carries said Hall generator and is disposed in said housing, a permanent magnet having pole surfaces defining an air gap, a pushrod member carrying said magnet and disposed in said housing, means for displacing said pushrod member from outside said housing, and a spring disposed in said housing and acting on said pushrod member to bias said pushrod member to a position in which said Hall generator is outside said air gap of said magnet, displacement of said pushrod member by said means bringing said magnet to a position in which said Hall generator is between said pole surfaces, wherein said magnet is in the interior of said pushrod member, and the displacing means comprises:

A. a pushrod integrally connected to said pushrod member, and

B. an operating button on said pushrod outside said housing,

the operator further comprising a retaining loop bracket having a central portion and two resilient limb portions projecting therefrom provided with inwardly projecting portions which engage behind corresponding projections on holders extending inwardly from an end member of the housing, said plate being held between said central portion and said end member.

2. An operator according to claim 1 wherein said central portion carries on its side remote from said plate a projecting pin for centering said spring.

* * * * *