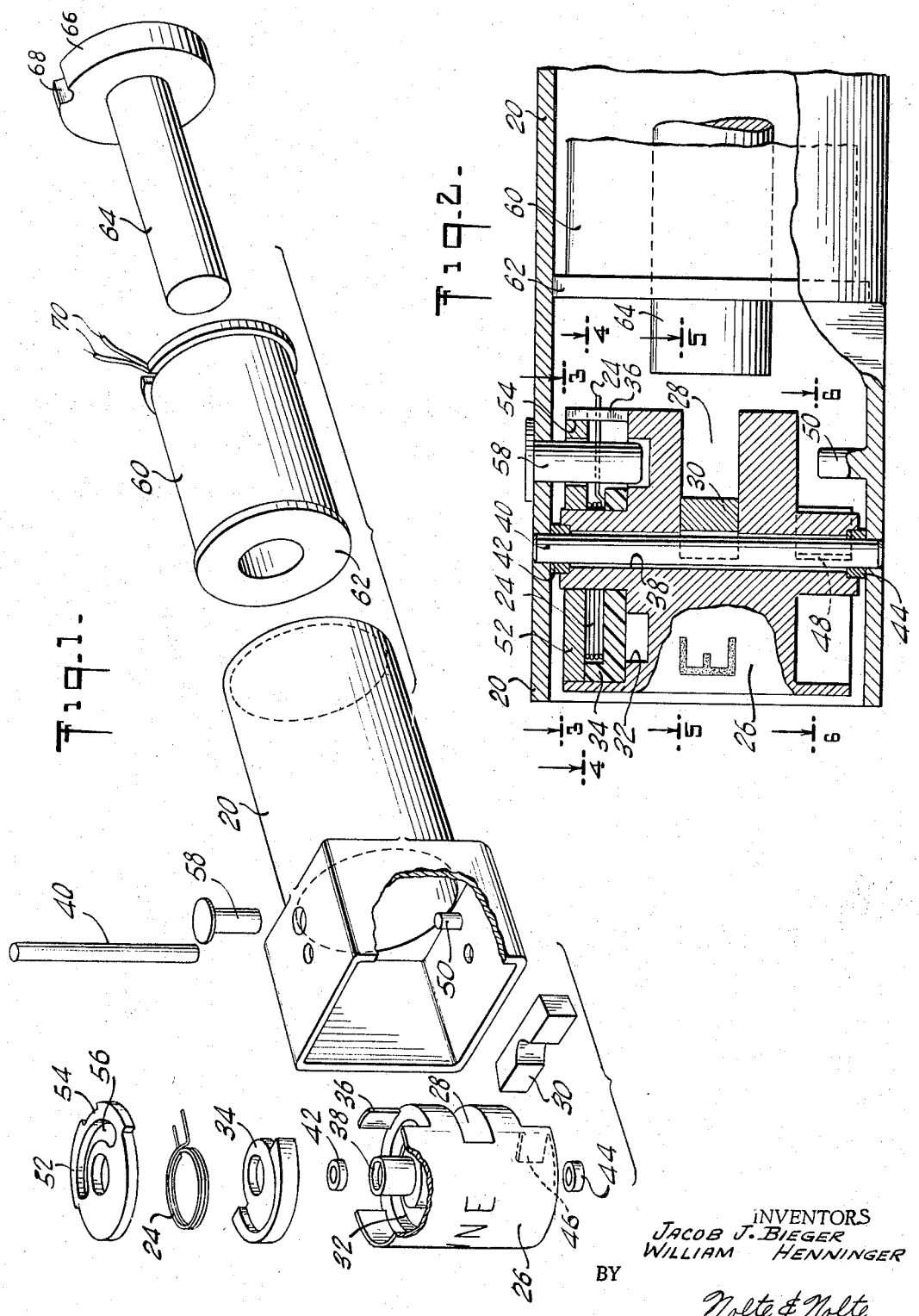
March 28, 1967 J. J. BIEGER ET AL 3,311,859

MAGNETIC DEVICE HAVING A PERMANENTLY MAGNETIZED ROTOR

Original Filed June 5, 1964 2 Sheets-Sheet 1



March 28, 1967 J. J. BIEGER ET AL 3,311,859

MAGNETIC DEVICE HAVING A PERMANENTLY MAGNETIZED ROTOR

Original Filed June 5, 1964 2 Sheets-Sheet 2

Fig. 3.

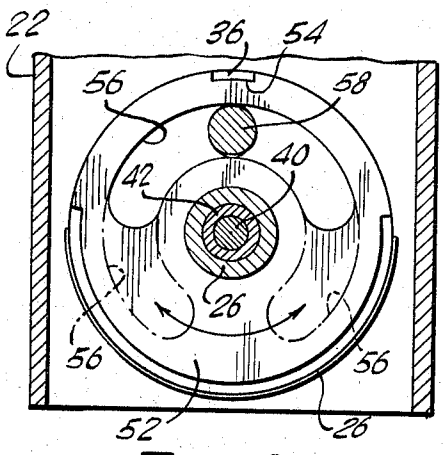


Fig. 4.

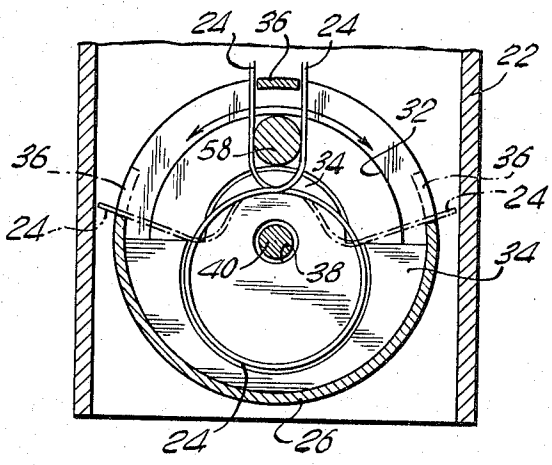


Fig. 6.

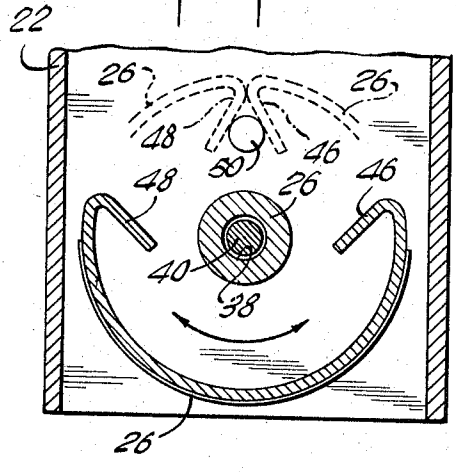


Fig. 5.

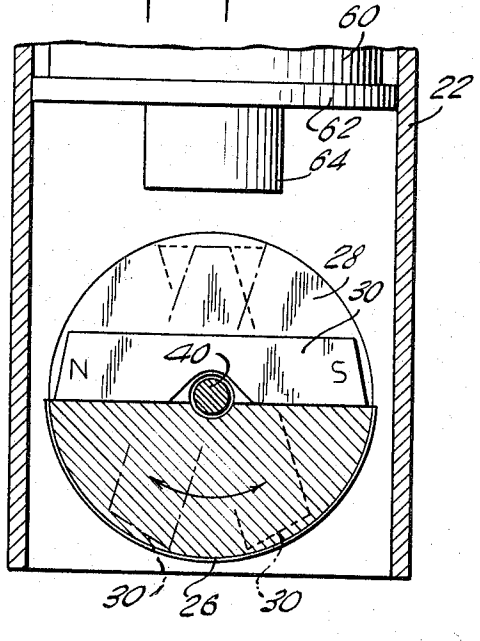
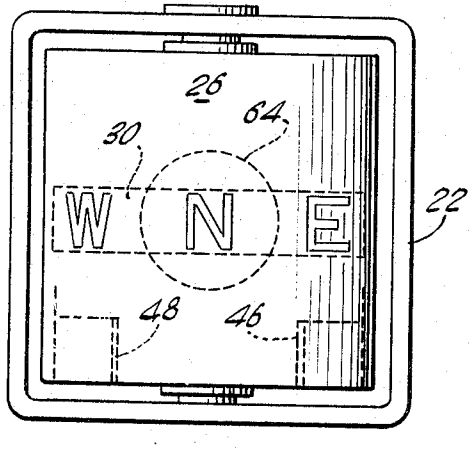


Fig. 7.



INVENTORS
JACOB J. BIEGER
WILLIAM HENNINGER

BY

Nolte & Nolte
ATTORNEYS

United States Patent Office 3,311,859 Patented Mar. 28, 1967

3,311,859

MAGNETIC DEVICE HAVING A PERMANENTLY MAGNETIZED ROTOR

Jacob J. Bieger, Queens Village, N.Y., and William Henninger, Paramus, N.J., assignors to Daco Instrument Company, Brooklyn, N.Y., a corporation of New York

Continuation of application Ser. No. 372,925, June 5, 1964. This application May 17, 1966, Ser. No. 550,872
5 Claims. (Cl. 335—230)

This invention relates in general to rotary actuators and more particularly to a three position rotary solenoid which may be used as an indicating device and is a continuation of application Serial No. 372,925, filed June 5, 1964, and now abandoned.

An object of the invention is to provide an improved three position rotary solenoid in which the rotor rotates about an axis perpendicular to the axis of the solenoid, and wherein a return spring biases the rotor to one of the three positions.

A feature of this invention is the use of a permanent bar magnet as a means for rotating the indicating device.

Another feature of this invention is the use of a mechanical spring for positioning the indicating device in a neutral position.

Further features and objects, and a more complete understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings in which:

FIG. 1 is an exploded perspective view of the invention.

FIG. 2 is a partial cross-section elevation view showing the rotor section of the invention.

FIG. 3 is a view along the line 3—3 of FIG. 2.

FIG. 4 is a view along the line 4—4 of FIG. 2.

FIG. 5 is a view along the line 5—5 of FIG. 2.

FIG. 6 is a view along the line 6—6 of FIG. 2.

FIG. 7 is a front view of the invention showing its use as an indicating device.

With reference to the drawings, in a preferred embodiment the invention is housed in a case comprising a cylindrical section 20 and a rectangular section 22. The case may be made of a magnetic material if shielding from other apparatus is desired. The rectangular section 22 of the case holds the rotor assembly, and the cylindrical case section 20 holds the stator or electromagnet coil assembly. A coil spring 24 cooperates with the rotor and stator to position the rotor in a neutral position as described more fully below.

The rotor includes a non-magnetic drum frame 26 which serves as a housing for the drum components and as a direct reading visual indicator. The structure of the drum frame 26 is best shown in FIG. 2. The center of the frame includes a longitudinal slot 28 to receive a permanent bar magnet 30. An annular opening 32 is cut in the top part of the frame 26 to receive an apertured semi-circular spring nest piece 34. A vertical tab 36 protrudes upwardly from the top part of the frame 26 between the extremities of the laterally extending arms of coil spring 24. Frame 26 has a cylindrical opening 38 running axially therethrough of sufficient diameter to receive a vertical rotor shaft 40. The top and bottom ends of the opening 38 are countersunk a sufficient depth to receive bearings 42 and 44 respectively. The bottom section of the frame 26, as shown in FIG. 6, includes inwardly bent tabs 46 and 48. These tabs limit the rotation of the rotor by contacting a vertical stop pin 50 located in the bottom of rectangular section 22 when the rotor is rotated approximately ninety degrees in a clockwise or counter-clockwise direction from the neutral position.

The rotor is assembled by seating spring 24 in a semicircular nest 34, and thereafter placing the spring and

nest assembly in the annular opening 32 in the top of drum frame 26 so that the vertical tab 36 projects between the horizontally extending arms of the spring 24 as shown in FIG. 4. Bearings 42 and 44 are then inserted in drum opening 38 and a plate cover 52, including a peripheral groove 54 and curved slot 56, placed over the top of the drum assembly so that the groove 54 engages vertical tab 36. After the drum assembly is inserted into the rectangular portion 22 of the housing, a stationary pin 58 is inserted through portion 22 and curved slot 56 between the arms of spring 24 so that it rests in the annular opening 32 in the drum frame 26. Shaft 40 is then inserted through the drum assembly and case 22, and secured in a suitable manner to provide an axis of rotation for the drum assembly.

The electromagnet coil assembly comprises a wire coil 60 wound on a spool-like coil form 62 into which a core 64, made of a magnetic material having relatively poor retentivity, is inserted. The coil assembly is inserted in the cylindrical case 20. A circular back cover 66 is also provided, the cover having a slot 68 to receive the electrical wires 70 of coil 60.

The permanent bar magnet 30 is positioned in drum 26 and positioned with respect to vertical tab 36 and stationary pin 58 so that it is perpendicular to the axis of the electro-magnet coil assembly. Thus, when a direct current or pulsating current is passed through coil 60, a magnetic-flux is generated in core 64 depending upon the direction of current flow in coil 60, causing magnetic poles to be established at the ends of core 64. Since one end of the core 64 is in close proximity to the drum frame 26, and thus to permanent magnet 30 located in the drum, drum frame 26 is caused to rotate in a clockwise or counter-clockwise direction depending upon the polar axis of permanent magnet 30 and the polarity of the magnetic pole of the core 64 adjacent permanent magnet 30. The rotation caused by the force of the magnetic fields, causes an increase in force in the opposite direction to be applied by the spring 24 against the vertical tab 36, causing one of the arms of the spring 24 to move in the same direction of rotation as the drum 26, the other arm being held by stationary pin 58. Removal of the energizing current causes the magnetic field in the core 64 to collapse, and thus the force applied by the spring 24 on the vertical tab 36 moves the drum 26 back to its neutral position.

A possible application of the rotatable actuator would be as an indicator, for example, to give three direct visual signals, such as N, E, W, as shown in FIG. 7.

Although the invention has been described with a certain degree of particularity, the present disclosure has been made only by way of example and numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. An electromagnetic device comprising housing means, a stationary electromagnet mounted in said housing means, said electromagnet including a core having a predetermined axis and made of a material having relatively poor retentivity characteristics, and an energizing coil concentrically mounted around said core for establishing magnetic flux in said core having a direction determined by the polarity of the energizing current applied to said coil, said core being magnetically polarized at its end sections in accordance with the direction of said flux, a rotor mounted for rotation in said housing means and being in an operable relationship with one of the poles of said electromagnet, said rotor having an axis of rotation perpendicular to the axis of said core, said rotor including a drum piece and permanent bar magnet, said

bar magnet having poles at opposite ends thereof and being mounted in said drum piece transverse to the axis of rotation of said rotor and magnetically cooperating with the poles of said electromagnet, and spring biasing means cooperating with said rotor for rotatably positioning said rotor in said housing means so that the polar axis of said bar magnet is transverse to the axis of said core of said electromagnet when the electromagnet is not energized.

2. An electromagnetic device according to claim 1, wherein said spring biasing means comprises a coil spring having ends parallel to each other and extending transversely from the axis of said coil spring, said device further including an upstanding tab member mounted along the wall of said drum piece and parallel to the axis of rotation of said rotor, the ends of said coil spring extending on both sides of said upstanding tab member, and a stationary stop pin extending through a hole in said housing means between said arms of said coil spring and into an aperture of said rotor.

3. An electromagnetic device according to claim 2, and further including a nest piece of positioning said coil spring on said rotor, said rotor also including an annular opening in the top portion of said drum piece to receive said nest piece, said coil spring being seated in the top portion of said nest piece, and a cover piece having a semicircular opening to accommodate the passage of said

stationary stop pin, said cover piece being mounted on top of said coil spring.

4. An electromagnetic device according to claim 3, further including a pair of tab members inwardly angled from opposite wall portions of the lower part of said drum piece, and a pin suitably mounted on an inner surface of said housing means so that said pin contacts one of said tab members when said rotor is rotated approximately 90° from a neutral position.

5. An electromagnetic device according to claim 1 and wherein said housing means has a cylindrical portion and a rectangular portion, said stationary electromagnet being mounted in said cylindrical portion and said core being concentrically arranged within said cylindrical portion of said housing means, said rotor being mounted for rotation in the rectangular portion of said housing means and having an axis of rotation perpendicular to the axis of said core.

References Cited by the Examiner

UNITED STATES PATENTS

2,415,452	2/1947	Taylor et al.	340—273
3,025,512	3/1962	Bloechi	340—373

BERNARD A. GILHEANY, *Primary Examiner.*

G. HARRIS, *Assistant Examiner.*