

March 29, 1966

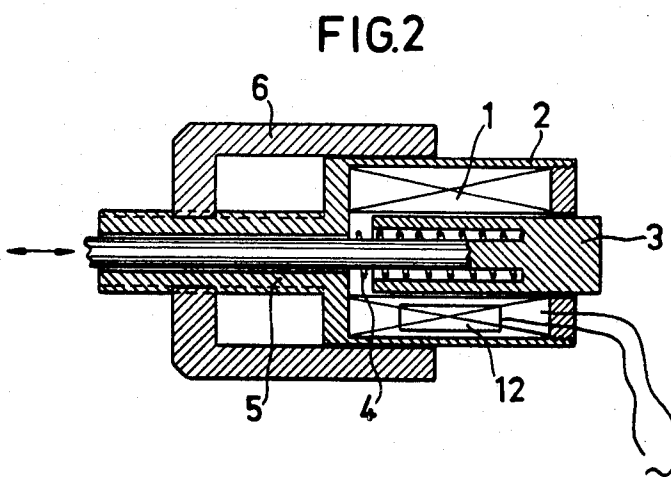
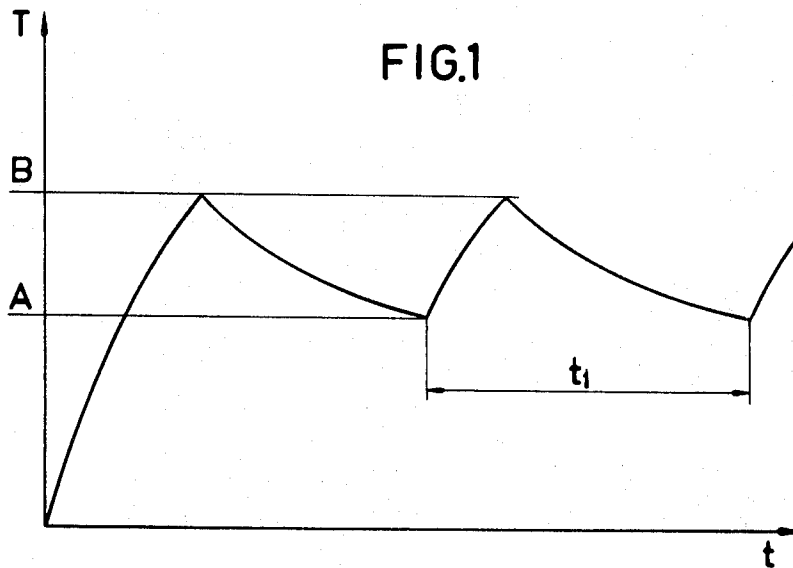
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ELECTRO-MECHANICAL ACTUATING DEVICES

Filed Oct. 28, 1963

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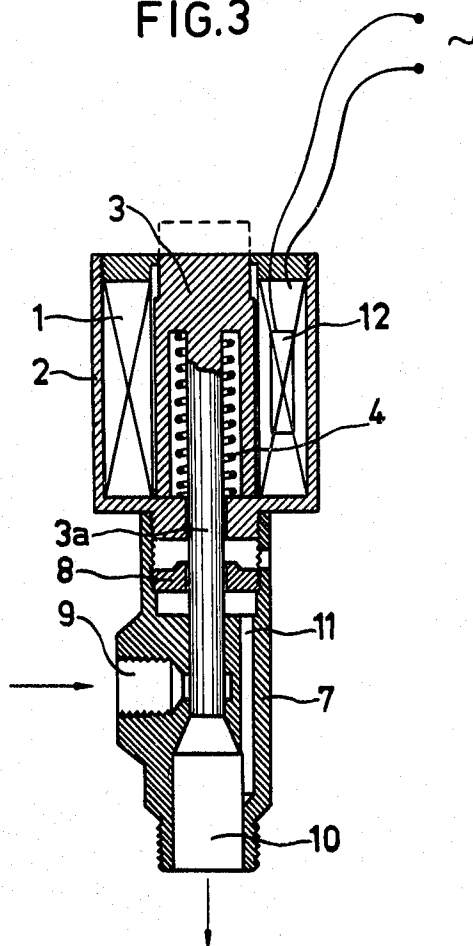
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ELECTRO-MECHANICAL ACTUATING DEVICES

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FIG.3



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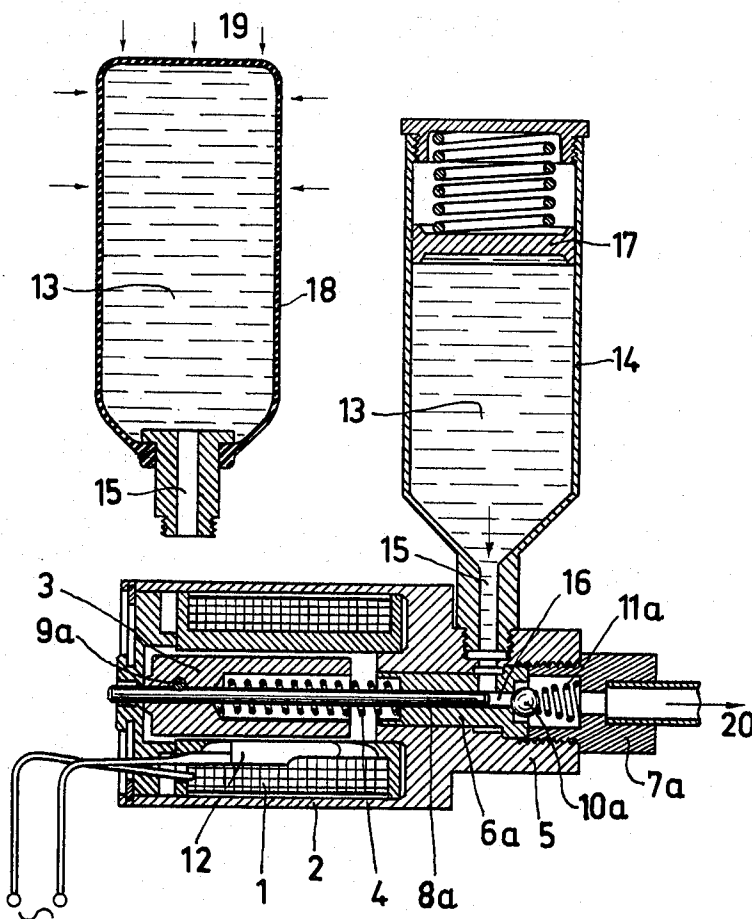
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FIG. 4a

FIG. 4



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ELECTRO-MECHANICAL ACTUATING DEVICES
Urban Molin, Lidingo, and Stig Lennart Hallerback,
Sodertalje, Sweden, assignors to Aktiebolaget W. Dan
Bergman, Sodertalje, Sweden, a Swedish joint-stock
company

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4 Claims. (Cl. 184—14)

The present invention relates to an electro-mechanical actuating device of the type provided with a coil (solenoid) and a spring-loaded magnet core which is movably disposed within the coil or close thereto.

It is known to employ electric actuating devices for the purpose of energizing or de-energizing apparatus which is fed with an electric current. In a simple form, such apparatus may be a common electric buzzer.

It is an object of the invention to provide an actuating device that may generate actuating pulses with a very low frequency which lies outside (below) the range of that of known apparatus, but which is desirable in certain cases. According to the invention, this and other objects are attained by providing temperature-sensitive means, within or close to the coil winding, said means being a switch for example of the bi-metal type, connected in series with the coil winding so that after connecting the coil to a source of current, the heating of the coil and the temperature-sensitive means will cause the breaking-off of the current passing through the coil, when a predetermined temperature has been attained, whereas the ensuing cooling will cause closing of the current at another predetermined temperature. Consequently a reciprocating movement of the magnet core with a frequency which is very low by reason of the relatively great heat inertia of the device will be caused. For some fields of use frequencies of the order of a few pulses per hour may be desired. That will be readily attained with a device according to the invention and that even within a narrowly limited temperature range.

According to another aspect of the invention, the frequency of energizing and de-energizing the coil may be controlled by means of heat accumulating means formed as a sleeve which surrounds the coil for a greater or lesser part of its length. By this arrangement the rate of heat dissipation from the coil may be controlled, and consequently the frequency by which the coil is energized and deenergized.

Some embodiments of the invention will now be described with reference to the drawings, in which:

FIG. 1 illustrates diagrammatically the operation of a device according to the invention,

FIG. 2 is an axial sectional view of an actuating device, FIG. 3 is an axial sectional view of an actuating device combined with an automatic flow valve,

FIG. 4 is an axial sectional view of a lubricating device, and FIG. 4a illustrates a modification of a portion of the assembly of FIG. 4 which latter illustrates the lubricating device forming a unit with an actuating device according to the invention.

FIG. 1 shows the temperature T of an electric coil 1, such as illustrated in FIGS. 2 to 4, plotted against time t . The rising branches of the curve correspond to the energizing of the coil, i.e., heating, and the down-grade (falling) curve portions illustrate the cooling of the coil when it is de-energized. The current is closed at A and broken off at B. Particularly through variation of the cooling conditions, it is possible to influence, to a great extent, the frequency by which the coil is energized and de-energized, and consequently the duration t_1 of a complete cycle.

In FIG. 2 an actuating device is illustrated. The said device comprises a coil 1 which is surrounded by a cylindrical housing 2. The coil 1 surrounds, in its turn, an axially movable magnet core 3 which will be pulled into the coil, when energized, against the action of a compression spring 4, housed in a recess in the core 3 and abutting the end wall of housing 2.

A small temperature-sensitive switch 12 is connected in series with the coil, and is disposed within or close to the latter, so that it will break off the current passing through the coil, when the latter has attained a predetermined temperature. When the coil has cooled down to another predetermined temperature, the switch will close again.

The housing 2 is shaped integrally with an extension 5 with reduced cross section, and this extension is threaded, and receives a cup-shaped member 6. The latter may be brought to cover housing 2 over a greater or lesser portion of its length by being turned relative to the latter, its inner diameter being slightly greater than the housing outer diameter. In that way, the heat dissipation from the coil 1, and consequently the frequency by which the coil is energized and de-energized may be varied within wide limits.

The cup member 6 may alternatively be rigidly mounted relative to the housing 2, or may be left out altogether, if the said frequency need not be variable.

In FIG. 3 an actuating device according to the invention is illustrated as combined with a flow valve, to form an automatic flooding device. The reference numerals correspond to those in FIG. 2. The extended portion 3a of the magnet core 3 forms the movable member of a flow valve, the housing 7 of which is threaded onto the housing 2. In the valve housing 7 a seal 8 is mounted, and is passed through by the extension 3a. The latter fills up a central bore in the valve housing 7 sealingly, but with axial freedom of movement. A passage 9 for connection to a source of pressurized water joins the central bore laterally, and when the extension 3a is raised by the force of the spring 4, water will flow off through the valve outlet 10. Water that may have penetrated into the chamber below the seal 8 is lead off through a lateral passage 11 from the said chamber to the outlet. A small temperature-sensitive switch 12 is mounted within the coil 1, and closes and breaks off the current when the coil has cooled down to a predetermined temperature, or has been heated up to another, predetermined higher temperature, respectively, corresponding to A and B on FIG. 1.

In the illustrated embodiment flooding will take place when the coil 1 becomes de-energized. The opposite arrangement may, however, readily be employed within the scope of the invention.

A most important field of use for the present invention is for the automatic lubrication of machinery of different kinds, particularly such machinery which is not well suited for manual lubrication. As an example a submersible pump may be chosen which may have to operate unattended for long hours below the water level, and which must receive adequate lubrication of its bearing seals to prevent water from penetrating into the shaft bearings.

A lubricating arrangement of this kind is illustrated on FIG. 4. As in the embodiments described above, the coil 1 is accommodated in the housing 2, and surrounds an axially movable magnet core 3 which is pulled into the coil when the latter is energized by an electric current passing therethrough.

A small temperature-sensitive switch 12 is connected in series with the coil, and is mounted within or close to the latter. The switch 12 breaks off the current when the coil has reached a predetermined temperature, and

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closes it again after the coil has cooled down to another predetermined temperature. The housing 2 is formed with an extension 5, and a cylinder 6a is mounted within said extension 5, and is secured by a threaded clamping element 7a. A plunger 8a is axially movable within the cylinder 6a, and is rigidly connected to the magnet core by a dowel pin 9a. The outer end of the cylinder 6a is closed by a ball 10a which is loaded by a compression spring 11a.

Lubricant 13 is kept in a reservoir 14 which is connected by a conduit 15 to a pressure chamber 16 in front of the plunger 8a. A spring-loaded piston 17 acts against the lubricant 13 to force the latter through conduit 15 to pressure chamber 16 when the magnet core 3 and the plunger 8a are in their inactive position illustrated in the drawing (coil de-energized).

When the switch 12 closes the current the magnet core 3 will be pulled into the coil 1. The plunger 8a consequently forces the lubricant in chamber 16 past the ball valve 10a and the displaced lubricant in its turn forces the lubricant already behind the valve and in the lubricating line forward. When the coil 1 has been heated to such a degree that the switch breaks off the current, the magnet core 3 and the plunger 8a will be forced back by spring 4. The chamber 16 will now be filled with a fresh quantity of lubricant, partly by the pressure acting upon the latter, partly by the vacuum which forms in the chamber when the plunger 8a is moved back. When the temperature of the coil 1 and switch 12 has sunk to a predetermined value, the current will be closed again, and the cycle will be repeated.

The lubricant reservoir 18 (FIG. 4a) may be made of an elastomer such as synthetic rubber as illustrated by FIG. 4a. An outer pressure, for instance water pressure, will cause the lubricant to be fed to the chamber 16, and the piston 17 with its spring will become unnecessary. Such an arrangement is particularly suited for a pump or other machinery upon which an exterior pressure 19 acts.

In a further development of the invention, an electrical coupling device may be provided which is actuated by the mechanical movement of the magnet core. By that arrangement it will be possible to energize or de-energize with a low frequency solenoids or to let them receive brief current pulses. This principle may also be applied to the flooding device and lubricating apparatus described above. In the former case, it would be preferable to use energizing and de-energizing cycles, and in the latter case to employ brief current pulses. The energizing and de-energizing cycles may readily be generated by using the mechanical movement of the magnet core for closing or opening a pair of contacts, respectively. The brief current

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pulses may be generated by employing a mercury dip switch, the mercury of which flows momentarily over the contacts to be closed or opened, during its movement from one end position to the other.

5 What we claim is:

1. With an electro-mechanical device comprising an electric coil and a magnet core disposed coaxially therewith, and movable against the bias of a pretensioned spring accommodated in a recess in said coil, a heat-sensitive current switch incorporated with the coil, and a housing disposed around the latter, the combination of a flow valve comprising a valve housing, means for rigidly connecting said valve housing to said coil housing, and a valve member adapted to control a passage between a liquid inlet and a liquid outlet in said valve housing, said valve member forming an extension of said magnet core.

2. The combination of an electro-mechanical actuating device with a lubricating apparatus, wherein said actuating device comprises an electric coil, a magnet core movable within said coil coaxially thereof, spring means adapted to bias said core in the longitudinal direction, heat-sensitive switch means incorporated with said coil and electrically connected in series therewith, and a housing surrounding the coil-and-core assembly, with a lubricating apparatus comprising a lubricating pressure cylinder accommodated in a bore in said housing and held in a predetermined position therein by locating means, a plunger member movable within said cylinder and rigidly connected to said magnet core, a reservoir for lubricant connected to said housing to feed lubricant into said cylinder through a transverse bore in the latter, and biased valve means for admitting lubricant into lubrication line means upon the forward stroke of said plunger member.

3. The combination claimed in claim 2, comprising means adapted to exert a pressure upon the lubricant held in the reservoir, to feed it into said cylinder when the plunger member has performed its return stroke.

4. The combination claimed in claim 2, comprising means adapted to transmit an ambient pressure to the lubricant held in the reservoir, whereby said lubricant will be fed into said cylinder when the plunger member has performed its return stroke.

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50 LAVERNE D. GEIGER, *Primary Examiner*.

H. BELL, *Assistant Examiner*.