

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 0 779 413 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.06.1997 Bulletin 1997/25

(51) Int. Cl.⁶: **F01M 11/04**, F01M 11/06

(21) Application number: **96119797.7**

(22) Date of filing: **10.12.1996**

(84) Designated Contracting States:
CH DE ES FR GB IT LI SE

(30) Priority: **12.12.1995 IT TO950994**

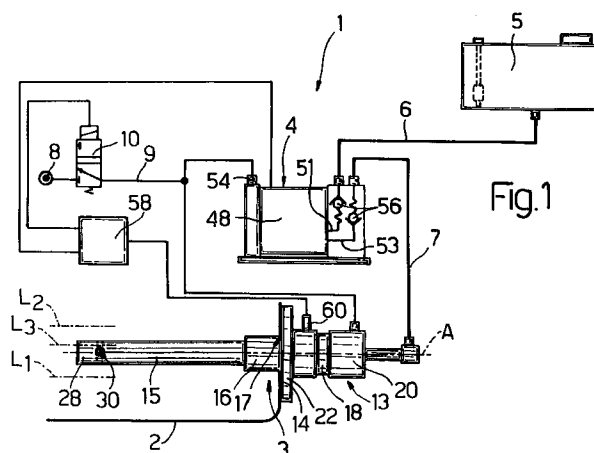
(71) Applicant: **IVECO FIAT S.p.A.**
10156 Torino (IT)

(72) Inventors:
• **Chicarella, Mauro**
14010 Revignano (IT)
• **Lucco, Antonio**
10091 Alpignano (IT)

(74) Representative: **Franzolin, Luigi et al**
STUDIO TORTA S.r.l.,
Via Viotti, 9
10121 Torino (IT)

(54) **Device for automatically topping-up a container with liquid and method for controlling said device**

(57) A device (1) for automatically topping-up a container (2) with liquid, provided with a pump (4) having a piston (50) moving in a chamber (49) having an intake orifice (51) connected to a liquid collecting reservoir (5) and a delivery orifice (53) connected to the container (2), with means (8, 10) for actuating the pump (4), with a sensor assembly (15, 33, 60) adapted to enable a topping-up cycle to be carried out if the level of liquid in the container (2) is below a desired level (L3), and with an electronic control unit (58) which is connected to said actuating means (8, 10) and to the sensor assembly (15, 33, 60), and which energises for intervals of time T_2 of preset duration the actuating means (8, 10) to carry out successive topping-up cycles in response to an enabling signal (S) generated by the sensor assembly (15, 33, 60).



EP 0 779 413 A1

Description

The present invention relates to a device for automatically topping-up a container with liquid, in particular for topping-up with lubricating oil the sump of a heat engine of a commercial vehicle, to which the following description will refer explicitly without resorting to unnecessary generalities. Furthermore, the present invention relates to a method for controlling said device.

The known devices essentially comprise a pump provided with a pneumatically operated piston moving in a chamber having an inlet orifice connected via an intake duct to an oil collecting reservoir and an outlet orifice connected via a delivery duct to the sump; the piston can move from a retracted position into an advanced position, and vice versa, so as to carry out a cycle for topping-up the sump with oil.

Devices of this type also comprise a level sensor adapted to enable the topping-up cycle to be carried out if the oil level in the sump is below a desired level and they are operative while the vehicle is in operation.

However, devices of the type briefly described above have a number of drawbacks.

In particular, owing to the variability of the ambient temperature and, therefore, of the viscosity of the oil, a timed topping-up cycle involves feeding a variable quantity of oil from the pump to the sump; in the particular case of low ambient temperature and, therefore, high oil viscosity, the completion of injection could be precluded within the preset time.

Moreover, the reading of the oil level in the sump while the vehicle is in operation cannot be carried out accurately or reliably, since it cannot take into account the quantity of oil in use in the lubricating circuit and, therefore, not present in the sump.

The object of the present invention is to devise a device for automatically topping-up a container with liquid, which does not have the drawbacks associated with the known devices described above.

This object is achieved by the present invention in that it relates to a device for automatically topping-up a container with liquid, comprising:

- a pump comprising, in turn, a first piston moving in a first chamber having an intake orifice connected to a liquid collecting reservoir and a delivery orifice for the liquid itself, said piston being able to move from a retracted position into an advanced position, and vice versa, so as to carry out a cycle for topping-up said container with liquid;
- means for actuating said pump;
- means for hydraulically connecting said delivery orifice to said container;
- sensor means for enabling a topping-up cycle to be carried out if the level of liquid in said container is below a desired level, and
- an electronic control unit connected to said actuating means and to said sensor means;

characterised in that said control unit comprises energising means for intervals of time of preset duration of said actuating means to carry out successive topping-up cycles in response to an enabling signal generated by said sensor means.

The present invention also relates to a method for automatically topping-up a container with liquid.

According to the present invention a method is provided for controlling a device for automatically topping-up a container with liquid, in particular with oil in the sump of a vehicle engine, said device comprising:

- a pump comprising, in turn, a piston moving in a first chamber having an intake orifice connected to a liquid collecting reservoir and a delivery orifice for the liquid itself, said piston being able to move from a retracted position into an advanced position, and vice versa, so as to carry out a cycle for topping-up said container with liquid;
- means for actuating said pump;
- means for hydraulically connecting said delivery orifice to said container, and
- sensor means for enabling a topping-up cycle to be carried out if the level of liquid in said container is below a desired level, and

said method being characterised in that it comprises the stages of:

- energising said actuating means for intervals of time of preset duration, and
- de-energising said actuating means;

said energising and de-energising stages defining said topping-up cycle and being repeated cyclically to carry out successive topping-up cycles in response to an enabling signal generated by said sensor means.

With a view to a better understanding of the present invention a preferred embodiment will be described non-restrictively by way of example below, with reference to the accompanying drawings, in which:

Figure 1 illustrates schematically a device for automatically topping up a container with liquid, designed in accordance with the present invention. Figure 2 is an axial section, on an enlarged scale, of a detail of the device in Figure 1; Figure 3 is an axial section, on an enlarged scale, of another detail of the device in Figure 1; Figure 4 is a section along the line IV-IV in Figure 3, and Figure 5 is a logic block diagram showing the operations performed by a control unit of the device in Figure 1, in accordance with the control method of the present invention.

Referring now to Figure 1, the reference numeral 1 generally designates a device for automatically topping-up a container with liquid, in particular for topping-up

with lubricating oil a sump 2 of a heat engine (not shown) of a commercial vehicle (not shown).

The device 1 comprises a pneumatically operated injector 3 adapted to feed a predetermined quantity lubricating oil to the sump 2, and a pneumatically operated pump 4 connected to an oil reservoir 5 and to the injector 3 respectively by means of an intake duct 6 and a delivery duct 7. The device 1 also comprises a compressed air supply 8 connected via a pipe 9 to the injector 3 and to the pump 4, and a two-way, two-position solenoid valve 10 which is normally closed and arranged in series with the pipe 9.

Referring now to Figures 1 and 2, the injector 3 comprises a casing 13 fixed externally to and projecting through a side wall 14 of the sump 2 and having an axis A substantially parallel to the free surface of the oil in the sump 2 itself, and an internally hollow blind cylinder 15 which has an axis A and is arranged inside the sump 2 between the minimum and maximum oil levels, respectively L1 and L2 in Figure 1, and which is securely connected with the casing 13.

In particular, the casing 13 comprises a first sleeve 16 partly inserted inside the sump 2 through a hole 17 coaxial to the axis A provided in the wall 14, a second sleeve 18 disposed outside the sump 2 and securely connected with the sleeve 16, a cylindrical body 20 which is securely connected with the sleeve 18 on the other side of the sleeve 16 and which has a passage 21 on the axis A. The casing 13 also comprises a flange 22 which is fitted on to the sleeve 16 and is securely connected therewith, and which is adapted to be fixed to the wall 14 of the sump 2 with the interposition of sealing means 24.

The sleeves 16 and 18 define internally a cylindrical chamber 23 on the axis A and communicating at one end with the internal volume of the cylinder 15 and at the opposite end with the passage 21.

The cylindrical body 20 also comprises a blind radial threaded hole 26 adapted to be engaged by an end connector of the pipe 9, and an opening 27 parallel to the axis A and connecting the hole 26 with the chamber 23.

The cylinder 15 has a blind end 28 disposed in a substantially central position inside the sump 2 and an opposite end 29 accommodated in the sleeve 16. In particular, the cylinder 15 is provided with a plurality of radial through-holes 30 which are provided in its side wall and are disposed in the vicinity of its blind end 28, and which are adapted to communicate the interior of the sump 2 with the cylinder 15 itself. Moreover, in alignment with its end 29 the cylinder 15 has an annular projection 31 arranged to abut against an associated inner annular shoulder 32 provided in the sleeve 16.

The injector 3 also comprises a piston 33 mounted to slide axially and in a sealed manner inside the cylinder 15 and defining with the walls of the blind end 28 of the cylinder 15 itself a substantially cylindrical chamber 34, a pneumatic actuator member 35 adapted to actuate the piston 33, and a tubular shaft 36, which is coax-

ial to the A, securely connected to the piston 33 and to the actuator member 35 and defining an axial duct 37 communicating with the oil-delivery duct 7 through an end connector 43; moreover, the shaft 36 extends through the cylinder 15 and the casing 13 and engages in a sliding manner the passage 21 of the cylindrical body 20.

The piston 33 acts as a level sensor for the oil in the sump 2 and is adapted to slide inside the cylinder 15 only when the oil level in the sump 2 is below a level L3 at which the cylinder 15 is completely submerged and, therefore, a given amount of compressible air is present in the chamber 34.

The piston 33 also comprises an intermediate section 38 of reduced diameter defining with the wall of the cylinder 15 itself an annular duct 39 and a substantially T-shaped duct 40 which is provided in the body of the piston 33 itself and has an axial hole 41 on the axis A communicating with the duct 37 and a diametral hole 42 which communicates with the annular duct 39.

The actuator member 35 is adapted to displace the piston 33 between a retracted fluidtight separating position between the duct 40 and the holes 30 in the cylinder 15 and an advanced opening position, in which the duct 40 communicates with the holes 30.

The actuator member 35 is formed by a further annular piston which is coaxial to the axis A and is mounted to slide in a sealed manner inside the sleeve 18, and which is securely connected outwardly to the side wall of the shaft 36 by means of a resilient abutment ring 46 secured to the shaft 36 and compressed between the piston 33 and a bush 44 screwed therein. The piston 35 is held adjacent the body 20 by a helical spring 47 accommodated in the chamber 23 around the shaft 36 and compressed axially between the piston 35 and the annular projection 31 of the cylinder 15. The piston 35 is actuated pneumatically by the compressed air supplied by the supply 8 to the opening 27 and acting on the piston 35 itself in the opposite direction to the force of the spring 47.

Referring now to Figures 3 and 4, the pump 4 comprises a substantially parallelepipedal body 48 defining internally a substantially cylindrical chamber 49, and a piston 50 mounted to slide in a sealed manner inside the chamber 49 itself.

The pump 4 also has an inlet orifice 51 provided in a head 52 of the body 48 and connected with the oil-intake duct 6 and with the chamber 49, an outlet orifice 53 also provided in the head 52 and connected with the delivery duct 7 and with the chamber 49 on the same side as the orifice 51, and a compressed-air supply orifice 54 provided in a head 55 opposite the body 48 and connected with the pipe 9 and with the chamber 49 on the opposite side to the orifices 51 and 53. Respective non-return valves 56 are also provided in the orifices 51 and 53 and they are adapted to allow flow only to and from the chamber 49, as indicated by the arrows in Figure 4.

The piston 50 is held pressed against the head 55

by a helical torsion spring 57 accommodated in the chamber 49 and compressed between the piston 50 and the head 55 itself.

According to the present invention, the device 1 also comprises an electronic control unit 58 connected to the solenoid valve 10, to the injector 3 and to the pump 4, and a proximity sensor 60 which is accommodated in a radial seat 61 provided in the sleeve 16 and is connected to the control unit 58, and which is adapted to detect any displacement of the piston 35 relative to the casing 13 and to generate an enabling signal S for carrying out a topping-up cycle of oil in the sump 2, if the piston 35 is displaced with respect to its inoperative position.

The control unit 58 is adapted to manage automatically the operation of topping up the oil in the sump 2 in accordance with the method described below.

Referring now to the diagram in Figure 5, from a block 62 at the start of the cycle a block 63 is reached for verifying the removal of the ignition key of the vehicle from the respective control panel. If this is not so, a return to the start of the cycle takes place; in the affirmative, a delay block 64 of predetermined duration T_1 is reached, for example five minutes, so as to allow all the oil in circulation to return to the sump 2.

At this point, the operation passes to a block 65 for energising the solenoid valve 10, which is switched over into a position for opening the connection between the supply 8 and the pipe 9.

Therefore, from the block 65 the operation passes to a delay block 66 for a period of time T_2 of predetermined duration, for example equal to ten seconds, calculated so as to allow the flow of all the oil to the sump 2 at any value of oil viscosity within a range which is defined as a function of the possible ambient operating temperatures of the vehicle. At this point, the operation passes to a block 67 for reading the proximity sensor 60 and to a block 68, in which it is verified whether the sensor 60 has generated the enabling signal S. If this is not so, the operation passes to a block 77 for de-energising the solenoid valve 10 and to a block 69. In the affirmative, the operation passes to a block 70 for calculating and verifying whether the number of times the solenoid valve 10 is energised is equal to or higher than a preset number N, in the case in question sixty energising operations. In the affirmative, the operation passes to an alarm block 71 and to the end-of-cycle block 69; if this is not so, the operation passes to a block 72 for de-energising the solenoid valve 10 which is switched to a position closing the connection between the supply 8 and the pipe 9.

Therefore, from the block 72 the operation passes to a delay block 73 for a period of time T_3 of predetermined duration, for example equal to ten seconds, which is sufficient to ensure that the device returns to the inoperative condition and to ensure the filling of the chamber 49 of the pump 4.

The operation then passes to a block 74 for reading the proximity sensor 60 and to a block 75, in which it is

verified whether the enabling signal S of the sensor 60 is de-energised. In the affirmative, a return to the start of the cycle takes place; if this is not so, the operation passes to the alarm block 71 and to the end-of-cycle block 69.

Finally, the control unit 58 comprises a push-button 76 for the manual actuation of the operation of topping up the sump 2 with oil. In the event of manual operation, the operations carried out by the control unit 58 are those described above starting from block 65.

The operation of the device 1 has been described starting from an initial condition, in which the vehicle engine is inoperative, the solenoid valve 10 is closed and the ignition key for the engine is removed from the control panel (not shown) of the vehicle itself. Moreover, in this initial condition, the piston 50 of the pump 4 is held by the spring 57 in abutment against the head 55, the piston 35 of the injector 3 is held by the spring 47 in abutment against the body 20 and the duct 37 is filled with oil.

The signal sent by the control unit 58 induces the opening of the solenoid valve 10, thus allowing compressed air to flow towards the orifice 54 and the opening 27. The pressure applied by the air originating from the orifice 54 induces the piston 50 to be displaced towards the head 52 of the body 48, whereby the oil present in the chamber 49 is fed to the injector 3.

If the oil level in the sump 2 is equal to or higher than the level L3, the oil in the sump 2 completely fills the chamber 34 and, owing to its inability to be compressed, prevents the full travel of the piston 33 towards the advanced opening position and, therefore, also of the piston 35 secured thereto. No topping up takes place since the duct 40 remains isolated from the injector holes 30. The piston 35, which is prevented from completing its travel, does not induce the tripping of the proximity sensor 60 and, therefore, the control unit 58 operates the stopping of the operation.

In the event that the oil level in the sump 2 is below the level L3, the presence of compressible air inside the chamber 34 allows the full travel of the pistons 33 and 35. However, the piston 33 is displaced towards the blind end 28 of the cylinder 15 in the connecting position of the annular duct 39 with the holes 30 and allows the injection of oil into the sump 2. The displacement of the piston 35 towards the sleeve 16 induces the tripping of the proximity sensor 60 which sends an enabling signal to the control unit 58. After the time T_2 has elapsed, which is sufficient for the flow of all the oil from the chamber 49 to the sump 2, the solenoid valve 10 is switched over and the topping-up cycle is terminated.

The control unit 58 verifies that the number of already completed energising operations of the solenoid valve 10 is not higher than the number N, in which case it actuates the alarm.

At this point, the control unit 58 de-energises the solenoid valve 10 by switching it to the closed position and thus preventing the flow of compressed air towards the orifice 54 and the opening 27. Therefore, the control

unit 58 verifies that the enabling signal S of the sensor 60 is disabled and thus that the piston 35 has returned into its inoperative position.

After the time T_3 from the de-energising of the solenoid valve 10 has elapsed, the control unit 58 energises the solenoid valve 10 again and this cycle is repeated until the oil level L3 in the sump 2 is fully restored, with consequent omission of the signal from the proximity sensor 60 and the stopping of the operation.

The advantages which can be achieved with the present invention are apparent from a study of the features of the device 1 designed in accordance therewith.

In particular, the fact that the restoring of the oil level L2 in the sump 2 is carried out in successive cycles of sufficient length to allow the flow of all the oil from the pump 4 to the sump 2 in any condition of ambient temperature and, therefore, of oil viscosity, assures the efficiency and repeatability of the topping-up operation.

Furthermore, the fact that the cycle of topping up the sump 2 with oil is carried out with the vehicle stationary and that it is started after the period of time T_1 from the switching-off of the engine allows all the circulating oil to return to the sump 2 and, therefore, accurate and reliable reading of the oil level

Finally, it is evident that the device 1 can be subject to modifications and variants which do not depart from the scope of protection of the claims.

Claims

1. A device (1) for automatically topping-up a container (2) with liquid, comprising:

- a pump (4) comprising, in turn, a first piston (50) moving in a first chamber (49) having an intake orifice (51) connected to a liquid collecting reservoir (5) and a delivery orifice (53) for the liquid itself, said piston (50) being able to move from a retracted position into an advanced position, and vice versa, so as to carry out a cycle for topping-up said container (2) with liquid;
- means (8, 10) for actuating said pump (4);
- means (37, 40) for hydraulically connecting said delivery orifice (53) to said container (2);
- sensor means (15, 33, 60) for enabling a topping-up cycle to be carried out if the level of liquid in said container (2) is below a desired level (L3), and
- an electronic control unit (58) connected to said actuating means (8, 10) and to said sensor means (15, 33, 60);

characterised in that said control unit (58) comprises energising means (65) for intervals of time T_2 of preset duration of said actuating means (8, 10) to carry out successive topping-up cycles in response to an enabling signal (S) generated by said sensor means (15, 33, 60).

2. A device according to claim 1, characterised in that said actuating means comprise a compressed air supply (8) connected via a pipe (9) to said first chamber (49) of the pump (4), and a solenoid valve (10) which is normally closed, is arranged in series with the pipe (9) and which is adapted to be disposed in a position opening the connection between said supply (8) and said first chamber (49) under the control of said energising means (65).
3. A device according to claim 1 or 2, characterised in that said sensor means comprise a cylindrical piston (15, 33) having a second piston (33) adapted to slide in a sealed manner in a second chamber (34) when the level of liquid in said container (2) is below said desired level (L3), and a proximity sensor (60) adapted to detect the displacement of said second piston (33) inside said second chamber (34) and to generate said respective enabling signal (S).
4. A device according to any one of the preceding claims, characterised in that said control unit (58) also comprises means (67, 74) for reading the enabling signal (S) generated by said sensor means (15, 33, 60), means (68) for calculating the number of energising operations of said actuating means (8, 10), and means (71) for actuating an alarm if said number of energising operations exceeds a preset value (N).
5. A device according to any one of the preceding claims, characterised in that said container (2) is the sump of a heat engine of a commercial vehicle, and said liquid is lubricating oil.
6. A device according to claim 5, characterised in that said control unit (58) comprises enabling means (64) for energising said actuating means (8, 10) after a period of time (T_1) of preset duration has elapsed after the switching-off of the engine of said vehicle.
7. A device according to claim 5 or 6, characterised in that the duration (T_2) of the energising operation of said actuating means (8, 10) is calculated so as to allow the flow of all the oil from the pump (4) to the sump (2) at any value of oil viscosity within a range which is defined as a function of the possible ambient operating temperatures of the vehicle.
8. A method for controlling a device (1) for automatically topping-up a container (2) with liquid, in particular with oil in the sump (2) of a vehicle engine, said device comprising:
 - a pump (4) comprising, in turn, a piston (50) moving in a first chamber (49) having an intake orifice (51) connected to a liquid collecting reservoir (5) and a delivery orifice (53) for the liq-

uid itself, said piston (50) being able to move from a retracted position into an advanced position, and vice versa, so as to carry out a cycle for topping-up said container (2) with liquid;

5

- means (8, 10) for actuating said pump (4);
- means (37, 40) for hydraulically connecting said delivery orifice (53) to said container (2), and
- sensor means (15, 33, 60) for enabling a topping-up cycle to be carried out if the level of liquid in said container is below a desired level (L3),

10

said method being characterised in that it comprises the stages of:

15

- energising said actuating means (8, 10) for an interval of time (T_2) of preset duration, and
- de-energising said actuating means (8, 10);

20

said energising and de-energising stages defining said topping-up cycle and being repeated cyclically to carry out successive topping-up cycles in response to an enabling signal (S) generated by said sensor means (15, 33, 60).

25

9. A method according to claim 8, characterised by comprising a preliminary delay stage of preset duration (T_1) after the switching-off of the engine.
10. A method according to any one of claims 7 to 9, characterised in that said energising stage comprises the operation of displacing at least one movable member (33) of said sensor means (15, 33, 60).
11. A method according to claim 10, characterised in that it comprises a stage for enabling the repetition of said energising and de-energising stages, said enabling stage comprising verification of the displacement of said movable member (33).

30

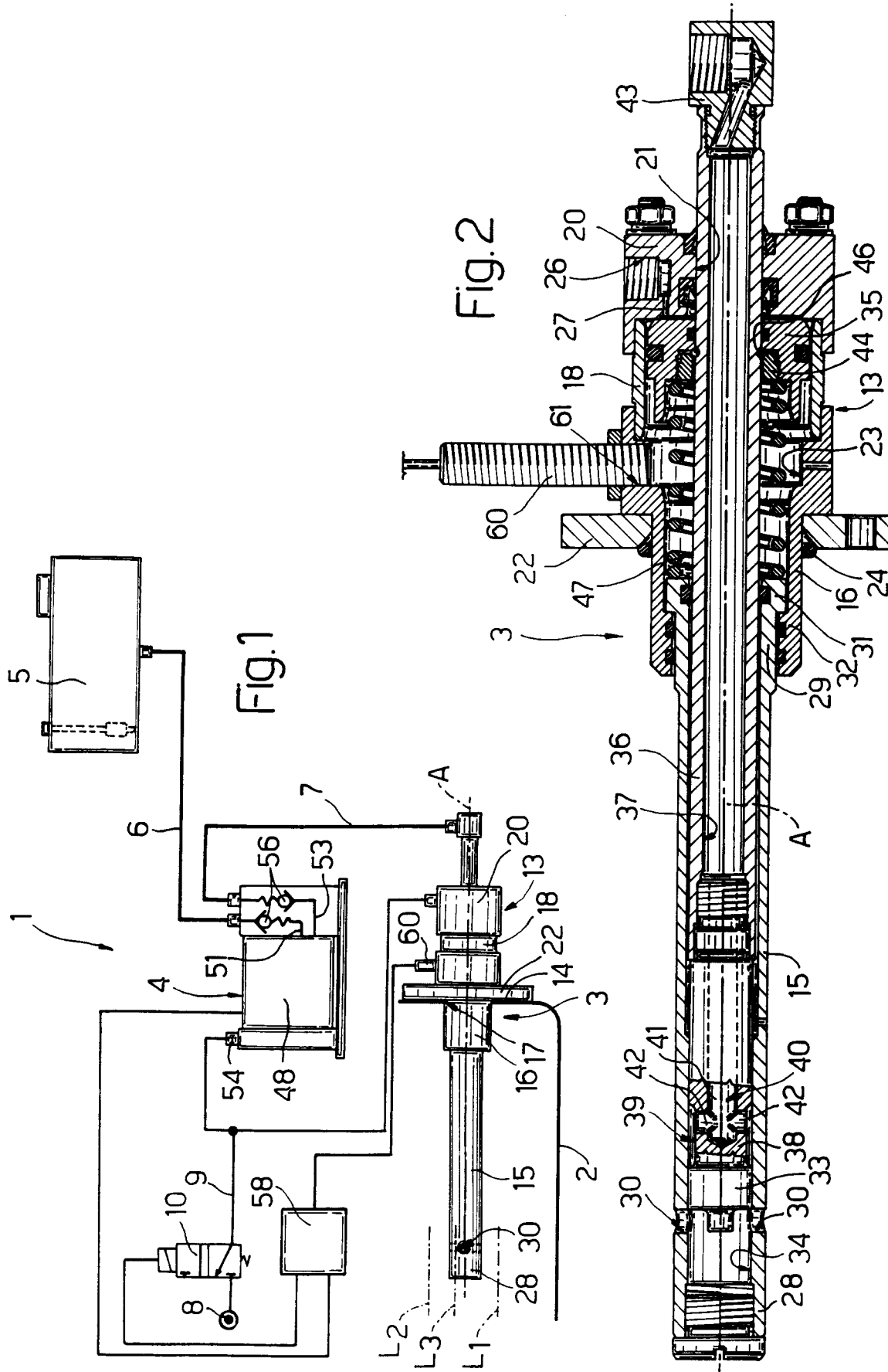
35

40

45

50

55



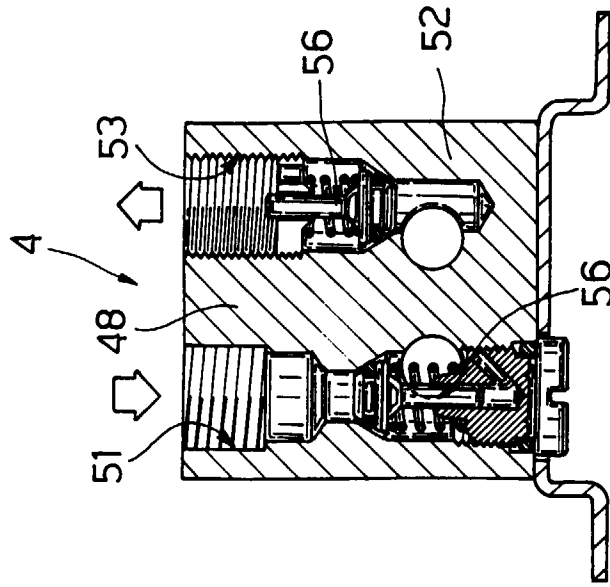


Fig. 4

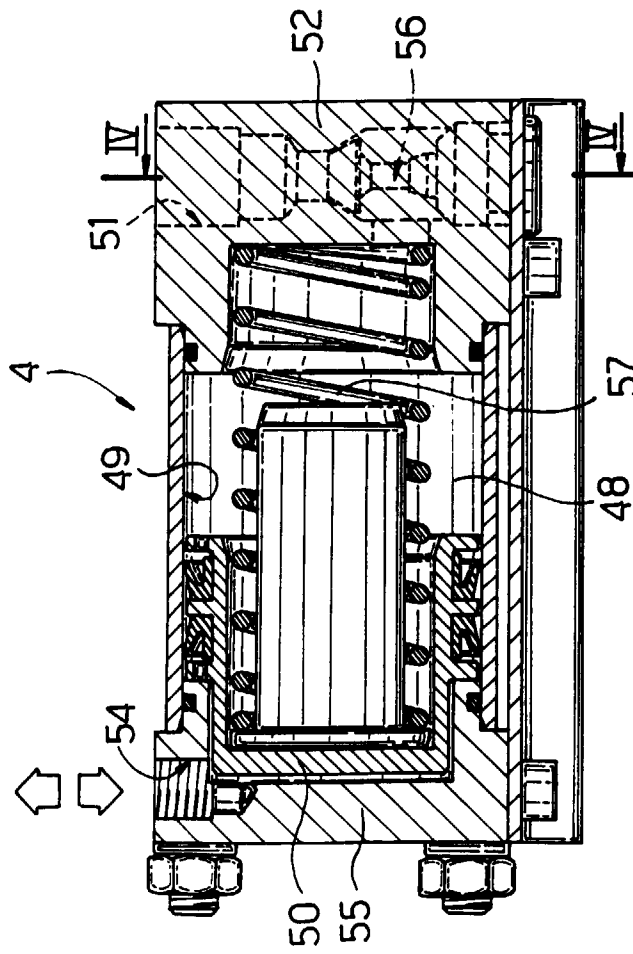
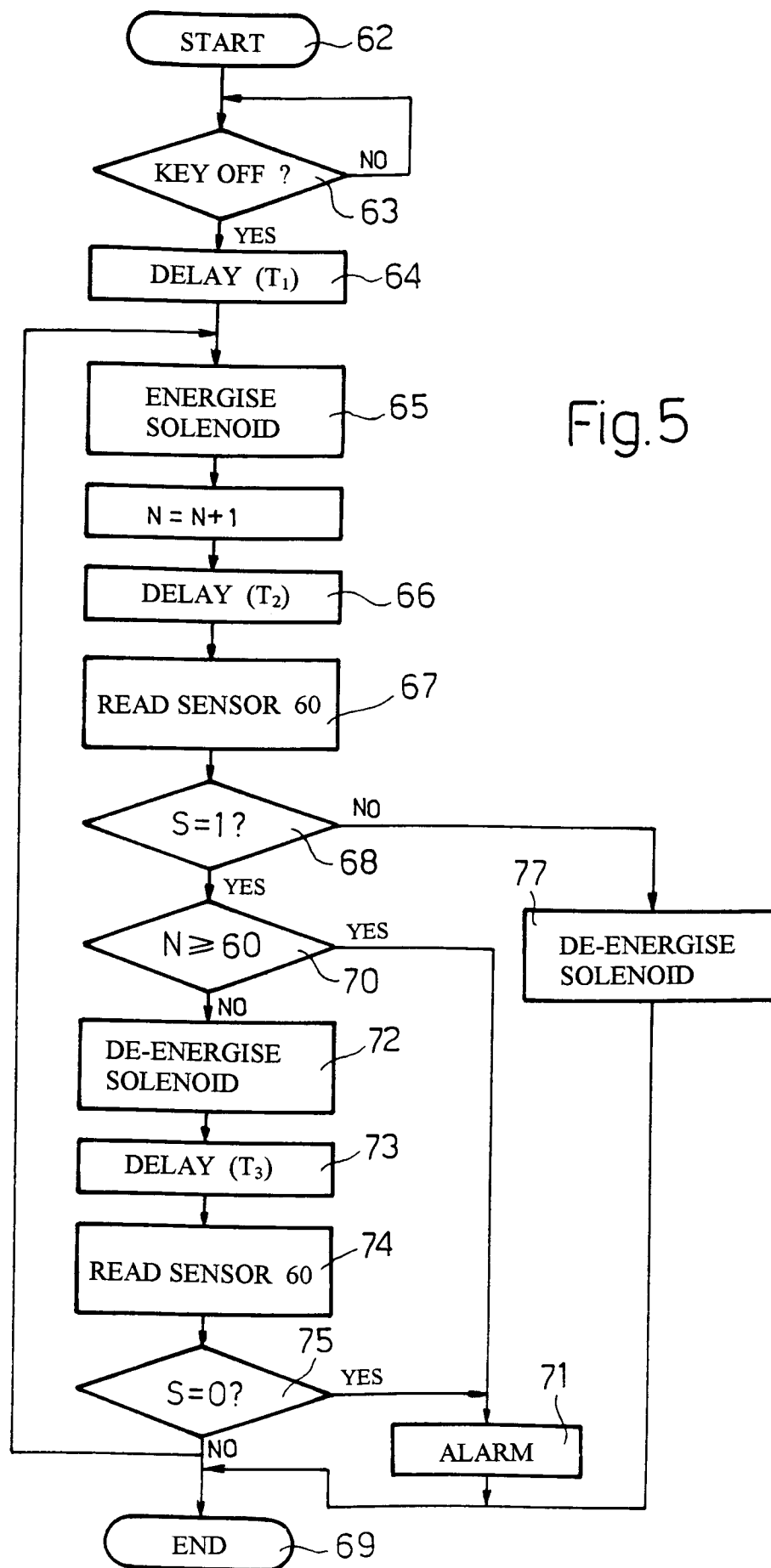


Fig. 3





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 11 9797

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 515 326 A (IVECO FIAT) 25 November 1992 * abstract; figure 1 * ---	1	F01M11/04 F01M11/06
A	EP 0 538 660 A (IVECO FIAT) 28 April 1993 * abstract; figure 1 * ---	1	
A	US 4 883 148 A (WELCH RICHARD C) 28 November 1989 * abstract; figure 1 * ---	1	
A	US 4 491 103 A (DEADMAN RAY) 1 January 1985 * abstract; figure 1 * -----	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) F01M
Place of search THE HAGUE		Date of completion of the search 17 February 1997	Examiner Wassenaar, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.92 (P04C01)