(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 081 371 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.03.2001 Bulletin 2001/10

(51) Int. Cl.[7]: **F02M 37/22**

(21) Application number: **00117757.5**

(22) Date of filing: **18.08.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **03.09.1999 IT ME990006**

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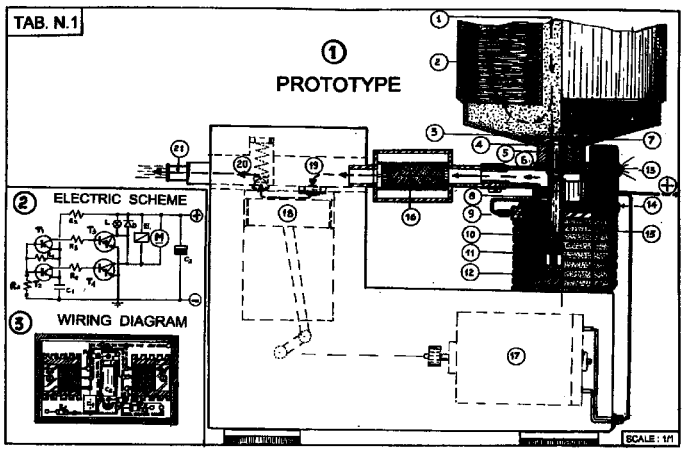
(54) Device for automatically discharging water and air from fuel filters

(57) The most frequent problems of water and air drainage devices designed for diesel motors are the following: a) in car motors, if water or air has to be drained from the filter, the car must be left in a garage; b) high power motor-water-separators need expensive maintenance and do not allow air discharge. The following notes show the new device peculiarity (device for immediate water and air expulsion from fuels).

1) The device is capable of detecting any kind of water by the use of one electrode (see CH. 1-2-3-9).
2) It can expell instantly even very small amounts of water.
3) Opening and closing filter plug (it has an external paching) by an electrovalve placed in the plug which has a threaded sleeve where the electrode is placed (see CH. 4-5-6).
4) Manual test available by an external pushbutton and warring light (see ch. 9)
5) A high degree of pump-depression allows water and air simultaneous discharge; in the same way, once the filter is replaced, water and fuel in excess are discharged in a few seconds by starting the device (see CH. 10 - 11).
6) The istruments-board-warning-lamp can also be used here (see CH. 8)
7) The pump can also be placed away from the filter and in high position
8) A particular filter precedes the pump (see CH. 7)



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Description

- Current devices for fuels water drainage-

[0001] Water drainage problems from fuels affect mostly Diesel oil, both for traction and for naval or industrial use.

[0002] Drainage devices are normally connected to Diesel oil filters. There are two types:

a) manual device for drainage of water accumulated on the bottom of filters;
b) drainage device with water separators, in which watwr flows into lower containers.

- Current devices features analyisis-

[0003] ***Manual drainage*** **-** It is a manual drainage used in standard Diesel engined cars or in yard Diesel motors.

[0004] It works by totally or partially unscrewing the drainage plug, (the plug has a particular longitudinal channelling in its threaded part).

[0005] In the cheapest standard cars, there is no warning-light indicating water presence; therefore a precautional drainage is needed every now and then..

[0006] Nevertheless, seepage in the injection pump may occur (filling up in a filling station in witch the tanks are notchecked and water is not drained often).

[0007] In good make standard cars, water presence in the filter is checked by two electrodes placed inside the filter-plug. A particular warning light on the dashboard shows any water presence in the electrodes' area. In this case the engine must be stopped as soon as possible and have the water manually drained at the mechanic's by unscrewing the plug and letting water flow until the warning ligth on the dashboard goes out.

[0008] Soon afterwards the air that has got into the filter in the meantime has to be discharged. This operation is carried out by a mechanical membrane- pump fitted on all cars.

- Diesel-oil filters used in naval or industrial fields have a particular bottom container witch also worhs as a water separator. The presence of water in the separator is displayded by a special level indicator wich allows manual automatic drainage by electrovalve.

- Innovation target-

[0009] The current devices designed for manual water drainage from filters in Diesel cars have a ligth indicator but, despite all that, they need prompt garage maintenance where water and air drainage is done by the operator.

[0010] All the same , with great amounts of water in the tank, after having drained and after a few kilometres, the warning light on the dashboard might be on again. Therefore, another stop is needed to drain and to pour the Diesel-oil.

[0011] The very expensive and bulky separators used in the naval and industrial fields allow manual and automatic drainage of the water, but do not allow the simultaneous air discharge. In addition, separators need constant maintenance.

[0012] However, the temporary presence of water at the bottom of filters is dangerous. In fact, several turbulences (air in Diesel oil, strong depression following swift accelleration, car bumping) may affect the Diesel oil contained in the filters and may also carry small amounts of water which can eventually affect the Diesel oil injection-pump efficiency.

[0013] ***"However, this device is designed to expell automatically and quilckly, even small amounts of water and air located at the bottom of filters (or tanks)".***

[0014] Consequently, the new elctronic device drives a particular high-tightness-electric-pump through one electrode (see CH.7); water located near the electrodes is quilckly expelled by the pump whose start is indicated by a warning light to be placed on the dashboard (in cars without warning light, or connected to the existing lamp to the new device).

[0015] For naval or industrial use in particular, this device allows to get rid of bulky and expensive separators and ensures prompt water and air expulsion from the bottom of filters.

-Operating theory and technical features-

[0016] The electronic water detector technique is based on the specific resistance of the water near the the electrode located at about 2-3 mm. from the bottom of the filter. Its resistivity depends on the amount of mineral salts contained in water; it is between 40 and 100 Kohm in waters with many mineral salts, or between 10 and 200 Mohm in waters with fewer mineral salts or in semi-demineralized waters.

[0017] The electronic circuit and wiring diagram are enclosed with the report (table n.1-illustrations 2-3). The circuit analysis shows that the water resistance between the electrode and earth (Ra) allows the negative bias of T1-T2 (BC212 PNP type) transistors'bases.

[0018] These transistors are very sensitive to the total bias-resistance variation and work in conduction with very low bias tension (between 0,3 and 0,5 V), and this also happens with very high water resistivity.

[0019] When only Diesel oil is present, the resistance between earth and the electrode is very high; when water is detected by the electrodes Ra biases negatively the two BC212 transistors'bases making them conduct.

[0020] Ice1- Ice2 output currents, trough the resistors R3-R4 bias the power-transistors'bases separetely T3-T4 (BDX53 NPN Type). The two transistors T3-T4

can supply no more than 8A (Ice), but when in conduction, the output current is doubled as they are connected is in parallel.

[0021] That is enough to supply the pump in emergency, wich may require a starting-current of about 10 A. The pump is monitored by a flashing LED diode (CH.13), while D1 diode protects the electrovalve's coil from overvoltage when T1 and T2 "open" or "close".

[0022] *Other components details:* R1:330Kohm; R3-R4:1 Kohm; C1:100KpF (polyiester); C2:220uFarad (electrolytic); D:1N4007; L:Led-lamp (with a 1Kohm resistor in series); EL:electrovalve (8w-0,7A-12V.); M: D.C. electric motor (12 V.-In:4A-Pn:50w); Ra:water-resistance (10 kohm- 200 Mohm).

[0023] Near the pump-intake, a filter prevents the membrane-intake-valve from obstrucion (CH.16). As the pump provides a sufficient delivery, the new device can be installed with various options; the electronic circuit and the pump can be placed away from the filter.

[0024] The electrovalve is a part of the filter-plug and this reduces fuel-residue in the connection between the filter and the electrovalve so that only water is expelled.

[0025] *Illustration n°1 shows a description of the device working technique.* This drawing represents the partial section of some components (main filter, electrovalve, connections optional filter, pump) whose main elements are:

1)- Filter Diesel-oil intake-connection; 2)-Filter-material; 3)-Maximum level of water at the bottom (3 mm.); 4)- Threaded-filter-connection; 5)- Hole in the plug-threaded-connection for water flow; 6)-Rubber-tight-packing; 7)-Electrode contained in the plug-threaded-connection whose metal section is out from the plug at 3 mm. from the bottom;
8)-Threaded connection with rubber-packing-ring for electrovalve coupling; 9)-Electrovalve-coil-terminals; 10)- Soft-iron-sheet to increase magnetic flux; 11)-Electrovalve-coil (n° 1200 turns- 0,2 mm. section copper); 12)-Movable core with spring-tight-joint pin; 13)- Electronic circuit container with flashing Led-lamp;
14)- Container- tightening-clamp inside suitable PVC shell; 15)- PVC-shell to hold the electrovalve and the little electronic circuit-box; 16)- Optional filter to prevent the pump from foreign bodies seepage during drainage; 17) Pump-motor (Pn:50 w);
18)- Pump-piston (driven by rod-lever with special flywheel and reduction-gear);
19)- Pump intake-valve ; 20)- Pump delivery-valve; 21)-Water draining-connection (to channel externally by special pipe).

[0026] ***To sum up, the device works as follows: When water at the bottom of the filter reaches a level of nearly 3 mm. it connects the plug-electrode to the metallic side of the filter.***

[0027] Ra is run by a current that makes T1 and T2 transistors go in conduction; these transistors pilot T3 and T4 respectively. The two collectors (in parallel) are connected both to the electrovalve-coil (I:0,7 A) and to the pump motor-coil. The supply circuit is closed by T3 and T4, the electrovalve opens the water-drainage-pipe and simultaneously the pump starts.

[0028] The device is very sensitive: a few drops of water drainage can lower slightly the water level around the electrode. Consequently, the previous insulation is restored and in the same time, the electrovalve shuts again and pump motor stops.

[0029] ***Therefore, all the tests carried out on this protothipe prove that water presence in fuel located at the bottom of the filter, over the electrodes'level, is promptly expelled by the electric pump. Actually the amount of water to discharge is rather small and so the pump does not continuolsly.***

Claims

1. Electronic circuit capable of detecting even very small amount of water located at the bottom of fuel filters (or tanks) and sensitive to any tyipe of water (also semi-distilled water).

2. Filter closing plug with electrovalve with increased magnetic intensity and strengthened-tigh-spring (absorbed power: 10W- 12V).

3. Single electrode water-detector.

4. Little compressor adjusted as a high-tight-pump with intake filter.

5. Electronic circuit with two separeted inputs and with power-transistors collectors connected in parallel, in order to double the load capability and compensate the starting-current of the pump-motor.

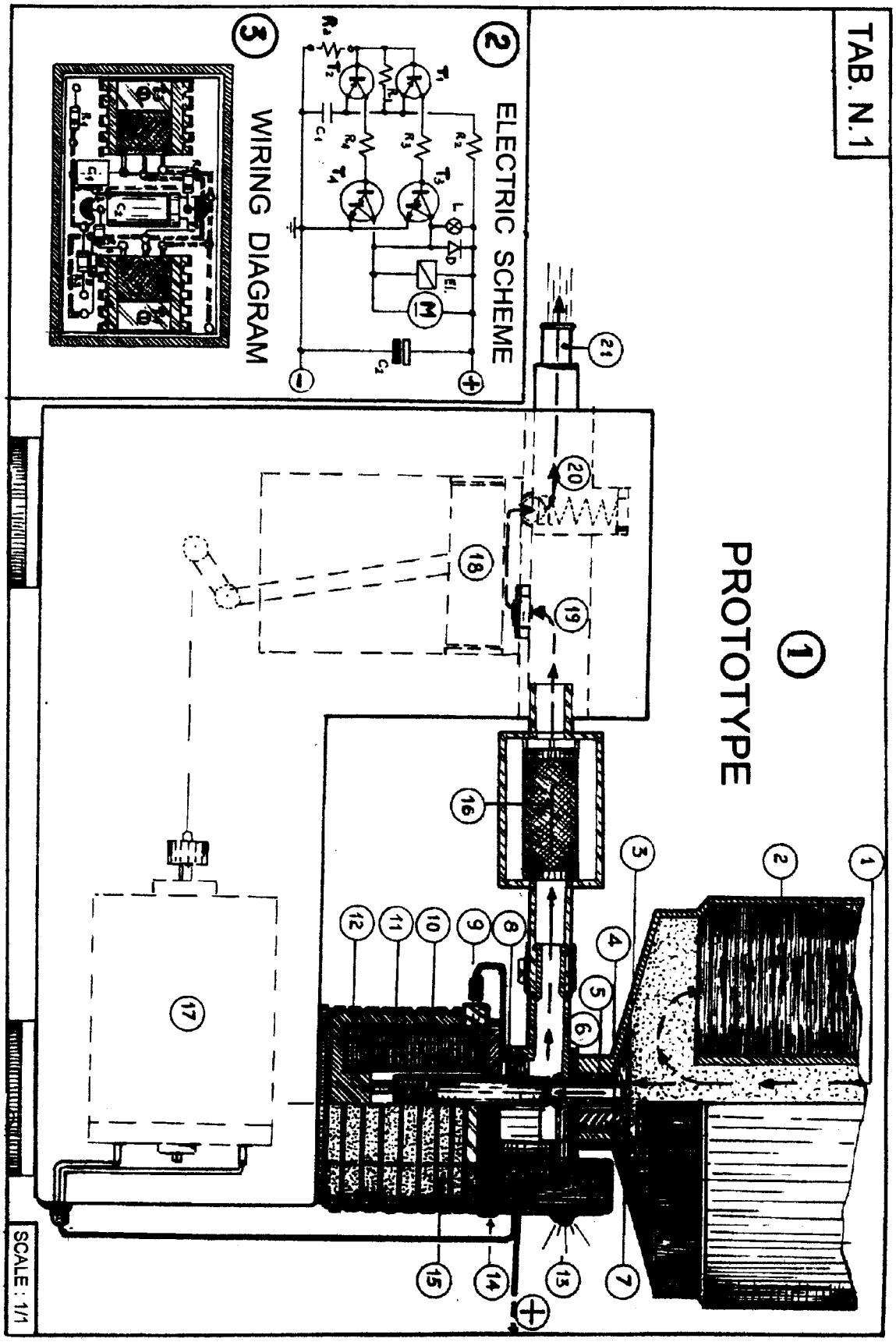
6. Electronic circuit whose PVC container has a small external metal plate similar to contact-switches and Led-lamp for test and manual control of the new device.

7. Particular electronic circuit, in witch the current between earth and electrode is very few microAmperes, thus its electrolytic corrosion is very low.

8. Electronic circuit capable of supplying also the "water warning-lamp" fitted on various vehicles.

9. The electric pump can replace the small manual pump fitted on vehicles for air-discharging.

10. High pump-draining capability for industrial or naval use (average draining capability 0,25 liters/minute).


TAB. N.1
1 PROTOTYPE
2 ELECTRIC SCHEME
3 WIRING DIAGRAM
SCALE : 1/1