OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(12) (19) (CA) **Demande-Application**

(21) (A1) **2,335,821**

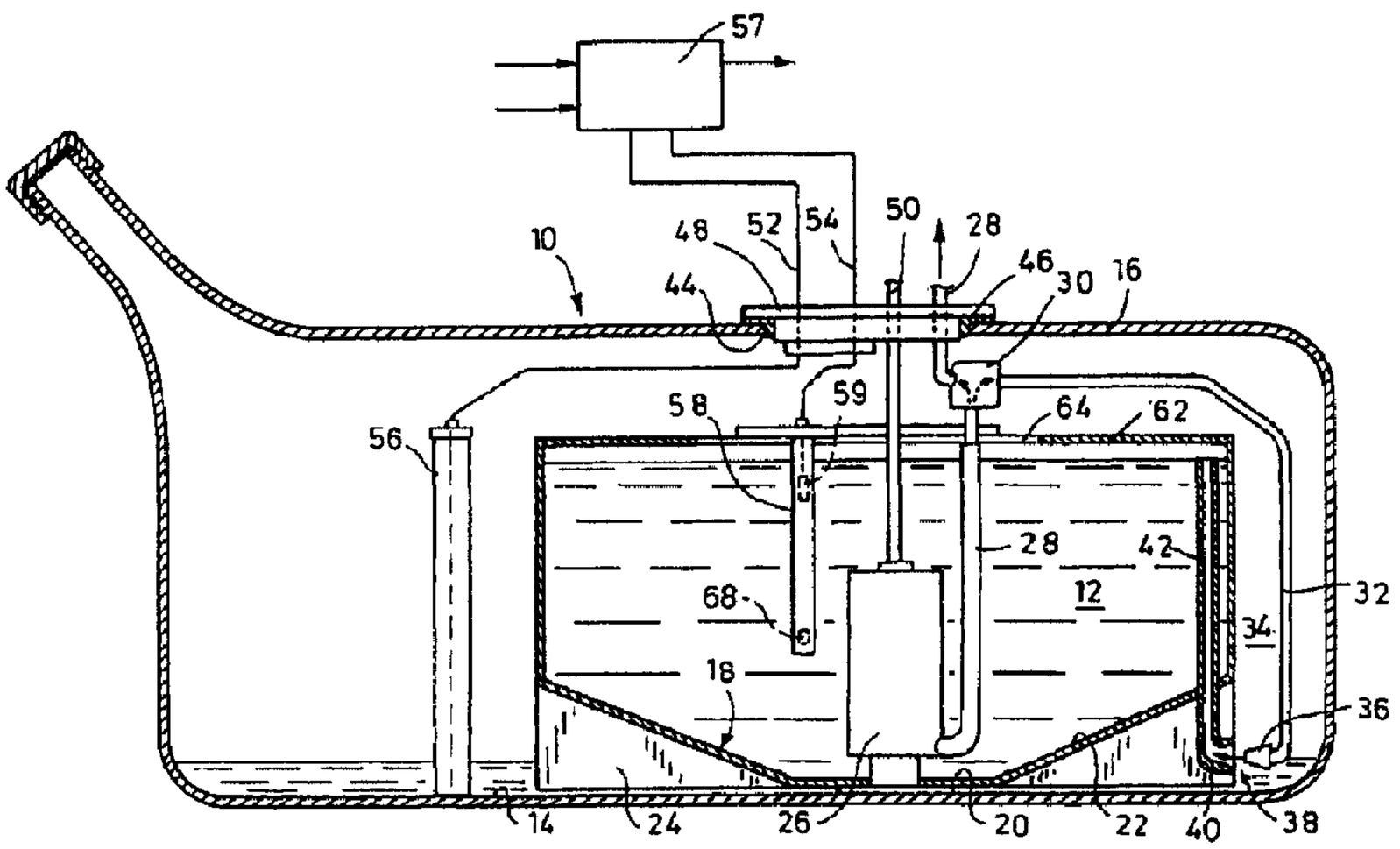
(86) 1999/06/22
(87) 1999/12/29

(72) WAGNER, AXEL, DE
(72) RUDIGER, WALTER, DE
(71) KAUTEX TEXTRON GMBH & CO. KG., DE

(51) Int.Cl.[6] B60K 15/06, B60K 15/077, G01F 23/00
(30) 1998/06/25 (198 27 944.2) DE

(54) **PROCEDE ET DISPOSITIF POUR DETERMINER LA QUANTITE RESIDUELLE DE CARBURANT DANS UN SYSTEME DE CARBURANT D'UN VEHICULE AUTOMOBILE**

(54) **PROCESS AND DEVICE FOR DETERMINING THE RESIDUAL AMOUNT OF FUEL IN A MOTOR VEHICLE FUEL SYSTEM**



(57) L'invention concerne un procédé et un dispositif pour déterminer la quantité de carburant dans le réservoir de carburant d'un véhicule automobile. Ce réservoir de carburant comporte un réservoir principal équipé d'un dispositif de mesure de niveau de remplissage pour déterminer la quantité de carburant contenue à l'intérieur, et un réservoir de quantité résiduelle qui présente un volume sensiblement inférieur à celui du réservoir principal, est autonome et alimenté par une pompe avec du carburant provenant du réservoir principal. Une fois que le réservoir principal est vide, la quantité résiduelle de carburant encore contenue dans le réservoir est calculée sous la forme de la différence entre un volume défini du réservoir (12) et la consommation de carburant cumulée dans le temps.

(57) A process and device are disclosed for determining the amount of fuel in the fuel tank of a motor vehicle. The fuel tank has a main reservoir (34) fitted with a filling level meter (56) for determining the amount of fuel contained therein, and a residue reservoir (12) having a substantially smaller volume than the main reservoir, closed in itself and supplied by a pump (38) with fuel from the main reservoir. After the main reservoir is emptied, the residual amount of fuel still contained in the reservoir is calculated as the difference between a defined volume of the reservoir (12) and fuel consumption summed over time.

PCT

WELTORGANISATION FÜR GEISTIGES EIGENTUM
Internationales Büro

INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

(51) **Internationale Patentklassifikation** 6 :
B60K 15/00

A2

(11) **Internationale Veröffentlichungsnummer:** **WO 99/67103**

(43) **Internationales Veröffentlichungsdatum:** 29. Dezember 1999 (29.12.99)

(21) **Internationales Aktenzeichen:** PCT/DE99/01853

(22) **Internationales Anmeldedatum:** 22. Juni 1999 (22.06.99)

(30) **Prioritätsdaten:**
198 27 944.2 25. Juni 1998 (25.06.98) DE

(71) **Anmelder** *(für alle Bestimmungsstaaten ausser US)*: KAUTEX TEXTRON GMBH & CO. KG [DE/DE]; Kautexstrasse 52, D–53229 Bonn (DE).

(72) **Erfinder; und**
(75) **Erfinder/Anmelder** *(nur für US)*: WAGNER, Axel [DE/DE]; Rheinaustrasse 34, D–53225 Bonn–Beuel (DE). RÜDIGER, Walter [DE/DE]; Karl–Leissner–Strasse 10, D–53123 Bonn (DE).

(74) **Anwalt:** KOEPSELL, Helmut; Frankenforster Strasse 135–137, D–51427 Bergisch Gladbach (DE).

(81) **Bestimmungsstaaten:** CA, JP, US, europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

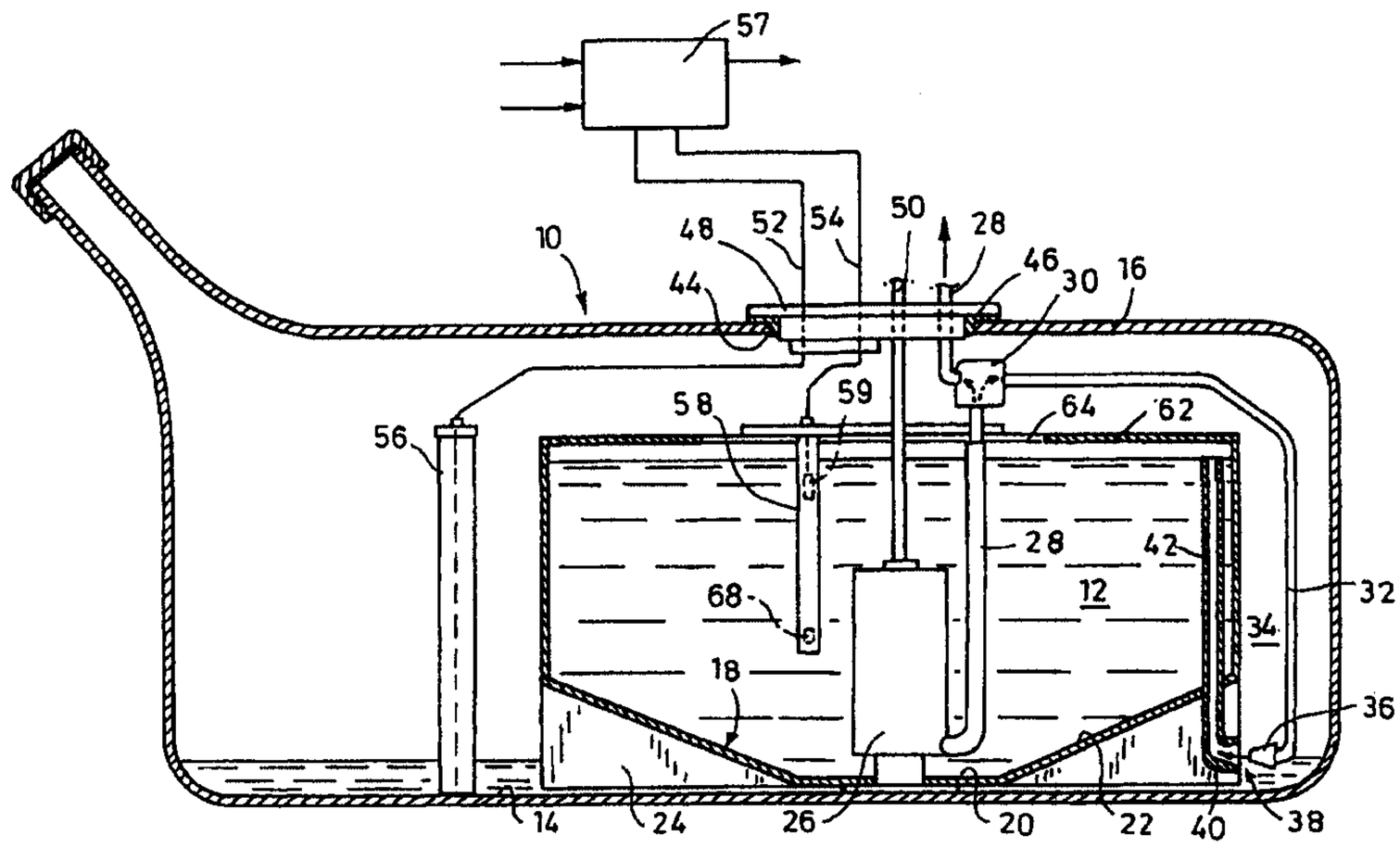
Veröffentlicht
Ohne internationalen Recherchenbericht und erneut zu veröffentlichen nach Erhalt des Berichts.

(54) **Title:** PROCESS AND DEVICE FOR DETERMINING THE RESIDUAL AMOUNT OF FUEL IN A MOTOR VEHICLE FUEL SYSTEM

(54) **Bezeichnung:** VERFAHREN UND EINRICHTUNG ZUR BESTIMMUNG DER KRAFTSTOFF–RESTMENGE IN EINEM KRAFTSTOFFSYSTEM EINES KRAFTWAGENS

(57) **Abstract**

A process and device are disclosed for determining the amount of fuel in the fuel tank of a motor vehicle. The fuel tank has a main reservoir fitted with a filling level meter for determining the amount of fuel contained therein, and a residue reservoir having a substantially smaller volume than the main reservoir, closed in itself and supplied by a pump with fuel from the main reservoir. After the main reservoir is emptied, the residual amount of fuel still contained in the reservoir is calculated as the difference between a defined volume of the reservoir (12) and fuel consumption summed over time.



Process and apparatus for determining the residual amount of fuel in a motor vehicle fuel system

The invention concerns a process and an apparatus as set forth in the classifying portions of claim 1 and claim 11 respectively.

German patent specification No 32 24 919 discloses a measuring apparatus for operating fluid storage arrangements of motor vehicles which are provided with a fuel system having a main storage reservoir and a secondary storage reservoir which is of substantially smaller volume in comparison with the main storage reservoir and which is closed in itself and which is supplied with fuel by a pump from the main storage reservoir.

In that case associated with the main storage reservoir and the secondary storage reservoir are a main sensor device and an auxiliary sensor device respectively, for detecting the fuel store. Up to the moment in time at which the main storage reservoir is completely emptied, the main sensor device which is associated with the main storage reservoir supplies a signal specifying the filling level in the fuel tank so that, on the basis of the tank geometry, it is possible to calculate a value in respect of fuel amount, that gives a display specifying the respective amount of fuel which is present in total in the main storage reservoir and the second storage reservoir. After the main storage reservoir is completely emptied, the display of the fuel which is still present in the secondary storage reservoir is implemented by the auxiliary sensor device associated with the secondary storage reservoir. That is intended to provide a more accurate display in respect of the fuel reserve which is still present.

(Continue at line 29 on page 1 of the translation of the PCT text)

(Continued from line 27 on page 2 of the translation of the PCT text)

is substantially emptied, still forms a reserve amount for a given distance to be travelled.

The invention is based on a process and an apparatus for determining the amount of fuel respectively contained in the fuel tank of a motor vehicle, as set forth in the classifying portions of claim 1 and claim 11 respectively, wherein the respective classifying portions take account of the state of the art disclosed in DE-A1-32 24 919.

The object of the present invention, with simple means, is to permit determination with the maximum possible level of accuracy of the residual amount which is still respectively present in the fuel system in the last phase of emptying thereof, when fuel is only still present in the surge pot which is also referred to as the residual amount reservoir, in order thus to provide the driver with more accurate information about the respective amount of fuel which is still present. In this respect, the invention seeks to provide that it is not necessary for the tank used for that purpose to be fundamentally different in structure from that of conventional tanks.

That object is attained by the means recited in the characterising portions of claim 1 and claim 11 respectively.

Further features of the invention are set forth inter alia in the appendant claims.

A process that is particularly desirable is one in which the moment in time at which the operation of determining the residual amount in the residual amount reservoir by consumption calculation begins is established in dependence on the filling level in the main storage reservoir and a given filling level in the residual amount reservoir, for example in such a way that a filling level meter associated with the main storage reservoir outputs a signal which states that the main storage reservoir is empty, and in addition a signal is triggered by a sensor associated with the residual amount reservoir when the level falls below the given filling level in the residual amount reservoir. The sensor is desirably arranged beneath the maximum filling level in the residual amount reservoir so that consumption calculation only begins when the level of liquid in the

(Continue at line 29 on page 3 of the translation of the PCT text)

amount reservoir is not associated with the maximum possible filling level therein prevents the residual amount calculation procedure being initially started and then cut off again, when, with the main reservoir almost empty, small amounts of fuel are still being conveyed into the residual amount reservoir, for example in dependence on the travelling conditions of the vehicle, so that the filling level reaches the sensor again. The arrangement of the sensor in the residual amount reservoir should therefore be so selected that, under normal operating conditions, no further fuel is conveyed out of the main storage reservoir into the residual amount reservoir after the level of fuel has fallen below the filling level determined by the position of the sensor in the residual amount reservoir, whereby calculation of the fuel consumption has been triggered off, to ascertain the residual amount of fuel.

In dependence on the dimension of the residual amount reservoir, in particular in the plane in which the movements of the vehicle while moving occur, it may also be desirable to provide the residual amount reservoir with internal fitments which substantially reduce movements of the fuel in the residual amount reservoir. If the beginning of the moment in time at which the operation of determining the respectively present residual amount by calculation of the fuel consumption begins is determined in dependence on the presence of two signals - one which indicates that the main storage reservoir is substantially empty and a later second signal which displays the filling level of the residual amount reservoir - the amount of liquid which is still present at the beginning of the consumption calculation procedure can be determined with a level of accuracy which is adequate for all practical requirements.

In this respect it may be desirable for the tank to be so designed that filling thereof is effected by way of the residual amount reservoir. For that purpose there may be provided a filling pipe which connects the filling opening of the tank to the residual amount reservoir.

If, in the operating phase in which the residual amount of fuel in the residual amount reservoir is ascertained by consumption measurement, fuel is added for example from a spare fuel can in an amount which is not sufficient to fill the residual amount reservoir to the filling level corresponding to the position of the sensor, correction of the procedure for ascertaining the residual amount of fuel would not be possible. On the contrary, the display of the residual amount of fuel would remain at the value calculated prior to the refilling operation. It may therefore be desirable to associate with the residual amount reservoir a second sensor which is arranged at a spacing beneath the first sensor and which thus responds to a smaller volume of fuel in the residual amount reservoir. As soon as the level of fuel, in operation of the motor vehicle, falls below the level of the second sensor in the residual amount reservoir, the signal which is triggered thereby can be used to calculate the residual amount of fuel still present in the residual amount reservoir, once again by way of the consumption, in which case naturally the procedure starts from an initial value which is smaller than that of the volume which corresponds to the position of the first sensor. Desirably, the second sensor is so arranged that after a usual volume (for example 5 liters) of fuel has been added from a spare can, the second sensor is beneath the level of liquid which then occurs.

In accordance with a further proposal of the invention, it may be desirable for the engine of the motor vehicle to be switched off automatically after the amount of fuel in the residual amount reservoir falls below a given minimum amount of fuel. That is intended to prevent air which causes operational problems to the engine from passing into the fuel supply system for the engine, in particular in the high-pressure part thereof. Before the engine is automatically shut off, the attention of the driver should be directed to the fact that the engine is soon going to be shut off, by virtue of a suitable display, at a sufficient time interval before the engine is shut off.

In other respects, the arrangement is such that the filling level meter associated with the main storage reservoir is re-activated as soon as, with a rising level of fuel in the main storage reservoir, the filling level meter switches from the empty display to displaying a given level of liquid in the main storage reservoir. The signal can at the same time also influence the on-board computer or the like so that computation of the fuel consumption is terminated. The computer is only re-activated for that computation when, in the course of travel of the vehicle, the prerequisites already referred to above recur, more specifically, an empty display in respect of the main storage reservoir and the level of liquid in the residual amount reservoir falling below the filling level which is established by the position of the first sensor.

Two embodiments of the invention are diagrammatically illustrated in the drawing in which:

Figure 1 is a view in longitudinal section through a first embodiment of a tank, and

Figure 2 is a view in longitudinal section through a second embodiment.

The fuel tank 10 can be made in various ways in one piece or in a multi-piece structure from plastic material or metal. It is provided with a residual amount container or reservoir 12 which is of a markedly smaller volume than the main space 34 surrounding the residual amount reservoir 12, and which represents the reserve region of the fuel system. The residual amount reservoir 12 is suitably fixed to the bottom 14 of the tank. The residual amount reservoir 12 which is partially open at the top terminates at a spacing from the upper wall 16 of the tank. The residual amount reservoir is provided at its upper end with an internally peripherally extending edge portion 62 so that there is only an overflow opening 64. Otherwise the residual amount reservoir 12 is closed in itself so that no fuel can pass from the residual amount reservoir into the main storage reservoir 34.

The bottom 18 of the residual amount reservoir 12 is provided with a central region 20 which extends substantially perpendicularly to the longitudinal axis of the residual amount reservoir and parallel to the bottom of the tank 14. The outer region 22 of the bottom 18, which adjoins the central region 20, is arranged to extend in a rising configuration towards the periphery of the residual amount reservoir, so that the outer region 18, starting from the central region 20, is at a spacing from the bottom 14 of the tank, that spacing increasing in a direction towards the periphery. In order to be able to mount the residual amount reservoir 12 with the necessary degree of stability within the tank 10, it is provided at its underside in the outer region of its bottom with substantially radial ribs 24 which are arranged at spacings over the periphery of the residual amount reservoir and which rest on the bottom 14 of the tank.

Fixed within the residual amount reservoir 12 in the central and deepest region 20 of the bottom 18 thereof is a single-stage electric fuel pump 26 to which there is connected a conduit 28 which leads to the engine. Connected into the conduit 28 in known manner within the tank 10 is a pressure regulator 30 from which a return conduit 32 extends. The excess amount of fuel is branched off in the pressure regulator 30. That excess amount of fuel is returned to the space 34 of the tank 10, which surrounds the residual amount reservoir 12, through the return conduit 32 which is disposed outside the reservoir 12. At the discharge flow end thereof, the return conduit 32 is provided with a propulsion nozzle 36 of a suction jet pump 38 whose catch or receiving nozzle 40 forms the intake flow end of an overflow pipe 42, as is shown in the drawing. The overflow pipe is arranged to extend substantially vertically and opens at a small spacing from the upper boundary of the residual amount reservoir 12 within same and is passed in liquid-tight relationship through the outer region 22 of the bottom, the configuration thereof permitting the suction

jet pump 38 to be disposed in the region beneath the residual amount reservoir 12.

In its top wall 16, the tank is provided with an opening 44 which is closed by a cover 48, with the interposition of a seal 46. The fuel conduit 28 leading to the engine as well as electric lines 50 for the power supply to the pump 26 and electric connecting lines 52 and 54 are passed in liquid-tight relationship through the cover 48. The line 52 serves to make a connection between the filling level meter 56 which is a capacitive meter or which is designed in some other fashion, and an electronic computer 57 which can be the on-board computer of the vehicle. The line 54 represents the connection between a first sensor 59 and/or a second sensor 68 in the residual amount reservoir 12 and the computer. The filling level meter 56 is arranged in the main space 34 of the tank 10, which surrounds the residual amount reservoir 12, while the first sensor 59 and the second sensor 68 are arranged within the residual amount reservoir 12 in a dip pipe 58.

The fuel which is to be fed to the engine is taken from the residual amount reservoir 12, in which case the fuel which is conveyed into the reservoir 12 from the main space 34 of the tank by way of the suction jet pump 38 always maintains the level within the reservoir 12 at a maximum height as long as fuel is still being conveyed out of the space 34.

The operation of determining the filling level in the tank 10 is effected as long as fuel is still present in the main space 34 surrounding the residual amount reservoir 12, above the filling level meter 56 which can be designed in conventional manner, for example also in the form of a float-operated sender. It is however also possible to use other filling level meters. Up to more or less complete emptying of the space 34 surrounding the residual amount reservoir 12, the filling level meter 56 supplies the signals which specify the filling level of the space 34 and from which the respective amount of fuel still present is determined.

At the moment in time at which the empty condition of the space 34 surrounding the residual amount reservoir 12 is indicated by the filling level meter 56, a signal is sent to the electronic computer 57. The effect of that signal is that the fuel which is still respectively present in the system and which is practically exclusively present in the residual amount reservoir 12 and the volume of which is determined is now calculated by way of the level of fuel consumption, and the display of the respective amount of fuel which is still present is implemented on the basis of the difference between a defined volume of the residual amount reservoir and the consumption which has occurred up to the time of input of the signal. The level of consumption can be readily ascertained from the respectively available operational data of the device for engine management by means of the computer. It will be apparent that in this fashion a highly accurate display is possible in a very simple manner precisely in regard to the operating phase of a motor vehicle in which the reserve amount of fuel which is present in that case in the residual amount reservoir 12 is consumed as the last partial amount of all of the fuel which had respectively been present in the system. The first sensor 59 is disposed at a comparatively short spacing beneath the upper boundary of the residual amount reservoir 12. It can - possibly alternatively - also be used to trigger off the signal by which the residual amount of fuel which is respectively still present in the residual amount reservoir is calculated by way of the fuel consumption of the engine. It may however be advantageous to make the change-over in terms of establishing the residual amount of fuel from the display of the filling level meter 56 to the consumption calculation procedure, dependent on both the empty signal being outputted by the filling level meter 56 and also a signal being outputted from the first sensor 59 to the computer 57, in which case the signal of the sensor 59 is triggered by virtue of the fact that the fuel in the residual amount reservoir 12 drops below the level which is established by the position of the sensor 59.

The second sensor 68 which is disposed in the downwardly open dip pipe 66 and which is positioned at a spacing beneath the first sensor 59 and which is also connected to the computer 57 by way of the appropriately arranged line 54 serves in particular to make it possible to establish a volume of fuel in the residual amount reservoir 12, which is less than the volume which the sensor 59 displays. In that way, when adding relatively small amounts of fuel whose volume together with the residual volume which had still been present in the residual amount reservoir 12 is less than the total volume of the reservoir and thus gives rise to a filling state at which the level of liquid is below the level of the sensor 59, it is possible, when the level falls below the sensor 68, to again start a consumption calculation procedure which then naturally starts from an initial value which is less than the value which corresponds to the position of the sensor 59.

In the embodiment illustrated in Figure 1 of the drawing, the added amount of fuel would firstly pass into the main storage reservoir 34, but from same a large part thereof would be conveyed by the suction jet pump 38 into the residual amount reservoir again, until the main storage reservoir is again empty, so that, irrespective of the part of the tank into which the added amount of fuel initially flows, it nonetheless passes into the residual amount reservoir and therein causes a rise in the level of liquid.

In order to take account in a simple fashion of the possibility of adding amounts of fuel whose volume is so small that in total, that is to say with the residual volume which was previously still contained in the residual amount reservoir, the result is a volume which is less than the volume determined by the position of the first sensor 59, it may be desirable, in accordance with the embodiment shown in Figure 2, for the tank 10 to be provided with a particular filling pipe 74 which extends from the filling connection 76 of the tank into the residual amount reservoir 12, the side wall of which is for that purpose provided with an opening 78

through which the end region 72 of the filling pipe 74 is passed in liquid-tight relationship.

As the tank 10 is filled with fuel through the filling pipe 74 which in the region of the filling connection 76 can bear in liquid-tight relationship against the internal boundary wall thereof the entire amount of fuel which is introduced into the tank firstly flows into the residual amount reservoir 12 so that, even when a small amount of fuel is introduced into the tank, the level of liquid in the residual amount reservoir 12 immediately rises and it is then only a question of positioning in particular the lower sensor 68, when it responds, that is to say at what amount of fuel. At any event this ensures that fuel supplied to the tank 10 from the exterior firstly passes into the residual amount reservoir 12 and possibly - if the amount is sufficiently large - overflows from there through the upper opening 64 into the main storage reservoir 34. This embodiment avoids the situation where, when small amounts of fuel are introduced, the empty signal from the filling level meter 56 is cancelled and consequently the display in respect of the residual amount of fuel which is still present in the tank is initially again effected by way of the filling level meter 56. In Figure 2 parts which are the same as those in Figure 1 are denoted by the same references.

The arrangement of the sensor 59 at a spacing from the upper end of the riser pipe 58 or the upper boundary of the residual amount reservoir 12 permits more accurate determination of the amount of fuel present in the residual amount reservoir 12 at the time of beginning measurement of the fuel consumption, as inaccuracies due to fuel slopping or sloshing out of the residual amount reservoir are substantially avoided. In order to obviate faulty switching by the sensor 59, it may also be desirable for it to be first rendered operative at the time at which the filling level meter 56 indicates the empty condition of the main space 34.

If there is a gap between the moment in time at which the filling level meter 56 associated with the main space 34 produces the empty

signal and the moment in time at which the consumption calculation procedure begins for the purposes of determining the respective amount of fuel still present in the residual amount reservoir, that is of no practical significance as such a time gap is in any case very short and the fuel consumption which takes place during the duration thereof is too slight for it to result in a markedly incorrect display of the amount of fuel present.

Even when the main space 34 is empty, the kinetic energy of the returned fuel means that it practically completely passes into the residual amount reservoir 12 again, by way of the riser pipe 42.

In addition, as a departure from the embodiments illustrated in the drawing, instead of a single-stage electric fuel pump in combination with a suction jet pump, it is also possible to use a two-stage electric fuel pump, in which case the bottom of the residual amount reservoir 12 must be provided with an opening for the fuel which is to be sucked in from the main space 34 surrounding the residual amount reservoir 12, and the arrangement must be such that, when the space 34 is empty, no fuel flows back out of the residual amount reservoir 12 into the space 34 through that opening. In addition, under some circumstances, by taking suitable measures, care would have to be taken to ensure that, when the space 24 is empty, the first stage of the two-stage fuel pump does not become excessively hot in the absence of a cooling action due to fuel flowing in from the space 34. The measures which are possibly to be taken for that purpose however have nothing to do with the core of the invention as, in terms of use of the invention, it is immaterial how specifically the fuel is conveyed from the space 34 into the residual amount reservoir 12. The only essential consideration in both cases is that the amount of fuel fed to the residual amount reservoir 12 is greater than the amount of fuel which is taken from the reservoir 12 and fed to the engine.

As already mentioned, the step of reverting to normal measurement of the amount of fuel in the system by means of the filling level meter 56

associated with the space 34, when the tank is next filled, can be effected by means of a signal which is triggered by that filling level meter 56 and by means of which the computer 57 is caused to switch back to normal operation for measuring the amount of fuel in the tank system.

Process and apparatus for determining the residual amount of fuel in a motor vehicle fuel system

CLAIMS

1. A process for determining the respective amount of fuel in the fuel tank of a motor vehicle, wherein the fuel tank has a main storage reservoir (35) provided with a filling level meter (56) for determining the respective fuel contained therein, and a residual amount reservoir (12) which is of substantially smaller volume in comparison with the main storage reservoir (34) and which is closed in itself and which is supplied with fuel by a pump (38) from the main storage reservoir (34), characterised in that the residual volume of fuel respectively disposed in the fuel tank is calculated on the basis of the fuel consumption, wherein after emptying of the main storage reservoir (34) the respective residual amount of fuel which is then still contained in the residual amount reservoir (12) is calculated as a difference from a defined volume of the residual amount reservoir (12) and the fuel consumption summed over time, and that the signal for establishing the moment in time from which determination of the residual amount of fuel in the residual amount reservoir (12) by means of consumption calculation begins is triggered in dependence on the fuel falling below a given filling level in the residual amount reservoir (12).

2. A process as set forth in claim 1 characterised in that the fuel consumption is calculated from operational data of the device for engine management.

3. A process as set forth in claim 1 characterised in that the signal for establishing the moment in time from which determination of the residual amount of fuel in the residual amount reservoir (12) by means of consumption calculation begins is triggered in dependence on the display

of the empty condition in the main storage reservoir (34) and on the fuel falling below a given filling level in the residual amount reservoir (12).

4. A process as set forth in claim 1 characterised in that the signal by which the consumption calculation is triggered is used to trigger the reserve display on the instrument panel.

5. A process as set forth in claim 1 characterised in that the engine of the motor vehicle is automatically shut off after the fuel falls below a given minimum amount of fuel in the residual amount reservoir.

6. A process as set forth in claim 5 characterised in that before the engine is automatically shut off a corresponding display is triggered for the driver in dependence on the filling level in the residual amount reservoir (12).

7. A process as set forth in claim 1 characterised in that a signal for establishing a new time from which determination of the residual amount in the residual amount reservoir (12) by calculation of fuel consumption begins is triggered in dependence on the fuel falling below a second filling level in the residual amount reservoir (12).

8. Apparatus for determining the respective amount of fuel in the fuel tank of a motor vehicle, wherein the fuel tank has a main storage reservoir (34) provided with a filling level meter (56) for determining the respective fuel contained therein, and a residual amount reservoir (12) which is of substantially smaller volume in comparison with the main storage reservoir (34) and which is closed in itself and which is supplied with fuel by a pump (38) from the main storage reservoir (34), characterised in that there is provided a first sensor (56) which is associated with the residual amount reservoir (12) and which after

emptying of the main storage reservoir (34) outputs a signal triggering a calculation procedure by which the respective residual amount of fuel still contained in the residual amount reservoir (12) is determined as a difference from a defined volume of the residual amount reservoir (12) and the fuel consumption summed over time.

9. Apparatus as set forth in claim 8 characterised in that the filling level meter (56) associated with the main storage reservoir (34), when the empty condition of the main storage reservoir (34) is reached, produces a signal which is used for triggering calculation of the level of fuel consumption, wherein the signal for establishing the moment in time from which determination of the residual amount in the residual amount reservoir (12) by means of consumption calculation begins is triggered in dependence on the empty display in the main storage reservoir (34) and on the fuel falling below a given filling level in the residual amount reservoir (12).

10. Apparatus as set forth in claim 8 characterised in that the residual amount reservoir (12) is provided in its top with an opening which is defined by an edge extending peripherally on the inside on the residual amount reservoir.

11. Apparatus as set forth in claim 8 characterised in that the residual amount reservoir (12) is so designed that movements of the fuel therein are at least substantially reduced.

12. Apparatus as set forth in claim 8 characterised in that the residual amount reservoir (12) is additionally provided with at least one further sensor (68) which is arranged beneath the first sensor (59).

13. Apparatus as set forth in claim 8 characterised in that the residual amount reservoir is of a volume of between 2 and 12 liters.

14. Apparatus as set forth in claim 8 characterised in that the residual amount reservoir is of a volume which is between 2 and 15% of the volume of the tank (10).

15. Apparatus as set forth in claim 8 characterised in that the filling opening of the tank (10) is connected to the residual amount reservoir (12) in such a way that at least the major part of the fuel introduced into the tank (10) passes into the residual amount reservoir and from same possibly into the main storage reservoir (34).

FIG.1

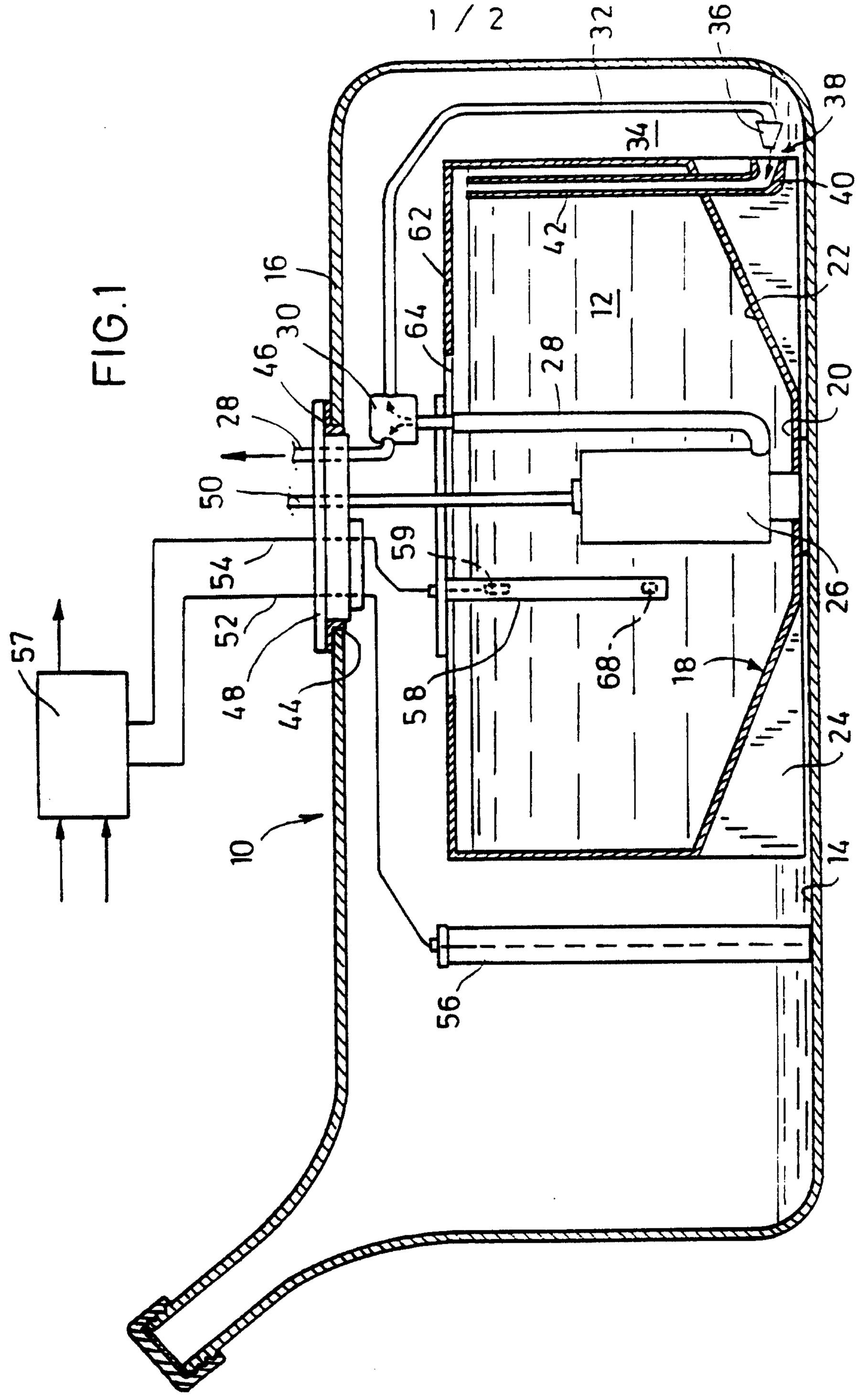
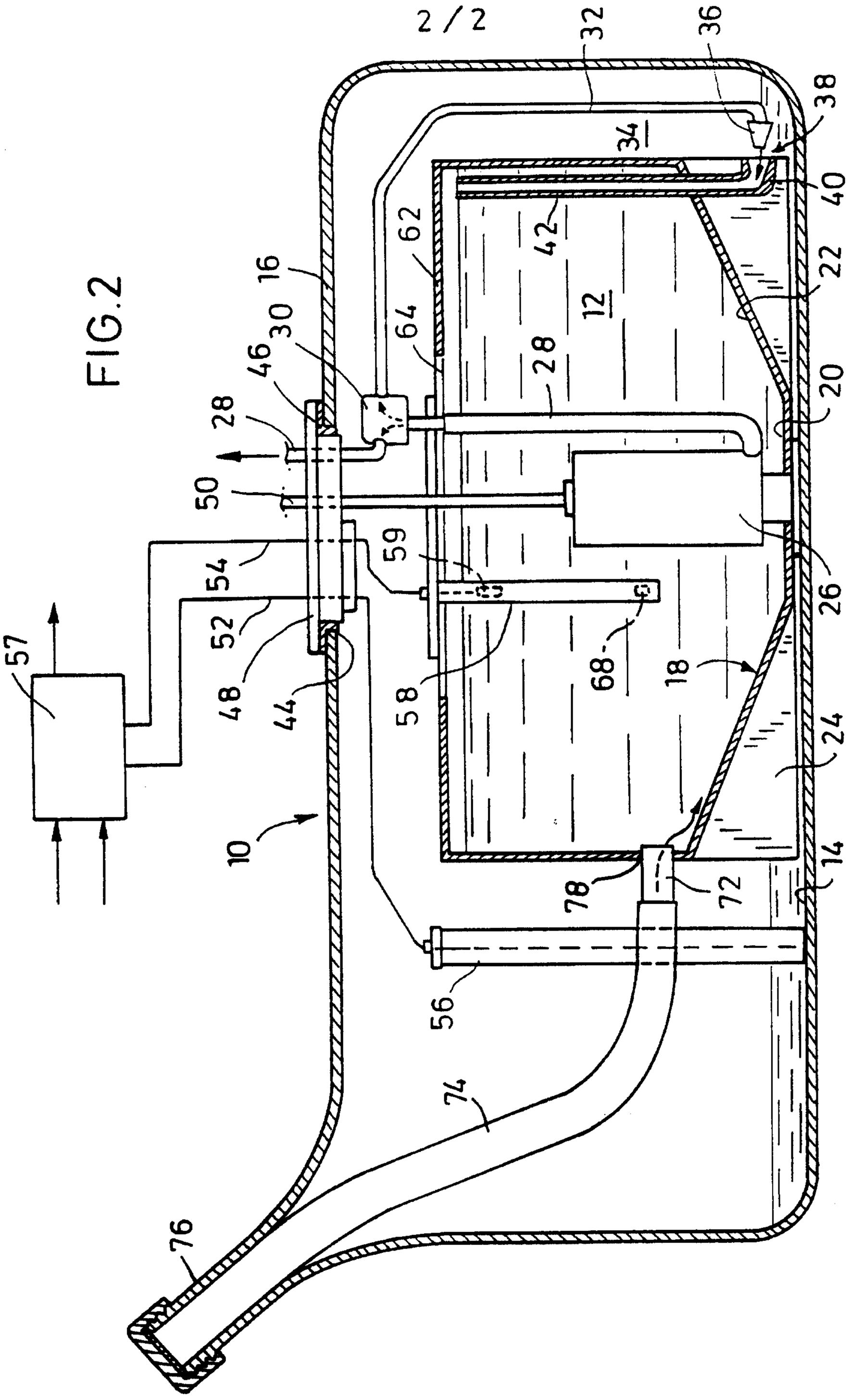
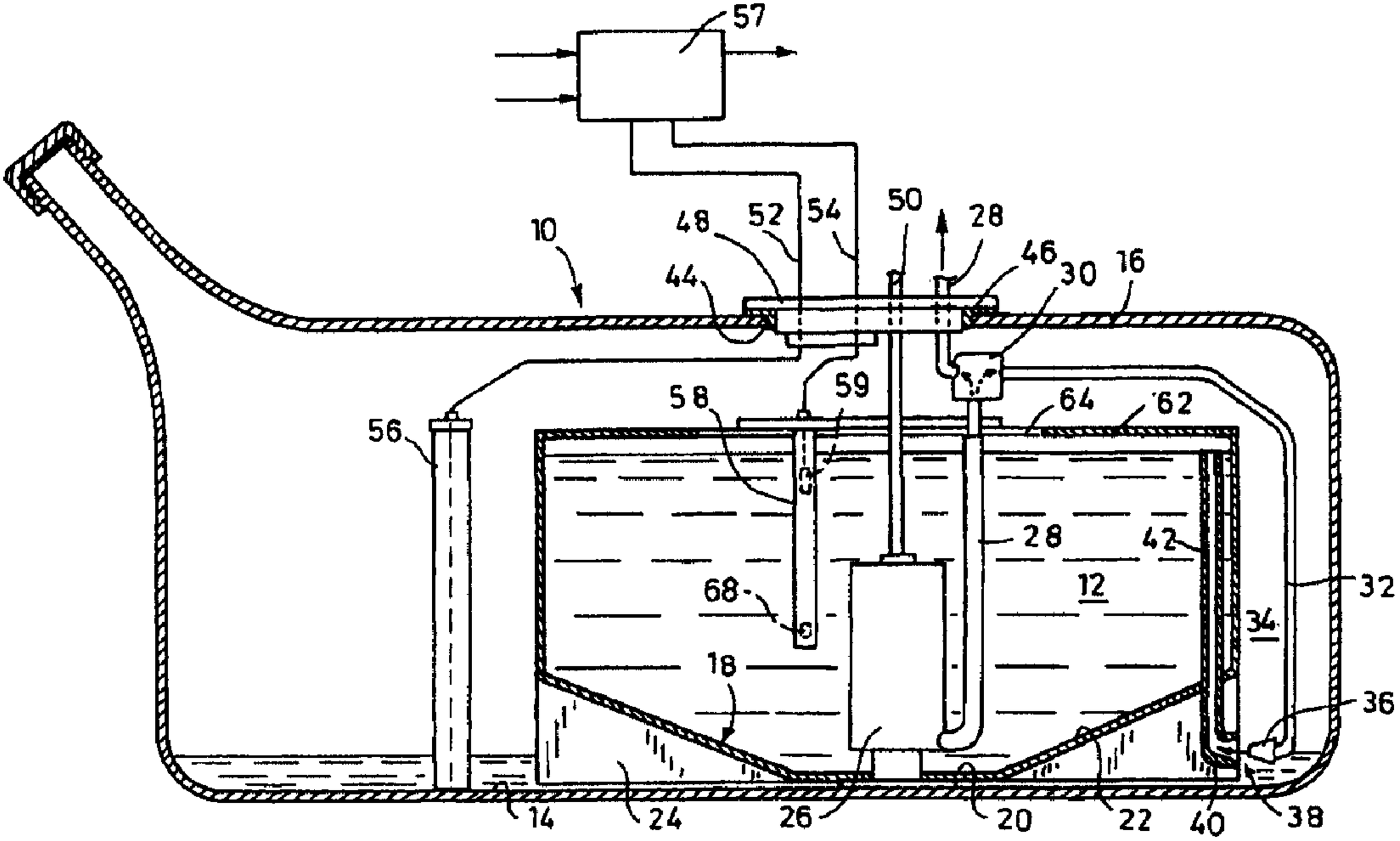

32
36
38
34
40
42
62
22
16
64
12
30
46
28
28
20
50
59
54
26
52
68
68
18
48
44
24
58
10
14
56

FIG.2


32
36
38
34
40
62
42
16
64
22
12
30
28
46
28
20
50
59
54
26
52
48
44
58
68
18
57
10
24
78
72
14
56
74
76


57
10
48
52
54
50
28
46
30
16
44
58
59
64
62
56
53
28
42
12
32
34
68
18
36
14
24
26
20
22
40
38