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METERING MEANS FOR RESERVE SUPPLY OF LIQUID MOTOR FUEL

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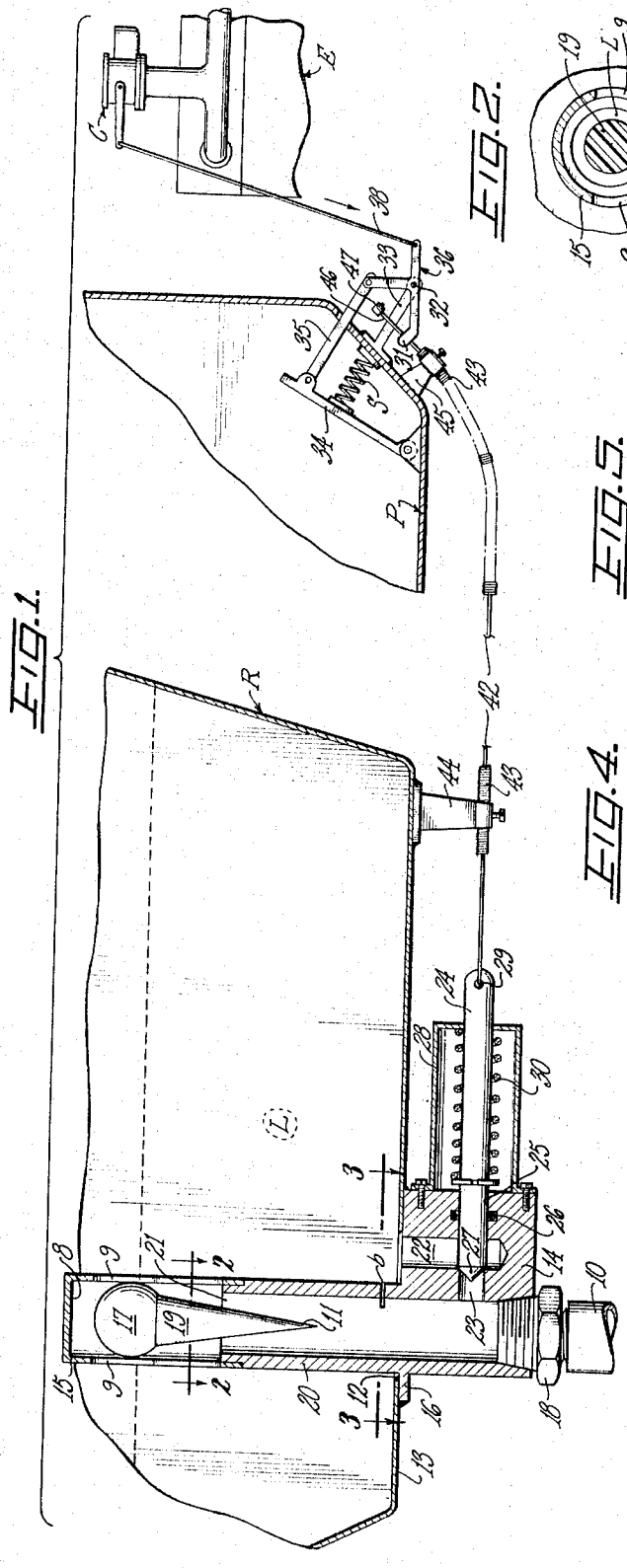


FIG. 1.

FIG. 2.

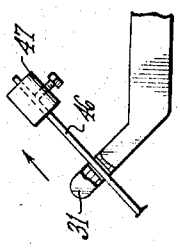


FIG. 6.

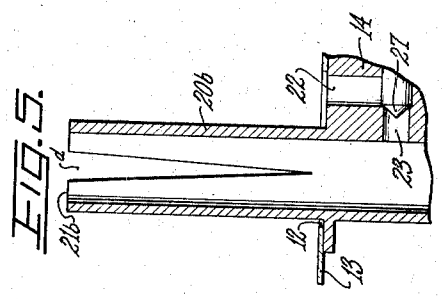


FIG. 5.

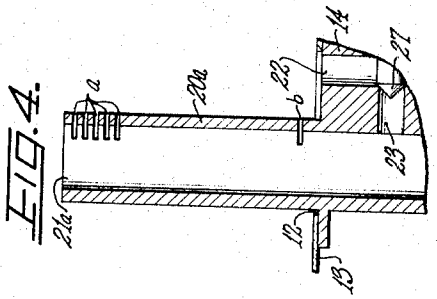


FIG. 4.

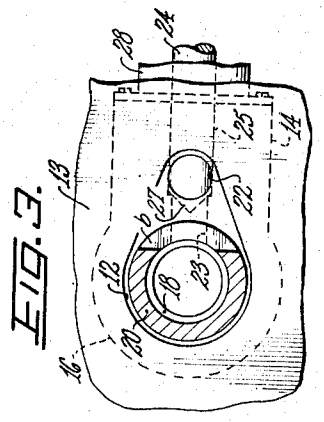


FIG. 3.

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METERING MEANS FOR RESERVE SUPPLY OF LIQUID MOTOR FUEL

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This invention relates to a supply system for conveying liquid motor fuel to an engine, wherein the final quantity of fuel in the supply tank or reservoir is automatically metered to the engine at a reduced rate, thereby (1) warning the operator that the fuel is approaching the point of exhaustion, and (2) conserving such final quantity for maximum operation of the motor by thus rationing it at a reduced rate. Such a system can be used in conjunction with stationary engines, but may find particular application with motor vehicles. Especially for such use, there is also provided means by which the vehicle operator can override the reduced fuel flow and obtain a sudden surge of fuel at the unrestricted demand rate, such as may suddenly be required to avoid a highway collision or the like. Otherwise the vehicle is progressively and automatically retarded in its rate of travel by the slowed engine operation, which then at a minimum speed of say 20 miles per hour, consumes the reserve supply of fuel, say two gallons, at this most economical rate which serves both to continually remind the operator that he should head for a refueling depot, and also serves to furnish the vehicle with as much mileage as possible in order to get there. During this retarded travel, the operator can as often as necessary (or continually if desired) still use up the reserve supply of fuel at the normal rate, simply by cutting out this automatic metering unit, for example, by means of full depression of the foot pedal which normally operates the carburetor by way of a conventional butterfly valve or throttle. A further advantage of such a system is that it requires no resetting when replenishing the fuel supply. In addition, after the fuel level has dropped to a point at which the metering effect becomes automatically apparent, no effort is required of the operator (other than fully depressing the accelerator) to override the metering effect, either transiently or for the whole life of the reserve fuel supply. However, since an auto is seldom driven continuously with the accelerator held at its extreme position, the operator will be reminded as soon as he partially releases foot pressure (by the car slowing to 20 m.p.h.) that he is consuming the reserve fuel supply.

Various alarm and reserve means intended to deal with this problem have been suggested in the past but without complete success. For example, some motor vehicles have dual fuel tanks, with manual means for connecting the reserve supply to the supply line when the contents of the main tank are exhausted. However, after this required shift is made, the driver may forget that such has occurred (due to leaving the car, or even being replaced by another driver without refueling) so that the reserve supply in turn is consumed without further warning and without the driver being continuously aware of the threatening condition. On the other hand, the present metered rate of delivering reserve fuel which constantly reminds the driver that he is using up the reserve, need not unduly retard his progress. Thus, at the time that the auto begins to slow down as a result of diminished fuel supply with the present system, if the operator for example sees a service station a mile or two ahead, he can continue there at his normal rate of travel simply by intermittently depressing the gas pedal all the way to the floor, theerby to bypass the fuel metering mechanism (at the end of each stroke).

The objects of my invention include the achievement of the advantages set forth and to effect such related purposes as will become evident. In the drawings which illustrate by way of example, presently preferred embodiments of the invention:

FIG. 1 is a vertical axial sectional view through my fuel metering means installed in the gasoline tank of a motor vehicle, with a control cable attached to the accelerator pedal, with fragments of the tank, driver's compartment and engine seen in elevation;

FIG. 2 is an enlarged, transverse section taken through the float-containing cage within the gasoline tank along the line 2—2;

FIG. 3 is a similar section taken along the line 3—3 of FIG. 1;

FIGS. 4 and 5 are fragmental axial sectional views through modified forms of drainage tube which lack a cage and float; and

FIG. 6 is an enlarged detail elevation of the lost-motion, foot-pedal-cable connection which opens the bypass conduit of FIG. 1.

In the embodiment of the invention here detailed, there is shown (fragmentarily) a gasoline tank or liquid fuel reservoir R which can be conveniently mounted at any suitable location on a motor vehicle. A fuel supply line or drainage conduit **10** is coupled to a bottom outlet **12** of the reservoir, in position to gravitationally drain the liquid from the tank and convey it to an internal combustion engine E. It is not required that the movement of liquid between reservoir and engine be solely by gravitational flow. In a motor vehicle, ordinarily a fuel pump (not shown) draws the liquid from the reservoir and usually raises it to a higher level in introducing it to a carburetor C from which it is conveyed to the engine after vaporization and mixture with air. However, the improvement of my invention is applied to an initial construction of this type simply by attaching the metering assembly between the tank outlet **12** and the fuel conduit **10**, and then mounting a control cable terminus adjacent the accelerator pedal or throttle control element **34** at the driver's location. But it will be apparent that when the liquid is normally moved by pressure or suction, as long as the conduit take-off (**10**) is from the bottom of the tank, the conduit itself need not necessarily penetrate the bottom wall but may go out through the top or side thereof.

Flow restriction means are mounted intermediate the drainage conduit **10** and the bottom **13** of the reservoir R. There is fixedly mounted a casting or assembly **14**, having a flange **16** secured underlying the bottom wall **13** and a threaded coupling **18** detachably connecting the conduit dependently. The assembly **14** is formed with an open-top tube **20** projecting generally upright into the body of liquid L through the reservoir opening **12**, thus forming an intermediate conduit between the drainage conduit **10** and reservoir R. The size or capacity of the outlet mouth **21** thus determines the maximum flow rate at which the liquid contained in the tank R can be emptied or delivered to the carburetor and engine. When the contained liquid falls below this level in the tank, the remaining liquid then enters the tube solely through the lateral openings or slots *a* and *b*; the outflow is accordingly restricted by the (decreased) number of openings through which it can pass.

Instead of the vertically separated slots *a* of FIGURE 4, the mouth of the drainage tube **20** may be formed with a downwardly constricted or V-shaped opening *d* (FIGURE 5) which thus passes progressively less liquid L from the reservoir into the conduit, as the fuel level drops in the former. Both of these forms are especially adapted to use with a reservoir which is drained gravita-

tionally. However, for use with a fuel delivery pump such as is found on most motor vehicles, I prefer the construction of FIGURE 1 wherein the tube **20** additionally bears on its top a cage **15** which houses a generally ball-shaped float **17** which thus rises and falls within the cage with the liquid level of the reservoir R.

The float **17** may be formed of gasoline-impervious plastic foam, or be formed of cork or light wood, or be a metal sphere, etc. Dependently it carries a downwardly constricted or generally conic pendant **19**, the tip **11** of which always extends (loosely) partway into the outlet mouth **21**. That is, the dimensions of the cage **15** are such that the pendant is never completely withdrawn from the mouth (hence cannot become inverted or stuck in the cage) and accordingly is always in alignment to descend further into the interior of the tube **20** as the level of liquid L falls in the reservoir. The further it descends, the more it blocks the mouth **21** and decreases the fluid flow therethrough, until the ball **17** itself seats across the mouth **21** and completely closes it. At such time, fluid flow through the drainage conduit **10** is limited to the fuel which passes through the metering aperture *b*. The function of the float itself is (after being seated) to prevent air from being sucked into the fuel line **10** by a high-speed fuel pump (not shown), which might otherwise occur. The purpose of the pendant **17** is of course to gradually restrict the metered fuel flow (before it reaches the minimum passable by the aperture *b*) so that the vehicle operator becomes aware—as manifest by a decreasing maximum possible speed with unchanged highway condition—that his fuel supply is approaching the point of contemplated exhaustion.

Within the casting **14** is formed a vertically directed bypass line or conduit **22**, opening into the reservoir through the bottom aperture **12** and at its lower end connected to the drainage conduit **10** by a lateral outlet **23**. Within a generally horizontal bore **25** of the casting **14** is a piston or plunger **24**, the forward end **27** of which functions as a valve and normally seats in the bypass lateral **23** so as to block the same. Traversing a sealing gasket or O-ring **26** in the casting, the body of the piston **24** is reciprocally retained in a hollow housing **28** which also retains a coil spring **30** disposed about the piston.

Over-ride means are provided to enable a vehicle driver to overcome the flow restriction or metering means. The bypass conduit **22** is opened and shut by means of an elongated, control cable **42** which is movable lengthwise within a flexible sheath **43** suspended by brackets **44**, **45** beneath the chassis (not shown) so as to extend from the piston at **29** to a bell crank **36** beneath the floor panel P of the driver's compartment. At the latter location is situated the usual accelerator pedal or foot control **34** which by a connecting rod **38** activates the carburetor C to the extent that the operator's foot pressure thereon overcomes the force of the spring S. A bell crank **36**, pivoted at **32** to a support **33** has a terminally apertured arm **31** through which is loosely threaded the end **46** of the control cable **42**. By lost-motion leverage, depression of the foot pedal **34** to its extreme position (i.e. against the floor board) slides the arm **31** along the cable segment **46** to abut a terminal lug or collar **47** and then to move the whole cable **42** lengthwise so as to retract the piston end valve **27** from the bypass outlet **23**.

In other words, only by a nearly complete depression of the gas pedal **34** (which simultaneously opens the throttle element of the carburetor to full throttle position) will the bypass conduit **22** be rendered operative, so as to override the fuel metering effect of the inlets *a*, *b*, and *d* after the reservoir liquid has dropped below the level of the tube mouth **21**. Then as soon as pressure on the accelerator **34** is relieved, the piston **24** will reseat (due to action of spring **30**) and the engine will continue to operate with only the fuel supply which passes the metering outlets such as *b*. However as long as the operator holds down the throttle control element or pedal **34** all

the way or keeps repeatedly pushing it to the floor P, the fuel supply which such action continues to pass to the carburetor bowl will enable the engine to continue high-speed operation. But as soon as the driver eases up on the pedal or ceases such "pumping" action therewith, the vehicle will again slow down. On the other hand, as long as he is required to continue this unusual manuever in order to get the car to go faster than the metered or predetermined minimum (e.g. 20 m.p.h.), the driver cannot forget the need of soon replenishing the fuel supply. Alternately, if the accelerator **34** is moved to its extreme position in normal driving (at a time when the float **17** is unseated and located adjacent the top **8** of the cage, and accordingly fuel is flowing unrestrictedly into the tube **20** through the cage openings **9**), the fact that the bypass **22** is intermittently (or continuously) open due to retraction of the valve piston **24** will make no difference.

It will be apparent that in the construction of FIG. 4, the initilal length of the tube **20***a* from the lowermost slot *a* to the edge of the mouth **21***a* constitutes a segment of progressively decreasing fluid flow; beneath that level to the wall **13** is the ultimate segment from which all fluid flow is at the rate metered by slot *b*. A similar two-stage metering is obtained with the construction of FIG. 1. Also, a ball float **17** (without a pendant) can be used with the upstanding tubes **20***a* or **20***b*, and the graduated flow apertures *a* or *d* will produce a similar, progressive flow restriction as the pendant **19** in FIGURE 1. But the intermediate conduit formed by the tube **20** is always open (even when partially closed by the float **17**) and thus is the main connection of the reservoir R to supply conduit **10**.

Various changes of construction and operation including the substitution of functional equivalents may be made within the present inventive concept which is not to be limited to the precise details described by way of illustration.

I claim:

1. An assembly of the character described, adapted to couple a drainage conduit to a reservoir in position to drain essentially all of the liquid contents of said reservoir at two successive flow rates, the first being a normal flow rate adapted to drain the predominant quantity of said liquid, and the last being a restricted rate adapted to drain the residual quantity thereof, said assembly including, in combination:

(a) a housing having an open-top tube adapted to project upward from the bottom of such reservoir part way into the interior thereof with its open top thus providing an outlet mouth for normal flow therethrough of liquid which is above the level of the outlet mouth within the reservoir, which projecting tube is formed with lateral aperature means of progressively decreasing flow capacity spaced downward from said mouth, whereby liquid may flow through said aperture means from the reservoir into the tube at a progressively decreasing rate as the liquid level drops in the reservoir below said outlet mouth;

(b) a bypass conduit having a flow capacity similar to said outlet mouth and disposed to connect such drainage conduit with the level of liquid adjacent the bottom of said reservoir; and

(c) selectively operable valve means normally closing said bypass conduit, and lost-motion leverage means adapted substantially simultaneously to fully open said valve means and the throttle of a carburetor to which said conduit may be connected.

2. The assembly of the preceding claim **1** which additionally contains cage means overlying said outlet mouth of the tube, and a ball float retained by said cage means and adapted to act as a closure for the outlet mouth upon descent of the liquid level within the reservoir adjacent said mouth, said float having a dependently tapered

pendant of downwardly decreasing transverse area disposed to progressively block said outlet mouth by descent therein prior to seating of said float.

3. The combination of the preceding claim 1 wherein said assembly additionally contains cage means overlying said outlet mouth of the tube, and a ball float retained by said cage means and adapted to act as a closure for the outlet mouth upon descent of the liquid level within the reservoir adjacent said mouth.

4. In combination with an automotive vehicle having an internal combustion engine and a throttle-controlled carburetor supplied with fuel from a liquid fuel reservoir by means of conduit means which form the only fuel connection between said reservoir and engine, said conduit means being adapted normally to convey a predominant quantity of the liquid fuel to the engine at varied demand rates which permit operation of the engine within range of power output as required for operation of the vehicle;

flow restriction means associated with said conduit means and operable when the amount of liquid within said reservoir decreases to a predetermined residual quantity, said restriction means being adapted to meter said residual quantity by allowing it to pass through said conduit means only at a minimum rate of flow which enables continued engine operation of the vehicle only at a slow speed on a level road;

and over-ride means associated with said conduit means and responsive to intermittent manual operation from the driver's compartment during continued operation of the vehicle from said residual quantity of fuel, said override means being adapted selectively to pass part or all of said residual quantity of fuel at a maximum flow rate only, thereby permitting use of said residual quantity for transient increase of minimum power output of the engine as may be required by operation of the vehicle.

5. The combination of the preceding claim 4 which includes bypass valve means associated with said conduit means and disposed to overcome the effect of said restriction means by allowing full fuel flow from said residual quantity, and said over-ride means comprises a throttle control element and means responsive to movement of said throttle control element to substantially full-throttle position by the driver to permit said use of the residual quantity of fuel.

6. The combination of the preceding claim 5 wherein said means responsive to movement of the throttle control element is characterized by a longitudinally retractable, resiliently-mounted cable connecting said bypass valve means and said throttle control element by means

of bell crank means having one arm coupled by lost-motion leverage to said throttle control element and another arm connected to the throttle.

7. The combination of the preceding claim 4 wherein said restriction means comprises an open-top tube coupled to said conduit means and having a length projecting upward from the bottom of the reservoir part way into the interior thereof with its open top thus providing an outlet mouth for normal flow therethrough of liquid fuel which is above the level of the outlet mouth within the reservoir, which length is formed with lateral aperture means of progressively decreasing flow capacity spaced downward from said mouth along the projecting length of the tube, whereby liquid fuel flows through said aperture means from the reservoir into the tube at a progressively decreasing rate as the liquid level drops in the reservoir below said outlet mouth.

8. The combinaton of the preceding claim 7 wherein said over-ride means comprises a bypass conduit having a flow capacity similar to said outlet mouth and disposed to connect said conduit means with said residual quantity of fuel, valve means normally closing said bypass conduit, and wherein said means responsive to movement of the throttle control element is characterized by a longitudinally retractable, resiliently-mounted cable connecting said bypass valve means and said throttle control element by means of bell crank means having one arm coupled by lost-motion leverage to said throttle control element and another arm connected to the throttle.

9. The combinaion of the preceding claim 7 which additionally contains cage means overlying said outlet mouth of the tube, and a ball float retained by said cage means and adapted to act as a closure for the outlet mouth upon descent of the liquid level within the reservoir adjacent said mouth.

10. The combination of the preceding claim 9 wherein said float is characterized by a dependently tapered pendant of downwardly decreasing transverse area disposed to progressively block said outlet mouth by descent therein prior to seating of said float.

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