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C. H. BRASELTON ET AL

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FUEL SUPPLY SYSTEM FOR AUTOMOTIVE VEHICLES

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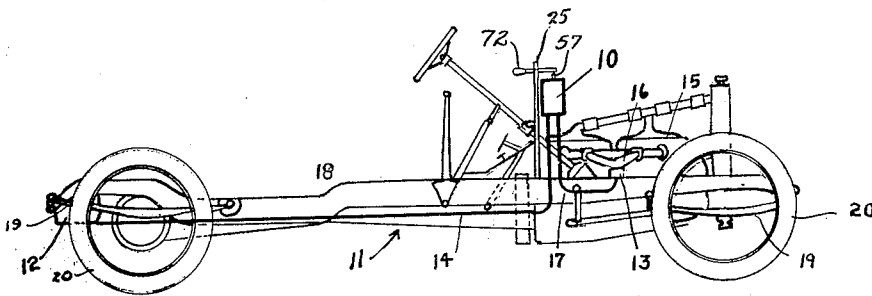


Fig. I

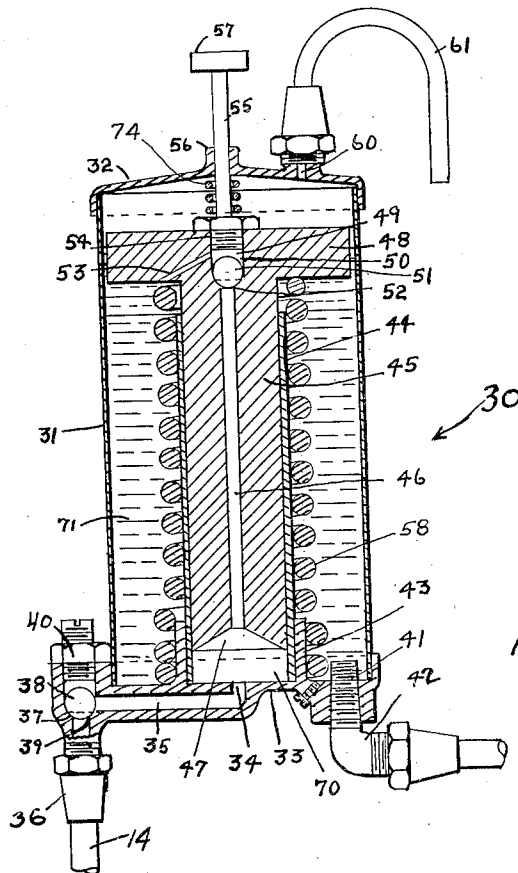


Fig. II

INVENTORS
Chester H. Braselton
and
Fred B. MacLaren
BY
Chester H. Braselton
ATTORNEY

UNITED STATES PATENT OFFICE

CHESTER H. BRASELTON, OF NEW YORK, AND FRED B. MACLAREN, OF JAMAICA, NEW YORK; SAID MACLAREN ASSIGNOR TO SAID BRASELTON

FUEL SUPPLY SYSTEM FOR AUTOMOTIVE VEHICLES

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This invention relates to a system and mechanism for utilizing the relative movements of coacting means actuated by vibration for feeding fuel from a supply tank to a fuel consuming means, such as the charge forming device of a powerplant or an internal combustion engine of an automotive vehicle with means operating to control the feeding action of said fuel feeding means.

One of the main objects of our invention is to provide a fuel supply system for the engine of an automobile in which the vibration inherent in the automobile, when it is in operation, is utilized to pump fuel from a supply tank to a secondary tank for feeding therefrom to the engine and in which such pumping action is automatically rendered ineffective or inoperative when the liquid fuel in the secondary tank reaches a certain level.

A further object is to provide a fuel feeding system in which a receptacle is provided for holding liquid fuel pumped or fed from a supply tank until it is used up by the fuel consuming means and which has means for limiting the pressure at which the liquid fuel is supplied to the fuel consuming means by utilizing the liquid pumped into the receptacle as a means for modifying the action of the pumping mechanism.

In the embodiment of the mechanism shown and described in this application, we use vibrations such as caused by a moving vehicle or vehicle standing still, but subjected to vibration by the operation of a driving mechanism or other means, to bring about the lifting of a liquid from a lower level, such as the supply tank of an automobile to a higher level tank from which the liquid fuel may be fed as desired by gravity or otherwise to the engine, and we control the pressure at which said fuel to fed from the higher tank by means dampening the liquid lifting or pumping mechanism.

More particularly the present invention has for its object to provide a gasoline feeding system for an automotive vehicle in which an auxiliary tank is fed from a supply tank by pumping mechanism including an element normally out of contact with the liquid pumped but arranged so that when the height

of the liquid in the auxiliary tank rises to a certain level the liquid comes in contact with a surface thereof whereby further movement of the pumping mechanism is dampened by the surface action of the liquid or the liquid is forced to pass through a reduced passage and the pumping action is thereby dampened.

Various other objects are within the scope of this invention, such as will appear from the arrangement of the related elements of structures including various details of construction and economies of manufacture, all appearing from the design and operation herein disclosed which shows a form of the invention for a certain application and representing an illustrative preferred embodiment for one useful application of our method and mechanism for broadly utilizing the same.

In the embodiment shown,

Figure I illustrates a specific application of our invention to an automobile, and

Figure II is a vertical section through the fuel lifting pump showing the detailed construction thereof.

Referring to Figure I of the drawings, there is shown an application of our invention embodied as a pumping mechanism wherein the pump 10 is shown applied to an automobile 11 for the purpose of pumping liquid fuel from a main tank 12 at a lower level to a chamber in the pump tank 10 at a higher level, in order that the liquid fuel may flow by gravity from this fuel chamber in the pump tank 10 to the carburetor 13 for supply to the engine. The main tank 12 has a pipe 14 which connects the main tank to the pump tank 10. The carburetor 13 is mounted in this form on the internal combustion engine 15, adjacent the intake manifold 16, and this carburetor is connected to the pump tank 10 by a feed pipe 17.

The pump tank 10 is positioned intermediate the carburetor and main tank and is secured to the dash 25 of the automobile and sufficiently above the level of the carburetor that the liquid fuel in the pump tank will readily flow by gravity through the pipe 17 to the carburetor in all normal positions of the automobile.

The conventional features of an autom-

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bile chassis are disclosed in Figure I including a frame 18 supported through springs 19 and the usual axles, on wheels 20. The transmission control and engine and other automobile details are merely conventional and are not described specifically, they being immaterial to an explanation of this invention.

Referring now to Figure II of the drawings there is shown in this figure a detailed section of an illustrative pump unit and tank 10, showing the relationship of the various parts and their operation. A cylindrical tank 30 is shown, the body 31 of which is formed preferably of sheet or stamped metal and fitted with gas or liquid tight end caps or plates 32 and 33 which caps may be fastened on in any convenient manner. The lower plate 33 is formed with a central aperture 34 connected by a lateral conduit 35 to a pipe coupling 36 coupling with one end of supply pipe 14, the other end of which by suitable coupling leads to the interior of the main or lower tank 12 near the bottom thereof. In the conduit 35 is located a valve 37 shown as a ball valve in which the ball 38 cooperates with the valve seat 39. Above the valve is a screw plug 40 adapted to be removed for the insertion of the valve and for the cleaning of the valve and conduit. The valve 37 and pipe coupling 36 may of course lead directly into the central part of plate 33 instead of at one side as shown, and the valve may be carried by the coupling member or in any way desired and be removable with it. In fact the exact arrangement of this part of the construction is a matter of preference in design and not material to the invention.

Fuel pipe 17 from the tank to the carburetor has its upper end connected by suitable coupling to a joint 42 screwing into an opening in the lower plate 33 so as to connect the carburetor through this pipe and joint with the inside of the liquid chamber in the pump tank surrounding the pump mechanism and inside the wall of the casing 31. The upper end of the joint 42 instead of stopping flush with the bottom of the inside of the tank projects upwardly into the chamber 71 a short distance to allow a space in the extreme bottom end of the chamber 71 in which sediment or water may collect and prevent the sediment from flowing on into the carburetor. We also propose to place an opening (for the purpose of simplicity not shown) in the bottom of the tank at its lowest inside point and have the same filled by a removable plug or a manually operable valve in order that the tank may be drained from the bottom to draw off the liquid fuel or to clean the pump tank.

Projecting upwardly from the base cap 33 and preferably integral therewith is an annular projection 43 surrounding the inlet aperture 34 and supported by this annular member 43 is an upwardly extending guide or

pump cylinder 44. Within the pump cylinder and adapted for relative movement axially thereof is a vibration or inertia operated pump plunger or piston 45. This piston 45 in the form shown is provided with an axial opening 46 the lower end of which opens into the preferably concave end, 47, of the piston to facilitate by means of the concavity, the escape of air bubbles if there should be any, and to intensify the suction effect of the piston.

The upper end of the plunger 45 is laterally extended to form a weight or annular plate 48, the circumference of which terminates at points adjacent to the inside of the pump tank casing 31 but not forming a tight fit therewith. This fit is to be such that liquid may pass between the casing 31 and the periphery of the annular plate but we prefer that the fit be sufficiently close that the passage of liquid from above the plate 48 to below it, or vice versa, is more or less hindered by the constricted passage area. This passage area also will allow free passage of air from above the plate 48 to below it and vice versa in order that the liquid in the chamber 71 may always be under atmospheric pressure. This construction makes use of the enlarged portion 48 of the piston not only for increasing the weight of the piston to get a greater pumping effect, but also for dampening the vibration of the piston when the liquid in the chamber 71 is in contact with the lower surface thereof or liquid is forced to pass between the edge of the disk 48 and the wall of the container 31. Further dampening action is caused by the plate 48 losing weight as it becomes submerged in the liquid whereby the lower normal limit of the amplitude of vibration is raised and the stroke shortened. When the vibration is thus dampened the pumping action of the pump practically stops until the level of the liquid in the space 71 is lowered as this liquid is consumed by the carburetor. The piston then will begin pumping again until the upper surface of the liquid in the space 71 again reaches the lower surface of the plate 48 when the pumping effect again stops. The center of the plate 48 is formed into a recess 49 which communicates at its base with the upper end of the opening 46 in the plunger or piston 45, and a check valve 50, the ball 51 of which rests on the valve seat 52, normally closes the connection between the opening 46 and recess 49. Recess 49 communicates with the space 71 or the interior of the tank casing through opening 53, the outlet of which terminates in the base of the annular plate 48 or at any convenient point on the exterior of the plunger or piston member above the upper end of the cylinder 44.

The recesses 49 is closed on top by means of a plug 54 which forms the lower terminal of a rod 55 extending through an aperture 56

in the top cap 32. In this way the top cap acts as a guide for the upper end of the piston through the rod 55 or instead of the rod 55 the piston may have an integral projection adapted to project through an opening through the top cap 32 so that the latter may serve as a guide for the upper part of the piston. It is not necessary that the upper plate 32 be the guide or that there be any beside the casing 44. Then too the plate 48 may serve as a guide by its periphery contacting at some point in the inside periphery of the casing 31, other points of the periphery of the plate 48 being relieved to allow restricted passage of liquid or air from above the plate 48 to below it and vice versa. We prefer, however, that either the piston or a part of it or some means connected with it project outwardly through an opening in the plate 32 so that if desired at any time the pump piston could be manually operated either by manipulating the projecting portion direct or by suitable wire or rod connection to the dash, such as the lever 72 shown in Figure I which may be used by the operator without having to leave his seat or to raise the hood of the automobile to get to the tank direct which tank is mounted beneath the hood of the automobile. By pushing the rod 55 down, allowing it to return several times, the liquid chamber 71 in the pump tank will be supplied with liquid fuel even though the automobile is standing still or there be insufficient vibration at any time to cause automatic filling of the tank chamber. As soon as the automobile starts to move, however, the tank will be automatically supplied in a short time with the liquid fuel from the rear tank, this due to the operation of the pumping mechanism caused by the vibration of the car. The pumping mechanism will also be operated by merely the shaking of the automobile as by jumping up and down on the running board, or in fact, with some cars and with carefully arranged valve mechanism, it is possible to cause the pumping to be performed merely by the vibration of the car or pump support resulting from the operation of the running of the engine.

There is positioned about the guide cylinder 44 a coil spring 58, one end of which contacts against the base plate 33 and the other end of which bears against the lower side of the plunger plate 48. The object of this spring is to support the plunger or piston 45 yieldingly at a point of balance, with the bottom of the plate 48 normally above the stop determined by the top of the guide cylinder 44 to such an extent that an oscillatory movement of the plunger or piston within a restricted amplitude is possible, the upper limit of movement being the top cap 32 buffed, however, by a spring 74. The spring 58 is not altogether necessary to an operation of the device, though it is preferable. Sufficient

pumping action will be obtained without the spring 58 if the vibration of the operating mechanism is sufficiently rapid or of sufficient strength; in fact, this does not need to be rapid or strong for a small amount of pumping. To take care of a normal amount of pumping with a small vibration amplitude or a very slow period of vibration the spring should be quite long before deflecting to support the piston, i. e. the piston should be very heavy relative to the size of piston and the spring deflection to balance the weight should be very long. The exact relationship, however, is a matter of calculation and design for the particular work to be accomplished.

The capacity of the pump and the height to which the pump will pump the liquid are factors of the area of the piston and its weight as well as the amplitude of vibration. Greater pressure may be obtained by having a smaller diameter piston keeping the weight the same while a larger volume of liquid may be pumped keeping the weight of the piston the same, but pumped to a less height by enlarging the diameter of the piston. The dampening effect, due to the plate 48 contacting with the liquid in the space 71, depends upon the area of the undersurface of the plate 48 in contact with the liquid having in mind a particular size diameter of the piston. With these points in mind the characteristics of the pump may be readily changed to produce the particular effect desired under the conditions existing.

The operation of the mechanism will appear from the above description as follows: The piston plunger 45 is freely movable in the cylinder 44 and is maintained at a balance point determined by the mass of the plunger or piston element and the strength of the spring 58. Due to the inertia of the piston and to its spring support, if used, any movement of the container 31 in which there is a force component parallel to the axis of free movement of the piston causes a relative axial movement between the cylinder 44 and piston 45, the piston 45 due to its inertia if standing still tending to remain still, and if in motion, to continue in motion in the same direction. The cylinder 44, however, being connected positively with the support upon which it is mounted, will be caused to follow whatever vibration or motion its support or the car has. This relative movement of the container and piston, it will be seen, enlarges or decreases the size of the chamber between the lower end of the piston and lower inside end of the cylinder in which it fits, and with the cooperation of the valve tends to pump fluid from the tank 12 to the space 71 in the pump tank. Thus any relative oscillation between the piston and its cylinder about their relative normal point of balance as determined by the mass of the piston and the strength of the spring, continues the pump-

ing action until the relative movement stops. Relative movement between the piston and cylinder increasing the space 70 operates to suck gasoline from the rear tank 12 through pipe 14 and valve 38 and pipe 35 into the pump chamber 70 and the reverse relative movement between the piston and cylinder 44 when the space 70 is being reduced operates to force some of the liquid in the pump chamber 70 through opening 46, valve 50 and hole 53 into the space between the guide cylinder 44 and the inside of the casing 31. The valves 38 and 50 are adapted to permit flow of liquid in this direction and prevent the flow in the opposite direction. Thus the valve 38 in the inlet pipe, and the valve 50 in the piston form the outer limit of an expansible chamber 70 in which liquid or fluid is movable in one direction only, namely, from the main tank 12 through the pump chamber 70 and from there into the space 71. A downward movement of the piston seats valve 38, should the expansible chamber 70 be filled with liquid, and unseats valve 50, the liquid moving through the hole 53 into the pump tank space 71. A succeeding upward movement of the piston closes valve 50 and opens valve 38, liquid from pipe 14 following the piston into chamber 70 by virtue of atmospheric pressure according to well known principles of suction pump action.

It is, of course, obvious that the oscillations of the piston about its point of rest are rapidly damped, since the piston works against atmospheric pressure in the one direction and the resistance of the liquid in the other direction, but the persistence of the oscillation may be varied in accordance with the variations in the value of the constant of the spring and piston, and with the variation in the viscosity of the liquid. However, the operation may be made so sensitive that the engine vibration is enough to supply the liquid fuel for idling the motor by properly designing the valves and parts. The valves in the normal pumping operation of the mechanism are submerged in the liquid.

The object of the atmospheric port 60 will now be apparent inasmuch as in order to not obstruct movement of the piston against a back air pressure in the upper part of the tank, free air movement between the tank exterior and the interior of the tank should be provided. However, obvious means are provided in the port 60 so that splashing of the liquid out of the tank through this port will be avoided. It should be observed, however, that this port opening is made as small as possible without hindering the efficiency of the mechanism, in order to diminish, as far as possible, the escape of vapor from the tank interior. This object to prevent undue escape of vapor, is also somewhat facilitated by the U-design of the vent tube 61 in that especially during the movement of the automobile the

temperature of the tube is below that of the tank and hence a certain amount of condensation takes place the liquid returning to the tank. Of course the opening tube 61 can be eliminated and a loose fit between the rod 55 and the guide 56 be made to permit passage of air between the outside of the pump tank and the inside.

The tank space 71 of the container 31 is initially supplied with liquid by manually operating the piston by means of the exterior connection 55 to the piston or shaking the car or tank support.

Should the automatic pump action be such as to fill the space 71 in the container with liquid up to the piston plate 48, the movement of the piston will then be abnormally hindered by the surface suction and by reason of the restricted passage between the edge of the disk 48 and the container wall through which the liquid must pass in the further pumping action and by the change of balance between the spring and the piston due to the losing of weight of the disk 48 as it becomes submerged in the liquid, thereby decreasing or dampening the pump action until the liquid level has again fallen. The effect of the dampening due to the liquid being adjacent the bottom of plate 48 is that the pump automatically will maintain the height of the liquid in space 71 substantially constant for as liquid runs out through pipe 42 to the carburetor the pumping action increases and automatically refills the space 71 to its substantially constant level. Through this operation the effect is that the pump operates only, and on the average, to such an extent as is needed to keep a reasonably constant level in the space 71.

This invention is an improvement upon the basic invention described and claimed in our copending application, Serial No. 533,493, and the claims herein contained are drawn to features not covered by the said broader application.

The system and apparatus disclosed herein constitutes merely one embodiment of our invention and may be altered or changed considerably without departing from the spirit of our invention. Therefore, we claim our present invention in broad terms, as indicated by the appended claims.

What we claim is:

1. In a fuel supply system for an internal combustion engine, a vibration operated pumping mechanism for feeding liquid fuel from a supply tank, and means controlling the pressure at which liquid fuel is fed by said fuel supply system to the engine, said means operating by contact of the liquid pumped with a surface movable with the pumping mechanism.

2. In a vibratory pump mechanism of the class described in which there is relative movement between an inertia-actuated piston

and a cylinder, the combination with said inertia-actuated piston and cylinder and valves therefor and a chamber to receive the discharge from the pump of means for disabling the pump controlled by the amount of liquid in the receiving chamber.

3. In mechanism of the class described the combination of a vibratory cylinder; a piston working therein and adapted to be given relative movement with respect to the cylinder when the latter is vibrated; valve connections whereby the cylinder and piston cooperate to perform a pumping operation; and means for dampening the vibrations of the pistons with respect to the cylinder when the liquid in the receiving chamber from the pump reaches a certain level.

4. A fuel supply system for an internal combustion engine comprising a fuel supply tank, a pump for pumping liquid fuel from the supply tank for the engine, including a piston and a pump chamber having relative movement due to inertia when subjected to vibration, and automatic means for restricting the stroke of said piston when the liquid circulating in said system reaches a predetermined height.

5. A fuel supply system for automotive vehicles comprising a fuel supply tank, a pump for pumping liquid fuel from the supply tank for an engine of the vehicle, said pump being actuated by the vibration normally inherent in the automotive vehicle when in operation, an automatic means for restricting the stroke of said pump and thereby limiting the pumping action.

6. A fuel supply system for internal combustion engines comprising a tank, a pump in said tank including a pump chamber connected with a source of supply and a resiliently supported piston working in said pump chamber, and means for automatically restricting the stroke of said piston when the liquid reaches a predetermined level in said tank.

7. A fuel supply system for automotive vehicles comprising a tank, a pump chamber connected to a source of supply and discharging liquid fuel therefrom into the tank, an inertia-operated piston working in the pump chamber, and automatic means for restricting the stroke of said piston when the liquid rises to a predetermined level in the tank.

8. A fuel supply system for automotive vehicles comprising a tank, a cylinder having an inlet communicating with a source of supply and discharging into the tank, a resiliently supported piston working in said cylinder, and means for damping the stroke of said piston when the level of the liquid in the tank reaches a predetermined height.

9. A fuel supply system for automotive vehicles comprising a fuel supply tank, a pump chamber within the tank connected with a source of supply and discharging into the

tank, a resiliently supported piston working in said pump chamber and means whereby the liquid in said tank interposes a resistance effective to check the movement of said piston when the liquid rises to a predetermined level in the tank.

10. A fuel supply system for automotive vehicles comprising a fuel supply tank, a pump chamber within said tank connected with the source of supply to receive liquid fuel therefrom, and discharging into the tank, a resiliently supported piston working in said pump chamber and having an enlarged portion fitting within the tank so as to provide restrictive passage between said portion and the wall of the tank whereby the liquid in said tank is effective to restrict the stroke of said piston when said liquid reaches a predetermined level.

11. A device of the class described comprising a receptacle, a pump including two relatively movable elements, one of which is fixed to the receptacle and the other of which is free for relative movement with respect thereto under the influence of inertia, and automatic means controlled by the level of liquid in said receptacle for restricting said relative movement.

12. A device of the class described comprising a receptacle open to the atmosphere, a pump chamber discharging into said receptacle, a resiliently supported piston working in said pump chamber, and means controlled by the level of liquid in said receptacle for automatically restricting the stroke of said piston.

13. A device of the class described comprising a receptacle, a pump chamber located within said receptacle and discharging liquid thereinto, a resiliently supported piston working in said pump chamber and provided with an extended surface adapted to engage the liquid in said receptacle when the level thereof reaches a predetermined limit, whereby said liquid is effective to interpose a resistance checking the movement of said piston.

14. A fuel supply system for automotive vehicles comprising a supply tank and a pump for pumping liquid fuel from a source of supply to the tank, said pump including a piston having a surface engaged by the liquid in said tank, when said liquid reaches a predetermined level, to restrict the stroke of said pump.

15. A device of the class described comprising a receptacle open to the atmosphere, a pump chamber within said receptacle, a piston working in said chamber and pumping liquid into said receptacle, and means controlled by the liquid level in said receptacle for automatically restricting the stroke of said piston.

16. A device of the class described comprising a tank, a cylinder supported within said tank and having a valve-controlled inlet

adapted to be connected to an external source of supply, and a piston resiliently-supported within said tank and working in said cylinder, said piston having an enlarged portion above the upper end of the cylinder extending into proximity to the wall of said tank and automatically restricting the piston stroke when the liquid in the tank rises to the level of said enlarged portion.

17. A device of the class described comprising a tank, a pump chamber within said tank having a valve-controlled inlet adapted to be connected to an external source of supply, a piston working in said chamber and provided with a piston-actuating mass, a spring supporting said piston from the bottom of the tank, and a buffer interposed between said piston and the top of the tank to check extreme movements of the piston.

18. A device of the class described comprising a tank, a pump chamber within said tank having a valve-controlled inlet adapted to be connected to an external source of supply, a piston working in said chamber and provided with a piston-actuated mass, a spring supporting said piston from the bottom of the tank, an operating stem extending from the upper end of the piston through the top of the tank, and a buffer spring disposed on said stem between the piston and the top of the tank.

19. A means for elevating fuel from the main tank of a motor vehicle to the carburetor thereof comprising an element operable by vibration, means responsive to the operation of said vibrating element to effect elevation of said fuel, a chamber enclosing said vibratory element for the storage of a local pool of fuel, said chamber enclosing said vibratory element and having such relation thereto that the accumulation of a predetermined quantity of fuel in said chamber will stop further vibration of said vibratory element.

20. A fuel supply system for an internal combustion engine comprising a fuel supply tank, a pump for pumping liquid fuel from the supply tank for the engine including a piston and a pump chamber having relative movement due to inertia when the latter is subjected to vibration, said piston having an elevated horizontal plate secured thereto whereby automatic means is effected for restricting the stroke of said piston when the liquid circulating in said system reaches the elevation of the plate.

21. A liquid supply system comprising a liquid supply tank, a pump for pumping liquid from the supply tank including a piston and a pump chamber having relative movement due to inertia when the latter is subjected to vibration, said piston having a horizontal plate elevated in the system whereby automatic means is provided for re-

stricting the stroke of said piston when the liquid circulating in the system reaches the level of the elevated plate.

22. A fuel supply system for internal combustion engines comprising a tank, a pump in said tank including a resiliently supported piston mounted for reciprocation in a cylinder connected with a source of fuel supply, said piston having a horizontal plate elevated in the tank whereby when the fuel in the tank reaches the elevation of the plate the action of the piston will be disabled.

23. A fuel supply system for automotive vehicles comprising a fuel supply tank, a secondary tank located at a higher level than the supply tank, a resiliently supported piston in the secondary tank, a cylinder connected to the fuel supply tank and adapted to cooperate with the piston to pump fuel from the supply tank into the secondary tank, said piston having a horizontal plate elevated in the secondary tank, said plate operating to dampen the action of the piston by the incompressibility of the fuel when the same reaches the level of the plate.

24. A fuel supply system for automotive vehicles comprising a fuel supply tank, a secondary tank located at a higher level than the supply tank, an open-ended cylinder in the secondary tank having a piston mounted therein, said piston being resiliently supported in the secondary tank and operating upon reciprocation to withdraw fuel from the supply tank and introduce the same into the secondary tank, said piston having a horizontal plate elevated in the secondary tank, said plate operating to dampen the action of the piston by incompressibility of the fuel when the same reaches the level of the plate.

25. A fuel supply system for automotive vehicles comprising a fuel supply tank, a secondary tank located at a higher level in the supply tank, an open-ended cylinder in the secondary tank having an inlet connected to the fuel supply tank, a hollow piston resiliently mounted in the secondary tank and adapted to reciprocate in the cylinder to withdraw fuel from the supply tank and deposit the same in the secondary tank, a horizontal plate formed on the piston in elevated position with respect to the secondary tank to dampen the action of the piston when the fuel reaches the level of the plate, there being an opening connecting the interior of the piston with the underside of the plate whereby fuel may pass through the piston to the underside of the plate when the piston is reciprocated in the cylinder.

26. A fuel supply system for automotive vehicles comprising a fuel supply tank, a secondary tank located at a higher level than the supply tank, a cylinder in the secondary supply tank having a hollow piston mounted for reciprocation therein, said cylinder being connected to the fuel supply whereby reciprocating the stroke of said piston when the liquid circulating in the system reaches the level of the elevated plate.

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cation of the piston will introduce fuel from the supply tank to the secondary tank through said hollow piston, a plate on said piston elevated in the secondary tank, there being a
5 passage connecting the interior of the piston with the space beneath said elevated plate, and means permitting exclusion of gas beneath said plate when the liquid in the secondary tank reaches a predetermined level
10 whereby action of the piston will be dampened by the incompressibility of the fuel.

27. A device of the class described comprising a tank, a pump cylinder extending from the bottom of the tank to the upper part thereof and having a valve controlled inlet at the
15 lower part thereof, a piston working in said cylinder and provided at its upper end with a piston actuating mass which cooperates with the upper end of the cylinder in limiting the downward movement of the piston, a
20 spring surrounding said cylinder and interposed between the bottom of the tank and the piston actuating mass to determine the normal position of the piston, said piston having
25 a fluid passage extending upwardly from the lower end thereof and having at its upper end a ball valve chamber communicating with the upper end of said passage and with the upper side of said piston actuating mass and
30 a discharge passage extending from the ball valve chamber to the lower side of said piston actuating mass, a ball in said ball valve chamber, and means to close the upper end of said ball valve chamber.

28. A device of the class described comprising a tank, a pump cylinder extending from the bottom of the tank to the upper part thereof and having a valve controlled inlet at the
40 lower part thereof, a piston working in said cylinder and provided at its upper end with a piston actuating mass which cooperates with the upper end of the cylinder in limiting the downward movement of the piston, a
45 spring surrounding said cylinder and interposed between the bottom of the tank and the piston actuating mass to determine the normal position of the piston, said piston having
50 a fluid passage extending upwardly from the lower end thereof and having at its upper end a ball valve chamber communicating with the upper end of said passage and with the upper side of said piston actuating mass, and
55 a discharge passage extending from the ball valve chamber to the lower side of said piston actuating mass, a ball in said ball valve chamber, and a guiding member extending through the cover of the tank and threaded into the upper end of the ball valve chamber so as to close the upper end of the ball valve chamber
60 and serve as a guiding and actuating device for the piston.

In testimony whereof, we affix our signatures.

CHESTER H. BRASELTON.
FRED B. MACLAREN.