Dec. 9, 1930. C. S. BURTON 1,784,130

VACUUM TANK

Filed Feb. 21, 1929

Fig. 1.

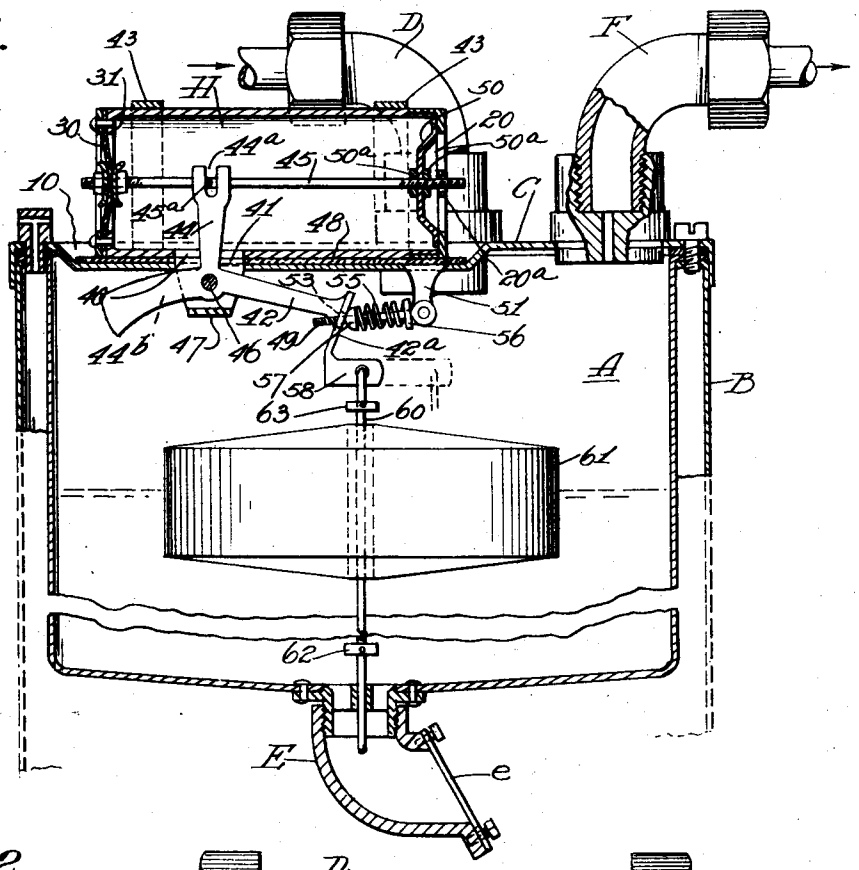
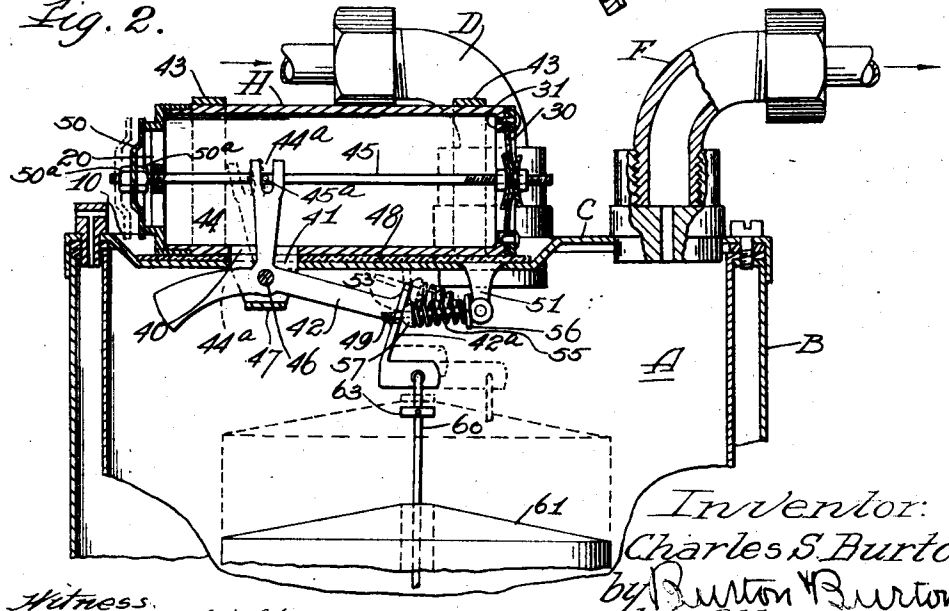


Fig. 2.



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Patented Dec. 9, 1930 1,784,130

UNITED STATES PATENT OFFICE

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VACUUM TANK

Application filed February 21, 1929. Serial No. 341,586.

The purpose of this invention is to provide an improved construction in a vacuum tank adapted to facilitate dispensing with a valve to control the suction connection without creating the embarrassment which is liable to accompany the omission of the suction valve. It consists in the elements and features of construction shown and described as indicated in the claims.

It is well understood by those familiar with vacuum fuel feeding devices, that when, for any reason, in a vacuum tank the valve usually provided for controlling the suction port is omitted, it is necessary to limit the size of the suction port to a very small fraction of the atmosphere port and valve, in order that the opening of the atmosphere valve shall reduce the vacuum to a degree to permit the chamber of convenient depth to discharge by gravity for a substantial portion of the depth. And it is also well understood that the relatively large size of the atmosphere valve necessitates a correspondingly large float to have the buoyant value necessary for breaking the suction hold on the valve for opening it when the chamber is filled and should be discharged.

Dispensing with the valve at the suction port thus creates the dilemma that if the suction port is made large enough to ensure rapid filling of the vacuum chamber with fuel, the atmosphere port must be so large that the float required to break the suction hold must be very large and the vacuum chamber correspondingly large without enlarged fuel capacity around the float, thus rendering the total construction large and correspondingly expensive and inconvenient for installation on engine or vehicle suction.

On the other hand, if the suction port is made small enough to permit the atmosphere port to be small enough to require a valve small enough to be broken from the suction hold by a moderate size float, the fuel feeding capacity is rendered undesirably low.

This dilemma is avoided in the present invention by the expedient of getting the atmosphere valve, which is stressed to its seat inwardly with respect to the vacuum chamber by the suction, with another element also arranged to be stressed inwardly by the same suction, the connection between the two elements being arranged to oppose the two stressed to each other, so that they are substantially counter-balanced; and however large the atmosphere inlet port may be made, the counter-balancing element may be made of equal or nearly equal exposure to the suction, so that the valve will be held to its seat by only the amount of pressure which is produced by the relative dimensions of the parts for causing the valve to be thus held by the minimum force judged necessary to ensure that it will not be jarred from its seat by the running of the engine or the travel of the vehicle.

The character of this expedient adapts it to be employed either in a construction in which the atmosphere valve is seated interiorly, so as to be held to its seat by the suction, as in the usual vacuum tank construction, or in a construction in which that valve is located exteriorly of the vacuum chamber and would be unseated by the suction; for the counter-balancing element may be arranged in either case for experiencing the suction in the same direction as the valve, and may be connected for transmitting the stress in the reverse direction for counter-balancing the stress on the valve.

In the construction illustrated, the counter-balancing element is a flexible diaphragm mounted at an aperture in the chamber wall so as to constitute a movable part of that wall; and in one of the forms of construction shown the valve is exterior,—to be seated by the suction; and in the other form shown it is interior, adapted to be opened by the suction.

In either of these forms the areas of the valve and diaphragm may be effectively equal, separate means being employed to create overbalance of pressure in favor of seating the valve during the filling period and like overbalance of pressure in favor of opening the valve during the discharging period. In the construction shown in both forms the overbalance is furnished by the reaction of a spring snap action which is brought into action in the manner of snap actions com-

monly employed in the familiar type of vacuum tanks.

In the drawings:

Fig. 1 is a vertical section of a vacuum tank embodying this invention in the form having the atmosphere valve seated interiorly of the vacuum chamber, so that the suction tends to unseat it.

Figure 2 is a similar view of a form having the atmosphere inlet valve seated exteriorly of the vacuum chamber so that the suction tends to hold it to its seat.

Referring to the drawings in both forms, the vacuum chamber is indicated by reference letter, A; the outer or reserve chamber by B; the cap which closes both chambers at the top and secures them together is denoted by reference letter, C. The fuel inlet connection is shown at D, mounted in the cap, B. The outlet fitting is shown at E, and the outlet valve at *e*. The suction connection is shown at F mounted in the cap plate, C.

The cap plate is formed exteriorly with a depression, 10, for seating a cylindrical auxiliary chamber, H, and in the bottom of the depression the cap plate has a slot, 40, with the left hand portion of which an aperture, 41, in the lower side of the cylindrical auxiliary chamber, H, is registered, said chamber, H, being fitted to the depression, 10, in the cap and lodged therein with an interposed packing, 48, for rendering the junction liquid tight when the auxiliary chamber is clamped in place by means of clamping straps, 43, 43. Registered slots, 40 and 41, serve to make the cavity of the auxiliary chamber a continuation of the cavity of the main vacuum chamber so that the two elements, B and H, constitute together an enclosure in which partial vacuum may be produced by suction through the suction connection, F.

The atmosphere inlet port is formed in one end of the auxiliary cylindrical chamber, H, as seen at 20. The opposite end wall of this chamber is formed by a flexible diaphragm, 30, clamped at its peripheral margin on the inturned flange, 31, of the cylindrical chamber.

A rod, 45, which may be referred to as the valve stem and also as the diaphragm stem, is secured at one end to the diaphragm, 30, at the center of the latter, and at the other end the rod carries the atmosphere valve, 50, adjustably secured on the threaded end of the rod between binding nuts, 50^a, 50^a, the rod being furnished with a guide bearing at the center of a spider-formed cap, 20^a, which constitutes the head of the chamber having the atmosphere inlet, 20, as mentioned.

A bracket, 47, depending from the under side of the cap, C, striding the slot, 40, supports the fulcrum, 46, of a bell crank lever, 44, one arm of which extends up through the registered slots, 40 and 41, and at its upper end engages by means of a forked slot, 44^a, a pin, 45^a, projecting from the valve-and-diaphragm stem, 45. The other arm, 42, of the bell crank lever constitutes one member of a snap action which comprises a rod, 49, pivoted to a bracket, 51, depending from the cap plate, C, the free end of the rod extending loosely through a small aperture, 53, in a laterally bent flange, 42^a, of the lever arm, 42, and a coil spring, 55, on the rod, 49, reacting between washers, 56 and 57, loose on the rod affords snap action in the familiar manner not requiring further description. The lever arm, 42, has an extension, 58, from the lower end of the flange, 42^a, from which there is pivotally suspended a rod, 60, for carrying a float, 61, slidingly between lower and upper stops, 62 and 63, respectively.

The operation of this construction will be understood from the foregoing description of the structure, but may be further described as follows:

Starting with the tank empty and having the suction connection, F, connected with the source of connection as the intake manifold of the engine to be served, the atmosphere valve being held closed by the weight of the float operating through the lever connections with the diaphragm and valve stem, 45, liquid will be drawn in by suction and delivered through the connection, D, into the vacuum chamber, A, lifting the float, 61, until it encounters the upper stops, 63, whereupon the rise of the float will be halted until the further rise of the liquid level causes the float to be sufficiently immersed past its plane of balance as to buoyancy, until the buoyant value resulting from such immersion is sufficient to overcome the resistance of the snap action spring; whereupon the bell crank lever will be rocked in the direction for opening the atmosphere valve. In this operation it will be remembered that the partial vacuum developed in the chamber while the atmosphere valve is closed and the chamber is filling with liquid, operates for suction to a substantially equal degree upon the diaphragm, 30, tending to hold the valve closed, and upon the valve itself, tending to open it, so that the valve is initially held seated by the reaction of the snap action spring; and since this snap action spring need only be stiff enough to hold the parts safely against the liability of the valve being jarred open by the vibration of the engine or the jolting of the vehicle, a very small float is sufficient to operate the device in the manner described. The atmosphere port being very large relative to the suction port, *f*, the vacuum in the chamber is substantially overcome by the opening of the atmosphere valve, and the liquid content is discharged by gravity, lowering the float until it encounters the lower stop, 62, where it will be halted for a brief instant while the continued lowering of the

level causes the float to be incompletely supported by the liquid to the extent that its weight will overcome the resistance of the snap action spring which, reacting, reverses the movement, and seats the atmosphere inlet valve; whereupon the parts being in the initial position, the cycle of operation will be repeated.

In order that the forces operating on the valve for moving it in either direction shall be balanced except as to the action of the snap action spring, and so that the reaction of that spring constitutes the only force to be overcome by the buoyant value of the float rising or the weight of the float descending in order to operate the valve, the bell crank lever, 42, may desirably be formed with a counterbalancing arm, 44^a, as shown.

The above description as to the parts applies to the construction shown in Figure 2 with the exception that the atmosphere valve is shown at the opposite end of the cylindrical auxiliary chamber, D, and is seated exteriorly of the chamber, the diaphragm being at the right hand end and mounted as in Figure 1. Without further description it will be understood that the operation of the device is identical with that of the construction shown in Figure 1, the pressures due to vacuum in the chamber acting upon the diaphragm and valve being balanced, the suction tending to hold the valve seated instead of opening it, and acting on the diaphragm for opposing the seating instead of opposing the opening movement of the valve.

I claim:

1. In a construction for the purpose indicated, a casing enclosing a chamber having connection with a source of suction for producing partial vacuum in the chamber, said chamber having a liquid inlet, a liquid outlet and an atmosphere inlet; a valve controlling the atmosphere inlet; a limited part of the enclosing wall exteriorly exposed to atmosphere being inwardly and outwardly movable without opening the wall; operating connections between said movable part of the wall and the atmosphere inlet valve arranged for opposing to each other respectively the actions due to vacuum in the chamber, said connections being dimensioned and arranged for substantially balancing said actions against each other; means operated by change of level of the liquid content of the chamber for operating said connections for opening and closing the valve, and a snap action interposed between said liquid level-operated means and said operating and balancing connections between the valve and the movable wall arranged to exert force in opposition to one of said counter-balanced actions by its snap caused by the high liquid level and in opposition to the other of said counterbalanced actions by its snap caused by the low liquid level.

2. In a construction for the purpose indicated in combination wth a vacuum chamber having connection with a source of suction for producing partial vacuum in the chamber, said chamber having a liquid inlet and a liquid outlet; an auxiliary chamber mounted on the vacuum chamber, said two chambers having ports of communication which are registered with each other, the auxiliary chamber having two apertures at opposite ends respectively; a flexible diaphragm closing one of said apertures and exteriorly exposed to the atmosphere, a valve arranged to seat at and close the other aperture, means positively connecting said diaphragm and said valve arranged to hold the valve seated at a normal position of the diaphragm from which it is adapted to be limitedly moved by flexure; a lever fulcrumed for extending through the registered apertures of communication between the two chambers operatively connected with said positively connecting means, means in the vacuum chamber adapted to be operated by change of level of the liquid content of said chamber, and operating connections between said level-operated means and said lever for moving the connected diaphragm and valve in valve-opening direction at a predetermined position of said level-operated means due to high level of the liquid content of the chamber, and for moving the valve and diaphragm in the direction for closing the valve at a predetermined low level of said liquid content.

3. In the construction defined in claim 2, the areas of the two apertures in the auxiliary chamber which are closed respectively by the diaphragm and the valve being effectively equal for exposure of the diaphragm and valve respectively to opposed atmospheric pressure and suction within and without said auxiliary chamber, the connection between the level-operated means in the vacuum chamber and the lever connected for operating the diaphragm and valve, comprising a spring snap action arranged for adding the reaction of its spring to the atmospheric pressure for opening the valve at the upper limit of the change of level and to said pressure on the diaphragm for closing the valve at the lower limit.

4. A construction for the purpose indicated comprising a vacuum chamber having suction connection, and fuel inlet and fuel outlet, an auxiliary chamber mounted upon the vacuum chamber, said chambers having registered ports of communication between them, the auxiliary chamber having two apertures, a flexible diaphragn mounted on the chamber wall for closing one of said apertures, a valve suitably mounted for closing the other aperture at seating position of the valve, positive connection between the diaphragm and the valve for simultaneous movement upon flexure of the diaphragm due to partial

vacuum produced in the auxiliary chamber by the access of suction to the vacuum chamber; a lever fulcrumed for extending one arm through the registered apertures of communication between the two chambers, and engaging the connection between the diaphragm and valve within the auxiliary chamber; a float in the vacuum chamber operatively connected with the other arm of the lever for actuating the lever in the direction for opening the valve when the float is lifted by the rise of the liquid content to a predetermined level, and in the direction for closing the valve upon the descent of the float due to a predetermined low level of the liquid content, the connection between the float and said lever arm comprising a spring snap action arranged to add the reaction of its spring to the action of suction for opening the valve at said predetermined high level and to the action of atmospheric pressure for closing the valve at a predetermined low level.

5. In a construction for the purpose indicated in combination with a vacuum chamber having suction connection and a fuel inlet, an auxiliary chamber mounted upon the vacuum chamber, the walls of said chambers having registered apertures for fluid communication between them, the auxiliary chamber having in opposite walls substantially equal apertures, a flexible diaphragm closing one of said apertures, the valve arranged to seat at and close the other aperture, positive connection between the diaphragm and the valve for moving the valve in seating direction upon the flexure of the diaphragm in one direction and in direction for opening upon opposite flexure of the diaphragm; a lever fulcrumed for extending one arm through the registered apertures of communication between the two chambers, a float in the vacuum chamber operatively connected with the other arm of the lever and arranged for actuating the lever in one direction when the float is lifted by the rise of the liquid contents of the vacuum chamber to a predetermined level and in the opposite direction when the float is lowered by subsidence of the liquid level to a predetermined low level, the operating connections between the float and the lever comprising a spring snap action arranged to apply the reaction of its spring to the lever for supplementing the suction action in opening the valve by the movement due to the rise of the float, and for closing the valve upon the movement due to the fall of the float.

6. In a construction for the purpose indicated in combination with a casing enclosing a chamber having a fuel inlet, a fuel outlet, a suction connection and an atmosphere inlet, a valve for controlling the atmosphere inlet; a flexible diaphragm mounted so as to be exposed at one side to atmospheric pressure and at the other side to the pressure existing in the enclosure due to suction through the suction connection, and mechanical connections between the atmosphere valve and the diaphragm arranged for opposing the suction action on the diaphragm to the suction action on the valve; means operated by change of level of the liquid content of the chamber for opening and closing the atmosphere valve, and operating connections from said means to the connection between the diaphragm and the valve, said operating connections comprising a snap action having a spring whose resilient action is added to the suction to afford the force for holding the valve seated and unseated during the rising and descending movements respectively of the float.

7. In the construction defined in claim 6, the enclosure comprising a vacuum chamber and an auxiliary chamber having constantly open communication with each other at the upper part of the vaccum chamber, said auxiliary chamber having at one end the atmosphere inlet port and at the opposite end the flexible diaphragm; a stem extending through said supplemental chamber positively connecting the valve and the diaphgram for their simultaneous movement; a lever fulcrumed for extending one arm through the communication between the two chambers, the other arm being connected by the snap action with the float.

In testimony whereof, I have hereunto set my hand at Chicago, Illinois, this 18th. day of February, 1929.

CHARLES S. BURTON.