Nov. 3, 1925. 1,560,190

E. C. RICHARD

VACUUM PUMP SYSTEM

Filed Oct. 17, 1919 2 Sheets-Sheet 1

Fig. 1

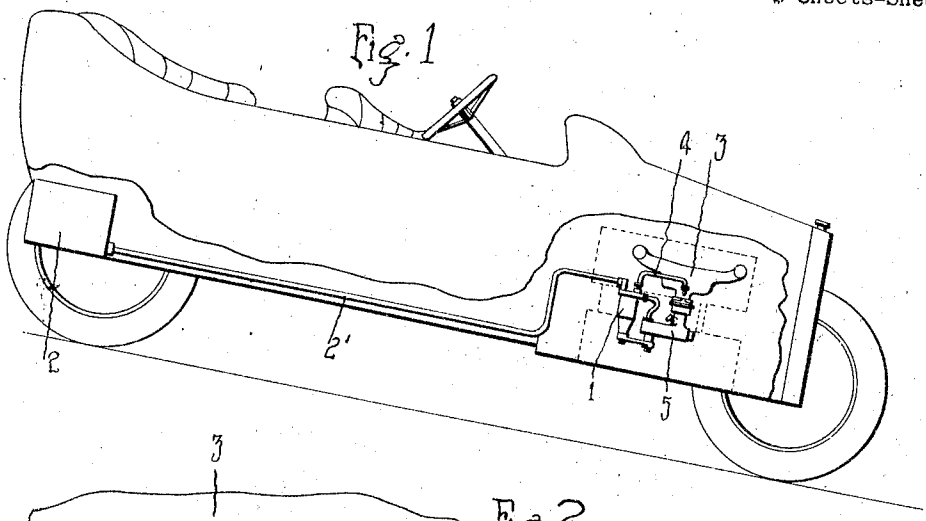

Fig. 2

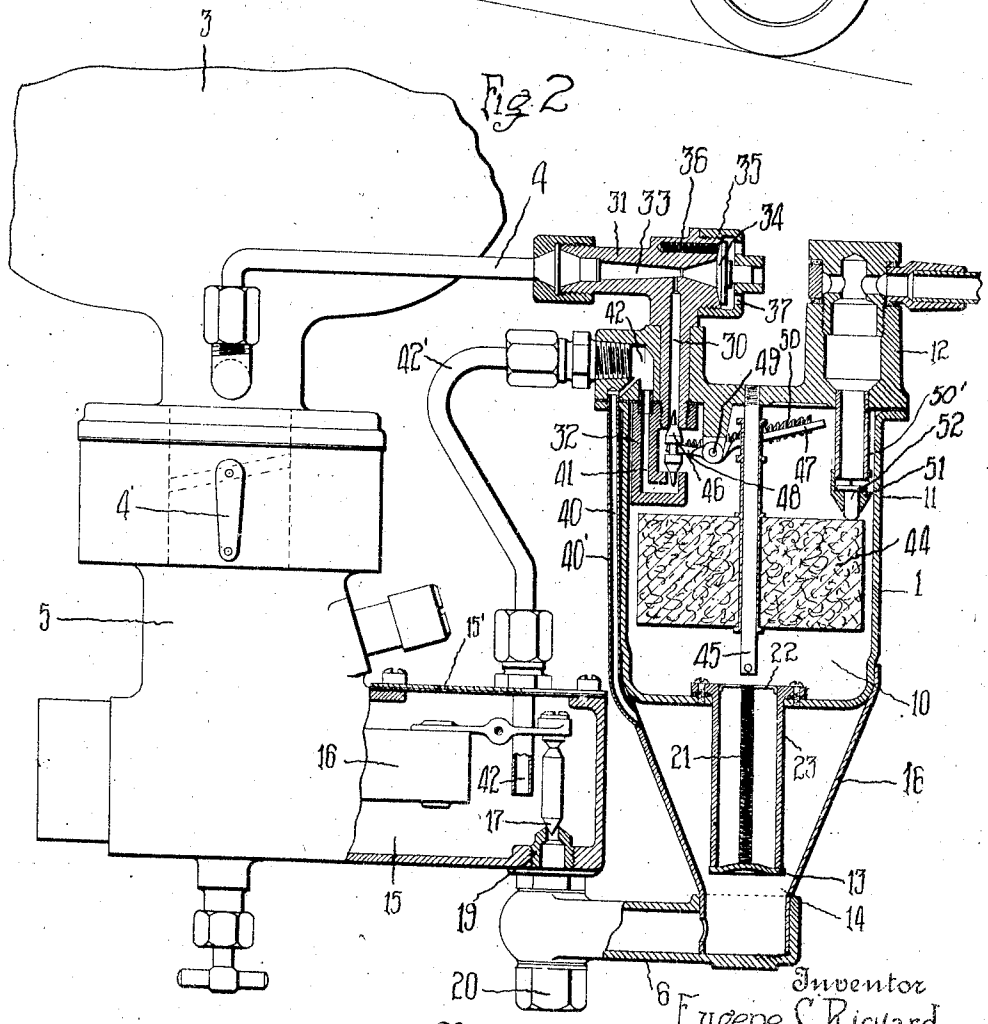

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Fig. 3

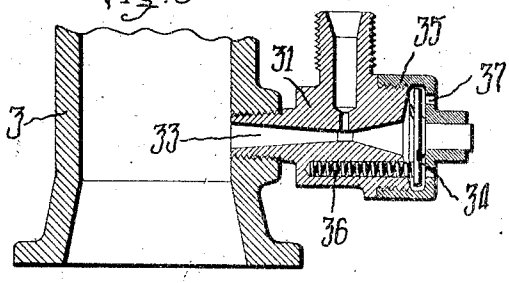


Fig. 4

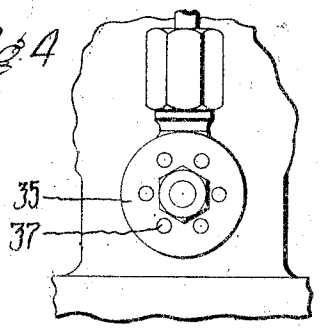
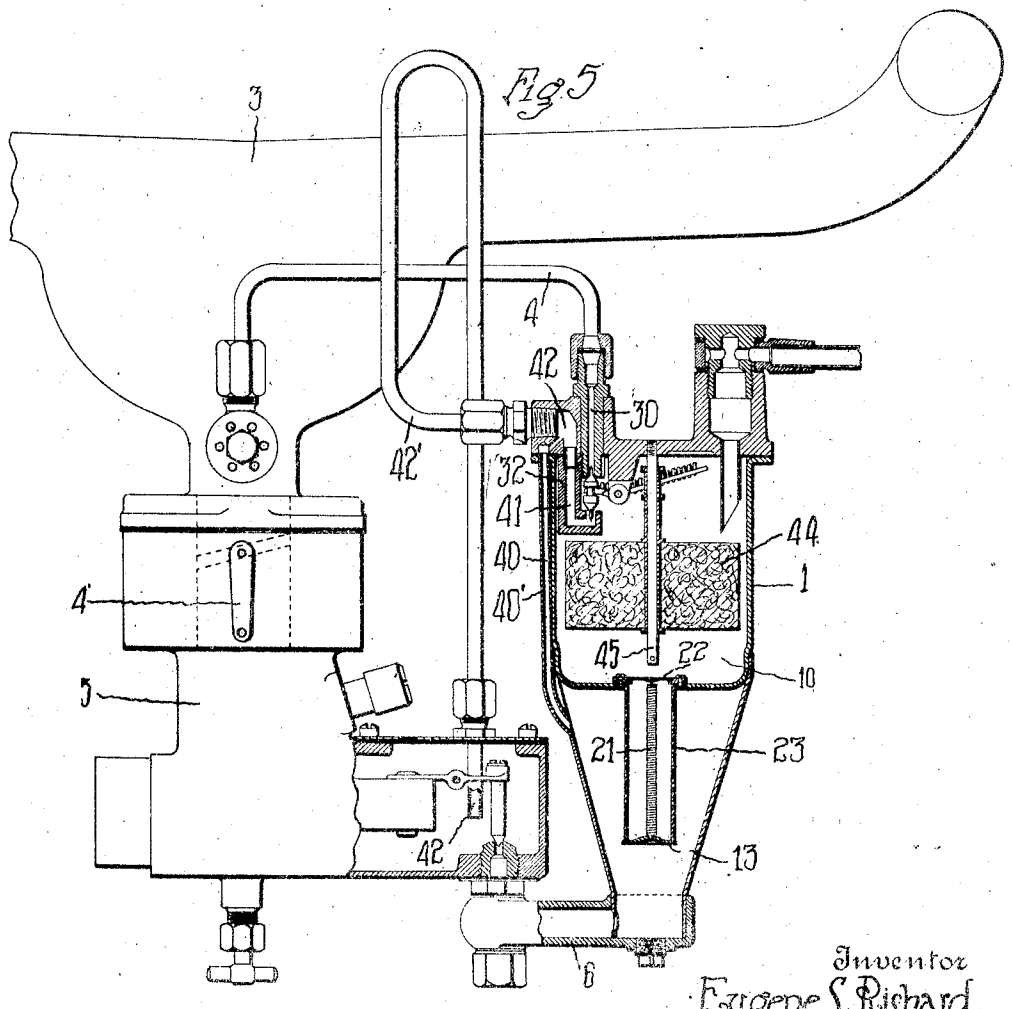


Fig. 5



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Patented Nov. 3, 1925. 1,560,190

UNITED STATES PATENT OFFICE.

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VACUUM-PUMP SYSTEM.

Application filed October 17, 1919. Serial No. 331,485.

To all whom it may concern:

Be it known that I, EUGENE C. RICHARD, a citizen of the United States, and a resident of Flint, county of Genesee, and State of Michigan, have invented certain new and useful Improvements in Vacuum-Pump Systems, of which the following is a full, clear, concise, and exact description, such as will enable others skilled in the art to which the invention relates to make and use the same, reference being made therein to the accompanying drawings, which form a part of this specification.

It is a matter of common knowledge that fuel feeding systems of the vacuum type, as heretofore constructed, have been incapable of supplying the motor with fuel on mountain climbing, since the suction on open throttle at low speed was inadequate to elevate the liquid through the head required. As a typical example, in one of the best known cars on the market the fuel from the rear tank must be lifted approximately twenty-five inches on a 10% grade in order to flow over into the vacuum tank, but assuming that the car is traveling at 10 miles per hour on open throttle, the vacuum in the manifold is equivalent to only about ten inches of gasoline or less than half that required to insure a constant supply of fuel.

It is the purpose of the present invention to overcome this condition by boosting or increasing the suction on low suctions to a degree ample to meet the demands of even the sharpest grades, this being accomplished however, in such a manner as not to interfere with idling conditions. Related and more specific objects are (1st) to render possible a material reduction in the size of the vacuum tank thereby lessening the cost and economizing in space under the hood, and (2nd) to decrease the danger from boiling of the fuel by causing it to circulate relatively rapidly through the vacuum tank. To these ends I draw in air to the intake passage at low suctions and utilize this air to transform or intensify the suction as applied to the vacuum chamber, providing, however, for cutting off the intake of air at higher suctions to such measure at least as prevents with interference with the idling of the engine. It will be understood later that this action may be secured in various ways such as by a manually operated valve or valves, but I prefer to accomplish the result automatically by a suction controlled device which bleeds in air to the suction transforming or intensifying apparatus only on low suctions and which is put out of operation by the rise in suction and without attention from the driver. In the preferred apparatus the normal suction is automatically applied to the vacuum tank synchronously with cutting out of the suction transforming or intensifying effect, but it will be evident that here again manually operated valves or means might be substituted.

Again, the invention is concerned with the construction of the vacuum tank itself, particularly in the matter of reducing cost. In this connection, the use of the suction intensifier enables me to materially reduce the size of the vacuum tank inasmuch as it is no longer necessary to carry a relatively large supply of fuel therein to insure the car getting over ordinary hills—stated otherwise, the suction intensifier in insuring the desired suction makes it possible to operate the tank with a less charge than heretofore and this possibility applies likewise when the suction intensifier is used with tanks of ordinary construction.

One novel feature of the tank construction resides in a pipe or passage for venting the supplemental passage or discharge chamber from the carburetor bowl to thus admit air to the former as when the fuel level in the latter falls to a predetermined point and to automatically interrupt the venting action as the fuel level rises.

The invention further consists in certain details in the construction and arrangement of the valved passage which connects the suction tank to the discharge chamber or passage.

Another object is to prevent the overflow of fuel into the suction chamber when the vehicle is traveling down hill, and for this purpose it consists in a normally-open valve positively operated by the float to close the passage between the main tank and the suction chamber upon the tank becoming filled

to an abnormal level. This passage, being normally open, permits full application of the vacuum chamber suction to the main tank as distinguished from the use of a passage normally closed by ordinary loaded or spring pressed check valve such as is used in connection with pressure pumps of all types.

The invention also provides a vacuum tank construction of less height than the usual devices for this purpose, thereby reducing the lift from the main tank; the present tank, by virtue of its low height and small liquid content, allows better protection from the heat of the exhaust and more rapid circulation of fuel through the tank and is therefore less subject to the difficulties caused by the boiling of the gasoline. The use of the smaller vacuum chamber also results in increased efficiency of the vacuum apparatus as a whole.

Other objects and features will be pointed out later.

In the drawings, Fig. 1 is a side elevation showing the application of the invention to a motor vehicle. Fig. 2 is a part-elevation part-section on a larger scale, showing a preferred embodiment of the invention. Fig. 3 is a section showing a modification. Fig. 4 is an elevation of the modification shown in Fig. 3. Fig. 5 is a view, similar to Fig. 2, showing a modification in the vent pipe which is itself adapted to prevent overflow.

The apparatus consists briefly in a vacuum tank 1 connected to the main or low-level reservoir 2, disposed in this instance at the rear of the car, and also connected to suction means—as shown, to the intake manifold 3 through the pipe 4 which communicates with said intake above the throttle 4'—whereby fuel is elevated to the tank 1 to be delivered later therefrom by gravity to the carburetor 5 through the pipe 6 or an equivalent passage. In some instances the tank 1 may be made integral with or otherwise as a part of the carburetor, but the construction shown is preferred on account of considerations of manufacture.

The vacuum tank includes a receiving or vacuum chamber 10 formed preferably of a pressed or drawn sheet metal cup 11 having a cover 12; below the chamber 10 and communicating therewith through the medium of the outwardly opening valve 13 is a passage 14 that leads to the float chamber 15 of the carburetor (vented as usual at 15'), communication with the latter being under control of the float 16 and associated valve 17 so that fuel from the passage 14 can only flow into the chamber 15 sufficiently to replace that delivered to the engine as will be readily understood. The passage 14 is preferably formed by means of a funnel shaped stamping 16 and a fitting (heretofore designated 6), the lower end of the stamping being received in the fitting and the latter being secured to the valve seat 19 by a cap screw 20. The valve 13, in the construction shown, is a stamping of disc-form, and is preferably positioned well down into the passage 14, so that it is ordinarily covered by fuel and therefore less subject to leakage than would be the case were it open to the air. A spring 21, preferably very flexible and of the helical type, and having its upper end carried by the cross-wire or bar 22 soldered across the tubular valve seat 23, is provided for the purpose of normally retaining the valve in contact with the seat when the tank is empty, but other valves, such as those in ordinary use, might be employed. The pipe 4 communicates with the vacuum chamber through a passage 30 formed in a shouldered member 31 which preferably passes through the cover 12 for clamping thereto by threaded connection with the element 32 interiorly thereof; and interposed between the manifold and the passage 30 is a suction transformer or intensifier consisting preferably in a Venturi passage 33 opening on low suctions to the outer air and preferably entirely closed to the outer air on high suctions, so that under conditions of low engine suction the actual suction applied to the passage 30 is materially increased whereas high engine suctions, as in idling, are applied substantially directly to said passage. As a highly desirable construction for this purpose a valve 34, the stem of which is guided in a cap 35 threaded on to the Venturi-forming member, is provided, said valve being held away from the entrance to the venturi on low engine suctions by suitable springs 36 (but one of which is shown) housed in the Venturi-forming member, and then permitting the admission of air to the Venturi passage through the ports 37 formed in the cap. The Venturi-forming member may be made integral with the element 31, as in Fig. 2, or separate therefrom, in which case it may be threaded into the manifold wall as indicated in Fig. 3.

In either event, it will be observed that the suction transformer or intensifier includes a three branched passage, the branches of which communicate at a restriction; that the first branch leads to the intake passage at a point of high suction therein; that the second branch leads to the vacuum chamber; that the third branch leads to a source of air supply (as shown, the external atmosphere) at a higher pressure than that at the outlet of the first branch into the intake; and that the restriction is so arranged that air or fluid, entering by way of the third branch, intensifies the suction in the second branch relatively to that in the first.

To maintain the proper pressure in the

chamber 10 and the passage or chamber 14 and to permit proper feeding from the passage 14 to the float chamber of the carburetor, I have interconnected them by a common air passage having three branches one of which— 9—extends upwardly from the passage 14 by means of the pipe 40′, the second—41—communicating with the first and with the vacuum chamber 10 through the element 32, and the third—42—leading from the other two through the pipe 42′ preferably to a point in the carburetor float chamber slightly below the normal level of fuel therein. The passage 41 preferably opens into the vacuum chamber in line with the passage 30, and these passages are alternately opened and closed, depending upon the level of the fuel in the chamber 10 by means of the float 44, which is slidable on the guide or stem 45 carried by the cover 12, the common valve 46, and a quick acting connection consisting, in the construction shown, in the two arms 47—48 pivotally mounted at 49 and having their ends joined by the tension spring 50.

Operation.—As stated heretofore the suction applied to the passage 30 varies in respect to the engine, having a materially higher relative value on low suctions and thus assuring under all conditions sufficient vacuum in the passage 30 to lift the fuel from the tank 2 to the chamber 10 even on the steepest grades. As the chamber 10 is being emptied through the outwardly opening valve 13, the weight of the float 44 is increasingly applied to the arm 47 and causes the latter to swing downwardly about the pivot 49 and against the tension of the spring 50 which finally passes over center and snaps the valve 46 away from the passage 30 and into the entrance to the passage 41. This occurring, the suction of the engine, either normal or boosted as the case may be, is applied to the chamber 10 to close the valve 13 and draw fuel from the tank 2 through the pipe 2′, whereupon the float rises and ultimately snaps the valve 46 into the position shown to thus shut off the suction from the chamber 10. Simultaneously, communication is opened between said chamber and the passage 41—42 whereby equalization of pressure in the chamber 10 and the passage 14 takes place and permits a gravity flow of fuel into the latter to meet the demands of the carburetor. Such additional air as may be needed is bled in from time to time as the lower end of the passage 42 becomes uncovered upon the lowering of the fuel, thus permitting the fuel to flow past the valve 17 whenever the float 16 sinks.

Were no means provided to prevent it, fuel from the tank 2 might overflow into the chamber 10 when the vehicle or aeroplane is inclined downwardly and forwardly. I therefore preferably deliver the fuel into the chamber 10 through the pipe 50 which carries a guide or support 51 for a check valve 52. The latter normally permits free in-flow of the fuel even when the float is at a level high enough to operate the snap valve, but the parts are so arranged that a higher lift of the float, such as would take place should an overflow from the tank 2 occur, elevates the valve across the entrance to the pipe 50 or its equivalent. When the device is used on stationary installations, such as farm light and power out-fits, the valve 52 would, of course, be omitted. Somewhat the same general result may be accomplished by extending the pipe 42′ upwardly in a loop as shown in Fig. 5.

It will be evident that my intensifier is applicable to other tanks regardless of whether the tanks are of the usual or of reduced size, and that the present tank may be used without the booster; also that various changes, other than those pointed out, may be made within the scope of the invention.

I claim:—

1. A fuel supplying system for internal combustion engines including a chamber to which fuel is elevated by suction, means for applying suction to said chamber, means including a Venturi tube flaring outwardly in opposite directions from an intermediate throat portion of lesser diameter, means for applying engine suction to one of said flaring portions, said other end portion terminating in a valve seat, a passage connecting said chamber to said throat portion, and a valve arranged to close against said seat under conditions of high engine suction.

2. Fuel feeding apparatus including a Venturi tube having oppositely flaring aligned end portions, converging at an intermediate restricted point, means for applying suction to one of said end portions, a passage through which intensified suction from said tube is applied for lifting fuel, said passage connecting to the Venturi tube at a point between said restricted point therein and the end to which suction is applied, a valve guide, a valve slidable therein parallel to the axis of said tube, and a spring tending to hold said valve in open position.

3. Fuel feeding apparatus comprising a vacuum chamber, a suction intensifier in communication therewith, said intensifier including a Venturi tube having opposite aligned outwardly flaring end portions and an intermediate restricted portion leading to said chamber, means for applying suction to one of said ends, a cap for the other end, said last named end having a valve seat, and a valve slidable in said cap toward and from said seat.

4. Fuel feeding apparatus comprising a

vacuum chamber, a suction intensifier in communication therewith, said intensifier including a Venturi tube having opposite aligned outwardly flaring end portions and an intermediate restricted portion leading to said chamber, means for applying suction to one of said flaring ends, a valve for closing said other flaring end, and a spring housed in said intensifier and tending to force said valve into open position.

In testimony whereof I affix my signature.

EUGENE C. RICHARD.