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COMBINED VACUUM TANK AND PRESSURE PUMP

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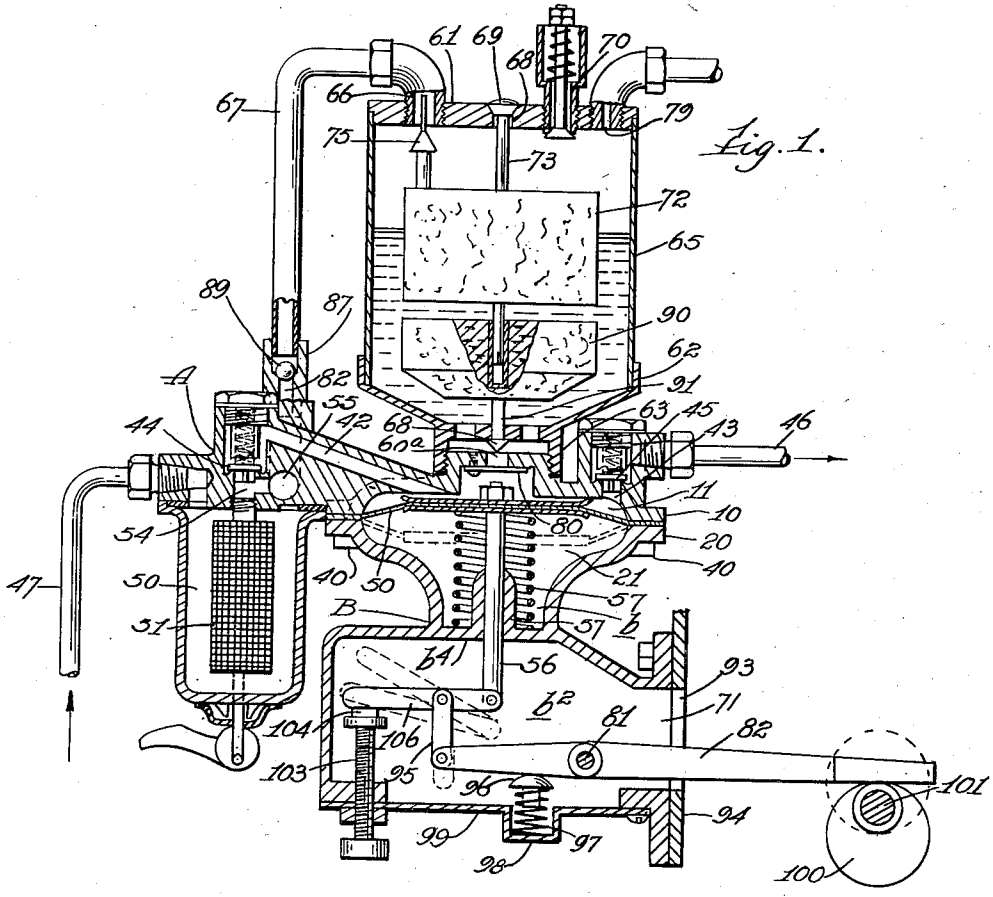


Fig. 1.

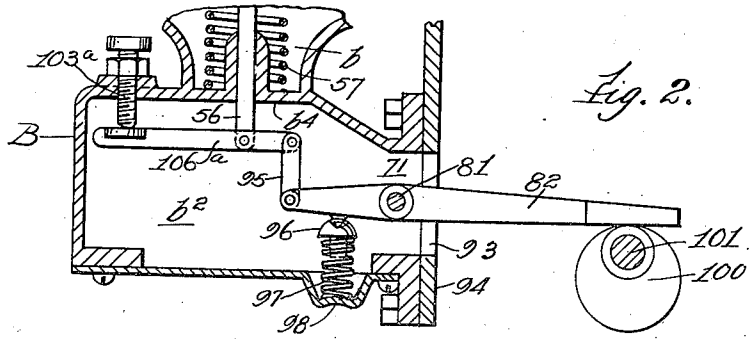


Fig. 2.

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UNITED STATES PATENT OFFICE

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COMBINED VACUUM TANK AND PRESSURE PUMP

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The purpose of this invention is to provide an apparatus for supplying fuel to the carbureter of an internal combustion engine which shall avoid certain defects observed in devices heretofore in common use, with respect to adaptation of the pressure of the fuel feeding means on the fuel line extending to the carbureter, to the construction and condition of the carbureter particularly in respect to the float controlled valve of the carbureter fuel chamber, and in respect to prompt supply of fuel upon starting the engine after a considerable period of rest during which the fuel may have subsided and flowed back to the fuel source. It consists in the elements and features of construction shown and described as indicated in the claims.

In the drawings:

Figure 1 is a vertical section of the structure embodying this invention.

Figure 2 is a detail section in a corresponding plane of the lower part of the structure showing a slight modification.

The present invention is shown in the drawings applied to a fuel feeding apparatus which comprises a pump of the diaphragm type. It has been found in the practical use of diaphragm pumps of this type that after the pump has stood idle for some time, the gasoline pressure in the feed line between the pump and carbureter will cause the gasoline to feed back into the pump and finally back through the inlet valve of the pump into the fuel line from the main tank.

The valves always present in such construction between the main tank and the carbureter will not hold the pressure for any length of time, as the gasoline seeps past the valves and their seats, especially when under any substantial pressure.

The results of this seeping back of the gasoline is to leave the pumping chamber of the pump only partially filled with gasoline, and it may be in some cases entirely empty, and when the engine is again started, vacuum must be built up in the pumping chamber and also in the main fuel feed line leading back to the main tank at the rear of the vehicle.

Pumps of the diaphragm type necessarily having very short stroke, require a substantial amount of time to build up the pressure and feed gasoline through the whole length of the fuel line from the main tank to the pump chamber, and thus filling the pumping chamber and priming the pump for its operation.

During this interval of building up the priming charge of the pump, the carbureter has no pressure or fuel supply, and in a few strokes it becomes exhausted of the gasoline which may have been in the float bowl of the carbureter. The situation is made more embarrassing by the fact that the pump must be operated slowly by operating the starter, and so putting the pump through its movements very slowly. This slow operation is inefficient in pumps of the diaphragm type.

Because of the short stroke of the diaphragm which is only about one-fourth of an inch, any vacuum produced in the pump chamber must be built up step by step, and if a substantial amount of air is present in the pump chamber and the operation of the pump is slow, the air is alternately compressed and expanded by the movement of the diaphragm without resulting in any feeding of the gasoline.

Furthermore, in the diaphragm pumps at present in use, in which the pump diaphragm is operated for its feeding stroke by a main spring, and the operating lever is also operated in one direction by a spring, if either of these springs breaks or any of the connections break, the running of the engine must fail because there is no other means of supplying fuel to the carbureter.

The present invention is directed to overcoming these defects of constructions heretofore in common use.

One characteristic feature of the present invention consists in the provision of a vacuum tank located in position for discharging into the pumping chamber for supplying the pumping chamber independently of the action of the pump for fuel intake to the pumping chamber, so that the first stroke of the pump serves to send fuel through the fuel supply line to the carbureter without the delay which otherwise occurs while the pump

is building up the vacuum in the pumping chamber for drawing supply from the main tank.

I employ the term "vacuum tank" in the present commercial sense of that term to designate any form of devices thus commonly named, which comprise a vacuum chamber having suction connection with the intake manifold of the engine for producing vacuum by which the fuel is drawn from the main tank with which the vacuum chamber is connected until the vacuum chamber is filled to a predetermined depth for causing a float in the chamber to open an atmosphere inlet valve and to break the suction and permit the fuel to be delivered by gravity from the chamber until the lowering of the float causes it to operate the inlet valve for closing, permitting the cycle of operations to be repeated. In the present construction, the vacuum tank is shown without the fuel reserve chamber commonly pertaining to the commercial vacuum tank, the vacuum chamber being arranged for delivering fuel directly into the pumping chamber of the pump above which this vacuum tank is mounted as mentioned.

Referring to the drawings in detail, the structure consists of a casing comprising two cast members, A, and B, formed with mated flanges, 10 and 20, encompassing recesses, 11 and 21, in said cast members, respectively, said flanges, 10 and 20, serving to clamp between them when they are secured together by bolts, 40, the diaphragm, 50, which constitutes the pumping element of the pump, of which the pump chamber is formed by the recess, 11, in the casting, A, above the diaphragm.

In the member, A, there are formed the fuel intake passage, 42, fuel discharge passage, 43, with fuel inflow valve, 44, controlling the inflow passage, and discharge valve, 45, controlling the discharge passage.

The discharge passage leads to the pipe connection shown at 46, extending for supplying the carbureter. The fuel supply connection leading from the main supply tank, not shown, is indicated at 47, from which the fuel reaches the fuel intake controlling valve, 44, by way of a fuel accumulating and sediment chamber, 50, containing a strainer or filter screen, 51, through which the liquid passes to reach the port, 54, controlled by the valve, 44. The construction of the pumping apparatus as thus far described is familiar and does not constitute part of the present invention. The member, A, has at the upper side a hollow exteriorly threaded boss, 60, to which the vacuum tank is attached. Said vacuum tank, as shown, comprises an upper cap, 61, and the lower cap member, 62, terminating in the interiorly threaded boss, 63, which is screwed to the boss, 60, the body of the chamber being formed by a hollow cylinder, 65, which connects the top and bottom caps. The top cap has the suction connection, 66, the fuel supply connection, 67, and atmosphere inlet, 68, controlled by a valve, 69, hereinafter referred to. There is also mounted in said cap a suction relief device, 70, hereinafter more particularly referred to. In the chamber, 65, there is contained the customary float, 72, which, as shown, is mounted fast on the stem, 73, of the atmosphere inlet valve, 69, so that in the absence of any liquid content in the chamber, the float serves as a weight for holding the valve, 69, seated, until, upon the rise of the liquid content to a predetermined height for submerging the float to a predetermined degree, the float operates by its buoyancy for opening the atmosphere inlet valve, 69.

The float, 72, carries also projecting upwardly from it, a valve, 75, which, at the high position of the float for opening the valve, 69, seats at the port of discharge into the chamber of the fuel supply pipe, 67.

The parts thus far described of the vacuum tank operate in the manner well understood for alternating dominance of suction and atmospheric pressure in the chamber for alternately drawing the fuel into and permitting it to be discharged from the chamber; but in addition to the usual construction of vacuum tank, in the present instance the float which operates the atmosphere inlet valve for alternating the dominance of suction and atmospheric pressure also operates the valve 75 for cutting off the fuel delivery at the time the atmosphere valve is open for breaking the suction dominance. The provision of this valve for cutting off the fuel flow is considered desirable particularly in view of the fact that there is no suction controlling valve, the suction being continuously open through a restricted port, 79, so that there is a limited degree of partial vacuum at all times in the chamber when the engine is running, which might in some instances be sufficient to cause the flow of fuel into the chamber unnecessarily and with the possibility of flooding the chamber.

At the port of communication from the vacuum tank to the pumping chamber, which is shown at 60^a, formed at the center of the boss, 60, there is provided a check valve, 80, opening for flow from the vacuum tank into the pumping chamber and seating against reverse flow.

Upon considering the operation of this construction it will be recognized that the operation of the engine by the starter will very promptly produce vacuum in the vacuum chamber, by which the fuel will be lifted from the main supply tank, causing the vacuum chamber to be filled to the point at which the float, 72, will operate the atmosphere inlet valve, 69, for permitting atmospheric pressure to overcome the suction, and permit the fuel to be delivered by gravity past the valve,

80, into the pumping chamber; so that the first stroke of the pump occurring after the discharge of the vacuum tank,—which will be many strokes in advance of the time when the fuel will have been drawn into the pumping chamber by the action of the pump itself,—will find the pumping chamber full, so that the feeding stroke of the pump will be operative for sending fuel to the carbureter immediately.

Referring to Figure 1, it may be understood that the fuel reaches the pipe, 67, for delivery to the vacuum tank by way of a duct, 82, leading from the short passage, 55, immediately below the fuel inflow controlling valve, 44, said duct extending in a boss, 87, to the upper end of which the pipe, 67, is connected. And a check valve may be provided, as shown at 89, in said duct for preventing back flow of the fuel lifted past the valve on its way to the vacuum tank.

In order that when the vacuum tank is empty, the suction or intake stroke of the pump diaphragm shall not operate for drawing in air to the pump chamber instead of drawing in fuel from the fuel source, there is provided in the vacuum tank a second float, 90, located in the lower part of the tank, and as shown, guided upon the stem, 73, of the float, 72 and valve, 69.

The float, 90, has a downwardly projecting stem, 91, by which the float is further guided in the diaphragm formed at the center of the bottom cap, 62, said stem terminating below the diaphragm in a valve, 93, dimensioned for seating at and closing the port, 60^a. Upon considering this construction it will be seen that when the vacuum tank is empty, the weight of the float, 90, will cause the valve, 91, to be effectively seated at the port, 60^a, so that the suction stroke of the diaphragm for fuel intake will not be satisfied by air drawn into this port, 60^a, instead of through the fuel passage, 42.

The pumping element consisting of the flexible diaphragm, 50, is actuated for its intake stroke by means of a stem, 56, which extends through a guide bearing, 57, provided in the casing member, B. Said stem terminates in a chamber, b^2, of the casing member, B, with which the cavity, b, of the casing has no communication. In said chamber, b, there is provided coiled about the stem, 56, a spring, 57, which reacts between the diaphragm, 50, and the web, b^4, of the casing member, B, which partitions the chamber, b, from the cavity, b^2, for giving the diaphragm its feeding stroke and maintaining the pressure of the fuel column on the carbureter.

For actuating the stem, 56, to give the diaphragm its intake stroke, there is provided fulcrumed at 81 in the casing member, B, a lever, 82, which extends out of the casing through an opening, 71, which registers with an aperture, 93, in the engine casing indicated at 94, and is arranged at the end which protrudes into the engine casing for actuation in one direction by a one-way acting cam, 100, on the engine shaft, 101.

The lever, 82, at the end within the pump casing is connected by a link, 95, with a second lever, 106, which is pivotally connected to the stem, 56, and extends in alignment with its two pivots for lodgement on the upper end of a post, 103, which is screwed in through the bottom wall of the chamber, b^2, of the pump casing, and provided at its upper end with a fibre block, 104, for noiseless encounter of the lever, 106.

Upon considering this construction it may be understood that the cam, 100, in its active phase actuates the lever and link connections described for positively retracting the diaphragm pumping member, 50, against the resistance of the spring, 57, for giving the diaphragm its intake stroke; and that in this action the lever, 106, fulcrums at its free end upon the post, 103, while the spring, 57, is compressed and conditioned for reaction to give the diaphragm its feeding stroke during the idle phase of the cam, 100.

Upon further consideration it will be recognized that the degree to which the spring, 57, is compressed in the intake stroke of the pumping member, and the force of its reaction for the feeding stroke and for maintaining pressure of the fuel column on the carbureter, may be modified by the adjustment of the post, 103, shifting the fulcrum of the lever, 106, at its upper end, the lowering of the fulcrum of the lever operating to elevate the range of the diaphragm stroke and reduce the compression of the spring, and correspondingly reduce its reaction for the feeding stroke, and the elevation of the post raising the fulcrum of the lever, 106, operates to increase the compression of the spring in the intake stroke and correspondingly increase its reaction for the feeding stroke and for maintaining pressure of the fuel column on the carbureter.

It will be further observed upon considering the construction, that the lever and link connection described provides for lost motion in the movement in one direction, making it possible to provide for the lever, 82, following the cam in the idle phase of the latter, and for this purpose there is provided the spring, 97, lodged at its lower end in a pocket shown at 98 in the bottom plate, 99, of the pump casing, this spring reacting at its upper end through a button, 96, on the inner arm of the lever, 82, causing its outer arm to follow the cam in its idle phase as mentioned.

Referring to Figure 2: It is found more convenient in some cases to arrange the adjustable fulcrum of the second lever so as to be accessible above rather than below the casing member, B; and this involves stopping

the lever upwardly instead of downwardly requiring its pivotal connection to the stem, 56, to be intermediate its connection to the operating lever, 82, and the opposite fulcrum end of said second lever. Figure 2 shows the construction thus modified, the second lever being indicated at 106^a, and the fulcrum stop being afforded by the screw, 103^a, set through the upper side of the chamber, b^2, of the casing member, B.

The operation of the devices is as follows:

When the engine of the car is first started, the diaphragm is given its maximum stroke and draws gasoline from the vacuum tank and from the main source of supply and supplies it under pressure to the carburetor. This pressure is of course greatly in excess of the pressure that might be had from a gravity feed vacuum tank alone with all the advantages of feed to be had by such pressure. As the pressure in the carburetor line reaches its maximum because of the closing of the float valve of the carburetor, the spring 57 fails to overcome this pressure and the diaphragm takes up very short strokes that about equal the amount of fuel that is being fed through the carburetor.

During the operation of the machine at normal speeds the pump practically does not have to lift gasoline at all as the vacuum tank performs this office and then delivers the fuel to the pump by gravity. The efficiency of the pump is thus greatly increased. This is particularly true when the car is first started after standing for some time as the gravity feed of the fuel from the vacuum tank forms a priming charge for the pump which may, in the time of standing have lost its charge by leakage of the valves, this charge returning by gravity to the main tank which is mounted at a lower level.

Further in the event of an accident to the pump which would prevent its feeding the fuel to the carbureter, the vacuum tank alone will supply the carburetor provided the latter is mounted at a point below the tank and thus enable the driver to reach a repair station.

As the diaphragms of pumps of the type here shown, are usually made up of several layers of flexible fabric and as this material when very cold becomes stiff, it follows that after a car has been standing in the cold for a long time, the diaphragm does not take up its maximum movement when the car is started, and if the pump has lost all or part of its prime, then the pump will fail to feed fuel to the carburetor by the time that the fuel which is trapped in the carburetor bowl is exhausted.

When the vacuum tank has become filled and the atmosphere valve 69 is open, atmospheric pressure is present in the upper part of the tank and this pressure would negative the suction of the pump, through the connecting pipe 67 if it were not for the valve 89 which is drawn into its seat at this time to prevent the passage of air. The gasoline trapped in the pipe 67 above the valve 89 liquid seals the valve against the passage of any air.

I claim:

1. An apparatus for supplying fuel to the carbureter of an internal combustion engine comprising a vacuum tank operated by engine suction for lifting the fuel from the fuel source; a pumping chamber into which the vacuum tank discharges having a pumping member and engine-actuated operating connections for causing the pumping member to perform its feeding stroke, the pumping chamber having fuel inflow connection with a fuel source independent of the vacuum tank.

2. In combination with an engine-operated pump for pumping fuel from a fuel source to an engine carbureter, a vacuum-operated device constructed for lifting fuel from the source having a vacuum chamber connected for discharge into the pumping chamber of the engine-operated pump; a valve controlling said discharge opening for such discharge and seating against reverse flow, a float in the lower part of the vacuum chamber, and a valve carried by the float for controlling the discharge port leading to the pumping chamber arranged to be seated for closing said port except when lifted by the buoyant effort of the float due to its submergence in the liquid content of the vacuum chamber to a predetermined degree; whereby discharge from the vacuum chamber to the pumping chamber is prevented when the vacuum chamber is not supplied with fuel above said predetermined degree.

3. A pumping apparatus for supplying fuel to an internal combustion engine comprising a casing having a pumping chamber with a movable wall constituting the pumping member; a spring reacting between the casing and said pumping member in the direction of its feeding stroke; a lever fulcrumed on the casing arranged for positive actuation in one direction by a cam adapted to have an active and an idle phase; operating connections between the first mentioned lever and the pumping member comprising a second lever pivotally connected with the pumping member, and a link connecting said second lever with the first mentioned lever; a stop carried by the casing positively positioned for encounter of the second lever for fulcruming the latter in the positive movement of the first lever for retracting the pumping member in the intake stroke against the reaction of the spring first mentioned, and a second spring reacting on the first mentioned lever to cause it to follow the cam in the idle phase of the latter, said abutment being adjustable in the direction of movement

of the lever into encounter therewith for varying the length of the positive intake stroke.

4. A pumping apparatus for supplying fuel to the carbureter of an internal combustion engine from a fuel source at a lower level comprising a casing having a pumping chamber with a movable wall member constituting the pumping element; engine driven connections for positively actuating the pumping element for its fuel intake stroke; spring means reacting between a fixed part of the casing and the movable wall member for stressing the latter in the direction of the fuel feeding stroke, the engine-driven connection consisting of a lever fulcrumed in the casing and extending for engagement with an engine cam for positive actuation in one direction in the active phase of such cam; a spring reacting on the lever for causing it to follow the cam in the idle phase of the latter; a second lever in the casing; a stem of the movable wall member to which said second lever is connected; a link connecting said second lever with the first mentioned lever, and an abutment mounted in the casing positively positioned for lodgement and fulcruming thereon of the second lever in the movement derived by said second lever through the first lever from the engine cam in the active phase of the latter, said abutment and said second lever being cooperatively formed and relatively mounted for impassability of the abutment by the lever in the movement of the lever due to the positive actuation of the engine cam.

5. A pumping apparatus for supplying fuel to the carbureter of an internal combustion engine comprising in combination with a casing having a pumping chamber, a diaphragm constituting a movable wall and the pumping member of said chamber, a spring reacting between the casing and the diaphragm in the direction of its fuel feeding stroke, a lever mounted in the casing and extending therefrom for actuation by an engine cam, connections from said lever to the diaphragm stem for actuating the diaphragm, said connections comprising a second lever pivoted to the diaphragm stem, and a link connecting said second lever with the first mentioned lever, a fulcrum member for the second mentioned lever, said fulcrum member being mounted in the casing, and means for adjusting it in direction parallel to the operating movement of the lever for varying the fixed position of the fulcrum and the reactional capacity of said spring with only negligible variation of the leverage for action on the diaphragm stem and said spring, and a second spring reacting on the first mentioned lever to cause it to follow the cam in the idle phase of the latter.

6. A pumping apparatus for supplying fuel to an internal combustion engine comprising a casing having a pumping chamber with a movable wall constituting the pumping member; a spring reacting between the casing and said pumping member in the direction of its feeding stroke; a lever fulcrumed on the casing arranged for positive actuation in one direction by a cam adapted to have an active and an idle phase; operating connections between the first mentioned lever and the pumping member comprising a second lever pivotally connected with the pumping member, and a link connecting said second lever with the first mentioned lever; a stop carried by the casing positively positioned for encounter of the second lever for fulcruming the latter in the positive movement of the first lever for retracting the pumping member in the intake stroke against the reaction of the spring first mentioned, and a second spring reacting on the first mentioned lever to cause it to follow the cam in the idle phase of the latter, said abutment being adjustable in the direction of the movement of the lever into encounter therewith for varying the length of the positive intake stroke, and said abutment and said second lever being cooperatively and relatively formed for impassability of the abutment by the lever in the movement of the lever into said fulcruming encounter.

In testimony whereof, I have hereunto set my hand at Chicago, Illinois, this 27th day of February, 1929.

WILLIAM H. MUZZY.