E. H. ARQUEMBOURG.

FEEDING APPARATUS FOR INTERNAL COMBUSTION MOTORS.

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1,195,764. Patented Aug. 22, 1916.

Fig. 1.

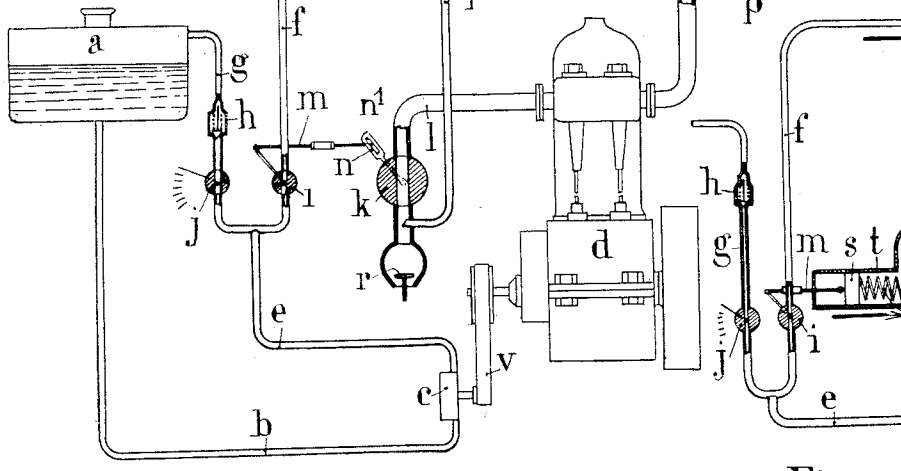
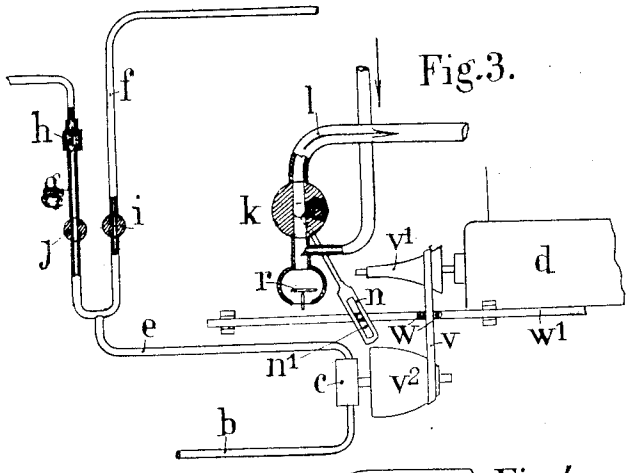


Fig. 2.

Fig. 5.

Fig. 3.



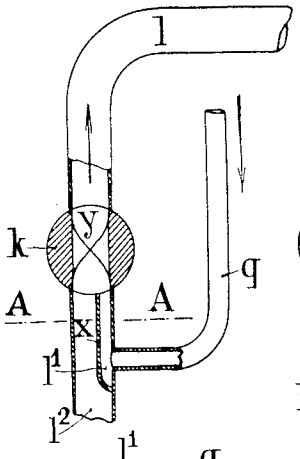


Fig. 6.

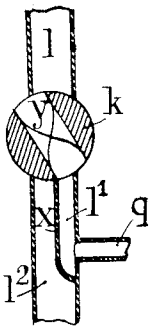


Fig. 4.

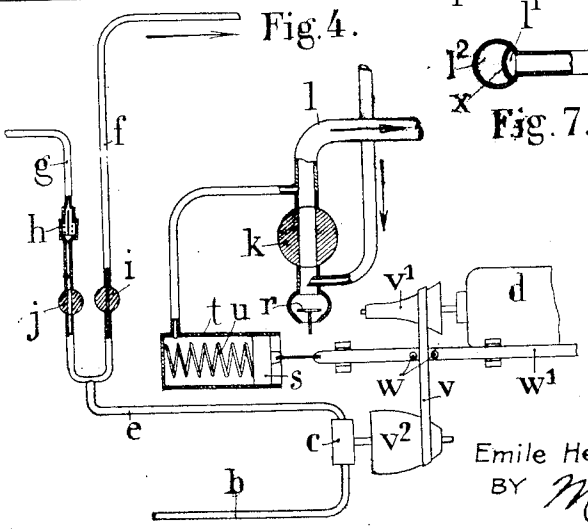


Fig. 7.

WITNESSES

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FEEDING APPARATUS FOR INTERNAL-COMBUSTION MOTORS.

1,195,764. Specification of Letters Patent. Patented Aug. 22, 1916.

Application filed October 27, 1911. Serial No. 657,134.

To all whom it may concern:

Be it known that I, EMILE HENRI ARQUEMBOURG, of 71 Rue du Moulin Vert, in the city of Paris, Republic of France, engineer, have invented a Feeding Apparatus for Internal-Combustion Motors, of which the following is a full, clear, and exact description.

In apparatus for feeding ordinarily employed, the carbureting liquid is admitted to the motor either by suction or by injection. In the first case the air sucked by the motor, lays hold of and draws with it the necessary quantity of fuel oil for its carburation. When the motor is running with constant speed and power, the flow of air and the flow of the carbureting liquid may be regulated so that the quantity of fuel picked up may be in a determined proportion to the quantity of air sucked by the motor; but when the speed and power of the motor are varied, as in the case of automobiles, it becomes impossible, by reason of the differences of density and viscosity of the two fluids, air and liquid fuel, to maintain this proportion; in effect, when the motor increases its speed, the quantity of air sucked up remains always approximately in proportion to the speed of this motor, but the liquid fuel, having a greater density and possessing from this fact a vital power which increases much more rapidly than that of air in proportion as the speed increases, arrives in excess, in variable proportions according to the differences in speed. In the second case, that is to say, when the liquid fuel is injected by means of a pump, the inertia of the liquid in movement, particularly when the motor and consequently the pump, rotating at great speeds, holds the pump valve lifted beyond the end of the expulsion stroke of the piston of this latter there follows a supplementary admission of liquid fuel which varies in different proportions for each speed; it is, therefore, equally impossible in this case to maintain the proportions of the liquid fuel and the air sucked up.

The present invention has for its object a feeding device for internal combustion motors, constructed in such a way as to furnish to the motor a quantity of liquid fuel always strictly in proportion to the quantity of air sucked by the motor, whatever may be the speed and the power of this motor, and thus remedying the above-mentioned inconveniences.

The accompanying drawing shows, by way of example only, this feeding device.

Figure 1 represents, in the form of a diagram, the whole of the apparatus. Figs. 2, 3 and 4 show modifications. Figs. 5 and 6 show, in section, in two positions, the modification of a detail. Fig. 7 is a section on the line A—A of Fig. 5.

In the present apparatus shown in Fig. 1, the tank *a*, which contains the liquid fuel, is connected by a pipe *b* to a pump *c* operated by the internal combustion motor *d*. This pump, which is a rotary pump for example, should produce a flow in proportion to its speed; further, this flow is calculated in such a way as to be considerably above the maximum requirement of the motor, with the object of permitting a more easy regulation and to compensate for losses due to wear. The outflow pipe *e* of this pump *c* divides into a main pipe *f* and a branch pipe *g*; the main pipe *f* opens into a carbureting apparatus and the branch pipe *g* returns to the tank *a*.

The main pipe *f* and the branch pipe *g*, or one or the other, is or are provided with regulating means intended either to compensate the differences of height of outflow of these two pipes or to regulate conveniently their outflows. Upon the less elevated pipe is arranged a valve *h* loaded in such a way as to balance the difference of height of outflow of the liquid in the main pipe *f* and in the branch pipe *g*; in the case represented in Fig. 1 this valve *h* is placed upon the branch pipe *g* but if the tank *a* was placed at a more elevated level than that at which the main pipe flows into the carbureter, this valve would be placed upon this main pipe *f*. In addition, two cocks *i*, *j*, are placed in the two pipes *f* and *g*, with the object of conveniently dividing in these two pipes the quantity of liquid expelled by the pump *c* so that the main pipe *f* delivers always the exact quantity of liquid necessary to provide a perfect carburation. The cock *i*, placed upon the main pipe *f*, is controlled by the throttle *k* placed in the suction pipe *l* of the motor.

The connection of the two cocks *i*, *k* may be made by means of a link *m*, the length of which may be regulated at will; for example, an extensible link consisting of two parts

connected by a right and left hand screw threaded sleeve, so that by rotating this sleeve in one or the other direction, it is possible to increase or decrease the length of this link; further, the operating lever n of the gas throttle k, has a slot n^1 which enables the position of the point of articulation of the extensible link m to be varied; by this arrangement it is possible to regulate at will the maximum degree of opening of the cock i and, nevertheless, to make the closing and full opening, the extremes of regulation, of the cock i and of the cock k always correspond, that is to say, to obtain always the proportionate opening of these two cocks. So as to obtain always proportionate flow through the cocks k, i, the sections of the passage of these cocks will have form such that, notwithstanding the initial regulation of the cock i, these sections, in the simultaneous displacements of the two cocks, remain always proportional between themselves. The most simple sections which can be employed preferably with this object are sections having a rectangular form or having the form of a lozenge. The cock j, placed upon the branch pipe g, may be provided with an index moving over a graduated quadrant. Therefore, by the manipulation of this cock j and of the sleeve of the extensible link m, it is always possible to regulate conveniently the flow in the two pipes f, g.

The carbureting apparatus comprises a vaporization chamber o in communication with the atmosphere and into which opens the pipe f; this chamber o is located in a casing p in the interior of which circulate the exhaust gases from the motor. The vaporization chamber o is connected by a pipe q, to the suction tube l which terminates at the suction valve or inlet pipe of the motor; this tube l is provided at its base with an extra air inlet valve r.

The operation of the present arrangement for supplying the fuel is as follows: Suppose the throttle k is completely open and the cock i at its maximum regulated opening, as shown in Fig. 1, and that the motor d is working at full power. The pump c driven by the motor, sucks the fuel drawn from the tank a by the pipe b, and sends it into the pipe e, and then into the two pipes f, g. The liquid sent into the pipe f is projected into the vaporization chamber o, heated by the exhaust gases which circulate in the casing p, and is vaporized in this chamber until it is drawn away by the motor. Under the effect of the suction of the motor, the exterior air enters equally into the chamber o and mixes with this carbureting vapor; there is thus formed a very rich carbureted mixture which enters the suction tube l below the throttle k, there dilutes in the extra air entering by the valve r, and arrives finally at the motor. The pump being calculated to furnish a flow above the maximum consumption of fuel oil by the motor, this excess of fuel oil passes through the branch pipe g, which returns it to the tank a; this pipe g only allows the excess fuel oil to pass, not consumed by the motor, owing to the resistance opposed by the throttling of the cock j. If the motor rotates slowly, the quantity of air sucked up in a given period of time is small; the air enters then principally by the chamber o, and in very small quantity by the valve r which offers a certain resistance. If the motor rotates quickly, the air enters at the same time by the chamber o and by the valve r, which opens more completely and allows the necessary addition of air to pass. When working at full power, the flow in the main-pipe f and in the branch pipe g being always in proportion to each other, as has already been stated above, and the volume leaving the pump being in proportion to the speed of the motor, there is necessarily a constant proportion between this speed of the motor and the quantity of fuel oil which flows through the main-pipe. If the motor ought to work at reduced power, the plug of the cock k is turned so as to reduce the suction of the passage of the suction pipe l; this displacement of the plug of the cock k causes a corresponding displacement of the plug of the cock i upon the main pipe f; the section of the passage of this pipe f is thus reduced in the same proportion, and the excess of fuel returns by the branch pipe g to the tank a. In this case, the quantity of fuel oil sent to the motor is always in proportion to the quantity of air sucked in, because the two cocks k, i which determine the sections of passage of the carbureted air and of the fuel, control each other and retain thus the proportion of each flow. Therefore, in all cases, the present arrangement of supply assures a rigorously proportioned carburation.

In some cases, it may be advantageous instead of having a fixed regulation cock j upon the branch pipe g, to connect this cock j by a small link or by any other mode of control connection to the cock i upon the main pipe f, so that when the speed is reduced, the section of the passage in the branch pipe is increased when the main pipe is closed, and inversely. In the apparatus above described the two cocks k and i control each other by a mechanical connection; Fig. 2 shows another method of realizing this control.

The plug of the cock i of the main pipe f of the fuel is connected by an extensible link m to a piston s which is movable in a cylinder t; the part of this cylinder opposed to the link m with relation to the piston s, is in communication with the suction pipe l of

carbureted air in the part comprised between the throttle k and the inlet part of the motor. An antagonistic spring u is interposed between the piston s and the bottom of the cylinder t; this spring is calculated so as to retain the piston s in the position corresponding to the opening of the cock i when the throttle is completely open. When the throttle k is partially closed it produces a partial vacuum in the suction tube l of the motor; the piston s, actuated by atmospheric pressure, enters the cylinder t in the direction of the arrow, and closes the cock i to an extent which it is easy to determine by choosing a suitable spring u which balances the difference of the pressures to which the two faces of the piston are submitted; the cock i may therefore receive by this apparatus displacements in proportion to those of the throttle k. The connection between the two cocks k and i may be effected equally by a mechanical transmission comprising the interposition of a cam the profile of which will be determined so as to regulate conveniently the opening of the cock i with relation to that of the cock k.

Figs. 3 and 4 show two other methods of realizing the present system of feeding, in which the variation of flow of the fuel, in case of driving at reduced power, is obtained by diminution of the speed of the pump. The transmission of the motion of the motor d to the pump c is realized by means of a belt v passing over two conoidal surfaces v^1 and v^2 keyed respectively upon the shafts of the motor and of the pump; a fork w, carried by a rod w^1 enables the belt to be moved upon these conoidal surfaces and the speed of the pump to be varied. The displacement of the rod w^1 may be controlled either, as represented at Fig. 3, by a slotted arm n^1 keyed upon the plug of the throttle k, or as shown in Fig. 4 by a piston s which is moved by the effect of the partial vacuum produced in the pipe l by the partial closing of the cock k, as above stated with respect to the method of carrying the invention into effect shown at Fig. 2. These two arrangements assure the simultaneous displacement of the gas throttle and the variation of corresponding speed of the pump, and consequently a variation always proportionate of the quantity of fuel and of the quantity of air. Any other system of transmission providing a progressive change of speed could be applied to connect the motor to the pump c.

Figs. 5 to 7 show an arrangement applicable to the present system of feeding, by means of which the valve r may be done away with and permitting the gas throttle to assure the mixture of carbureted air and additional air sucked by the motor. In front of the throttle k, the suction tube is divided into two unequal parts l^1, l^2, by a partition x of rounded form, as shown at Fig. 6; the part l^1 is in communication with the tube q which directs the carbureted air, and the part l^2 opens into the atmosphere. When the throttle k is completely open, Fig. 5, the suction of the motor takes place at the same time in the two parts l^1, l^2; to assure the homogeneity of the mixture, the plug of the throttle k or the tube l may take the form of a helicoidal partition y, which will compel the mixture to take a gyratory movement. When the throttle k is partially closed, the suction diminishes in the part l^2, and when this plug is moved into the position shown in Fig. 6, the suction of the motor takes place only in the part l^2.

Besides the advantages above indicated, and particularly that of maintaining constant the proportion of air and of fuel under all conditions of speed of the motor, the present system of feeding possesses also the advantage of assuring the formation of a homogeneous carbureted mixture; in effect, the fuel, being completely volatilized by its passage through the heater, is brought to a perfectly gaseous state and is thus mixed intimately with the air.

The present system of feeding may be employed with any kinds of fuel, not only fuel oil or alcohol, but also hydrocarbons of a somewhat great density. This arrangement of feed has also the advantage of being unaffected by vibration and of permitting the fuel tank to be placed at any level with respect to the various parts of the carbureting system. The present system of feeding may be applied equally well to motors having a single cylinder as to multiple cylinder motors.

The above indicated arrangements are only given as examples; the forms, dimensions and details of construction of the various parts of the apparatus may be varied according to the applications.

Claims:

1. A feeding apparatus for internal combustion motors, comprising in combination, a tank containing the liquid fuel, a pump operated by the internal combustion motor and the suction of which is connected to said tank, the flow of the pump being proportional to its speed and distinctly above the maximum consumption of the motor, a carbureting apparatus, an outflow conduit leading from the pump and bifurcating in two conduits, one leading to the carbureting apparatus and the other to the tank and adapted to return to the tank the carbureting liquid not passing to the motor, and regulating means intercalated on the one hand on the pipe in which is sent the liquid driven back by the pump and leading to the carbureting apparatus and, on the other hand, on the branch pipe, said regulating means

being adapted to compensate for the differences of height to which the liquid is driven back in each of said pipes and to regulate the outflow of the latter according to the quantity of air sucked by the motor whatever may be the speed and power of the said motor.

2. A feeding apparatus for internal combustion motors, comprising in combination, a tank containing the liquid fuel, a pump operated by the internal combustion motor and the suction of which is connected to said tank, the flow of the pump being proportional to its speed and distinctly above the maximum consumption of the motor, a vaporizing carbureting apparatus heated by the exhaust gases of the motor, an outflow conduit leading from the pump and bifurcating in two conduits, one leading to the carbureting apparatus and the other to the tank and adapted to return to the tank the carbureting liquid not passing to the motor, and regulating means intercalated on the one hand on the pipe in which is sent the liquid driven back by the pump and leading to the carbureting apparatus and, on the other hand, on the branch pipe said regulating means being adapted to compensate for the differences of height to which the liquid is driven back in each of said pipes and to regulate the outflow of the latter, according to the quantity of air sucked by the motor, whatever may be the speed and power of the motor.

3. A feeding apparatus for internal combustion motors, comprising in combination, a tank containing the liquid fuel, a pump operated by the internal combustion motor and the suction of which is connected to said tank, the flow of the pump being proportional to its speed and distinctly above the maximum consumption of the motor, a vaporizing carbureting apparatus heated by the exhaust gases of the motor and connected to the outlet pipe of the pump, a branch pipe on the outlet pipe of the pump and adapted to return to the tank the carbureting liquid not passing to the motor, a check valve arranged upon that pipe which has the less elevation for regulating the outflow of said pipes, a cock placed upon the branch pipe, a gas throttle upon the carbureted air inlet pipe, a cock upon the outlet pipe and a device by which the cock of the outlet pipe is controlled by said gas throttle.

4. A feeding apparatus for internal combustion motors, comprising in combination, a tank containing the liquid fuel, a pump operated by the internal combustion motor and the suction of which is connected to said tank, the flow of the pump being proportional to its speed and distinctly above the maximum consumption of the motor, a carbureting apparatus connected to the outflow of said pump, a branch pipe on the outlet pipe of the pump and adapted to return to the tank the carbureting liquid not passing to the motor, a check valve arranged upon that pipe which has the less elevation for regulating the outflow of said pipes, a cock placed upon the branch pipe, a gas throttle upon the carbureted air inlet pipe, a cock upon the outlet pipe, and a link the length and travel of which is regulable, connecting the cock of the outlet pipe and the gas throttle.

5. In a feeding apparatus for internal combustion motors, a motor having a suction pipe, a valve in said pipe, a supply tank, a carbureter connected with the suction pipe of the motor, a pump operated by the motor and connected with the supply tank, an outlet pipe leading to the carbureter, a valve in said outlet pipe, and means whereby the position of the valve in said outlet pipe will be controlled by the position of the valve in the suction pipe of the motor.

6. In a feeding apparatus for internal combustion motors, a supply tank, a carbureter, a motor having a suction pipe with which the carbureter is connected, a pump operated by the motor and connected with the supply tank, an outlet pipe leading from the motor and having branches, one of the branches being connected with the supply tank and the other with the carbureter, a valve in the suction pipe of the motor, a valve in the branch of the outlet leading to the carbureter, and means for controlling the valve in the said branch pipe from the valve in the suction pipe of the motor.

7. In a feeding apparatus for internal combustion motors, a motor having a suction pipe provided with an air valve and a throttle, a supply tank, a carbureter connected with the suction pipe of the motor between the air valve and throttle, a pump operated by the motor and connected with the supply tank, an outlet pipe leading from the pump, and having branches, one branch being connected with the supply tank and the other with the carbureter, a valve in each branch of the said outlet, and means for controlling the valve in the branch leading to the carbureter from the throttle of the suction pipe of the motor.

The foregoing specification of my feeding apparatus for internal combustion motors signed by me this tenth day of October, 1911.

EMILE HENRI ARQUEMBOURG.

Witnesses:
H. C. COXE,
GEORGES CHARLES COQUET.