June 17, 1930. C. L. STOKES 1,764,659

AUTOMATIC FUEL REGULATOR

Filed Nov. 9, 1925

Fig. 1

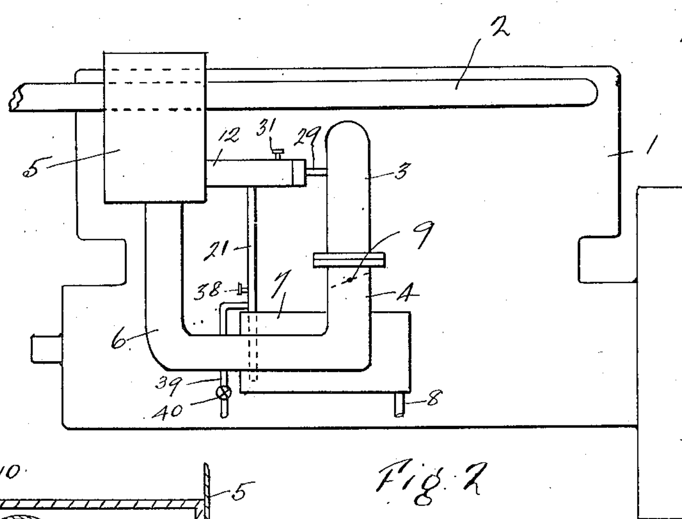
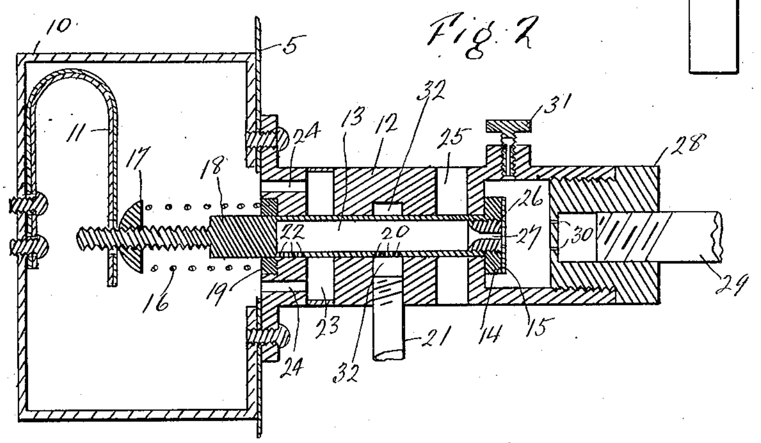


Fig. 2



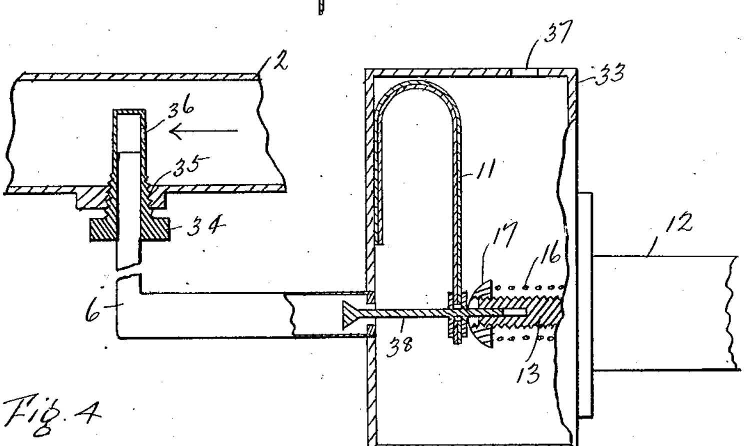
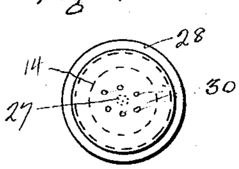


Fig. 3

Fig. 4



INVENTOR

Charles L. Stokes

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UNITED STATES PATENT OFFICE

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AUTOMATIC FUEL REGULATOR

Application filed November 9, 1925. Serial No. 67,864.

My invention relates to improvements in automatic apparatus designed to control the rate of fuel flow to an internal combustion engine for priming the same at starting.

The principal object of my invention is to provide a simplified regulator which is accurately controlled by the engine vacuum and/or temperature.

Another object of my invention is to provide automatic priming regulation for starting, running and accelerating an internal combustion engine up to the time it attains a satisfactory operating temperature.

Other objects will become apparent as my invention is more fully disclosed hereafter.

This application is a continuation in part of a prior application S. N. 56,513 filed September 15, 1925.

Referring to the drawings in which the same numbers indicate like parts:

Fig. 1 is a view showing my apparatus in operative relation to an internal combustion engine.

Fig. 2 is a sectional view of my specific structure.

Fig. 3 is an alternative construction to be used in place of that shown in Fig. 2.

Fig. 4 is a view of part of Fig. 2.

An internal combustion engine 1 has an exhaust pipe 2, an intake pipe 3, a carburetor 4 attached to pipe 3, a hot air stove 5 surrounding the exhaust pipe 2 and a hot air pipe 6 connecting the stove 5 with the air intake of carburetor 4.

Carburetor 4 may be of any well known make provided with a float chamber 7 to which liquid fuel is fed through pipe 8 by any well known means, and in general my invention is adapted to be connected to any source of liquid fuel supply, wherein the level of the liquid fuel does not rise above a predetermined maximum generally being float controlled, or otherwise controlled. The supply of a mixture of liquid fuel and air from carburetor 4 to the cylinders of engine 1 is controlled by a throttle valve 9.

Referring now particularly to Fig. 2 it may be seen that one wall of the stove 5 is made to support an open bracket 10 wherein is fastened a bi-metallic thermostat 11 and bracket 10 is fastened inside of stove 5 whereby thermostat 11 is exposed to air heated by its flow past exhaust pipe 2 due to the suction in carburetor 4, and is also exposed to the direct radiation of heat from exhaust pipe 2.

Externally of stove 5 a casting 12 is fastened to the same in any suitable manner and a hollow stemmed valve 13 is arranged to slide centrally of 12. Valve 13 has a head 14 thereon adapted to limit the movement of 13 in two directions and head 14 is fitted with a gasket 15 suitably fastened thereto. Head 14 is actuated in one direction by the action of a spring 16 which operates against a button 17 adjustably fastened to one end of valve 13 and valve 13 is held in casting 12 in predetermined relation thereto by having a portion squared at 18 adapted to move through a squared guide 19 fixed in casting 12. Thus valve 13 will always reciprocate in a predetermined manner with respect to casting 12, which is necessary in the construction described. This fixed motion is necessary because the interior of valve 13 is connected by a series of fine fuel orifices 20 to a liquid fuel pipe 21 adapted to pass below the liquid level in float chamber 7 for drawing liquid fuel therefrom and the interior of 13 has a second series of small air orifices 22 adapted to admit air to the interior thereof through a chamber 23 connected by passages 24 to an air supply, which preferably may be a supply of heated air coming from inside the stove 5.

An air passage 25 is adapted to surround valve 13 on the engine side of orifices 20 and 22 and the end of valve 13 contains a plug 26 in which is drilled a discharge port 27 which should preferably be of much smaller diameter than the interior of 13.

One end of casting 12 is closed by a plug 28 whereby a chamber is formed wherein head 14 is reciprocated by the action of spring 16 and the engine vacuum and a connection 29 joins 28 to intake pipe 3 to the end that the engine vacuum on the engine side of throttle 9 may be applied through a series of small orifices 30, port 27 and orifices 20 for drawing liquid fuel from float chamber 7 through pipe 21. The degree of vacuum applied from manifold 3 and orifices 30 to the discharge port 27 may be controlled by an air admission valve 31 and the vacuum applied through port 27 may be cut off by the seating of head 14 over the orifices 30 whereby the same are closed because they are spaced a distance greater than the diameter of port 27, as illustrated in Fig. 4.

The button 17 is adapted at predetermined temperatures to be in contact with one end of thermostat 11 so that at said temperatures valve 13 will be under the control of thermostat 11.

The operation of this device is as follows:

If it be assumed that engine 1 is cold and at rest, the valve 13 will be in a position as shown in Fig. 2 whereby all the orifices 20 will be placed in open communication with the liquid fuel in float chamber 7, it being preferred to have the orifice 20 closest to intake manifold 3 of larger diameter than the remaining orifices 20, but I do not limit myself to this construction inasmuch as the number, size and position of the orifices 20 may be varied to get a desired effect with every engine and also with the type of carburetor used.

The orifices 20 being completely open, the air orifices 22 will be shrouded, with the possible exception of perhaps one small orifice which may constantly admit a small amount of air to the interior of valve 13 but here again I do not limit myself to the number, size or position of orifices 22 because their number and size will also vary with the type of engine and carburetor used but in general when fuel orifices 20 are completely opened, air orifices 22 will be substantially closed.

Upon cranking engine 1, with throttle valve 9 substantially closed, the engine vacuum will be applied through orifices 30, port 27, and orifices 20 to draw a large supply of liquid fuel from float chamber 7 through pipe 21, which fuel is continuously fed through pipe 29 and manifold 3 to the engine cylinders until they commence to fire, together with a small amount of air for spraying effects through an orifice 22, or valve 31 or both. As soon as the cylinders fire the engine vacuum will suddenly increase whereupon said increase of vacuum causes a predetermined movement of valve 13 against spring 16 whereby one or more of the orifices 20 are closed by being shrouded in casting 12 and one or more of orifices 22 are opened.

This action has two functions. The first function is to positively reduce the volume of fuel by shrouding one or more orifices 20, the second function is to reduce the vacuum applied to the remaining fuel orifices 20 by admitting more air through the air orifices 22 to the interior of 13 whereby the engine vacuum applied through port 27 is reduced and thus the amount of fuel being drawn through a given orifice 20 will also be reduced.

It will be noted that this sudden movement of valve 13 responsive to a sudden increase of vacuum will draw the button 17 clear of the thermostat 11 and while engine 1 continues to run the air being drawn through stove 5, and air pipe 6 to the carburetor 4 will be increasingly warmed whereby thermostat 11 will increasingly expand and after a predetermined period the thermostat 11 will again come in contact with button 17 and thereafter until a satisfactory operating temperature is attained by engine 1, the movement of thermostat 11 will serve to succeedingly close fuel orifices 20 and simultaneously successively open air orifices 22 until finally head 14 is seated over orifices 30 at which time all of fuel orifices 20 will be closed and all of air orifices 22 will be open. When this occurs head 14 will be held tight over orifices 30 not only by the engine vacuum but also by the pressure of thermostat 11. This is advantageous in order to affect the functioning of carburetor 4 when a satisfactory operating temperature has been reached.

During the initial period of priming, the movement of 13 due to the engine vacuum suddenly increasing after starting, the distance between button 17 and thermostat 11 may be so arranged that upon accelerating engine 1 by opening throttle 9 a predetermined amount, the vacuum in pipe 3 will drop substantially whereby more fuel orifices 20 will be suddenly opened thus providing an excess of fuel for increased load conditions when the engine is cold.

It should be especially noted that valve 13 is a balanced valve because the passage 32 wherein pipe 21 is placed extends on each side of valve 13 whereby the vacuum applied through orifices 20 is applied equally all around valve 13. Air passages 23 and 25 are primarily provided in order that there shall be no leak of liquid fuel from pipe 21 to the exterior of casting 12, the reason for this being that the vacuum applied to passage 32 tends to draw air inwardly thereto from the air passages 23 and 25 should the fit of valve 13 in casting 12 be somewhat loose.

The adjustable air valve 31 is primarily for supplying sufficient air therethrough to mix with the liquid fuel drawn through port 27 and spray the same, so that at starting periods in cold weather, engine 1 will idle at a much faster rate than when the engine reaches a normal operating temperature and this factor is necessary in very cold weather, it being understood of course that for a certain definite engine, the adjustable feature of valve 31 may be replaced by a fixed orifice, or plurality of orifices for that particular engine.

The gasket 15 is provided to take care of machining inaccuracies in commercial construction so that when orifices 30 are closed, no liquid fuel will be drawn from float chamber 7 and thereby disturb carburetion when a satisfactory running temperature is attained. Therefore another function of air valve 31 becomes apparent because should 15 imperfectly cover the orifices 30, the vacuum applied therethrough may be satisfied by the air coming through 31. In any event it will be seen that the fuel coming through orifices 20 may be positively cut off at predetermined engine temperatures, first by closing orifices 30 tightly, second by providing excess air through valve 31 to take care of any leaks, third by completely shrouding orifices 20 and fourth by having orifices 22 wide open to atmosphere.

In the alternative shown in Fig. 3, the thermostat 11 is placed in a substantially closed case 33 and the pipe 6 is securely held in a fitting 34 which extends to the interior of exhaust pipe 2. Fitting 34 has a tapered thread 35 thereon and has an orifice 36 adapted to receive exhaust gases coming in the direction of the arrow so that the same will be diverted through pipe 6 to the interior of casing 33 whence they pass to atmosphere through an orifice 37. The actions already described with respect to valve 13 will be the same but in order that the flow of exhaust gases may not continue excessively after a satisfactory operating temperature is reached, there is provided a valve 38, moved by thermostat 11, which closes off pipe 6 from casing 33, to the end that there may be no excess accumulation of oil vapors and carbon in 33.

The speed at which thermostat 11 moves to control the valve 13 may be regulated by the size of orifice 36, or by the distance which bracket 10 is placed from the exterior of exhaust pipe 2 and this function is governed by the condition desired to be met in any particular engine.

It should be noted that the action of valve 13 is automatically governed by the engine vacuum and temperature, both coordinately and separately, according to conditions to provide excess fuel to the engine solely during a period required to bring the engine to a good operating temperature and the functions of the apparatus are entirely suspended when said period has expired, being entirely apart from the functions of carburetor 4 which will normally be inadequate to take care of priming conditions except by manual control.

For instance, if it is assumed that engine 1 has been cranked and started by the use of my invention, a certain number of orifices 20 will become closed, but if the fuel supplied through the remaining orifices 20 be insufficient to keep engine 1 running, a decrease of engine speed occurs with decrease of vacuum applied to valve 13, whereupon more of orifices 20 will be open and thus automatically sufficient fuel will be supplied for causing engine 1 to pick up.

The opening of more orifices 20 is also coincident with the closing of some of orifices 22, thereby increasing the vacuum applied to orifices 20 and hastening the delivery of excess fuel to the engine for causing it to pick up. However, it is to be noted when engine 1 first fires that the sudden increase in vacuum due to a higher piston speed than at cranking causes a decrease in the supply of fuel. At the same time it is highly desirable to introduce sufficient air through valve 31 to cause engine 1 to run at a higher idling speed when cold than the normal idling speed when an optimum operating temperature has been reached, the air being then cut off when head 14 covers orifices 30.

It should also be noted that, when orifices 20 are completely closed, atmospheric pressure will prevail interiorly of valve 13 through orifices 22 and this permits the recession of fuel through pipe 21 to float chamber 7 after a satisfactory operating temperature has been reached. While at times it is convenient to supply liquid fuel from a carburetor float chamber 7, it is apparent that liquid fuel may be supplied from any well known source on a modern automobile, such as a vacuum tank etc., or the casting 12 itself may include a float chamber on the lower side thereof for supplying liquid fuel therethrough.

It is of course apparent that many modifications, or additions can be applied to the structure shown. For instance, an air admission valve 38 (which may also be a fixed orifice) can be used in the pipe 21 as described in my aforesaid application. Also the series of orifices 20 and 22 might be a continuous fine slit in the circular valve 13, but inasmuch as the application of invention to any particular engine is purely a matter of trial no fixed sizes of orifices etc., can be universally stated.

With almost every system of priming, or choking, the excess liquid fuel at low temperatures has a tendency to wash the walls of the engine cylinders so that lubrication is impaired, and if the priming is carried to excess serious mechanical difficulties may ensue. In order to obviate such possible lubrication troubles, there is provided a pipe 39 controlled by a valve 40 which leads to the oil sump in the crank case of engine 1 at one end, the other end being connected to the pipe 21, or instead of going to the oil sump, one end of pipe 39 may be connected to the pressure side of the engine lubricating oil pump (not shown). In this manner, a limited amount of lubricating oil may be added to the liquid fuel and conveyed to the engine cylinders automatically until priming ceases, thereby preventing scoring of the cylinder walls and pistons.

If air is to be introduced through valve 38 to pipe 21, it will aid in rapidly lifting and passing excess fuel for starting engine 1, because an oil and air emulsion is formed, in which case the areas of orifices 20 and port 27 may be materially larger than if solely liquid fuel is being passed through pipe 21, but as before stated, the sizes and locations of any of the orifices utilized are subject to change or substitution depending on the change desired for operating conditions.

I claim:

1. Means for providing excess fuel for starting an internal combustion engine including a liquid fuel reservoir, a hollow stemmed valve for passing liquid fuel from the reservoir to the engine responsive to its suction and a thermostat for causing said valve to cut off said suction at predetermined temperatures upon heating up of said engine.

2. Means for providing excess fuel for starting an internal combustion engine including a liquid fuel reservoir, a reciprocating hollow stemmed valve for passing liquid fuel from the reservoir to the engine responsive to its suction and a thermostat for causing said valve to cut off said suction at predetermined temperatures when the engine is heated up.

3. Means for providing excess fuel for starting an internal combustion engine including a liquid fuel reservoir, a hollow stemmed valve reciprocating in fixed relation to a containing chamber for passing liquid fuel from the reservoir to the engine responsive to its suction and a thermostat for causing said valve to cut off said suction at predetermined temperatures when the engine becomes hot.

4. Means for providing excess fuel for starting an internal combustion engine including a liquid fuel reservoir, a hollow stemmed valve reciprocating in fixed relation to a containing chamber for passing liquid fuel from the reservoir to the engine responsive to its suction and a U shaped thermostat for causing said valve to cut off said suction at predetermined temperatures when the engine becomes hot.

5. In a mechanism for supplying excess fuel to the intake passage of an internal combustion engine for starting said engine while cold, a valve casing provided with fuel and air ports, a valve for opening and closing said ports, said valve being adapted to be moved by suction for partially closing said fuel port and for partially opening said air port, and means operated by the heat of the exhaust of said engine for closing said ports.

6. In a fuel feeding system for internal combustion engines, valve mechanism for supplying excess fuel for starting said engine, said mechanism comprising a valve casing having a chamber therein, means for placing said chamber in communication with the intake manifold of said engine and with a fuel reservoir for forming a passage from said reservoir to said manifold, a valve movably mounted in said chamber for gradually opening and closing said passage, a spring for resisting the movement of said valve for closing said passage, said valve being operated by the suction of said engine for partially closing said passage, and thermally operated means for closing said valve.

7. In a mechanism for supplying excess fuel to the intake passage of an internal combustion engine for starting said engine while cold, a valve casing provided with fuel and air ports, and a valve for opening and closing said ports, said valve being adapted to be moved by suction for partially closing said fuel port and for partially opening said air port.

8. In a mechanism for supplying excess fuel to the intake passage of an internal combustion engine for starting said engine while cold, a valve casing provided with fuel and air ports, a valve for opening and closing said ports, said valve being adapted to be moved by suction for partially closing said fuel port and for partially opening said air port, and thermally operated means for closing said fuel port.

9. In a mechanism for supplying excess fuel to the intake passage of an internal combustion engine for starting said engine while cold, a valve casing provided with fuel and air ports, a valve having a plurality of air ports normally out of alinement with the air port in said casing and a plurality of fuel ports normally in register with the corresponding ports in said casing, said valve being adapted to be moved by suction on starting the engine, for moving certain of said fuel ports of said valve out of register with the fuel port in said casing and for moving certain of said air ports in said valve into register with the air port in said casing, and a thermostat for moving said valve to close the fuel port in said casing.

10. In a mechanism for supplying excess fuel to the intake passage of an internal combustion engine, a casing having a fuel port and an air port, a sliding valve for controlling said ports, said air port being normally closed and said fuel port normally open for supplying an overly rich mixture to said intake on starting said engine, means whereby said valve is moved by suction to partially close said fuel port and open said air port on starting said engine for reducing said mixture to a rich one, and means independent of said suction operated means for automatically closing said fuel and air ports when said engine reaches its normal running temperature.

11. In a mechanism for supplying an overly rich mixture of fuel to an internal combustion engine upon starting the same while it is cold, said means comprising a slidable valve operated by suction for decreasing the

richness of the mixture, and a thermostat for closing said valve when the engine reaches normal running temperature whereby when said engine is started while hot said valve will be held in closed position.

12. A fuel priming system for internal combustion engines comprising a passage having a port for communicating with the intake manifold of an internal combustion engine, an air inlet and a fuel inlet, said air inlet being normally closed, said fuel inlet normally communicating with said port, and means responsive to the differential in the pressure between intake manifold depression and atmospheric pressure for decreasing the fuel supply to said port and for connecting the air inlet with said port upon starting of said engine.

13. A fuel priming system for internal combustion engines comprising a passage having a port for communicating with the intake manifold of an internal combustion engine, an air inlet and a fuel inlet, said air inlet being normally closed, said fuel inlet normally communicating with said port, means responsive to the differential in the pressure between intake manifold depression and atmospheric pressure for decreasing the fuel supply to said port and for connecting the air inlet with said port upon starting of said engine, and other means cooperating with said first named means for closing the fuel port as the temperature of the engine increases to normal running temperature.

Signed at Wilmington, in the county of Los Angeles and State of California, this 14th day of October A. D. 1925.

CHARLES LAWRENCE STOKES.