

May 21, 1957

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2,793,014

CARBURETOR

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3 Sheets-Sheet 1

Fig. 1.

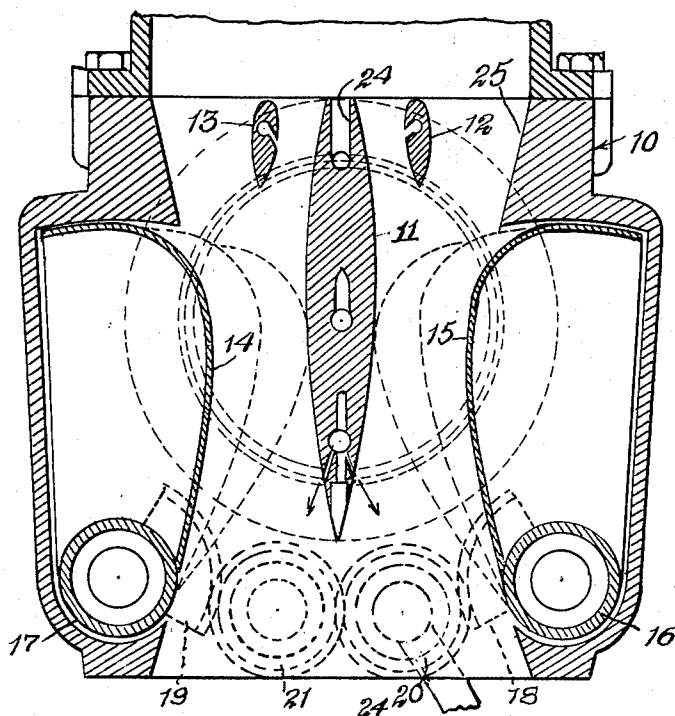
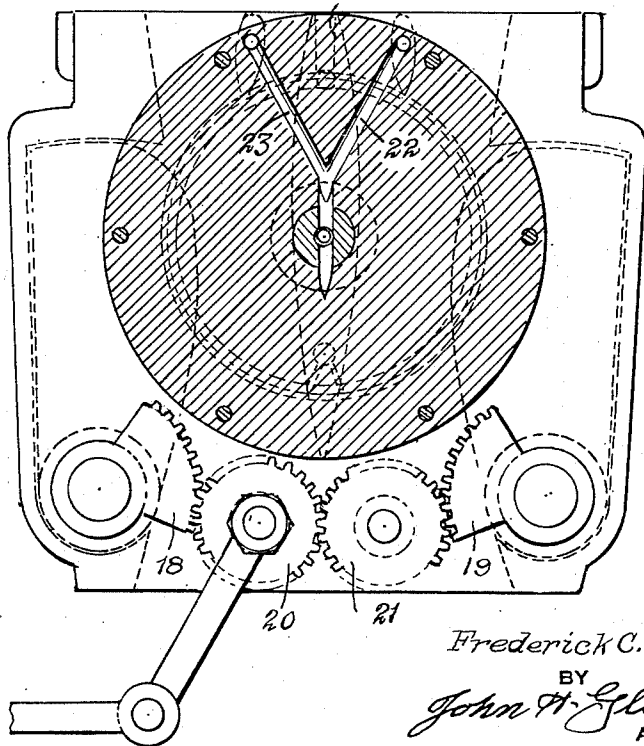


Fig. 4.



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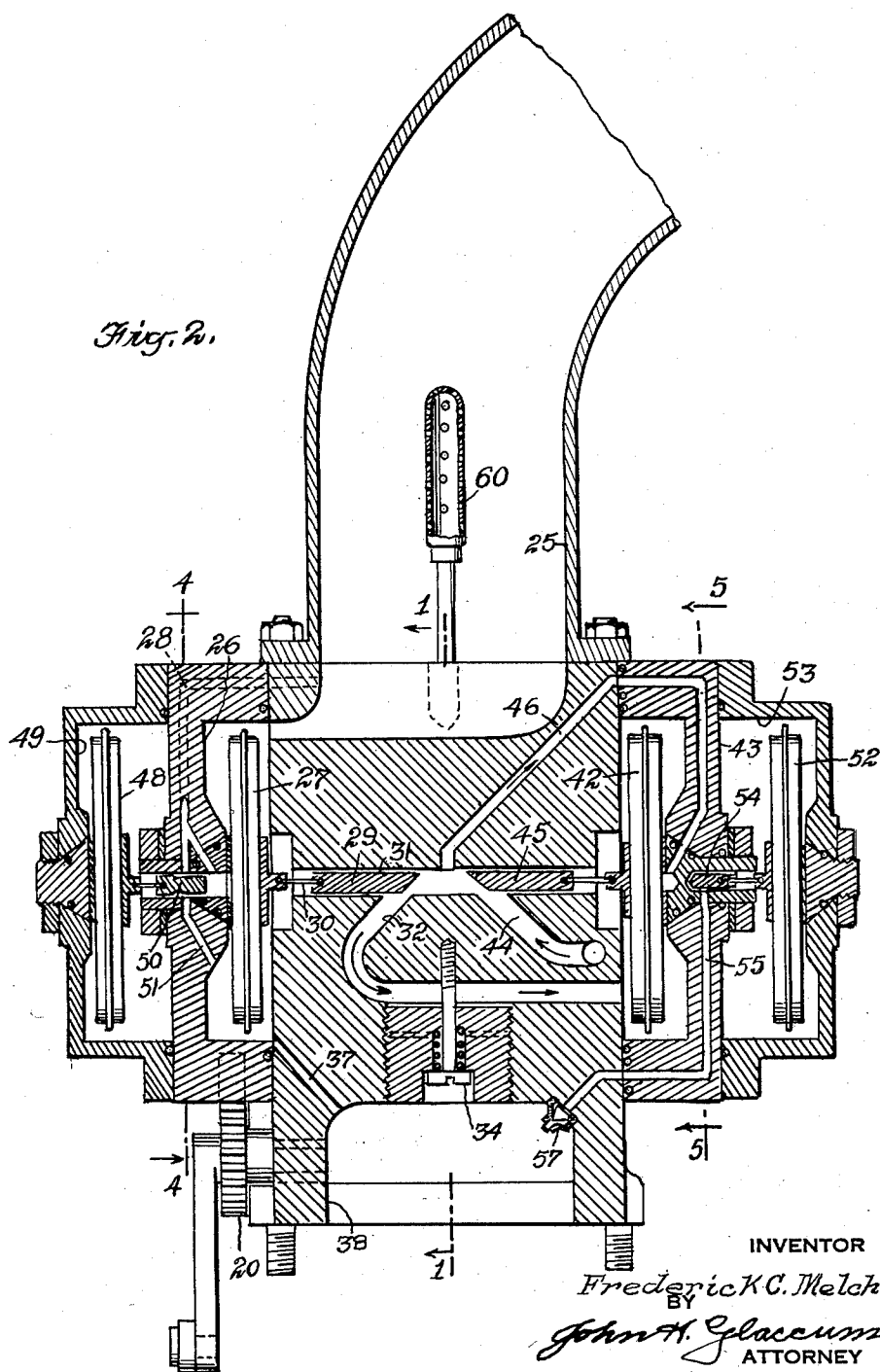
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Fig. 3.

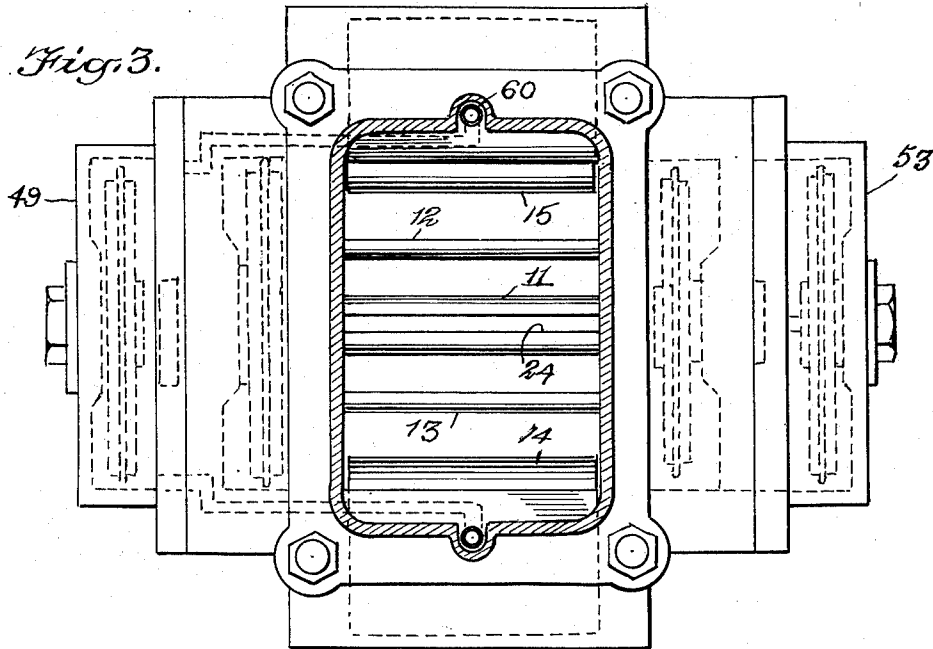
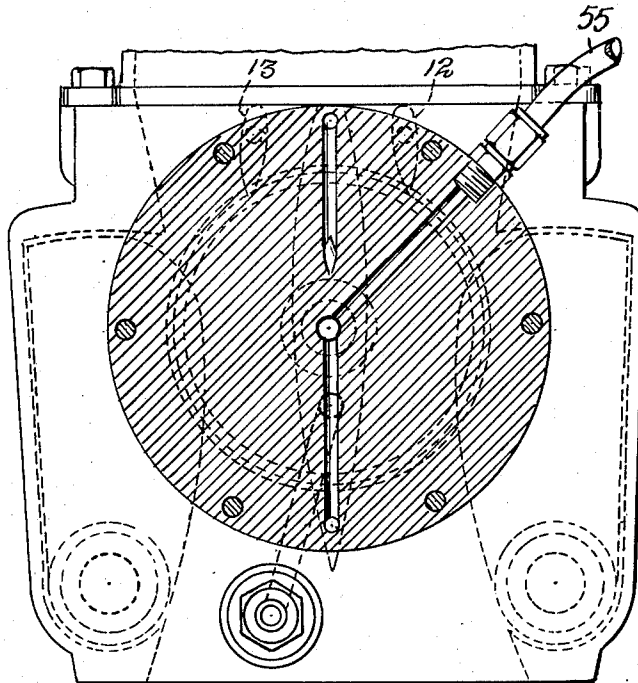


Fig. 5.

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6 Claims. (Cl. 261—18)

This invention relates to combustion control apparatus more generally known as carburetors, the purpose of which is to provide a uniform mixture of fuel and air in the correct proportions for all combustion in engines and furnaces.

Specific reference is here made to the injection type of carburetor in which pressure actuated devices operating in response to air flow factors meter the fuel admitted under pressure to an injection type or spray nozzle discharging into the air stream and entering the intake pipe or manifold.

An object of the invention is to provide a metering apparatus of highest accuracy avoiding the variables affecting the functions of conventional carburetors such as acceleration and gravitation forces, variations in density and volatility of fuel and air and always supplying the correct amount of fuel for the desired air/fuel ratios in the mixture throughout the operating range.

Another object is to obtain a minimum of pressure drop through the induction system by the use of true venturi throttles and highly sensitive self-contained pressure responsive capsules as metering elements.

A further object is to prevent icing by injecting the fuel directly into the intake manifold below the throttles or any other obstruction on which atmospheric moisture could freeze because of the temperature drop from the vaporization of the fuel.

It is also an object of the invention to produce a fully automatic unit which provides precise air/fuel mixture ratios for all output and operating conditions without the aid of any manual controls.

A still further object is to provide a device of such simplicity and foolproof design that service or maintenance will rarely be required.

Other objects and advantages of my improved carburetor will become apparent from the following description and the accompanying drawings.

In the drawings—

Fig. 1 is a cross-sectional view taken on the line 1—1 of Fig. 2.

Fig. 2 is a longitudinal section.

Fig. 3 is a top plan view of the apparatus.

Fig. 4 is a cross-sectional view taken on the line 4—4 of Fig. 2.

Fig. 5 is a cross-sectional view taken on the line 5—5 of Fig. 2.

Referring more particularly to the drawings, and particularly Fig. 1, I provide a housing 10 which may be made of a light metal casting and which mounts a central nozzle bar 11 and boost venturis 12 and 13. The two variable venturi throttles 14 and 15 are mounted in plain bearings 16 and 17 and are synchronized by gear sectors 18 and 19 and the pinions 20 and 21. The upper portions of the boost venturis are made hollow substantially through their length and these communicate by slots 22 and 23 with the venturi passages between the nozzle bar and the boost venturi. On the leading edge of the streamlined nozzle bar is a slot 24 which receives the

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impact pressure of the mass flow of air as it enters from the intake scoop 25.

Referring to Fig. 2 it will be seen that the slot 24 communicates the impact pressure to sealed chamber 26 in which is mounted a pressure sensitive diaphragm capsule 27 of a type now used in my master instruments, thus applying such impact pressure to the outside of the capsule. In a similar manner the boost venturis communicate venturi suction to the interior of the capsule by way of a separate passage 28.

The differential between impact pressure and venturi pressure is a function of mass flow of air for a given density and is proportional to the square of the velocity. This is the metering force acting upon the capsule 27 to which is attached a metering needle 29 by means of the link 30. The metering needle 27 operates with a smooth sliding fit in the precision bored longitudinal passage which extends through the nozzle bar and the housing. The metering needle 29 controls access to another passage 32 leading to the spray nozzle 34. The inner section is so dimensioned that it is completely closed off by the metering needle when the capsule is fully extended, that is, at rest. As previously stated, the metering force is proportional to the square of the air flow velocity. It is therefore not only necessary to accurately control fuel pressure but also to automatically govern the admission of fuel to the metering needle 29 and that pressure consistently remain inversely proportional to the square root of the said metering force, thus to bring the fuel rate into correct first power relation to the mass flow of air over the entire operating range. This is accomplished by means of the fuel regulator capsule 42 mounted in the sealed chamber 43 which communicates directly with the passage 32 thus applying metered fuel pressure which is the same as nozzle pressure to the outside of the capsule 42.

The fuel from the pump, which may be equipped with a by-pass relief valve to insure constant delivery pressure, enters by way of the passage 44 in the housing 10 and flows past the regulator needle 45 into the longitudinal passage 31. The capsule 42 communicates with the passage 31 at a point ahead of the metering needle 29 by way of a further passage 46, its interior thus being exposed to unmetered fuel pressure, notably nozzle pressure, plus the metering pressure. Consequently, with the nozzle pressure cancelled out it will be seen that the difference between unmetered and metered fuel pressure—the pressure drop—is the only force which operates the capsule 42 and its regulator needle 45. For instance, when reduced air flow causes the metering needle 29 to close a certain amount the higher pressure built up at this point immediately causes the regulator capsule 42 with its needle 45 to respond by closing a substantial amount, thereby reducing the admission pressure until equilibrium is established. Working in unison, the two needles 29 and 45 constitute in effect a double variable jet, automatically dividing the pressure between them, thereby reducing the fuel metering to a first power relation to the mass flow of air.

In Fig. 2 there is shown a bleed passage 37 from the capsule chamber 27 to the intake manifold 38. With its relatively small diameter this bleed is able to dissipate only a very small percentage of the impact pressure and this factor is included in the overall metering calibration. The function, it is believed, is twofold: besides disposing of any fuel condensate or minute leakage, the bleed rate will be obviously less at higher manifold pressures, thus automatically enriching the mixture for increased power demand and higher mean pressures.

For uses in aircraft or in automotive installations, where optimum performance and efficiency are desired, several important features may be added as integral components.

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Looking at Fig. 2, on the left is shown a barometer capsule 48 and a sealed chamber 49 which is vented to the air intake scoop by means of conventional static tubes 60 so as to obtain as true static pressure as possible. This capsule will respond to both temperature and pressure, thus, for instance, expanding with increasing altitudes. This capsule operates a small needle valve 50 which controls the passage 51 into the chamber 26 at a rate that increases as the density of the intake air decreases, consequently sustaining correct air/fuel mixture ratio.

On the right of the carburetor is shown another barometric capsule 52 in the sealed chamber 53 whereby this capsule completely evacuated and sealed is operated solely by absolute manifold pressure. As an aneroid it is compressed by atmospheric pressure whereas exposure to the lower absolute pressures of manifold causes it to expand at an inverse first power ratio to pressure, the useful stroke for the practical manifold pressure range being about 0.125 inch. This capsule operates a needle valve 54 in the passage 55 to allow the passage of water and alcohol from a small gear pump or gravity tank attached to the passage 56 and terminating in the nozzle 57. Thus, as the manifold pressure increases the valve is exposed more and more as the pressure increases and the water-alcohol mixture allowed to pass through the auxiliary spray 57.

The repeating accuracy of the capsules used in this metering device has frequently been demonstrated as better than one part in ten thousand. They are unaffected by acceleration and gravitation forces and by the same token variations in density and volatility of the fuel will be inconsequential because of the direct metered pressure feed in place of atmospheric pressure working against a fuel head. Vapor locks are eliminated and water is no longer a cause of malfunction as it is forced through together with the fuel as the latter is mechanically atomized in the spray nozzle. Since the injection takes place below any and all obstructions and directly into the manifold where prevailing temperatures will not permit formation of ice there is no possibility of icing.

I claim:

1. A carburetor having an air intake, venturi tubes in said intake, a central nozzle bar, throttle members cooperating with the central nozzle bar to control the intake of air, a pressure nozzle on the inner end of said nozzle bar, a fuel intake line into said nozzle bar, a valve passage in said nozzle bar communicating with said pressure nozzle and with said fuel intake line, a pair of valve members in said passage metering the flow of fuel from said fuel intake to said pressure nozzle, a pair of pressure sensitive capsules each controlling one of said valve members, a passage from said venturi tubes to the interior of the first of said capsules to exert suction thereon, an opening from the air intake to the exterior of said capsule, a passage from the valve passage to the interior of the second of said capsules upstream of the valve passage to allow the passage of unmeasured fuel, and a further passage from the valve passage downstream of the valve to the exterior of the second capsule to subject the exterior of said capsule to the pressure of the metered fuel.

2. In a pressure injection carburetor an air passage cooperating with pressure responding elements actuating

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respectively a fuel metering valve and a fuel flow control valve in a common passage, one of said elements responding to air flow factors, its motion transmitting to the metering valve in said common passage, a fuel supply passage joining the aforesaid common passage adjacent to the flow control valve, said flow control valve being operated by a second pressure responsive element actuated by the pressure differential of the flow past the aforesaid metering valve, an injection nozzle, a nozzle feed passage connecting with the adjacent common passage adjacent the metering valve, the flow into the nozzle feed passage being controlled by the position of said metering valve.

3. In a pressure injection carburetor, an air passage including a venturi, an injection nozzle for discharging fuel into the air passage and means for metering fuel to the nozzle, said means comprising a fuel supply passage, a fuel valve and a second valve downstream of the first in the fuel supply passage, a first pressure responsive member actuating the first valve, said first pressure responsive member responding to the pressure differential across said second valve a second pressure responsive member, said second responsive member actuating the second valve and responding to the air pressure differential across the venturi.

4. A carburetor as in claim 3 in which the nozzle is contained in a nozzle bar, said bar having a receiving slot for air impact pressure and a passage for transmitting the impact pressure to one side of the second pressure responsive member, the venturi suction being transmitted to the other side of the second pressure responsive member, and the first and second valves are contained in the nozzle bar, the bar also having a passage for transmitting the fuel pressure from between the valves to one side of the first pressure responsive member, and an additional passage for transmitting the fuel pressure from downstream the second valve to the other side of the first pressure responsive member.

5. In a carburetor as defined in claim 3, having a third pressure sensitive member for altitude adjustment, a valve controlled by said member in the passage running from the venturi tubes to the interior of the metering member and to the area exposed to impact air whereby expansion of said pressure sensitive member will cause the valve to open and to cut down the suction from said venturi tubes.

6. In a carburetor as defined in claim 3, supplemental means for introducing water and alcohol, including a source of water and alcohol, a supplemental nozzle, a line running from said source to said nozzle and a valve in said line, said valve being controlled by an additional pressure sensitive member subject to manifold pressure.

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