

July 23, 1929.

J. F. HERMANN

1,722,145

CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

Filed May 28, 1925

5 Sheets-Sheet 1

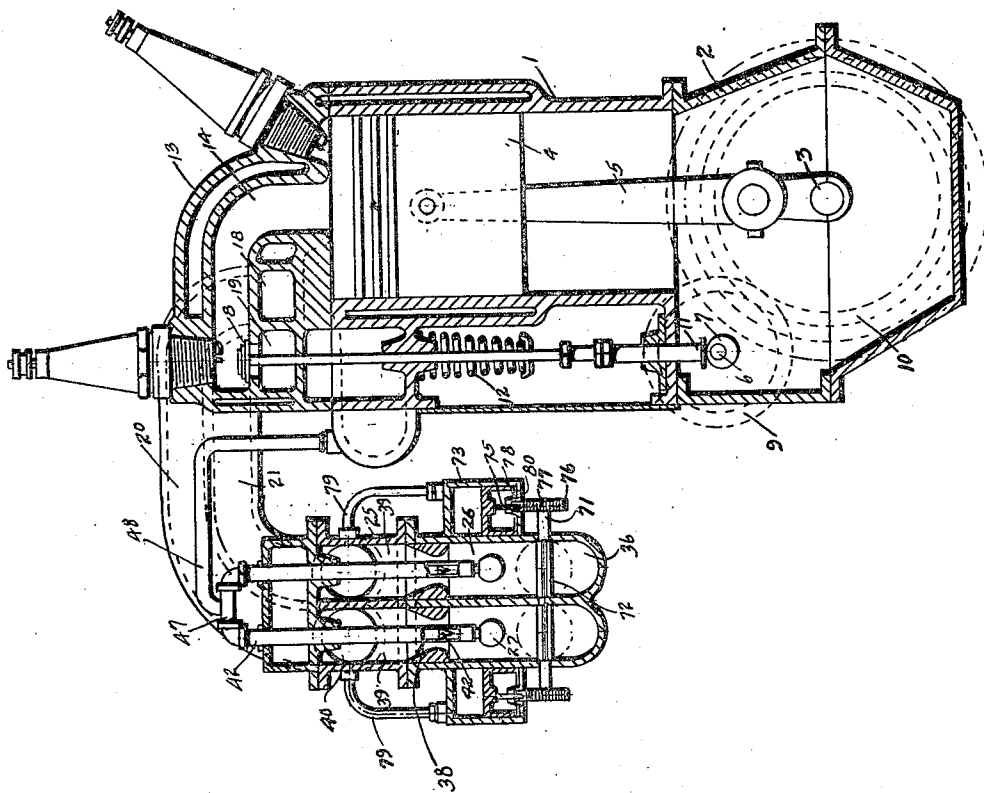


FIG. 1

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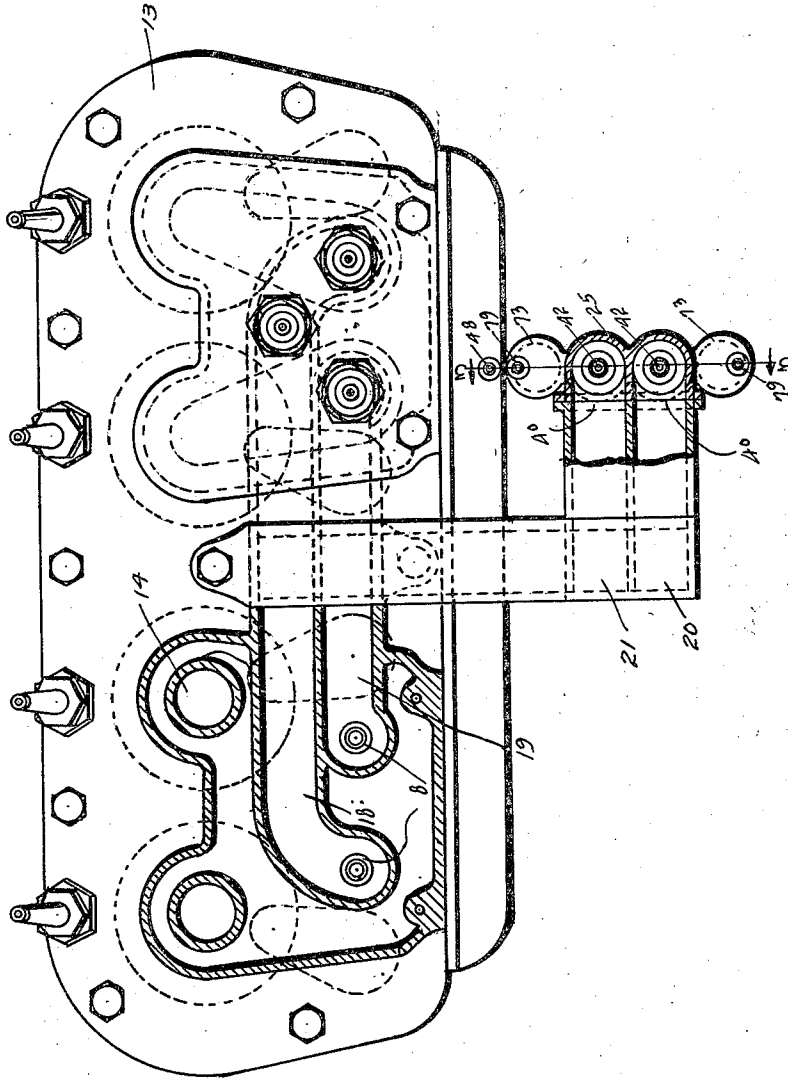


FIG. 2

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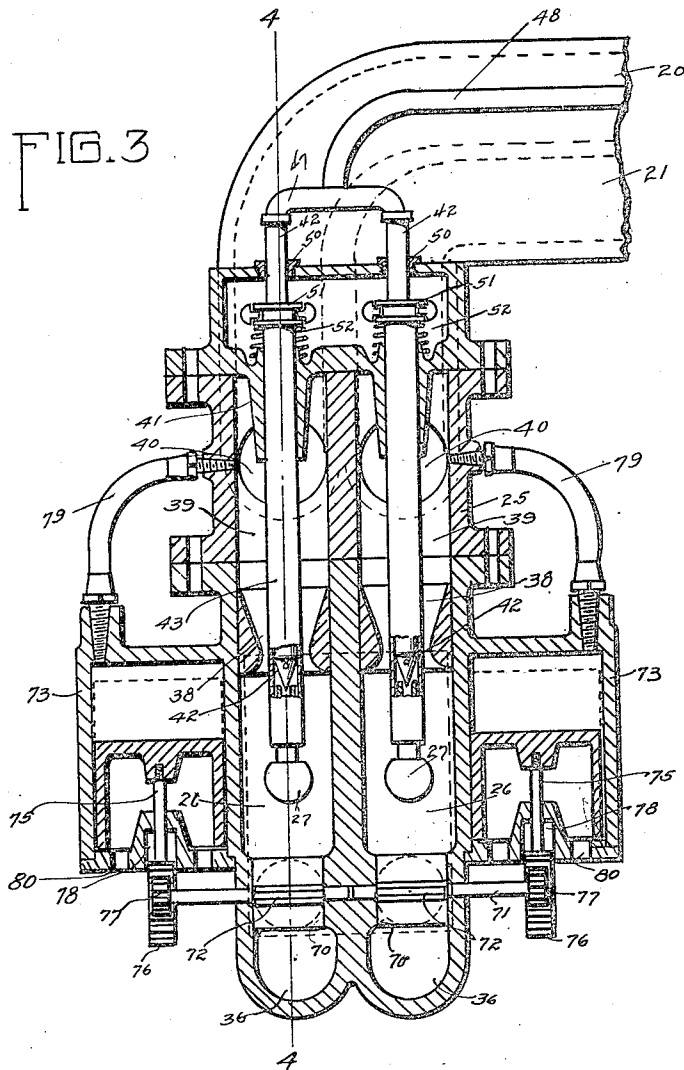
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CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

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FIG. 3



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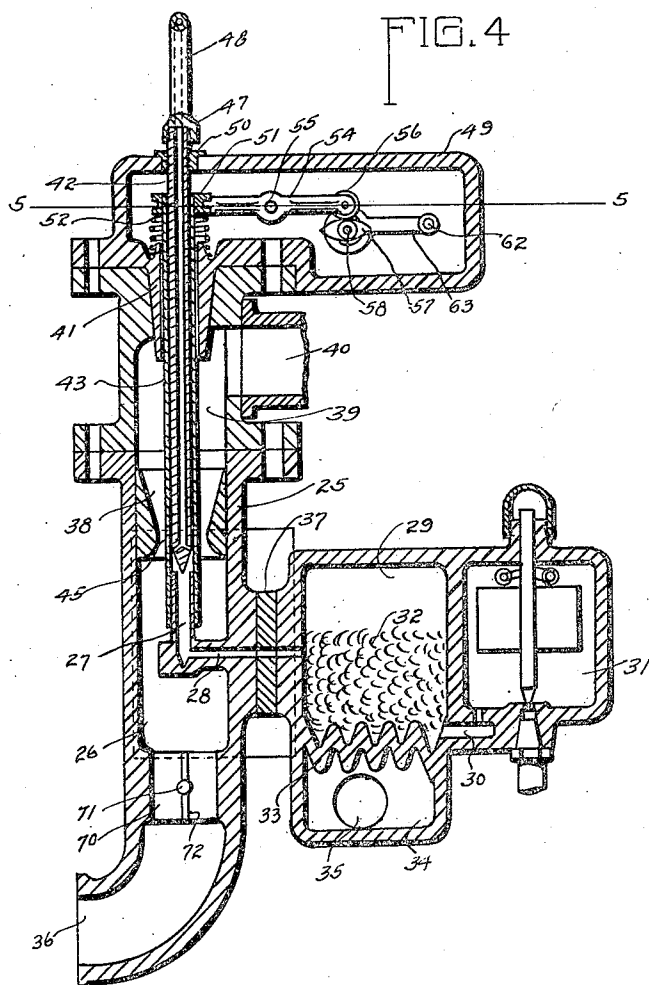
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CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

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5 Sheets-Sheet 4



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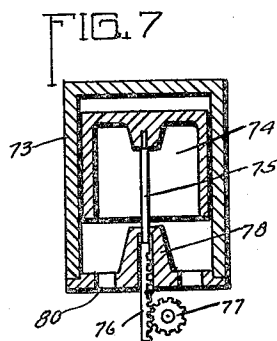
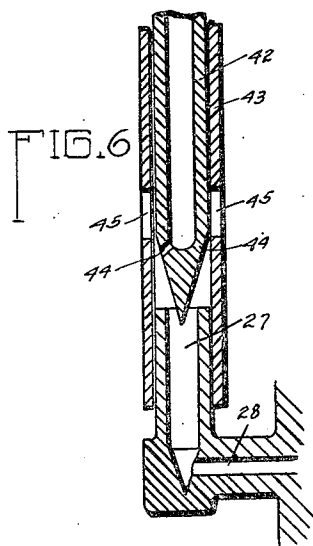
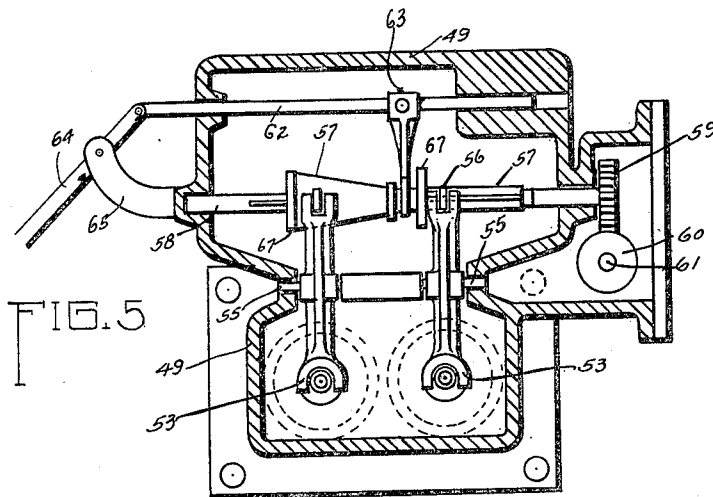
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CHARGE FORMING DEVICE FOR INTERNAL COMBUSTION ENGINES

Filed May 28, 1925

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE.

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CHARGE-FORMING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

Application filed May 28, 1925. Serial No. 33,460.

My invention relates to improvements in charge-forming device for internal combustion engines of the four-cycle, multiple-cylinder type, and it is shown and described
5 herein as applied specifically to the smaller type of four-cylinder, four-cycle, internal combustion engines. It is not intended, however, to limit the use of my invention to the type and size of internal combustion engine
10 shown since it is adaptable as well and can be arranged for use on larger and different types of such engines.

The principal objects of my invention are:

15 First, to provide a fuel cycle in timed relation to the intake valve of the engine whereby free air and a combustible gas may be admitted to the engine at predetermined points in the piston stroke.

20 Second, to provide an improved charge-forming device for internal combustion engines which will efficiently handle such hydrocarbons as kerosene and distillate.

25 Third, to provide an improved charge-forming device for internal combustion engines which utilizes a portion of the high temperature exhaust gases in heating the fuel and assists in vaporizing the heavy ends of such fuel.

30 Fourth, to provide a means whereby the air supply valves may be opened or closed automatically as the vacuum of the intake varies thereby maintaining a nearly constant vacuum.

35 Fourth, to provide an improved charge-forming device for internal combustion engines which is simple, durable, requiring a minimum attention with regard to adjustment, and of a compact nature requiring a minimum of repair while in use.

40 Fifth, to provide an external cycle in a charge-forming device for internal combustion engines whereby the amount of fuel consumed in the operation of the engine will be greatly reduced from that used by present
45 types of such engines.

50 Sixth, to provide a charge-forming device for internal combustion engines capable of introducing successive charges of pure air and combustible mixtures wholly separate from each other in timed relation to the piston travel of the engine.

Seventh, to provide a charge-forming device for internal combustion engines capable of exact control, with regard to the amount

of fuel introduced into the engine, comparable with the load placed upon the engine thereby greatly increasing the efficiency of the engine.

These and other advantages and objects will be more fully pointed out in the following specifications, reference being had to the accompanying drawings which illustrate the embodiment of my invention in one of its important phases, in which:

Fig. 1 is an elevation of an engine, of the internal combustion type, with my invention applied thereto, partly in section.

Fig. 2 is a plan view of an engine, of the internal combustion type, with my invention applied thereto.

Fig. 3 is a vertical sectional view of my invention detached from the engine, such section being taken along the dotted line 3—3 of Fig. 2.

Fig. 4 is a vertical section of my charge-forming device taken on the dotted line 4—4 of Fig. 3.

Fig. 5 is a sectional view taken on the horizontal line 5—5 of Fig. 4.

Fig. 6 is an enlarged detail of the needle valve and fuel injecting device in vertical section.

Fig. 7 is a vertical section of one of the differential pressure actuated piston controls.

Figs. 1 and 2 of the drawings seek to portray the head and cylinder details of a four cylinder engine with my invention thereon and since the respective cylinders are similar in form and mode of operation, the application of the invention thereto will be set forth only with relation to one of the cylinders, it being understood that the application thereof to the other cylinders will be practically the same.

In this embodiment of my invention the engine comprises a cylinder 1 opening into a crank case 2 in which is journaled a crank-shaft 3 having mounted on one of its ends a gear 10 in mesh with a gear 9 mounted on a cam-shaft 6 arranged parallel to the crank-shaft. The piston 4 is connected in the usual way to the crank shaft 3 by the connecting rod 5. The cam-shaft 6 is journaled in a suitable manner in the crank case 2 and carries, disposed along its length, suitable cams 7 which operate valves such as shown at 8 in the ordinary and well known manner of such devices.

Each cylinder of the engine is provided with two valves comprising an intake valve 8 and an exhaust valve 9, each operated at predetermined intervals by the cam-shaft 5 operating on the valve tappet 11, such valves being normally held tightly closed by the springs 12.

Above the cylinders is a head 13, attached thereto, and within the head is a chamber 14 surrounded by water spaces. Also within the head and extending longitudinally thereof are a pair of intake manifolds 18 and 19, communicating through pipes 20 and 21 with my charge forming device.

The charge-forming device shown in Figures 3 and 4 is constructed in duplicate form, one unit thereof being connected with one of the intake manifolds, to provide the various charges therefor. Said mechanism comprises a casing 25, containing a pair of cylindrical chambers 26, in each of which is a fuel intake 27, connected by a passage 28 with a chamber 29, in communication through a passage 30 with a carburetor bowl 31, to which the liquid fuel is furnished from the main source of supply thereof. The chamber 29 contains a quantity of steel wool, as shown at 32, through which the hydrocarbon passes in its movement towards passage 28. In the lower part of the compartment 32 is a series of radiation plates 33, beneath which is a small chamber 34, having a vent 35 for communicating with the exhaust manifold of the engine. While the engine is in operation a supply of heated gas is conducted to the chamber 34, through the plates 33 heating the steel wool and thereby disintegrating the fuel passing through the same.

Below the chamber 26 is an intake 36, permitting a supply of outside air to enter such chamber, from which it passes upwardly through a Venturi passage 38 into a chamber 39, and thence through outlets 40 to the pipes 20 and 21. Heat from the chamber 29 is prevented from radiating therefrom in the direction of the air intake by means of an insulating pad 37 interposed between said chamber and the casing 25.

At a point at the lower end of the Venturi passage 38 successive charges of explosive mixture are injected into the current of air, in such a manner as to form strata or pockets therein, to function in the manner herein-after set forth. The mechanism referred to is as follows:—At the upper end of the chamber 39 is mounted a sleeve 41 in which is supported a pipe 42, between which pipe and the sleeve 41 is held a tubular valve member 43. The lower end of the pipe 42 is pointed and supported a little distance above the fuel intake 27. Said pointed end is provided with openings 44, downwardly directed, and in the lower end of the sleeve 43 is a series of apertures 45, which are normally closed by the pipe 42, as shown in figure 6. The pipes 42

are connected at their upper ends by a union 47, from which a pipe 48 leads to the exhaust manifold of the engine.

The upper ends of the pipes 42 pass through a casing 49, supported on the casing 25, in which said pipes are capable of a limited vertical adjustment by means of the nuts 50, rotatable in the upper wall of the casing 49, and having a threaded connection with the pipes 42. On the upper ends of the sleeves 43 are collars 51, between which and the sleeves 41 are coil springs 52, which serve to hold the sleeves 43 normally in an elevated position. Levers 54 provided with yokes 53 are fulcrumed on a rod 55 fixed in the casing 49. Journaled in the casing 49 are shafts 58 having mounted thereon and slidable endwise but prevented from separate rotatable movement therefrom cams 57. Rollers 56 are mounted on the ends of the levers 54 said rollers being held in contact with the periphery of the cams 57 by the springs 52 previously referred to. One end of the shaft 58 is provided with a gear wheel 59 meshing with a worm-gear 60 secured on a shaft 61 to which rotatable movement is supplied from some point on the engine such as the distributor shaft.

Mounted slidable in the casing 49 is a shifting lever 62 carrying an arm 63 in engagement with a collar uniting the cams 57, and upon movement of which, said cams can be moved in one direction or the other, lengthwise of the shaft 58. The cams 57 are of special formation and of a similar pattern, except that the greater diameter of one of said cams is at right angles with the greater diameter of the other cam. The high points of the cams are 180 degrees apart and elliptical in cross section having a large portion or bell at their large ends as at 67.

When the cams are rotated, the rollers 56 pass over their high points raising and alternately lowering the levers 54, the degree of such movement depending upon the position of the cams with the levers. This reciprocatory motion is imparted to the sleeve-valves 43, causing them to open the apertures 45 to a greater or less extent. This causes a discharge of a portion of the fuel through the pipe 27 and simultaneously releases a current of heated gases through the openings 44 in the end of the pipe 42. A violent expulsion of the fuel atoms into the current of cool air takes place at the throat of the venturi 38 forming a stratum or pocket of fuel vapor in the current of air. This results in the supply to the engine of two currents of fuel vapors, one of which is introduced through the manifold 18 to a pair of the cylinders of the engine and the other through the manifold 19 to the remaining pair of cylinders. Each of said currents is made up of successive charges of air and combustible vapor, the operation being such that the charge of pure air precedes

the combustible vapor. As a result, on the suction stroke of the piston, the cylinder fills with pure air while the combustible vapor merely enters the combustion chamber. Upon the compression stroke of the engine the charge is compressed and ignited in the usual and well known manner.

The pipe 42 is preferably made from some heat conducting metal, such as copper, and the point thereof is maintained at a high temperature by the gases passing through same. The fuel coming through the pipe 27 strikes against said point and the temperature thereof raised to a high point, aided by the heat of the gases coming through the pipe 42. The point of said pipe also assists in further breaking up the fuel and a limited portion of the heavier ends of the fuel are therefore reduced to a condition rendering them more efficient in combustion. The violent injection of the fuel into the air channel also gives a turbulent action thereto which further prepares it for efficient combustion.

As the load on the engine increases it becomes necessary to increase the amount of gas fuel thereto and this is accomplished by shifting the cams 57 so that the rollers 56 will run higher up on the cams or continuously on the tracks 67 for maximum load.

The density of the fuel charge is entirely under manual control through the movement of the cams 57 on their shaft 58 making it necessary to provide some means for further controlling the air supply. I prefer the method disclosed in Figure 3 comprising a chamber or air passage 70 situated directly below the chamber 26. Shafts 71 are journaled therein carrying throttle-valves 72, by means of which the air supply may be partially or entirely shut off as required by the load conditions of the engine. At the sides of the chambers 26 are supported cylinders 73 in which are contained vertically movable plungers or differential pressure actuated pistons 74. Secured to said plungers at a central point are rods 75, the outer ends of which are in the form of gear-racks 76 in mesh with gears 77 fixed on the shaft 71. The racks are permitted movement in cavities in the bearings 78 in the lower ends of the cylinders 73. Said cylinders are connected by pipes 79 to chambers 39 and the lower ends of said cylinders are provided with ports 80 through which free air is admitted below the pistons 74 when they rise. Upon variations in the suction within the chambers 39 and the suction pipes 79 the pistons move upwardly within the cylinders 73 serving to open the valves 72 and thereby admitting a greater supply of air. Said differential pressure actuated pistons are capable of independent action from each other to compensate for any variation in the engine operation from one cylinder to another.

While I have shown and described but a single embodiment of my invention, it is believed that various other physical and structural modifications may be effected within the spirit and scope of the same and I intend that only such limitations be imposed as may be indicated in the appended claims, in which it is my intention to claim all novelty inherent in my invention as broadly as possible in view of the prior art.

What I claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, an air conduit adapted for connection with the manifold of the engine so as to cause the passage of a current of air through said conduit, a Venturi passage in said conduit, a fuel intake at the lower end of said Venturi passage, a pipe connected with the exhaust system of the engine provided with a perforated point in proximity to said intake, a sleeve valve normally closing said intake, and means for actuating said valve to open said intake and permit the injection into said air current of a quantity of fuel in the form of explosive vapor, forming a pocket in said air current and traveling therewith.

2. In a device of the class described, an engine intake manifold, a Venturi tube connected to said manifold, a needle valve provided with a longitudinal central opening and a perforated point, a fuel intake opposed to said point, one end of said hollow needle valve connecting with the exhaust of the engine, a hollow sleeve enveloping said needle valve and provided with ports near its lower end adapted for alignment with said perforated pointed needle valve, said sleeve capable of being moved so that its ports are beyond the end of said needle valve to admit a gaseous fuel or liquid into said venturi for the purpose substantially as set forth.

3. In a device of the class described, an engine intake manifold, an air conduit adapted for connection with said manifold of the engine so as to cause the passage of a current of air through said conduit, a Venturi passage in said conduit, a fuel intake at the lower end of said Venturi passage, a hollow tube provided with a pointed end adapted to be heated by the engine exhaust, said heated point being in proximity to said intake, a sleeve enveloping said heated point and provided with ports normally closed by said point but adapted to be moved to open said port and permit the injection into said air current and over said heated point of a quantity of fuel in the form of explosive vapor, forming a pocket in said air current and traveling therewith.

In testimony whereof I hereunto affix my signature.

JOHN F. HERMANN.