Aug. 28, 1923. 1,466,425

I. COWLES

AUTOMATIC VAPOR FEED FOR HYDROCARBON MOTORS

Filed June 1, 1915 3 Sheets-Sheet 1

Fig. 1.

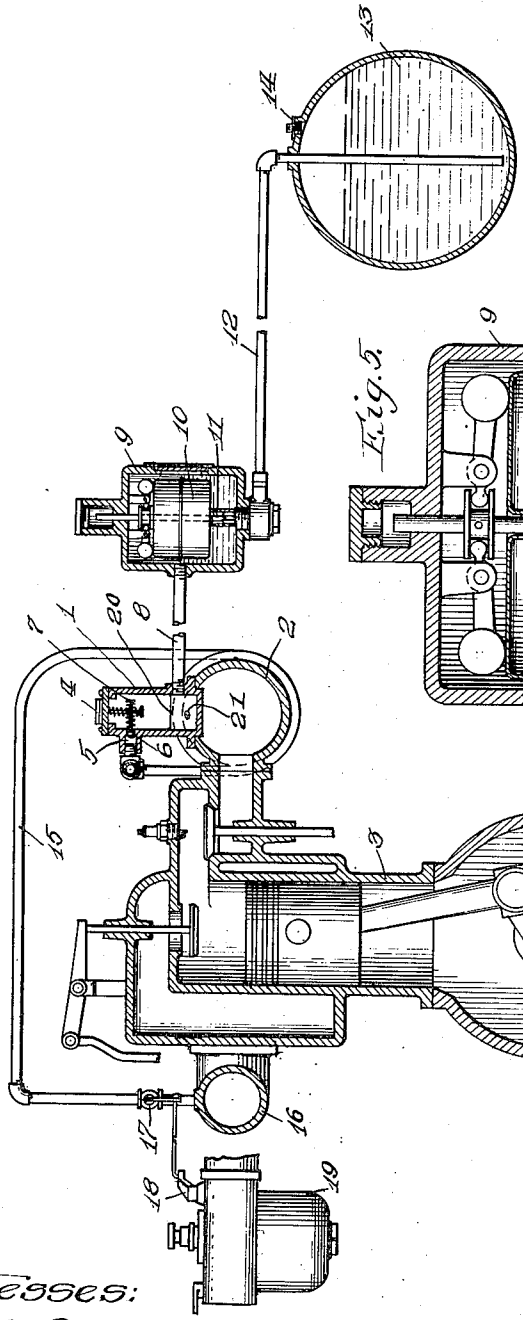
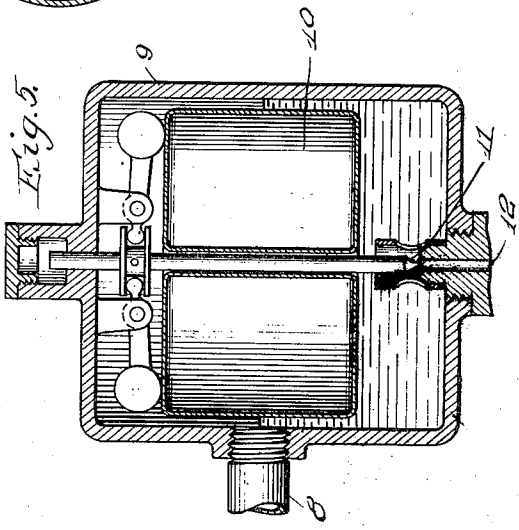


Fig. 5.



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AUTOMATIC VAPOR FEED FOR HYDROCARBON MOTORS

Filed June 1, 1915 3 Sheets-Sheet 2

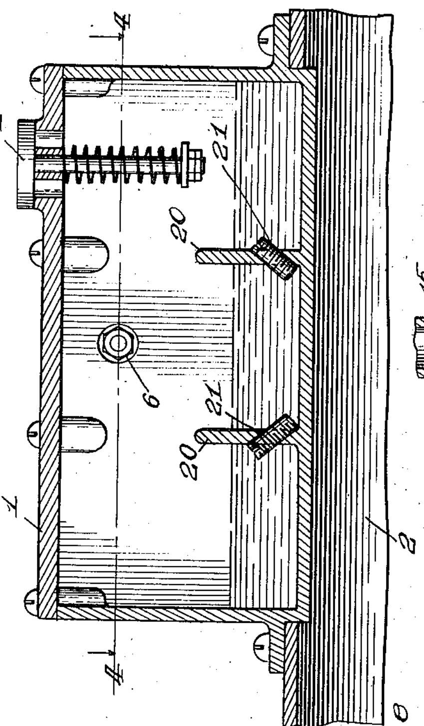

Fig. 3.

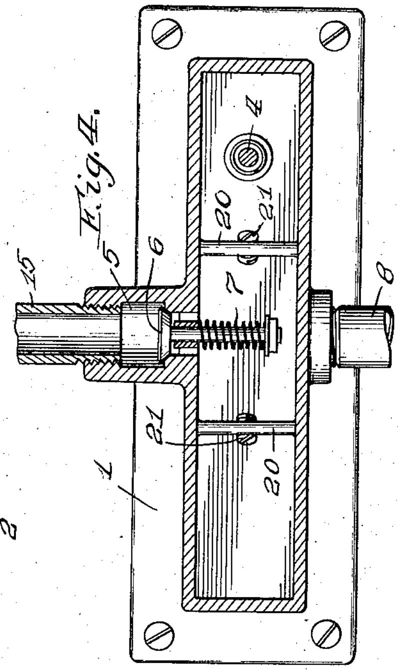

Fig. 4.

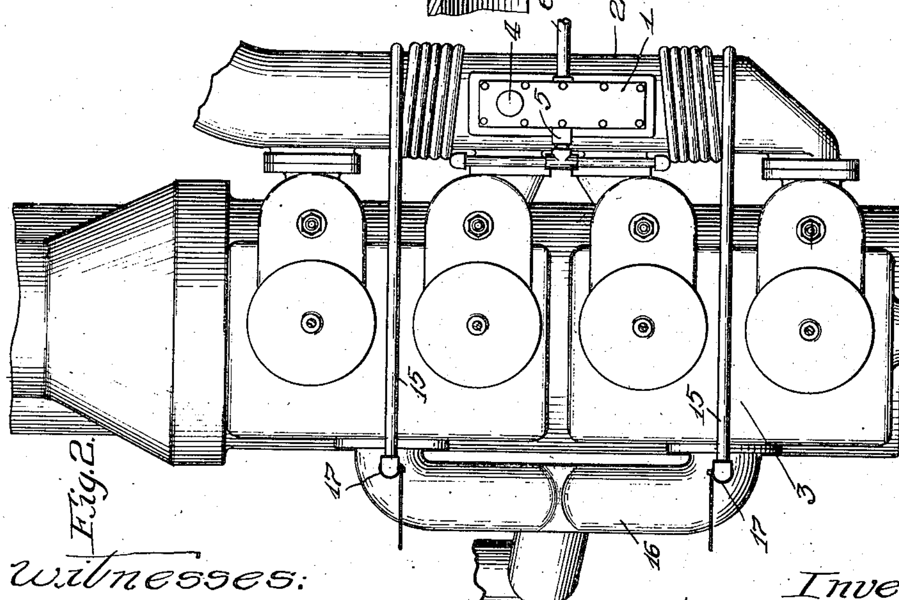

Fig. 2.

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AUTOMATIC VAPOR FEED FOR HYDROCARBON MOTORS

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Fig. 6.

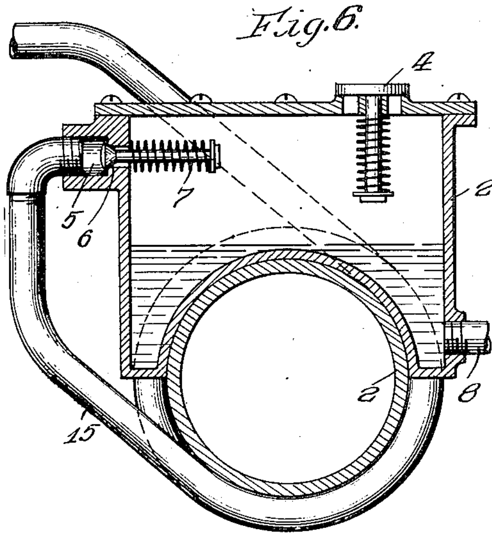


Fig. 7.

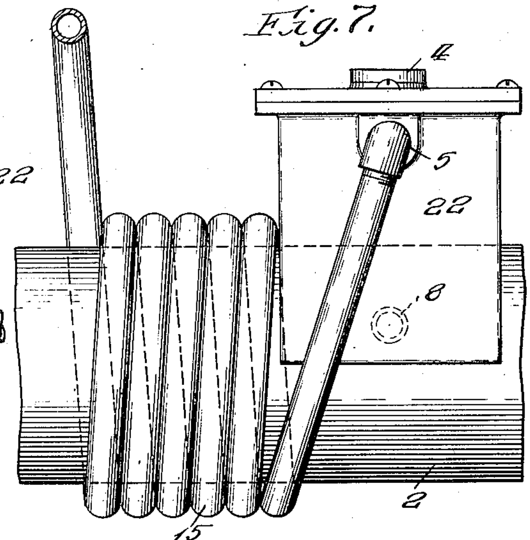


Fig. 8

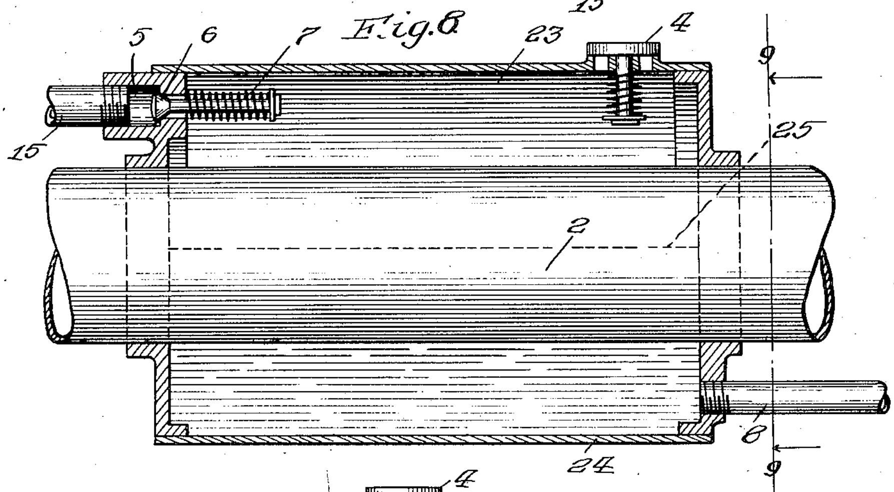
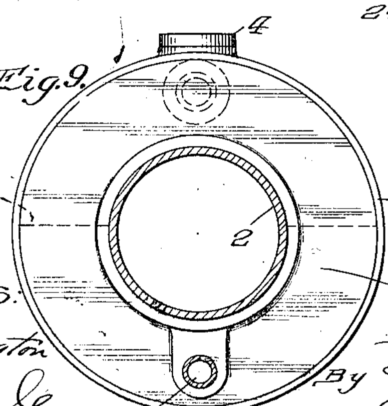


Fig. 9.



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Patented Aug. 28, 1923. 1,466,425

UNITED STATES PATENT OFFICE.

IRVING COWLES, OF CHICAGO, ILLINOIS.

AUTOMATIC VAPOR FEED FOR HYDROCARBON MOTORS.

Application filed June 1, 1915. Serial No. 31,583.

To all whom it may concern:

Be it known that I, IRVING COWLES, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Vapor Feed for Hydrocarbon Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention has for its object to provide means for introducing steam or vapor into internal combustion motors to be admixed with the charges of carbureted air, to secure the well-known advantages resulting therefrom.

The particular object of the invention is to provide means of the character set forth, constructed and arranged to supply steam or vapor to the motor without in any way affecting the volume of air or materially affecting the volume of carbureted air admitted, and in which the steam or vapor generated and fed, is automatically adjusted to accord with the needs of the motor at varying speeds thereof regardless of any manual valve adjustment to attain this end.

A further object of the invention is to provide steam or vapor generating and feeding means which becomes and remains automatically effective only so long as the motor is in operation and becomes ineffective to supply steam or vapor to the motor as soon as the latter ceases to operate.

A further object of the invention is to provide a steam or vapor feed for internal combustion motors in which the generation of steam or vapor and its supply to the motor is controlled by the maintenance of a partial vacuum in the steam or vapor generator, through the connection of the latter with the motor.

Another object of the invention is to provide mechanical means whereby the volume of steam or vapor admitted to the motor is automatically regulated and controlled to maintain the same in a substantially uniform ratio to the combustible fluid admitted thereto.

Other objects of the invention will appear from the following specification.

Suitable embodiments of the invention are illustrated in the accompanying drawings, in which:

Figure —1— is a sectional view through an internal combustion engine equipped with devices embodying my invention, the latter being shown mainly in section and partly in elevation.

Figure —2— is a top plan view of an internal combustion engine and a portion of apparatus embodying my invention connected therewith.

Figure —3— is a detail vertical longitudinal section through a boiler and a portion of the exhaust pipe of the engine constituting a part of my said apparatus.

Figure —4— is a horizontal section on the line 4—4 of Figure —3—.

Figure —5— is a detail sectional view of a water reservoir and float-controlled valve for the same constituting a part of my said apparatus.

Figure —6— is a detail transverse section through the exhaust pipe of a motor equipped with a boiler and a super-heater coil embodying my invention and constituting a part of the said apparatus.

Figure —7— is a fragmentary detail view in elevation of the device shown in Figure —6—.

Figure —8— is a detail central longitudinal section of a modified construction of boiler embodying my invention.

Figure —9— is an end elevation of the same partly in section on the line 9—9 of Figure —8—.

My said apparatus comprises a steam generator 1 adapted to be mounted upon the exhaust pipe 2 of an internal combustion engine 3 and adapted to be heated by the products of combustion passing from the exhaust end of the internal combustion engine to generate steam. The said steam generator consists of a suitable receptacle for water which is equipped with a blow-off or safety valve 4 normally maintained closed by a light spring, and is further equipped with an exhaust port 5 controlled by a check-valve 6 maintained normally closed by a spring 7 having greater resistance than the said spring controlling the safety valve 4. The said steam generator is further provided contiguous to its bottom with an inlet port for water connected by means of the pipe 8 with a float chamber 9 in which a given level of water is normally maintained by means of the float 10 controlling the valve 11 which controls the inlet port for water to said float chamber 9. The said float may be connected with the valve 11 in the same

manner as the floats of carbureters are connected with the inlet valves for maintaining given levels of hydro-carbon liquid in the float chambers of said carbureters. The lower end of said float chamber 9 is connected by means of the pipe 12 with the lower end of a tank 13 containing water or other suitable vapor fluid, the latter being disposed at an elevation below that of said float chamber 9, and in such position that water cannot possibly flow into the latter therefrom by gravity. The tank 13 is provided with a filling plug 14 having a vent therein for the admission of air.

The exhaust port 5 of the steam generator 1 is connected by means of a pipe 15 with the intake manifold 16 of the motor, the said pipe being preferably coiled around the exhaust manifold 2 of the motor so that steam or vapor passing through said pipe from the boiler 1 to the motor will be increased in temperature during passage to the latter. If the exhaust manifold 2 becomes very hot the said steam or vapor may obviously be superheated in passage.

Where the device is used in connection with a multicylinder motor a number of said pipes 15 may be used to connect the steam generator with the intake manifold at a plurality of points as particularly shown in Figure —2—.

It will be noted that there is no inlet for air to the tank 13 below the level of liquid therein or to the float chamber 9 or steam generator 1, this being one of the essential features of the invention as it enables the device to be used without requiring any readjustment of the air inlet valves to the intake manifold to allow for the air admitted through the steam or vapor-feeding means.

The apparatus as above described operates as follows:

Assuming that the motor is cold and is about to be started, then the usual cranking operation is performed to admit carbureted air which is rich in hydro-carbon vapor. As no air can be admitted through the parts comprising my apparatus the adjustment of the throttle valve, etc., is the same as usual. The steam generator 1 will not, of course, supply any vapor or steam until after the motor has been in operation a sufficient length of time to heat the steam generator and the water contained therein to the boiling point, but it will be observed that by reason of the connection with the pipe or pipes 15 with the intake manifold 16 a relatively constant vacuum will be maintained in the steam generator 1 depending, of course, upon the speed of the motor. Hence, as soon as the steam or vapor is generated in the steam generator 1 it will pass from the same into the exhaust port 5 and through the pipe or pipes 15 into the intake manifold where it will become admixed with the carbureted air, and will pass into the cylinders. As the exhaust manifold 2 becomes hotter the generation of steam will proceed at a more rapid rate, but the only effect of such generation will be to break the vacuum in the steam generator 1 so that a greater volume of steam will pass the check-valve 6. If the steam should be generated with such rapidity as to create a pressure in said generator 1 then the surplus of steam will pass out through the safety valve 4.

The maintenance of a partial vacuum in the steam generator will cause the generation of vapor therein to take place before the water is heated to two-hundred-twelve degrees Fahr., the exact degree of heat at which this occurs being obviously dependent upon the degree of partial vacuum maintained. Thus the time elapsing between the starting of the motor and the generation of vapor will be more or less short depending upon the speed of the motor from the time of starting the same, said speed determining the degree of vacuum and the volume of products of combustion discharged. Thus, if the motor is started and maintained running at high speed, the heating of the steam generator will proceed more rapidly and the degree of vacuum will be relatively great and more uniform than if the motor runs at low speed.

It is also desirable that the vapor be admitted to the intake manifold at high temperature and in the shape of dry steam as, in coming into contact with the much cooler charge of carbureted air it will be condensed to some extent but not to liquid form and will be carried into the cylinders as vapor more or less intimately mixed with the charge of carbureted air, the heat absorbed by the latter from the steam or vapor being advantageous to the combustion thereof and thereby increases the efficiency of the charge.

The float and valve in the float chamber 9 controlled thereby will maintain a substantially constant level of liquid in said float chamber, this being substantially the level of the axis of the pipe 8. The water will flow by gravity through the pipe 8 from the chamber 9 into the steam generator 1, but its level in the latter can at no time exceed its level in the former. The admission of water to the chamber 9 from the tank 13 is obviously dependent upon maintaining a vacuum in the steam generator 1 which would be communicated to the float chamber 9 and through the latter to the tank 13 so that as long as a vacuum is maintained in the generator 1 water will obviously be fed to the float chamber 9 and to said generator. As soon, however, as the generation of steam exceeds the consumption of the same so that a breaking of the vacuum in said steam generator results, then the supply of water to

the float chamber 9 will be discontinued, and as soon as the water in the steam generator is exhausted, the generation of steam will obviously cease and thereupon a vacuum will again be created in said generator which will cause a flow of water into the float chamber 9 and into said generator. As soon as such water comes in contact with the hot surfaces of the generator an immediate generation of steam will result which may again almost instantaneously break the vacuum so that the latter will act as the so-called "flash boiler" so long as the motor is maintained in operation after the water in the generator has once been completely exhausted. Should the motor stop, then of course, the admission of steam to the intake manifold thereof will cease immediately by reason of the fact that the check valve 6 offers greater resistance to opening than the safety valve 4 and, hence, though the generation of steam in the generator may continue until the latter and the intake manifold have cooled down the steam so generated will pass out of the safety valve 4 to the atmosphere without in any way affecting the motor. Thus the intake manifold will be maintained free of water from condensed steam in the intervals between operation of the motor.

It will be understood, of course, that while it is probable that no liquid other than water will be contained in the tank 13 a mixture of water and alcohol or other fluid may be used particularly in the winter months to prevent the water in the tank 15 and in the float chamber 9 and generator 1 from freezing and bursting said parts. Other fluids may be known or may be hereafter ascertained which could be substituted for water with better results and it is obvious that any such liquid may be used without departing from the spirit of the invention.

The generator 1 as shown particularly in Figure 3, is preferably divided into three compartments by means of partition walls 20 therein and each of said partition walls is provided with an opening which may be closed by means of a screw plug 21. The purpose of this is to enable the effective heating surface of the generator to be increased and diminished according to the number and size of the cylinders of the motor so as to proportion the steam supply to the requirements of the motor.

My invention is, of course, capable of modification within the skill of a mechanic without departing from the invention, example of such modifications being shown in Figures 6 to 9 inclusive. In the construction shown in Figure 1 it will be noted that the exhaust manifold 2 is provided with an opening through which the bottom of the boiler projects. The cutting of the manifold may be objectionable and obviously the same or substantially the same result may be obtained by connecting the generator 22 as shown in Figure 6, with a concave bottom to receive the upper portion of the exhaust manifold 2. The connection from the generator to the intake manifold of the motor through the pipe 15 is the same as in the construction shown in Figure 1.

In Figure 8 I have shown a generator 23 having flanged end plates through which the exhaust manifold 2 passes and which carry the circumferential wall 24, the annular water chamber being adapted to receive water in the lower end, the level of the latter being maintained at the level indicated by the dotted line 25. Any other form of boiler or steam generator suited to the purpose may obviously be substituted for any of the constructions hereinabove illustrated and described.

I claim as my invention:

1. In an internal combustion engine, a steam generator, and connection between the engine intake and said generator whereby the vacuum within the former during operation of the same is communicated to said generator for drawing steam or vapor only from the latter into said intake, said connection including means for preventing feed of fluid from said generator to said intake as the vacuum in the latter is broken by stoppage of the engine.

2. In an internal combustion engine, a steam generator, a plurality of outlets for steam or vapor only from said generator, one thereof connected with the engine intake for supplying steam or vapor only thereto, and valves controlling said outlets adapted to prevent the passage of fluid from said generator to the intake except when vacuum develops in the latter by operation of said engine.

3. In an internal combustion engine, a sealed container for water mounted upon a portion of the engine adapted to become heated during operation of the same to generate steam, a pipe connecting said container with the intake for causing generated steam to become admixed with the gaseous charges admitted to the cylinder, a relief valve for said container, a check-valve for said pipe, said valves maintained closed by springs, the check-valve offering greater resistance to opening than the relief valve.

4. In an internal combustion engine, a sealed container for water mounted upon a portion of the engine adapted to become heated during operation of the same to generate steam, a pipe connecting said container with the intake for causing generated steam to become admixed with the gaseous charges admitted to the cylinder, means for maintaining a substantially constant water-level in said container, a relief valve for said container, a check-valve for

said pipe, said valves maintained closed by springs, the check-valve offering greater resistance to opening than the relief valve.

5. In an internal combustion engine, a sealed container for water mounted upon a portion of the engine adapted to become heated during operation of the same to generate steam, a pipe connecting said container with the intake for causing generated steam to become admixed with the gaseous charges admitted to the cylinder, a sealed water feed chamber having connection with said container, a source of supply of water at a lower level than the chamber, connected to the chamber and from which water may be drawn into the chamber only when sufficient vacuum exists therein.

6. In an internal combustion engine, a sealed container for water mounted upon a portion of the engine adapted to become heated during operation of the same to generate steam, a pipe connecting said container with the intake for causing generated steam to become admixed with the gaseous charges admitted to the cylinder, a sealed water feed chamber having connection with said container, connection between said chamber and a source of supply of water, the latter disposed at a lower level than said chamber and feeding to the said chamber only when a partial vacuum is produced therein and means establishing communication between said chamber and said container above and below the normal water level in the former for maintaining the same water level in the latter.

7. In an internal combustion engine, a sealed container for water mounted upon a portion of the engine adapted to become heated during operation of the same to generate steam, a pipe connecting said container with the intake for causing generated steam to become admixed with the gaseous charges admitted to the cylinder, a sealed water feed chamber having connection with said container, connection between said chamber and a source of supply of water, the latter disposed at a lower level than said chamber and feeding to the said chamber only when a partial vacuum is produced therein, a float actuated valve in said chamber controlling a substantially constant water level in said chamber, and means establishing communication between said chamber and said container above and below the normal water level in the former for maintaining the same water level in the latter.

8. In an internal combustion engine, a sealed steam generator disposed to be heated by the hot products of combustion of said engine, check-valve controlled connection between said generator and the engine intake for maintaining a partial vacuum in the former while the engine is running to cause the generated steam or vapor to be drawn into said intake and a relief valve for said generator adapted to permit the discharge of steam at a pressure below that required to open said check-valve whereby the discharge of steam under pressure into the engine intake during inertia of the engine is prevented.

9. In an internal combustion engine, a steam generator, a valve-controlled port therefor leading to the atmosphere, connection between said generator and the engine intake, and a fluid-pressure-actuated valve interposed in said connection, said first-named valve adapted to permit the creation of a partial vacuum in said generator, and said fluid-pressure-actuated valve adapted to offer resistance to the passage of steam to the intake and coacting with the first-named valve to prevent steam under pressure forcing its way into said intake.

10. The combination with an internal combustion engine, of a steam chamber, means for generating steam for said chamber, a relief valve for the chamber, a connection between said chamber and the intake manifold of the engine, and a check valve in said connection opening toward the intake manifold and held closed against relief-valve opening pressure, said check valve opening under such relief valve opening pressure combined with the engine suction.

11. The combination with an internal combustion engine, of a water tank, a steam chamber, a connection leading from the water tank to the steam chamber and heated by the exhaust gases from the engine, a connection leading from the steam chamber to the intake manifold, a check valve in said connection between the steam chamber and manifold, and a relief valve in the steam chamber and adapted to be opened by a less pressure than that necessary to open the check valve.

In testimony whereof I have signed my name in presence of two subscribing witnesses.

IRVING COWLES.

Witnesses:
R. W. Lotz,
M. M. Boyle.