To all whom it may concern:

Be it known that FRANÇOIS ROCHEFORT, citizen of the French Republic, residing 81 Rue Blomet, Paris, France, has invented a certain new and useful Improvement in Fuel Atomizers and Vaporizers, of which the following is a specification.

My invention relates to liquid fuel atomizers and vaporizers. In the apparatus according to my invention, the liquid fuel is subjected to several successive actions, viz:

1. Forced feeding under high pressure and mingling of the fuel at a predetermined temperature.

2. Atomization.

3. Vaporization and diffusion under the mechanical action of a compressed and expanded gas suited to the nature of the liquid to be vaporized.

4. Ignition, when applied to combustion apparatus.

The accompanying drawing, for purposes of illustration, shows an embodiment of my apparatus in combination with an igniting device, intended for supplying liquid fuel directly to an internal combustion engine.

The apparatus comprises a cylinder 1 containing a movable piston-valve 2. This piston-valve 2 is hollow in order to have a very low inertia and terminates at one end in a valve 3 the movement of which, in direct relation to the movement of the piston valve, is limited by an abutment.

The fuel to be vaporized is forced under high pressure into the cylinder 1, through the port 4.

The compressed gas used to effect the vaporization is introduced at 5 and, together with the spring 6, causes the return of the piston-valve 2 and the closing of the valve 3.

A port 7 normally closed by the piston-valve 2 is connected to a pipe 8 leading the fuel to the injector 9 where it enters grooves 10 of increasing cross-section, straight or helicoidal according to the applications, and which are provided in the periphery of, and extend lengthwise along, a mass of non-oxidizable metal, constituting the heater 11 located within the injector body 9 which is at its end provided with a multiple-jet nozzle 12. Its main jet aperture 15 forms an extension of the central feed channel 13. Fine grooves are provided in the injector body 9 so as to constitute a series of secondary jets, gauged and fed by means of obliquely extending conduits opening out into an annular groove which forms a communication between all the grooves 14.

A casing 16 enclosing the injector-body 9 forms around same an annular chamber 17 of increasing cross-section.

A check valve 18 establishes at the required moment a communication between the chamber 17 and the supply of compressed gas at 5. A small automatic ball-valve 19 allows communication with the atmosphere at the required moment through the port 20.

The casing 16 ends in a series of discharge openings 21 constituted by the nozzle 12, the casing itself, and the body of the igniting device 22 opening out into the cylinder 30 of the engine.

The feeding of the first discharge opening occurs through the helicoidal recesses 23 provided in the body of the nozzle 12, and that of the second discharge opening occurs through the annular chamber 24 formed by bores in the wall of the casing 16 and opening out into the chamber 17. In some cases, a hollow heat-conducting metal sphere 25 brought to the temperature of ignition of the fuel before starting, forms a temperature regulator for the casing 16 and the injector 9.

The inside of this sphere 25, which is in contact with the gases during their combustion, may carry blades or wings 26 to increase the radiation surface; its purpose is to regulate the temperature of the above-mentioned elements. The part 22 which is a bad conductor, effects the ignition. Apertures 27 are provided to secure the formation of a carburetted zone in front of the igniting device.

Conduits 28 provided in the casing 16 allow communication between the chamber 17 and the inside of the sphere 25. A coiled spring 29 constitutes a compensator for the expansion of the heater 11, which is able to move within the body 16 of the injector.

The element 11 is heated by conduction, being in contact through its longitudinal projections forming the grooves 10 with the injector 9, which in turn is in contact with the casing 16. The latter receives its heat from the metal sphere 25.

The operation of the apparatus is as follows:

The liquid fuel, fed under high pressure by means of a pump, enters through the
port 4. Being non-compressible, it pushes
before it the piston valve 2 which controls
the opening of the air admission valve 3 and
uncovers the port 7 through which the liq-
uid fuel, by way of the pipe 8, reaches the
expansion grooves 10 around the heater 11,
whereby the temperature of the fuel is
raised. The fuel is thoroughly mingled and
expelled through the conical jet apertures 14
and 15, of small cross-section, so as to al-
low the expansion of the fuel which, owing
to its gyratory motion, and its fluidity,
leaves the jet apertures completely atomized.

At the moment when the fuel is introduced
under pressure and the valve 3 is opened
thereby, compressed air under high pressure
enters through the port 5 and opening check
valve 18 flows into the annular chamber 17
increasing section. The air is heated by
the walls of the casing 16 and while pass-
ning, carries away with it the atomized liq-
uid escaping from the inclined jet apertures
14 around the channel 13.

This compressed air passes through the
helicoidal grooves 23 provided in the body
of the nozzle 12 carrying away with it the
atomized fuel escaping through the central
jet aperture 15 and, a jet of compressed air also
coming from the annular chamber 24. The
resulting vaporized mixture, escaping at 21,
at high velocity, causes a suction, through
the apertures 27, of compressed air into the
ingine cylinder, thus facilitating the dis-
fusion of the mixture in the mass. Con-
sequently, the ignition is more rapid, being
made easier by the creation of the agitation
and the whirlwind-like currents around the
igniting device 22.

During the feeding of the fuel, a certain
quantity of air passes through the conduits
28 in order to renew the supply of gases
within the sphere 25, which constitutes a
temperature-regulating device, in that this
sphere being heated by the gases of combus-
tion yields a certain amount of its heat to
the feeding device.

As the injection is completed, the hydra-
umatic pressure ceases and the compressed air
exerting a strong pressure on the upper por-
tion of the valve 3 closes the same at the
same time returning the piston-valve 2 to
its initial position. The port 7 is now again
closed until the next injection. During the
closing movement of the piston-valve 2 the
compressed air still penetrates into the an-
nular chamber 17 and by its expansion com-
pletely carries away all the fuel in order to
avoid the formation of a carbonaceous
clogging at the end of the injector. The
automatic ball-valve 19 allows the admission
of pure air to expel the burnt gases con-
tained in the chamber 17 when the driving
piston is at the admission stage. The cir-
culation and the expansion of the cold air
through the annular chamber 17 make it
possible to control the temperature of the injector-body 9, the expanded air absorbing
doing off a certain quantity of heat in order to
avoid the condensation of the fuel during
vaporization.

The drawing illustrates one embodiment
of my invention, but it is quite obvious that
the arrangement of the elements composing
the pulverizer may vary without the mode
of operation being changed.

The device also may have other uses than
that indicated.

I claim as my invention:
1. A liquid fuel atomizer and vaporizer
comprising a central heating body, an in-
jector casing enclosing said heating body
and being spaced therefrom, an injector
nozzle at the end of the said casing, an
outer casing surrounding the said injector
casing and forming therewith an annular
chamber, a cylinder in communication with
the said injector casing, a piston valve mov-
able in the said cylinder and adapted to be
operated by the pressure of the liquid fuel
to admit the same to the said injector cas-
ing, and an air-inlet valve moving with the
said piston-valve, so as to admit propor-
tionally to the amount of fuel injected into
the said injector casing compressed air into
the said annular chamber, the compressed air
forming a mixture with the heated atomized
fuel in the said injector nozzle and carrying
the fuel along with it.
2. The combination as set forth in claim
1, comprising also a spring-controlled check
valve interposed between the said air-inlet
valve and the said annular chamber.
3. The combination of the fuel atomizer
and vaporizer as set forth in claim 1 with
an internal combustion engine, the said com-
bination comprising also a hollow spherical
body arranged around the said outer casing
in communication with the engine cylinder,
so as to be heated by the hot combustion
gases.
4. The combination of the fuel atomizer
and vaporizer as set forth in claim 1 with
an internal combustion engine, the said com-
bination comprising also a hollow spherical
body arranged around the said outer casing
in communication with the engine cylinder,
so as to be heated by the hot combustion
gases, and heat absorbing and conduct-
 ing blades provided in said hollow spherical
body.
5. A combined liquid fuel atomizer and
vaporizer comprising a central heating body
for the fuel containing grooves so as to im-
port a gyrating motion to the fuel, an in-
jector casing enclosing the said heating body
being spaced therefrom, an injector nozzle
at the end of said casing and having axial
and radial apertures, an outer casing sur-
rounding the said injector casing forming
therewith an annular chamber, a cylinder in

communication with said injector casing, a piston-valve movable in said cylinder and adapted to be operated by the pressure of the liquid fuel, thereby admitting the same to the said injector casing, an air-inlet valve moving with the said piston valve so as to admit compressed air to the said annular chamber in proportion to the amount of fuel injected into the said injector casing, the compressed air forming a mixture with the heated atomized fuel in the said injector nozzle, and a spring-controlled check valve interposed between the said air-inlet valve and the said annular chamber.

6. The combination as set forth in claim 1, comprising also an automatic ball-valve so arranged as to periodically admit pure air to the said annular chamber.

In testimony whereof I affix my signature.

FRANÇOIS ROCHEFORT.