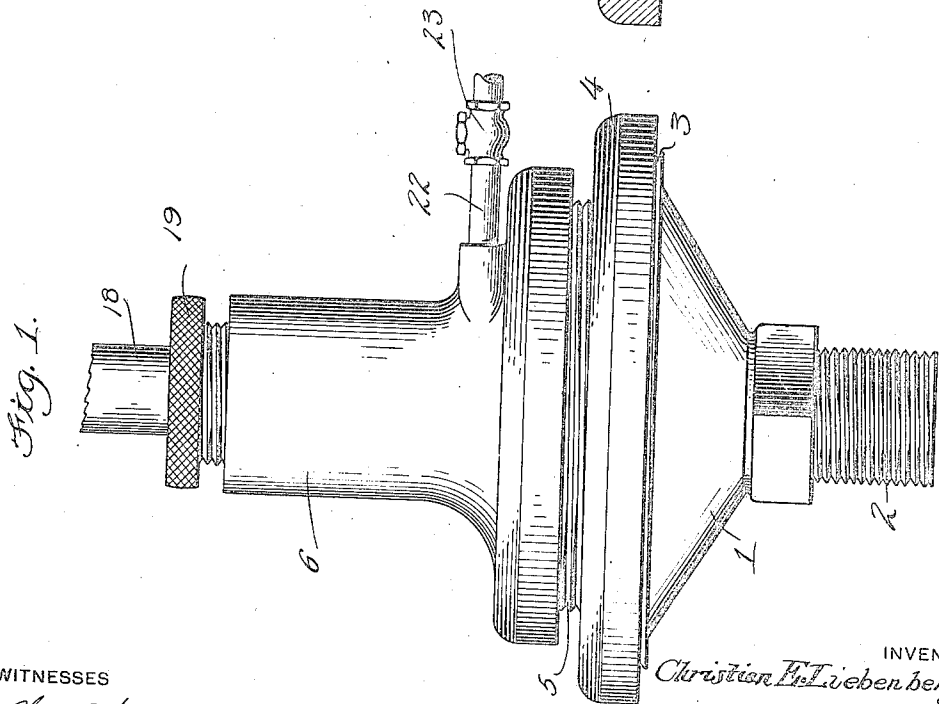
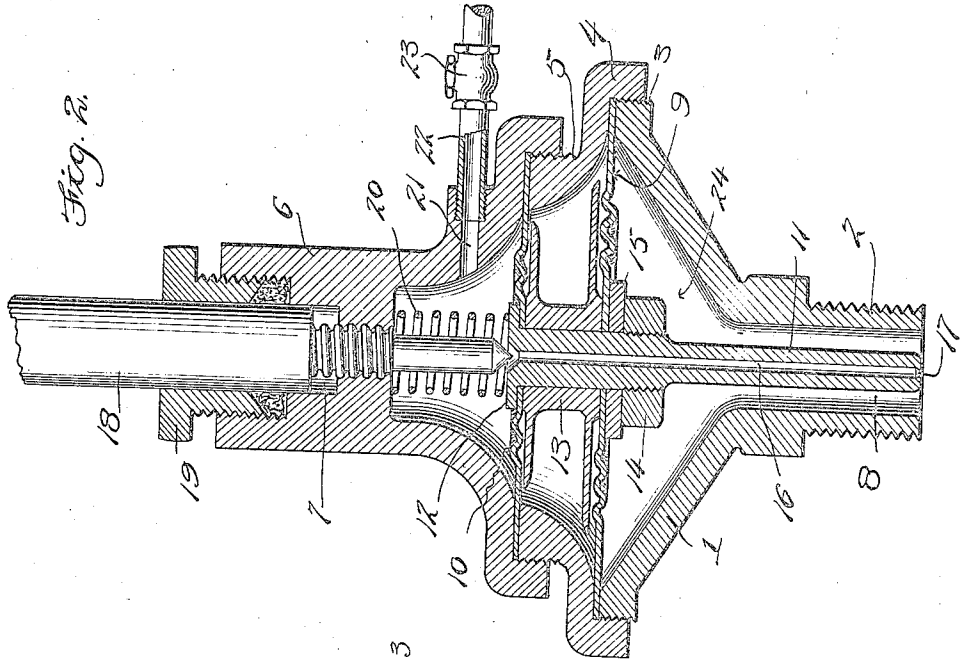


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 AUTOMATIC LIQUID INJECTOR FOR INTERNAL COMBUSTION ENGINES.
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WITNESSES

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AUTOMATIC LIQUID-INJECTOR FOR INTERNAL-COMBUSTION ENGINES.

1,301,463.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CHRISTIAN E. LIEBENBERG, a citizen of the Union of South Africa, residing at Erith, in the county of Kent, England, have invented certain new and useful Improvements in Automatic Liquid-Injectors for Internal-Combustion Engines, of which the following is a specification.

This invention relates to an improvement in automatic liquid injectors and more particularly to a device of this character intended for use upon internal combustion engines of the stationary type, upon engines installed as power plants on automobiles or other vehicular machines, or in other like connections, where it is desired to humidify the explosive charge as the same is contained within the explosion chamber.

An object of my invention is to provide mechanism which may be applied to a motor of the type described by being placed to communicate with a combustion chamber or directly with the main explosion chamber, and which is constructed to receive operating impulse from the explosive pressure, following ignition of the explosive charge, to automatically inject a charge of liquid (water for preference) in spray form into the flaming charge, to thus attain a higher efficiency by converting as much internal heat to propulsive energy as is possible, at the same time cushioning the working parts through the effect of the steam present in the charge.

A further object resides in so constructing the parts that a diaphragm is provided to be distended through impulse directed thereagainst by the firing of the explosive charge and the liquid is thus introduced substantially at the moment of commencement of the combustion of the explosive charge, and in providing means by which the quantity of liquid as injected into the flaming charge is automatically governed and can be manually regulated and varied.

Other objects will in part be described and in part understood from the specification and claims, and from the drawings, in which:—

Figure 1 is a view showing the device of my invention in elevation; and

Fig. 2 is a vertical sectional view through the device showing the parts in their normal position.

A base casing member 1 is made substantially funnel-shaped and around the end of

the tube like formation thereof has a reduced portion which is screw threaded as shown at 2, to thus permit the fitting of this base casing member to have communication with the combustion chamber of an engine or directly to the explosion chamber of the cylinder. At its flared edge, this base casing member 1 is externally screw threaded as shown at 3, and an intermediate casing member 4 is shaped to be fitted and tightened upon the screw threaded upper portion of the member 1. This intermediate casing member 4 is made constricted or drawn in at its upper extremity and is provided with the external screw threads at 5. An upper casing section 6 has a stem receiving bore 7, formed through the upper part thereof, and its lower portion is flared and internally screw threaded to be fitted and secured upon the externally threaded portion of the intermediate casing or body member 4. By fitting the casing members 1, 4, and 6 in the relation as set forth, the passage 8 of the member 1 is substantially in alinement with the stem receiving bore 7 of the member 6, and a chamber is provided within the several members.

The members 1, 4 and 6, may be finished up from castings or any suitable metal or alloy, might be die-cast, or might be perhaps constructed in some other way, and when assembled will form the casing. Certain operative parts are to be fitted and mounted within the casing and are to be held in place, in part, by the tightening of the various casing members. A diaphragm 9, which will be hereinafter referred to as the larger diaphragm is made of such size that it will fit upon the upper edge or flared portion of the lower casing member 1, and will be rigidly secured and clamped around its edge between the members 1 and 4, by the tightening of the member 4 upon the screw threads 3 of the member 1, and a diaphragm 10 to be later referred to and designated as the smaller diaphragm is made of such size that it may be fitted to be clamped and held between the intermediate and the upper casing members 4 and 6. The two diaphragms 9 and 10 will in this way be spaced by the intermediate casing member 4, and as any distention of the diaphragm must occur in the middle portion of the diaphragm, due to the fact that the entire peripheral edge is clamped rigidly in place, it is perhaps preferable that each of

the diaphragms be provided with corrugations concentrically arranged around the center. Thus it will be seen that the chamber within the casing 1 is divided into three compartments, being an upper or inlet compartment above the upper diaphragm 10, an air compartment between the two diaphragms, and a pressure compartment below the lowermost diaphragm 9, called pressure compartment because it is in communication with the pressure in the engine cylinder. Bores or openings are provided through the centers of the diaphragms 9 and 10 for a tube 11, a head 12 being provided on the upper end to support the tube from the smaller diaphragm 10. A spool-shaped distance or separating piece 13 has a central bore of such size that the tube will fit with reasonable snugness therethrough and the tube is provided with external screw threads throughout a part of the body thereof so that as the spool is fitted between the larger and smaller diaphragms and the tube is passed through the openings of the diaphragms and through the central bore of the spool, a nut 14 may be fitted and tightened upon the tube to draw the diaphragm tightly against the spool, it being preferable that a washer 15 be fitted over the tube to bear against the diaphragm 9 previous to setting up the clamp nut 14. The bore 16 of said tube is constricted at the lower extremity of the tube to form or provide a nozzle or spray opening 17, the upper or head end of the tube being provided with a counter sink communicating with the central bore, and a valve seat 16' being thus formed. When the parts are connected in the manner as set forth with the clamp nut 14 tightened, and the diaphragms 9 and 10 are clamped in place between the intermediate and top and bottom casings, the structure will be mounted substantially as a unit and the only movement of the parts will be through the distortion of the diaphragms.

A portion of the stem receiving bore 7 of the upper casing member 6 is provided with internal screw threads formed to a rough pitch, and a control stem or spindle 18 is provided with a screw threaded portion to be received in the internally screw threaded length of the stem receiving bore so that upon turning of the control stem or spindle, the same will be forced into or withdrawn from the central recess of the casing. The inner end of the stem or spindle 18 terminates in a needle valve point 18' pitched to fit the valve seat 16' and thus it will be seen that turning of the stem or spindle 18 will vary the proximity of this needle valve end of the stem to the valve seat of the tube 11, and that upward distention of the diaphragms will cause the valve seat to close upon the needle valve point. Any form of handle or adjusting means can be

provided on the stem or spindle 18, and to provide against the leakage of liquid back around the stem, a packing nut 19 is provided to be turned into an internally screw threaded enlargement at the outer end of the stem receiving bore 7. A coiled spring is mounted around the inner end of the stem or spindle 18 to bear between the head 12, and the structure of the casing member 6 around the stem receiving bore 7, and this coil spring 20 thus holds the structure carried by the diaphragms 9 and 10 normally resiliently pressed downwardly to such a point that distention of the diaphragms to bring the valve seat against the needle valve point will not take place under ordinary pressure.

A liquid inlet passage 21 is provided through the wall of the casing member 6 to establish communication to the chamber provided within this casing member, a pipe or tube 22 for the supply of liquid being connected with this passage, and a check or non-return valve 23 being mounted to permit supply of water to the chamber and to check the passage against the back flow of the water. The liquid supply pipe 22 is connected with a tank or reservoir adapted to contain water or other liquid which is to be injected into the engine, and the reservoir or tank is preferably so placed that the chamber within the casing member 6 will be kept filled with the liquid.

While the spool 13 is provided with flanges extending laterally to bear against the diaphragms, due to the fact that the coil spring 20 at all times exerts yielding pressure against the structure supported by the diaphragm, it is preferable that some form of stops such as indicated at 24 be provided to positively stop and limit movement of the diaphragm supported parts under the pressure of the spring and as the liquid is to be discharged through the spray nozzle 17 only upon the exertion of explosive pressure against the diaphragm 9, it may under some circumstances be found desirable or necessary to provide a spring held valve within the bore 16 of the tube 11 to overcome the force exerted by the suction stroke of the piston which might otherwise draw liquid from the chamber within the casing member 6 through this bore 16 and into the cylinder of the engine.

As has been stated, the screw threaded lower end of the casing member 1 will be screwed into a suitable orifice of the engine to thus communicate with the combustion chamber, and the expanding gases will upon ignition of the explosive charge blow back through the passage 8 and thus exert pressure on the diaphragm 9, which will be sufficient to overcome any pressure upon the smaller diaphragm 10 and also the bearing pressure of the spring 20, and thus the water

or other liquid will be introduced into the flaming charge after ignition has already occurred, in this way converting the highest percentage of internal heat to propulsive energy. It will be seen that the adjustment of the stem or spindle 18 will make it possible to regulate and vary the quantity of liquid injected into the burning explosive charge, and that the water or liquid will be introduced through the spray nozzle even though the charge within the explosive chamber is in a state of increasing expansion due to the relatively large area of the diaphragm 9 in comparison with the opening of the spray nozzle.

From the foregoing it will be seen that I have provided a liquid injector which is automatically operated by impulses received from the ignition of the explosive charge, and that liquid is introduced into the flaming charge in such a manner that steam is generated to humidify the burning gases and to act against production of carbon; and, that by introduction of the water or other liquid heat which would otherwise be absorbed by the engine structure is used to convert the liquid into vapor or steam, while at the same time the parts of the engine structure are kept at a lower temperature and are cooled in such a way that in some engine structures the result may be ultimate abolition of provision for a water cooling system.

While I have shown and described only one form of the device and have set forth only one manner of mounting the structure in conjunction with an engine and of using the same, it will of course be understood that a number of changes and variations might be resorted to in the form and arrangement of parts to adapt the structure for application to various types and styles of engines; that variations might be made in the manner of mounting the device and connecting the same with the source of liquid supply, and that a number of other changes might be resorted to without departing from the spirit and scope of my invention, in view of which fact I do not desire to be limited to the exact disclosure but only to such points as may be set forth in the claims, and the equivalent of the parts therein defined.

I claim:—

1. In an injector of the class described, the combination with a casing, two spaced diaphragms therein dividing its interior into inlet, air, and pressure compartments respectively, the last named compartment being adapted for connection with an engine cylinder and the first-named compartment being connected with a source of liquid supply, of a spacer between the diaphragms, an upright tube through both diaphragms and the spacer and having a nozzle at its lower

end, and a valve seat at its upper end, and a valve adapted to co-act with said seat.

2. In an injector of the class described, the combination with a casing, two spaced diaphragms therein dividing its interior into inlet, air, and pressure compartments respectively, the last-named compartment being adapted for connection with an engine cylinder and the first-named compartment being connected with a source of liquid supply; of a tube fixed through the centers of both diaphragms and having a nozzle at its lower end standing within the outlet from said pressure compartment, yielding means for depressing said tube, and means for closing the inlet, to the tube when said yielding means is overcome.

3. In an injector of the class described, the combination with a casing, two spaced diaphragms therein dividing its interior into inlet, air and pressure compartments respectively, the last-named compartment being adapted for connection with an engine cylinder and the first named compartment being connected with a source of liquid supply; of a tube fixed through the centers of both diaphragms and having a nozzle at its lower end standing within the outlet from said pressure compartment, and a valve seat at its upper end, a valve point carried within the casing in position to co-act with said valve seat when the tube is raised, and an expansive spring surrounding the point and bearing on the upper end of the tube, for the purpose set forth.

4. In an injector of the class described, the combination with a casing, two spaced diaphragms therein dividing its interior into inlet, air, and pressure compartments respectively, the last named compartment being adapted for connection with an engine cylinder and the first-named compartment being connected with a source of supply; of a tube fixed through both diaphragms and having a nozzle at its lower end standing within the outlet from said pressure compartment, and a valve at its upper end, a manually adjustable stem through the upper end of the casing, a needle valve point carried by its lower end within the inlet compartment and in position to co-act with said valve seat when the seat is raised, and yielding means normally depressing said tube so as to open the valve, for the purpose set forth.

5. In an injector of the class described, the combination with a casing whose lower end is adapted to be connected with an engine cylinder, a diaphragm across the interior of the casing producing an inlet compartment above such diaphragm, and means for supplying liquid to this compartment; of an upright tube mounted through said diaphragm and having a nozzle at its lower end and a valve seat at its upper end, a manually

adjustable stem through the upper end of the casing, a valve point at its lower end adapted to co-act with said seat when the seat rises and close the valve, and yielding means within the upper portion of the casing for depressing the tube and normally opening said valve, for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

CHRISTIAN E. LIEBENBERG.

Witnesses:

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ALICE L. FITZ-GERALD.