

[54] **COLD STARTING INSTALLATION FOR INTERNAL COMBUSTION ENGINES**

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[75] Inventors: **Ferdinand Anton Ernst Porsche**,  
 Stuttgart-Nord; **Robert Binder**,  
 Schwieberdingen; **Ernst Rudolf  
 Weyersberg**, Stuttgart-Bad  
 Cannstatt, all of Germany

*Primary Examiner*—Al Lawrence Smith  
*Attorney, Agent, or Firm*—Craig and Antonelli

[73] Assignee: **Dr. -Ing. h.c.F. Porsche KG**,  
 Stuttgart-Zuffenhausen, Germany

[57] **ABSTRACT**

[22] Filed: **Mar. 15, 1972**

[21] Appl. No.: **234,712**

A cold-starting installation for internal combustion engines, especially for multi-cylinder internal combustion engines of motor vehicles, which includes individual injection lines connected with the fuel line and an electrically controlled cold-starting valve for the control of the fuel injection quantity; a predetermined fuel quantity is injected during the starting of the internal combustion engine by way of the injection lines into the suction pipes of the internal combustion engine whereby a stopped bore is provided laterally of each suction pipe of the internal combustion engine for receiving the injection line, into which is inserted the discharge end of the injection line which is provided with an injection nozzle; the discharge ends are held in place in the stepped bore, for example, by spring clamps.

[30] **Foreign Application Priority Data**

Mar. 23, 1971 Germany ..... 2114051

[52] **U.S. Cl.** 123/179 G, 123/119 R, 123/139 AW,  
 123/180 R, 123/187.5 R

[51] **Int. Cl.** ..... F02m 39/00, F02n 17/00

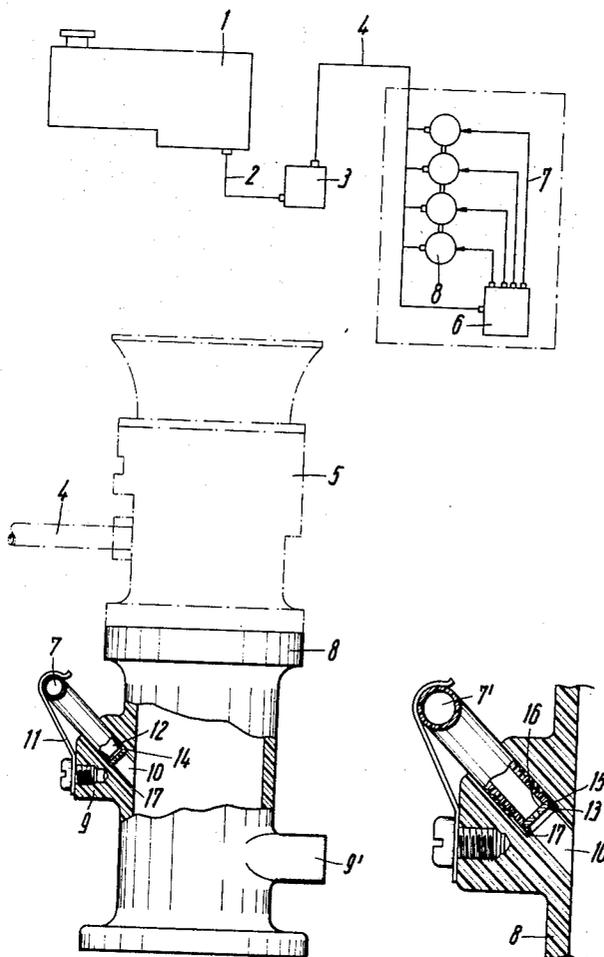
[58] **Field of Search** ..... 123/179 G, 187.5, 139 AW,  
 123/180 AC, 180 P, 119

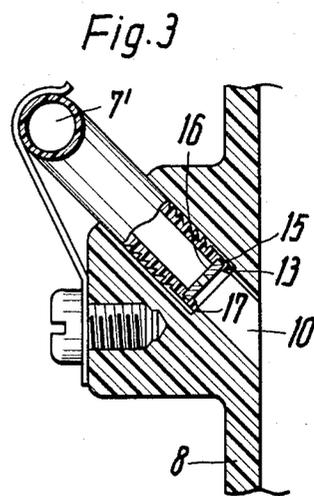
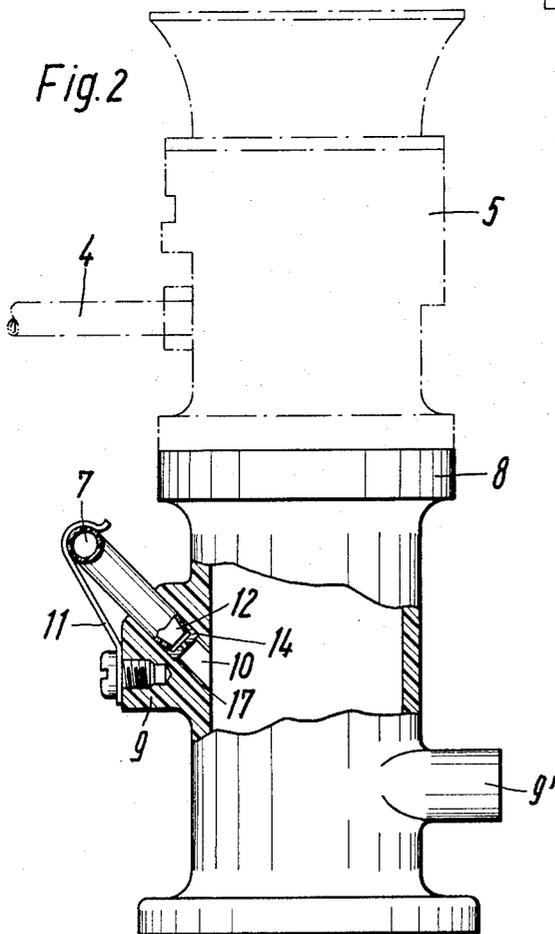
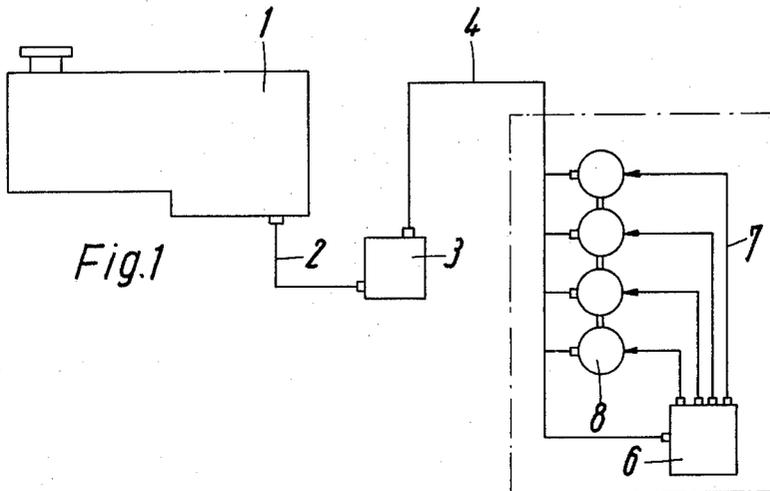
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**12 Claims, 3 Drawing Figures**





## COLD STARTING INSTALLATION FOR INTERNAL COMBUSTION ENGINES

The present invention relates to a cold starting installation for internal combustion engines, especially for multi-cylinder internal combustion engines of motor vehicles, which consist of individual injection lines connected with the fuel line and of an electrically controlled cold-start valve for the control of the fuel injection quantity, by means of which during the starting of the internal combustion engine a predetermined fuel quantity is injected by way of the injection lines into the suction pipes of the internal combustion engine.

The aim of the present invention is the arrangement and fastening of the injection lines of a cold-starting installation for internal combustion engines of motor vehicles.

It is known for facilitating the starting of internal combustion engines of motor vehicles to equip the same with a cold-starter installation which effects during the starting operation an additional fuel enrichment of the fuel-air mixture. This takes place for the most part through a starter valve arranged in the carburetor of the internal combustion engine which is closed automatically or manually during the starting operation whereby the air supply into the combustion space is throttled and the fuel supply is increased. With multi-cylinder internal combustion engines which possess more than two carburetors, this arrangement is possible only with high structural expenditures since the control of the starter valves requires a costly carburetor- and actuating-linkage construction. Furthermore, in multi-cylinder internal combustion engines there exists the danger of an excessive fuel enrichment by an excessively long closure of the starter valves whereby the mixture loses the ignitibility and the internal combustion engine does not start. In order to avoid these disadvantages, a construction is known in which an injection line is shifted to the air filter housing which includes individual nozzle-like apertures coordinated to the respective suction funnels (Porsche-Reparaturleitfaden I/1970, Page 0. 1-2/1 and 0. 1-4/1). In this installation fuel is removed from the other fuel line and is conducted by way of a cold-starting valve to the injection lines arranged in the air filter. Depending on the temperature of the internal combustion engine, more or less fuel is injected into the suction funnels of the internal combustion engine by the cold-starting valve during the starting operation. The arrangement of the injection lines in the air filter of the internal combustion engine, however, entails the disadvantage that after the terminated injection operation, the residual fuel quantity present in the injection lines drips through the nozzle-like openings thereof into the filter housing and evaporates thereat. That fuel vapor quantity, which, for example, after a short drive is not sucked-in by the internal combustion engine, thereby evaporates in the engine space whereby in addition to a strong air contamination and of a foul fuel odor, also a great incendiary danger exists.

The present invention in contradistinction thereto, is concerned with the task to provide a cold-starter installation of the aforementioned type which excels by a simple and safe arrangement of the injection lines and by low manufacturing costs and which assures a safe operation preventing an air contamination and danger of fire.

The underlying problem is solved according to the present invention in that for receiving and mounting the injection lines, a stepped bore formed by differently large diameters is arranged laterally at the suction pipe of the internal combustion engine into which the discharge ends of the injection lines provided with nozzles are inserted and are held in position therein. It is of particular advantage that the discharge ends of the injection lines are constructed conically and extend into the interior space of a nozzle which is constructed pot-shaped. Advantageously the nozzle is held in position by the discharge end of the injection line. In a further embodiment of the present invention, the discharge ends of the injection lines are constructed cylindrically and are provided with a radial recess into which is inserted a disk-shaped nozzle adapted to snap into the recess. It is of particular advantage that the disk-shaped nozzle is held in position by the clamping force of the material of the injection lines. Advantageously the injection lines consisting of conventional synthetic plastic material, such as synthetic resinous materials, are retained in the stepped bores of the suction pipe also consisting of similar or different synthetic plastic material of any known type of spring clamps whereby the suction pipes includes cast-on or molded-on bosses for the fastening of the actuating linkage for the carburetors of the internal combustion engines. Appropriately, spring clamps are arranged laterally at the suction pipe within the area of the stepped bore and abut with their free end against the injection line coordinated to the suction pipe. Advantageously, the nozzles consist selectively of sheet metal or of synthetic resinous material of the class of polyamides or polyfluoro-olefines.

The advantages achieved with the present invention consist in particular in that by the described arrangement of the injection lines consisting of synthetic resinous material a secure fastening and simple manufacture of the injection lines is made possible by simple means for the cold-starting installation for multi-cylinder internal combustion engines, in which in case of eventually occurring troubles a rapid disassembly and assembly is made possible. Furthermore, as a result of the fastening of the injection lines at the suction pipes consisting of synthetic resinous material the residual fuel quantity remaining in the injection lines after the injection, is sucked off with certainty into the combustion space of the internal combustion engine so that the described disadvantages such as odor annoyance, fire danger, etc. are far-reachingly avoided. By the selective construction of the nozzles and of the discharge ends of the injection lines, the same can be manufactured with savings in costs and small expenditures whereby the assembly and mounting thereof in the stepped bore of the suction pipe as well as in the discharge end can be carried out in a time-saving and simple manner. One achieves by the construction of the suction pipe of plastic material an extraordinarily smooth surface of the inner walls, a very favorable weight and a cost-saving manufacture thereof. Moreover the suction pipe can be manufactured together with all fastening and support means for actuating linkage whereby the stepped bore can be cast-in or molded-in at the time of the manufacture so that separate after-finishing operations of the suction pipe are dispensed with.

These and other objects, features and advantages of the present invention will become more apparent from

the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, two embodiments in accordance with the present invention, and wherein:

FIG. 1 is a schematic view of a cold-starter installation for a multi-cylinder internal combustion engine in accordance with the present invention,

FIG. 2 is a partial longitudinal cross-sectional view through one of the suction pipes of the internal combustion engine according to FIG. 1 with the fastening of a pot-shaped nozzle by means of the injection line in accordance with the present invention, and

FIG. 3 is a partial longitudinal cross-sectional view through the walls of the suction pipe within the area of the stepped bore according to FIG. 2 with a modified fastening of a disk-shaped nozzle by the injection line in accordance with the present invention.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, the fuel system of a multi-cylinder internal combustion engine, not illustrated further in detail, consists of the fuel tank 1 which is connected by way of a line 2 with a fuel pump 3. From the fuel pump 3 a further fuel line 4 leads to the individual carburetors 5 of the internal combustion engine. The fuel line 4 further terminates in a cold-starting valve 6 from which injection lines 7 (FIGS. 1 and 2) or 7' (FIG. 3) lead to the individual suction pipes 8 which are arranged between the carburetors and the cylinder heads (not shown) of the internal combustion engine. Bosses 9, 9' are laterally cast-on or molded-on at the suction pipes 8. The boss 9 serves for the accommodation of a stepped bore 10 extending obliquely to the direction of flow of the gas mixture and the boss 9' for the fastening of an actuating linkage (not shown) for the throttle valves of the carburetors 5. An injection line 7 or 7' is inserted into the stepped bore 10 of the suction pipe 8 and is held in its position by a spring clamp 11 secured at the boss 9. All the other injection lines 7, 7' are arranged in the same manner and secured in the manner to be described more fully hereinafter. The discharge ends 12 (FIG. 2) or 13 (FIG. 3) of the injection lines 7 or 7' consisting of synthetic resinous material of any known type may be constructed differently. Thus, in one embodiment according to FIG. 2, the discharge end 12 is constructed conically at its outer diameter and serves for receiving a pot-shaped nozzle 14. In the embodiment according to FIG. 3, the discharge end 13 is constructed cylindrically and includes a radial recess 15 into which is inserted a disk-shaped nozzle 16. The nozzles 14 or 16 are constructed as formed or shaped parts of brass whereby the nozzle 14 abuts on the shoulder 17 formed by the stepped bore 10 and is held there against by the discharge end 12 of the injection line 7. In the embodiment according to FIG. 3, the discharge end 13 rests on the shoulder 17 of the stepped bore 10.

During the starting of the internal combustion engine, the cold-starter valve 6, known as such, opens the supply of the fuel from the fuel line 4 into the injection lines 7 or 7' over a certain period of time depending on the temperature of the internal combustion engine. The fuel supplied by the pump 3, reaches by way of the nozzles 14 or 16 the interior space of the suction pipe 8 whereby the internal combustion engine is fed additionally with fuel during the starting operation. The starting operation is facilitated thereby. After the start-

ing operation, the cold starting valve 6 closes the feed line to the injection lines 7 or 7' whereby simultaneously the residual fuel quantity, which remains in the injection lines 7 or 7' is drawn off by the suction stroke of the internal combustion engine. In case of a disassembly of the injection lines 7 or 7' which may become necessary, the latter can be disassembled and re-assembled without auxiliary tools in that only the spring clamps 11 have to be lifted off from the abutment at the injection lines 7 or 7' whereby the injection lines 7 or 7' together with the nozzles 14 or 16 can be removed from the stepped bore 10 of the suction pipe 8.

While we have shown and described only two embodiments in accordance with the present invention, it is understood that the invention is not limited to the illustrated embodiments but is susceptible of numerous changes and modifications as known to those skilled in the art. For example, the arrangement of the injection lines of the cold-starter installation can also be utilized for motor vehicles with injection engines. Hence, we do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

What we claim is:

1. A cold-starting installation for internal combustion engines with suction pipe means, which includes individual injection lines connected with a fuel line and an electrically controlled cold-starting valve means for the control of the fuel injection quantity which is operable to inject a predetermined fuel quantity into the suction pipe means of the internal combustion engine during the starting of the internal combustion engine by way of the injection lines, characterized in that a stepped bore means is provided laterally at the suction pipe means of the internal combustion engine for the accommodation of a respective injection line, the discharge ends of the injection lines provided with nozzle means being inserted into the stepped bore means and being retained therein, characterized in that the discharge ends of the injection lines are constructed conically and extend in the interior space of a respective nozzle means which is constructed pot-shaped and rests on a shoulder of the stepped bore means, and characterized in that the nozzle means is retained in its position by the discharge end of the corresponding injection line.

2. A cold-starting installation for internal combustion engines with suction pipe means, which includes individual injection lines connected with a fuel line and an electrically controlled cold-starting valve means for the control of the fuel injection quantity, which is operable to inject a predetermined fuel quantity into the section pipe means of the internal combustion engine during the starting of the internal combustion engine by way of the injection lines, characterized in that a stepped bore means is provided laterally at the suction pipe means of the internal combustion engine for the accommodation of a respective injection line, the discharge ends of the injection lines provided with nozzle means being inserted into the stepped bore means and being retained therein, and characterized in that the discharge ends of the injection lines are constructed cylindrically and are provided with a radial recess into which is inserted a disk-shaped nozzle means.

3. A cold-starting installation according to claim 2, characterized in that the stepped bore means is formed by diameters of different sizes.

4. A cold-starting installation for internal combustion engines, according to claim 2, characterized in that the engine is a multi-cylinder internal combustion engine for motor vehicles which includes a separate suction pipe means for each cylinder equipped with its own carburetor.

5. A cold-starting installation according to claim 2, characterized in that the disk-shaped nozzle means is held in position by the clamping force of the material of the injection line.

6. A cold-starting installation for internal combustion engines with suction pipe means, which includes individual injection lines connected with a fuel line and an electrically controlled cold-starting valve means for the control of the fuel injection quantity, which is operable to inject a predetermined fuel quantity into the suction pipe means of the internal combustion engine during the starting of the internal combustion engine by way of the injection lines, characterized in that a stepped bore means is provided laterally at the suction pipe means of the internal combustion engine for the accommodation of a respective injection line, the discharge ends of the injection lines provided with nozzle means being inserted into the stepped bore means and being retained therein, characterized in that the injection lines consist of synthetic resinous material and are held in the suction pipe means also consisting of synthetic resinous material by spring clamp means, the suction pipe means including integrally formed boss means for the fastening thereon of actuating linkage means for carburetor means of the internal combustion engine, characterized in that the spring clamp means are arranged laterally at the suction pipe means within the area of the stepped bore and abut with a free end thereof respectively against the injection line coordinated to the suction pipe means, characterized in that the nozzle means consists of a material selected from the group consisting of sheet metal, polyamide and polyfluorol-olefines, and characterized in that the nozzle means is retained in its position by the discharge end of the corresponding injection line.

7. A cold-starting installation for internal combustion engines with suction pipe means, which includes individual injection lines connected with a fuel line and an electrically controlled cold-starting valve means for the control of the fuel injection quantity, which is operable to inject a predetermined fuel quantity into the suction pipe means of the internal combustion engine during the starting of the internal combustion engine by way of the injection lines, characterized in that a stepped bore means is provided laterally at the suction pipe means of the internal combustion engine for the accommodation of a respective injection line, the discharge ends of the injection lines provided with nozzle means being inserted into the stepped bore means and being retained therein, characterized in that the injection lines consist of synthetic resinous material and are held in the suction pipe means also consisting of synthetic resinous material by spring clamp means, the suction pipe means including integrally formed boss means for the fastening thereon of actuating linkage means for carburetor means of the internal combustion engine, characterized in that the spring clamp means are arranged laterally at the suction pipe means within

the area of the stepped bore and abut with a free end thereof respectively against the injection line coordinated to the suction pipe means, and characterized in that the discharge ends of the injection lines are constructed cylindrically and are provided with a radial recess into which is inserted a disk-shaped nozzle means.

8. A cold-starting installation according to claim 7, characterized in that the disk-shaped nozzle means is held in position by the clamping force of the material of the injection line.

9. A fuel injection system for internal combustion engines, comprising an individual carburetor and suction pipe means for each cylinder of the internal combustion engine, each said suction pipe means having a stepped bore means laterally of the suction pipe means; a fuel line extending from a fuel pump to a first set of injection fuel lines, each line of said first set connected to one of said individual carburetors; an electrically controlled cold-starting valve means further connected to said fuel line for controlling the injection of a predetermined fuel quantity into the suction pipe means during the starting of the internal combustion engine; a second set of injection fuel lines, each line of said second set extending from said cold-starting valve means to one of said individual suction pipe means and having a discharge end, each said discharge end of said second set of injection fuel lines being inserted into said stepped-bore means of corresponding suction pipe means; and nozzle means provided at the discharge ends of said second set of injection fuel lines in said stepped bores, wherein the discharge ends of the second set of injection lines are conical and wherein each respective nozzle means is pot-shaped and abuts on a shoulder of the stepped bore means, said conical discharge ends extending into the interior of a respective pot-shaped nozzle means, and said each respective nozzle means being retained in its position by the discharge end of the corresponding injection line.

10. A fuel system according to claim 9, wherein spring clamp means are arranged laterally at the suction pipe means within the area of the stepped bore and abut with a free end of said spring clamp means, respectively, against the injection line of said second set, coordinated to the suction pipe means.

11. A fuel injection system for internal combustion engines, comprising an individual carburetor and suction pipe means for each cylinder of the internal combustion engine, each said suction pipe means having a stepped bore means laterally of the suction pipe means; a fuel line extending from a fuel pump to a first set of injection fuel lines, each line of said first set connected to one of said individual carburetors; an electrically controlled cold-starting valve means further connected to said fuel line for controlling the injection of a predetermined fuel quantity into the suction pipe means during the starting of the internal combustion engine; a second set of injection fuel lines, each line of said second set extending from said cold-starting valve means to one of said individual suction pipe means and having a discharge end, each said discharge end of said second set of injection fuel lines being inserted into said stepped-bore means of corresponding suction pipe means, said discharge ends of the second set of injection lines being cylindrical and being provided with a radial recess; and nozzle means provided at the discharge ends of said second set of injection fuel lines in said stepped bores, each respective nozzle means being disk-shaped and being inserted into the radial recess of each discharge end.

12. A fuel system according to claim 11, wherein the disk-shaped nozzle means is held in position by the clamping force of the material of the injection line.