

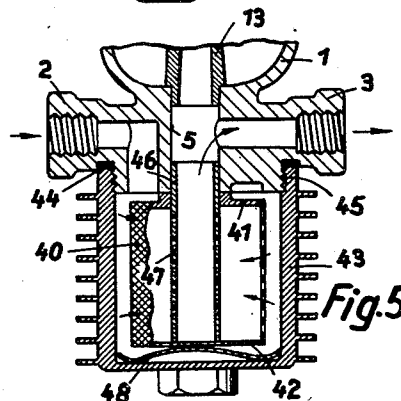
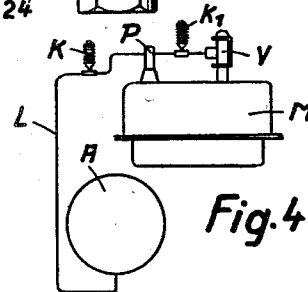
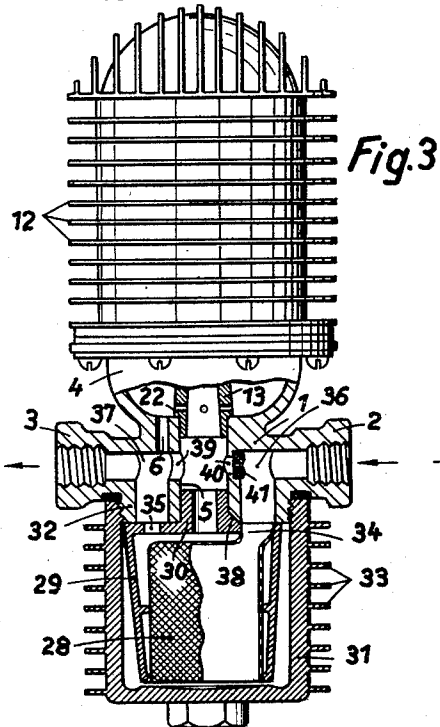
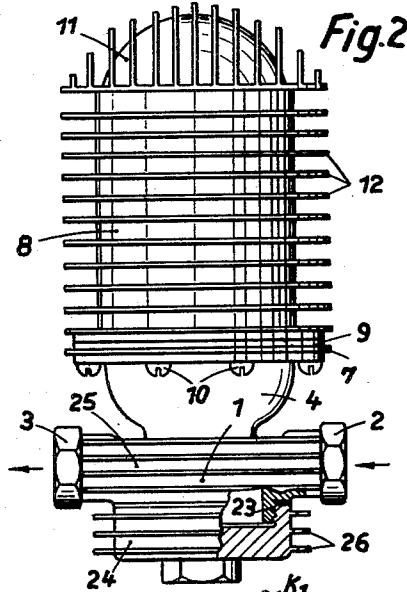
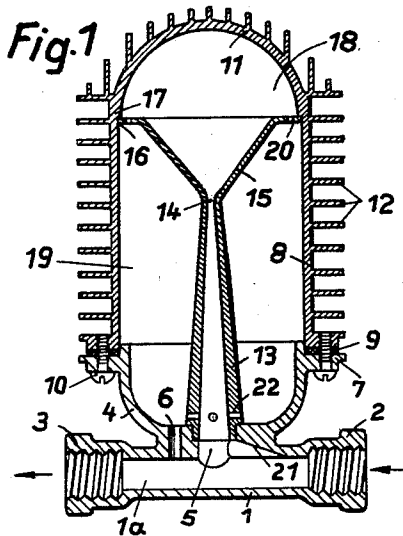
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FUEL CONDENSER AND STRAINER

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FUEL CONDENSER AND STRAINER

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5 Claims. (Cl. 210—181)

The present invention relates to improvements in fuel condensers for internal combustion engines, the purpose of which is to prevent the formation of a vapor lock in the fuel line leading to such engine.

In internal combustion engines the danger often occurs that, especially on very hot summer days, the ingredients of the gasoline which have a relatively low boiling point tend to evaporate and to form bubbles of fuel vapor in the fuel line leading to the carburetor of the engine. Such vapor bubbles retard the even flow of fuel to the engine and may even block the fuel supply entirely, thus forming what is commonly called a "vapor lock" in the fuel line.

Various efforts have already been made prior to this invention to oppose the formation of such vapor bubbles or gas fumes in the fuel line by insulating the latter against the heat of the surrounding atmosphere by means of an asbestos covering. Other attempts to prevent such vapor lock resided in the provision of means to condense those vapor bubbles which might have already formed in the fuel tank and the fuel line before they might accumulate to cause a serious interference in the even supply of fuel to the carburetor. For this purpose, the fuel line was cut at a suitable place and some sort of casting or T-fitting was connected to the ends thereof, and a condenser similar to an air chamber and provided with cooling ribs on its outside was mounted on the vertical branch of such fitting to permit the vapor bubbles contained in the fuel to escape upwardly during the passage of the fuel through such fitting. It has also been previously proposed to mount upon such casting or T-fitting a vertical tube which reaches deeply into the condenser vessel and has a nozzle-like opening through which the vapor bubbles or fumes pass into an upper chamber constituting the actual condenser chamber which is separated from the lower chamber by a wall provided with a series of openings near its peripheral edge through which the condensate is then returned through the lower chamber and subsequently to the fuel current. The object of such a design is to carry out the condensation of the vapor as much as possible within the upper part of the condenser which is more highly cooled than the lower part and will thus carry out its condensing function more effectively. The vertical or riser tube in such construction consists of a cylindrical tube having a thin nozzle-like opening at its upper end, whereas the wall separating the upper and lower chambers is of conical shape forming a roof over the nozzle-like upper end of the riser tube and provided with a small opening in the apex thereof coaxially with such nozzle.

It is the object of the present invention to provide a condenser of the general type as described above with improvements therein which will render it far superior in action to the designs previously proposed.

Another object of the invention resides in the application of the principles of a Venturi tube in a condenser of the type as described, to accelerate the upward passage of the fuel vapors into the condenser vessel and against

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the coolest upper wall thereof, and substantially without any losses in the flow of the vapors by avoiding the eddying thereof in their passage through such Venturi tube.

More specifically, the invention resides in the provision of a substantially T-shaped casting forming the base of a condenser cylinder, the horizontal ends of such casting being connected to the open ends of a fuel line, whereas the vertical branch thereof which is located within the central axis of the condenser cylinder has a relatively large opening in which a conical upright tube shaped substantially like a Venturi tube is mounted, such tube gradually tapering upwardly from its wide lower end to a relatively narrow constriction, and then continuing upwardly by tapering outwardly at a large angle, the funnel-like wall of such upper taper forming the separating wall between the upper and lower chambers within the condenser vessel, the upper chamber constituting the actual condensing chamber while the lower chamber forms a collecting and cooling chamber for receiving the condensate formed in the upper chamber and gradually returning it into the fuel current passing through the T-shaped base.

The particular design of the upright tube within the condenser vessel in the shape of a Venturi tube constitutes a considerable improvement over previous condenser designs, inasmuch as the gas fumes and bubbles are not merely allowed to ascend of their own accord and through their own buoyancy toward the condensing surface but are accelerated by such Venturi tube to a high velocity, thus to be thrown against the condensing surface and to be followed more quickly by other vapor or bubbles discharged from the fuel stream. Thus, the danger of a vapor lock forming in the ascending tube of the condenser by the vapor or bubbles not passing therethrough at sufficient velocity and thus retarding the operation of the condenser or even rendering it completely ineffective, is avoided by the present invention.

Another feature of the invention resides in making the dome-shaped upper part and the cylindrical lower part of the condenser of a single unitary piece of material, and to mount it directly upon the base containing the fuel passage and having the Venturi tube mounted thereon by providing such base with an integral cup-shaped portion forming the bottom of the lower condenser chamber and having a peripheral flange thereon upon which the main body of the condenser may then be securely mounted.

The advantage of such a design is one of easier manufacture and installation, as well as greater solidity as compared with previous condensers of this type in which the upper chamber formed a separate element which had to be carefully fitted to, and mounted on, the lower cylindrical part of the condenser which had an integral bottom with a threaded central aperture therein, into which the vertical tube had to be screwed, and which likewise served as the sole means to screw the entire condenser upon a T-fitting inserted into the fuel line. Apart from the fact that both the assembly as well as servicing of the new condenser is considerably easier than that of previous design as described above, it also has the advantage of a greater stability of adjustment over such prior design in which a single screw thread is supposed to secure both the vertical tube within the condenser bottom as well as the entire condenser upon the T-fitting without being shaken loose by the concussions due to driving along a rough road.

Another important feature of the invention consists in the provision of a smoothing chamber or surge tank provided underneath the base of the condenser and simply formed by a lower flange thereon intermediate the pipe connections secured to the two ends of the fuel line, and

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a cap being screwed onto such flange. Such chamber has the advantage of facilitating the rise of the gas bubbles from the larger mass of gasoline within such chamber, especially when the flow of fuel is of relatively low velocity. Also, for improved cooling action, both the main fuel passage in the base of the condenser as well as the lower cap thereon may be provided with cooling ribs.

Still another feature of the invention resides in the provision of a fuel filter securely attached to the lower end of the base of the condenser by means of a suitable housing screwed to the lower flange on said base and likewise provided with cooling ribs.

Still further objects, features and advantages of the present invention will be apparent from the following detailed description of several embodiments thereof and the appended drawings, wherein—

Fig. 1 shows a vertical section through a condenser according to the invention in the simplest form thereof;

Fig. 2 shows a side view, partly in section, of a condenser with a smoothing chamber in the lower part thereof;

Fig. 3 is a similar view of a condenser with a fuel filter attached thereto;

Fig. 4 is a diagrammatic view of a fuel supply system according to the invention; while

Fig. 5 is a view similar to Fig. 3 but showing a modification of the filter structure.

Referring to Fig. 1 of the drawings, the condenser according to the invention consists of a lower casting or base 1 comprising a fuel channel 1a and having threaded end portions 2 and 3 for connecting the fuel line thereto, the fuel thus entering the condenser at the pipe connection 2 and leaving it to pass to the carburetor of the engine through the connection 3. At its upper end, the base 1 has an enlarged cup-shaped extension 4 which communicates with the fuel channel 1a through a central aperture 5 of relatively large diameter, as well as through a second aperture 6 of smaller diameter. Near its upper end, the cup-shaped extension 4 has a peripheral flange 7 carrying a sealing gasket 9, and a cylinder 8 firmly secured thereto by screws 10. Cylinder 8 has at its upper end, and integral therewith, a dome-shaped portion 11 which closes the cylinder 8 entirely toward the outside. The relatively thin walls of the cylinder 8 and its dome-shaped end portion 11 carry on all sides cooling ribs 12. Fitted tightly into the central aperture 5 of the casting 1 and positioned centrally within the cylinder 8 is a vertical pipe or riser 13 of substantially conical shape, gradually tapering upwardly from the large aperture 5 at its lower end toward its narrowest point 14 centrally within the cylindrical part of the member 8 so that the cross sectional area of flow at the point 14 is of considerably smaller size than that of the aperture 5. Directly above the narrow passage 14, the riser 13 again tapers strongly outwardly so as to form a funnel-like extension 15, the entire riser 13 thus having the essential features of a Venturi tube. At its upper end, the funnel-like portion 15 of the tube 13 has an outer peripheral flange 16 of a diameter substantially corresponding to the inner diameter of the cylinder 8. Thus, when inverting the cylinder 8 over the tube 13, the peripheral edge 16 slides snugly along the smooth inner wall of the cylinder until it comes to rest against an inner shoulder 17 at the upper end of the cylindrical wall portion and forming the base of the dome-shaped portion 11. By inserting and tightening the screws 10, the upper peripheral edge 16 of the tube 13 is then forced tightly against the shoulder 17, thereby separating the interior of the entire cylinder 8, 11 into an upper chamber 18, which communicates with the fuel channel 1a through the tube 13, and a lower chamber 19, the two chambers 18 and 19 communicating with each other merely by a series of small openings 20 in the outer flange 16 of the funnel-like portion 15 of riser 13. The openings 20 are preferably made of such a diameter

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that the sum of the cross sectional area of all of these openings is smaller than the cross sectional area of flow of the narrowest passage 14 of the riser 13. The lower chamber 19 communicates with the fuel passage 1a through the small aperture 6 which is preferably provided in the bottom of the cup-shaped part 4 of the casting 1 adjacent the aperture 5 and the Venturi tube 13 but at a point within the discharge side of the fuel passage 1a, i. e. toward the left of the aperture 5, as shown in Fig. 1.

The operation of the new fuel condenser as above-described and shown in Fig. 1 may be described to be as follows: As the fuel passes in the direction shown by the arrows through the fuel channel 1a of the casting 1, it carries along vapor bubbles which are primarily caused by evaporation of the most volatile ingredients of the fuel within the gasoline tank and in the fuel line, and which tend to retard the even flow of the fuel toward the carburetor of the engine and if permitted to accumulate, may even interrupt the flow of fuel entirely, thus forming a vapor lock within the fuel line. These vapor bubbles have the natural tendency to move along with the fuel within the upper part of the cross sectional area of flow of the fuel line, and when passing through the fuel channel 1a, to escape upwardly into and through the large aperture 5 and the Venturi tube 13 and thus into the upper chamber 18 of the cylinder 8, where they will condense along the thin and relatively cool outer dome-shaped wall 11. This causes a drop in pressure within the cylinder chambers 18 and 19 in accordance with the temperature of condensation, which raises the fluid level within the riser 13, causing the vapor to surge upwardly. As the consequence of the Venturi tube-like design of the riser 13, at the narrowest point 14 thereof the vapors are accelerated to a multiple of their original velocity, and at an even flow substantially without losses through eddying, until emerging into the upper chamber 18 where they hit upon the dome-shaped wall 11 and are deflected thereby in a downward direction and along such wall. Thus, the vapor remains in contact with the wall 11 and has ample opportunity to condense thereon. The condensate then flows downwardly along this wall to the peripheral edge 16 of the tube 13 and then drips through the small openings 20 into the lower chamber 19, from which it flows through the aperture 6 back into the current of fuel flowing through the channel 1a. Any condensate which might run past the openings 20 into the funnel-like extension 15 may flow downwardly through the narrow passage 14 in the tube 13 and thus back into the fuel current in the channel 1a, unless during such flow it will be picked up and carried along in the opposite direction by the vapor current, or be absorbed by such current.

To facilitate the entry of the vapor into the riser 13, it may also be advisable to provide an incline or ascent 21 at the roof of the fuel channel 1a, leading from the entry side thereof into the aperture 5. Also, in place of, or in addition to, the drain 6, the tube 13 may be provided at its lowest point with radial drain openings 22, in which event the condensate may then flow back into the fuel channel 1a through the main aperture 5.

The embodiment of the invention shown in Fig. 2 differs from that shown in Fig. 1 insofar as the lower wall portion of the fuel channel 1a is omitted and the casting 1 is provided at its lower side with a threaded flange 23 upon which a cap 24 may be screwed. The inner diameter of the flange 23 substantially corresponds to the inner diameter of the cylinder 8, thus forming a smoothing chamber or surge tank which facilitates the vapor separation underneath the Venturi tube 13. The outer walls of the fuel channel 1a as well as of the cap 24 are preferably provided with cooling ribs 25 and 26, respectively.

The embodiment of the invention shown in Fig. 3 comprises a casting 1 outwardly similar to that shown in Fig. 2, that is, with a threaded flange 32 extending downwardly therefrom upon which a caplike filter housing 31 with

outer cooling ribs 33 is screwed. However, instead of a straight fuel channel 1a, as shown in Fig. 1, the wall forming the central aperture 5 is extended in downward direction thus forming a pair of walls separating the space within the casting 1 into three channels, an inlet channel 36 communicating with the inlet connection 2, an outlet channel 37 communicating with the outlet connection 3, and a central channel 5 communicating with the Venturi-tube 13. A filter holder 29 is removably attached to the central channel 5, and for this purpose has a nipple 30 on its upper end fitted into the lower end of the channel. A strainer 28 is mounted within the holder 29, and both the strainer and its holder have an upper inlet opening 34 eccentrically thereto for connecting the strainer with the inlet channel 36. The inlet of the strainer 28 may be attached to the inlet of the holder 29 in any suitable manner, either so as to be removable therefrom in a downward direction when the strainer itself is to be removed through the open bottom of holder 29, or by being soldered to the inlet of the holder. The strainer 28 and its holder 29 are suitably shaped so as to be spaced from each other on all sides so that the fuel entering the strainer through the inlet 34 can freely pass through the side walls thereof into the cylindrical chamber formed by the inner wall of the holder 29 and thence through the wide central channel 5 to the Venturi tube 13 as well as through the smaller outlet 35 in the upper wall of the holder directly into the outlet channel 37. To insure the inlet openings 34 of the strainer and its holder to be properly located with respect to the inlet channel 36 when the nipple 30 is being fitted into the lower end of the central channel 5, the nipple 30 is preferably provided with a lateral nose or lug 38 which is adapted to fit into a corresponding notch in the lower edge of the channel 5.

The opposite walls of the channel 5 are also provided with direct fuel passages 39 and 40 leading in a substantially straight line through the casting 1 corresponding to the general direction of flow as indicated by the arrows. However, inlet passage 40 is made of considerably smaller size than the inlet 34 into the strainer 28 and additionally provided with a nozzle 41. Thus, an excess of vapor pressure in the fuel line will be able to escape from the main current of fuel before passing through the strainer 28 and directly into the Venturi tube 13. The outlet opening 39 within the channel 5 is preferably made larger than the outlet opening 35 from the filter holder 29 so that the largest part of the fuel, after rising through the central channel 5 leading to the Venturi tube 13, will pass therethrough. If desirable, the outlet opening 35 from the filter holder 29 may be omitted so as to force the entire fuel to pass through the channel 5 into the outlet channel 37.

Fig. 4 illustrates the application of the condensers according to the invention to the fuel line of an internal combustion engine. In this case it is assumed that a fuel pump P is mounted in the fuel line leading from the fuel tank A to the carburetor V of the engine M. It will then be advisable to insert a condenser K and K₁ in the fuel line, both in front of, as well as behind the fuel pump P, even though one or the other of these condensers may be omitted if desired.

The condenser illustrated in Fig. 5, similar to that shown in Fig. 3, also carries a fuel filter on the casting 1. It consists of a cylindrical strainer 40 which is mounted between two disks 41 and 42, for example, by being soldered thereto. Similarly as in Fig. 3, the caplike housing 43 enclosing the filter is tightly screwed upon a lower flange 45 on the casting 1 with a gasket 44 placed intermediate the flange and housing. The upper disk 41 of the strainer has a central aperture in which a short tube 46 is mounted which fits slidably into the lower end of the central channel 5 which communicates with the riser 13. In the particular embodiment shown in Fig. 5, the tube 46 is extended to the bottom disk 42 of

the strainer and is provided with a series of radial perforations 47 in its wall through which the fuel may pass into the strainer. The perforated tube 46 solidifies the structure of the strainer especially in the axial direction thereof. Thus, a leaf or coil spring 48 placed in the bottom of the cap 43 may press upon the bottom disk 42 of the strainer without deforming the latter and may thus press the upper disk 41 against the lower end of the casting 1. Spring 48 will prevent the strainer 40 from being shaken loose from its mounting or from rattling within the housing 43 when the car is being driven over rough ground. The fuel passes through the inlet 2 into the housing 43, thence through the wire mesh of the strainer 40 and the perforations 47 in the tube 46, and upwardly through this tube toward the outlet 3, during which time the bubbles of vapor are being discharged from the fuel current to pass upwardly into the Venturi tube 13.

While the invention has been described in detail with respect to certain now preferred examples and embodiments thereof, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, what I claim as new is:

1. A fuel condenser for a fuel supply system of an internal combustion engine having a fuel line, comprising a base connected with the fuel line, a closed vessel mounted on said base and having cooling ribs on its outside and an aperture of relatively large diameter in its bottom communicating with the fuel line in said base, a Venturi tube mounted within said aperture and extending substantially vertically from said base, said tube tapering gradually from its relatively large bottom opening to a relatively narrow opening within the upper portion of said vessel and then again tapering outwardly at a funnel-like angle toward a peripheral upper edge abutting against the inner wall of said vessel, the funnel-like portion of said tube above said narrow opening separating said condenser vessel into upper and lower chambers, said funnel-like portion having a series of drain openings near said peripheral edge, whereby the fuel vapor rising through said Venturi tube and projected against a wall of said upper chamber is condensed thereon and then flows downwardly along said wall to pass through said drain openings into said lower chamber, and said lower chamber having at least one opening therein communicating with said fuel line for draining the condensate from said lower chamber.

2. A fuel condenser for a fuel supply system of an internal combustion engine having a fuel line comprising a base having a fuel passage therein, a cup-shaped element integral with said base and projecting upwardly therefrom, with a central aperture in the bottom of said element communicating with said fuel passage, a cylindrical vessel having a dome-shaped top integral therewith and being open at its lower end, cooling ribs on the outer surface of said vessel, said vessel being mounted upon said cup-shaped element, means for securing said vessel to said cup-shaped element, a Venturi tube mounted within said central aperture of said cup-shaped element and extending substantially vertically therefrom, said tube tapering gradually from its relatively large bottom opening to a relatively narrow nozzlelike opening within the upper portion of said vessel and then again tapering outwardly at a funnel-like angle toward the peripheral upper edge thereof, and a rim formed along said upper edge and abutting against the inner wall of said vessel adjacent the base of said dome-shaped top, the funnel-like portion of said tube above said nozzlelike opening separating said condenser vessel into upper and lower chambers, said lower chamber consisting of the cylindrical part of said vessel and said cup-shaped element of

said base, said funnel-like portion having a series of drain openings within said rim, whereby the fuel vapor rising through said Venturi tube and projected against a dome-shaped wall of said upper chamber is condensed thereon and then flows downwardly along said wall to pass through said drain openings into said lower chamber, and said lower chamber having at least one opening within said cup-shaped element communicating with said fuel passage for draining the condensate from said lower chamber.

3. A fuel condenser for a fuel supply system of an internal combustion engine having a fuel line, comprising a base having a fuel passage of the fuel line therein and having a flange downwardly extending therefrom and forming an opening of said fuel passage, a cap threaded on said flange so as to form an enlarged smoothing chamber within said fuel passage, a closed vessel mounted on said base and centrally of said smoothing chamber and having cooling ribs on its outside and an aperture of relatively large diameter in its bottom communicating with said fuel passage and smoothing chamber, a Venturi tube mounted within said aperture and extending substantially vertically from said base, said tube tapering gradually from its relatively large bottom opening to a relatively narrow opening within the upper portion of said vessel and then again tapering outwardly at a funnel-like angle toward a peripheral upper edge abutting against an inner wall of said vessel, the funnel-like portion of said tube above said narrow opening separating said condenser vessel into upper and lower chambers, said funnel-like portion having a series of drain openings near said peripheral edge, whereby the fuel vapor rising through said Venturi tube and projected against the wall of said upper chamber is condensed thereon and then flows downwardly along said wall to pass through said drain openings into said lower chamber, and said lower chamber having at least one opening therein communicating with said fuel passage for draining the condensate from said lower chamber.

4. A fuel condenser and filter for a fuel supply system of an internal combustion engine having a fuel line, comprising a base having a fuel passage of the fuel line therein and having a flange downwardly extending therefrom and forming an opening of said fuel passage, a cap threaded on said flange so as to form a chamber below said base, cooling ribs on the outer surface of said cap,

a fuel strainer within said chamber, and at least one separating wall within said passage for diverting the fuel current from said inlet downwardly into and through said strainer and back upwardly to the fuel passage, a closed vessel mounted on said base and centrally of said strainer chamber, and having cooling ribs on its outside and an aperture of relatively large diameter in its bottom communicating with said strainer chamber, a Venturi tube mounted within said aperture and extending substantially vertically from said base, said tube tapering gradually from its relatively large bottom opening to a relatively narrow opening within the upper portion of said vessel and then again tapering outwardly at a funnel-like angle toward a peripheral upper edge abutting against an inner wall of said vessel, the funnel-like portion of said tube above said narrow opening separating said condenser vessel into upper and lower chambers, said funnel-like portion having a series of drain openings near said peripheral edge, whereby the fuel vapor rising through said Venturi tube and projected against the wall of said upper chamber is condensed thereon and then flows downwardly along said wall to pass through said drain openings into said lower chamber, and said lower chamber having at least one opening therein communicating with said fuel passage for draining the condensate from said lower chamber.

5. A fuel condenser for a fuel supply system of an internal combustion engine, comprising a base through which the fuel supply flows and having an opening therein, a closed vessel mounted on said base and having cooling ribs on its outside and mounted over the opening, and a Venturi tube mounted in said vessel and extending substantially vertically from said base from the opening, said tube tapering gradually from the opening to a relatively narrow opening within the upper portion of said vessel and then again tapering outwardly to the inner wall of the vessel at the upper part thereof.

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