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FUEL CHARGE VALVE ASSEMBLY IN GAS-FUELED CIGARETTE LIGHTER

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Fig. 1

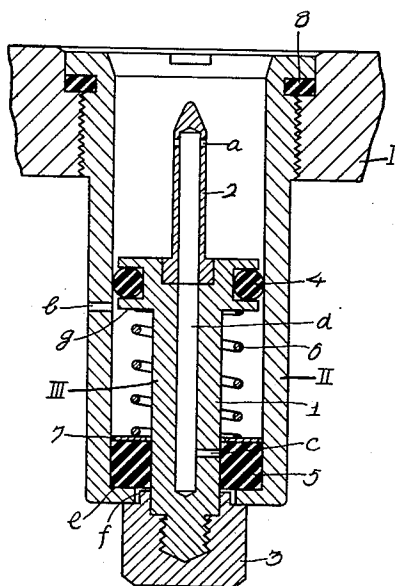


Fig. 2

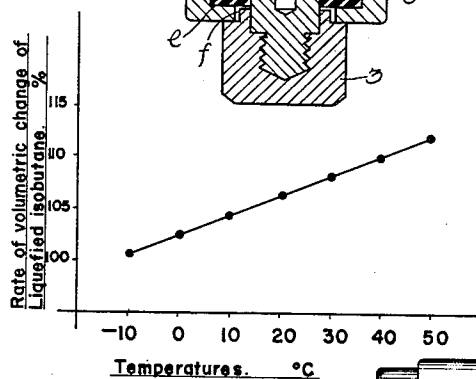
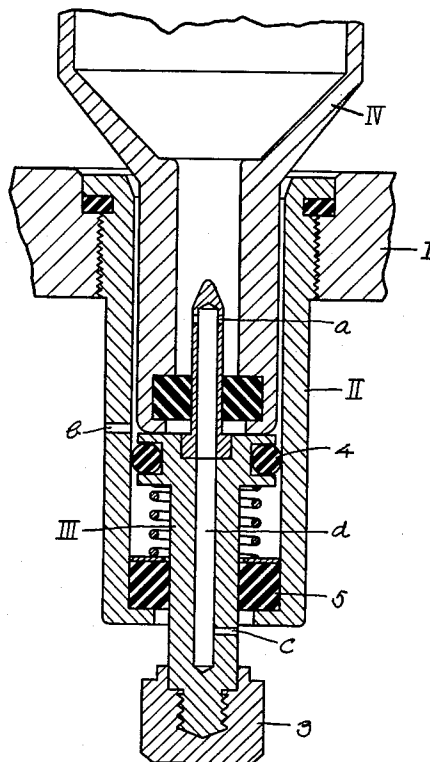


FIG. 4

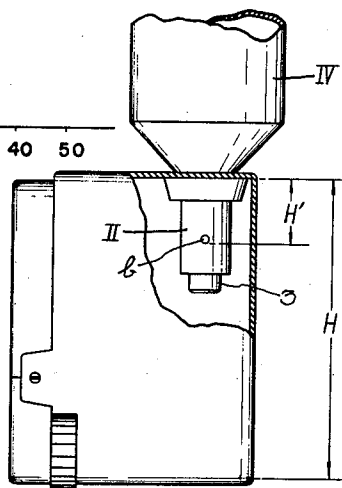


FIG. 3

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FUEL CHARGE VALVE ASSEMBLY IN GAS-FUELED CIGARETTE LIGHTER

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1 Claim. (Cl. 141-293)

The present invention relates to a gas lighter in general and to a charge or injection valve in particular, which is incorporated into a gas-fueled cigarette lighter.

These cigarette lighters are provided with a container for preserving compressed gas, which container is constructed in such manner that liquefied fuel, as liquid isobutane, can be injected into the container, whenever required, from a disposable fuel cartridge.

It is an essential requirement to provide the possibility for charging a predetermined, maximum allowable quantity of liquefied fuel accurately and efficiently into the container with the charge valve, thus obviating possible damage to or breakage of the container, which may be caused if the liquefied fuel is overcharged beyond a predetermined safety limit, due to thermal expansion of the thus charged fuel. Another important requirement for the charge valve is to provide only a minimum loss of fuel, which is possible in the course of such fuel charging operation.

Most of the conventional charge or injection valves are provided with controllable closing means and are equipped for connecting a disposable fuel cartridge with the interior of the fuel container or reservoir of the lighter. With such a charge valve, however, the liquefied fuel can be injected into the container only to such extent, that the vapor pressure prevailing within the container is brought into balance with the cartridge pressure. Such a balanced condition can be easily attained, even when a relatively small quantity of liquefied fuel has been transferred from the cartridge into the lighter reservoir. Thus, it will be seen that with such conventional means a satisfactory quantity of liquefied fuel cannot be injected into the lighter reservoir for practical purposes.

In order to obviate the above mentioned drawbacks and disadvantages which have been encountered in conventional gas lighters, it has already been proposed to construct the gas lighter in such manner that the fuel charging is carried out, while relieving the internal gas pressure at the same time, thus avoiding possible balancing of the internal pressure with the cartridge pressure. Such arrangement has been found practical to a certain degree. In order to perform the injection, it is thus required that the internal pressure prevailing within the lighter reservoir is kept lower than the cartridge pressure during the entire charging operation. In this case, the exhausting will cause evaporation of a part of the already injected liquid fuel and the vaporized gaseous fuel will be discharged from the fuel container. Such evaporation will consume the corresponding quantity of latent heat supplied from the ambient atmosphere, so that the container is cooled to a corresponding degree. On account of this cooling effect, the difference between the reservoir pressure and the cartridge pressure will be still further increased, which means that the injection can be more effectively carried out than in the former case, as described hereinabove. Particular attention is required in this case, however, due to the possible occurrence of an overcharge or a full charge of liquefied fuel into the reservoir. Should this be done, the aforementioned possible breakage or damage of the container may occur under circumstances.

It is the main object of the present invention to provide an assembly which prevents an overcharge or a full charge of liquefied fuel, and to provide the possibility for

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charging an accurately predetermined quantity of fuel under accurate control, which quantity appears to be safe, to reduce the possible loss of fuel by exhausting to a minimum, and further to prevent any overcharge or full charge of the liquid fuel, even when a user, for instance by his carelessness, should bring about such overcharge.

With this and other objects in view, which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawing, in which:

FIGURE 1 is a vertical sectional view of a preferred embodiment of the invention, wherein the movable parts of the charge valve assembly are shown in their normal or off-service position;

FIG. 2 is a view similar to that shown in FIG. 1, wherein however, the movable parts of the valve assembly are shown in their operative or charging position;

FIG. 3 shows diagrammatically an elevational view, partly broken away, of a gas lighter including the charge valve assembly constructed according to the present invention, said lighter being shown attached with a disposable fuel cartridge, which is illustrated, however, partly only; and

FIG. 4 shows a temperature-volume curve of liquefied isobutane.

Referring now to the drawing and particularly to FIG. 1, the assembly I comprises a lighter container or reservoir, which is, however, only partially represented for the purpose of simplifying the drawing, the container being detachably connected by screw means, as shown with a cylindrical skirt member II, having a bottom portion *e* equipped with an aperture *f*. A sealing ring 8 is provided to establish an effective seal at the screw connection between the container I and the skirt member II. A stem member 1 is formed at its upper end with a double flanged enlarged portion *g*, a rubber packing ring 4 of circular cross-section being fitted into the circumferential groove between the double flanges of the portion *g*. A needle member 2 is suitably fitted fixedly to the double flanged portion *g* as by press-fitting. An elongated blind bore *d* is formed in the stem member 1 and the needle member 2, extending substantially over the entire length of the members 1 and 2 and adapted to act as a common charging passage. As will be described more in detail hereinafter, the needle member 2 acts as a fluid connecting means between a disposable fuel cartridge IV (see FIG. 2) and the lighter container I by means of the intermediary of the skirt member II, when it is desired to charge the container I. For this purpose, lateral passages *a* are formed close to the tip of the needle member 2, communicating with the bore *d*. On the bottom wall *e* of the skirt member II is placed a sealing ring 5, preferably of rectangular cross-section, which in turn abuts a washer 7. A coil spring 6 is disposed between the washer 7 and the double-flanged portion *g*, whereby the stem member 1 is urged upwardly, as seen in FIGS. 1 and 2, the stem member 1 projecting through said bottom aperture *f* in the bottom wall *e* inwardly or downwardly relative to the skirt member II. A stopper 3 is screwed to the projecting thread bearing end of the stem member 1, the stopper 3 abutting against the lower or bottom surface of the apertured wall *e* under the force of the coil spring 6. A slidably movable assembly III is thus formed by the stem member 1, the needle member 2, the stopper 3 and the sealing ring 4, which assembly is urged upwardly by the coil spring 6, as already described. The stem member 1 is formed with a lateral passage *c* extending through the cylindrical wall and close to the lower end of the bore *d*, the passage *c* being sealingly covered by the sealing ring 5, when the charge valve assembly is in its normal or non-charging, outermost position. If, however, a fuel charge

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is to be injected into the container I, the passage *c* acts as a channel means to put the longitudinal bore passage *d* in communication with the internal space of the lighter container I, as will be described in greater detail hereinafter.

The skirt member II is formed with a discharge passage *b* extending through its cylindrical wall, which passage *b* is disposed at a level below the sealing ring 4, when the charge valve assembly is in its non-charging, outermost position, as illustrated in FIG. 1. When the movable assembly III is manually pushed downwardly against the action of the coil spring 6 from the position shown in FIG. 1 to that illustrated in FIG. 2 for the purpose of fuel charging, the discharge passage *b* is at a level higher than the sealing ring 4. The position of the discharge passage *b* plays decidedly an important role upon the allowable maximum or safety charging quantity of liquefied fuel for the gas.

In FIG. 3, the height *H'* of the allowable minimum gas level to be kept within the lighter vessel or container I upon charging the latter with liquefied and cool fuel is disclosed, in order to avoid possible breakage of the container I, which otherwise may occur by thermal expansion of the overcharged, cool liquefied fuel by absorbing ambient heat in the course of time upon the charging thereof, the overall net height *H* of the fuel container I being also shown in FIG. 3. It will thus be clear from the foregoing, that the height *H* minus the height *H'* represents the allowable maximum height of the liquefied fuel charge to be contained within the container I.

When the disposable fuel cartridge IV is operatively connected with the movable assembly III, as shown in FIGS. 2 and 3, and depressed manually downwardly, it may sealingly descend, with the sealing ring 4 kept in sliding contact with the inside wall surface of the skirt member II, and with the cylindrical outside surface of the stem member 1 being snugly guided by the stationary sealing ring 5, until the lateral charging passage *c* emerges from the skirt member II and comes to rest at a level slightly lower than the bottom wall *e* thereof, thus directly opening into the inside space of the fuel container I of the gas lighter. In this way, a charging conduit is established which leads from the lateral passages of the needle 2 through the longitudinal bore *d* of the needle member 2 and the stem member 1 to the lateral charging passage *c*, which is in this case directly opening to the inside space of the fuel containers. Under these conditions, the discharge passage *b* is brought into and kept in communication with the ambient atmosphere.

In the above mentioned way and as shown in FIGS. 2 and 3, liquefied fuel is charged from the cartridge IV through the charging conduit into the container I, while at the same time, a part of the charged liquid fuel emerges from the discharge passage *b*, as well as from a narrow gap space formed between the inside wall surface of the skirt member II and the attached fuel cartridge IV into the ambient atmosphere. Thus, the charging is carried out at a lower pressure as that contained in the cartridge IV. More specifically, when the upper level of the charged liquefied fuel gradually elevates in the course of the charging operation and arrives at last at the level corresponding to the position of the discharge passage *b*, the fuel will overflow through the discharge passage *b* and thus evaporate. At this point, the user will feel an extraordinary cooling effect, thereby being able to observe instantly the occurrence of such an overflow of the liquefied fuel, and will interrupt the charging operation. Thus, the charging of liquefied fuel will be terminated at a proper time. It is thus apparent, that any superfluous charging of liquefied fuel will not be carried out, even if the charging operation should be continued further from the point just above described under some circumstances. At the conclusion of the charging operation, the user releases the pressure upon the cartridge, whereupon the movable assembly III will automatically restore its normal, outermost position, as shown in FIG. 1. Thus any

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further charging as well as discharging of liquefied fuel will be normally interrupted completely.

It will be noted from the drawing, that the discharge passage *b* is disposed at a substantial distance from the charging passage *c* and at a substantially higher level than that of the latter, any possibility of the charged liquid being discharged even at the initial period of the charging operation, as frequently experienced with the conventional gas lighters, can be completely avoided. The discharge of liquefied fuel is brought about, only when the liquid charge has amounted to the predetermined specific quantity. Before that specific point is reached, only gaseous fuel will escape from the fuel container I, thus considerable losses of liquefied fuel during the charging operation, as frequently encountered with conventional gas lighters is reduced to a minimum, when gas lighters constructed according to the present invention are used. This feature constitutes also an important feature of the present invention.

Should, on the other hand, the charging operation be continued further, under some circumstances as by incidental carelessness on the part of the user, or by intentional operation by the user, for a considerable time period after the overflow of the liquid charge has started, whereby a relatively large amount of liquid fuel is discharged from the lighter container I and thus brought into evaporation, the lighter as a whole will be cooled to a substantial degree and the liquefied fuel prevailing in the neighborhood of the discharge passage *b* will have substantially no over-atmospheric pressure, while the newly charged liquid fuel prevailing in the range of the charging passage *c* is naturally substantially higher than that of the former fuel. When such conditions prevail during a relatively longer period of time, it may happen that the upper level of the charged fuel arrives at a level higher than that of the discharge passage *b*. Such an occurrence must naturally be avoided. Injection valve means adapted for prevention of such occurrence and capable of providing additionally the necessary gas phase space for the required safe charging, even when the additional superfluous charging operation has been carried out beyond the predetermined safety charging limit, is also included in the charge valve assembly according to the present invention.

FIG. 4 discloses a curve in terms of rate of volumetric change of liquefied isobutane, a preferable fuel employable for the gas lighter of the type described herein, plotted against the temperatures thereof. It will be noted, that with the increase of each 10° C. in the illustrated temperature range the liquefied fuel will increase in its volume by about 2%. Since the boiling point of liquefied isobutane is at -10° C., the injected liquid fuel may be considered to be cooled at that time to this temperature. Further, it can be assumed, that the highest temperature attainable during the service period of the gas lighter is about 40° C., so that the maximum temperature difference which is possibly experienced is 50° C. With this possible temperature difference, the charged fuel will be subject to about 10% of its volumetric increase. In addition, a small additional percentage must be allotted to possible erroneous manipulation at the side of the user in the case of charging, thus 12-15% of free or gaseous space should be kept within the lighter container I at the conclusion of a charging operation. The height *H'* shown in FIG. 3 is so selected, that a liquid phase space corresponding to 85-88% of the overall net volumetric capacity of the container I is kept therein at each charging operation.

It is a particular constructional feature of the present invention that the movable assembly having a charging conduit formed therein is sealingly reciprocable along the inside wall surface of the cooperating skirt member II by means of a plurality of sealing means and that these sealing means are arranged to be moved, so as to bring the discharge passage *b* serving as means for defining the maximum allowable or safety charging quantity of lique-

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fied fuel into communication with the ambient atmosphere, or out of communication therewith, as the case may be.

Although a particular embodiment of the present invention has been described hereinbefore for purposes of explanation, further modifications thereof will be apparent to those skilled in the art to which the present invention pertains. Reference should accordingly be had to the objects and appended claim in determining the scope of the invention.

I claim:

In a gas fuel lighter construction,

a container having a bore, for receiving compressed gas,

a substantially cylindrical skirt member removably secured in said bore and extending into said container,

said cylindrical skirt member having a discharge opening,

a stem axially movable in and extending through said skirt member and having an axial feeding passage leading into a radial passage for injecting fuel into said container,

said stem having a flange at its outer end,

a first packing means received by said flange and engaging the inner face of said skirt member during the axial movement of said stem, thereby controlling said discharge opening of said skirt member,

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said discharge opening in said cylindrical skirt member being disposed at a point thereof below said first packing means in its inoperative position,

a second packing means fitted tightly against the inner wall of said skirt member substantially at the bottom thereof and closing the outer end of said radial feeding passage in the inoperative position of said stem, said first packing means being moved axially with said stem into said skirt member during an injection stroke of said movable stem to expose said discharge opening to the ambient atmosphere and in a direction out of said skirt member during a closing stroke of said stem, so that the outward movement of said stem causes closing of said discharge opening to the atmosphere upon passing said stem beyond said discharge opening, and

spring means urging said stem into its outermost position.

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