Jan. 29, 1963 D. HERBERT 3,075,576

IMPROVEMENTS IN RESERVOIRS FOR INTERNAL COMBUSTION ENGINES

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Fig. 1

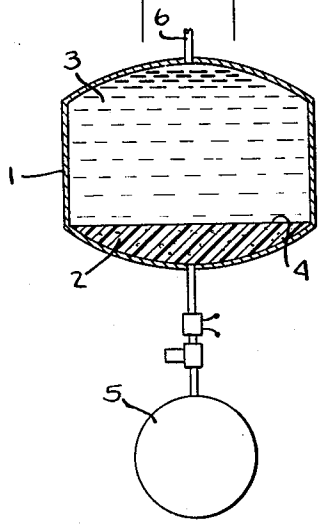


Fig. 2.

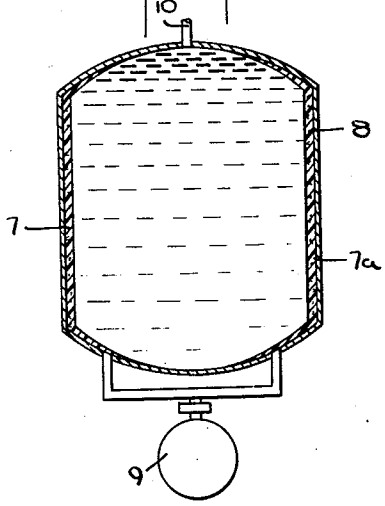


Fig. 3.

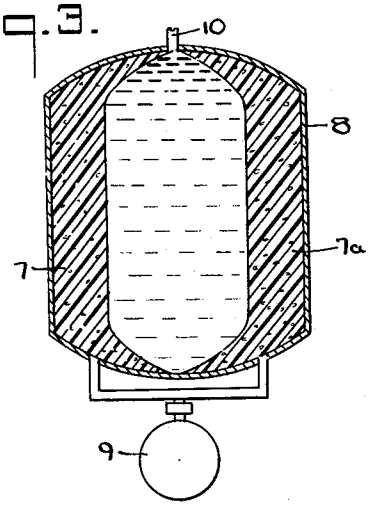


Fig. 4.

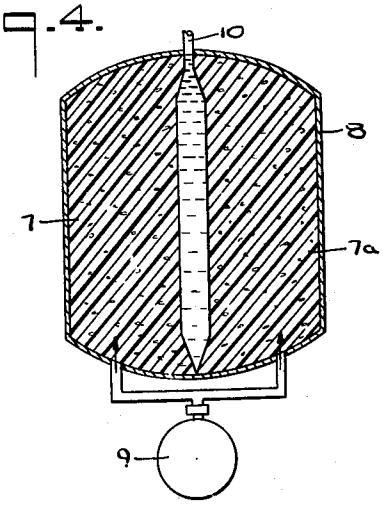


Fig. 5.

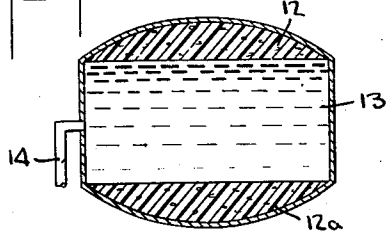
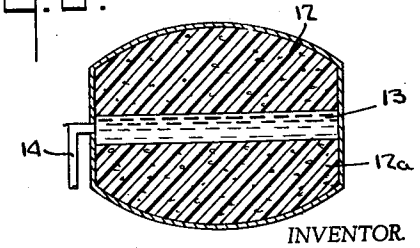


Fig. 6.



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IMPROVEMENTS IN RESERVOIRS FOR INTERNAL COMBUSTION ENGINES

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2 Claims. (Cl. 158—50.1)

The present invention relates to improved reservoirs intended in particular for containing fuels and combustive liquids for the feeding of internal combustion engines and more particularly to reaction engines such as those with which rockets are equipped. Briefly stated this invention consists in providing in the reservoir one or several layers of cellular elastic material which are compressed when the reservoir is full and which resume their initial volume as it empties, localizing the liquid in a given zone.

It is known that during the emptying process, the inconvenience of irregular displacements of the centre of gravity occurs in the reservoirs of the usual type. This provokes harmful effects, disturbing the stability of the vehicle equipped with such reservoirs.

The improvement according to the invention allows the complete elimination of this inconvenience by regularizing the displacement of the centre of gravity of the reservoir during the process of emptying or even by maintaining in a fixed position the centre of gravity. This improvement consists in providing in the reservoir one or several layers of cellular elastic material which are compressed when the reservoir is full and which resume their initial volume as it empties, localising the liquid in a given zone.

During the filling of the reservoir with liquid, the one or the several cellular layers are compressed under the pressure of the filling and their volume is reduced to a fraction of their original volume. The form which the volume of the liquid assumes at this moment depends, as is evident, on the shape of the reservoir and on that of the compressed cellular layers, that is to say in accordance with the space available. As the reservoir empties, the layer or layers of cellular material resume their initial form, preventing any sudden displacements of the liquid mass.

The layer or layers of cellular elastic material can be placed in the reservoir in such a way that the centre of gravity of the liquid is displaced regularly following a straight line which can for example be the axis of symmetry of the engine which is equipped with the reservoir.

Likewise they can be placed in such a way that the centre of gravity of the liquid mass does not undergo any displacement during the course of emptying.

The cellular layer or layers can be made of any convenient material which is chemically resistant to the liquid contained in the reservoir. The cells or the pores of the cellular material may or may not be intercommunicating. In the case of communicating cells, a covering or an impervious lining on the surface or surfaces of the mass in contact with the liquid can be provided to prevent the penetration of the liquid into the interior of the mass.

The improved reservoirs according to the invention are applicable whatever be the system of feeding, by employing convenient types of cellular layers.

Thus in the case of pump feeding, cellular layers with closed pores are used. Gases (for example air) filling the pores are compressed during the filling process and expand during the emptying process.

For feeding by pressure, the cellular layers have communicating pores, the gas used to exert the pressure expands uniformly through the whole interior of the layers producing a uniform pressure on the whole surface separating the cellular layers from the liquid.

Likewise one can realise a system of feeding by using

cellular layers with non-communicating pores, the pressure in the pores giving a corresponding pressure to the liquid. In this case the pressure of the gas compressed in the pores during the filling process provokes the ejection of the liquid out of the reservoir.

The attached outline drawing provides some non-limitating examples of several ways of realising the invention.

FIG. 1 is a sectional drawing of the reservoir partially filled with liquid.

FIG. 2 is a sectional view of a second emodiment of the invention showing a full reservoir.

FIG. 3 shows the embodiment of FIG. 2 partially emptied.

FIG. 4 shows the embodiment of FIG. 2 with even less liquid therein than in FIG. 3.

FIG. 5 is a sectional view of a third embodiment of the invention with the reservoir substantially filled.

FIG. 6 shows the third embodiment with a substantial portion of the contents of the reservoir of FIG. 5 extracted.

In the example represented in FIG. 1 the reservoir **1** contains a cellular elastic layer **2** placed symmetrically in relation to the axis of the reservoir. The liquid is represented by **3** and fills the volume left free between the lining of the reservoir and the surface **4** of the cellular layer. The running of the liquid out of the reservoir through the pipe **6** can for example be obtained by employing a pressure of gas supplied by a source **5** and acting on the mass **2** the cells of which are communicating. The filling process can itself be executed by evacuating the mass **4**.

It is to be seen that, owing to this arrangement, the centre of gravity of the liquid is displaced regularly along the axis of the reservoir, at the time of the emptying process.

In the example represented in FIGS. 2–4 the reservoir contains two layers of cellular material **7**—*7a*, placed symmetrically in relation to the axis of the reservoir **8**. These two are connected with the source of pressurized gas **9**. As the liquid empties from the reservoir through the pipe **10**, the space between the two masses **7**—*7a* decreases and one sees (FIGS. 3 and 4) that the centre of gravity is not subject to any displacement.

In the variation represented in FIGS. 5–6 the reservoir **11** likewise contains two cellular layers **12**—*12a* placed symmetrically, the filling and emptying processes of the said reservoir in liquid **13** being effected by a conduit **14**.

According to the nature of the liquid contained in the reservoir, one can use cellular layers obtained from different plastic materials, for example polythene, polyvinyl chloride, polyurethane, natural or artificial rubber, etc.

To give an example, for combustives such as the following ones, one may use the indicated plastic materials:

For concentrated and fuming nitric acid, the polythene, the polyvinyl chloride,

For liquid oxygen, the fluorocarbons for example that known commercially under the name of KEL-F, the pores being filled with a gas with a sufficiently low boiling point,

For fluorhydric acid, the polythene, the polyvinyl chloride, the fluorocarbons as KEL-F.

For fuels such as:

For hydrocarbons and oils, the polythene, the polyvinyl chloride, the polyurethane,

For alcohols, the polythene, the polyvinyl chloride, the rubbers,

For aniline, the polythene, the polyvinyl chloride.

It should be well understood that the invention is not limited to the indications and forms of realisation which have been stated, but that it can be realised also according to different variations.

I claim:

1. A liquid reservoir for statically holding varying liquid charges in voidless repose with a liquid center of gravity on a substantially predetermined axis during filling and emptying thereof despite tilting of the reservoir comprising a closed symmetrical liquid-tight chamber; orifice means therein for selectively introducing and extracting liquid from said chamber; and a pair of multi-cellular elastic means symmetrically and fixedly lining opposed portions of said reservoir; said elastic means occupying the entire inner volume of said reservoir when in a relatively relaxed condition and, meeting at an interface therein, said orifice means communicating with said interface, said pair of multicellular elastic means each being resiliently compressible away from said interface, whereby varying liquid charges are accepted at said interface in a symmetrical configuration with a substantially predetermined center of gravity during filling and emptying thereof without voids, and each cell of said multicellular elastic means communicating with an external gas cushion source.

2. A liquid reservoir for statically holding varying liquid charges in voidless repose with a liquid center of gravity on a substantially predetermined axis during filling and emptying thereof despite tilting of the reservoir comprising a closed symmetrical liquid-tight chamber, orifice means therein for selectively introducing and extracting liquid from said chamber, and a pair of multicellular elastic means symmetrically and fixedly lining opposed portions of said reservoir, said elastic means occupying the entire inner volume of said reservoir when in a relatively relaxed condition and meeting at an interface therein, said orifice means communicating with said interface, said pair of multicellular elastic means each being resiliently compressible away from said interface, said elastic means each comprising a plurality of mechanically interdependent cells each adapted to resiliently retain shape against compression, whereby varying liquid charges are accepted at said interface in a symmetrical configuration with a substantially predetermined center of gravity during filling and emptying thereof without voids, and said cells are each intercommunicated with an external gas cushion.

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