United States Patent

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[54] **FUEL TANK FOR INTERNAL COMBUSTION ENGINE**
6 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **123/136,** 244/135
[51] **Int. Cl.** **F02m 37/00**
[50] **Field of Search** 123/119, 136, 179A; 244/135, 135B; 261/72

[56] **References Cited**
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ABSTRACT: A fuel tank for internal combustion engines used on hand-held tools comprises a rigid container associated with the crank case of the internal combustion engine and a flexible bladder disposed within the rigid container. Fuel inlet and outlet ports are provided in the bladder. The rigid container has an air inlet port which presents the outside surface of the bladder with filtered air of the carburetor air intake chamber. As fuel is withdrawn from the bladder by the engine, the bladder collapses around the remaining body of fuel preventing the creation of a vacuum and thus eliminating the need for a fuel tank vent.

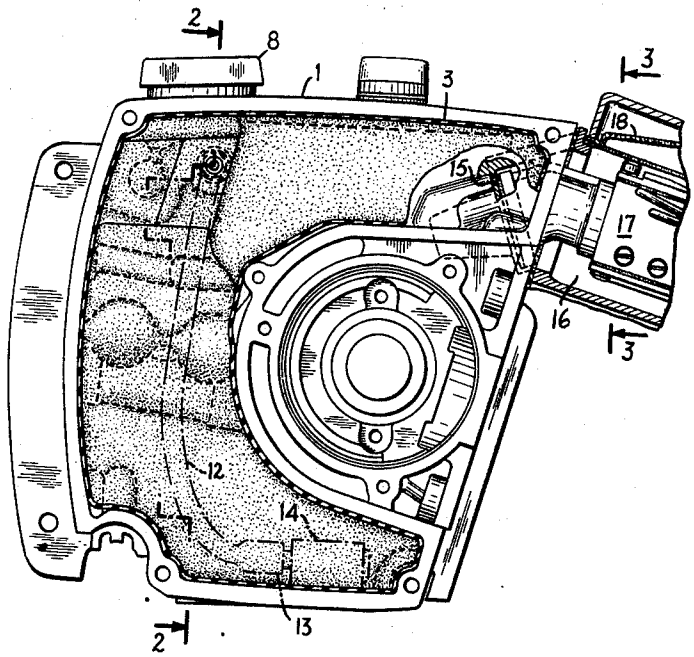
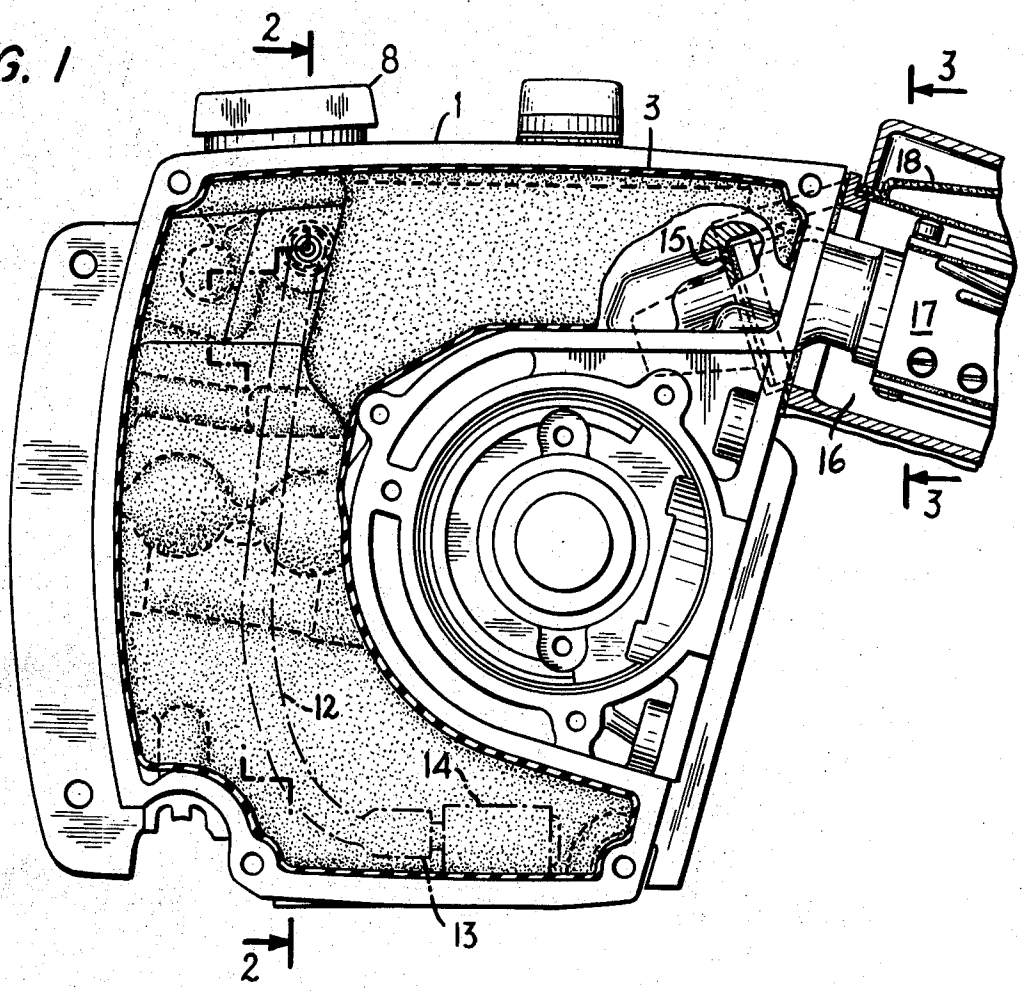


FIG. 1



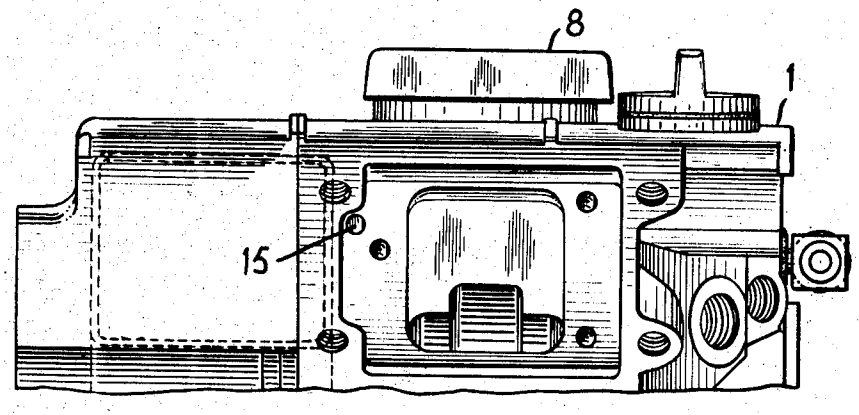


FIG. 3

FIG. 2

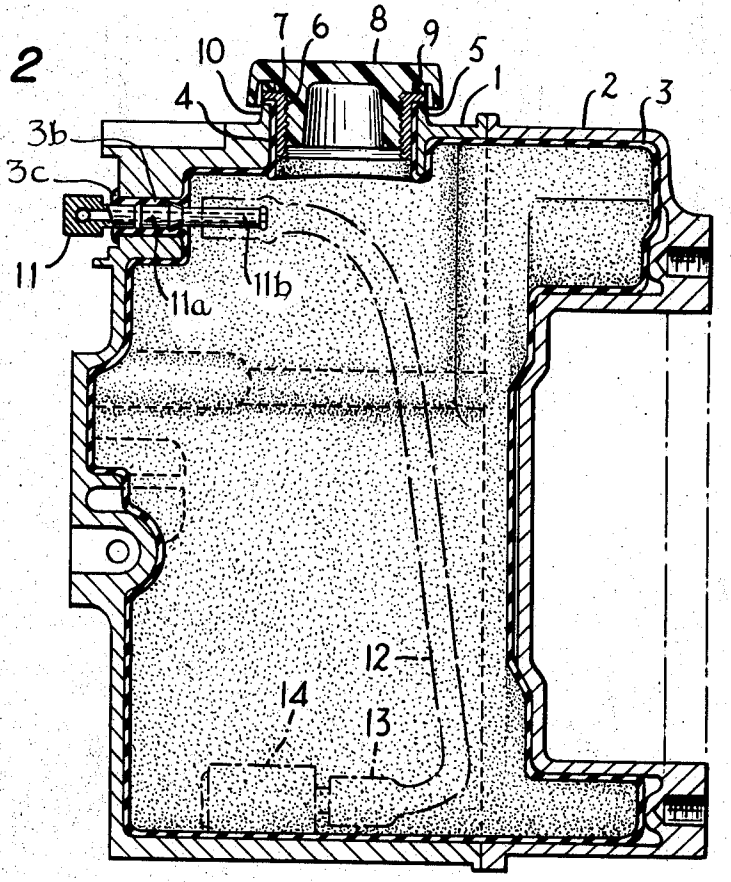
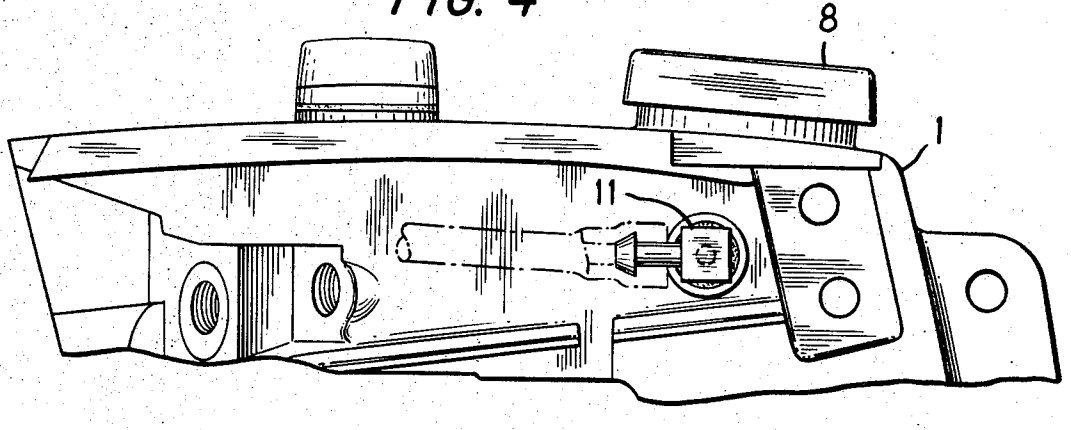


FIG. 4



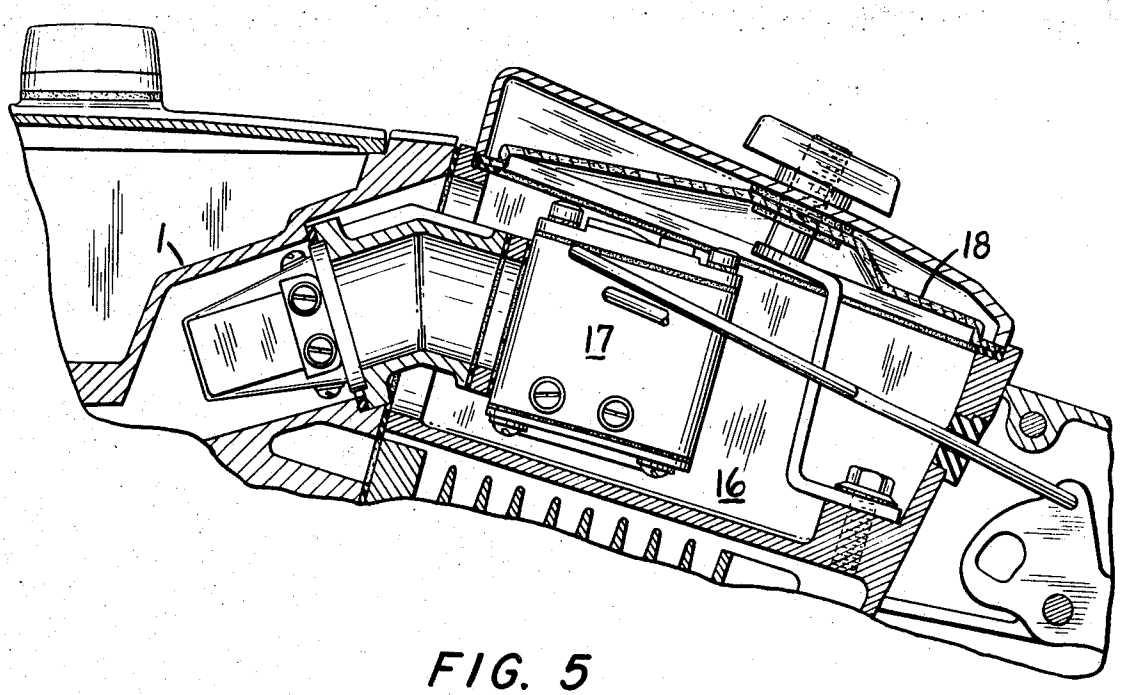


FIG. 5

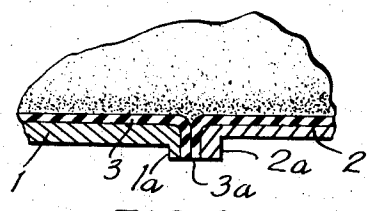


FIG. 6

FUEL TANK FOR INTERNAL COMBUSTION ENGINE

The invention relates in general to fuel tanks and more particularly to fuel tanks used on internal combustion engines for chain saws or other hand-held tools.

Present fuel tanks for internal combustion engines are rigid containers made of metal or plastic. These fuel tanks are vented to atmosphere or in some cases are pressurized so that a vacuum is not built up in the tank as fuel is used by the engine. Vented tanks have presented certain problems such as: (1) fuel leakage through the vents thus resulting in a fire hazard, (2) vent valves, if used, sometimes fail to function properly and cause a vacuum in the fuel tank which in turn results in fuel starvation or a vapor lock condition, thus detrimentally affecting engine performance, (3) in designs where the fuel tank may receive heat from the engine, or from other sources and where the fuel tank has a vacuum relief valve only, a positive pressure might build up in the tank high enough to flood the carburetor. If a pressure relief valve is used it is possible that fuel would be sprayed into the atmosphere and possibly over the hot engine resulting in a fire hazard.

Another disadvantage of the present rigid fuel tanks is the possibility of cracks occurring in the tanks and resulting in down time on the engine due to replacement of the tanks. A possible fire hazard due to fuel lost through the cracks also exists.

It is an object of this invention to provide a flexible fuel container which eliminates the need for a vent valve.

Another object of this invention is to provide a fuel tank which eliminates the possibility of fuel starvation or a vapor lock condition.

Another object of this invention is to provide a fuel tank having a flexible inner bladder which will contain the fuel and prevent a fire hazard even if the outer tank is ruptured.

Another object of this invention is to provide a fuel tank having a flexible inner bladder in which less fuel remains in an out-of-fuel condition than remains in a conventional rigid fuel tank.

Another object of this invention is to provide a fuel tank in which less heat is transmitted from the engine to the fuel than in a conventional fuel tank.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawing in which:

FIG. 1 is a longitudinal cross-sectional view of a crankcase of an internal combustion engine having an integral fuel tank incorporating the invention.

FIG. 2 is a cross-sectional view taken along the line 2–2 of FIG. 1.

FIG. 3 is a fragmentary view of the exterior of the crankcase shown in FIG. 1 taken along the line 3–3 of FIG. 1 showing the filtered air intake from the carburetor air intake chamber to the area surrounding the bladder.

FIG. 4 is a fragmentary view of the exterior of the crankcase shown in FIG. 1 showing the fuel outlet.

FIG. 5 is a somewhat enlarged view of a portion of the fuel tank and adjacent carburetor chamber.

FIG. 6 is a fragmentary sectional view corresponding to a portion of FIG. 2 but showing an alternative construction.

The fuel tank is secured to the crankcase for example by screws or, as shown by way of example in the accompanying drawing, comprises a rigid container integral with the crankcase of an internal combustion engine and a flexible fuel bladder disposed within the rigid container. A fuel inlet is provided, and a pendulously mounted fuel outlet is positioned within the bladder. An air inlet is disposed so as to present the outside of the bladder with a supply of filtered air. As fuel is withdrawn, the bladder collapses around the remaining body of fuel.

With reference to the drawings, the fuel tank comprises a portion of the main engine casting **1** having a fuel tank cavity and a fuel tank cover **2**. A relatively thin flexible bladder **3** is disposed within the fuel tank cavity. The end of a fuel inlet

neck portion **4** of the bladder **3** has the form of an outwardly flared flange **5**. An internally threaded fitting in the form of a sleeve **6** having a flange **7** is inserted in the neck portion **4** of the bladder **3** which is clamped between the fitting and a collar portion **10** of the casting **1**. A threaded cap **8** having a gasket **9** is assembled onto the fitting **6**. The cap **8** bears on the gasket **9** which in turn bears on the flange portion **7** of the fitting **6**. The flange portion **7** of the fitting **6** bears on the flange portion **5** of the bladder **3** which in turn bears on integral collar portion **10** of the casting **1**. There is no vent hole or vent valve in the cap **8**. The assembly thus forms an airtight and a fuel-tight seal.

The bladder **3** is conveniently formed of two hollow portions each molded with an outwardly flared peripheral flange (which is not shown in the drawing). The flanges are clamped together in a suitable fixture, heat sealed and trimmed or not, as the assembly method dictates. The bladder is assembled into the fuel tank by one of two alternative methods. In the first method, the untrimmed flange portion **3***a* of the bladder is clamped between the flanged edge **2***a* of the fuel tank cover **2** and the flanged edge **1***a* of the main casting **1** as seen in FIG. **6**. In the second method, a slight vacuum is applied to the trimmed bladder so as to collapse the bladder. The bladder is then placed in the main casting cavity and the fuel tank cover is assembled onto the main casting using screw means or epoxy bonding means. The trimmed flange portion of the bladder is entirely within the rigid cavity formed by the main casting and the fuel tank cover. The application of a vacuum to the bladder collapses the bladder so that no portion of the bladder is pinched between the fuel tank cover and the main casting during assembly. This construction is illustrated in FIG. **2**.

In an alternative construction, a locking pin is disposed piercing the neck portion **4** of the bladder **3** and locking the fitting **6** to the collar portion **10** of the casting **1**. The bladder **3** also has a fuel outlet neck portion **3***b* which extends through an outlet opening of the casing **1** and has a flange **3***c* at its outer end. A fuel outlet fitting **11** has a nipple portion **11***a* which fits into the neck portion **3***b* of the bladder and clamps it between the fitting and the periphery of the outlet opening of the casing. The nipple portion **11***a* has an inner end portion **11***b* which projects into the interior of the bladder.

The outer end of the fuel outlet fitting **11** is connected to the inlet of the fuel pump or the carburetor and the inner end is connected to a flexible fuel pickup tube **12** which is disposed within the bladder. The end **13** of the flexible tube is connected to a weighted fuel inlet fitting **14** having a wick type fuel filter. The flexible tube and the inlet fitting are pendulous so as to seek the lowest portion of the bladder and thus receive fuel even if the main casting is inverted or if a portion of the fuel has been withdrawn.

In an alternative construction a fixed fuel outlet port is disposed at the bottom portion of the bladder thus eliminating the flexible tube.

An air inlet port **15** which communicates with a supply of filtered air, for example the filtered air of the intake chamber **16** of the engine carburetor **17**, is provided in casting **1**. Air enters the chamber **16** through a filter **18**. Filtered air from the carburetor air intake chamber at approximately atmospheric pressure acts against the outside surface of fuel bladder serving to collapse the fuel bladder as fuel is consumed. It is an advantage to use filtered air rather than ambient air since in normal chain saw operation, the ambient air contains an objectionable amount of dirt and saw dust.

As fuel is consumed by the engine, the bladder being relatively thin, collapses around the remaining body of fuel and maintains contact with the body of fuel. Atmospheric pressure is constantly acting on the outer surface of the bladder thus eliminating the need for a vent or a pressure relief valve. As the bladder collapses, it draws away from the rigid cavity formed by the main engine casting and the fuel tank cover and thus decreases the amount of heat conducted to the fuel from the engine casting which is normally quite warm when the engine is in operation. The bladder has a wall thickness sufficient

to provide the requisite mechanical strength while being sufficiently thin to collapse readily under atmospheric pressure as the fuel in the bladder is consumed. The consumption of fuel hence does not result in creation of a subatmospheric pressure in the fuel tank.

The flexible bladder **3** is molded of a material which has the following properties: good flex life, good abrasion resistance, flexibility at low temperatures of −40° F., resistance to deterioration at high temperatures of +250° F. and imperviousness to fuels used in internal combustion engines. Typical materials which may be used are polyurethane elastomers such as B. F. Goodrich formulation Nos. 58101 and 58102. Suitable characteristics of the elastomeric material used are indicated by way of example in the following tabulation:

Property	Typical value	ASTM test method
Specific gravity	1.1–1.3	D12–27
Hardness, Shore	75A–55D	D676
Tensile strength, p.s.i.	5,000–7,550	D412
Modulus at 300% elongation, p.s.i.	1,110–3,700	
Resilience, percent	50–80	
Elongation, percent	490–600	
Low temperature brittleness point, ° F.	−100	
Taber abrasion, mg. loss (CS–17 wheel, 1,000 gms. wt. 5,000 cycles)	3	D1044–49T
H–18 wheel, 1,000 gms. wt. 2,000 cycles	85	D1044

Although I have described my invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim:

1. In a hand-held portable internal combustion engine having a casing and a carburetor, a fuel tank cover secured to said casing and defining therebetween a hollow housing having a fuel inlet opening, a fuel outlet opening and an air vent opening, a flexible fuel bladder disposed in said housing and conforming in shape to the interior of the housing, said bladder having a fuel inlet neck portion received in said fuel inlet opening and a fuel outlet neck portion received in said fuel outlet opening of said housing, means for securing said fuel inlet neck portion of the bladder in said inlet opening of the housing, a removable airtight closure for said inlet opening, means connecting said fuel outlet neck portion of the bladder with said carburetor of the engine, said bladder being hermetically sealed except for said inlet neck portion and said outlet neck portion, air intake means including means for filtering intake air and means connecting said air vent opening of said housing with said air intake means to supply filtered air between said bladder and said housing.

2. An internal combustion engine according to claim **1**, in which said filtered air intake means supplies filter air to the carburetor of said engine.

3. An internal combustion engine according to claim **1**, in which said fuel tank inlet opening of the housing comprises a cylindrical neck portion in which said fuel inlet neck portion of the bladder is received, and in which said means for securing said fuel inlet neck portion of the bladder in said inlet opening of the housing comprises a sleeve press fitted into said fuel inlet neck portion and gripping said fuel inlet neck portion tightly between said sleeve and said cylindrical neck portion of the housing, said sleeve being internally threaded and having an externally projecting flange at its outer end, said closure being externally threaded to screw into said sleeve and having a gasket seating on said flange to provide a fluid-tight seal.

4. An internal combustion engine according to claim **1**, in which said means connecting said fuel outlet neck portion with said carburetor includes a nipple press fitted into said fuel outlet neck portion of the bladder and clamping said fuel outlet neck portion between said nipple and the inner periphery of said fuel outlet opening of said housing, said nipple having an inner end portion projecting into the bladder, and in which a flexible fuel pickup tube inside the bladder has one weighted end and has the other end fitted onto said inner end portion of said nipple.

5. An internal combustion engine according to claim **1**, in which said casing and said cover have congruent peripheral flanged portions and in which said bladder has an outwardly projecting flange portion clamped between said flanged portions of said casing and said cover.

6. An internal combustion engine according to claim **1**, in which said fuel bladder is free of attachment to said housing except for said fuel inlet neck portion and said fuel outlet neck portion.