March 12, 1968 W. H. AITKEN 3,372,679

FUEL TANK VENTING SYSTEM

Filed April 27, 1966 2 Sheets-Sheet 1

Fig. 1.

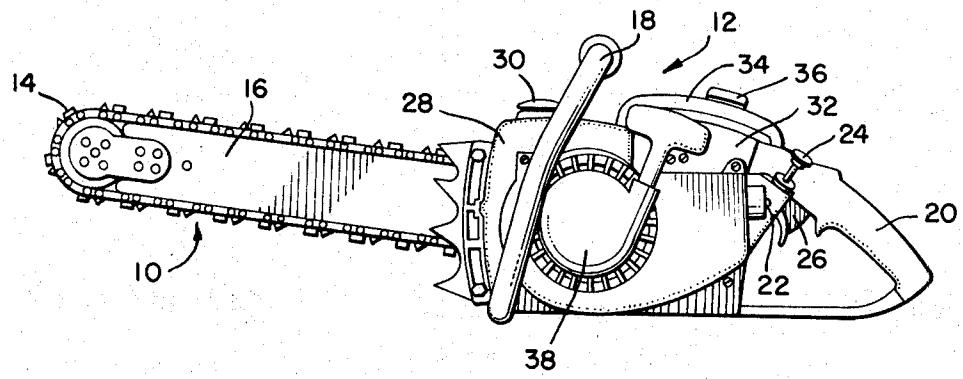
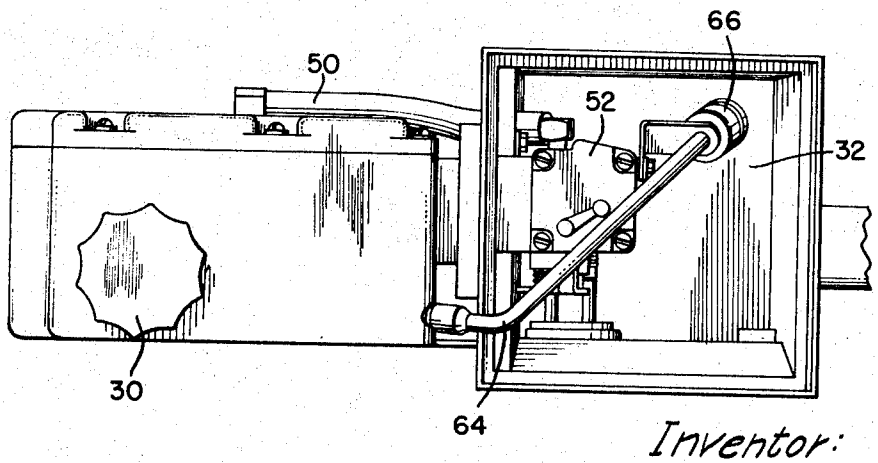


Fig. 4.



Inventor:
William H. Aitken

by John H Lewis Jr
John W. Phipps
Nicholas Skovran
Attorneys

March 12, 1968 W. H. AITKEN 3,372,679

FUEL TANK VENTING SYSTEM

Filed April 27, 1966 2 Sheets-Sheet 2

Fig. 2.

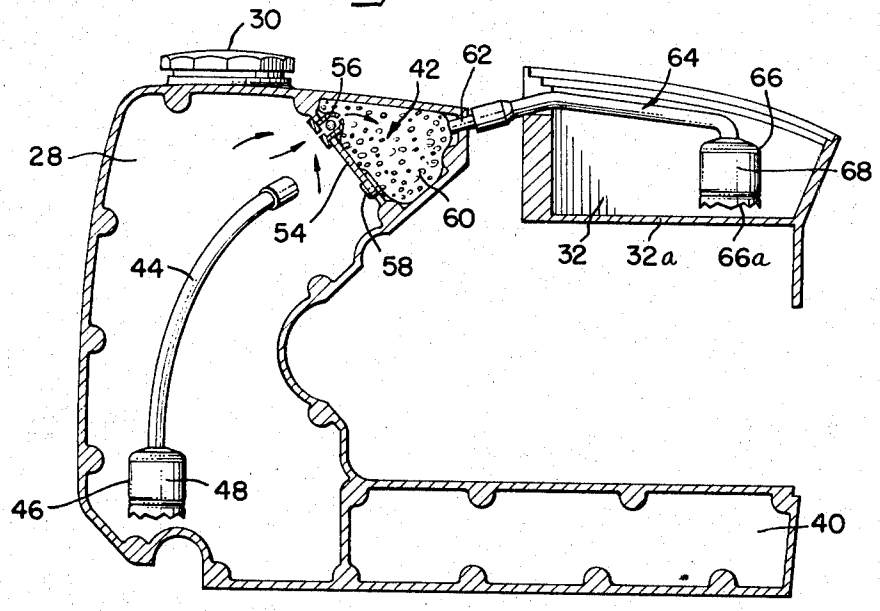
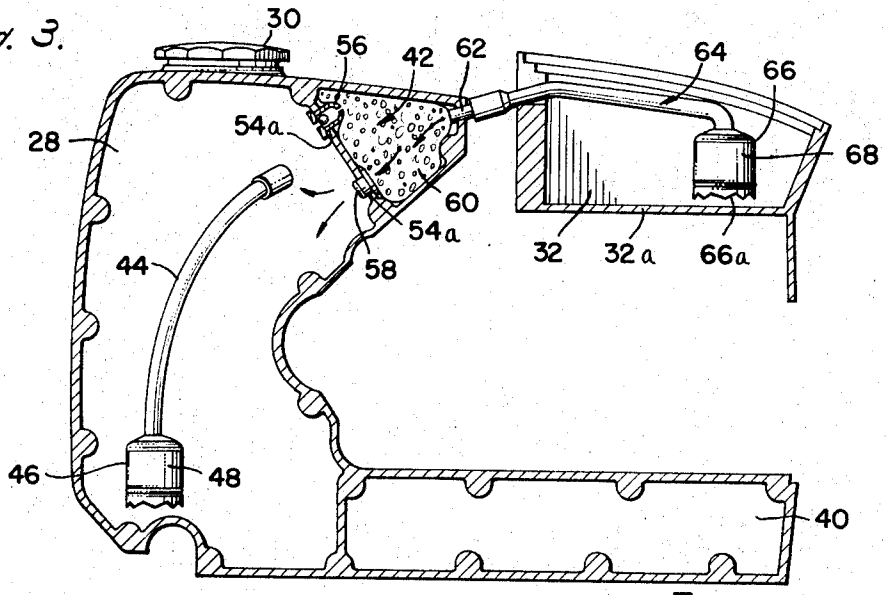


Fig. 3.



Inventor:
William H. Aitken

by John H. Lewis Jr.
John W. Phipps
Nicholas Skovran
Attorneys

United States Patent Office 3,372,679 Patented Mar. 12, 1968

3,372,679

FUEL TANK VENTING SYSTEM

William H. Aitken, Park Forest, Ill., assignor to Remington Arms Company, Inc., Bridgeport, Conn., a corporation of Delaware

Filed Apr. 27, 1966, Ser. No. 545,729
8 Claims. (Cl. 123—136)

The present invention relates to a fuel tank venting system and particularly to a venting system for chain saws driven by internal combustion engines.

In the design of chain saws, one of the necessary considerations is an adequate fuel tank venting system. General practice in the industry has been the use of two-way valving systems installed in the fuel tank filler opening cap. These valves consist of metal and neoprene disk combinations, special rubber diaphragms with slitted protuberances and the like. Many thousands of dollars have been expended to perfect such systems with only a minimum degree of success. Some of these systems work fairly well until a small wood chip or other foreign material gets caught in between disks or in the slits, etc., and then when pressure builds up in the tank, a spurt or drizzle of fuel is ejected from the tank. In some cases, a small orifice in the top surface of the cap allows a jet of fuel to spurt three or four feet into the air.

In other cases, a small hole is drilled in the threaded portion of the cap, above the seal, which allows the fuel to ooze out of the tank for the purpose of being less conspicuous to the chain saw operator than the spouting type. Since the presence of fuel on an operator's clothing or on the chain saw is dangerous as a fire hazard, such venting systems are banned in certain areas—particularly in Canada. In addition to the chain saw operator's safety, the danger of setting fire to the woods is probably one of the main reasons for banning use of saws with dribbling or spurting fuel tank vents in certain Canadian pulp wood areas.

There are some manufacturers who use a small tube to carry overflow fuel from the tank to a location where it is wasted on the cutting chain. Some chain saws have a fuel cap which is equipped with a one-way inlet valve to relieve vacuum in the fuel tank but provide no means of releasing pressure build-up other than by the flow of fuel through the engine carburetor. This system cannot be successfully used unless the carburetor used is of the type that will properly function when subjected to fuel pressure as high as 15 p.s.i.

Pressures in a chain saw fuel tank will build up from one or more of the following causes: (1) By filling a warm fuel tank with cool or cold fuel. As heat is transferred from the saw to the fuel mix (gasoline and oil), the fuel expands and produces pressure. (2) When gasoline is agitated or shaken, it builds up pressure in the tank. (3) Heat produced by operation of the chain saw engine will cause fuel to expand and vaporize causing pressure. (4) In any circumstance in which a cool saw is filled with fuel and then subjected to an increase in temperature, tank pressure will be increased.

In small gasoline engines used in an upright position, i.e., with the fuel tank cap on top as in lawn mowers, tillers, etc., fuel tank venting is no particular problem. A small orifice in the tank cap, above the fuel level, will bleed off gases and relieve pressure in the tank. Usually a porous disk of some type of fuel resistant material is placed on the underside of the cap to keep fuel from splashing through the hole. Only filling the tank too full will cause it to overflow if fuel expansion takes place.

It is obvious that such a system cannot be successfully used in a chain saw fuel tank since normal operation may position the fuel tank upside-down, on its sides, or in any

other possible attitude. For example, a chain saw is used to cut down trees while in one position while it is used in other positions to cut up trees or cut off limbs after the trees are felled. Thus, in the normal "felling" position, a chain saw is turned over on its right side with the guide bar and saw chain in a horizontal plane. In the normal "bucking" position, the chain saw is positioned vertically so that the fuel tank opening cap is on top and the guide bar and saw chain are in a vertical plane. Obviously, the chain saw can be used in any position but the most common positions are the felling and bucking positions mentioned above.

It is an object of the present invention to provide a fuel tank venting system for a portable tool driven by an internal combustion engine.

It is another object of the present invention to provide a fuel tank venting system for a portable tool which will minimize the possibility of fuel leakage despite the position of the tool while still venting the tool fuel tank.

It is still another object of the present invention to provide a fuel tank venting system for a chain saw which permits the use of a solid fuel tank filler cap.

Other features, objects, and advantages of the invention will appear from the following description and claims, and from the accompanying drawings in which:

FIGURE 1 shows a left side view of a chain saw in which the invention can be used;

FIGURE 2 shows a left side schematic view of the fuel tank venting system with arrows to show the direction of the excess fuel, etc. when excessive pressure is present in the fuel tank;

FIGURE 3 is similar to FIGURE 2 except that the venting system is now working in the situation where there is excessive vacuum in the fuel tank; and

FIGURE 4 is a top view of the fuel tank and carburetor chambers showing the air venting means.

It should be appreciated that although the invention is disclosed in a chain saw, it is intended that the invention can be used on any tool which is driven by an internal combustion engine.

FIGURE 1 of the drawing shows a conventional chain saw **10** having a gasoline engine **12** to drive a saw chain **14** around a stationary guide bar **16**. An operator would normally hold the chain saw by grasping the front handle **18** with his left hand and the rear handle **20** with his right hand. The ignition switch **22**, the manual oiler button **24** and the engine throttle trigger **26** are thus easily within reach of the operator's right hand. The fuel tank **28** is shown at the front of the engine and has a solid filler cap **30**. The carburetor chamber **32** is shown to the rear of the fuel tank and has a cover **34** removably attached thereto. Cover knob **36** is a threaded nut to secure cover **34** to carburetor chamber **32** and provides an operator with something to grab when lifting the cover **34** from the carburetor chamber to gain access thereto. Carburetor chamber **32** has an imperforate bottom wall **32***a* which permits any excess fuel to accumulate in the bottom portion of the carburetor chamber.

A recoil starter assembly **38** is shown on the left side of the engine.

FIGURE 1 shows the chain saw in the normal bucking position in which the fuel tank **28**, saw chain **14**, and guide bar **16** are vertically disposed. The felling position would be when the chain saw is turned at a right angle in a clockwise direction from the position shown in FIGURE 1 as viewed from the rear so that the fuel tank, saw chain and guide bar are in a substantially horizontal position.

Looking at FIGURE 2 or 3, we can now discuss the venting system. Fuel tank **28** is part of an integral structure which also includes an oil reservoir **40** and an ex-

pansion chamber 42. A fuel pick-up 44 having a bell-type end 46 with a felt filter 48 therein is positioned within the fuel tank. The other end of the pick-up 44 extends to a fitting through a side wall of the fuel tank which connects to a feed line 50 which enters the carburetor chamber 32 and connects to the carburetor 52.

The fuel tank 28 and the expansion chamber 42 are separated by a common wall 54 having apertures 54*a* and 54*b* therein in which an excess pressure valve assembly 56 and an excess vacuum valve assembly 58 are mounted. Preferably, the excess pressure valve 56 is a ball check valve while the excess vacuum valve 58 is a sensitive flutter-type valve. However, applicant's invention is not limited to the type of valve used en either instance.

A fuel retainer 60, e.g., a sponge made of flexible polyurethane, is positioned to fill the expansion chamber 42 and functions to pick up and hold liquid fuel which is forced into the expansion chamber. This prevents most of such fuel from flowing out through the air tube opening located on the opposite side of the chamber. The fuel retainer 60 also serves to filter out any small particles of foreign matter that might clog the delicate flutter valve 58, on the lower side of the expansion chamber when fuel returns to the tank 28 from the expansion chamber 42. Connected to the upper, rear, left-hand corner of the expansion chamber by use of a fitting 62 is an air vent means comprising an elongated tube 64. This connection location prevents fuel from flowing into the air vent tube (by gravity) during usual bucking and felling positions of the saw. The other end of the tube 64, including a bell-end 66 having notches 66*a* thereon and a felt filter 68 inserted therein, is fastened to bottom wall 32*a* in the right rear corner of the carburetor chamber so that when a felling cut is made with the fan side of the saw down—i.e., when the chain saw is turned 90 degrees counterclockwise of the position shown in FIGURE 1, as viewed from the rear, fuel will not flow into the air tube by gravity because the outer end of the tube is now in a higher position than the expansion chamber. Fuel pick-up 44 and air vent tube 64 can be conventional fuel resistant rubber tubes or, in general, any flexible member would work satisfactorily.

As previously mentioned, when a fuel tank is completely filled with a mixture of gasoline and oil, expansion of the fuel takes place when its temperature is raised. To prevent fuel from being expelled to the exterior of the tank through the air inlet, the expansion chamber 42 is provided into which the excess volume of fuel may flow. Volume of this chamber should be about one twelfth of the fuel tank volume in order to be sufficient to hold expansion induced by a temperature increase of 150° F. Before the fuel can flow into the expansion chamber, ball check valve 56 (see FIGURE 2) must be partially opened by excessive pressure within the fuel tank. As an example, the valve 56 may be set to open at about 6 p.s.i. This would then prevent liquid fuel from splashing into the expansion chamber and keep gases below 6 p.s.i. pressure from entering the chamber.

When a partial vacuum occurs in the main fuel tank 28, air is sucked through notches 66*a* of the air vent tube 64 into the expansion chamber and on into the main fuel tank. Fuel that may have accumulated in the air tube sponge 68 and the expansion chamber sponge 60 is drawn back into the main fuel tank 28. A further function of the air vent assembly 64 is to suck up fuel which at times may accumulate from carburetor "spit back" into the carburetor chamber 32. This fuel is absorbed by the felt filter 68 in the bell end 66 of the tube 64. The bell end 66 is purposely clamped to the floor of the carburetor chamber 32 to carry out this function. The notched lower rim 66*a* of the bell end 66 allows fuel to reach the filter 68 for the sponge action to take place.

Although a preferred form of the invention has been illustrated and described above, it is not intended that the invention is to be limited to the precise details of structure shown but rather it is desired to avail myself of such variations and modifications as come within the scope of the appended claims.

What is claimed is:

1. In a portable tool driven by an engine utilizing a volatile fuel, a fuel tank having an opening therein to provide access to the interior of said tank, removable cap means closing off said opening, an expansion chamber located outside of and adjacent to said tank, valve means through which said fuel and air can pass between said fuel tank and said expansion chamber, said valve means being actuated by predetermined pressure conditions within said fuel tank, air vent means having a first portion thereof in communication with said expansion chamber and having a second portion connected to a second chamber which is open to atmospheric pressure.

2. In a portable tool as recited in claim 1, said fuel tank and said expansion chamber being separated by a common wall, said valve means being positioned in said common wall and comprising at least one excess pressure valve assembly and one excess vacuum valve assembly, said excess pressure valve assembly being adapted to open up upon a predetermined excessive pressure being present in the fuel tank to permit excessive fuel and pressure to escape into said expansion chamber, said excess vacuum valve assembly being adapted to open up upon an excessive vacuum being present in the fuel tank to permit atmospheric air and any excess fuel in the expansion chamber to enter said fuel tank.

3. In a portable tool as recited in claim 1 wherein said expansion chamber has a fuel absorbing material positioned therein which functions to hold the excessive fuel which has entered the expansion chamber.

4. In a portable tool as recited in claim 1 wherein said air vent means comprises an elongated tube, said first portion of said air vent means comprising the inner end of said tube which is connected to said expansion chamber at a location which prevents fuel from flowing by gravity into the tube during the normal vertical position of the tool when the fuel tank cap means is on top and when the tool is turned to the right so as to be perpendicular to said vertical position; the other outer end of the tube being located in said second chamber so that when the tool is turned to the left so as to be perpendicular to said normal vertical position, the fuel will not flow into the tube by gravity because the outer end of the tube is in a higher position than the expansion chamber.

5. In a portable tool as recited in claim 1 wherein said second chamber comprises a carburetor chamber in which a carburetor is mounted, said carburetor chamber having an imperforate bottom portion which permits accumulation of excess fuel from the expansion chamber and "spit back" from the carburetor, said air vent means comprising an elongated tube having one end thereof connected to said expansion chamber and having the opposite end mounted so as to rest on said imperforate bottom portion of said carburetor chamber, said opposite end of said elongated tube having means thereon to permit air and any excess fuel in the carburetor chamber to be pulled into said elongated tube.

6. In a portable tool as recited in claim 1 wherein said expansion chamber is located adjacent the upper portion of the fuel tank when said portable tool is in its normal position in which the fuel tank cap means is on top, said air vent means comprising an elongated tubular member having absorbent filter means therein thereby permitting the aid vent means to function as a storage area for excess fuel as well as a filter for air and excess fuel which passes through the air vent means to reach the expansion chamber.

7. A venting system for a chain saw which is driven by an internal combustion engine comprising a fuel tank mounted on said chain saw, an opening in the top of said fuel tank to provide access thereto, an imperforate, re-

movable, cap means to close off said opening, an expansion chamber integrally connected with said fuel tank and having a common wall therewith, apertures in said common wall to provide communication between said fuel tank and said expansion chamber, valve means positioned in said apertures which are normally closed when the pressure within the fuel tank is at atmospheric pressure, certain of said valve means being actuated by predetermined pressure above atmospheric pdessure and certain of said valve means being actuated by predetermined vacuum pressure below atmospheric pressure within said tank to open up and permit the passage of air and fuel therethrough, a fuel retaining means positioned in said expansion chamber which filters and retains excess fuel which has entered the expansion chamber, and air vent means having one portion in communication with said expansion chamber and another portion open to atmospheric pressure.

8. A venting system as recited in claim 7 wherein said chain saw includes a carburetor chamber which is open to atmospheric pressure and in which a carburetor is mounted, said air vent means comprising an elongated tube which has the inner end thereof connected to said

expansion chamber at a preferred location which prevents fuel from flowing into the tube by gravity during usual bucking and felling positions of the saw, the other outer end of the tube being connected to the carburetor chamber so that when a felling cut is made with the left-hand side of the saw in a down position and the saw chain is horizontal, the outer end of the tube is in a higher position than the expansion chamber.

References Cited

UNITED STATES PATENTS

1,653,387	12/1927	Brown	220—85
1,689,352	10/1928	Maxon	220—85
1,841,691	1/1932	Wilson.	
2,126,367	8/1938	Clawson et al.	220—85
2,407,622	9/1946	Wells	220—86
2,640,627	6/1953	Doelter	220—85
2,696,931	12/1954	Whidden	220—88
3,170,005	2/1965	Phillips	123—136 X
3,259,752	7/1966	Honda	123—198 X
3,277,812	10/1966	Behlen	220—88 X

AL LAWRENCE SMITH, *Primary Examiner.*