

United
States
of
America



To Promote the Progress



of Science and Useful Arts

The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.



Katherine Kelly Vidal



DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

Maintenance Fee Notice

If the application for this patent was filed on or after December 12, 1980, maintenance fees are due three years and six months, seven years and six months, and eleven years and six months after the date of this grant, or within a grace period of six months thereafter upon payment of a surcharge as provided by law. The amount, number and timing of the maintenance fees required may be changed by law or regulation. Unless payment of the applicable maintenance fee is received in the United States Patent and Trademark Office on or before the date the fee is due or within a grace period of six months thereafter, the patent will expire as of the end of such grace period.

Patent Term Notice

If the application for this patent was filed on or after June 8, 1995, the term of this patent begins on the date on which this patent issues and ends twenty years from the filing date of the application or, if the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121, 365(c), or 386(c), twenty years from the filing date of the earliest such application (“the twenty-year term”), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b), and any extension as provided by 35 U.S.C. 154(b) or 156 or any disclaimer under 35 U.S.C. 253.

If this application was filed prior to June 8, 1995, the term of this patent begins on the date on which this patent issues and ends on the later of seventeen years from the date of the grant of this patent or the twenty-year term set forth above for patents resulting from applications filed on or after June 8, 1995, subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b) and any extension as provided by 35 U.S.C. 156 or any disclaimer under 35 U.S.C. 253.



US011850539B2

(12) **United States Patent**
Richardson

(10) **Patent No.:** **US 11,850,539 B2**

(45) **Date of Patent:** ***Dec. 26, 2023**

(54) **FUEL FILTER DEVICE**

(71) Applicant: **Michael Richardson**, Sandusky, OH
(US)

(72) Inventor: **Michael Richardson**, Sandusky, OH
(US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **17/480,808**

(22) Filed: **Sep. 21, 2021**

(65) **Prior Publication Data**

US 2022/0001313 A1 Jan. 6, 2022

Related U.S. Application Data

(63) Continuation of application No. 15/383,714, filed on Dec. 19, 2016, now Pat. No. 11,123,666, which is a (Continued)

(51) **Int. Cl.**

- B01D 35/143** (2006.01)
- B01D 35/30** (2006.01)
- B01D 37/04** (2006.01)
- B01D 36/00** (2006.01)
- B01D 27/06** (2006.01)
- B01D 27/08** (2006.01)

(52) **U.S. Cl.**

CPC **B01D 35/143** (2013.01); **B01D 27/06** (2013.01); **B01D 27/08** (2013.01); **B01D 35/306** (2013.01); **B01D 36/005** (2013.01); **B01D 37/04** (2013.01); **B01D 045** (2013.01); **B01D 2201/302** (2013.01); **B01D 2201/52** (2013.01); **B01D 2201/56** (2013.01)

(58) **Field of Classification Search**

CPC B01D 35/306
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 4,470,301 A 9/1984 Hutchins et al.
 - 4,512,882 A 4/1985 Fischer et al.
- (Continued)

FOREIGN PATENT DOCUMENTS

- DE 102007031382 A1 1/2009
 - DE 102008043197 A1 4/2010
- (Continued)

OTHER PUBLICATIONS

PCT International Search Report and Written Opinion from International Application PCT/US2014/048861, dated Nov. 12, 2014, 14 pages.

(Continued)

Primary Examiner — Jamel E Williams

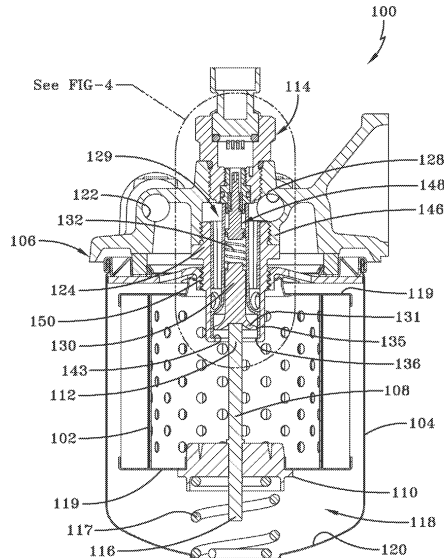
Assistant Examiner — Alex T Devito

(74) *Attorney, Agent, or Firm* — Tucker Ellis LLP;
Michael G. Craig

(57) **ABSTRACT**

A filter device including a probe where a filter element probe first end selectively engages with a sensing unit located in a filter head and a filter element probe second end is located in a contaminant portion of a filter canister. The probe fixedly engages through the filter element utilizing a sealing component. The filter element is disposed in the filter canister that engages with the filter head.

17 Claims, 5 Drawing Sheets



Related U.S. Application Data

continuation of application No. 13/965,583, filed on Aug. 13, 2013, now Pat. No. 9,522,353.

(56)

References Cited

U.S. PATENT DOCUMENTS

4,638,305	A	1/1987	Sutton	
4,659,466	A *	4/1987	Farr	B01D 35/30 210/541
5,213,682	A	5/1993	Richardson	
5,216,409	A	6/1993	Ament et al.	
5,462,658	A *	10/1995	Sem	F02M 37/54 210/438
5,879,543	A	3/1999	Amini	
6,248,236	B1	6/2001	Hodgkins	
6,558,444	B1 *	5/2003	Hunter	B01D 46/429 96/417
6,852,217	B2	2/2005	Jokschas et al.	
7,368,060	B2	5/2008	Faxides	

D588,935	S	3/2009	Richardson et al.
7,574,899	B2	8/2009	Minott et al.
2001/0004061	A1	6/2001	Popoff et al.
2003/0158635	A1	8/2003	Pillar et al.
2006/0157421	A1	7/2006	Faxides
2010/0117842	A1	5/2010	Fachidis
2011/0259088	A1	10/2011	Fisher et al.
2011/0284448	A1	11/2011	Dewes

FOREIGN PATENT DOCUMENTS

DE	102011078362	A1	1/2013
EP	0863788	B1	7/2003

OTHER PUBLICATIONS

PCT International Preliminary Report on Patentability, International Application PCT/US2014/048861, dated Feb. 25, 2016, 10 pages. Extended European Search Report for EP Application No. 14836485. 4, dated Apr. 4, 2017, 9 pages.

* cited by examiner

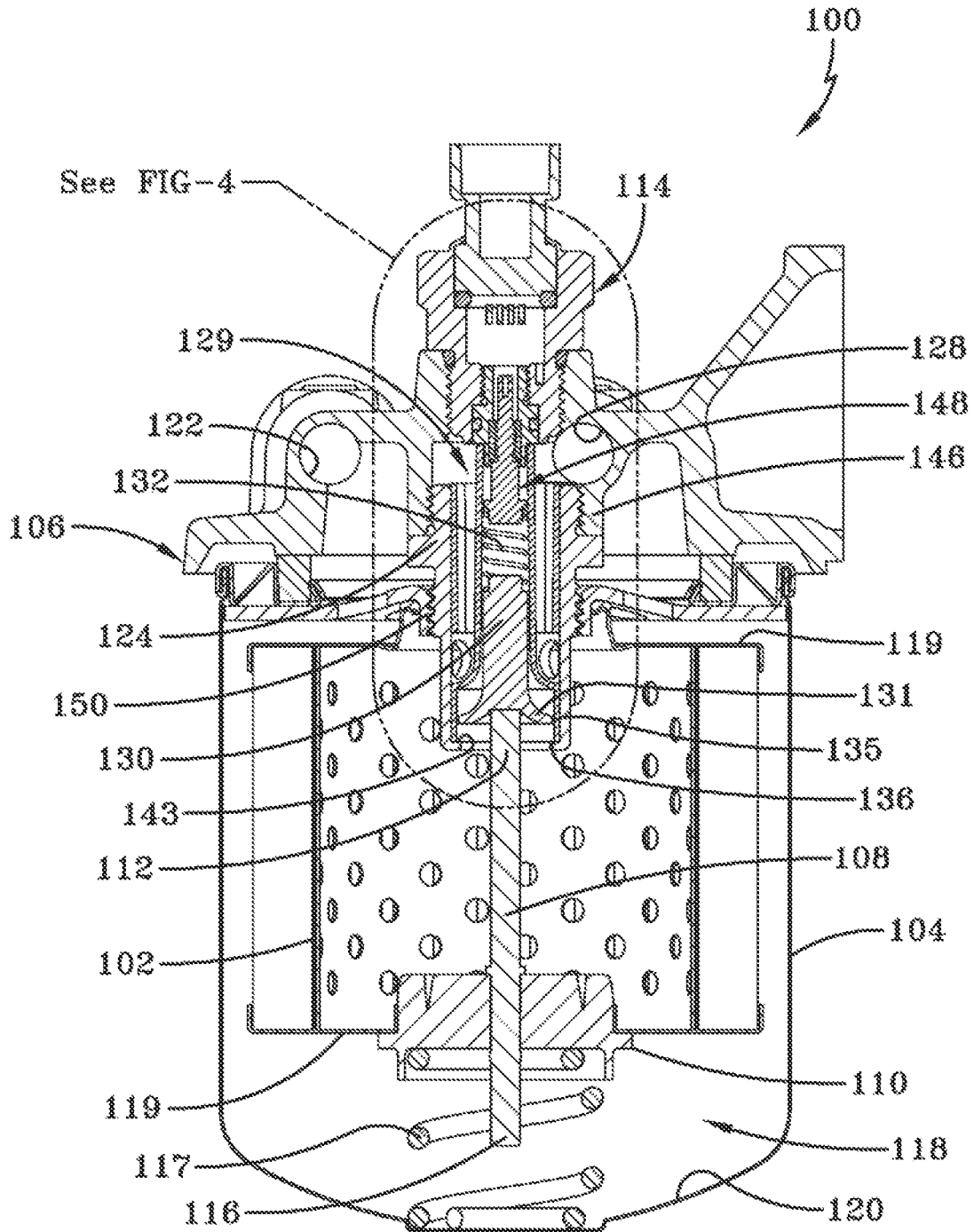


FIG-1

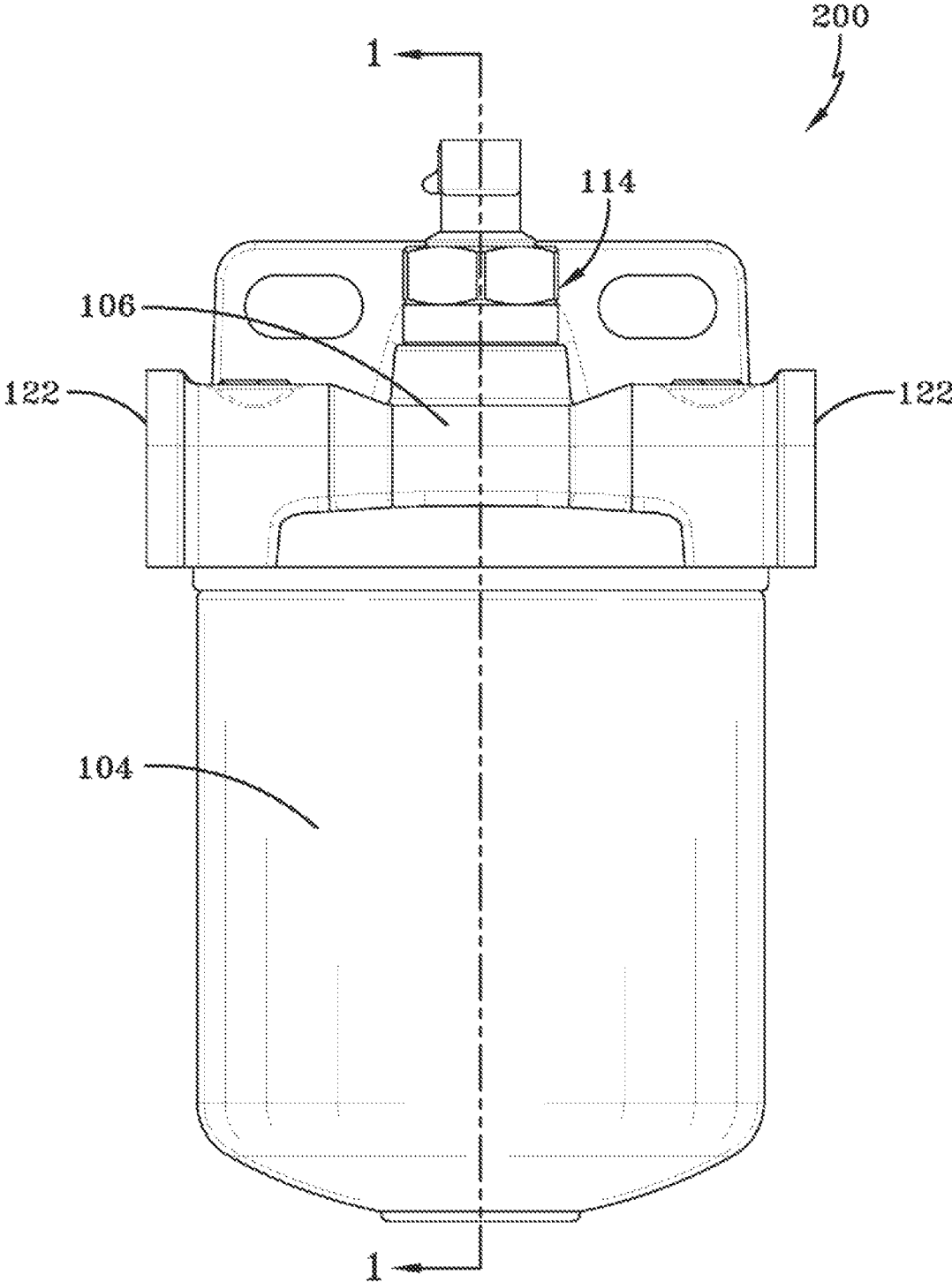


FIG-2

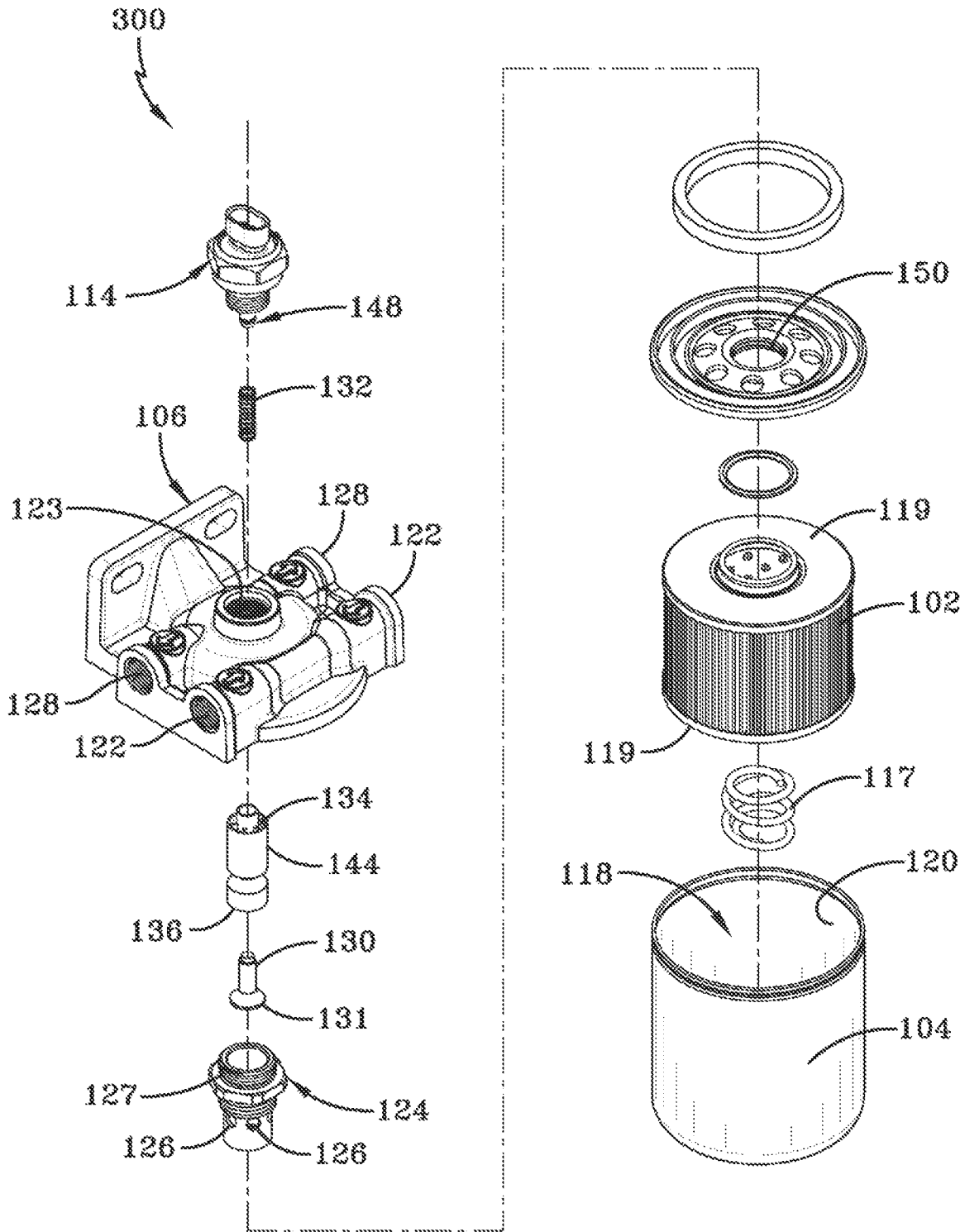


FIG-3

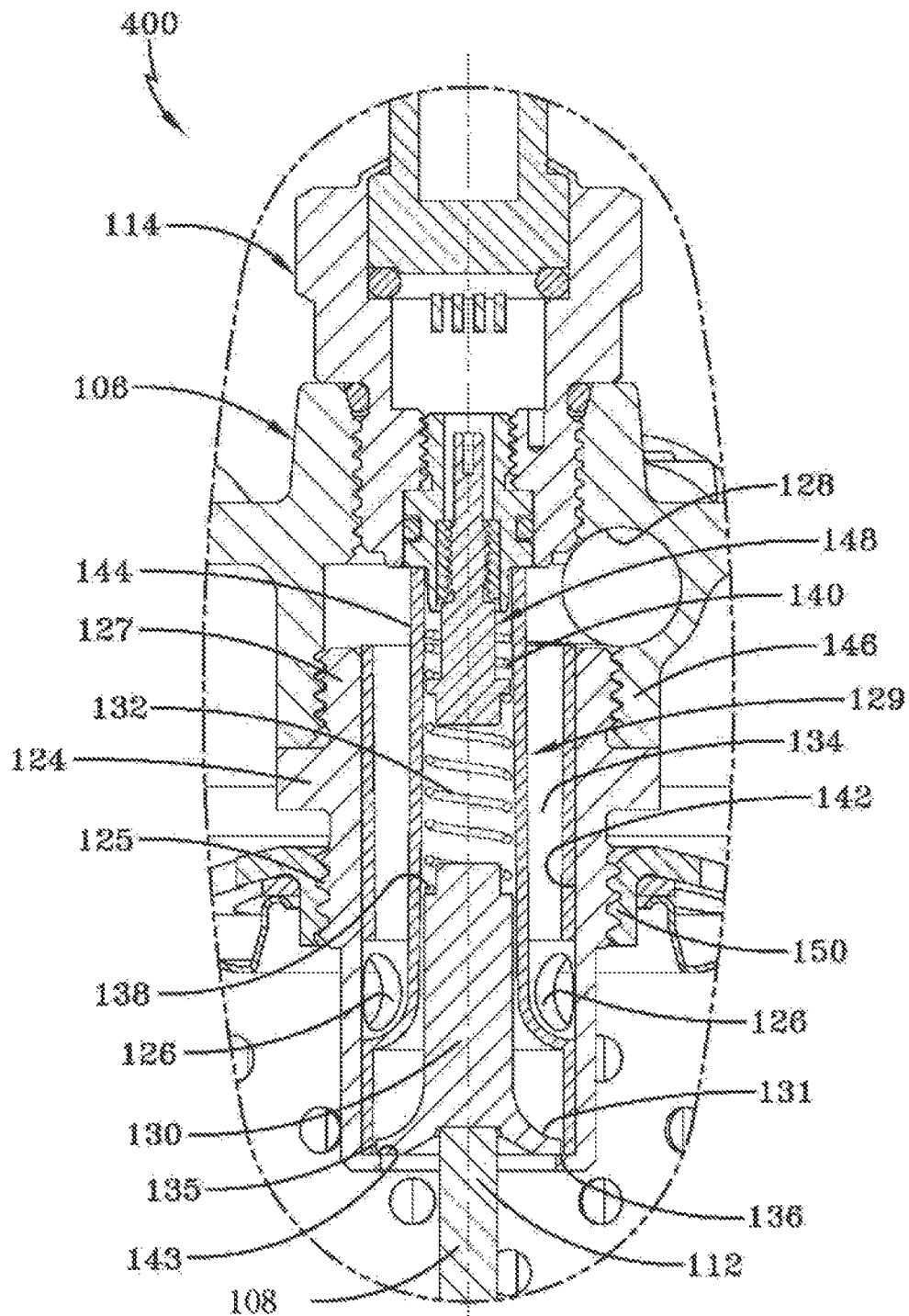


FIG-4

1

FUEL FILTER DEVICE**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application is a continuation of, and claims priority to, U.S. Ser. No. 15/383,714, entitled FUEL FILTER DEVICE, filed Dec. 19, 2016, which is now patented as U.S. Pat. No. 11,123,666, issued on Sep. 21, 2021, of which claims priority to, U.S. Ser. No. 13/965,583, entitled FUEL FILTER DEVICE, filed Aug. 13, 2013, which is patented as U.S. Pat. No. 9,522,353, issued on Dec. 20, 2016, all of which are incorporated herein by reference.

BACKGROUND

In general, automobiles, boats, ships, industrial vehicles, construction vehicles and other transportation vehicles incorporate a filter device. The filter device sometimes has a sensor or system for indicating the degree of contamination, the timing for replacing a filter or timing of renewal of contaminated oil thereby preventing occurrence of problems or issues in the vehicle engine, hydraulic system, etc.

Many of these prior art devices detect water or contamination after damage to the engine or engine shutdown has already occurred. In addition, many prior art contamination sensors are located on the outside of a filter canister which exposes them to debris and damage, for example when the filter is located in a wheel well.

Water in the fuel, for example if not detected quickly enough could result in the failure of the engine at a critical time in the operation of a vehicle.

SUMMARY

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key factors or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

The instant invention relates to a water or contaminant detection filter suited for use in connection with fuel supply systems, hydraulic systems and where the presence of water in a fuel or fuel mixture may cause loss of power when needed or damage to an engine.

The sensing instrumentalities of the instant invention are of a form which will minimize possible damage the engine and in turn provide for actuation of a sensing circuit located in the filter device. The instant invention provides the convenience, safety, and reliability of a spin on metal filter.

BRIEF DESCRIPTION OF THE DRAWINGS

What is disclosed herein may take physical form in certain parts and arrangement of parts, and will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIG. 1 is a cross sectional side view of an exemplary filter device enclosing a filter element with a probe, where a probe first end is constructed to selectively engage with a sensing unit, a probe second end is disposed in a contaminant receiving portion of a filter canister and the filter canister is attached to the fuel filter head.

FIG. 2 is a side view illustrating the exemplary filter device illustrated in FIG. 1 attached to the fuel filter head.

2

FIG. 3 is an exploded view of FIG. 2 illustrating an exemplary arrangement of the essential parts of the filter device in relation to one another.

FIG. 4 is a cross-sectional view of a spud and sensor assembly.

FIG. 5 is a side view illustrating an exemplary filter device attached to the fuel filter head where a wireless sensor and signal communicator wirelessly communicates with an electronic control module.

DETAILED DESCRIPTION

The claimed subject matter is now described with reference to the drawings, wherein like reference numerals are generally used to refer to like elements throughout. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the claimed subject matter. It may be evident, however, that the claimed subject matter may be practiced without these specific details. In other instances, structures and devices may be shown in block diagram form in order to facilitate describing the claimed subject matter.

Referring now to the drawings and particularly to FIGS. 1-3 illustrated in FIG. 1 is a cross-sectional side view of an exemplary filter device 100. FIGS. 2-3 illustrate a side view of the exemplary filter device 200 and an exploded view of the exemplary filter device 300, respectively. The filter device 100 comprises a filter element 102 that is arranged within a filter canister 104 (FIG. 2) to block a contaminant, for example, water within a fuel or mixture. The filter element 102 within the filter canister 104 is threaded, sealedly or non-sealedly engaged with a filter head 106, for example. The filter element 102 is non-fixedly sealedly engaged with a filter head 106 utilizing a filter element compression spring 117. Although this embodiment utilizes the filter element compression spring 117, other elements known by those of skill in the art are contemplated herein. A probe 108 fixedly or non-fixedly engages with the filter element 102 through a sealing component 110. The probe 108 comprises a probe first end 112 that is configured to selectively engage a sensing unit 114 (shown within the dashed oval) attached to the filter head 106. A probe second end 116 is disposed or located in a contaminant receiving portion 118 of the filter canister 104.

The probe second end 116 is located to electrically couple the sensing unit 114 when water is detected within the contaminant receiving portion 118 of the filter canister 104. An interior of the canister 120 comprises an electrically conductive material that is utilized to electrically couple with the sensing unit 114 when the filter canister 104 is selectively engaged with the filter head 106.

The filter element 102 comprises an end cap 119 where the end cap 119 defines a bottom end of the filter element 102 and the end cap 119 defines a top of the contaminant receiving portion 118 of the filter canister 104. The bottom interior wall of the interior of the canister 120 below the end cap 119 defines the bottom and sides of the contaminant receiving portion 118. The probe 108 is sealedly engaged with the sealing component 110 fixedly or non-fixedly connected with the filter element end cap 119.

Thus, for example if fuel or a mixture within the contaminant receiving portion 118 contains water, as soon as the water reaches the probe second end 116, the sensing unit 114 will sense a reduced electrical resistance and complete a circuit for sensing and signaling purposes. The sensing unit 114 determines a reduced electrical resistance between the

probe second end **116** and the electrically conductive interior of the canister **120**, for example, sensing the lower resistive through water as compared with diesel fuel.

The filter head **106** comprises inlet ports **122**, a threadably engaged electrically conductive spud assembly **123** with a spud **124** having side openings **126** providing mixture flow access to the outlet ports **128**. A threaded spud end **127** threadably engages with the filter head threaded opening **146** (FIG. 4). A threaded spud center portion **125** threadably engages with a canister top plate threaded opening **150**. A spring/touch plug assembly **129** comprises an electrically conductive touch plug **130**, a conductive spring **132**, an insulated spring capsule **144** and a sensor wire assembly **148**. The probe first end **112** is configured to engage the electrically conductive touch plug **130** that is slidably disposed within the insulated spring capsule **144** located within the spud **124**, wherein the touch plug **130** is biased by the spring **132** toward the probe first end **112**, when the filter canister **104** is selectively engaged with the filter head **106** (See e.g., FIG. 4). The electrically conductive touch plug **130** can comprise brass, stainless steel and the like. The compression spring **132** acts as a conductor between the touch plug **130** and the sensor wire assembly **148**. The mixture or fuel within the filter canister **104** is in communication with the mixture outlet ports **128** by passing through the multiple spud side holes **126**, and a defined passageway **134** within the insulated spring capsule **144**. The insulated spring capsule **144** can be a molded component, for example. The insulated spring capsule materials comprise fuel resistant polymers, fuel resistant composites, metals and the like.

The conductive touch plug **130** is disposed in contact with the conductive spud **124** when the probe first end **112** is not selectively engaged with the touch plug **130**. (e.g., a filter without a probe is attached to the filter head **106**). A touch plug first end outer lip **131** comes into contact with a spud inner lip **143** creating a touch off point **136**. In this situation the sensing unit **114** determines electrical contact between the spud **124** and the touch plug **130**, for example that indicates the lack of a probe in a filter device. The touch plug **130** is not in contact with the spud **124** (i.e., isolated by an insulated spring capsule **144**, see FIG. 4) when the probe first end **112** is selectively engaged with the touch plug **130** which overcomes the bias force of the spring **132** and moves the touch plug **130** away from contact with the spud **124**. The touch plug **130** and the spring **132** are retained within the insulated spring capsule **144** positioned between the spud inner surface **142** and the touch plug **130**. A spring first end **138** is attached to and restrained by a second end of the touch plug **151** as illustrated in FIG. 4 and a spring second end **140** is attached to the sensor wire assembly **148**, as illustrated.

In one aspect, the exemplary filter device (e.g., **100**, **200**, **300** of FIGS. 1, 2 and 3, respectively) may be used to filter an undesired contaminant from a desired constituent. For example, the exemplary filter device may be configured to be used in a fuel-water separator, where water mixed with a fuel supply can be filtered out, resulting in an output of fuel comprising less water.

In one implementation, in this aspect, the exemplary filter device may be disposed in a filter canister (e.g., **104** of FIG. 1). As one example, the combined filter device and filter canister may comprise a disposable filter unit, selectively engaged with a filter head (e.g., **106** of FIG. 1), which, in turn, is configured to receive a (potential) mixture of the desired constituent (e.g., fuel) and undesired contaminant (e.g., water). Further, in this example, the filter head may be

configured to output the desired constituent mixed with less of the undesired contaminant when the disposable filter unit is selectively engaged.

In one implementation, the disposable filter unit can comprise a contaminant receiving portion (e.g., **118**), that may be configured to receive and store the undesired contaminant. As an example, when the contaminant is removed from the constituent mixture it may collect in the contaminant receiving portion of the disposable filter unit, where it can be stored apart from the mixture filtering portion of the disposable filter unit. That is, for example, water filtered from a fuel-water mixture or mixture may collect in a bottom portion of the filter canister, where it can be stored, and can remain separate from the mixture and/or the filtered fuel. In one implementation, the contaminant can be drained from the storage area, such as through a coupled drain port. In another implementation, the entire filter may be removed and replaced when the contaminant area is full.

In this aspect, in one implementation, the filter device can comprise a probe (e.g., **108**) that is fixedly disposed in the filter device, such as through an end cap (e.g., **119**) engaged with a filter element (e.g., **102**) of the filter device. As an example, the end cap may comprise a sealing device (e.g., **110**), such as a disk, gasket, polymer or rubber grommet, or the like, that is configured to fixedly engage with the probe, while being fixedly engaged with the end cap. In this way, in this example, a second end of the probe (e.g., **116**) may be disposed through the end cap into the contaminant receiving portion of the disposable filter unit, while still maintaining a leak resistant barrier between the contaminant receiving portion and the filtered fuel.

In one implementation, in this aspect, the second end of the probe may be disposed in the contaminant receiving portion of the disposable filter unit at a point that corresponds to a desired filter change level. That is, for example, when the contaminant in the contaminant receiving portion reaches the second end of the probe, the contaminant receiving portion may comprise sufficient contaminant to indicate that the filter should be changed out with a new filter, and/or the contaminant receiving portion should be emptied of the contaminant, so that the filtering operations are not compromised (e.g., the contaminant overflows into the filtering operation). As an example, the level in the contaminant receiving portion at which the second end of the probe may be disposed may depend on a size and volume of the contaminant receiving portion, and/or an expected fill rate of the contaminant receiving portion.

In one implementation, a first end of the probe (e.g., **112**) may be disposed at a distal end from the second end, and may be configured to selectively engage with a touch plug (e.g., **130**, disposed in the filter head), such as when the filter unit is selectively engaged with the filter head. In this implementation, the first end and second end of the probe are electrically connected. In this implementation, the touch plug can be comprised in a touch plug assembly (e.g., **129**), which is electrically connected with a sensor coupling unit (e.g., operably or communicatively engaged with a sensor). Therefore, for example, a sensor **151** may be communicatively (e.g., wired or wirelessly) or operably coupled with the first end of the probe **112**, which is further operably coupled with the second end of the probe **116**. In this way, for example, when the contaminant reaches the level of the second end of the probe **116**, the wireless sensor and signal communicator **151** may be communicatively or operably coupled with the contaminant. The wireless sensor and signal communicator **151**, selectively engaged with the filter head **106** and electrically coupled with an ECM **152**.

5

In another implementation, sensor may be operably coupled with a user indicator, for example, configured to indicate to a user that the contaminant level in the filter has reached the desired change out level. That is, for example, when the contaminant fills the container to the level where it comes into contact with both the inside wall of the filter canister and the second end of the probe, the sensor may detect a change in electrical resistance, which may result in the user indicator being activated. In this way, the user may be able to identify when the filter needs to be changed, for example, by observing the user indicator (e.g., light, notice, sound, etc.).

Although the invention has been illustrated and described with respect to one or more implementations, alterations and/or modifications may be made to the illustrated examples without departing from the spirit and scope of the appended claims. In particular regard to the various functions performed by the above described components or structures (assemblies, devices, circuits, systems, etc.), the terms (including a reference to a “means”) used to describe such components are intended to correspond, unless otherwise indicated, to any component or structure which performs the specified function of the described component (e.g., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function in the herein illustrated exemplary implementations of the invention. In addition, while a particular feature of the invention may have been disclosed with respect to only one of several implementations, such feature may be combined with one or more other features of the other implementations as may be desired and advantageous for any given or particular application. Furthermore, to the extent that the terms “including”, “includes”, “having”, “has”, “with”, or variants thereof are used in either the detailed description and the claims, such terms are intended to be inclusive in a manner similar to the term “comprising.”

The word “exemplary” is used herein to mean serving as an example, instance or illustration. Any aspect or design described herein as “exemplary” is not necessarily to be construed as advantageous over other aspects or designs. Rather, use of the word exemplary is intended to present concepts in a concrete fashion. As used in this application, the term “or” is intended to mean an inclusive “or” rather than an exclusive “or.” That is, unless specified otherwise, or clear from context, “X employs A or B” is intended to mean any of the natural inclusive permutations. That is, if X employs A; X employs B; or X employs both A and B, then “X employs A or B” is satisfied under any of the foregoing instances. Further, at least one of A and B and/or the like generally means A or B or both A and B. In addition, the articles “a” and “an” as used in this application and the appended claims may generally be construed to mean “one or more” unless specified otherwise or clear from context to be directed to a singular form.

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims. Of course, those skilled in the art will recognize many modifications may be made to this configuration without departing from the scope or spirit of the claimed subject matter.

6

What is claimed is:

1. A filter system, comprising:

a filter head configured to operably engage with a filter, and that operably receives a fluid mixture at an inlet and provide a filtered fluid at an outlet, the filter head comprising:

a water sensor that detects water in the filter, the water sensor comprising:

a touch plug that operably, electrically connects with the probe when the filter is disposed on the filter head; and

a signal detector that detects an electrical signal from the probe through the touch plug; and

a transmitter that is electrically coupled with the water sensor, the transmitter communicatively coupling with a remote computer comprising a user display; the filter operably, selectably engaged with the filter head, the filter comprising:

a filter media that operably separates water from the mixture; and

a water collection cavity; and

a probe fixedly engaged with and disposed inside the filter, the probe extending from the water collection cavity to and in contact with the water sensor merely when the filter is engaged with the filter head;

wherein the touch plug end is slidably biased toward the filter in the filter head, and is configured to slide into the filter head when engaged with the probe to create an electrical coupling between the water collection cavity and the signal detector.

2. The system of claim **1**, the transmitter comprising a wireless signal transmitter that uses a wireless connection to communicatively couple with the remote computer.

3. The system of claim **1**, the transmitter comprising a wired communication bus that uses a wired connection to communicatively couple with the remote computer.

4. The system of claim **1**, the remote computer comprising a user interface providing an indication of a water level status in the water collection cavity.

5. The system of claim **4**, the user interface providing an alert indicative of water in the water collection cavity reaching a level that contacts the probe during operation.

6. The system of claim **5**, the alert indicative of the water collection cavity of the filter is being filled to a predetermined threshold fill level.

7. The system of claim **1**, the touch plug configured to open a normally closed fluid path between the inlet and the filter when engaged by the probe to slide the touch plug into the filter head.

8. The system of claim **1**, the filter device comprising an outer shell that holds fluids, the outer shell defining a wall of the water collection cavity.

9. The system of claim **8**, at least a portion of an interior of the shell comprising an electrically conductive material that is electrically coupled with the water sensor when the filter device is engaged with the filter head.

10. The system of claim **9**, the probe configured to electrically couple the water sensor with the interior of the shell when water contacts the probe in the water collection cavity.

11. A filter system, comprising:

a filter head comprising:

a mixture intake port where an unfiltered mixture of water and other fluids are introduced into the filter head;

a mixture discharge port where a filtered mixture with water removed is discharged from the filter head;

7

a filter head spud that operably engages with a filter for filtering the unfiltered mixture;
 a water sensor that detects a water level in the engaged filter;
 a touch plug that is slidably biased toward the filter inside the filter head spud, the touch plug electrically coupling the water sensor with a probe fixed inside the engaged filter, wherein the spud and touch plug respectively comprise electrically conductive material, and:
 the touch plug is in electrical contact with the spud when the probe is not engaged the touch plug; and
 the touch plug is not in electrical contact with the spud when the probe is engaged with the touch plug; and
 a transmitter that is electrically coupled with the water sensor, the transmitter communicatively coupling with a remote computer comprising a user display.

12. The filter head of claim **11**, the water sensor generating a signal for the transmitter when the touch plug is electrically coupled with the filter head spud.

13. The filter head device of claim **11**, the filter head spud comprising a fluid passageway that allows fluid into the filter.

14. The filter head of claim **13**, the filter head spud comprising proximal and distal ends, and:
 a first chamber that houses the touch plug in a biased, slidable disposition; and
 a second chamber in fluid communication with the fluid passageway at the proximal end of the filter head spud, the first chamber is electrically insulated from the second chamber.

15. The filter head of claim **11**, the transmitter comprising a wireless signal communicator electrically coupled with the water sensor, and wirelessly, remotely, communicatively coupled with the remote computer.

8

16. The filter system of claim **11**, the water sensor operably detecting the presence of water inside the filter when the water contacts the probe, electrically coupling an outside shell of the probe with the water sensor through the probe.

17. A method of making a filter system, comprising:
 disposing a water sensor in a filter head, wherein the filter head is configured to operably engage with a filter, to receive an unfiltered fluid mixture at an inlet, and to discharge a filtered fluid mixture from an outlet, and wherein the water sensor detects a presence of water in the engaged filter;
 disposing a transmitter in the filter head, wherein the transmitter is electrically coupled with the water sensor, and the transmitter communicatively couples with a remote computer comprising a user display;
 engaging the filter with the filter head, wherein the filter comprises a filter media configured to separate water from the unfiltered mixture, and wherein the filter further comprises a water collection cavity defined by at least a portion of an outer shell of the filter, and wherein the outer shell is comprised of an electrically conductive material that is operably in electrical contact with the water sensor, and wherein the filter comprises a fixedly engaged probe disposed inside the filter, wherein the probe extends from the water collection cavity to and in contact with the water sensor when the filter is engaged with the filter head;
 wherein when a water level in the water collection cavity operably contacts the probe a circuit is created between the outer shell, the probe, and the water sensor.

* * * * *