MULTI-DENSITY SCREW-ON THROW AWAY TYPE FILTER

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11 Claims

ABSTRACT OF THE DISCLOSURE

Screw-on, throw away filter cartridges having dual con-
centric filter elements therein.

This application is a continuation of our application
Ser. No. 483,012, filed Aug. 18, 1965, which in turn is a
continuation of our application Ser. No. 346,745, filed
Feb. 24, 1964, both now abandoned.

This invention relates to improvements in filter and
particularly to an improved oil filter of the spin-on throw
away type which is generally mounted on the engine
block of an internal combustion engine or the like.

An object of the present invention is to provide a full
flow filter of the screw-on throw away type having a
novel multi-density parallel flow construction.

Another object is to provide a full flow filter of the
screw-on throw away type, having a novel multi-density
construction in which the filtering elements are arranged
for series flow of fluid there-through.

Known types of multi-density filters having parallel
flow paths, embody a core or central flow passage. Such
core or flow passage constitutes wasted space insofar
as adding to the filtering efficiency or effective life of the
filter is concerned. It is accordingly an important object
of the present invention to provide an improved filter structure of the type referred to in which the previously
wasted core space is utilized for providing a multi-density
parallel flow, or to provide a series-parallel flow con-
struction.

Another object of the invention is to provide an an-
nular pleated paper, spin-on or screw-on throw away
filter with a second filter element, which may be of
the pleated paper type or of the molded-depth type, as
associated therewith in a novel manner whereby the useful
life of the filter is greatly increased over that of the
normal, or known, annular pleated paper type filter.

Another object of the present invention is the at-
tainment of the object set forth in the preceding para-
graph without increasing the size of the normal annular
pleated paper type filter.

A further object of the invention is to provide an im-
proved filter construction of the outside-in flow type
embodying an elongate annular filter element having a
central flow passage in which is disposed a secondary
parallel, or series parallel, filter element and wherein the
filter elements may have the same or different degrees of
porosity.

Still another object of the invention is to provide an
improved filter construction of the outside-in flow type
embodying an elongate annular paper, such as a primary annular pleated paper
filter element having a secondary, elongate filter element of a higher porosity disposed concentrically therein with means for directing fluid flow initially from the outer side of the primary filter element into and through the second-
ary filter element to the core of the primary element, fol-
lowed by passage of fluid through the primary element to and through the core thereof, with pressure relief
means for full flow of fluid to the lubricated parts of the
engine, or machine, when a pre-determined level of con-
tamination of the elements is reached.

Still another object of the invention is to provide an
improved filter structure of the outside-in flow type, hav-
ing an elongate annular filter element of known porosity
censuring a foraminous reinforcing tube, and another
elongate filter element of tubular form within and of
materially smaller outside diameter than said reinforcing
tube and having a fluid inlet end and a fluid outlet end
and being of the same porosity as, or greater or less
porosity than the surrounding element, with pressure actu-
ated valve means between the outlet end of the smaller
element and the fluidizer fluid outlet of the filter structure,
adapted to open when a predetermined level of contami-
nation of the elements is reached.

Still another object of the invention is to provide an im-
proved anti-drainback pressure relief filter structure of
the outside-in flow type, having an elongate center flow
passage filter element of known porosity, and another
elongate filter element of tubular form concentrically
within and of materially less outside diameter that the said flow passage, which latter filter element may be of
the same porosity as, or of greater or less porosity than,
the surrounding filter element. The latter filter element
having a fluid inlet and outlet end, with a pressure relief
valve between the said outlet end of said latter element
and the fluidizer fluid outlet of the filter structure, adapted
to open when a pre-determined level of contamination of
the filter elements is reached.

Other objects and advantages of the invention will
become apparent as a description of the invention, in its
several disclosed forms, proceeds, with the understanding
that the invention is not confined to a strict conformity
thereof, but with the showing of the drawings, wherein:

FIGURE 1 is an exterior perspective view of a filter
structure embodying in its interior one of the dual filter
assemblys of the following figures.

FIGURE 2 is a central longitudinal section taken sub-
stantially on the line 2—2 of FIGURE 1.

FIGURE 3 is a transverse section taken substantially
on the line 3—3 of FIGURE 2.

FIGURE 4 is a section corresponding to the lower
portion of FIGURE 2 and showing the anti-drainback
valve and the pressure relief valve in open position.

FIGURE 5 is a transverse section taken substantially
on the line 5—5 of FIGURE 2.

FIGURE 6 is a perspective exploded view of the sev-
eral elements making up the dual filter unit construction
shown in FIGURE 2.

FIGURE 7 is a vertical section through the top por-
tion of a modified construction in which is shown an
apportioning orifice leading into the high porosity valve
element.

FIGURE 8 is a vertical longitudinal section illustrating
another dual filter element arrangement or association
having control valves at the inlets and outlet ends of the
center passage of the high porosity element.

FIGURE 9 is an exploded perspective view of the parts
associated with the high porosity element of FIGURE 8.

FIGURE 10 is a longitudinal section through another
embodiment of the filter structure illustrating another
association of the parts of the central high porosity element
and a pressure relief valve, the latter being shown in anti-
drainback closed position.

FIGURE 11 is a sectional view corresponding with
the lower portion of the structure of FIGURE 10 and show-
ing the pressure relief valve in fully opened position.

FIGURE 12 illustrates a modified construction of top
end of the filter structure can or housing having a safety
nut arrangement associated therewith to prevent exces-
sive tightening of the filter structure upon installation on
3,467,256

a supporting stud but providing wrench engaging means for facilitating its removal.

FIGURE 13 is a longitudinal section through another construction of the filter structure showing the inner or central filter element extending the full length of the cartridge having the pressure relief valve in the top end thereof.

FIGURE 14 is a transverse section taken substantially on the line 14--14 of FIGURE 13 showing the "M" form pleat or of the outer filter element.

FIGURE 15 is a vertical longitudinal section through the embodiment of the filter structure showing the use of the tubular central filter element functioning as a center reinforcing means in place of the foraminous center tube and also illustrating the two valve arrangement in the construction.

FIGURE 16 is a vertical sectional view through a structure generally corresponding to FIGURE 15 but showing the lower end of the center filter element closed, the filter structure being designed for use where the filter pressure relief valve would be located in the filter mounting base or elsewhere in the engine.

FIGURE 17 is a transverse section taken substantially on line 17--17 of FIGURE 16.

FIGURE 18 illustrates an embodiment of the invention wherein the molded center filter element is formed or molded inside the corrugated center reinforcing tube and wherein egression of the fluid from the molded central element is downward between the pleats of the pleated filter medium or element.

FIGURE 19 is a longitudinal section through an embodiment of the invention wherein the central filter element is extended into the domed section of the filter cartridge encasing can, and illustrating the use of another type of anti-flowback and pressure relief valve in the base of the structure.

Referring now more particularly to the drawings, the numeral 10 generally designates the complete screw-on, throw away type filter structure of the present invention. In this perspective view, the can or shell of the filter structure is designated 12. This can or shell is preferably formed in one piece, the side wall being designated 14 while the closed end wall or head is designated 16. The opposite or inner end is closed by an end closure unit which is generally designated 18.

For convenience of description, in referring to the drawings where the filter structure is illustrated in upright position, the outer, head or closed end and the inner closure unit end, or inlet and outlet end, will be referred to, respectively as the top and bottom ends. Corresponding terms are used in describing the elements of the cartridge within the can. It is to be understood, however, that since the filter structure in many applications will be mounted at an angle, or even hanging generally downward relative to the engine, the use of the terms "top end" and "bottom end" is not to be taken as limiting the position of use of the filter structure.

The end closure unit 18 for the shell may be formed in or have a number of different configurations to provide an anti-flowback valve means. The numeral 18, therefore, will be used generically for the end closures of the different embodiments of the invention hereinafter described without regard to the particular form of anti-flowback valve means forming a part of the end closure structure. Such valve means will be specifically described as necessary for each of the different embodiments of the invention illustrated.

Where the anti-flowback valve means is the same in different figures, the same reference characters will be applied.

In addition to the foregoing, the reference characters 14 and 16 will be used in each of the figures of the drawings to designate respectively the side wall and end wall of the can except in the structure of FIGURE 12 where a modification of the head or end wall of the can is disclosed.

The end closure 18 embodies a wall part 20 having fluid inlet apertures 22 therein. At the center of the wall part a threaded nut 24 is fixed by means of which the filter structure may be threaded directly onto the engine block of an internal combustion engine in accordance with standard well known practice. Through this nut, filtered oil passes back from the filter structure to the oil galleries of the engine.

Upon the inner side of the wall part 20 is the flexible valve disk 26. This valve disk encircles the inner end portion of the nut 24 and is movable relative to the inlet apertures 22 to form an anti-flowback valve means which, when closed, has the flexible disk 26 resting upon the inner surface of the wall part 20 over and in closing relation with the apertures 22. This type of valve is well known and further description of the same is not considered necessary for an understanding of its operation.

The invention in each of the different embodiments thereof is characterized primarily by the formation of a cartridge structure having an outer annular filter element with a center flow passage or core, in which is positioned an inner or secondary tubular filter element. These filter elements may be constructed to have the same degree of porosity or the inner filter element may have a greater or lesser degree of porosity than the filter element. In addition to the foregoing, it is to be understood that whereas the illustrations of the different embodiments show the outer filter element to be in the form of an annular pleated paper element with the inner tubular filter element illustrated as a molded element or depth type filter, the inner element may be a smaller pleated paper filter of either the same or a different flow rate material, depending on the filter's intended use. Also, the outer element may be a depth media associated with a pleated or depth media inner element.

Referring now to the invention as illustrated in FIGURES 2 to 6 inclusive, the numeral 28 generally designates the dual element filter cartridge which comprises the outside or primary filter element 30 and the inside or secondary filter element 32.

The primary element 30 is in the form of an elongate annular structure which may be a pleated paper structure as illustrated in FIGURE 3 or it may be a depth type structure. This element thus has the axial inner flow passage 34 and the pleats 33 extend, wide-sidedly, radially of the element.

The outside diameter of the primary filter element 30 is smaller than the inside diameter of the can whereby the annular flow passage around the primary element is formed as indicated at 34 when the cartridge is installed in the shell.

The top and bottom ends of the primary element have fixed therein the top and bottom end caps 36 and 38 respectively. These caps carry the peripheral flanges 40 and 42 which encircle the filter element as illustrated.

The end caps partially cover the flow passage or core area 34 of the element as shown and each of the caps has a central opening therein, the opening in the top cap 36 being designated 44 while the opening in the lower cap is designated 46.

The numeral 48 designates a flanged collar which is disposed within the opening 46 and rests at its lower end upon the valve disk 26 with the flange 50 thereof secured to the underside of the adjacent end cap 38. This collar receives and encircles the inner end portion of the nut 24 and forms a mounting or support for the filter element 30.

Disposed concentrically within the flow space 34 of the primary filter element is a corrugated foraminous flow tube 52 which functions as a reinforcement for the primary filter element.

The flow tube has its ends secured to the annular, or apertured, end caps which are designated 54 and which
engage against the inner surfaces of the top and bottom end caps 36 and 38 of the filter element.

The inner or secondary filter element 32 is of tubular form as illustrated and is disposed concentrically within the foraminous flow tube 52 and the ends of the secondary filter element are engaged in the centrally apertured caps 56 and 58.

These caps 56 and 58 have the apertures thereof axially aligned with the flow passage 60 which extends through the filter element 32.

As shown, the secondary filter element 32 is of materially less outside diameter than the inside diameter of the foraminous flow tube 52 and this filter element is also of materially less length than the foraminous tube.

The bottom or lower end cap 58 of the secondary filter element has fixed thereto a pressure relief valve 62. This pressure relief valve consists of the substantially U-shaped cage 64, the coil spring 66 within the cage, and the valve disk 68.

Lateral ears carried by the opposite sides of the cage 64 are fixed, by welding or other suitable means, to the underside of the cap 58 and, as shown, the valve disk 68 is pressed by the spring 66 against the cap 58 in a covering relation with the central opening therein.

The secondary filter element 32 is supported centrally within the foraminous flow tube 52 by the helical spring 72. The spring rests at the lower end upon the bottom end cap 54 of the foraminous tube and at its top end it encircles the pressure relief valve and presses against the bottom end cap 58, of the secondary filter element. Thus the secondary element is supported by the spring 72 and firmly, at its upper end, against the top cap 54 of the foraminous tube.

While the bottom end of the entire filter cartridge structure is supported by the flange 50 which bears upon the valve disk 26 and which disk in turn is supported by the enclosure wall part 20 through the medium of the nut 24, the top end of the filter cartridge is maintained in spaced relation from the top end or head 16 of the can by the resilient spacer element 74 which is interposed between the head 16 and the top end of the cartridge. This spacer element comprises the centrally apertured spring metal body 76 which rests upon the top end cap 36 of the primary filter element and is concentric with the passage 60 in the secondary filter element. Resilient arms 78 extending outwardly from the body portion 76 of the spacer element press at their outer ends against the underside of the end wall 16 of the can. These arms, being under tension, press the cartridge down firmly upon the end closure 18 as will be readily apparent.

Thus, there is provided an oil receiving chamber 80 in the outer end of the can.

This and the other filter units are of the outside-in flow type as will be readily apparent. In operation the oil to be filtered enters under the anti-flowback valve disk 26 by way of the apertures 22 and flows upwardly in the space 34 to the top of the filter elements into the chamber 80 as indicated by the arrows.

Preferably, the primary or outer filter element is of less porosity than the inner element 32. Accordingly, the major portion of the oil will pass downwardly from the chamber 80 into the passage 60 and then laterally, as indicated by the arrows, through the body 32 which is of greater porosity and passes downwardly between the second filter body 32 and the foraminous flow tube 52, to pass out through the nut 24 as indicated.

A pressure builds up within the filter, due to contamination of the secondary filter element 32, the oil will then flow through the primary filter 30 and down around the secondary filter to the outlet.

Complete stoppage of flow of oil through the two filter elements will then result in sufficient build-up of pressure to effect the opening of the pressure relief valve 62 so that a full flow of unfiltered oil will be permitted to pass through, as will be readily evident.

In the description of succeeding figures where elements of the filter structure are the same as illustrated and described in connection with FIGURES 2 to 6 inclusive, the same reference characters will be applied and used to avoid repetition.

Referring now to FIGURE 7, a modified resilient spacer element is shown together with means forming an apportioning orifice through which oil is directed from the chamber 80 in the head end of the filter passage 60 of the inside or secondary filter 32.

The lower end of the structure of FIGURE 7 may be the same as the lower end of the structure of FIGURE 2. The upper end of the inner filter 32, however, terminates below the top end cap 36 of the primary filter 30 and has secured thereto the disc 100, the center of which is provided with the apportioning aperture 102.

In this location, disks with apertures of different sizes may be employed to regulate the amount of oil flowing from the chamber 80 into the passage 60 of the primary filter.

The opening in the cap 36 has suspended therein a cup 104, the bottom of which rests upon the disk 100 and has a central opening 105 therein. The cup has the out-turned flange 106 which rests upon the top of the disk 36 as illustrated.

Positioned in and resting upon the bottom of the cup 104, is a coil spring spacer element 108 which performs the same function as the spacer element 74 hereinafore described. The top of this spring spacer element bears against the underside of the head 16 of the can and the spring, being under tension, holds the entire filter cartridge structure firmly against the wall part of the end closure.

The numeral 110 designates a nut secured to the head wall 16 of the can to facilitate the use of a wrench or a similar tool in applying and removing the filter structure.

FIGURES 8 and 9 illustrate a construction in which the inner or secondary filter comes into play only after a predetermined pressure is reached on the outer filter element. In this construction a pressure control valve, generally designated 112, is suspended in the upper end of the flow passage 60 of the inner or secondary filter element 32. The pressure control valve consists of the elongate, U-shaped spring cage 114 having the laterally projecting suspension ears 116 which rest upon the top end of the valve element 32 as shown. These ears 116 are maintained in place by the centrally apertured top end cap 118 in which the top end of the filter element 32 is seated. Mounted within the cage 114 is the coil spring 120 which supports the valve disk 122 and presses the latter against the underside of the cap 118 to close the aperture 124 of the cap.

The lower end of the passage 60 is closed by a bypass valve which is here generally designated 126. This valve structure, however, is similar to the structure of the pressure relief valve 62 hereinafore described, opening downwardly to permit full flow of oil through the cartridge, bypassing the filter elements when the latter become contaminated to an extent to build up sufficient pressure to force this valve, as well as the valve 112, open.

In this double valve construction for the center or secondary filter element, the pressure control valve will remain closed for a predetermined period, thereby causing oil to flow through the outer filter element 30 until a predetermined pressure is built up against the secondary filter. This pressure will then cause the control valve 112 to open and oil will flow into the passage 60 and laterally through the filter element 32 whereby parallel flow of oil from the two filter elements will be obtained. Upon continued pressure build-up due to increased contamination of the two filter elements, the bypass valve 126 will be forced open so that oil will then flow directly from the chamber 80 through the passage 60 of the inner filter element and out of the filter can.

In this construction of FIGURE 8 the end closure 18
of the can and the anti-drainback valve are of a different construction from that shown in FIGURE 2.

The end closure of FIGURE 8 comprises a relatively thin metal annular wall part 128, the inner periphery of which is provided with the sealing gasket 130 while the outer portion or outer periphery is joined to the can wall 14 by a conventional can seam.

Upon the inner side of the wall part 128 is a relatively heavy plate 132 which is formed integral with the central internally threaded nut portion 134 which corresponds to the nut 124 previously described.

The plate 132 is also provided with oil admission apertures 136, two only of which are shown but which preferably form a circular series around the nut portion 134.

These apertures 136 lie upon the inner surface of the plate 132 and have a central opening 140.

The collar 142, here shown and which corresponds to the collar 48 of FIGURE 2, encircles the nut 134 and rests at its lower end upon the plate 132 and then is extended into the upturned and laterally projecting flange 144 which bears against the underside of the bottom end cap 38 of the outer or primary filter element 30. This lower portion of the collar 142 is encircled by or extends through the valve disk opening 140 and the valve disk is sufficiently loose around the collar to permit it to be moved up and down.

The valve disk, as shown, lies flat upon the top of the plate 132 and extends over and closes the inlet openings 136.

The valve disk 138 is lightly pressed onto the surface of the plate 132 by spring fingers 146 which are preferably formed from the disk and extend upwardly and bear against the underside of the bottom end cap 38 of the outer filter.

The anti-drainback valve here shown and described is more fully illustrated and described in pending application Ser. No. 622,477, filed Nov. 15, 1956, now Patent 3,193,101, July 6, 1965.

FIGURES 10 and 11 illustrate another embodiment of the invention wherein the lower end of the flow passage of the inner, secondary or high porosity filter element is closed.

With this embodiment of FIGURES 10 and 11 there is illustrated the use of a pressure relief or safety valve structure such as is illustrated in pending application 164,940, filed Jan. 8, 1962, now Patent 5,253,805, Feb. 15, 1966.

The inner or secondary filter element 32 of FIGURES 10 and 11 has the central flow passage 60 thereof closed by an imperforate cap 148 which rests upon the top end of the coil spring 72. The lower end of this spring is supported in the same manner as is illustrated in FIGURE 2. Thus, the closed lower end of the filter element 32 is located a substantial distance above the bottom end cap 38 of the outer filter 30.

As shown, the top end of the filter element 32 is covered by and bears against the top cap 56, as in the FIGURE 2 structure, and the cap has the central opening thereof forming a communication between the chamber 80 in the top of the can and the flow passage 60.

The safety or pressure relief valve 150 co-acts directly with the apertured wall plate 152. This wall plate is approximately the same in design as the wall plate 20, but since it is slightly different in the central portion thereof, it will be described specifically.

Numeral 154 designates the oil inflow passages formed in the plate 152.

Fixed in the center of the plate 152 is the internally threaded nut 156 which is formed with the upwardly facing surrounding shoulder which encircles the relatively upwardly extending neck 160.

The safety or pressure relief valve is combined with anti-drainback means as shown. This valve includes the flat valve disk 162 which is of sufficient diameter to rest at its outer periphery upon the wall plate 152 beyond the inlet openings 154 so that these openings are covered or closed when the valve is in the position shown in FIGURE 10.

The valve disk is formed with an upwardly extending outer sleeve member 164 and an inner sleeve member 166 spaced therefrom to form the upwardly opening wall 168.

The inner sleeve member 166 encircles and has vertical sliding movement on an inner relatively long vertical sleeve 170 of the filter support member 172 while the outer sleeve member 164 is adapted to slidable engage the inner surface of the outer vertical portion 174 of the filter support member, which vertical portion carries the outwardly extending surrounding flange 176 upon which the bottom end cap 38 of the outer filter 30 rests.

As shown, the neck portion 160 of the nut extends into the lower end of the vertical sleeve 170 and this lower end of the sleeve has sealed engagement with the surface of the shoulder 158 as indicated at 178.

The sleeves 164 and 166 are of sufficient length so that when the valve disk 163 is seated to close the oil inlet ports 154, the upper end thereof is above the outer space or chamber 180 so as to close off the bypass ports 182.

A spring 184 resting in the well 168 and extending upwardly into the chamber 180 normally urges the valve disk 162 downwardly to the closed position shown in FIGURE 10.

The filter element supporting portion of the valve structure 150 extends into the lower portion of the spring 72 as shown and the spring maintains the cap 148, which closes the lower end of the passage 60, at a substantial distance above the top of the filter support member. From the foregoing it will be seen that when the filter structure of FIGURES 10 and 11 is in operation and when the inner or secondary filter element is of higher porosity than the outer filter element 30, all of the oil flow would be through the center or inner filter element 32 while part of the flow would go through the lower porosity main or outer filter element 30 and then through the center passage below the cap 148 to and through the valve structure 150 and through the nut 156.

FIGURE 11 illustrates the position of the safety bypass valve when the two filter elements have become contaminated to a condition where high pressure is built up in the filter structure. Under this condition, the valve disk 162 would be raised to its fullest extent as shown so as to uncover the bypass ports 182, thereby permitting the oil to flow directly from the inlet openings to and through the mounting nut 156 and back to the oil galleries of the engine.

By providing openings leading from the chamber 80 into the annular space between the two filters in the manner illustrated and described in connection with the following figures, and by controlling the size of such openings, a certain portion of the fluid could be forced through the low porosity outer or main filter 30. By the provision of such openings opening from the chamber 80 into the annular space between the inner and outer filter elements, a condition is obtained whereby the low porosity outer or main filter would be warmed from the outside and inside.

When the valve 150 comes into operation to directly bypass fluid, there would be no necessity for fluid to pass by the dirty portions of the filter before being directly bypassed.

FIGURE 12 illustrates the structure for controlling the flow of oil between the two filters and also illustrates a safety nut mounted upon the head of the can in such a manner as to prevent the use of a wrench in screwing the filter structure onto its mounting but providing means for the use of such a tool to effect the unscrewing or removal of the filter from its mounting.

In this FIGURE 12 the head 186 of the can is provided
with a recess or well 188, in the bottom of which is fixed the upstanding threaded stud 190.

The nut 192 is threaded, together with the stud, to be of opposite hand to the threads of the nut in the end closure of the filter structure. Thus, if the filter structure is designed to be mounted upon its support with righthand threads, the nut and stud threads would be lefthand. Accordingly, the nut would back off of the stud if a wrench or other tool were used to screw the filter structure onto its mounting. But if the mounting of the filter structure should have become too tight to permit unscrewing the filter by hand, a wrench could be applied to the nut 192 and it would merely tighten up on the stud 190 so that the filter could then be readily unscrewed from its mounting.

This FIGURE 12 also illustrates the hereinafter referred to openings leading into the annulus between the two filters whereby a certain portion of the fluid may be forced through the low porosity main filter, when such openings are used in conjunction with a valve in the top end of the fluid passage 60 of the inner filter element.

As here shown, the top end cap 36 of the outer filter element is provided with a number of small apertures 194 at a location where these apertures will pass oil from the chamber 80 in the head end of the can, into the annular space 34 between the inner filter element 32 and the foraminous reinforcing flow tube 52. These apertures 194 may be arranged in a circular series or may be arranged in a circular series and as before stated, by controlling the size of the openings 194 the amount of oil passing into the annular space or passage 34 can be controlled or regulated.

The end cap 36 has an inner marginal portion extending inwardly beyond the inner peaks of the plating of the paper filter element and has a central opening 36 therein. Outwardly of the opening 36' there are a plurality of openings 194' thereof. On the inner side of the end cap there is disposed and held a ring-like member A having a central opening B and with a plurality of spaced openings A' thereof and which said openings are in registry with the openings 194. The arrangement of the inwardly disposed member with its openings in registry with the openings in the marginal portion of the end cap provides a means whereby when different sized registered openings are utilized the amount of oil to be discharged into the annular space is determined. Obviously, these openings may be varied in the different filters to provide this regulating feature as to the amount of oil that passes through the registered openings.

The apertures 194 are used in conjunction with the downthrust valve unit 196. This valve unit opens to permit fluid to bypass the filter elements to return directly to the engine, when the filter elements become blocked or cease to function by reason of an excessive accumulation of contaminating material, as will be readily obvious.

In the structure illustrated in FIGURE 13 all of the fluid flow will go through the high porosity center core or inner filter element which is generally designated 198, while part of the flow will go through the low porosity main or outer filter element which in the filter construction shown in this figure, is generally designated 200.

In this construction the annular pleated paper filter material 202 is positioned at the lower or bottom end in the bottom end cap 204 which has a center opening 206 defined by the upturned flange 208, the outside diameter of which is approximately the same as the diameter of the passage 210 through the inner filter element 198.

The end closure structure shown in this FIGURE 13 and the entire drainback valve element with the supporting nut therefore, are of approximately the same design as shown in FIGURE 2 and accordingly the same reference numerals are applied to these parts.

The collar 210 which encircles the inner end portion of the nut 24 has an upwardly directed annular flange 212 which fits into the annular flange 208. This collar, as illustrated, rests upon the valve disk element 26 as in the previously described structure.

The inner filter element 198, referred to as the high porosity element, extends entirely through the length of the outer filter element as shown and rests at its lower end upon the top surface of the end cap 204.

The flow passage 210 has suspended in the upper end thereof the downwardly opening valve element 214 which, like the valve element 196, is of substantially the same design or construction as the pressure control valve 112, shown in FIGURE 8.

In this construction of FIGURE 13, as in the structure shown in FIGURE 12, a number of apertures 216 are formed in the top end cap of the outer filter element, which cap is here designated 218, and through adjacent underlying parts of the structure to permit fluid to pass downwardly from the area above the cap 218 into the annular space 220 between the inner and outer filter elements.

With the construction illustrated in FIGURE 13, it will thus be seen that the size of the openings 216 will control the amount of fluid forced through the outer valve element and the fluid flow in addition to being from the outside inwardly through the outer filter element into the annular passage 220, will also be by way of the openings 216 into this passage and then through the inner low porosity element 198 to the central passage 210 thereof. When the degree of contamination of the two filter elements becomes such as to retard the flow of filtered oil to a sufficient degree, the bypass or pressure relief valve 214 will open to permit full flow directly to the engine.

While the pleated paper portion forming the outer filter element may be of the same design as that shown in FIGURE 3, it is here illustrated as having long and short pleats a and b, respectively, which have the appearance in cross section of the latter M. This particular pleat formation is illustrated in Patent No. 2,627,350.

FIGURES 15, 16 and 17 illustrate a filter construction or unit built without a reinforcing center tube in the central passage of the outer filter element. In the construction illustrated in these figures, the inner filter element, illustrated as a molded element or depth type member or element, itself serves as a center reinforcing core and the fluid flows from the outside inwardly through the pleated outer or denser filter element and down between the pleats of the denser element to the lower end of the central element and then into the central flow passage to the outlet.

Referring particularly to FIGURE 15, it will be seen that the container or housing structure for the filter core unit may be the same as the structure illustrated in FIGURE 2 and accordingly the same reference characters are applied as are used in the description of the structure of FIGURE 2.

The outer or pleated paper filter element is here generally designated 222 and is maintained between the top and bottom end caps 224 and 226, respectively.

The inner filter element is generally designated 228. This inner element, as shown, is of larger overall diameter than the corresponding elements in the forms of the invention where the foraminous reinforcing tube is employed and accordingly, being of larger diameter, the exterior surface of the inner element is in very close proximity to the inner ends of the pleats of the outer element, or has direct contact with the inner ends of the pleats, and thus provides reinforcement for the outer element.

The inner element 228 is also considerably shorter than the outer element and has the top and bottom end caps 232 and 234, respectively, which are centrally apertured at 235 and 236 as shown.

Within the upper end of the inner element 228 there is mounted the downwardly opening valve unit 236 which is of similar construction to units shown in previously
described structures such as, for example, the structure shown in FIGURE 8.

The bottom cap 234 of the inner unit has fixed to the underside thereof the downwardly opening valve unit 238 and the entire cartridge structure is maintained in position between the coil spring 240 and the spring unit 242 in the top or dome of the can.

The coil spring 240 corresponds to the hereinbefore described supporting spring units such as are shown in FIGURES 2 and 8, for example, while the spring element 242 corresponds to the element 74 hereinbefore described.

In FIGURE 16 there is shown a different lower end construction from that shown in FIGURE 15 where the lower end valve or pressure relief valve instead of being joined to the lower end of the filter element, would be located in or supported by the filter mounting base or elsewhere in the engine. The upper end of the structure of FIGURE 16 could have either the single valve similar to the valve shown in the upper end of the inner filter element of FIGURE 15 or the structure could be combined with the orifice illustrated in FIGURE 7. In this FIGURE 16 it will be seen that the inner filter element which is generally designated 243, extends farther down in the central passage or core of the outer filter element, which is generally designated 244, and functions, like the element 228, because of its close proximity to the inner part of the element 244, as a reinforcing means for the latter element.

The lower end of the inner element 243 is closed by an impervious end cap 245. Thus, it would be apparent that with a fluid admission orifice in the top end of the element 243 or by using a valve unit corresponding to the valve 256 of FIGURE 15, the fluid flow might be in part through the outer filter element and from the inside of the element 243 outwardly into the spaces 246 between the pleats of the outer element, into the area 247, below element 243, to pass out through the tubular mounting nut 24.

FIGURE 17 illustrates the M formation of the pleats for the filter element 243 employed in FIGURE 16 and also in FIGURE 15, as well as in other embodiments of the invention.

FIGURE 18 illustrates an embodiment of the invention wherein the molded member which forms the inner filter element is actually molded inside of the corrugated foraminous tube. Here, as in the structures of FIGURES 15 and 16, ejection of fluid from the molded or center filter element would be directly into the spaces between the pleats of the outer denser pleated filter element or filter medium and then downwardly between the pleats into the central area or space below the inner element.

In this FIGURE 18, above referred to, the can or housing for the filter cartridge is illustrated as being the same as illustrated in FIGURE 2, for example. Accordingly, the same reference characters are applied to designate the same parts.

In FIGURE 18 the outer low porosity filter element is generally designated 250.

The high porosity inner filter element is generally designated 252.

The top and bottom end caps for the outer filter element are designated 254 and 256, respectively, and in the construction here illustrated the central part of the upper or top end cap 254 has the central opening 258 therethrough. Fixed to the underside of the cap 254 is the downwardly opening valve unit 260.

The inner element 252 is closed at its bottom end as indicated at 262 and this element 252 is formed or molded directly in the corrugated foraminous tube 264 and has its top end, together with the tube 264, positioned directly against the underside of the cap 254 with the valve unit 260 extending down into the central passage 266 in the molded element 252.

In place of the downwardly opening valve element 260, use may be made only of the opening 258 for conducting fluid from the area above the filter cartridge, that is, from the chamber 80, corresponding to the chamber illustrated in previously described figures, downwardly or directly into the passage 266. This opening would then function as an apportioning or metering orifice as in FIGURE 7.

By employing the construction illustrated in FIGURE 18 where the inner element 252 is molded directly in the foraminous tube, the need for the supporting spring and end closure cap shown in FIGURE 16 is eliminated.

The molded inner filter element is to share flow with the denser filter element or filter medium when the denser medium is incapable of accommodating the full requirements of the engine.

The valve, such as the valve 260, would be used at the domed end of the filter in the different embodiments of the filter structure shown when the filter size is sufficiently great so that the dense filter medium will accommodate flow for a substantial period of time before it becomes clogged to the point at which the inner or molded filter element would be required to come into play.

The orifice at the domed end of the can, as in FIGURES 2 and 7, would be used when the denser filter medium, that is the outer filter element, could not accommodate the full flow requirements of the engine for any substantial period of time. In such a case, the molded inner element would function almost from the outset, once the filter structure would have been installed on the engine.

The downwardly opening valve at the lower end of the inner filter element, that is, at the threaded end of the filter structure, will, in all cases, function as a safety pressure relief valve to provide full flow of oil to the engine, when the temperature is extremely low or when the filter elements are so clogged that the elements and the flow control valve, together, are incapable of supplying full flow to the engine.

It will be seen from the foregoing that the inner molded filter element, having associated with it, either at one or both ends, the valve units, will, in effect, function as a molded filter control valve.

The filter structure in the several different embodiments illustrated and described, has been shown with different forms of anti-drainback valve means and pressure relief means carried by the end closure 18. This illustrates the fact that the molded filter control valve structure in its association with the outer low porosity pleated filter element may be readily used interchangeably with the different end closure carried valve elements.

An additional end closure carried anti-drainback and pressure relief valve supported on the end closure is illustrated in FIGURE 19 and is generally designated 268. This anti-drainback and pressure relief valve structure forms the subject matter of Patent No. 3,601,101 and while it is decidedly different in its construction, it will be seen that it performs the same function as the valve structure 150 shown in FIGURES 10 and 11. Since the construction and operation of the valve 268 is fully described in the patent referred to, it is not believed that a detailed description of its structure and mode of operation is here necessary.

FIGURE 19 illustrates a modified construction in the top end thereof. In this construction, the inner molded filter control valve or valve element is extended into the domed top end of the cartridge encasing can.

In the construction here shown in FIGURE 19 the bottom end cap, designated 270, has been modified to accommodate the valve structure 268 while the top end cap 272 has been modified, from the construction shown in the previously described valve structures, to have a relatively large central opening 274 which is defined by an upwardly extending collar 276 which terminates in the inwardly extending circular flange 278.

The outer filter 280 is, of course, held between the bottom and top caps 270 and 272 and has extending therethrough the foraminous corrugated reinforcing tube 282.
The inner filter element 284 extends at its upper end into the collar 276 and engages against the inturned annular flange 278 and is held in that position in a suitable manner as, for example, by the employment of a coil or helical spring 286 supported in the manner illustrated and bearing at its top end against the closure plate 288 which covers the lower end of the passage 290 in the inner element 284.

This extension of the inner filter element into the dome end of the can has been illustrated in association with the valve structure 268, it is to be understood that it is not limited to this arrangement or association. It will be readily obvious that the structures of the other figures shown might be modified to extend the inner filter element into the dome end of the can. For example, such a modification might be made in the structure of FIGURE 2 or the structures of FIGURES 8 and 10.

It will be apparent, that while several modifications of the two filter elements have been shown and described with several types of valves at various places within the shell, that any of the valves shown and described may be placed in operative association with any of the filter elements and the respective shell so that the valves are interchangeable with each other, may be substituted for each other or may be placed in the association at various places as long as they serve their purpose and/or perform their function.

Filter structure in the several embodiments herein illustrated and described may be used, and is capable of functioning efficiently, in any mounted position. Accordingly, although in the description the end closure plate 18 has been designated as being at the bottom of the structure and the end wall 16 has been described as being at the top end of the structure, it will be evident that when the structure is mounted upon an engine to hang downwardly or be suspended, as hereinbefore stated, what has been referred to as the bottom or lower end would become the top end and what was referred to as the top end, becomes the bottom end. It will be understood, therefore, that the terms "top" and "bottom" have been used for reference purposes primarily to facilitate describing relative positions of parts of the filter cartridge and not as terms of limitation as to the position of the structure when in use.

We claim:

1. A screw-on throw away, anti-drainback filter structure, comprising a fluid tight shell closed at one end and having at the opposite end a mounting end closure having an anti drainback valve controlled fluid inlet means and having a central fluid outlet means, a dual element filter cartridge in the shell comprising an outer pleated paper filter element having longitudinal fluid flow spaces between the pleats thereof, end caps on said pleated element adjacent to said closed and mounting ends of the shell, said caps closing the ends of said longitudinal fluid flow spaces, the end cap adjacent to said mounting end of the shell having a central opening, tubular means having fluid tight engagement in said central opening and supporting the cartridge in the shell spaced from and in fluid tight connection with said mounting end closure around said fluid outlet means, a foraminous reinforcing tube within said pleated paper filter element and in contact with the inner peaks of the inner folds and throughout the length thereof, a molded substantially rigid depth type tubular inner filter element within said tube and being substantially the same length as said tube and having its circumference joined throughout its length to said reinforcing tube, said tubular element having an axial passage therein, said tubular inner filter element being secured with respect to the inner side of said end cap which is adjacent the said closed end of the shell, the last stated end cap having a central aperture opening into the adjacent end of said axial passage of the inner filter element, an inwardly opening valve within said axial passage at said adjacent end thereof, said inner filter element terminating at its other end short of the end cap having said tubular means in the central opening thereof, means closing said axial passage at the said other end of the inner element but permitting fluid to flow into the center portion of the outer filter element and foraminous tube and then to the said fluid outlet means, and having a common flow path on the outlet side of the filters, said cartridge and shell being in spaced relation radially and between the said closed end of the shell and the adjacent end of the cartridge, and spring means between said spaced top ends of the shell and cartridge and urging said tubular supporting means into said fluid tight connection with said mounting end closure.

2. A filter structure according to claim 1, wherein the said means closing the said axial passage at the said other end of the inner element consists of the material of said molded filter element.

3. A screw-on throw away, anti-drainback filter structure, comprising a fluid tight shell having a closed end and an opposite mounting end closure, the mounting end closure having an anti-drainback valve controlled fluid inlet means and having a central fluid outlet means, a center tube in the filter structure, a dual element filter cartridge in the shell comprising a tubular outer filter element, end caps on said filter element, one end cap being adjacent the closed end and the other end adjacent the mounting end and both end caps having central openings therein, tubular means having fluid tight engagement at the mounting end in said central opening of the inner element and supporting the cartridge in the shell spaced from and in fluid tight connection with said mounting end closure around said tubular means, a tubular inner filter element having an axial passage therein and positioned concentrically within said outer element, said inner filter element being of substantially the same length as the outer filter element and being secured between said end caps and having connection at its ends with said caps, the one end cap having a central aperture opening into the said axial passage of the inner filter element, said axial passage having one end opening directly into said fluid outlet means, the center tube being in contact with the inner surface of the outer filter element, said inner and outer filter elements having a dual spaced relation to each other with the center tube being spaced from the inner filter element and providing an annullar flow passage therebetween, opening means outwardly of the opening in the one end cap to allow predetermined flow of fluid directly into the annular passage, a pressure relief valve in the other end cap disposed between the fluid passage adapted to open and pass fluid from the said closed end of the shell into the axial passage upon a predetermined restriction of fluid flow through the filter elements, said cartridge and shell being in spaced relation radially and between the said closed end of the shell and the other end cap, and spring means between said closed end of the shell and said one end cap and urging said tubular supporting means into said fluid tight connection with the mounting end closure.

4. A filter structure according to claim 3 wherein one of said filter elements is a pleated paper element.

5. A screw-on throw away, anti-drainback filter structure, comprising a fluid tight shell having a closed end and having an opposite mounting end closure, the mounting end closure having a central threaded tubular mounting nut therein providing a fluid outlet means and having fluid inlet means therethrough, a combined pressure relief and anti-drainback means comprising a tubular portion supported on and encircling said nut and forming an outflow means and a valve disc encircling said tubular portion and normally closing said inflow apertures, the valve disc having opening and closing movement axially of said tubular portion, a foraminous reinforcing tube within said pleated paper filter element, one end cap on said filter element, one end cap having a central opening, said tubular portion extending through said one end cap opening and having
fluid tight engagement in the opening, means supporting the cartridge on said tubular portion in spaced relation with said valve disk, means whereby axial movement of said valve disk is predetermined extent away from said inflow apertures opens a bypass port leading from between the shell and the filter cartridge directly into said tubular portion and to the tubular mounting nut, a tubular substantially rigid molded inner filter element having an axial passage therein and positioned concentrically with said outer element and providing an annular space therebetween, means supporting and maintaining said inner filter element with the one end thereof adjacent to the inner side of the other end cap, said other end cap having a central aperture opening into the one end of said axial passage of the inner filter element, said inner filter element terminating a substantial distance above the inner end of the said tubular portion of the pressure relief and anti-drainback means, a cap means closing the other end of the said axial passage of the inner filter element, the center tube being within the annular space and in spaced relation to the inner peaks of the outer filter element and the outer surface of the inner filter elements at the passage end of the center tube for maintaining the same in said spaced relation, the cartridge and shell being in spaced relation radially and between the said closed end of the shell and the said other end cap providing a fluid flow space between the outermost part of said outer filter element and the surrounding encasing shell and further providing a fluid chamber between the said closed end of the casing shell and the adjacent end of the cartridge, and spring means between the said spaced closed end of the shell and cartridge and urging said tubular supporting means into fluid tight engagement with the mounting nut.

6. A screw-on, throw away, anti-drainback fluid filter structure comprising a fluid tight shell having a closed head end wall and having an opposite mounting end wall, said mounting end wall having an anti-drainback valve controlled fluid inlet means and having a central fluid outflow means, a dual element filter cartridge in the shell comprising a molded, elongate, annular outer filter element having an axial passage therethrough and a molded, elongate annular inner filter element within said axial passage and concentric therewith and having an axial passage therethrough, an end cap on said outer filter element adjacent to said head end wall and having a central circular portion extending outwardly beyond the plane of the cap and with an innermost flanged portion with a central opening therein, the adjacent end of said inner filter element extending beyond the plane portion and into the central portion and abutting the flanged portion, means for maintaining said inner filter element in engagement with the flanged portion and against longitudinal movement, a second end cap, said second end cap being on that end of the outer filter element nearest to said mounting end wall and spaced from the valve controlled fluid inlet means and having a central opening there-through, tubular means having one end in fluid tight engagement with and in said central opening of said second end cap and extending into the passage of the outer filter element and supporting the cartridge in the shell spaced from and in fluid tight connection with said outflow means around said mounting end wall, said inner filter element and outer filter element being in spaced relation one to the other to provide an annular flow passage therebetween, the inner filter element terminating at the end thereof nearest to said mounting end wall short of said tubular means, means closing the end of the inner filter element passage nearest to said tubular means, a pressure relief valve within said tubular means and closing communication between the space between the valve controlled fluid inlet means and said fluid outlet means and adapted to open and pass fluid from said space directly to said outflow means upon a predetermined restriction of flow through the filter elements, and spring means between the other end of said tubular means and the adjacent closed end of the inner filter element and maintaining the latter element supported in operative position against the said holding means.

7. A screw-on throw away, anti-drainback filter structure comprising a fluid tight shell having a closed end and having an opposite mounting end closure, the mounting end closure having a central threaded tubular mounting nut therein providing a fluid outflow means and having fluid inflow means therearound, an anti-drainback means normally closing said inflow means, a foraminous center tube, a dual element filter cartridge in said shell comprising an outer pleated paper filter element, end caps on said filter element, one end cap having a central opening, a tubular substantially rigid molded inner filter element having an axial passage therein and positioned concentrically with said outer element, and providing an annular space therebetween, spring means supporting and maintaining said inner filter element with the one end thereof adjacent to the inner side of the other end cap, said other end cap having a central aperture opening into the one end of said axial passage of the inner filter element, said inner filter element terminating a substantial distance above the said one end cap, and providing a fluid chamber therebetween, a cap means on the other end of the said axial passage of the inner filter element and having a central opening therein, spring loaded valve means normally closing said opening, the center tube being within the annular space and in spaced relation to the inner peaks of the outer filter element and the outer surface of the inner filter element, means at each end of the center tube for maintaining the same in said spaced relation, the cartridge and shell being in spaced relation radially and between the said closed end of the shell and the said other end cap providing a fluid flow space between the outermost part of said outer filter element and the surrounding shell, said spring means being in the fluid chamber in engagement with the one end cap and an adjacent cap means on the inner filter element.

8. The filter structure as defined in and by claim 7 wherein the other end cap has a relatively large opening therein, a cup-shaped circular member having an opening therein substantially that of the inner wall of the inner passage of the tubular element and positioned and held in the said opening and an apportioning disk located between the upper end of the filter element and the lower flat portion of the cup-shaped member, the disk has a relatively small apportioning aperture substantially centrally thereof and in alignment with the passageway of the inner filter member, and spring means disposed in one end portion of the cup member and the other end being in engagement with the closed end so that the pressure is exerted against the inner filter member tending to force the cartridge as a whole downwardly into proper relationship with respect to the casing.

9. The filter structure as defined in and by claim 7 wherein there is a spring-loaded valve means normally closing the central aperture in the said other end cap.

10. A screw-on throw away, anti-drainback filter structure comprising a fluid tight shell having a closed end and having an opposite mounting end closure, the mounting end closure having a central threaded tubular mounting nut therein providing a fluid outflow means and having fluid inflow means therearound, an anti-drainback means normally closing said inflow means, a dual element filter cartridge in said shell comprising an outer pleated paper filter element, end caps on said filter element, one end cap having a central opening, a tubular substantially rigid molded inner filter element having an axial passage therein and positioned concentrically with said outer element, and providing an annular space substantially contacting inner peaks of the pleated outer filter element throughout a substantial portion of the length thereof, spring means supporting and maintaining said inner filter element with the one end thereof adjacent to the inner side of the
other end cap, said other end cap having a central aperture opening into the one end of said axial passage of the inner filter element, said inner filter element terminating a substantial distance above the inner end of said one end cap and providing a fluid chamber therebetween, cap means on each end of the inner filter element each having a central opening therein, spring-loaded valve means normally closing each of the openings in the cap means, the cartridge and shell being in spaced relation radially and between the said closed end of the shell and the said other end cap providing a fluid flow space between the outermost part of said outer filter element and the surrounding shell, said spring means being in the fluid chamber in engagement with the one end cap and an adjacent cap means on the inner filter element.

11. The filter as defined in and by claim 10 wherein there is an imperforate cap means on the end of the inner filter element adjacent the mounting end closure, and said imperforate cap means supplanting the perforate cap means and valve means associated therewith.

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