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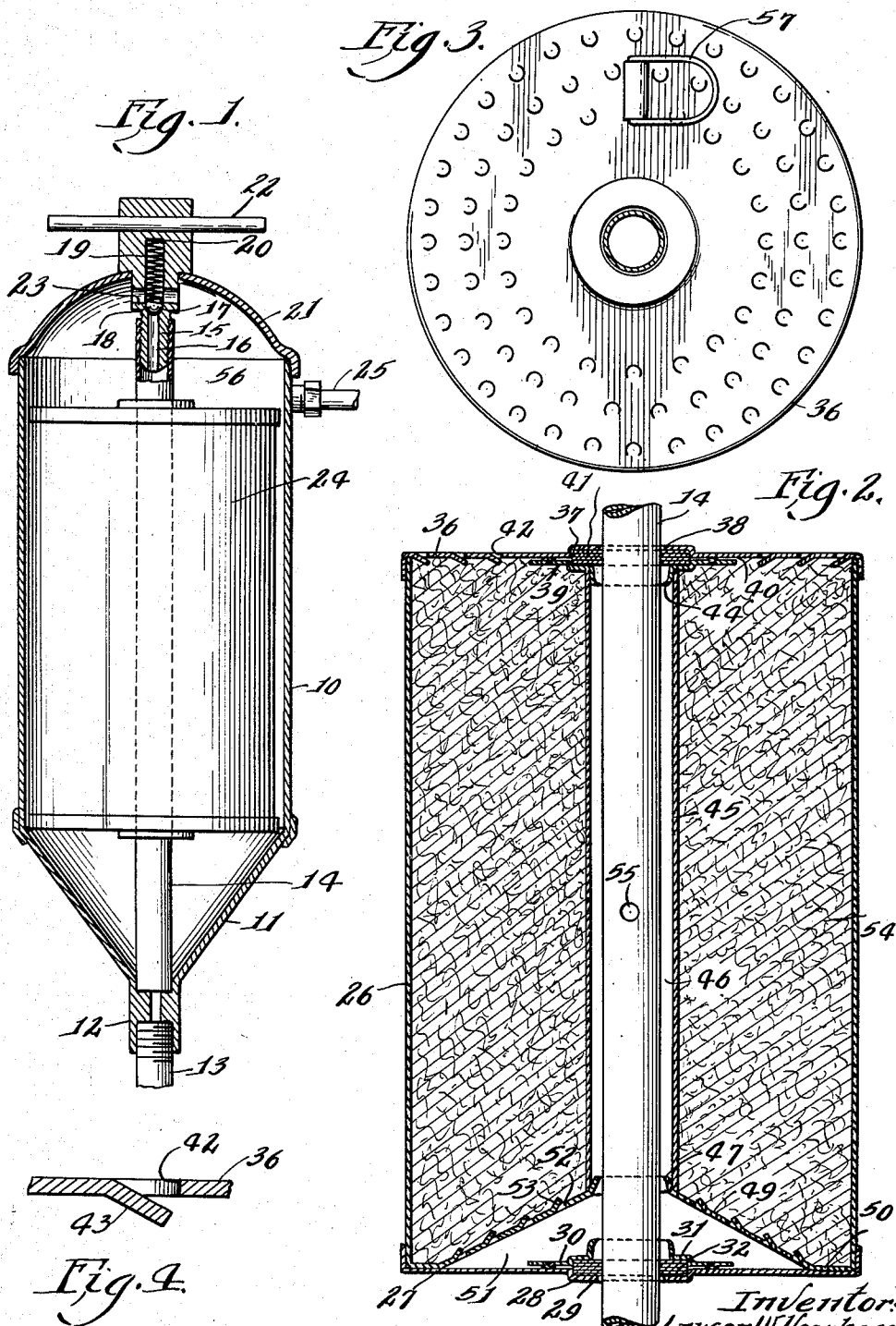
L. W. VOORHEES

2,522,975

FILTER

Filed Feb. 23, 1946

2 Sheets-Sheet 1



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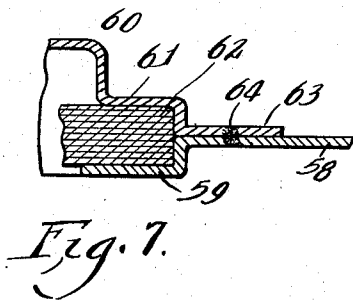
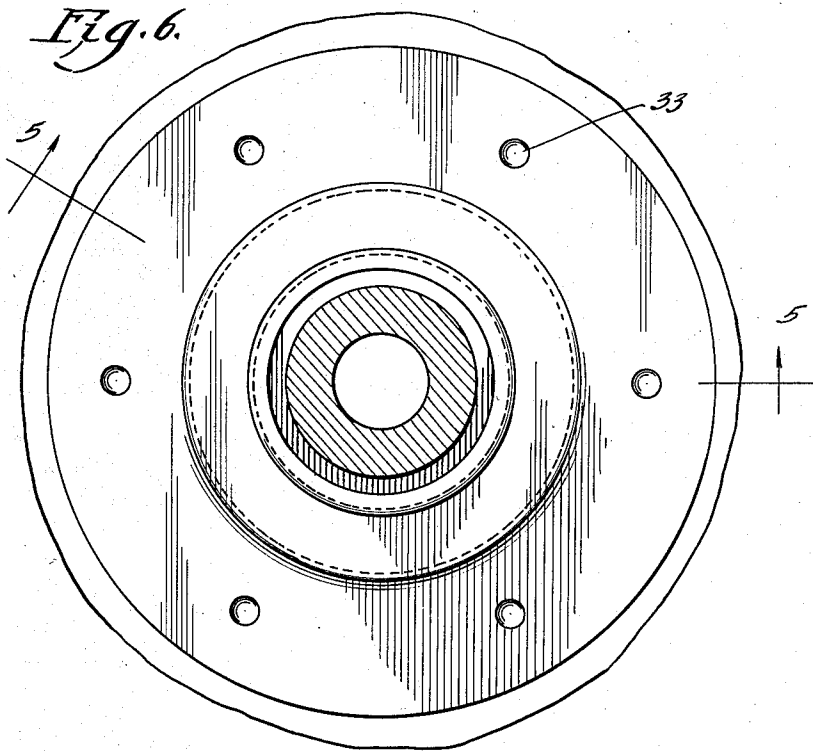
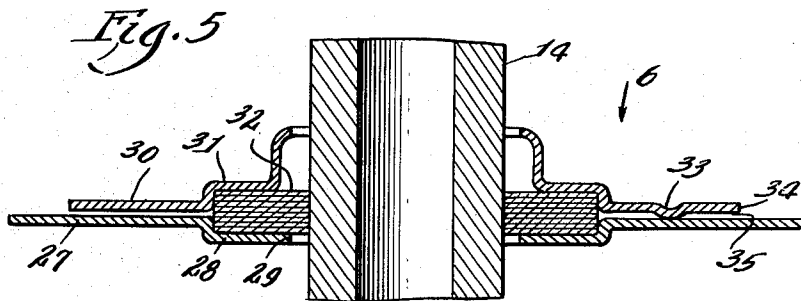
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UNITED STATES PATENT OFFICE

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FILTER

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9 Claims. (Cl. 210—131)

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My invention relates to filters and more particularly to those of the replaceable, absorption pad type which are customarily employed as cleansing agents for the lubricating oil of internal combustion engines and for other purposes.

While certain features of the present invention are capable of a more general application, as hereinafter described, the disclosure will be directed by way of example to a specific embodiment intended for use with automotive engines. In a characteristic arrangement, the filter cartridge is insertible in a container permanently mounted on the engine and is removable when the filtering capacity of the cartridge has been exhausted. The cartridge generally comprises an annular pad of filtering material whose inner surface is retained by a perforated sleeve which extends the length of the pad and which is telescoped over and in spaced relation to an oil supply tube when the cartridge is inserted in the container. The tube extends upwardly through the bottom of the container and is perforated within the sleeve so that oil may flow through the pad and thence into the upper end of the container for delivery to a pipe leading to the points of use in the engine. Gaskets or some form of sealing arrangement are necessary between the sleeve and oil supply tube, or between the latter and portions of the cartridge, to prevent short circuiting of the oil around the filter pad. The axial spacing between these gaskets varies in different containers which thus requires that cartridges be manufactured to accommodate each spacing.

Moreover, since the diameters of the oil supply tubes also vary in different installations, it is necessary to provide cartridges with different size seals because the efficiency of the seals depends upon their elastic grip on the tubes. This situation and that of the variant gasket spacing obviously complicates and increases jobbing costs since the distributor must stock from twenty to twenty-five sizes of cartridges. Costs are also increased by the necessity of perforating the center sleeve and requiring this sleeve to extend the full length of the cartridge.

It is therefore one object of my invention to provide a cartridge which is capable of being used with the conventional container, as contrasted with the present practice of supplying a specific cartridge for a specific container due to variations in the diameter of the supply tube and of the spacing between the sealing gaskets.

A further object is to provide a cartridge which is constructed and arranged to secure an ade-

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quate seal with the supply tube and which is independent of any specific requirement as to spacing between the sealing means or of the diameter of the supply tube.

5 A further object is to provide a filter cartridge equipped with seals capable of establishing a sealing contact with any of the supply tubes customarily encountered in practice.

10 A further object is to devise a cartridge of the character indicated in which the parts are constructed and arranged to utilize the oil pressure as a means of furthering the contact intimacy of the seal with the supply tube, thus improving the efficiency of the seal between the tube and the cartridge and lessening the possibility of leakage and the passage of unfiltered oil to the bearings and wearing surfaces.

15 A further object is to provide a cartridge in which the oil flows the full length of the filter pad and in which manufacturing costs are reduced by the use of a non-perforated, center sleeve having a length less than that of the pad.

20 A further object is to provide an inexpensive method of collecting and uniformly distributing oil to the inlet end of the pad.

25 A further object is to devise a cartridge whose inlet and outlet ends are simply and economically arranged to prevent the escape of the filtering material when subjected to pressure while insuring an adequate flow of oil.

30 A further object is to provide a cartridge in which the oil or liquid being filtered may flow therethrough in either direction.

35 These and further objects of the invention will be set forth in the following specification, reference being had to the accompanying drawings, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

40 In the drawings:

Fig. 1 is a sectional elevation of a typical automotive filter equipped with my improved filter cartridge.

45 Fig. 2 is an enlarged section of the cartridge shown in operative relation to an oil supply tube.

Fig. 3 is a top plan view of the cartridge.

Fig. 4 is an enlarged, structural detail of one end of the cartridge.

50 Fig. 5 is an enlarged, fragmentary, sectional elevation of the bottom of the cartridge as taken along the line 5—5 in Fig. 6.

Fig. 6 is a partial plan view of the cartridge bottom, looking in the direction of the arrow 6 in Fig. 5.

Fig. 7 is a fragmentary view showing an alter-

native method of obtaining a pressure seal with the supply tube.

Referring to Fig. 1, the numeral 10 designates a cylindrical container as customarily employed to receive an automotive, filtering cartridge and having a bottom 11 provided with a reduced extension 12 to which is connected an oil pipe 13 that communicates with a source of oil under pressure, such as the delivery side of an oil pump. Also mounted in the extension 12 and in communication with the pipe 13 is the lower end of an oil supply tube 14 which extends upwardly through and in coaxial relation to the container 10.

The upper end of the tube 14 is interiorly threaded to receive the lower end of a connector 15 having a passage 16 whose upper end is shaped as a valve seat 17 that is normally contacted by a ball, relief valve 18 to close the passage. The valve 18 is constantly urged in a seating direction by a spring 18 mounted in a pocket 20 in the upper end of the connector 15 that is carried by a cover 21. Outwardly of the cover, the connector is provided with a finger grip pin 22 whereby the connector may be threaded in the tube 14 and the cover 21 tightly secured to the upper end of the container 10. Above the valve 18, the connector 15 includes lateral passages 23 whose outer ends communicate with the chamber 56 which are placed in communication with the passage 16 when the valve 18 is lifted by an excessive pressure in the tube 14 which may occur when the engine is cold and the oil viscosity high. Under these conditions, a portion of the oil is bypassed around the filter cartridge which is of the can type, generally indicated by the numeral 24 in Fig. 1, and which surrounds the tube 14 between the ends of the container. Discharge from the upper end of the container 10 is effected through a pipe 25. The structure so far as set forth represents a standard operating environment and in and of itself forms no part of the invention, except in the combinative relations presently described.

My improved, filtering cartridge is more particularly illustrated in Figs. 2 to 6, inclusive, to which reference will now be made. It comprises a cylindrical shell 26 whose lower end is closed by a bottom 27, the central portion of which is offset downwardly as at 28 and the offset being apertured at 29 to receive and permit the free sliding of the cartridge along the tube 14. A retaining washer 30 is positioned on the inner side of the bottom 27 and is formed with an offset 31 that extends oppositely from and is cooperably related to the offset 28 to form an annular recess for receiving a seal ring 32. This ring may be made of an oil resistant, elastic material, such as a suitable synthetic rubber.

The ring 32 is intended to provide a seal between the tube 14 and the bottom 27 and the manner in which this seal is established constitutes an important feature of my invention. Referring to Figs. 5 and 6 which more particularly illustrate this detail, it will be noted that a plurality of bosses 33 are equispaced circumferentially around the peripheral portion 34 of the washer 30, these bosses being preferably formed by offsetting the portion 34 in the indicated localities towards the bottom 27 to thereby space the portion from the bottom and provide an annular passage 35 connecting the space above the bottom 27 with the peripheral surface of the ring 32 for a purpose presently explained. The washer 30 is

firmly secured in position by spot welding the bosses 33 to the bottom 27.

The upper end of the shell 26 has secured thereto a top 36 having a centrally disposed, upward offset 37 that is apertured at 38 to freely receive the tube 14. A retaining washer 39, identical in shape with the washer 30, is secured to the inner surface of the top 36 in the same manner as the washer 30 is secured to the bottom 27. Accordingly, an annular passage 40 is formed between the top 36 and the peripheral portion of the washer 30 which connects the interior of the shell 26 and the peripheral surface of a seal ring 41 that is similar to the ring 32 and is positioned in like manner between the top 36 and washer 39 to establish a seal with the tube 14.

Between the shell 26 and the periphery of the washer 39, the top 36 is provided with a plurality of apertures 42 which may be arranged in the concentric rings formation shown in Fig. 3 to provide a substantially uniform distribution of oil flowing through the cartridge. Each aperture is preferably formed (see Fig. 4) by making a parti-circular or any other shaped cut through the top 36 and bending inwardly of the shell 26 and out of the plane of the top 36 the tongue 43 thus formed. These tongues are characterized by some measure of resiliency and fulfil a purpose presently explained.

The washer 39 is provided with a downwardly extending, annular flange 44 which is coaxial with the shell 26 and extends within and serves to center the upper end of a sleeve 45 in spaced relation to the supply tube 14 when the cartridge is operably mounted in the container 10, thus defining an annular passage 46 between the tube and sleeve which extends lengthwise of the cartridge. The lower end of the sleeve 45 is centered by a flange 47 provided on the upper and minor end of a frusto-conical, distributing plate 49 whose annular and major base 50 rests on the bottom 27. The sleeve 45 acts as a spacer to maintain the position of the distributing plate 49 and also as a conduit for the oil. The plate 49 defines with the bottom 27 a collecting chamber 51 that communicates with the passage 46. A plurality of apertures 52, also preferably arranged in concentric rings, are provided in the plate 49 and each aperture 52 is formed by cutting and bending a tongue 53 so that it will lie above the plate. In the annular space between the shell 26, sleeve 45, top 36 and plate 49 is disposed a filter pad 54 that may be made of any of the materials customarily employed for this purpose and may be formed of any efficient, absorbent material, such as long thread, long fibre cotton waste obtained by carding bobbin ends.

When in operative position in the container 10, the relation of the cartridge 24 to the oil supply tube 14 is as generally indicated in Fig. 2. The oil is pumped upwardly through the tube and is discharged through an aperture 55 therein which may be disposed mid-way between the ends of the cartridge. The oil then flows downwardly through the passage 46 into the chamber 51 and upwardly through the apertures 52, the absorbent pad 54 and outwardly through the apertures 42 into a chamber 56 in the container 10 above the cartridge for delivery to the outlet pipe 25.

The pressure established in the chamber 51 becomes effective through the annular passage 35 against the peripheral surface of the seal ring 32 and wedges this ring in sealing contact with the tube 14 and offsets 28 and 31, thus sealing the lower end of the cartridge. At the

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upper end, sealing is effected by the pressure in the pad 54 acting through the annular passage 40 to tightly grip the seal ring 41 around the tube 14 and to expand the ring into sealing contact with the offset 37 and the offset portion of the washer 39. It will be noted that, while the pressure in the passage 46 and chamber 51 tends to separate the rings 32 and 41 from contact with the tube 14, an overcoming, differential force exists by reason of the differences between the inner and outer, peripheral areas of the respective sealing rings and it is this differential which establishes the required pressure seal in the noted locations. An important advantage of this construction is its capacity to effect a seal with supply tubes of various diameters, including those which the seal rings 32 and 41 would normally fit loosely. Such variations are normally of the order of $\frac{1}{16}$ " or slightly more and they are effectively sealed by my improved arrangement. It is therefore possible to satisfy most of the operating situations encountered in practice by a cartridge having a single size seal whose sealing efficiency increases with the pressure.

The method of forming the apertures in the top 36 and the plate 49 also constitutes an important feature of the invention. The partial masking of the apertures by the tongues prevents loss of the fibres of the pad 54 regardless of the direction of flow. In the event of abnormal pressure existing in the cartridge which may force the pad against the top 36, for example, the tongues 43 will partly close and prevent escape of the pad fibres while still permitting oil flow. This arrangement obviates any necessity for covering the apertures with cloth, screen or filter paper and is economical to manufacture.

The provision of the frusto-conical, distributing plate 49 enables the sleeve 45 to be shortened in length and eliminates the common practice of perforating the sleeve, thus enabling certain economies in production costs. Moreover, this arrangement insures that the oil will flow the full length of the pad 54 to thus utilize the full, filtering capacity of the pad, while the structural relation between the sleeve 45 and plate 49 eliminates the usual projections, recesses or brackets that heretofore have been used to support this plate or its equivalent in existing installations. This construction therefore provides an efficient and simple distributing position of the plate 49 with reference to the pad.

The cartridge may be varied in length as desired and flow may be reversed through the pad as may be required in certain installations. A pull ring 57 secured to the top 36 enables the cartridge to be withdrawn from the container 10 when replacement becomes necessary.

With this improved construction, it is possible to satisfy present operating needs with a materially smaller number of cartridge sizes which facilitates distribution in that stocking requirements are simplified as to the number of sizes to be carried.

Satisfactory results as regards the securing of a pressure seal with the supply tube have been obtained with the arrangement shown in Fig. 7 wherein the numeral 58 designates the bottom of the cartridge shell corresponding to the bottom 27 and which is likewise provided with a central disposed offset 59. A retaining washer 60 having an offset 61 is disposed in cooperating relation to the bottom 58 and between the offsets is positioned a seal ring 62.

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So far as described, the construction is identical with that shown at the bottom of Fig. 2, but instead of spacing the peripheral portion 63 of the washer 60 from the bottom 58, this portion directly abuts the bottom and is secured thereto by spaced spot welds 64 which may be arranged as in Fig. 6. While, in a geometrical sense, the abutting of the portion 63 and bottom 58 is coextensive over the full annular surface therebetween, the fact is that between the spot welds, sufficient spacing exists to enable the oil pressure to become effective against the peripheral surface of the seal ring 62, particularly when the oil becomes hot. The same construction may be used at the top of the cartridge.

I claim:

1. A can type, filter cartridge for filtering liquid under pressure and arranged for insertion in a container in coaxial relation to a tube extending through and apertured between the opposite ends of the cartridge, comprising means for filtering the liquid, and means providing a seal between each end of the cartridge and the tube, each seal means including a retaining washer for encircling the tube and secured in spaced relation to the adjacent end to define therewith an included space around the tube and an annular passage connecting the included space with the interior of the cartridge, and a compressible seal ring for encircling the tube in the included space and operably positioned between and by the washer and end, the peripheral surface of the ring being exposed to pressure in the cartridge acting through the annular passage and the ring being thereby forced into sealing contact with the tube, end and washer.

2. A can type, filter cartridge for filtering liquid under pressure and arranged for insertion in a container in coaxial relation to a tube extending through and apertured between the opposite ends of the cartridge, comprising means for filtering the liquid, and means providing a seal between each end of the cartridge and the tube, each seal means including a retaining washer for encircling the tube and having its peripheral portion secured in spaced relation to the adjacent end to define an annular passage, the central portions of the washer and end being oppositely offset to form a chamber that communicates with the interior of the cartridge through the annular passage, and a compressible seal ring positioned in the chamber to encircle the tube, the peripheral surface of the ring being exposed to pressure in the cartridge acting through the annular passage and the ring being thereby forced into sealing contact with the tube, end and washer.

3. A can type, filter cartridge for filtering liquid under pressure and arranged for insertion in a container in coaxial relation to a tube extending through and apertured between the opposite ends of the cartridge, comprising means for filtering the liquid, and means providing a seal between each end of the cartridge and the tube, each seal means including a retaining washer for encircling the tube and having a plurality of circumferentially spaced bosses welded to and separating the washer from the adjacent end to define therewith an included space around the tube and an annular passage connecting the included space with the interior of the cartridge, and a compressible seal ring for encircling the tube in the included space and operably positioned between and by the washer and end, the peripheral surface of the ring being exposed to pressure in

the cartridge acting through the annular passage and the ring being thereby forced into sealing contact with the tube, end and washer.

4. A filter cartridge adapted for insertion in a container comprising an annular mass of filtering material, the opposite ends of the mass being respectively abutted by a flat and a frusto-conical plate each of which is apertured, an imperforate, flat plate having its outer periphery abutting the outer periphery of the frusto-conical plate to thereby form a collecting chamber, and a spacer sleeve extending between and abutting the perforated, flat plate and frusto-conical plate to maintain the operative relation of the last named and imperforate plates, the flat plates including aligned openings for receiving a tube spaced from and apertured within the sleeve.

5. A can type, filter cartridge for filtering liquid under pressure and arranged for insertion in a container in coaxial relation to a tube extending through and apertured between the ends of the cartridge comprising means for filtering the liquid, and means providing a seal between each end of the cartridge and the tube, each seal means including a compressible seal ring for encircling the tube, means confining the ring in operative relation to the adjacent cartridge end, and means of communication connecting the interior of the cartridge with the peripheral surface of the ring within the confining means whereby the pressure in the cartridge forces the ring into sealing contact with the tube, end and confining means.

6. A filter cartridge comprising a shell having plates closing the ends thereof, the plates including aligned openings for receiving an apertured tube in coaxial relation to the shell, a frusto-conical plate having its major base abutting one of the end plates and defining therewith a collecting chamber, an imperforate sleeve concentric with the shell and having its opposite ends respectively abutting the minor base of the frusto-conical plate and the other end plate, the diameter of the sleeve being sufficient to provide an annular passage around the tube, and a filter body located between the last named plates, sleeve and shell, each of the last named plates having a plurality of tongue members partially cut therefrom and bent inwardly of the shell to define a plurality of apertures for enabling liquid to flow through while preventing loss of the filtering material.

7. A filter cartridge comprising a shell having plates closing the ends thereof, the plates including aligned openings for receiving an apertured tube in coaxial relation to the shell, a frusto-conical plate having its major base abutting one of the end plates and defining therewith a collecting chamber, an imperforate sleeve concentric with the shell and having its opposite ends respectively abutting the minor base of the frusto-conical plate and the other end plate,

the diameter of the sleeve being sufficient to provide an annular passage around the tube, and a filter body located between the last named plates, sleeve and shell, each of the last named plates having a plurality of apertures registering with and enabling liquid to flow through the body.

8. A can type, filter cartridge for filtering liquid under pressure and arranged for insertion in a container in coaxial relation to a tube extending through and apertured between the ends of the cartridge comprising means for filtering the liquid, and means providing a seal between each end of the cartridge and the tube, each seal means including a retaining washer whose central portion defines with the adjacent end of the cartridge an included space around the tube and whose peripheral portion is flat and spot welded to an annular flat portion of the adjacent end in a plurality of spaced locations the peripheral edge of the washer being exposed within the cartridge, and a compressible, seal ring for encircling the tube in the included space, said flat portions including therebetween crack-like passages extending between the spot welds and connecting the interior of the cartridge with the peripheral surface of the ring whereby the pressure in the cartridge forces the ring into sealing contact with the tube, end and washer.

9. A filter cartridge adapted for insertion in a container comprising an annular mass of filtering material, the opposite ends of the mass being respectively abutted by first and second, apertured plates, an imperforate plate abutting the outer periphery of the second plate, the second plate being otherwise offset from the imperforate plate and forming a collecting chamber therewith, and a spacer sleeve extending between and abutting the first and second plates to maintain the operative relation of the second and imperforate plates, the first and imperforate plates including aligned openings for receiving a supply tube spaced within the sleeve.

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