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MEANS FOR TREATING LUBRICANTS

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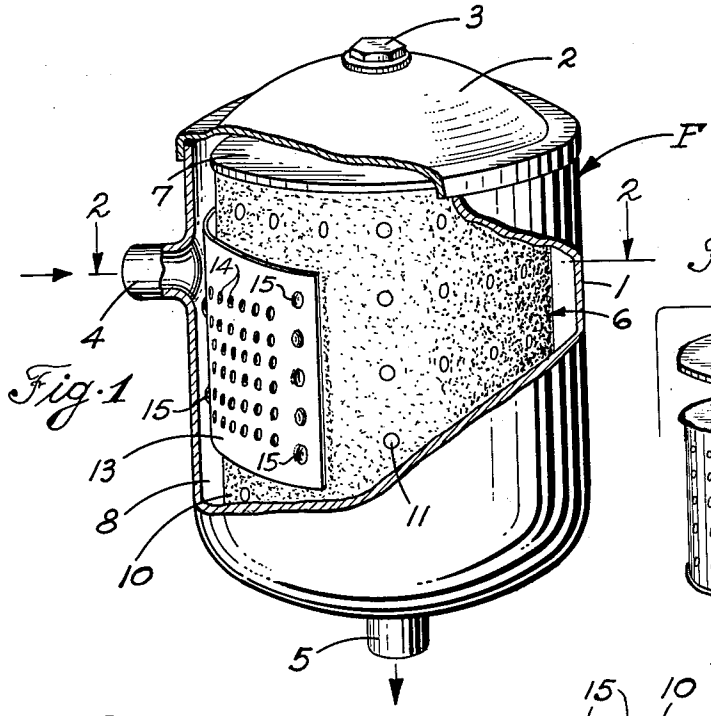


Fig. 1

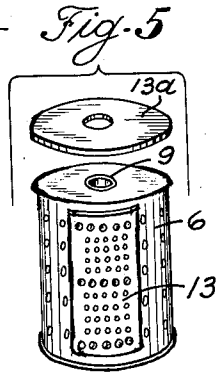


Fig. 5

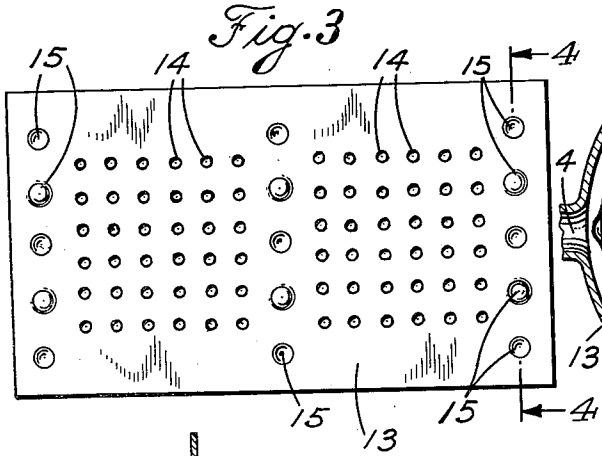


Fig. 3

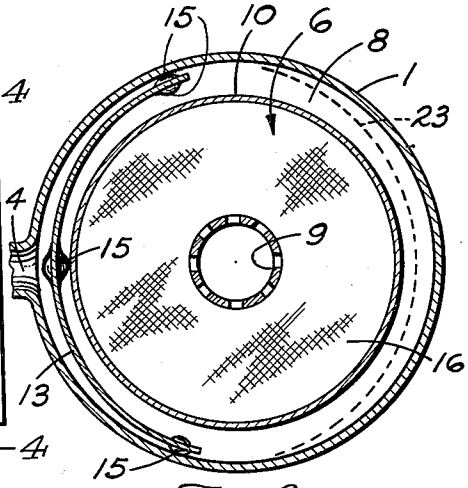


Fig. 2

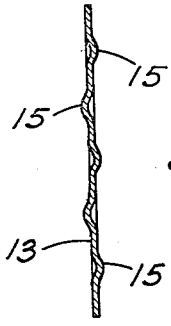


Fig. 4

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MEANS FOR TREATING LUBRICANTS

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This invention relates to neutralizing acids in the lubricating oil of internal combustion engines, removing the acid salts as well as the acids from the engine oil, and preserving the oil and the engine from the deleterious incidents and effects of acids and/or acid salts or compounds found or formed therein.

The deleterious incidents and effects of acids formed in internal combustion engines which contaminate and are carried by the lubricating oil and/or water content thereof has been largely appreciated, and are believed to manifest themselves in etching and corroding wearing and bearing surfaces forming or tending to form sludge and varnishes in the oil, "varnishing" wearing and bearing surfaces and otherwise hampering lubrication, augmenting engine wear and deterioration, reducing engine life and impairing engine performance.

Liquid or suspended alkaline oil additives, while tending to neutralize such acids, tend in themselves to subtract or detract, pro tanto, from the lubricating value of the oil, and the acid salts or residuum formed in the oil are not desirable lubricants. Moreover, it is difficult to apportion or maintain an optimum quantity of liquid neutralizing additive in the oil, since none would be best from the point of view of lubrication, and therefore the last alkaline molecule would be the optimum quantity in that sense, wherefore the spending of that molecule would require the addition of another, and so on. The employment of metal, such as magnesium, in solid form in the crankcase of engines has been practiced not, it is believed, without benefit. But this approach has been burdened with limitations. Metallic acid salts retained on the surface of the metal impair its efficiency while those washed or lost from the surface may enter the oil pump and circulate with the oil to the hazard and detriment of the pump and engine. Moreover, dirt, sludge or other substances foreign to the magnesium metal tend to collect on or obscure its surface and impair, restrict or forbid its intended function.

An object of my invention is to provide a solution to the problems mentioned above that can be practiced and enjoyed with advantage, efficiency, economy and facility. Another object is to provide an "acid hungry," expendable metal in a form, time and place in the engine oil system and cycle of circulation that will for relatively long periods of time offer a large, clean, and/or self-cleaning, active metal surface to be etched or consumed by the acids carried in the oil, whereby to neutralize and remove the acids. Another and concurrent object is to trap out from and free the oil, oil pump and engine from the metal acid salts or other residuum created by the metal acid reaction substantially simultaneously with the reactions. Another object is to free the oil from liquid or suspended alkaline additives and the need therefor. Another object is to provide a continuous surplus of neutralizing agent freely available at all times to the oil and acid borne or entrained therein without diluting the oil therewith. Another object is to facilitate the easy provision, inspection and replacement of the neutralizing agent. A further object is to provide an acid hungry metal in a form with a great ratio of surface to volume and with a large surface area exposed in and to the moving oil stream of the engine with correspondingly great opportunity for the oil-borne acids to be spent in etching or reacting with the metal.

More specifically my objects include the provision of a large, thin, perforate acid neutralizing sheet of magnesium, magnesium alloy, zinc or other acid-hungry metal of size and thickness permitting flexing or bending for insertion in the engine-oil filter interiorly of the filter shell and exteriorly of the filter element whereby the acid-bearing oil will wash or flow over and/or through and around the metallic sheet, and the acid-metal salts, residuum and/or erroded or corroded parts or particles of the expended sheet will be filtered out of the oil stream in and by the closely adjacent filter element. It is also among my objects to encompass in whole or in part a permanent or replaceable filter element or cartridge with acid-hungry metal or materials in a form or shape not tending to deleteriously impair the flow of oil through the filter element or cartridge, but offering a great or sufficient surface area to oil entrained acids for facile reaction therewith.

Another object is to dispose acid-hungry metal of great surface area in the oil stream of an acid forming engine at a place where the stream is given wide, thin form coextensive with the wide surface area of the reactant metal wherewith to gain a wide and extensive contact between the oil and the reactant metal and to use the motion of the thin stream to promote reaction and opportunity for reaction between the oil entrained acids and the metal. It is a collateral object that the oil stream and/or the thinness and velocity thereof tend to work or scrub the acid reactant metal surface tending to clean the same and maintain reactant metal exposed or freshly exposed and reactantly available to oil entrained acids.

Other objects and advantages of my invention will appear from the following description of preferred and modified forms thereof, reference being had to the accompanying drawings in which:

FIGURE 1 is a perspective view of an oil filter with the shell and cover partly broken away showing the acid neutralizing, expendable metallic sheet disposed between the shell and filter element .

FIGURE 2 is horizontal section taken along the lines 2—2 of FIGURE 1.

FIGURE 3 is an elevation of one side of the neutralizing sheet in flat form.

FIGURE 4 is a section of the sheet taken along the line 4—4 of FIGURE 3.

FIGURE 5 is a diagrammatic perspective on reduced scale of the neutralizing sheet and filter element arranged with the long axis of the sheet parallel with the axis of the element, cf. FIGURE 1.

In FIGURE 1 a conventional form of automobile engine filter F, which may be taken as illustrative of various forms, comprises a shell 1 and a removable cover 2 secured to the shell by a bolt 3; the shell having an oil inlet 4 and an oil outlet 5. Within the shell and radially spaced from the interior of the shell is the filter element 6 through which the oil is constrained to pass in its flow from the inlet 4 to the outlet 5. The expendable acid-hungry metal 13, preferably in perforate sheet form is curved to lie freely between the shell and the element, see FIGURE 2, and is preferably disposed near the inlet 4 to be washed in the stream of oil entering the shell and flowing longitudinally and circumferentially of the filter element and in the directions of the major dimensions of the sheet wherewith to expose a great wide surface area to the oil-entrained acids and promote reaction therewith.

Conventionally the filter element 6 has fluid impervious upper and lower end closures, the upper closure 7 along being shown in part in FIGURE 1, and presents a cylindrical exterior surface or superficial surface juxta-

posed to the interior of the shell and spaced therefrom describing an annular space **8**, see also FIGURE 2, between the interior of the shell and the exterior of the element. It is illustrative of the operation of conventional oil filters compatible with my invention that the "dirty" oil entering the shell through the inlet **4** flows longitudinally and circumferentially of the space **8** and radially through the filter element to the central core or passage **9** thereof thence axially to the outlet **5**; the passage **9** being appropriately sealed off from the space **8** according to known practice. I speak of the superficial external pervious surface of the filter element to distinguish from the impervious end enclosures thereof and also from the vast and/or microscopic filtering surfaces and interstices in the body **16** of the filter element **6**. Often the body or actual filtering components of the element are enclosed or wrapped in paper or metallic cases **10** having perforations **11**, FIGURES 2 and 1, in which event the superficial pervious exterior surface of the element, as the term is here employed, would substantially correspond to the cylindrical surface of the perforate casing **10** of the element.

Whether or not the shell and element takes some or all the forms and characteristics used for illustration herein, the general relation of the element disposed within the shell with a space for oil to flow within the shell and around the element to find ingress to the filtering interstices of the body of the element is compatible with the practice and operation of my invention.

In the form of my invention illustrated in FIGURE 1 I prefer to dispose a thin, flexible somewhat resilient, perforate sheet of metallic magnesium, or magnesium-aluminum alloy of low aluminum content, **13** in the space **8** opposite or near the inlet **4** and radially spaced at least in part from the exterior cylindrical surface of the element **6** as well as from the interior of the shell **1** so that some or all the oil and entrained acids flowing into the filter element will wash and flow over, around and/or upon, through and along the surfaces of the sheet, its edges and perforations. This provides a large and long wetting contact with surfaces of the sheet and affords much opportunity for the acids to spend themselves in reaction with the magnesium and be removed from the oil stream thereby. Based on present experience and the practicability of rolling and working magnesium in sheet form it has been found practicable and advantageous to employ a magnesium-aluminum alloy of about 94–96% magnesium and 4–6% aluminum, the aluminum not deleteriously detracting from the acid reactive quality of the alloy and giving the sheets better resilience, working qualities and cheapness than "pure" or commercially pure magnesium.

For one advantageous form and practice of my invention the sheet or insert **13** may be formed about "post-card" size 3¼" x 5½" x .010" to .020" and perforated preferably as shown in FIGURE 3 with many 1/10" to ⅛" holes **14** and preferably also lightly and alternately and oppositely dimpled as at **15**, FIGURE 4, so that the raised convexity of the dimples taken with the resilience of the sheet tend to space the main surfaces of the sheet from the shell and filter element and limit direct contact with the parts to the raised backs of the dimples, FIGURE 2. Using as many as 72 perforations of ⅛" diameter reduces the whole surface area less than one square inch so that the whole surface area of both sides of the sheet of the size mentioned is about 35 square inches. Taking conventional filter elements to run between about 3½ inches to 5 inches in diameter and from about 4 inches to 6½ inches in length, and regarding the external cylindrical surface as the "oil entering" superficial area of the element, an acid-hungry sheet made only 3¼" x 5½" provides surface area equal to about ¼ to ⅓ the superficial exterior area of large elements and nearly the same as the superficial exterior area of small elements. The volume of my sheet in its preferred form and size is but about .179 to .358 cubic inch, whence its surface to volume ratio is between about 100:1 and 200:1.

I do not, of course, disclaim sheets of different size, form, thickness, material or location in or near the filter so long as my teaching as a whole and the principles of my invention are followed and enjoyed. For example, changes in the thickness of the sheet **13** without other change tends to depart from my present preference thus: Thicker sheets, while easier to roll at the rolling mill and while providing more metal, are correspondingly less flexible and require noticeably more manual effort to be curved to the approximate radius of the filter element, see FIGURE 2. While ease of bending largely concerns the ease of installation of the sheet into the filter, the sheet if not easily bendable and lightly resilient when curved about as shown in FIGURE 2 might tend to exert enough more than a most desirable resilient lateral thrust on the element and tend to mitigate against easy and correct sealing of the end openings of the passage **9** or disturb the most desirable and facile alignment of the element in the shell when the element and sheet are being inserted in the shell. Thinner sheets tend naturally to be expended more rapidly and require more frequent replacement. Present experience suggests the preferred thickness for the balance of convenience of safe and easy installation with desirable self-supporting resilience of the sheet tending to locate it near the oil inlet. Larger sheets while practicable and not undesirable as will more fully appear below, tend to lack universality of easy insertability into filters of nearly all presently used sizes. Smaller sheets would naturally tend to be consumed more rapidly. Materials other than magnesium or high magnesium alloys that are highly reactive to the kinds of deleterious acids formed in engines, or which otherwise intrude into lubricating oils, such as zinc, for example, may serve the purposes of my invention, albeit zinc reacts more slowly to some or all such acids and is therefore, as presently advised, less desirable than magnesium.

In FIGURE 5 it is suggested that the sheet or insert **13** may be curved about its long axis and longitudinally aligned and used with the filter element **6** when the length of the element (between end closures or overhanging end closures) equals or exceeds the length of the reactant sheet. Such is a good disposition of the sheet particularly in the styles and forms of filters having no side inlet for oil, but wherein the oil enters the shell, not shown in FIGURE 5, all around the periphery of one of the ends of the element.

A modified form of my invention is also suggested in FIGURE 5, particularly for the forms of filters wherein the oil enters at the end and flows over one of the end closures of the element before entering the element. Assuming the place of oil entry of such a filter is at the top as viewed in FIGURE 5, the acid reactant sheet **13*a*** may take disc form with a central aperture to accommodate the oil exhaust passage **9** and with its periphery corresponding to the periphery of the closure, and be placed upon and overlie the end closure to be washed by all the oil and acid entering the filter. For convenience of illustration, the disc-like sheet **13*a*** is shown in space above the upper closure preliminary to being placed thereon. The sheet **13*a*** may be used alone, or with the sheet **13**. The disc **13*a*** may with advantage also have dimples and small perforations, not shown, to space the disc from the closure and induce wetting of the lower surface adjacent the closure as well as the upper surface. Unless the diameter of the element and closure is great in relation to the length of the element the ratio of the surface area of the disc to the superficial exposed pervious area of the element will be smaller than I believe to be most desirable per se, but this possible lack tends to be offset by the advantage of position in relation to the entering oil stream. The disc **13*a*** being used in flat form may be thicker than the sheet **13** since considerations of resilience and flex-

ibility as effecting alignment and sealing of the element in the filter are not involved with use of the disc 13*a*.

Another modified form of my invention comprises that all or part of the perforate cylindrical casing 10 of the filter element 6, or of any filter element having, or desirably susceptible of having, a casing corresponding to the casing 10, be made of acid-hungry sheet metal or material and thus be similarly exposed to the oil entrained acids with like or substantially identical operation, advantage and results as my preferred form. Limitations or precautions in this form of my invention presently occur to me thus: The filter element should not be dependent on the structural strength of the casing for sealing off the oil stream or for its correct flow through the filtering body of the element if the casing is made wholly of expendable material without risking the efficiency of the filter as the casing is consumed by the acid with which it reacts. Similarly the life of an acid reactant casing would not necessarily correspond to the useful life of filter body as a filter, depending, inter alia, on the rate of acid formation in any given engine. For practical purposes however, the prompt and continuous neutralization of acid and consequent inhibition of acid build-up in the engine oil is such that consumption of the casing would measure a worth-while useful life of the whole element. Should the whole casing 10 of the filter element be made of acid reactant material, it would provide reactant surface area equal to substantially 200% of the superficial pervious oil-entering area of the filter body: A thing desirable per se, and as presently advised, a thing which would give an extraordinarily long, useful life to the filter body as a filter compared with the currently accepted life span of such bodies. Among other things, my invention in all forms gives added life to all filter elements that are subject to deterioration from filtering oil with entrained acids by virtue of reducing and/or substantially eliminating such acids from the oil stream.

It may also be convenient to practice my invention by attaching a sheet of highly acid-reactant metal substantially corresponding to the sheet 13 to the casing 10 of the filter shell as at the time and place of manufacture of the filter element, assuming the casing 10 according to prior practice is made of paper or not highly acid-reactant material. In this form of my invention better practice suggests that the reactant sheet be attached exteriorly of the casing to appear much as shown in FIGURES 1 or 5, the perforations of the reactant sheet be fairly aligned with the perforations of the casing, the dimpling of sheet be retained or increased, and the attaching done not too snuggly, as with light staples, adjacent the dimples so that the sheet will be largely relieved from tight surface contact with the casing and tend to be wetted on its interior as well as exterior surface by oil and oil entrained acids. This form of my invention facilitates the use of thicker reactant sheets, if desired; the light, resilient flexibility mentioned as desirable in the sheet 13 when used as a separate insert, not having the same pertinence where the reactant sheet is attached to the element before both are inserted into the shell together.

Reference to conventional forms of replaceable filter elements is not intended to suggest any lack of advantage or utility of my invention in filters having so-called permanent filter elements, my teaching and preference comprehending the latter form of filter elements as well as the former. Nor need the specific size and shape of the filter element in relation to the shell detract from the advantage or impair the utility of my invention so long as opportunity is afforded for the acid-hungry metal to be wetted by the oil-entrained acids to neutralize the latter in the oil stream in its path of movement near and toward the filtering body. Nor is my invention essentially more or less compatible with by-pass type filters than so-called full-flow filters, except as the latter perhaps tend to take better advantage of my invention by bringing more of the oil more often to wetting contact with the acid-reactant sheet. In all forms of my invention the freedom of flow of oil, and/or acid-bearing oil, along, past, around and/or through the reactant metal sheet promotes the desired acid neutralizing action quite consistently with the freedom of flow of oil to the filter element and/or through the filter element. Sludge inhibition alone as induced by my invention is an especial boon to full-flow filters.

In the use and operation of my invention, oil-entrained acids are brought to wetting and reacting contact with the exposed surface or surfaces of the acid-reactant sheet and form insoluble metal-acid salts that tend to be washed, erroded or corroded off the sheet whence they either fall out of the oil stream to the bottom of the filter shell or are mechanically filtered out of the stream in and by the filter element or the filtering body or parts thereof. Oil leaving the filter is thus freed from both acid and the products of the acid reaction with the reactant sheet. The operation of my invention includes the consumption and expenditure of the acid reactant sheet metal and the consequent deterioration and disintegration of the sheet which on the one hand measures the success of the operation, and on the other hand measures the coaction of the filter element in its role of removing the metal acid salts, as well as discreet particles and fragments of the sheet, which are formed in the course of disintegration and consumption of the sheet, from the oil stream and from the engine. As the filter body strains out discreet particles of the reactant metal, these particles still and necessarily lie in the oil stream passing through the filter and still react with acid borne thereby. Therefore, a secondary and useful mode of operation of my invention comes into play even as the reactant metal loses its initial sheet form and changes to fragmentary or discreet particle form, tending, incidentally, to increase the surface to volume ratio of the reactant metal. And this same secondary mode of operation persists in kind though perhaps not in like degree whether or not all or part of the particles or fragments of the reactant metal are carried to the interstices of the filter body or are gathered by gravity in the shell since their presence in the filter, wherever it may be in the path or in part of the path of the oil-borne acids, permits their useful reaction therewith. As a practical matter the insertion of a second new and pristine reactant sheet before the first sheet is consumed beyond recognition as a sheet, and without removing the remnants of the first sheet nor necessarily "cleaning" or replacing the filter element, so long as the element is functioning advantageously, is a practicable way of enjoying my invention and both its primary and secondary modes of operation as above described.

When the reactant sheet 13 or 13*a* is or can be located in the filter immediately adjacent the oil inlet and in the path of all the oil and acids entering the filter as I prefer, then naturally and advantageously all the acids tend to have immediate opportunity of contact, and/or turbulent scrubbing contact, with the reactant metal before reaching the filter element. As a practical matter, only a fraction of the oil-entrained acids (literally dilute acids) need be neutralized every "pass" of the oil and acids over and near the reactant metal to maintain an advantageous relatively acid-free condition of the lubricant and prevent build-up of the acid content above a substantially innocuous minimum. Should a droplet of oil carrying a few molecules of acid pass through the engine and filter a number of times without losing the acid molecules, the law of probability, taken with the greater acid hunger of the magnesium metal and the lesser acid hunger of the other metals of the engine and the continuous exposure of the large magnesium surface to the oil stream, makes it a near certainty that the acid will react with the magnesium before reacting with anything else, and therefore literally prevent acid injury to the engine. Similarly as the magnesium has a great affinity for acid relative to the

affinity of the lubricant for acids, the reaction of acid with the magnesium will tend to precede, ergo prevent, sludge or varnish-forming reactions between the acid and the lubricant. It therefore follows that the utility of my invention persists in kind and substance when the reactant sheet is disposed in the filter remotely from the oil inlet as suggested in the dotted line **23**, FIGURE 2, since at least much of the oil stream entering the element near the sheet washes the sheet, and all the oil in its continuous cycle of circulation and remixing in the engine tends to make frequent contact with the reactant sheet for appreciable lengths of time whenever the engine is operating.

In all forms of my invention the acid-bearing oils are brought to extensive surface-wetting contact with acid-hungry material in form having a high surface to volume ratio to promote opportunity for acid neutralizing reaction between the acid and the acid-hungry reactant material, and, as I believe, the engine is not only protected from injury from acids but is also protected from the products and effects of the acid reaction with the oil and with the expendable material. Viewed as a method, my invention spreads the oil stream with its acid burden into a form corresponding to the form and extent of the acid-hungry material to promote acid neutralizing reactions preferably immediately prior to the filtering of the oil and/or the oil and the products and effects of the neutralizing reaction.

Changes, improvements and modifications of and upon the forms and embodiments of my invention hereinabove specifically illustrated and described will occur to those skilled in the art without departing from the spirit and substance of the principles of my invention or the teaching hereof, and therefore I do not desire to be limited in the scope and effect of my patent to the forms herein specifically disclosed nor in any manner inconsistent with the progress by which my invention has promoted the art.

I claim:

1. In an oil filter the combination of a filter shell having an inner cylindrical surface, a filter element disposed in said shell with an annular space between the inside of the shell and the exterior of the filter element, and an expendable reactant for deleterious constituents of internal combustion engine oil removably inserted in said annular space between the interior surface of said oil filter shell and the exterior of said filter element without deleteriously impairing the flow of oil through the filter, said reactant comprising a thin, bendable, resilient, perforate sheet having exposed surfaces reactant with said constituents of engine oil and having thickness not substantially greater than about ¼ the radial dimension of said space, width appreciably less than the axial length of said space but more than one hundred times the thickness of the sheet, and length greater than width but less than the circumferential length of said space, and having a ratio of surface to volume not substantially less than about 100:1, and having a surface area reactant to said constituents equal to from between about ¼ to all the superficial area of said filter element, said sheet being manually bendable to a curvature of radius similar to but greater than the interior of said filter shell and having resilience when constrained to enter said annular space and engaging said shell frictionally and resiliently at the ends of the sheet on one side and engaging the filter element frictionally and resiliently in the middle of said sheet on the other side and tending to space itself otherwise from both said shell and said element.

2. The combination of claim 1 in which the reactant comprising said sheet has alternate, oppositely facing, spaced raised portions of limited area and disposed in the middle and at the ends of the sheet on both sides of the sheet and tending to space all but the proximate raised portions of the sheet from contact with said shell and element at the middle and ends of the sheet respectively.

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