Sept. 14, 1937. F. W. MANNING 2,093,090

FILTERING COMPOSITION

Filed Aug. 7, 1934 2 Sheets-Sheet 1

Fig. 3.

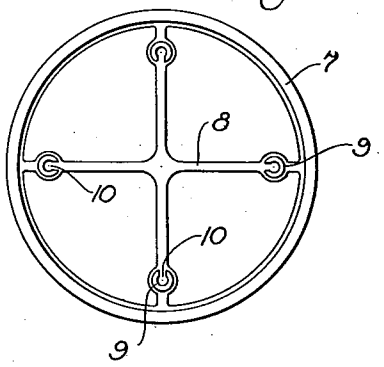


Fig. 4.

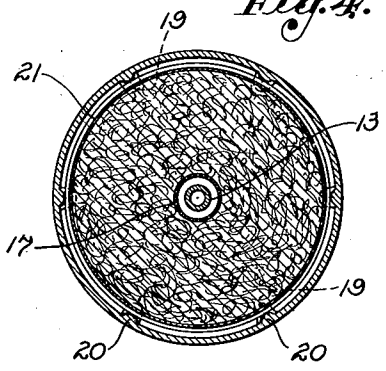


Fig. 1.

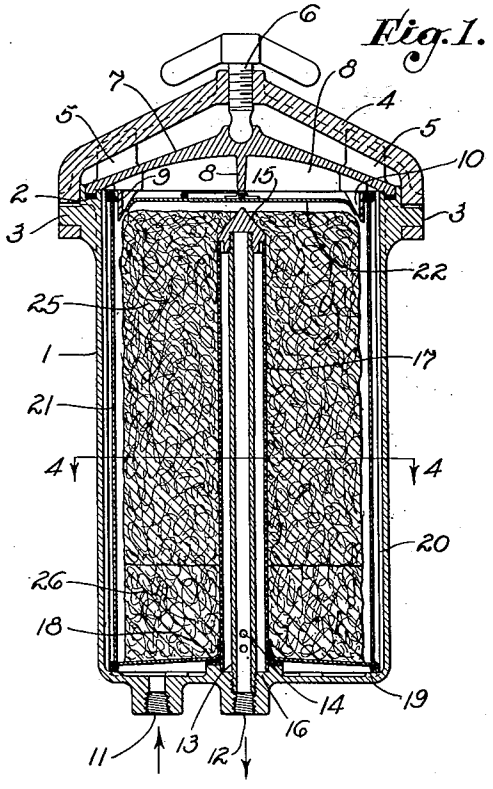
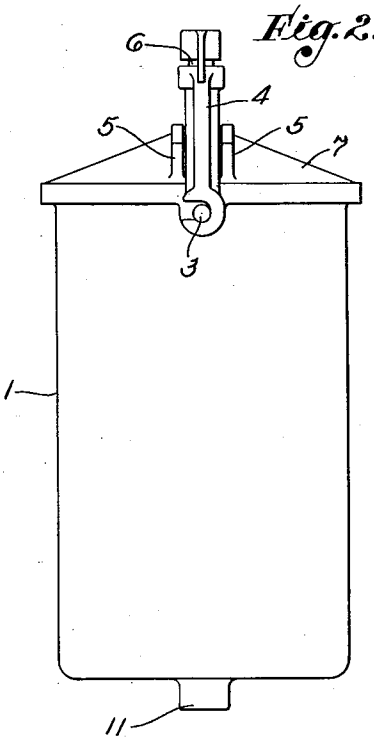


Fig. 2.



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Fig. 6.

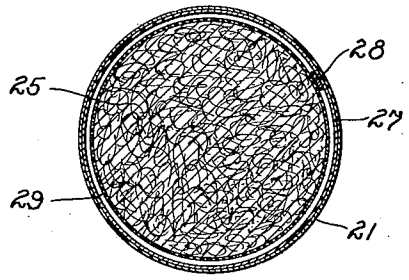


Fig. 8.

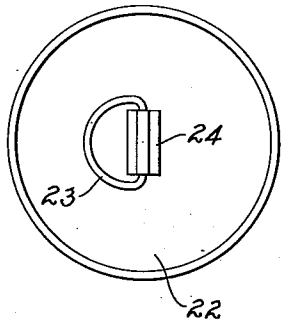


Fig. 5.

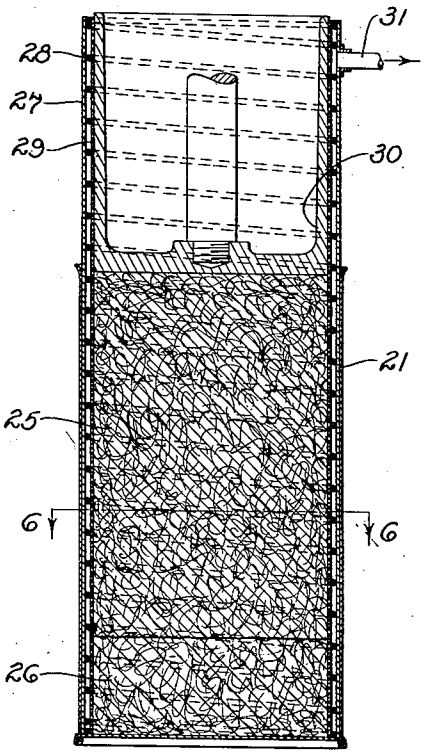
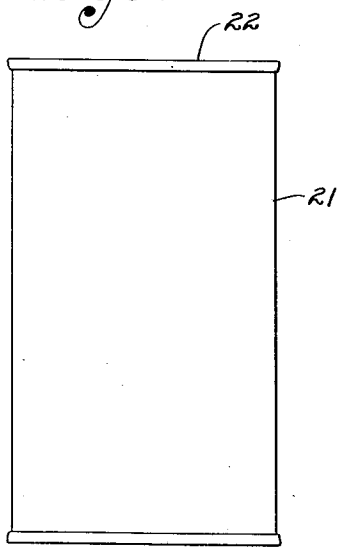


Fig. 7.



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2,093,090

FILTERING COMPOSITION

Fred W. Manning, Los Angeles, Calif., assignor to Fred W. Manning Company, Ltd., Los Angeles, Calif., a corporation of California

Application August 7, 1934, Serial No. 738,789

17 Claims. (Cl. 210—203)

This application is a continuation-in-part of applications Serial Nos. 588,396 and 684,023, filed by me on January 23, 1932, and August 7, 1933, respectively. My invention relates to the art of removing suspended solids from liquids. It is well adapted to the treatment of lubricating oils, and particularly adapted to the treatment of crankcase oils used in internal combustion engines.

Internal combustion engines are commonly lubricated by oil which is taken from the crankcase and forced by an oil pump to the various parts to be lubricated, the oil then draining back into the crankcase. In the ordinary operation of internal combustion engines, especially when used in motor vehicles, the oil becomes contaminated by filterable matter, such as carbon, road dust, and metal particles abraded from the moving surfaces of the engine. This contamination is so great that it is common practice to periodically remove the contaminated oil from the engine and replace it with clean oil. To lessen the frequency of the oil changes, some motor vehicles are provided with an oil filter through which the oil from the crankcase is continuously circulated while the engine is running for the purpose of removing from the oil the most abrasive of the solid particles.

It has been the practice heretofore to remove filterable impurities from crankcase oils by circulating the oil through sheet material, which is usually a felted or woven fabric. In such fabric filters the filterable material is deposited on the surface of the fabric and builds up a coating thereon. To prevent rapid clogging, the sheets are made sufficiently porous to allow the finer carbon particles to pass through, and after the sheets have been coated sufficiently with the larger solid impurities to retain the finer ones, the filtrate flow is not rapid enough to remove the finer particles as quickly as formed in the engine. In either case the oil gradually becomes darker in color and finally must be changed. Since such fabric filters, filter almost exclusively at the surface at which the oil enters, and the effective life of the fabric is limited by the coating built up on its surface, the capacity of the filter to remove filterable matter is directly proportional to the area of its surface.

It is an object of my invention to provide a gel-like material which is produced by the use of fine fibres of animal, vegetable, or mineral origin, and a suitable vehicle; the fibrous material being of such a nature that with the vehicle it will form an adsorption and filtering medium. An extensive filtering medium is thus formed without the necessity of weaving or felting such fibres into a sheet prior to their introduction into the filter. In such a medium the foreign impurities are distributed through its depth rather than on its surface so that its capacity is very nearly proportional to its volume.

It is also an object of my invention to provide a gel-like composition of matter containing discrete fibres, the composition being of such a nature that under pressure it behaves like most greases in that it will flow freely and uniformly under pressure without material alteration in its characteristics. This permits the gel-like filtering material being moved by pressure out of a bulk supply space into cheap containers adapted for use in the lubricating systems of internal combustion engines.

In this particular embodiment of my invention I use for a vehicle a moderately viscous lubricating oil at any suitable temperature, those commonly employed for crankcase lubrication being quite suitable. The fibres, such as wood or cotton and asbestos, are intimately and uniformly mixed with a sufficient amount of the oil to form a consistency characteristic of a fairly stiff "gel", which may be then consolidated by expressing a portion of the oil. Other vehicles than oil may be used, provided the vehicle is not deleterious to the liquid to be filtered, or is removed before the liquid is filtered; and provided further that the vehicle is one that will produce a sufficiently stable gel-like system, as for instance, syrup may be used as the vehicle when the gel composition is to be used for the filtering of sugar liquors. A mixture of 80 to 85% of fine cellulose fibres of exceedingly short length, similar to what is commonly called linter dust, and 20 to 15% of fine short length asbestos fibres has proven very successful; and I find that about four ounces of such mixture to each quart of vehicle works very well although greater quantities of fibres up to at least six ounces per quart may be used. If cellulose fibres are used alone, even more fibres may be employed.

Increasing the proportion of cellulose fibres to the amount of asbestos fibres used in the gel increases the porosity of the mass when used as a filtering medium, with consequent increase in flow and decrease in clarity of the filtrate. Hence, of the gel-mass consisting of a fibre mixture suitable for removing all of the finer particles of carbon from crankcase oil, is placed at the end of the filter receptacle adjacent to the oil feed inlet, and a more porous fibre mixture fills the opposite end of the receptacle, there

will result a rapid circulation of the crankcase oil, the oil coming in from the clear filtrate end and passing out at the free flow end with consequent quick heating of the filter and contents, and this will speed up the flow through the clear filtrate section.

The more or less permanent compacting or consolidating of the fibres in the filter under pump pressure when the gel-mass is put into service, results from the flow movement of the vehicle against the resistance set up by the fibres to passage of the impurities, the fibres being restrained from free movement by a foraminous filter cake retaining wall. If this resistance is not sufficient to result in the necessary consolidation of fibres to catch all of the impurities during the filtering operation, the resistance can be increased by increasing the filtering pressure, using a finer fibre as by increasing the percentage of asbestos in the gel-mass, and sometimes by decreasing the filtering temperature. There is also a repeated expanding and compacting of the fibre mass in the filter resulting from the continual starting and stopping of the engine in a motor vehicle, and this with the constant vibration of the car tends to maintain the fibre mass in a porous condition.

To produce this gel-like medium I thoroughly mix the fibres in the liquid in the proportion of two to three ounces per quart of liquid, preferably by feeding the fibres slowly into the vehicle while the latter is kept in agitation; and the fibre content of the gel-mass may be then further increased by expressing a portion of the vehicle during the charging of the gel containers, until the weight of fibre is from four to six ounces per quart of liquid, this preconsolidation of the fibres depending on the filtering pressure to be used. The higher the filtering pressure, the greater should be the preconsolidation of the fibres in order to maintain as great a volume of fibre filter bed as possible. But any other means may be used which thoroughly and uniformly disperses and consolidates the fibres in the vehicle and gives a system of interlacing fibres which imparts to the gel-like mass its rigidity. The higher the viscosity of the liquid vehicle the more "stiff" can the gel mixture be made and still preserve the desired pressure-mobile characteristics. Likewise this desired fluidity of the gel under pressure, or during the oil expressing operation, can be increased by increasing the viscosity of the vehicle and sometimes by changing the fibre mixture. The same degree of wetting and adhesion tension against the fibrous material will vary with different liquids of the same viscosity and will also vary for the same liquid with different fibres. In the case of the gel material herein described, the interfacial tension existing between the fibrous material and the liquid vehicle is such that a high degree of adsorption results at the interface.

By "stable gel-like system" I mean a gelatinous product consisting of fibres and of liquid, the product having the characteristics of certain gels and most greases in that it will not flow under normal temperatures except under pressure, and in which the fibres remain in a suspended or dispersed and interlacing condition for long periods of time, the rigidity of the gel-like material, and the fixed and uniform distribution of the fibres in the body of it, persisting as the gel is moved from place to place. Most thin liquids as for instance water, gasoline, unconcentrated fruit juices, etc., do not have the property of forming such a stable gel-like mass with the fibres. The property of forming such a gel-like mass depends largely upon the viscosity of the liquid and upon the degree of wetting or the adhesion tension of the liquid against the fibres. If cellulose fibres are mixed with a liquid such as water, etc., a gel-like mass is not formed, but a mixture will result from which the water will readily drain, leaving a felted mass of fibres which cannot be made to flow under pressure and which is ineffective for my purpose. A non-clotting or non-matting of the fibres when a small amount of the gel-like material is squeezed between two thin sheets of paper, is an indication that such a mixture can be used as a stable pressure-mobile mass, for in such a case the fibres can be considered as remaining uniformly distributed and unclotted when the mixture is subjected to pressure. It is fairly common knowledge that certain gelatinous materials, and some gels, may be forced through small openings and when forced under high pressure they function as viscous liquids, giving true characteristics of liquid flow. At low pressure this flow may not be obtained, in which case the pressure is below the so-called "yield value" or "zero mobility point."

The majority of true gels are two-phase solid-liquid systems. Such gels consist of a network of interlacing solid fibrils the spaces between which are permeated by liquid which is held therein by so-called capillary forces. In some cases the solid fibrils may be of ultra-microscopic dimensions and in other cases of microscopic dimensions. In both cases, the fibrils may form gelatinous masses with certain liquids, the liquid being firmly held by the fibre so that the whole mass may be rigid and have the appearance and properties of a true gel. The product of my invention is of this latter type. In order to avoid the possibility of misunderstanding in the use of terms, my product will be referred to as a "pseudo-gel".

Due to the peculiar physical characteristics of my novel separating medium, it is possible to use a very simple form of filter or separator such as that shown in the accompanying drawings, of which,

Fig. 1 is a vertical section of the filter showing the consolidation of the fibres after use.

Fig. 2 is an elevation of the filter.

Fig. 3 is a plan view of the underside of the cover showing the piercing points.

Fig. 4 is a cross-section on line 4—4 of Fig. 1.

Fig. 5 is a vertical section of an open gel container with the compacting mechanism in position.

Fig. 6 is a cross-section on lines 6—6 of Fig. 5.

Fig. 7 is an elevation of the gel container.

Fig. 8 is a plan view of the gel container.

Referring more specifically to the drawings by reference characters. The filter receptacle 1 is equipped with a gasket 2, and trunnion pins 3 for the saddle 4, which is kept central with the cover by means of the guiding lugs 5. Passing through the central portion of the saddle is an adjusting screw 6, the lower spherical end of which is embedded in the cover 7, and the latter is strengthened by the cross ribs 8. These ribs also support the piercing points 9, which encircle the feed openings 10. The receptacle has a fluid inlet 11, and a filtrate outlet 12; and inserted on the inside of the latter is a tube 13, which has openings 14 in its lower end. The

tube supports a piercing point 15, which may have two or more cutting edges; and between the piercing point and the recessed boss 16 of the receptacle, is a foraminous tubular plate or screen 17; the foraminous member, piercing point, and supporting tube, forming the filtrate thimble of the filter. The receptacle is also equipped with a cork gasket 18, and patches 19, for supporting the container, and ribs 20 for centralizing the container.

The gel container, which may be of tin, paper or other suitable material, consists of a shell 21, cover 22, lifting ring 23, bracket 24, and the clear filtrate and free flow gels 25 and 26, respectively. A compacting device for charging the gel into the container consists of a sleeve 27, spacing wire 28, foraminous member 29, the plunger 30, and outlet 31.

The operation of the apparatus thus constructed has been in part indicated in connection with the foregoing description. Upon unscrewing the adjusting screw and giving the saddle a slight turn in the proper direction, both cover and saddle may be lifted entirely from the filter receptacle; and by means of the ring 23 the contaminated gel container may be lifted out and discarded. As the piercing point 15 of the filtrate thimble is a little below the top of the receptacle, a new container may be partly inserted before its bottom will rest on the thimble point. The container can then be thrust down over the thimble, the point, or cutting edges of the point, easily piercing the bottom of the container, and the displaced gel liquid passing into and out through the thimble. The saddle can then be swung into position, its outer ends engaging with the trunnion pins 3. This places the cover 7 in a central position where it is sufficiently adjustable by virtue of its spherical connection with the adjusting screw, to find its seat; and the screwing down of the cover will cause the piercing points to enter the top of the container near its circumference, the cork gasket 18 making the joint between the bottom of the container and the recessed boss 16. The fluid to be filtered, after passing through the inlet opening 11, will distribute itself around the container, which is maintained in a central position by the ribs 20; and will then pass into the container through the openings 10 in the piercing points 9 that have been thrust through the cover of the container. As the gel is mobile under pressure, the pressure of the incoming fluid will be exerted throughout the container, and will displace the gel liquid, which passes out through the filtrate thimble, the gel solids also moving towards the thimble as clogging of the fibres occurs, as indicated by the outline of the solids in Fig. 1.

If the gel containers are filled by hand, or with the ordinary can filling machines, the fibre content of the gel-mass will usually be from two to three ounces to each quart of vehicle, the amount of fibre incorporated in the vehicle depending on the "stiffness" to which it is mixed. Such a mixture placed in a filter receptacle will give satisfactory results for many purposes but the fibre content may not be sufficient if the mixture is to be used in the lubricating system of a motor car. The vibrations of the car and the constant varying lubrication pressure, due to starting and stopping of the engine, will ultimately result in sagging of the fibre cake; and the ordinary lubricating pressure of motor cars will result in too much dead space in the container, due to the consolidation of the fibres around the filtrate thimble. To avoid these undesirable results, I increase the fibre content of the gel-mass in the charging operation to from four to six ounces per quart of vehicle by means of a compacting device, such as is described in Fig. 5. This device may be inserted within the container either before or after the former has been filled with the requisite amount of gel-mass, and the downward movement of the plunger 30 will cause the oil in the gel-mass to be expressed through the foraminous member 29, upward around the spacing wire 28, and through the outlet 31. The compacting cylinder can then be withdrawn, after which the plunger may be raised and the container capped. In actual practice where a great number of containers are to be filled per hour, it is probable that the compacting cylinder would be filled and the gel-mass consolidated to the desired extent in one movement of the filling machine, and the resulting plug or mass of fibres shoved out of the compacting cylinder into its container in a second movement of the filling machine; and as a further precaution against drippings wetting the outside of the container, the latter may be placed in an upside down position for charging purposes and then automatically righted and capped. Increasing the fibre content within reasonable limits does not alter the characteristics of the gel except to increase the pressure at which it becomes mobile; but the fibre content must not be increased to a point where the film of oil is completely squeezed from between the individual fibres, otherwise the fibre mass ceases to be a pressure-mobile suspension.

It will be obvious from the foregoing description that if a fibrous material is to be used for the purifying of a crankcase oil, it should be introduced directly into the filter. If it is introduced in the form of dry fibres, the spacing of the individual fibres cannot be accomplished uniformly, or discretely, and consequently the passage of oil through a mass of such fibres will never result in a pressure-mobile suspension. If it is mixed with an oil and introduced as a flowable mixture, as is often done in refining operations, there will not be sufficient flow of a clean oil through the comparatively small pipe lines of the lubricating system to consolidate the fibres sufficiently to make the mixture mobile only under pressure; and as soon as sufficient carbon has been carried into the filter to cause the fibre mass to be no longer flowable under atmospheric pressure, it will at the same time cease to be mobile under pressure; and the consolidation of the fibre mass will be such that the capacity of the filter has been greatly reduced, this capacity being nearly proportional to the volume of the fibre mass. Moreover, in a compressible filter bed built up by the fibres being carried into position by the flow of the liquid being filtered under a substantially constant maximum pressure, the consolidation of the fibres increases directly with the depth of the bed. This is due to the pressure to be supported by the fibres in each successive layer, as they are built up, becoming less as the depth increases, because the pressure across the layer is in ratio of its thickness to the total thickness of the filter bed. When the cake is thin, at the start, the first layer will have to bear nearly the whole of the pressure and afterwards much less. As the depth of the bed increases the later fibres are not submitted to so great an unbalanced pressure as were the earlier fibres,

and are consequently laid down in a more open structure. See "Filtration and Filters" by J. A. Pickard. Therefore, to obtain the greatest possible capacity for the filter, suitable fibres must not only be uniformly and discretely spaced, but the fibre mass must be introduced into the filter as a preconsolidated pressure-mobile suspension with a sufficient fibre content to retain all impurities without further consolidation of the fibres during use, altho under normal operating conditions a slight further consolidation will occur which will be sufficient to permit free circulation of the oil around the filter bed. In other words, preconsolidation of the fibres will prevent later consolidation of the fibres during the filtering operation with consequent loss of filtering capacity. The filtering pressures of lubricating systems of motor cars usually vary from five to fifty pounds per square inch, and for such pressures four to six ounces of fibres per quart of oil will be found most serviceable. The higher the filtering pressure, the greater should be the preconsolidation of the fibres in the gel-mass; and the greater the preconsolidation of the latter, the less the amount of finer fibre, such as asbestos, that would be required, usually 15 to 20% being sufficient for normal lubrication pressures and corresponding preconsolidations of the gel-mass. Two or more pressure-mobile suspensions containing different kinds, or consolidations, of fibres may function adjacent to one another, as the clear filtrate and free flow gels **25** and **26**, respectively, shown in Fig. 1, or the concentric gels **23**, **24**, and **25**, shown in Figs. 1 to 4 of my copending application Ser. No. 684,023, filed August 7, 1933.

It will also be evident that a gel mixture may be used to filter fuel oils, such as gasoline, in the feed lines of internal combustion engines; and that the gel-mass may be charged into almost any of the usual types of gasoline filters, the oil vehicle being washed out into the cylinders and replaced in the fibre mass by gasoline during operation of the engine.

It will still further be evident that the piercing points for the container may be placed in the cover, as shown, or in the bottom of the receptacle, or even in the sides of the receptacle if the container is tapered; or the container may be dispensed with entirely, and the gel introduced directly into the receptacle, and upon exhausting of the gel the entire receptacle replaced.

It will be understood throughout the specification and appended claims that a "pseudo-gel" is a pressure-mobile suspension in which the fibres are uniformly dispersed in a discrete condition throughout the vehicle and unbonded to the extent that they are capable of flow under pressure without the addition of a liquid and therefore cannot be considered as forming a unitary felt-like mass.

I claim as my invention:

1. A filter element comprising fibres uniformly dispersed in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

2. A filter element comprising cellulosic fibres uniformly dispersed in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

3. A filter element comprising asbestos fibres uniformly dispersed in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

4. A filter element comprising cellulosic fibres in mixture with non-cellulosic fibres and both of said fibres uniformly dispersed in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

5. A filter element comprising fibres uniformly dispersed in a discrete condition throughout an oil, such as is used in the lubricating systems of internal combustion engines, to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

6. A filter element comprising fibres uniformly dispersed in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass containing from four to six ounces of fibres for each quart of liquid, the said fibres remaining uniformly distributed throughout the said mass during the filtering operation.

7. A filter element comprising fibres uniformly dispersed in a discrete condition throughout an oil, such as is used in the lubricating systems of internal combustion engines, to form a pressure mobile stable gel-like filtering mass containing from four to six ounces of fibres for each quart of oil, the said fibres remaining uniformly distributed throughout the said mass during the filtering operation.

8. A filter element comprising asbestos fibres in mixture with a preponderant proportion of cellulosic fibres and both of said fibres uniformly dispersed in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

9. A filter element comprising asbestos fibres in mixture with a preponderant proportion of cellulosic fibres and both of said fibres uniformly dispersed in a discrete condition throughout an oil, such as is used in the lubricating systems of internal combustion engines, to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

10. A method of forming a filter element comprising uniformly dispersing fibre dust in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass throughout which mass the said fibres remain uniformly distributed during the filtering operation.

11. A method of forming a filter element comprising: uniformly dispersing fibres in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass; and removing a portion of the liquid therefrom, the fibres remaining uniformly distributed throughout the said mass during the said removing and also the filtering operation.

12. A method of forming a filter element comprising: uniformly dispersing fibres in a discrete condition throughout an oil, such as is used in the lubricating systems of internal combustion engines, to form a pressure mobile stable gel-like filtering mass; and removing a portion of the oil therefrom, the fibres remaining uniformly dis-

tributed throughout the said mass during the said removing and also the filtering operation.

13. A method of forming a filter element comprising: uniformly dispersing fibres in a discrete condition throughout a liquid to form a pressure mobile stable gel-like filtering mass; and removing a portion of the liquid therefrom to consolidate the said fibres in the said mass, the fibres remaining uniformly distributed throughout the said mass during the consolidating and filtering operations.

14. A method of forming a filter element comprising: uniformly dispersing fibres in a discrete condition throughout an oil, such as is used in the lubricating systems of internal combustion engines, to form a pressure mobile stable gel-like filtering mass; and removing a portion of the oil therefrom to consolidate the said fibres in the said mass, the fibres remaining uniformly distributed throughout the said mass during the consolidating and filtering operations.

15. A method of forming a filter element comprising: uniformly dispersing fibres in a discrete condition throughout a liquid to form a pressure mobile stable gel-like mass; and removing a portion of the liquid therefrom until a consolidated filtering mass is formed containing from four to six ounces of fibres for each quart of liquid, the fibres remaining uniformly distributed throughout the said mass during the consolidating and filtering operations.

16. A method of forming a filter element comprising: uniformly dispersing fibres in a discrete condition throughout an oil, such as is used in the lubricating systems of internal combustion engines, to form a pressure mobile stable gel-like mass; and removing a portion of the oil therefrom until a consolidated filtering mass is formed containing from four to six ounces of fibres for each quart of oil, the fibres remaining uniformly distributed throughout the said mass during the consolidating and filtering operations.

17. A method of forming a filter element comprising: uniformly dispersing fibres in a discrete condition throughout an oil; such as is used in the lubricating systems of internal combustion engines, in the proportion of two to three ounces of fibres to each quart of oil, to form a pressure mobile stable gel-like mass; removing a portion of the oil therefrom until a consolidated filtering mass is formed containing from four to six ounces of fibres for each quart of oil, the fibres remaining uniformly distributed throughout the said mass during the consolidating and filtering operations.

FRED W. MANNING.