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SUSPENSIONS FOR LUBRICATING AND OTHER PURPOSES

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This invention relates to freely flowing suspensions of finely divided solid particles of organic liquid vehicles, and especially to suspensions of particles of greater than colloidal size. A particular object of the present invention is to provide freely flowing suspensions of sulfur for lubricants and grinding, lapping and polishing compounds.

Stable, freely flowing suspensions are produced, in accordance with this invention, by distributing through the desired organic liquid vehicles finely divided particles of solvated hydrogenated castor oil wax having an elastic gel nature. This may be conveniently accomplished, for example, by dissolving a small amount of the wax in the vehicle at an elevated temperature and then cooling to form a waxy precipitate, which, upon proper manipulation of the mixture, becomes broken up into finely divided gel particles distributed throughout the vehicle, the gel particles being substantially in contact. The resulting mixture will be of free-flowing consistency if a suitably small amount of wax has been used.

The particles to be suspended, when distributed through this mixture of vehicle and gel particles, are prevented from moving by the gel particles and thus are maintained indefinitely in a stable state of suspension. In other words, the wax is used to effect a mechanical suspension of the particles without converting the mixture into a semi-solid or non-flowable state.

As indicated, the function of the solvated wax particles (gel particles) is not to increase the viscosity and thereby slow down the settling or rising of the suspended particles, which would require that the mixture be made of the consistency of a cake or paste to secure reasonable stability as to suspended particles of greater than colloidal size, but is to entrain the suspended particles and mechanically prevent movement thereof without rendering the mixture incapable of free flow. The use of the wax in accordance with my invention necessarily somewhat increases the viscosity of the mixture, but this is incidental, and does not prevent securing suspension mixtures which may be freely poured and pumped.

While suspensions of solid particles of greater than colloidal or sub-microscopic size constitute the most important application of my invention, which may be applied to suspensions of particles large enough to be visible to the naked eye, it is evident that particles of colloidal size may likewise be stably suspended in accordance with the invention. Colloidal particles thus suspended are rendered stably suspended not only when in colloidal state but also in the event of agglomeration into particles of greater than colloidal size, which is not true of particles in ordinary colloidal suspensions.

The gel particles in the suspension mixture are elastic in nature and resist deformation and displacement in a manner such that a small force will merely deflect them without producing continuous motion, and a force in excess of a minimum which depends upon the materials and conditions is required to produce continued motion of any object present in a mass of the particles. The result is that the gel particles, and other particles present, are prevented from moving through the mass, the force of gravity or buoyancy on each particle being less than the minimum force required for continuous motion. In this manner even such dense particles as those of finely divided lead can be prevented from settling out, and finely divided air bubbles can be prevented from rising and escaping.

In order to produce the above effect, the gel particles must be sufficiently close together so that they cannot be merely carried through the liquid vehicle without influencing each other, and this minimum requirement may be readily determined by experiment in any desired case.

The wax-vehicle mixture capable of sustaining particles in stable suspension may be broadly characterized as a mobile discontinuous gelatinous mass composed of particles of waxy elastic gel substantially in contact with each other and having the interspaces containing the liquid vehicle, the particles to be suspended being distributed in or between the gel particles and prevented from moving thereby.

The term "gelcosity" is used to designate this property of mobile discontinuous gelatinous masses, and the degree of force required to produce continuous motion without such gel masses. The higher the gelcosity, the greater the force needed to cause continued motion of a particle through the gelatinous mass, and hence the greater the mass of a particle may be without the particle settling out.

The possession of gelcosity and the relative gelcosity of various mobile media may be easily determined by using a light metal plate or vane suspended in a vertical plane by a fine wire or fibre secured to a fixed support. The wire should be surrounded by a fixed tube or sleeve to prevent sway. The vane is placed in the medium to be tested and the latter rotated a certain amount, as by turning the receptacle, whereupon the vane will swing about its axis and then return toward its initial rest position due to the restoring force exerted by the wire. If the medium possesses the property of gelcosity, the vane will not return completely, but will come to rest in a displaced position. The greater the displacement the greater the force needed to cause continuous movement or flow within the medium and hence the greater the gelcosity. If the mobile medium is continuous, it can have no gelcosity and the vane will slowly return to the initial position even

though the medium is highly viscous; while a medium of high gelcosity will cause a large displacement even though of quite free flowing consistency. In other words, a displacement of the vane, which measures a static equilibrium condition, is a consequence of the gelcosity and not of the viscosity.

This characteristic of mobile discontinuous gelatinous masses is not possessed by mobile continuous gelatinous masses, that is, gelatinous masses in which no discrete gel particles exist. In the latter case an infinitely small force will produce flow and no gelcosity will be indicated by the above test, just as in the case of non-gelatinous liquids of high or low viscosity. An example of a mobile continuous gelatinous mass is a solution of raw rubber dissolved in a petroleum oil. This possesses the characteristics of elasticity, stringiness and may have a high viscosity, but an infinitely small force will produce flow and hence no gelcosity will be exhibited. A gelatinous mass which has "set", forming a solid jelly, is also a continuous gelatinous mass, but of course is not mobile and exhibits the overall characteristics of a solid until broken up to form a discontinuous mass, and thus obviously does not possess the characteristics of a mobile discontinuous gelatinous mass containing discrete gel particles.

A representative hydrogenated castor oil wax (produced by hydrogenating castor oil to an extent resulting in a hard waxy product), is milk-white in color, has a specific gravity of about 0.99 at 20° C., has a melting or solidifying point in the range of about 171–178° F., an acid number of about 2, a saponification number of about 180, and an iodine number of about 3.

The term "wax" is applied to the hydrogenated castor oil in accordance with technical usage, since this product is of waxy appearance and is generically similar to the so-called natural or true waxes in respect to many properties.

Hydrogenated castor oil wax is relatively insoluble at room temperature and thereabouts in most organic vehicles, and in many cases can be satisfactorily used in amounts of 1% or less (for example, with mineral oils, petroleum ether, petroleum naphtha, linseed oil, "Cellosolve", and others). It appears to approximate universality, as it has been found to be satisfactory when used in amounts of 3% or less with the following liquids selected from commonly known oils and organic solvents: mineral oil, fish oil, castor oil, corn oil, soy bean oil, cotton seed oil, linseed oil (both raw and boiled), tung oil, polymerized tung oil, petroleum naphtha (V. M. & P.), petroleum ether, benzene, toluene, xylene, coal tar naphtha, ethyl alcohol (abs. and 95%), methyl alcohol, isobutanol, acetone, amyl acetate, "Cellosolve" (ethylene glycol monoethyl ether), "Methyl Cellosolve" (ethylene glycol monomethyl ether), tricresyl phosphate, turpentine, carbon tetrachloride and carbon disulfide.

Combinations of organic liquids can be used, that is, the liquid vehicle may be comprised of one or more components. Pairs or groups of liquids which may be used individually with a given wax may generally be used in combination, if miscible with each other, as the vehicle. For example, the following combinations, among others, may be used satisfactorily with hydrogenated castor oil wax: linseed oil and mineral oil, linseed oil and naphtha, linseed oil and turpentine, and soy bean oil and "Cellosolve". In this way a thin liquid may be thickened, a thick liquid thinned, and other modifications and combinations made use of in preparing the vehicle, as is well known in the art.

In the preparation of lubricants and of grinding and lapping compounds, non-volatile petroleum oil fractions are customarily employed as vehicles, and as little as 1–3% or less of the hydrogenated castor oil wax may be incorporated therewith to obtain stable suspensions of finely divided solid lubricants and abrasives.

The organic liquid vehicles which may be employed in accordance with the invention may be generically characterized as those in which the wax is solvatable or lyophilic, meaning that the liquid is capable of being dissolved in or adsorbed by solid wax particles to render them gelatinous, and in which the wax is relatively insoluble at normal room temperature (20° C. or 68° F.) and thereabouts.

If the wax is readily dissolved in the liquid at an elevated temperature (as disintguished from melting without dissolving), a mutual compatibility exists indicating that at lower temperatures solid wax particles will be solvatable (lyophilic) in the liquid. The wax-vehicle combination should be such that it is freely flowing and possessed of substantial gelocity (suspending power) throughout at least the temperature range 10–35° C. (50–95° F.) Hence the wax should have a solubility-temperature characteristic in the liquid such that no great increase of solubility occurs within the limits of about 10–35° C. (50–95° F.), as otherwise if sufficient wax is employed to produce gelcosity at the upper temperatures, there will be so much wax out of solution at the lower temperatures that the mixture will not be freely flowing at temperatures to be expected under room conditions.

I prefer to employ liquid vehicles in which an amount of the wax not exceeding about 5% by weight, relative to the vehicle, can be used to produce suspending media which will be freely flowing and possessed of substantial gelcosity throughout at least the temperature range of 10–40° C. (50–104° F.), and this standard is met and exceeded by all of the various liquid vehicles heretofore named. For example, a suspension having a petroleum oil vehicle (such as a neutral oil of 28–32° Baumé gravity) and containing about 1% of hydrogenated castor oil wax, will be freely flowing and stable at temperatures up to about 71° C. (160° F.).

The relative insolubility of hydrogenated castor oil wax in a number of common organic liquid vehicles at room temperature and thereabouts, in which the wax is solvatable, is shown by the following table:

Solvent	Solubility of hydrogenated castor oil wax in grams per 100 c. c. of solvent—	
	At 18–20° C.	At 33° C.
Toluene	1.5	1.5
Carbon tetrachloride	1.4	1.5
Carbon bisulfide	1.3	1.9
Xylene	1.2	1.2
Acetone	0.6	1.1
Ether	0.3	1.2
Isobutanol	0.3	0.9
Cellosolve	0.3	0.4
Ethyl alcohol (abs.)	0.2	0.4
Methyl alcohol	0.2	0.2
Petroleum ether	0.1	0.2
Methyl Cellosolve	0.1	0.3
Ethyl alcohol (95%)	0.05	0.4

Lubricant suspensions may be prepared con-

taining finely divided solid lubricant particles of greater than colloidal size, such as flowers of sulfur and finely divided selenium, tellurium, talc, slaked lime, white lead, white zinc and cork dust.

As further examples of suspensions to which the invention applies, mention is made of grinding, lapping and polishing mixtures containing suspended particles of emery, carborundum, rouge, whiting, or similar substances.

The term "solid particles", as used herein includes semi-solid or plastic particles, such as particles of natural and synthetic resins.

The actual preparation of freely flowing suspensions and suspending media will now be described in more detail. All methods involve the essential steps of distributing the wax in the liquid vehicle in the form of finely divided discrete particles and solvating or gelatinizing the particles. These steps may be performed concurrently or successively; and if performed successively they may take place in either order, that is, the wax may be finely divided and then solvated of gelled, or may be gelled and then the gel mass finely divided. In any case, the initially formed waxy particles may be further subdivided, or solvated, or both, to secure increased gelcosity, and this is generally desirable.

In ordinary practice, I use the plan of solvating or gelling the wax with the vehicle of the final product, the wax being either introduced into the whole amount of the vehicle at once, or being first combined with a portion of the vehicle and the remainder then added at an appropriate stage. Alternatively, the wax may be gelled with one liquid substance and the gel particles thereafter distributed in another liquid substance. In any case, a concentrated suspension product may be prepared containing more wax than is needed for stably suspending the pigment or other solid particles, and this concentrate may later be diluted by mixing with the same or a different liquid.

The sulfur or other solid material, in powdered form, may be introduced at any stage of preparation, that is, it may be mixed with the vehicle before or after the wax is added; and if mixed in after the addition of the wax it may be added either before or after the wax has been reduced to a subdivided gelled state.

It is generally most convenient to incorporate the wax in the vehicle by dissolving the wax in the vehicle at a temperature sufficient for this purpose, and then cooling the solution, preferably, but not necessarily, without agitation, to a temperature at which most of the wax insoluble at room temperature comes out of solution. The wax may be dissolved in a portion of the vehicle and the remainder (which is at room temperature) then added to facilitate cooling. If the wax readily forms a gel with the vehicle, a gelatinous phase will be formed, but in some cases a flocculent wax precipitate will be formed which is only partly solvated at this stage.

The next step has as its object the subdivision of the undissolved wax material and the solvation of this material (particularly if it is not already in a highly solvated condition) to form finely divided elastic gel particles distributed throughout the vehicle. This is accomplished by subjecting the material to thorough mechanical agitation. The mixture may be agitated by the action of a propeller type stirrer which is sufficiently vigorous, by being pumped and repumped through a mixing type pump, or by being milled in a ball or pebble mill, in a roll mill, or in a colloidal mill.

Pumping treatment may be conveniently performed with a gear pump, for example, having an inlet pipe communicating with the bottom of a tank or other receptacle in which the mixture is placed, and having an outlet pipe discharging above the surface of the mixture in the tank. Increased mechanical action on the mixture may be effected by placing a fine orifice in the discharge pipe line. A spring-loaded check valve serves well, the spring being set so that the fluid mixture pumped therethrough will force the valve disk from its seat to form a ring shaped orifice. The advantage of this type of orifice over an ordinary fixed jet-orifice is that greater uniformity is obtained and clogging is avoided. When material is deposited on the valve seat and disk, the disk will automatically move away from the seat so as to maintain the orifice and permit the deposited material to be washed away.

It is generally preferable to mix the sulfur or other material to be suspended, in powdered form, with the wax-vehicle mixture before the latter is subjected to mechanical treatment, or during the course of such treatment, in order to distribute the sulfur or other particles uniformly throughout the mixture at the same time that the finely divided gel particles are being formed and distributed. The mechanical treatment in the presence of the wax material assists in breaking up and deagglomerating the solid material, and at the same time the sulfur or other particles increase the mechanical action on the wax particles and facilitate their subdivision and solution. Grinding of sulfur material in the vehicle of the product is often resorted to, and such grinding may be performed following incorporation of wax in accordance with the present invention, the grinding simultaneously subjecting the wax to the desired mechanical action.

Mechanical working of a severe nature is generally required to cause adequate solvation of wax in vehicles of the non-viscous organic solvent type, such as petroleum ether, naphtha, benzene, toluene, turpentine, alcohol, acetone, Cellosolve, carbon tetrachloride, and the like. With respect to incorporation of wax in these vehicles, it is not enough to merely subdivide the wax material, and mechanical work is needed to cause the liquid to solvate the solid wax phase so as to obtain elastic gel particles. When viscous oil vehicles are used, the wax will usually gel satisfactorily with the vehicle without agitation, that is, a gel will be formed merely by cooling the initial hot solution of wax in oil, and a mere stirring will produce a mixture which possesses gelcosity; although agitation should be used in order to subdivide the gel into fine particles. When a non-viscous vehicle is employed, cooling of the initial solution will generally result in a flocculent wax precipitate and the mixture will not exhibit substantial gelcosity upon mere stirring, severe mechanical working being needed to cause liquid to dissolve in or be adsorbed by the wax particles.

A small amount of a wetting agent may be added to facilitate subdivision of the wax or gel particles during mechanical working. Subdivision of the particles produces an increase in the total surface area of the particles, resulting in an increase in the interfacial or surface energy of the particle system. The greater the magnitude of this energy the greater the resistance to further subdivision, and the greater the tendency of the particles to agglomerate in order to decrease the surface area and surface energy.

Under any given working conditions, for example with a particular pumping set up, the available kinetic energy acting on the individual particles is able to reduce the particle size to a more or less definite value only, and no smaller, the energy required for further subdivision being greater than that available. By using a wetting agent, which is adsorbed by the particles, the surface energy per unit of surface area is made lower than it would be otherwise, and hence a greater subdivision and smaller particle size will be produced. Sulphonated castor oil (Turkey red oil) is an example of a suitable wetting agent and is effective when added to the wax vehicle mixture in amounts of a fraction of one percent. The wetting agent will also act as an agglomeration inhibitor for the wax particles, and may serve the same functions with respect to the pigment or other suspended particles. Other examples of suitable wetting agents are those sold under the trade-names of "Erkalin" and "Avirol".

The smaller the size of the gel particles, the greater the suspending power (gelcosity) of the medium, and hence the smaller the amount of wax needed.

Unless sufficient gel material is present to exist in equilibrium with the liquid phase, a serum layer will form even without the presence of sulfur or other suspended solid particles in the gelatinous mass. This may be caused by an insufficient concentration of gel particles, due to insufficient wax having been incorporated, resulting in a settling of the gel particles until in substantial contact, the mass of gel particles being surmounted by a serum layer of the liquid. If the wax particles are of lower specific gravity than the vehicle, the serum layer will form on the bottom of the container.

Even when substantially in contact, the individual gel particles will tend to contract, with a resultant bleeding out of liquid contained therein, until an equilibrium is established, if they have originally taken up too much liquid; this effect being known as syneresis. This may be avoided by employing a greater amount of wax.

The presence of entrained sulfur or other particles of greater density will result in compression of a mass of gel particles, with the result that a portion of the liquid present in and between the gel particles may be squeezed out and rise to the surface as a serum layer. This may be avoided by employing a sufficient amount of wax, but the formation of a serum layer is not necessarily detrimental. That is, the formation of a serum layer does not mean that the sulfur or other particles are not stably entrained and suspended in the mass of gel particles, but it indicates that an excess of liquid is present. There is no settling of the sulfur or other particles to a cake or compact layer on the bottom of the receptacle, as the sulfur or other particles will be stably suspended in the mass of gel particles (assuming that this mass possesses adequate gelcosity). Gentle agitation or stirring will cause the serum layer to redistribute itself throughout the gelatinous mass to reform a completely uniform mixture.

The tendency to form a serum layer will be counteracted by finely divided air bubbles which become entrained during extended pumping or other mechanical agitation of the suspension during preparation. Such dispersed air globules of small size will be held within the gelatinous mass and will be mechanically prevented from rising and escaping just as the solid suspended particles are prevented from settling, the force of buoyancy on the air particles being insufficient to produce movement, owing to the gelcosity effect. The buoyant force of the air bubbles tends to offset the downward drag of the suspended solid particles and reduces the compression exerted by the latter, thus reducing the tendency to form a serum layer. This effect may be further increased, to minimize any serum layer, by so conducting the agitation of the mixture as to favor the entrainment of air. For example, a pumping arrangement, as hereinbefore described, in which the mixture is discharged from the circulating pump in a stream onto the surface of the main body, will cause splashing favoring the entrainment of air, and the pumping will tend to finely divide the bubbles thus incorporated. Air may also be forced into the pipe line and thus introduced, and this will be particularly effective when the mixture is forced through a fine orifice. This use of air for the minimization of serum layers is described in more detail in the patent to V. R. Abrams, No. 2,007,137, issued July 2, 1935, to which reference may be made.

The following examples illustrate the preparation of sulfur suspensions having great value as cutting lubricants and for other lubrication purposes under extreme pressure and/or high temperature conditions. Reference may be made to the patent to V. R. Abrams, No. 1,913,300, issued June 6, 1933, for details as to the lubricating action of sulfur suspensions.

Example 1

Melt and dissolve about 1¼% (by weight relative to the final product) of hydrogenated castor oil wax in about 20% of petroleum oil, such as a neutral oil of 28–32° Baumé gravity, heating to a temperature of 200–250° F. Discontinue the heating and add a further quantity of the oil, amounting to about 60% and having about room temperature, thereby causing cooling and gelling. Then add about 5% of finely divided sulfur (flowers of sulfur, for example), and thoroughly mix and agitate, preferably by pumping and repumping through a small orifice. Add the remainder of the oil (about 13¾%) and thoroughly agitate, as by pumping through a small orifice, to produce smoothness of texture and a finely divided condition of the gel and sulfur particles.

Example 2

Melt and dissolve 3% of hydrogenated castor oil wax in 12% of petroleum oil, such as a neutral oil of 28–32° Baumé gravity, by stirring and heating to 200–250° F. Discontinue the heating and add 50% of petroleum oil at about room temperature, producing cooling and gelling. Agitate by pumping under pressure through a small orifice, or in any suitable manner, to produce smoothness of texture and finely divided gel particles. Add 1% of sulfonated castor oil and 15% of flowers of sulfur. Agitate and stir to produce a uniform mixture containing finely divided sulfur distributed therethrough and stably suspended. Then add 19% of oil and agitate and stir for about one hour.

This mixture provides a lubricant base of concentrated form which the user can dilute with two parts of petroleum oil to secure a freely flowing cutting lubricant containing stably suspended sulfur particles of greater than colloidal size.

A valuable feature resulting from the use of

hydrogenated castor oil wax is that sufficient gelcosity and suspending power will be present even if the user over-dilutes to the extent of producing 15:1 dilution, which in this extreme case would mean that only 1/5% of wax would be present.

Example 3

Melt and dissolve 1% of hydrogenated castor oil wax in about 93⅔% of petroleum oil, by stirring and heating to 200–250° F. Cool by any means to about 120° F. Add about ⅓% of sulfonated castor oil (as commercial Turkey red oil) and about 5% of powdered sulfur. Then agitate and pump under pressure through a small orifice to produce smoothness of texture and a uniform distribution of finely divided gel and sulfur particles.

A freely flowing mixture is obtained in which the sulfur is held in stable suspension, and it is adapted to be used directly as a cutting lubricant.

This application is in part a continuation of my copending application Ser. No. 751,413, filed November 3, 1934, and is a division of my application Ser. No. 84,589, filed June 10, 1936.

In the claims the word "solvated" is used in its usual sense, meaning compounded with a liquid to form a gel-like substance, similar to "hydrated" particles where water is the liquid.

I claim the following as my invention:

1. A freely flowing lubricant especially adapted for use under extreme-pressure and/or high temperature conditions, comprising a mineral oil vehicle gelled with a small amount of hydrogenated castor oil wax, constituting a discontinuous gelatinous mass containing finely divided gel particles and possessing the property of gelcosity, and finely divided sulfur particles of greater than colloidal size distributed therethrough in an amount to function as a lubricating ingredient and be stably suspended therein.

2. A freely flowing lubricant comprising a mobile discontinuous gelatinous mass containing finely divided particles of elastic gel composed of mineral oil and a small amount of hydrogenated castor oil wax, said particles being substantially in contact with each other and having the interspaces containing oil, and finely divided sulfur particles of greater than colloidal size distributed therethrough and stably suspended therein to function as a lubricating ingredient.

3. A lubricant comprised of a mineral oil vehicle gelled with hydrogenated castor oil wax constituting a discontinuous gelatinous mass containing finely divided gel particles and containing finely divided sulfur particles of greater than colloidal size distributed therethrough in amount sufficient to function as an effective lubricating ingredient upon a predetermined dilution, sufficient wax being employed to permit of a stable suspension of the sulfur upon said dilution when the gelled material is in finely divided form.

4. A lubricant comprised of petroleum oil gelled with about 1¼% of hydrogenated castor oil wax, constituting a discontinuous gelatinous mass containing finely divided gel particles and possessing the property of gelcosity, and about 5% of sulfur in the form of finely divided particles of greater than colloidal size distributed therethrough and stably suspended therein.

5. A freely flowing lubricant comprised of a mineral oil vehicle containing finely divided solid lubricant particles of greater than colloidal size and finely divided gel particles distributed therethrough, said gel particles being composed of mineral oil gelled with hydrogenated castor oil wax and stably suspending said lubricant particles, and said lubricant particles being substantially insoluble in the mixture.

6. A freely flowing lubricant composed of a mineral oil vehicle gelled with a small amount of hydrogenated castor oil wax, constituting a discontinuous gelatinous mass containing finely divided gel particles and possessing the property of gelcosity, and finely divided solid lubricant particles of greater than colloidal size distributed therethrough in an amount to function as a lubricating ingredient and be stably suspended therein, said lubricant particles being substantially insoluble in the mixture.

7. A freely flowing lubricant comprising a mineral oil vehicle gelled with a small amount of hydrogenated castor oil wax, constituting a discontinuous gelatinous mass containing finely divided gel particles and possessing the property of gelcosity, finely divided sulfur particles of greater than colloidal size distributed therethrough in an amount to function as a lubricant ingredient and be stably suspended therein, and a wetting agent to inhibit agglomeration of said sulfur particles.

8. A lubricant comprising a mobile discontinuous gelatinous mass containing finely divided particles of elastic gel composed of mineral oil and a small amount of hydrogenated castor oil wax, said particles being substantially in contact with each other and having the interspaces containing oil, finely divided sulfur of greater than colloidal size distributed therethrough in amount to function as a lubricating ingredient and be stably suspended, and a small amount of sulfonated castor oil as an agglomeration inhibitor.

9. A freely flowing lubricant comprised of petroleum oil gelled with about 1% of hydrogenated castor oil wax, constituting a discontinuous gelatinous mass containing finely divided gel particles and possessing the property of gelcosity, about 5% of finely divided sulfur of greater than colloidal size suspended therein, and about ⅓% of sulfonated castor oil.

10. A lubricant comprising a mineral oil vehicle gelled with a small amount of hydrogenated castor oil wax, constituting a discontinuous gelatinous mass containing finely divided gel particles, finely divided solid lubricant particles of greater than colloidal size distributed therethrough, and a small amount of sulfonated castor oil.

11. A lubricant base comprised of petroleum oil gelled with about 3% of hydrogenated castor oil wax, constituting a discontinuous gelatinous mass containing finely divided gel particles, about 15% of finely divided sulfur particles of greater than colloidal size distributed therethrough, and about 1% of sulfonated castor oil.

12. A freely flowing suspension comprising a freely flowing viscous vehicle in which hydrogenated castor oil wax is lyophilic and relatively insoluble at room temperature, containing finely divided particles of hydrogenated castor oil wax gelled with the vehicle and finely divided sulfur particles distributed therethrough in a suspended state, the wax being in amount to stably suspend said sulfur particles without preventing free flow.

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