The invention provides a method of lubricating containing: (a) employing a first functional fluid, (b) adding or contacting the first functional fluid with a controlled release gel wherein the controlled release gel has the desired additives to be released imparting the desired properties into the first functional fluid which is for lubricating a mechanical device; and/or adding a delivery system with the desired additives for a second functional fluid; (c) releasing the desired additives from the delivery system into the first functional fluid resulting in the first functional fluid changing into a second functional fluid, with the proviso that the second functional fluid is different from the first functional fluid.
CONTROLLED RELEASE OF ADDITIVE GEL(S) FOR FUNCTIONAL FLUIDS

Field of the Invention

The present invention relates to a delivery system for providing one or more functional fluids with desired additives. The invention further relates to the systems use in lubricant technology.

Background of the Invention

Modern mechanical equipment such as a transmission, hydraulic, engine or gear all require a functional fluid to possess a number of different properties. These properties allow the equipment to operate in a range of equipment environments, including various regimes of soot/sludge formation, friction, corrosion, thermal decomposition, oxidation, extreme pressure and wear. In many instances these different properties are unique to a component of the mechanical device. The unique properties may depend on chemical interactions between additives (for example, synergistic effects or antagonists competing for same reactive sites), component design, as well as the materials used. Consequently, a number of functional fluids are required to lubricate various components within the mechanical equipment. Having a number of functional fluids may result in difficulties such as in handling or storage and confusion of application for the operator. Confusion of application may result in improper use resulting in equipment down time.

Furthermore, functional fluids degrade over time through use. The additives in the functional fluids deplete or change over the lifetime of the fluid in an engine or other mechanical device. Replenishment of additives in a functional fluid by a slow release additive package in the form of a gel is disclosed in US Patent Application 2004/0014614. Other time release additives include coatings or polymers as disclosed in U.S. Patent Application 2004/0154304A1; and U.S. Patents 4,075,098; and 4,066,559.

Accordingly, it is desirable to provide a delivery system for additives and a method of lubricating a mechanical device with the delivery system. The delivery
system and method of lubricating allows for improved storage or handling of functional fluids as well as reduced confusion of application. The present invention provides a delivery system and a method of lubricating capable of improving at least one of replenishing additives in a lubricating oil, storage and handling of functional fluids.

**Summary of the Invention**

The invention provides a method for lubricating a comprising:

(a) employing a first functional fluid, wherein the first functional fluid is selected from the group consisting of an oil of lubricating viscosity, a gear oil including automotive and/or industrial, a manual transmission oil, an automatic transmission oil, a hydraulic fluid, an engine oil, a two cycle oil, a metalworking fluid and an axle fluid;

(b) contacting the first functional fluid with a delivery system wherein the delivery system has the desired additives to be released imparting the desired properties into the first functional fluid which is for lubricating a mechanical device;

(c) releasing the desired additives from the delivery system into the first functional fluid resulting in the first functional fluid changing into a second functional fluid selected from the group consisting of a gear oil, a manual transmission oil, an automatic transmission oil, a hydraulic fluid, an engine oil, a two cycle oil, a metalworking fluid and an axle fluid, with the proviso that the second functional fluid is different from the first functional fluid.

In another embodiment the invention is a method for lubricating a mechanical device comprising:

(a) employing one or more delivery systems, wherein the delivery systems may be the same, similar, different or combinations thereof and wherein the composition of the delivery systems depends on the desired additives to be added into a first functional fluid or to change the first functional fluid into a second functional fluid;

(b) contacting the first functional fluid with one or more delivery systems wherein the functional fluid may be of more than one type, and wherein the delivery systems comprises at least one additive comprising detergents, dispersants, acids, bases, over based detergent, succinated polyolefins, viscosity modifier(s), friction
modifier(s), detergent(s), cloud point depressant(s), pour point depressant(s),
demulsifier(s), flow improver(s), anti static agent(s), dispersant(s), antioxidant(s),
antifoam(s), corrosion/rust inhibitor(s), extreme pressure/antiwear agent(s), seal
swell agent(s), lubricity aid(s), antimisting agent(s), or mixtures thereof;
resulting in changing the first functional fluid into the second functional fluid
when the delivery systems are contacted with the first functional fluid.

The present invention provides a process for supplying one or more desired
additives to a functional fluid by contacting the functional fluid with the additized
controlled release gel.

**Detailed Description**

In one embodiment the invention provides a method for lubricating a
mechanical device comprising the methods disclosed above.

The delivery system comprises at least one of liquids, solids, a controlled
release additive gel, capsules (for example melamine or urea formaldehyde
microencapsulation polymers), polymer bags (e.g. linear low density polyethylene),
perforated sheets, baffles, injectors, polymers which are oil-permeable at elevated
temperatures (as defined in US Patent 4,066,559), particles which are oil-insoluble
but oil wettable (as defined in US Patent 5,478,463), oil-soluble solid polymers
capable of functioning as viscosity improvers (as defined in US Patent 4,014,794),
or mixtures thereof. Typically the oil-soluble solid polymers are delivered from
within an oil filter, but any means by which the delivery system can be brought into
contact with the functional fluid can be used e.g., container/delivery device within
the oil pan, or within a fluid by-pass loop.

In accordance with one embodiment of the present invention, a controlled
release additive gel is provided for a fluid conditioning device(s). The present
invention provides a process for supplying one or more desired additives to a
functional fluid by contacting the functional fluid with the additized controlled
release gel.

The present invention of a delivery system can be used in any fluid
conditioning device including internal combustion engines which include mobile
and stationary applications; hydraulic systems; automatic transmissions; gear boxes
which include manual transmissions and differentials (e.g. front and rear drive axles
and industrial speed increasers or reducers); metalworking fluids; pumps; suspension systems; other lubricated mechanical systems; and the like. The fluid conditioning devices that can use the additive gel include, internal combustion engines, stationary engines, generators, diesel and/or gasoline engines, on highway and/or off highway engines, two-cycle engines, aviation engines, piston engines, marine engines, railroad engines, biodegradable fuel engines and the like; lubricated mechanical systems such as gear boxes, automatic transmissions, differentials, hydraulic systems and the like.

In one preferred embodiment, the first functional fluid is not a gear oil because difficulties may be encountered transforming the gear oil into a second functional fluid. The reason for this is believed to be the presence of excessive amounts of antiwear/EP agent additives based on sulphurised olefins. In some instances where the amount of sulphurised olefin is reduced it may be possible to change a first functional fluid derived from a gear oil into a different second functional fluid.

The functional fluid becomes diminished and depleted of its additives over time. The additive delivery system is specifically formulated to meet the desired performance requirements of the functional fluid system and to condition the fluid. The present invention provides for the use of an additive delivery system to increase the performance of the functional fluid by replenishing the depleted desired additives or introducing new desired additives to the functional fluid. Thus the functional fluid can add and/or maintain consistent performance over the functional fluid's life because the device should perform closer to optimum for a longer period of time.

The functional fluids useful to be readditized through the additized delivery system include gear oil, transmission oil, hydraulic fluid, engine oil, two cycle oil, metalworking fluid and the like. In one embodiment the preferred functional fluid is an engine oil. In another embodiment the preferred functional fluid is a gear oil. In another embodiment the preferred functional fluid is a transmission fluid. In another embodiment the preferred functional fluid is a hydraulic fluid.

In one embodiment the additive delivery system dissolves into the functional fluid by contacting the additive delivery system with the functional fluid in the
system. The additive delivery system is positioned anywhere the additive delivery system will be in contact with the functional fluid. In one embodiment, the additive delivery system is positioned anywhere that the circulating functional fluid contacts the additive delivery system. In one embodiment the functional fluid is an engine oil and the additive delivery system is positioned in the engine oil system which includes the lubricating system, filter, drain pan, oil bypass loop, canister, housing, reservoir, pockets of a filter, canister in a filter, mesh in a filter, canister in a bypass system, mesh in a bypass system, oil lines and the like. In one embodiment the functional fluid is a gear oil and the additive delivery system is located in the gear system which includes oil drain pan, sump, filters, a full flow or bypass oil line, lines, loop and/or filter, canisters, mesh, other spaces within the device in which a delivery system might be contained and the like. In one embodiment the functional fluid is transmission fluid and the additive delivery system is located in the transmission system which includes the space such as a hole within a transmission magnet, the oil pan, oil lines, lines, canisters, mesh and the like. In one embodiment the additive delivery system is located in the engine oil line, which includes a full flow filter, a by-pass filter, the oil pan, and the like. In one embodiment, the functional fluid is a hydraulic fluid and the additive delivery system is located in the hydraulic cylinder, sump, filter, oil lines, pan, full flow or by pass oil loop, line and/or filter, canister, mesh, other spaces in the system and the like.

One or more locations in a line, loop and/or the functional fluid system can contain the additive delivery system. Further, if more than one additive delivery system for the functional fluid is used the additive delivery system can be identical, similar and/or a different additive delivery system composition.

In one embodiment the method for lubricating a mechanical device comprises employing one or more additive delivery systems in a container.

In one embodiment the properties imparted by the desired additives include dispersancy, antioxidancy, corrosion inhibition, wear prevention, scuffing prevention, pitting prevention including micro and macro pitting, friction modifying properties including increased and/or decreased friction coefficients, detergency, viscosity control using viscosity modifiers, foam control or mixtures thereof.
In one embodiment the mechanical device comprises axles, gear boxes, automatic transmissions, manual transmissions, differentials or mixtures thereof.

In one embodiment of the invention the first functional fluid is changed into the second functional fluid different from the first functional fluid. Changing the first functional fluid into the second functional fluid may be attained by releasing the desired additives from a delivery system in an amount sufficient to provide a different ratio of additives.

The first functional fluid may be changed into the second functional fluid by adding and/or modifying the ratio of additives in the first functional fluid. Modifying the ratio of additives by the addition the desired additives is obtained by adding or contacting the first functional fluid with a delivery system composition of the desired additives. The desired additives controlled released into the first functional fluid resulting in the first functional fluid changing into the second functional fluid. The change from the first functional fluid to the second functional fluid occurs when the desired additives are released from the delivery system and providing the desired properties to the second functional fluid.

In one embodiment the first functional fluid is a manual transmission fluid additized with a sufficient amount of an antiwear agent/extreme pressure agent and other additives including dispersants and/or detergent to form the second functional fluid, an axle fluid.

In one embodiment the functional fluid system comprises additive delivery systems suitable for forming a functional fluid for an axle. The compositions of the additive delivery systems suitable forming a functional fluid for an axle and/or gear oil in one embodiment contains reduced amounts of a sulfurized olefin antiwear agent in the presence of a sulfonate detergent. In another embodiment the functional fluid for an axle and/or gear oil contains reduced amounts of sulfonate detergent in the presence of a sulfurized olefin antiwear agent. In another embodiment the sulfonate detergent in the delivery system is substantially retained, thus reducing the amount of detergent in a functional fluid for an axle and/or gear oil. In one embodiment, it is desirable that the sulfonate detergent in the delivery system does not release in a gear oil applications.
In one embodiment the line, loop and/or the functional fluid system contains two or more different additive delivery systems located at two or more locations. The different compositions of the additive delivery systems provide the first functional fluid with desired additives to be control released to change to a second functional fluid that lubricates the mechanical device.

In one embodiment, the mechanical device contains two or more first functional fluids which are contacted with one or more, for example two or three additive delivery systems. After contacting the additives delivery systems, the first functional fluids are changed into second functional fluids (which can be the same or different depending on the delivery systems) with two or more compositions that are employed to provide appropriate lubricating properties to various components within the mechanical device.

In one embodiment the mechanical device comprises one first functional fluid contacting multiple delivery systems resulting in changing the first functional fluid into multiple second functional fluids.

In one embodiment the mechanical device comprises multiple first functional fluids contacting multiple delivery systems resulting in changing the first functional fluids into multiple second functional fluids.

In one embodiment it is desirable to provide a container to hold the additive delivery system, such as a housing, a canister or a structural mesh anywhere in the functional fluid system, for example, a canister within a bypass loop of a stationary gas engine for power generation. The necessary design feature for the container is that at least a portion of the additive delivery system is in contact with the functional fluid.

In one embodiment the delivery system is a controlled release gel. The gel comprises;

i.) at least two additives selected from the group comprising detergents, dispersants, acids, bases, over based detergent, succinated polyolefins or mixtures thereof wherein the selected additives when combined form a gel;

ii.) optionally at least one additive comprising viscosity modifier(s), friction modifier(s), detergent(s), cloud point depressant(s), pour
point depressant(s), demulsifier(s), flow improver(s), anti static agent(s), dispersant(s), antioxidant(s), antifoam(s), corrosion/rust inhibitor(s), extreme pressure/antiwear agent(s), seal swell agent(s), lubricity aid(s), antimisting agent(s), or mixtures thereof.

The additive gel needs to be in contact with the functional fluid. In one embodiment the additive gel is in contact with the functional fluid in the range of about 100% to about 1% of the functional fluid in the system, in another embodiment the additive gel is in contact with the functional fluid in the range of about 75% to about 25% of the functional fluid in the system and in another embodiment the additive gel is in contact with the functional fluid in the range of about 50% of the functional fluid in the system. As the flow rate decreases there is less dissolution of the additive gel and as the flow rate increases there is greater dissolution of the additive gel.

In one embodiment, the additive gel is positioned in the functional fluid system so that the additive gel and/or spent additive gel can easily be removed, and then replaced with a new and/or recycled additive gel.

The additive gel is added to the system by any known method depending on the total amount of gel that is desired to be released over time, the desired form of the additive gel (e.g. stiffness, consistency, homogeneity and the like), the desired overall dissolution of the gel, the desired release rates of a specific component, the desired mode of operation and/or any combinations of the above.

The release rate of the additive gel is determined primarily by the additive gel formulation. The release rate is also dependent on the mode of addition of the additive gel, the location of additive gel, flow rate of the functional fluid, the form of the additive gel (e.g., stiffness, consistency, homogeneity and the like) and the like. The additive gel is positioned in a location desirable for the specified and desirable dissolution rate of the additive gel components.

The additive gel's formulation may be composed of one or more components that selectively dissolve or a portion of one or more components remain till the end of its service life or combinations thereof. In general, the components in category ii will typically dissolve faster than the components in i) as defined above. This allows a desired component(s) ii) as defined above to be selectively released into the
functional fluid while other components remain undissolved or less dissolved. Thus
depending on the fluid conditioning device and its functional fluid, the gel would
contain the desired component(s) in category ii to dissolve into the functional fluid
to replace or introduce the desired additive.

In one embodiment, it has been found that the gel slowly dissolves its
component additive parts into the functional fluid when exposed to heated fluid with
no or limited flow over the surface of the gel. The rate of dissolution of additive gel
under these conditions is controlled to be slow, and because the gel dissolves into its
component additives, it effectively achieves slow and selective release of the desired
additives into the functional fluid. If exposure to the hot fluid is continued beyond
the point that certain additive(s) are selectively released, the gel will continue to
dissolve over time so that the other additives, i.e. b) components, continue to be
released. These release rates can be optimized, using the parameters described
above, so that the desired gel component(s) are released over a substantial portion to
all of the functional fluid's useful life.

The gel can be used as is, without an inert carrier or a non additive matrix,
such as a polymeric membrane or complicated mechanical systems needed in earlier
systems for achieving controlled release of additives over time.

The gel is a mixture of two or more additives from category i component that
when combined form a gel and further contain at least one additive from category ii
components. The gel exists in a semi-solid state more like a solid than a liquid, see
© 1994. See, also, Larson, "The Structure and rheology of Complex Fluids",
Chapter 5, Oxford University Press, New York, New York, © 1999, each which is
incorporated herein by reference. The rheological properties of a gel can be
measured by small amplitude oscillatory shear testing. This technique measures the
structural character of the gel and produces a term called the storage modulus which
represents storage of elastic energy and the loss modulus which represents the
viscous dissipation of that energy. The ratio of the loss modulus/storage modulus,
which is called the loss tangent, or "tan delta", is > 1 for materials that are liquid-like
and < 1 for materials that are solid-like. The additive gels have tan delta values in
one embodiment of about ≤ 0.75, in another embodiment of about ≤ 0.5 and in
another embodiment of about $\leq 0.3$. The gels have tan delta values in one embodiment of about $\leq 1$, in one embodiment of about $\leq 0.75$, in one embodiment of about $\leq 0.5$ or in one embodiment of about $\leq 0.3$.

The additive gel contains a combination of gelling additives of i) components in the range of about 0.01% to about 95%, in one embodiment in the range of about 0.1% to 80% and in another embodiment in the range of about 1% to about 50% of the total weight of the gel.

The additive gel contains a combination of optional additives of the ii) components in the range of about 0.1% to about 95%, in one embodiment in the range of about 0.1% to 90%, in another embodiment in the range of about 0.1% to 80%, and in another embodiment in the range of about 0.5% to about 50% of the total weight of the additives and/or base oil of the delivery system (i.e. excluding the weight of the mechanical device).

In accordance with the present invention, any delivery system formed from the combination of two or more additives comprising detergents, dispersants, acids, bases, over based detergents, succinated polyolefins, and the like can be used to make the additive gel. The additive gel comprises at least two additives selected from the group including detergents, dispersants, acids, bases, over based detergent, succinated polyolefins or mixtures thereof wherein such selected additives when combined form a gel. Further in one embodiment the additive gel includes combining dispersants, or combining a dispersant and an acid, or combining a dispersant and a base, or a dispersant and an over based detergent, and the like.

In one embodiment, a category of gel which finds particular use are those in which gellation occurs through the combination of an overbased detergent and an ashless succinimide dispersant. In one embodiment, the ratio of the detergent to the dispersant is from about 10:1 to about 1:10, in another embodiment from about 5:1 to about 1:5, form about 4:1 to about 1:1 and in another embodiment from about 4:1 to about 2:1. In addition, the TBN of the overbased detergent which participates in the gel-forming matrix, is normally at least 200, more typically at 300-1,000 and most typically 350 to 650. Where mixtures of overbased detergents are used, at least one should have a TBN value within these ranges. However, the average TBN of these mixtures may also correspond to these values.
The dispersant includes dispersants; ashless type dispersants such as Mannich dispersants; polymeric dispersants; carboxylic dispersants; amine dispersants, high molecular weight (Cn wherein n <\_12) esters and the like; esterfied maleic anhydride styrene copolymers; maleated ethylene diene monomer copolymers; surfactants; emulsifiers' functionalized derivatives of each component listed herein and the like; and combinations and mixtures thereof, hi one embodiment the preferred dispersant ispolyisobutenyl succinimide dispersant.

The dispersants includes ashless-type dispersants, polymeric dispersants, Mannich dispersants, high molecular weight (Cn wherein n \>12) esters, carboxylic dispersants, amine dispersants and combinations thereof. The dispersant may be used alone or in combination.

The dispersant includes but is not limited to an ashless dispersant such as a polyisobutenyl succinimide and the like. Polyisobutenyl succinimide ashless dispersants are commercially-available products which are typically made by reacting together polyisobutylene having a number average molecular weight ("Mn") of about 300 to 10,000 with maleic anhydride to form polyisobutenyl succinic anhydride ("PIBSA") and then reacting the product so obtained with a polyamine typically containing 1 to 10 ethylene amino groups per molecule.

Ashless type dispersants are characterized by a polar group attached to a relatively high molecular weight hydrocarbon chain. Typical ashless dispersants include N-substituted long chain alkenyl succinimides, having a variety of chemical structures including typically:

![Chemical Structure]

\[ R_1 \] \[ R_2 \] \[ n \] \[ H \] \[ NH_2 \]
wherein each $R_1$ is independently an alkyl group, frequently a polysiobutyl group with a molecular weight of 500-5000, and $R^2$ are alkenylene groups, commonly ethylene ($C_2H_4$) groups. Succinimide dispersants are more fully described in U.S. Patent 4,234,435 which is incorporated herein by reference. The dispersants described in this patent are particularly effective for producing delivery systems in accordance with the present invention.

The Mannich dispersant are the reaction products of alkyl phenols in which the alkyl group contains at least about 30 carbon atoms with aldehydes (especially formaldehyde) and amines (especially polyalkylene polyamines). Mannich bases having the following general structure (including a variety of different isomers and the like) are especially interesting.

Another class of dispersants is carboxylic dispersants. Examples of these "carboxylic dispersants" are described in Patent U.S. Patent 3,219,666.
Amine dispersants are reaction products of relatively high molecular weight aliphatic halides and amines, preferably polyalkylene polyamines. Examples thereof are described, in U.S. Patent 3,565,804.

Polymeric dispersants are inter polymers of oil-solubilizing monomers such as decyl methacrylate, vinyl decyl ether and high molecular weight olefins with monomers containing polar substituents, e.g., amino alkyl acrylates or acrylamides and poly-(oxyethylene)-substituted acrylates. Examples of polymer dispersants thereof are disclosed in the following U.S. Patents: 3,329,658, and 3,702,300.

Dispersants can also be post-treated by reaction with any of a variety of agents. Among these are urea, thiourea, dimercaptothiazoles, carbon disulfide, aldehydes, ketones, carboxylic acids, hydrocarbon-substituted succinic anhydrides, nitriles, epoxides, boron compounds, and phosphorus compounds.

Dispersants can be used alone or in combination. The dispersant is present in the range from about 0 wt % or 0.01 wt % to about 95 wt % gel, in another embodiment in the range from about 1 wt % to about 70 wt % gel, and preferably in another embodiment in the range from about 5 wt % to about 50 wt % total weight of the additives and/or base oil of the delivery system.

The detergents include overbased sulfonates, phenates, salicylates, carboxylates, overbased calcium sulfonate detergents which are commercially-available, overbased detergents containing metals such as Mg, Ba, Sr, Na, Ca and K and mixtures thereof and the like.

Detergents are described, for example, in U.S. Patent 5,484,542 which is incorporated herein by reference. The detergents may be used alone or in combination. Detergents are described, for example, in U.S. Patent 5,484,542 which is incorporated herein by reference.

The detergents may be used alone or in combination. The detergents are present in the range from about 0 wt % or 0.01 wt % to about 99 wt %, in one embodiment in the range from about 1 wt % to about 70 wt % and in another embodiment in the range from about 5 wt % to about 50 wt % total weight of the additives and/or base oil of the delivery system.

Typically the additive gel further contains at least one desired additive for controlled release into the functional fluid. The additive gel desired components...
include viscosity modifier(s), friction modifier(s), detergent(s), cloud point depressant(s), pour point depressant(s), demulsifier(s), flow improver(s), anti static agent(s), dispersant(s), antioxidant(s), antifoam(s), corrosion/rust inhibitor(s), extreme pressure/antiwear agent(s), seal swell agent(s), lubricity aid(s), antimisting agent(s), and mixtures thereof; resulting in a controlled release gel that over time releases the desired additive(s) into a functional fluid when the gel is contacted with the functional fluid. The desired additive component is further determined by the functional fluid formulation, performance characteristics, function and the like and what additive is desired to be added for depleted additives and/or added new depending on the desired functions.

Antioxidants include alkyl-substituted phenols such as 2, 6-di-tertiary butyl-4-methyl phenol, phenate sulfides, phosphosulfurized terpenes, sulfurized esters, aromatic amines, diphenyl amines, alkylated diphenyl amines and hindered phenols, bis-nonylated diphenylamine, nonyl diphenylamine, octyl diphenylamine, bis-octylated diphenylamine, bis-decylated diphenylamine, decyl diphenylamine and mixtures thereof.

The antioxidant function includes sterically hindered phenols and includes but is not limited to 2,6-di-tert-butylphenol, 4-methyl-2,6-di-tert-butylphenol, 4-ethyl-2,6-di-tert-butylphenol, 4-propyl-2,6-di-tert-butylphenol, 4-butyl-2,6-di-tert-butylphenol, 2,6-di-tert-butylphenol, 4-pentyl-2,6-di-tert-butylphenol, 4-hexyl-2,6-di-tert-butylphenol, 4-heptyl-2,6-di-tert-butylphenol, 4-(2-ethylhexyl)-2,6-di-tert-butylphenol, 4-octyl-2,6-di-tert-butylphenol, 4-nonyl-2,6-di-tert-butylphenol, 4-decyl-2,6-di-tert-butylphenol, 4-undecyl-2,6-di-tert-butylphenol, 4-dodecyl-2,6-di-tert-butylphenol, 4-tridecyl-2,6-di-tert-butylphenol, 4-tetradecyl-2,6-di-tert-butylphenol, 4-methylene-bridged sterically hindered phenols include but are not limited to 4,4-methylenebis(6-tert-butyl-o-cresol), 4,4-methylenebis(2-tert-amyl-o-cresol), 2,2-methylenebis(4-methyl-6-tert-butylphenol), 4,4-methylene-bis(2,6-di-tertbutylphenol) and mixtures thereof.

Another example of an antioxidant is a hindered, ester-substituted phenol, which can be prepared by heating a 2,6-dialkylphenol with an acrylate ester under based conditions, such as aqueous KOH.
Antioxidants may be used alone or in combination. The antioxidants are typically present in the range of about 0 wt % or 0.01 wt % to about 95 wt %, in one embodiment in the range from about 0.01 wt % to 95 wt %, and in another embodiment in the range from about 1 wt % to about 70 wt % and in another embodiment in the range from about 5 wt % to about 60 wt % total weight of the additives and/or base oil of the delivery system.

The extreme pressure/anti-wear agents include a sulfur or chlorosulphur EP agent, a chlorinated hydrocarbon EP agent, or a phosphorus EP agent, or mixtures thereof. Examples of such EP agents are amine salts of phosphorus acid acid, chlorinated wax, organic sulfides and polysulfides, such as benzyl disulfide, bis-(chlorobenzyl) disulfide, dibutyl tetrasulfide, sulfurized sperm oil, sulfurized methyl ester of oleic acid sulfurized alkylphenol, sulfurized dipentene, sulfurized terpene, and sulfurized Diels-Alder adducts; phosphosulfurized hydrocarbons, such as the reaction product of phosphorus sulfide with turpentine or methyl oleate, phosphorus esters such as the dihydrocarbon and trihydrocarbon phosphate, i.e., dibutyl phosphate, diheptyl phosphate, dicyclohexyl phosphate, pentylophenyl phosphate; dipentylphenyl phosphate, tridecyl phosphate, distearyl phosphate and polypropylene substituted phenol phosphate, metal thiocarbamates, such as zinc diocetyldithiocarbamate and barium heptylphenol diacid, such as zinc dicyclohexyl phosphorodithioate and the zinc salts of a phosphorodithioic acid combination may be used and mixtures thereof.

In one embodiment the antiwear agent/ extreme pressure agent comprises an amine salt of a phosphorus ester acid. The amine salt of a phosphorus ester acid includes phosphoric acid esters and salts thereof; dialkyldithiophosphoric acid esters and salts thereof; phosphites; and phosphorus-containing carboxylic esters, ethers, and amides; and mixtures thereof.

In one embodiment the phosphorus compound further comprises a sulfur atom in the molecule. In one embodiment the amine salt of the phosphorus compound is ashless, i.e., metal-free (prior to being mixed with other components).

The amines which may be suitable for use as the amine salt include primary amines, secondary amines, tertiary amines, and mixtures thereof. The amines include those with at least one hydrocarbyl group, or, in certain embodiments, two
or three hydrocarbyl groups. The hydrocarbyl groups may contain about 2 to about 30 carbon atoms, or in other embodiments about 8 to about 26 or about 10 to about 20 or about 13 to about 19 carbon atoms.

Primary amines include ethylamine, propylamine, butylamine, 2-ethylhexylamine, octylamine, and dodecylamine, as well as such fatty amines as n-octylamine, n-decylamine, n-dodecylamine, n-tetradecylamine, n-hexadecylamine, n-octadecylamine and oleylamine. Other useful fatty amines include commercially available fatty amines such as "Armeen®" amines (products available from Akzo Chemicals, Chicago, Illinois), such as Armeen C, Armeen O, Armeen OL, Armeen T, Armeen HT, Armeen S and Armeen SD, wherein the letter designation relates to the fatty group, such as coco, oleyl, tallow, or stearyl groups.

Examples of suitable secondary amines include dimethylamine, diethylamine, dipropylamine, dibutylamine, diamylamine, dihexylamine, diheptylamine, methylethylamine, ethylbutylamine and ethylamylamine. The secondary amines may be cyclic amines such as piperidine, piperazine and morpholine.

The amine may also be a tertiary-aliphatic primary amine. The aliphatic group in this case may be an alkyl group containing about 2 to about 30, or about 6 to about 26, or about 8 to about 24 carbon atoms. Tertiary alkyl amines include monoamines such as tert-butylamine, tert-hexylamine, 1-methyl-1-amino-cyclohexane, tert-octylamine, tert-decylamine, tert-dodecylamine, tert-tetradecylamine, tert-hexadecylamine, tert-octadecylamine, tert-tetracosanylamine, and tert-octacosanylamine.

Mixtures of amines may also be used in the invention. In one embodiment a useful mixture of amines is "Primene® 8IR" and "Primene® JMT." Primene® 8IR and Primene® JMT (both produced and sold by Rohm & Haas) are mixtures of C11 to C14 tertiary alkyl primary amines and C18 to C22 tertiary alkyl primary amines respectively.

Suitable hydrocarbyl amine salts of alkylphosphoric acid of the invention may be represented by the following formula:
wherein $R^3$ and $R^4$ are independently hydrogen or hydrocarbyl groups such as alkyl groups; for the phosphorus ester acid, at least one of $R^3$ and $R^4$ will be hydrocarbyl. $R^3$ and $R^4$ may contain about 4 to about 30, or about 8 to about 25, or about 10 to about 20, or about 13 to about 19 carbon atoms. $R^5$, $R^6$ and $R^7$ may be independently hydrogen or hydrocarbyl groups, such as alkyl branched or linear alkyl chains with 1 to about 30, or about 4 to about 24, or about 6 to about 20, or about 10 to about 16 carbon atoms. These $R^5$, $R^6$ and $R^7$ groups may be branched or linear groups, and in certain embodiments at least one, or alternatively two of $R^5$, $R^6$ and $R^7$ are hydrogen. Examples of alkyl groups suitable for $R^5$, $R^6$ and $R^7$ include butyl, sec-butyl, isobutyl, tert-butyl, pentyl, n-hexyl, sec-hexyl, n-octyl, 2-ethylhexyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, octadecenyl, nonodecyl, eicosyl groups and mixtures thereof.

In one embodiment the hydrocarbyl amine salt of an alkylphosphoric acid ester is the reaction product of a C14 to C18 alkylated phosphoric acid with Primene 81R™ (produced and sold by Rohm & Haas) which is a mixture of C11 to C14 tertiary alkyl primary amines.

Similarly, hydrocarbyl amine salts of dialkyldithiophosphoric acid esters of the invention used in the rust inhibitor package may be represented by the formula:

wherein the various $R$ groups are as defined above, although typically both $R$ groups are hydrocarbyl or alkyl. Examples of hydrocarbyl amine salts of dialkyldithiophosphoric acid esters include the reaction product(s) of hexyl, heptyl or octyl or nonyl, 4-methyl-2-pentyl or 2-ethylhexyl, isopropyl dithiophosphoric acids with ethylene diamine, morpholine, or Primene 81R™, and mixtures thereof.
In one embodiment the dithiophosphoric acid may be reacted with an epoxide or a glycol. This reaction product is further reacted with a phosphorus acid, anhydride, or lower ester. The epoxide includes an aliphatic epoxide or a styrene oxide. Examples of useful epoxides include ethylene oxide, propylene oxide, butene oxide, octene oxide, dodecene oxide, styrene oxide and the like. In one embodiment the epoxide is Propylene oxide. The glycols may be aliphatic glycols having from 1 to about 12, or from about 2 to about 6, or about 2 to about 3 carbon atoms. The dithiophosphoric acids, glycols, epoxides, inorganic phosphorus reagents and methods of reacting the same are described in U.S. Patent numbers 3,197,405 and 3,544,465. The resulting acids may then be salted with amines. An example of suitable dithiophosphoric acid is prepared by adding phosphorus pentoxide (about 64 grams) at about 58 °C over a period of about 45 minutes to about 514 grams of hydroxypropyl O,O-di(4-methyl-2-pentyl)phosphorodithioate (prepared by reacting di(4-methyl-2-pentyl)-phosphorodithioic acid with about 1.3 moles of propylene oxide at about 25 °C). The mixture is heated at about 75 °C for about 2.5 hours, mixed with a diatomaceous earth and filtered at about 70 °C. The filtrate contains about 11.8% by weight phosphorus, about 15.2% by weight sulfur, and an acid number of 87 (bromophenol blue).

The EP / antiwear agent can be used alone or in combination.

In one embodiment the EP / antiwear agent may be in the delivery system from about 0 wt % or 0.05 wt % to about 10 wt % or about 0.1 wt % to about 5 wt %.

The EP / antiwear agents are present in the range of about 0 wt % to about 20 wt %, in one embodiment in the range from about 0.25 wt % to about 10 wt % and in another embodiment in the range from about 0.5 wt % to about 25 wt % total weight of the additives and/or base oil of the delivery system.

The antifoams include organic silicones such as poly dimethyl siloxane, poly ethyl siloxane, polydiethyl siloxane, polyacrylates and polymethacrylates, trimethyl-triflouro-propylmethyl siloxane and the like.

The antifoams may be used alone or in combination. The antifoams are used in the range of about 0 wt % to about 20 wt %, in one embodiment in the range of about 0.02 wt % to about 10 wt % and in another embodiment in the range of 0.05
wt % to about 2.5 wt % total weight of the additives and/or base oil of the delivery system.

The viscosity modifier provides both viscosity improving properties and dispersant properties. Examples of dispersant-viscosity modifiers include vinyl pyridine, N-vinyl pyrrolidone and N,N'-dimethylaminoethyl methacrylate are examples of nitrogen-containing monomers and the like. Polyacrylates obtained from the polymerization or copolymerization of one or more alkyl acrylates also are useful as viscosity modifiers.

Functionalized polymers can also be used as viscosity modifiers. Among the common classes of such polymers are olefin copolymers and acrylate or methacrylate copolymers. Functionalized olefin copolymers can be, for instance, interpolymers of ethylene and propylene which are grafted with an active monomer such as maleic anhydride and then derivatized with an alcohol or an amine. Other such copolymers are copolymers of ethylene and propylene which are reacted or grafted with nitrogen compounds. Derivatives of polyacrylate esters are well known as dispersant viscosity index modifiers additives. Dispersant acrylate or polymethacrylate viscosity modifiers such as Acryloid™ 985 or Viscoplex™ 6-054, from RohMax, are particularly useful. Solid, oil-soluble polymers such as the PIB (polyisobutylene), methacrylate, polyalkystyrene, ethylene/propylene and ethylene/propylene/l,4-hexadiene polymers and maleic anhydride-styrene interpolymer and derivatives thereof, can also be used as viscosity index improvers. The viscosity modifiers are known and commercially available.

The viscosity modifiers may be used alone or in combination. The viscosity modifiers are present in the range of about 0 wt % to 20 wt %, in one embodiment in the range from about 0.25 wt % to about 10 wt % and in another embodiment in the range from about 0.5 wt % to about 2.5 wt % total weight of the additives and/or base oil of the delivery system.

The friction modifiers include organo-molybdenum compounds, including molybdenum dithiocarbamates, and fatty acid based materials, including those based on oleic acid, including glycerol mono oleate (GMO), those based on stearic acid, and the like.
In one embodiment, the friction modifier is a phosphate ester or salt including a monohydrocarbyl, dihydrocarbyl or a trihydrocarbyl phosphate, wherein each hydrocarbyl group is saturated. In several embodiments, each hydrocarbyl group contains from about 8 to about 30, or from about 12 up to about 28, or from about 14 up to about 24, or from about 14 up to about 18 carbons atoms. In another embodiment, the hydrocarbyl groups are alkyl groups. Examples of hydrocarbyl groups include tridecyl, tetradeetyl, pentadecyl, hexadecyl, heptadecyl, octadecyl groups and mixtures thereof.

In one embodiment, the phosphate salts may be prepared by reacting an acidic phosphate ester with an amine compound or a metallic base to form an amine or a metal salt. The amines may be monoamines or polyamines. Useful amines include those amines disclosed in U.S. Patent 4,234,435 at Col. 21, line 4 to Col. 27, line 50.

Useful amines include primary ether amines, such as those represented by the formula, R"(OR')XNH₂, wherein R' is a divalent alkylene group having about 2 to about 6 carbon atoms; X is a number from one to about 150, or from about one to about five, or one; and R" is a hydrocarbyl group of about 5 to about 150 carbon atoms.

The phosphate salt may be derived from a polyamine. The polyamines include alkoxyalated diamines, fatty polyamine diamines, alkylenepolyamines, hydroxy containing polyamines, condensed polyamines, arylpolyamines, and heterocyclic polyamines.

The metal salts of the phosphorus acid esters are prepared by the reaction of a metal base with the acidic phosphorus ester. The metal base may be any metal compound capable of forming a metal salt. Examples of metal bases include metal oxides, hydroxides, carbonates, borates, or the like. Suitable metals include alkali metals, alkaline earth metals and transition metals. In one embodiment, the metal is a Group IIA metal, such as calcium or magnesium, Group IIB metal, such as zinc, or a Group VIIB metal, such as manganese. Examples of metal compounds which may be reacted with the phosphorus acid include zinc hydroxide, zinc oxide, copper hydroxide or copper oxide.
In one embodiment, the friction modifier is a phosphite and may be a monohydrocarbyl, dihydrocarbyl or a trihydrocarbyl phosphite, wherein each hydrocarbyl group is saturated. In several embodiments each hydrocarbyl group independently contains from about 8 to about 30, or from about 12 up to about 28, or from about 14 up to about 24, or from about 14 up to about 18 carbons atoms. In one embodiment, the hydrocarbyl groups are alkyl groups. Examples of hydrocarbyl groups include tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl groups and mixtures thereof.

In one embodiment, the friction modifier is a fatty imidazoline comprising fatty substituents containing from 8 to about 30, or from about 12 to about 24 carbon atoms. The substituent may be saturated or unsaturated, preferably saturated. In one aspect, the fatty imidazoline may be prepared by reacting a fatty carboxylic acid with a polyalkylenepolyamine, such as those discussed above. A suitable fatty imidazoline includes those described in US Patent 6,482,777.

The friction modifiers can be used alone or in combination. The friction reducing agents are present in the range of about 0 wt % to 10 wt %, or from about 0.25 wt % to about 10 wt %, or from about 0.5 wt % to about 2.5 wt % total weight of the additives and/or base oil of the delivery system.

The anti-misting agents include very high (>100,000Mn) polyolefins such as 1.5 Mn polyisobutylene (for example the material of the trades name Vistanex®), or polymers containing 2-(N-acrylamido), 2-methyl propane sulfonic acid (also known as AMPS®), or derivatives thereof, and the like.

The anti-misting agents can be used alone or in combination. The anti-misting agents are present in the range of about 0 wt % to 10 wt %, or from about 0.25 wt % to about 10 wt %, or from about 0.5 wt % to about 2.5 wt % total weight of the additives and/or base oil of the delivery system.

The corrosion inhibitors include alkylated succinic acids and anhydrides derivatives thereof, organo phosphonates and the like. The rust inhibitors may be used alone or in combination. The rust inhibitors are present in the range of about 0 wt % to about 90 wt %, and in one embodiment in the range from about 0.0005 wt % to about 50 wt % and in another embodiment in the range from about 0.0025 wt %
% to about 30 wt % total weight of the additives and/or base oil of the delivery system.

The metal deactivators include derivatives of benzotriazoles such as tolyltriazole, N,N-bis(heptyl)-ar-methyl-1H-benzotriazole-1-methanamine, N,N-bis(nonyl)-ar-methyl-1H-Benzotriazole-1-methanamine, N,N-bis(decyl)-ar-methyl-1H-Benzotriazole-1-methanamine, N,N-bis(undecyl)-ar-methyl-1H-Benzotriazole-1-methanamine, N,N-bis(2-ethylhexyl)-ar-methyl-1H-Benzotriazole-1-methanamine and mixtures thereof. In one embodiment the metal deactivator is N,N-bis(1-ethylhexyl)-ar-methyl-1H-benzotriazole-1-methanamine; 1,2,4-triazoles, benzimidazoles, 2-alkyldithiobenzimidazoles; 2-alkyldithiobenzothiazoles; 2-N,N-dialkyldithiocarbamoyl)benzotriazoles; 2,5-bis(alkyl-dithio)-1,3,4-thiadiazoles such as 2,5-bis(tert-octyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-nonyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-decyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-undecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-dodecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-tridecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-tetradecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-octadecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-nonadecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-eicosyldithio)-1,3,4-thiadiazole and mixtures thereof; 2,5-bis(N,N-diaUcyldithiocarbamoyl)-1,3,4-thiadiazoles; 2-alkydithio-5-mercapto thia diazoles; and the like.

The metal deactivators may be used alone or in combination. The metal deactivators are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

The demulsifiers include polyethylene and polypropylene oxide copolymers and the like. The demulsifiers may be used alone or in combination. The demulsifiers are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

The lubricity aids include glycerol mono oleate, sorbitan mono oleate and the like. The lubricity additives may be used alone or in combination. The lubricity additives are present in the range of about 0 wt % to about 90 wt %, or from about
0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

The flow improvers include ethylene vinyl acetate copolymers and the like. The flow improvers may be used alone or in combination. The flow improvers are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

The cloud point depressants include alkylphenols and derivatives thereof, ethylene vinyl acetate copolymers and the like. The cloud point depressants may be used alone or in combination. The cloud point depressants are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

The pour point depressants include alkylphenols and derivatives thereof, ethylene vinyl acetate copolymers and the like. The pour point depressant may be used alone or in combination. The pour point depressant are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

The seal swell agents include organo sulfur compounds such as thiophene, 3-(decyloxy)tetrahydro-l, 1-dioxide, phthalates and the like. The seal swell agents may be used alone or in combination. The seal swell agents are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

Optionally, other components can be added to the delivery system includes base stock oils, inert carriers, dyes, bacteriostatic agents, solid particulate additives, and the like so long as these components do not have a detrimental effect on the delivery system.

When the delivery system is a gel, typically the gel contains small amounts (about 5-40 wt %) of base stock oils, which include but are not limited to mineral-
based, synthetic (including Fischer-Tropsch gas-to-liquid synthetic procedure as well as other gas-to-liquid oils) or mixtures thereof.

 Optionally, an inert carrier can be used if desired. Furthermore, other active ingredients, which provide a beneficial and desired function can also be included in the gel. In addition, solid, particulate additives such as the PTFE, MoS\textsubscript{2} and graphite can also be included.

 Optionally, dyes can be used and include halo-alkanes and the like. The dyes may be used alone or in combination. The dyes are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005 wt % to about 50 wt %, or from about 0.0025 wt % to about 30 wt % total weight of the additives and/or base oil of the delivery system.

 Optionally, bacteriostatic agents can be used and include formaldehyde, gluteraldehyde and derivatives, kathan and the like. The bacteriostatic agents may be used alone or in combination. The bacteriostatic agents are present in the range of about 0 wt % to about 90 wt %, or from about 0.0005% to about 50 wt %, or from about 0.0025% to about 30 wt % total weight of the additives and/or base oil of the delivery system.

 The components are mixed together sequentially or all together to form a mixture. After mixing of the components of the gel, a cure may be required in order for gelation to occur. If a cure is required, it is typically done in the range of about 20 °C to about 165 °C for about 1 min to about 60 days, or about 50 °C to about 120 °C for about 1 to about 24 hours, or about 85 °C to about 115 °C for about 4 to about 12 hours.

**Specific Embodiment**

For all the examples the components listed in each example in the specification were mixed together to form the gel. The gels were cured at about 100°C for about 8 hours.

**Example 1 Controlled Release of Antiwear Agent in Manual Transmission Fluid**

Antiwear agents such as amine salts of a phosphorus acid esters are well known as being suitable for a gear oil, transmission fluid or axle fluid.

Controlled release of an antiwear agent can be accomplished using a gel composed of:
a. about 45 wt % of an overbased detergent,

b. about 10 wt % of a 2000 MW polyisobutenyl succan;

c. about 15 wt % of a succininide dispersant, and

d. about 30 wt % of an amine salt of a phosphorus ester acid.

A manual transmission fluid is passed over the controlled release gel containing the antiwear agent. The resulting composition contains an acceptable amount of antiwear agent to allow the fluid to be used as an axle fluid.

A FZG scuffing test is carried out on the manual transmission fluid (MTF) and the manual transmission fluid containing antiwear agent from the controlled release gel (MTFGAW). The FZG scuffing test is carried out using "AlO" type gears of about 10mm face width, at a pitchline velocity of about 16.6 m/s in reverse direction and at about 120 °C (test also referred to as A10/16.6R/120 test). The results obtained are shown in Table 1.

<table>
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<th>Sample</th>
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<tr>
<td>MTF</td>
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<tr>
<td>MTFGAW</td>
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The results indicate that the controlled release gel is capable of modifying a lubricant designed for one mechanical device and providing desired additional additives to provide a lubricant with a different composition with acceptable properties in another mechanical device requiring a different lubricant additive composition.
We claim:

1. A method of lubricating comprising:
   (a) employing a first functional fluid, wherein the first functional fluid is selected from the group consisting of an oil of lubricating viscosity, a gear oil including automotive and/or industrial, a manual transmission oil, an automatic transmission oil, a hydraulic fluid, an engine oil, a two cycle oil, a metalworking fluid and an axle fluid;
   (b) contacting the first functional fluid with a delivery system wherein the delivery system has the desired additives to be released imparting the desired properties into the first functional fluid which is for lubricating a mechanical device;
   (c) releasing the desired additives from the delivery system into the first functional fluid resulting in the first functional fluid changing into a second functional fluid selected from the group consisting of a gear oil, a manual transmission oil, an automatic transmission oil, a hydraulic fluid, an engine oil, a two cycle oil, a metalworking fluid and an axle fluid, with the proviso that the second functional fluid is different from the first functional fluid,

2. The method of claim 1, wherein the delivery system comprises at least one of a liquids, solids, controlled release additive gel, capsules (for example melamine or urea formaldehyde microencapsulation polymers), linear low density polyolefin bags, perforated sheets, baffles, injectors, polymers which are oil-permeable at elevated temperatures, particles which are oil-insoluble but oil wettable, oil-soluble solid polymers capable of functioning as viscosity improvers, or mixtures thereof.

3. The method of claim 1, wherein the delivery system comprises a controlled release additive gel.

4. The method of claim 1, wherein the first and/or second functional fluid comprises an antiwear/EP agent present from about 0.1 wt % to about 5 wt %.

5. The method of claim 3, wherein the controlled release gel composition comprises
i.) at least two additives selected from the group comprising detergents, dispersants, acids, bases, over based detergent, sacculated polyolefins or mixtures thereof wherein the selected additives when combined form a gel;

ii.) optionally at least one additive comprising viscosity modifiers, friction modifiers, detergent(s), cloud point depressant(s), pour point depressant(s), demulsifier(s), flow improver(s), anti static agent(s), dispersant(s), antioxidant(s), antifoam(s), corrosion/rust inhibitors, extreme pressure/antiwear agent(s), seal swell agent(s), lubricity aid(s), antimisting agent(s), or mixtures thereof;
resulting in a controlled release gel that over time releases at least one desired additive into a functional fluid when the gel is contacted with the functional fluid.

6. The method of claim 3, wherein the controlled release gel composition has a ratio of detergent to dispersant is from about 10:1 to about 1:10 and the detergent is an over based detergent having a TBN of at least 200.

7. The method of claim 6, wherein the dispersant is selected from the group consisting of ashless type dispersants, polymeric dispersants, Mannich dispersants, carboxylic dispersants, amine dispersants, high molecular weight esters, esterified maleic anhydride styrene copolymers, maleated ethylene diene monomer copolymers, surfactants, functionalized derivatives, and combinations thereof and where the dispersant is present in a range of about 0.01 wt. % to about 95% of the additive gel, and wherein the detergent is selected from the group consisting of over based sulfonates, phenates, salicylates, carboxylates, over based calcium sulfonate detergents, overbased detergents containing metals such as Mg, Ba, Sr, Na, C and K, and mixtures thereof and wherein the detergents are in the range from about 0.01 wt. % to about 99% by wt. of the additive gel.

8. The method of claim 5, wherein component i) is present in the range from about 0.01 wt. % to about 95 wt. % of the additive gel and wherein component ii) is present in the range of about 0% to about 95% by wt of the additive gel.

9. The method of claim 6, wherein optionally at least one other component can be added to the additive gel composition which is selected from the group consisting of base stock oils, inert carriers, dyes, bacteriostatic agents, solid particulate additives and mixtures thereof.

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10. The method of claim 3, wherein the gel comprises an over based detergent, a succinimide dispersant and an anti-foam agent resulting in a controlled release gel that over time releases an antifoam additive into the functional fluid so as to reduce the foaming tendency and to improve stability of the fluid.

11. The method of claim 3, wherein the gel comprises an over based detergent, a succinimide dispersant, an ashless anti-oxidant and a polysuccinated polyolefin resulting in a controlled release gel that over time releases an antioxidant additive into the functional fluid of an engine.

12. The method of claim 3 comprising an over based detergent, a succinimide dispersant, a friction modifier and a polysuccinated polyolefin resulting in a controlled release gel that over time releases the friction modifier into the functional fluid so as to reduce the coefficient friction between metal parts.

13. The method of claim 12 further comprising an antiwear agent/extreme pressure agent.

14. The method of claim 13, wherein the antiwear agent/extreme pressure agent comprises an amine salt of a phosphorus ester acid.

15. The method of claim 14, wherein the phosphorus ester acid is selected from the group consisting of phosphoric acid esters and salts thereof; dialkyldiophosphoric acid esters and salts thereof; phosphites; and phosphorus-containing carboxylic esters, ethers, and amides; and mixtures thereof.

16. The method of claim 1, wherein the first functional fluid is a manual transmission fluid; and wherein the second functional fluid is an axle fluid.

17. A method for lubricating a mechanical device comprising:
   (a) employing one or more delivery systems, wherein the delivery systems may be the same, similar, different or combinations thereof and wherein the composition of the delivery systems depends on the desired additives to be added into a first functional fluid or to change the first functional fluid into a second functional fluid;
   (b) contacting the first functional fluid with one or more delivery systems wherein the functional fluid may be of more than one type, and wherein the delivery systems comprises at least one additive comprising detergents, dispersants, acids, bases, over based detergent, succinated polyolefins, viscosity modifier(s), friction

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modifiers), detergent(s), cloud point depressant(s), pour point depressant(s),
demulsifier(s), flow improver(s), anti static agent(s), dispersant(s), antioxidant(s),
antifoam(s), corrosion/rust inhibitor(s), extreme pressure/antiwear agent(s), seal
swell agent(s), lubricity aid(s), antimisting agent(s), or mixtures thereof;
resulting in changing the first functional fluid into the second functional fluid when
the delivery systems are contacted with the first functional fluid.

18. The method of claim 17, wherein the delivery systems comprise a
controlled release additive gal.

19. The method of claim 18, wherein the controlled release gel
composition comprises
i.) at least two additives selected from the group comprising detergents,
dispersants, acids, baaca, over based detergent, succinated polyolefins or mixtures
thereof wherein the selected additives when combined form a gel;
ii.) optionally at least one additive comprising viscosity modifiers(s), friction
modifier(s), detergent(s), cloud point depressant(s), pour point depressant(s),
demulsifier(s), flow improver(s), anti static agent(s), dispersant(s), antioxidant(s),
antifoam(s), corrosion/rust inhibitor(s), extreme pressure/antiwear agent(s), seal
swell agent(s), lubricity aid(s), antimisting agent(s), or mixtures thereof;
resulting in a controlled release gel that over time releases at least one
desired additive into a functional fluid when the gel is contacted with the functional
fluid.

20. The method of claim 17, wherein the mechanical device comprises one
first functional fluid contacting multiple delivery systems resulting in changing the
first functional fluid into multiple second functional fluids.

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SUBSTITUTE SHEET (RULE 26)
## INTERNATIONAL SEARCH REPORT

### A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

CIOM

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>paragraph [0071]; claims 1,22; table 1</td>
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<td>paragraph [0039]; claims 1,7; examples</td>
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<td>paragraphs [0050], [0051], [0070]; claim 14; examples</td>
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<td>[US]; PUD) 3 August 2006 (2006-08-03)</td>
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**Further documents are listed in the continuation of Box C**

**See patent family annex**

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

- **A** document defining the general state of the art which is not considered to be of particular relevance
- **E** earlier document but published on or after the international filing date
- **L** document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- **O** document referring to an oral disclosure, use, exhibition or other means
- **P** document published prior to the international filing date but later than the priority date claimed
- **T** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- **X** document of particular relevance, the claimed invention cannot be considered, novel or cannot be considered to involve an inventive step when the document is taken alone
- **Y** document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- **&** document member of the same patent family

Date of the actual completion of the international search: 9 January 2007

Date of mailing of the international search report: 17/01/2007

Authorized officer: Bertrand, Samuel
## DOCUMENTS CONSIDERED TO BE RELEVANT

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