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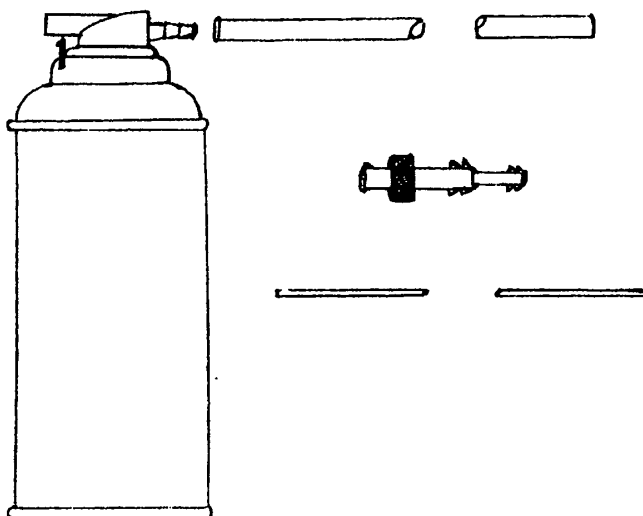
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(54) **An upper internal combustion engine cleaning composition**

(57) For decades the slow accretion of carbonaceous deposits on the upper cylinder areas of the internal combustion engines has acted to impair optimum performance and to significantly reduce gasoline or Diesel mileage per gallon. It has now been discovered that these formerly rather intractable engine deposits can be efficiently removed by dispersing and dissolving them through the use of optimized mixtures of polar protic and dipolar aprotic solvents that have the essential capability of acting in concert synergistically. For practical reasons these solvents must have a melting point higher than

about 41°F (5°C). The finished product must also have a dielectric constant of about 20 and a pH value of at least 11.0 at 77°F (25°C). These parameters are considered vital to success. For example, in a test using a blend with a dielectric constant of 15, the removal of the carbonaceous deposits was either *de minimus* or very limited, even at pH values of 12.0 at 77°F (25°C) or higher. However, at a dielectric constant of 20 the degree of removal was quite satisfactory. Preferred compositions of this invention may be utilized in the form of self pressurized (aerosol) dispensers.



**FIG. 1**

**Description**

## CROSS-REFERENCE TO RELATED APPLICATIONS

5 **[0001]** Not Applicable

## STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

10 **[0002]** Not Applicable

## REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISC APPENDIX

15 **[0003]** Not Applicable

## BACKGROUND OF THE INVENTION

20 **[0004]** Over the past fifteen (15) years or so the chemistry of the injurious, baked-on carbonaceous deposits have changed somewhat, primarily due to improvements in petroleum refining and the need to comply with various federal and state regulations. Changes have also been made in the composition of gasoline and oil additives and in mechanical aspects of engines - now increasingly controlled and monitored by numerous computer chips. All are designed to provide more engine efficiency, thus increasing U.S.EPA mileage ratings, while decreasing noxious tailpipe emissions.

25 **[0005]** Despite these many sophistications the problem of carbonaceous deposits remains, and in fact, continues unabated. At least in part, these build-ups can be related to unsaturated hydrocarbons (olefinics), which constitute a significant percentage of fuels, and which cannot be removed by any economically feasible process. If anything, the more complex and sensitive nature of modern engines has made them more susceptible to the many problems caused by these insidious carbon-based deposits. The need for their periodic removal remains a pressing issue.

30 **[0006]** The problems arising from the accretion of these carbonaceous engine deposits can be described with more specificity. They cause a general loss of power in the internal combustion engine. Multiplicities of factors are involved. They may cause rogue combustions that are out-of-synchrony with the timing of the primary combustion sequence. Aside from the obvious "contra-combustion" event, this acts to steal fuel from the next primary combustion stage. One result is inefficient combustion, with unburned hydrocarbons then being emitted into the atmosphere through the exhaust pipe. These fuel hydrocarbons are recognized by the U.S.EPA and the various states as Volatile Organic Compounds (VOC's), which can then act indirectly to create more ozone in the air.

35 **[0007]** As is well documented, troposphere ozone is an extremely reactive and dangerous air contaminant, condemned by the National Academy of Science and other experts, and now regulated to a limit of 0.08 part-per-million in air as an official interpretation of the Clean Air Act Amendments of 1999. At this time most states are in non-attainment, and are straining their resources to be compliant, as evident from their State Implementation Plans (SIPS), submitted periodically to the U.S.EPA. Given this background, it will be seen that the minimization of unburned fuel (VOCs) is a very important element in tropospheric ozone reduction. It will be welcomed by both regulators and environmentalists as one of the many that will ultimately lead to cleaner air.

40 **[0008]** Carbonaceous build-ups on valve seats (valve tulips) cause loss of compression and an interference with optimum air-to-fuel ratios. Deposits in combustion chambers act to reduce the tension in compression rings. In turn, this reduces compressions, as well as engine power. Because of unbalanced piston compressions, engine vibrations will increase, causing excessive engine wear and reduced fuel mileage, plus even more emissions of unburned hydrocarbon fuel. Deposits on spark plugs also interfere with optimum fuel burn, due to the changing of their dynamic kilovoltage (KV) and millisecond pulse width. Carbonaceous deposits in the EGR valve are the cause of engine surging, rough engine syndrome and giving a check engine light. Similarly, these deposits on the oxygen sensor unit will cause a slow response to necessary air-stoichiometric or optimum proportions. Without sufficient oxygen to burn the excess of fuel, the mileage-per-gallon will decrease and the unused fuel will be emitted into the atmosphere via the tail pipe. Finally, a build up of carbonaceous deposits on the catalytic converter screen will act to reduce the rate of heat transfer, ultimately causing the screen to disintegrate. When fragments are blown into the converter, permanent damage will result. The vehicle operator will generally be oblivious to the circumstance, often driving many thousands of miles with little or no remediation of the raw exhaust fumes before the next converter check-up.

55 **[0009]** Numerous studies have demonstrated that carbonaceous engine deposits can reduce fuel mileage by as much as 10%, and even as high as 15%, after 15,000 to 20,000 miles of driving, especially under city driving (stop-and-go) conditions. The physico-chemical action of my invention, when properly used as a preventative maintenance program - - - typically after 15,000 miles of city driving, or about 20,000 miles of rural driving - - - will act to increase fuel efficiency

by an average of 15%. In today's world of high fuel prices, concerns about air quality and fears of global warming effects this improvement in fuel efficiency can be viewed as quite significant and welcome.

**[0010]** Laboratory tests have been developed as early as 1985 to detect, develop and then maximize the synergistic chemistry of carbonaceous sludge removal. In particular, the Cold Spark Plug Immersion Test (CSPIT) was developed to access the ability of various solvent mixtures to disperse baked-on carbonaceous engine deposits. The preferred test is fully described in U.S. Patent No. 4,992,187. Spark plug deposits were given a descriptive rating of A, B, C and D, in terms of their relative thickness and density. For example, soil type C represents a fairly serious deposit representative of about 10% of all spark plug deposits. Type D is the most serious, described as "a dense, dark, carbonized baked-on deposit" and this affects the majority of spark plugs. It is very similar to the deposits found on upper internal combustion engine surfaces.

**[0011]** In the interest of convenience the detail of the current test procedure are presented here as follows:

- a. Approximately 100 used spark plugs must be obtained from a suitable engine tune-up shop or similar source.
- b. These spark plugs are hand-sorted to separate out those that qualify as category D.
- c. The category D spark plugs are briefly rinsed with a brake cleaner solution composed of one or more chlorinated solvents, such as trichloroethylene, after which they are dried for 24 hours at about 70 deg. F. (21 deg. C.).
- d. The evaluation is made by partially immersing individual spark plugs in typical four fluid ounce (120 ml) jars containing 1.7 fluid ounces (50 ml) of test solution. After tightening the jar lid, the jar must be briefly tilt about 45 degrees, to allow the test solution to completely fill the hollow base that contains the spark plug electrode. The jar is then stored upright for exactly five minutes at about 70 deg. F. (21 deg. C.).
- e. The jar is then opened and the spark plug removed - - - shaking it slightly to assure that the test liquid inside the spark plug fully drains back into the jar.
- f. The 1.7 fluid ounces (50 ml) of test solution is then diluted with de-ionized water to 250 ml.
- g. A suitably small aliquot of this mixture is then transferred into a colorimetric tube and placed in an Orbeco-Hellige tester, so that the color can be compared to a standard No. 620-C-43 Low Varnish Hellige Color Disc. The disc is selected to provide a range of 1 through 9 color scale, referencing ASTM D-1544. A second disc may be used, identified as standard No. 620-C-44 for High Varnish Colors. This provides an extended range: from 9 through 18.
- h. Experience has shown that a reading of ten (10) signifies 100% removal of the baked-on carbonaceous deposit. A reading of nine (9) is equivalent to a 90% removal, and so forth.

**[0012]** This experimental technique has been shown to be highly reliable as a valid screening process for evaluation and ability of various test solutions to disperse and dissolve carbonaceous deposits from upper cylinder engine surfaces.

#### BRIEF SUMMARY OF THE INVENTION

**[0013]** Our invention can be employed to provide a series of synergistic liquid mixtures, each capable of dispersing and dissolving modern baked-on carbonaceous deposits from the surface of the upper cylinder area of internal combustion engines, including the spark plugs and all the other component surfaces in this enclosure. Maintaining surface cleanliness is a major element in sustaining maximum operating efficiency of these engines. We have found that polar protic and dipolar aprotic solvents, either independently or in blends having a dielectric constant above 25 or more, can be synergized by raising the pH value to 11 or above (at 25 deg. C.). (See Fig. 10, Graph No. 3).

**[0014]** As the dielectric constant increases beyond 30, cleaning efficacy also increases. Methyl Formamide, with a uniquely high dielectric constant in excess of 200, is unusually effective. We have, in fact, found two single compounds able to clean modern upper cylinder carbonaceous deposits without the usual need to be synergized. These are Hydrazine (and certain close derivatives), with a dielectric constant of about 53 and a pH value of over 13 (at 25 deg. C.), as well as concentrated aqueous Ammonium Hydroxide Solutions (typically with 28.6% ammonia content), and having a dielectric constant of about 61 and a pH value of over 13 (25 deg. C.).

**[0015]** Our invention provides three distinct techniques for cleaning the component of the upper cylinder area of internal combustion engines. These are:

1. A preventative technique, wherein the synergistic product is delivered as a finely particulated spray into the plenum of the upper engine while the engine is at idling speed. The product is ideally delivered from a self-pressurized (aerosol) dispenser.

Once attached to the plenum by means of a hose and adapter, the aerosol actuator is fully depressed and locked down. The system is then fully independent of manual control and can be left alone until the injection operation is complete. The length of chemical contact time is approximately five (4) to six (7) minutes, depending on the LD. of the capillary dispensing tube, which produces optimum delivery rate - - - and is thus the same as in the laboratory simulation test.

2. A "hands-on" engine maintenance technique, where the synergistic composition is delivered into the engine plenum in the form of a heavy, oscillating type residual spray, while the engine is running at about 1500 rpm. This mode requires constant control by an operator.

3. This technique involves a maintenance process requiring that a trained mechanic remove the spark plugs from a fully warmed-up engine, and then, using a special adapter, simply attach to the self-pressurized (aerosol) and then enter the tip of the adapter into the threaded spark plug hole. The synergistic formulation is then sprayed into each upper cylinder area for five (5) seconds, after which the spark plugs are replaced with one thread turn or very loose and then the engine is permitted to hot soak for approximately one hour. All of the spark plugs are then removed and a towel, wet with water, is placed over the spark plug holes. Then spend the engine, thus through-in out, the liquid carbonaceous deposits which are absorbed into the wet towels safely.

**[0016]** In the marketing of products that take advantage of this invention, aerosols with the desired synergistic composition and pre-determined delivery rate would be made available, together with the appropriate connector of plastic tubing and adapters. Each aerosol dispenser could be sized to provide maintenance for a multiplicity of internal combustion engines.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

**[0017]** In the drawings:

1. Figs. 1-3: Illustrate an aerosol dispenser and adaptors for use with the invention,
2. Figs. 4-7: Illustrate various means for delivering the chemical composition of the invention to approximate areas of an engine, and
3. Figs. 8-10: Illustrate graphs demonstrating effective use of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0018]** Our invention provides specific compositions of matter ideal for dispersing and dissolving dense layers of heavy, baked-on carbonaceous deposits that form on surfaces within the upper internal combustion engine chambers; wherein a polar protic or dipolar aprotic solvent is synergized with a primary, secondary or tertiary amine, up to a pH value of at least 11 (at 25 deg. C.). As notation alkali metal hydroxides cannot be used as synergists because of their ability to chemically attack aluminum engine components, etching the metal and producing solid aluminate salts that are potentially more damaging to the engine than the carbonaceous deposits.

**[0019]** We have found that high dielectric constant formulations with pH values ten (10) or less display little or no ability to disperse and dissolve carbonaceous deposits. (See Table One for details.) Additionally, formulas with a satisfactory pH value 11 to 13 plus, but with a dielectric constant below about 15, also shows very limited ability to disperse and dissolve these deposits. (See Table Two for details.) However, compositions with suitably high PH values (above 11) and dielectric constants (above 25) display very satisfactory removals of carbonaceous deposits, typically 80 to 100%. (See Table Three for details.)

**[0020]** Test results from actual cleaning of upper engine areas show that, ideally, the synergistic cleaning compositions should have a pH of 13 (at 25 deg. C.) or higher, and a dielectric constant of 35 or higher. This high level of cleaning efficiency is required because of limits imposed on engine cleaning time by OE shops, which is usually in the range of 5 to 10 minutes. (See Table Four.) The optimized upper engine aerosol formula for gasoline engines has a pH value of about 13.6 (25 deg. C.) and a dielectric constant of 32.01. When this optimized composition is blended in the order listed, (with moderate agitation) the batch temperature increases by approximately 16% after adding De-Ionized Water to N-Methylformamide and then increases another 16% when the primary alkylamine is added. Accordingly the blend tank should be tightly closed and maintained with slow agitation until the batch temperature returns to room temperature. The blending room should be well ventilated. The aerosol is made by a two stage fill. First filling the concentrate into the aerosol unit and then pressure filling with the propellant and mechanically crimping the valve onto the aerosol unit. When this composition is sprayed into a test jar, using the appropriate adapter, about 40% of the product is gassed-off, due to propellant evaporation. The remaining fluid, approximately 50 ml of liquid product will typically have a temperature of about -4 deg. F. (-20 deg. C.). (50% or more of the propellant evaporates when sprayed into the plenum of a warmed-up engine, which raises the dielectric constant of the fluid to 50 plus).

**[0021]** To conduct the spark plug cleaning test, the plug must be lowered very slowly into the very cold liquid. This will cause some boiling, but will avoid an excessive boil-out and loss of some liquid. Use a stopwatch or other timer and wait for two (2) minutes; then lift out the plug. The test solution is then slowly poured into the standard 250 ml cylinder and brought to 250 ml with De-ionized Water, taking care not to have an excessive final boil-off of propellant. Stir until

uniform. Transfer some of this solution into the Orbeco-Hellige glass tube and insert into the colorimetric test unit. Under these very cold conditions the scale reading will typically show 3.4, indicating that about 35% of the baked-on carbonaceous deposit has been dispersed and dissolved. If the same experiment is performed, but now at 70 deg. F. (21 deg. C.) the scale reading will be about 5.0. At 100 deg. F. (38 deg. C.) the reading is about 6.2, and at 130 deg. F. (54 deg. C.) it is 8.5. (These data are displayed on Fig. 8, Graph Number One.) The solubility activity continues to increase at still higher contact temperatures. (See Fig. 9, Graph Number Two). Diluting the test sample in De-ionized Water and then transferring an aliquot sample of the dilution for reading should be conducted as quickly as possible for accurate readings. When the diluted test solution sets for five (5) to ten (10) minutes a gelatinous precipitation occurs which interferes with an accurate reading.

**[0022]** On a fully warmed engine the lower area of the plenum temperature will average about 150 deg. F. (62 deg. C.), and this increases to about 220 deg. F. (105 deg. C.) on the surfaces of the intake valves. Engine test have shown that the optimum time for the synergistic composition to contact the carbonaceous deposits in these areas to be between four (4) to six (6) minutes.

**[0023]** The optimized formula for preventative maintenance, as illustrated in Table Four (Formula 524), is packaged as a 7.5 ounce (212 grams) filled in an aerosol container, which is then attached to the upper engine plenum by the use of a special adapter (Fig. 1). It is important to assure that the product is delivered into the plenum in form of a mist of finely divided particles. To do this we have selected two capillary type extension tubes; one with a 0.033" (0.84 mm) and one with a 0.042" (1.07 mm) inside diameter. [See Fig. 4, Product part No. 610000 (0.042 I.D.) and Product Part No. 640000 (0.033 I.D.)]. These capillary tubes are inserted into a Locking Actuator Cap. The O.D. of the capillary tube is 0.102" (0.259 mm) and the I.D. of the tube housing which protrudes from the Locking Actuator Cap is 0.107" (2.718 mm) and narrows to 0.100" (2.54 mm) at the center of the Actuator. [See Fig. 5 A]. The capillary tubes are pressed firmly toward the center of the Actuator and extend out ward 30" to 40", (this long adapter lets the user place the aerosol unit away from the hot vehicle engine during the cleaning process). A clear PVC tube is placed over the capillary tube for protection and pressed fitted over the protruding tube-housing on the Actuator and then a multi-adapter is inserted into the other end of the clear PVC tube, so this can be attach to the air intake vehicle plenum, (See Fig. 6, clear PVC tube.) and (See Fig. 7, multi-adapter for the vehicle plenum). The capillary tube will protrude approximately one inch (1") out of the multi-adapter, so that the synergistic spray mist goes directly into the plenum. Using the 0.033" (0.84 mm) capillary tube adapter gives a product delivery rate of about 0.50 grams per second and will last approximately seven minutes. The 0.042 (1.07 mm) capillary tube adapter delivers about 0.90 gram of product per second and will empty the aerosol unit in approximately four (4) minutes. The lower delivery rate works best for small gasoline and diesel engines.

**[0024]** A preferred use of this product is to attach the over-cap actuator onto the aerosol valve stem and mounting cup, and then position the other end of the eductor tube, protruding through the variable diameter plenum adapter, into the upper engine plenum. Then slowly depress the actuator pad until a mechanical feature locks the valve in an "open" position. The aerosol unit will then spray until it is empty. The discharge rate is normally four (4) to seven (7) minutes depending on the size of the capillary I.D. selected. Since there is no operator present, in the event that the engine should stall, the aerosol will continue to spray until empty. This controlled spray mist will not cause any harm to the stalled engine, because this capillary adapter prevents the possibility of discharging the synergistic mixture as a heavy wet spray or liquid stream that would tend to run down the plenum wall to the closest intake runner. It would then accumulate behind a single intake valve, or if that valve was open, it would then leak down upon the top of the piston. If these things happen, when the operator attempts to start the engine, there will be the risk of hydraulically locking it, cracking the top of the piston or bending a piston rod, thus severely damaging or even destroying the engine.

**[0025]** The optimized Diesel mist formula ( Table Four), Formula 526, also requires the use of this same adapter, which will deliver a finely particled mist into the center of the intake air flow, after the air filter has been removed, and when the diesel engine is at idle speed. Alternatively, a different formula (Table Four), Formula 525, can utilize this same adapter without the capillary inner tube and without a lock-down aerosol valve actuator. (This is illustrated in Fig. 2). The adapter for this assembly is designed to deliver a heavy, wet, residual spray into the plenum of a gasoline engine and adjust the engine speed to about 1500 rpm. The mechanic will then shake the aerosol dispenser, using a spray and release technique until the aerosol is empty. This spray technique requires the mechanic to fully actuate the aerosol dispenser for about 5 to 10 seconds, this will produce a flooding action in the upper engine which will cause the speed to decrease to about 500 rpm. The mechanic will then shut off the spray and this will allow the engine to recover its original speed of about 1500 rpm. The procedure is repeated, until the aerosol is less than about 5% full. At this point, the aerosol should be actuated until the engine stalls, after which the dispenser can be sprayed for a few more seconds until the can is empty.

**[0026]** The mechanic will then let the engine "soak" for ten (10) to fifteen (15) minutes. Then he should crank the engine very slowly until it has made one complete revolution, after which regular cranking can be initiated until the engine starts. The engine is brought to about 3000 rpm, then snapped to about 5000 rpm briefly, to blow out any loose carbonaceous fragments. Finally, the vehicle should be driven for 3 to 5 miles, to fully exhaust the combustion chambers and catalytic converter.

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**[0027]** Over 300 tests have been conducted, to fully refine and demonstrate the superior upper engine cleaning activity, resulting from the use of this high dielectric constant formulation, when synergized by the inclusion of high pH valve ingredients, and when applied to older vehicles and some relative new vehicles, Formula 525 can be effectively used to "soak" cylinders, to clean entire combustion chambers, cylinder domes, piston heads and to release compression rings that have been frozen into place by hard carbonaceous depositions. This cleaning technique requires the use of a unique adapter 360 degree tip (illustrated in Fig. 3), attached to a standard plenum adapter, by replacing the multi-adapter tip with the 360 degree brass spray tip.

**[0028]** See Table No.5 for a more complete summary of data listed in Tables No.'s 1,2 and 3. There does not appear to be a direct correlation between the chemicals dipole moment and synergism.

**TABLE No.1**

| CHEMICALS TESTED             | pH   | DIELECTRIC CONSTANT | ORBECO-HELLIGE TEST %<br>REMOVAL CSPIT RESULTS |
|------------------------------|------|---------------------|------------------------------------------------|
| ACETONE                      | 7.5  | 20.7                | 2                                              |
| ACETONITRILE                 | 6.5  | 37.5                | 0                                              |
| ETHYL ALCOHOL                | 7.5  | 24.3                | 0                                              |
| ETHYLENE GLYCOL              | 7.0  | 41.2                | 0                                              |
| N-ETHYL-2-PYRROLIDONE        | 10.0 | 29.0                | 20                                             |
| FORMAMIDE                    | 9.0  | 111.0               | 10                                             |
| GLYCERIN                     | 8.0  | 42.5                | 0                                              |
| HEXAMETHYLPHOSPHORAMIDE      | 7.7  | 30.0                | 0                                              |
| ISOPROPYL ALCOHOL            | 7.5  | 18.3                | 0                                              |
| N-HYDROXYETHYL-2-PYRROLIDONE | 9.8  | ----                | 0                                              |
| METHYL ALCOHOL               | 7.5  | 41.8                | 1                                              |
| METHYLFORMAMIDE              | 7.5  | 200.1               | 10                                             |
| METHYL PYRROLE               | 6.5  | ----                | 0                                              |
| NUROMETHANE                  | 6.1  | 35.9                | 0                                              |
| 1-OCTYL-2-PYRROLIDONE        | 9.7  | ----                | 2                                              |
| 2-PYRROLIDONE                | 10.5 | 12.5                | 10                                             |
| TETRAMETHYLENE SULFONE       | 8.0  | ----                | 0                                              |

**TABLE No. 2**

| CHEMICALS TESTED        | pH   | DIELECTRIC CONSTANT | ORBECO-HELLIGE TEST %<br>REMOVAL CSPIT RESULTS |
|-------------------------|------|---------------------|------------------------------------------------|
| ALLYLAMINE              | 12.3 | 3.2                 | 15                                             |
| BUTYLAMINE              | 12.5 | 4.88                | 5                                              |
| BUTYL PYRROLIDINE       | 11.2 | ----                | 0                                              |
| CYCLOHEXYLAMINE         | 12.5 | 4.73                | 0                                              |
| DIETHYLAMINE            | 13.3 | 3.7                 | 2                                              |
| ISOBUTYLAMINE           | 12.3 | 4.43                | 5                                              |
| ISPPROPYLAMINE          | 13.3 | 5.45                | 10                                             |
| METHYL PYRROLIDM        | 11.7 | 9.8                 | 2                                              |
| MONOETHANOLAMINE        | 13.1 | ----                | 10                                             |
| MORPHOLINE              | 11.0 | 7.3                 | 10                                             |
| TETRAHYDROFURFURYLAMINE | 12.5 | ----                | 10                                             |
| TRIEIYLAMINE            | 12.0 | 2.42                | 0                                              |

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TABLE No. 3

|    | CHEMICALS TESTED   |       | pH   | DIELECTRIC CONSTANT | ORBECO-HELLIGE TEST %<br>REMOVAL CSPIT RESULTS |
|----|--------------------|-------|------|---------------------|------------------------------------------------|
| 5  | Methylformamide    | 98.8% |      |                     |                                                |
|    | Isopropylamine     | 1.2%  | 12.0 | 197.8               | 100                                            |
|    | Formamide          | 98.4% |      |                     |                                                |
| 10 | Isopropylamine     | 1.6%  | 12.0 | 109.4               | 90                                             |
|    | Deionized water    | 98.0% |      |                     |                                                |
|    | Isopropylamine     | 2.0%  | 12.0 | 78.5                | 90                                             |
| 15 | Dimethyl Sulfoxide | 98.8% |      |                     |                                                |
|    | Isopropylamine     | 1.2%  | 12.0 | 48.4                | 90                                             |
|    | Methanol           | 90.0% |      |                     |                                                |
| 20 | Isopropylamine     | 10.0% | 12.0 | 38.2                | 100                                            |
|    | Ethylene Glycol    | 90.0% |      |                     |                                                |
|    | Isopropylamine     | 10.0% | 12.0 | 37.6                | 80                                             |
| 25 | Formamide          | 83.0% |      |                     |                                                |
|    | Isopropylamine     | 17.0% | 12.8 | 93                  | 100                                            |
|    | Formamide          | 20.0% |      |                     |                                                |
| 30 | Isopropylamine     | 80.0% | 13.3 | 26.6                | 90                                             |
|    | Pyrrolidine        | 66.0% |      |                     |                                                |
|    | Deionized water    | 34.0% | 13.2 | ~ 30.0              | 80                                             |
| 35 | Tert Butylamine    | 66.0% |      |                     |                                                |
|    | Deionized water    | 34.0% | 11.8 | 29.4                | 80                                             |
|    | Triethylamine      | 64.0% |      |                     |                                                |
| 40 | Deionized water    | 36.0% | 12.0 | 30.3                | 80                                             |
|    | Methyl Alcohol     | 30.0% |      |                     |                                                |
|    | Isopropylamine     | 70.0% | 13.3 | 16.4                | 60                                             |
| 45 | Ethylene Glycol    | 50.0% |      |                     |                                                |
|    | Isopropylamine     | 50.0% | 13.3 | 23.3                | 70                                             |
|    | Methylformamide    | 10.0% |      |                     |                                                |
|    | Isopropylamine     | 90.0% | 13.2 | 24.9                | 80                                             |
| 50 | Methylformamide    | 20.0% |      |                     |                                                |
|    | Isopropylamine     | 80.0% | 13.2 | 44.4                | 100                                            |
|    | Methylformamide    | 6.0%  |      |                     |                                                |
| 55 | Isopropylamine     | 94.0% | 13.3 | 17.1                | 60-70                                          |
|    | Methylformamide    | 60.0% |      |                     |                                                |
|    | Pyrrolidine        | 40.0% | 13.5 | 120.0               | 90                                             |

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(continued)

|    | CHEMICALS TESTED      |       | pH   | DIELECTRIC CONSTANT | ORBECO-HELLIGE TEST %<br>REMOVAL CSPIT RESULTS |
|----|-----------------------|-------|------|---------------------|------------------------------------------------|
| 5  | Methylformamide       | 60.0% |      |                     |                                                |
|    | 2-Furfurylamine       | 40.0% | 12.0 | 120.0               | 60                                             |
|    | Butyl Pyrrolidine     | 66.0% |      |                     |                                                |
| 10 | Deionized water       | 34.0% | 11.2 | ~ 30.0              | 70                                             |
|    | 2-Furfurylamine       | 66.0% |      |                     |                                                |
|    | Deionized water       | 34.0% | 11.5 | 27 +                | 70 +                                           |
| 15 | Morpholine            | 66.0% |      |                     |                                                |
|    | Deionized water       | 34.0% | 11.0 | 31.5                | 70                                             |
|    | Monoethanolamine      | 66.0% |      |                     |                                                |
| 20 | Deionized Water       | 34.0% | 13.1 | 27 +                | 80                                             |
|    | Isobutylamine         | 66.0% |      |                     |                                                |
|    | Deionized water       | 34.0% | 12.3 | 29.6                | 80                                             |
| 25 | Methylformamide       | 99.4% |      |                     |                                                |
|    | Sodium Hydroxide 50%  | 0.6%  | 12.0 | 199                 | 100                                            |
|    | Methylformamide       | 95.6% |      |                     |                                                |
| 30 | Ammonia Hydroxide 28% | 4.4%  | 12.0 | 194                 | 100                                            |
|    | Methylformamide       | 97.4% |      |                     |                                                |
|    | Hydrazine             | 2.6%  | 12.0 | 196.3               | 100                                            |

35

**TABLE No. 4**

|    | PREFERRED FORMULA No. 522<br>INTERNAL COMBUSTION ENGINE SOAKING<br>FOR 30 MINUTES TO ONE HR. | pH     | DIELECTRIC<br>CONSTANT | CSPIT TEST                                                                                                                                                                                       |
|----|----------------------------------------------------------------------------------------------|--------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40 | Methylformamide                                                                              | 25.00% |                        |                                                                                                                                                                                                  |
|    | Deionized Water                                                                              | 54.60% |                        |                                                                                                                                                                                                  |
|    | Isopropylamine                                                                               | 20.00% |                        |                                                                                                                                                                                                  |
|    | Air                                                                                          | 0.40%  | 13.6                   | 94.79                                                                                                                                                                                            |
| 45 | PREFERRED FORMULA No. 524<br>MIST SPRAY FOR GASOLINE ENGINES                                 |        |                        |                                                                                                                                                                                                  |
|    | Methylformamide                                                                              | 10.00% |                        |                                                                                                                                                                                                  |
|    | Deionized Water                                                                              | 10.00% |                        |                                                                                                                                                                                                  |
|    | Isopropylamine                                                                               | 10.00% |                        |                                                                                                                                                                                                  |
| 50 | Dimethyl Ether                                                                               | 70.00% | 13.6                   | 32.01                                                                                                                                                                                            |
|    | After 40% DME loss                                                                           |        | 13.6                   | 50.06                                                                                                                                                                                            |
|    | After 60% DME loss                                                                           |        | 13.6                   | 72.61                                                                                                                                                                                            |
| 55 |                                                                                              |        |                        | Sparkplug placed in test jar with 50 ml's of formula: two minute soak time, score = 8                                                                                                            |
|    |                                                                                              |        |                        | Sparkplug placed in test jar, spray in 50 ml's of formula, temp. was -4 deg. F. with 40% loss of DME. Soak time two minutes; Score = 3.5. In five minutes; Score = 10.0 with 60% DME boiled off. |

(continued)

|                   |
|-------------------|
| Methylformamide   |
| Isopropyl Alcohol |
| Isopropylamine    |
| A-70 Propellant   |

Sparkplug placed in test jar, spray in 50 ml's of formula, temp. was -8 deg.F. With 40% loss of A-70. Soak time Five minutes; score = 2. Ten minute Score = 4. (Twenty Minute score = 8. Temp. 30 deg. F.).

|                 |        |      |       |
|-----------------|--------|------|-------|
| Methylformamide | 25.00% |      |       |
| Deionized Water | 46.21% |      |       |
| Isopropylamine  | 15.00% |      |       |
| A-46 Propellant | 13.79% | 13.3 | 88.03 |

Sparkplug placed in test jar, spray in 50 ml's of formula. temp. approx. 70 Deg. F. soak time Two minutes; score = 5. soak time four Minutes; score = 8.

|                       |        |      |      |
|-----------------------|--------|------|------|
| Methylformamide       | 11.35% |      |      |
| Isopropyl Alcohol     | 11.65% |      |      |
| Isopropylamine        | 10.00% |      |      |
| P-152a Propellant     | 67.00% | 13.3 | 27.0 |
| Or (P-161 Propellant) |        |      |      |
| Or (other             |        |      |      |
| Hydrofluorocarbon     |        |      |      |
| Propellants)          |        |      |      |

Test results are  
Similar to formula  
No. 526.

[illegible]

| CHEMICALS TESTED |                           | pH   | D.E.C. | D.P.M. | CSPIT TEST RESULTS |    |
|------------------|---------------------------|------|--------|--------|--------------------|----|
| 1.               | Acetamide                 | 6.0  | 60.6   | 3.9    | 2                  |    |
| 2.               | Acetone                   | 7.8  | 20.7   | 2.77   | 5                  |    |
| 3.               | Acetone                   | 66%  |        |        |                    |    |
|                  | Water                     | 34%  | 7.8    | 37.0   | 2.77               | 7  |
| 4.               | Acetonitrile              | 6.5  | 37.5   | 3.97   | 0                  |    |
| 5.               | Acetonitrile              | 66%  |        |        |                    |    |
|                  | Water                     | 34%  | 6.5    | 51.66  | 3.97               | 0  |
| 6.               | Allylamine                | 12.3 | 3.2    | 1.3    | 15                 |    |
| 7.               | Allylamine                | 66%  |        |        |                    |    |
|                  | Water                     | 34%  | 12.2   | 28.0   | 1.3                | 80 |
| 8.               | Ammonium Hydroxide 28 Be. | 12.4 | 61.0   | ----   | 80                 |    |

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(continued)

CSPIT TEST ON POLAR PROTIC AND DIPLOAR APROTIC SOLVENTS:

CHEMICALS TESTED

pH

D.E.C.

D.P.M.

CSPIT TEST  
RESULTS

|    |     |                       |     |         |       |      |    |
|----|-----|-----------------------|-----|---------|-------|------|----|
| 5  | 9.  | 1-Amino-2-Propanol    |     | 13.7    | ----  | ---- | 20 |
|    | 10. | 1-Amino-2-Propanol    | 66% |         |       |      |    |
|    |     | Water                 | 34% | 13.6    | 27.2+ | ---- | 50 |
| 10 | 11. | 3-Amino-1-Propanol    |     | 13.7    | ----  | ---- | 10 |
|    | 12. | 3-Amino-1-Propanol    | 66% |         |       |      |    |
|    |     | Water                 | 34% | 13.6    | 27.2+ | ---- | 50 |
| 15 | 13. | Butylamine            |     | 12.5    | 4.88  | 1.0  | 5  |
|    | 14. | Butylamine            | 66% |         |       |      |    |
|    |     | Water                 | 34% | 12.5    | 30.0  | 1.0  | 80 |
| 20 | 15. | Butyl Pyrrolidine     |     | 11.2    | ----  | ---- | 0  |
|    | 16. | Butyl Pyrrolidine     | 66% |         |       |      |    |
|    |     | Water                 | 34% | 11.2    | ~30.0 | ---- | 70 |
| 25 | 17. | Cyclohexylamine       |     | 12.5    | 4.73  | 3.8  | 0  |
|    | 18. | Cyclohexylamine       | 66% |         |       |      |    |
|    |     | Water                 | 34% | 11.8    | 30.0  | ---- | 75 |
| 30 | 19. | Diethylamine          |     | 13.3    | 3.7   | ---- | 2  |
|    | 20. | Diethylamine          | 66% |         |       |      |    |
|    |     | Water                 | 34% | 13.3    | 29.1  | ---- | 75 |
|    | 21. | Dimethylacetamide     |     | 11.0    | 37.78 | 3.8  | 70 |
|    | 22. | Dimethylacetamide     | 66% |         |       |      |    |
|    |     | Water                 | 34% | 8.0     | 51.8  | 3.8  | 20 |
| 35 | 23. | Dimethylformamide     |     | 10.5    | 38.3  | 3.66 | 20 |
|    | 24. | Dimethylformamide     | 66% |         |       |      |    |
|    |     | Water                 | 34% | 7.6     | 52.2  | 3.66 | 5  |
| 40 | 25. | Dimethylsulfoxide     |     | 10.5    | 48.9  | 3.9  | 25 |
|    | 26. | Dimethylsulfoxide     | 66% |         |       |      |    |
|    |     | Water                 | 34% | 8.5-9.0 | 59.3  | 3.9  | 10 |
| 45 | 27. | Ethylene Glycol       |     | 7.0     | 41.2  | 2.27 | 0  |
|    | 28. | Ethylene Glycol       | 66% |         |       |      |    |
|    |     | Water                 | 34% | 7.0     | 54.1  | 2.27 | 0  |
| 50 | 29. | N-Ethyl-2-pyrrolidone |     | 10.0    | 29.0  | ---- | 20 |
|    | 30. | N-Ethyl-2-pyrrolidone | 66% |         |       |      |    |
|    |     | Water                 | 34% | 10.0    | 46.0  | ---- | 20 |
| 55 | 31. | Formamide             |     | 9.0     | 111.0 | 3.73 | 10 |
|    | 32. | Formamide             | 66% |         |       |      |    |
|    |     | Water                 | 34% | 8.5     | 100.6 | 3.73 | 10 |
|    | 33. | Glycerin              |     | 8.0     | 42.5  | 2.68 | 0  |

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(continued)

CSPIT TEST ON POLAR PROTIC AND DIPLOAR APROTIC SOLVENTS:

CHEMICALS TESTED

pH

D.E.C.

D.P.M.

CSPIT TEST  
RESULTS

|    |     |                              |     |      |       |      |     |
|----|-----|------------------------------|-----|------|-------|------|-----|
| 5  | 34. | Glycerin                     | 66% |      |       |      |     |
|    |     | Water                        | 34% | 8.0  | 55.0  | 2.68 | 0   |
|    | 35. | Hexamethylphosphoramide      |     | 7.7  | 30.0  | 4.31 | 0   |
| 10 | 36. | Hexamethylphosphoramide      | 66% |      |       |      |     |
|    |     | Water                        | 34% | 7.7  | 46.6  | 4.31 | 2   |
|    | 37. | Hydrazine                    |     | 13.0 | 52.9  | ---- | 100 |
| 15 | 38. | Hydrazine 64% / Water 36%    |     | 13.0 | 62.0  | ---- | 80  |
|    | 39. | N-Hydroxyethyl-2-Pyrrolidone |     | 9.8  | ----  | ---- | 0   |
|    | 40. | N-Hydroxyethyl-2-Pyrrolidone | 66% |      |       |      |     |
| 20 |     | Water                        | 34% | 9.3  | 27+   | ---- | 0   |
|    | 41. | Isobutylamine                |     | 12.3 | 4.43  | 1.27 | 5   |
|    | 42. | Isobutylamine                | 66% |      |       |      |     |
| 25 |     | Water                        | 34% | 12.3 | 29.6  | 1.27 | 80  |
|    | 43. | Isopropylamine               |     | 13.3 | 5.45  | 1.45 | 3   |
|    | 44. | Isopropylamine               | 66% |      |       |      |     |
| 30 |     | Water                        | 34% | 13.3 | 30.3  | 1.45 | 80  |
|    | 45. | Isopropylamine               | 90% |      |       |      |     |
|    |     | Water                        | 10% | 13.3 | 12.9  | 1.45 | 15  |
|    | 46. | Isopropylamine               | 94% |      |       |      |     |
| 35 |     | Water                        | 6%  | 13.3 | 9.92  | 1.45 | 10  |
|    | 47. | Methyl Alcohol               |     | 7.5  | 41.8  | 1.69 | 1   |
|    | 48. | Methyl Alcohol               | 66% |      |       |      |     |
| 40 |     | Water                        | 34% | 7.5  | 54.5  | 1.69 | 1   |
|    | 49. | Methylformamide              |     | 7.5  | 200.1 | 3.86 | 20  |
|    | 50. | Methylformamide              | 66% |      |       |      |     |
| 45 |     | Water                        | 34% | 7.5  | 160.0 | 3.86 | 5   |
|    | 51. | Methyl Pyrrole               |     | 6.5  | ----  | ---- | 0   |
|    | 52. | Methyl Pyrrole               | 66% |      |       |      |     |
|    |     | Water                        | 34% | 6.5  | 27+   | ---- | 0   |
| 50 | 53. | Methyl Pyrrolidine           |     | 11.7 | 9.8   | ---- | 2   |
|    | 54. | Methyl Pyrrolidine           | 66% |      |       |      |     |
|    |     | Water                        | 34% | 11.7 | 33.2  | ---- | 75  |
| 55 | 55. | Monoethanolamine             |     | 13.1 | ----  | ---- | 10  |
|    | 56. | Monoethanolamine             | 66% |      |       |      |     |
|    |     | Water                        | 34% | 13.1 | 27+   | ---- | 80  |

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(continued)

CSPIT TEST ON POLAR PROTIC AND DIPLOAR APROTIC SOLVENTS:

CHEMICALS TESTED

pH

D.E.C.

D.P.M.

CSPIT TEST  
RESULTS

|    |     |                         |                  |      |       |      |    |
|----|-----|-------------------------|------------------|------|-------|------|----|
| 5  |     |                         |                  |      |       |      |    |
|    | 57. | Morpholine              |                  | 11.0 | 7.3   | 1.75 | 10 |
|    | 58. | Morpholine              | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 11.0 | 31.5  | 1.75 | 70 |
| 10 |     |                         |                  |      |       |      |    |
|    | 59. | Nitromethane            |                  | 6.1  | 35.87 | 3.46 | 0  |
|    | 60. | Nitromethane            | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 6.1  | 50.5  | 3.46 | 0  |
| 15 |     |                         |                  |      |       |      |    |
|    | 61. | 1-Octyl-2-Pyrrolidinone |                  | 9.7  |       | 3.82 | 2  |
|    | 62. | 1-Octyl-2-Pyrrolidinone | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 9.7  |       | 3.82 | 10 |
| 20 |     |                         |                  |      |       |      |    |
|    | 63. | 2-Pyrrolidone           |                  | 10.5 | 12.5  | 3.55 | 10 |
|    | 64. | 2-Pyrrolidone           | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 10.5 | 35    | 3.55 | 25 |
| 25 |     |                         |                  |      |       |      |    |
|    | 65. | Tert Butylamine         |                  | 11.5 | 4.2   | 1.29 | 2  |
|    | 66. | Tert Butylamine         | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 11.5 | 29.4  | 1.29 | 80 |
| 30 |     |                         |                  |      |       |      |    |
|    | 67. | Tetrahydrofurfurylamine |                  | 12.5 | ----  | ---- | 10 |
|    | 68. | Tetrahydrofurfurylamine | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 12.5 | 27+   | ---- | 70 |
| 35 |     |                         |                  |      |       |      |    |
|    | 69. | Tetramethylene Sulfone  |                  | 8.0  | ----  | ---- | 0  |
|    | 70. | Tetramethylene Sulfone  | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 8.0  | 27+   | ---- | 15 |
| 40 |     |                         |                  |      |       |      |    |
|    | 71. | Triethylamine           |                  | 12.0 | 2.42  | .66  | 0  |
|    | 72. | Triethylamine           | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 12.0 | 28.3  | .66  | 80 |
| 45 |     |                         |                  |      |       |      |    |
|    | 73. | Sodium Methylate        | 25%(in methanol) | 12.1 | 31.4  |      | 2  |
|    | 74. | Sodium Methylate 25%    | 66%              |      |       |      |    |
|    |     | Water                   | 34%              | 12.1 | 47.6  | ---- | 2  |
| 50 |     |                         |                  |      |       |      |    |
|    | 75. | Sodium Methoxide        | 10% in Water     | 123  | ~72   | ---- | 10 |
|    | 76. | Acetonitrile            | 50%              |      |       |      |    |
|    |     | Isopropylamine          | 50%              | 13.7 | 24.8  | ---- | 80 |
| 55 |     |                         |                  |      |       |      |    |
|    | 77. | Formamide               | 20%              |      |       |      |    |
|    |     | Isopropylamine          | 80%              | 13.3 | 23.3  | ---- | 95 |
|    | 78. | Acetone                 | 66%              |      |       |      |    |
|    |     | Isopropylamine          | 34%              | 12.5 | 15.6  | ---- | 15 |

(continued)

## CHEMICALS TESTED

## Claims

(a) one or more polar protic or dipolar aprotic solvents each having a melting point above 32°F. (0°C.),  
(b) wherein said solvents are selected from the following group that have dielectric constants ranging from 200 to about 15 as indicated after the solvent name:

13

(continued)

|    |                          |      |
|----|--------------------------|------|
|    | Dimethyl Sulfoxide       | 48.9 |
|    | Glycerin                 | 42.5 |
| 5  | Methanol                 | 41.9 |
|    | Ethylene Glycol          | 41.2 |
|    | Dimethyl Formamide       | 38.3 |
|    | Dimethyl Acetamide       | 37.8 |
| 10 | Acetonitrile             | 37.5 |
|    | Nitromethane             | 35.9 |
|    | Hexamethyl Phosphoramide | 30.0 |
|    | N-Ethyl-2-Pyrrolidone    | 29.0 |
|    | Ethanol                  | 24.3 |
| 15 | Allyl Alcohol            | 22.8 |
|    | Acetone                  | 20.7 |
|    | Isopropanol              | 18.3 |

and

(c) wherein said composition contains a synergistic amount to bring the pH value to 11 (at 25°C.) or higher, of a compound which is an organic alkaline nitrogen- containing compound.

2. The upper engine cleaning composition of claim 1 wherein the alkaline nitrogen- containing compound is select from the group of primary, secondary or tertiary alkylamines, hydrazine, ammonium hydroxide solutions, quaternary ammonium hydroxides, and their derivatives.
3. The upper engine cleaning composition of claim 1 wherein the alkaline nitrogen- containing compound is a primary, secondary or tertiary amine.
4. The upper engine cleaning composition of claim 1 wherein the alkaline nitrogen- containing compound is a primary amine.
5. The upper engine cleaning composition of claim 1 wherein the alkaline nitrogen- containing compound is a secondary amine.
6. The upper engine cleaning composition of claim 1 wherein the alkaline nitrogen- containing compound is a tertiary amine.
7. The upper engine cleaning composition of claim 1 wherein the solvent having the dielectric is an alkylamide.
8. The upper engine cleaning composition of claim 7 wherein the alkylamide is methylformamide.
9. The upper engine cleaning composition of claim 1 wherein the solvent having the dielectric constant is hydrazine.
10. The upper engine cleaning composition of claim 1 wherein the solvent having the dielectric constant is an ammonium hydroxide solution.
11. The upper engine cleaning composition of claim 1 wherein the solvent having the dielectric constant is a quaternary ammonium hydroxide.
12. The upper engine cleaning composition of claim 1 wherein the synergistic solvent composition is blended with dimethyl ether (DME) and wherein the final blend has a dielectric constant above 15, with a pH value above 11, and is packaged in a self-pressurized aerosol dispenser.
13. The upper engine cleaning composition of claim 12 which is delivered to a motor vehicle plenum via a protected capillary tube and an adapter, providing a finely particulated, misty spray, suitable for cleaning baked-on carbonaceous deposits from an upper engine surface while said engine is idling, and without the presence of an operator.

14. The upper engine cleaning composition according to claim 1, wherein the composition is blended with hydrocarbon propellants selected from propane, isobutene, n-butane and mixtures thereof, and where the final blend has a dielectric constant above 15 and a pH value at 25°C. Above 11, and which is packaged in a self-pressurized aerosol dispenser.
15. The upper engine cleaning composition of claim 14 which is delivered to a motor vehicle plenum via a protected capillary tube and an adapter, providing a finely particulated, misty spray, suitable for cleaning baked-on carbonaceous deposits from an upper engine surface while said engine is idling, and without the presence of an operator.
16. The upper engine cleaning composition according to claim 1, wherein the composition is blended with 1,1-difluoroethane (HFC-152a), fluoroethane (HFC-161), or other hydro fluorocarbon propellants and where the final blend has a dielectric constant above 15 and a pH value at 25°C, greater than 11, and which is packaged in a self-pressurized aerosol dispenser.
17. The upper engine cleaning composition of claim 16 which is delivered to a motor vehicle plenum via a protected capillary tube and an adapter, with valve orifice and inside capillary diameter designed to provide a finely particulated, misty spray, suitable for cleaning baked-on carbonaceous deposits from an upper engine surface while said engine is idling, and without the presence of an operator.
18. The upper engine cleaning composition of claim 1, wherein the synergistically activated solvent has a dielectric constant of at least 35 and a pH value of at least 12, at 25°C, and is packaged in a self-pressurized aerosol dispenser.
19. An upper engine cleaning composition of claim 18 which is pressurized with a small amount of propane, isobutene, n-butane hydrocarbon propellant or their mixtures, in order to deliver a large particulated, heavy wet spray into a vehicle's plenum by use of a vapor tap valve and with the use of a standard, adapter, without the use of a capillary tube, in the presence of an operator.
20. The upper engine cleaning composition of claim 18 that is contained in a self-pressurized aerosol dispenser and pressurized with about 29 to 181 psi-g at 70°F (2.0 to 12.1°C) of nitrous oxide, compressed air, nitrogen, argon, hydrocarbon or fluorocarbon propellant in order to deliver a heavy, wet, spray where the mean aerodynamic particle size diameter is greater than about 0.002 (50 microns), into the combustion chambers of a fully warmed engine for about 30 to 50 minutes soak time, using a 360 degree spray adapter in the presence of an operator.
21. A process for removing carbonaceous deposits on the upper cylinder areas of internal combustion engines which comprises contacting said upper cylinder areas with the upper engine cleaning composition of claim 1.

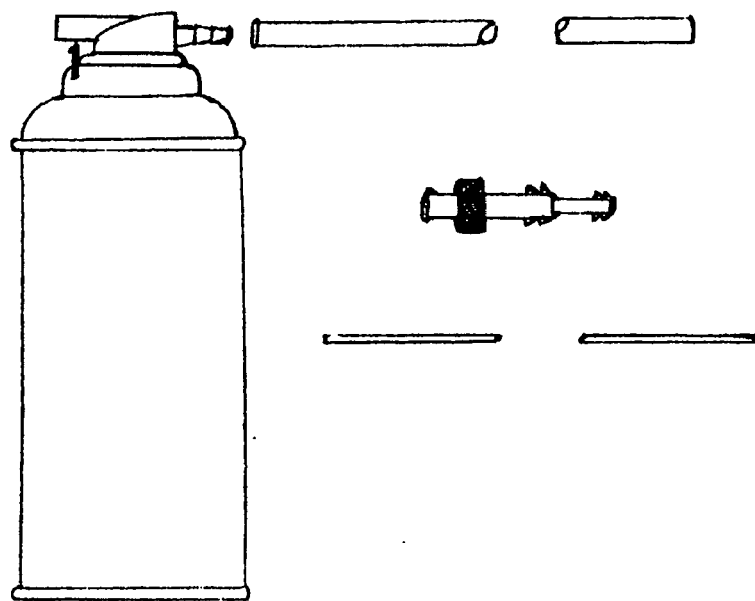


FIG. 1

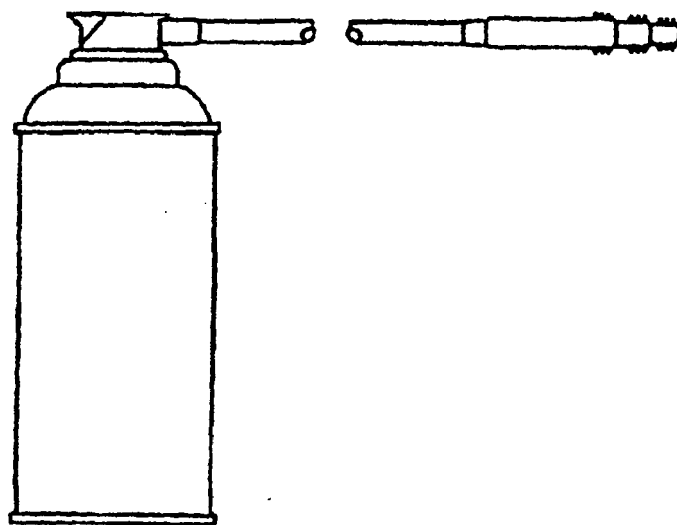


FIG. 2

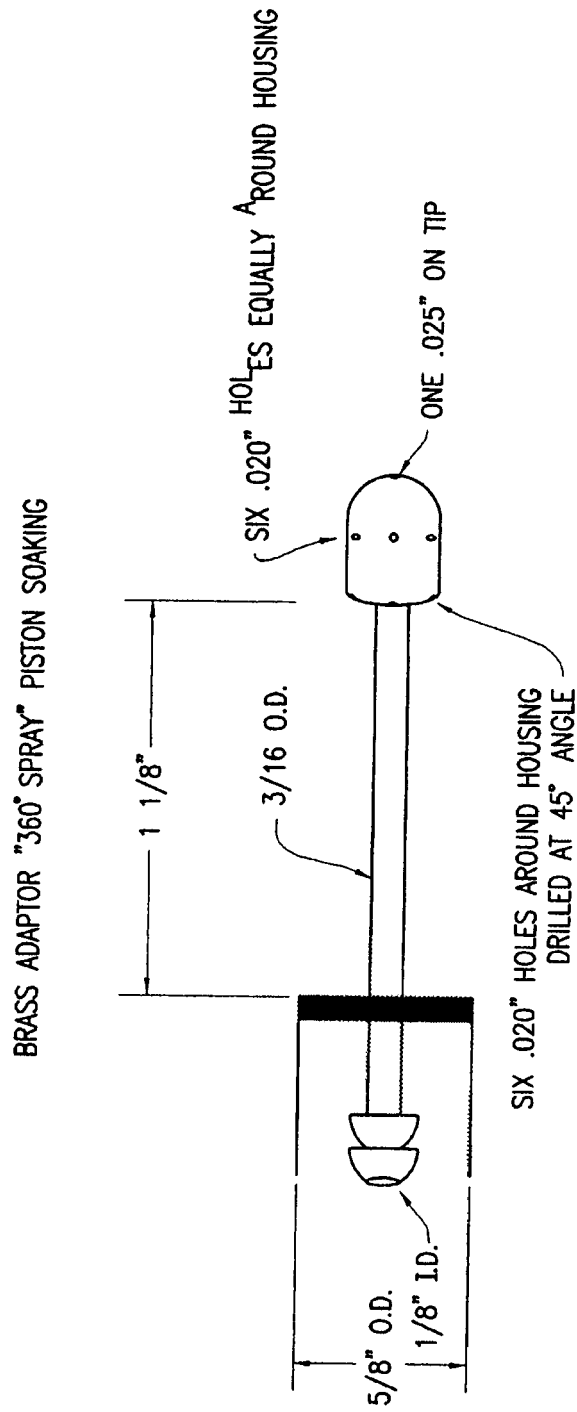


FIG. 3

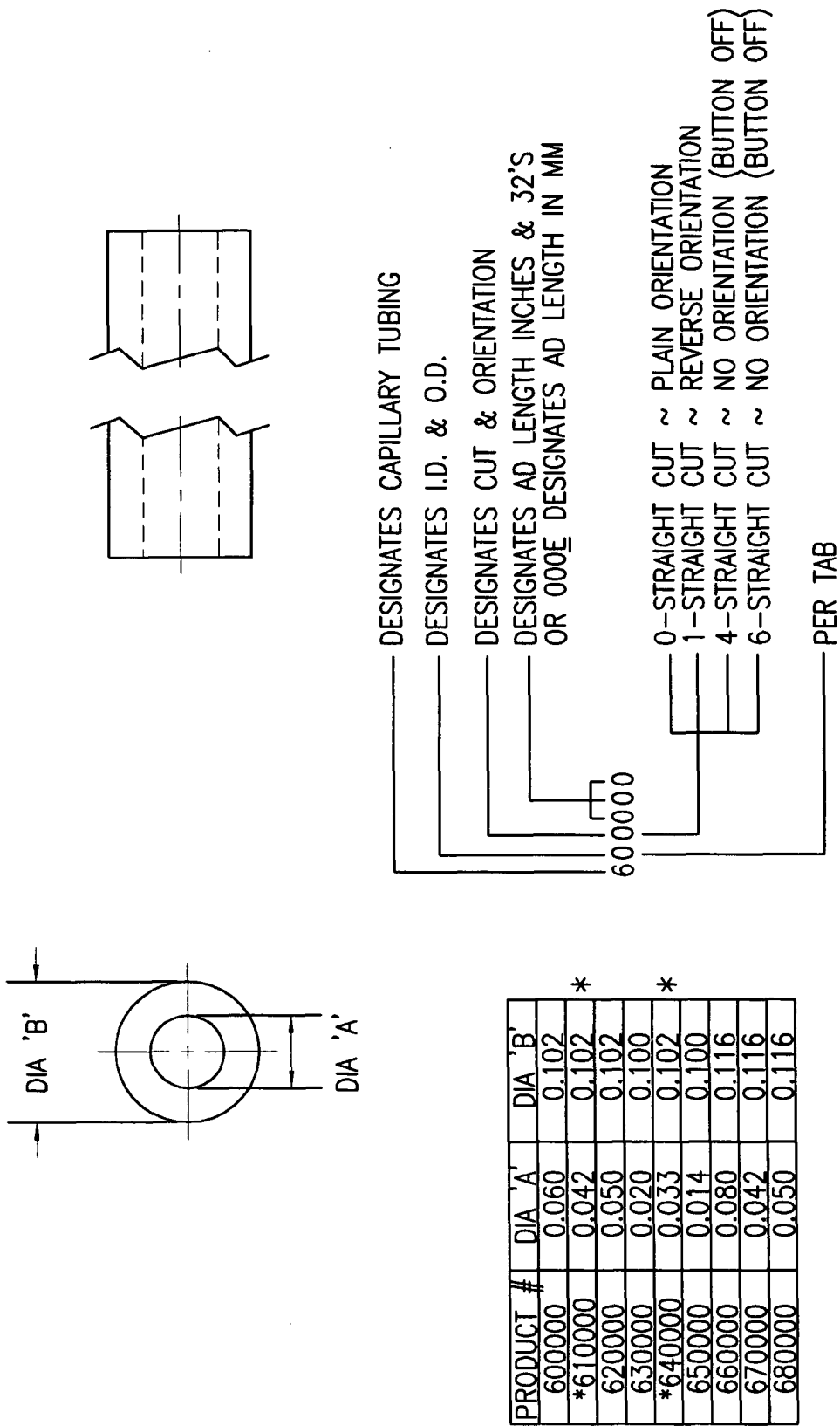
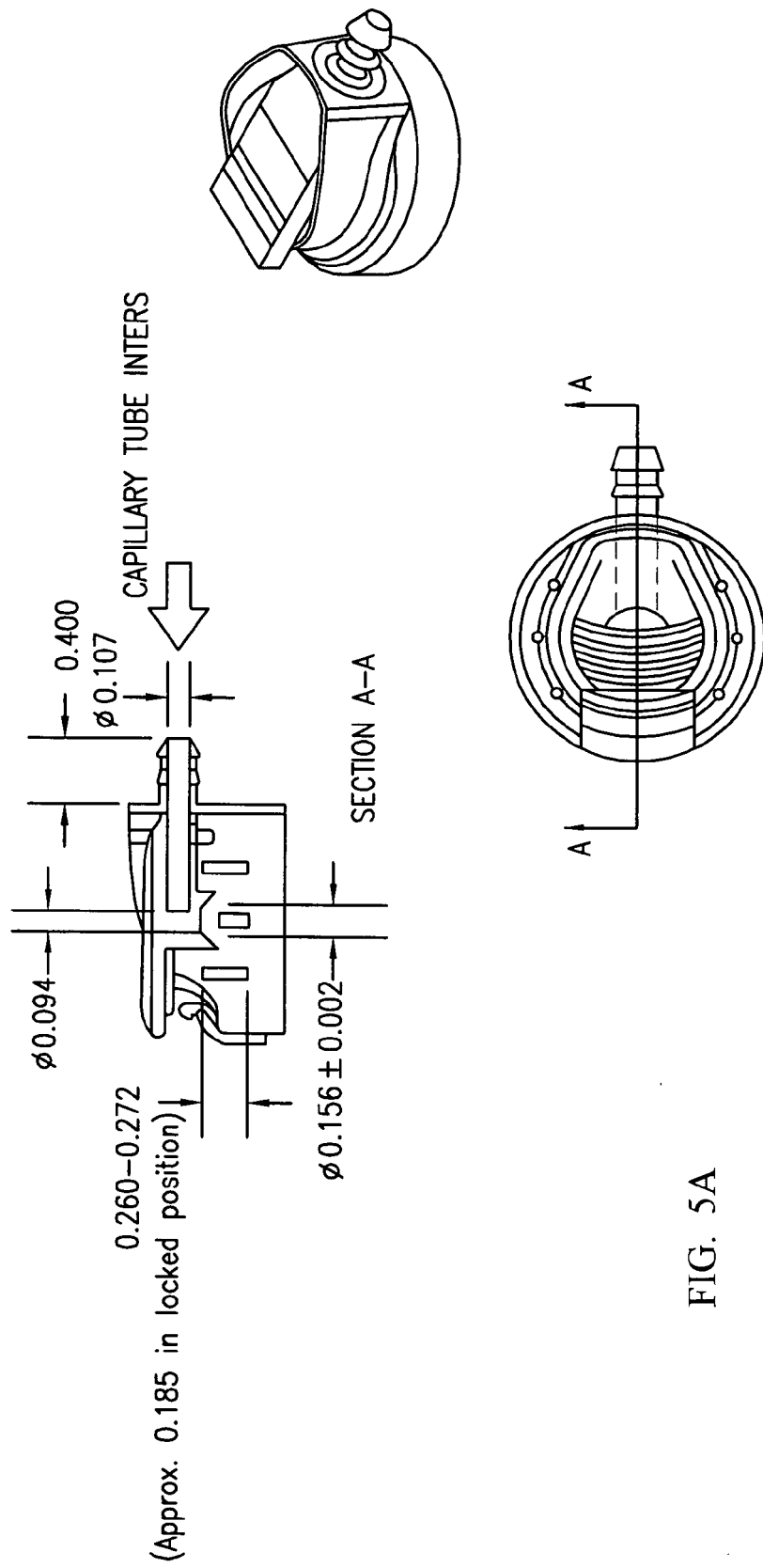


FIG. 4



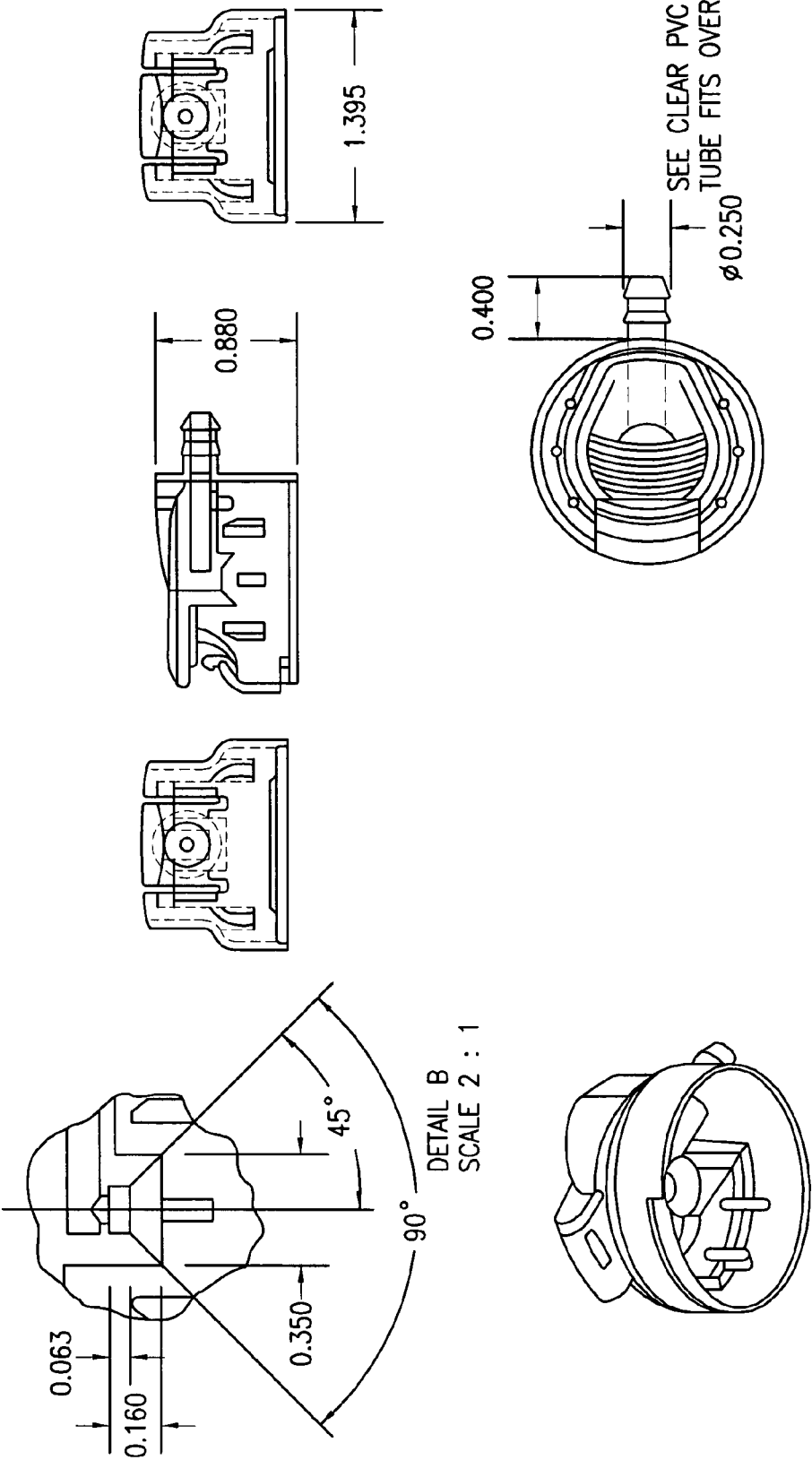
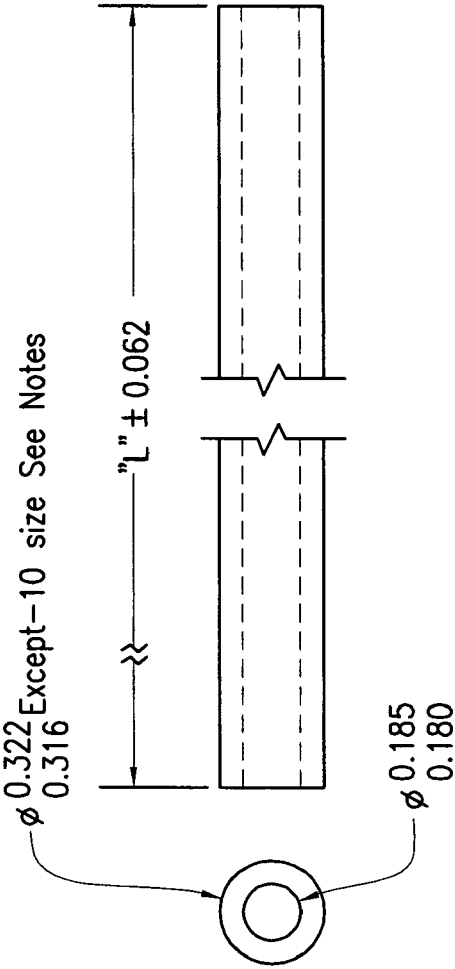


FIG. 5B

| Parts List   |               |
|--------------|---------------|
| PART NUMBER  | Length "L"    |
| PTC600113-01 | 7.38          |
| PTC600113-02 | 15.00         |
| PTC600113-03 | 9.63          |
| PTC600113-04 | 6.75          |
| PTC600113-05 | 5.63          |
| PTC600113-06 | 8.00          |
| PTC600113-07 | 60.00-63.00   |
| PTC600113-08 | 72.00-76.00   |
| PTC600113-09 | 36.00-38.00   |
| PTC600113-10 | 18.00-19.50   |
| PTC600113-11 | 11.50-12.75   |
| PTC600113-12 | 14.50-16.00   |
| PTC600113-13 | 186.00-192.00 |
| PTC600113-14 | 372.00-378.00 |
| PTC600113-15 | 7.00          |
| PTC600113-16 | 1.88          |
| PTC600113-17 | 5.00          |
| PTC600113-18 | 4.63          |
| PTC600113-19 | 6.00          |
| PTC600113-20 | 8.50          |



NOTES:

The OD for the-10 size only is to be  $\varnothing 0.322-0.328$

FIG. 6

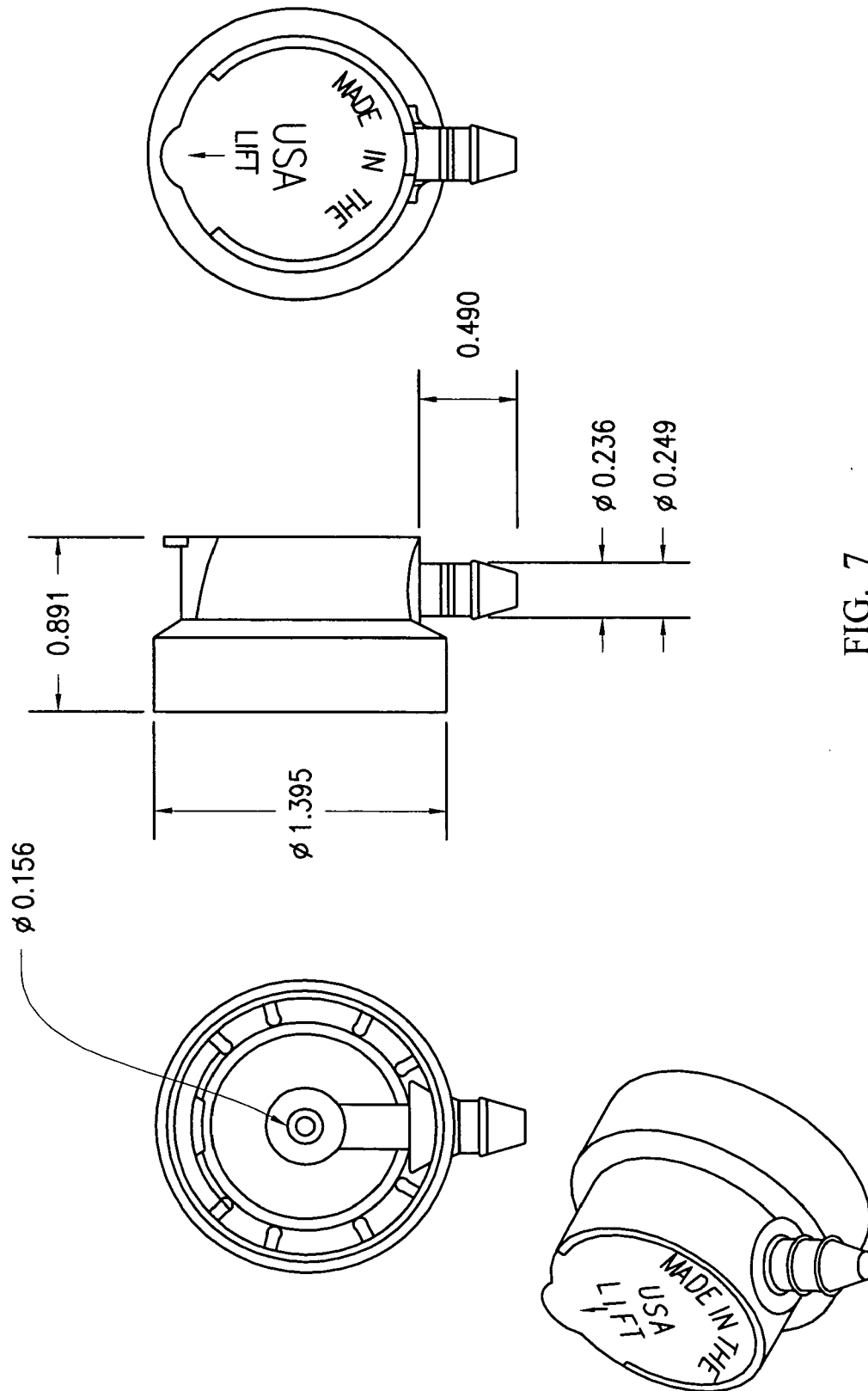


FIG. 7

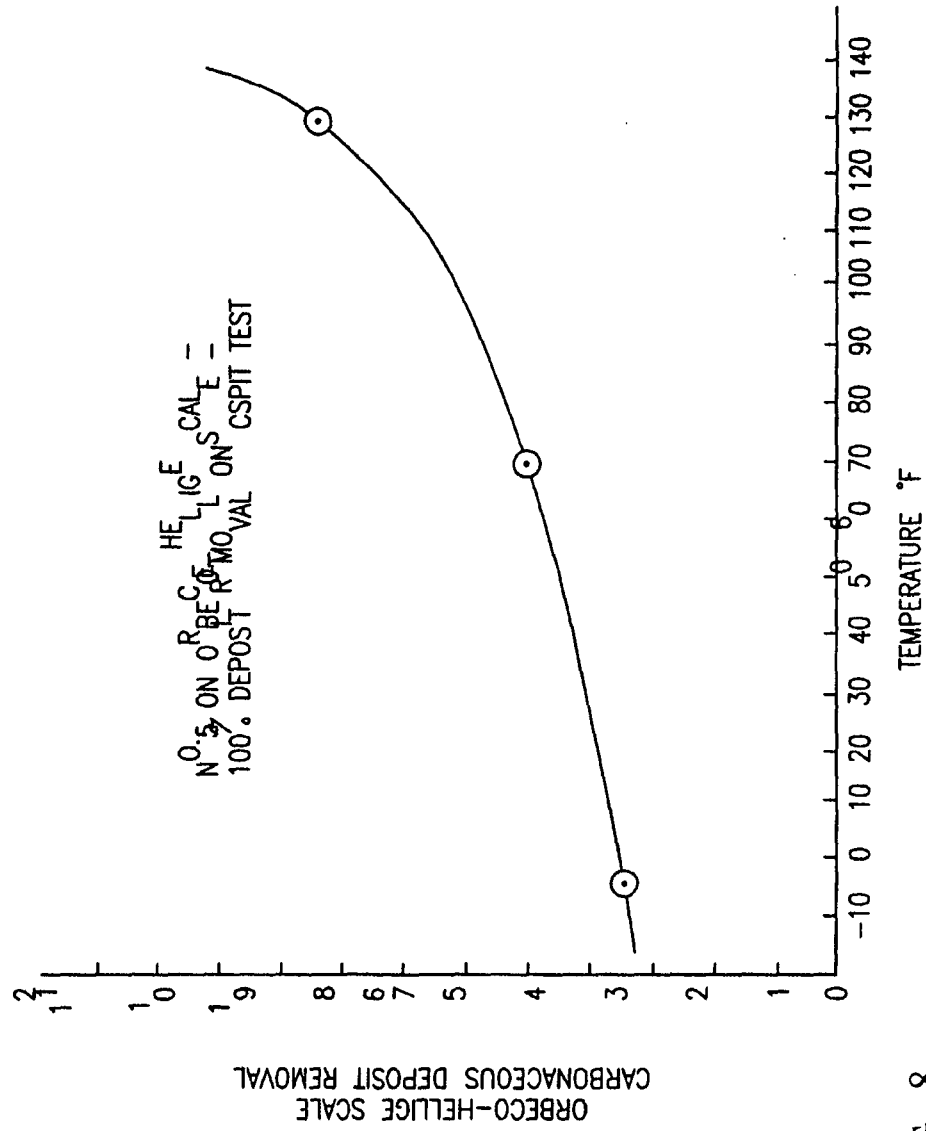


FIG. 8

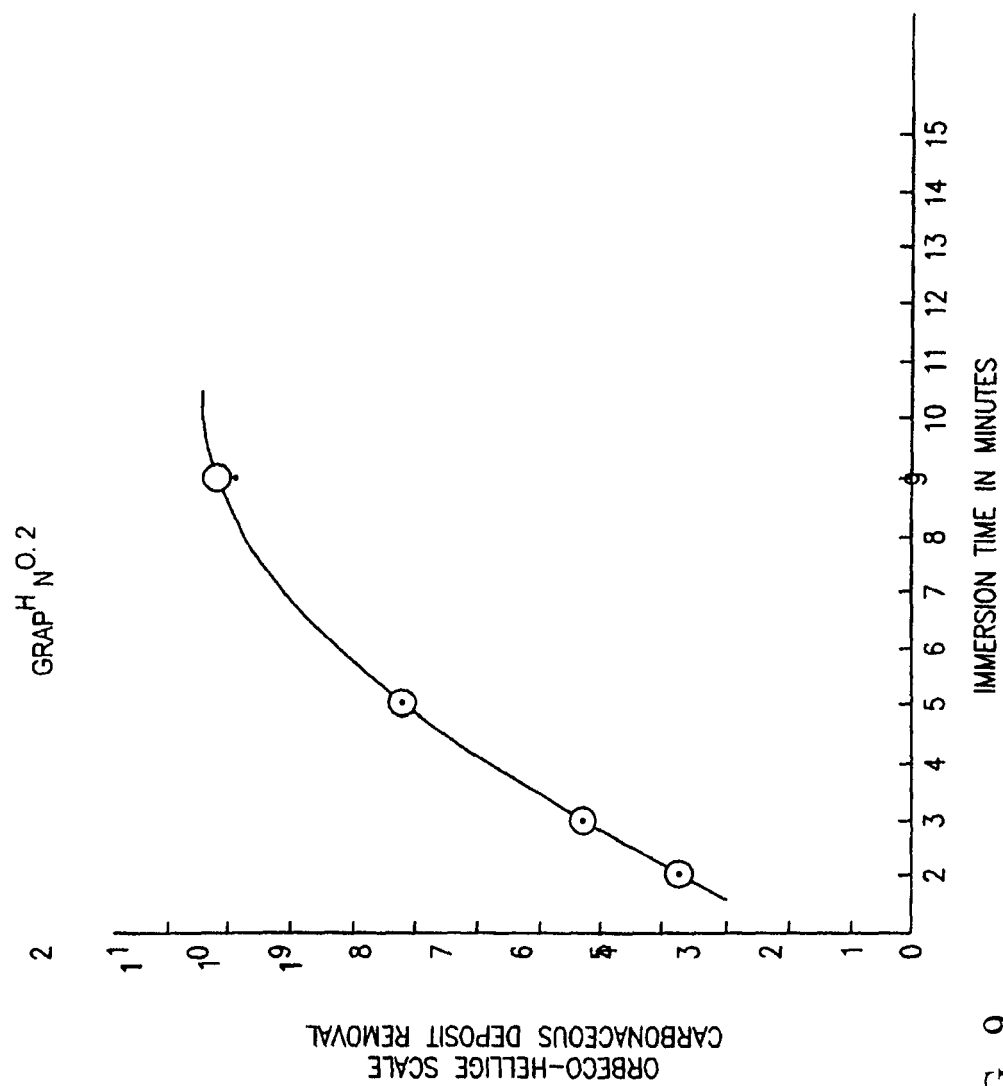


FIG. 9

GRAPH NO. 3

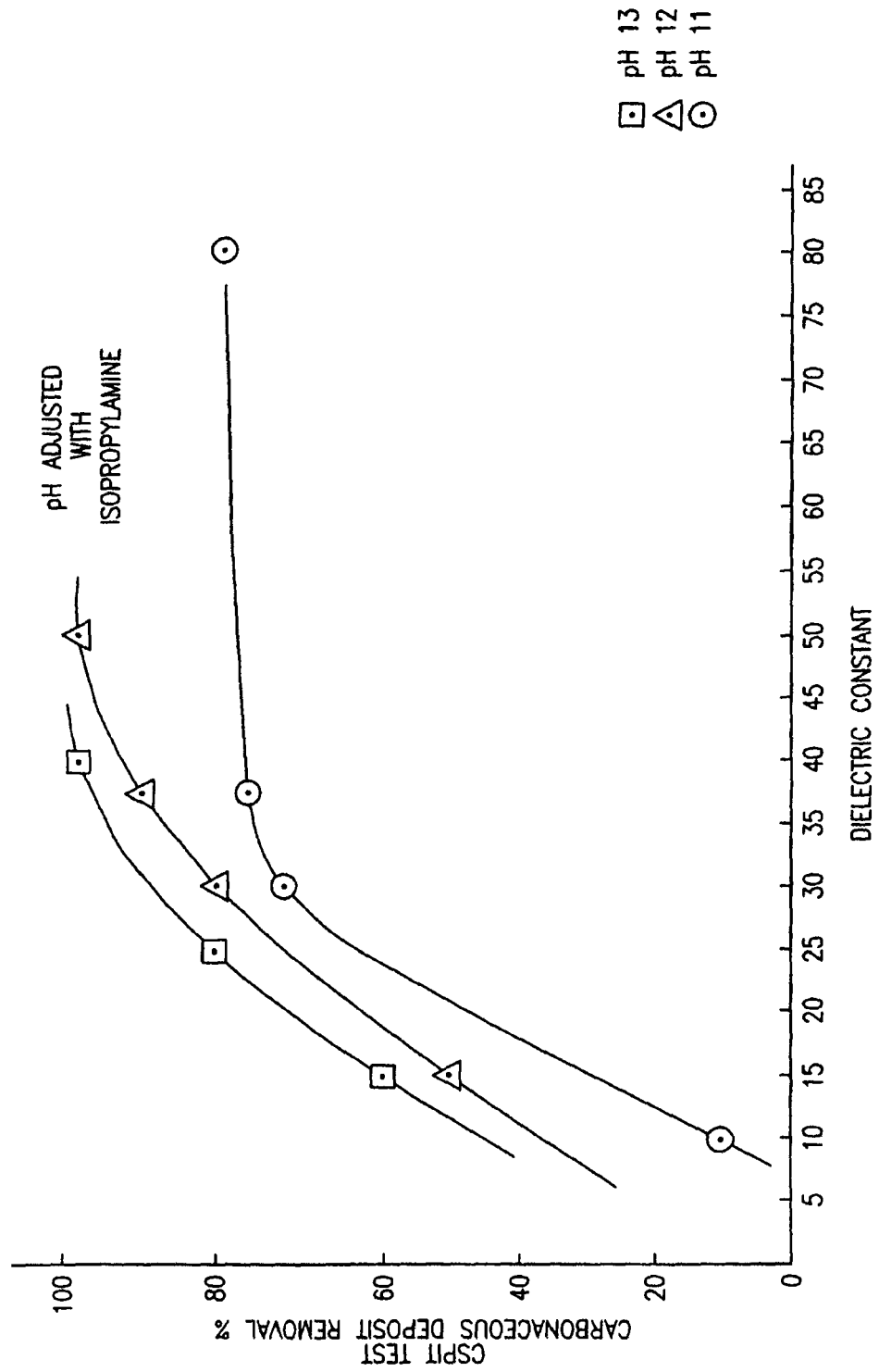


FIG. 10



## EUROPEAN SEARCH REPORT

Application Number  
EP 08 01 5093

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                              |                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Category                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                                                                                                                                                                                                                                                                                                 | Relevant to claim                                                                                                                                                                                                                                                            | CLASSIFICATION OF THE APPLICATION (IPC)     |
| E                                                                                                                                                                                                                                                      | US 2009/011968 A1 (HUGHETT PAUL [US])<br>8 January 2009 (2009-01-08)<br>* the whole document *                                                                                                                                                                                                                                                                                                                                | 1-18,21                                                                                                                                                                                                                                                                      | INV.<br>C10L10/06<br>C11D11/00<br>F02B77/04 |
| D,X                                                                                                                                                                                                                                                    | US 4 992 187 A (ADAMS LAWRENCE J [US] ET AL) 12 February 1991 (1991-02-12)                                                                                                                                                                                                                                                                                                                                                    | 1-6,9,<br>10,18,<br>20,21                                                                                                                                                                                                                                                    | C11D7/06<br>C11D7/26<br>C11D7/32            |
| Y                                                                                                                                                                                                                                                      | * column 3, line 16 - line 53; claims 1,3,4,6,8-13; examples 1-9 *<br>* column 6, line 33 - column 7, line 41 *<br>* column 8, line 35 - line 57 *<br>* column 9, line 3 - column 11, line 4 *<br>* column 17 - column 18 *<br>* column 21 - column 24 *<br>* column 27 - column 36 *<br>* column 38, line 50 - line 67 *<br>* column 41 - column 42 *<br>* column 45, line 1 - line 35 *<br>* column 48, line 21 - line 25 * | 12-17,19                                                                                                                                                                                                                                                                     | C11D7/34<br>C11D7/36<br>C11D17/00           |
| Y                                                                                                                                                                                                                                                      | WO 95/28236 A (ENGINE FOG INC [US]; ADAMS LAWRENCE J [US]; HUGHETT PAUL D [US])<br>26 October 1995 (1995-10-26)                                                                                                                                                                                                                                                                                                               | 12-17,19                                                                                                                                                                                                                                                                     | TECHNICAL FIELDS SEARCHED (IPC)             |
| A                                                                                                                                                                                                                                                      | * page 5, line 9 - page 6, line 11; claims 1-5,8,11-13,15,18-21,23,24,26,28-40; figures 3,7,8,12-19 *<br>* page 8, line 11 - page 9, line 39 *<br>* page 16, line 22 - page 17, line 33 *<br>* page 23, line 16 - line 17 *<br>* page 29 - page 30 *<br>* page 33, line 17 - page 34, line 11 *<br>* page 37, line 4 - line 12 *                                                                                              | 1-4                                                                                                                                                                                                                                                                          | C10L<br>F02B<br>C11D                        |
| X                                                                                                                                                                                                                                                      | EP 0 580 413 A (EXXON RESEARCH ENGINEERING CO [US]) 26 January 1994 (1994-01-26)<br>* claims 1,4-7,10; examples 2-4 *                                                                                                                                                                                                                                                                                                         | 1-6,21                                                                                                                                                                                                                                                                       |                                             |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                              |                                             |
| Place of search<br>The Hague                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                               | Date of completion of the search<br>29 September 2009                                                                                                                                                                                                                        | Examiner<br>de La Morinerie, B              |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                                                                                                                                                                                                                                                                                                               | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                             |

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## EUROPEAN SEARCH REPORT

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                   |                                                       |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Citation of document with indication, where appropriate, of relevant passages                                                                                                                                                     | Relevant to claim                                     | CLASSIFICATION OF THE APPLICATION (IPC) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | WO 2006/011747 A (ADMS TECHNOLOGY CO LTD [KR]; LEE KWANG-YONG [KR]; KIM WOONG [KR]; CHA) 2 February 2006 (2006-02-02)<br>* paragraphs [0012], [0021], [0022];<br>claims 1,3-5; table 1 *                                          | 1-8,11                                                | TECHNICAL FIELDS SEARCHED (IPC)         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | GB 116 010 A (PERKINS JOHN BROADBENT) 30 May 1918 (1918-05-30)<br>* the whole document *                                                                                                                                          | 1,2,21                                                |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | US 2 047 191 A (BUC HYIM E ET AL) 14 July 1936 (1936-07-14)<br>* column 1, line 19 - line 24; claims 1,8,9,13-15,17,18 *<br>* column 1, line 30 - line 48 *<br>* column 2, line 36 - line 40 *<br>* column 2, line 54 - line 56 * | 1,2,21                                                |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | US 1 787 789 A (WHEELER G. LOVELL ET AL.) 6 January 1931 (1931-01-06)<br>* the whole document *                                                                                                                                   | 1-6,21                                                |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EP 1 610 185 A (AIR PROD & CHEM [US]) 28 December 2005 (2005-12-28)<br>* paragraphs [0014], [0016] - [0018], [0024]; claims 1-3,6-9,17,18,20,22; tables I,III,V *                                                                 | 1,2,7,8                                               |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | WO 2007/104746 A (BASF AG [DE]; TSAI MOHSUN; SU KUOCHEN; CHENG SHIH-SONG; TU SHENGHUNG) 20 September 2007 (2007-09-20)<br>* claims 1,2,4-6; table 1 *                                                                             | 1-3,7                                                 |                                         |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | US 2003/060382 A1 (LEE GEUN SU [KR] ET AL) 27 March 2003 (2003-03-27)<br>* paragraphs [0016] - [0020]; claims 1-7,10; examples 1-3 *                                                                                              | 1-4,6,9,10                                            |                                         |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                   |                                                       |                                         |
| Place of search<br>The Hague                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                   | Date of completion of the search<br>29 September 2009 | Examiner<br>de La Morinerie, B          |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                                                                                                                                   |                                                       |                                         |

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EPO FORM 1503 03.82 (P04C01)



## EUROPEAN SEARCH REPORT

Application Number  
EP 08 01 5093

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                  |                                                       |                                         |                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------|---------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                                                                                                                                                                                                    | Relevant to claim                                     | CLASSIFICATION OF THE APPLICATION (IPC) |                                 |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 5 693 599 A (AOYAMA TETSUO [JP] ET AL)<br>2 December 1997 (1997-12-02)<br>* claims 1,3; examples 1-13; tables 1,2 *                                                                                                                                                                                           | 1,2,9                                                 |                                         |                                 |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | JP 04 154900 A (ASAHI CHEMICAL IND)<br>27 May 1992 (1992-05-27)<br>* abstract *                                                                                                                                                                                                                                  | 1-7                                                   |                                         |                                 |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 2004/113461 A (PPG IND OHIO INC [US])<br>29 December 2004 (2004-12-29)<br>* paragraphs [0019], [0020]; claims 1,4-7,9,10,14-16,18,25-28,30; examples 1,4 *                                                                                                                                                    | 1-6                                                   |                                         |                                 |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2 700 005 A (KLINGEL JR ARTHUR R)<br>18 January 1955 (1955-01-18)<br>* the whole document *                                                                                                                                                                                                                   | 1-21                                                  |                                         |                                 |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WO 02/46588 A (3M INNOVATIVE PROPERTIES CO [US])<br>13 June 2002 (2002-06-13)<br>* page 2, line 28 - page 3, line 2; claims 1,2,4-6,8-11; figures 2,2a; table 1 *<br>* page 7, line 13 - line 31 *<br>* page 8, line 22 - line 28 *<br>* page 10, line 16 - line 26 *<br>* page 12, line 19 - page 13, line 27 * | 1-6,<br>12-21                                         |                                         | TECHNICAL FIELDS SEARCHED (IPC) |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 1 176 425 A (W. H. BRISTOL)<br>21 March 1916 (1916-03-21)<br>* column 1, line 54 - line 55; figure 1 *                                                                                                                                                                                                        | 13,15,<br>17,19                                       |                                         |                                 |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | US 2002/116782 A1 (BOWSMAN SHELBA F [US] ET AL)<br>29 August 2002 (2002-08-29)<br>* paragraphs [0027], [0031], [0053], [0070], [0075], [0131], [0143] - [0146], [0148]; claims 1,2,4-6,11,13; figures 1,2,6,10C,10D,12,13,15B,16,18,22,26 *                                                                      | 1,12,13,<br>15,17,<br>19-21                           |                                         |                                 |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                  |                                                       |                                         |                                 |
| Place of search<br>The Hague                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                  | Date of completion of the search<br>29 September 2009 | Examiner<br>de La Morinerie, B          |                                 |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                                                                                                                                                                                  |                                                       |                                         |                                 |

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-09-2009

| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|----|---------------------|----------------------------|---------------------|
| US 2009011968                             | A1 | 08-01-2009          | NONE                       |                     |
| US 4992187                                | A  | 12-02-1991          | US 5340488 A               | 23-08-1994          |
| WO 9528236                                | A  | 26-10-1995          | AT 233132 T                | 15-03-2003          |
|                                           |    |                     | AU 2385595 A               | 10-11-1995          |
|                                           |    |                     | DE 69529742 D1             | 03-04-2003          |
|                                           |    |                     | EP 0755308 A1              | 29-01-1997          |
|                                           |    |                     | US 5858942 A               | 12-01-1999          |
| EP 0580413                                | A  | 26-01-1994          | CA 2099403 A1              | 21-01-1994          |
|                                           |    |                     | DE 69310451 D1             | 12-06-1997          |
|                                           |    |                     | DE 69310451 T2             | 28-08-1997          |
|                                           |    |                     | JP 7233733 A               | 05-09-1995          |
|                                           |    |                     | US 5324363 A               | 28-06-1994          |
| WO 2006011747                             | A  | 02-02-2006          | KR 20060010366 A           | 02-02-2006          |
| GB 116010                                 | A  | 30-05-1918          | NONE                       |                     |
| US 2047191                                | A  | 14-07-1936          | NONE                       |                     |
| US 1787789                                | A  |                     | NONE                       |                     |
| EP 1610185                                | A  | 28-12-2005          | JP 2006009006 A            | 12-01-2006          |
|                                           |    |                     | KR 20060049205 A           | 18-05-2006          |
|                                           |    |                     | SG 136946 A1               | 29-11-2007          |
|                                           |    |                     | US 2006003910 A1           | 05-01-2006          |
| WO 2007104746                             | A  | 20-09-2007          | NONE                       |                     |
| US 2003060382                             | A1 | 27-03-2003          | KR 20030025521 A           | 29-03-2003          |
| US 5693599                                | A  | 02-12-1997          | NONE                       |                     |
| JP 4154900                                | A  | 27-05-1992          | JP 2089152 C               | 02-09-1996          |
|                                           |    |                     | JP 7119438 B               | 20-12-1995          |
| WO 2004113461                             | A  | 29-12-2004          | US 2004259746 A1           | 23-12-2004          |
| US 2700005                                | A  | 18-01-1955          | NONE                       |                     |
| WO 0246588                                | A  | 13-06-2002          | AU 4735601 A               | 18-06-2002          |
|                                           |    |                     | CA 2431259 A1              | 13-06-2002          |
|                                           |    |                     | EP 1339958 A1              | 03-09-2003          |
|                                           |    |                     | JP 2004515684 T            | 27-05-2004          |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 01 5093

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

29-09-2009

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| WO 0246588                                | A                   | US 2004103920 A1           | 03-06-2004          |
|                                           |                     | US 2003015554 A1           | 23-01-2003          |
| US 1176425                                | A                   | NONE                       |                     |
| US 2002116782                             | A1                  | 29-08-2002                 | NONE                |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- US 4992187 A [0010]