United States Patent [19]

Holmes

[11] **3,809,150**

[45] **May 7, 1974**

[54] **MINIMIZING CORROSION OF OVERFLOW RECEPTACLE EQUIPPED ENGINE COOLING SYSTEM**

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[22] Filed: **Apr. 16, 1973**

[21] Appl. No.: **351,371**

[52] **U.S. Cl.** **165/1,** 165/51, 165/134, 123/41.54

[51] **Int. Cl.** **F28f 19/00,** F01p 3/00

[58] **Field of Search** 165/134, 1, 51; 123/41.54

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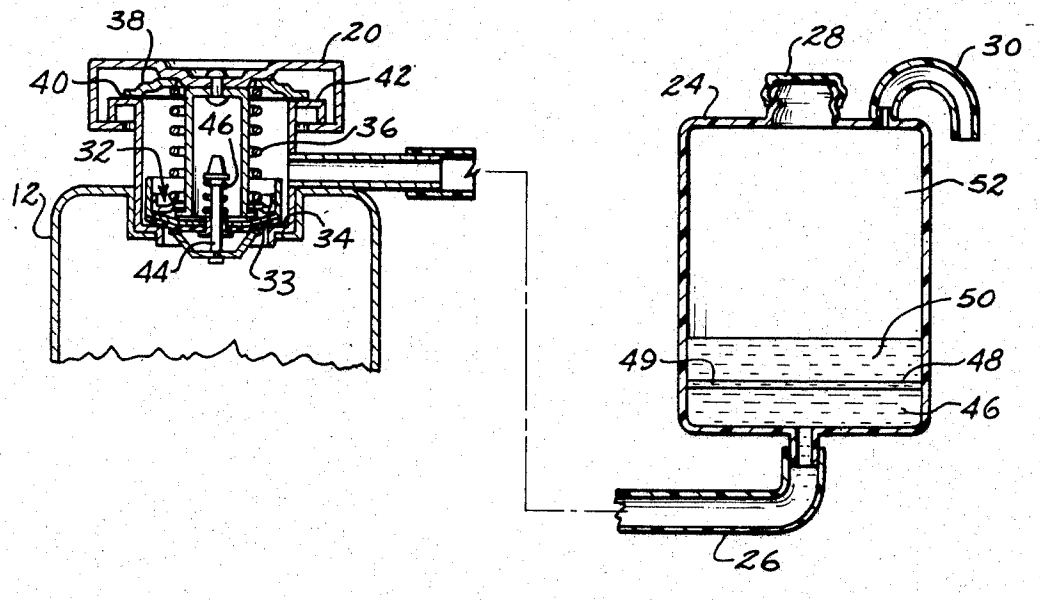
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Primary Examiner—Manuel A. Antonakas
Assistant Examiner—Daniel J. O'Connor

[57] **ABSTRACT**

A method and system for minimizing corrosion in a vehicle engine cooling system containing a water base coolant and having an overflow receptacle vented to atmosphere and connected to the cooling system to receive overflow coolant from the system and to return the coolant to the system. The method and system includes maintaining a liquid seal on the surface of the coolant in the overflow receptacle. The liquid seal completely covers the surface of the coolant in the overflow receptacle and includes a coolant insoluble air excluding component and a coolant soluble corrosion inhibiting component. The air excluding component prevents absorption of fresh air by the coolant in the overflow receptacle and the corrosion inhibiting component gradually dissolves in the coolant over long periods of time to prevent cooling system corrosion.

11 Claims, 3 Drawing Figures



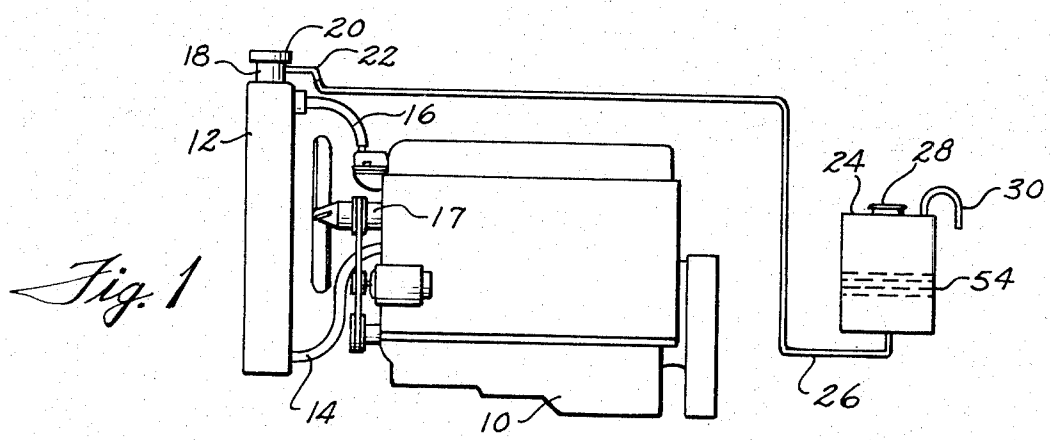


Fig. 1

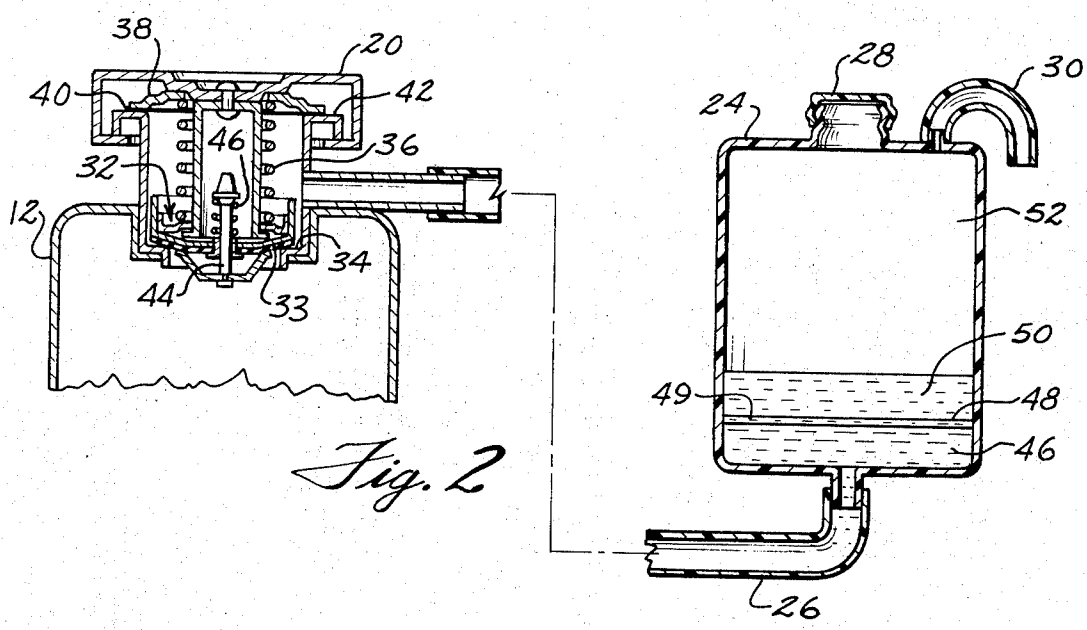


Fig. 2

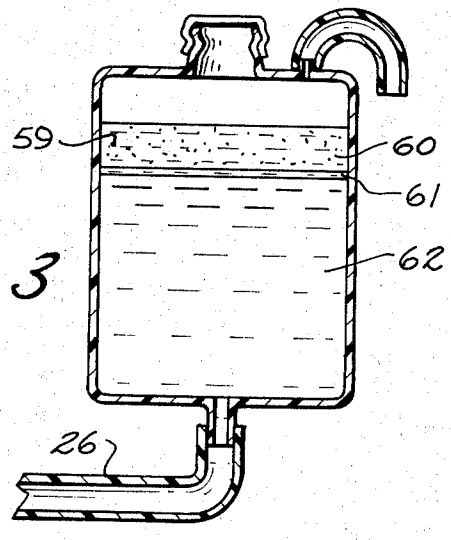


Fig. 3

MINIMIZING CORROSION OF OVERFLOW RECEPTACLE EQUIPPED ENGINE COOLING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to a method and system for minimizing corrosion in internal combustion cooling systems of the type equipped with an overflow vessel.

Overflow vessels to receive coolant when the coolant is heated and to return the coolant to the cooling system when the coolant cools are widely used. One such recovery system includes a thin walled container connected to the usual overflow pipe of the cooling system radiator. In such a system, when the engine is started, the coolant expands and drives the coolant through the pressure valve in the cap of the radiator to the region of the overflow opening at the radiator neck so the coolant flow through the opening and into the receptacle. Subsequently, when the engine is stopped and the coolant in the cooling system contracts, a vacuum is created which draws the coolant from the recovery vessel back into the cooling system thereby maintaining the cooling system full at all times.

The most widely used overflow receptacle is vented to atmosphere so the coolant can freely flow into and out of the receptacle without either pressurizing or vacuumizing the overflow receptacle. It has been found, however, that a distinct disadvantage of this type of receptacle is that each time the cooling system expands and contracts, fresh air is drawn into the space in the overflow receptacle above the coolant. This fresh air contains oxygen and it is the oxygen dissolved in the coolant which causes corrosion of the metal parts of the cooling system which are contacted by the coolant.

U. S. Pat. No. 3,083,701 Peras relates to an internal combustion cooling system having an overflow receptacle in which a liquid seal is provided on the surface of the liquid in the overflow receptacle to reduce evaporation of coolant from the receptacle and to exclude air from the surface of the coolant in the receptacle. This liquid seal has, however, not proven to be entirely satisfactory for minimizing corrosion because fresh air and oxygen enters the system at other locations. For example, as a radiator cap ages, the seal between the cap and the top of the neck becomes imperfect with the result that some air is drawn into the cooling system with the coolant from the overflow receptacle, as the engine cools. In addition, small amounts of air frequently enter the cooling system through the water pump even though there is no apparent leakage of coolant at the pump. Slight leakage of corrosive gases from the cylinders of the engine into the cooling jacket also frequently occurs, even though the spaces which permit the leakage are too small for the leakage of coolant. Such gases in the coolant can also corrode metal parts of the cooling system.

THE INVENTION

This invention relates to an improved method and system for minimizing corrosion in cooling systems equipped with overflow vessels which are either continuously open to atmosphere or become open to atmosphere under predetermined conditions.

In accordance with the invention a liquid seal is provided on the surface of the coolant in the overflow receptacle, the liquid seal consisting of a liquid component of a specific gravity less than the coolant so the liquid floats on the surface of the coolant and air is effectively excluded from the surface of the coolant in the overflow receptacle, and a corrosion inhibitor component mixed with the air excluding liquid component.

The air excluding component of the liquid seal can take several different forms but it is preferred that this liquid be a relatively heavy petroleum base oil such as motor oil or hypoid grease of a viscosity in the range of SAE 30-90. This air excluding component liquid is immiscible with the coolant and has very low air and oxygen absorbing characteristics.

The corrosion inhibiting component is preferably a water soluble oil mixed with the oil forming the liquid component of the seal. The water soluble oil can be a petroleum base oil containing an emulsifier or surfactant which makes the oil soluble in water. Alternatively, the rust inhibiting component can be finely divided particles of a corrosion inhibiting material such as sodium matasilicate which are intimately dispersed in and mixed with the seal liquid.

It has been found that the air excluding liquid seal containing the corrosion inhibitor gradually releases the corrosion inhibitor components over a long period of time so that the coolant is constantly supplied with corrosion inhibitor for a substantial length of time after a fresh supply seal liquid is placed in the overflow receptacle. Evidently, where a soluble oil is mixed with the air excluding oil, only that portion of the soluble oil at the interface between the coolant and the liquid mixes with the coolant. Because the base liquid component of the seal is immiscible with the coolant, there will only be a very small area of contact between the water soluble oil and the coolant. Where the corrosion inhibiting component is a particulate material some particles dissolve at the interface between the coolant and the liquid seal, and some particles settle into the coolant in the overflow receptacle and are drawn into the cooling system during flow of coolant from the overflow receptacle as the cooling system cools.

It has been found that this liquid seal provides a continuing supply of corrosion inhibitor to the coolant for long periods of time, for example, 6 months, during which the cooling system not only has most of the air which would normally be absorbed into the coolant at the overflow receptacle excluded, but in addition, the coolant contains sufficient corrosion inhibitor that no corrosion occurs. These advantageous results are obtained without the need for overloading the cooling system with rust inhibitor with the attendant problems of overdepositing of the soluble oil on the metal surfaces of the system, or in the case of particulate corrosion inhibiting substances, the possibility of clogging the small radiator flow passages with an overabundance or excess of such particles.

The overflow receptacles of many cooling systems, and many add-on type overflow receptacles are formed from a semi-transparent or translucent material which permits visually checking the level of coolant in the overflow receptacle without removing the cover or cap from the overflow receptacle. In accordance with this invention, the translucent nature of the receptacle is used to advantage by mixing a dye or colorant with the

liquid seal so the level of the seal and coolant in the receptacle can be easily inspected visually.

Correspondingly, an object of this invention is a unique method of minimizing corrosion in an internal combustion cooling system including an overflow receptacle in which coolant is exposed to air by maintaining a liquid seal of a lower specific gravity than the coolant on the surface of the coolant in the overflow receptacle, with the liquid seal containing an air excluding component immiscible with the coolant and a rust inhibitor component which is gradually fed into the coolant over a long period of time.

Another object is a system for minimizing corrosion in the cooling system of an internal combustion engine of the type equipped with an overflow receptacle in which an air excluding liquid immiscible with the coolant contains a corrosion inhibitor component soluble in coolant and forms a liquid seal on the surface of the coolant in the overflow receptacle.

Another object is a system for minimizing corrosion in the cooling system of an internal combustion engine of the type equipped with an overflow receptacle in which an air excluding liquid immiscible with the coolant contains a particulate material rust inhibitor material mixed with the liquid, the mix forms a liquid seal on the surface of the coolant in the overflow receptacle, and gradually feeds the particulate corrosion inhibitor to the coolant.

Another object is a unique liquid seal for the overflow receptacle of a cooling system of an internal combustion engine, which liquid seal contains a quantity of corrosion inhibitor which is gradually fed or mixed with the coolant to substantially prevent corrosion in the cooling system while the liquid seal excludes air from the coolant in the overflow receptacle.

Another object is a liquid seal arrangement according to one or more of the preceding objects where the overflow receptacle has side walls formed from a translucent or semi-transparent material and where the liquid seal contains a dye or colorant so the level of the liquid seal and coolant in the overflow receptacle can easily be determined visually.

Numerous other objects and advantages will become apparent with reference to the accompanying drawings which form a part of this specification and in which:

FIG. 1 is a side view in elevation, partly in schematic, showing an engine cooling system including a radiator, an overflow receptacle connected to the overflow pipe of the radiator neck, and the liquid seal of this invention floating on the surface of the coolant in the overflow receptacle;

FIG. 2 is an enlarged partial view of the radiator neck and overflow receptacle of FIG. 1, and shows a first embodiment of the liquid seal floating on the surface of coolant in the overflow receptacle; and

FIG. 3 is a view of the overflow receptacle of FIG. 2 showing a second embodiment of the liquid seal of this invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings in detail, and particularly to FIG. 1 there is shown an automobile engine **10** having the usual cooling system including a radiator **12** connected to the engine by appropriate hoses **14** and **16** and equipped with a water pump **17** for circulating the coolant through the cooling jacket of the engine and back through radiator **12.**

Radiator **12** has the usual filling neck **18** which is normally closed by the usual pressure type radiator cap **20** when the engine **10** is in operation. Extending from filling neck **18** is an overflow pipe **22** which is connected to the bottom of an overflow receptacle **24** by a hose or tube **26.** Overflow receptacle **24** has a filling opening closed by a cap **28,** and has its upper end vented to atmosphere by a tube **30** which carries excess coolant overflow away from overflow receptacle **24.** Alternatively, the overflow vent can be an opening (not shown) in cap **28.** Where the cooling system for engine **10** is of a capacity on the order of 15–20 quarts, overflow receptacle **24** conventionally has a capacity of approximately 2 quarts.

As shown at FIG. **2,** filling neck **18** is sealed to the upper end of radiator **12.** Pressure cap **20** is shown as including a pressure relief valve **32** with a gasket **33** which is urged downwardly against a transverse valve seat **34** of the neck **18** by a spring **36** to seal the opening at the bottom of the neck. A seal plate **38** presses a gasket **40** against the top rim **42** of the radiator neck to seal the upper end of the neck. Pressure cap **20** also includes a vacuum relief valve **44** which seats on the underside of gasket **33** and is normally urged upwardly by spring **46.**

Pressure relief valve **32** is of the conventional type which opens when the pressure within radiator **12** is in the range of 7–15 PSI, and vacuum relief valve **44** conventionally opens when a vacuum within the radiator is approximately 1 PSI below atmospheric pressure.

Receptacle **24** can be a thin walled container of sufficient capacity to accommodate overflow coolant from radiator **12.** Receptacle **24** can be formed from a polystyrene plastic which is translucent, and cap **28** can be a conventional screw on type cap.

Overflow receptacles such as receptacle **24** improve the efficiency of the automotive cooling system by maintaining the radiator **12** full of coolant when the coolant is cold as well as when the engine is operating and the coolant is hot. Assuming a condition where engine **10** is stopped, the coolant in the cooling system is cool, and there is only a small amount of coolant **46** (perhaps an inch or so) near the bottom of receptacle **24** (FIG. **2**). Starting engine **10** and running the engine until the coolant reaches operating temperature will cause the coolant to expand. As the coolant expands the pressure in the cooling system increases until the resistance of the pressure valve **32** of the radiator cap **20** is exceeded, whereupon, coolant is forced into the portion of neck **18** above seat **34.** This overflow coolant flows through overflow pipe **22** and hose **21** into receptacle **24** which is customarily mounted below the level of overflow pipe **22.** Such outflow of coolant continues until the coolant reaches its operating temperature and there is a pressure balance in the cooling system but the radiator is still full. Coolant in receptacle **24** will then be at the level of FIG. **3.**

When engine **10** is stopped and the coolant cools, a vacuum is gradually created in the cooling system. When this vacuum reaches the predetermined release value of vacuum relief valve **44,** the valve opens to create a vacuum within the upper part of neck **18,** since the top of the neck is sealed by gasket **40.** Reduced pressure in neck **18** causes coolant in overflow receptacle **24** to be drawn into the neck through hose **26** and

overflow pipe **22** and the coolant flows through a vacuum relief valve **44** into the radiator thereby maintaining the radiator substantially full when the coolant cools.

In accordance with this invention, applicant has found that the upper surface **48** of the coolant in the overflow receptacle, being normally exposed to fresh air from vent **30** adds oxygen to the coolant in the radiator each time the coolant is drawn into the radiator from the overflow receptacle. The oxygen from the air causes corrosion of various metal parts of the cooling system with the result that it is necessary to normally frequently change the coolant and add some form of rust inhibitor or preventative to the collant. While most automobile owners frequently check the level of the coolant in the radiator, the condition of the coolant is rarely checked, and as a result, cooling system problems are frequently encountered during the second year of operation of most automobiles.

While one solution to this problem would be to add substantial amounts of corrosion inhibitor to the cooling system initially, there are no commercially available corrosion inhibitors which will prevent corrosion for a period of several years without initially overloading the cooling system with materials that could cause more damage to the system than occurs from normal corrosion without an inhibitor.

In accordance with this invention, corrosion in an engine cooling system equipped with an overflow receptacle is substantially eliminated and is minimized to the extent that cooling system corrosion problems are quite rare. Such minimizing of corrosion in the cooling system is accomplished by maintaining a layer of liquid floating on the surface **48** of the coolant in the overflow receptacle to form a liquid seal **50** about 1 inch thick which excludes fresh air from the coolant in overflow receptacle **24.**

Liquid seal **50** is lighter than the coolant so it floats on the surface of the coolant. The liquid seal contains a first component which is an air excluding liquid, and a second component mixed with the air excluding liquid and which has corrosion inhibiting characteristics when mixed with the coolant. The air excluding liquid component can be a petroleum base oil of a viscosity greater than the coolant and in the range of SAE 20–120 and of a density less than the coolant. In areas where ambient temperatures are high, viscosities in the range of SAE 90–120 are desirable whereas in colder or arctic areas viscosities in the range of SAE 20–50 are desirable. This is because it is desirable to maintain the liquid seal in a state somewhat more viscous than the coolant so the surface of the coolant will not be exposed to air in the overflow receptacle head space **52** even though the liquid seal **50** vibrates or is agitated somewhat as a result of engine vibration or vehicle motion. On the other hand, if the liquid seal becomes too thick it will tend to adhere to the side walls of the overflow receptacle and will not follow the rise and fall of the coolant in the overflow receptacle.

The corrosion inhibiting component can be a water soluble oil mixed with the air excluding liquid component in a ratio as high as 3 parts soluble oil to one part insoluble seal liquid, by volume. The ratio can also be as low as one part soluble oil by volume to four parts insoluble seal liquid, by volume.

A satisfactory liquid seal **50** can be obtained by mixing equal volumes of 90 weight gear oil and a water soluble oil such as that available from Mobile Oil Company as MOBILE MET S-122, which is a water soluble petroleum base oil having a gravity of 20.2 and a viscosity of 280 at 180° F. Eight ounces (by volume) of this mix, poured onto the surface **46** of coolant in overflow receptacle **25** will maintain the cooling system free of corrosion for periods of time on the order of 6 months to a year.

Another satisfactory liquid seal **50** can be obtained by mixing equal volumes of SAE 30 motor oil and MOBILE MET S-122 soluble oil. A small quantity of dye or colorant can be added to this mix. A suitable dye is Oil Yellow No. 2 which imparts a brilliant yellow color to this mix, if added in an amount of 0.001 percent by weight, and enables the level of the liquid seal in translucent wall receptacle **24** to be easily seen. Various different dyes and colorants can be used, so long as the colorants mix well with the liquid seal, are compatible with the components of the liquid seal, do not cause corrosion or deterioration of the coolant, and do not cause deterioration of the rust inhibitor. Where the dye is soluble in the coolant, as is the case with Oil Yellow No. 2, the dye will disperse in the coolant in approximately the same time that the corrosion inhibiting liquid disperses in the coolant, and this feature serves as a useful indicator to indicate that the corrosion inhibiting component of the liquid seal is dissipated when a distinct yellow band is no longer visible in the overflow receptacle.

Where the corrosion inhibiting component is a liquid, the liquid is mixed with the air excluding liquid to form a homogeneous liquid which does not separate, and which is poured onto the surface **48** of the coolant in overflow receptacle **24.** Since the resulting liquid seal is a homogeneous liquid, only a very small quantity of the water soluble liquid is exposed to the coolant at the interface **49** at upper surface **48** of the coolant. Hence, the water soluble liquid mixes very slowly with the coolant in the overflow receptacle, and this resulting mix of coolant and corrosion inhibiting liquid is drawn into the cooling system each time the coolant cools. The flow of coolant to and from the overflow receptacle **24,** and the road vibration of the automobile in motion causes the overflow receptacle to vibrate with the result that the interface **49** between liquid seal **50** and coolant **46** changes and additional water soluble liquid is available to mix with the coolant. Correspondingly, the corrosion inhibiting water soluble liquid remains in the air excluding liquid for long periods of time and gradually bleeds or is fed into the coolant.

It is to be understood that the volume ratios given above are merely exemplary and that these ratios will depend on various factors such as the capacity of the cooling system as well as the capacity of overflow receptacle **24.** In addition, the amount of colorant, when used, will also vary.

Where the corrosion inhibiting substance is a liquid in the form of water soluble oil, virtually any water soluble oil can be used. For example, the water soluble oil can be a mineral base, animal base, or vegetable base oil having a surfactant, emulsifier, or auxiliary solvent to cause the oil to be miscible in the aqueous base coolant commonly used in automobile engine cooling systems. The aqueous base coolant will of course, in most instances, contain a glycol base antifreeze which is necessary in the colder climates, and is also required in warmer climates where the automobile is equipped

with air conditioning. A suitable water soluble oil is disclosed in U. S. Pat. No. 2,580,719. Where the corrosion inhibiting component is a liquid, the liquid can also be the wax emulsion disclosed in U. S. Pat. No. 2,318,558. In addition, any other water soluble corrosion inhibitor can be used so long as it mixes well with the air excluding liquid component and remains suspended in the air excluding component for long periods of time.

The corrosion inhibiting component can also take the form of finely divided particulate or powder form corrosion inhibitor material intimately mixed with the air excluding seal liquid to form the liquid seal **60** of FIG. **3.** Good results can be obtained by mixing 2 ounces by weight of finely divided crystals of benzotriazole in 8 ounces (by volume) of 90 weight gear oil. This mix will adequately protect a 20 quart cooling system when poured onto the surface of the coolant in the overflow receptacle **24.** The air excluding liquid component can be a petroleum base, animal base, or vegetable base oil of SAE 30–120 weight. The corrosion inhibiting component can be any solid corrosion inhibitor which is available in powder or finely divided particle form, which will mix with the air excluding liquid and not settle, and which will not deteriorate the air excluding liquid and which will dissolve or disperse in the coolant. Other suitable solid corrosion inhibitors are tolyltiazole, pottassium dicromate, sodium nitrite, sodium nitrate, borax, sodium metasilicate, and sodium chromate, or mixes of several of these. Small amounts of one or more of these solid corrosion inhibitors can be added to the soluble oil or liquid — air excluding liquid mix to obtain additional corrosion resistance. A dye or colorant can also be added to these mixes so the liquid seal will be visible as a band **54** (FIG. **1**) through the translucent sides of overflow receptacle **24.** FIG. **3,** shows particles **59** of corrosion inhibitor mixed with the liquid of liquid seal **60.**

The mechanism of dispersing or dissolving the particulate or powder form corrosion inhibitor in the coolant is similar to that previously described in that only a small amount of the corrosion inhibitor will be exposed to the coolant at the interface **61** between coolant **62** and liquid seal **60.** As a result of road vibration of the automobile in which overflow receptacle **24** is installed, liquid seal **60** will be agitated, and during flow of coolant into and out of overflow receptacle **24,** liquid seal **60** will be further agitated with the result that different particulate or powder form corrosion inhibitor will be exposed to the coolant at interface **61.** As a result, the corrosion inhibitor dissolves or is dispersed very slowly into the coolant over long periods of time and is gradually added to the cooling system as the coolant expands and contracts during on-off operation of engine **10.**

Should the cooling system malfunction with the result that either liquid seal **50** or liquid seal **60** is completely drawn into the cooling system and is circulated with the coolant, the cooling system will not be adversely affected. The air excluding liquid as well as some of the corrosion inhibitor will tend to float on the surface of the coolant in the radiator, and when the level of the coolant is brought back to the level required to maintain an inch or two of coolant in overflow receptacle **24** when the coolant is cool, the air excluding liquid and some of the corrosion inhibitor will be forced back into the overflow receptacle during the next heating-cooling cycle.

While several preferred compositions of liquid seals for use in overflow receptacles of automobile engine cooling systems have been described, it is within the scope of this invention that any liquid lighter than the coolant, which is immiscible with the coolant, and which exclude air from the surface of the coolant in the overflow receptacle can be used as the air excluding component, and that any liquid or solid corrosion inhibitor suitable for use in aqueous base or water containing heat exchange liquids can be employed so long as the corrosion inhibitor mixes well with the air excluding liquid, does not separate from the air excluding liquid in a short period of time, and disperses or is soluble in the coolant so the corrosion inhibitor can be carried to the various parts of the cooling system by the coolant.

It is, therefore, to be understood that numerous changes can be made in the embodiments described herein without departing from the scope of this invention as set forth in the appended claims.

What is claimed is:

1. In an engine cooling system containing a coolant and having an overflow receptacle connected to the cooling system, and wherein the coolant in the overflow receptacle is vented to atmosphere so coolant can be forced into the receptacle as the temperature of the coolant in the cooling system increases, and can be drawn out of the receptacle as the temperature of the coolant in the cooling system decreases, the method of minimizing corrosion in the cooling system comprising,

maintaining on the surface of the coolant in the receptacle a floating seal including a layer of a substance of a specific gravity lower than the specific gravity of the coolant, the substance comprising

a first component immiscible with the coolant and having air excluding characteristics, and

a second corrosion inhibitor component mixed with the first component and soluble in the coolant; and

allowing the corrosion inhibitor component to gradually mix with the coolant so that the corrosion inhibitor is gradually added to the coolant over a long period of time.

2. The method according to claim **1** wherein

the first component of the floating seal is a liquid; and

the second component of the floating seal is a water soluble liquid.

3. A method according to claim **2** wherein

the first component of the seal is an oil; and

the second component of the seal is a water soluble oil.

4. A method according to claim **2** wherein

the floating seal further includes

a small quantity of a solid corrosion inhibitor in particulate form mixed with the first and second components.

5. A method according to claim **2** wherein

the overflow receptacle has a light transmitting side wall; and

the floating seal further includes

a colorant mixed with the floating seal substance so that the existence of the floating seal as well as

the height of the seal in the overflow receptacle can be determined visually.

6. A method according to claim 1 wherein

the first component is a liquid; and

the second component is a solid corrosion inhibitor in finely divided particle form mixed with the first component liquid.

7. A method according to claim 1 wherein

the floating seal further includes

a dye mixed with the floating seal components and soluble in the coolant, the dye having dispersion characteristics in the coolant similar to those of the corrosion inhibitor to enable visually determining when the corrosion inhibitor is exhausted from the liquid seal.

8. In a vehicle engine cooling system containing a water base coolant and having an overflow receptacle connected to the cooling system into which overflow coolant from the system flows when the temperature of the coolant increases and from which coolant is returned to the cooling system when the temperature of the coolant decreases, and wherein the coolant in the overflow receptacle has a surface exposed to air, the improvement comprising,

seal means covering and floating on the surface of the coolant in the overflow receptacle for excluding air from said surface of the coolant and for gradually releasing a corrosion inhibitor into the coolant to minimize corrosion of metal parts of the cooling system, and comprising

coolant insoluble air excluding means for excluding air from the surface of the coolant in the overflow receptacle, and

coolant soluble corrosion inhibitor means for inhibiting corrosion of the cooling system, said corrosion inhibitor means being intimately mixed with the air excluding means so that the corrosion inhibitor gradually dissolves in the coolant over a long period of time.

9. The improvement according to claim 8 wherein

the coolant insoluble air excluding means comprises

a liquid of a density less than the coolant; and

the coolant soluble corrosion inhibitor means comprises

a coolant soluble liquid.

10. The improvement according to claim 8 wherein

the overflow receptacle has a side wall which is at least semi-transparent; and

said seal means further includes

a colorant intimately mixed with the coolant insoluble air excluding means and the coolant soluble corrosion inhibitor means.

11. The improvement according to claim 8 wherein

the coolant insoluble air excluding means is a liquid; and

the coolant soluble corrosion inhibitor means comprises

a solid corrosion inhibitor in finely divided particle form.

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