

UNITED STATES PATENT OFFICE

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FLAW DETECTION FLUID

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1 This invention relates to a composition of matter for detecting flaws, cracks and imperfections extending inwardly from the surface of bodies, usually metallic bodies that are subject to mechanical or physical stresses, and particularly refers to an improved fluid composition that may be applied to the said surface or carried thereto by hydraulic or capillary forces and, after suitable treatment, will give an indication of the nature and extent of the flaw or the like that may be examined under visible light, such as daylight.

Heretofore it has been proposed to examine surfaces for flaws by the use of fluid materials which would fluoresce under ultraviolet light and in the absence of visible light, as in United States Patent No. 2,259,400, issued October 14, 1941, to R. C. Switzer. Because of the inconvenience of excluding visible light from the objects to be examined, it was proposed by T. deForest, in United States Patent No. 2,340,940, issued February 8, 1944, to use two liquids, one carrying a dyestuff or coloring agent visible in ordinary daylight or artificial light, which was placed on the surface after it had previously been treated with an oily material, which, when it exuded or crept out of flaws in the object, would, through a surface tension effect, give a visible indication of the said flaw or defect. The oily material preferably included an emulsifying agent so that it was removable by washing with water, after which it was dried so as not to interfere with the action of the dye or color-carrying liquid.

This invention is a simplification and a material improvement over the procedures just described and comprehends broadly a new composition of material that requires but a single application to the surface followed by a washing-off step, after which flaws and imperfections extending inwardly from the surface may be observed by ordinary visible light. Alternatively the improved may be used as a hydrostatic test fluid for hollow castings, pressure vessels, linings and the like, in which case flaws or porous spots, defective welds, or the like may be determined that are detectable in no other manner. It has been found that the preferred material and the modes of operation for its use described herein are particularly adaptable to large units which are not transportable or which cannot be placed in darkness, and particularly those structures which are made of stainless steel.

Basically the material consists of a fluent vehicle such as a light mineral oil, for example kerosene, in which is placed an emulsifying agent so that it is removable from the outer surface of

2 the object to be examined, as by a washing operation involving water, together with a light-reflecting dyestuff which will leave a visible stain in ordinary light.

5 Desirably the product should contain an agent or agents to promote rapid and complete washing under unfavorable conditions such as with cold water. Agents which have been found to be particularly desirable are the water soluble alcohols such as methyl, ethyl, and isopropyl alcohol and the glycols such as ethylene glycol, diethylene glycol, glycerine, and other polyhydric alcohols. This has been found desirable in order that residual strains or splashes of the dye-containing liquid material may easily and completely be removed from the surface to be examined by a stream of cold water. Certain of the prior art materials, such as those described in Patent No. 2,359,400 cited above, are objectionable from this standpoint is that smears and stains remain which give false or ambiguous indications of flaws where none in fact exists.

Following is an example of a preferred composition for the practice of this invention:

	Percent
Oil soluble emulifier (sodium salt of preferentially oil soluble petroleum sulfonic acids) -----	5-15
30 Water soluble emulsifier (sodium salt of preferentially water soluble petroleum sulfonic acids) -----	5-15
Low viscosity mineral oil (kerosene) -----	70-90
35 Rhodamine B Base (E. I. du Pont de Nemours) -----	0.25-1.5

It may be here stated that numerous types of dyes may be utilized for the purpose of this invention. Those dyes which are both water soluble and soluble in the blend of oil and emulsifying agent are particularly suitable because the excess of dye is readily and completely removed from the surface being tested by water washing. Extensive tests have shown that the group consisting of Safranin and Rhodamine are particularly suitable. Specific types are Safranin Y, Rhodamine B, Rhodamine B base, and Rhodamine Extra S. Although water soluble dyes are preferred this invention is by no means limited to the water soluble types. Dyes of the water insoluble types can be employed by the selection of emulsifying agent that emulsifies the dye as well as the oil when the surface is water washed.

Although a blend of petroleum sodium sulfonates commonly referred to as refined mahogany

soaps is preferred as the emulsifying agent, other materials can also be used.

Other suitable emulsifiers include the alkali metal salts or alkanol amine salts such as triethanol amine salts of rosin, tall oil, naphthenic acids, fatty acids and the like. These may be used separately or in combination. Emulsifiers suitable for this invention are well known to those skilled in the art as emulsifiers for the so-called soluble oils whose emulsions are used as cutting lubricants in the machine shop trade or as lubricants in the textile field.

If desired the addition of approximately from .5 to 3% of water soluble alcohol and glycols as previously listed will be found to improve the emulsification properties and aid in the removal of the excess liquid from the surface being treated. In addition an odorant or perfume, for example 0.01 to 0.05% of oil of citronella, may be included.

As stated above, the desirable, but not necessarily essential, features of this composition of material are a fluent or penetrating vehicle which may be washed off from the surface being examined by the use of water and a dyestuff which is soluble to a certain degree in the vehicle and also in the flushing water. Emulsifying agents to promote the removal of the excess fluid are similarly desirable and in addition wetting agents, for example water-soluble sodium sulfonates, alkyl aryl sodium sulfonates, sodium lauryl sulfate known as "Lorol," dioctyl ester of sodium sulfosuccinate known as "Aerosol" and the like, which will increase the penetrating power of the vehicle so that it will more readily flow through minute flaws or cracks under hydraulic pressure or capillary forces may be included.

As a further improvement in this invention a volatile solvent can be included in the product. The evaporation of the solvent from the composition in the cracks draws the dye and oil to the surface of the crack by capillary forces thereby enhancing the coloration visible on the surface of the flaw. This improvement is particularly desirable in facilitating the examination for extremely fine defects. A preferred composition is as follows:

	Per cent
Petroleum solvent of 150 to 250° F. boiling range	25
Petroleum sodium sulfonates	15
Low viscosity mineral oil (kerosene)	69
Rhodamine B Base	1

Although a volatile petroleum hydrocarbon solvent is preferred, other volatile solvents can be employed. Examples of other suitable solvents include chlorinated solvents such as carbon tetrachloride, chloroform, trichlor ethylene and the like, volatile alcohols such as ethyl, *n* propyl, isopropyl and butyl alcohol, ketones such as acetone and methyl ethyl ketone, esters such as ethyl acetate, propyl acetate and butyl acetate, and other volatile organic solvents.

We claim:

1. A composition for examination under visible light of metal surfaces and the like for flaws,

cracks or defects, consisting essentially of about 70 to 90% of a penetrating mineral oil, about 5 to 15% of an emulsifier for said oil, and about 0.25 to 1.5% of a light-reflecting dyestuff which will leave a visible indication in said flaws after said composition has been applied to said surface and then washed off with water.

2. A composition according to claim 1 with the addition of a wetting agent.

3. A composition according to claim 1 with the addition of a wetting agent and a water soluble alcohol.

4. A composition according to claim 1 with the addition of a volatile organic solvent for said oil.

5. A composition for examination under visible light of metal surfaces and the like for flaws, cracks or defects, consisting essentially of about 70 to 90% of a penetrating mineral oil, about 5 to 15% of a water-soluble emulsifying agent, about 5 to 15% of an oil-soluble emulsifying agent, and about 0.25 to 1.5% of a light-reflecting dyestuff which is at least partially water soluble and which will leave a visible indication in said flaws after said composition has been applied to said surface and then washed off with water.

6. A composition for examination under visible light of metal surfaces and the like for flaws, cracks or defects consisting of:

	Per cent
Sodium salt of preferentially oil soluble petroleum sulfonic acids	5-15
Sodium salt of preferentially water soluble petroleum sulfonic acids	5-15
Low viscosity mineral oil	70-90
Rhodamine B Base	0.1-1.5

7. A composition according to claim 6 with the addition of

	Per cent
Isopropyl alcohol	1-3
Odorant	0.1-0.5

8. A composition for examination under visible light of metal surfaces and the like for flaws, cracks or defects consisting of:

	Per cent
Petroleum oil soluble sodium sulfonate	5-10
Sodium naphthenate	5-10
Petroleum water soluble sodium sulfonate	5-10
Kerosene	60-85
Rhodamine dyestuff	0.1-1.5

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REFERENCES CITED

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