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Currie

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[54] **APPARATUS FOR VAPOR PHASE HEATING OF TRAFFIC LINE PAINTS**

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[51] **Int. Cl.** **F22b 1/16**

[58] **Field of Search** 94/1.5, 44; 239/129, 130, 239/134, 135, 136, 139, 150; 122/33

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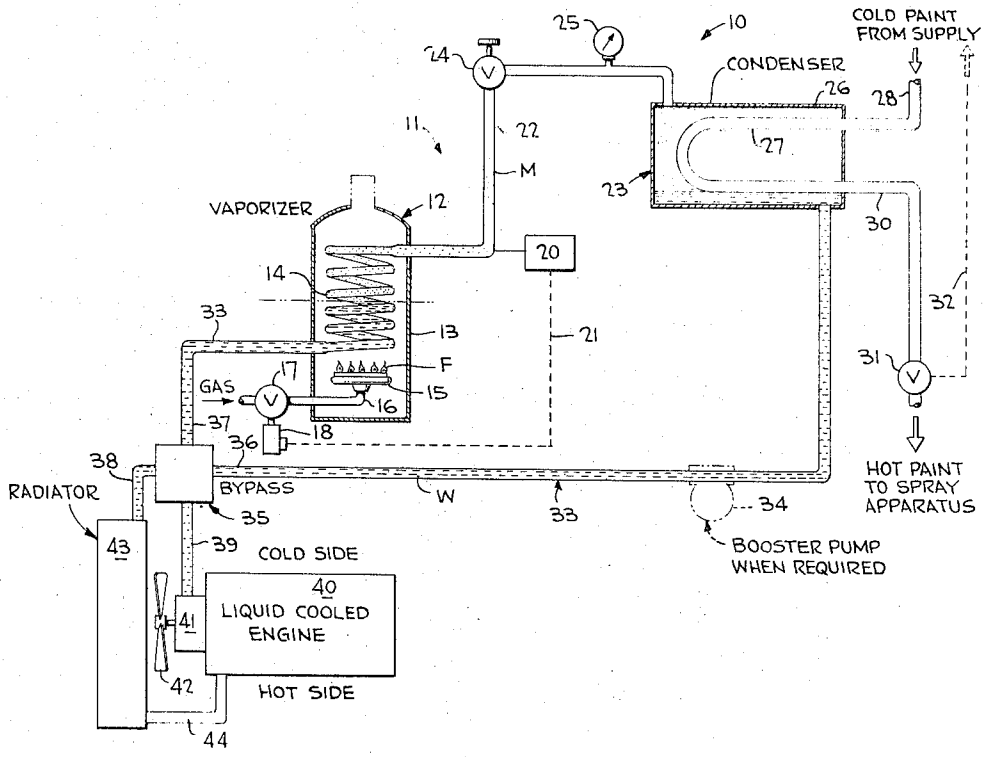
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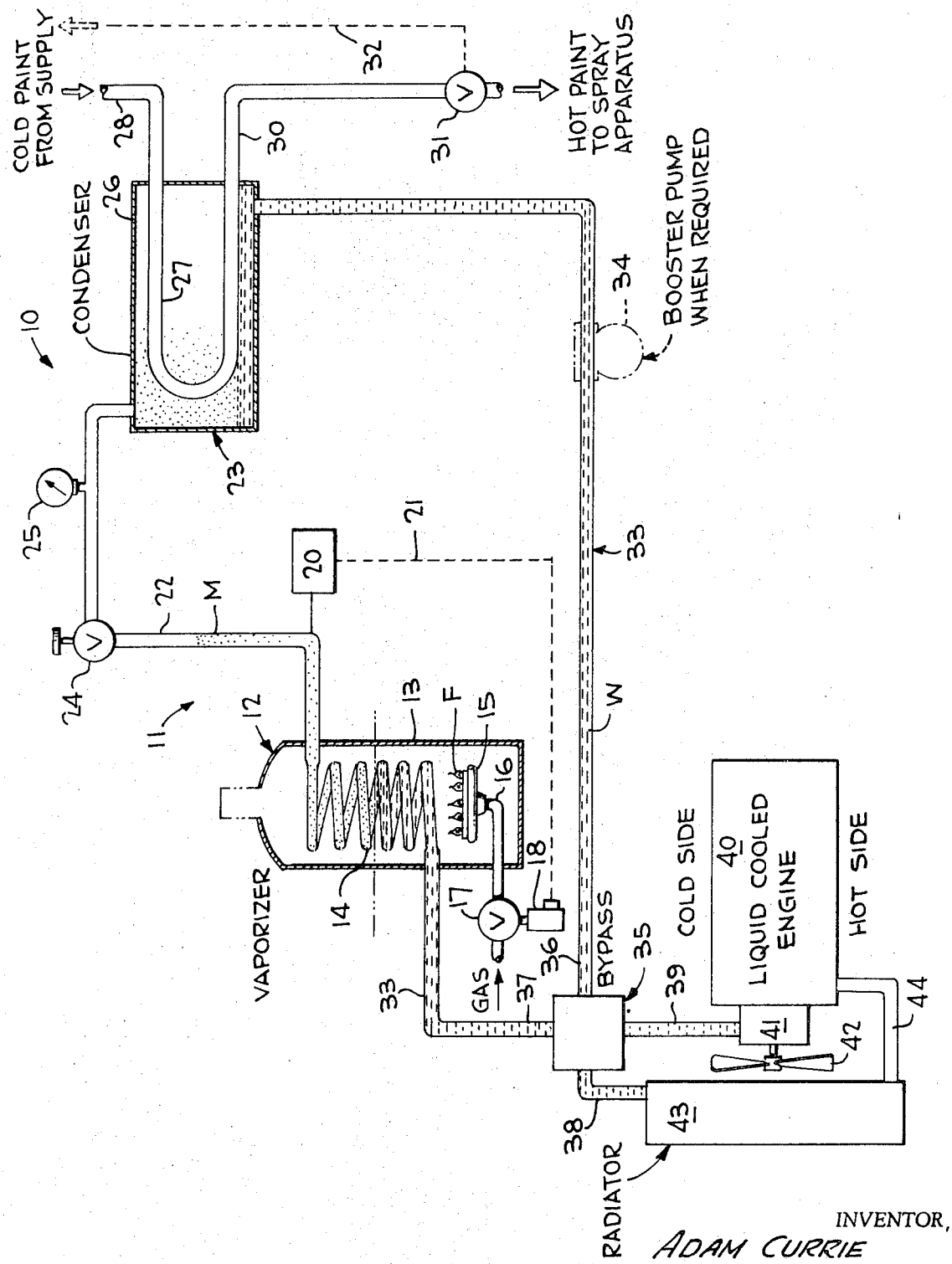
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[57] **ABSTRACT**

This disclosure relates to an apparatus for applying a marking liquid medium to a substrate and more particularly traffic line paints to roadways, and includes vaporizer means for heating a heat transfer liquid to the saturation temperature of the liquid and its vapor to produce a wet mixture thereof, and condensing means for heating the marking liquid medium by the wet mixture at generally the aforesaid saturation temperature to thereby accurately control the temperature of the marking liquid medium. The vaporizer and condenser means are portions of a closed fluid system which additionally includes as a portion thereof a liquid cooled engine having a cooling system with hot and cold sides, and the latter cooling system being connected to receive return flow from the condenser means into its cold side while transferring the heat transfer liquid from its hot side to the vaporizer means.

7 Claims, 1 Drawing Figure





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APPARATUS FOR VAPOR PHASE HEATING OF TRAFFIC LINE PAINTS

FIELD OF INVENTION AND BACKGROUND

The present invention is directed to an apparatus for applying a marking liquid medium to a substrate. More particularly, the invention is directed to an apparatus for applying traffic and/or pedestrian line paints to roadways or walkways at an elevated temperature to ensure rapid drying. The device permits uniform and accurate temperature control of the marking liquid medium over a wide range of application temperatures.

Conventional means are known for applying traffic or pedestrian line paints to roadways and/or walkways by first elevating the temperature of the paint prior to its application to a suitable substrate. The elevated temperature decreases the drying time of the paint. As the need for more rapid drying traffic paints is increased, the trend is toward higher temperature applications. At higher temperatures, paints become increasingly heat sensitive and require extremely close temperature control. Above a pre-determined temperature the paint deteriorates; whereas below the predetermined temperature the required drying time increases, precluding any substantial fluctuation in application temperatures. Further, to obtain a constant thickness of film for a given speed and pressure of application, it is again necessary that the temperature be maintained within a narrow range.

The conventional prior art stripping or paint applying machines generally use hot water, hot oil, and/or hot air as the heat transfer fluid for elevating the temperature of the paint prior to its application. However, such devices using the aforesaid fluids include one or more disadvantages which render the same particularly unsuitable for applying paints to streets and highways subject to heavy traffic flow necessitating very rapid dry to reduce traffic congestion, etc. More specifically, hot water systems are undesirable since they can only make use of the sensible heat and, accordingly, cannot raise the temperature of the paint above a finite level. Since the temperature range of such systems is limited, the decrease in drying time of the paints is limited. While hot oil or hot water systems can provide the necessary high temperature for application, accurate temperature control is difficult. Fluctuations in temperature occur in such systems and, as a result of the heat sensitivity of the paints, scorching of the paint and/or clogging or plugging of the equipment being utilized occurs, particularly in applications where the paint spraying is an intermittent process. In the latter instances overheating is particularly pronounced when the spray gun or the applicator is shut-off, enchancing the possibility of paint scorching and/or clogging or plugging of the system.

OBJECTS OF THE INVENTION

Accordingly, it is a primary object of the present invention to avoid the disadvantages heretofore noted in conventional traffic line painting machines by (1) employing vaporizer means for heating a heat-transfer liquid (such as water) to its saturation temperature to produce at least a wet mixture thereof; and (2) utilizing condenser means for heating the paint through the media of the wet mixture at generally the saturation temperature to thereby accurately control the temperature of the paint avoiding scorching, plugging, etc.

A further object of this invention is to provide a novel apparatus of the type heretofore set forth wherein the vaporizer and condenser means are portions of a closed fluid system, and means are provided for regulating the pressure and/or temperature of the fluid system to vary the saturation temperature thereby adapting the apparatus for use with a variety of different heat-transfer liquids.

Still another object of this invention is to provide a novel apparatus of the type described wherein the closed fluid system includes as a portion thereof a cooling system of a liquid cooled engine having hot and cold sides, and the engine cooling system being connected to receive return flow into its cold side while directing the heat transfer liquid from its hot side to the varporizer means.

DRAWING AND DETAILED DESCRIPTION OF THE INVENTION

With the above and other objects in view which will appear hereinafter, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claimed subject matter, and the accompanying drawing.

In the drawing, the single FIGURE is a highly schematic illustration of the apparatus of this invention for applying a marking liquid medium to a substrate and illustrates a vaporizer for heating a heat-transfer liquid (water) to the saturation temperature of the liquid and its vapor to produce a wet mixture thereof and transferring the wet mixture to condensor means for heating the marking liquid medium to thereby accurately control the temperature thereof.

The phrase "saturation temperature" of the liquid and vapor as used herein means the temperature of the boiling process of a particular liquid at a particular pressure where vapor exists and liquid remains. The mixture of such liquid and its vapor is referred to as a "wet mixture." Of primary importance with respect to the present invention is a characteristic of the saturation temperature, in that the temperature of the liquid and any vapor thereof remains constant as long as there is liquid present. This statement assumes a condition of equilibrium. In practical application, small differences of temperature in the various parts of the wet mixture may exist. These differences are not sufficient to be detrimental to the claimed system.

The constant and accurate control of the temperature realized using the presently described system, therefore, is based on the characteristic that the temperature of the liquid and vapor remains constant at the saturation temperature of the liquid and vapor as long as there is any liquid present. Experiments have shown that if heat is transferred to heat-sensitive traffic paints at constant temperature in accordance with the presently disclosed system, scorching is eliminated, plugging and/or clogging does not occur, and constant line thickness can be maintained even in the presence of intermittent cut-off of the system as usually occurs. Moreover, by adjusting the pressure and/or liquid transfer fluid, the degree of the constant temperature can be varied over a wide range.

Referring to the drawing, an apparatus **10** is provided which includes as a portion thereof a vapor phase system **11** including heat-transfer means **12** in the form of a vaporizer for heating a liquid W such as water, ethylene glycol, an aqueous salt solution, or other heat-

transfer liquids to the saturation temperature of the liquid and vapor to produce a wet mixture M therefrom. The vaporizing means **12** includes a suitable housing **13** internally of which are coils **14** through which the liquid W is transformed into the wet mixture M by flames F from a burner **15** having a conduit **16** coupled to a gas, oil, or similar source of combustible fluid with a suitable valve **17** being provided to adjustably regulate the flame F through a conventional solenoid **18** operable in response to a conventional sensing mechanism **20** over conductor means **21.** The valve **17,** therefore, operates in response to the temperature of the wet mixture M as the wet mixture M flows through first conduit means **22** to second heating means in the form of a condenser **23.** The conduit **22** may include a suitable conventional safety valve **24** and a pressure gauge **25** since the pressure within the system **11** as indicated by the pressure gauge **25** will establish the saturation temperature of the liquid W.

The condenser **23** may be of a conventional surface condenser type and include an outer housing or shell **26** housing metallic condenser tubes **27** having an inlet **28** coupled to a source (not shown) of paint preferably retained in a reservoir and an outlet **30** coupled to spray nozzles or similar applicators (not shown) through a valve **31.** The valve **31** may be selectively positioned to feed the paint spray nozzles, close flow thereto, or redirect the heated paint over a conduit **32** to the reservoir (not shown) for subsequent recirculation into the condenser **23** through the inlet **28.** The paint or similar liquid marking medium is circulated continuously through the condenser tubes **27** and is heated as it picks up and carries away the heat released by the wet mixture M resulting in the retransformation of the wet mixture to its liquid form W as condensate. As was heretofore noted, since the wet mixture is at its saturation temperature, the temperature within the condenser **23** will be substantially uniform at all times so long as the pressure is maintained as desired which can obviously be effected by suitably regulating the valve **24.** In this manner the paint transmitted through the condenser tubes **27** can be heated to a precise temperature and maintained thereat irrespective of the intermittent use of the apparatus **10,** including a total shut-off or closing of the spray nozzles (not shown).

Second conduit means **33** which may or may not include a conventional booster pump **34** are provided for returning the liquid W to the coils **14** of the vaporizer **12** through a bypass valve **35.** The bypass valve **35** is at the juncture of four legs **36** through **39** of the conduit means **33** and functions when positioned at one setting to direct the liquid W directly from the leg **36** into the leg **37** to bypass a conventional liquid cooled engine **40** of a truck or like vehicle including its own cooling system which includes a pump **41,** a fan **42,** and a radiator **43.** In a second position of the bypass valve **35** the leg **36** is directly connected to the leg **38** and the liquid W returning from the condenser **23** is fed directly into the radiator **43** through the leg **36,** the bypass valve **35,** and the leg **38.** The liquid circulates through the radiator and is introduced by a conduit **44** into the cold side of the jacketed cooling system of the engine **40** while the hot side thereof is placed in fluid communication with the coils **14** of the vaporizer through the leg **36,** the bypass valve **35,** and the leg **37.** By this construction the apparatus **10** may be operated irrespective of the on or off condition of the engine **40;** and, for that matter, when associated with mobile vehicles devoid of liquid-cooled engines or simply portable vehicles, the bypass valve **35** could be eliminated and the legs **36, 37** of the conduit means **33** would be directly coupled to each other without in any way affecting the operation of the system **11** to heat the paint in the condenser tubes **27** at generally the saturation temperature of the wet mixture M.

The essence of this invention insofar as the over-all vapor phase system **11** is concerned is the use of the vaporizer or vapor generator **12,** the condenser **23,** and as necessary ancillary equipment to transfer heat at its saturation temperature either as a wet mixture M or as a vapor up to but not beyond the saturated vapor state. As a result, a very uniform and constant paint temperature issuing from the conduit **30** is maintained due to the constant temperature of the condensing wet mixture M with, of course, the saturation temperature being readily determined in dependence upon primarily the particular liquid W involved, the pressure of the system **11** and, obviously, the speed of application of the paint. As an example, if it is assumed desirable to apply a traffic line of the paint 4 inches wide and 0.015 inch thick at a speed of 2 miles per hour, then the B.T.U.'s per hour required for such a paint line would be for 180°F. paint at 60°F. ambient 13,800 B.T.U.'s per hour. A vapor pressure of 10 psig is generated at the vaporizer **12** and since the wet mixture and/or vapor will contain 952 B.T.U's per pound, then the condenser **23** will have to condense:

$$13{,}800/952 = 14.5 \text{ lbs./hr.}$$

and the pump **34** will return this condensate to the vaporizer **12.**

As indicated hereinbefore, by varying the pressure of the heat-transfer liquid, the temperature which is to be maintained constant can be controlled within a wide range. Thus, where liquid W in the system **11** is water and the pressure is atmospheric, i.e., 14.696 lbs./in.^{2}, the saturation temperature will be approximately 212°F. However, if the pressure is increased, the saturation temperature of water will also be increased. For example, when operating at 100 pounds per square inch of pressure, the water will boil at 327.8°F., thereby increasing the saturation temperature of the system and, accordingly, increasing the temperature at which the paint is maintained. The constant temperature of the system and, accordingly, the temperature of the paint can be further varied by utilizing a liquid other than water. These modifications will be apparent to one skilled in the art.

While preferred forms and arrangements of parts have been shown in illustrating the invention, it is to be clearly understood that various changes in details and arrangement of parts may be made without departing from the spirit and scope of this disclosure.

What is claimed:

1. In an apparatus for applying paint for marking traffic lines or the like to a road surface, the improvement comprising means for heating a heat-transfer liquid to the saturation temperature of the liquid and its vapor to produce a wet mixture thereof, and means for conducting said paint in indirect heat transfer relationship with said wet mixture for a time sufficient to heat said paint to generally said saturation temperature, to thereby accurately control the temperature of said paint.

2. The improvement in the apparatus as defined in claim 1 wherein said heating means include a vaporizer and condenser.

3. The improvement in the apparatus as defined in claim 2 wherein said heating means is a portion of a closed fluid system, and includes means for regulating the pressure of said fluid system to vary the saturation temperature of said heat-transfer liquid.

4. The improvement in the apparatus as defined in claim 3 wherein said heating means is a portion of a closed fluid system, and said closed fluid system includes first conduit means for the flow of said wet mixture from said vaporizer to said condenser, and second conduit means for return flow from said condenser to said varporizer.

5. The improvement in the apparatus as defined in claim 3 wherein said heating means is a portion of a closed fluid system, said closed fluid system includes first conduit means for the flow of said wet mixture from said vaporizer to said condenser, second conduit means for return flow from said condenser to said vaporizer, a liquid cooled engine having a cooling system with hot and cold sides, and said liquid cooled engine cooling system being a portion of said closed fluid system and being connected to receive return flow into its cold side through said second conduit means and direct the heat-transfer liquid from its hot side to said vaporizer through said second conduit means.

6. The improvement in the apparatus as defined in claim 3 wherein said heating means is a portion of a closed fluid system, and said closed fluid system includes first conduit means for the flow of said wet mixture from said vaporizer to said condenser, second conduit means for return flow from said condenser to said vaporizer, a liquid cooled engine having a cooling system with hot and cold sides, said liquid cooled engine cooling system being a portion of said closed fluid system and being connected to receive return flow into its cold side through said second conduit means and direct the heat-transfer liquid from its hot side to said vaporizer through said second conduit means, and means for by-passing said engine including the cooling system thereof and effecting return flow directly from said condenser to said vaporizer.

7. The improvement in the apparatus as defined in claim 1 including means responsive to the temperature of said wet mixture to regulate said heating means.

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