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FLASH POINT APPARATUS

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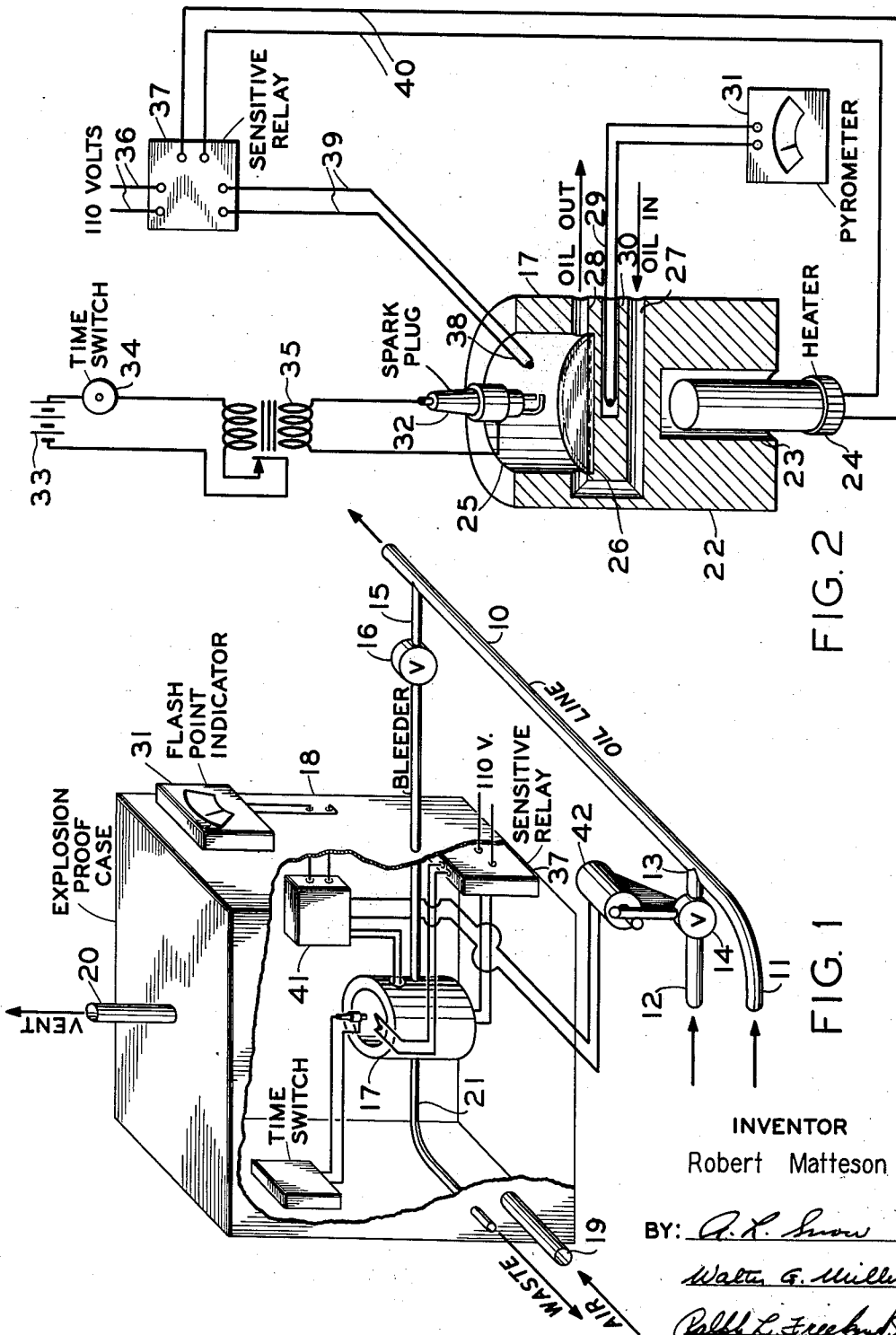


FIG. 2

FIG. 1

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FLASH POINT APPARATUS

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4 Claims. (Cl. 73-36)

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The present invention relates to flash point apparatus and, more particularly, relates to apparatus for controlling or indicating the flash point of a volatile liquid.

In the production of certain commercial mixtures of hydrocarbon liquids such as kerosene, stove oil, lubricating oils and the like, it is essential to maintain the flash point, that is, the temperature at which the liquid becomes vaporized sufficiently to be ignitable so that the finished product will meet manufacturing specifications. While the flash point may be measured from individual samples taken from the plant stream or finished product, it is likewise desirable to maintain close control over the volatility of the product during the manufacture thereof. For this reason, there has long been a need in the art of measuring and indicating the flash point of a volatile liquid for an apparatus which is capable of continuously determining the flash point of the sampled material. While previous apparatus for making such measurements and determinations have been proposed, these devices have in general altered the composition of the sample by boiling off of the lighter hydrocarbons in the mixture. Such alteration or at least modification of composition has been inherent in these tests due to the fact that it is necessary to heat such a large volume of the sample to drive off the more volatile products that the liquid may be distilled or broken down to its constituent parts. It is essential in the determination of flash point of the tested liquid that this does not occur, since it is the flash point of the lighter components of the complete product which is desired.

In its broader aspects, the present invention is directed to a flash point apparatus which may be used for indication or control of the flash point of a volatile liquid and in particular is directed to a test cup having a chamber to which liquid is introduced by means of an inlet conduit so that the oil may be heated by a heater means provided for the test cup prior to the introduction of the oil to the chamber in which it is permitted to vaporize. Outlet conduit means are then so connected to the test cup chamber that only a film of liquid is present which may be uniformly vaporized, and temperature responsive means provided for measuring the temperature of the liquid at its flash point. Control means for maintaining the liquid film at substantially its flash point may be provided by an electrical circuit incorporating a spark means adapted to ignite the vapor. Additionally, means responsive to the flash generated by the ignition of the

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vapors are provided for controlling the heat applied by the heater means.

It is an object of the present invention to provide a flash point apparatus adapted to measure without alteration of the liquid the temperature at which the most volatile liquid vaporizes sufficiently to be flashed or ignited.

It is another object of this invention to provide a test cup for flash point apparatus which is capable of heating a small sample of a liquid, whose flash point is to be measured, sufficiently to vaporize the liquid without altering the chemical composition thereof prior to evaporation of the more volatile components.

Another object of the invention is to provide a flash point apparatus which is faster and easier to operate than previously known devices to reduce the cost of time and material required in determining the flash point of a volatile liquid.

Further objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawing which forms an integral part of this specification.

In the drawing:

Fig. 1 is a schematic representation of flash point apparatus in accordance with the present invention utilized in monitoring and controlling the flash point of an oil product during its manufacture.

Fig. 2 is a schematic representation of flash point apparatus in accordance with the present invention in which the electrical control system for measuring flash point is shown in conjunction with a vertical sectional view of a test cup constructed in accordance with the present invention.

Referring now to the drawing and, in particular, to Fig. 1, there is shown an oil product line 10 containing a product whose flash point is to be controlled to meet manufacturing requirements for the finished product. For the purpose of controlling such flash point in the manufacture of the finished liquid, two supply lines, 11 and 12, which contain products of different flash point characteristics, are adapted to be intermixed at the junction 13 of liquid lines 10, 11 and 12. In the present arrangement, a valve 14 is adapted to control the supply of liquid flowing in line 12 which may be either higher or lower in flash point than the desired end product intermixed in line 10.

In order to measure the flash point and utilize such measurement for the control of valve 14, a bleeder line 15 having a valve 16 therein is pro-

vided for withdrawing a small portion of the product liquid flowing in line 10. Line 15 provides an inlet conduit means for test cup 17 which is preferably positioned within an explosion-proof case 18 adapted to be supplied with air at a pressure above atmospheric through line 19 and vented by line 20. Such an explosion-proof case is necessary for safety in the operation of the electrical system to be utilized in making the desired tests. In order to discharge the liquid from test cup 17, an outlet conduit means 21 may be connected to the cup and vented through case 18.

For purposes of explaining the operation of test cup 17 and the associated testing apparatus, reference is now made to Fig. 2, wherein an enlarged view of test cup 17 and the associated electrical circuits are more clearly shown. As there shown, test cup 17 in general comprises a heat conductive body 22 which may be of cylindrical configuration and made of Duralumin or other thermally conductive metals of high conductivity and low heat capacity. Body 22 may be provided with a cylindrical bore 23 into which an electrical heater means, such as heater 24, may be inserted in order to elevate the temperature of the sampled liquid to its flash point. The test liquid is admitted through an oil inlet passage 27 to a combustion chamber which may be a cylindrical bore 25 preferably having a flat base 26. As seen in Fig. 2, the oil inlet passage 27 preferably passes transversely, or radially, through body 22 so that passage 27 lies between the heater means 24 and base 26 of test cup chamber 25. In this way the incoming fluid may be heated to substantially the desired temperature prior to the arrival of the liquid in the bottom of chamber 25, but the more volatile products in the fluid are prevented from vaporizing until the fluid enters chamber 25.

As distinguished from prior flash point apparatus, provision is made for insuring that only a small sample of the liquid need be heated to its vaporization or flash point and thereby thermal decomposition or change of the material may be prevented prior to its introduction into the combustion chamber. For this reason the liquid discharge, or outlet, conduit is connected through a bore 28 which is so located with respect to bottom or base 26 that only a thin film of liquid is present on base 26 of chamber 25 and this film is continuously changed due to the flow over base 26.

For the purpose of determining the temperature at which the liquid attains its flash point, a temperature measuring means is provided by thermocouple 29 which may be inserted in a bore 30 lying intermediate the base 26 and passage 27. Thermocouple means 29 may be connected to an electrical measuring instrument, such as pyrometer 31, which is arranged to serve as the flash point indicator, as identified in Fig. 1.

For the purpose of automatically maintaining the temperature of the liquid sample at substantially its flash point, a spark means, such as spark plug 32, may be positioned with respect to the vapors generated in chamber 25 so that an electrical spark may be generated at plug 32 by the operation of battery 33, time switch 34 which controls the frequency of application of the spark, and ignition coil 35. In this manner, the spark plug may be energized at predetermined time intervals to test the ignitibility of the vapors generated in chamber 25. To control the power applied to heater means 24 and thereby control

the heat applied through body 22 to the liquid under test, heater means 24 is adapted to be energized by any conventional power supply such as a 110-volt line supplied by lines 36 which may be connected to a relay 37. Relay 37 in turn may be controlled by means responsive to the flash, such as thermocouple 38, which is so located that it is subjected to the flash generated by the ignition of vapors in test cup 17. In this way relay 37 is adapted to connect or disconnect heater means 24 to supply lines 39 through lines 40. While in the present embodiment the flash responsive means is shown to be thermocouple 38, it will be apparent that an ionized gap device may be used in which the flash, or flame, completes an electrical circuit between a pair of closely spaced electrodes. Likewise it will be appreciated that a pair of spark electrodes may be incorporated in the side wall of chamber 25, instead of being provided by spark plug 32.

It will be noted that the control system shown in Fig. 1 is similar to the measuring system in Fig. 2 with the addition of amplifier means 41 which is connected between thermocouple 29 and pyrometer 31. In addition to the function of amplifying the thermocouple voltage for the pyrometer, variations in thermocouple voltage may be amplified for the purpose of controlling an electric motor 42 which is arranged to operate valve 14 in supply line 12. By this arrangement a proportioning control of the two liquids supplied through lines 11 and 12 may be obtained to produce a liquid having the desired flash point in product line 10. While amplifier means 41 is illustrated as having a self-contained power supply capable of energizing electric motor 42, it will be apparent that the amplifier may be externally energized and control relay means operated by amplifier 41 may be provided for connecting motor 42 to a source of power.

In operation, the liquid whose flash point is to be determined is introduced through inlet passage 27 wherein it is preheated by heater means 24 so that the temperature of the liquid is raised to substantially its flash point prior to its entrance into combustion chamber 25. In chamber 25 the vapors of the thin film formed on base 26 are permitted to rise in the chamber so that they may be ignited by spark plug 32. The ignition of the vapors in chamber 25 by the periodic application of a spark elevates the temperature of thermocouple 38 to such an extent that relay 37 may be energized to open the electrical circuit for heater lines 40. However, when the temperature of body 22 decreases to a sufficient extent so that ignitable vapors are not generated, relay 37 becomes de-energized so that heater means 24 is again connected to the supply voltage.

In the embodiment of the control apparatus shown in Fig. 1, the liquid sample withdrawn through line 15 and valve 16 is introduced into inlet passage 27 and outlet conduit 21 may be connected to waste passage 28 to provide a continuously operating device for determining the flash point of the liquid flowing in line 10. By the arrangement shown, thermocouple means 29 is adapted to measure the temperature of the liquid sample in chamber 25 and simultaneously control the operation of electric motor 42. This is accomplished by connecting thermocouple 29 to amplifier means 41 which is arranged to amplify the thermocouple voltage for pyrometer 31 and regulate by means of motor 42 the percentage of volatile material in product line 10 by adjusting the opening of valve 14 for the in-

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roduction of liquid from line 12 into line 10. In the present embodiment, line 12 preferably carries a more volatile liquid than line 11 so that when the flash point temperature rises control motor 42 is automatically operated to reduce the amount of volatile liquid passing through valve 14. In this way, control means comprising amplifier 41, motor 42 and valve 14 are provided for regulating the flash point of the liquid in line 10 in accordance with and in response to the temperature measured by thermocouple 29.

It will be apparent from the foregoing that by virtue of the present invention flash point indicating and control means which are adapted to provide a measure of the true flash point of the liquid are provided for monitoring the flash point of a volatile liquid. With the present apparatus, such measurement may be made without thermal alteration of the liquid.

While the foregoing detailed description particularly discloses the invention as being adapted to measure the "open" cup flash point of a liquid, it will be understood that a cover can be provided for chamber 25 so that the apparatus can be utilized to determine the "closed" cup flash point. In such a device a cover can be arranged to be removed from its position over the chamber periodically, or in conjunction with application of the spark to ignite the vapors generated in chamber 25. This removal of the cover may be performed either manually or automatically. In this way, "closed cup" flash point determinations may be performed by apparatus in accordance with the present invention to obtain all of the inherent advantages of the invention.

While various modifications and changes in the apparatus will be apparent to those skilled in the art, all such modifications and changes which fall within the scope of the appended claims are intended to be included thereby.

I claim:

1. In a test cup for the determination of the flash point of a volatile liquid by periodic exposure of a heated film of said liquid to an igni-

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tion source, means comprising a heat-conductive body, a substantially flat-bottomed chamber in said body, a heater for said body, a confined liquid inlet passage for said chamber traversing said body between said heater and the bottom of said chamber for heating liquid uniformly prior to its exposure in said chamber, and an outlet for said chamber spaced above the bottom thereof to limit the depth of liquid therein to a thin film of uniform composition and temperature.

2. In a test cup of the character defined by claim 1, the addition of temperature-responsive means in said body adjacent the bottom of said cup and said liquid inlet passage for measuring the temperature of said cup bottom and the film of liquid thereon.

3. In a test cup of the character defined in claim 1, the addition of temperature-responsive means in said cup above the liquid film and responsive to combustion of vapors from said film to control said heater.

4. In a test cup of the character defined by claim 1, the addition of a first temperature-responsive means in said body adjacent the bottom of said cup for measuring the temperature of said cup bottom and the film of heated liquid thereon, and a second temperature-responsive means in said cup above said liquid film and responsive to combustion of vapors from said film to control said heater.

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