Oct. 27, 1936. A. L. SMYLY 2,058,522

CALORIMETER

Filed Dec. 9, 1933

Fig. 1

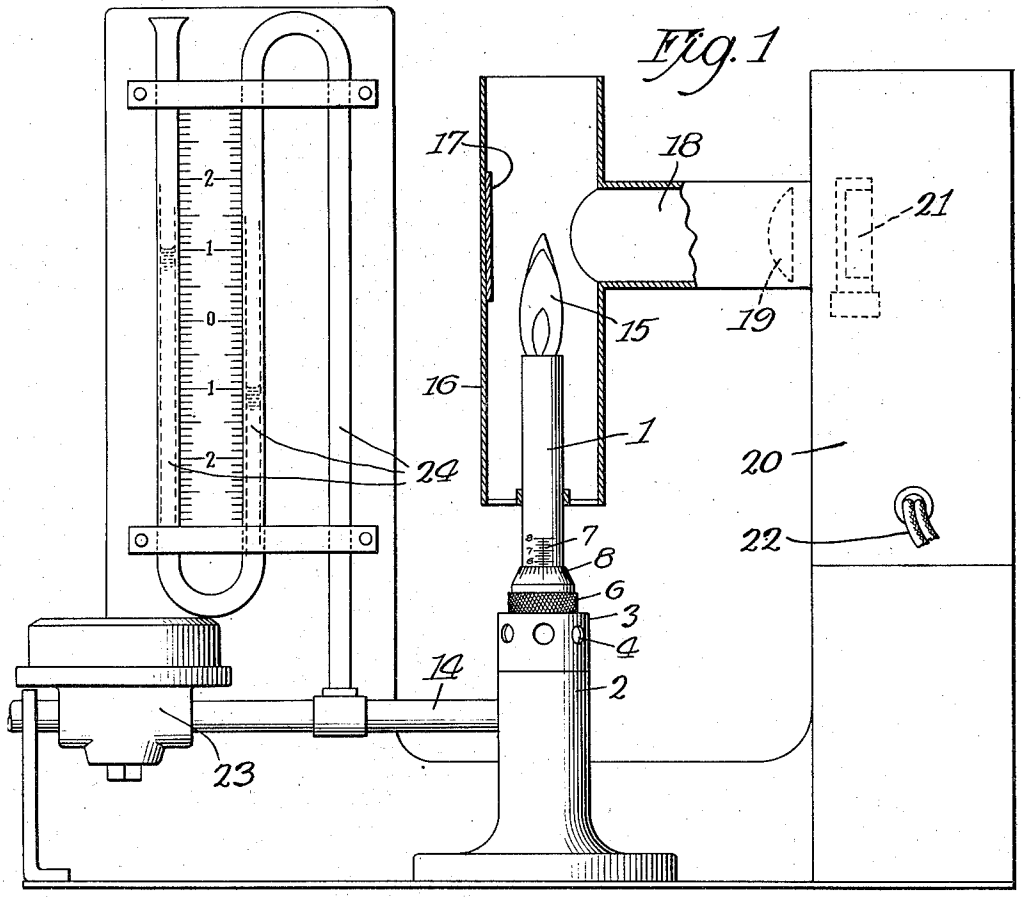


Fig. 2

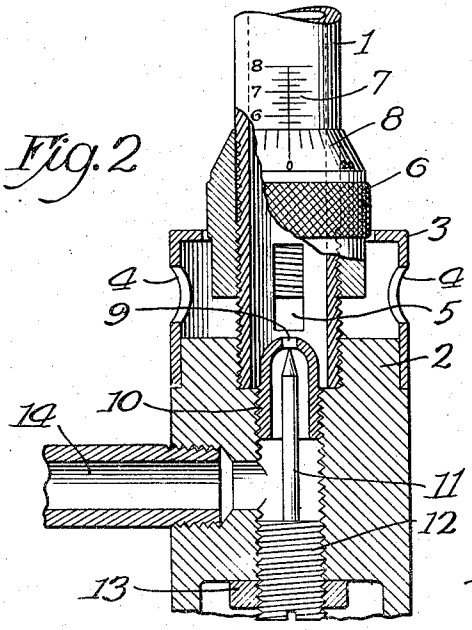
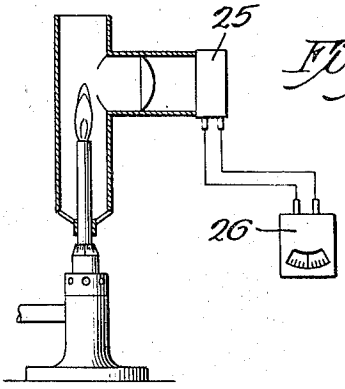


Fig. 3



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CALORIMETER

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5 Claims. (Cl. 73—190)

This invention relates to calorimeters for measuring the heat value of illuminating gas in British thermal units, without the employment of calculations for corrections, for barometer, thermometer, pressure, etc., being a modified form of Bunsen burner, the indication for reading being the point of exact elimination of the yellowish, or illuminating, tip of the inner cone of the Bunsen flame, which is the point of complete combustion of the gas.

Generally stated, the object of the invention is to provide a novel and improved construction and arrangement whereby a photoelectric cell is combined with other instrumentalities for giving a signal, either visual or audible, when the tip of the flame becomes yellowish, in the use of a calorimeter of this character, so that it will not be necessary to continually inspect the flame itself in order to correct undesirable changes in the gas, to insure the desired heat value thereof.

It is also an object to provide certain details and features of improvement tending to increase the general efficiency and the desirability of a calorimeter having alarm or signal means of this particular character.

To the foregoing and other useful ends, the invention consists in matters hereinafter set forth and claimed and shown in the accompanying drawing, in which—

Fig. 1 is a front elevation, partly in vertical section, of a calorimeter involving the principles of the invention.

Fig. 2 is an enlarged detail sectional view.

Fig. 3 is a view similar to Fig. 1, but on a smaller scale, showing a different form of the invention.

As thus illustrated, the invention comprises a Bunsen burner tube 1 having its lower screw-threaded end screwed into the base 2, as shown more clearly in Fig. 2 of the drawing. Said base has a cap 3 provided with air intake openings 4 at intervals in the circumference thereof. The tube 1 has its lower portion provided with one or more air intake openings 5 and a rotatable knurled indicator 6 is screw-threaded on the tube, in the manner shown in Fig. 2 of the drawing, whereby this member 6 may be rotated and thereby made to move up or down on the tube. The tube is calibrated at 7, and the rotary indicator is calibrated at 8 on the beveled upper end portion thereof. The gas inlet 9 at the bottom of the tube is provided by a cap-shaped member 10 which is screwed into the base 2, in the manner shown. This gas inlet 9 is adapted to be regulated by a needle valve 11 on the screw-threaded plug 12, screwed into the bottom of the base, and the adjustment can be maintained by the nut 13 on said plug. The gas enters the calorimeter through a tube or pipe 14, and the gases from there in the proper proportions pass upwardly from the tube 1 and form a flame 15 at the upper end thereof.

A tube or shield 16 is mounted on the Bunsen burner tube 1, with a mirror or reflector 17 inside thereof, the center of said mirror being substantially opposite the tip of the flame. A horizontal tube 18 extends laterally from the tubular shield 16, on the opposite side of the flame from the said reflector, and a lens 19 is mounted in the outer end of this tube 18, in the manner shown. In the housing 20, at the outer end of the tube 18, there is a photoelectric cell and relay unit 21, of any suitable character, for controlling the circuit or lead wires 22 leading to a suitable signal, which latter may either be visual or audible, whereby the signal is displayed or sounded when the relay of said unit 21 closes the circuit.

Any suitable means can be employed for supplying the gas to the pipe or tube 14, such as the ordinary gas governor 23, and an ordinary glass tube pressure indicator 24 may be mounted on the connection between the governor and the Bunsen burner, in the manner shown, to indicate the pressure of the gas.

As shown in Fig. 3, the calorimeter construction is similar, but in this case the photoelectric cell 25 is of the kind ordinarily called a photronic cell, and the latter is connected with an ordinary microammeter 26 of any suitable character. In this way, the electrical instrument 26 will indicate the extent of variation in the British thermal units in the gas.

Referring to Figs. 1 and 2, the operation is as follows: the indicator 8 may be adjusted until the flame 15 has no yellowish tip, if the cell 21 is very sensitive, or the flame may be adjusted until it is only luminous at the tip or upper end portion thereof, say a quarter of the flame. Thereafter, if the quality of the gas changes, and the tip becomes yellowish, or nearly yellowish, the mirror 17 will reflect the light of the yellowish portion of the flame through the lens 19 onto the sensitive portion of the photoelectric cell unit 21, with the result that the relay of said unit will operate and close the signal or alarm circuit.

In Fig. 3, the operation is substantially the same, but in this case the sensitive cell 25 operates the electrical instrument 26, and the latter not only indicates a change in the quality of the gas, but also the extent of such change.

It will be understood that the said photoelectric cell relay unit 21 may be of any suitable

known or approved form; for example, it may be of the kind shown in Bulletin No. 880, issued August, 1931, by the well known Allen-Bradley Company. Also, said photronic cell **25** may be of the well known type made and sold by the Weston Electrical Instrument Corporation. Similarly, the said microammeter **26** may be of the well known type made and sold by said Weston Electrical Instrument Corporation.

Thus it will be seen that an indication is given, either at the burner or at a point more or less remote therefrom, when the richness or quality of the gas changes, after the calorimeter has been set to maintain a flame with no illuminating tip. By eliminating the yellow from the flame, or by reducing the yellow, it will be readily understood, is meant the yellowish or whitish or illuminating portion of the flame, the idea being to maintain the flame all blue to prevent operation of the photoelectric cell, if the latter is enough sensitive to detect a slight reappearance of yellow, or to maintain the flame only partly yellow, except when the quality of the gas changes and the yellow or illuminating portion of the flame becomes greater. A plurality of cells can be grouped around the flame, very obviously, and connected in multiple, to provide a more powerful control of the indicating instrument. In this way the operator who controls the richness or mixture of the gas is assisted in maintaining the gas at the desired point of richness or quality, and does not have to make frequent inspection of the calorimeter itself to see whether the proper richness of the gas is being maintained.

Furthermore, it will be seen that the housing around the flame, in both forms of the invention, which is open at top and bottom, constitutes a sort of chimney for steadying the flame, and for preventing the flame from flickering, which tends to insure greater accuracy of control and indication of the quality of the gas. In addition, the pressure indicator **24** makes it possible to know the exact pressure of the gas when the calorimeter is inspected, and the amount of air necessary in the Bunsen burner to insure the desired result.

Obviously, the housing around the flame may have a window through which the flame can be viewed, in order to set or read or rectify the calorimeter, by observing the appearance of the flame, and to facilitate such work the interior surface of the housing or chimney may be black or some dark shade.

Of course, by signaling or indicating means is meant anything that will respond to the action of the photoelectric cell, and such means might be an audible signal, or a visual signal, with the signal the only function thereof, or it might be a mechanical valve, or a motor, or something else, that would not only give an indication, so to speak, but that would have some other function as well.

In accordance with the invention, therefore, a photoelectric cell is employed in position to respond to and be affected by variations in the luminosity of a light, and for the specific purpose described, this light is preferably a Bunsen burner flame, and the variation in the luminosity thereof, to which the photoelectric cell responds, is caused by an increase in the richness of the gas, with a consequent reappearance of the yellow tip at the end of the flame. Normally, the photoelectric cell is unresponsive to the light of said flame, but becomes responsive the instant the flame becomes abnormal by the presence of the yellow tip at the end thereof. Means are provided, as shown and described, responsive to the action of said photoelectric cell, when the richness of the gas increases beyond the required point, to give a signal of some kind, either visual or audible, and if the microammeter **26** is employed the signal not only shows that the gas is not of proper quality, but also to what extent the character of the gas has changed from the predetermined quality desired.

From the foregoing, it will be seen that a photoelectric cell is employed to co-operate with the Bunsen burner flame to produce a signal or indication, at a point more or less remote from said flame, when there is a fluctuation in the quality or character of the gas supplied to the Bunsen burner, and with this simple method of automatically detecting fluctuations in the quality or character of the gas, in a commercial gas plant, the desired results are obtained, in a simple and inexpensive manner, and with apparatus much less expensive than the things heretofore employed for testing gas, whereby small plants that could not afford to buy the expensive apparatus may nevertheless have something of this kind that will and does satisfactorily serve the purpose.

Of course, the electric eye is much more sensitive than the human eye, and can detect changes in the flame that would not be observed by the human eye. The device, therefore, is not a candle power instrument, as the invention is not concerned with the candle power or illuminating value of the gas, but to the contrary the device is a B. t. u. or heat value instrument, being concerned only with the heating value of the gas, as previously stated.

Of course, the change from an entirely blue flame, to one having a slightly yellowish tip, is discernible to the human eye, but that is not the preferable way of using the apparatus shown and described, although it is possible to do that, if the photoelectric cell is made exceedingly sensitive. Therefore, the preferable method is to employ a photoelectric cell of somewhat less sensitiveness, and to then adjust the flame of the Bunsen burner to a point where the tip or upper portion of the flame is yellow for about a quarter of the length of the entire flame. That provides enough light to keep the photoelectric cell in condition to respond to only a very slight increase in the luminosity of the flame, an increase that would not be visible to the human eye. In this way, the photoelectric cell does not have to start from zero, so to speak, as would be the case if the flame were normally entirely blue, for with the flame normally partly yellow, or normally luminous to some extent, the normal condition of the cell is not at zero, so to speak, but to the contrary is at a point somewhat higher, although not quite at the point of responsiveness to light. Therefore, with even a very slight increase in the luminosity of the flame, under such conditions, the point of responsiveness of the photoelectric cell is reached by a very slight increase in the luminosity of the flame, and in this way the apparatus is operative on a very narrow differential in the luminosity of the flame, practically a difference not discernible to the human eye, and the consequence is that the quality of the gas is practically maintained automatically at the point desired, and a skilled observer with a trained eye is not necessary, and the Bunsen burner flame can be used in a way that would

not be possible with the human eye. In addition, the partly luminous flame is cooler than the entirely blue flame.

It will be seen, therefore, that means are necessary for regulating the flow of gas, to insure constant pressure at the burner, and that means are essential for calibrating the air supply to the flame, as well as to regulate the flame height and the luminosity thereof. Hence, a flame that is deficient in oxygen is necessary for the functioning of the photoelectric cell.

It will also be seen that the housing 16 is open at the top and bottom, thereby affording ventilation for the housing and the connecting tube 18, while preventing infiltration of light from external sources and at the same time keeping the temperature due to radiation and conduction low enough to prevent injury to the photoelectric cell element, and to prevent errors in the indications of the apparatus.

What I claim as my invention is:

1. An indicating apparatus for use in the manufacture of gas, operated automatically by variations of the luminosity of a Bunsen burner gas flame, to indicate changes in the quality of the gas, or variations in the heating value thereof, comprising means for providing said Bunsen burner flame, means to regulate the flow of gas and insure constant pressure at the burner, means for calibrating the air supply to said flame, for regulating the flame height and the luminosity thereof, instrumentalities including a photoelectric cell sensitive and responsive to any increase of the luminosity of the tip portion of said flame, which might be an increase not detectable to the human eye, resulting from any increase in the richness of the gas, and means responsive to the action of said photoelectric cell to indicate any increase in the richness of the gas, a flame deficient in oxygen being necessary for the functioning of said photoelectric cell.

2. A structure as specified in claim 1, for giving a more or less remote indication of the quality of gas supplied to said burner, in a gas plant, said instrumentalities comprising a reflector at one side of said flame, means for supporting the photoelectric cell at the other side of the flame, and a lens between the variable flame and the photoelectric cell, to in effect increase the responsiveness of the latter to slight changes in the flame, not discernible to the human eye.

3. A structure as specified in claim 1, comprising a housing acting as a chimney to enclose and steady the flame, with an opening in the side thereof for the beam of light from the flame to the cell.

4. A structure as specified in claim 1, comprising a gas pressure indicator adjacent said apparatus, the latter being adjustable in accordance with the amount of air required for any given gas pressure, all in one unit.

5. In an indicating apparatus for use in the manufacture of gas, operated automatically by variations of the luminosity of a Bunsen burner flame, to indicate changes in the quality of the gas, or variations in the heating value thereof, the combination of (1) means to regulate the flow of gas to insure constant pressure at the burner; (2) means for the regulation of the volume of gas flow, having means of adjustment and means to lock the adjustment to set the flame height so that the zone of maximum luminosity may be presented at a predetermined point; (3) means for the regulation of the air by regulated gas velocity and air port area suitably calibrated and adapted to be set for each gas to be tested, so that a flame may be produced with a certain deficiency in oxygen to provide a base light, and to enable values to be calibrated and set in comparison with a known standard; (4) a photoelectric cell, a reflector for directing the light of the flame against said cell, and a lens to amplify the luminosity of the tip portion of the flame, concentrating the light into the cell and thereby increasing the sensitiveness of the apparatus, and automatic means responsive to the action of said photoelectric cell to indicate any increase in the richness of the gas; and (5) means to insulate and reduce the conduction of heat from the flame, in the form of a housing around the flame, with a connecting cylinder therefrom for said lens and cell, serving to avoid infiltration of light from external sources, but with ventilation of the housing and cylinder to reduce heat accumulation, thereby to prevent injury to the cell element and errors in the indications given by the apparatus.

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