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(54) FLAME MONITORING APPARATUS

(71) We, LGZ LANDIS & GYR ZUG AG, a body corporate organised and existing under the laws of Switzerland, of CH-6301 Zug, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to a flame monitoring apparatus.

Flame sensors in furnaces have to recognise the appearance and presence of a flame and its accidental extinction in operation with the degree of reliability required by safety regulations.

A flame sensor must be able to distinguish between the radiation emanating from the flame to be monitored and background radiation not emanating from the flame but, for example, from glowing combustion chamber lining or even daylight. However, some of the possible faults of flame sensors result in the loss of this ability to distinguish, and background radiation may then produce the same output signal from the flame sensor as the flame radiation.

According to the present invention there is provided a flame monitoring apparatus comprising a flame sensor responsive to flame radiation from a flame, and means for testing the flame sensor, said testing means comprising means arranged to expose the flame sensor during first intervals to flame radiation from a flame plus background radiation associated with said flame, and during other intervals only to radiation from a source which simulates said background radiation.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an apparatus with an alternating shield;

Figure 2 shows an apparatus with a sliding shield; and

Figure 3 shows an apparatus with liquid crystal shields.

In Figure 1 a burner nozzle 2, at which a flame 3 is formed, projects into a combustion chamber 1 of a furnace. Chamber 1 has a refractory lining 4 made of firebrick, and a flue 5. A flame monitoring apparatus 6 is exposed to the chamber 1 so that radiation S from the flame 3 falls on a flame sensor 7. Background radiation H, which emanates from the glowing lining 4 is added to the flame radiation S and also falls on the flame sensor 7. The background radiation H may also contain a proportion of daylight.

In the Figure 1 example, the flame sensor 7 is a diode sensitive to ultra-violet radiation, which in the fault-free state does not react to the background radiation H or daylight. These diodes are known to become faulty sometimes and then to respond to daylight or to the glowing of the firebrick, but nevertheless to give a dark signal in a fully darkened state.

For operational testing of the flame sensor 7, a switch-over device incorporating a shield system is arranged in the flame monitoring apparatus 6. The shield system comprises first and second sectorial screening members 8 and 10, arranged on a shaft 9 and extending in respective opposite directions. The shaft 9 may be turned through 180° by a drive means 11, for example a rotary magnet, so that, as shown in Figure 1, the first member 8 screens the flame sensor 7 from the flame radiation S plus the background radiation H and instead allows the radiation from a source 12, for example an electric light bulb, to reach the flame sensor 7. The radiation from the source 12 is such that it exerts the same influence on the flame sensor 7 as the background radiation H alone, and hence is referred to as simulated background radiation. The source 12 accordingly acts as a simulator for the background radiation H which, with a faulty flame sensor 7 and in the absence of flame radiation S, can give rise to the same output signal from the sensor 7 as when the flame radiation S is present. If operational testing is continuously to be carried out periodically at a frequency of several tests per second, a stepping or geared motor is used to form the drive means 11.

In Figure 2 similar components have the same reference numerals as in Figure 1. The shield system here comprises a fixed screen 14 which surrounds the source 12 except for an opening which can be closed by a sliding shield 13. When moved by the drive means 11, here in the form of a lifting magnet, it alternately allows the flame radiation S plus the background radiation H, and the simulated background radiation from the source 12 to reach the flame sensor 7.

In the examples shown in Figures 1 and 2, it is important for the simulator to operate correctly with certainty and to be checked. This is achieved, as illustrated, simply by connecting the source 12 in series with the drive means 11, so that the drive means 11 will remain blocked if the simulator is defective.

In the examples shown in Figures 1 and 2, the radiation from the source 12 has to be screened off or switched off during normal operation, that is outside operational testing, so that the sum of the simulated background radiation and the background radiation H cannot give the appearance of a flame. This can be done in a very simple way with the above-mentioned series connection. Thus during operational testing the drive means 11 and the source 12 are always switched on together, whereas outside operational testing they are switched off together. If the simulated background radiation from the source 12 disappears immediately with the switching off of the source 12, then the second member 10 shown in Figure 1, which during normal operation would be swung into the path of the rays from the source 12 to the flame sensor 7, becomes unnecessary.

The second member 10 is also unneccessary if the apparatus is operated in a different way. In this case the sensor 7 is acted on (a) by the flame radiation S plus the background radiation H together with the simulated background radiation generated by the source 12, and (b) by the simulated background radiation alone. In order to prevent the background radiation H together with the simulated radiation from simulating a flame when the flame has failed, it is advantageous with this mode of operation for that part of the simulated background radiation which strikes the flame sensor 7 to be made considerably more intense than that part of the background radiation H which reaches the sensor 7.

Figure 3 explains the application of the solution described to burning off waste gas on a blast furnace 15. A waste gas flare 16 is checked by the flame monitoring instrument 6 with the flame sensor 7. The background radiation H is daylight in this case. Two alternating controllable liquid crystal shields 17 and 18 enable operational testing to be carried out similarly to the examples already described; neutral radiation from the sky here acts as the simulated background radiation, and the 'drive means' is integrated with the shields.

The idea of using a simulator to reproduce at least a portion of the background radiation not separable from the flame radiation, in operational testing of a flame sensor, can be applied to other types of flame sensor, for example, to acoustic-radiation sensors which sense flame noises.

WHAT WE CLAIM IS:

1. A flame monitoring apparatus comprising a flame sensor responsive to flame radiation from a flame, and means for testing the flame sensor, said testing means comprising means arranged to expose the flame sensor during first intervals to flame radiation from a flame plus background radiation associated with said flame, and during other intervals only to radiation from a source which simulates said background radiation.

2. Apparatus according to claim 1 wherein said exposing means comprises a switch-over device whereby the flame sensor is alternately exposed (a) to said flame radiation plus said background radiation, and (b) to said simulated background radiation alone which gives rise to the same output signal from the flame sensor as said background radiation alone.

3. Apparatus according to claim 1 wherein said exposing means comprises a switch-over device whereby the flame sensor is alternately exposed (a) to said flame radiation plus said background radiation plus said simulated background radiation which simulated background radiation gives rise to the same output signal from the flame sensor as said background radiation alone, and (b) to the simulated background radiation alone.

4. Apparatus according to claim 2 or claim 3 wherein the switch-over device comprises a shield system operated by a drive means, the shield system having a first condition in which the flame sensor is exposed at least to said flame radiation, and a second condition in which the flame sensor is exposed to said simulated background radiation alone.

5. Apparatus according to claim 4 wherein the energy supply to said drive

means is blocked if said further source is defective.

6. Apparatus according to claim 5 wherein said drive means and said source are arranged electrically in series.

7. Apparatus according to any one of the preceding claims wherein said further source is an electric light bulb.

8. Apparatus according to claim 4 wherein said sheild system comprises a sliding shield moved by said drive means, and a fixed screen.

9. Apparatus according to claim 4 wherein said shield system comprises at least a first screening member arranged on a shaft which is operated by said drive means.

11. Apparatus according to any one of claims 2 to 7 wherein said switch-over device comprises liquid crystal shields.

12. A flame monitoring apparatus substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

13. A flame monitoring apparatus substantially as hereinbefore described with reference to Figure 3 of the accompanying drawings.

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Fig. 1

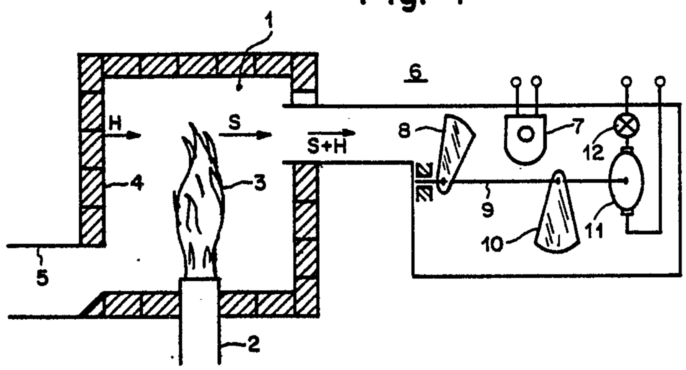

Fig. 2

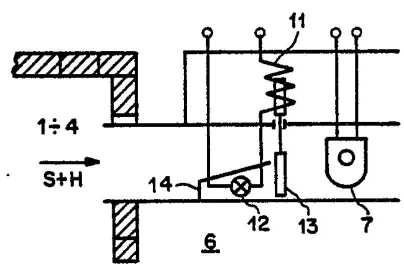

Fig. 3