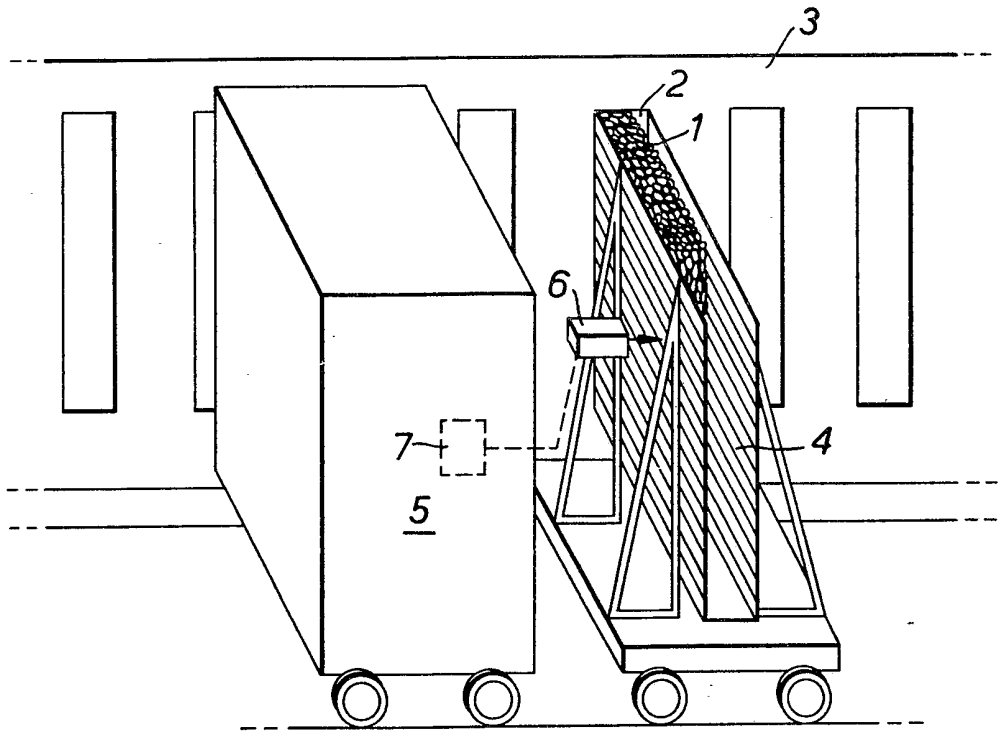
(12) UK Patent Application (19) GB (11) 2 073 408 A

(21) Application No **8011182**
(22) Date of filing
2 Apr 1980
(43) Application published
14 Oct 1981
(51) **INT CL³ G01J 5/10**
(52) Domestic classification
G1A A1 C10 C12 C1 C4 C8 C9 G16 G1 G2 G7 HP R6 S2 SM
(56) Documents cited
None
(58) Field of search
G1A
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(54) **Temperature monitoring device and method**

(57) In a method and device for monitoring the temperature of coke as it is ejected from coke oven 3, temperature sensor 6 is mounted alongside guide car 4 at ejection exit 2. The sensor provides electrical signals representative of the coke temperature as it is ejected, and circuit 7 divides the signals into time increments, determines the maximum signal level within each time increment, and provides an output signal sequentially corresponding to all such maximum temperatures.

FIG.1.



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

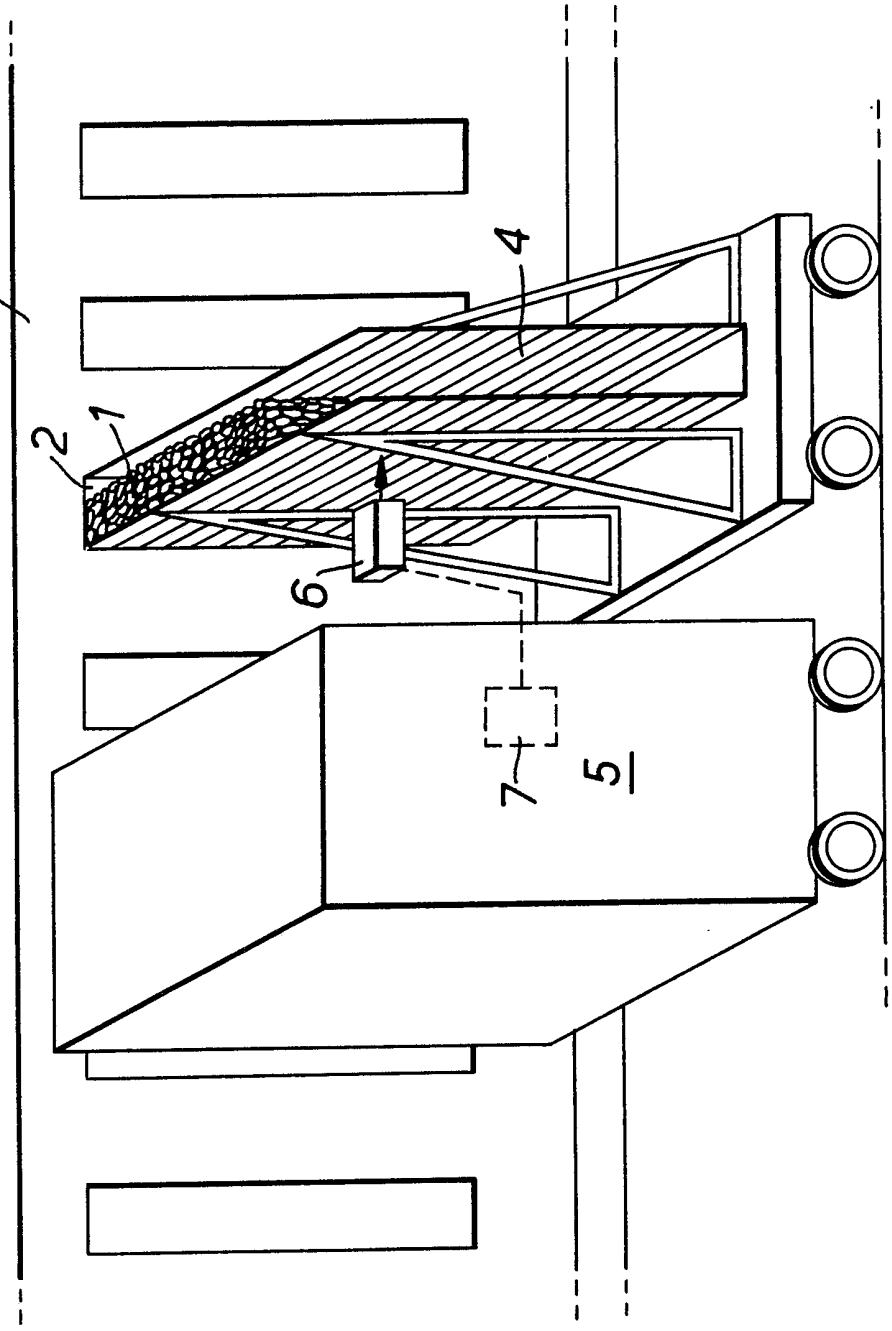


FIG.1.

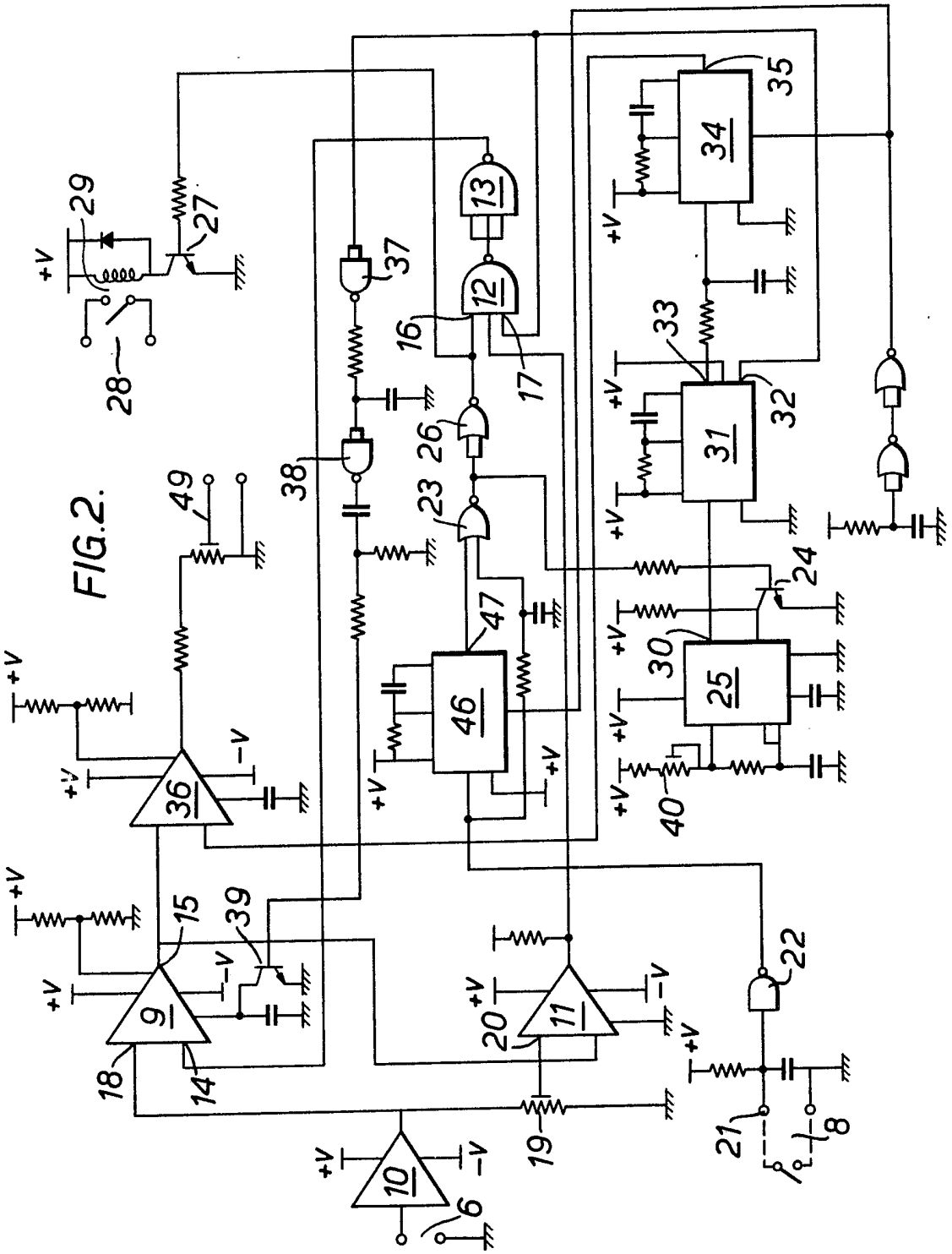

+V
-V
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27
28
37
13
12
16
17
38
26
23
49
47
46
34
35
33
31
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6
21
8

FIG.2.

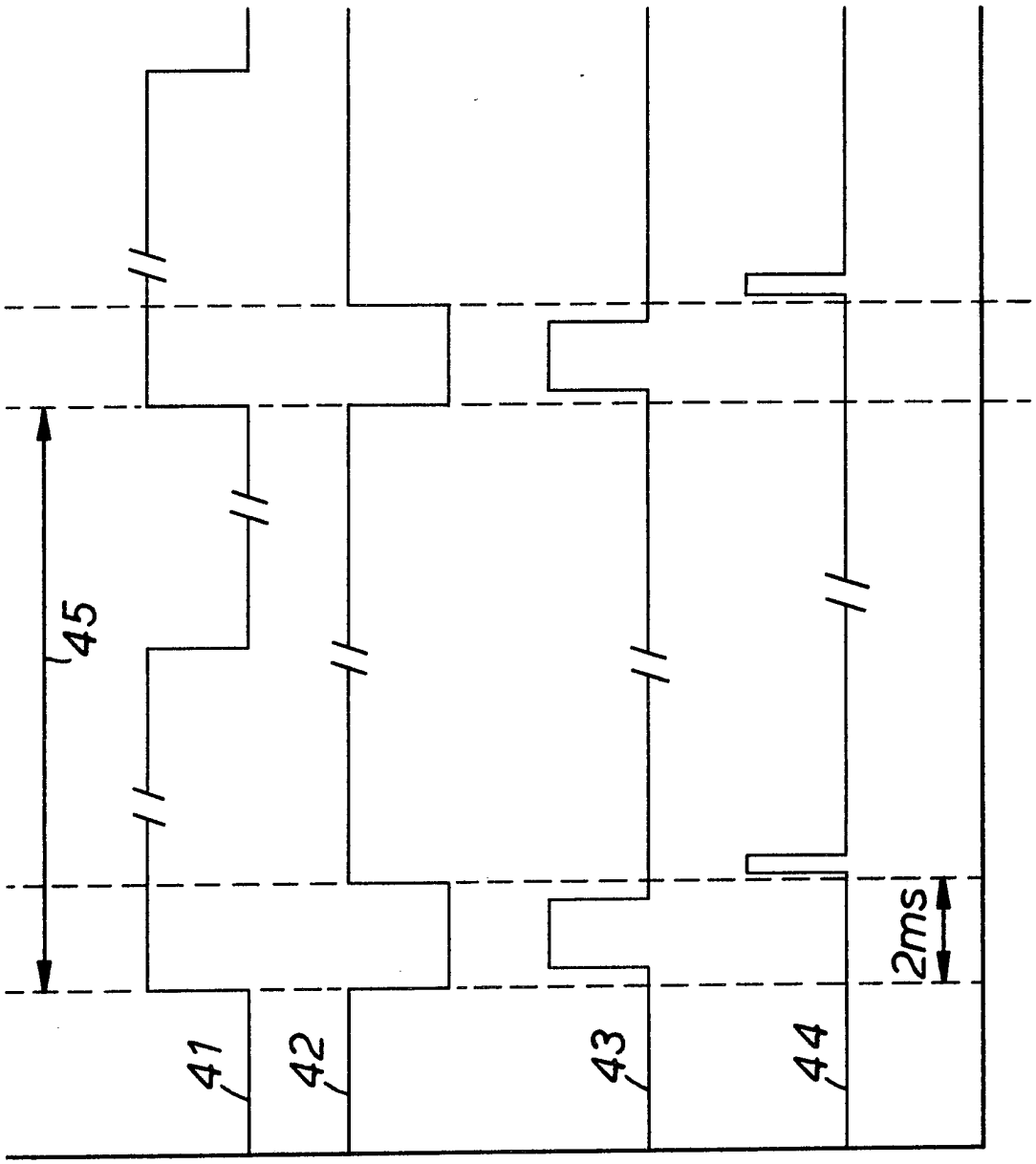
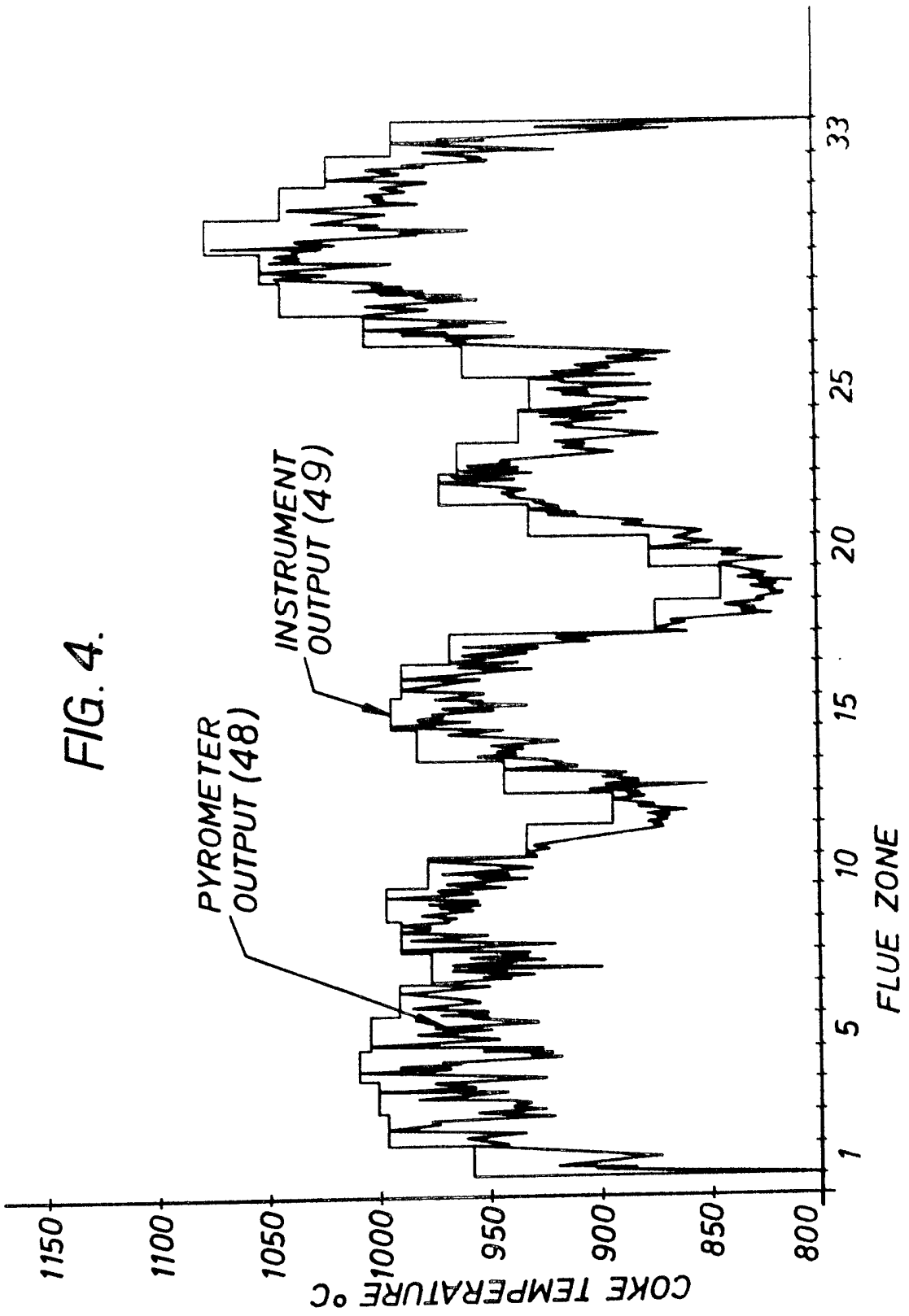


FIG.3.

FIG. 4.


COKE TEMPERATURE °C
1150
1100
1050
1000
950
900
850
800
1
5
10
15
20
25
33
FLUE ZONE
PYROMETER OUTPUT (48)
INSTRUMENT OUTPUT (49)

SPECIFICATION

Improvements in or relating to temperature monitoring devices and methods of monitoring temperatures

This invention relates to temperature monitoring devices and methods of monitoring temperatures and more particularly to such devices and methods for monitoring the temperature of coke as it is ejected from a coke oven and is concerned with the general problem of monitoring the temperature and hence operation of a coke oven.

According to one aspect of the invention there is provided a device for monitoring the temperature of coke as it is ejected from a coke oven comprising a temperature sensor mounted alongside the ejection exit of a coke oven, said temperature sensor being adapted to provide electrical signals representative of the sensed temperature of coke as it is ejected past the sensor, and circuit means adapted to divide the electrical signals from the temperature sensor into time increments, determine the signal level indicative of the maximum temperature sensed in each such time increment, and provide an output signal sequentially corresponding to all such maximum temperatures sensed.

According to a second aspect of the invention there is provided a method of monitoring the temperature of coke as it is ejected from a coke oven comprising sensing the temperature continuously of coke as it is ejected from a coke oven, providing continuous electrical signals representative of the sensed temperatures, dividing the electrical signals into time increments, determining the signal level indicative of the maximum temperature sensed in each such time increment, and providing an output signal sequentially corresponding to all such maximum temperatures sensed.

The invention is based upon the realisation that by, in effect, scanning the detectable temperature of coke as it exits from a coke oven, it is possible to obtain a good approximation of temperatures across the coke oven walls, the invention thereby providing valuable and highly desirable data concerning the functioning of the coke oven and cold areas or hot spots occuring within it.

It is to be appreciated that the surface of the coke mass upon emergence from the oven will be chilled by the cooling action of the ambient air, to an extent dependent upon the prevailing weather conditions; but within the coke surface there will be fissures within which the temperature will remain substantially independent of weather conditions and dependent only upon the local temperatue of the bulk of the coke mass. An important feature of the present invention therefore is the provision of a circuit adapted to identify peak temperatures within finite increments of time, and hence increments of distance across the body of coke as it is ejected, thereby providing readable and usable signals of temperature variation across the coke body.

The temperature sensor may conveniently comprise a pyrometer.

Temperatue sensors may be provided so as to monitor each side of the coke mass simultaneously. A vertical array of temperature sensors may be provided so as to give temperature readings at a plurality of levels of the coke oven.

Commonly the body of coke, on ejection from the coke oven, passes through a guide car before falling into coke cars for removal, and in this case the sensor or sensors may be mounted on or in association with the guide car.

In order that the invention may be more readily understood, one embodiment thereof will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic representation of a device according to the invention mounted adjacent the exit openings of a coke oven;

Figure 2 is a diagram of part of the electrical circuit of the device of Fig. 1;

Figure 3 is a representation of the time gates of the circuit of Fig. 2 when in operation; and

Figure 4 is a graph shown typical output signals from the device of Fig. 1 when in operation.

As can be seen from Fig. 1, coke 1 being ejected from one exit 2 of a coke oven battery 3 passes through a guide car 4 before falling into coke cars (not shown). The guide car is associated with a control car 5.

A scanning optical pyrometer 6 is mounted on the guide car and is electrically connected to an operational circuit or signal processing unit 7 carried in the control car. As will be apparent from the figure, ejection of coke through the guide car 4 permits the pyrometer 6 to scan across the length of the mass of coke, producing electrical signals which are passed to the circuit carried in the control car in the form illustrated in Fig. 2 with operational time gates as indicated in Fig. 3.

The signal processing unit, accepts signals from the pyrometer 6 (Fig. 1) during pushing of coke from the oven, and divides them into periods of time in which it automatically computes the absolute peak coke temperature. From knowing the pushing speed these periods can be so adjusted as to represent specific flue zones on the oven wall. The pyrometer is so chosen as to have a minimum target area and response time sufficiently adequate as to be able to resolve the temperatures in the fissure.

Overall control of the processing circuitry is effected by a hot coke detector 8, located alongside the pyrometer 6 on the guide car 4.

This device is so arranged that, during pushing, it detects the presence of coke in the guide assembly some time prior to it reaching the target area scanned by the pyrometer. In this delay period the unit enables the circuitry and also switches a chart recorder on, so allowing it to run up to speed before temperature is received. Conversely, at the end of the push, the detector signal is itself delayed so that the coke mass can clear the pyrometer target area before the recorder is stopped and circuitry disabled.

The circuit diagram of the unit is shown in Fig. 2. Essentially the unit consists of two sections, a peak temperature picker and the associated control logic, the function of which is described below.

It is to be noted that in the following description "High" refers to a logical."1" (= 12V) and "Low" refers to a logical "0" (= 0V).

The peak temperature picker consists of integrated circuits 9, 10, 11, 12 and 13. Circuit 9 is a sample and hold device which when the logical input 14 thereof is high acts as a unity gain amplifier. However, when input 14 goes low the last value present at the input is held at the output pin 15.

If inputs 16 and 17 of circuit 12 are high, the input signal from pyrometer 6 buffered by circuit 10 is fed to circuit 9 input pin 18, and some fraction of it (set by variable resistor 19) fed to the non-inverting input pin 20 of the circuit 11 (acting as a comparator). If the input voltage exceeds the voltage existing on the output pin 15 of circuit 9, the comparator 11 output will switch high enabling circuit 9 via circuits 12 and 13 which are triple nand gates. The output of circuit 9 rises towards the input value, and as it attempts to exceed the value on pin 20 of circuit 11 inverting input this switches low disabling circuit 9. A fraction of the input voltage is therefore stored. If the input voltage now decreases below the value stored the comparator 11 output will remain low. Hence circuit 9 will only be enabled if the input exceeds the current value stored, hence the circuit functions as a peak detecting-device.

Assuming the circuit is in the reset state; when the coke detector 8 senses coke in the guide, it switches a relay driving input pin 21 low. This is inverted by circuit 22 (a NAND gate), which via integrated circuit 23 (a NOR gate) switches off transistor 24, so enabling master oscillator 25. Simultaneously the output of integrated circuit 26 (a NOR gate) goes high which switches on transistor 27 which starts the Chart Recorder 28 via Relay 29. The first positive-going edge of oscillators 25 (pin 30) triggers Monostable integrated circuit (31) the output (pin 32) of which goes high disabling integrated circuit 9 via integrated circuits 12 and 13. The other output of 31 (pin 33) after a small delay triggers Monostable integrated circuit 34 the output of which (pin 35) enables integrated circuit 36 (a sample and hold device) for 0.5ms. The last value stored by integrated circuit 9 prior to it being disabled is therefore fed into integrated circuit 36 and hence to the Chart Recorder via output pin 49. After 31 has timed out, 32 goes high. This positive transition inverted by integrated circuit 37 (a dual NAND gate), delayed and inverted again by integrated circuit 38 (a dual NAND gate) and differentiated. This positive going pulse switches on transistor 39 so discharging the storage capacitor of circuit 9, hence the output to zero. As pin 17 of circuit 12 is now high the peak picker is now enabled and ready to accept signals from the pyrometer 6.

The above sequence of operation is repeated at every positive transition of the oscillator 25, the period of which is set by variable resistor 40 to represent a complete flue zone at the prevailing pushing speed.

Overall operation of the circuit is summarised as follows:

1. Peak picker accepting pyrometer signals
2. Peak picker disabled
3. Last value sampled and fed to the chart recorder.
4. Peak picker zeroed
5. Peak picker enabled
6. Peak picker accepting pyrometer signals

A logic timing diagram is shown in Fig. 3. In this figure, line 41 represents the output from oscillator 25, line 42 represents output 32 of circuit 31, line 43 represents output 35 of circuit 34, and line 44 represents the base of transistor 39. The period indicated by line 45 represents the adjustable clock period.

The unit will continue to operate until the push ends at which time the coke detector 8 on sensing the end of the coke mass, switches forcing input 21 high. The negative going output from circuit 22 triggers monostable integrated circuit 46, output 47 of which goes high for approximately 3 seconds which keeps the circuit operating until the coke has cleared the guide.

As can be seen from Fig. 4, a comparison of typical output signals 48 direct from the scanning pyrometer and the final device output signals 49 after processing by means of the circuit of Fig. 2 shows the real importance of this feature provided by the invention.

The pyrometer output signals produce a complex and confused curve which cannot usefully be used in any real sense.

The instrument output, providing, in the graph shown, a histogram for finite discrete intervals across the coke body enables the identification of temperatures across the coke oven flue so that any problems or faults developing in flue zones can be detected and dealt with.

CLAIMS

1. A device for monitoring the temperature of coke as it is ejected from a coke oven comprising a temperature sensor mounted alongside the ejection exit of a coke oven, said temperature sensor being adapted to provide electrical signals representative of the sensed temperature of coke as it is ejected past the sensor, and circuit means adapted to divide the electrical signals from the temperature sensor into time increments, determine the signal level indicative of the maximum temperature sensed in each such time increment, and provide an output signal sequentially corresponding to all such maximum temperatures sensed.

2. A device according to Claim 1 wherein the temperature sensor comprises a pyrometer.

3. A device according to Claim 1 or 2 wherein temperature sensors are provided so as to monitor each side of the coke mass simultaneously.

4. A device according to any one of Claims 1 to 3 wherein a vertical array of temperature sensors is provided to give temperature readings at a plurality of levels of the coke oven.

5. A device according to any one of Claims 1 to 4 wherein the temperature sensor or sensors is or are mounted on or in association with a guide car through which the coke transfers from the coke oven to coke cars.

6. A device according to any one of Claims 1 to 5 including a hot coke detector arranged to detect the ejection of hot coke from the coke oven and initiate operation of the temperature sensor or sensors in dependence thereon.

7. A method of monitoring the temperature of coke as it is ejected from a coke oven comprising sensing the temperature continuously of coke as it is ejected from a coke oven, providing continuous electrical signals representative of the sensed temperatures, dividing the electrical signals into time increments, determining the signal level indicative of the maximum temperature sensed in each such time increment, and providing an output signal sequentially corresponding to all such maximum temperatures sensed.

8. A device for monitoring the temperature of coke substantially as shown in and as hereinbefore described with reference to the accompanying drawings.

9. A method of monitoring the temperature of coke substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1981.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.