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METHOD AND APPARATUS FOR DETERMINING CONDITIONS AT SPACED POINTS WITHIN A CHAMBER

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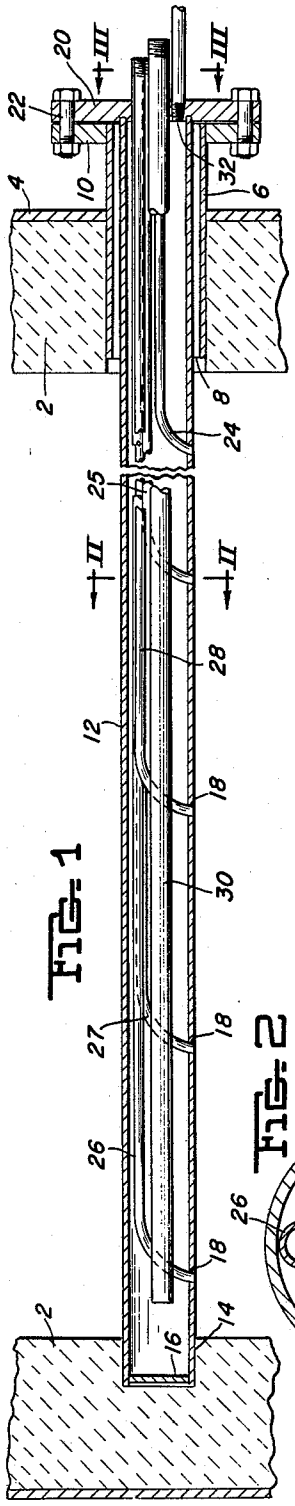

FIG. 1

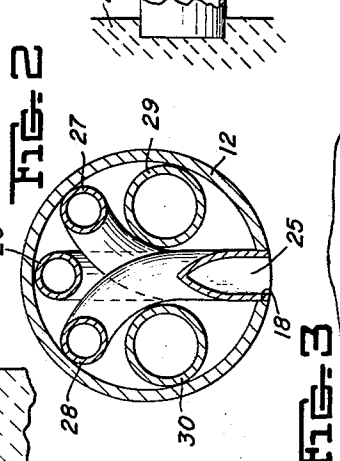

FIG. 2

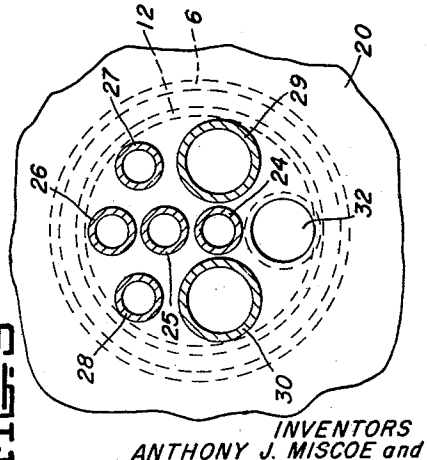

FIG. 3

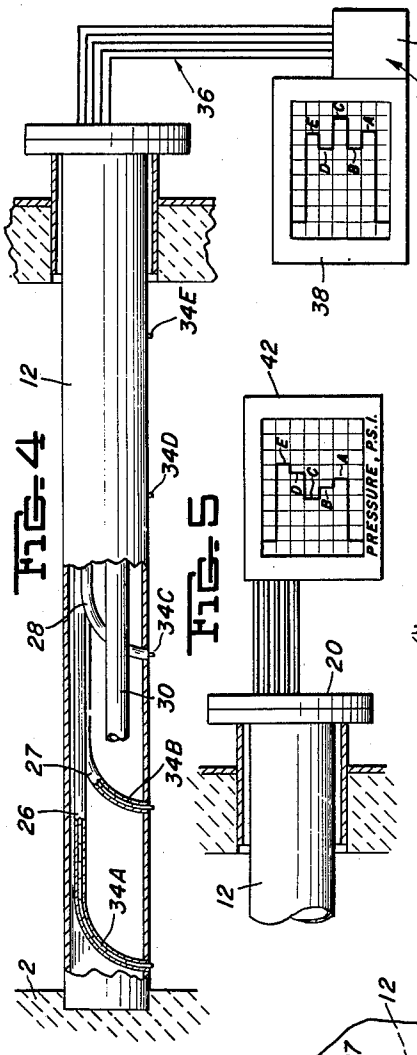

FIG. 4

FIG. 5

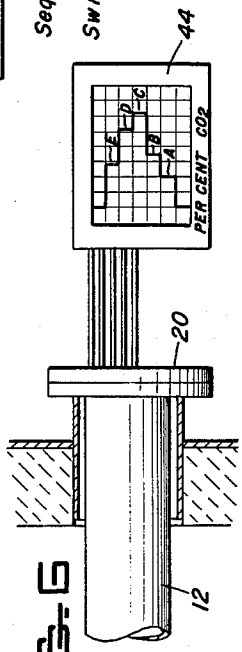

FIG. 6

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METHOD AND APPARATUS FOR DETERMINING CONDITIONS AT SPACED POINTS WITHIN A CHAMBER

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3 Claims. (Cl. 73—344)

This invention relates to a method and apparatus for determining conditions at spaced points within a chamber and more particularly to the determination of conditions along a diameter of an iron-producing blast furnace. Prior to applicants' invention, devices used for this purpose had to be forced through the burden materials during furnace operation to the position where a condition was to be determined. After the conditions at this one point were determined it was necessary to move the device to determine the conditions at a different point. Since this movement required considerable time and since the conditions vary continuously it was impossible to obtain an accurate evaluation of the conditions within the furnace. Also because of the sliding action of the device through the burden material, gas leakage at the packing gland often occurred, thus creating toxic and explosive conditions.

It is therefore an object of our invention to provide apparatus for determining conditions at spaced positions within the furnace at approximately the same time.

Another object is to provide such apparatus which can be permanently installed.

A still further object is to provide a method of determining conditions such as temperature, gas analysis and pressures almost simultaneously at spaced points along a diameter of a blast furnace.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a sectional view showing the device of our invention installed in a blast furnace;

FIGURE 2 is an enlarged view taken on the line II—II of FIGURE 1;

FIGURE 3 is an enlarged view taken on the line III—III of FIGURE 1;

FIGURE 4 is a view, partly in section, showing the apparatus installed in a blast furnace with thermocouples extending into the blast furnace and a temperature recorder connected to the thermocouples;

FIGURE 5 is a fragmentary view, similar to FIGURE 4, showing a pressure recorder connected to the sampling device; and

FIGURE 6 is a fragmentary view, similar to FIGURE 5, but showing gas analyzing equipment attached to the sampling device.

Referring more particularly to the drawings, reference numeral 2 indicates the wall of a blast furnace having the usual metal shell 4. A tube 6 passes through a horizontal opening 8 in the wall of the furnace with a flange 10 being connected to the outer end of the tube. The tube 6 is preferably welded to the shell 4 by means of a gas-tight weld. Probe tube 12 extends from the outside of the furnace through the opening in tube 6 and through the furnace to the diametrically opposite portion of the wall 2. A recess 14 is provided in the wall 2 for receiving closed end 16 of the tube 12. A plurality of longitudinally spaced holes 18 are provided in the wall of the tube 12 along the bottom thereof. While five such holes are shown the number may vary as desired. The open end of the tube 12 has a flange 20 welded thereto. The flange 20 is fastened to the flange

10 in the usual manner, as shown, by means of bolts 22. Five sampling tubes 24, 25, 26, 27 and 28 are welded to and extend through the flange 20 to the outside thereof. The inner ends of the tubes extend into the associated hole 18 and are welded to the tube 12. Two water cooling tubes 29 and 30 extend through and are welded to the flange 20. The outer end of the tubes 29 and 30 are connected to the usual source of cooling water and the inner ends terminate adjacent the closed end 16 of tube 6. The cooling water is discharged from the tube 12 through an opening 32 in the flange 20. To install the sampling tubes 24, 25, 26, 27 and 28 in the tube 6 it may be necessary to split the tube 6 into upper and lower halves. After fastening the sampling tubes in the lower half of tube 6, the two halves can be reunited by welding along their longitudinal edges.

When determining temperatures, thermocouples 34A, 34B, 34C, 34D and 34E are inserted through the sampling tubes 24 to 28 with their ends extending into the furnace chamber. Lead wires 36 connect the thermocouples to a single pen strip chart recorder 38 through a sequence timer and switching unit 40. The operation is such that thermocouple 34A is first connected to the recorder 30 to indicate temperature A after which the sequence temperature and switching unit 40 connects the thermocouple 34B to the recorder 38 to record temperature B. In the same manner the recorder 38 is connected successively to thermocouples 34C, 34D and 34E to record temperatures C, D and E. Thus the chart shows a profile of the temperatures across the furnace. If desired a multiple pen strip chart recorder may be used to record the temperatures simultaneously with the sequence timer and switching unit 40 being omitted.

When determining pressure conditions within the furnace each of the tubes 24 to 28 is connected to a multiple pen pressure recorder 42 as shown in FIGURE 5. When determining the analyses of gases within the furnace each of the tubes 24 to 28 is connected to a standard flue gas analyzer 44.

While one embodiment of our invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. The method of determining conditions at spaced points along a diameter of a blast furnace which comprises inserting a probe tube into the blast furnace, said probe tube having a plurality of sampling tubes therein extending from the outside of said furnace and opening downwardly into said furnace at spaced points along the length of the tube, inserting thermocouples in each of said sampling tubes with their hot junctions within said furnace, approximately simultaneously taking temperature readings on said thermocouples, connecting said sampling tubes to gas analyzing apparatus and analyzing the gas at spaced points in said furnace at approximately the same time, and connecting said sampling tubes to pressure gages to determine the pressure at spaced points in said furnace at approximately the same time.

2. Apparatus for determining conditions at spaced points across a blast furnace comprising a cylindrical tube extending through the wall of said furnace below the burden therein toward the opposite side thereof, the inner end of said tube in said furnace being closed and the outer end open, a flange attached to the wall of said furnace and surrounding the said open end of the tube, said tube having a plurality of longitudinally spaced downwardly facing holes in the wall thereof, a second flange attached to the open end of said tube, means securing said second flange to said first named flange, a plurality of sampling tubes extending through and attached to said second flange,

the inner end of each sampling tube being attached to the wall of said first named tube at one of said holes, means for connecting gas sampling apparatus to the outer end of each sampling tube, a thermocouple extending through each of said sampling tubes to the outlet end thereof, a cooling water tube extending through and attached to said second flange with its inner end terminating adjacent said closed end of said first named tube, and means connected to said second flange for removing cooling water from said first named tube.

3. Apparatus for determining conditions at spaced points along a diameter of a blast furnace comprising a cylindrical tube having a closed end supported by the wall of the blast furnace below the burden therein and an open end extending through the wall of the blast furnace at a point diametrically opposite the support of the closed end, a flange attached to said blast furnace and surrounding the said open end of the tube, said tube having a plurality of longitudinally spaced downwardly facing holes in the wall thereof adjacent the bottom thereof, a second flange attached to the open end of said tube, means securing said second flange to said first named flange, a plurality of sampling tubes extending through and attached to said second flange, the inner end of each sampling tube being attached to the wall of said first named tube at one of said holes, means for connecting gas sampling apparatus to the outer end of each sampling tube, a thermocouple extending through each of said sampling tubes to the outlet end thereof, a cooling water tube extending through and attached to said second flange with its inner end terminating adjacent said closed end of said first named tube, and means connected to said second flange for removing cooling water from said first named tube.

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