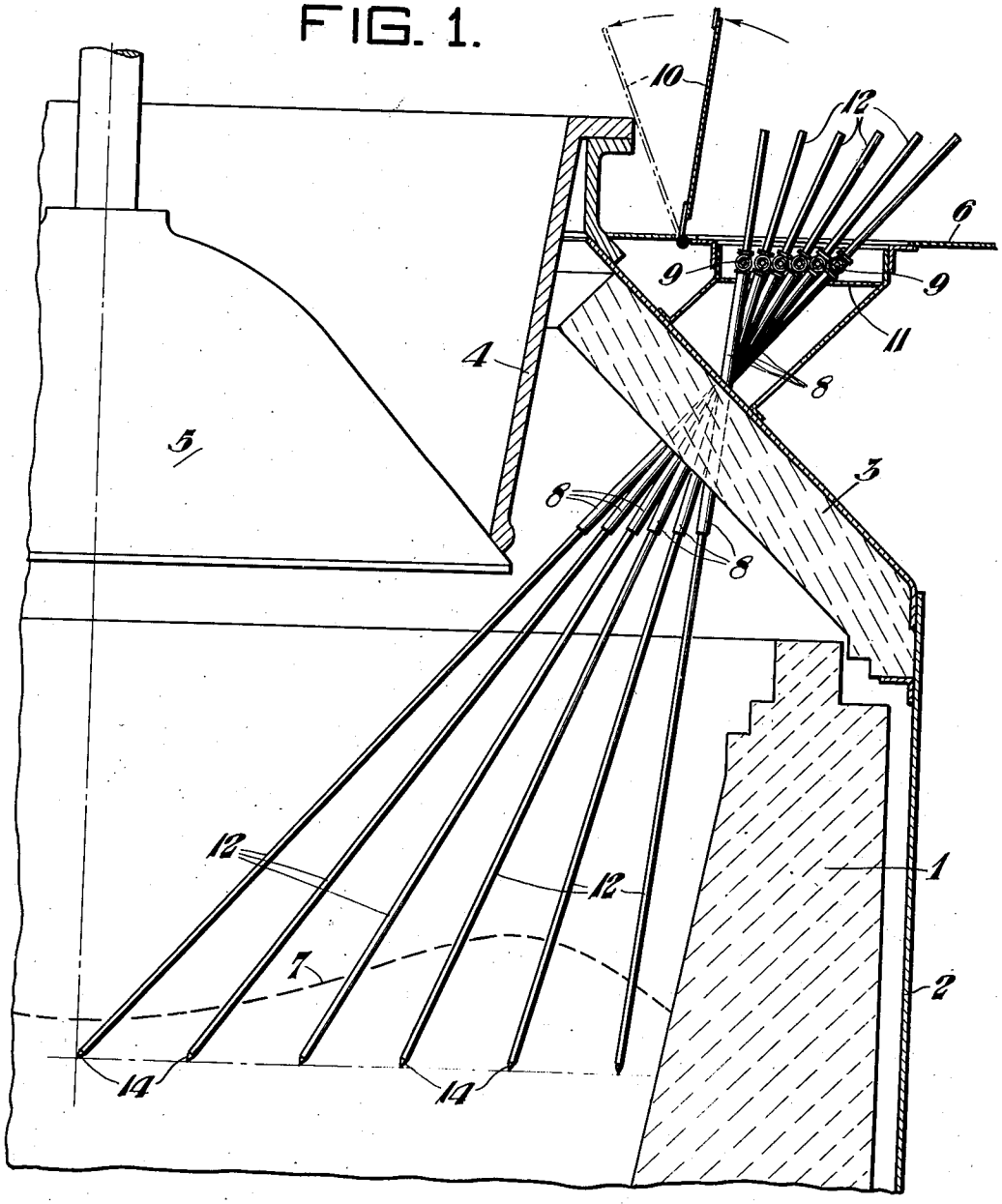
Oct. 28, 1941. G. E. STEUDEL 2,260,794

APPARATUS FOR TESTING INTERIOR FURNACE CONDITIONS

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FIG. 1.



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FIG. 2.

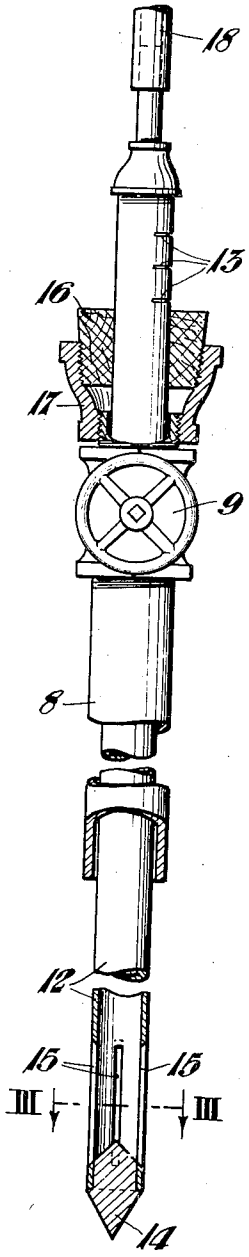


FIG. 4.

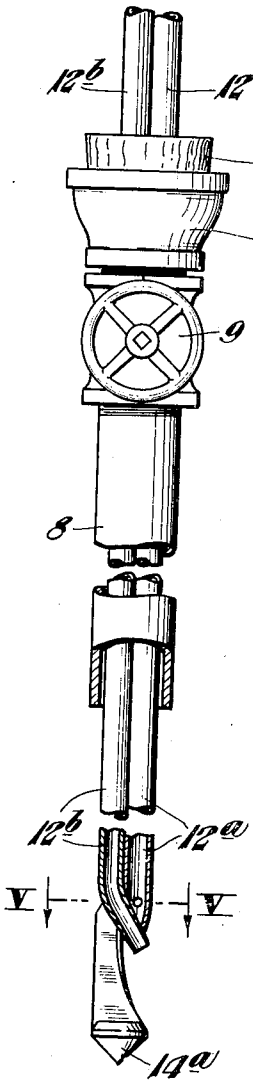


FIG. 6.

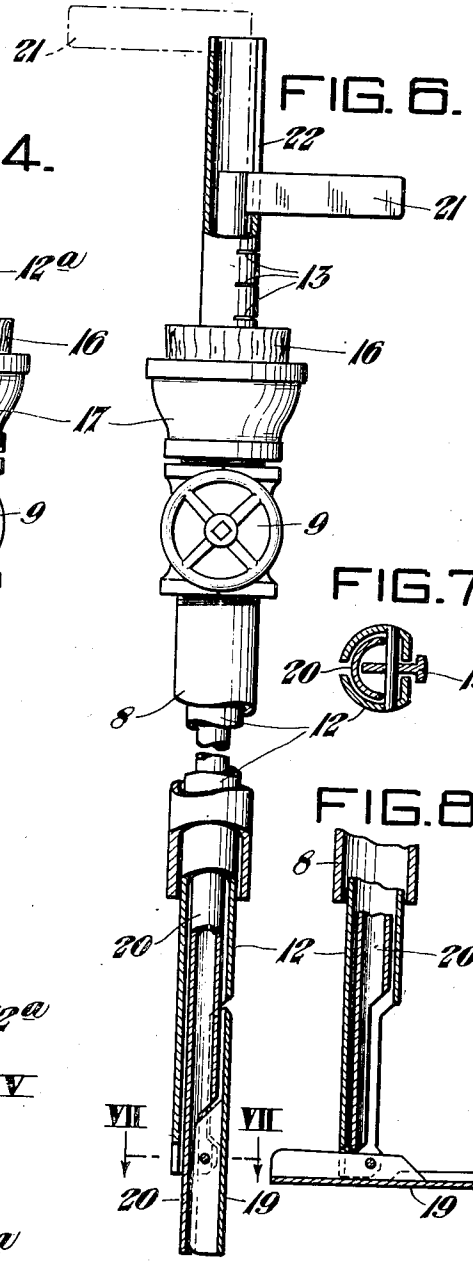


FIG. 7.

FIG. 8.

FIG. 3.



FIG. 5.



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APPARATUS FOR TESTING INTERIOR FURNACE CONDITIONS

George E. Steudel, Chicago, Ill.

Application July 22, 1939, Serial No. 286,013

6 Claims. (Cl. 33—126)

This invention is concerned with determining the conditions existing inside of a metallurgical blast furnace, both chemical and physical. The determination of such conditions is of importance in judging the operation of the furnace and the effects furnace design and working have on its operation. At the present time there is no means for obtaining such data that is sufficiently convenient and practical to satisfy the furnace operators.

A specific example of the present invention is illustrated by the accompanying drawings, in which:

Figure 1 is a section of the upper portion of a blast furnace with the example in use;

Figure 2 is an enlargement from Figure 1;

Figure 3 is a section from the line III—III in Figure 2;

Figure 4 is a modification of Figure 2;

Figure 5 is a section from the line V—V in Figure 4;

Figure 6 is another modification of Figure 2;

Figure 7 is a section from the line VII—VII in Figure 6; and,

Figure 8 shows the working of the modification shown by Figure 6.

More specifically, these drawings illustrate the upper portion of a blast furnace, showing the brick lining 1, the furnace shell 2, the furnace dome 3, the large bell hopper 4, the large bell 5 and the gas seal platform 6, the latter being the working platform on the outside at the top of the furnace provided for the workmen. The stock line of the furnace is indicated by the broken line 7.

A plurality of tubes 8 extend downwardly through the dome 3 and are provided with gate valves 9, these tubes being permanently built into the furnace dome with their bottom ends extending short distances inside the furnace and their top ends terminating beneath platform 6, the latter having a trap door 10. These tubes are fixed in the dome 3 in a gas-tight manner, preferably by welding their peripheries to the steel dome shell, their upper portions being rigidly supported by a plate 11 built between the platform 6 and the furnace shell.

A plurality of test pipes 12 are provided for passage through the tubes 8, the latter being arranged at such angles that when the test pipes 12 are passed through the tubes 8 predetermined extents, their bottom ends are brought to predetermined spaced positions inside the furnace. The tops of the pipes are provided with suitable depth marks 13 for the purpose of enabling their proper positioning in the tubes.

It is suggested that the angularity of the tubes 8 and the depths to which the pipes 12 are passed through these tubes, be correlated so that the bottom ends of the pipes extend to a horizontal level that is approximately one foot below the normal furnace stock level or about eight feet below the big bell 5, the bottom ends to be spaced with the innermost one starting at the axis of the furnace and the outermost one coming to within six inches from the stock line. However, the arrangement will depend upon the fancy of the furnace operator.

Various kinds of test tubes may be used depending on the data desired. In Figures 1 and 3, one of the pipes 12 is shown, its lower end being pointed as at 14 to facilitate its being thrust through the furnace stock, while its side is provided with openings 15 through which the furnace gases may pass. This figure also shows the use of a wooden plug 16 surrounding the pipe and thrust tightly into a conventional pipe reducer 17 that is fixed to the top end of the tube 8. Other arrangements may be used for making gas-tight the space existing outside of the pipe and the inside of the tube. The top end of the pipe 12 is connected with a rubber hose 18, the particular test pipe under discussion being for the purpose of obtaining samples of the gases passing through the furnace. In case it is desired to determine the temperatures existing at the various points of the furnace, the test pipes may be provided with thermocouples of conventional design placed in their ends where the gases pass through the opening 15 and impinge directly on the same.

Another type of test pipe is illustrated in Figures 4 and 5, this consisting of two pipes 12^a and 12^b welded together with an extension providing a circularly pointed end 14^a for thrusting a passage through the stock. Such a test pipe is suitable for determining gas velocities, the pipe 12^b having a downwardly extending end in which the gases enter and the pipe 12^a being provided with small radial openings for obtaining the static pressure at the same point.

Still another type of test pipe is illustrated by Figures 6, 7 and 8, this having its bottom end provided with a retractable shoe 19 in the form of a pivoted element adapted to swing transversely as the end of the pipe leaves the bottom end of the tube 8. The inside of the pipe in this instance carries a reciprocative pipe 20 connecting with the shoe 19, and provided at its upper

end with a handle 21 riding in a slot 22 formed in the top end of the pipe 12. When this handle is raised and turned so as to rest on the top of the pipe 12, it swings the retractable shoe 19 to a transverse position. This test pipe enables the tester to determine the contour of the stock.

To use the apparatus herein disclosed, the trap door 10 is raised and the gate valves 9 opened one by one, the test pipes 12 being successfully thrust through the tubes 8 as the valves 9 are opened. Each test pipe is brought to the proper position by resorting to the use of the depth marks 13, the wooden plugs 16 then serving to prevent further escape of the furnace gases. The manipulation of the pipes 12 will, of course, depend upon the type used, this, in turn, depending upon the data that is being collected. It is to be noted that the data collected is representative of what is occurring at predetermined spaced positions inside of the furnace, whereby very informative charts may be produced from the results of the tests. When no test is in progress, the trap door 10 is closed and the platform 6 is available for unimpeded use.

I claim:

1. Apparatus for determining conditions existing inside a blast furnace, including at least one tube extending downwardly through the furnace dome, a test pipe for passage through said tube and means for closing said tube when said pipe is withdrawn completely from said tube, said tube being positioned in such an angular manner as to bring the bottom end of said pipe to a predetermined position inside said furnace when said pipe is passed through said tube a predetermined extent said pipe having open ends with the bottom end providing access to the furnace interior and the upper end providing access to said lower end.

2. Apparatus for determining conditions existing inside a blast furnace, including at least one tube extending downwardly through the furnace dome, a test pipe for passage through said tube and means for closing said tube when said pipe is withdrawn completely from said tube, said pipe having a pointed bottom end for penetrating the furnace stock and said bottom end having an opening in its side for the entrance of the furnace gases, the top end of said pipe being open to provide access to the gases entering said opening.

3. Apparatus for determining conditions existing inside a blast furnace, including at least one tube extending downwardly through the furnace dome, a test pipe for passage through said tube and means for closing said tube when said pipe is not in use, said pipe having its bottom end provided with a retractable shoe and being equipped with means operable from its top end for controlling said shoe.

4. Apparatus for determining conditions existing inside a blast furnace, including a plurality of tubes extending downwardly through the furnace dome, a plurality of test pipes for passage through said tubes and means for closing said tubes when said pipes are withdrawn completely from said tubes, said tubes being permanently fixed in said dome and extending in such angular manner as to bring the bottom ends of said pipes to predetermined spaced position inside said furnace when said pipes are passed through said tubes predetermined extents.

5. Apparatus for determining conditions existing inside a blast furnace, including a plurality of tubes extending downwardly through the furnace dome, a plurality of test pipes for passage through said tubes and means for closing said tubes when said pipes are withdrawn completely from said tubes, said tubes being permanently fixed in said dome and extending in such angular manner as to bring the bottom ends of said pipes to predetermined spaced positions inside said furnace when said pipes are passed through said tubes predetermined extents, said pipes having open ends with the bottom ends providing access to the furnace interior and the upper ends providing access to said lower ends.

6. Apparatus for determining conditions existing inside a blast furnace, including a plurality of tubes extending downwardly through the furnace dome, a plurality of test pipes for passage through said tubes and means for closing said tubes when said pipes are not in use, said tubes being permanently fixed in said dome and extending in such angular manner as to bring the bottom ends of said pipes to predetermined spaced positions inside said furnace when said pipes are passed through said tubes predetermined extents, said pipes having their bottom ends equipped with retractable shoes and their top ends provided with means connecting with said shoes for retracting the same.

GEORGE E. STEUDEL.