

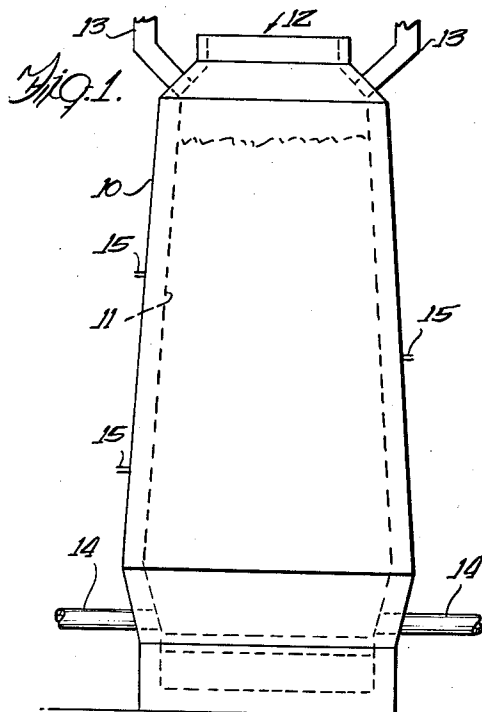
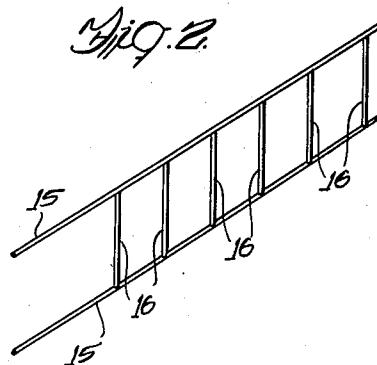
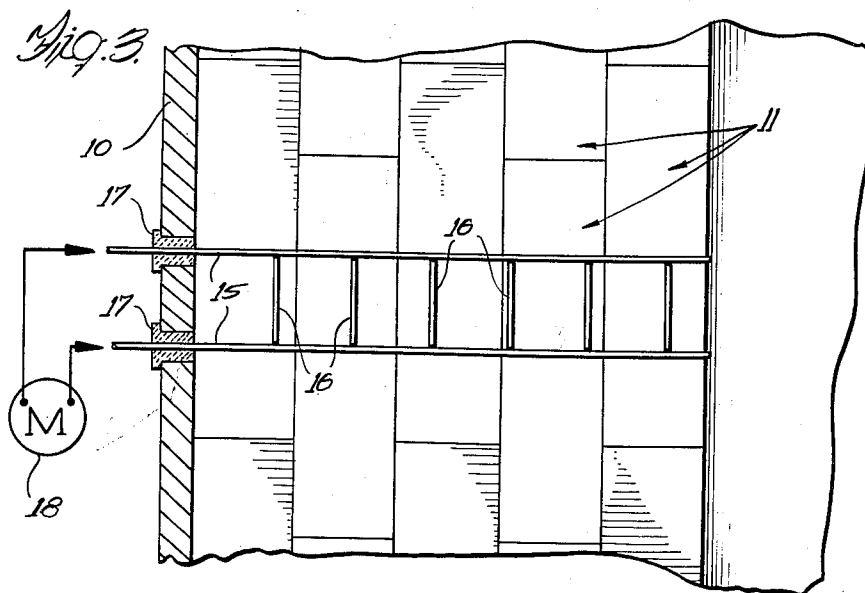
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THICKNESS GAGE FOR BLAST FURNACE WALL

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THICKNESS GAGE FOR BLAST FURNACE WALL
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This invention relates generally to electrical measuring devices, and more specifically to a measuring arrangement for the walls of a blast furnace.

The blast furnace for the production of iron is generally an extremely expensive furnace. These furnaces are generally constructed of an outer steel shell which is lined with blocks or bricks of a refractory material. In use the furnace is charged with the necessary ingredients from the top and as the various ingredients are dumped therein abrasions of the walls of the refractory material occurs which after periods of from three to six years will abrade away enough of the refractory material above the melt line of the furnace to necessitate a shutdown of the furnace and a complete rebuilding of the refractory material. It is desirable that some simple means be provided for gauging the thickness of the refractory material periodically in order to determine the rate of abrasion of the walls and to estimate the remaining life of the walls.

It is the object of the present invention to provide a simple, accurate and positive arrangement for determining the thickness of the refractory material comprising the walls of a blast furnace.

It is a further object of the present invention to provide an electrical network in combination with the refractory blocks of a blast furnace to provide a gauging device for measuring the thickness of the refractory wall as wearing by abrasion thereof occurs.

Other objects and features of the present invention will be apparent upon a perusal of the following specification and drawing, of which:

FIGURE 1 is a side elevational view of a portion of a blast furnace including the present invention;

FIGURE 2 is an enlarged isometric view of the electrical network for measuring the wall thickness; and

FIGURE 3 is an enlarged cross-sectional view of a portion of a blast furnace wall including the present invention.

The present embodiment is the preferred embodiment but it is to be understood that changes can be made in the present embodiment by one skilled in the art without departing from the spirit and scope of the present invention.

For a general description of the present invention reference is made to the drawing. The invention comprises a plurality of resistance wires of known resistance connected in parallel to a pair of conductors at predetermined spaced positions along the length of the conductors with the pair of conductors and the resistance wires being built into or positioned between the refractory blocks of a blast furnace wall while the blast furnace walls are being built or rebuilt. An ohmmeter connected across the ends of the conductors outside the blast furnace wall will produce a resistance reading of the parallel resistance network. As the refractory material of the furnace wall is abraded by the furnace charges, the pair of conductors and parallel resistance wires also gradually are abraded away and by simple periodic measurement the remaining thickness of the wall and its rate of destruction may easily be computed.

For a detail description of the present invention continued reference is made to the drawing.

The blast furnace comprises a generally cylindrical chamber of over a hundred feet in height. The outer

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wall 10 of the furnace is constructed of a sheet or plate steel, and the inner wall thereof is laid in refractory blocks or bricks 11. The blocks 11 are generally formed of silica material and have the property of low electrical conductivity. The blocks are generally laid in a horizontal depth sufficient to provide for a furnace life of from three to six years. The showing of a block depth of five blocks in FIGURE 3 is merely for example and is not to the exclusion of other depths or patterns of laying of the blocks. The upper portion of the blast furnace is provided with an opening 12 and stacks 13. The opening 12 is provided for charging of the furnace and into this opening are dumped the ores, coke and limestone for the production of iron. The stacks 13 are provided for drawing out the various gaseous by-products formed in the production of iron. The lower portion of the blast furnace is provided with conduits 14 for appropriate heating of the furnace charge. The molten iron as produced is drawn from the lower portion of the furnace. The portion of the furnace above the melt line or above the molten iron is generally worn away more rapidly than the portion below the melt line, and this is due to the abrasive action of the charge as it is dumped into the furnace and as it moves downwardly in the production of the iron.

The present invention comprises the insertion of a certain wall thickness measuring arrangement in the walls of the furnace when it is being built or rebuilt. As the blocks 11 are laid, the arrangement of the two conductors 15 and resistance elements 16 or wires 16 is positioned between the blocks 11 and substantially along a line perpendicular to the wall surface. One end of each of the conductors 15 extends through suitable insulators 17 which are positioned in openings through the outer wall 10. A number of the assemblies 15 and 16 may be disposed at various positions about the furnace.

Since the blocks 11 are of a material having a low electrical conductivity, the conductors 15 and the resistance elements 16 are electrically interconnected substantially only through their specific connections. The conductors 15 may be formed of a material such as a soft steel wire, and the resistance elements 16 may be formed of a resistance wire such as some alloy of nickel and chromium. The resistance elements 16 are bridged across the conductors 15 by any means such as mechanical fastening or welding, and are spaced from each other certain predetermined distances. If it be desirable to know the thickness of the inner wall within two inch increments the resistance elements 16 would then be spaced along the conductors 15 at two inch intervals. Further, the spacing need not be uniform, for example if it be desirable to know the wall thickness in smaller increments in the area adjacent the outer wall 10, the resistance elements 16 may be more closely spaced in that area.

By connecting a meter 18 such an ohmmeter to the ends of the conductors 15 extending from the outer wall 10, the wall thickness may be simply calculated by converting the resistance reading into a thickness reading based upon the predetermined resistance of each portion of the network. As the wall is worn away, conductors 15 and resistance elements 16 will also gradually be destroyed with the wall, and the increasing resistance measured by the meter 18 will indicate the decreasing thickness of the wall with a high degree of accuracy.

Having described the invention what is considered new and desired to be protected by Letters Patent is:

1. In a furnace having at least one wall of given electrical conductivity, which wall is reduced in thickness over a period of time by the abrasion of charges delivered to the furnace and measuring means are utilized to sense such thickness reduction, said furnace wall hav-

ing a certain predetermined thickness, a pair of electrical conductors carried in said furnace wall and positioned generally perpendicular to the wall, said conductors being positioned in a spaced-apart relationship to each other and one end of each of said conductors extending through said wall to the exterior thereof, a plurality of resistance elements of predetermined resistance, said resistance elements connected between said conductors in an electrically parallel relationship, each of said resistance elements exhibiting an electrical conductivity high with respect to said given conductivity of the wall, each being positioned in a predetermined spaced-apart relationship to each other, and each resistance element being disposed generally parallel to the furnace wall, whereby said conductors and said elements will be abraded away with said wall, and means, including the conductor ends extending to the exterior of said wall, for coupling said measuring means to said conductors for measuring the thickness of said wall by measuring the total resistance of said parallel-connected resistance elements as said wall is reduced in thickness by abrasion.

2. In a furnace wherein the walls thereof are reduced in thickness over a period of time by the abrasion of charges delivered to the furnace and measuring means are utilized to sense such thickness reduction, a furnace wall of a refractory material of a certain predetermined thickness and of a material having a low electrical conductivity, a pair of electrical conductors carried by said refractory material perpendicularly through said wall, said conductors being positioned in a spaced-apart relationship to each other and one end of each of said conductors extending through said wall to the exterior thereof, a plurality of resistance elements of predetermined resistance, said resistance elements connected between said conductors in an electrically parallel relationship, each of said resistance elements being positioned in a predetermined spaced-apart relationship to each other and being disposed generally perpendicular to said conductors and generally parallel to said wall, whereby said conductors and said elements will be abraded away with said wall, and means, including the conductor ends extending to the exterior of said wall, for coupling said measuring means to said conductors for measuring the thickness of said wall by measuring the total resistance of said parallel-connected elements as said wall is reduced in thickness by abrasion.

3. In a furnace wherein the walls thereof are reduced in thickness over a period of time by the abrasion of charges delivered to the furnace and measuring means are utilized to sense such thickness reduction, a furnace wall of a refractory material of a certain predetermined thickness and of a material having a low electrical conductivity, a pair of electrical conductors carried by said refractory material perpendicularly through said wall, said conductors being positioned in a parallel spaced-apart relationship to each other and one end of each of said conductors extending through said wall to the exterior thereof, a plurality of resistance elements, each of said resistance elements having substantially the same predetermined resistance, said resistance elements connected between said conductors in an electrically parallel relationship, each of said resistance elements being positioned in a certain predetermined spaced-apart relationship to each other and being disposed generally perpendicular to said conductors and generally parallel to said wall, whereby said conductors and said elements will be abraded away

with said wall, and means, including the conductor ends extending to the exterior of said wall, for coupling said measuring means to said conductors for measuring the thickness of said walls by measuring the total resistance of said parallel-connected elements as said wall is reduced in thickness by abrasion.

4. In a furnace wherein the walls thereof are reduced in thickness over a period of time by the abrasion of charges delivered to the furnace and measuring means are utilized to sense such thickness reduction, a furnace wall of a refractory material of a certain predetermined thickness and of a material having a low electrical conductivity, a pair of electrical conductors carried by said refractory material perpendicularly through said wall, said conductors being positioned in a parallel spaced-apart relationship to each other and one of each of said conductors extending through said wall to the exterior thereof, a plurality of resistance elements, each of said resistance elements having substantially the same predetermined resistance, said resistance elements connected between said conductors in an electrically parallel relationship, each of said resistance elements being positioned in a predetermined uniform spaced-apart relationship to each other and being disposed generally perpendicular to said conductors and generally parallel to said wall, whereby said conductors and said elements will be abraded away with said wall, and means, including the conductor ends extending to the exterior of said wall, for coupling said measuring means to said conductors for measuring the thickness of said wall by measuring the total resistance of said parallel-connected elements as said wall is reduced in thickness by abrasion.

5. In a furnace wherein the walls thereof are reduced in thickness over a period of time by the abrasion of charges delivered to the furnace and measuring means are utilized to sense such thickness reduction, a furnace wall formed of blocks of refractory material having a low electrical conductivity, said wall having a certain initial thickness determined by the number of said blocks, a pair of electrical conductors positioned between certain adjacent ones of said blocks in a plane which is substantially perpendicular to the surface of said wall, said conductors being positioned in a parallel spaced-apart relationship to each other and one of each of said conductors extending through said wall to the exterior thereof, a plurality of resistance elements, each of said resistance elements having substantially the same predetermined resistance, said resistance elements connected between said conductors in an electrically parallel relationship, each of said resistance elements being positioned in a predetermined uniform spaced-apart relationship to each other and being disposed generally perpendicular to said conductors and generally parallel to said wall, whereby said conductors and said elements will be abraded away with said wall, and means, including the conductor ends extending to the exterior of said wall, for coupling said measuring means to said conductors for measuring the thickness of said wall by measuring the total resistance of said parallel-connected elements as said wall is reduced in thickness by abrasion.

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