March 2, 1954 G. D. BAGLEY 2,671,124

ELECTRIC REDUCTION FURNACE

Filed May 24, 1951 2 Sheets-Sheet 1

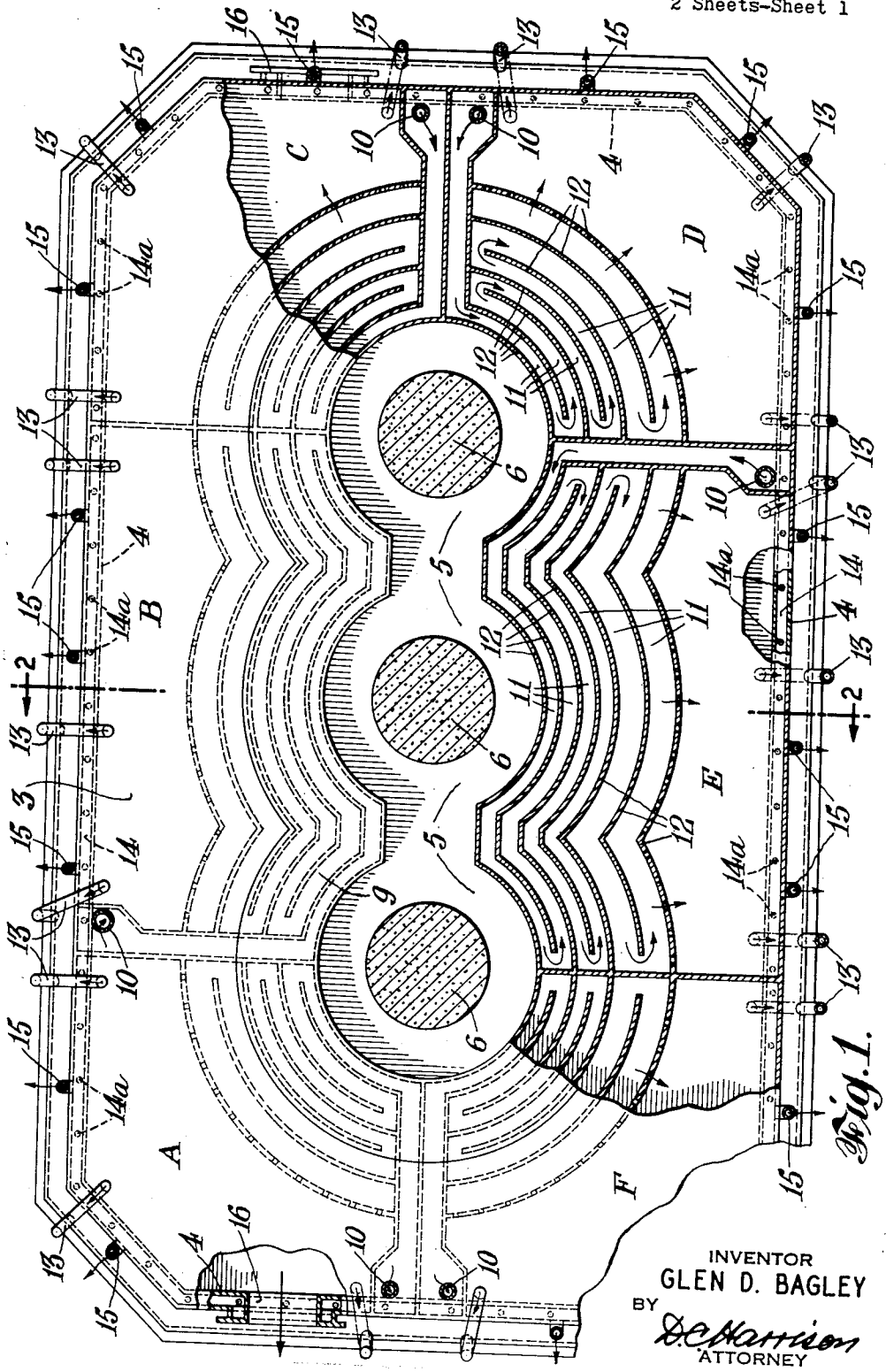


Fig. 1.

INVENTOR
GLEN D. BAGLEY
BY D. C. Harrison
ATTORNEY

March 2, 1954

G. D. BAGLEY

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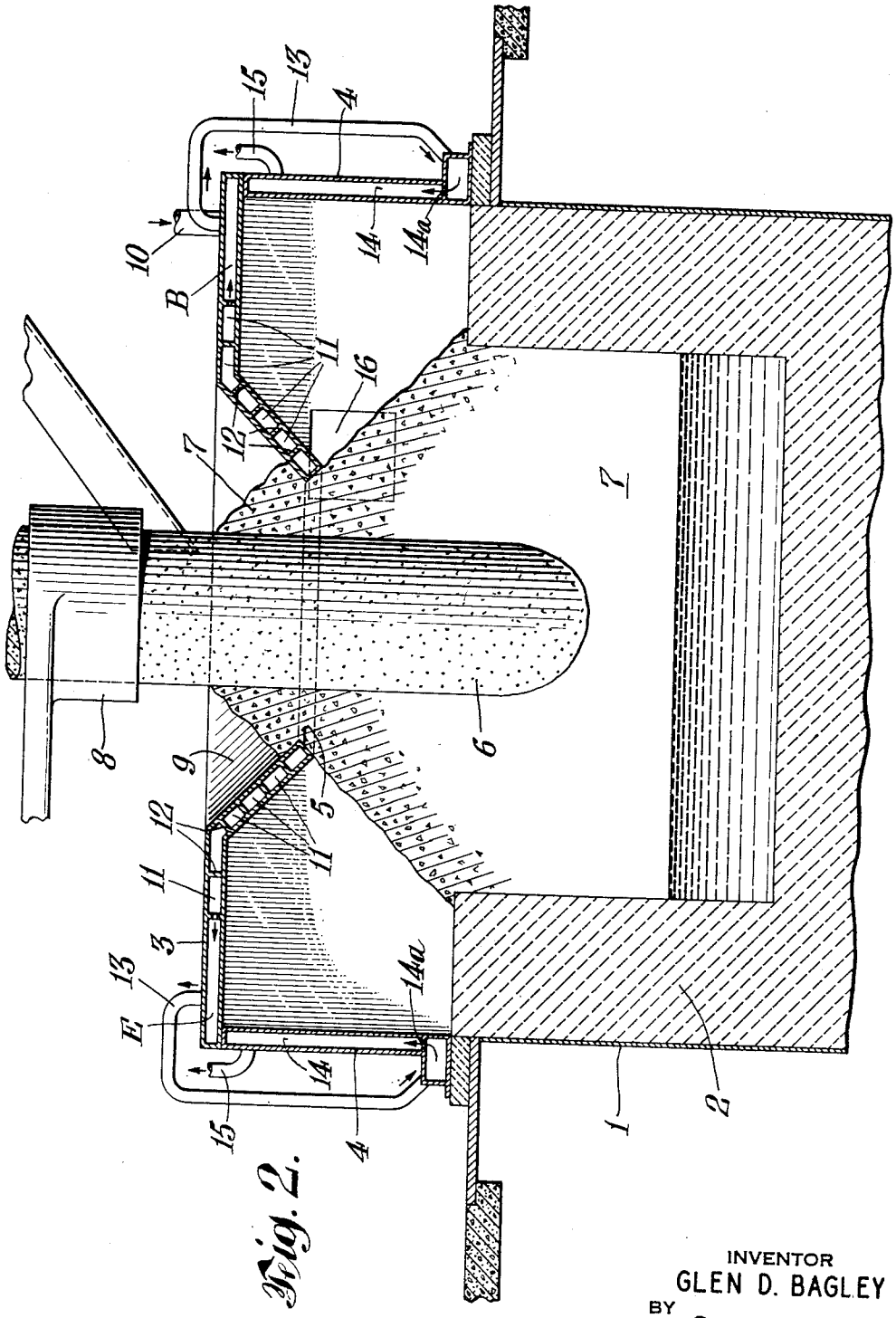


Fig. 2.

INVENTOR
GLEN D. BAGLEY
BY
D. C. Harrison
ATTORNEY

Patented Mar. 2, 1954

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UNITED STATES PATENT OFFICE

2,671,124

ELECTRIC REDUCTION FURNACE

Glen D. Bagley, Lewiston, N. Y., assignor to Union Carbide and Carbon Corporation, a corporation of New York

Application May 24, 1951, Serial No. 227,995

10 Claims. (Cl. 13—23)

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This invention relates to electric furnaces and their operation, and, more particularly, to electric reduction furnaces of the type which is provided with a cover whereby the gases produced by the reaction within the furnace may be removed and, if desired, utilized.

An object of this invention is to provide an electric reduction furnace wherein the cover is composed substantially of metal, but which is not subject to induction losses.

Another object is to provide for a method of operation of said covered reduction furnace whereby the escape of exhaust gas from the furnace into the furnace room will be reduced to a minimum.

A further object is to provide for a covered reduction furnace which can be operated so that the volume of exhaust gases is reduced, thereby simplifying the dust removal problem.

Still another object is to provide for a covered electric reduction furnace wherein the top-fed charge is preheated by the combustion of the reaction gases.

Other objects and advantages of this invention will be apparent during the course of the following description.

In the accompanying drawings:

Fig. 1 is a top plan view of a furnace embodying this invention, parts being broken away; and

Fig. 2 is a vertical sectional view of the furnace along the line 2—2 of Fig. 1.

One modification of the furnace comprises an outer shell 1, refractory lining 2, a unitary cover 3 of metal, and upper furnace walls 4 of the same material. By the word metal it is meant that the cover is comprised substantially of any conventional structural ferrous metal or ferrous alloy. This cover is provided with a single aperture 5 through which a plurality of electrodes 6 extend and through which the furnace charge 7 is fed. Current is supplied to the electrodes through the electrode holder 8. A portion of the cover bordering the aperture 5 is inclined into the furnace, thereby forming a hopper 9 to hold the charge around the electrodes. The furnace cover contains passages for the circulation of cooling fluid. These passages are arranged in six units which are represented by the letters A through F of Fig. 1. Each unit has an intake pipe 10 through which the cooling fluid flows to the chambers 11 in the interior of the cover formed by the baffle plates 12. In the drawings the arrows represent the direction of flow of the cooling fluid. After passing through the cover the cooling fluid passes through pipes 13 into the base of the upper side walls from whence it passes through

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the passages 14 and 14a in said upper side walls 4 to the discharge pipes 15. At opposite ends of the furnace gas exhaust ducts 16 are located in the upper side walls.

The plurality of electrodes introduced through the aperture 5 may have any arrangement with respect to one another, the longitudinal arrangement shown in the drawing not being critical to this invention.

The simplicity of construction of the furnace of the present invention is attained by having all electrodes pass through a single aperture in the cover. This feature makes possible the construction of a unitary cover of metal without the need for electrical or magnetic insulation since the sum of the instantaneous values of the currents in any three-phase circuit, balanced or unbalanced, is always zero. This is also true of single-phase circuits.

When operating the furnace of this invention exhaust fans may be connected to the furnace exhaust ducts and adjusted to give suction sufficient to prevent any gases, and consequently any dust, from escaping around the electrodes. It has been found that in ore reducing operations conducted at approximately $\frac{1}{16}$ inch of water suction, the amount of air drawn into the furnace through the charge is about ten times that of the gas generated by the reacting charge within the furnace. The air thus drawn in supports combustion of the reaction gases and serves to preheat the charge and to prevent it from becoming sufficiently sticky to seal off the furnace and cause blows. In this manner the carbon monoxide gas generated within the furnace is almost completely burned in the charge, reducing the final content of carbon monoxide in the gases delivered by the fans to less than one per cent, thereby eliminating the danger of explosion. By use of the furnace of the present invention the elimination of dust formation within the furnace room is so complete that it is difficult to tell by observation whether the furnace is in operation.

The volume of gas discharged from the furnace of the present invention is only about $\frac{1}{40}$ of that passing through the roof stacks of uncovered furnaces of the same capacity. This great reduction in volume makes possible the use of dust removal procedures which are quite inapplicable in operations wherein large volumes of stack gases are involved.

What is claimed is:

1. An electric reduction furnace comprising side walls, a cover of metal, and a plurality of

electrodes, said cover being provided with a single aperture through which said electrodes are inserted, said electrodes being disposed within said aperture without contact with said cover and the electric circuit in said furnace being completed solely through said plurality of electrodes and the furnace charge.

2. An electric reduction furnace as claimed in claim 1 wherein said cover is provided with internal passages through which a cooling fluid may be passed.

3. An electric reduction furnace comprising side walls, a unitary cover of metal, and a plurality of electrodes, said cover being provided with a single aperture through which said electrodes are inserted, said electrodes being disposed within said aperture without contact with said cover and the electric circuit in said furnace being completed solely through said plurality of electrodes and the furnace charge.

4. An electric reduction furnace as claimed in claim 3 wherein said unitary cover is provided with internal passages through which a cooling fluid may be passed.

5. An electric reduction furnace comprising side walls, a cover of metal, and a plurality of electrodes, said cover being provided with a single aperture through which said electrodes are inserted, said cover being so shaped that the aperture contours the electrodes at a distance from said electrodes, said furnace being further characterized in that said cover is inclined downwardly into said furnace in the vicinity of said aperture to form a hopper through which a charge may be fed into said furnace and the electric circuit in said furnace is completed solely through said plurality of electrodes and the furnace charge.

6. An electric reduction furnace as claimed in claim 5 wherein said cover is provided with internal passages through which a cooling fluid may be passed.

7. An electric reduction furnace comprising side walls, a unitary cover of metal, and a plurality of electrodes, said cover being provided with a single aperture through which said electrodes are inserted, said cover being so shaped that the aperture contours the electrodes at a distance from said electrodes, said furnace being further characterized in that said cover is inclined downwardly into the furnace in the vicinity of said aperture to form a hopper through which a charge may be fed into said furnace and the electric circuit in said furnace is completed solely through said plurality of electrodes and the furnace charge.

8. An electric reduction furnace as claimed in claim 7 wherein said unitary cover is provided with internal passages through which a cooling fluid may be passed.

9. In an alternating current electric reduction furnace having side walls, a unitary cover of metal and a plurality of electrodes, wherein the electric circuit in said furnace is completed solely through said plurality of electrodes and the furnace charge thereby presenting the problem of induction losses in a unitary cover of metal, the improvement wherein said metal cover is formed with a single aperture through which said electrodes are inserted, and said electrodes are disposed within said aperture without contact with said cover.

10. In an electric reduction furnace as claimed in claim 9, the further improvement wherein said unitary cover is provided with internal passages through which a cooling fluid may be passed.

GLEN D. BAGLEY.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
572,312	Price	Dec. 1, 1896
583,936	Price	June 8, 1897
686,551	Simon	Nov. 12, 1901
699,654	Chalmot	May 13, 1902
760,312	Cowles	May 17, 1904
942,110	Snyder	Dec. 7, 1909
942,350	Price	Dec. 7, 1909
1,073,684	Hess	Sept. 13, 1913
1,830,992	Frenzel	Nov. 10, 1931
1,922,312	Mansfield	Aug. 15, 1933
1,992,465	Blagg	Feb. 26, 1935
2,222,004	Smith	Nov. 19, 1940