May 6, 1924. 1,492,685

E. W. HALE

REFRACTORY LINING FOR METALLURGICAL PURPOSES

Original Filed Aug. 16, 1921

Fig. 1.

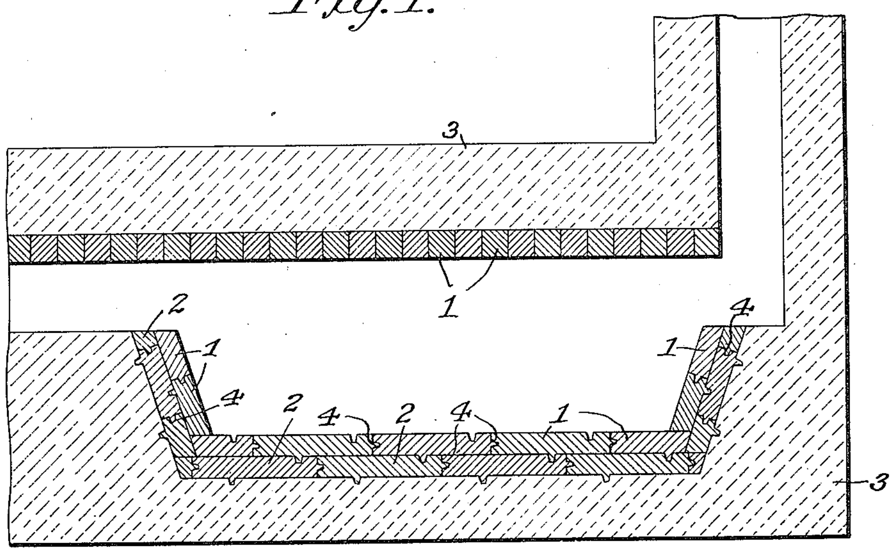
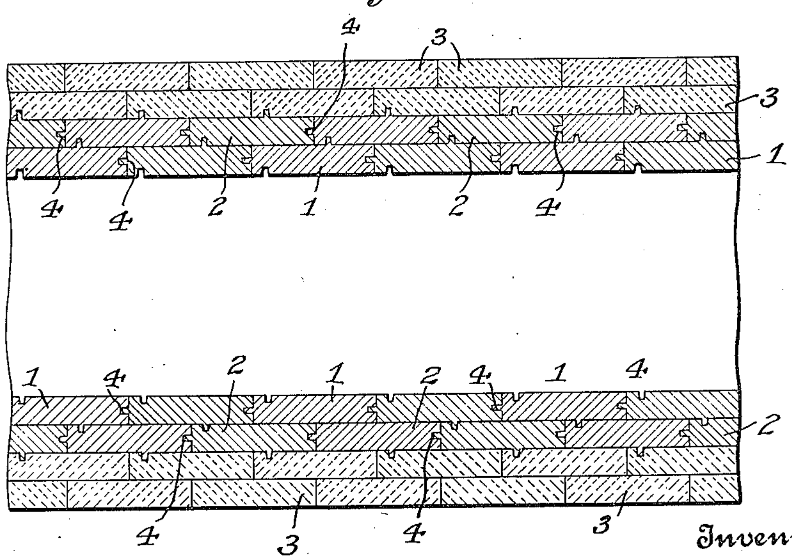


Fig. 2.



Inventor
EDWIN W. HALE

By his Attorney [signature]

Patented May 6, 1924. 1,492,685

UNITED STATES PATENT OFFICE.

EDWIN W. HALE, OF GREENWICH, CONNECTICUT.

REFRACTORY LINING FOR METALLURGICAL PURPOSES.

Original application filed August 16, 1921, Serial No. 492,685. Divided and this application filed August 1, 1922. Serial No. 578,986.

To all whom it may concern:

Be it known that I, Edwin W. Hale, a citizen of the United States of America, residing at Greenwich, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Refractory Linings for Metallurgical Purposes, of which the following is a specification.

My invention relates to containers for metals, ores, and similar materials, which containers are primarily intended to be used for treating high melting metals, as in the making of brass by melting copper and zinc, but are also useful in smelting or reducing ores, or in annealing or distilling metals, and this application constitutes a division of my application Serial No. 492,685, filed August 16, 1921.

Heretofore refractory linings for furnaces or retorts for melting such metals as zinc, brass and tin have generally been made of magnesite and fire clay. Retorts of this character made in one piece, have necessarily been made small, and even then have to be watched closely during the heating operation to detect loss of contents through cracks or excessive soakage. Sectional linings of non-metallic brick for larger retorts or furnaces, such as have been used in reverberatory furnaces for treating tin, are very inefficient on account of loss of metal through the lining and soakage into the lining, and by reason of the formation of slag formed by the materials of the lining going into combination or solution with the molten metals or their oxides.

Heretofore it has been supposed that it was not practicable to make or line retorts or other containers to be used for the purposes above recited out of metal because ordinarily the metal in the lining will alloy with the molten metal contents of such containers, or will disintegrate through oxidation or other form of corrosion by the hot gases or metal vapors.

It is a fact, however, that certain ferro-alloys are highly resistant to corrosion by hot gases of an oxidizing nature, or by molten or gaseous zinc, tin, copper, lead, silver, antimony, bismuth and similar metals, and will not alloy with them when used to form or line retorts or other forms of heat-resisting containers. The best alloy of this character at present known to me is an alloy of chromium and iron containing approximately 36 per cent of chromium. The degree of resistance increases with the proportion of chromium in the alloy, but the cost and difficulty of working increase correspondingly, and the above stated proportions present a satisfactory working compromise in most cases.

While I am not at present certain as to the exact cause of the high power resistance to attack presented by such ferro-chrome alloy under the above recited conditions, I believe that it results from the initial production of a defensive film of chromium oxide on the surfaces of the lining when exposed to great heat. Such chromium oxide is not reduced by zinc or other metals enumerated, whether in molten or gaseous form, even at the high temperatures needed for their fusion and volatilization. Also it is not reduced by hydrogen or by carbon monoxide, and so persists as a protecting film throughout the operation of the furnace. The solid, unoxidized metallic alloy behind this protecting film is therefore safe from attack by the corroding gases and molten metals and metal vapors, and cannot alloy with such metals as it is out of contact therewith.

The iron constituent of the ferro-chrome alloy gives it strength and ease of working and comparative cheapness in the first cost.

The casting of any ordinarily large body of any such highly refractory metal or alloy, such as the ferro-chrome alloy above specified, is an extremely difficult and costly operation, and commercially impracticable but according to my present invention I cast the alloy into bricks which can easily be done and then build the retorts and necessary parts of furnaces or other containers out of these bricks which may be electrically butt welded together, or may be laid in high temperature cement, or may be simply keyed together, thus overcoming the above mentioned practical difficulty.

In the latter case fins of the fused metal in the retort or other container will initially penetrate the interstices between the bricks during the first heating operation, but will congeal in said interstices before reaching the exterior of the lining, and will thus automatically render said lining liquid tight. The seams at the lining facings may also be welded by an electric arc, so that the adjacent, exposed margins of the inner course will be united in a continuous, integral film.

I am aware that it has been heretofore proposed to use various ferro-chrome alloys in the production of retorts, crucibles and so forth, but the impossibility of casting such alloys of the high chromium percentage necessary for the uses to which my invention is designed has heretofore rendered such theoretical suggestions of no practical value. My present invention, based on the discovery that such crucibles or retorts, or furnace linings, can be successfully built up of bricks, or small sections, and that the molten metal will not escape through the joints between such bricks or small sections, has overcome this difficulty and opened this field to practical employment of these alloys previously shut out from it.

In the accompanying sheet of drawings I have shown several typical embodiments of my invention.

Fig. 1 shows a longitudinal cross-section through a reverberatory furnace.

Fig. 2 shows a cross-section through a tube furnace.

Throughout the drawings like reference characters indicate like parts. 1, 1 represent the bricks forming the inner course of each lining, and 2, 2 represent those in the second course, which preferably break joints with those in the first course. 3, 3 represent the backing and supporting walls and foundations of ordinary brick, concrete or other suitable materials. 4, 4 represent interlocking projections for keying together the bricks in adjacent courses.

Among the advantages of my invention may be mentioned the resulting facility of construction inherent in the brick formation; impermeability or high resistance to metallic soakage of the refractory lining resulting from its metallic nature; reduction of losses of metal treated through avoidance of slag formation; elimination of any impurities in the product of the furnace which might result from contamination by an eroded or corroded lining; electrical conductivity of the lining, whereby the cost of installing at least one of the usual electrodes in electrically heated furnaces of slag-resistance or muffled-act types may be saved; possible economies resulting from the use of the more costly high chromium content alloy only at those points in the structure where acute attacks by the molten contents or heated gases or vapors occur, while cheaper, low chromium-content alloys may be used at other points, as in the furnace hearth or roof; ease of repair by removal of injured brick without disturbing the rest of the structure; facility in making tap holes by removing one or more bricks, and economy in operation of externally heated retorts, etc., due to the relatively high heat conductivity of the ferro-chrome alloy as compared with that of walls formed of non-metallic materials, such as magnesite and fire clay.

In many cases it would only be necessary to face with the bricks made according to my invention the slag line of the furnace or other container, or other portions of such furnaces or containers, which are most exposed to the corrosive and disintegrating reactions above referred to.

Other alloys might be substituted for ferro-chrome, such as ferro-titanium, ferro-silicon, ferro-vanadium, or other alloys which do not readily combine with and are not easily corroded by zinc, tin, copper or combinations of the last mentioned metals and, in the case of furnaces or containers for some molten metals, bricks made of a single refractory metal without alloy, might be used.

Having described my invention I claim:

1. As an article of manufacture, a container for molten metals and other materials, the portions of the lining of which container most liable to be exposed to the destructive action of the molten materials and gases are faced with bricks made of an alloy containing chromium.

2. As an article of manufacture, a container for molten metals and other materials, the portions of the lining of which container most liable to be exposed to the destructive action of the molten materials and gases are faced with bricks made of an alloy containing chromium and iron.

3. As an article of manufacture, a container for molten metals and other materials, the portions of the lining of which container most liable to be exposed to the destructive action of the molten materials and gases are faced with bricks made of an alloy containing chromium and iron in approximately the proportion of 36 per cent of chromium and 64 per cent of iron.

4. As an article of manufacture, a container for fusing and holding high melting metals and their compounds, the walls of which container are faced with bricks made of an alloy containing chromium substantially as described.

5. As an article of manufacture, a container for fusing and holding high melting metals and their compounds, the lining of which container comprises bricks made of an alloy containing chromium, the bricks located at points exposed to the most active corroding action of the contents of the container having a higher percentage of chromium than those located at other points.

6. As an article of manufacture, a container for fusing and holding high melting metals and their compounds, the walls of which container are faced with bricks made

of an alloy containing chromium and iron.

7. As an article of manufacture, a container for fusing and holding high melting metals and their compounds, the lining of which container comprises bricks made of an alloy containing chromium and iron, the bricks located at points exposed to the most active corroding action of the contents of the container having a higher percentage of chromium than those located at other points.

8. As an article of manufacture, a container for fusing and holding high melting metals and their compounds, the walls of which container are faced with bricks made of an alloy containing chromium and iron, said bricks being welded together along their adjacent exposed margins.

9. As an article of manufacture, a container for molten metals, the lining of which container comprises bricks made of a metallic alloy, one component of which is highly resistant to corrosion by, and combination with, such molten metal, and is present in sufficient proportion to protect other components from such reactions.

10. As an article of manufacture, a container for molten metals, the lining of which container comprises bricks made of a metallic alloy, one component of which is capable of producing a defensive film of oxide on the surface of the lining when exposed to great heat.

11. As an article of manufacture, a container for molten metals, the lining of which container comprises bricks made of a metallic alloy, one component of which is capable of producing a defensive film on the surface of the lining when exposed to great heat.

12. As an article of manufacture, a container for molten metals, the lining of which container comprises bricks made of a refractory metallic material capable of resisting the destructive effects of the molten and vaporous content.

EDWIN W. HALE.