F. THARALDSEN.

METHOD OR PROCESS FOR THE REDUCTION AND SMELTING OF ORE AND ARRANGEMENT THEREFOR.

APPLICATION FILED MAY 31, 1911.

1,007,990.

Patented Nov. 7, 1911.

3 SHEETS—SHEET 1.

Fig. 1

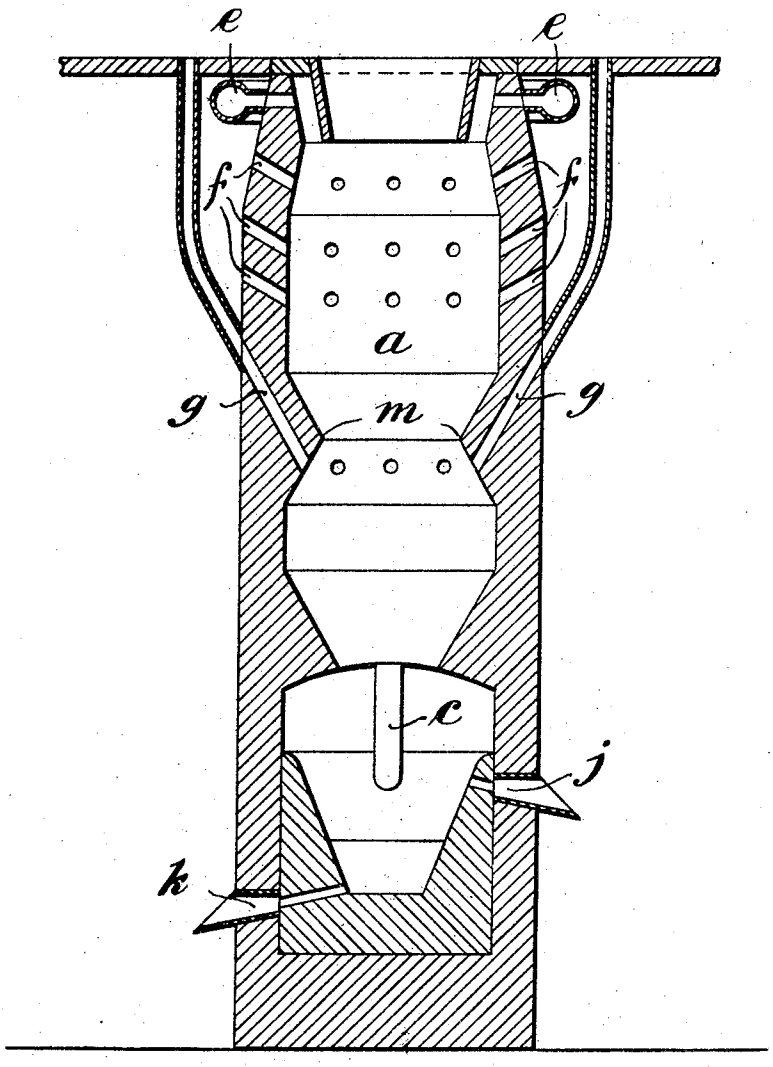

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Fig. 2

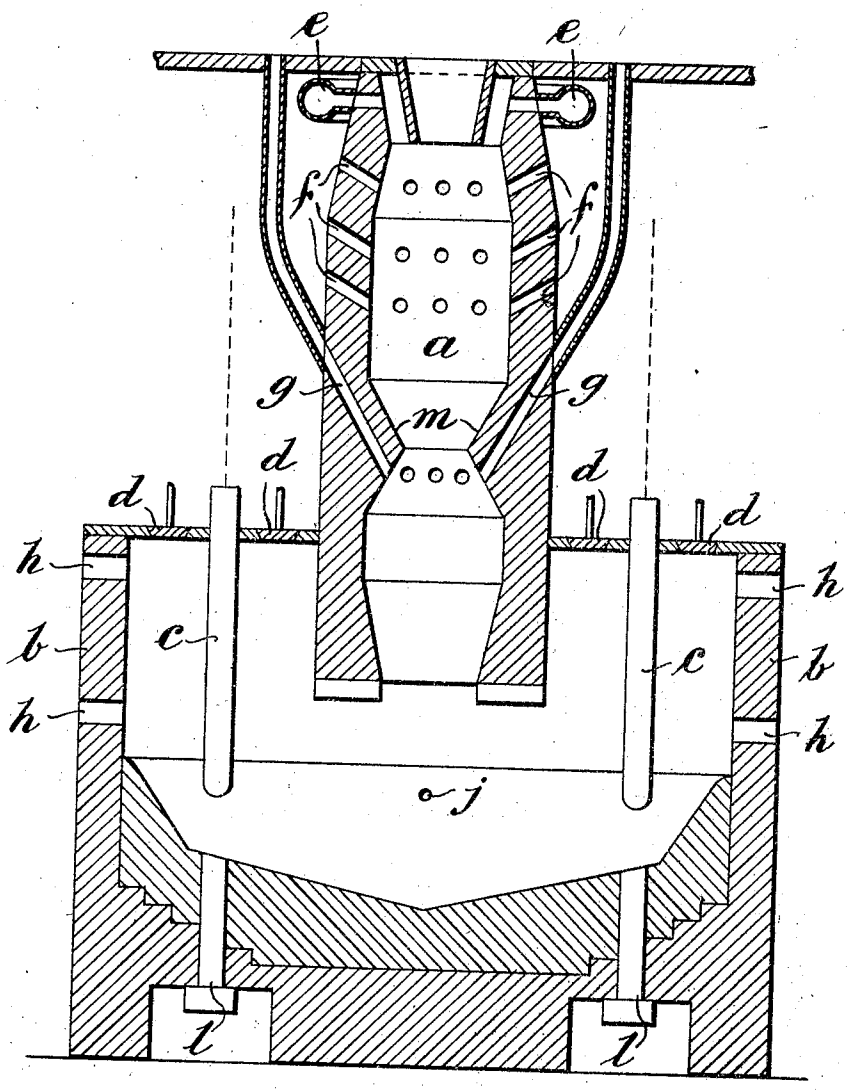

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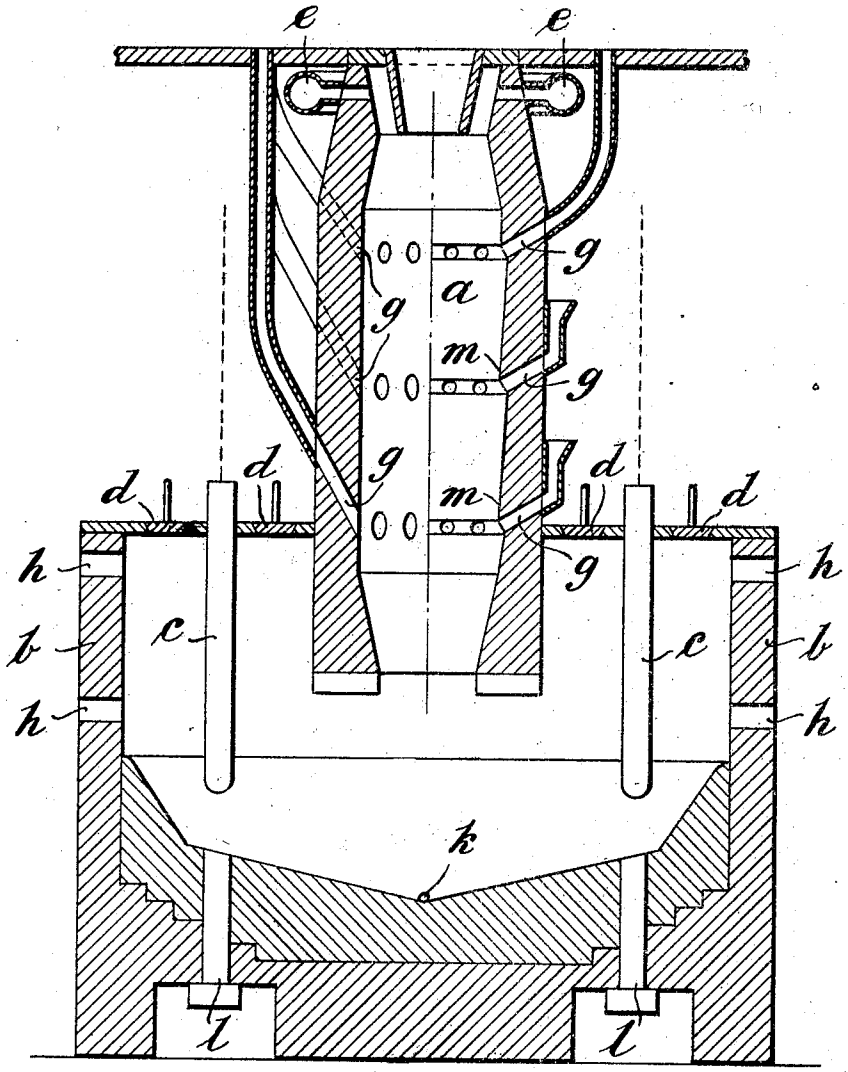
Fig. 3



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UNITED STATES PATENT OFFICE.

FILIP THARALDSEN, OF TRONDHJEM, NORWAY.

METHOD OR PROCESS FOR THE REDUCTION AND SMELTING OF ORE AND ARRANGEMENT THEREFOR.

1,007,990. Specification of Letters Patent. Patented Nov. 7, 1911.

Application filed May 31, 1911. Serial No. 630,384.

To all whom it may concern:

Be it known that I, FILIP THARALDSEN, a subject of the King of Norway, residing at the city of Trondhjem, Norway, have invented certain new and useful Improvements in Methods or Processes for the Reduction and Smelting of Ore and Arrangements Therefor, of which the following is a specification, reference being had therein to the accompanying drawings.

The present electric and ordinary furnaces for reduction and smelting of ores are defective because no means are provided by which the operator is enabled to correct or adjust the composition of the charge in or toward the smelting-zone; a further inconvenience consists in the consumption of the walls of the furnace by the fire. The electric furnaces have the defect that the electrodes are in direct contact with the heated charge, which has passed through the reduction-shaft of the furnace and partly consists of unreduced ore, which causes a great consumption of the elctrodes.

The present invention relates to a method or process and arrangement for effecting such process, for obviating the said drawbacks and consists in, that I add to the charge, which is principally ore, during its passage through the furnace, substances such as reducing-agent and ore, with the object to be able to control the proportion of component parts in the charge toward and in the melting-zone. The reducing-agent is advantageously introduced in such a manner that a layer of the same is formed on the interior side of the wall of the furnace so as to inclose the charge; preferably the said layer is formed so as to increase in thickness toward the melting-zone, for the purpose of protecting the furnace walls, the active gases in the layer of carbon being reduced, thereby relatively lowering the temperature next to the walls. Thus if it appears that an excess of carbon is present in the melting-zone I am able to adjust the proportion of the component parts by introducing ore at the different heights, whereas in the furnaces of the old type such adjustment can only be made in the new charge fed in at the top of the furnace. With regard to electric furnaces I also provide an arrangement so that the electrodes shall lie in a charge composed principally of reducing-agent; by this arrangement the active gases also here must pass through a charge principally composed of reducing-agent. The gases (CO_2) in passing through the carbon-charge near the electrodes, where they are converted to CO, consume heat. The result is obtained that this heat-consuming part of the process (conversion of CO_2 to CO), which thus takes place in that part of the charge, which consists of carbon (reducing-agent), that is, next to the electrodes, keeps the latter relatively cool.

When using electric furnaces I preferably provide one or more separate shafts for the disposition of the electrodes and for supplying or introducing the charge composed mainly of reducing-agent so that it is not necessary for the latter to pass through the main shaft (reduction-shaft) and said charge may consequently be supplied to the electrodes in cold condition. By this provision the electrodes will not be consumed so quickly and the electric current, which passes through the heated material, is concentrated toward the bottom of the furnace. Into said shafts are also introduced gases, which will further lower the temperature by their conversion to CO, all of these features of the process tending to protect the walls and the roofs of the said shafts against melting.

In the appended drawings I show different forms of construction of electric furnaces suitable for carrying out the present method or process, in which:—

Figure 1 is a vertical sectional view of a furnace; Fig. 2 is a vertical sectional view of same at right angles to Fig. 1; and Fig. 3 is a vertical section of a furnace each half showing a different arrangement of the supply passages for the reducing-agent and for the gases to the main shaft.

The furnace has a main shaft *a* (the reduction shaft) and two side-shafts *b*, *b*, in which latter the electrodes *c*, *c* are placed; in the roof of the latter shafts openings *d* are provided for supplying the charge. The main shaft *a* is provided at the top with a pipe *e* or flues for the exit of the waste-gases. I further may, as shown in Fig. 1, provide flues *f* for the introduction of gases; said flues *f* may be provided with dampers or valves for regulating the supply of gases. *g* are flues for the introduction of reduc-

ing-agent or other materials or substances and through said flues I may also introduce gases.

h are openings for introducing such gases as may be suitable.

j and *k* are openings for drawing off the slag and the molten product respectively.

l, *l* are bottom-electrodes; however the latter may be placed in different positions or may even be dispensed with altogether.

By the arrangement of furnace described and shown I am enabled to regulate the proportions of the material in the charge at different steps during the travel of the charge through the furnace in such a manner that the charge at the beginning may consist exclusively of ore (or the material to be reduced) while said charge may be supplied through the flues *g* with reducing-agent and flux if necessary.

In order to insure that the materials introduced through the flues *g* shall enter freely into the shaft *a* I arrange projections *m* so as to provide free spaces just above the mouth of the flues.

I claim:

1. Method or process of reducing and smelting ores, which consists in feeding a charge consisting principally of ore into the top of a suitable furnace, supplying charges of solid material comprising a reducing agent to said first named charge during the passage of the latter through the furnace at points near the melting zone, so as to control the proportions of ore and reducing agent required in the charge toward and within the melting zone, and at the same time feeding in said charge comprising the reducing agent so that it forms a layer on the interior side of the furnace which forms an envelop entirely surrounding or inclosing the central charge consisting principally of ore.

2. Method or process of reducing and smelting ores, which consists in feeding a charge consisting principally of ore into the top of a suitable furnace, supplying charges of solid material comprising a reducing agent to said first named charge during the passage of the latter through the furnace at points near the melting zone, so as to control the proportions of ore and reducing agent required in the charge toward and within the melting zone, and at the same time feeding in said charge comprising the reducing agent so that it forms a layer on the interior side of the furnace entirely surrounding or inclosing the central charge consisting principally of ore, and forming said layer containing reducing agent so that it increases in thickness toward the melting zone, for the purpose of protecting the furnace walls, the active gases in the layer being reduced, whereby the temperature next to the walls is lowered.

3. Method or process of reducing and smelting ores, which consists in feeding a charge consisting principally of ore into a suitable furnace, supplying charges comprising a reducing agent to said first named charge after it has entered the furnace at points below the region of entrance of said first named charge, so as to control the proportions of ore and reducing agent required in the charge toward and within the melting zone, and at the same time forming a layer consisting of said second named charge on the interior side of the wall of the furnace so as to entirely surround or inclose said first named charge which latter consists principally of ore, and introducing additional charges of reducing agent into the furnace.

4. Method or process of reducing and smelting ores, which consists in feeding a charge consisting principally of ore into a suitable furnace, and feeding in charges consisting of a reducing agent and ore to all sides of said first named charge at a plurality of points below the region of entrance of said first named charge during its passage through the shaft of the furnace, so as to regulate the proportions of ore and reducing agent required in the charge toward and within the melting zone, and supplying additional charges consisting of reducing agent into the furnace.

5. Method or process of reducing and smelting ores, which consists in feeding a charge consisting principally of ore into a suitable furnace, supplying charges consisting of a reducing agent and ore to said first named charge at different levels and at points below the region of entrance into the furnace of said first named charge during its passage through the shaft of the furnace so as to regulate the proportions of ore and reducing agent required in the charge toward and within the melting zone, and introducing said second named charge so as to form an outer layer of approximately circular shape completely surrounding or inclosing said first named charge, and at the same time forming said layer so that it will increase in thicknes stoward the melting zone of the furnace, and supplying additional charges consisting of reducing agent into the furnace.

6. Smelting furnace comprising a main shaft, a side shaft having communication with said main shaft, electrodes disposed in said side shaft, the latter being provided with openings for supplying charges in the region of the electrodes, and flues for the introduction of reducing agent or other materials into said main shaft at points below the region of entrance into the shaft of the main charge.

7. Smelting furnace comprising a main shaft, two side shafts one to each side of

the main shaft and having communication with the latter, electrodes disposed in each side shaft, the latter being provided with openings for supplying charges of reducing agent to the region of the electrodes, and flues for the introduction of reducing agent or other material into said main shaft at points below the region of entrance into the shaft of the main charge.

8. Smelting furnace comprising a main shaft, two side shafts one to each side of the main shaft and having communication with the latter, electrodes disposed in each side shaft, the latter being provided with openings for supplying charges of reducing agent to the region of the electrodes, flues for the introduction of reducing agent or other materials into said main shaft at points below the region of entrance into the shaft of the main charge, and projections on the interior walls of the main shaft in which said flues have their inlet openings.

9. Smelting furnace comprising a main shaft, two side shafts one to each side of said main shaft and having communication with the latter, electrodes disposed in said side shafts, the latter being provided with openings for supplying charges to the region of the electrodes, each of the said side shafts being provided with openings for the introduction of gases, flues for the introduction of reducing agent or other materials into said main shaft at points below the region of entrance into the shaft of the main charge, and flues for the introduction of gases into the main shaft.

10. Smelting furnace comprising a main shaft, two side shafts one to each side of the main shaft and having communication with the latter, electrodes disposed in said side shafts, the latter being provided with openings for supplying charges of reducing agent to the region of the electrodes, and each side shaft being further provided with openings for the introduction of gases thereto, flues for the introduction of reducing agent or other materials into said main shaft at points below the region of entrance into the shaft of the main charge, projections on the interior wall of the main shaft in which said flues have their inlets, and flues disposed above said last named flues for the introduction of gases into the main shaft.

In testimony whereof I affix my signature in presence of two witnesses.

FILIP THARALDSEN.

Witnesses:
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C. AUP. ABRAHAMSERS.