C. B. HILLHOUSE.

ART OF REDUCING METAL ORES AND FUSING OTHER MATERIALS.

APPLICATION FILED NOV. 25, 1912.

1,193,783.

Patented Aug. 8, 1916.

2 SHEETS—SHEET 1.

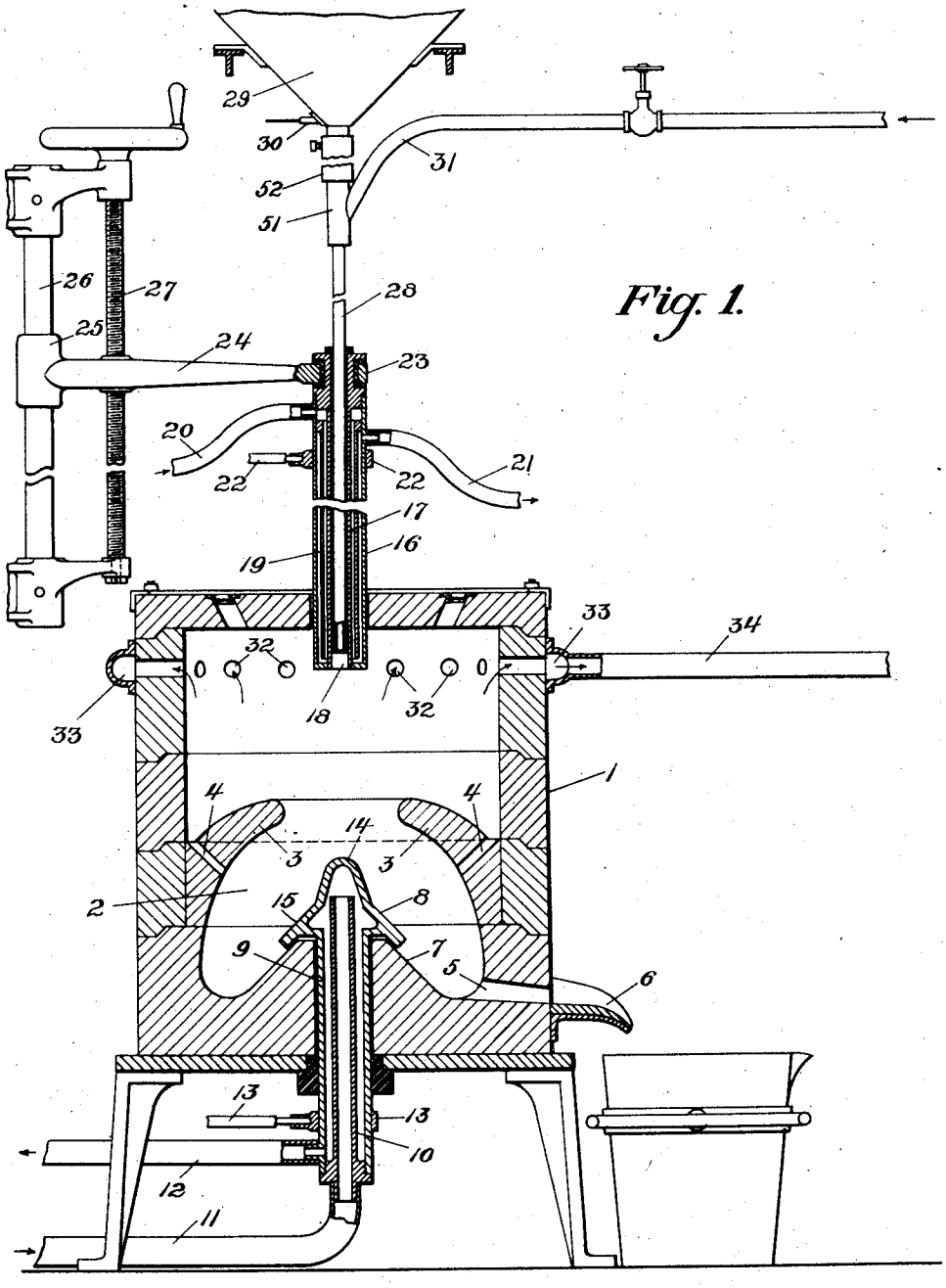


Fig. 1.

Witnesses:
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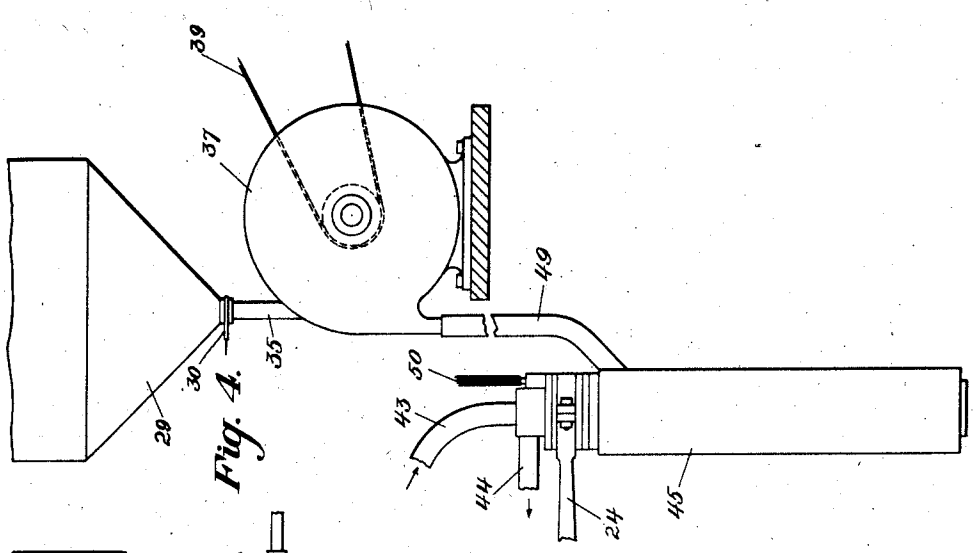


Fig. 4.

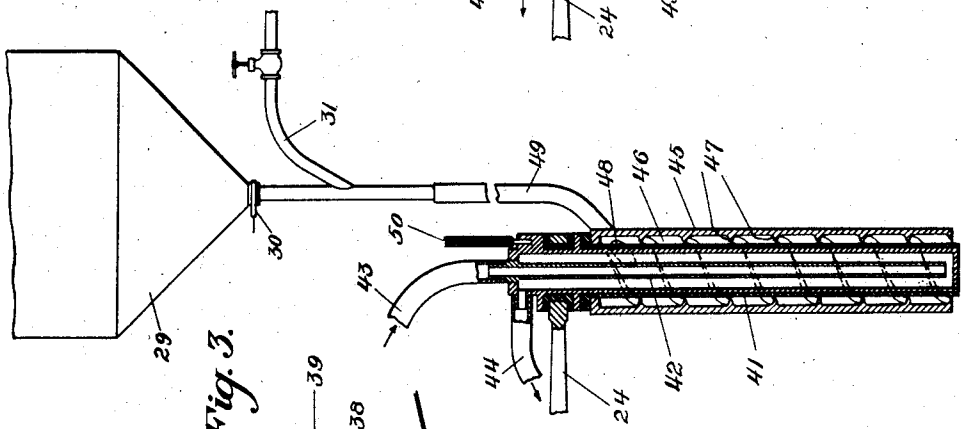


Fig. 3.

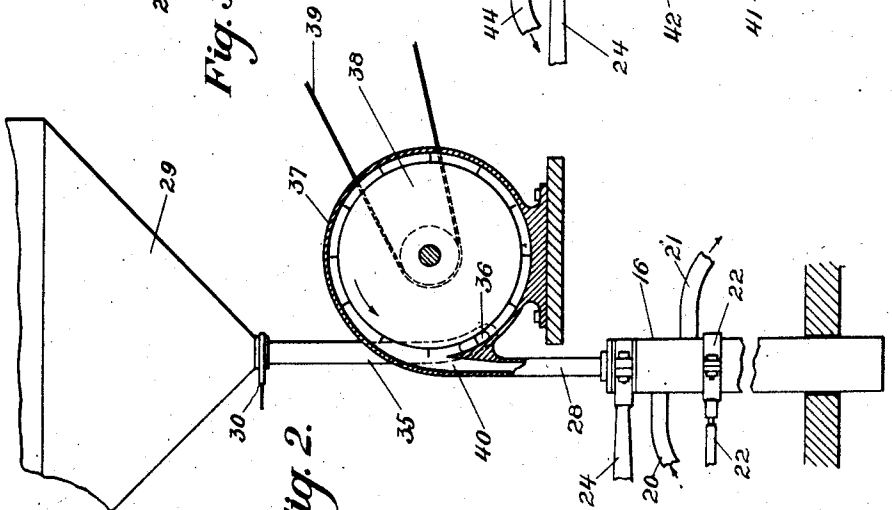


Fig. 2.

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UNITED STATES PATENT OFFICE.

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ART OF REDUCING METAL ORES AND FUSING OTHER MATERIALS.

1,193,783. Specification of Letters Patent. Patented Aug. 8, 1916.

Application filed November 25, 1912. Serial No. 733,303.

To all whom it may concern:

Be it known that I, CHARLES B. HILLHOUSE, a citizen of the United States of America, residing in the borough of Manhattan, city, county, and State of New York, have invented a certain new and useful Improvement in the Art of Reducing Metal Ores and Fusing other Materials, of which the following is a specification.

The process comprising the subject matter of this invention is one in which finely divided ore mixed with flux or reducing agents, as occasion may require, is fed through or along an electric arc or arcs where it is subjected to a sufficient temperature to effect its reduction during transit. The degree of fineness to which the ore is reduced should be appropriately related to the arc area and its intensity. The electric arc or arcs may be arranged horizontally and the comminuted ore passed therethrough vertically, or the arc or arcs may be arranged at various angles through which, vertically or at an angle, the ore may be passed: or, again the arc may be disposed vertically and the ore passed through or along the arc lengthwise. An important feature of the invention is feeding the comminuted ore at accelerated speed beyond that afforded by a mere gravity drop. The apparatus employed may assume a variety of forms although in the drawing but one general arrangement of arc is illustrated.

In the accompanying drawings which show an organization of apparatus appropriate for practising this invention; Figure 1 is a general view partly in elevation and partly in vertical section in which the comminuted ore is fed by an air blast; Fig. 2, a detail elevation partly in section indicating a modification in which the ore is fed at accelerated speed by a centrifugal apparatus; Fig. 3, a modification in the arrangement of one of the electrodes and feed passage for the ore which is indicated as fed by an air blast; and Fig. 4, a side elevation indicating apparatus such as is shown in Fig. 3 except that the ore is fed by a centrifugal apparatus.

Referring to Fig. 1, 1 is a retort that may be built up of sections of appropriate refractory material. In its cover there is centrally disposed an aperture for an electrode and in its bottom there is a co-incident aperture for a corresponding electrode. Around the lower aperture is a depressed annular chamber 2 having an upwardly and inwardly extending overhanging annular wall 3 through which there are apertures 4 of any appropriate number. From the bottom of this chamber opens a discharge passage 5 leading to a chute 6 that discharges into any suitable receptacle. The central elevated floor 7 of chamber 2 is flat and in it is centrally formed the aperture through which the lower electrode passes. This electrode 8 is formed with an exterior shell 9 fitting the aperture in the floor of the retort and an inner tube 10 open at the top and connected for cooling purposes with an inlet water supply 11, a water outlet 12 being connected with the shell or outer tube of the electrode. 13 indicates the electrical connection with the exterior of the electrode. These connections are all located below the bottom of the retort. The electrode head 14 has an annular flange or curtain 15 that extends below the flat floor of the central portion of the chamber 2. The upper electrode comprises an outer shell 16 and an inner shell 17 thus leaving an open central bore or passage way 18. Between the shells 16 and 17 is disposed an annular shell 19. Cooling water is introduced at 20 and withdrawn at 21. 22 indicates the electrical connection with the outer shell 16 of the electrode. It is designed that the electrode shall be movable vertically through the aperture in the top of the retort and to this end it is embraced by a collar 23 from which extends a horizontal arm 24 having a hub 25 that runs on a shaft 26. A screw shaft 27 passing through the arm 24 and provided with an appropriate hand wheel serves to elevate or lower the electrode. Disposed in the central bore 18 of the upper electrode is a feed pipe 28 that receives the comminuted ore with or without flux or reducing agents as may be required. The ore is placed in the hopper 29 which has an ordinary gate valve 30 and below the valve there is introduced an air or other gas jet under appropriate pressure through pipe 31 which may be flexible. The air at appropriate pressure may be taken from any suitable source. In the upper part of the wall or retort are a plurality of apertures 32 opening to an annular chamber 33 on the exterior of the retort and to which is connected a pipe 34 leading to an exhaust fan or other apparatus for removing gases from the retort.

When the arc is established between the

electrodes the finely divided ore is fed, at a speed in excess of that obtainable by gravity, by means of the air jet and is introduced into or to the arc axially thereof. The purpose of accelerating the speed is to increase the out-put of the furnace. So far as I am aware, however, I am the first to pass comminuted ore axially through or along an electric arc or arc area. It is designed that the ore shall be reduced during transit through the arc and that the molten product of the operation shall be drawn from the chamber 2 either continuously or from time to time. The greater the intensity of the arc and the greater its length, the higher the speed at which the comminuted ore may be passed through it and, as before stated, the degree of fineness to which the ore is ground or crushed may be such that the particles thereof will break down or be reduced during transit through or along the arc. The apertures 4 serve to discharge into chamber 2 reduced or melted material that may fall outside of the overhanging wall 3.

The feed pipe at 51 may be formed with a telescoping section 52 to afford adjustment of the feed pipe relatively to the electrode.

The stream of ore, as accelerated by a jet of air or other gas, will make feasible a longer arc than would otherwise be obtainable. The stream of comminuted material may be of any desired cross section.

Referring now to Fig. 2, assuming the apparatus to be as already described except with respect to the air jet, it will be seen that the comminuted ore from the feed pipe 35 is tangentially introduced at 36 into the shell of a centrifugal machine 37 having a driving cylinder 38 with radial plates or blades dividing the annular space between it and the shell. This inner disk or cylinder is driven at appropriate speed by a belt 39 or otherwise and the comminuted ore is discharged tangentially at 40 into the feed pipe 28.

Fig. 3 shows a different construction of electrode there being an outer shell 41 within which is disposed a tube 42. Cooling water enters at 43 to the inner tube and leaves the outer shell at 44. Around the electrode is disposed a shell 45 so spaced as to leave an annular chamber 46 between it and the outer shell of the electrode. The outer chamber is divided into a helical passage way by helical ribs 47 on the interior of the shell 45. Comminuted ore is introduced tangentially into the annular chamber 46 at 48 from which a pipe 49 leading to the hopper and into which below the hopper enters a compressed air jet through pipe 31. In this figure the electrical connection with the electrode is indicated by 50. The ore passes around the outside of the upper electrode and falls on to the lower electrode. The arc or arcs area is determined by the electric current flowing between various portions of the under surface of the upper electrode and lower electrode, so that the ore, etc., is intimately associated with the arc, and is submitted to the full action of the arc as its flow is coincident with the axis of the arc area. The fineness to which the ore is ground or pulverized will be governed by the speed of flow of the ore, the intensity of the current and the length of the arc and its area.

Fig. 4 indicates an apparatus such as is shown in Fig. 3 except that instead of the air jet the centrifugal apparatus 37 is employed to accelerate the speed of the ore. This feature of passing the material through a helical passage, thus causing the stream to flow spirally longitudinally through or along the electric arc, is elaborated and claimed in an application for Letters Patent filed by me July 3, 1913, under Serial No. 777,143.

I claim:

1. An improvement in the art of reducing metal ores which consists in passing finely divided ore at higher speed than that due to gravity axially through or along an electric arc area.

2. An improvement in the art of reducing metal ores which consists in passing finely divided ore at higher speed than that due to gravity axially longitudinally through and along an electric arc.

3. An improvement in the art of reducing material which consists in passing it vertically when comminuted axially through or along an electric arc area at accelerated speed beyond that due to gravity, the axis of the arc being vertically arranged.

4. An improvement in the art of reducing material which consists in passing it by means of a gas under pressure at a speed greater than that due to gravity axially through or along an electric arc area whose axis is vertically arranged, the said material falling upon a surface included in and heated by the arc circuit.

In testimony whereof, I have hereunto subscribed my name.

CHARLES B. HILLHOUSE.

Witnesses:

LAURA E. SMITH,

MILDRED L. SMITH.