the electrodes is about 7 feet high, and is of greater diameter than any other part. The shaft is about 18 feet high, the lower end of which—for about 4 feet—has the form of a truncated cone; for the purpose of directing the charge into the crucible in such a manner that the electrodes, lining, and descending charge, could not come in contact. This special feature in the design was introduced by the inventors after repeated experiments, which demonstrated that the upper surface of the column formed by the materials charged into the furnace assumes a definite angle, viz., 50 degrees to 55 degrees to the vertical, when the materials—crushed to normal size, and at the same temperature as that existing in the melting chamber—are allowed to fall through a circular aperture into a free space. In Fig. 5 the slope is indicated by dotted lines.

It is this isolation of the descending charge from the lining at the point where the electrode enters the furnace that constitues the particular economic advantage of the construction, since it prevents the destruction of the lining, which occurred in all previous furnaces where the electrode came directly in contact with the melting charge and the lining; for the temperature of the brickwork in close proximity to the electrodes becomes so great that the most refractory lining materials are rapidly destroyed—even when the electrodes are cooled by the water jackets.

The contracted neck of the shaft immediately over the central opening into the melting chamber is not supported by the arched roof, but the entire weight of the shaft is carried by six cast-iron columns arranged symmetrically around the furnace hearth.

The melting chamber is made in the form of a crucible, and is covered with an arched roof provided with openings for the reception of the electrodes and descending charge. The roof and walls of the crucible are lined with magnesite.

For the purpose of cooling the brickwork composing the lining of the roof of the melting chamber, and thereby increasing its life, three tuyeres are introduced into the crucible—just above the melting zone—through which the comparatively cool, tunnel-head gases* are forced against the lining of the roof into the free spaces. This gas absorbs heat from the exposed lining of the roof and walls, and the free surface of the spreading charge, thus effectively lowering the temperature of the roof and exposed walls.

With the exception, however, of radiation from the tuyeres, no heat is lost by this method of cooling or lowering of temperature, since the heat given up by the lining of roof and wall to the comparatively cool gas introduced through the tuyeres, is imparted in passing upward through the shaft to the cooler portions of the descending charge. This effects not only a better utilization of the reducing power of the CO, but in addition, produces a better distribution of heat throughout the charge in the shaft than in any electric furnaces previously constructed.

The tuyeres are provided with sight holes, covered with mica, through which the interior surface of the arched roof can be observed. By means of this device it is possible to determine approximately the necessary quantity of gas required to effectively cool the roof lining at the mouth of the melting chamber.

Each electrode was built up from two carbons 11 inches square × 63 inches long, making the total cross section of the built-up electrode 11 inches × 22 inches. The electrode holder is made of a strong steel frame, forming a support for the wedges by means of which the copper plates conducting the current from the copper cables are pressed against the faces of the electrode. The electrode is clamped in the steel frame mentioned above, and slides on two guides, which serve the two-fold purpose of keeping the angle of inclination to the vertical constant and relieving the arched roof of any undue strain which would arise from the weight of the electrode—if insufficiently supported. A steel cable, secured to the top of the electrode holder and passing over a system of guide wheels or pulleys to the drum operated by the hand-wheel on the switchboard, serves to lower and raise the electrode, by winding or unwinding the drum. In order to protect the parts of the electrodes outside the furnace from the oxidizing action of the air, a suitable covering is provided.

The water-cooled stuffing boxes, through which the electrodes enter the melting chamber, are provided with special devices (not shown on the drawing) for preventing the gas under pressure within the melting chamber from leaking out around the electrodes.

The shaft—as previously mentioned—is supported by an iron plate, resting on six cast-iron pillars arranged symmetrically around the furnace hearth. To prevent the pillars from being cut off in the event of the molten iron accidentally finding its way to them, the lower parts are protected by sand enclosed in a sheet-iron casing. This mode of construction enables the operator to repair or replace—without removing the shaft—those parts of the furnace needing the most frequent repairs, viz., the lower part of the shaft, and the melting chamber.

In order to collect the waste gases at the throat of the furnace—with the object of utilizing them economically for the purposes specified, and at the same time to protect the charcoal fuel from premature combustion—the top of the shaft is closed by an iron cover, fitted with a charging bell and hopper, covered in by means of a specially constructed sheet-iron hood, designed to prevent gas explosions caused by the intrusion of atmospheric air into the shaft when a charge is being introduced.

The collected gases at the throat of the furnace are discharged into a downcomer pipe, provided with a dustcatcher, from which the gases—largely denuded of dust—are drawn by means of a fan, and forced down into the smelting chamber through the tuyeres. With a view of preventing excessive pressure in the interior of the furnace, an uptake pipe—provided with loaded, self-closing valve—is placed at the junction of the outlet pipe and top of downcomer, for conducting the gases generated in the furnace (when the pressure reaches a certain point) to apparatus designed for the utilization of the waste gases, or to the atmosphere.

Raw Materials Used.—The iron ore placed at the disposal of the inventors for the trial run was magnetite from Grängesberg, and had the following compostion:—Fe_3O_4, 66.46 per cent.; Fe_2O_3, 21.21 per cent.; MnO, 0.30 per cent.; MgO, 0.98 per cent.; CaO, 3.84 per cent.; Al_2O_3, 1.07 per cent.; SiO_2, 3.16 per cent.; P_2O_5, 2.34 per cent.; S, undetermined; metallic iron, 62.96 per cent.

During the first part of the trial run, coke containing 85 per cent. C and 0.55 per cent. S was used. This, however,

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* During the run of the furnace now in progress (July 7) an examination of the tunnel-head gases was made, resulting as follows:—The escaping gases were kept (by regulating the circulation) at a temperature of 200° to 300°; and the following is an analysis when using:—

Hematite:	Per Cent.	Magnetite:	Per Cent.
CO_2	40	CO_2	25
CO	50	CO	65
H	10	H	10