No. 889,431. PATENTED JUNE 2, 1908.

K. BIRKELAND & S. EYDE.

FURNACE FOR METALLURGICAL AND SMELTING PURPOSES.

APPLICATION FILED JAN. 6, 1906.

4 SHEETS—SHEET 1.

Fig. 1

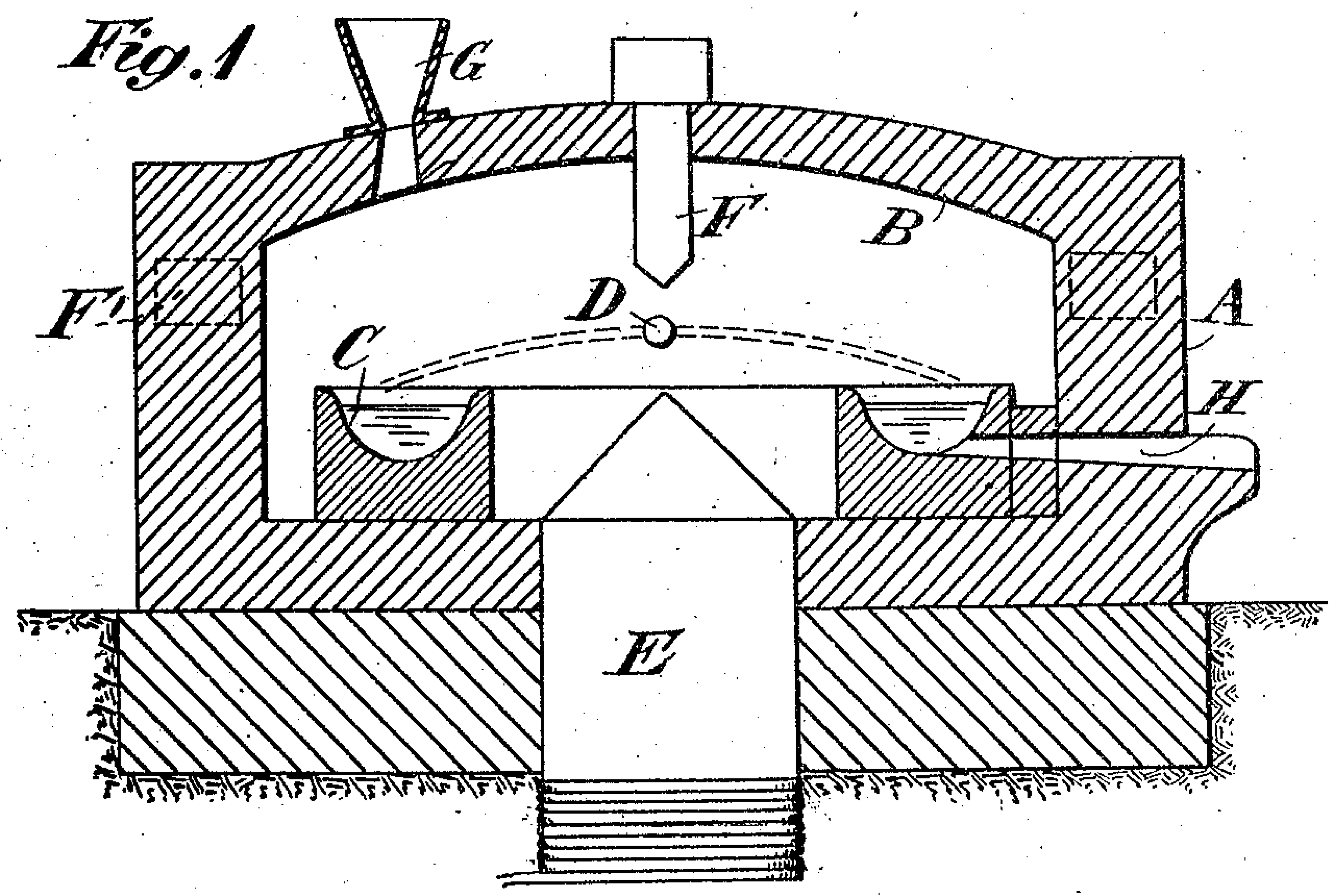
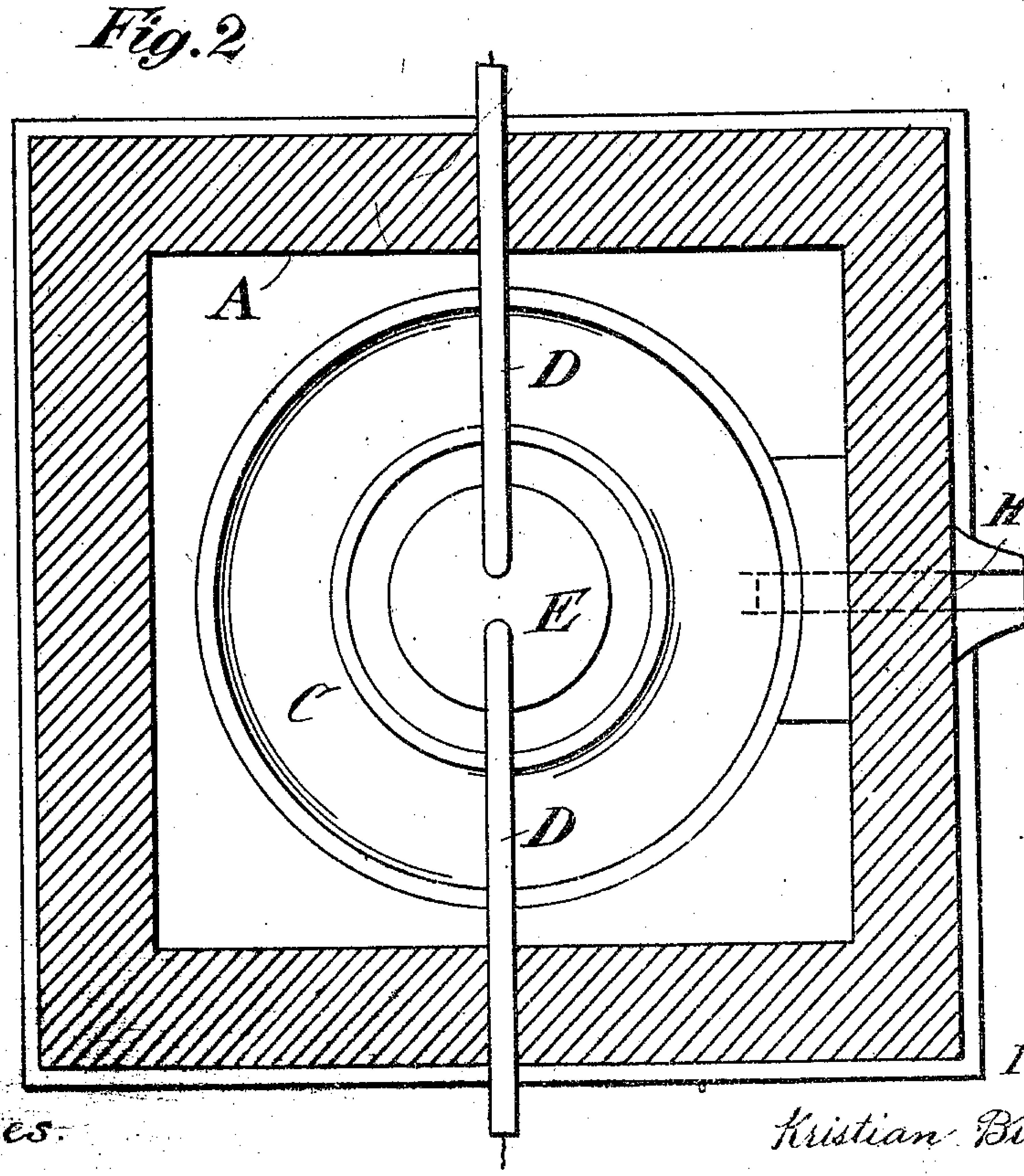


Fig. 2



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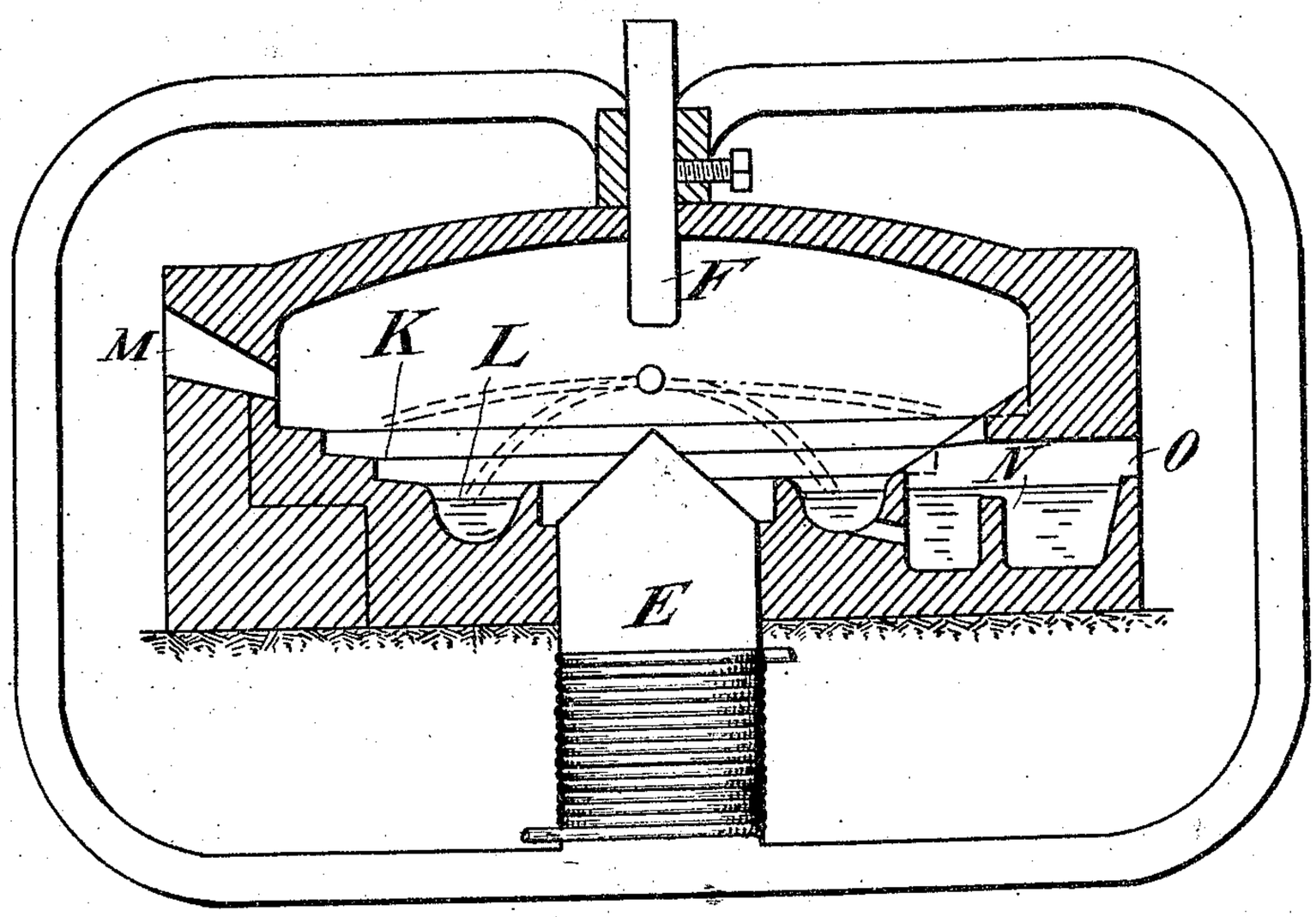
4 SHEETS—SHEET 2

Fig. 3



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4 SHEETS—SHEET 3.

Fig. 4

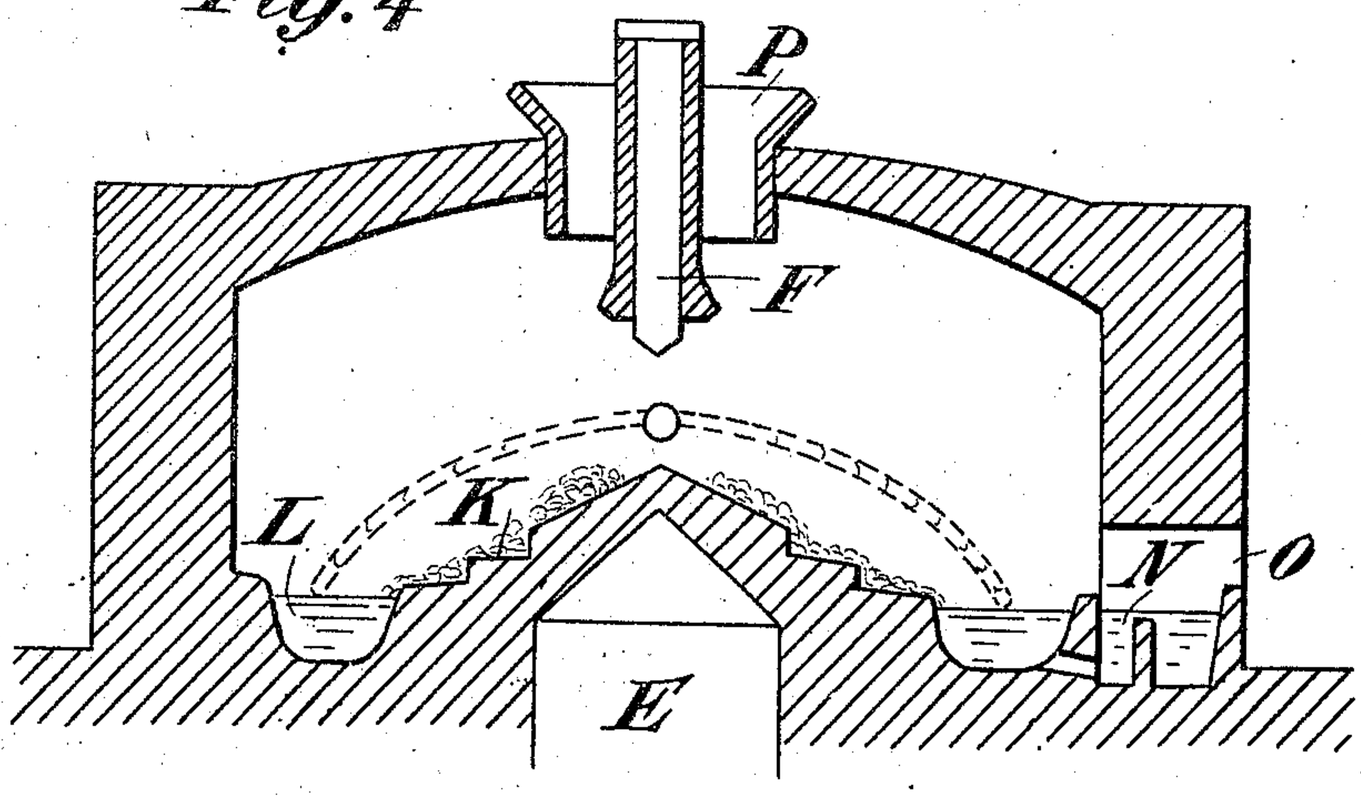
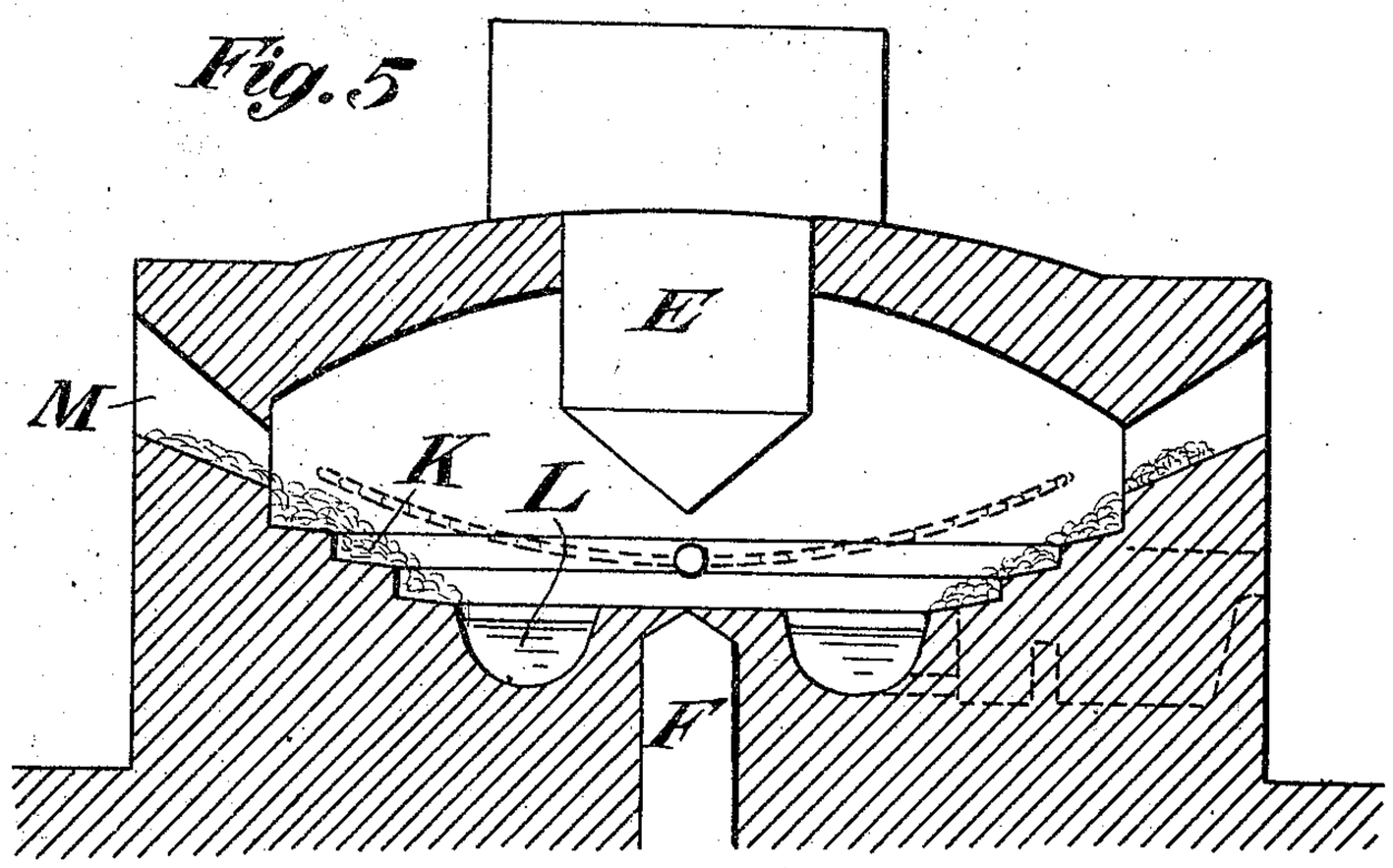


Fig. 5



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FURNACE FOR METALLURGICAL AND SMELTING PURPOSES.

APPLICATION FILED JAN. 6, 1906.

4 SHEETS—SHEET 4.

Fig. 6

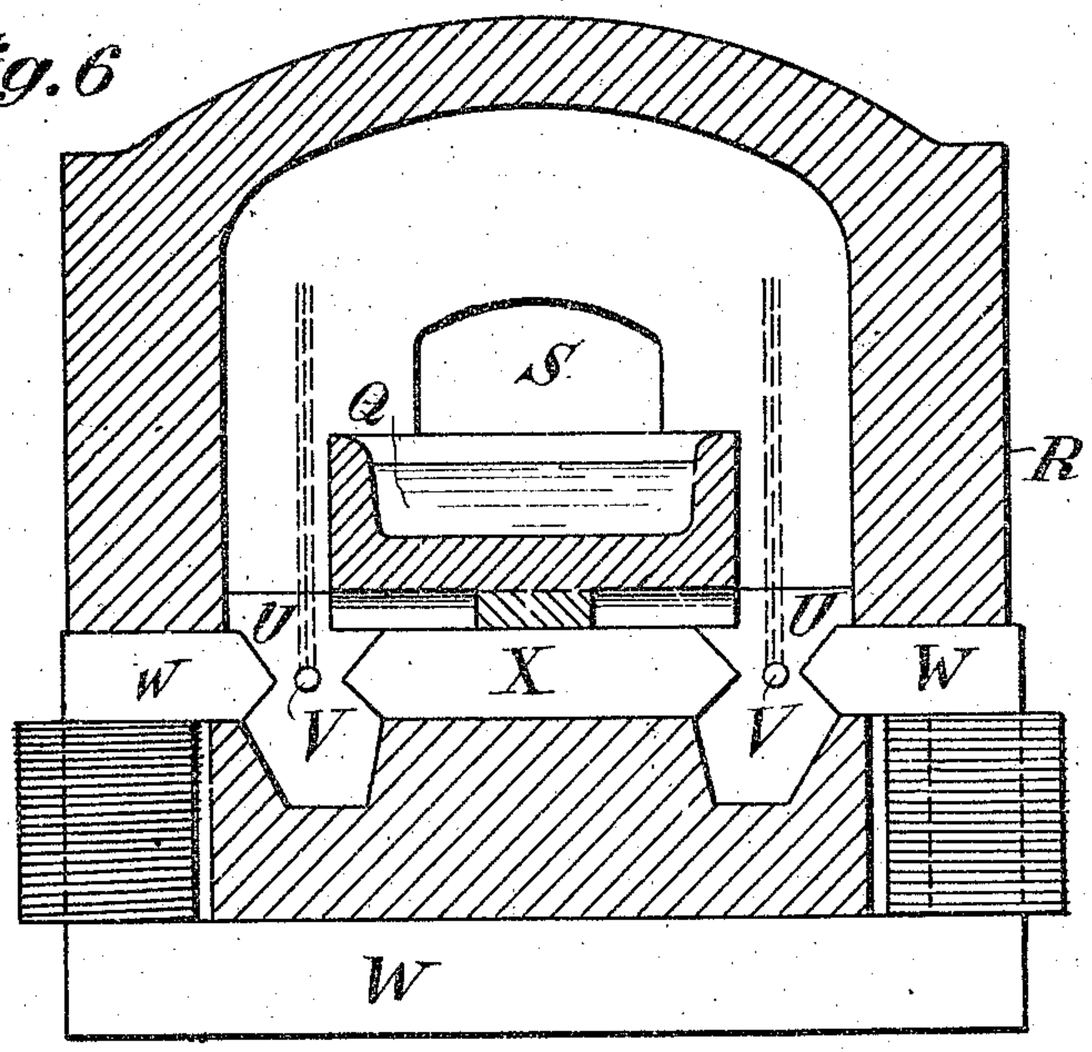
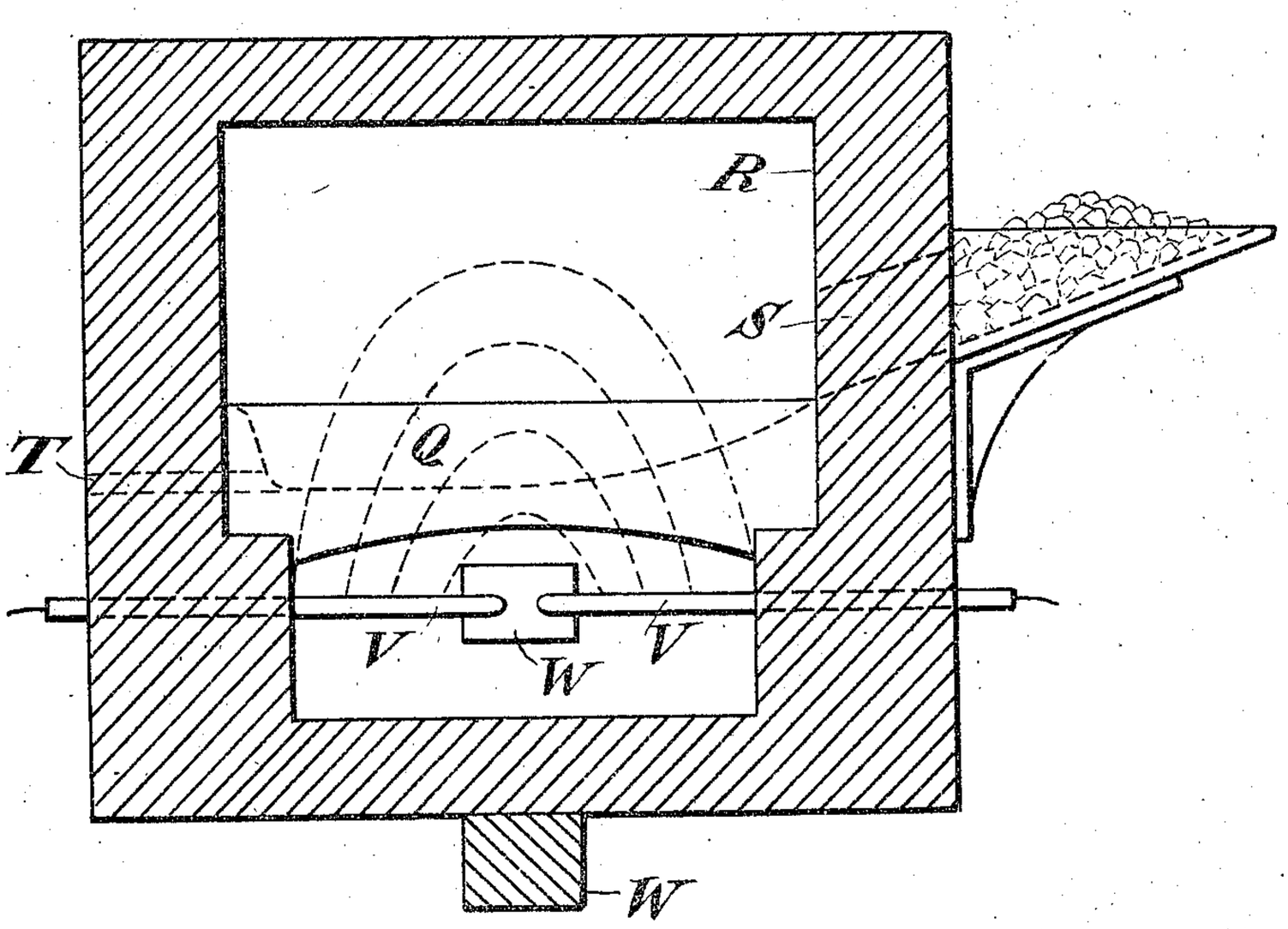


Fig. 7



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UNITED STATES PATENT OFFICE.

KRISTIAN BIRKELAND, OF LYSAKER, NEAR CHRISTIANIA, AND SAMUEL EYDE, OF CHRISTIANIA, NORWAY.

FURNACE FOR METALLURGICAL AND SMELTING PURPOSES.

No. 889,431. Specification of Letters Patent. Patented June 2, 1908.

Application filed January 6, 1906. Serial No. 294,900.

To all whom it may concern:

Be it known that we, KRISTIAN BIRKELAND and SAMUEL EYDE, subjects of the King of Norway, residing, respectively, at Lysaker, near Christiania, and at Christiania, Norway, have invented certain new and useful Improvements in Furnaces for Metallurgical and for Smelting Purposes; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Our invention relates to furnaces for metallurgical and for smelting purposes, such as are used in the treatment of ores to produce metals or for smelting glass.

More especially our invention relates to such furnaces in which the treated solid matter is exposed to the action of an electric arc.

The object of our invention is to improve the efficiency of this kind of furnaces and to so arrange the electric arc, that a great quantity of material may be effectively acted upon and heated by means of only a single set of electrodes. For this purpose we make use of an electric arc of the peculiar shape and nature obtained by passing a high tension current between electrodes so placed in a strong magnetic field, that the points of the electrodes are in near proximity to each other. The especial nature of the arc thereby obtained, which as explained in prior patents enables us to obtain a constant disk shaped flame of a diameter of 3 or 4 feet or even more on a single pair of electrodes and keep it burning for days and weeks without injury to the electrodes, makes it very useful in smelting operations; this not only because of its great surface of radiation and the fact, that its energy is to a great extent concentrated in the periphery, but also for the reason that the electrodes may be so placed that they are out of the way from the smelting zone proper and can not get injured by the handling of the material.

Our invention also comprises a special arrangement of the magnetic field whereby the form of the disk flame may be modified to take a more or less spherical or vault shaped form, which shape may for the purposes of this invention be more suitable than a plane disk. This spherical shape of the flame is produced by means of a magnetic field, in which the lines of force are not symmetrically distributed relatively to the flame; such field can be obtained by disposing inducing members of less capacity on one side of the electrodes than on the other as will be hereinafter explained.

Other features of our invention will be explained with reference to the annexed drawings in which:

Figure 1 is a vertical and Fig. 2 a horizontal section of a metallurgical or smelting furnace; Figs. 3, 4 and 5 show vertical sections of three different forms of modified furnaces, chiefly designed for glass melting and the like. Figs. 6 and 7 are cross-sections, taken from opposite directions, of a furnace having a flame arranged in a substantially vertical plane.

In Figs. 1 and 2 A is a furnace closed by a vault shaped roof B.

C is an annular hearth or smelting channel. Above the hearth are mounted two electrodes D, placed diametrically in the furnace. In the center of the furnace sole the pole E of a powerful magnet is arranged; F is a smaller magnet mounted in the roof of the furnace.

G is a feed-chute and H a tap hole; there may be arranged several chutes and tap-holes.

There may be placed an iron ring F′, indicated in dotted lines in the masonry work of the furnace, which ring will increase the magnetic action in the peripheral parts of the furnace.

When the current on the electrodes as well as on the magnet coils is suitably regulated, the flame may be brought to take a form as indicated in dotted lines, so that it plays nearly all round the annular channel and in close proximity to the material. The annular channel may be continuous all round or made in two halves.

In the form shown in Fig. 3 there is ar-

ranged a sloping terrace-formed annular hearth K outside of the annular channel L. The material is brought in on the uppermost step of the terrace, through several openings M and the material thereupon in a molten state runs down from step to step till it reaches the channel L and is thereby exposed to the action of the flame; in this instance a pulsatory magnetic field is or may be made use of, whereby the flame may be caused to vibrate or swing up and down as indicated by dotted lines. The flame or the peripheral part of the same is thereby brought very near to the material flowing down the terrace steps in thin streams, so that a very energetic action is obtained.

N is a chamber into which the molten mass runs from the channel L and from which it may be taken out through the opening O. The bottom and top magnets are shown connected with arms whereby a concentration of magnetic lines of force is obtained.

In the modification shown in Fig. 4 the electrodes and the magnetic system are arranged in a similar way as in the previous figures, but the hearth is so arranged, that the annular channel forms the peripheral part of the furnace, while the terrace-shaped part of the sole is placed inside of the annular channel. The material is fed down on the hearth through a chute P around the top magnet which latter is protected by a suitable refractory covering. As will be seen from the drawing the material will by this arrangement of the hearth be fully covered by the vault-shaped flame and a very energetic heating is thereby obtained.

In Fig. 5 we show an arrangement which is different from the one shown in Fig. 3 in that the strongest magnet is placed on the top whereby the flame will turn its convex side downwards.

It may be convenient in the furnaces described to place the electrodes at an angle with each other so that they obtain a position substantially parallel to the sloping sole.

In Fig. 6 and 7 we show a furnace having the flame arranged in a substantially vertical plane. In this form of furnace a smelting hearth Q is arranged in the longitudinal axis of the furnace R. In one end of the furnace there is formed an opening S through which the raw material is fed into the furnace and in the other end there is a taphole T. On both sides of the hearth there is a free space U in each of which a pair of electrodes V are arranged so that a vertical or substantially vertical flame as indicated with dotted lines is formed. The magnet system consists of the horseshoe-formed electro-magnet W and a piece of iron on X placed underneath the hearth. The current on the electrodes and on the magnet windings is so arranged as to cause the flame only to be formed on the top side of the electrodes. The flame will partly directly heat the sides of the hearth, partly radiate heat on the material on the hearth, and partly create an upgoing stream of hot air, which will be reflected down on the material from the roof of the furnace.

Claims.

1. In an electric furnace, electrodes, means to produce an arc between the ends of the latter, a hearth adjacent the arc gap between the electrodes but not immediately below the same, means to prevent material fed thereon from coming into contact with the arc ends of the electrodes and means to spread the arc over the hearth.

2. In an electric furnace, a pair of electrodes, means to produce a strong magnetic field varying in intensity between the field producing means, the arc gap between the electrodes at substantially the center of said field, and a hearth situated to one side of the arc gap and magnetic field center and within the field and influence of the spread arc.

3. In an electric furnace, a pair of electrodes, means to produce an arc between the ends of the latter, a hearth adapted to prevent material fed thereon from coming into contact with the arc ends of the electrodes, and magnets of different intensity adapted to spread the arc over the hearth.

4. In an electric furnace, a pair of electrodes, means to produce an arc between the ends of the latter, a hearth beneath both electrodes having a channel therein surrounding said ends, a plurality of steps concentric with the channel, means to feed material onto the steps, and means to spread the arc over the material.

5. In an electric furnace, a channeled annular hearth, a pair of electrodes having their ends extending over the center thereof, means for feeding raw material onto the hearth, means to produce an arc between the electrodes, and magnets mounted centrally of the hearth adapted to spread the arc over the hearth.

6. In an electric furnace, a hearth having a central aperture, a pair of electrodes projecting over the aperture, means to produce an arc between the electrodes, and magnets mounted above and below the apertures adapted to spread the arc over the hearth.

7. In an electric furnace, a hearth having a central aperture, a pair of electrodes projecting over the aperture, means to produce an arc between the electrodes, and magnets of unequal intensity mounted above and below the apertures, for the purpose specified.

8. In an electric furnace, a hearth having a central aperture and a concentric channel in the hearth surrounding the aperture, a plurality of steps surrounding the channel, a

pair of electrodes having their ends projecting over the aperture, means to produce an arc between the electrodes, means to feed raw material onto the steps of the hearth, a magnet mounted centrally of the aperture, and a magnet of greater intensity than the aforesaid magnet mounted above the latter.

In testimony that we claim the foregoing as our invention, we have signed our names in presence of two subscribing witnesses

KRISTIAN BIRKELAND.
SAMUEL EYDE.

Witnesses:
HENRY BORDEWICH,
MICHAEL ALGER.