No. 660,043.

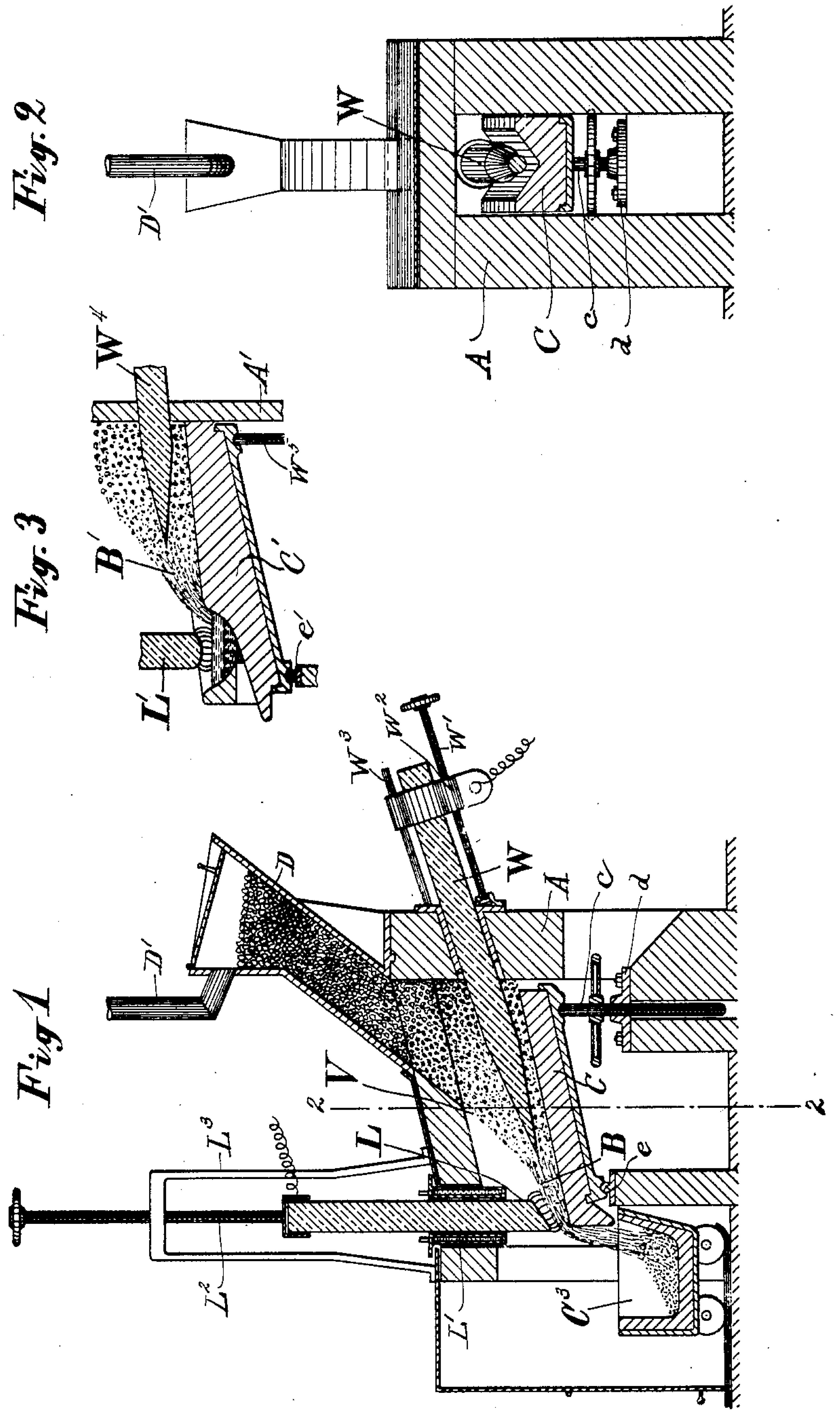
Patented Oct. 16, 1900.

W. BORCHERS.
ELECTRICAL FURNACE.

(Application filed Dec. 22, 1898.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses

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Fig. 5

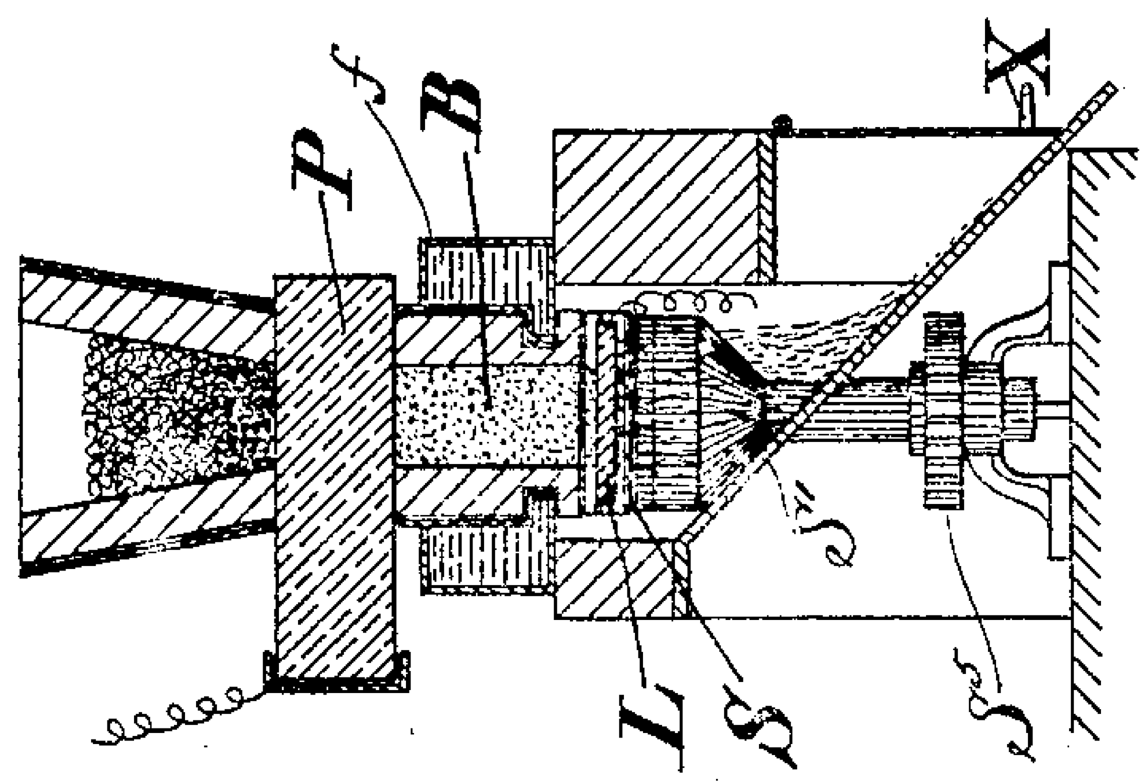
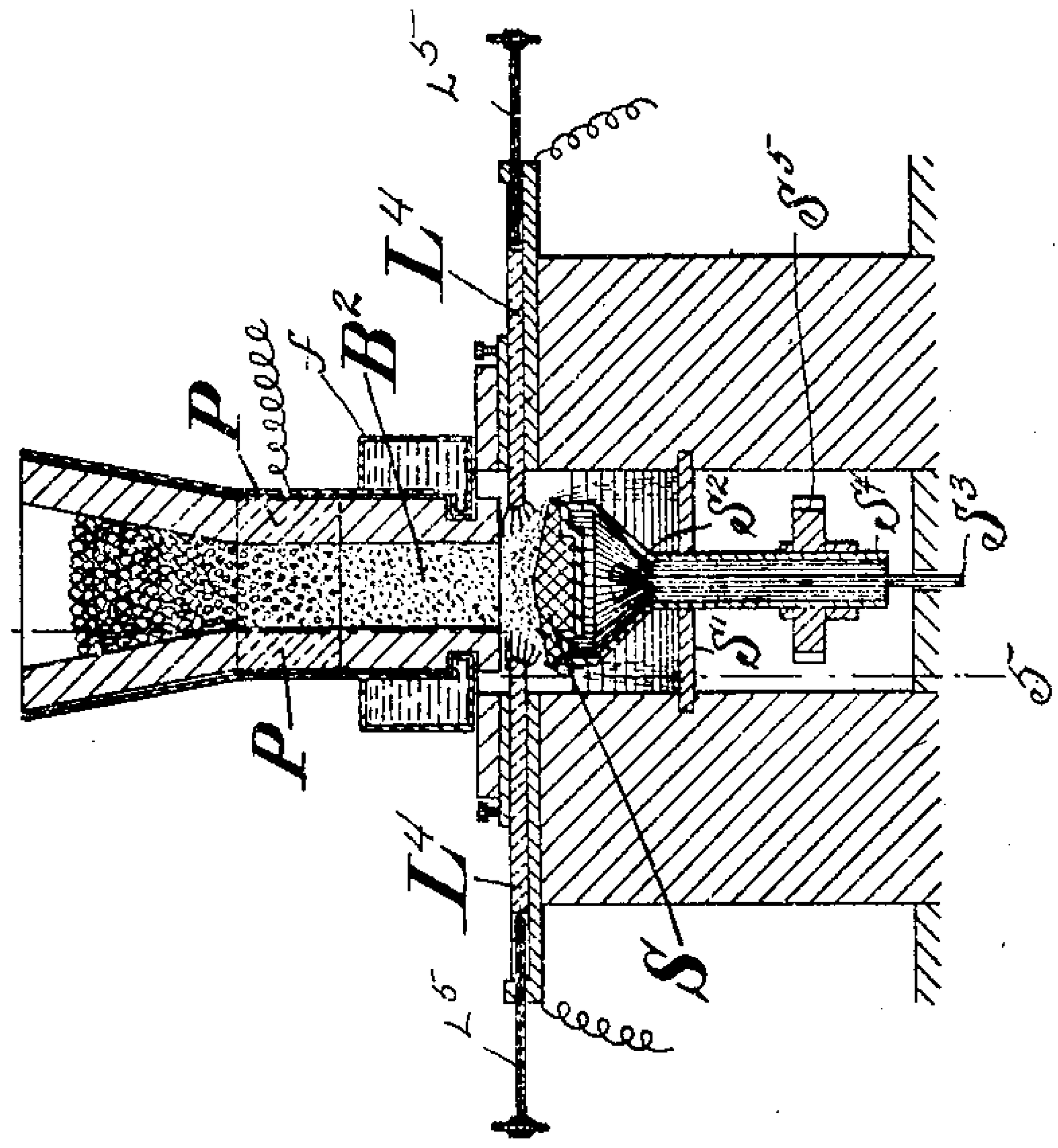


Fig. 4



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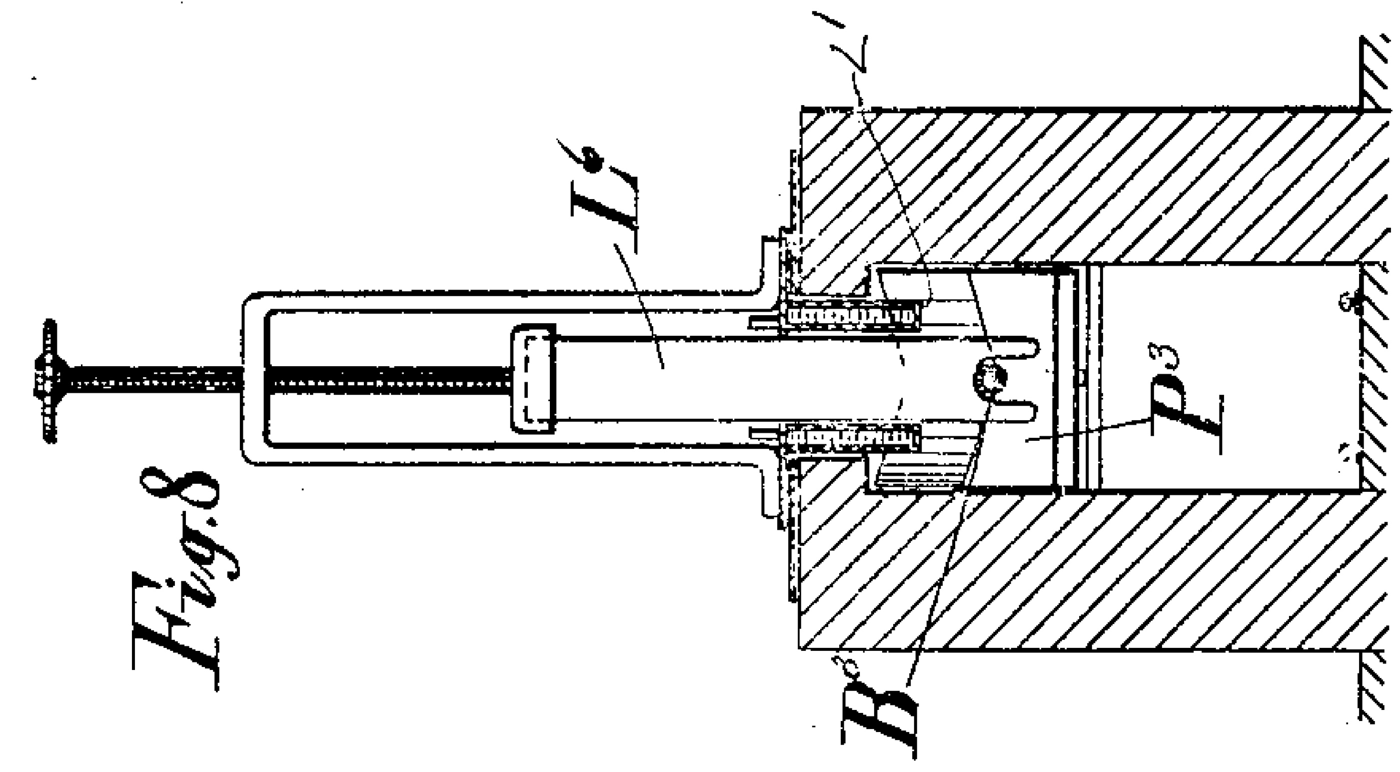

Fig. 8

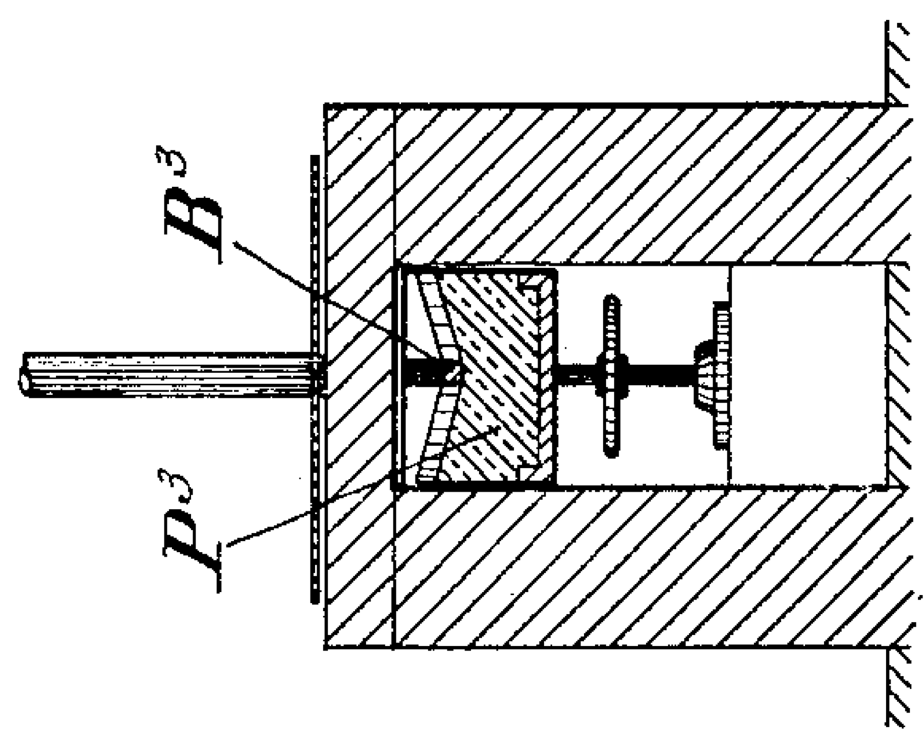

Fig. 7

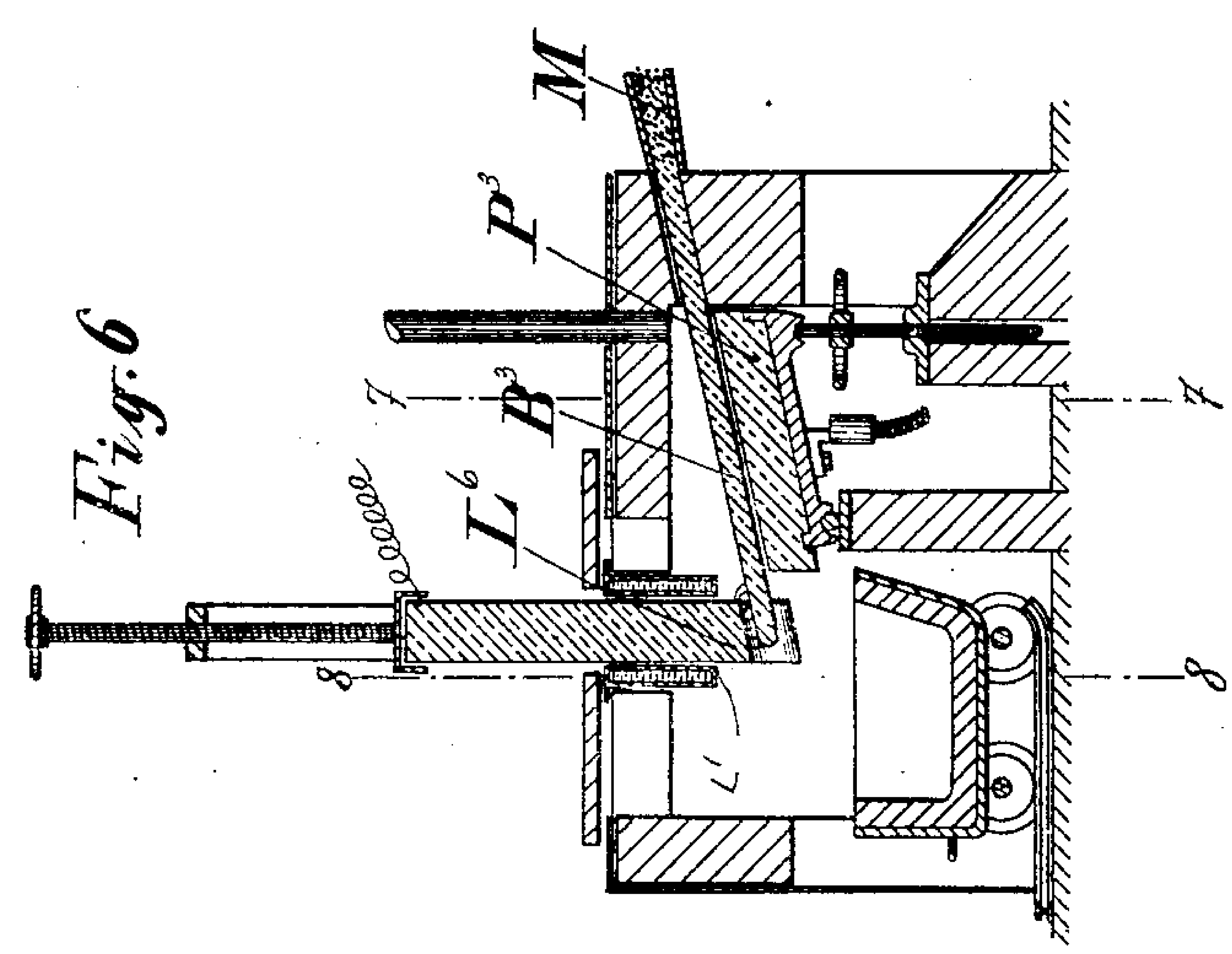

Fig. 6

Witnesses

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UNITED STATES PATENT OFFICE.

WILHELM BORCHERS, OF AACHEN, GERMANY.

ELECTRICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 660,043, dated October 16, 1900.

Application filed December 22, 1898. Serial No. 700,018. (No model.)

To all whom it may concern:

Be it known that I, WILHELM BORCHERS, a subject of the Emperor of Germany, residing at Aachen, Germany, have invented Improvements in Electrical Furnaces, of which the following is a specification.

This invention has for its object to provide a new and improved apparatus for electrically heating compact or pulverized materials or substances, and this object is accomplished in the manner and by the means hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical central sectional view of an electric furnace embodying my invention. Fig. 2 is a sectional view taken on line 2 2, Fig. 1. Fig. 3 is a detail sectional view of a modification hereinafter explained. Fig. 4 is a vertical transverse sectional view showing another modification. Fig. 5 is a sectional view taken on the line 5 5, Fig. 4. Fig. 6 is a vertical sectional view showing still another modification. Fig. 7 is a sectional view taken on the line 7 7, Fig. 6; and Fig. 8 is a sectional view taken on the line 8 8, Fig. 6.

According to my invention the materials or substances to be electrically heated in an uninterrupted manner are first subjected to a preliminary heating effect and subsequently presented to the fusing zone produced by electrodes and proper electric connections. This order of procedure can be carried into effect through the medium of any one of the furnaces illustrated in the accompanying drawings and hereinafter described.

The construction of electric furnaces as at present employed is based upon the following principles: The substance to be heated itself forms the heating resistance, or is brought into contact with an electrically-heated resistance, or forms one or both poles of an electric arc, or is placed in a chamber heated by independent arcs. Now in all cases where it was found necessary to heat a substance by the electric arc the following defects could not be entirely overcome when using furnaces of the kind heretofore constructed for this purpose. For example, the heat generated by the arc was distributed over a too-limited space. The distribution of this heat by the grouping of several smaller arcs in or around the substances to be fused presented great difficulties as regards the regulation of these arcs. Moreover, it frequently occurred that in the case of difficultly-fusing substances, in view of the reduced area of radius within which the heat acted, the electrodes became welded or stuck to the substances treated or to other parts. Notwithstanding the many reactions taking place in electric furnaces that are mainly owing to the sudden nature of the heating, yet it occasionally occurred—for example, in the heating of continuous bands or slabs of material, such as hereinafter referred to—that a too-rapid change of temperature—for instance, from the normal to the assumed temperature of 3,500° centigrade of the arc—was either injurious or undesirable. If, therefore, in the case of reactions in electric furnaces a preliminary heating of the charge is not only not injurious, but even advantageous, or if in the case of more easily fusible substances it should be desired to keep the fused product heated when leaving the zone of the arc, I can by combining both heating methods apply the advantages of resistance heating (consisting in facilitating the distribution and regulation of heat) to arc-furnaces.

In Figs. 1 and 2 I show an electric furnace for producing calcium carbid. The letter A indicates the furnace structure, having an inclined hearth C pivotally mounted at it lower end on a pivot-bearing *e*, so that it can be more or less inclined relative to the inclined electrode W by means of a screw *c*, working in a nut *d*. The material B to be electrically heated descends by gravity into and through chamber V from a hopper D, through which the hot gases of reaction ascend and effect a preliminary heating of the charge prior to the latter reaching and being smelted at the zone of the arc produced between the vertical electrode L and inclined electrode W. The gases may escape through the flue or pipe D′. The electrode L is adjustable vertically in a stuffing-box L′ by means of the screw L^2, working in a nut in the frame L^3. On starting the apparatus the electrode W, which is later on to serve as the heating resistance, is moved by screw W′ so close to the electrode L that the arc is struck. It is then withdrawn, whereupon, in the case of charges capable of conducting or capable of becoming conductive in the presence of heat, that portion of the charge B which lies between the electrodes W and L will come into the circuit and at its extreme end will form a counter-electrode to L. The screw W′ engages a clip W^2, secured to the electrode W and movable on a guide W^3, whereby said electrode can be moved back and forth or adjusted as above set forth. The gradually-tapering electrode W and the charge B constantly decrease in cross-sectional area as they approach the electrode L, and hence the resistance proportionately increases, and consequently there is a proportionate increase in the temperature produced by the increase of resistance as the arc is approached, at which point only a slight increase of temperature is required in order to effect the fusion. The fused material flows into a collecting vessel C, located in an adjacent chamber.

In Fig. 3 is shown a modified arrangement particularly designed for separating fluid products by differences in their specific gravity, as is effected in the case of ordinary metallurgical furnaces. The furnace structure A′, Fig. 3, contains the inclined hearth C′, resting at its lower end on pivot-bearing *e′* and adjustable by screw W^5. The charge is indicated by B′, and L′ and W^4 indicate the electrodes, the former being placed above a trough at the lower end of the hearth.

Pulverized substances capable of conducting, as well as substances which are infusible or which are fusible only with difficulty, may also be raised to the desired temperature by this heating process by using furnaces constructed as shown in Figs. 4 and 5, wherein A^2 indicates the furnace structure, L^4 two horizontal electrodes adjusted by screws L^5, and S a disk mounted on a hollow shaft S^4, which may be driven by gear-wheel S^5 or otherwise to rotate the disk, which latter serves to regulate the descent of the charge B^2. The disk is cooled by a rose-head S^2, supplied with cooling fluid by a pipe S^3. In this case carbon blocks or plates P are employed as the contacts for the portion of the charge B^2 to be brought into the circuit as heating resistance and which is in the form of an upright column or pile. The electrodes L^4 of the same polarity surround the charge. The lower part of the charge B^2 thus forms the counter pole or electrode, while the charge located between the arc zone and the contact blocks or plates P is so chosen, as regards its cross-sectional area, as to offer a sufficiently-strong resistance to permit of its being heated sufficiently by the passing current. The material falling from the disk S is received by a chute S′ and collects in a pocket of iron or other appropriate material, from the bottom of which it can be discharged by opening a slide X. The substances to be treated in the furnace, Figs. 4 and 5, are conductive.

It is also possible by means of the furnace shown in Figs. 6, 7, and 8 to introduce into the furnace briquet-shaped charges of material, consisting of substances either capable of conducting or of becoming conductive when heated. The substances constituting these charges may be made up into cakes or slabs with the aid of a suitable binding material. M is the outlet of a machine—like a brick-making machine—from which the charge B^3, in the form of a continuous slab or bar, is propelled over a carbon contact-block P^3 into the arc, where it either melts or, if infusible, periodically breaks up under its own weight. The portions of the slab B^3 which lie between the zone of the arc L^6 and the contact-block P^3, as well as those which lie between the lowermost and uppermost end of the said contact-block, form a resistance. Now starting from the upper edge of the block P the amount of current supplied to this resistance increases as the resistance approaches the lower edge of P. Hence the said resistance will as it proceeds toward the zone of the arc be gradually heated more and more until on reaching the arc it will attain the maximum temperature.

In Figs. 4 and 5 of the drawings I have shown means for cooling the walls of the furnace—that is to say, surrounding the lower part of the furnace, or that part of the furnace subjected to the most excessive heat, is a water-jacket *f*, of ordinary and well-known construction, which operates to prevent the heat generated in that part of the furnace from exercising a destructive effect upon the furnace-walls. In like manner the stuffing-boxes L′, (shown in Figs. 1, 6, and 8,) through which the vertical electrodes are fed to the furnace, are made in the form of hollow cylinders or water-jackets. These cooling means are of well-known and ordinary construction and form no part of the present invention and need not, therefore, be specially described in detail.

Having thus described my invention, what I claim is—

1. In an electric furnace, the combination of a furnace structure, a feed-chute for the material operated upon, two electrodes adjustably arranged in the furnace to form an arc, one of said electrodes being disposed between the feed-chute and the other electrode and gradually tapered to a point, and means for feeding the material from the chute in a mass gradually decreasing in cross-sectional area over and past the tapered electrode to the arc, substantially as and for the purpose specified.

2. In an electric furnace, the combination of a furnace structure, a pivoted hearth therein, means for tilting the hearth to vary its angle of inclination, an electrode disposed over the lower end of the hearth, a tapered electrode disposed longitudinally over the hearth and adjustable toward and from the other electrode, means for feeding the material to be heated onto the hearth and over and

past the tapered electrode, and electrical connections for establishing an arc between the electrodes, substantially as described.

3. The combination, in an electric heating-furnace, of a furnace structure, an inclined pivoted hearth therein, means for adjusting the hearth to vary its angle of inclination, an inclined, gradually-tapering electrode over the hearth, a vertically-adjustable electrode above the lower end of the hearth, and means for feeding the material onto the inclined electrode and hearth, and electrical connections, substantially as described.

4. A furnace for the purpose described, comprising a furnace structure, with hearth pivotally mounted and having means for its adjustment, a vertically-adjustable electrode, an electrode disposed at an angle to the said electrode and adjustable in the direction of its length, a hopper arranged above the last-mentioned electrode and electrical connections substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

WILHELM BORCHERS.

Witnesses:

CLARA E. BRUNDAGE,

FRANK M. BRUNDAGE.