No. 705,076. Patented July 22, 1902.

C. M. HALL.

MANUFACTURE OF CARBON ELECTRODES.

(Application filed Feb. 19, 1902.)

(No Model.) 4 Sheets—Sheet 1.

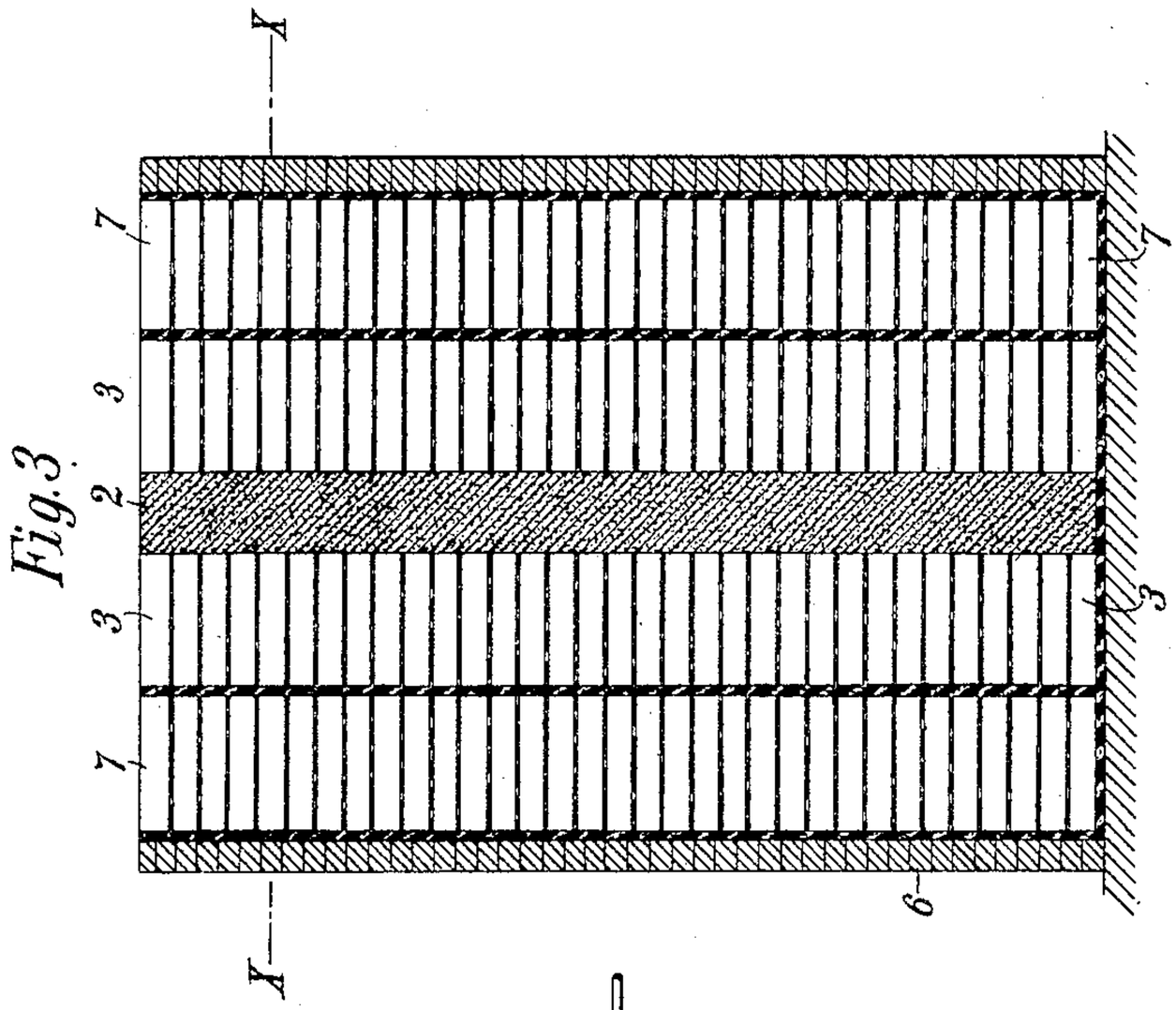

Fig. 3.

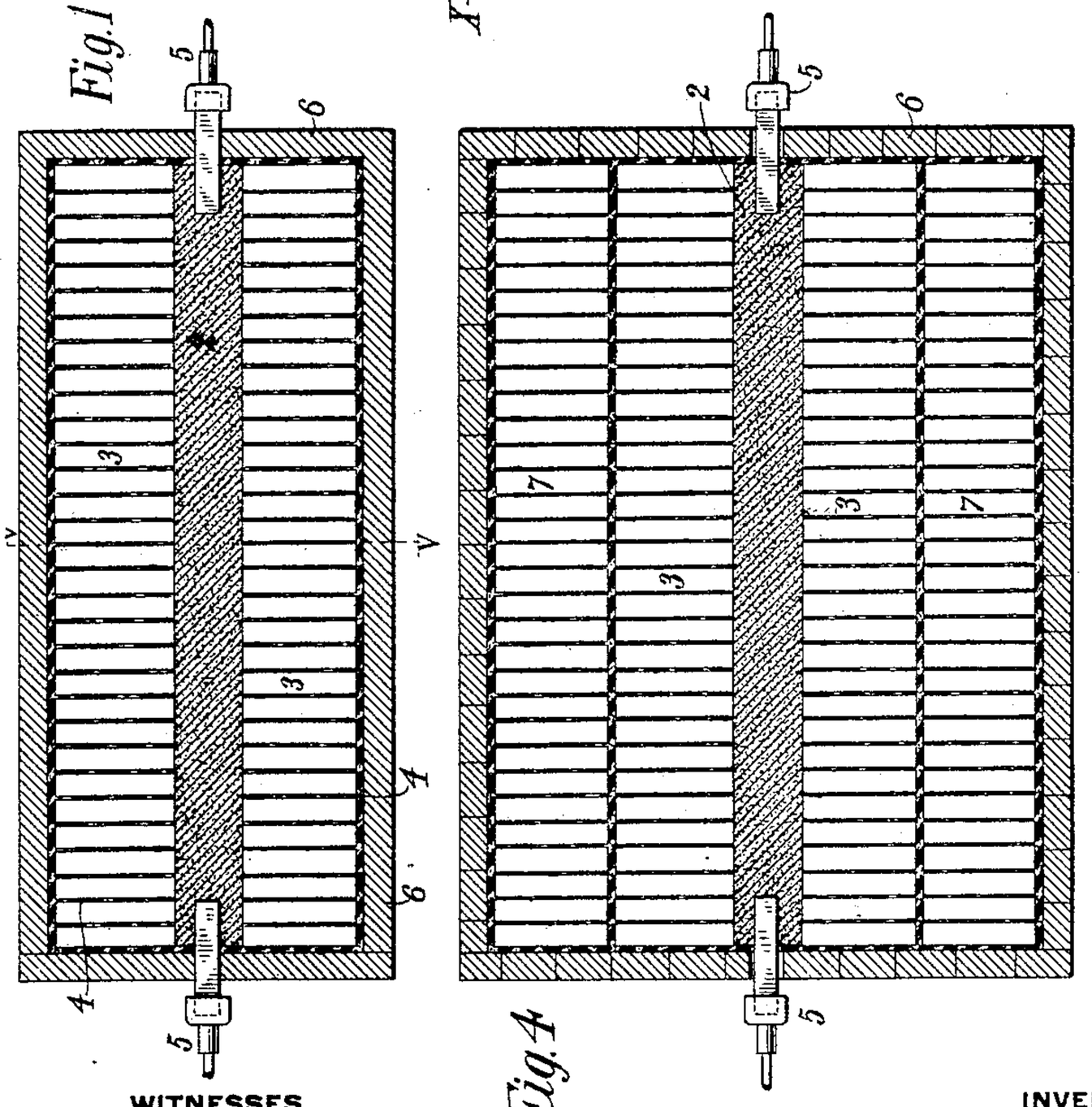

Fig. 1. Fig. 4.

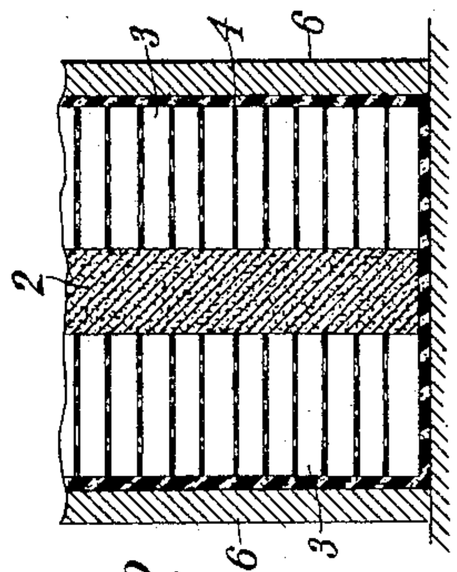

Fig. 2.

WITNESSES

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Fig. 5

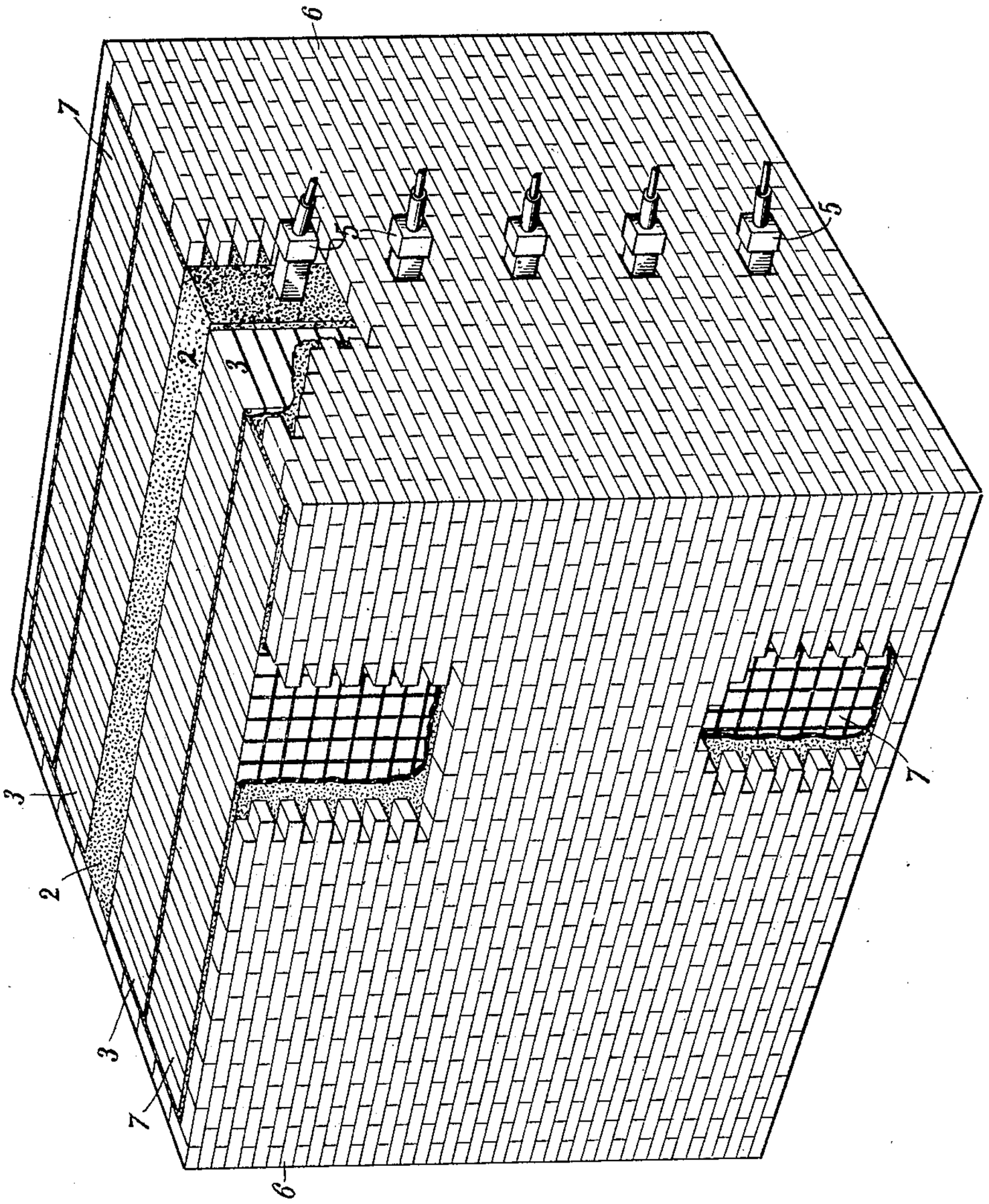

Fig. 6

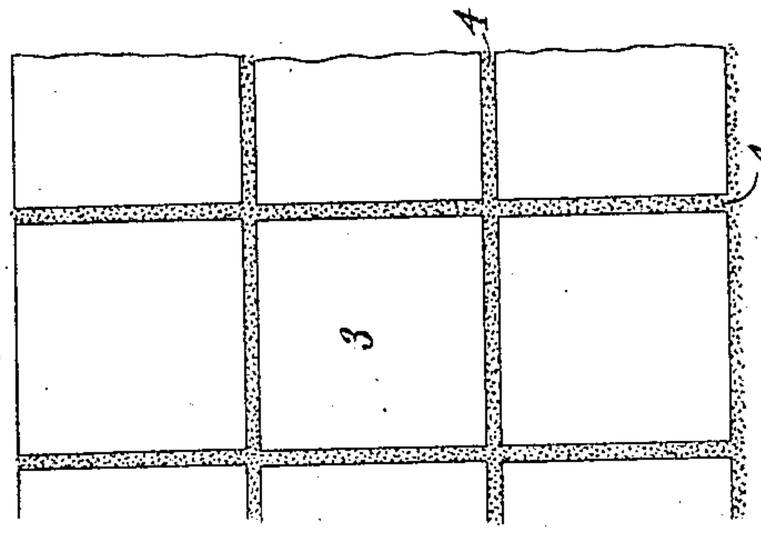

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Fig.7

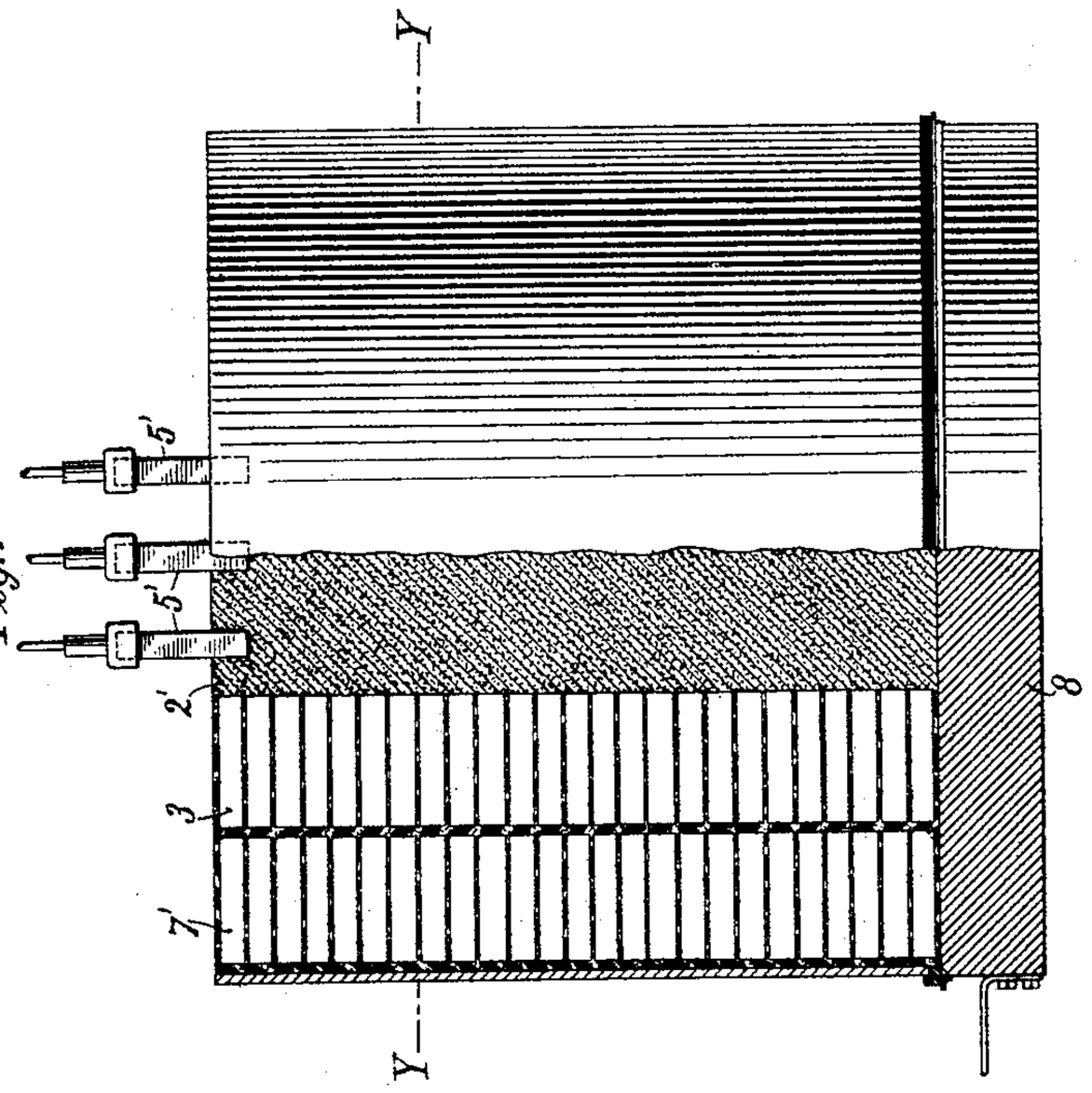

Fig.8

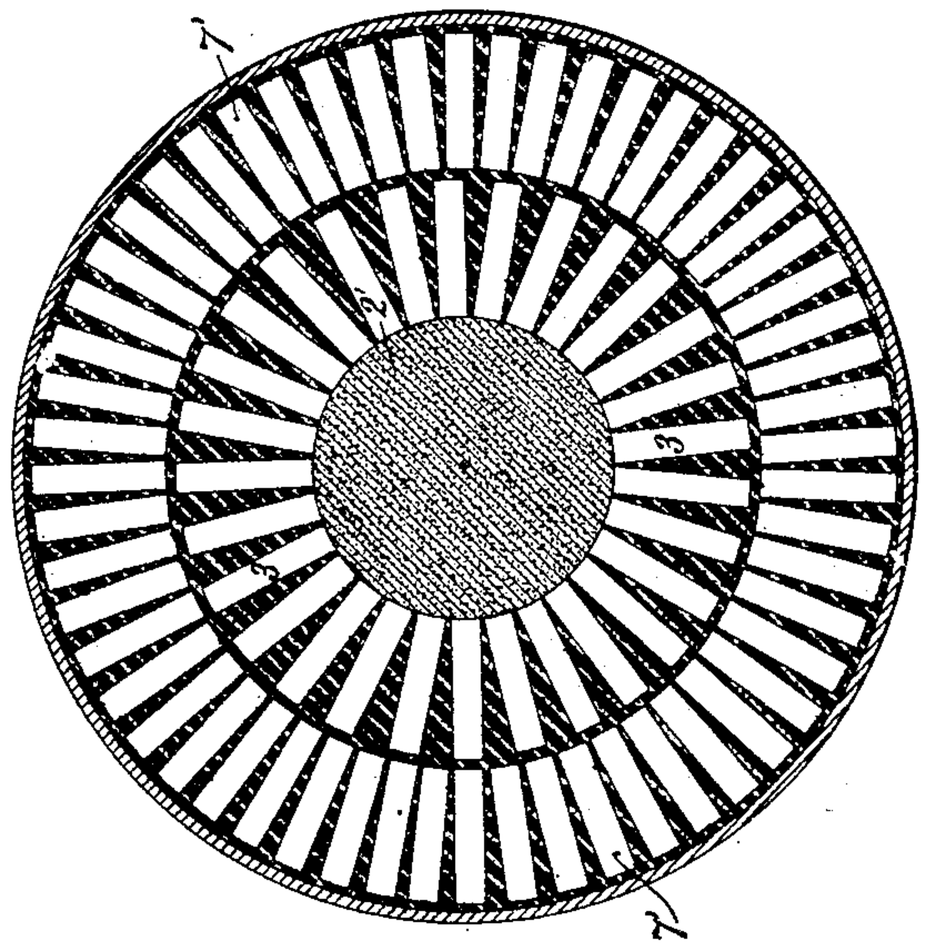

Fig.11

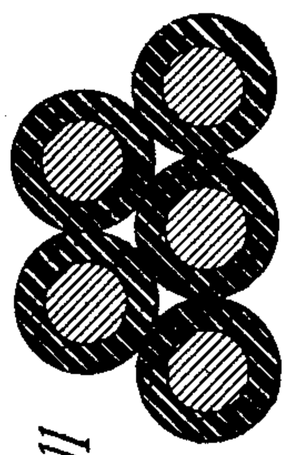

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Fig. 10

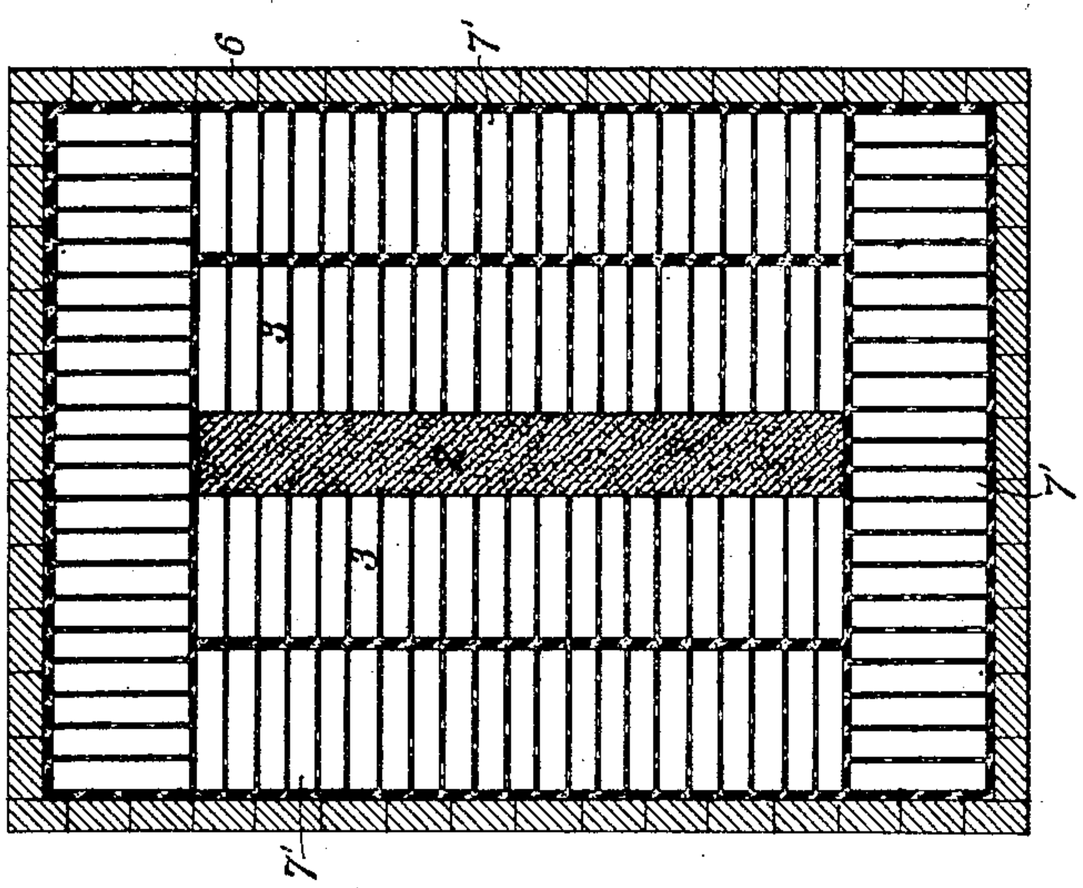
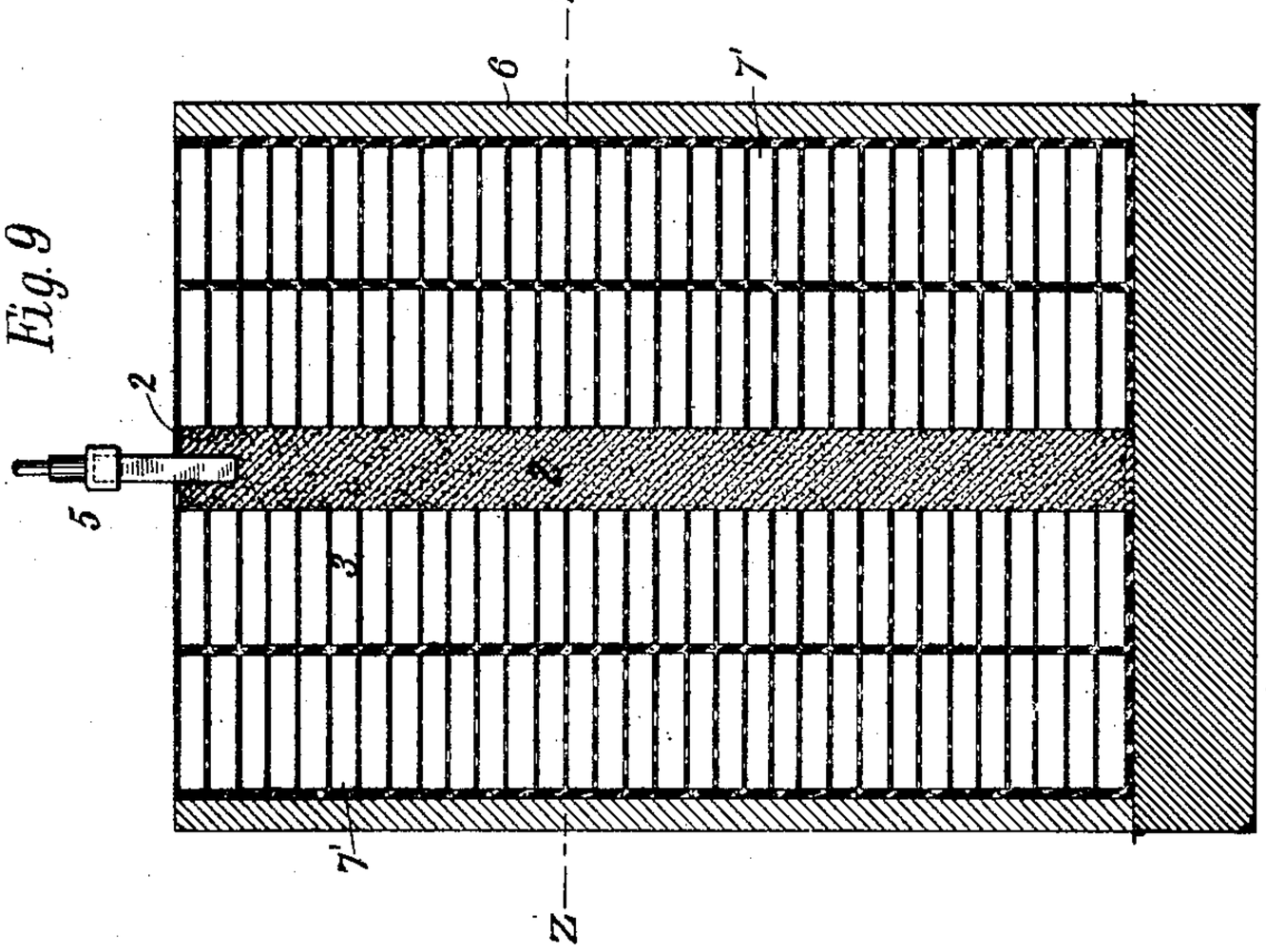


Fig. 9



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UNITED STATES PATENT OFFICE.

CHARLES M. HALL, OF NIAGARA FALLS, NEW YORK.

MANUFACTURE OF CARBON ELECTRODES.

SPECIFICATION forming part of Letters Patent No. 705,076, dated July 22, 1902.

Application filed February 19, 1902. Serial No. 94,725. (No specimens.)

To all whom it may concern:

Be it known that I, CHARLES M. HALL, of Niagara Falls, in the county of Niagara and State of New York, have invented a new and useful Improvement in the Manufacture of Carbon Electrodes, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view of an electrical furnace suitable for the practice of my invention. Fig. 2 is a vertical cross-section on the line V V of Fig. 1. Fig. 3 is a vertical cross-section of a furnace, showing an arrangement of the electrodes in four vertical piles. Fig. 4 is a horizontal section on the line X X of Fig. 3. Fig. 5 is a perspective view of the furnace of Figs. 3 and 4, the wall being partly removed in order to show the electrodes under treatment. Fig. 6 is a detail view, on a large scale, showing the preferable manner of insulating the electrodes. Fig. 7 shows in side elevation, partly in vertical section, a vertical furnace of cylindrical form. Fig. 8 is a horizontal cross-section on the line Y Y of Fig. 7. Fig. 9 is a vertical section of a vertical furnace having a core of oblong section. Fig. 10 is a horizontal section on line Z Z of Fig. 9. Fig. 11 is a detail view showing a mode of insulating the electrodes by coating them individually with refractory plastic material.

My invention provides a new mode of baking carbon electrodes. Such electrodes, especially those used in fused electrolytic baths, require to have good conductivity, mechanical strength, and toughness, with a high ignition-point. It has been common for the purpose of imparting these qualities to place the electrodes after they have been molded and compressed in gas or coal furnaces, where they are baked for a prolonged time; but the product is often irregular and unsatisfactory.

My invention provides means whereby electrodes in large quantities can be baked by electrical heat, and raised thereby to a temperature higher than that ordinarily obtained in gas-furnaces. I am thus enabled to produce electrodes of better character than those made heretofore from materials of like grade and to produce from materials of inferior grade electrodes of high quality well suited for the purpose required. I am informed that it has been attempted heretofore to bake electrodes with electrical heat, but the methods employed did not permit the treatment of more than a small number of electrodes at once and were therefore not economical.

My invention consists in piling the electrodes to be heated around or adjacent to a conducting core or path of suitable resistance, through which the current passes, and insulating the electrodes, so that the main heating-current shall be confined to the core without passing in large volume through the electrodes. The insulation accomplishes important functions. First, by restricting the current to the core it enables me to proportion the core so that it will have sufficient electrical resistance to develop the required heat without the use of current of excessive volume, whereas if the electrodes themselves constituted the current-path the resistance would be irregular and during the operation would become so low on account of the elevated temperature and loss of volatile matter and consequent increase in conductivity of the electrodes that the furnace would be impossible to regulate if the quantity of electrodes under treatment were large; second, the insulating of the electrodes by localizing the current within the core renders the transmission of heat to the electrodes gradual, and thus yields a better product.

I may insulate the electrodes by interposing between the individual electrodes or groups thereof a refractory non-conducting material—such as bauxite, purified alumina, magnesia, or lime alone or mixed with fine carbon—and the electrodes are arranged in a pile or piles around or at the sides of a conducting-core, of carbon, either in a horizontal or a vertical furnace.

In Figs. 1 and 2 I show a horizontal furnace having a conducting-core 2, of carbon, preferably of granular form. The electrodes 3 3 are arranged in piles at the sides of the core, preferably with their ends directed toward the core, so that the heat will be transmitted through them lengthwise. The electrodes or groups of electrodes are separated laterally from each other by a thin body 4 of insulating material of the character above stated, which may be in powdered or granu-

lar form, and the horizontal layers of electrodes are also preferably separated from each other in like manner. The core is connected at the ends to suitable carbon conductors 5, from which the current is supplied, and the electrodes are inclosed between walls 6, of brick or like material, which constitute the furnace structure, powdered material being preferably interposed between the ends of the electrodes and the walls to prevent loss of heat. When the current is passed through the core, the heat generated therein is transmitted to the electrodes, which are raised to that temperature which is necessary for producing the particular result desired. For example, when the electrodes are to be used for the electrolytic manufacture of aluminium they are raised to a temperature a little below that of the melting-point of alumina or, say, between 3,000° and 4,000° Fahrenheit. When the electrodes have attained the proper temperature and the process has been continued for the desired length of time, the current may be cut off and the furnace allowed to stand until the electrodes have cooled, when they may be removed.

The proportioning of the voltage of the current to the dimensions of the core and of the latter to the electrodes is a matter readily determined by the skilled electrician. I have obtained good results in the treatment of electrodes designed for use in the manufacture of aluminium by using an alternating current at a pressure of from thirty-five to fifty volts with a core from four to five feet long and having a cross-sectional area of about twelve by thirty inches to develop energy of four hundred to five hundred horse-power. Under these conditions I found it necessary to continue the operation for about five and one-half hours. It is desirable, however, to employ a comparatively large core in proportion to the power to be developed in order that the electrodes may not be heated too rapidly. I therefore preferably proportion the core and the mass of electrodes to the current, so that the carbons shall reach their maximum temperature in about twenty-four hours; but this may be varied.

The size of the core desirable to be used will depend somewhat upon its conductivity, which will vary according to the quality of carbon used therein and the size of its particles.

In Figs. 3, 4, and 5 I show a modified arrangement, in which a pile of electrodes 7 is placed at the outer side of each of the piles 3, but within the walls 6. The outer piles absorb the heat which would otherwise be lost, especially during the time when the furnace is cooling. They are thus partially baked and a considerable portion of their volatile matter is expelled, and when at the next charging of the furnace they are placed in close proximity to the core they require less time for their treatment. The electrodes of the outer pile being of green material are poor conductors and need not be insulated with such care as in arranging the inner pile.

Instead of insulating the electrodes by layers of powdered insulating material, as above described, I may use small blocks or tablets, preferably of compressed alumina or lime, mixed, if desired, with carbon, such blocks or tablets being placed at suitable intervals between the electrodes to be separated, or I may coat each layer with a coating of insulating material in plastic form before placing it in the furnace. This mode of insulation I illustrate in Fig. 11. It is especially adapted to the treatment of electrodes which are round in cross-section.

In Figs. 7 and 8 I show a vertical furnace suited for the practice of my invention. Here the core 2′ is vertical and is circular in cross-section. The current enters the core from conductors 5′ at the upper end and passes through a carbon base 8, on which the furnace is built. The electrodes 3 to be heated are piled radially in horizontal layers around the core, with an outer layer 7′ surrounding the inner layer, if desired. The electrodes are insulated from each other, as above described.

In Figs. 9 and 10 I show an arrangement similar to Fig. 7, except that the core is oblong in cross-section and the electrodes are piled radially around it.

The electrodes may be otherwise arranged. For example, I may employ a furnace in which the electrodes are piled at the sides of the core, with their longitudinal axes parallel with the line of flow of the current, and in such case the ends of the electrodes should be well insulated from each other.

Although I prefer to use a core composed of granular coke or charcoal, my invention is not limited thereto, for the core may be made of solid carbon rods or blocks or I may use material which will melt and will conduct the current, as an electrolyte. The furnace used for this operation may be constructed as shown in Figs. 7 and 8, the core in such case being vertical and composed of alumina or bauxite mixed, preferably, with carbon. Such core or the central portion thereof is fused by the current, and the heat generated therein by conduction and by arcs is communicated to the surrounding electrodes. By using bauxite in the core and properly proportioning the carbon mixed therewith the operation will not only bake the electrodes, but will purify the bauxite by separating wholly or partially its contained iron, silicon, and titanium, as described in my Patent No. 677,207, dated June 25, 1901. A convenient proportion for this purpose is eight to ten parts carbon and ninety-two to ninety parts bauxite; but these amounts may be varied considerably and good results still be obtained.

Having described my invention, what I claim is—

1. The method herein described of baking carbon articles, which consists in placing

them in proximity to a conducting path or core, insulating the articles or groups of articles, and passing a current through the core; substantially as described.

2. The method herein described of baking carbon electrodes, which consists in placing them in proximity to a conducting path or core, insulating the electrodes or groups of electrodes from each other, and passing a current through the core; substantially as described.

3. The method herein described of baking carbon electrodes, which consists in placing them in proximity to a conducting path or core, interposing refractory insulating material between the electrodes or groups of electrodes, and passing a current through the core; substantially as described.

4. The method herein described of baking carbon electrodes, which consists in placing them in proximity to a conducting path or core in piles transversely to the core with their ends in proximity thereto, insulating the electrodes or groups of electrodes, and passing a current through the core; substantially as described.

5. The method herein described of baking carbon electrodes, which consists in placing them in proximity to a conducting path or core, insulating the electrodes or groups of electrodes, piling other electrodes outside the first-named electrodes, heating the latter by heat transmitted through the inner electrodes, and subsequently placing them next to a core to receive final baking; substantially as described.

CHARLES M. HALL.

Witnesses:
BENJAMIN MILLER,
RICHARD DONOVAN.