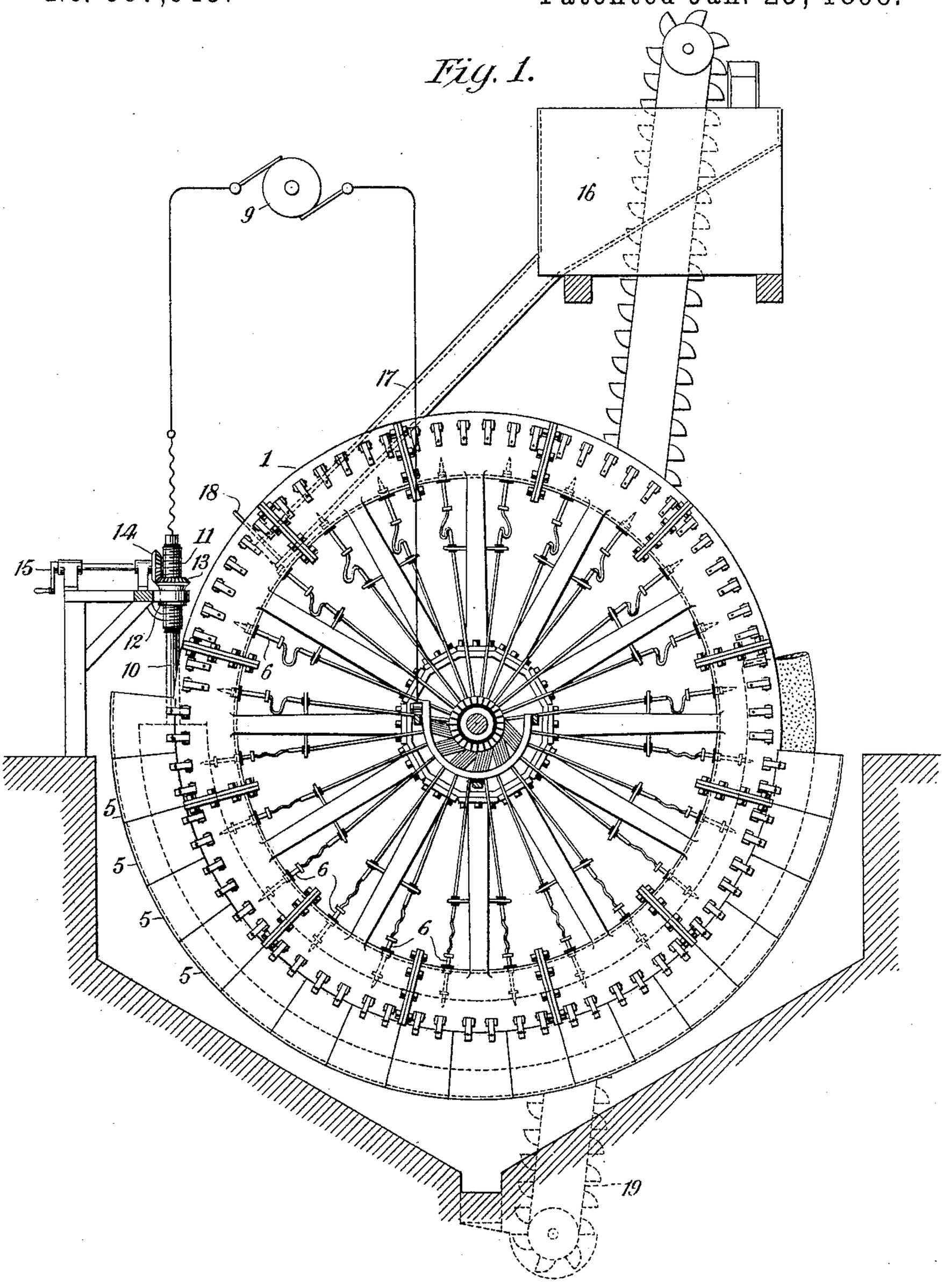
(No Model.) 3 Sheets—Sheet 1.

C. S. BRADLEY.

ELECTRIC FURNACE.

No. 597,945. Patented Jan. 25, 1898.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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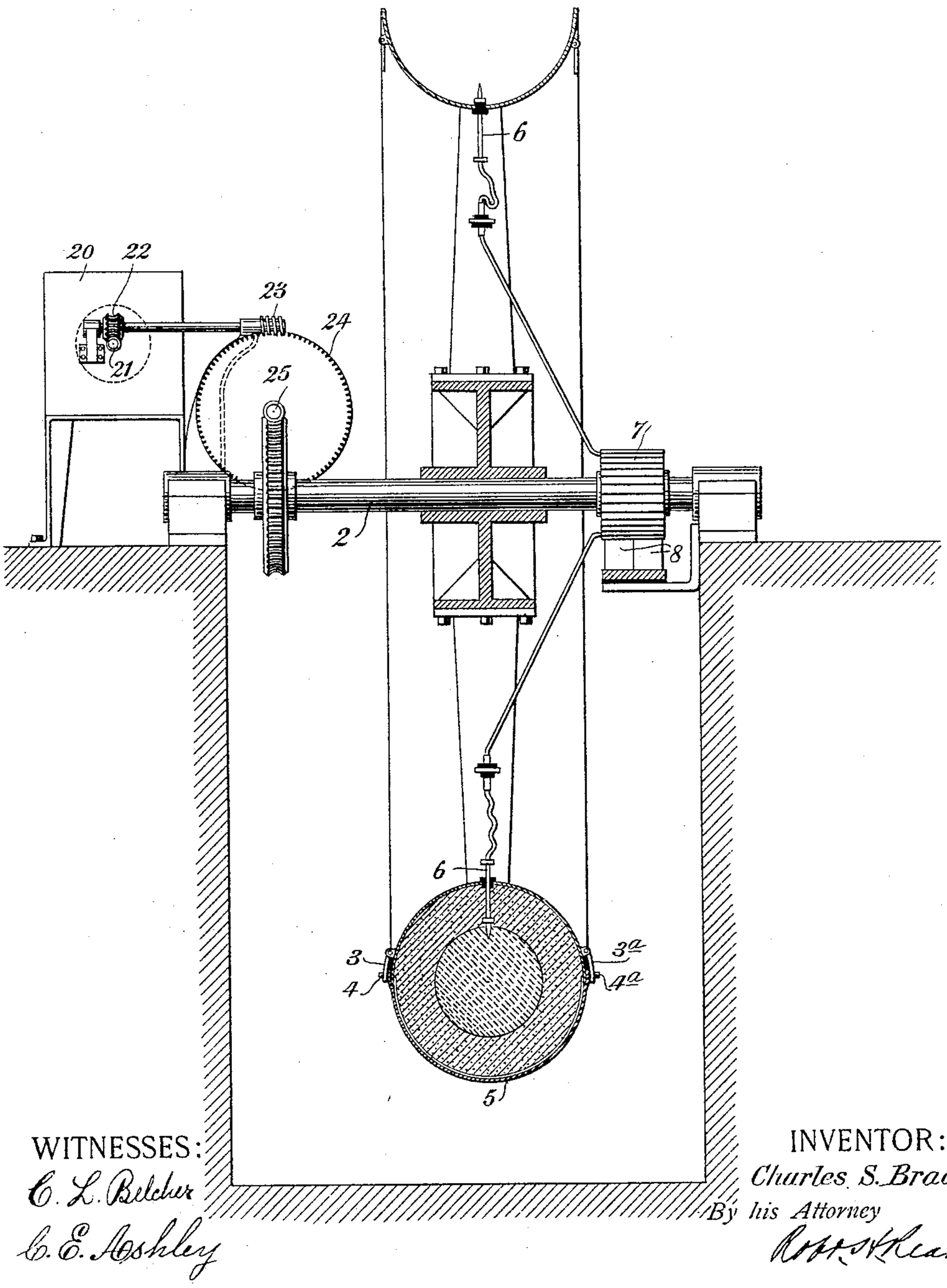
Fig. 2.



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(No Model.)

3 Sheets—Sheet 3.

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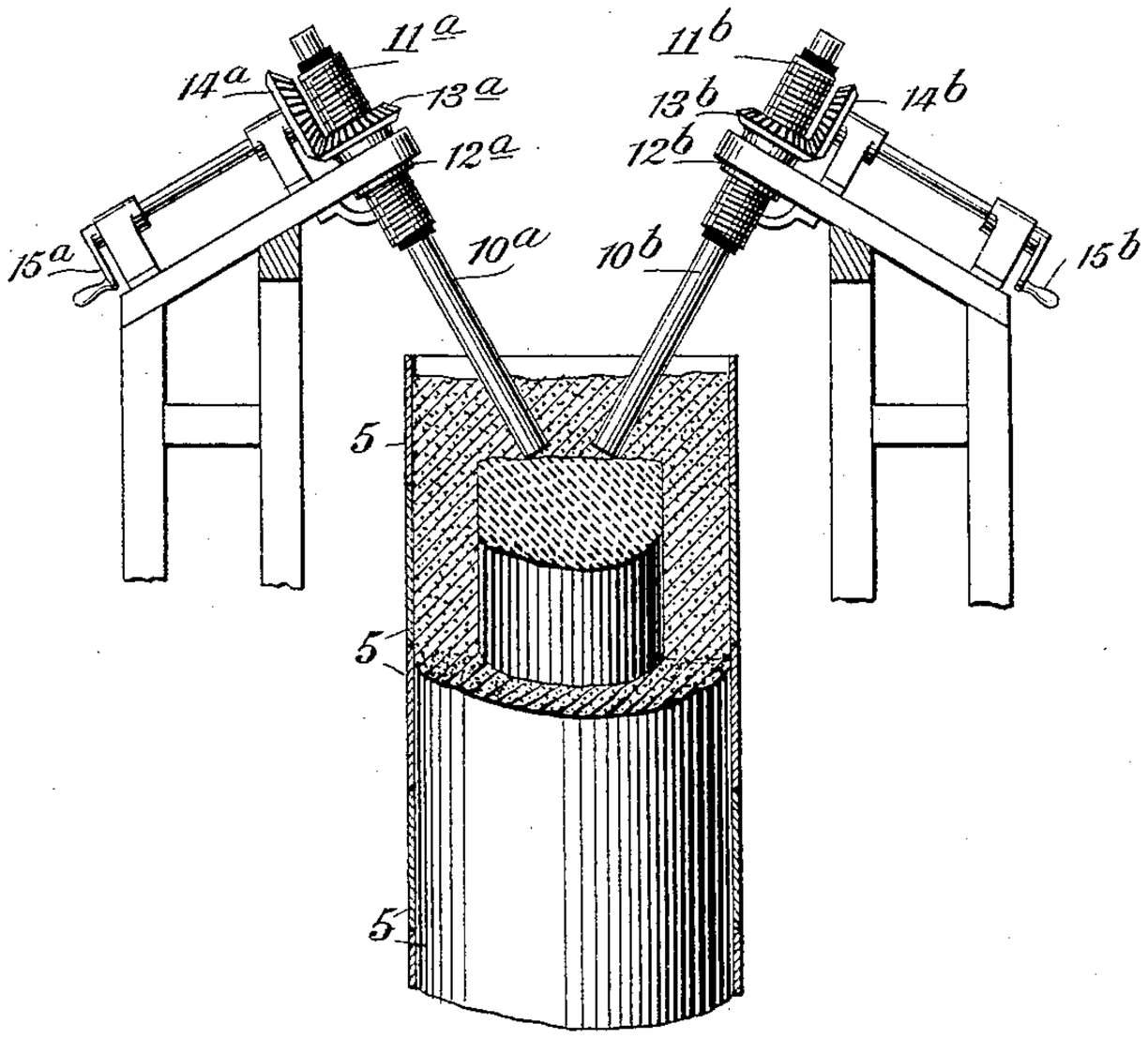
Fig. 3,



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UNITED STATES PATENT OFFICE.

CHARLES S. BRADLEY, OF AVON, NEW YORK.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 597,945, dated January 25, 1898.

Application filed December 12, 1896. Serial No. 615,432. (No model.)

To all whom it may concern:

Be it known that I, CHARLES S. BRADLEY, a citizen of the United States, and a resident of Avon, in the county of Livingston and State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

My invention relates to electric furnaces for the reduction or formation of refractory materials.

The object of the invention is to permit a continuous and uninterrupted operation of the furnace and withdrawal of the product and to protect said product from the action of the air when at a high temperature.

The furnace is especially designed for employment in the manufacture of metallic carbids. It comprises a receptacle for the charge to be operated upon, in which is inserted an electrode, means being provided for continuously moving the receptacle with relation to the electrode so as to bring fresh portions of material under the action of the electric current. The construction which I prefer to employ comprises a rotary wheel or annulus, into which projects at one side an electrode or pair of electrodes, and provided with means for preventing the material from spilling and means for supplying fresh material to be acted upon by the current and facilities for removing the product, the whole being so arranged that the operation may be carried on in an uninterrupted manner, the furnace constantly forming fresh additions to the product and permitting the latter to be removed as frequently as may be necessary. The wheel is preferably turned by power-driven machinery and is provided with a hollow periphery to which are attached over an arc covering the lower part of the wheel buckets forming throughout said arc a closed receptacle for the material to be operated upon. Said buckets are arranged to be withdrawn or opened when they reach the discharge end of the wheel-arc. The material, in the form of powder or granules, is supplied to the side of the wheel which contains the electrode or electrodes. The electric arc or the limits of the space within which the electric action on the material takes place are wholly within the mass of pulverized material, so that a wall of unchanged or unconverted material will surround the product of the furnace, and the motion of the wheel is in such direction as to surround the converted material by a body of unconverted material, and thus exclude air until the converted mass has become sufficiently cool to permit its removal and further treatment for packing for shipment or storage. In the formation of a carbid of calcium, for example, an intimate mixture of ground lime and ground carbon is supplied to that side of the wheel-arc into which the current is introduced and is fused, permitting the carbon and calcium to combine, and forming a pool of liquid carbid of calcium within the wheel-rim, which pool is surrounded by a mass of uncombined mixed carbon and lime, which acts as an efficient heat-insulator, keeping the walls of the receptacle comparatively cool. As the wheel turns the pool is withdrawn from the neighborhood of the electric arc or region of electrical activity and the liquid carbid cools and solidifies under a superincumbent and surrounding mass of material, which prevents access of air, and thus prevents wasteful consumption of carbon by combustion. Thus a core of solid carbid of calcium is formed within a granular or pulverized mass of material, said core growing in length as the receptacle recedes from the electrode until it emerges from the other end of the wheel-arc, when the removable sections of the wheel-rim may be taken off one at a time, permitting the pulverized material to fall away from the solid core of carbid, which may be broken off or otherwise removed periodically. Thus the formation of carbid goes on continuously without necessary interruption for recharging or removal of the product.

I am aware that an electric furnace has been proposed by M. Patin, of Puteaux, France, and also by Vincent, of Philadelphia, Pennsylvania, in which the pulverized material is fed into a stationary tube in which the electric arc is maintained, a movable platform being placed below the arc to form a core of carbid; but in this type of furnace the carbid is formed in short lengths, which are periodically discharged into a receptacle for cooling, after which the platform is returned to permit another core of carbid to be

formed. My apparatus differs from this in the essential feature of permitting the formation of carbid to go on without interruption, the finished cooled product being removed with convenience as often as desired without a moment's interruption of the process of formation.

The invention will be more perfectly understood in connection with the accompanying drawings, forming part of this specification, in which—

Figure 1 is a sectional view on a plane at right angles to the wheel-axis. Fig. 2 is a sectional view on a plane parallel to the wheel-axis, and Fig. 3 is a view of a modified manner of arranging the arc.

1 represents a wheel formed in sections and bolted together and having a horizontal axis mounted in boxes at or near the floor-level. The rim of the wheel is dish-shaped in cross-section and is provided at intervals with pivoted latches 3 3^a to engage studs 4 4^a on semi-cylindrical sections of plate-iron 5 to support them on the wheel. Auxiliary plates of thin sheet-iron may be bent around the joint between the sections on the inside of the wheel-rim to prevent the pulverized material from sifting through the cracks at the joints. The wheel may with advantage be made about fifteen feet in diameter and the rim and plate-iron sections of such proportions as to form a circular receptacle of thirty-six inches in diameter. The inner wall of the wheel-rim is provided with holes at intervals to receive copper plugs 6, connecting with the several plates of a commutator 7 by conductors 6^a, on which bears a brush 8, connecting with one pole of an electric generator 9. The other pole of the generator connects with a carbon electrode 10, about four inches in diameter, mounted in a sleeve 11, provided with a screw-thread on the outside, which engages an internally-threaded sleeve 12, secured to a bevel-gear 13, meshing with a gear 14, on the axis of which is a crank 15 for adjusting the electrode. The electrode and its regulating mechanism are mounted on a framework adjacent to the wheel-pit, so that the electrode may be fed into the receptacle formed by the wheel-rim and the rim-sections when partly consumed.

16 is a feed-hopper provided with a spout 17, projecting into the wheel-rim, and a gate 18 for regulating the supply of mixed material to be acted upon.

The wheel-pit is preferably provided with sloping sides, so that any powdered material which drops from the wheel at its discharging end or elsewhere may slide by gravity to a conveyer 19, the buckets of which return it to the feed-hopper to again pass through the furnace.

The wheel is preferably connected with an electric motor by speed-reducing gearing. Said motor is shown diagrammatically at 20. The motor-shaft carries a worm 21, acting on a spur-gear 22, on the shaft of which is secured a worm 23, meshing with another gear 24, on the shaft of which is a third worm 25, meshing with a gear on the wheel-shaft. By this mechanism a very slow speed of the wheel may be maintained, a complete revolution being made once in five days. In using the apparatus the rim-sections are latched over the wheel-rim over an arc covering the lower part of the wheel and the gate of the feed-hopper is opened. A charge of intimately-mixed pulverized carbon and lime in proper proportions to form carbid of calcium falls into the receptacle around the wheel-rim and accumulates until the top of the electrode is immersed therein. The circuit of the dynamo-electric machine may then be closed and the electric motor thrown into operation. As the charge is moved away from the electrode intense heat is created and the refractory material fuses, forming a pool of liquid carbid of calcium or other compound depending on the nature of the furnace charge. As the wheel turns, the pool gradually recedes from the electrode and slowly cools while inclosed within walls of refractory uncombined material on all sides, the cool product forming a bottom for the liquid compound. Thus a continuous core of the product is formed, new rim-sections being added by a workman at intervals of a few hours. The electrode at starting should project well into the receptacle, and as the wheel turns the electrode rises relatively to the charge, and when it reaches a point near the top of the rim-section a new rim-section is hung on the wheel by means of the next set of supports and a strip of sheet-iron is bent around the joint between the rim-sections. The gate of the hopper is then opened and the rim filled or partially filled with material. As this material in its powdered state is a very poor conductor of electricity as well as of heat, the immersion of the electrode does not interfere with the heating action. When a new rim-section is added on the electrode side of the wheel, one is removed at the other side. Thus the process continues until the solid core of the furnace product appears at the discharge end of the wheel, when a rim-section is taken off and the powdered material falls into the pit, leaving a pillar of solid product projecting vertically, which may be broken off or otherwise removed. Solid carbid of calcium is a conductor of electricity and the copper plugs make a good contact with the same, thereby constituting the carbid itself one of the electrodes. The action of the commutator leads the current to a point of the carbid core close to the electrode, and thereby prevents unnecessary resistance, which would intervene if the plugs were more widely spaced. The conducting-plugs 6, which are remote from the arc, help to carry the current, and thus heating of any one contact with the carbid core is reduced. It is evident that two electrodes or carbon pencils might be employed with similar results. Such an arrange-

ment (shown in Fig. 3) would be desirable in cases where the core or product of the furnace is a very poor electric conductor. The two carbon pencils in such a case should be placed in a plane lying across the receptacle and dipping into the same, the two pencils being at an angle to one another. (See Fig. 3, where parts similar to those of the other figures of the drawings are indicated by corresponding numerals with exponents *a b*.) The rationale of the process would, however, be precisely the same. I prefer the arrangement herein described at length in all cases in which it is capable of employment, as resulting in a more uniform shape of the core or product.

In starting the furnace into operation the receptacle should be primed with carbon between one of the plugs 6 and the electrode before starting the motor. Motion of the wheel then draws an electric arc and fuses part of the material of the charge, after which the process goes on, as hereinbefore described.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An electric furnace comprising a receptacle to contain a charge of material to be operated upon, electric connections for leading a current through the charge from an external circuit, including a current-leading electrode extending into the receptacle, and means for effecting a continuous downward movement of the charge relatively to the electrode by a movement of rotation.

2. An electric furnace comprising a receptacle for the charge of material to be operated upon, electric connections for leading a current through the charge from an external circuit including a current-leading electrode extending into the receptacle, and means for effecting a continuous recession of the receptacle and charge relatively to the electrode by a movement of rotation.

3. An electric furnace comprising a sectional receptacle for the charge of material to be operated upon, electric connections for leading a current through the charge from an external circuit including a current-leading electrode extending into the receptacle, and means for effecting a continuous recession of the receptacle and charge relatively to the electrode by a movement of rotation, the several sections of the receptacle being capable of removal.

4. An electric furnace comprising a rotary annulus turning on a horizontal axis, means for forming a closed receptacle, for a charge of material to be operated upon, over an arc at the lower part of the annulus and electric connections with the inside of the receptacle, and a current-leading electrode at one end of the arc-shaped receptacle.

5. An electric furnace comprising a rotary annulus turning on a horizontal axis, removable rim-sections for forming a receptacle for the material to be treated by the furnace over an arc of the annulus and electric connections with the inside of the receptacle, and a current-leading electrode in operative relation to the receptacle when the sections are in place.

6. An electric furnace comprising a rotary annulus turning on a horizontal axis, means for forming a receptacle, for material to be operated upon, over an arc at the bottom of the annulus and electric connections with the inside of the receptacle, an electrode at one end of the arc-shaped receptacle, and a source of supply for fresh material around the electrode.

7. An electric furnace comprising a rotary annulus turning on a horizontal axis, removable rim-sections for forming a closed receptacle for material to be treated by the furnace over an arc of the annulus and electric connections with the inside of the receptacle, a current-leading electrode in operative relation to the receptacle when the sections are in place, and means for sealing the joints to prevent leakage of the material to be treated.

8. An electric furnace comprising a rotary annulus turning on a horizontal axis provided around the rim with supports for movable rim-sections to form a receptacle for material to be treated over any part of the annulus and electric connections with the inside of the receptacle, and a current-leading electrode in operative relation to said receptacle when completed.

9. An electric furnace comprising a rotary annulus carrying on its periphery a receptacle for a charge, said receptacle having sectional walls permitting the receptacle to be opened and electric connections with the inside of the receptacle.

10. An electric furnace provided with a sectional receptacle for the charge movable with relation to an electrode, electric connections with the inside of the receptacle, the sections being capable of removal, a feed-hopper for supplying material, and an elevator for returning the unconsumed material to the hopper.

11. An electric furnace comprising a rotary annulus turning on a horizontal axis, removable rim-sections forming a receptacle for a charge over an arc of the annulus, a current-leading electrode extending into the receptacle having electrical connections therewith to the inside of said receptacle, a motor and speed-reducing gearing between the latter and the shaft of the annulus.

12. An electric furnace comprising a rotary annulus turning on a horizontal axis, removable rim-sections forming a receptacle for a charge over an arc of the annulus, a current-leading electrode extending into said receptacle connecting with one pole of an electric generator, and conducting-plugs in the wall of the annulus projecting into the receptacle connecting with the other pole of the generator.

13. An electric furnace comprising a rotary wheel having a hollow rim and turning on a horizontal axis, removable rim-sections forming a receptacle for a charge over an arc of the wheel, and a current-leading electrode adapted to be connected in an electric supply-circuit in operative relation to the receptacle when the sections are in place.

14. An electric furnace comprising a rotary wheel turning on a horizontal axis, removable rim-sections forming a receptacle for a charge over an arc of the wheel, a current-leading electrode connecting with one pole of an electric generator, conducting-plugs in the wall of the wheel-rim projecting into the receptacle-space, and a commutator for cutting the plugs successively into circuit.

15. An electric furnace comprising the combination of an annular receptacle having removable cover-plates, means for rotating said receptacle, and electric devices for fusing and delivering material to the interior of said rotating receptacle.

In testimony whereof I have hereunto subscribed my name this 11th day of December, A. D. 1896.

CHARLES S. BRADLEY.

Witnesses:
ROBT. H. READ,
WM. H. BRUDER.