J. THOMSON & F. A. J. FITZ GERALD.

FURNACE.

APPLICATION FILED MAY 13, 1909.

950,878. Patented Mar. 1, 1910.

3 SHEETS—SHEET 1.

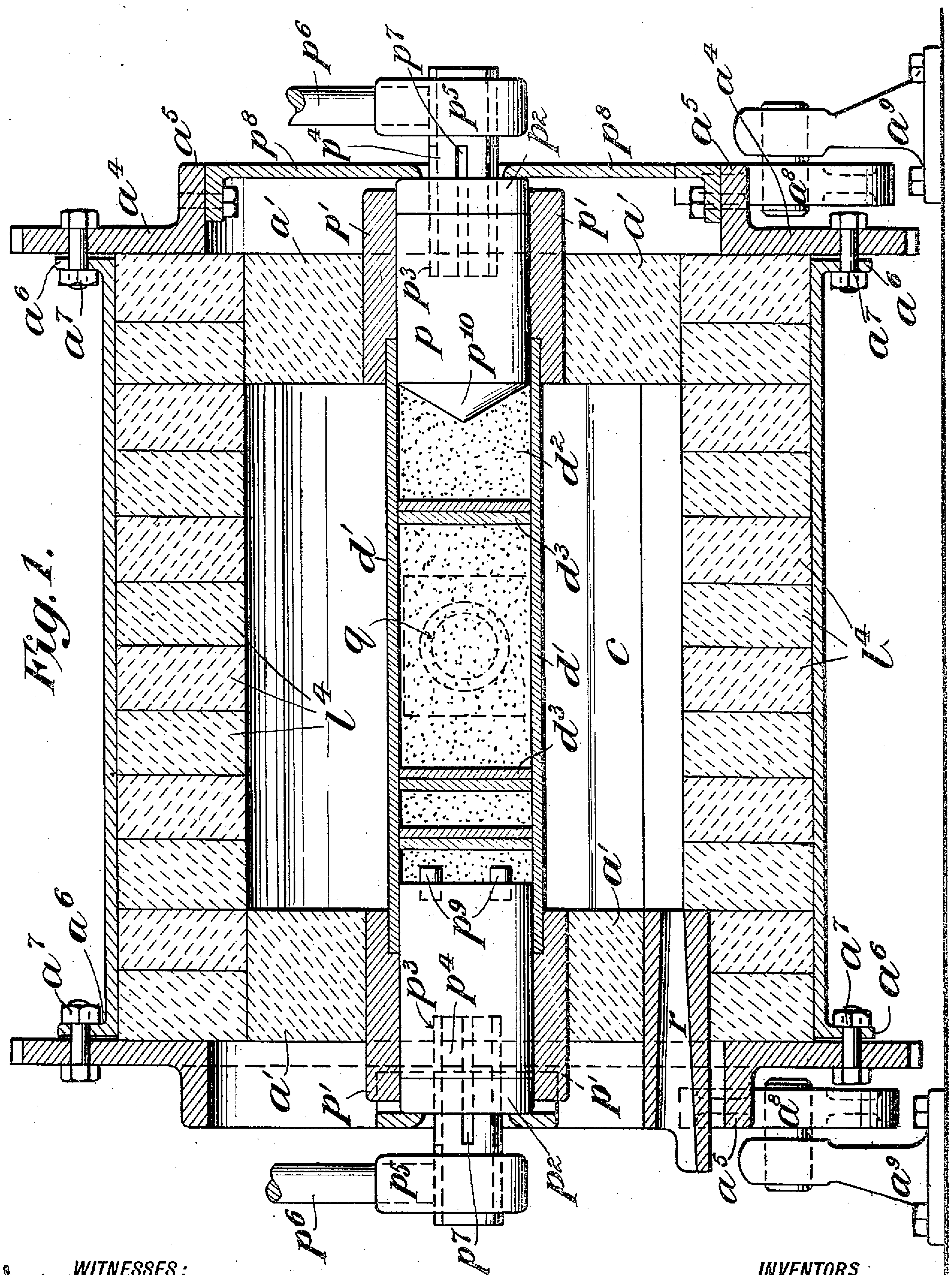

Fig. 1.

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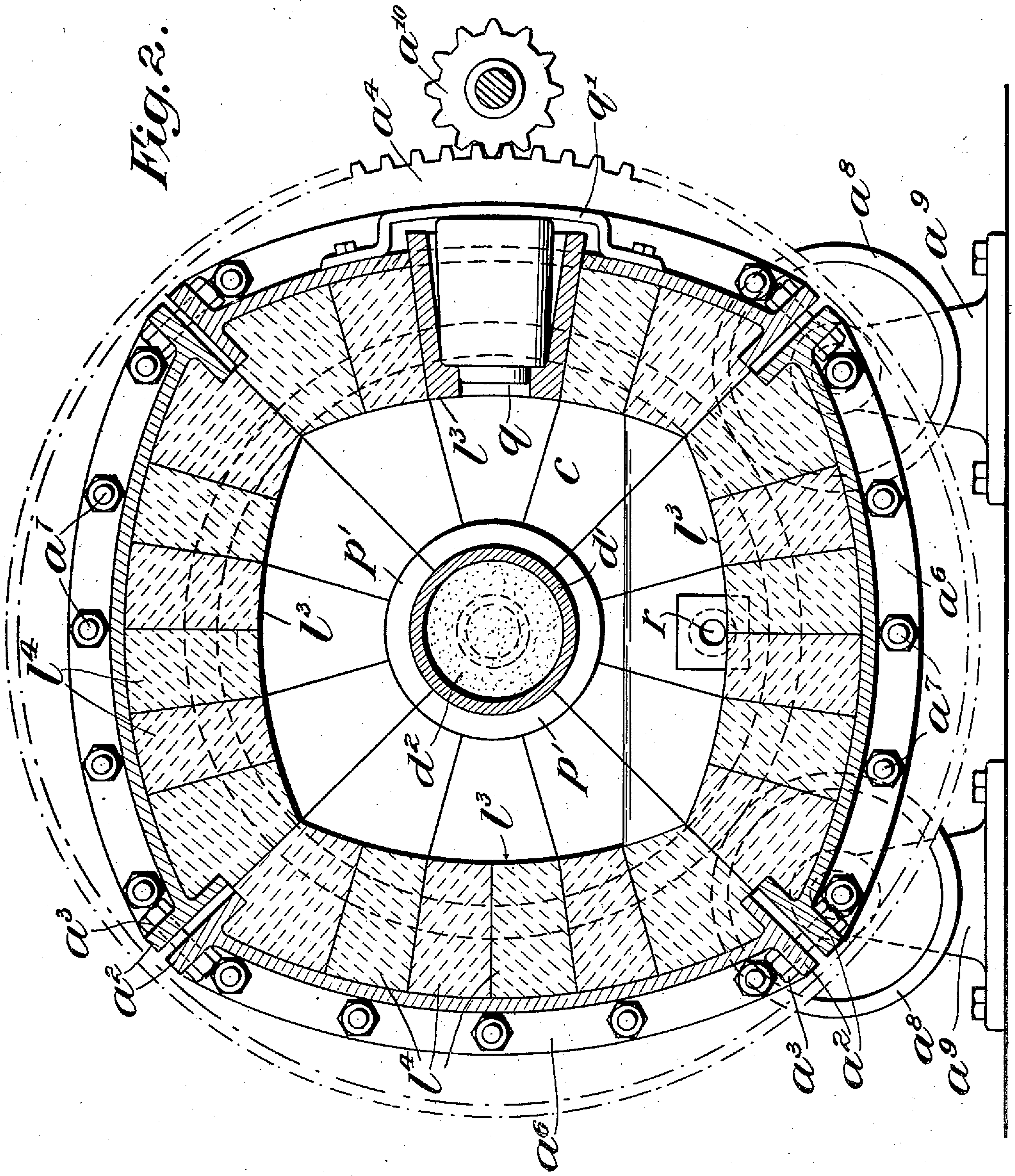
3 SHEETS—SHEET 2.

Fig. 2.



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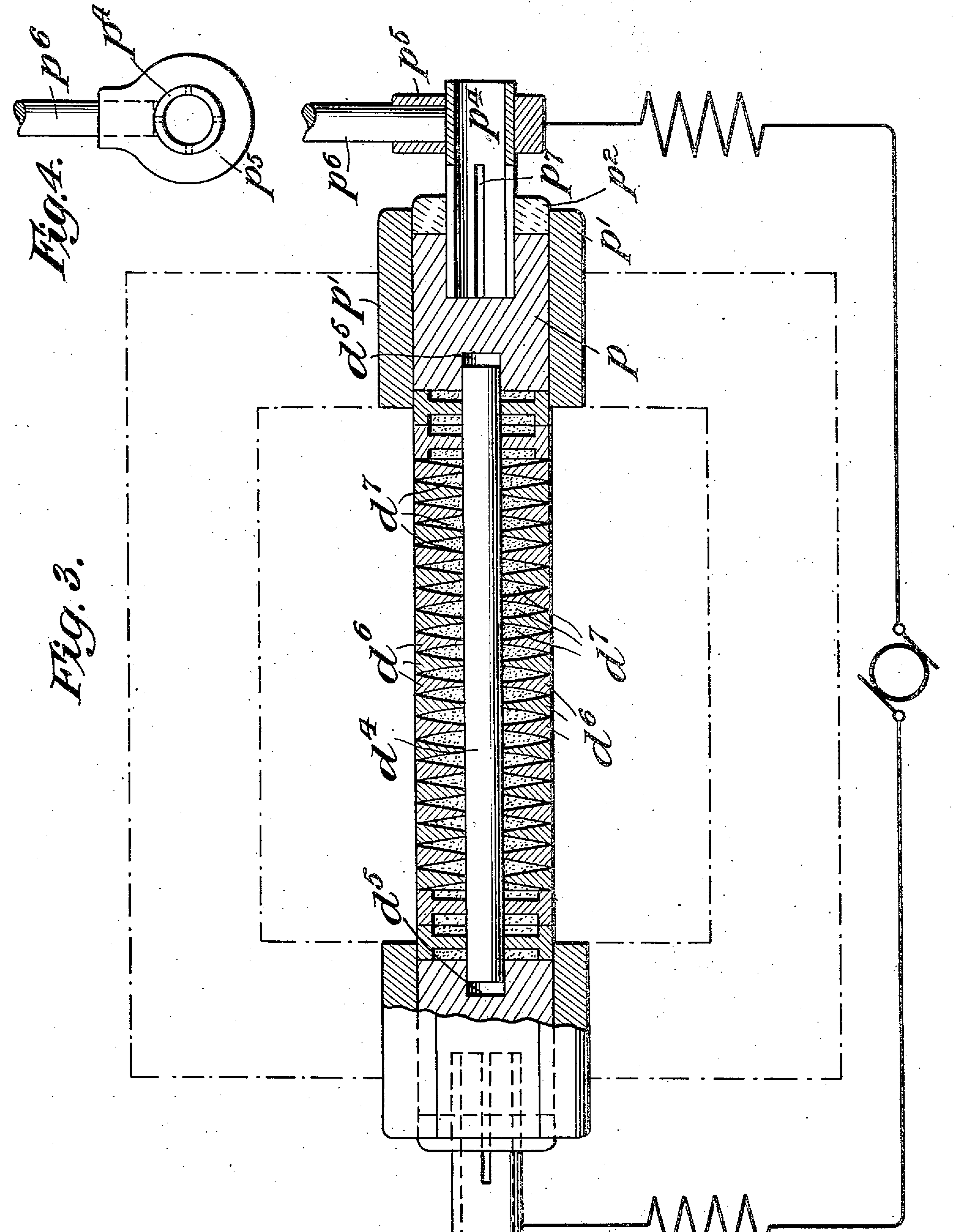
3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

OHN THOMSON, OF NEW YORK, AND FRANCIS A. J. FITZ GERALD, OF NIAGARA FALLS, NEW YORK, ASSIGNORS TO IMBERT PROCESS COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

FURNACE.

950,878. Specification of Letters Patent. Patented Mar. 1, 1910.

Application filed May 13, 1909. Serial No. 495,585.

To all whom it may concern:

Be it known that we, JOHN THOMSON, a citizen of the United States, and a resident of the borough of Manhattan of the city of New York, in the county and State of New York, and FRANCIS A. J. FITZGERALD, a subject of the King of Great Britain, and a resident of Niagara Falls, in the county of Niagara of said State of New York, have invented certain new and useful Improvements in Furnaces, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

The predominant advantages of fuel-fired, revolving, tubular furnaces, especially in ore smelting, have been fully demonstrated in practice, namely: the mixing of the charge, which reduces the time in fusing, the avoidance thereby of over-heating any portion of the smelting chamber, and the increased endurance of the refractories, due to the more uniform temperature and greater area.

The present improvements have to do with revolving furnaces and while they are particularly applicable to electric furnaces of this type, there are several features thereof which may be embodied in fuel-fired revolving furnaces as well.

The objects of the invention may be concisely stated as follows: to apply, in a revolving furnace, a carbon resister capable of being electrically heated to a state of incandescence; to construct the furnace in longitudinal sections separately removable; to form the coördinating hearth in a plurality of segments preferably curved to a radius about equal to the diameter of the furnace chamber; to provide convenient and adequate means for maintaining the refractories under compression; to mount the structure on roller wheels in a manner which shall be inexpensive to construct and require a minimum of power to operate; and to provide such a disposal and construction of the foregoing as shall generally adapt the furnace for metal melting and ore smelting.

In the embodiment of this invention shown in the accompanying drawings, Figure 1 is a view in central longitudinal section. Fig. 2 is a view in central transverse section. Fig. 3 is a view in longitudinal section through the resister and its terminals, showing a modification, and, Fig. 4 is a detached front elevation of an electrode connection.

The heads of the revolving furnace are indicated at a' and supported therein, as a central cylindrical core extending along the axis of the furnace, is a composite resister. In Figs. 1 and 2, the resister is shown as having a cylindrical casing d' which incloses carbon as the electro-resistive element. The material from which this casing is formed may be any refractory suitable for the temperature desired, but the preferred compound is carborundum which has been recrystallized. The process of constructing such a casing consists in taking the ordinary crystals combined with more or less fine powder, heating them in a cylinder, and then raising the temperature in the said cylinder to the formation of silicon carbid. In this wise the material is recrystallized and the resulting product has a very dense structure whose fracture is suggestive of steel. Not only can a casing of this kind be raised to a temperature of about 3,600° F. without damage, but it is an excellent conductor of heat. Therefore, this particular material is peculiarly applicable for the present purpose, in that it possesses adequate strength to avoid deformation, a sufficient refractorability to meet the majority of metallurgical requirements, and so high a coefficient of heat conduction as not to sensibly diminish the thermic efficiency. The carbon contained within the cylinder is to be of such form, or combination of forms, as will give the desired electrical resistivity in any case. Thus, as shown in Figs. 1 and 2, the main central portion is filled with granular carbon d^2 while at and toward each end a series of thin carbon disks d^3 are interposed. It will be evident that if the casing were entirely filled with powdered or granular carbon the resistivity would be at a maximum, while with plates of various thicknesses, or with a combination of plates and granular matter, as shown, the condition may readily be made to best fit the available voltage.

The carbon terminals p, to avoid excessive heating in the furnace-heads, preferably enter the ends of the resister casing, and the direct mounting for these, in the furnace heads, are quarter sections p', say of magnesite. End caps p^2 of suitable heat insulating material cover the outer ends of the terminal blocks, except where these caps and blocks are bored, as at p^3 to receive the metallic electrodes p^4, over which are applied the hubbed sleeves p^5 which receive the electric cables p^3. These metallic electrodes are preferably tubular and have longitudinal cuts p^7, whereby they are free to revolve in the terminals which, however, in consequence of the outward spring of the electrode-tongues, formed by the slots, will maintain a good electrical connection, and the heat therefrom will be rapidly radiated to the atmosphere. In order to maintain a practically constant pressure upon the carbon within the resister casing, which is essential to the accurate control of the electrothermicy, steel plates or strips p^8 are applied to the furnace heads, acting resiliently against the caps and thence upon the carbon terminals. Thus any change in the volume of the resister carbon will be compensated, either to take up for a diminution or to yield against extension. To insure effective electrical contact, the terminals may have a series of carbon pins, as p^9, in their faces, or be formed conical, as p^{10}, whereby to increase the surface area as between the granular carbon and the terminals.

A modified construction of composite resister is shown in Fig. 3. Here there is a shaft d^4, solid or hollow, supported in recesses d^5 in the terminals, and strung along this rod are a number of carbon disks d^6 having molded cavities d^7 of various forms, said cavities being filled with granular material. The terminals may be resiliently pressed against these disks, as in the instance already described. It will be observed that the outer edges of these carbon disks are shown as impinging each upon the other, but they may be separated to the extent that the granular carbon shall not escape. As there is greater length of granular carbon, longitudinally, contiguous to the supporting refractory shaft, the resistance will be greater along this zone, and therefore in this form of resister it will be hotter at its outer surface than at its center. In other respects its action is analogous to that of the resister already described except that so high a resistivity, in any given length, cannot be obtained.

The hearth in this furnace is formed in four quadrants l^3 of the refractory bricks l^4, the latter being set into iron casings, having 45° flanges a^2 whose outer extensions are adapted to receive bolts and nuts a^3. These quadrants extend the entire length of the furnace, the furnace chamber c being inclosed by the heads of wedge-bricks a'. At each end of the furnace is a cast iron annulus a^4 in whose outer peripheries gear teeth are cast and whose inner peripheries have circular flanges a^5. Each end of the peripheral iron casings is provided with a flange a^6. Now, upon assembling the structure, the bolts and nuts a^3 will act to draw the quadrants together radially, while bolts and nuts a^7 will act to press the brickwork of the quadrants together lengthwise. Hence, practically all of the material in the furnace which is subject to temperature stresses may be placed under initial tension with the result that extreme rigidity and very tight joints are insured, which are features of the first importance in a heavy revolving structure subjected to high internal temperature. The aforesaid circular flanges a^5 are availed of as tires, acting upon friction wheels a^8 mounted in brackets a^9 and a pinion or pinions a^{10} are suitably mounted to mesh with the gear teeth in the said annular heads. It will be apparent that with the relatively small diameter of the circular flanges, or tires, the relatively large diameter of the friction wheels and the high relation of the pinions to the gears, the furnace may be revolved with the utmost ease and regularity.

While it would be entirely feasible to form the quadrants of quarter circles, in cross section producing a circular hearth, the contour here shown is decidedly preferred, that is in which each hearth-section is the arc of a circle whose radius is about equal to the longest cross-section diameter of the chamber. The two-fold advantage of this design is that for a given mass in the bath its depth will be less, and that as the charge, whether this be a bath of metal or crushed ore, must pass from one hearth-section to another across the 45° intersection, it is necessarily subjected to an intermixture which is not realizable in a circular hearth.

For charging the furnace, a large tubular opening q is built into one of the hearth sections, being closed with a refractory plug held securely in place by a strap q' bolted to the casing. This opening may also be utilized for running off slag or quickly emptying the chamber. One or more tap-holes, as r may be provided in either or both heads.

The construction, as herein described, involves practically no machining. The resister and the furnace hearth have a maximum of endurance, but whenever necessary to substitute a resister, or to repair or renew the hearth, the entire structure, or any essential portion of it, may be quickly removed and replaced. The thermal efficiency is high in that while all surfaces of the furnace chamber receive the universally radiated heat from the resister, yet all of the hearth sections and a major portion of the heads act as temporary reservoirs of heat units which are absorbed by the relatively colder charge upon each revolution of the furnace.

We claim as our invention:

1. A revolving electric furnace having a carbon resister as a central core.

2. A revolving electric furnace having a cylindrical core containing the elements of the resister.

3. A revolving electric furnace having a carbon resister as a central core and its hearth formed in segments.

4. A revolving electric furnace having a cylindrical core containing the elements of the resister, and its hearth formed in four separable quadrants each extending the entire length of the furnace and being curved to a radius about equal to the diameter of the furnace chamber.

5. In a revolving furnace the combination with the heads thereof, of a segmental casing, means to form the hearth of the furnace, and fastening means to unite the segments of the casing together and to the heads, said fastening means being adapted to place the hearth forming means under initial tension.

6. In a revolving furnace, the combination with the heads thereof, of a hearth formed segmentally of refractory bricks, a peripheral casing having a corresponding number of segments, and means to bolt the segments of the casing together and to the heads, the relation of heads, bricks and casing being such that the bolting is adapted to place the bricks under initial tension.

7. In a revolving furnace, the combination of refractory bricks constituting the hearth, a peripheral casing, and an annulus at each end of the furnace bolted to the casing, the bolting being adapted to place the bricks under an initial tension lengthwise of the furnace.

8. In a revolving furnace, an annulus at each end thereof having a flange upon its inner periphery and gear teeth in its outer periphery, wheels upon which the flanges travel, and driving gears meshing with the teeth.

9. In a revolving furnace, the combination of a peripheral casing, an annulus at each end thereof, bolted thereto and having an outwardly projecting flange upon its inner periphery and gear teeth in its outer periphery, relatively large friction wheels upon which the flanges travel, and relatively small gear wheels engaging the teeth.

10. In a revolving electric furnace, a single central core comprising a refractory periphery and an electrically resistive filling.

11. In a revolving electric furnace, the combination of a single central core, and electric terminals entering the core at each end.

12. In a revolving electric furnace, the combination of a single central core comprising a refractory periphery and an electrically resistive filling, and electric terminals entering said periphery at each end.

13. In a revolving electric furnace, the combination of a cylindrical core, electric terminals entering the core at each end, and resilient electrodes entering said terminals.

14. In a revolving electric furnace, the combination of a core, resister material within said core, and means to maintain a constant pressure upon the resister material.

15. In a revolving electric furnace, the combination of a cylinder core, a carbon filling for the core, terminals at each end of the core, and resilient members to press the terminals against the carbon filling for the purpose set forth.

This specification signed and witnessed this 11th day of May, A. D., 1909.

JOHN THOMSON.
FRANCIS A. J. FITZ GERALD.

Signed in the presence of—
G. McGrann,
Lucius E. Varney.