W. K. BOOTH.

ELECTRIC FURNACE.

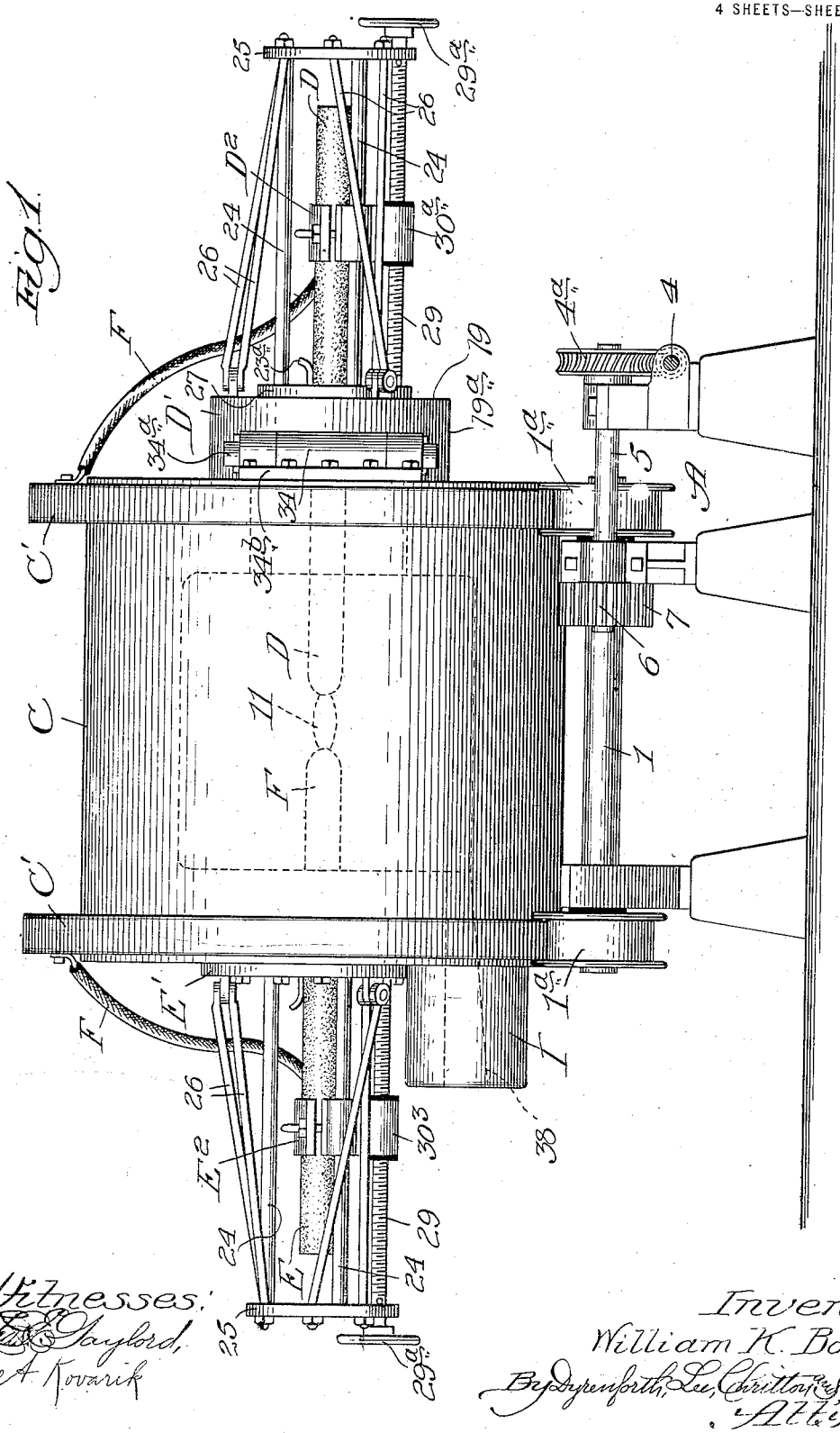
APPLICATION FILED FEB. 3, 1919.

1,332,795.

Patented Mar. 2, 1920.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 2.

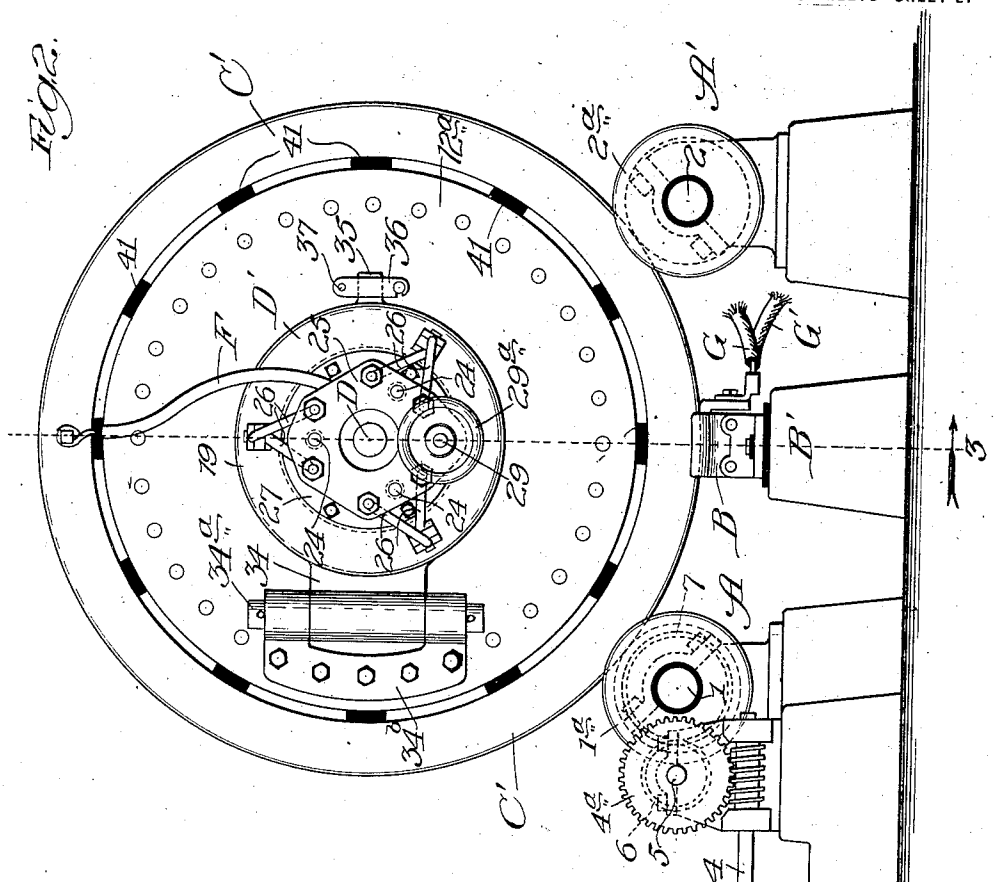


Fig. 8.

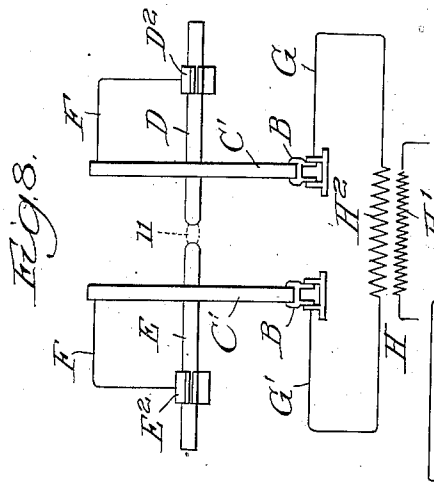
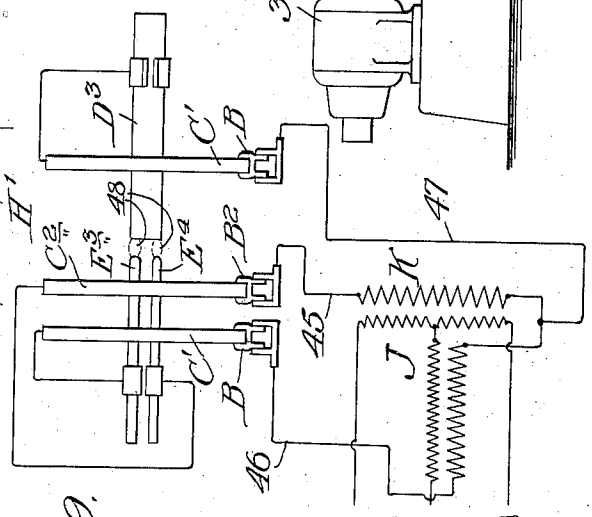


Fig. 9.



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4 SHEETS—SHEET 3.

Fig. 3.

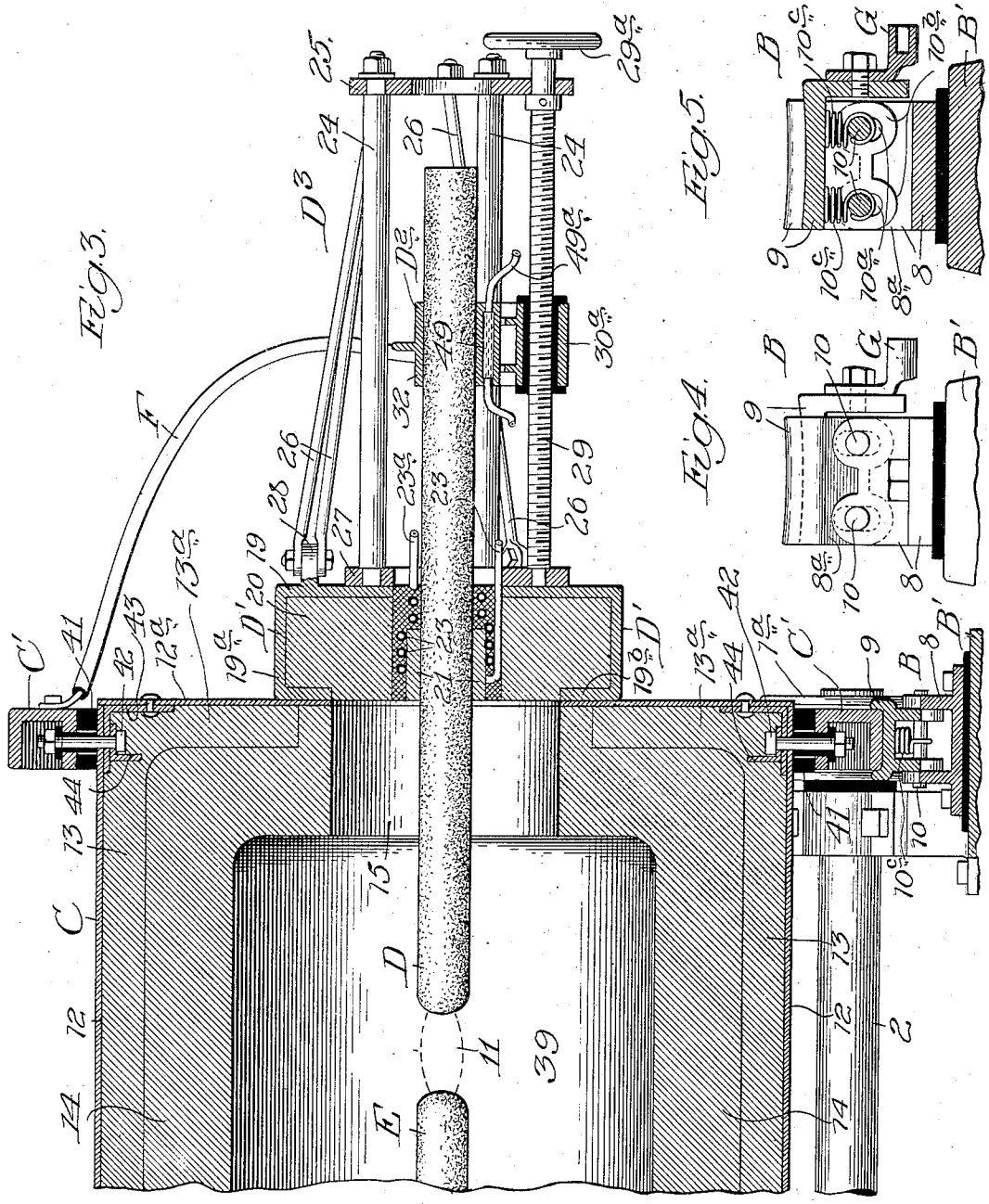


Fig. 5.

Fig. 4.

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4 SHEETS—SHEET 4.

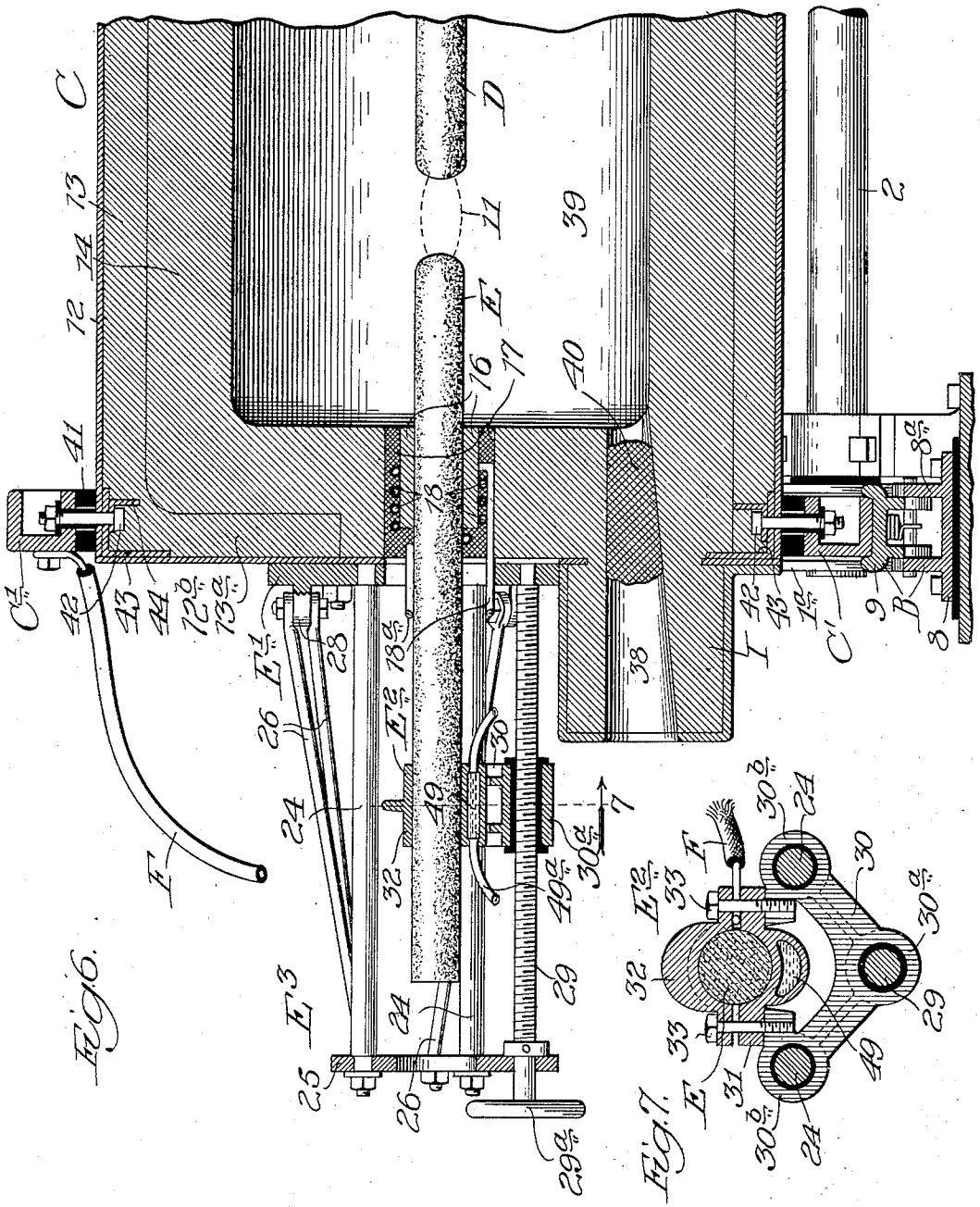


Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE.

WILLIAM K. BOOTH, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE BOOTH ELECTRIC FURNACE CO., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

ELECTRIC FURNACE.

1,332,795. Specification of Letters Patent. **Patented Mar. 2, 1920.**

Application filed February 3, 1919. Serial No. 274,721.

To all whom it may concern:

Be it known that I, WILLIAM K. BOOTH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Electric Furnaces, of which the following is a specification.

This invention relates particularly to electric furnaces of the revoluble or oscillatory type; and the primary object is to provide a thoroughly practicable furnace of this type, which is capable of being operated with great facility, which can be easily constructed, which will operate in an improved manner, and which will possess great longevity.

The invention is illustrated in its preferred embodiment in the accompanying drawings, in which—

Figure 1 represents an elevational view of a rotary furnace embodying my invention; Fig. 2, an end elevational view of the same; Fig. 3, an enlarged broken longitudinal section, showing the construction at one end of the furnace, where there is employed a charging-door in which is mounted an electrode, the section being taken as indicated at line 3 of Fig. 2; Fig. 4, an elevational view of one of the stationary contact-members employed; Fig. 5, a sectional view of the contact-member shown in Fig. 4; Fig. 6, an enlarged broken sectional view illustrating the construction at the other end of the furnace; Fig. 7, a sectional view taken as indicated at line 7 of Fig. 6; Fig. 8, a view, diagrammatic in its nature, illustrating the manner in which the furnace is adapted to the use of a single-phase current; and Fig. 9, a view diagrammatic in its nature, illustrating the manner in which the furnace is adapted to the use of a two-phase current.

In the construction illustrated, A, A^1 indicate means for supporting a furnace-body and turning it about its axis; B, B, a pair of stationary contact-members carried by a suitable support or supports B′; C, a revoluble furnace-body equipped with insulatingly-mounted peripheral contact-members C′, which serve also as annular flanges or tracks through the medium of which the furnace-body is mounted on the supporting and turning means; D, an axial electrode adjustably mounted on a centrally located charging-door D^1 with which the furnace-body is equipped at one end, the electrode projecting through said door into the furnace and being capable of adjustment through the medium of an adjustable electrode-clamp D^2; E, an axial electrode adjustably mounted upon an end plate E^1 secured to the other end of the furnace-body, the electrode E projecting through the end wall of the furnace-body and being adjustable by means of an electrode-clamp E^2 which is adjustably mounted; F, F^1, flexible electric-conductors connecting the contact-members C^1 with which the furnace-body is equipped with the electrode-clamps; and G, G^1, electric conductors connecting the stationary contact-members B with a source of electric energy.

The mechanism A, A^1, for supporting the furnace-body and turning it about its horizontal axis, preferably comprises a shaft 1 equipped with a pair of insulated grooved wheels or rollers 1^a which engage the combination track-members and contact-rings C^1; another shaft 2 equipped with a pair of insulated grooved rollers 2^a which engage the members C^1; and an electric motor 3 adapted to actuate the shaft 1 through the medium of a worm-shaft 4, a worm-gear 4^a and a shaft 5 which is equipped with a pinion 6 meshing with a gear 7 on the shaft 1. Suitable foundations are provided for the shafts 1 and 2 and for the driving means connected with the shaft 1, as clearly appears from Figs. 1 and 2.

The stationary contact-members B are preferably of the construction shown in detail in Figs. 4 and 5. Each of said devices comprises an insulated mounting 8 having upwardly-extending flanges 8^a; and a spring-projected flanged shoe 9 mounted between the flanges 8^a and adapted to bear against the periphery of the contact-rings C^1. The conductors G, G^1, which supply current to the furnace are connected with the spring-pressed shoes 9. In the illustration given, the flanges 8^a are connected by studs 10 which extend freely through slots 10^a in

downwardly-extending lugs or flanges 10^b with which the shoe 9 is equipped. The compression-springs 10^c are interposed between the shoe 9 and the transverse studs 10, the function of these springs being to press the shoe 9 into close contact with the contact-ring C^1 with which the furnace-body is equipped.

In Fig. 8, there is given a diagrammatic illustration of the manner in which the furnace is supplied with a single-phase current. In this case, the conductors G, G^1 form a part of the secondary circuit of a transformer device H, having a primary winding H^1 and a secondary winding H^2. Current may pass, for example, through the conductor G, thence through one of the shoes B to the annular contact-member C^1, thence through the corresponding conductor F to the electrode D, thence across an arc at 11 to the electrode E, and back by way of the other contact-ring C^1, shoe B and conductor G^1 to the coil H^2.

The construction of the furnace-body C preferably is as illustrated. In this form it comprises a cylinder equipped at one end with the plate E^1 carrying one electrode and equipped at the other end with the charging-door D^1 carrying the other electrode. The cylinder preferably comprises a cylindrical steel shell 12 having separately formed end plates 12^a and 12^b secured thereto; a heat-insulating lining 13 which may be tamped in place within the cylindrical portion of the shell and reflected over the inner surfaces of the ends of the shell, as indicated at 13^a; and a refractory lining 14 within the lining 13, which may be constructed of fire-bricks cemented in place. The lining 14 is continued around within the inner ends of the shell, as indicated at 14^a and 14^b. At one end of the furnace-body, the end portion 12^a of the steel-shell and the lining within the steel-shell are provided with an enlarged axial opening, affording a charging-door opening 15. This opening is normally closed by the charging-door D^1. At the other end of the furnace the end portion 14^b of the lining is provided with an axial opening, which contains a graphite bearing 16 which is set in a refractory packing (cement or clay) 17, in which are embedded the coils 18 of a water-cooling pipe, the end portions 18^a of which extend through a central opening in the plate E^1, and connect with any suitable source of water-supply (not shown). A very desirable use for the improved furnace is that of melting brass; and the graphite bearing 16, through which the electrode E extends, is adapted to permit the electrode to be adjusted with facility through the bearing. Were it not for the use of some such expedient, the zinc contained in the brass, which is liable to be vaporized to some extent, might freeze or collect on the electrode and interfere with the free adjustment thereof.

The charging-door D^1 preferably comprises a steel or iron plate 19 spaced some distance from the end wall of the furnace and having an inwardly-extending circumferential flange 19^a, from which extends inwardly a flange 19^b which is adapted to bear against the end member of the steel shell of the furnace-body. The hollow body thus formed is packed with refractory material 20.

Through the door extends an axial opening in which is placed a graphite sleeve 21 which is set in place by means of a refractory packing or cement 22 containing the coils of a water-cooling pipe 23 whose ends 23^a extend out through a central opening with which the plate 19 is provided and communicate with a suitable source of water supply (not shown).

The electrode-clamps D^2 and E^2 are adjustably mounted on supporting-frames D^3 and E^3, one of which is carried by the charging-door D^1 and the other of which is carried by the fixedly-mounted end plate E^1. The frames are similarly constructed and a description of the frame D^3 will suffice for both. Thus, the frame D^3 comprises three compression-rods 24, the lower two of which serve as guides for the clamp D^2; an outer plate 25 having sockets receiving the outer ends of the compression-rods 24; and tension-rods 26 which are adapted to cause the plate 25 to place the rods 24 interposed between said plate and the door D^1 under compression. The plate 25 is provided with sockets receiving the reduced ends of the compression-rods 24, and a plate 27, which bears against the plate or shell 19 of the door, is provided with sockets which receive the reduced inner ends of the rods 24. In the case of the frame E^3, the reduced inner ends of the corresponding compression-rods 24 are received directly in sockets with which the plate E^1 is provided. As shown, the door D^1 and the plate E^1 are provided with attaching lugs 28, to which the inner ends of the tension-rods 26 are secured. In each instance, the electrode-clamp is actuated by a screw-rod 29 equipped with a hand-wheel 29^a. As illustrated in Fig. 7, each clamp preferably comprises a V-shaped frame 30 having screw connection at its base portion 30^a with the screw 29 and having guide-connections 30^b at the extremities of its arms with the guide-members 24 of the supporting-frame; and a pair of clamping-jaws 31 and 32 mounted on the frame and connected together and to the frame by means of cap-screws 33. As appears from Figs. 6 and 7, the actuating screw is insulatingly journaled and is incapable of longitudinal movement, so that when the screw is turned by means of the hand-wheel 29^a, the elec-

trode-clamp will be moved toward or away from the furnace. Also, as appears from Fig. 7, the guide portions of the frame of the clamp are insulated with respect to the guide-rods 24.

The door D^1 is equipped at one edge with a hinge member 34 which connects with a pintle 34^a carried by a hinge-member 34^b which is securely attached to the end wall of the furnace-body. At the opposite edge, the door is equipped with a projecting lug 35 which is adapted to be engaged by a latch-member 36 pivotally supported at 37.

As appears from Figs. 1 and 6, the furnace-body is provided at one end, preferably at the end which carries the plate E^1, with a discharge-spout I, having a discharge-passage 38 which communicates with the peripheral portion of the melting-chamber 39. The passage 38 is stopped by a plug 40 which may be of fire-clay.

As will be understood from Figs. 2, 3 and 6, the contact-rings C^1, which constitute also the annular tracks upon which the furnace-body is mounted, are insulated from the shell of the furnace by insulation rings or plugs 41, through which extend the attaching bolts 42. The insulation might take the form of insulating rings extending completely about the shell of the furnace-body, but this would involve unnecessary expense. The cylindrical member 12 of the steel shell is connected with the end members of the steel shell of the furnace-body by means of angle-form rings 43, the parts being suitably riveted or bolted together. It is preferred, also, to embed in the lining 13 the angular washers 44 which engage the heads of the bolts 42, so that the bolts will not turn when the nuts are being applied. The members C^1 are preferably of U-form cross-section, the inner flanges serving, in this case, to receive the outer portions of the bolts 42. The contact-rings may be of brass, if desired, and of ample dimensions to carry the current without heating and also to support the body of the furnace without danger of breakage.

The construction described enables a revoluble furnace to be built with facility and at moderate cost. The lining can be introduced securely and with ease. In introducing the packing 17, a plate may be temporarily placed over the inner end of the opening which receives the packing and the packing may then be tamped in place. Access to the interior of the furnace is gained for this purpose through the door-opening 15. The packing 22 in the door D^1 may be introduced, of course, while the door is open, or, if desired, before the door is applied to the furnace.

In the operation of the furnace, the current passes through the brushes or shoes B to the peripheral contact-rings C^1 and through the flexible conductors F which connect the rings C^1 with the electrode-clamps. While the furnace is in operation, it may be rotated slowly by means of the electric motor, the construction providing for continuous rotation, if desired. This results in constantly changing the portion of the interior of the furnace, which serves as a hearth, so that undue heating of any portion of the lining of the furnace is avoided and consequent rapid deterioration of the lining is obviated.

In the illustration given, the electrodes and their supporting and adjusting means rotate with the furnace. If desired, the furnace may be given a movement of oscillation about its axis, by providing suitable automatic reversing means for the electric motor 3. Such means is not illustrated, however, and it is preferred to impart to the furnace a very slow, continuous rotary movement. The furnace can be charged at the door-opening 15, and the molten metal may be discharged through the passage 38. The electrodes are somewhat removed from the zone occupied by the metal in the hearth, so that when brass is being melted, the tendency of the zinc in the brass to vaporize is reduced to the minimum.

Fig. 9 illustrates the manner in which a furnace of this principle may be operated as a two-phase furnace. In this case C^1, C^1 may represent the annular tracks which support the furnace-body and serve also as annular contact-members; and C^2 may represent an additional annular contact-member insulatingly mounted on the furnace-body. As before stated, the current may pass to the contact-members C^1 through the contact-shoes B; and current may pass to the additional annular contact-member C^2 through a shoe B^2. D^3 represents an electrode adapted to extend through one end of the furnace-body, as through the door D^1; and E^3 and E^4 represent two electrodes adapted to extend through the other end wall of the furnace-body. J represents the primary windings of a two-phase transformer or transformers so connected as to deliver a two-phase secondary current, the primary current being a three-phase alternating current, if desired; and K, K^1 represent the secondary windings of the transformer device. One end or terminal of the secondary winding K is connected, through a conductor 45, with the shoe B^2; and the corresponding terminal of the secondary winding K^1 is connected through a conductor 46 with the shoe B which is at the same end of the furnace. The other terminals of the secondary windings K, K^1 are connected, through a common return-conductor 47, with the shoe B at the other end of the furnace. The current may pass, for illustration, from the secondary windings K, K^1 through the con-

ductors 45 and 46 to the annular contact-members C^2 and C^1 at that end of the furnace, thence to the electrodes E^3 and E^4 opposed to the electrode D^3, thence by arcs at 48 to the electrode D^3 and then back to the secondary windings. Thus, we have the two electrodes E^3 and E^4 in alinement with the electrode D^3 which may serve as a common return for the phases of current from the secondary windings K, K^1. This arrangement is adapted to enable the furnace to be operated without unbalancing the load of the line wires which supply the primary winding or windings of the transformer device.

The construction described finds a very useful application in melting brass, but it may be used for melting other metals. There is a wide field for the use of such furnaces, especially where means for melting metal in comparatively limited amounts are desired. In melting brass, not only is it true that the arc does not strike the charge, but also it is true that the rotary movement of the furnace effects a constant mixing action of the charge, thus tending to equable diffusion of the heat, so that volatilization of the zinc in the brass is practically eliminated. This applies also to the other constituents of the compound.

The construction affords a thoroughly practicable and durable electric furnace of the type adapted to turn about an axis during the operation of melting the charge; and such construction affords a furnace possessing great longevity and capable of being operated with the greatest facility. The electrode-clamps are preferably provided with water-cooling chambers 49 supplied with water through flexible pipes 49^a.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, but the appended claims should be construed as broadly as permissible in view of the prior art.

What I regard as new, and desire to secure by Letters Patent, is:

1. An electric furnace comprising a furnace-body adapted to turn about an axis, contact-members mounted to turn with said body, adjustable electrodes extending through the ends of said body, adjustable electrode-clamps supported on the ends of the furnace-body and engaging said electrodes, flexible conductors connecting said contact-members with said clamps, and means for supporting and turning said furnace-body and supplying current, including contact-members engaging said first-named contact-members, and an electric circuit connected with said second-named contact-members.

2. An electric furnace comprising a furnace-body adapted to turn about an axis while the fusing operation is in progress, means for supporting said body and turning it about its axis, including peripheral track-members mounted on said body and adapted to serve also as contact-members, and rollers supporting the furnace-body through the medium of said track-members, stationary contact-members engaging said track-members, an electric circuit connected with said stationary contact-members, electrodes extending through the ends of the furnace-body, and electric conductors connected with said track-members and with said electrodes.

3. The combination of a revoluble furnace-body, annular contact-members encircling said furnace-body and insulated therefrom, electrodes projecting into the furnace and extending through the walls thereof, conductors connecting said electrodes with said annular contact-members, stationary contact members engaging said annular contact-members, and an electric circuit connected with said stationary contact-members and adapted to supply current to the furnace.

4. The combination of a revoluble furnace-body, annular contact-members encircling the same and insulatingly mounted thereon, frames projecting from the ends of the furnace-body and turning therewith, electrode-clamps insulatingly and adjustably mounted on said frames, electrodes engaged by said clamps and projecting into the furnace through the ends thereof, conductors connecting said electrode-clamps with said annular members, stationary contact-members engaging said annular contact-members, a source of electric energy connected with said stationary contact-members, and means for supporting the furnace-body and turning it about its axis.

5. The combination of a furnace-body equipped with insulatingly mounted annular tracks adapted to serve as contact members, rollers engaging said tracks and serving to support the furnace-body, contact-members engaging said tracks, a source of electric energy connected with said last-named contact-members, electrode-holder frames projecting from the ends of the furnace-body, electrode-clamps insulatingly and adjustably mounted on said frames, electrodes engaged by said clamps and projecting inside the furnace-body, conductors connecting the said electrode-clamps with said annular tracks, and means for turning said furnace-body about its axis through the medium of said rollers.

6. The combination of a substantially cylindrical furnace-body equipped with a pair of annular metal tracks insulatingly mounted on said body, a pair of rollers engaging said tracks at one side of a vertical plane passing through the axis of said body, a pair of rollers engaging said tracks on the opposite side of the vertical plane, means

for driving one pair of rollers to effect rotation of the furnace-body, stationary contact-members located between the pairs of rollers and engaging said tracks, a source of electric energy connected with said stationary contact-members, electrodes extending through the ends of the furnace-body, and conductors connecting said electrodes with said tracks.

7. In an electric furnace, the combination of a furnace-body adapted to turn about its own axis, means for supporting said body and turning it about its axis, an axially-located charging-door at one end of the furnace-body, an electrode extending through said charging-door, an electrode extending through the opposite end of the furnace-body, and means for supplying electric current to said electrodes.

8. In an electric furnace, the combination of a hollow furnace-body adapted to turn about its own axis, annular contact-members encircling said furnace-body, an axial door carried by one end of the furnace-body, an electrode frame carried by said door, an electrode-clamp adjustably mounted on said frame, means for conducting current from one of said annular contact-members to said electrode-clamp, an adjustable electrode extending through the other end of the furnace-body, means for conducting current from said last-named electrode to the other annular contact-member, means for supporting the furnace-body and turning it about its axis, and a source of electric energy having its circuit equipped with contact-members engaging said annular contact-members.

9. In an electric furnace of the character set forth, the combination of a hollow furnace-body adapted to turn about its own axis, an annular contact-member adapted to turn with the furnace-body, an axial charging-door carried by one end of the furnace-body, an electrode adjustably mounted in said door, a conductor connecting said annular contact-member with said electrode, a source of electric energy equipped with a contact-member engaging said annular contact-member, and means for supporting the furnace-body and turning the same about its axis.

10. In an electric furnace of the character set forth, the combination of a revoluble furnace-body provided at one end with an axial charging-door opening, a charging-door mounted on that end of the furnace-body and provided with a bearing through which an electrode may be shifted longitudinally, an electrode extending through said bearing and projecting freely through the door-opening, an electrode-holder-frame extending outwardly from said charging-door, an electrode-clamp adjustably mounted on said frame and engaging said electrode, an annular contact-member adapted to turn with the furnace-body, means for conducting current from said clamp to said annular contact-member, and a source of electric energy having a circuit equipped with a contact-member engaging said annular contact-member.

11. In an electric furnace of the character set forth, the combination of a revoluble cylindrical furnace-body provided with end walls, one of said end walls having an enlarged central opening affording a charging-door opening, a charging-door mounted on the end wall of the furnace and serving to close said opening, an electrode extending through said charging-door, means mounted on the charging-door and adapted to adjust said electrode, an annular track insulatingly mounted on the end portion of the furnace-body, means for conducting current from said annular track to said electrode, an electrode extending through the opposite end of the furnace-body, an insulatingly-mounted annular contact-member connected with said last-named electrode, a source of electric energy having a circuit equipped with contact-members engaging said annular members, and means for supporting and rotating the furnace-body, including rollers engaging said track member.

12. In an electric furnace of the character set forth, a revoluble hollow furnace-body provided with end walls, one of said end walls having an enlarged axial opening affording a charging-door opening, a door mounted on the end wall and closing said opening, said door being provided with a bearing for an electrode, an electrode extending into the furnace and longitudinally adjustable in said bearing, an electrode-holder-frame comprising a plate spaced some distance from said door, compression rods interposed between said plate and said door, tension rods connecting said plate and door, an electrode-clamp mounted on said compression rods, and engaging said electrode, an adjusting screw connected with said plate and with said clamp, an annular contact-member adapted to turn with the furnace-body, a conductor connecting said annular contact-member with said clamp, means for supporting the furnace-body and turning it about its axis, and a source of electric energy having a circuit equipped with a contact-member engaging said annular contact-member.

13. An electric furnace of the character set forth, comprising a hollow cylindrical furnace-body having end walls, one of which is provided with an axial charging-door-opening, a charging-door mounted on the end wall and closing said opening, an electrode extending through the charging-door, means carried by the charging-door for adjusting said electrode longitudinally, an

electrode extending through the other end of the furnace-body, means carried by the corresponding end wall for adjusting said second-named electrode longitudinally, a pair of annular contact-members insulatingly mounted on the furnace-body, conductors electrically connected with said contact-members and with the electrodes, a source of electric energy having a circuit equipped with contact-members engaging said annular contact-members, and means for supporting the furnace-body and turning it about its axis.

14. An electric furnace of the character set forth, comprising a hollow cylindrical furnace-body having end walls, one of which is provided with an axial charging-door opening, and the other of which is provided with a discharge passage communicating with the peripheral portion of the interior of the chamber of the furnace, a charging-door mounted on the end wall and closing said opening, an electrode extending through the charging-door, means carried by the charging-door for adjusting said electrode longitudinally, an electrode extending through the other end of the furnace-body, means carried by the corresponding end wall for adjusting said second-named electrode longitudinally, a pair of annular contact-members insulatingly mounted on the furnace-body, conductors electrically connected with said contact-members and with the electrodes, a source of electric energy having a circuit equipped with contact-members engaging said annular contact-members, and means for supporting the furnace-body and turning it about its axis.

15. In an electric furnace, the combination of a furnace-body, a pair of electrodes extending through a wall thereof, an opposed return electrode co-acting with said pair of electrodes and extending through the opposite wall of the furnace-body, and transformer means whose secondary circuits are connected on one side to said pair of electrodes and connected on the other side to the opposed electrode.

16. In an electric furnace, the combination of a furnace-body, a pair of substantially parallel electrodes extending through one wall of the furnace-body, an opposed electrode extending through the opposite wall of the furnace-body and serving as a common return, and transformer means adapted to supply two-phase current and having its secondary windings connected on one side to said pair of electrodes and connected on the other side with said opposed electrode.

17. In an electric furnace, the combination of a revoluble furnace-body, a pair of electrodes extending through one end of the furnace-body, an opposed electrode extending through the opposite end of the furnace-body and serving as a common return, a pair of annular contact-members and a third annular contact-member adapted to turn with the furnace-body, conductors connecting said pair of annular contact-members with said pair of electrodes, a conductor connecting the other annular contact-member with the other electrode, and transformer means adapted to deliver two-phase current, and having secondary circuits connected on one side with conductors equipped with contact-members engaging said pair of annular contact members and connected on the other side with a conductor equipped with a contact-member engaging the other annular contact-member.

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