No. 775,654. PATENTED NOV. 22, 1904.

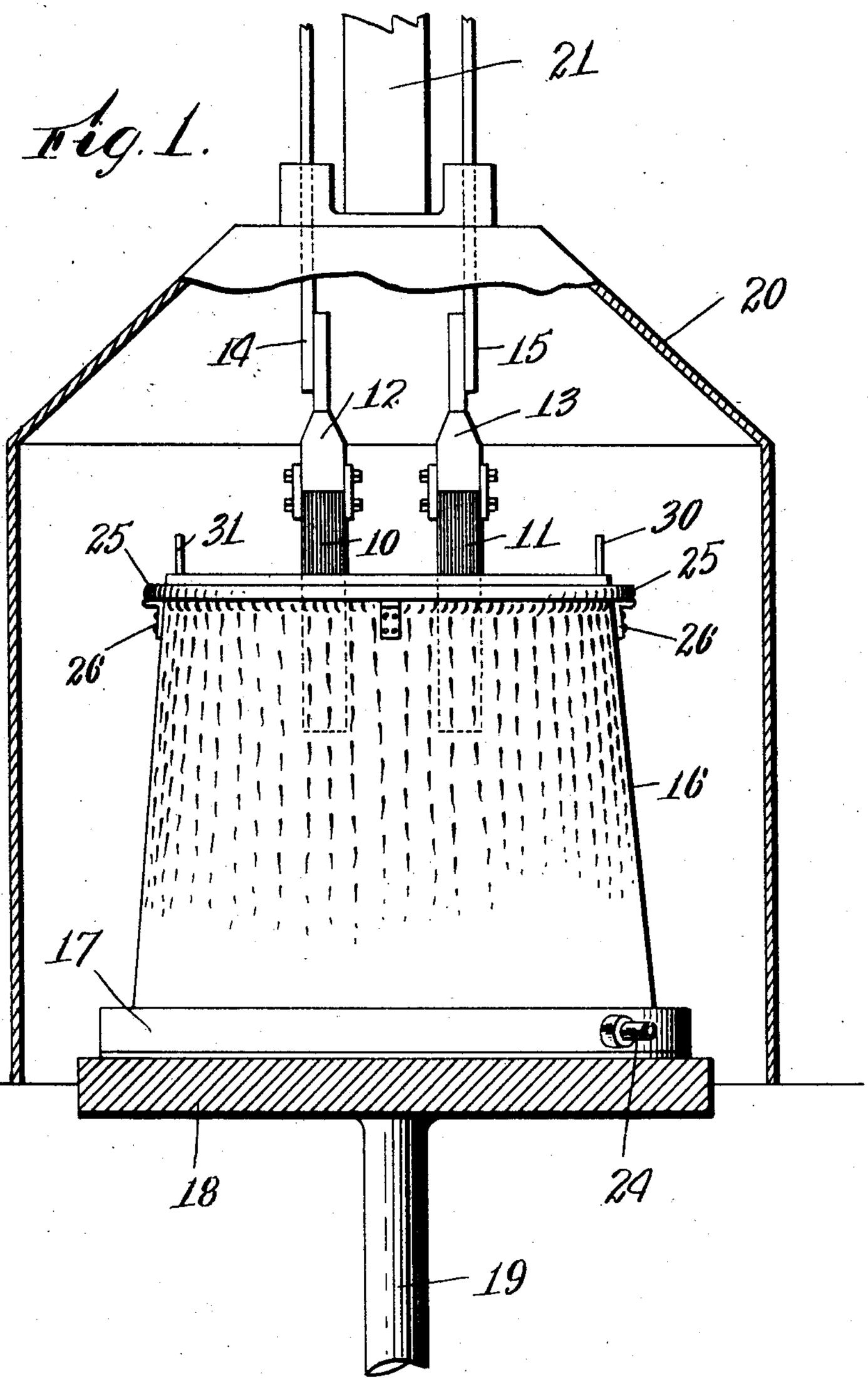
A. C. HIGGINS.

# ELECTRIC FURNACE.

APPLICATION FILED APR. 4, 1904.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.




Witnesses:
Ernest W. Despes
Arthur C. Scott

Inventor:
Alonzo C. Higgins.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

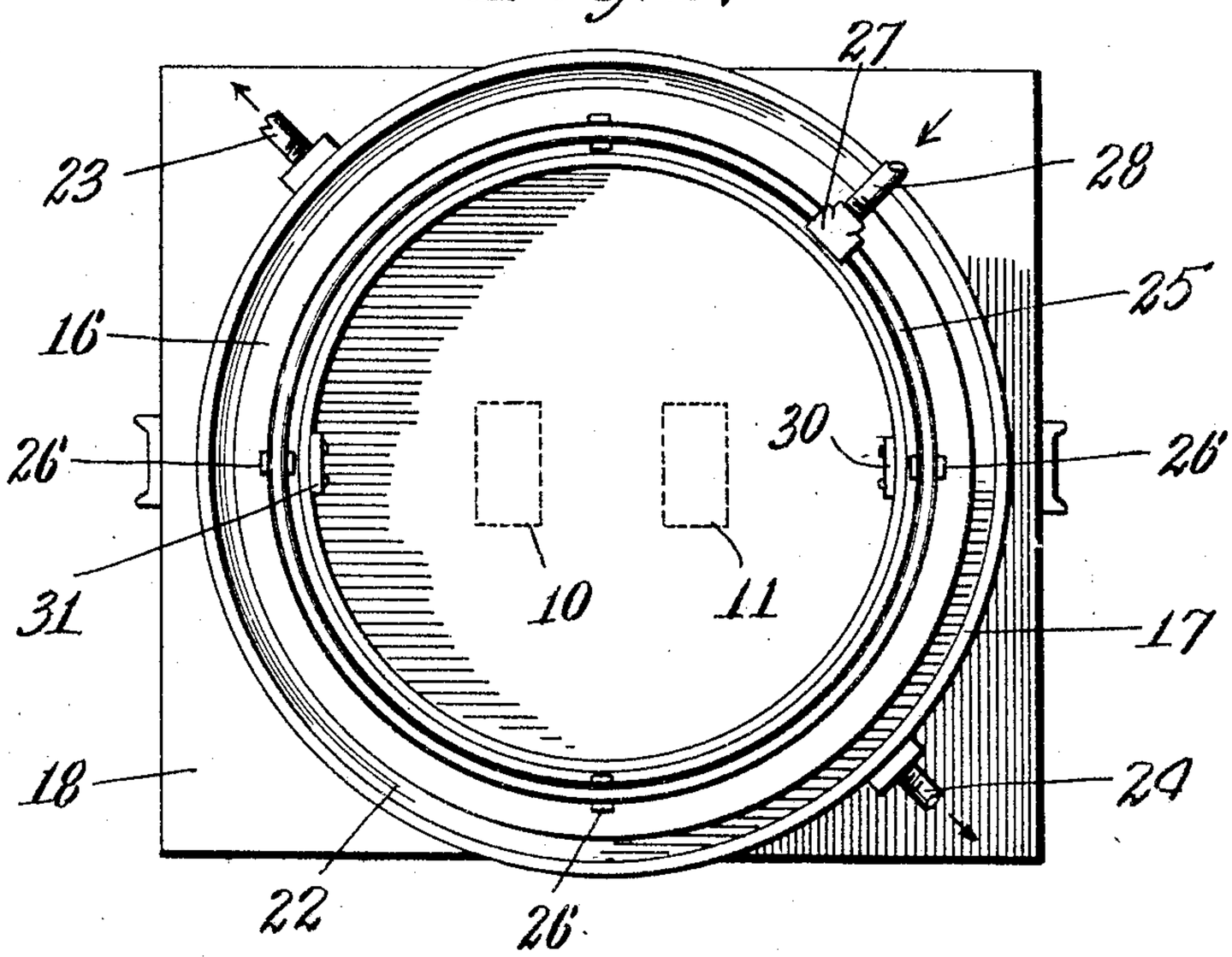
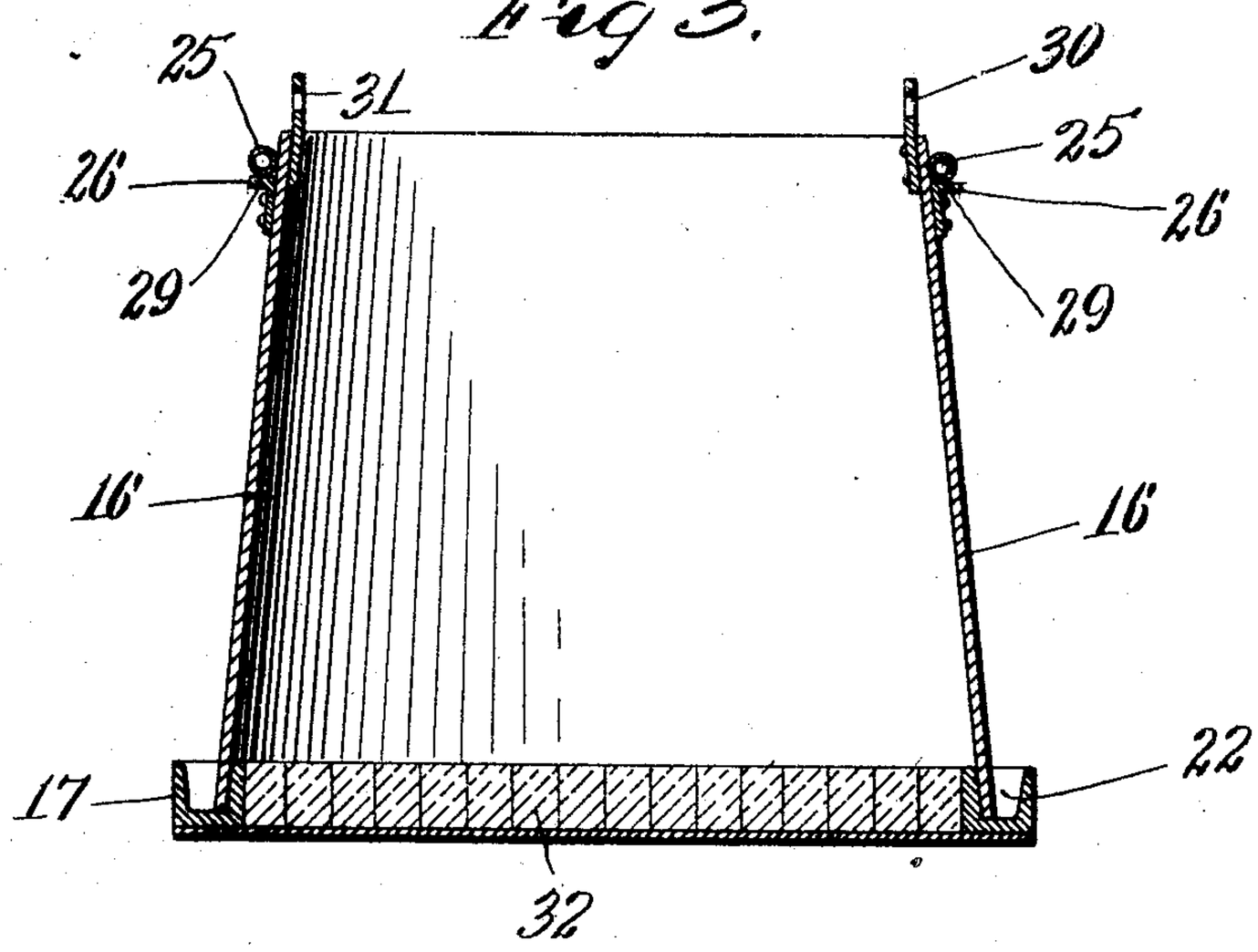



Fig 3.




Witnesses:
Ernest W. Despeaux
Arthur C. Scott

Inventor:
Alfred C. Higgins.

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A. C. HIGGINS.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 4.

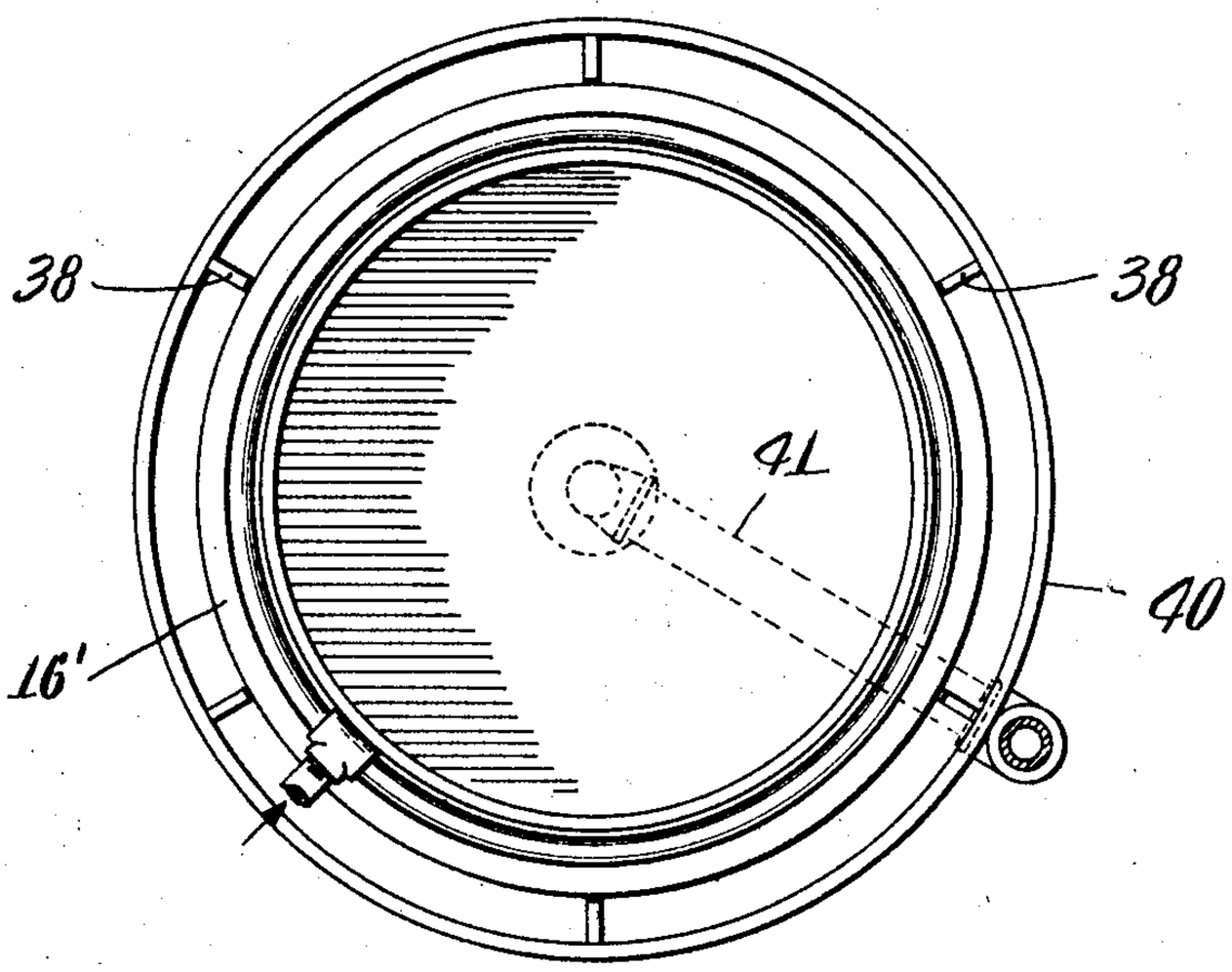
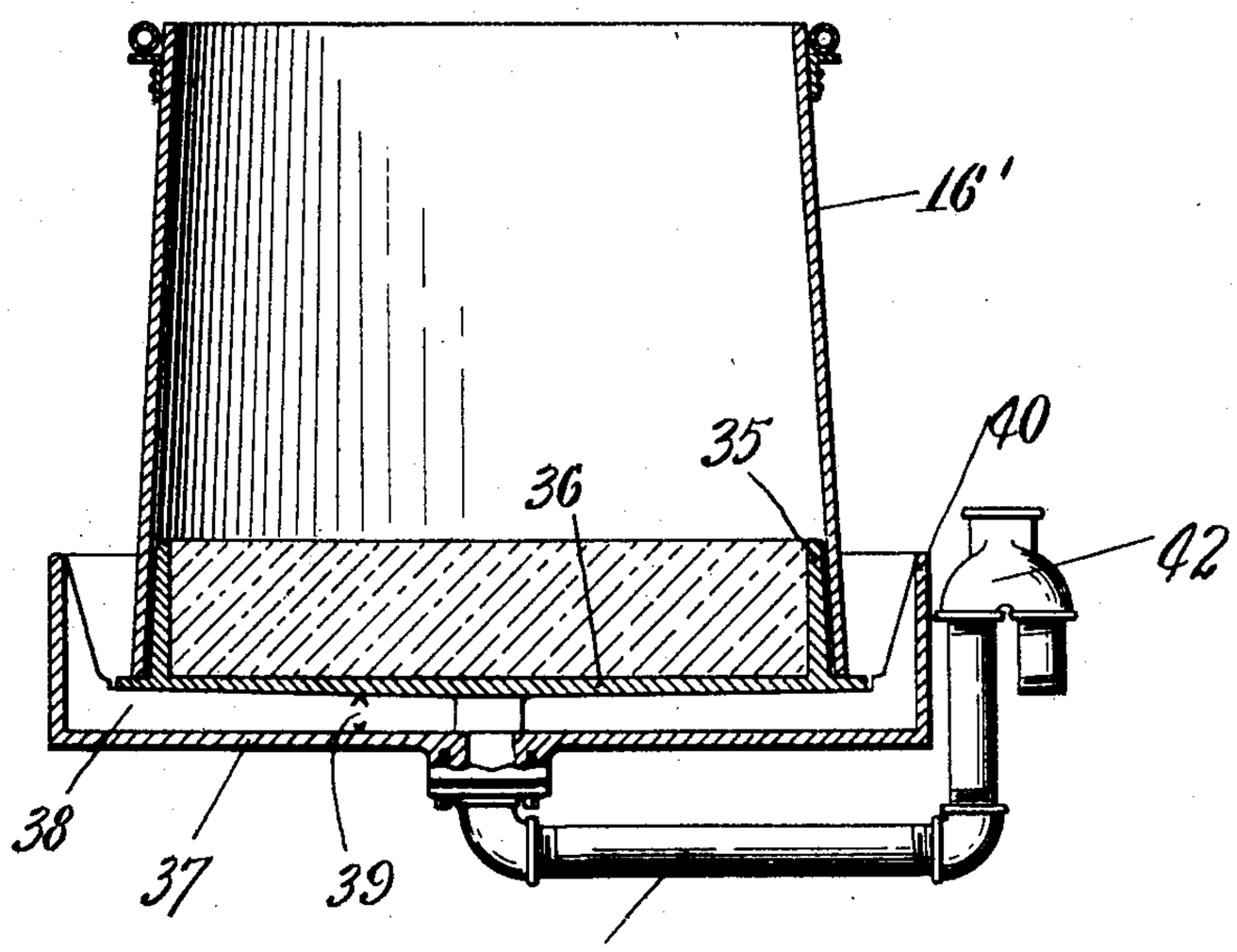



Fig. 5.




Witnesses:
Ernest W. Dispen.
Arthur C. Scott

Inventor:
Alden C. Higgins.

No. 775,654. Patented November 22, 1904.

# UNITED STATES PATENT OFFICE.

ALDUS C. HIGGINS, OF WORCESTER, MASSACHUSETTS.

## ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 775,654, dated November 22, 1904.

Application filed April 4, 1904. Serial No. 201,424. (No model.)

*To all whom it may concern:*

Be it known that I, ALDUS C. HIGGINS, a citizen of the United States of America, and a resident of the city and county of Worcester, Commonwealth of Massachusetts, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

My invention relates to improvements in the furnace pot or crucible of an electric furnace.

The intense heat developed in an electric furnace of great power is a source of considerable difficulty in providing a pot or crucible which will withstand the heat and safely hold the molten mass. It has heretofore been customary to line the pot with a refractory lining, and carbon is frequently used for this purpose, being laid up in specially-prepared blocks or in a cement-like mixture, which is afterward baked. The expense of these special linings, particularly where the furnace has to be torn down after each charge, and the care and labor necessary to properly build them up each time are among the serious objections to their use.

One feature of my invention consists in a water-cooled pot which does not require any special lining. Water-cooled devices, such as electrode-heads and pot-covers, which have been provided with pipes and confined spaces for the flow of water, have been applied to parts of electric furnaces. The element of danger, however, in the use of water confined in pipes, which by some accident might come into contact with the molten mass or become clogged and burn through without warning, has been an objection to the application of such devices to the pot or crucible.

These objections are avoided by my invention, which consists of an iron shell forming the outside of the crucible and suitable means for applying water on the outside of the shell to all parts of same in a continuously-flowing stream or blanket and conducting it away at the base. The water is not inclosed or confined as it flows over the heated surface, and the surface to be cooled is always exposed to and under the direct observation of the operator, who can regulate the water-supply to suit the needs of the particular case. Thus substantially the entire shell is acted upon by the free-flowing water over its surface, and the molten material, which is solidified by contact with the cooled shell, forms a lining for the rest of the molten mass—that is, the pot becomes lined with a mass of fused solidified material. In making the artificial abrasive alundum, for instance, bauxite or the amorphous oxid of alumina is fused inside this water-cooled shell, and this material, which is highly refractory, forms a lining of solid alundum for the shell.

Another feature of my invention consists in the construction of the shell separable from the hearth or bottom of the pot and in such way that it can be lifted off the charge after the latter has solidified, thus facilitating a rapid discharge of the furnace and its assembling for another run.

A better understanding of other features of my invention, as well as those briefly set forth above, will be secured from a full description of the apparatus, which follows.

Figure 1 is an elevation of an electric furnace embodying my invention. Fig. 2 is a plan view of same. Fig. 3 is a diametrical section through the furnace shell and ring. Figs. 4 and 5 are plan view and section, respectively, of a furnace in which both shell and bottom are water-cooled.

The form of furnace herein shown is of the arc type, in which the electrodes 10 11 are held stationary in heads 12 13, to which the cross bars or conductors 14 15 are connected. The invention, however, is not confined to this particular form of furnace. The furnace pot or crucible comprises the shell 16, fitting into the base-ring 17, mounted on the base or hearth 18. The base is raised or lowered by suitable mechanism, which may be a direct plunger hydraulic elevator, the plunger 19 being shown. As the material is melted, reduced, or otherwise treated the crucible is lowered until the same is full or the run completed. A hood 20, with suitable openings (not shown) for feeding the furnace and for observation, is provided to confine the gases and to direct their escape up the chimney 21.

The shell 16 is made of boiler-plate or sheet-

iron, circular in form and inclined or conical from the bottom up, being slightly smaller at the top than at the bottom. This particular form of shell may be varied without departing from the spirit of my invention. The bottom of this shell fits into a trough 22 in the base-ring 17. This trough extends around the ring and serves to catch the water and conveys same to the waste-pipes 23 24. Around the outside of the shell near the top the water-distribution pipe 25 is loosely mounted on brackets 26, the ends being joined in a T-union 27, which is connected with a suitable water-supply, as 28. The pipe 25 is provided with a row of small holes 29 for its entire length around the shell. These holes are drilled in a direction to direct the streams of water flowing from same onto the shell. Two rings or ears 30 31 are provided to lift the shell off the hearth and base-ring.

The hearth 18 in Fig. 3 is protected by a suitable lining of carbons 32.

The operation of the device is as follows: As the material to be treated is fed into the furnace it becomes fused or reduced to a molten mass by the action of the arc. The crucible is gradually lowered and more material fed in until the run is completed. During this operation numerous small streams of water flowing from the holes 29 play upon the shell and joining each other upon striking the shell flow down the outside thereof in one continuous sheet or blanket, covering the entire surface of the shell. This keeps the temperature of the shell below the melting or burning point and chills whatever molten material may come into contact with it on the inside. This material is frequently of itself of a most refractory nature except under the action of the arc, and is to a considerable extent a non or slow conductor of heat. Thus the layer of chilled material up against the inside of the shell serves as a lining for the molten mass, the attempt being to keep this lining down to a temperature which will not injure the shell. It will be seen that the water is not confined at the points of greatest heat, and the danger of a steam explosion by accident of the molten mass breaking through the shell is reduced to a minimum. The entire surface being cooled and the entire flow of water are exposed to the direct observation of the furnace operator, who can regulate the flow of water to suit the run and can note at once and receive full warning of any danger to the shell. At the end of the run the shell is lifted off by means of the ears, and the pig or mass of fused and hardened material can be lifted off the hearth with a suitable hoist and the furnace immediately assembled and placed in operation again.

Figs. 4 and 5 show a modification of my invention, in which the hearth is also water-cooled. The shell 16′ fits over the flange 35 of the hearth 36. This hearth fits into an iron water-pan 37 and rests on the wings or partitions 38, leaving a space 39 between the hearth and pan. The outside flange of the pan extends upward to just below the inside flange 35 to prevent any possibility of water entering the inside of the shell or hearth. The water is conducted away by the pipe 41, which is brought up at 42 to near the top of the flange 40 to maintain the water-level at a constant height in the pan above the bottom of the hearth 36. The operation is similar to that described above except that the water which flows down over the surface of the shell is conducted under the hearth, keeping that cool, and escapes through a waste-pipe at the center.

It may be noted that I do not confine myself to any particular form of shell or ring or in the particular means shown for applying and carrying off the water, and the details of the particular construction shown can be varied and added to without departing from the spirit or avoiding the scope of my invention.

What I claim is—

1. In an electric furnace, the combination of a shell adapted to contain and come in contact with the material to be fused, a base separable from said shell, and upon which the charge is entirely supported when the shell is removed.

2. In an electric furnace, the combination with a shell constituting the side walls of the furnace, of a furnace-base upon which the shell is removably supported, and devices connected to the shell whereby it may be lifted from the base.

3. In an electric furnace, the combination of a conical shell constituting the side walls of the furnace, a base on which said shell is adapted to be removably supported, and devices connected to the shell for lifting it from the base.

4. In an electric furnace, the combination of an unlined shell constituting the side walls of the furnace, a base upon which said shell is removably supported, and means for supplying to all the exterior surface of said shell flowing water to thereby cause the contained material to form a lining for the shell.

5. In an electric furnace, the combination of an unlined shell constituting the side walls of a furnace, a base upon which said shell is removably supported, means for supplying flowing water to the upper portion of said shell substantially throughout its extent and means for collecting the flowing water adjacent the base of the shell.

6. In an electric furnace, the combination of a conical unlined shell constituting the side walls of the furnace, a base upon which said shell is removably supported, and means for supplying free-flowing water near the top of said shell and distributing it over the outer surface thereof, to cool the shell and cause the contained material to form a lining therefor.

7. The combination with a shell constituting

the side walls of the furnace, means for applying an unconfined and exposed flow of water on the outside thereof, a base on which said shell is mounted, a trough in said base for catching the water and conducting it away, and means secured to the shell for removing the shell from the base.

8. The combination with a conical shell, means for applying a stream of water to the outside of said shell, and a separable base having a trough into which said shell sets.

Signed by me at Worcester, Massachusetts, this 29th day March, 1904.

ALDUS C. HIGGINS.

Witnesses:
A. J. DUPIE,
F. H. LINCOLN.