

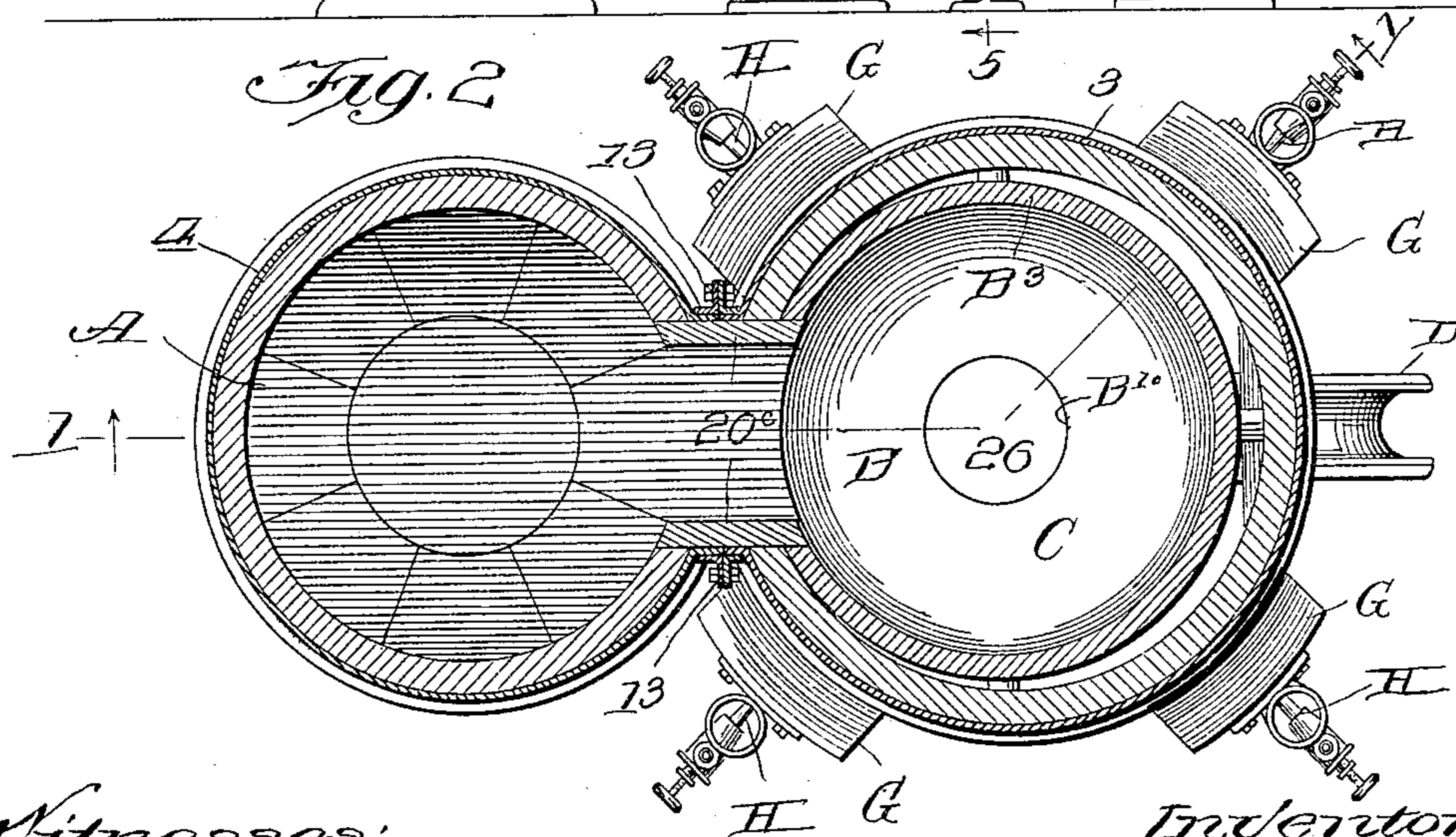
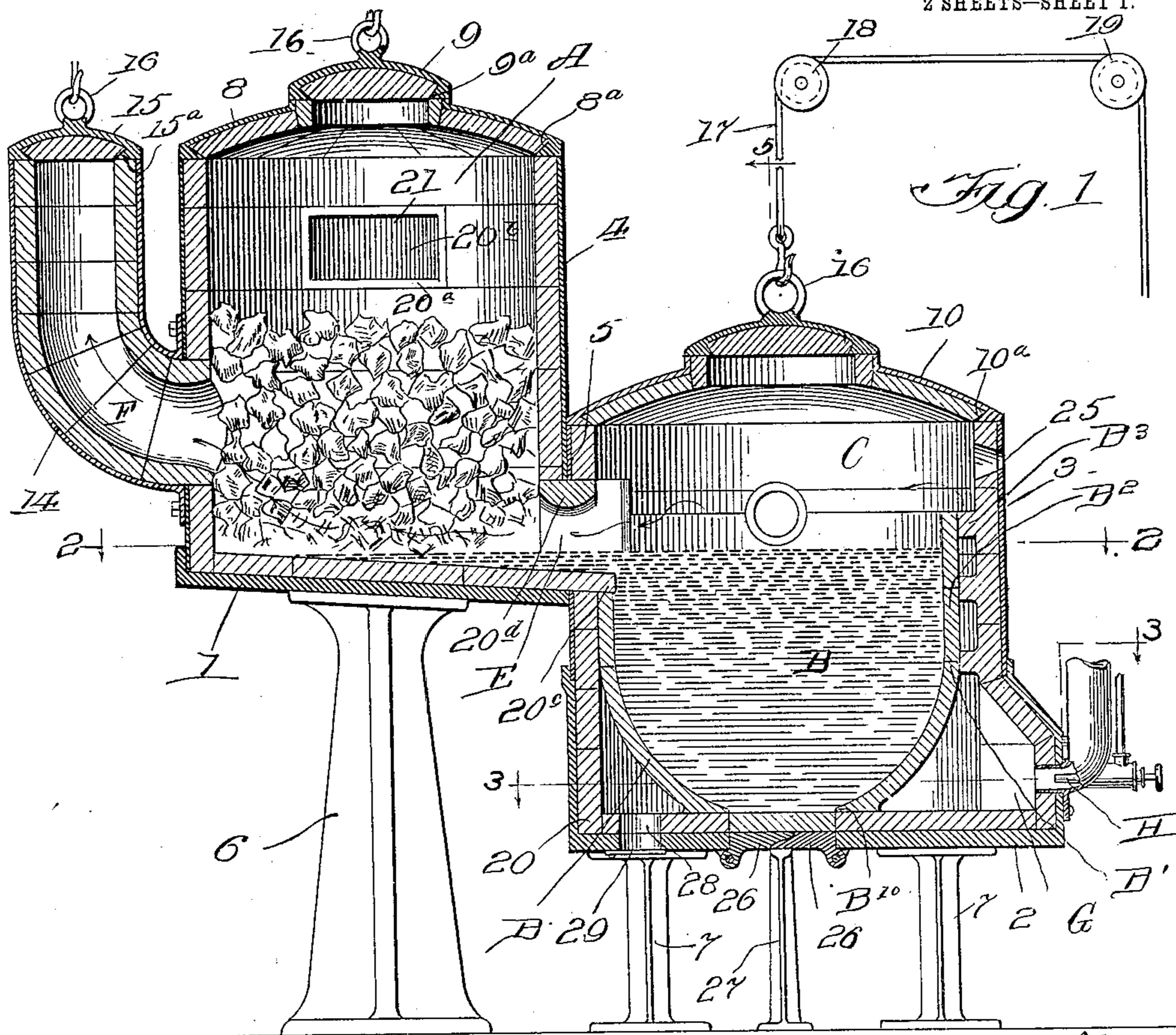
No. 814,769.

PATENTED MAR. 13, 1906.

F. N. CLINE.  
CUPOLA.

APPLICATION FILED OCT. 24, 1904.

2 SHEETS—SHEET 1.



Witnesses:  
H. S. Gault  
Fred G. Fischer

Inventor:  
Fred N. Cline  
by Burton Burton  
att'ys

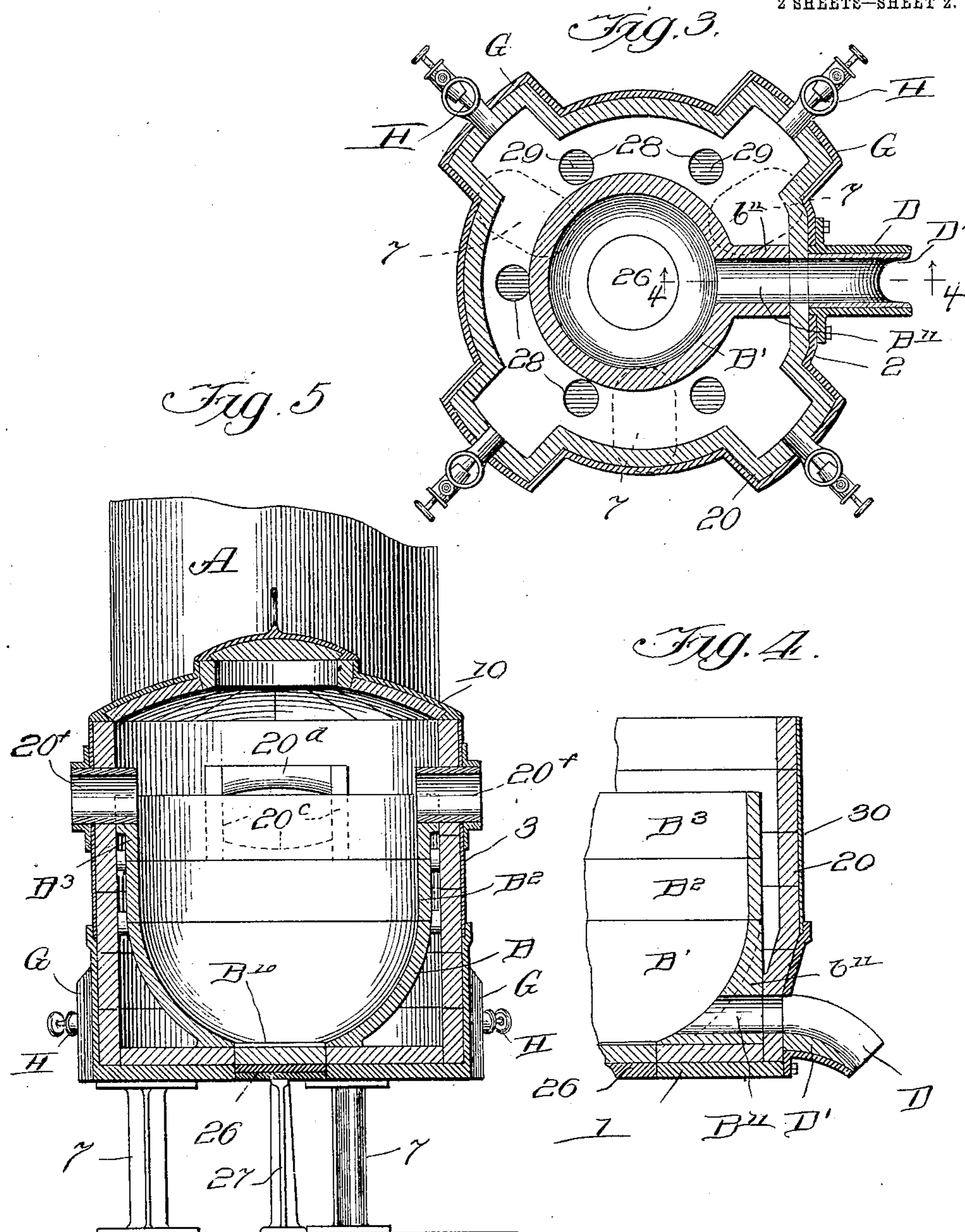
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# UNITED STATES PATENT OFFICE.

FRED N. CLINE, OF CHICAGO, ILLINOIS.

## CUPOLA.

No. 814,769.

Specification of Letters Patent.

Patented March 13, 1906.

Application filed October 24, 1904. Serial No. 229,775.

*To all whom it may concern:*

Be it known that I, FRED N. CLINE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Cupolas, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention is designed to constitute an improvement in a cupola for melting metal, with the special purpose of adapting the furnace to continuous operation by means of a crucible in which the molten metal flows and wherein it is kept heated and from which it is drawn for use, while fresh metal can be added to the melting-chamber as frequently as required to maintain the supply.

The invention consists of the features of construction of the device set out in the claims.

In the drawings, Figure 1 is a vertical section radial with respect to both the chambers at the line 1 1 on Fig. 2. Fig. 2 is a horizontal section at the line 2 2 on Fig. 1. Fig. 3 is a horizontal section at the line 3 3 on Fig. 1. Fig. 4 is a detail section at the line 4 4 on Fig. 3. Fig. 5 is a horizontal section at the line 5 5 on Fig. 1.

My improved cupola comprises two chambers A and C, in the first of which the metal is melted and from which it flows through a throat (shown at E) into a crucible B, mounted in the second chamber C, where it is exposed to even more intense heat than that which was adequate to melt it in the chamber A and from which it is withdrawn for casting through the spout D, leading from the bottom of the crucible B out across the flame-space through the outer wall of the chamber C. The melting-chamber A and the chamber C, within which the crucible B is mounted, are parts of a unitary rigid structure, the melting-chamber having fire-brick lining and such lining continuing through the throat E, which leads to the chamber C and on in the latter, which is completely lined in the same manner, but with this difference: The metal to be melted is deposited in the melting-chamber A, and the melting is effected, as more particularly hereinafter described, by the flame driven or drawn directly through the metal itself at the bottom part of that chamber; but the throat E, through which the metal when melted flows out of the chamber A, is constructed so as to lead the metal not onto the fire-brick lining of the chamber C, but into the

crucible B, which is mounted within the chamber C and spaced off from the fire-brick lining of the latter, the intervening space being a passage for the flame by which the crucible and the molten metal therein are kept at proper temperature.

In detail the structure comprises an outer metal casing which consists of cast-iron bottom plate or plates 1 for the melting-chamber and a cast-iron base 2 for the chamber C, the remainder of the casing of both chamber being preferably boiler-iron, consisting of the upper casing 3 of the chamber C and the upper casing 4 of the chamber A, these two upper casings both being cylindrical and joined together where they are tangent to each other for a few inches at the upper end of the casing 3 and lower end of the casing 4, as represented at 5 5, Fig. 2, for it will be seen from the drawings that the chamber A is elevated relatively to the chamber C, so that the two cylindrical forms overlap each other for only sufficient distance to afford the opportunity for the throat E, which connects them. The chamber A is supported by a pillar 6 and the chamber C by a plurality of shorter standards 7 7 7, upon which, respectively, the bottoms of the chambers rest. The chamber A is closed at the top by the slightly-convex cap or dome of which the metal casing 8 is formed for close junction with the cylindrical body portion of the chamber and is adapted to be lined with fire clay or brick, as more particularly hereinafter described, and it has also a central opening closed by a removable door or cover 9, similarly adapted to receive and be protected by a fire-clay lining. The chamber C is similarly closed at the top by a slightly-convex dome or cap 10, having fire clay or brick lining and provided with proper lugs or flanges 13 for joining it to the outer side of the casing 4 of the chamber A.

The flame supplied, as hereinafter described, for heating the crucible in the chamber C and for melting the metal in the chamber A obtains exit through an uptake-flue F, leading from the bottom of the chamber A, said flue being constructed similarly to said chamber A, comprising an outer metal casing 14, suitably joined to the metal casing 4 of the chamber A and having fire brick or clay lining similar to that of the chamber A, as more particularly hereinafter described. This uptake-flue is provided with a removable cap or cover 15, constructed similarly to the cap or cover of the chamber A—i. e.,

adapted to have fire brick or clay lining. All the caps or domes of the chambers and uptake-flue are provided with means for handling them at the center, such as the terret-rings 16 16 16, to which are attached the lifting-cables 17 17 17, which extend up over suitable guide-pulleys 18 18 18 and thence over other guides 19 19 19, as the situation may make necessary, so as to be operated by a downpull at the lower ends of the chains, which extend in convenient reach of the operator, whose position may be governed by circumstances, and the position to which these chains are shown extending in the drawings is not intended to be indicative of any preferential position.

The chamber A, uptake-flue F, and the chamber C have their continuous fire-brick lining, which may be provided and constructed in any manner found convenient, and the particular form of the several parts of such lining, as indicated in the drawings, is not intended to be indicative of any preferential structure or arrangement; but in whatever manner the lining-bricks are formed or adapted to fit their places and retain each other in place they are to be matched so as to make the lining continuous throughout the three parts of the structure mentioned—to wit, the two chambers A and C and the uptake-flue—so that the outer metal casing is protected at all points from direct contact with the flame. The numeral 20 indicates this fire-brick lining at all points in the structure, particular parts thereof being indicated by an exponential letter appended to said numeral 20. For example, it being necessary to provide a door 21, through which the chamber A may be charged with the metal to be melted, proper opening being made through the outer metal casing 4 and through the fire brick lining, a fire-brick thimble 20<sup>a</sup> is extended through such opening to meet the fire-brick or clay lining 20<sup>b</sup> of the door 21. In order that the fire-brick lining of the domes and covers may be securely retained therein, these domes and covers are formed in respect to the metal portion with inwardly-projecting converging flanges 8<sup>a</sup>, 9<sup>a</sup>, 10<sup>a</sup>, and 15<sup>a</sup>, respectively. In respect to the smaller of these closures 9 and 15, named “covers” rather than domes, the lining is preferably made of fire-clay molded in place. In respect to the caps or domes 8 and 10 the lining is represented as made of separate brick assembled together, and it will be understood that they are arranged to suitably interlock and retain each other with the assistance of the converging flanges mentioned in a manner familiar to those acquainted with the art. The crucible B is spaced from the fire-brick lining of the chamber C by means of projections on a sufficient number of the bricks forming the lining of the chamber C. Preferably for reasons hereinafter more fully explained the flame passage or throat to be

left between the crucible and the fire-brick lining of the chamber C is wider, affording greater capacity for passage of flame at the side of the crucible opposite the throat E and diminishes from that side around in both directions to the side at which the throat is located, there being, of course, no passage at that side, because the throat is constructed with the lining-brick 20<sup>c</sup> projecting over the upper edge of the crucible, so as to direct the discharge into the latter and not inside the space between said crucible and the fire-brick lining of the chamber C, and the crucible, therefore, at that side may be set abutting directly on the inner surface of the fire-brick lining of the chamber C. The crucible is necessarily provided with a notch at the side at which the throat thus intrudes into it, the lining-bricks 20<sup>c</sup> 20<sup>c</sup> at the two sides of the throat, as well as the brick 20<sup>c</sup> at the bottom, projecting over the edge of the crucible—i. e., over the edge of the notch through which the throatway enters the crucible. The upper side of the throat is preferably lined by a single piece of fire-brick 20<sup>d</sup>, so as to avoid any possibility of crevice at that upper side leading through to the metal casing, the single piece 20<sup>d</sup> extending so as to lap the fire-brick lining of both the chamber A and the chamber C.

The crucible is preferably made of a succession of rings lodged one upon the other, the bottom section B' being hemispherical, open upwardly, and having a central opening B<sup>10</sup> in the bottom for a purpose hereinafter explained and from one side at the bottom a spout-opening B<sup>11</sup>, which leads through a suitable exteriorly-projecting boss b<sup>11</sup>, and at this side the chamber C is slightly flattened, so that the fire-brick lining following the flattening abuts directly against the end of the boss b<sup>11</sup> and being apertured at this point constitutes a continuation of the discharge-passage, which is further continued in the spout-piece D, which is constructed so as to be bolted to the outer metal casing of the chamber and adapted to receive the fire-clay lining D', which continues the clay-lined discharge-passage. The next ring B<sup>2</sup> of the crucible presents no peculiarities of form; but the upper ring B<sup>3</sup>, being coextensive vertically with the depth of the notch through which the throatway mentioned leads into the crucible, is interrupted at the side toward the throat E and there abuts at the outer surface directly upon the fire-clay lining of the chamber C, which is suitably formed at that point for that purpose. In order that the crucible made in sections or rings in this manner may be securely braced and spaced within the chamber C, the projections are formed so as to abut against the crucible at and lapping the junction planes of the successive rings B' B<sup>2</sup> B<sup>3</sup>, as clearly seen in Fig. 1.

I prefer to heat this device by flame fur-

nished from oil-burners or vapor-burners; and for that purpose the base of the chamber C has the radially-projecting bays G G G G, through which the burners H H H H discharge flame into the cavity of the base which is continuous with the interspace between the fire-brick lining of said chamber C and the crucible, and each leads to the space above the crucible and thence through the throat E into the bottom of the chamber A, so that the flame-jets discharged from all the burners impinging against the bottom of the crucible are merged into a continuous sheet of flame which envelops the crucible and emerges over and around its upper margin, and being projected across the top becomes a concentrated blast drawn or driven through the throat E above the sheet of molten metal, which after the melting has commenced is discharged continuously over the lip-piece or lining-brick 20°, and thus renders the metal fluid at the instant of its discharge into the crucible.

The upper edge of the crucible has at a suitable number of points—two, as illustrated—notches for the lodgment of slag discharge, thimbles 20° 20°, which extend across the flame-interspace between the crucible and fire-brick lining and through the latter and the outer casing, both of which are apertured for that purpose, and it will be understood that the molten metal will be maintained in the crucible at such level that the slag may be withdrawn from the surface through these slag-ducts. In order that the operator may at all times observe the condition of the metal in the crucible and regulate the burners accordingly, observation-holes 25 25 25 are provided through the upper part of the chamber C above the level of the crucible.

For emptying the crucible the central aperture B' in the bottom of the hemispherical section B' is provided, as stated, and the same is closed by clay-lined doors 26 26, hinged out at the sides and adapted to be suitably engaged at their proximate edges, said doors being held closed during the use of the crucible by a removable prop or post 27, having a suitably-flanged upper end to lap the abutting edges of the doors.

In case of any accident causing the breaking of the crucible the molten metal therein flowing into the interspace or flame-cavity of the chamber C and solidifying therein would render the whole device useless, since the metal could not be dislodged without completely destroying the chamber. To prevent this result, the bottom of the chamber is apertured through both the brick lining and metal casing at a sufficient number of places 28 28 28 to permit the metal to escape quickly and before there is any opportunity for it to become solidified. If these apertures afford too free an air-supply by being at all times open, they may be closed to any desirable degree or completely, if necessary, by

combustible disks 29 29, covering them at the lower ends—i. e., the under side of the bottom. These disks may be of pasteboard or wood and may be retained in any temporary way and may be perforated to afford a partial supply of air, if found desirable. As soon as the molten metal touches them they will burn away and leave free path for the escape of the metal.

I claim—

1. A cupola-furnace comprising a metal-melting chamber having a gas-discharge passage leading from the bottom thereof; a crucible for the molten metal lower than the melting-chamber and adapted to receive molten metal by gravity from the bottom of the melting-chamber; a chamber within which the crucible is contained and of which the interspace about the crucible constitutes the fire-chamber, the sole flame-discharge from said fire-chamber leading into the bottom part of the melting-chamber laterally with respect thereto, and the sole metal-discharge from the melting-chamber leading into the crucible through the same lateral bottom passage.

2. A cupola-furnace comprising a metal-melting chamber having a gas-discharge passage; a crucible for the molten metal lower than the melting-chamber; a second chamber within which the crucible is contained, and the interspace of which about the crucible constitutes the fire-chamber, the sole flame-discharge from said fire-chamber leading into the lower part of the crucible laterally with respect thereto, the sole metal-discharge from the melting-chamber leading into the crucible through the same lateral bottom discharge-passage, the melting-chamber having a fire-clay lining which continues into and through said passage and over the upper edge of the crucible for conducting the molten metal into the crucible.

3. A cupola-furnace comprising a metal-melting chamber having a gas-discharge passage; a crucible for the molten metal lower than the melting-chamber; a chamber within which the crucible is contained whose cavity is continuous with that of the melting-chamber, the crucible-wall at the side toward the melting-chamber having the upper edge recessed, the throat or passage between the two chambers having a fire-brick lining which extends into such recess making junction with the lower and two side walls of the recess for conducting molten metal from the melting-chamber into the crucible, and means for directing flame into the interspace of the second chamber around the crucible for discharge over the upper edge of the crucible and through said throat into the melting-chamber.

4. A cupola-furnace comprising a metal-melting chamber having a gas-discharge passage leading from the bottom at one side and

thence upward; a crucible for the molten metal lower than the melting-chamber; a second chamber within which the crucible is contained and whose cavity is continuous with that of the melting-chamber, such cavity comprising a restricted throat or passage between the two chambers, said throat or passage leading off from the melting-chamber at a point in the periphery of the bottom thereof opposite that at which the gas-passage opens from said chamber and means for directing flame into the interspace of the second chamber around the crucible for discharge thereabove through said throat and across the lower part of the melting-chamber to the gas-discharge passage.

5. A cupola-furnace comprising a metal-melting chamber; a crucible into which said melting-chamber discharges the molten

metal; a chamber in which the crucible is contained having an interspace for flame around the crucible and means for directing flame thereinto for heating the same; a throat or passage leading from the melting-chamber for conducting the metal therefrom into the crucible, said throat or passage having free communication over the top of the crucible with the said flame-interspace, and a gas-discharge flue leading from the lower part of the melting-chamber.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 18th day of October, 1904.

FRED N. CLINE.

In presence of—

FRED G. FISCHER,  
J. S. ABBOTT.