No. 689,062.

Patented Dec. 17, 1901.

H. F. BROWN.

FURNACE.

(Application filed Dec. 27, 1899.)

(No Model.)

4 Sheets—Sheet 1.

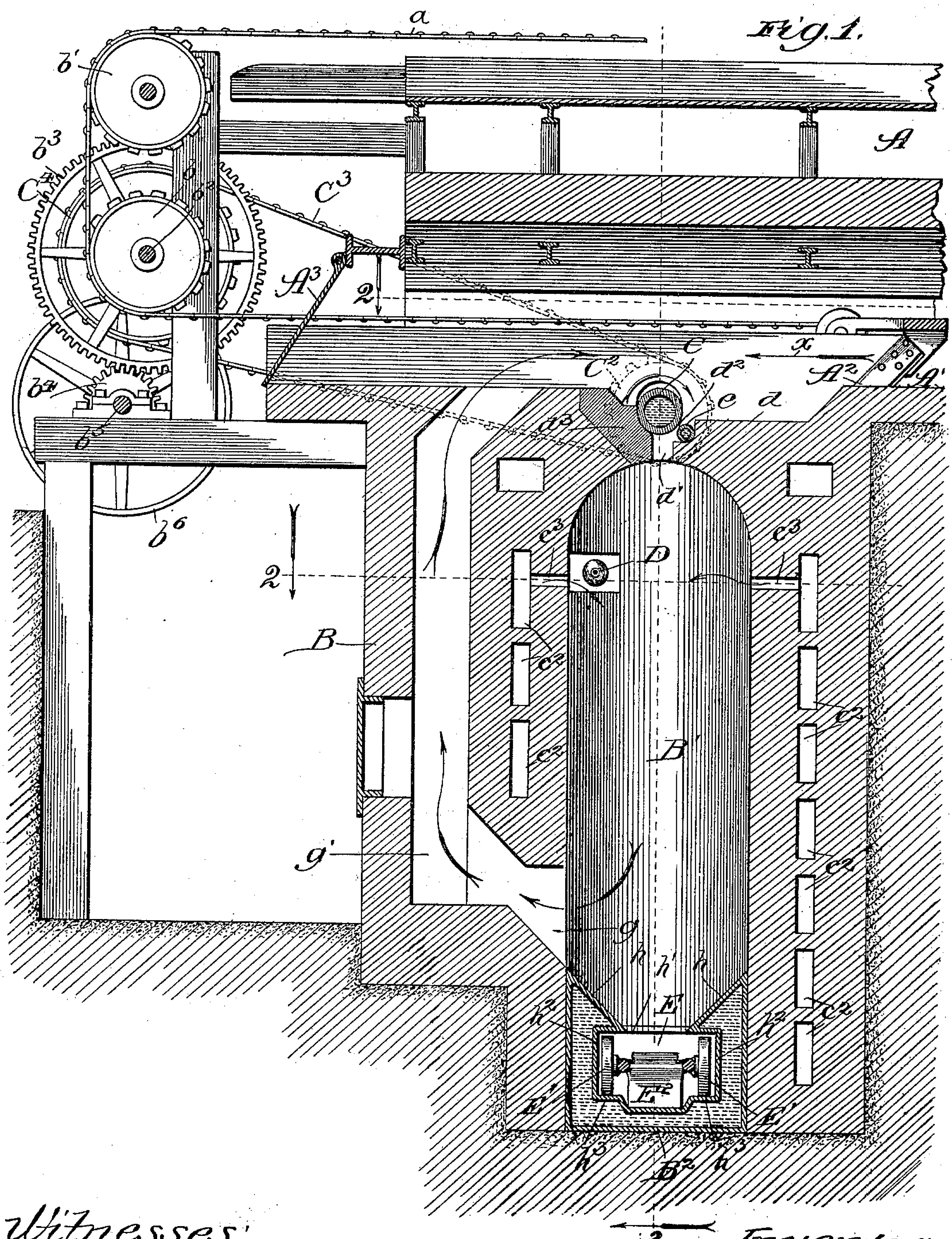

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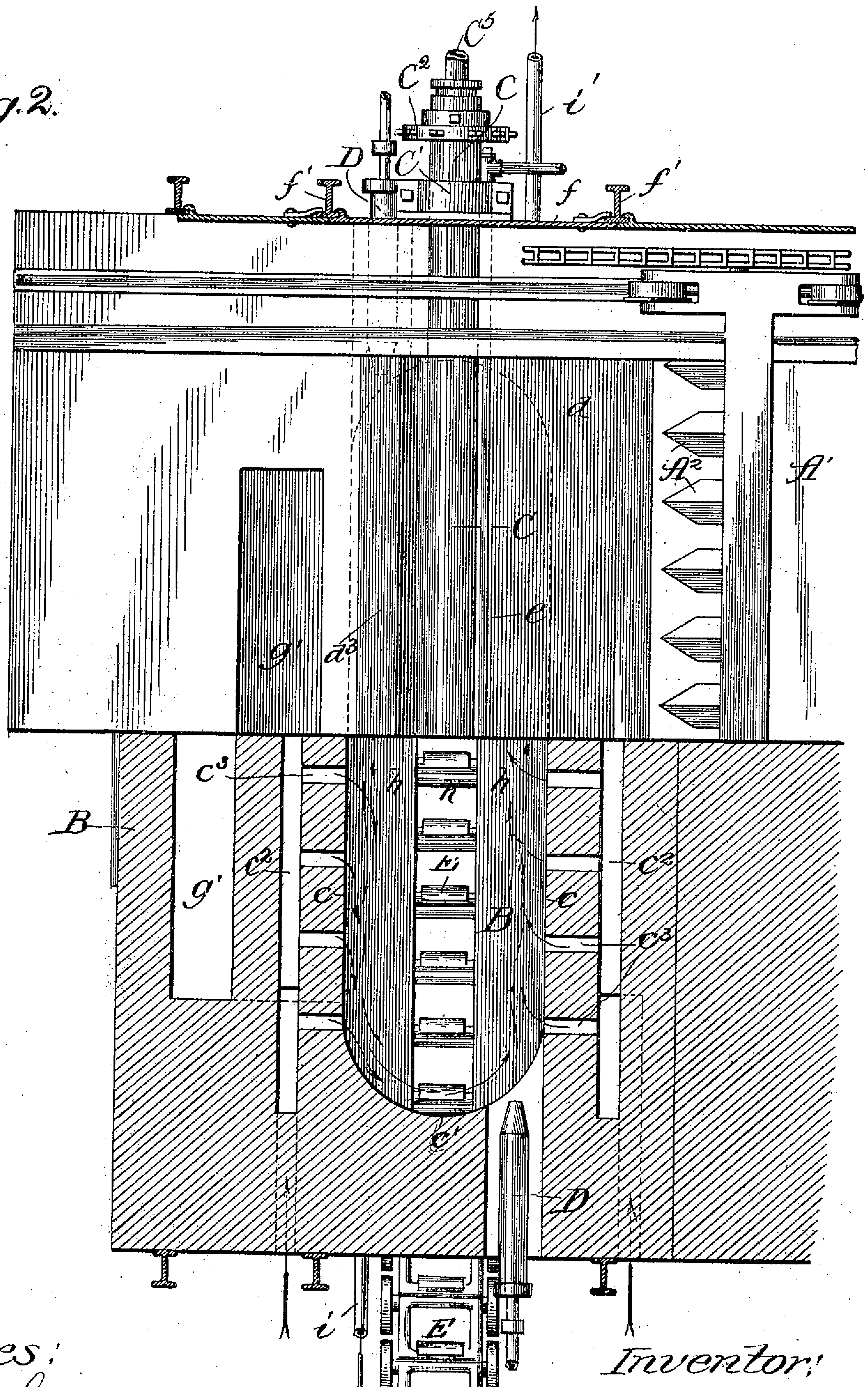
Fig. 2.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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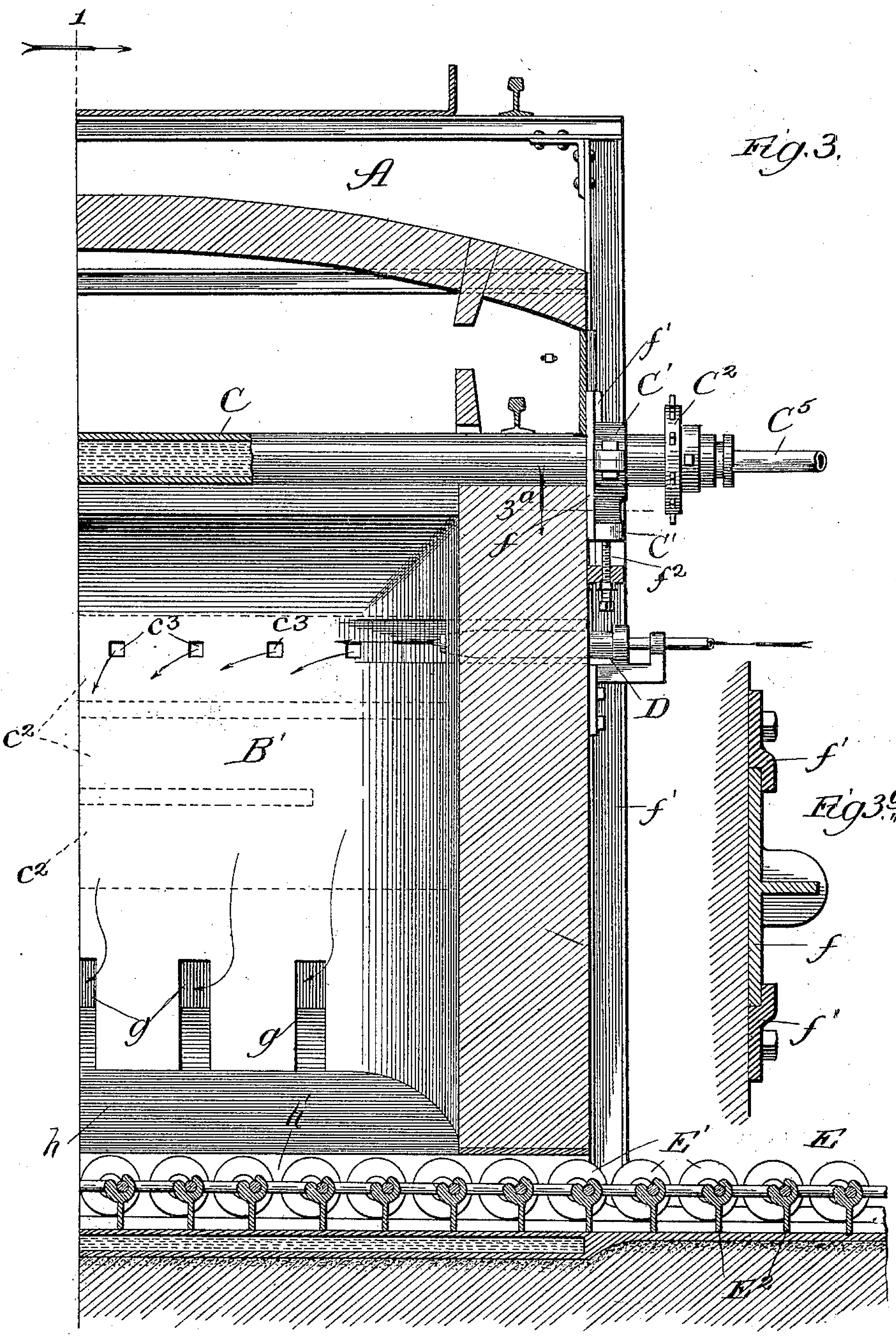

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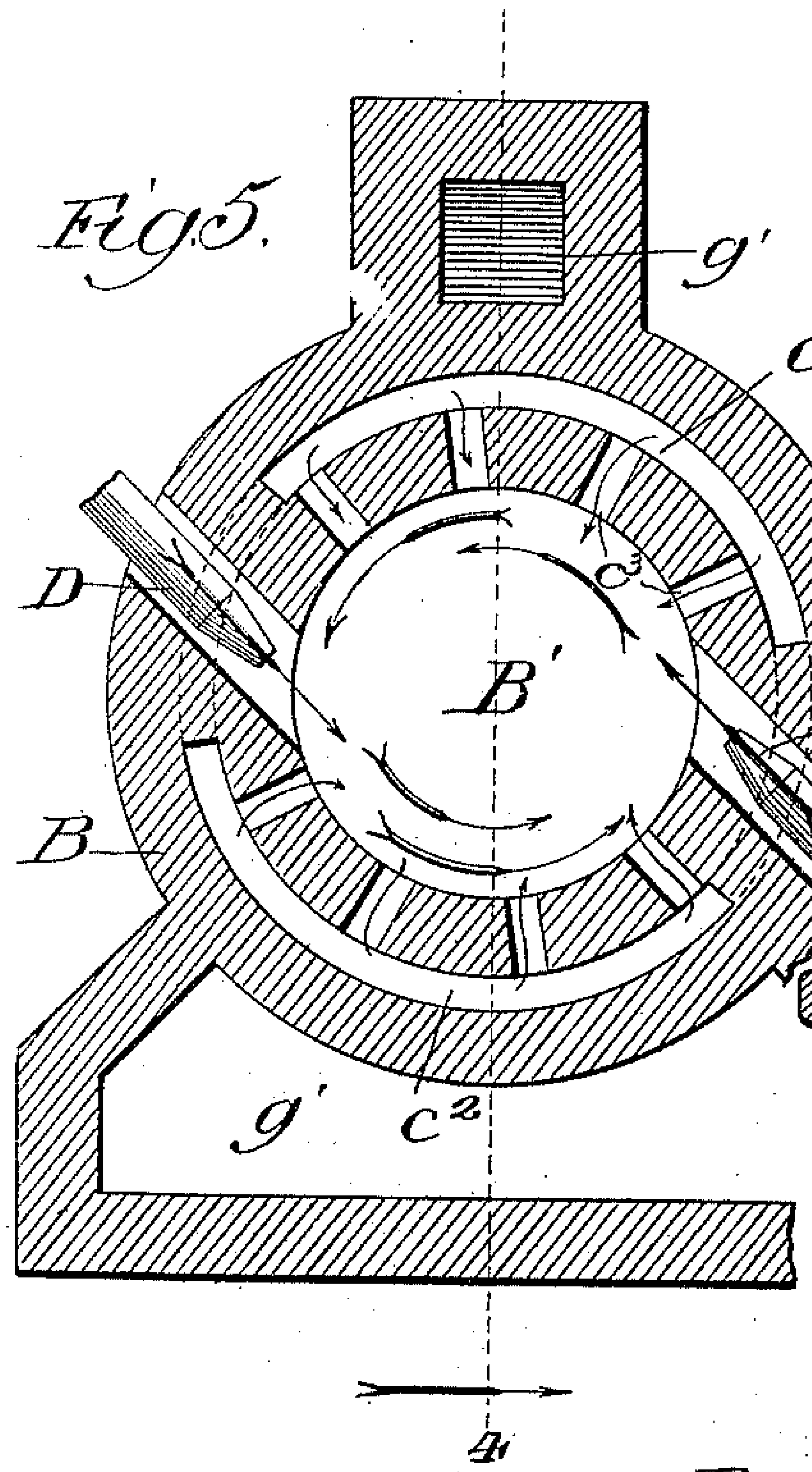

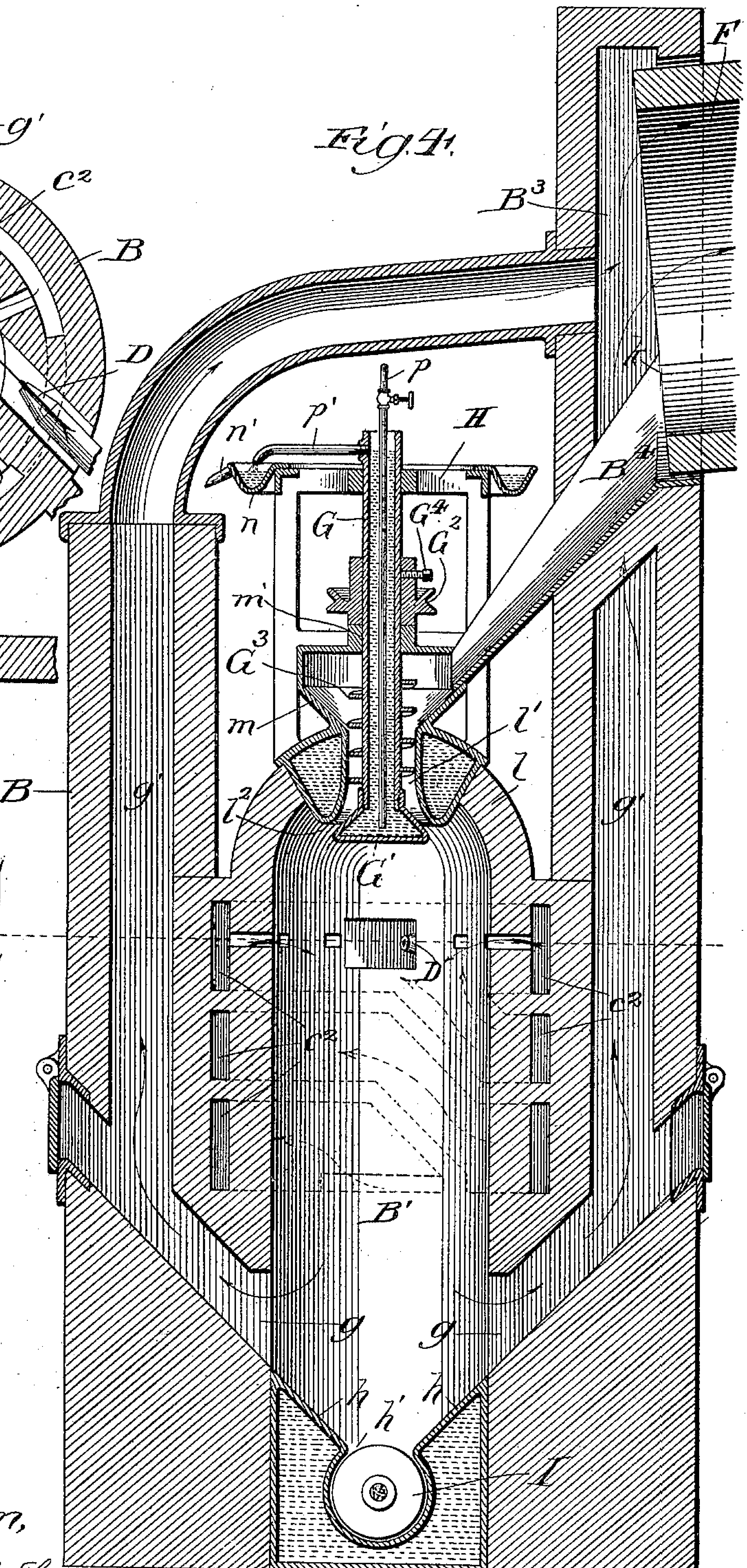

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UNITED STATES PATENT OFFICE.

HORACE F. BROWN, OF CHICAGO, ILLINOIS.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 689,062, dated December 17, 1901.

Application filed December 27, 1899. Serial No. 741,730. (No model.)

To all whom it may concern:

Be it known that I, HORACE F. BROWN, 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 Furnaces, of which the following is a specification.

My invention relates to an improved furnace for treating more or less finely divided fusible earths and ores. In ore reduction my improved furnace may be employed alone or as an adjunct to an ore-roasting furnace to automatically prepare the ores for treatment in matting or blast furnaces by agglomerating the fines under a fusing heat, so that the particles will adhere in suitable masses. This treatment is desirable to prevent the fine particles of the ore from being blown out of the blast-furnace stack by the blast. Hitherto it has been usual to fuse and mass the particles by causing the ore to remain under a strong heat until it became more or less pasty and then by suitable stirring to cause the softened ore particles to agglomerate together in masses of desired size. The stirring operation has necessarily been performed by hand, for the reason that in any attempt at mechanical rabbling the softened mass would adhere to the rabble-points and be drawn out of the furnace, and, besides, the rabble-points would become injured by the excessive heat required for fusing the charge.

A furnace constructed in accordance with my invention is also particularly well adapted for fusing together the ingredients of hydraulic cement to bring about the chemical reactions necessary in the manufacture thereof. Hitherto the most common and approved method of forming cement-clinker has been to calcine the slurry or mixture of lime, alumina, and silica in a long inclined and rotating cylinder, wherein the mass is subjected to an intense heat. In carrying out the said method or procedure the material is fed into the upper end portion of the cylinder and the latter revolved to slowly work the mass downward to the discharge end. The flame which heats the cylinder is admitted at the lower end and is in the nature of a blowpipe heat in intensity. The material is first dehydrated, and as the heat increases the carbonic-acid gas is driven off. The mass gradually fuses, forming itself into lumps of greater or less density, and these lumps or clinkers frequently imprison only partially-fused material in such a way that a certain percentage of the mass is insufficiently burned, thereby lowering the average strength of the cement and causing material loss.

My object is to provide a furnace of an improved construction into which the material to be fused is fed in a more or less finely divided state and in such a manner that all the particles are acted upon by heat-currents of sufficient intensity to thoroughly fuse them and cause them to be impacted together, whereby they agglomerate into small spheres or masses. In the case of cement-clinkers complete fusion may be caused to take place, so that all the particles will be vitrified and formed into homogeneous nodules or spheres, while in the case of ores destined for subsequent treatment in a smelting-furnace the heat may be so regulated that only the fine material will be actually fused and caused to adhere to the coarser particles to form a somewhat spongy mass.

To the above ends my invention consists in the general construction of my improved fusing-furnace, as well as in details of construction and combinations of parts, all as hereinafter described and claimed.

In the drawings, Figure 1 shows a fusing-furnace of my improved construction as an adjunct to a mechanical rabble-ore-roasting furnace to receive the ore as it is discharged from the latter. The view is a broken vertical section taken on line 1 in Fig. 3 longitudinally of the roasting-furnace and transversely of the fusing-furnace. Fig. 2 is a broken plan section taken upon the two lines 2 in Fig. 1; Fig. 3, a broken vertical section taken on line 3 in Fig. 1 longitudinally of the fusing-furnace; Fig. 3ª, a broken section taken on line 3ª of Fig. 3; Fig. 4, a broken vertical section of my improved furnace of the construction I prefer to provide for use in the manufacture of cement-clinkers, the section being taken on line 4 in Fig. 5; and Fig. 5, a plan section taken on line 5 in Fig. 4.

Referring first to the construction shown in Figs. 1, 2, and 3, A is a mechanical rabble-ore-roasting furnace, which may be of the general type first shown and described in my

Patent No. 471,264, granted March 22, 1892. Only the discharge end portion of the furnace is shown in the drawings. A′ is the hearth of the roasting-chamber, and A^2 is a carriage provided with rabble-points, which travels in the direction of the arrow x in Fig. 1. The carriage is propelled by means of endless chains a passing over similarly-disposed sprocket-wheels b b' at opposite ends of the furnace. The sprocket-wheel b shown is upon a shaft b^2, having a gear-wheel b^3, meshing with a pinion b^4, on a shaft b^5, driven from a pulley b^6. At the end of the roasting-chamber is a swinging door A^3, which is opened by the carriage as it moves out of the furnace and closes automatically when the carriage has passed.

B is my improved fusing-furnace located below the discharge end portion of the roasting or calcining furnace A. It is formed with a vertical fusion-chamber B′ of a length corresponding with the width of the hearth A′. It is oblong in shape and provided with inner side-wall surfaces c c and rounded inner end surfaces c'. The walls of the fusion-chamber may be formed of highly refractory fire-brick with interposed air spaces or conduits c^2. As I prefer to construct the walls the air-conduits c^2 overlie and communicate with each other and those on each side form together a continuous circuitous passage open at the lower end to the outside air and communicating at the upper end through ports c^3 with the fusion-chamber at about the plane of the burners, hereinafter described. Thus the air to support combustion is heated to a high temperature by the furnace-walls before it enters the fusion-chamber. At the end of the hearth A′ above the fusion-chamber B′ is a depression or pocket d of a length corresponding with the width of the hearth, the said pocket terminating in a slot or feed-opening d', extending through the top of the dome-shaped upper end of the fusion-chamber. Just below the plane of the depressed floor d, at the forward edge of the slot or feed-opening d', is a water-pipe e, extending the full length of the slot d' and connected with a water-supply, so that water is caused to circulate through it constantly.

Close to the pipe e and extending the full length of the slot d' is a pipe or drum C, mounted at opposite ends in bearings C′ in the furnace-walls and provided beyond one wall with a sprocket-wheel C^2, which is geared, by means of a drive-chain C^3, to a sprocket-wheel C^4 on the drive-shaft b^2. Beyond the sprocket-wheel C^2 the drum C is pivotally connected by a water-tight joint with a water-supply pipe C^5. Thus the drum is kept constantly filled with water and is rotated at desired speed. The journal-bearings C′ of the drum C are upon adjustably sliding plates f, fitting in guides f' at the outer sides of the furnace-wall, and these plates may be adjusted to a slight extent, as by means of an adjusting-screw f^2, Fig. 3, to move the drum C with relation to the water-pipe e, and thus increase or diminish the size of the feed-opening d^2. At its rear side the feed-drum C rotates in close contact with a bed-plate or slab d^3, extending along the rear edge of the slot d', as shown.

Extending horizontally into opposite ends of the chamber B′, near the top thereof, are hydrocarbon gas or oil burners D D. The burner at one end is at the forward side of the chamber, while the burner at the opposite end is at the rear side of the chamber, whereby the hot products of combustion from the burners move, as indicated by the arrows in Fig. 2, in the horizontal plane as they first enter the fusion-chamber. Near the lower end of the chamber B′ at one side is a series of outlets g, leading to a flue g', extending up the side of the structure and discharging into the roasting or calcining furnace A just in rear of the plate d^3.

The base of the chamber B′ in the furnace illustrated is formed of a casting or molded structure B^2 the full length of the chamber. The casting B^2 is hollow to present inclined hopper-shaped sides h h, terminating in a trough h'. The casting or structure is hollow and forms a water-jacket, connected at one end with an inlet-pipe i and provided at its opposite end with an outlet-pipe i'. In the sides of the trough h' are housed recesses h^2 h^2, the bases of which form tracks h^3 for a traveling conveyer E, having wheels E′, movable upon the tracks in the housed recesses. The conveyer E is shown merely as an expedient and is of a common form provided with scrapers E^2 in endless series and suitably mounted to travel an endless course into one end of the trough h' and out of the other end.

In operation after the more or less finely divided ore has been thoroughly calcined in the furnace A and all deleterious substances to the desired extent driven off it is discharged by the traveling rabble A^2 into the pocket d, which operates as a hopper. The feed-drum C rotates constantly to disintegrate and discharge the ore through the feed-opening d^2, the rate of rotation of the drum being such that all the ore brought to it by one rabbling-carriage will be fed through the opening d^2 by the time the next rabbling-carriage brings a fresh load. As the ore is thus fed in an even stream or sheet into the top of the fusion-chamber it is met by a temperature of, say, 3,000° Fahrenheit and given a rotary motion by the force of the currents from the burners D D, which have a tendency to whirl and force all the fine particles to the center of the fusion-chamber. The heat of the already hot particles of ore is almost instantly raised to the fusing-point, and by the impact, as well as by the natural law of attraction, the fine dust is formed into drops of fluid material that fall to the receptacle or trough below in a pasty condition and cool by contact with the water-jacketed trough, if provided, into clinkers or, in the case of partially-fused ore, into a spongy mass. The hot products of combustion from the burners D D enter under a comparatively high pressure and move with great rapidity around and around the chamber, sinking gradually downward to the outlets g, whence they move upward through the flue g' and are discharged into the chamber of the calcining or roasting furnace to assist in heating the latter. Thus none of the heat of the fusing-furnace is wasted. The descending mass of ore in the chamber B' will be more especially down the center thereof, where there will be the least resistance, and as the gases are deflected to the openings g the fused material will drop by gravity into the trough and be raked out by the traveling scraping device E, if provided. While it is desirable to employ an automatic scraping device for discharging the material as it accumulates in the trough h', my invention is not to be limited thereto. Material may be raked out by hand, if desired, or discharged by gravity into a smelting or matting furnace, where it will collect for further treatment.

The construction shown in Figs. 4 and 5 is intended more especially for use in connection with rotating-cylinder calcining-furnaces as commonly used in cement manufacture. F is an inclined and rotary cylinder, into the upper end of which the material is fed in a suitable manner and in which it moves downward by gravity to the discharge end k in the rotation of the cylinder. As before stated, the material in its movement to the discharge end of the cylinder is subjected to temperature sufficiently high and prolonged to dehydrate the mass and drive off the carbonic-acid gas. The fusing-furnace B, as I prefer to provide it for forming cement-clinkers, is round in cross-section, the fusion chamber or shaft B' being provided with a dome-shaped roof l, terminating in a round central feed-opening l', surrounded by a water-jacketed grinding-surface l^2. Fitting over the top of the dome is a hopper m, forming a close chamber with a central bearing-opening m' in its top. Journaled in the bearing-opening m' is a rotary pipe or drum G, provided below the feed-opening l' with a hollow flaring head G'. On the drum above the bearing m' is a drive-pulley G^2, which may be belted to a suitable driving power. Over the hopper m is a suitable frame H, provided at its top with a circular water-trough n, having a discharge pipe or spout n'. Extending vertically downward through the drum and terminating in the head G' is a water-supply pipe p, and near the top of the drum is a water-outlet pipe p', which moves over and discharges into the trough n. The lower end of the cylinder F terminates in a chamber B^3 above the fusing-furnace, and an inclined chute B^4 extends from the chamber B^3 into the upper part of the hopper m. On the drum G in the hopper and extending through the feed-opening l' is a worm G^3. The annular furnace-wall is formed, like the oblong furnace described, with a circuitous air-supply passage c^2, which extends around the fusion-chamber and discharges through ports c^3. On opposite sides of the chamber B' near the base are the outlet-openings g, extending to flues g', which terminate at their upper ends in the chamber B^3. In the base of the chamber B' is a cast or molded water-jacketed trough h', having inclined sides h, and in the trough is a discharge-conveyer consisting of an endless series of traveling scrapers I. Entering the chamber B' in a plane just below the head G' are tangentially-disposed hydrocarbon oil or gas burners D.

In operation the finely-divided and dehydrated cement mixture as it is discharged from the cylinder F falls into the chute B^4 and is conducted into the hopper m. The rotating drum G and worm G^3 feed the material downward, causing it to fall upon the inclined annular surface of the head G' and be disintegrated and distributed around the top of the chamber B'. Here it is met by the incoming currents from the burners D, which enter with comparatively great force and circle rapidly around, as indicated by the arrows in Fig. 5. The already hot particles are instantly raised to the fusing-point and impacted together and caused to whirl centripetally to form into small spheres or nodules which rain downward into the trough h' and agglomerate into homogeneous masses or clinkers. As fast as the material solidifies in the water-jacketed trough or receptacle h' it is carried off by the discharger I. Owing to the way that the material is fed into the fusing-chamber and acted upon by the heat-currents from the burner it becomes thoroughly fused throughout and no only partially-fused material will be present in the trough. As a consequence all the material will be of high grade. The grinding-head G' may be adjusted with relation to the grinding-surface l^2 by loosening the set-screw G^4, which supports the drum G. The air to support combustion enters the lower end of the passage and as it travels around the chamber B' becomes heated to a high temperature before it enters the latter.

The discharger I may be of any construction suitable for the purpose, and the various parts which together constitute my improvements may be variously modified without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a roasting or calcining furnace of a fusing-chamber having a feed-inlet toward its top in position to receive the product discharged from said furnace, feed mechanism at said inlet operating to regulate the feed of the said product into the said chamber, heating means near the top of said chamber, a heat-outlet toward the lower part thereof extending to and discharging

into said furnace, and means at the bottom of the chamber for collecting the fused material, substantially as and for the purpose set forth.

2. The combination with a roasting or calcining furnace of a fusing-chamber having a feed-inlet toward its top in position to receive the product discharged from said furnace, feed and disintegrating mechanism at said inlet operating to regulate the feed of the said product into the said chamber, heating means near the top of said chamber, a heat-outlet toward the lower part thereof, and means at the bottom of the chamber for collecting the fused material, substantially as and for the purpose set forth.

3. The combination with a roasting or calcining furnace, of a fusing-chamber having a feed-inlet toward its top in position to receive the product discharged from said furnace, feed mechanism at said inlet operating to regulate the feed of the said product into the said chamber, heating means near the top of said chamber, a heat-outlet toward the lower part thereof, a circuitous air-supply passage in the chamber-wall having discharge-openings toward the top of the chamber, and means at the bottom of the chamber for collecting the fused material, substantially as and for the purpose set forth.

4. In a furnace for treating finely-divided fusible material, the combination of a fusing-chamber having an inlet for the material toward its top, hydrocarbon-burners extending into the chamber near its top and at an angle to the center of the chamber to direct the products of combustion therefrom, on entering, in a path about the chamber to whirl the said material toward the center of the chamber as described, heat-outlets toward the lower part of the chamber and means at the bottom of the chamber for collecting the fused material, substantially as and for the purpose set forth.

5. In a furnace for treating finely-divided fusible material, the combination of a fusing-chamber having an inlet for the material toward its top, hydrocarbon-burners extending to the chamber near its top and at an angle to the center of the chamber to direct the products of combustion therefrom on entering, in a path about the chamber to whirl the said material toward the center of the chamber as described, heat-outlets toward the lower part of the chamber, a circuitous air heating and supply passage in the furnace-wall extending upward from the lower part thereof, and having discharge-ports near the plane of the burners, and means at the bottom of the chamber for collecting the fused material, substantially as and for the purpose set forth.

6. In a furnace for treating finely-divided fusible material, the combination of a fusing-chamber having an inlet for the material toward its top, hydrocarbon-burners extending to the chamber near its top and at an angle to the center of the chamber to direct the products of combustion therefrom on entering, in a path about the chamber to whirl the said material toward the center of the chamber as described, heat-outlets toward the lower part of the chamber, a circuitous air heating and supply passage in the furnace-wall extending upward from the lower part thereof, and having discharge-ports near the plane of the burners, and a water-cooled receptacle at the bottom of the chamber for the fused material, substantially as and for the purpose set forth.

HORACE F. BROWN.

In presence of—

M. J. Frost,

F. J. Martin.