No. 627,043. Patented June 13, 1899.

J. BOWING.

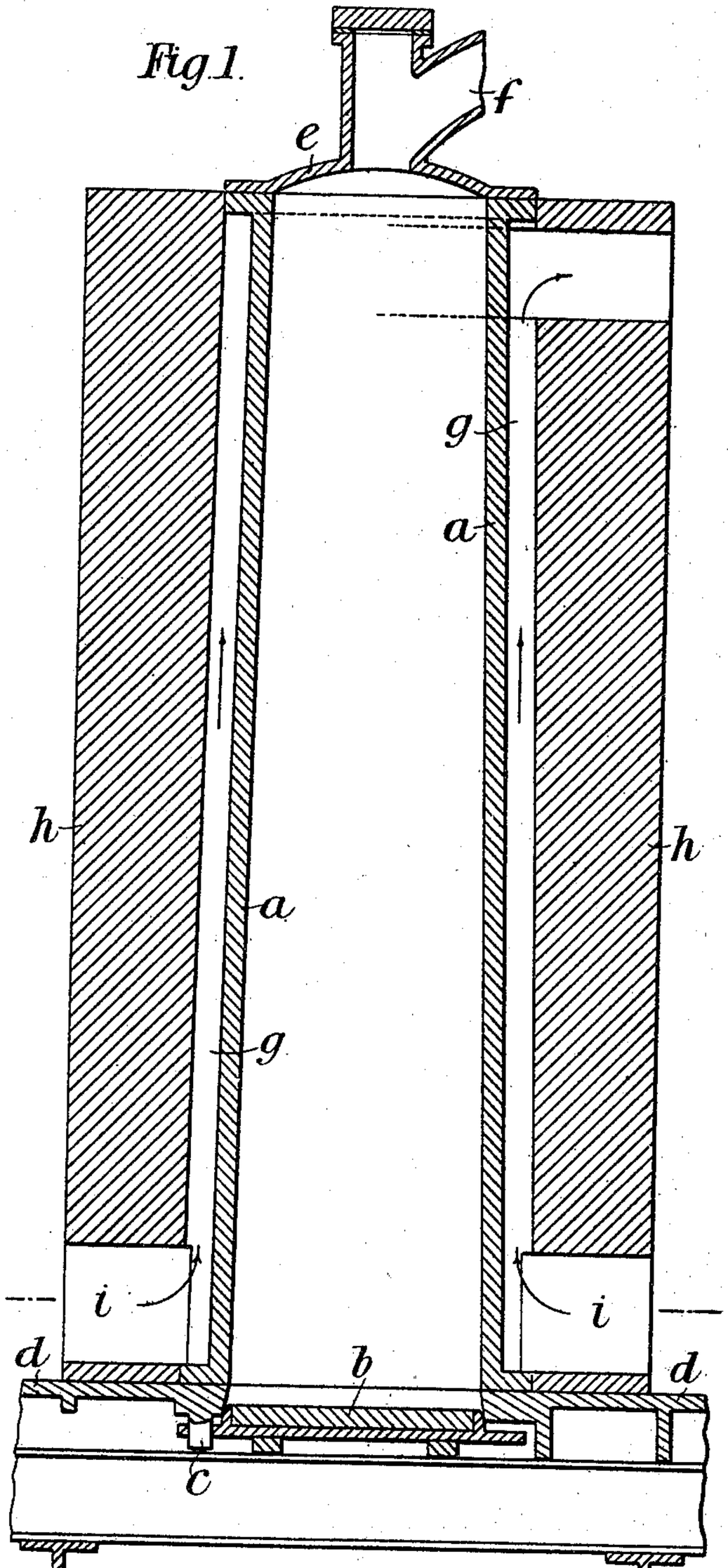
PROCESS OF AND APPARATUS FOR COKING.

(Application filed Dec. 20, 1897.)

(Specimens.)

3 Sheets—Sheet 1.

Fig 1.



Witnesses.
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Fig. 4.

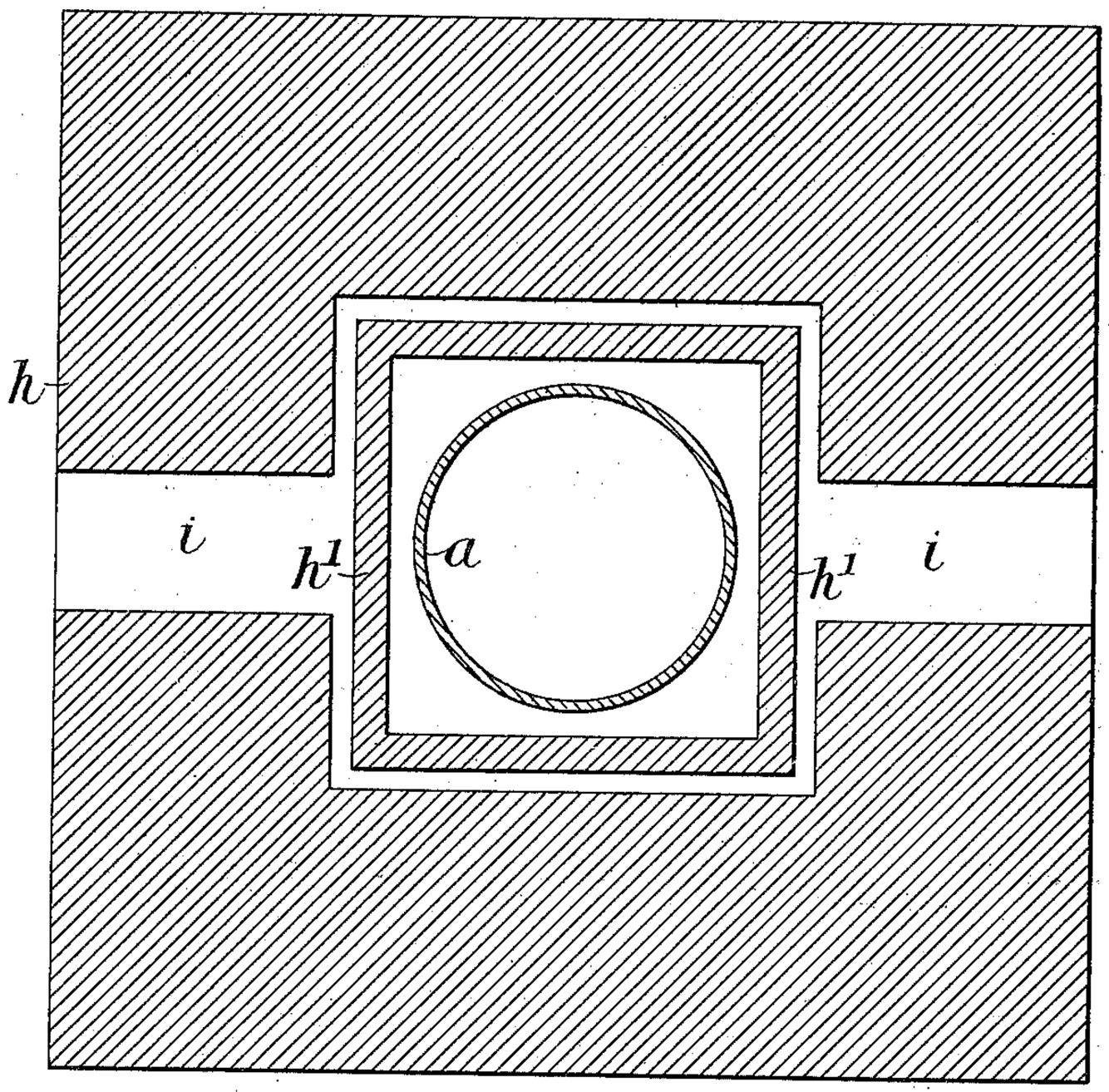

Fig. 2.

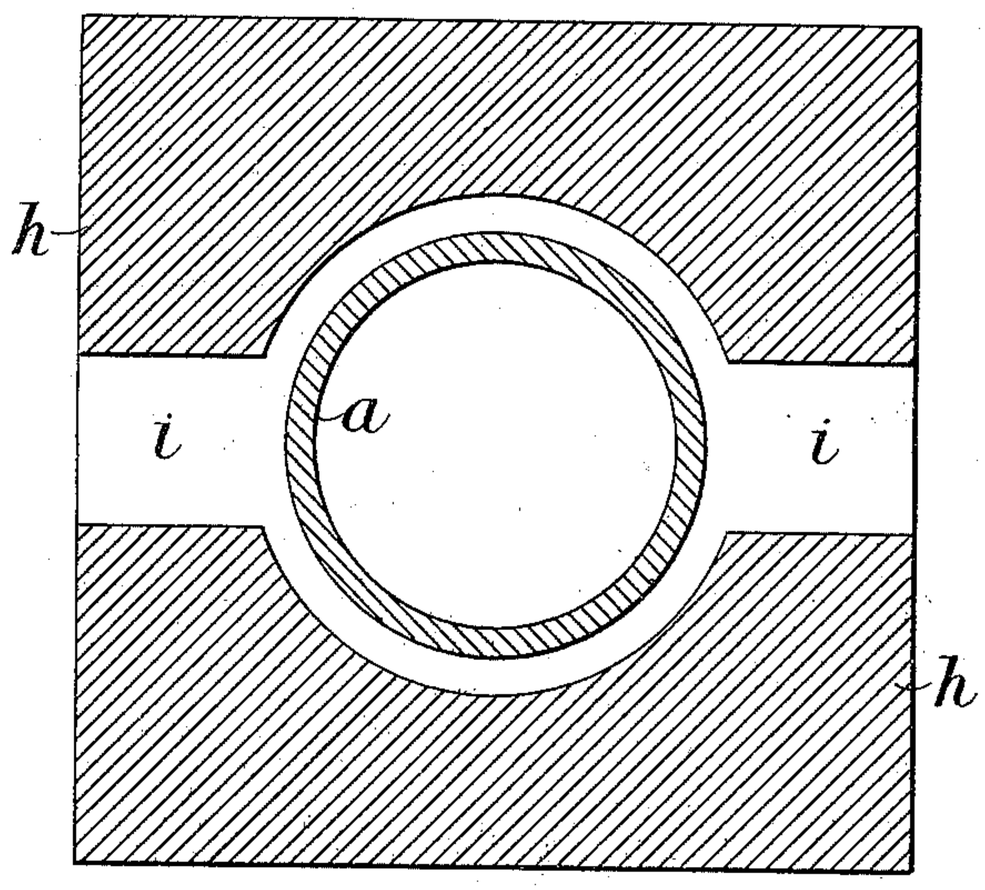

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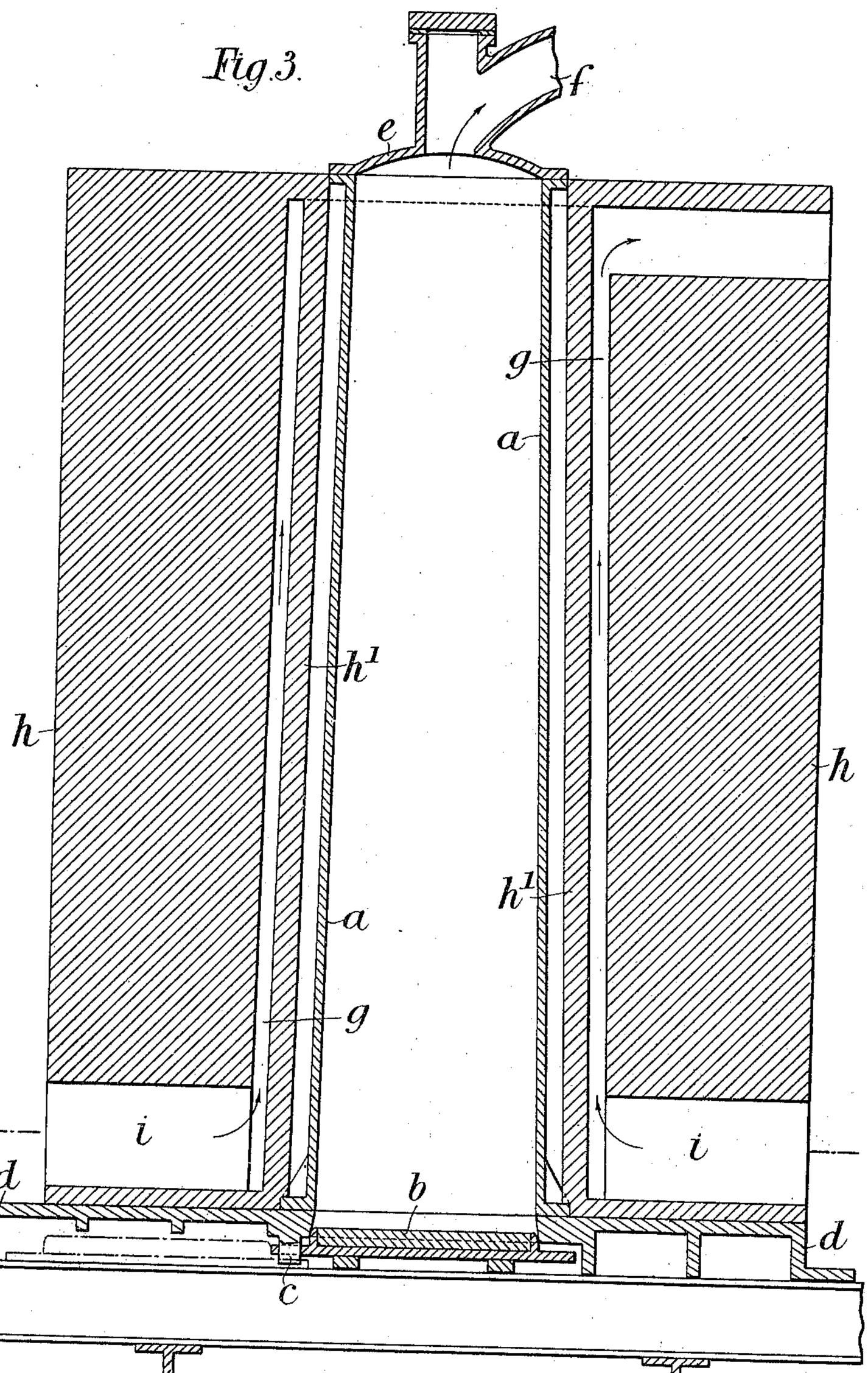
Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN BOWING, OF TILBURY, ENGLAND.

PROCESS OF AND APPARATUS FOR COKING.

SPECIFICATION forming part of Letters Patent No. 627,043, dated June 13, 1899.

Application filed December 20, 1897. Serial No. 662,709. (Specimens.)

To all whom it may concern:

Be it known that I, JOHN BOWING, a subject of the Queen of Great Britain, residing at Tilbury, Essex, England, have invented new and useful Improvements in Processes of and Apparatus Used for Coking, of which the following is a specification.

My invention relates to the manufacture of coke, and chiefly from coal of the kind usually regarded as unsuitable for coking—such, for instance, as Welsh steam-coal, which has formed the subject of many attempts to convert into coke; but these attempts have met with but little success on a commercial scale. I have observed in the course of many experiments, first, that if such coal as hereinbefore referred to is in the course of the coking operation subjected to a heat far below the coking temperature for a sufficient time it is more or less deprived of its coking property. For example, I have found that after coal has been exposed to a temperature of 150° centigrade for some hours a coking action cannot subsequently be set up, and, second, that after the coking temperature (which with Welsh steam-coal my experiments show to be from 440° centigrade to 480° centigrade) has been attained the temperature should never be allowed to fall to any great extent, even although the variation so caused takes place above the coking temperature, as an oscillation of the temperature of the charge during the process of coking, if it be considerable or prolonged, may result in complete or partial failure to coke. The natural corollary to these observations is that for the successful manufacture of coke the following conditions must be complied with, viz: First, the coal must be quickly raised to the coking temperature. In practice all parts of a large body of coal cannot be thus heated simultaneously; but the supply of heat must be sufficient to prevent any part remaining for a long time below the coking temperature. Second, the supply of the heat for coking should be capable of being uniformly maintained. I have discovered that these conditions can be complied with by using an oven containing a vertical retort (which is preferably made of a material of high heat conductivity) and which is entirely surrounded by a shallow flue in such a manner that the whole area of the vertical walls is acted upon by the heating-gases, which flue has a sectional area at any point measured at right angles to the flow of the heating-gases equal or approximately equal to the sectional area of the throats or culverts by which the heating-gases are conducted into the said flue measured in the same manner, the result of so proportioning the areas of the said throats or culverts and flue being that the incandescent gases, which must be supplied from the furnace (which may be adapted for either solid or gaseous fuel) in sufficient volume to fill the throats, maintain their temperature and produce uniform heating over the whole area of the retort.

An oven which I have found in practice to give good results is illustrated in Figures 1 and 2 of the accompanying drawings, Fig. 1 being a vertical section and Fig. 2 a horizontal section. This oven comprises a plumbago retort *a*, circular in transverse section and having a height of, say, ten feet, with a diameter at the upper end of, say, one foot ten inches and at the lower end of two feet two inches, (this slight taper being provided in order to facilitate the discharge of the coke,) so that the heat has only to penetrate a distance of about twelve inches. By employing this relatively great height for the retort as compared with its diameter I provide for treating a large body of coal in a comparatively thin section, whereby I attain the advantage on the one hand that the coke formed near the walls of the retort is not deteriorated to any great extent while the heat is penetrating the thickness of the coal layer or section and on the other hand I effect an economy of fuel, as with this cylindrical form of retort it is obvious that the area of coal surface upon which the coking heat is acting gradually decreases as the heat penetrates and the disproportion would be still greater if the diameter of the cylinder was increased.

The retort hereinbefore described is provided with a removable bottom *b*, which, as shown, is pivoted upon a stud *c* to permit of its being readily turned aside for discharging the retort and which is adapted to be wedged up into a taper seat in the base-plate *d* and luted to hermetically seal it. At the top of the retort is a cover *e*, having a tubular arm

or elbow *f*, through which the products of distillation may escape. Surrounding this cylinder is a narrow flue *g*, (hereinafter referred to as the "cylindrical" flue,) the adjacent surface of the wall *h* forming which is coaxial with the axis of the retort, so that the said cylindrical flue is of uniform width throughout. In practice this width is, say, three inches, which I find sufficient to give satisfactory results, while effecting large economy as compared with flues of greater dimensions. At the lower end of this cylindrical flue *g* are two or more horizontal flues *i*, (hereinafter referred to as "throats,") the total sectional area of which throats, measured as before described, is the same or approximately the same as the sectional area of the cylindrical flue at, say, the center of its height. The wall *h* is of sufficient thickness to insure stability and is faced on the flue-surface with fire-brick or other refractory material of low heat conductivity to prevent as far as possible loss of heat by radiation.

If the total of the united areas of the throats was smaller than that of the cylindrical flue, the gases might escape through the latter without passing over the whole area of the retort, while if the throats had a larger area unitedly than the cylindrical flue eddies might be set up in the throats, which would result in imperfect combustion, a waste of fuel, and uncertain temperatures.

The coal to be coked must be crushed fine in order that it shall lie very compactly in the retort, with the interstices as small as possible to prevent the formation of channels through which currents of heated gas might flow and so cause the premature partial heating of the mass, which would be detrimental to the formation of coke, as before indicated. In practice I have found that coal crushed fine enough to pass through a sieve with three-sixteenths of an inch mesh gives good results.

In using my apparatus the retort and also the flue-walls must first of all be heated to the required temperature which must be maintained throughout the operation, this being an easy matter for a skilled fireman by observing the character of the flame. To insure uniformity, however, fusion-plugs having known melting-points or other forms of pyrometer should also be applied. In practice the furnace and flues should be so proportioned that when the desired temperature is reached the heated gases in the flues will on inspection exhibit what is known as a "clean and hard" heat. The retort having been thus heated, a charge of coal which will completely fill the retort and in a wet condition is quickly introduced into the said retort, the falling of the coal and tamping, if necessary, serving to thoroughly compact the mass, the cover being finally applied. As the firing of the retort is continued, the heat, which is uniform on all the walls, gradually penetrates the mass in a uniform manner, so that a cylinder of coke is formed which gradually increases in thickness until the coking heat has reached the center of the retort. The steam and gases produced in the retort are driven toward the center into the uncoked coal, and I rely on the bad heat-conducting properties of the coal and its compact condition to keep the temperature of the latter below the point at which the detrimental action hereinbefore referred to takes place until the zone in which the coking heat is acting is so close behind the adjacent uncoked coal that the temperature of the latter will be quickly raised. Furthermore, the condensation of some of the products in the uncoked coal of the charge serves to enrich the latter.

The products of distillation which escape from the retort during the coking operation and the cessation of which indicates when this operation is complete are advantageously led into a closed condenser, which is preferably one of the bunkers in which coal for future treatment is stored. By adopting this course the coal to be subsequently treated is more or less enriched, and I obtain the further advantage that the coal under treatment is converted into coke of better quality than if the products of combustion escaped into the atmosphere or were drawn off by an exhauster. I am not prepared to state definitely the cause of this improvement in the quality of coke due to the discharge of the gases into the closed condenser, but I believe it to be due to the retardation of the flow of gases which results, and if this retardation is the cause it can be produced in other manners.

Although I obtain practical results with the plumbago retort hereinbefore described, difficulties might arise in the commercial working of my invention, due to the deterioration or injury of the retorts and the consequent expense of renewal. I therefore sometimes modify the construction of my apparatus in the manner shown in Figs. 3 and 4, which are respectively a vertical section and a horizontal section. In these figures the retort *a*, instead of being made of plumbago, is of iron or of steel, and to prevent the destruction of this retort, due to the action which the furnace-gases playing directly against it would exert, I surround the said retort by a wall *h'*, so that the retort is practically inclosed in a muffle, the heat being conveyed to the retort by radiation from the wall of the muffle instead of by direct conduction, as in the foregoing case. The throats and flue around the outside of this wall are constructed of uniform width and of equal or substantially equal areas in the same manner and in the same proportions as the cylindrical flue hereinbefore described. With this last-described form of oven the heat in the flue is somewhat greater than when the gases directly play upon the retort. For instance, I have found that to obtain the required temperature in the retort necessitates a temperature of, say, 520° centigrade in the muffle, to produce which a temperature of, say, 900° centigrade, more

or less, must be maintained in the flue. This last-described form of oven has also the advantage that slight variations of temperature in the flue are less likely to be felt in the retort than is the case with the oven first described.

Although I have described my invention as applied to the manufacture of coke from inferior coking-coal, it is to be understood that it is also applicable for the manufacture of coke from coal of superior quality, in which case the coking temperature and the mode of preparing the charges may have to be modified.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The herein-described process of coking refractory coal which consists in placing the coal in a finely-divided and wet condition in a closed retort, raising the temperature rapidly until the coking temperature is reached and maintaining the temperature of the coal without fluctuations until the coking is completed, substantially as described.

2. The herein-described process of coking refractory coal, which consists in placing the coal in a finely-divided and wet condition in a closed retort, raising the temperature rapidly until the coking temperature is reached, and maintaining the temperature of the coal without fluctuations until the coking is complete, and conducting the gases produced during the coking of the coal to the coal to be afterward acted upon, to enrich it, substantially as described.

3. A coking-oven provided with a retort of heat-conducting material, surrounded by a shallow flue, and provided with passages for conveying the products of combustion to said flue, the combined sectional area of said passages being equal to the sectional area of the flue, whereby the products of combustion will pass evenly through the entire length of the flue adjacent to the retort and fluctuations in the temperature of the retort and contents are prevented, substantially as described.

4. A coking-oven provided with a vertical retort of metal, a muffle of non-heat-conducting material surrounding said retort for protecting the same but separated therefrom by an intervening annular space, a circular flue surrounding said muffle and passages for conducting the products of combustion to the flue, the combined sectional area of said passages being equal to the sectional area of said flue, whereby fluctuations in the temperature of the retort and contents are prevented, substantially as described.

JOHN BOWING.

Witnesses:
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JOHN E. BOUSFIELD.