No. 888,136. PATENTED MAY 19, 1908.

J. ARMSTRONG.

APPARATUS FOR THE MANUFACTURE OF COKE AND GAS.

APPLICATION FILED JUNE 20, 1905.

4 SHEETS—SHEET 1.

FIG. 1.

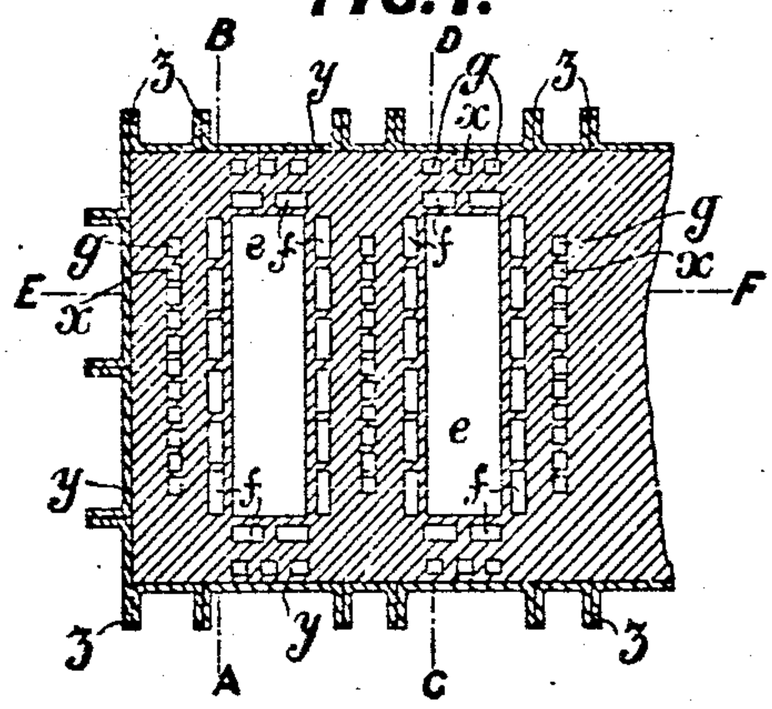


FIG. 2.

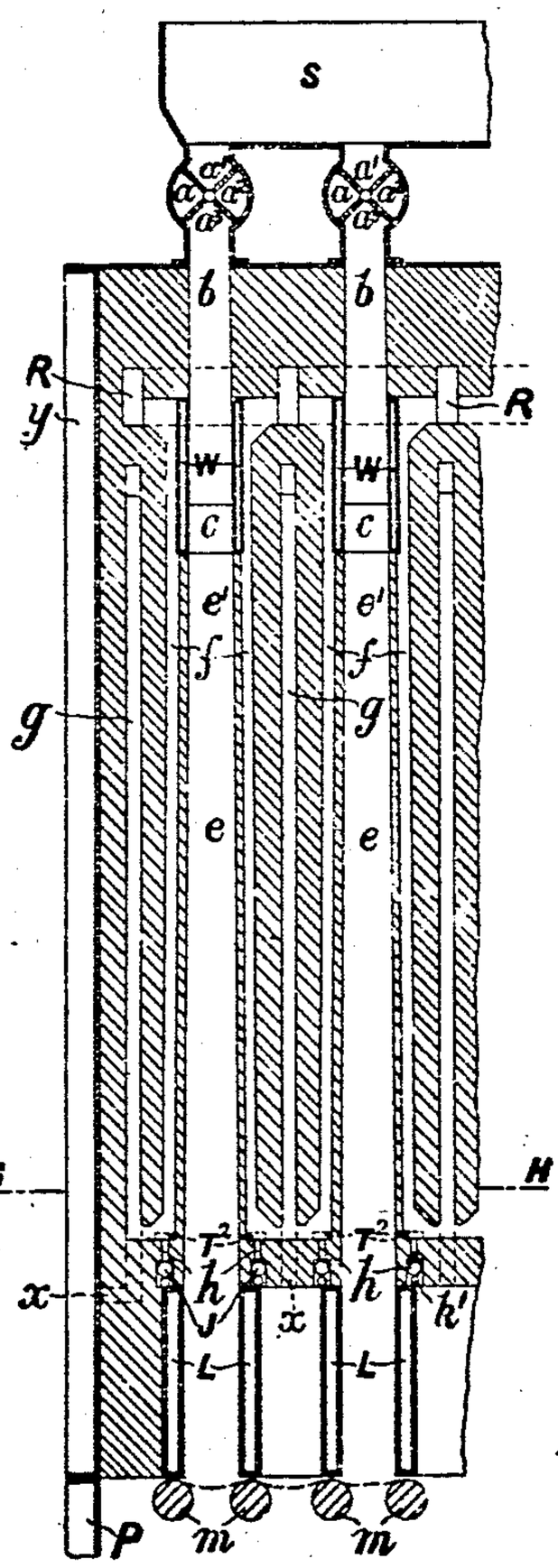
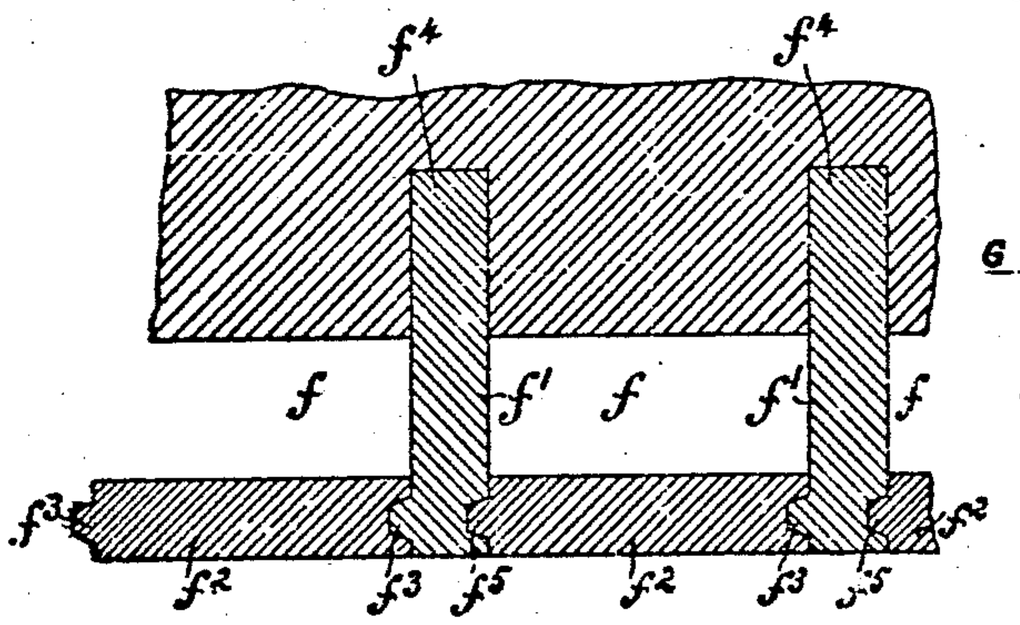


FIG. 5.



Witnesses

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4 SHEETS—SHEET 2.

FIG. 3.

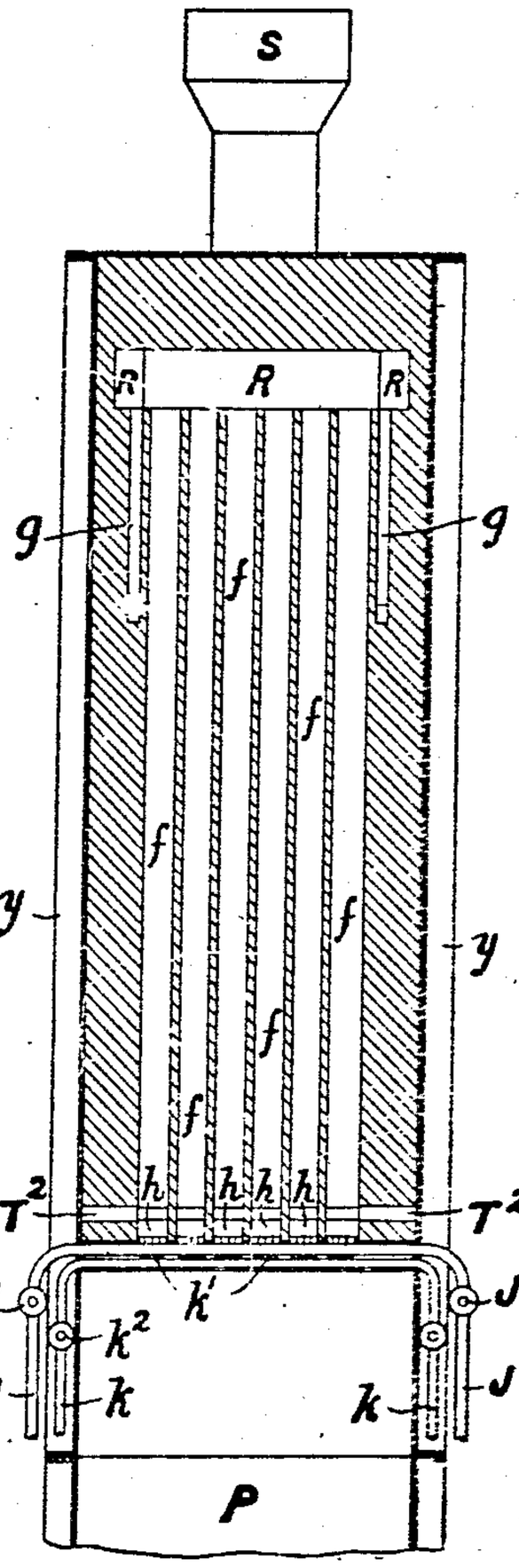
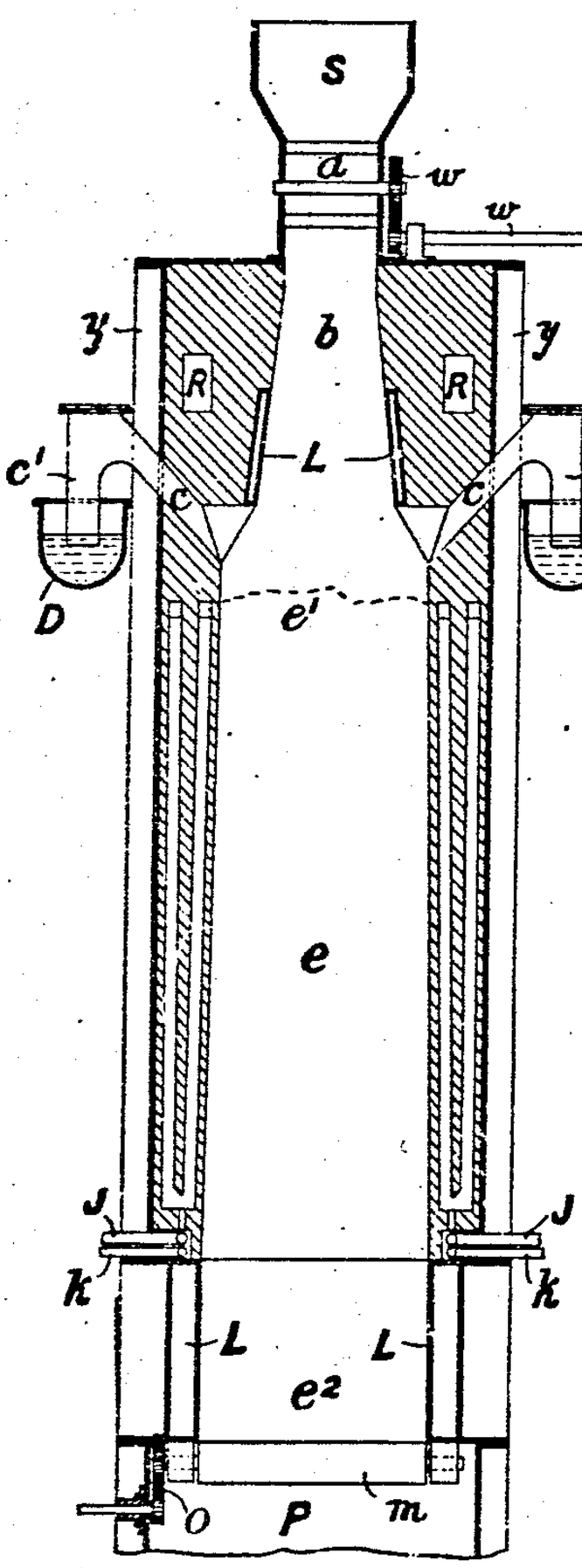


FIG. 4.



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4 SHEETS—SHEET 3.

FIG. 7.

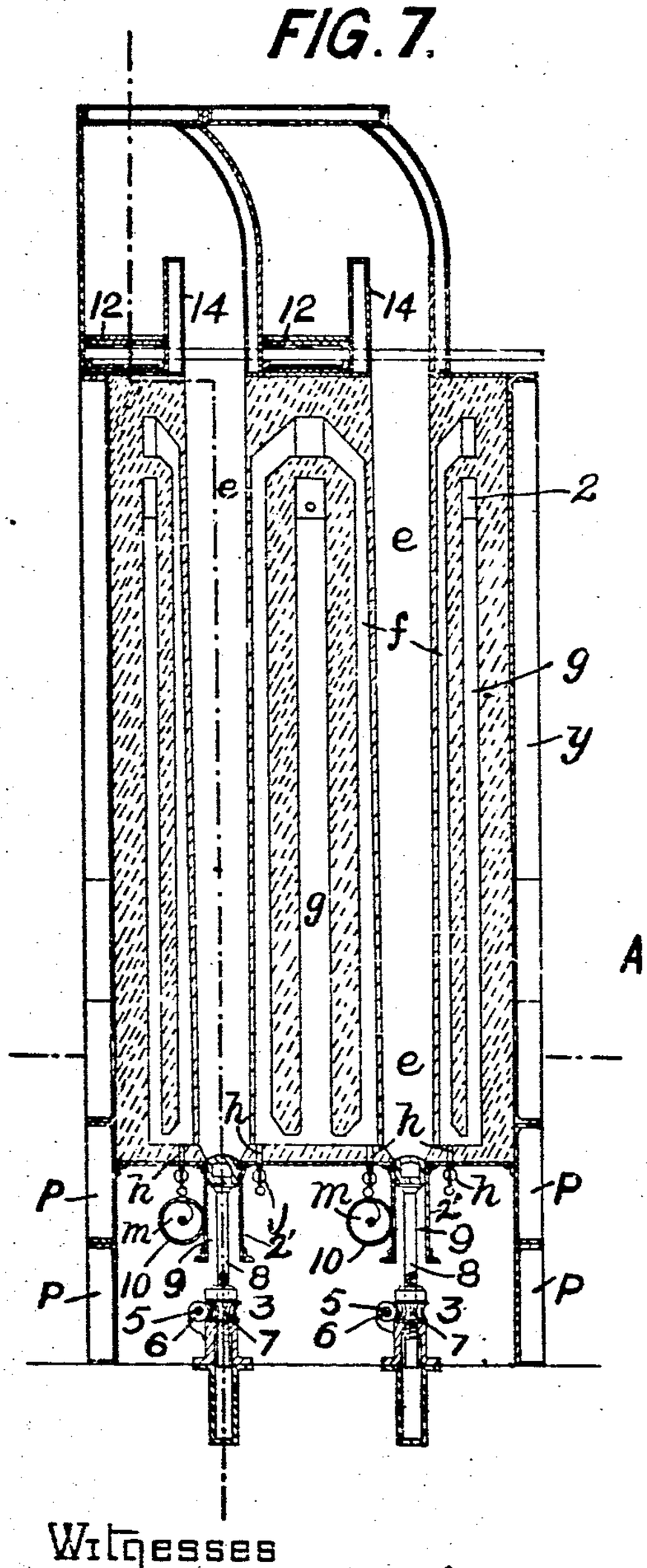
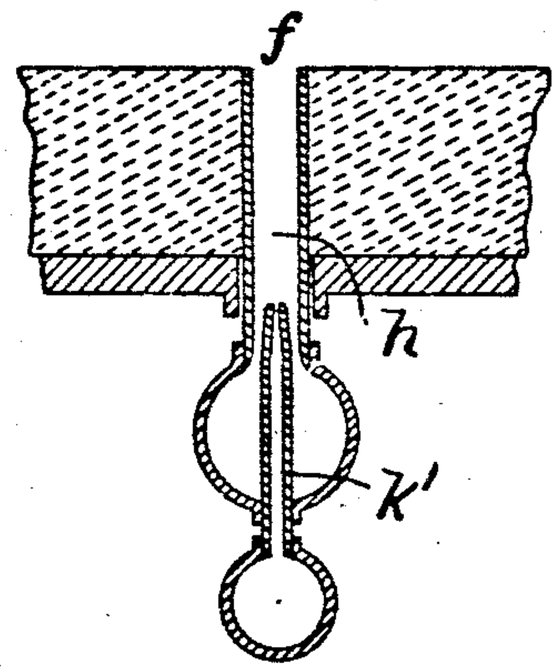


FIG. 6.



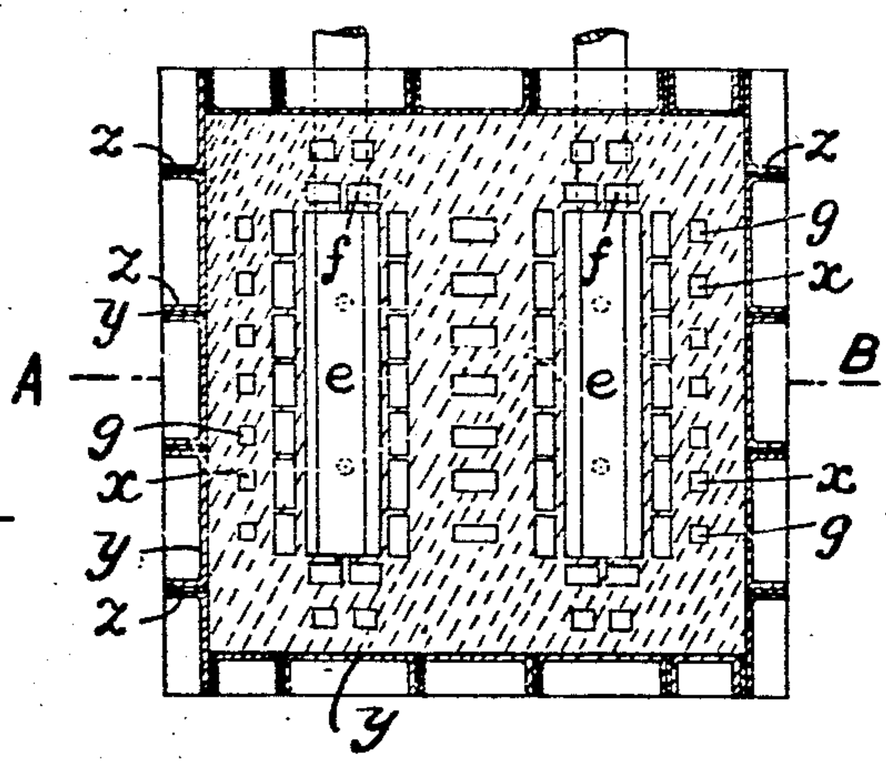


FIG. 9.

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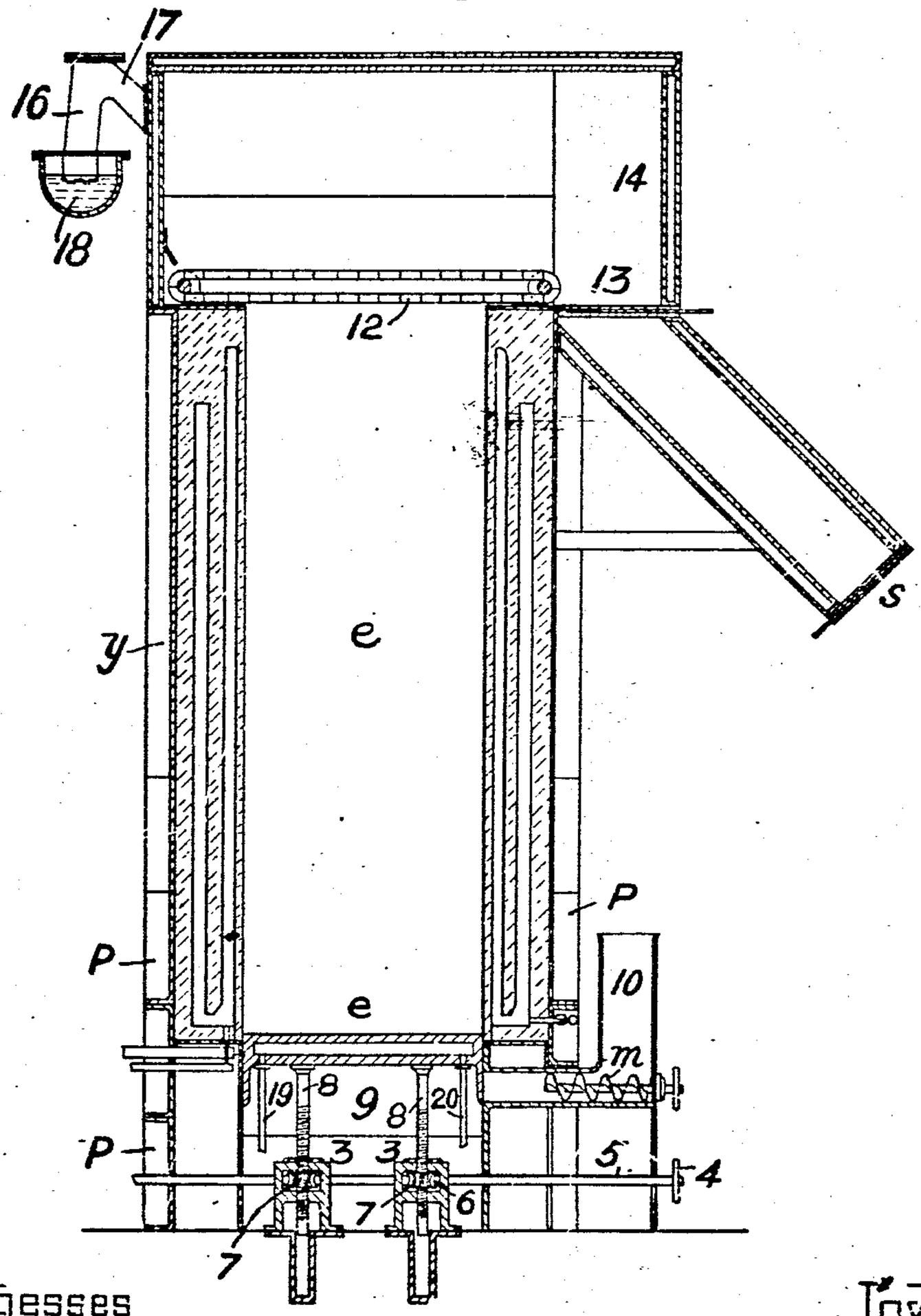
4 SHEETS—SHEET 4.

FIG. 8.



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JOHN ARMSTRONG, OF LONDON, ENGLAND.

APPARATUS FOR THE MANUFACTURE OF COKE AND GAS.

No. 888,136. Specification of Letters Patent. Patented May 19, 1908.

Application filed June 20, 1905. Serial No. 266,155.

To all whom it may concern:

Be it known that I, JOHN ARMSTRONG, a subject of the King of Great Britain, residing at London, E. C., England, civil engineer, have invented certain new and useful Improvements in Apparatus for the Manufacture of Coke and Gas, for which application has been made in Great Britain, No. 14,157, dated June 22, 1904.

This invention has for its object an apparatus for manufacturing coke of a denser, more compact and hard nature than ordinary furnace coke, and to be able to use in its manufacture coal or soft coke not generally used by present processes. The coal or soft coke such as gas coke or steam or anthracite or other coal, or a mixture of one or more of these can be used by itself, or in admixture with tar, pitch, bitumen or coking bituminous coal or like substances provided there be just sufficient hydrocarbons in the material to cake under pressure used. The materials are reduced to a fine powder and placed in the furnace or oven, or retort.

This furnace, oven, or retort, can be fed from either above or below.

In the drawings, Figure 1 is a horizontal section on the line G H of Fig. 2. Fig. 2 is a perpendicular section on the line E F of Fig. 1. Fig. 3 is a transverse perpendicular section on the line A B of Fig. 1, and Fig. 4 is a similar section on the line C D of Fig. 1. Fig. 5 is a sectional detail of the special bricks used for the flue, and Fig. 6 is a transverse section of the injector device. Fig. 7 is a vertical section through the line A B of Fig. 9. Fig. 8 a vertical section through the line C D of Fig. 1, and Fig. 9 a cross section through the brick-work of Figs. 7 and 8, Figs. 7, 8 and 9 being an alternative arrangement to Figs. 1 to 6.

I will describe first Figs. 1 to 6.

This furnace, oven or apparatus, is constructed of fire brick, or other fire resisting materials, bound on the outside with iron plates *y*, strengthened by the angle pieces *z*, these plates may be cast in sections, or made in wrought iron or steel sections, in convenient sizes, with steel strengthening pieces running the whole perpendicular height, inserted between the joints at *z*, the structure is erected upon an airtight chamber, either constructed of brick or metal, and shown at P P P. This chamber has at one or both ends airtight fitting doors not shown, so that when the coke is discharged from the apparatus above, it falls into wagons, which are periodically removed through the airtight doors, the object of this airtight chamber is for the purpose of collecting the coke and preventing the access of air to the apparatus or oven above.

The apparatus or oven consists of one or more perpendicular cells or chambers *e e*, this chamber is constructed in the upper part with firebricks, or other fire resisting materials, and is made with its walls tapering from top to bottom, that is, it is made wider at the bottom than at the top, so that the coke may descend freely, the lower part of the chamber may either be constructed with solid brickwork or preferably with water-jackets shown at L L on sections, the walls of the chamber or cell, are constructed with heating flues, marked *f f*. These are vertical flues running the whole height of the chamber. These flues are heated by gas, introduced by the burners *h h* by means of the gas pipes J J primary air may be introduced to the gas burners by high-pressure injectors shown at *k' k'* both the gas and the primary air are regulated by the valves J' and k^2, the apparatus may be heated with gas and primary air alone, or the injector jets *k'* may be made comparatively small and used in conjunction with secondary air, which ascends through the flues in the brickwork at *x*, and descends again by the flues *g* entering the combustion flue *f* at the bottom, the secondary air traversing the hot brickwork by means of the flues *x* and *g* becomes highly heated, and combining with the gas produces a very high temperature in the combustion flues *f f*. It may be also observed that these flues may be heated with the gas and the secondary air alone, as well as with the gas and the primary air alone, or with the three combined.

As it is essential to have a high temperature in the lower portion of the chamber *e e* the walls of the chamber are constructed very thin, by means of special fire bricks, or other fire resisting materials, formed as shown in Fig. 5; *f* is the combustion flue.

f^2 is the thin wall between the combustion flue and the chamber *e*.

f' shows the divisions between the separate combustion flues, in order to make this part of the apparatus rigid and strong, the divisions *f'* are prolonged into the solid wall at f^4, while f^2 and *f'* are provided with rabbeted joints f^3 and f^5. This not only strengthens the thin brickwork but forms the necessary

gastight joints, and the flues *f*, being very numerous and of comparatively small dimensions, the divisions *f''* become buttresses for the internal pressure in the chamber *e*. By this arrangement the heat is also evenly distributed round the chamber. The products of combustion are taken away from the top of the flues *f* by means of the main flue R to the chimney. The gas burners constructed on the gas pipe J and also the primary air pipe *k* are preferably connected up to the main pipes by means of flexible tubing, and are so constructed that they may be easily withdrawn, for the purpose of cleaning or repairs; apertures in the brickwork, shown at T^2, are inserted for the purpose of cleaning the bottom of the flues *f*, and for observation. These apertures are closed with proper doors.

The chamber *e* is surmounted on the top by the charging apparatus S, which supplies the coal in powder form through the revolving apparatus *a a' a² a³*, which is actuated by the gearing *w w*, the wings of the apparatus *a* are perforated for the purpose of allowing the gas that fills the empty division a^2 as it ascends to the position of *a'* to get back again into the top of the chamber *e* at *b*, otherwise at each revolution upwards of the compartments *a a' a² a³* gas would be lost, but with the perforations in the wings, and as the receptacle S is always kept full of powdered coal an effectual gas seal is made to the chamber *e*. The apparatus *a* is so arranged that it introduces the coal in small quantities at regular intervals, so that the surface of the coal in the chamber *e* is always kept at the level shown at *e' e'*. The sides of the chamber at this point are formed of a water jacket W to prevent the coking mass sticking and thus arching at this point. The chamber *e* is also provided with exits for gas, as shown at *c* into the hydraulic main, shown at D, or these may be dispensed with, and the gas drawn off at the bottom through the air-tight chamber P. By the first method illuminating gas is produced rich in hydrocarbons; by the second method a non-illuminating gas is produced rich in hydrogen; means are provided in the gas exits *c* and *c'*, in the hydraulic main, for cleaning purposes, by movable covers on the top of *c'*.

The theory of the working of this method consists as follows;—In producing better dry coke and more gas, than is possible by means of horizontal retorts, it is a well-known fact that under the retort system of gas production, where the feeding of the coal into ordinary hot retorts within which it is spread out a few inches deep, along the bottom of the retort, the gas comes in contact with the heated upper portion of the roof, of the retort, where a disintegrating process goes on by which the heavy hydrocarbons are deposited in the form of retort carbon, while in some instances, the hydrocarbons, which ought to be the illuminating portion of the gas, are given over in a condensable form as naphthalene, owing to the high temperature as above stated prevailing in the ordinary retort. On the other hand the heat prevailing in ordinary retorts is not high enough to extract the whole of the gas from the coal within the time allotted, whereby a large quantity of a low candle-power gas is lost. In the present invention these two ends are obtained, first, in the distillation of the illuminating hydrocarbons, at a low temperature, without the gas coming in contact with any highly heated surface, the coal is systematically charged in small quantities into the cool region of the chamber *e e*, which prevents the decomposition of the hydrocarbons; prevents the formation of naphthalene; and also prevents the decomposition of the ammonia in the gas, secondly, a larger quantity of gas can be produced than is possible by means of ordinary retorts, because the region of high temperature commences immediately above the burners *h*, and proceeds about half way up the chamber *e*, the products of combustion in the flues *f* loose their heat as they rise, thereby leaving a cool region at the top of the chamber *e*, just where it is required for the distillation of hydrocarbons, but as this system is a continuous one, the coal undergoing distillation is continually falling by its own gravity down the chamber *e e* whereby it is gradually exposed to an increasing temperature, until it attains the hottest regions, immediately above the burners *h*. The temperature in this region being greater than is possible in ordinary retorts the whole of the gas is expelled from the coal, producing an increased quantity beyond that which is possible by means of ordinary retorts, but the gas that is produced in the regions of high temperature will be poor in illuminants, but considering the high illuminating power of the hydrocarbons, distilled in the upper portion, when the two gases are mixed in the hydraulic main, a larger quantity of average illuminating gas is produced.

The high temperature prevailing in the second zone combined with the pressure of the superincumbent charge in the upper regions of the chamber *e*, produces a hard dense, and superior coke to that which is made in horizontal retorts, when it has passed this region, the coke then descends into the cooling zone, marked e^2, which is surrounded by the water-jackets L L; here the heat is totally abstracted from the coke. On the bottom of these water-jackets rollers *m m* are constructed which revolve at a certain speed by gearing O, discharging the coke at a rate commensurate with the charging apparatus on the top, keeping the level of the coal inside the chamber at *e' e'*. The rollers are constructed with grooves or notches on

their periphery for the purpose of catching the coke and discharging it through the aperture e^3 into the airtight chamber P P P underneath.

Referring now to Figs. 6, 7, 8 and 9, which as already stated show a modification of the preceding arrangement, the two differ chiefly from one another in that this modification is fed from below, while in the other it is fed from above. Like letters relate to like parts in the two sets of drawings, but parts in this modification not corresponding to any in Figs. 1 to 6 are described in numerals. The brickwork in both is substantially the same, and therefore need not further be described. It is heated by means of gas conveyed to flues *f* by the burners *h* shown more clearly in Fig. 6. A small jet of high pressure air is inserted at *k'* which forms an induced current of gas through the burners *h* in which the air and gas are mixed, air coming from pipe *k* and the gas through pipe *j*, these being mixed in the required proportions, but alterable at pleasure by valves in these pipes as already described, the dimensions of the pipes and the pressure of the gas and air respectively being designed for the purpose and by well known rules. By the force of the jet of the primary air, the gas is carried a longer distance up the flue *f'* before complete combustion takes place than would occur by ordinary means. It also induces a hot current of secondary air down pipe *g* from a flue 2 open to the atmosphere. This air has become heated in its descent down the flue *g*, and thus a high temperature can be maintained for a very great distance up the flues *f*. The coal is inserted into the chambers by means of the hydraulic rams 3 which can be worked by hydraulic means or by the hand wheel 4 on shaft 5 carrying worm 6 round worm wheel 7 on ram-rod 8. The coal enters the box 9 in which the ram is situated through a hopper 10, the worm *m* driving it forward when the ram is lowered. When the space closed by the lowering of the ram is filled in this way, the ram is raised, thus forcing the entire contents of the chamber *e* upwards. A firm consistency is thus given to the coal; and a sort of arch is formed through the curved surface of ram 3. Skew-backs or side jams 2' are provided at the bottom of chamber *e* at Fig. 7 which hold the coal in position when the ram is lowered in order to fill the chamber 9 with coal. The effect of this action is that the coal is introduced into the hottest region of the furnace under pressure equal to the weight of the coal and coke in the whole chamber, in some cases averaging from seven to ten pounds to the square inch. By this means coke has been manufactured of a very hard and dense nature, the cellular structure of which is exceedingly small and compact even from a class of coal which practically liquefies in the furnace, and which if ordinary means were employed would only result in a very light useless spongy coke. The apparatus is automatic in the discharge of the finished coke, for as fresh coal is inserted at the bottom, the chamber being full it gradually ascends while the coking process proceeds, the chamber being constructed with sloping sides a little wider at the top than at the bottom to assist this action. When the coke arrives at the top it passes through a water cooling jacket 14 and is automatically pushed over to spout 13 by the traveling endless digger 12. From the chute S it is discharged cold into wagons, the valves 26 being used for the purpose to prevent the escape of gas except during the moment of discharge. The gas can either be taken off at the bottom or it can be taken off at the top of the chamber by the pipe 17, and hydraulic main 18. If the gas be taken off at the bottom, it will retain all its hydrocarbons, ammonia and tar, whereas if it be taken off at the top it will have deposited all its higher hydrocarbons and tar in the coke and thus the coke will be enriched and improved while a gas consisting mainly of methane of a great heating power but little illuminating power will be given off. Means are provided for the circulation of a current of cold water through the head of the ram, pipes 19 and 20 being used for the purpose.

I claim as my invention.—

1. In an apparatus for the manufacture of coke and gas, comprising a high vertical coking chamber, vertical combustion flues surrounding said chamber and communicating with a flue leading into a suitable exhaust device and air heating flues formed in the brick work of said coking chamber and extending from the top thereof to a point in proximity to the bottom of said chamber; the combination of gas and air injecting devices adapted to force the air upwards into said combustion flues from the bottom thereof, and a connection at bottom between the air heating flues and the combustion flues beside the orifice of the injecting device to adapt said device to assist in drawing the secondary or heated air down through the hot brick work.

2. In a furnace of the character described of dovetailed brick construction, the combination of a coking chamber, a plurality of heating flues partly surrounding said chamber, and communicating with a suitable exhaust device, air heating flues located in the brick work and traversing substantially the entire length of said furnace, air injectors for forcing the air upwards into the combustion flues and means whereby the injectors are caused to assist in driving the secondary heated air down through the hot brick work.

3. The combination of a high vertical coking chamber with a vertically operating ram,

means for passing the coal introduced at the bottom of the said coking chamber into and through the hottest part of said chamber into a cooler portion, means for passing the disengaged gas through the highly heated coke, whereby tar and hydrocarbons released from the coal are decomposed and the carbon deposited in the coke enriching the same.

4. The combination of a high narrow vertical coking chamber closed to the admission of air, of vertically actuated feeding means at the bottom of said chamber, and discharging devices at the top of said chamber, cooling devices at the top and bottom of said chamber and in the vertical feeding means, and means for heating said coking chamber.

5. In an apparatus for the manufacture of coke and gas, a narrow vertical closed coking chamber, wider at the exit for the coke and gas than at the entrance point where the fuel is admitted, whereby the gas can freely pass through the fuel as it is formed, and can be decomposed by the hot fuel with deposition of carbon before its escape.

6. An apparatus for the manufacture of coke and gas comprising long narrow vertical coking chambers closed from access of air, a vertical feeding ram located below said chambers, and feeding directly into them, vertical heating flues arranged on each side of said coking chambers and a high pressure atmospheric air and gas burner for injecting air into the end of each heating flue in the direction of its axis.

7. In an apparatus for the manufacture of coke and gas, a plurality of coking chambers widening towards the point of exit of the gas and coke, a plurality of heating flues on both sides of said chambers, a ram located at the bottom of said chambers and carrying the weight of the charge, means for raising and lowering said ram, means for feeding coal on to the said ram in its lowest position, and side jambs for holding the fuel pressed up by the ram while the latter takes a fresh charge, substantially as described.

In witness whereof, I have hereunto signed my name this seventh day of June, 1905, in the presence of two subscribing witnesses.

JOHN ARMSTRONG.

Witnesses:
EDWIN COURTNEY WALKER,
JOSEPH PHILLIPS CRAWLEY.