No. 888,380. PATENTED MAY 19, 1908.

J. D. F. ANDREWS.

FURNACE.

APPLICATION FILED FEB. 29, 1908.

4 SHEETS—SHEET 1.

Fig. 1.

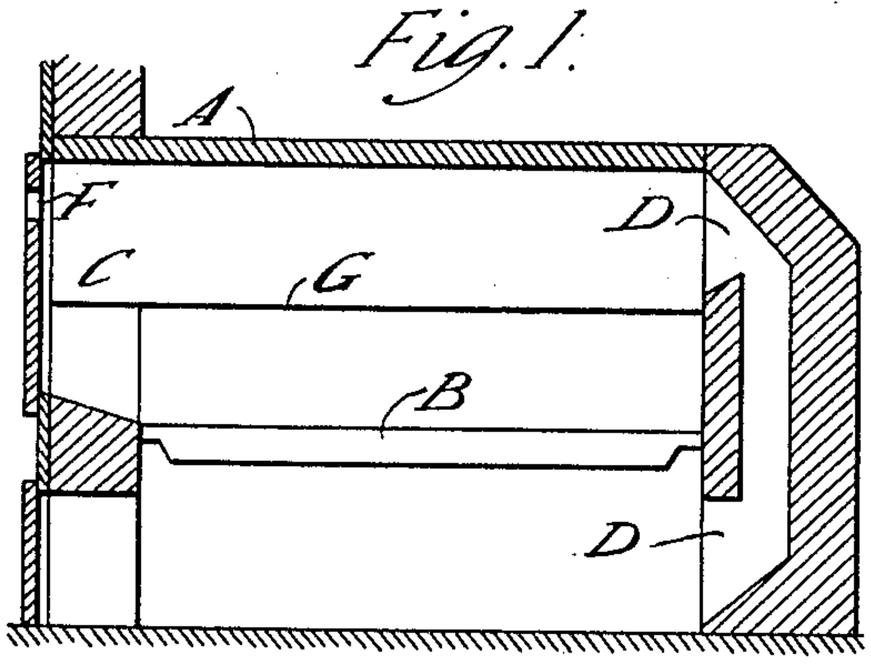


Fig. 2.

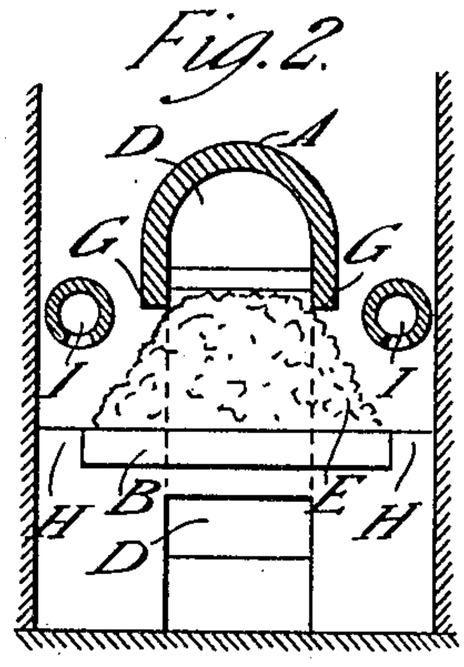


Fig. 3.

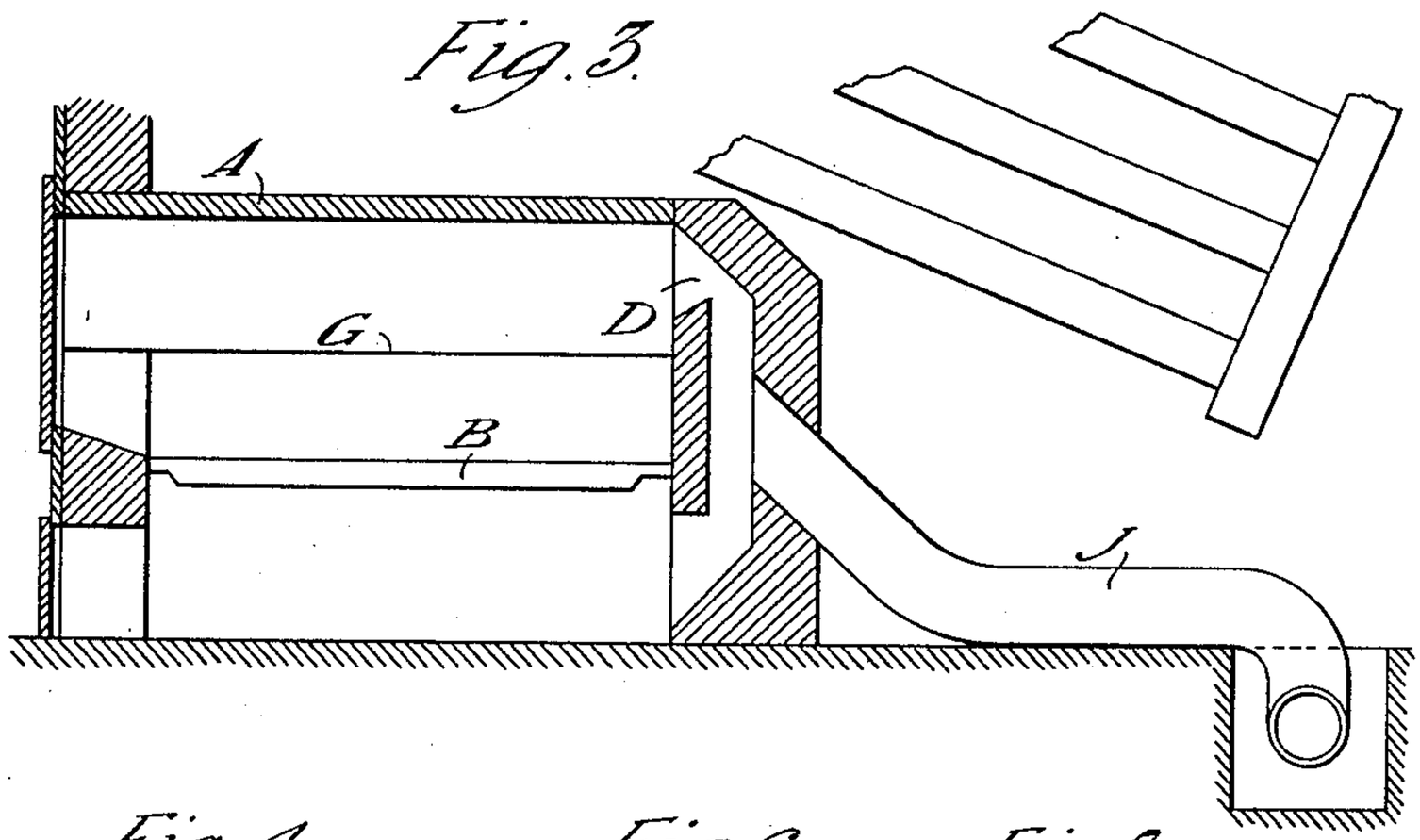


Fig. 4.

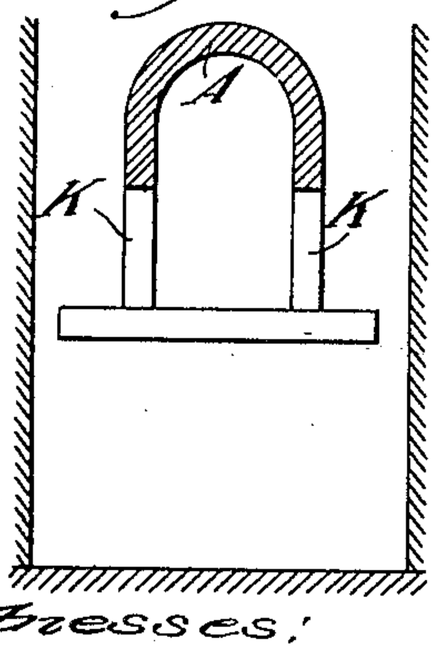


Fig. 6.

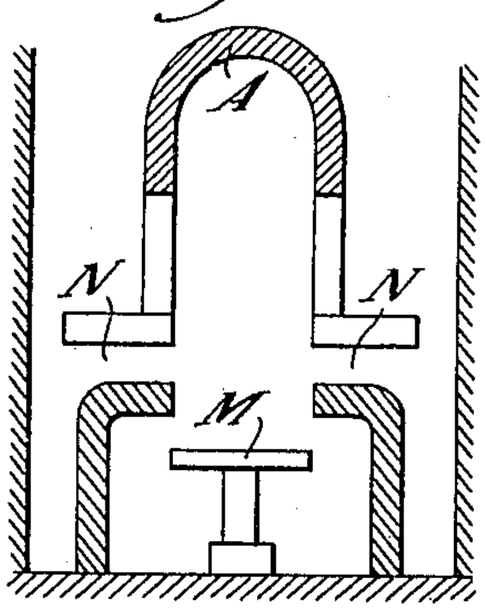
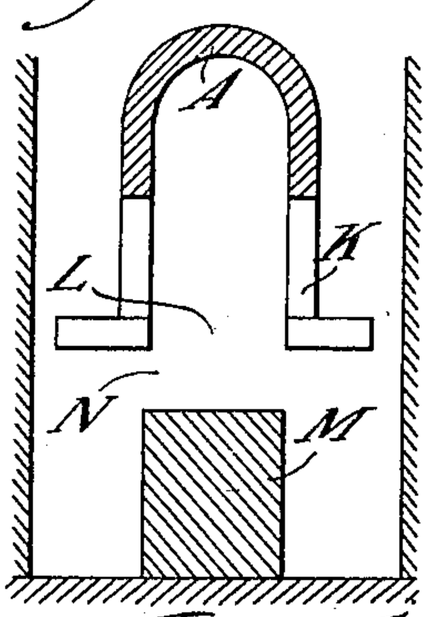


Fig. 5.



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No. 888,380. PATENTED MAY 19, 1908.

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4 SHEETS—SHEET 2.

Fig. 7.

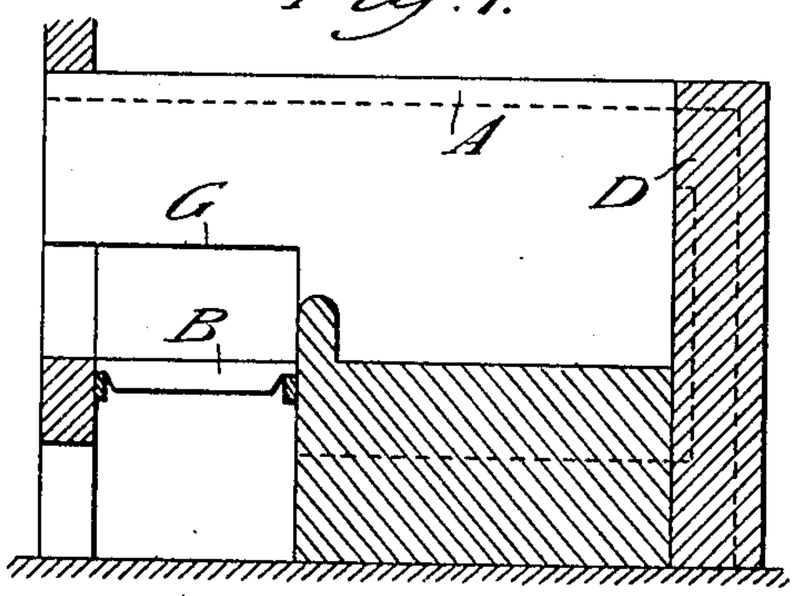


Fig. 8.

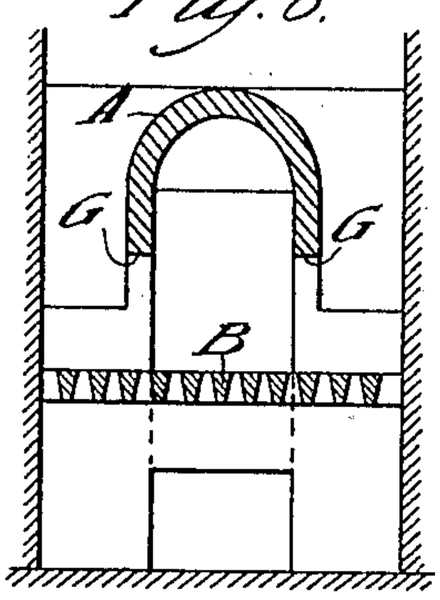


Fig. 9.

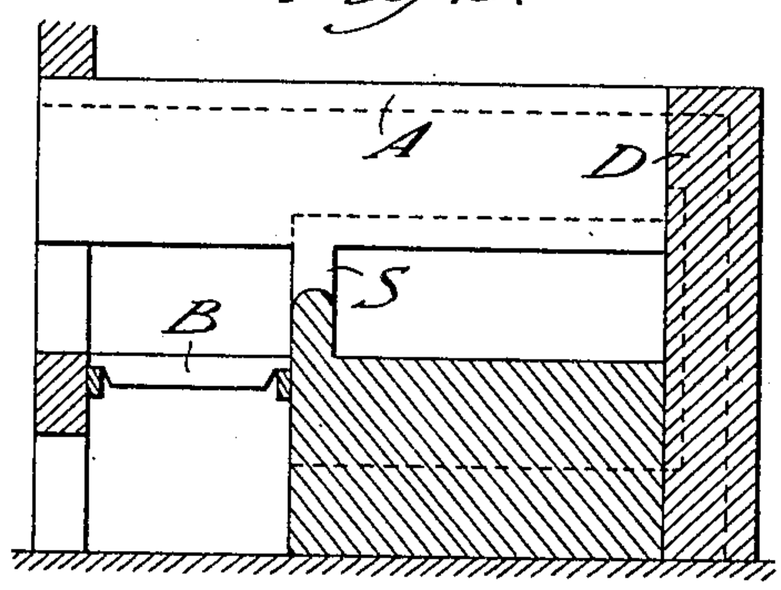


Fig. 10.

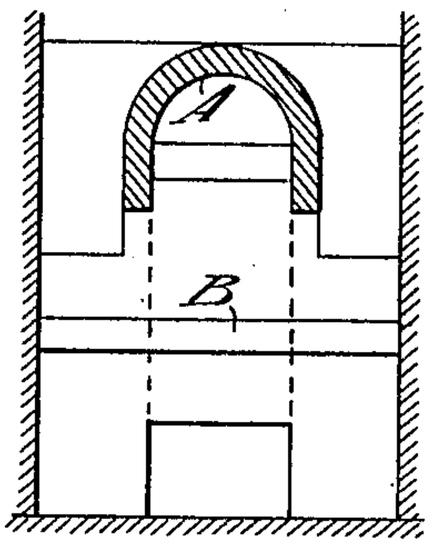


Fig. 11.

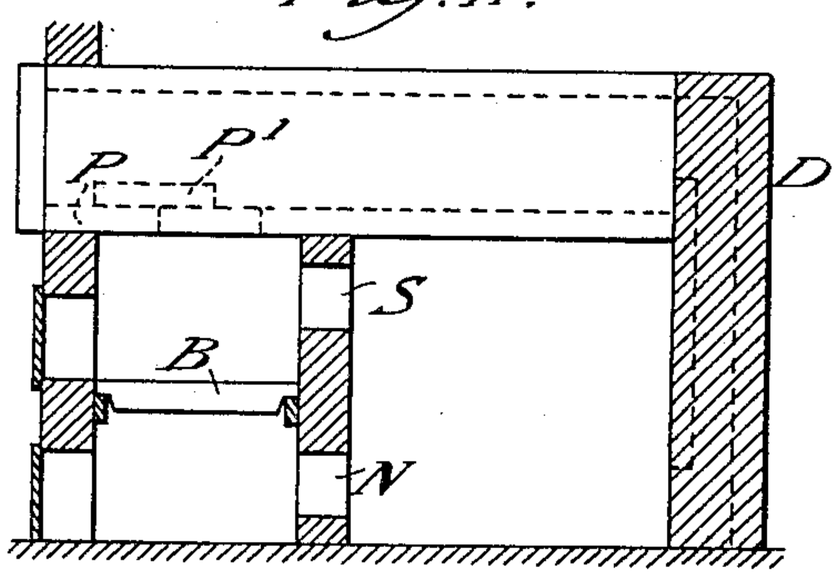
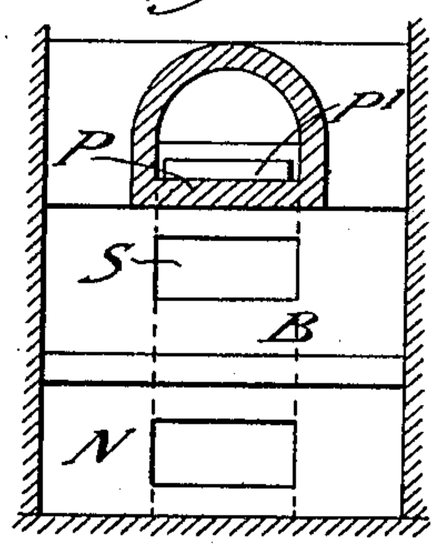


Fig. 12.



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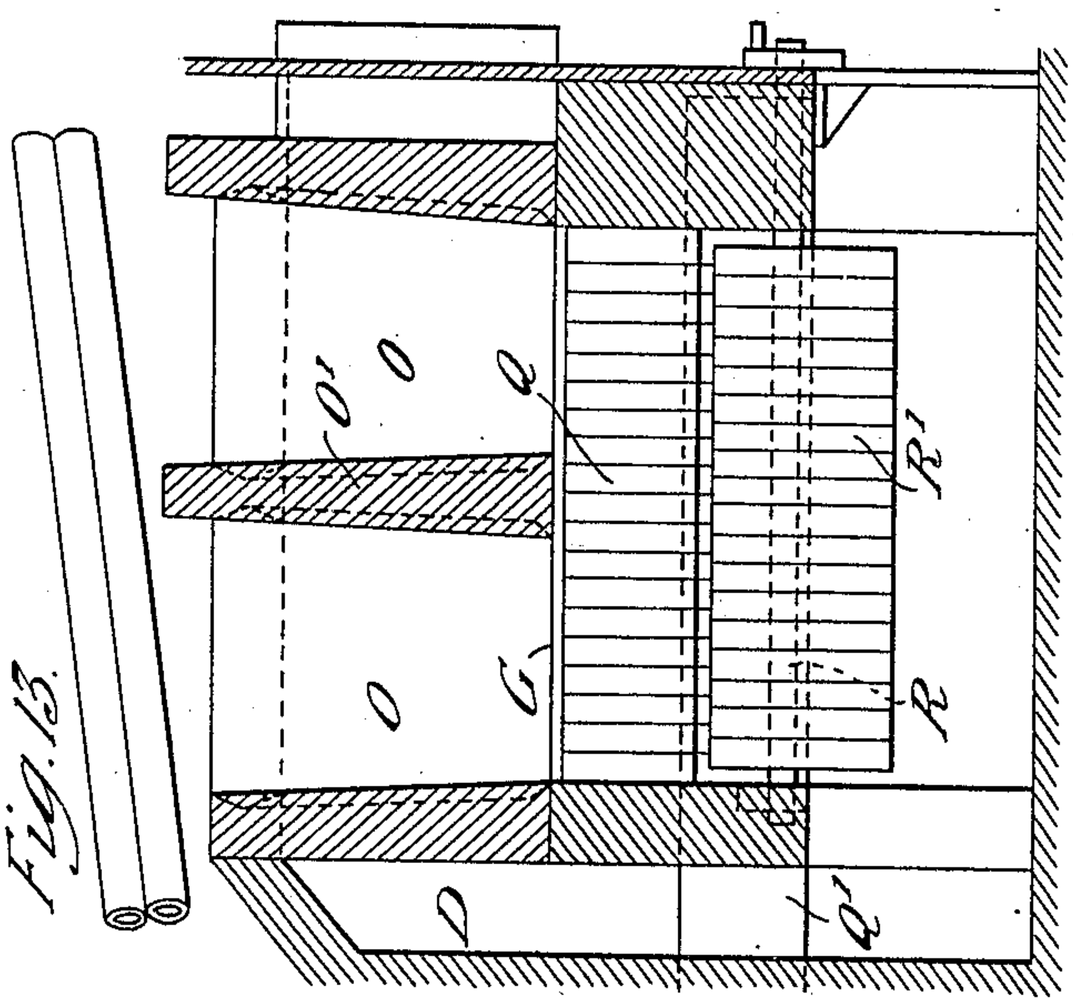
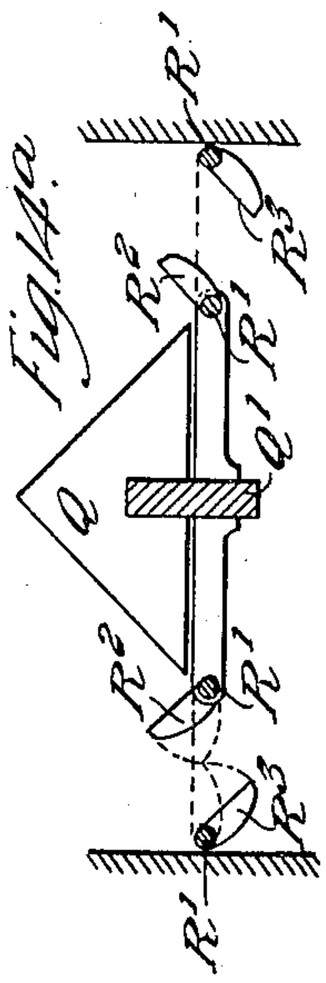
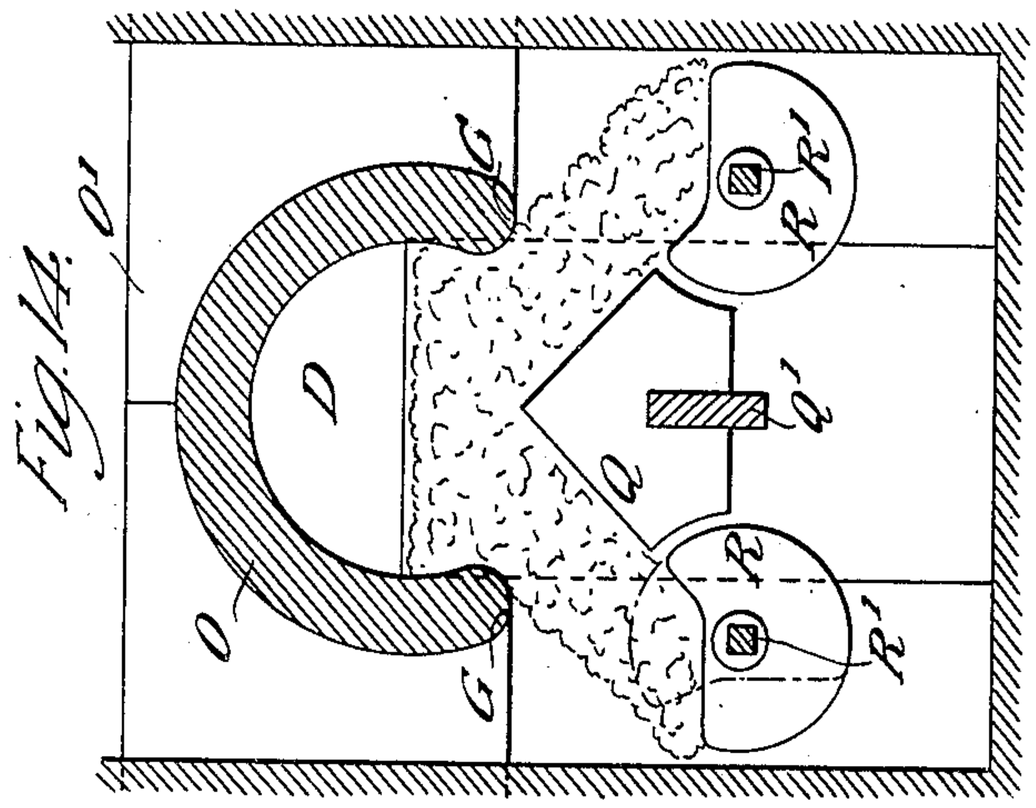
4 SHEETS—SHEET 3.







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No. 888,380. PATENTED MAY 19, 1908.

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FURNACE.

APPLICATION FILED FEB. 29, 1908.

4 SHEETS—SHEET 4.

Fig. 6.

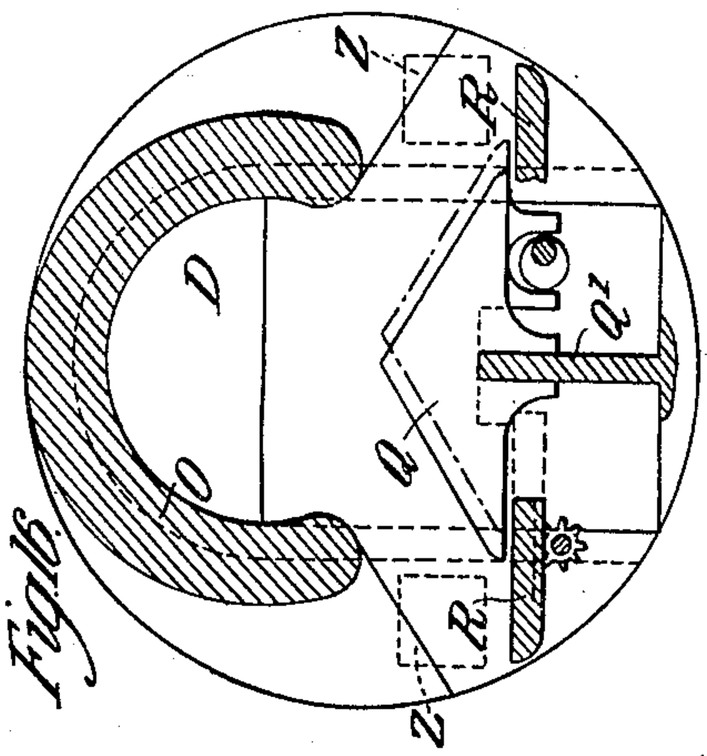
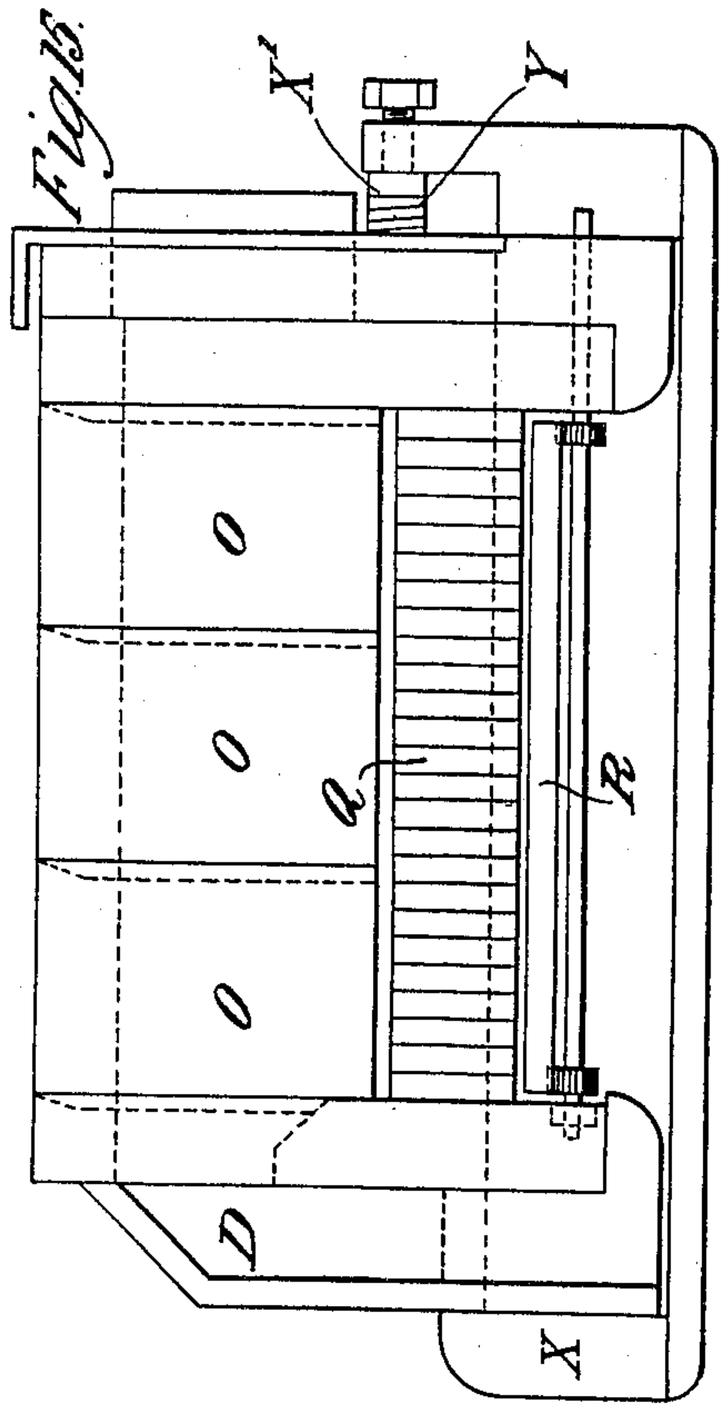


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOSEPH DEVONPORT FINNEY ANDREWS, OF EAST SHEEN, ENGLAND.

FURNACE.

No. 888,380. Specification of Letters Patent. Patented May 19, 1908.

Application filed February 29, 1908. Serial No. 418,616.

To all whom it may concern:

Be it known that I, JOSEPH DEVONPORT FINNEY ANDREWS, a subject of the King of Great Britain, residing at 2 Park avenue, East Sheen, in the county of Surrey, England, consulting engineer, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

The object of the present invention is to obtain complete combustion of any ordinary solid fuel or combustible refuse in steam boiler or other furnaces.

The type of furnace to which the invention applies is one in which the fuel is first charged into a retort or fuel chamber which is so constructed and arranged with respect to the combustion chamber of the furnace that the heat of combustion in the combustion chamber will heat the fuel chamber and react on the fuel so as to effect or assist its decomposition.

The present invention consists in a construction of furnace of this type which renders the processes of decomposition and combustion contemplated in the general arrangement of apparatus above referred to capable of being satisfactorily realized in practice, and this construction together with various modifications thereof, all however based upon the same general principles of construction, will be hereinafter described with reference to the various figures of the accompanying drawings to which they refer. Each of such alternative constructions however is characterized by a fuel chamber, preferably constructed of refractory material such as fire brick, similar to a gas retort but open at the bottom or having openings in or near the bottom or at either or both ends and supported by suitable means over a hearth or grate, the fuel chamber and grate preferably extending lengthwise of the furnace from or near the front thereof to or nearly to the furnace back or bridge according to its character.

Fuel is fed into the retort or fuel chamber by a suitable opening usually situated in the front or top of the chamber, and this fuel, when the chamber is constructed with an opening or openings at the lower part, falls through such openings on to the hearth or grate until the fuel rises up to or a few inches above the top of the opening or openings in the lower part of the chamber, this condition being usually maintained in ordinary working. When the bottom of the fuel chamber is closed the gaseous products of distillation are led to the combustion chamber through a discharge outlet.

Air is admitted to the chamber above the level of the fuel through a suitably situated opening or openings in the chamber walls either communicating directly with the atmosphere or by a duct or ducts built in the furnace walls or in or adjoining the furnace back or bridge and communicating with the ashpit or other suitable source, the admission of air being regulable by suitable means, such as by a damper in the duct or air inlet, or by the ashpit doors, or by the main boiler flue damper. Also, or alternatively, suitable means may be provided for forcing air into the fuel chamber, as by a steam jet or blower, through an opening in the rear of the chamber or other suitable opening or openings, the air in every case being delivered to the fuel chamber over the top of the fuel, and being if necessary or desirable pre-heated by any suitable means, preferably by the heat of the waste gases issuing from the boiler furnace, in which case it is not so necessary to build up the fuel to a higher level than the bottom of the chamber.

The furnace is started by igniting the surface fuel in the retort or fuel chamber, and in time the whole mass of fuel becomes incandescent, the volatile products of distillation and the gaseous products of combustion passing under the bottom edges of the chamber or through the opening or openings in its lower part or in its end or ends, and being then completely consumed by encountering an external supply of air from the ashpit passing up between the bars of the grate or through specially provided openings in the hearth. The coke or solid residue in the fuel chamber and the incandescent fuel will sink or fall out of the fuel chamber and also be consumed by such externally admitted air.

Suitable provision is made, by the construction of the grate or hearth or otherwise to assist the sinking or falling out of the solid products of distillation and, for the removal of the ash or clinker during the combustion of the fuel.

As already indicated the fuel chamber or retort may be constructed with a floor which is in part solid or closed and in part open, and this latter part of the floor may be at a

lower level than the other and fitted with a grate on to which the solid residue of the distilled fuel may fall or be drawn or pushed where combustion more or less complete of the solid residue is effected by means of air admitted through the grate or otherwise, the products of combustion passing into the external combustion chamber where, meeting with additional air, the combustion of the gases is completed.

These and other features of the improved furnace are illustrated in and hereinafter described with reference to the accompanying diagrammatic drawings in which

Figures 1 and 2 are respectively a longitudinal and a transverse section of one form of the improved furnace; Fig. 3 is a view similar to Fig. 1, showing the application of the invention to a tubulous boiler, and in which provision is made for pre-heating the air supply; Figs. 4, 5 and 6 are transverse sections, showing further modifications; Figs. 7 and 8 are views similar to Figs. 1 and 2 showing a further modification; Figs. 9 and 10, and also Figs. 11 and 12, are corresponding views showing still further modifications; Figs. 13 and 14 and 14[a] are corresponding views of a modified construction applied to a tubulous boiler and showing a further improvement in the retort hearth or grate; Figs. 15 and 16 show a similar construction applied to an ordinary Lancashire boiler but having a modified construction of grate.

Referring first to Figs. 1 and 2, A is the fuel chamber or retort which is erected over a grate or hearth B. The retort is preferably constructed of fire resisting clay and is supported over the grate at its ends. A door C is provided in front of the retort for stoking the furnace. Leading from the ashpit into the back end of the retort is a duct D to lead air above the fuel E in the retort. Air inlets F, preferably adjustable, are also provided in the doors C. The fuel is thrown in through the doors C and lighted on the top. As distillation and combustion proceeds the volatile and other gaseous products issue under the edges G and meeting with air issuing either between the bars in known manner or through special openings H in the hearth or grate these products are completely burned in what has been called the combustion chamber proper.

Instead of or in addition to the openings H, tubes I may be provided fixed parallel with the retorts and having openings along their under side for the emission of air. These tubes may be in communication with the ducts D or with openings in front of the boiler or with both.

To obtain greater economy the air supplied to the retort or the combustion chamber or to both may be preheated and this may be effected by admitting the air through a tube or tubes J heated by the gases in the main flue, and closing the ashpit doors (see Fig. 3). Also instead of allowing the fuel to spread from under the retort on to the hearth it may be retained under the retort by fire resisting uprights K (Fig. 4) fixed at suitable distances apart, which can also be arranged to support the retort over the grate or hearth.

To remove the clinker, a portion of the hearth immediately below the retort may be removed as indicated at L (Fig. 5). Below this space is provided a floor M on which the fuel can rest, the air passing in at open spaces N, through the fuel and out through the openings between the supports K. As indicated in Fig. 6 the bottom M may be arranged to be raised and lowered by any suitable means.

In the modified construction of Figs. 7 and 8, only a portion of the floor of the retort is provided with openings or a grate. In this case the heat of combustion distils the fuel in the rear portion of the retort, and when the distillation is sufficiently complete the solid residue is raked forward to the front portion or grate and a fresh supply of fuel thrown to the rear of the retort. To insure the efficient heating of the rear of the retort, it may be raised above the level of the remainder as indicated in Figs. 9 and 10. Also, as shown in Figs. 11 and 12, the grate part may be provided with a roof P, having an opening P′ therein provided with a removable cover, through which the coke can drop when removed from the rear part of the retort. The cover is left partly off the opening P′ during working to allow the gases to pass into the combustion chamber. In this case also as shown in Figs. 9 and 10 an opening S may be provided in the rear partition of the lower part of the retort through which the products of combustion pass from the furnace and if the combustion is incomplete they meet with additional air from inlet N (Figs. 11 and 12) whereby their combustion is completed.

Figs. 13 and 14 besides showing an improved grate for the distilling retort illustrate a convenient construction of the latter. As shown, the retort is built up of a plurality of circularly or otherwise arched segments O of fire clay or the like which taper in breadth from the crown of the arch to the lower edges G of the retort. The outer ends of the front and rear segments are built into the front and rear furnace walls, while intermediate transverse supporting arches or blocks O′ of similar material built into the side walls of the furnace are interposed between contiguous segments. These supporting blocks or arches have a taper corresponding with that of the ends of the segments O, but in the opposite direction, namely, from below upwards, and are also preferably V-grooved on each side to receive the correspondingly shaped edges of the arched segments O.

The grate is ridge-shaped as to the central

part Q the bars being carried by a central longitudinal beam Q′ built into the front and rear walls of the furnace or otherwise suitably supported. At each side of the central part of the grate and at a slightly lower level is a shelf R built up of transversely arranged segment shaped grate bars carried on a rock shaft R′ by which the shelf can be rotated from outside the furnace from the position shown in full lines to the dotted line position, whereby the accumulation of clinker and ashes may be dislodged into the ashpit.

Although only one retort or fuel chamber is shown in Figs. 13, 14, it is obvious that more than one such retort may be fitted in this construction, and this remark also applies to most of the constructions herein described. An alternative to the rocking grates R, R′, which in some respects is to be preferred, is illustrated diagrammatically in Fig. 14ª in which the grate is made in two parts R^2, R^3, each mounted on a rock shaft R′, the part R^2 being arranged to be tilted upwardly and the part R^3 downwardly both movements being preferably made simultaneously.

In the Lancashire boiler construction shown in Figs. 15 and 16 the retort is built up in a manner similar to that explained above, and the grate is of somewhat similar construction, but the shelf or shelves R, instead of being mounted on a rock shaft are mounted to be moved translationally inwards by means of rack and pinion gear applied to the grate R. Also, in addition to or in lieu of one or both of such shelves, the bars of the central grate Q, or some of them may be mounted on their supporting beam Q′ with lateral freedom and are suitably guided so that they can be moved to and fro transversely by suitable gear so as to facilitate the dislodgment of clinker and the clearance of the interspaces between the bars for the passage of the products of combustion or distillation. In this case the arched segments O of the retort are supported by longitudinal pressure applied to the two ends of the retort which are clamped between a fixed abutment X on the rear end of the beam Q′ and an adjustable abutment X′ on the front end thereof, between which adjustable abutment and the front of the furnace may be interposed a powerful spring Y to allow for difference of expansion. As before, the air is admitted to the retort above the fuel through the flue D.

In addition to or in lieu of the means hereinbefore described for facilitating the dislodgment or removal of clinker, small openings and doors therefor may be provided in front of the furnace, in addition to the door or doors C provided for the insertion of the fuel in the retort. The position of such doors with respect to the grate is approximately indicated by dotted lines at Z in several of the figures, and they need not be much larger than is necessary for the insertion of a suitable tool for breaking up the clinker although they may also be used for its removal. It will be obvious also that the method of preheating the air supply by the furnace waste gases described with reference to Fig. 3 may be equally well applied to the other modified constructions hereinbefore described.

Having thus described the nature of my said invention and the best means I know of carrying the same into practical effect, I claim:—

1. In a furnace, in combination, side and end furnace walls, an arch-shaped retort extending and supported between the end furnace walls and spaced from the side walls, a grate supported below the retort and spaced therefrom, the space below the grate serving as an ash pit, the rear end furnace wall having an air duct leading from the ash pit below the grate and discharging into the retort between the side walls thereof and means for supplying air to the furnace.

2. In a furnace, in combination, side and end furnace walls, an arch-shaped retort extending and supported between the end furnace walls and spaced from the side walls, a grate supported below the retort and spaced therefrom, said retort being provided with a floor in the rear of and above the grate, the space below the grate and the floor serving as an ash pit, the rear end furnace wall having an air duct leading from the ash pit below the grate and discharging into the retort between the side walls thereof and means for supplying air to the furnace.

3. In a furnace, in combination, side and end furnace walls, a retort supported between the end furnace walls and comprising a plurality of arch-shaped segments disposed in alinement and means for supporting said segments in alinement.

4. In a furnace, in combination, side and end furnace walls, a retort supported between the end furnace walls and comprising a plurality of arch-shaped segments, each tapering in breadth from the crown thereof to its edges, said segments being disposed in alinement and means for supporting said segments in alinement comprising arch-shaped blocks built into the side walls of the furnace and tapering from their lower edges upwardly to their crowns, said segments being articulated with said blocks as supports.

5. In a furnace, in combination, side and end furnace walls, an arch-shaped retort supported between the end furnace walls and spaced from one of the side walls, a grate supported below the retort and spaced therefrom, the space below the grate serving as an ash pit, the rear end furnace wall having an air duct leading from the ash pit below the grate and discharging into the retort between the side walls thereof, and means for supplying air to the furnace.

6. In a furnace, in combination, side and end furnace walls, an arch-shaped retort supported between the end furnace walls and spaced from the side walls, and a grate supported below the retort and spaced therefrom, said grate comprising a longitudinal beam and grate bars mounted thereon and formed with inclined sides, and grate sections on each side of said beam and independent thereof, said grate sections having movement to dislodge clinkers, the space below said grate serving as an ash pit.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH DEVONPORT FINNEY ANDREWS.

Witnesses:
JOSEPH WILLARD,
WALTER J. SKERTEN.