B. E. ELDRED.
PROCESS OF PRODUCING GAS.
APPLICATION FILED MAY 7, 1908.

901,232. Patented Oct. 13, 1908.

3 SHEETS—SHEET 1.

Fig. 1.

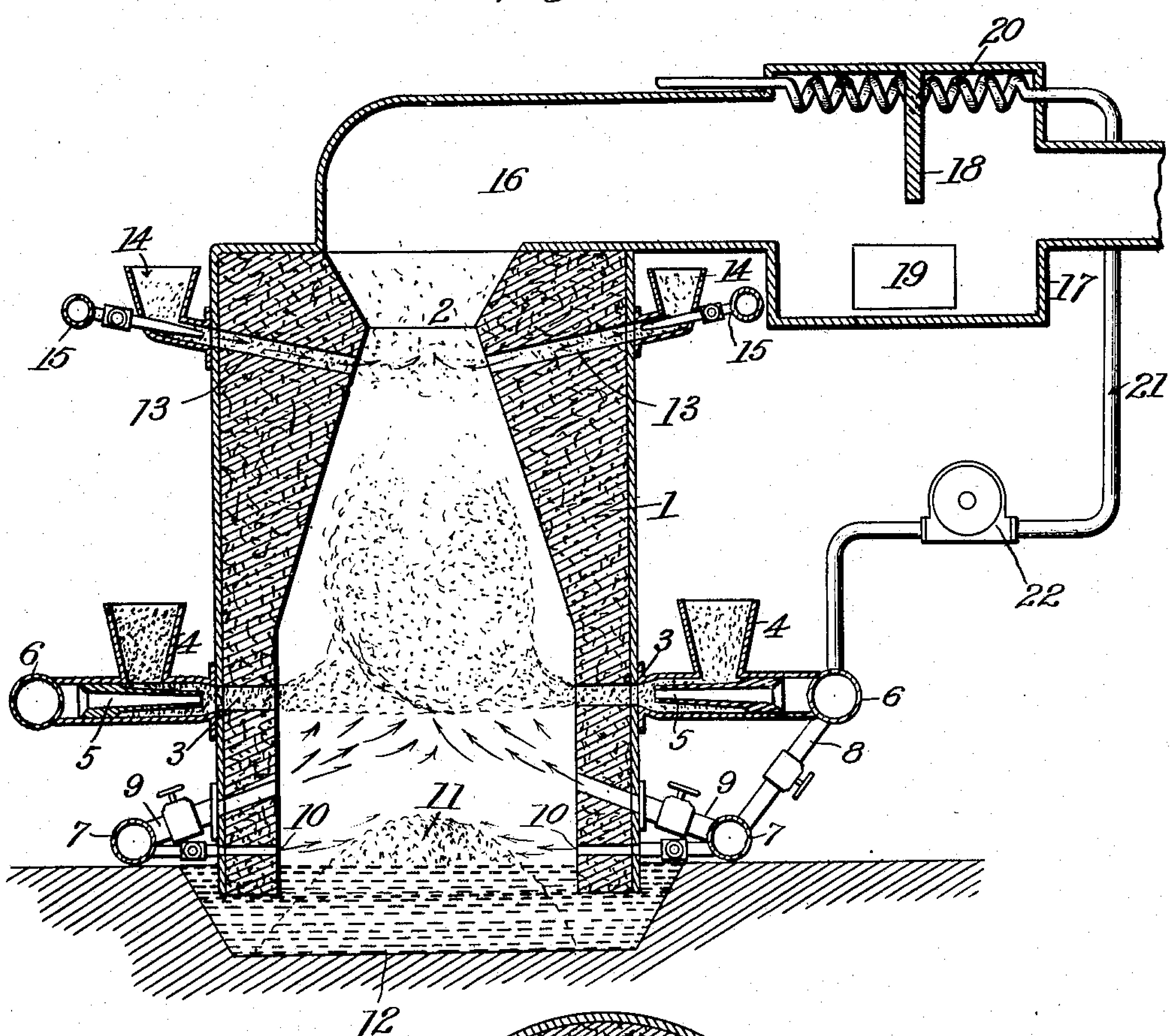
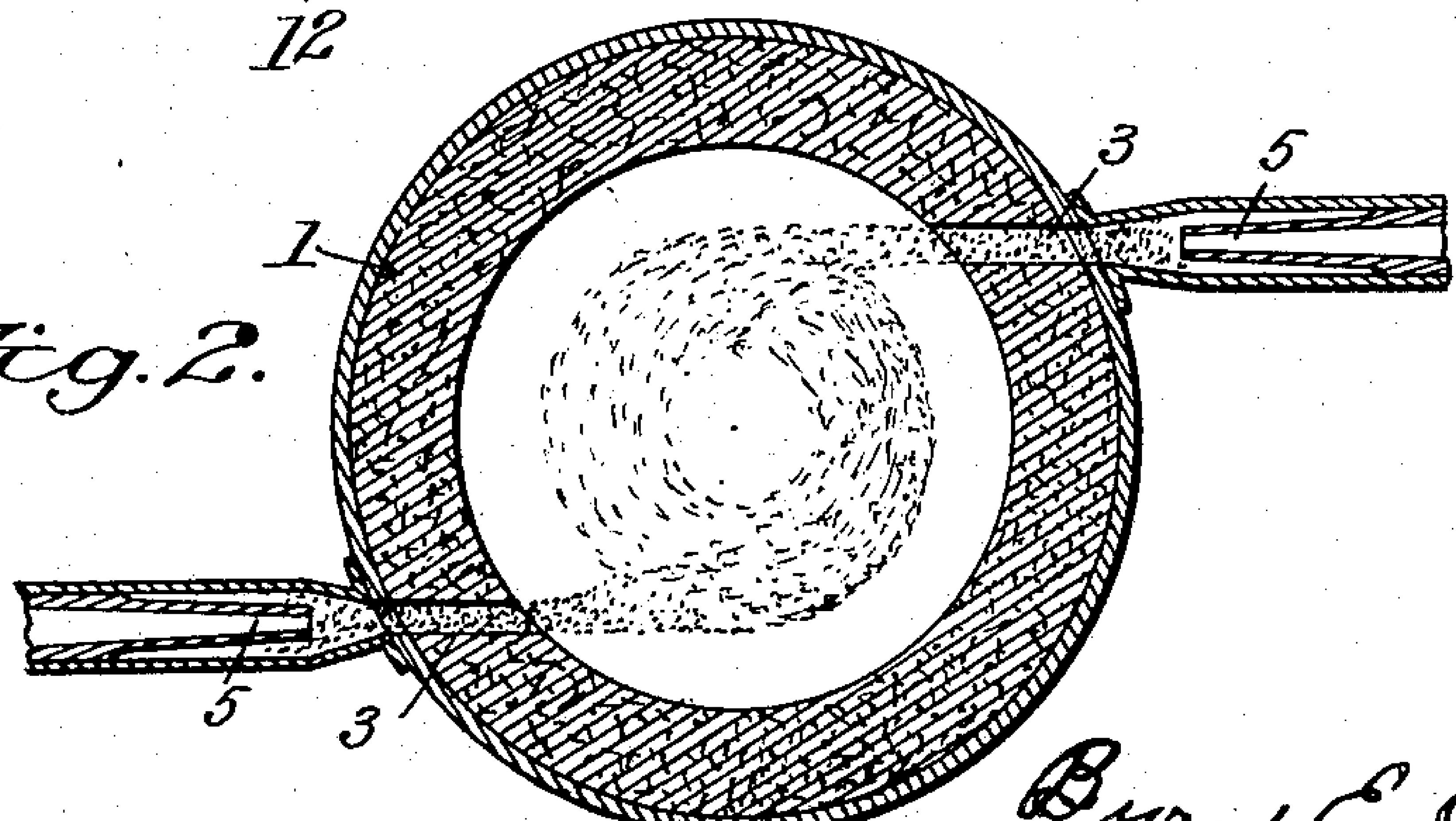


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

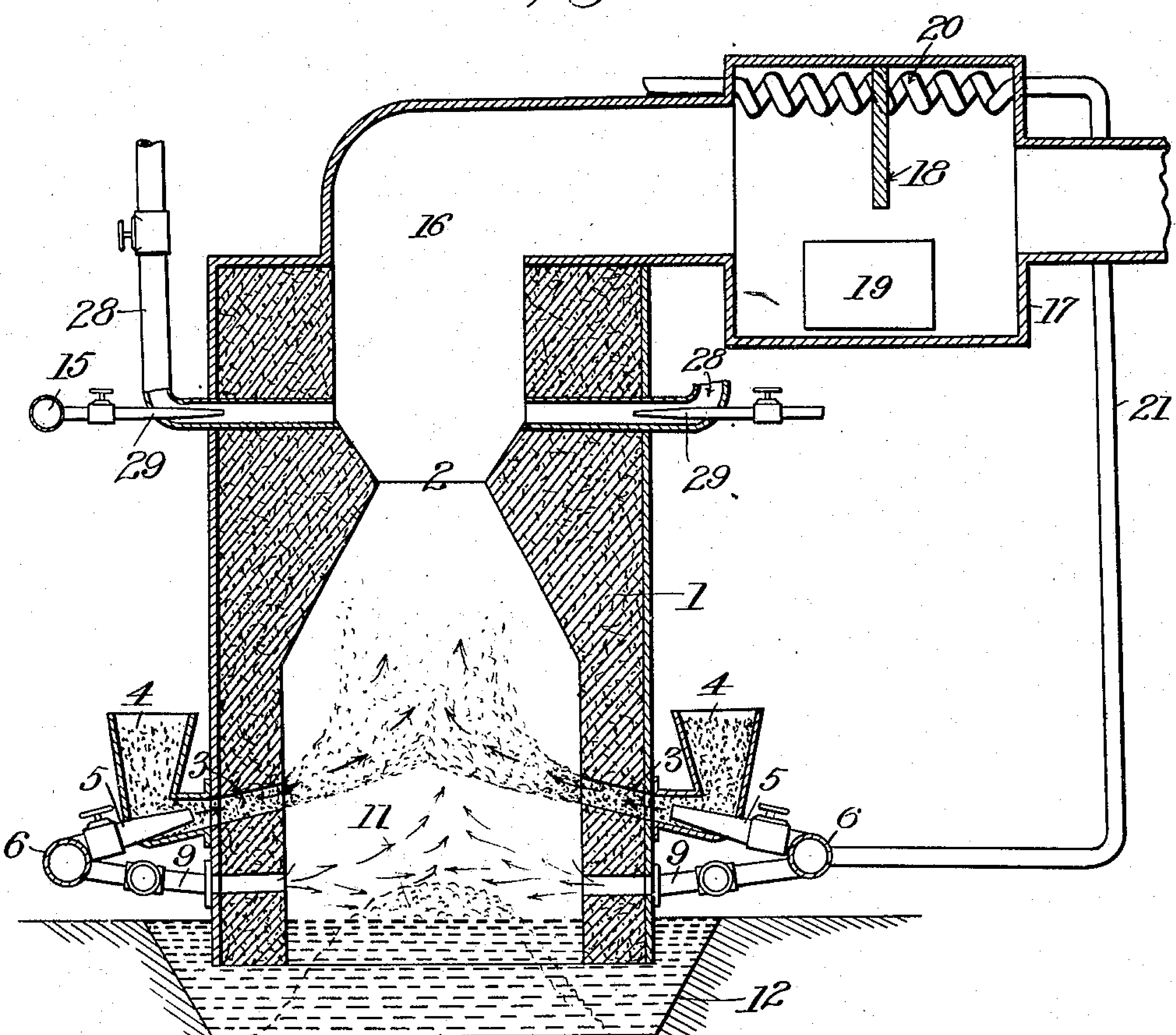
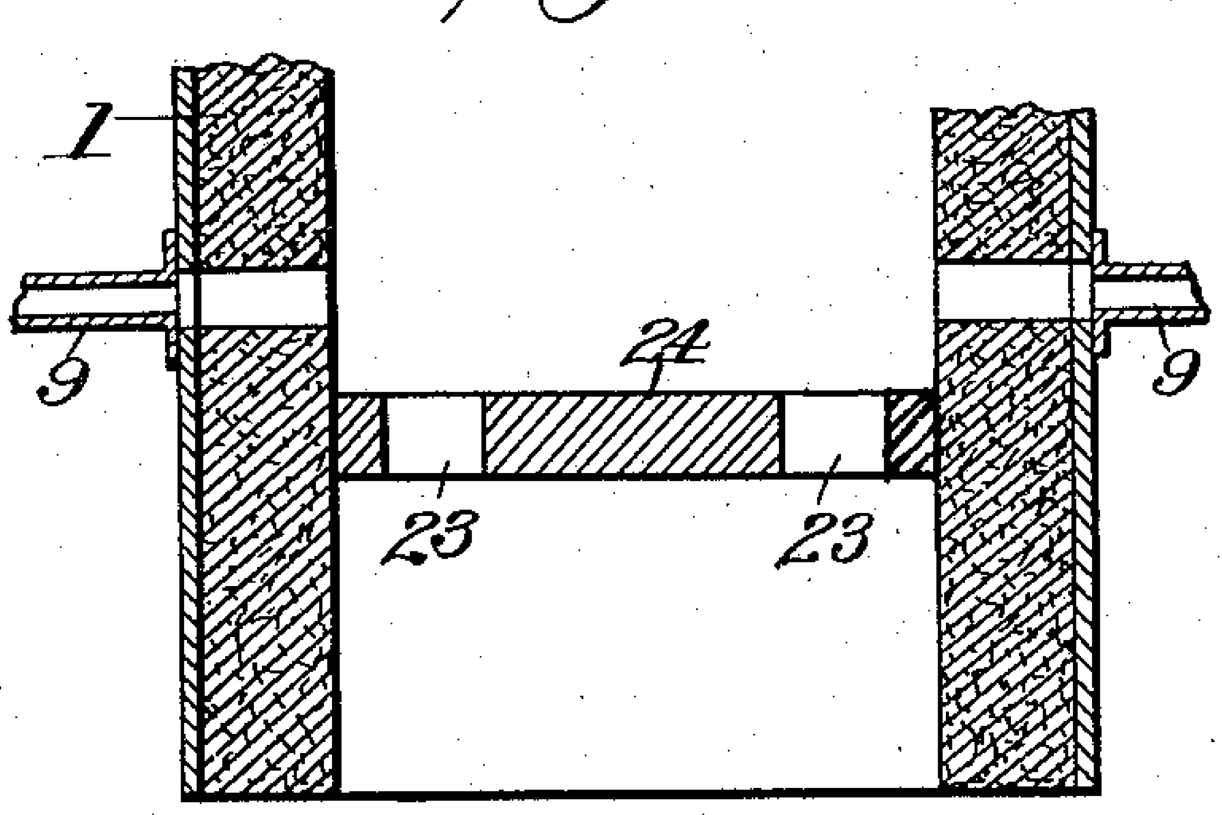
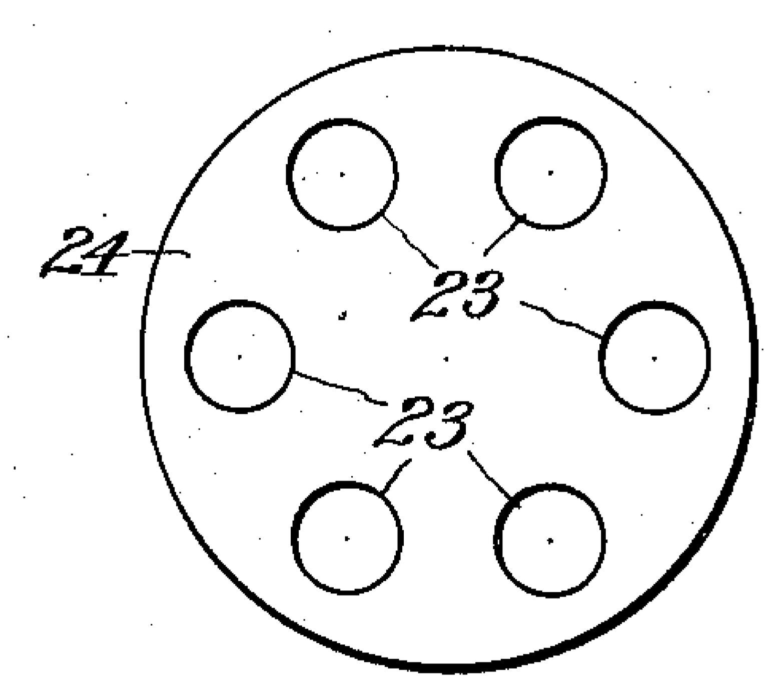


Fig. 5.

Fig. 4.





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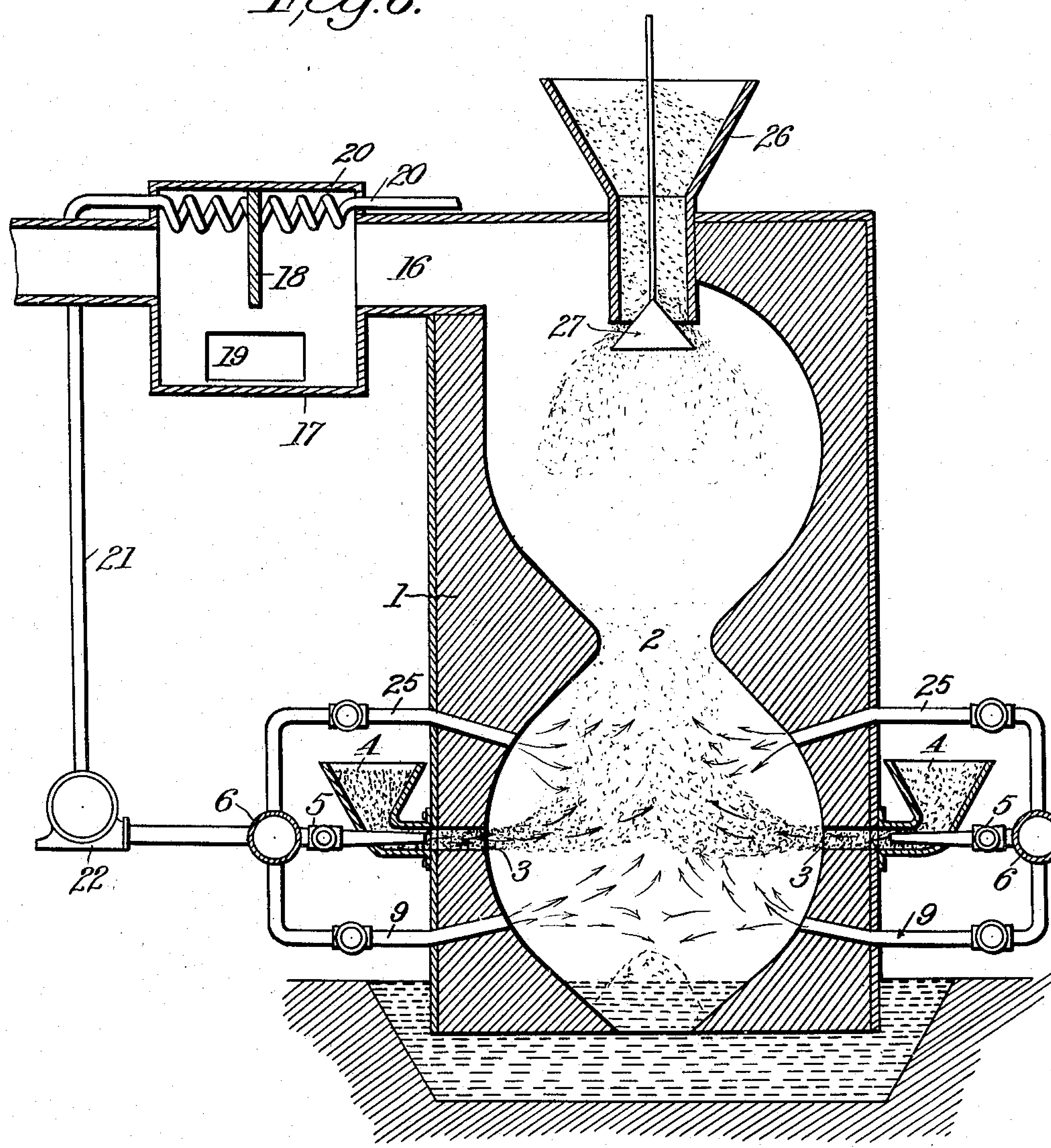
3 SHEETS—SHEET 3.

Fig. 6.



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UNITED STATES PATENT OFFICE.

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PROCESS OF PRODUCING GAS.

No. 901,232. Specification of Letters Patent. Patented Oct. 13, 1908.

Application filed May 7, 1908. Serial No. 431,301.

To all whom it may concern:

Be it known that I, BYRON E. ELDRED, a citizen of the United States, residing at Bronxville, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Processes of Producing Gas; and I do hereby declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to gas manufacture; and comprises a method of making gas by burning finely divided carbonaceous fuel in a state of suspension to produce an intensely hot flame in a closed chamber and subsequently distributing finely divided fuel through the flame and flame gases to reduce carbon dioxid to carbon monoxid and form combustible gas; all as more fully hereinafter set forth and as claimed.

It is the purpose of the present invention to provide means and devise a manner of producing gas more rapidly than is possible in the ordinary producer, producing relatively large volumes of gas in a unit of time from relatively small gasifying means and incidentally attaining certain other advantages. To this end, in lieu of exposing a resting body of fuel to a blast current driven therethrough, as in the ordinary types of gas producer the fuel in a finely divided form is blasted into the producer in gaseous supension and is burned to form an intensely hot flame, combustion being complete, or substantially so. The hot gases from this flame are treated with a further supply of fine fuel, also in suspension. The carbon of the secondary supply of fuel reduces the carbon dioxid formed in such complete combustion of the primary supply to form carbon monoxid, the reduction being made possible by the sensible heat of the flame gases. The amount of the air introduced with the primary fuel supply and in proximity to such supply should be as nearly as possible that requisite theoretically to produce complete combustion of such fuel without excess. The air should be heated and the flame should be produced in a hot-walled chamber to compensate for the slackening of combustion due to the absence of an excess of air, it being the object to produce as quick and hot combustion as possible. For this reason it is not ordinarily desirable to dilute the air used with the primary coal or fuel supply with endothermic agents such as products of combustion or steam. With a flame burning with heated air in an intensely heated flame chamber having walls of refractory material, no excess of air is ordinarily necessary.

Where high-carbon fuel such as anthracite or charcoal or coke is used both for primary and secondary fuel supply, the amounts of such primary and secondary fuel should be substantially equal since one atom of carbon burning to carbon dioxid requires one atom to reduce the dioxid to monoxid, but where a low-carbon fuel, such as soft coal or oil, is used in the secondary supply and the object is to produce a rich gas, the amount of such secondary supply should be somewhat varied, the secondary supply being adjusted until a rich gas practically free from tar is delivered at the outlet. It is not usually desirable to introduce the secondary fuel in aerial suspension, though this may be done if but a limited quantity of air be used. High-pressure steam or compressed endothermic gases containing CO_2, such as products of combustion or lime kiln gases, may be employed. Such endothermic carriers allow a slight increase in the amount of the secondary fuel supply and the formation of a richer gas, the excess of heat in the flame gases coming from the flame of the primary supply of fuel being utilized in the well understood way to furnish some hydrogen or further carbon monoxid as the case may be. Naturally, the amount of the endothermic body introduced proportionately to the amount of the secondary fuel should be capable of adjustment.

The object is to produce complete combustion, or substantially complete combustion, of the primary fuel to form carbon dioxid or carbon dioxid and water vapor and produce great heat, and the subsequent reduction of the flame gases by the secondary fuel supply to form inflammable gases.

In the accompanying illustration I have shown, more or less diagrammatically, certain types of apparatus of the many adapted to perform the described process.

In this showing Figure 1 shows a vertical section of one form of gas producer according to the present invention; Fig. 2 is a horizontal section of the same, showing a tangential arrangement of the coal dust feed; Fig. 3 is a vertical section of an alternative form of producer showing the fine fuel feed arranged to produce a baffled flame; Fig. 4 is a detail showing a form of ash bed; Fig. 5

is a plan view of the same; and Fig. 6 is another alternative form of producer.

Taking first the form shown in Figs. 1 and 2, 1 is the producer chamber. It has a comparatively wide base chamber narrowing to a constriction at 2. Midway of the wider portion are two or more coal injection nozzles 3, set tangentially to the chamber (see Fig. 2), and fed from hoppers 4 by means of jet nozzles 5, supplied with compressed air from bustle pipe 6. Below this bustle pipe is another bustle pipe 7, fed from it by valved connection 8 and communicating with twyers 9 entering the producer chamber below the coal nozzles. They are also set tangentially but have a slight upward inclination. A valved auxiliary air pipe 10 is set to introduce a little air horizontally to burn any coal dropping on the ash accumulation 11. At its base, the producer is shown set in water seal 12. Near the constriction in the producer chamber are the inlets 13 for the secondary fuel supply (here shown as adapted to be fed with coal from hoppers 14 by means of a wire drawn steam jet from steam pipe 15). Above this again is gas flue 16, provided with a dust settling and collecting chamber 17 having a depending baffle 18, dust door 19 and air heating coils 20. Hot air from these heaters is taken by pipe 21 and fan 22 to the bustle pipes.

Fig. 3 is substantially the same as Fig. 1, save that the nozzles for the primary and secondary fuel supplies are set to produce baffling jets, the primary fuel nozzles 3 being given somewhat of an upward tilt to produce meeting and baffling flames. Auxiliary air supply pipes or twyers 9 are set more nearly horizontal.

In the detail view of Fig. 4, the producer is provided with a perforated base, the perforations 23 constituting ash pits and being set in circular arrangement so that the spiral current of air from twyers 9 may sweep accumulating ash from central portion 24.

Fig. 6 shows an alternative method of introducing the air necessary to burn the primary fuel supply, an auxiliary set of twyers 25 being arranged above the primary fuel nozzles. In this figure, also, the secondary fuel is shown introduced by hopper 26, provided with bell closure 27.

In the arrangement shown in Figs. 1 and 2, the coal enters tangentially and forms a whirling, vertically developed flame. As however, it is inconvenient to introduce the full amount of air needed for combustion with the powdered coal, the residue necessary for fuel combustion is sent in at the twyers 9. These twyers are so set that the auxiliary air forms a vortex immediately below the powdered coal, supporting and burning it. The whirling flame extends upward some distance in the form of a reversed funnel but before the intensely hot flame gases arrive at constriction 2 combustion is completed. At or near the constriction, where mixture of the gases is complete, finely divided coal or oil is distributed into the hot flame gases, reducing the carbon dioxid to carbon monoxid and, with soft coal or with oil, adding some distilled gas. As shown, the secondary fuel is introduced by the aid of a steam jet. As the heat of the primary flame gases is much more than sufficient to insure reduction by the secondary fuel, the excess of heat allows the reduction of some steam by the secondary fuel, thus adding a little hydrogen. Lime kiln gases or products of combustion or other gas rich in carbon dioxid may be used in lieu of steam.

In the arrangement of Fig. 3, the primary fuel enters to form baffling flame jets, meeting centrally and producing a turmoil of flame. The secondary fuel may be oil or tar introduced through pipes 28 by steam jets 29. The air from the twyers 9 forms a vortex below the baffled flames, aiding substantially in producing the desired turmoil of flame.

In the arrangement of Fig. 6, the tangentially produced flames form a vortex as before, being burned and supported by the air from twyers 9, but additional twyers 25 above the flame body are provided to control the upward sweep of the flame and insure complete combustion prior to reaching the constriction 2. The sides of the producer chamber in this figure are curved to form a chamber of elliptical cross section, narrowing rapidly above, a chamber of this section being particularly well adapted to form the vortex flame desired. The chamber above the constriction is again expanded so that the violent rush of gases through such constriction slackens down somewhat. In the constriction, the flame gases are very thoroughly mixed and stratification destroyed. In the chamber above the constriction, powdered coal is introduced through the bell and hopper, sifting down through the hot flame gases and reducing the same until it reaches the strong upward current through the constriction and tends to float until entirely consumed.

With all constructions, the amount of air introduced with and in proximity to the primary fuel supply should be in total amount just about that sufficient theoretically to burn such fuel, producing complete combustion. While the theoretical amount of air in furnaces of the usual construction is not ordinarily deemed sufficient to produce a rapid and intense combustion, with the flame of the character described burning with hot air in a hot walled chamber of refractory material under the influence of radiant heat combustion is sufficiently rapid. With fuel rich in carbon, such as charcoal, the secondary fuel supply should be nearly exactly the same in amount as that primarily supplied plus an amount sufficient to reduce any steam or other endothermic body which may be introduced with such secondary fuel. With fuels richer in hydrogen used in the secondary supply, the amount in each case must be determined by experiment, the supply being gradually increased until the CO_2 in the effluent gas reaches a minimum figure and tar begins to increase. As a rough rule however, it may be said that enough fuel should be used in the secondary supply to give an amount of "fixed carbon" about equivalent to the fuel value of the coal used in the primary supply.

The gas produced is washed and scrubbed in the usual manner if it is to be stored. When it is desired to produce by-products such as ammonia, benzol, etc., the ordinary condensing devices may be used. In such cases, the amount of fuel primarily introduced may be much reduced, only sufficient being employed to institute and maintain a powerful flame, while the secondary supply is correspondingly increased. Operating in this manner, the action near the secondary supply when using rich soft coals is largely destructive distillation, the hydrocarbons distilling off and leaving finely divided coky carbon which reduces the upflowing gases as it sifts therethrough and finally burns completely in the flame formed of the primary fuel.

What I claim is:—

1. The process of producing gas which comprises forming a flame of finely divided suspended fuel in the presence of substantially enough air to cause complete combustion, and subsequently distributing a further supply of finely divided fuel in the hot flame gases.

2. The process of producing gas which comprises forming a flame of finely divided suspended fuel in the presence of substantially enough air to cause complete combustion, and subsequently distributing sufficient fine fuel through the hot flame gases to cause a reduction of the carbon dioxid to monoxid.

3. The process of producing gas which comprises forming a jet flame of finely divided fuel in an inclosed chamber, introducing sufficient air in proximity to said flame to cause combustion, and subsequently distributing finely divided fuel through the hot flame gases.

4. The process of producing gas which comprises forming a jet flame of finely divided fuel in an inclosed chamber, said fuel being in aerial suspension, introducing sufficient air to complete the combustion immediately below said jet flame and subsequently distributing finely divided fuel through the hot gases coming from such flame.

5. The process of producing gas which comprises forming a plurality of coöperating jet flames of finely divided suspended fuel in a closed chamber, introducing sufficient air to complete the combustion in such manner as to aid in maintaining the suspension of such fuel, and subsequently distributing finely divided fuel through the hot gases coming from such flame.

6. The process of producing gas which comprises forming a jet flame of finely divided suspended fuel in a closed chamber in the presence of sufficient air for complete combustion and subsequently distributing through the hot flame gases sufficient fuel to reduce the carbon dioxid formed.

7. The process of producing gas which comprises forming a jet flame of finely divided suspended fuel in a closed chamber in the presence of sufficient air for complete combustion and subsequently distributing through the hot flame gases fuel carried by an endothermic body, said secondary fuel being sufficient in amount to reduce the carbon dioxid formed and also to reduce said endothermic body.

8. The process of producing gas which comprises forming a jet flame of finely divided suspended fuel in a closed chamber in the presence of sufficient air for complete combustion and subsequently distributing through the hot flame gases fuel carried by a steam jet, said secondary fuel being sufficient in amount to reduce the carbon dioxid formed and also to reduce said steam.

9. The process of producing gas which comprises forming a vertically developed intensely hot flame within a closed chamber by a tangentially introduced jet flame of suspended finely divided fuel burning in the presence of substantially enough air to cause complete combustion, distributing a further supply of finely divided fuel through the flame gases and collecting the resultant combustible gas for use.

10. The process of producing gas which comprises forming a vertically developed intensely hot flame within a closed chamber by a plurality of coöperating tangentially introduced jet flames of suspended finely divided fuel burning in the presence of substantially enough air to cause complete combustion, distributing a further supply of finely divided fuel through the flame gases and collecting the resultant combustible gas for use.

In testimony whereof, I affix my signature in the presence of two witnesses.

BYRON E. ELDRED.

Witnesses:
E. D. KNOWLES,
A. M. SENIOR.