No. 798,239. PATENTED AUG. 29, 1905.

G. WALZEL.

APPARATUS FOR PRODUCING CARBONIC ACID.

APPLICATION FILED AUG. 10, 1904.

3 SHEETS—SHEET 1.

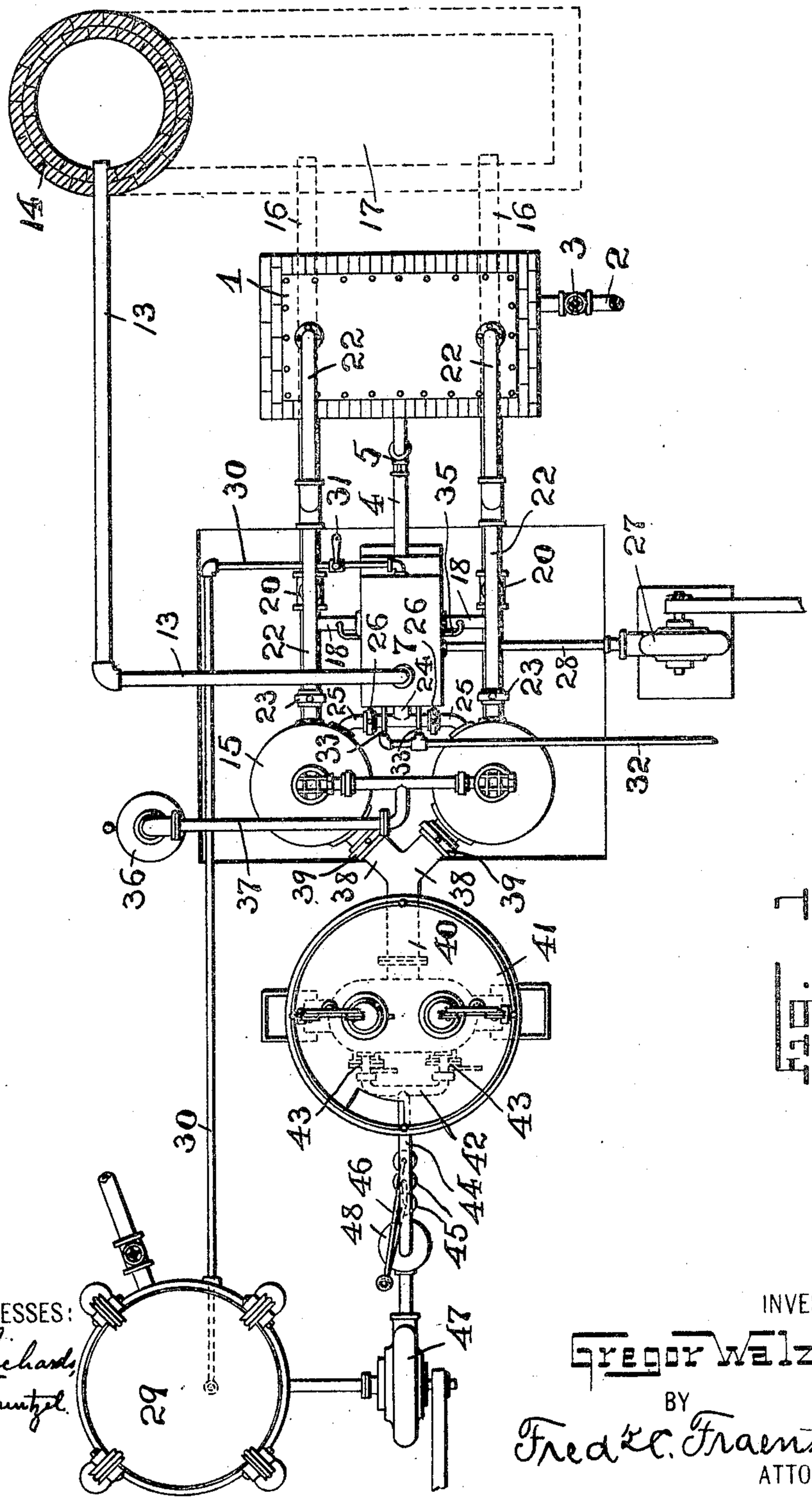

Fig. 1

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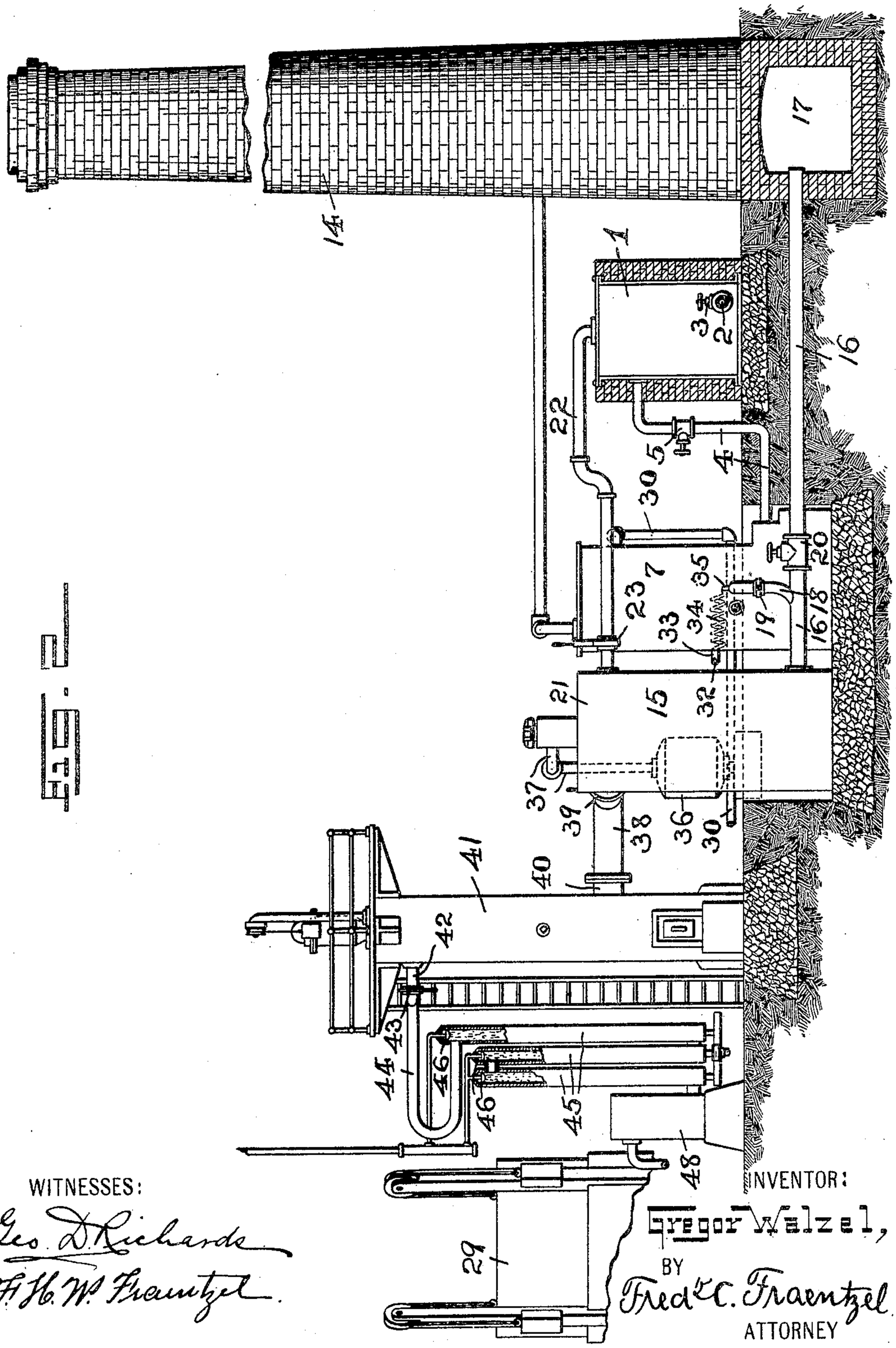

Fig. 2.

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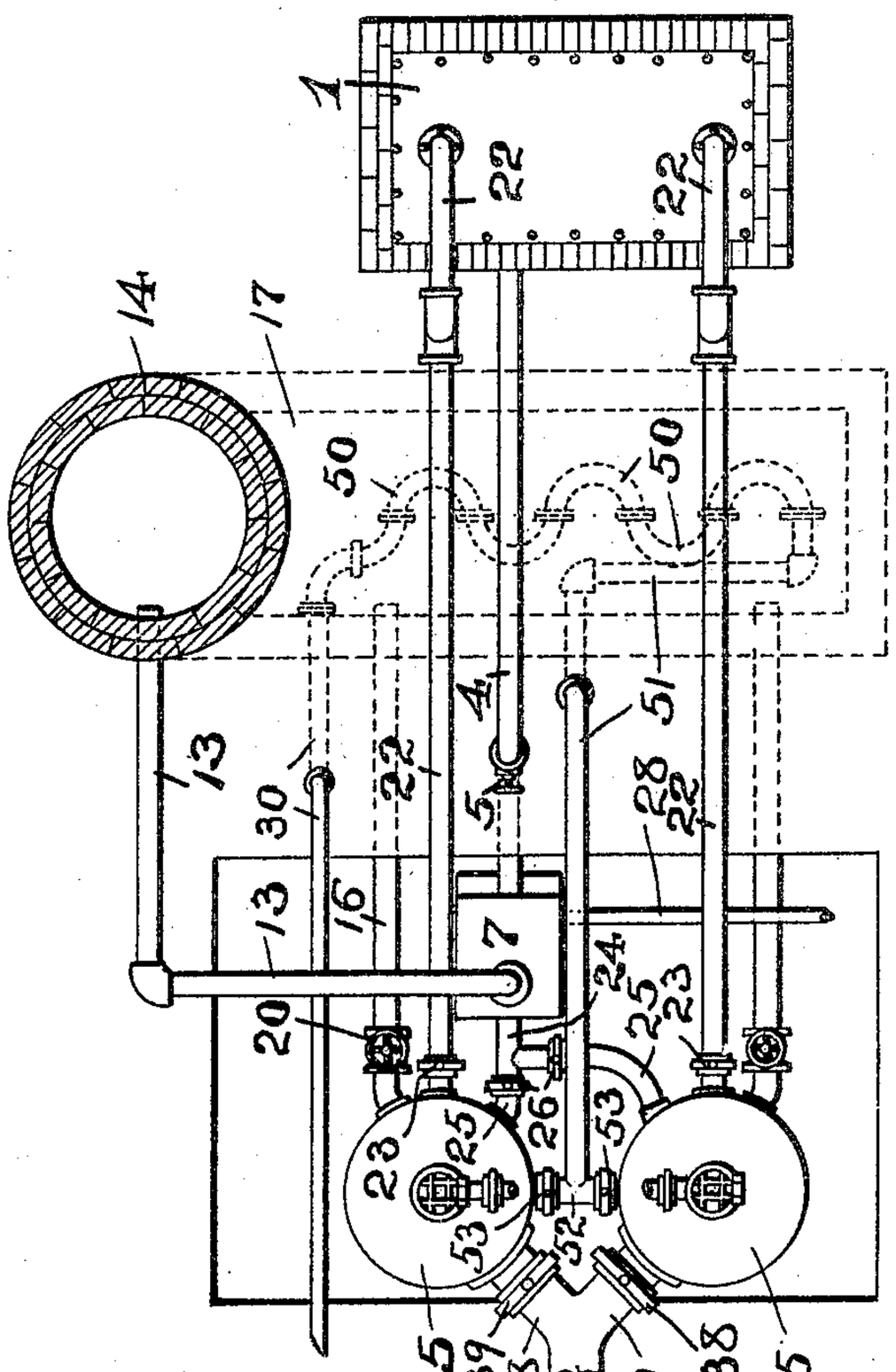

FIG. 4.

FIG. 3.

FIG. 5.

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APPARATUS FOR PRODUCING CARBONIC ACID.

No. 798,239. Specification of Letters Patent. Patented Aug. 29, 1905.

Application filed August 10, 1904. Serial No. 220,186.

To all whom it may concern:

Be it known that I, GREGOR WALZEL, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Apparatus for Producing Carbonic Acid; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form a part of this specification.

The present invention has reference to a novel apparatus for the manufacture of carbon dioxid from limestone; and this invention has for its principal objects to provide a new and improved means for the manufacture of carbon dioxid and lime in a simple and economical manner.

The invention has for its further object to provide a novel apparatus or plant comprising two or more regenerative furnaces burning producer-gas and a double-shaft reducing-furnace, both the said regenerators and shafts of the furnace being preferably water-sealed and all combined with a gas-producer, a hot-blast apparatus or device, a main carbon-dioxid receiver or holder, and systems of connecting pipes or ducts between the various devices and apparatus, all arranged that carbon dioxid can be produced uninterruptedly by carrying the gases first through the one regenerator and then into and through the limestone in the one shaft of the reduction-furnace for the calcining of the limestone to produce carbon dioxid and lime, while the heat from the active shaft of the reduction-furnace by radiation preheats the other shaft of the reduction-furnace to be ready for active work as soon as the reduction in the first-mentioned shaft of the furnace has taken place.

The method of operation may briefly be described as follows: One of the regenerators is heated to a temperature of, say, 1,000° centigrade or over, when the gas and air are shut off, the valve in the stack connection closed, and the connection leading into the one shaft of the reduction-furnace is opened. Carbon dioxid from the main carbonic receiving tank or reservoir is then passed through a hot-blast device or apparatus, where its temperature is raised to about 500° centigrade, then into and through one of the regenerators, where its temperature is further increased to 1,000° or 1,200° centigrade, the said regenerators being lined with such materials which will absorb and retain a great amount of heat, and then into one of the shafts of the reduction-furnace and through the limestone therein. At a temperature of 500° centigrade the limestone begins to give off carbon dioxid, which is drawn, by means of a suction-blower, pump, or other apparatus, through a suitable condenser, consisting, preferably, of iron pipes of large diameters and having sprays of water inside of the same. These sprays of water are so regulated that when the water comes in contact with the carbon dioxid the latter is sufficiently cooled that it can be forced into the main receiver or reservoir, from which the carbon dioxid can be withdrawn to be dried, compressed, and put into steel drums or other suitable vessels for the market. Meanwhile the other regenerator is being heated in the manner hereinafter stated, the second shaft of the reduction-furnace being preheated by radiation from the other previously-heated shaft of the reduction-furnace, and when the apparatus and devices in use begin to cool a shift is made by means of suitable valves, and the said other heated regenerator is utilized in connection with the second and preheated shaft of the reduction-furnace. The other regenerator is again reheated and the first shaft of the reduction-furnace replenished with a fresh supply of limestone and then preheated by radiation from the other shaft in operation. In order to facilitate the development of carbon dioxid in the reduction-furnace, superheated steam is admitted into the regenerator along with the carbon dioxid taken from the main carbonic-acid receiving tank or reservoir, and is thus carried through the regenerator and into the lime-reduction furnace. After the gas and air supply are shut off in one regenerator the carbon dioxid from the hot-blast device or chamber is blown through it for a short time to drive out the burned gases before opening the valve connecting with the lime-reduction furnace. Thus nothing but carbon dioxid and steam enter the furnace.

The hoppers at the top and the sliding valves at the bottom of the reduction-furnace are so arranged that the limestone can be

charged into the shafts of the furnace and the lime drawn out without the admission of atmospheric air.

The invention consists in the novel apparatus or plant for the manufacture of carbon dioxid from limestone hereinafter more particularly specified, and finally embodied in the clauses of the claim which are appended to and form an essential part of this specification.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view of an apparatus and devices showing the embodiment of the present invention, and Fig. 2 is a part elevation and part sectional representation of the same. Fig. 3 is a vertical section of a hot-blast apparatus, on an enlarged scale, adapted for heating the carbonic acid and also the air which are passed into the regenerators. Fig. 4 is a detail plan of a portion of the apparatus and devices embodying the principles of this invention in which the supply of carbonic acid from the main reservoir is raised to its proper temperature by being passed through a system of piping heated from the waste products in the flue connection with the stack of the plant, and Fig. 5 is a sectional representation of a hot-air-blast device to be used with the system shown in said Fig. 4.

Similar characters of reference are employed in the above-described figures of the drawings to indicate corresponding parts.

Referring now to Figs. 1, 2, and 3 of the drawings, the reference character 1 indicates a suitable gas-producer, provided with an inlet pipe or duct 2, having a valve 3. The producer-gas is fed from the said gas-producer 1 through a pipe 4, in which there is a valve 5, into an inlet 6 of a hot-blast apparatus or device 7, the gas passing into a combustion-chamber 8 of said device or apparatus 7, where it is mixed with atmospheric air entering the said chamber 8 through an inlet 10 and ignited beneath a pair of systems of coils 11 and 12 within said apparatus or device 7, substantially as illustrated in Fig. 3 of the drawings. The products of combustion after passing between the said coils 11 and 12 enter an exhaust-pipe 13, connected with the said apparatus or device 7 and with a stack 14, whence they escape from said stack into the open air. The reference character 15 indicates a pair of regenerators of any suitable and well-known construction, the lower or bottom portion of each regenerator having connected therewith a pipe or flue 16, leading into the chimney or stack flue 17, substantially in the manner illustrated. Connected with the lower and outlet portions 9 of the coils 11 within the hot-blast apparatus or device 7 and extending from the opposite sides of said apparatus or device 7 are pipes 18, each pipe 18 being provided with a valve 19 and terminating in a pipe or flue 16 and each pipe or flue 16 being also provided with a valve or shut-off 20 at a point between the junction of said pipes 18 with the pipes or flues 16 and the chimney or stack flue 17. Connected with the upper or dome portion 21 of each regenerator 15 is a gas-conveying pipe 22, provided with a suitable valve 23 in each pipe 22 and each pipe being in suitable communication with the gas-producer 1. Extending from the upper end or outlet portion of the coils 12 is a pipe 24 and connecting-pipe 25, provided with a pair of valves 26, substantially as illustrated in Fig. 1 of the drawings, the said connecting-pipe 25 being connected at its free ends with the upper or dome portions 21 of the respective regenerators 15 for bringing heated air from the coils 12 in the hot-blast apparatus or device 7 to either regenerator 15, as will be clearly evident. This air is forced, by means of a blower 27 or other suitable apparatus, through a pipe 28 into the said coil 12. The main carbonic-acid receiver or reservoir is indicated by the reference character 29, the same being of any usual and well-known construction, and connected with the said receiver or reservoir is a pipe 30, in which there may be a valve 31, the said pipe 30 extending into the hot-blast apparatus or device 7 and being connected with the coils 11 for conducting charges of carbonic acid from the said main receiver or reservoir 29 through the said coils 11 to be heated and then fed through the pipes 18 and portions of the pipes or flues 16, the valves or shut-offs 20 being closed, into the respective generators 15. A mixture of superheated steam and carbonic acid is produced by means of a steam-conveying pipe 32, having two branches 33 extending into the hot-blast apparatus or device 7, where these branches are made in the shapes of coils 34 for superheating the steam and then terminate in end pipes 35, which extend from the said apparatus or device 7 and are respectively connected with the respective pipes 18 on opposite sides of the said apparatus or device 7, as shown, to conduct the superheated steam directly into the heated carbonic acid before it is delivered into either regenerator 15. A water seal 36 and piping 37 may be connected with the regenerators, this construction and arrangement of water seal, however, forming the subject-matter of another application for Letters Patent filed by myself August 12, 1904, Serial No. 220,483, and allowed December 19, 1904. Extending from the upper or dome portion of the regenerators 15 are conveyer-pipes 38, each pipe being provided with a valve 39 and terminating in a main pipe 40, which is connected with the lower portion connecting two shafts of a reducing-furnace 41.

The general construction of this furnace 41 and water seals employed therewith forms the subject-matter of still another application for

Letters Patent filed by myself August 12, 1904, Serial No. 220,482, and allowed November 18, 1904, and need, therefore, not be described in detail at this time. Suffice it to say, however, that when the shafts of the said double-shaft reducing-furnace 41 are charged with the limestone the carbon dioxid and steam can be made to enter either shaft of the furnace for calcining the limestone in an atmosphere of carbon dioxid.

The carbon dioxid which is given off from the limestone is removed from the double-shaft furnace at the upper part of each shaft through the piping 42, having a pair of valves 43 and connected by means of a pipe 44 to a suitable condenser 45, comprising a series of pipes provided with sprayers 46 on the inside. When the hot carbon dioxid comes in contact with the sprays of water from said sprayers, the supply of water is so regulated that there is no excess of water, and the carbonic acid will be properly cooled. The carbonic acid is then forced, by means of a suction-blower, pump, or other suitable apparatus 47, preferably into a balancing tank or holder 48, and then into the main carbonic-acid-receiving tank or reservoir 29, heretofore mentioned, from which the main bulk of the carbon dioxid is drawn, and then dried, compressed, and put in steel drums or other suitable vessels for the market, a portion of the carbon dioxid when the plant is in operation always being drawn through the pipe 30 into the coils 11 to be heated in the blast apparatus or device 7 in the manner and for the purposes above described. Instead of leading the carbonic-acid-conveying pipe 30 into a hot-blast apparatus containing a heating-coil 11 this pipe 30, as will be seen from an inspection of Fig. 4 of the drawings, may be led directly into the chimney or stack flue 17, being arranged in the form of a coil 50 in said flue and terminating in a pipe 51, which extends from the said flue, substantially as illustrated. This pipe 51 is connected by means of the branch pipe 52, having a pair of valves 53 therein, directly with the respective regenerators 15. In all other respects the arrangement of the remaining devices and parts of the apparatus is the same as that previously described, except that the hot-blast apparatus or device contains but the hot-air coils 12, as clearly indicated in Fig. 5 of the drawings. Thus the carbonic acid to be conducted to the regenerators is heated from the waste gases and hot air in the flue 17.

In working the apparatus represented in the several figures of the drawings one of the regenerators is heated to a temperature of, say, 1,000° centigrade or over by admission of gas with sufficient atmospheric air from the chamber 8 and coil 12 for combustion into the dome or upper part of the regenerator, the valve connection with the other regenerator and the valve in the furnace flue or pipe 16 being both closed. After the regenerator has been properly heated hot air from the coils 12 in the apparatus or device 7 is forced into the dome of the regenerator, and by opening the valve 20 in the pipe or flue 16 the burned gases are forced from the said regenerator through the said pipe or flue into the stack-flue 17. After a time the valve 20 in the pipe 16 is again closed and the valve 19 in the pipe 18, connected with said heated regenerator, opened. Carbon dioxid from the reservoir 29 is passed into and through the coils 11 of the hot-blast apparatus or device 7 and by means of the pipes 18 and 16 into the lower portion of the regenerator 15, where its temperature is further increased to 1,000° or 1,200° centigrade, steam being admitted in the manner as above stated. The mixture of preheated carbon dioxid and steam is then admitted into one of the shafts of the reduction-furnace 41 through the pipes 39 and 40, the other regenerator 15 being shut off by the closing of one of the valves 39 in the pipe 38. The limestone in the furnace 41 next gives off carbon dioxid, which is drawn from said furnace in the manner previously described and finally collected in the main receiver or reservoir 29. Meanwhile the other regenerator and the other shaft of the reduction-furnace 41 are being preheated in the manner previously stated, and when the regenerator and the said shaft of the furnace just in use begin to cool a shift is made by properly closing and opening the various valves, and the preheated regenerator and other shaft of the furnace 41 are utilized, while the first-used regenerator and shaft of the reduction-furnace are again reheated, thus using the regenerators and shafts of the reduction-furnace 41 alternately and insuring a simple and inexpensive arrangement of apparatus and devices which is very complete in its work and provides a process of producing carbon dioxid which is continuous during the operations of the plant.

Having thus described my invention, what I claim is—

1. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a regenerator, a means of communication between the said regenerator and each shaft of the reduction-furnace, devices in said means of communication for shutting off the regenerator from either of said shafts of the furnace, a hot-blast device, a means of communication between said hot-blast device and the regenerator, mechanism in said means of communication for shutting off the regenerator from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerator, means for conducting carbonic acid into said hot-blast device to be heated therein, and

means for conducting the heated carbonic acid to said regenerator, substantially as and for the purposes set forth.

2. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a pair of regenerators, a means of communication between the said regenerators and said double-shaft furnace, devices in said means of communication for shutting off either of said regenerators from said reduction-furnace, a hot-blast device, a means of communication between said hot-blast device and said pair of regenerators, devices in said means of communication for shutting off either of the regenerators from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerators, means for conducting carbonic acid into said hot-blast device to be heated therein, and means for conducting the heated carbonic acid to either of said regenerators, substantially as and for the purposes set forth.

3. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a pair of regenerators, a means of communication between the said regenerators and said double-shaft furnace, devices in said means of communication for shutting off either of said regenerators from said reduction-furnace, a hot-blast device, a means of communication between said hot-blast device and said pair of regenerators, devices in said means of communication for shutting off either of the regenerators from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerators, means for conducting carbonic acid into said hot-blast device to be heated therein, means for conducting the heated carbonic acid to either of said regenerators, and means for conducting steam into the said carbonic-acid-conducting means between the hot-blast device and the said regenerators, substantially as and for the purposes set forth.

4. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a pair of regenerators, a means of communication between the said regenerators and said double-shaft furnace, devices in said means of communication for shutting off either of said regenerators from said reduction-furnace, a hot-blast device, a means of communication between said hot-blast device and said pair of regenerators, devices in said means of communication for shutting off either of the regenerators from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerators, means for conducting carbonic acid into said hot-blast device to be heated therein, means for conducting the heated carbonic acid to either of said regenerators, and steam-pipes leading into said hot-blast device and extending therefrom, said steam-pipes being connected with the said carbonic-acid-conducting means between the hot-blast device and the said regenerators, substantially as and for the purposes set forth.

5. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a regenerator, a means of communication between the said regenerator and each shaft of the reduction-furnace, devices in said means of communication for shutting off the regenerator from either of said shafts of the furnace, a hot-blast device, a means of communication between said hot-blast device and the regenerator, mechanism in said means of communication for shutting off the regenerator from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerator, a condenser and a main receiver, means between the reduction-furnace, condenser and receiver for drawing the carbonic acid generated through said condenser and into said main receiver, means between said main receiver and said hot-blast device for conducting a portion of the carbonic acid to said hot-blast device to be heated therein, and means for conducting the heated carbonic acid to said regenerator, substantially as and for the purposes set forth.

6. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a pair of regenerators, a means of communication between the said regenerators and said double-shaft furnace, devices in said means of communication for shutting off either of said regenerators from said reduction-furnace, a hot-blast device, a means of communication between said hot-blast device and said pair of regenerators, devices in said means of communication for shutting off either of the regenerators from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerators, a condenser and main receiver, means between the reduction-furnace, condenser and receiver for drawing the carbonic acid generated through said condenser and into said main receiver, means between said main receiver and said hot-blast device for conducting a portion of the carbonic acid to said hot-blast device to be heated therein, and means for conducting the heated carbonic acid to either of said regenerators, substantially as and for the purposes set forth.

7. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a pair of regenerators, a means of communication between the said regenerators and said double-shaft furnace, devices in said means of communication for shutting off either of said regenerators from said reduction-furnace, a hot-blast device, a means of communication between said hot-blast device and said pair of regenerators, de-

vices in said means of communication for shutting off either of the regenerators from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerators, a condenser and main receiver, means between the reduction-furnace, condenser and receiver for drawing the carbonic acid generated through said condenser and into said main receiver, means between said main receiver and said hot-blast device for conducting a portion of the carbonic acid to said hot-blast device to be heated therein, means for conducting the heated carbonic acid to either of said regenerators, and means for conducting steam into the said carbonic-acid-conducting means between the said hot-blast device and the said regenerators, substantially as and for the purposes set forth.

8. In an apparatus for producing carbonic acid, the combination, of a double-shaft reduction-furnace, with a pair of regenerators, a means of communication between the said regenerators and said double-shaft furnace, devices in said means of communication for shutting off either of said regenerators from said reduction-furnace, a hot-blast device, a means of communication between said hot-blast device and said pair of regenerators, devices in said means of communication for shutting off either of the regenerators from said hot-blast device, means for conducting a producer-gas into said hot-blast device and into said regenerators, a condenser and main receiver, means between the reduction-furnace, condenser and receiver for drawing the carbonic acid generated through said condenser and into said main receiver, means between said main receiver and said hot-blast device for conducting a portion of the carbonic acid to said hot-blast device to be heated therein, means for conducting the heated carbonic acid to either of said regenerators, and steam-pipes leading into said hot-blast device and extending therefrom, said steam-pipes being connected with the said carbonic-acid-conducting means between the hot-blast device and the said regenerators, substantially as and for the purposes set forth.

In testimony that I claim the invention set forth above I have hereunto set my hand this 6th day of August, 1904.

GREGOR WALZEL.

Witnesses:
FREDK. C. FRAENTZEL,
GEO. D. RICHARDS.