(No Model.) 3 Sheets—Sheet 1.

L. STEVENS & L. STEVENS, Jr.

GAS GENERATOR.

No. 563,892. Patented July 14, 1896.

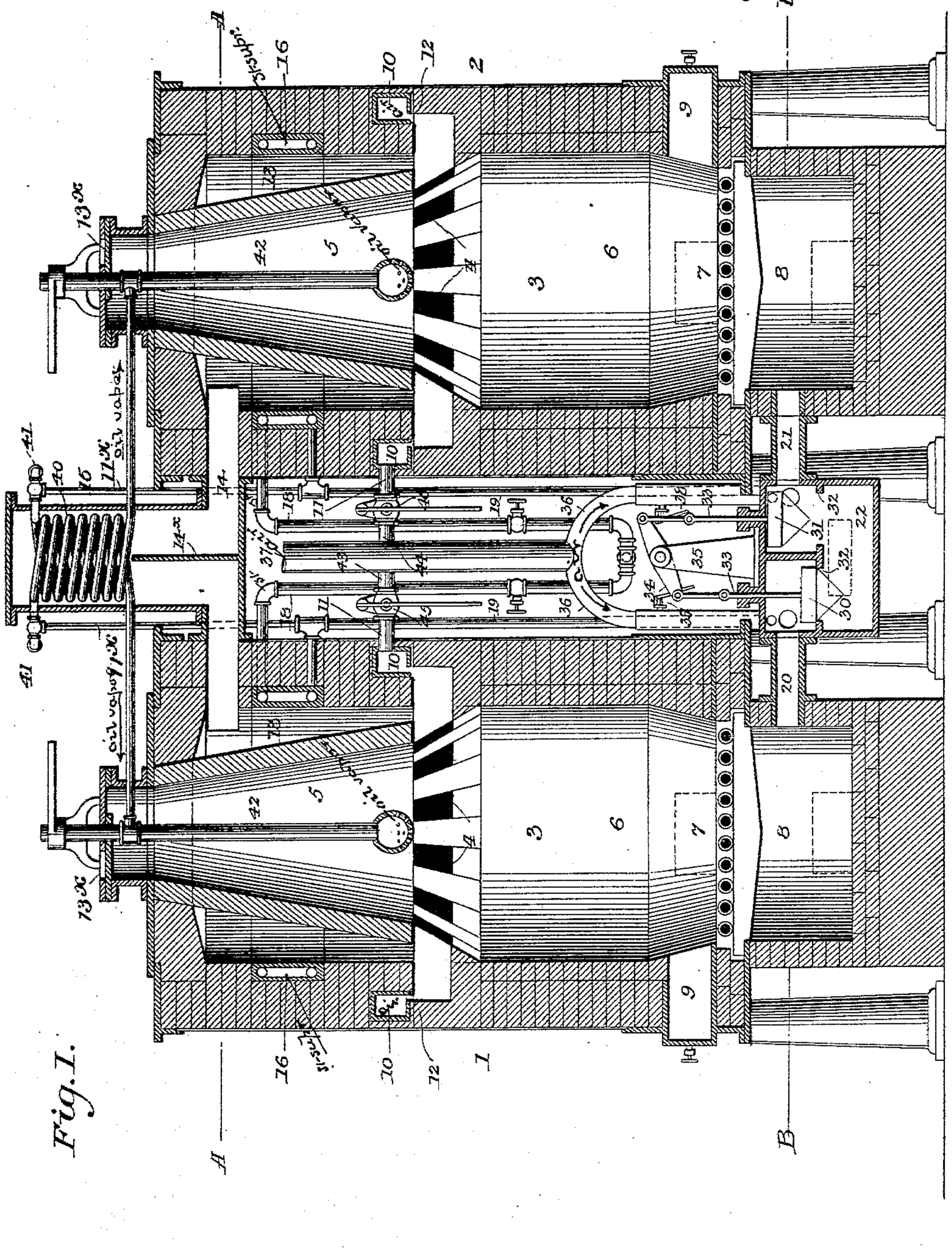

Fig. I.

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Fig. 2.
on line B-B.

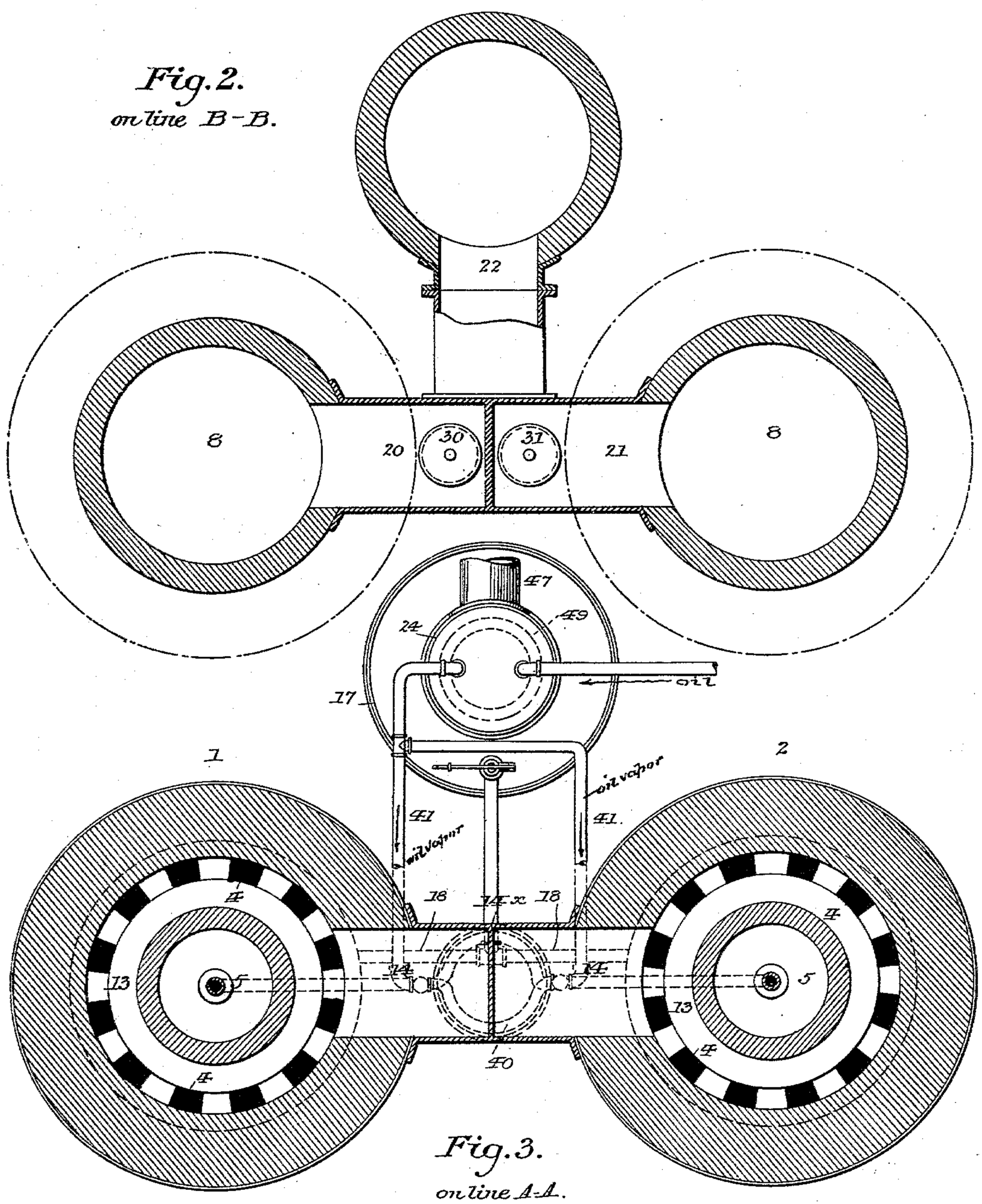

Fig. 3.
on line A-A.

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GAS GENERATOR.

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Fig. 4.

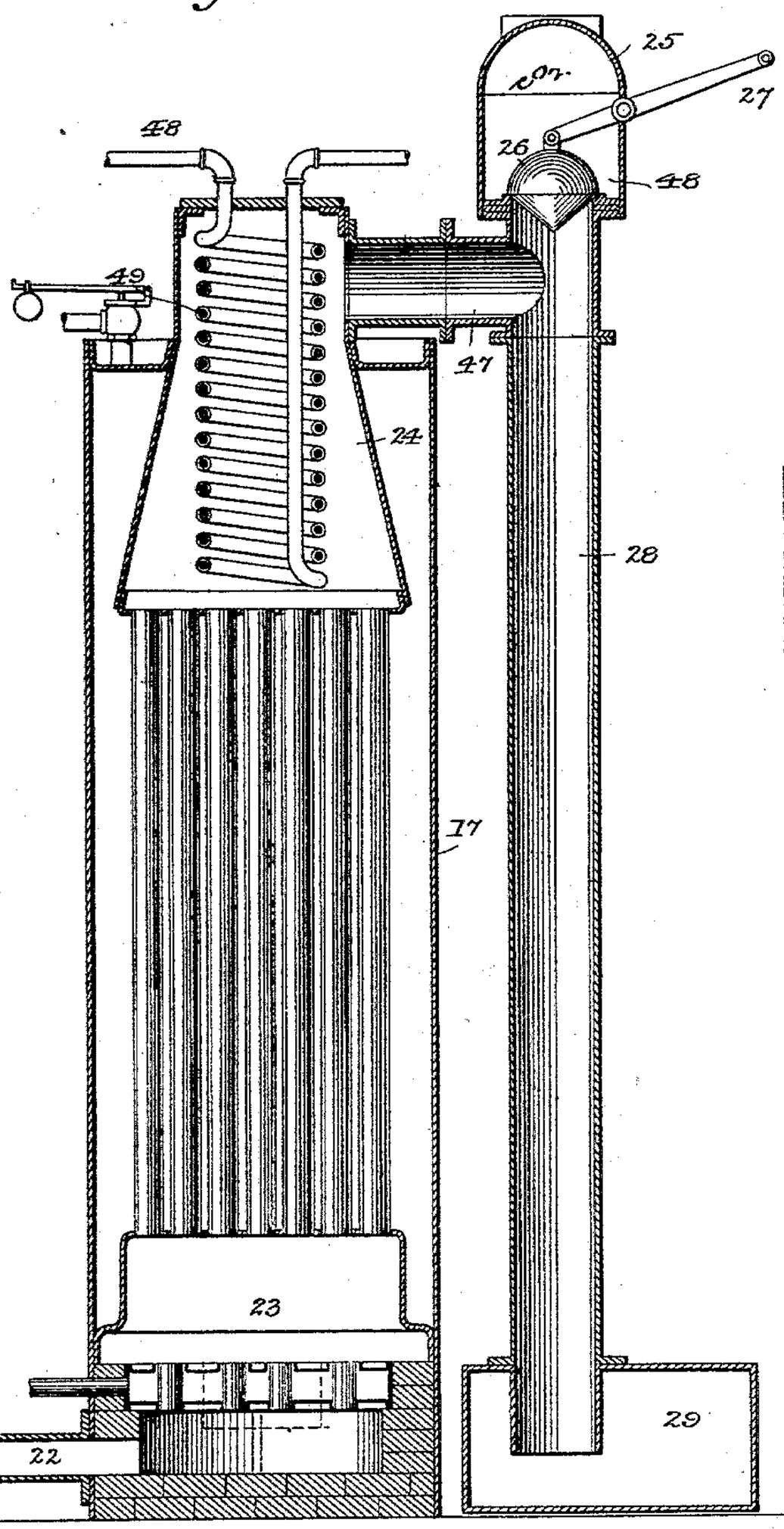
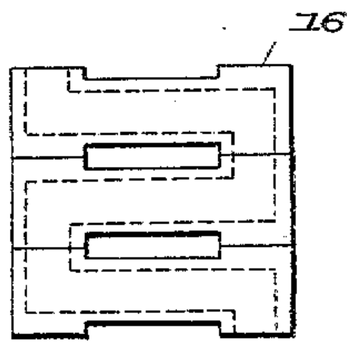


Fig. 5.



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UNITED STATES PATENT OFFICE.

LEVI STEVENS AND LEVI STEVENS, JR., OF TRENTON, NEW JERSEY.

GAS-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 563,892, dated July 14, 1896.

Application filed April 6, 1894. Renewed December 13, 1895. Serial No. 572,043. (No model.)

To all whom it may concern:

Be it known that we, LEVI STEVENS and LEVI STEVENS, Jr., of Trenton, county of Mercer, and State of New Jersey, have invented a new and useful Improvement in Gas Apparatus, of which the following is a specification.

Our invention relates to gas-generators, and has reference more particularly to the generation of oil and water gases. In the generation of gases of this description by the processes and apparatuses heretofore employed, as far as we are aware, there has been a considerable loss of energy owing to the heat abstracted from the coal by the steam introduced into the charge, and difficulty has been encountered by reason of the failure of the steam to be wholly decomposed and the oil-vapor to be retorted to a fixed gas, the result being that the steam and the oil are carried along mechanically until the scrubbers or purifiers are reached, where their condensation will take place. The present invention is designed to overcome these objectionable features incident to the imperfect operations of the processes and apparatuses as pointed out; and the invention comprehends an improved apparatus in which duplicate or twin generators are employed, the products of combustion and the gases generated being passed alternately in opposite directions through the same, the result being that while one generator is operating to produce the gases the other generator, previously heated by the passage of the products of combustion therethrough, will serve as a retort for the gases and will "fix" the same. When the heat in the first generator becomes insufficient to decompose the water and oil, the operation being reversed, the products of combustion from the second generator passing through the first generator will reheat the same, and the latter will serve as a retort, like in the first instance, for the gases produced by the second generator. We propose to combine with the twin generators a steam-boiler and to arrange the furnace of this boiler to receive the products of combustion from the generator and the retorted gases, and by these means to generate such steam as will be necessary for supplying the generators by the waste heat from the gases, &c.

Referring to the drawings, Figure 1 is a vertical section, partly in elevation, showing our improved gas-generating apparatus. Fig. 2 is a horizontal section through the same on a line B B. Fig. 3 is a horizontal section on line A A. Fig. 4 is a vertical section through the boiler, showing the manner in which the products of combustion and gases are introduced into the furnace and passed through the boiler. Fig. 5 is a detail.

We have illustrated in the accompanying drawings gas-generators 1 and 2 so arranged that they communicate with each other at their tops, while at their bottoms they communicate with a passage leading to a boiler-furnace, as will be more fully described hereinafter. Each of these generators is constructed of brickwork and inclosed in sheet metal, as usual. Centrally within each generator is a vertical producing-chamber 3, provided about midway of its height with a series of outlet-ports 4, which divide it horizontally into two sections 5 and 6, the lower section constituting the furnace-chamber and the upper section a reservoir and heating-chamber, through which coal descends to the furnace-chamber, and in which during its gradual descent it is heated by the ascending hot gases, as will be more fully described hereinafter.

At the bottom of the furnace-chamber are grate-bars 7, in the form of a pipe bent back and forth, the several bends constituting the grate-bars. This pipe is adapted to be supplied with water from any suitable source, and in this manner will successfully withstand the severe heat at this point in the furnace. Below the grate is a closed chamber 8, communicating with the furnace through the spaces between the grate-bars. An opening 9 leads through the base of the furnace-chamber to the outside, and affords access to the furnace for cleaning out the same, &c.

10 represents two annular chambers set up in the walls of the generators adjacent to the outlet-ports 4. Each of these chambers is provided with an inlet 11, through which air is supplied from a pipe 37, leading from any suitable source to a chamber 22, between the generators, which chamber communicates with the closed chambers 8 below the grate-

bars, as more fully described hereinafter, the entrance to the annular chambers communicating with said pipe 37 through pipes 43 and 44, which latter are provided with valves 45 and 46, as plainly shown. Each of these annular chambers has in its interior face a series of ports 12, through which the air escapes to consume the carbonic-oxid gas when the generator is being heated up.

Between the heating-chamber 5 and the surrounding brick walls of each chamber is an annular space or chamber 13, communicating at the bottom with the open space into which the ports 4 discharge. At their tops these annular chambers communicate with each other by means of a passage 14, which passage is in connection with a central chamber or dome 15, as plainly shown in Fig. 1. It will thus be seen that the two generators communicate with each other at their upper ends, so that the products of combustion and the gases pass from one to the other, and can be passed alternately in opposite directions through the generators, as will be more fully described hereinafter.

Near the top of each generator is located an annular superheater 16, which is set into the brick wall flush with the inner face of the same. Each superheater is made in sections of cast metal lined with non-oxidizable material. Each section has through it a passage, the ends of which open out through opposite ends, as represented in Fig. 5, the arrangement being such that when the sections are placed together the passages will communicate, the whole forming an endless sinuous channel.

The superheaters are supplied with steam from a boiler 17 by pipes 18, and discharge a portion of their superheated steam to the closed chamber 8 below the grates through pipes 19, as plainly shown in the drawings, the remaining portion of the superheated steam passing through vertical pipes $11^{\times}$ to pipes 41 of oil-vaporizing coils 40, more fully described hereinafter.

The two closed chambers beneath the grates communicate through pipes 20 and 21 with the passage or chamber 22, which leads to a furnace 23 beneath the boiler 17, before referred to. The products of combustion from this furnace pass upward through the tubes of the boiler to a chamber 24, communicating with a smoke-stack 25 through a lateral pipe 47, leading to a valve-chamber 48, the communication between the stack and valve-chamber being controlled by a valve 26, which is operated from the outside by a lever 27 in the customary manner. The valve-chamber communicates through a pipe 28 with a main 29. From this description it will be seen that when the valve 26 is opened, the products of combustion or gases, as the case may be, will pass upward from the furnace 23 through the boiler, the chamber 24, and thence to the stack. When the valve is closed, however, during the generation of the gas in the generators, the gas will pass through the boiler-tubes to the chamber 24, thence laterally through the pipes 47 and 28 to the main, where it is collected in the usual manner.

Where the two pipes 20 and 21, leading from the closed chambers beneath the grate, enter the common passage 22, I provide two valves 30 and 31, which are arranged to open or close the communication of the two pipes with the common passage, as desired. These valves are adapted to be seated upon valve-seats 32 at the junction of the pipes with the common passage and are provided each with vertical arms 33, which are pivoted to the opposite ends of a horizontal lever 34, which in turn is pivoted at its center to a standard 35. The arrangement is such that the two valves will rise and fall alternately as the horizontal lever is moved on its axis, the result being that when one of the valves rests on its seat and closes the communication between one of the pipes and the common passage, the other valve will be raised from its seat and the communication between the other pipe and the common passage will be opened.

Between the two generators we provide two vertical air-pipes 36, their lower ends entering the closed chambers beneath the grates of the generators, while at their upper ends they lead to the common pipe 37, before referred to, which is adapted to be connected to any suitable source of air supply. These two pipes are provided with valves 38 and 39, as plainly shown, for the purpose of controlling the admission of air to the closed chambers beneath the grates.

Within the central dome or chamber 15 with which the two generators communicate at their upper ends, we locate the two oil-vaporizing coils 40, which are connected at one of their ends by the pipes 41 to a pipe 48, leading to a coil 49 in the chamber 24, which coil is supplied with oil from any suitable source. The coils have their opposite ends extended through the sides of the dome, from which points they lead to the interior of the tops of the two heating-reservoirs of the generators. At these points they are connected to vertical pipes 42, which pass down centrally within the heating-chambers to a point well within the charge therein. At their ends the pipes are each provided with a shell or rose having perforations extending laterally and downwardly through the same for the purpose of preventing the too-rapid discharge of the vaporized oil, and for the purpose of causing the same to be discharged laterally in the surrounding incandescent coal.

The heating-chambers are provided at their upper ends with valved openings $13^{\times}$, through which the charges are introduced to about the height indicated by dotted lines in Fig. 1. The horizontal passage 14 by which communication is established between the two generators is provided at its center with a vertical partition $14^{\times}$, which serves to direct the

products of combustion or gases upward to the dome 15.

The operation of our improved apparatus is as follows: The fire being started on the grate of generator 1, valve 26 in the valve-chamber is opened to permit a direct draft, valve 30 closed, valve 31 opened, and valve 39 opened to admit air to the base of generator 1 for the purpose of blowing up the fire in the same. When the fire has been well started, the products of combustion will pass out through the ports in the base of the annular chamber in generator 1, and will rise through said chamber and pass into the passage 14 into the dome 15, thence to the top of the annular passage in generator 2. The heat from the products of combustion will heat the superheater and the coils in the dome. Continuing, they will pass through the ports in the base of the annular passage in generator 2, where they are met with a blast of air from ports 12, and pass through the charge in generator 2, heating the same to incandescence, and taking up carbon therefrom as carbonic oxid, and will pass thence through the closed chamber in the base of this generator to the common passage, whence they will enter the furnace of the boiler, where the carbonic oxid is burned. The remaining products will pass upward through the tubes of the boiler, and will be discharged from the stack. When sufficient heat has been thus generated in the charge in the generator, the admission of air to generator 1 is cut off, the valve 26 in the stack closed, and steam and oil admitted to generator 1 through the discharge-pipe 42. The oil passing through the coil in the dome is vaporized, and is discharged into the incandescent coal. The gas thus generated from the oil and steam will pass to the top of generator 1 through the communicating passage, thence downward through the incandescent charge in generator 2, which charge will act as a retort to "fix" the gas. From the base of this generator the gas will pass through pipe 21 into the common passage, thence to the furnace of the boiler, then upward through the pipes therein, converting the water in the boiler to steam, whence it will pass through the vertical pipe communicating with the valve-chamber to the main, where it is collected in the usual manner. This operation will be continued until the temperature in generator 1 becomes reduced, when the supply of steam and oil is shut off. The valve 26 is then opened again, valve 30 opened, valve 31 closed, and valve 39 opened to admit air to the base of generator 2. The products of combustion from generator 2 will pass upward into the communicating passage between the generators, from which they will pass downward through the charge in generator 1, and will reheat the same and will finally pass from the base of generator 1 to the common passage to the boiler-furnace, thence through the boiler and be discharged from the stack. When sufficient heat has thus been generated, the supply of air to the base of generator 2 is cut off by closing valve 38, the valve 26 in the stack is closed, and oil and steam are admitted to the second generator. The generation of gas will then begin, and it will pass through the communicating passage to the top of generator 1, downward through the incandescent charge therein, by which it will be retorted like in the first instance. This gas will then pass from the base of generator 1 through the common passage to the boiler-furnace, thence upward through the tubes therein to the vertical pipe, and finally to the main. The generation of gas by generator 2 will be thus continued until the heat has been reduced, when the supply of oil and steam is cut off and air admitted to the first generator to reheat the charge in the second generator. The operation is then continued as before.

It will thus be seen that the two generators are operated alternately, one acting as a retort for the gas generated by the other, and the reversal of the operations acting to reheat the generator previously operating. The operation is therefore practically a continuous one. There will be no liability of the steam and oil being carried mechanically in a partly-decomposed condition through the apparatus, and the heat from the products of combustion and the retorted gas is utilized to heat the vaporizing-coils and to generate such steam as is necessary for supplying the apparatus.

Having thus described our invention, what we claim is—

1. In a gas-producing apparatus the combination of two generators each provided with a furnace-chamber and a superposed heating-reservoir, annular inclosing chambers surrounding the heating-reservoirs and communicating at their upper ends through a passage, gas-passages forming communications between the furnace-chambers and the inclosing chambers, a common outlet-passage with which both of the generators communicate at their bases, means for controlling the communication of the generators with said outlet-passage, steam-superheaters in the inclosing chambers, oil-vaporizing coils in the communicating passage between the two inclosing chambers and suitable connections for introducing the superheated steam and vaporized oil into the gas-producing charges at the point of combustion.

2. The combination of two generators, a passage through which the generators communicate, and two oil-vaporizing coils located in said passage, said coils arranged to be connected at one end to an oil supply and having their opposite ends arranged to discharge into the generators.

3. The combination of two generators, a horizontal passage through which they communicate at their tops, a dome in communication with the horizontal passage, an oil-vaporizing coil in said dome, and a partition in

the horizontal passage; whereby the products of combustion and gases are caused to enter the dome in passing through the communicating passage.

4. The combination of two generators, a horizontal passage with which said generators communicate at their tops, a dome connected with said passage, two vaporizing-coils in said dome, supply-pipes for the coils, and discharge-pipes extending laterally through the dome to the generators.

5. The combination of two generators, a horizontal passage through which they communicate, vaporizing-coils located in said passage, vertical pipes located in said generators and arranged to discharge into the charges therein, and pipes leading from the vaporizing-coils to the vertical discharge-pipes.

6. The combination of two generators, a passage through which they communicate at their tops, vaporizing-coils located in said passage and arranged to discharge into the generators, means for supplying steam to the generators, a common outlet-passage with which both of said generators communicate, means for controlling the communication of the generators with the outlet-passage, a boiler and a furnace in communication with the outlet-passage.

In testimony whereof we hereunto set our hands, this 9th day of March, 1894, in the presence of two attesting witnesses.

LEVI STEVENS.
LEVI STEVENS, JR.

Witnesses:
PETER BACKES,
JAS. F. CLARK.