No. 807,532. PATENTED DEC. 19, 1905.

V. G. APPLE.

COKE AND GAS PLANT.

APPLICATION FILED SEPT. 10, 1903.

5 SHEETS—SHEET 1.

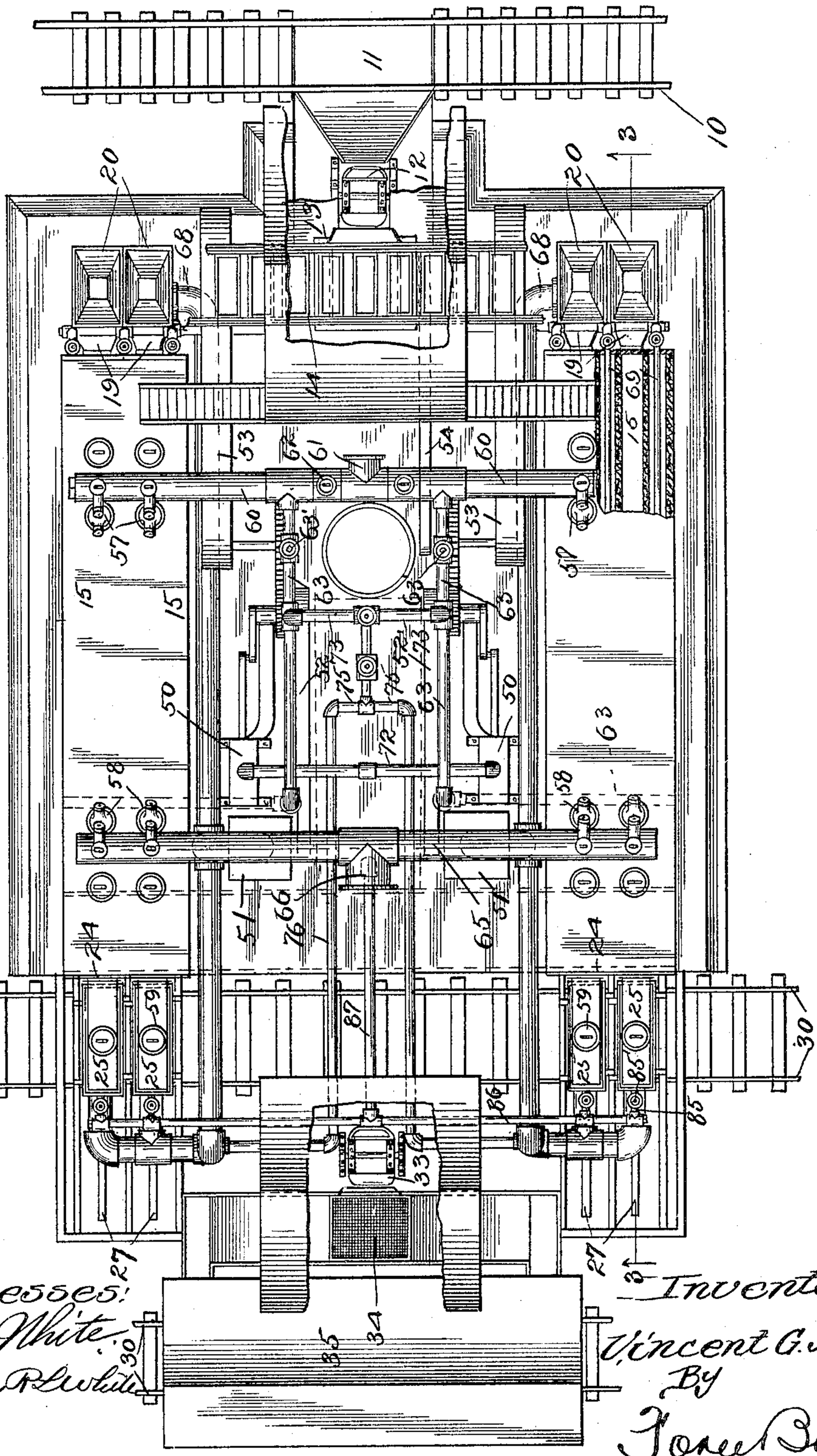

FIG. 1.

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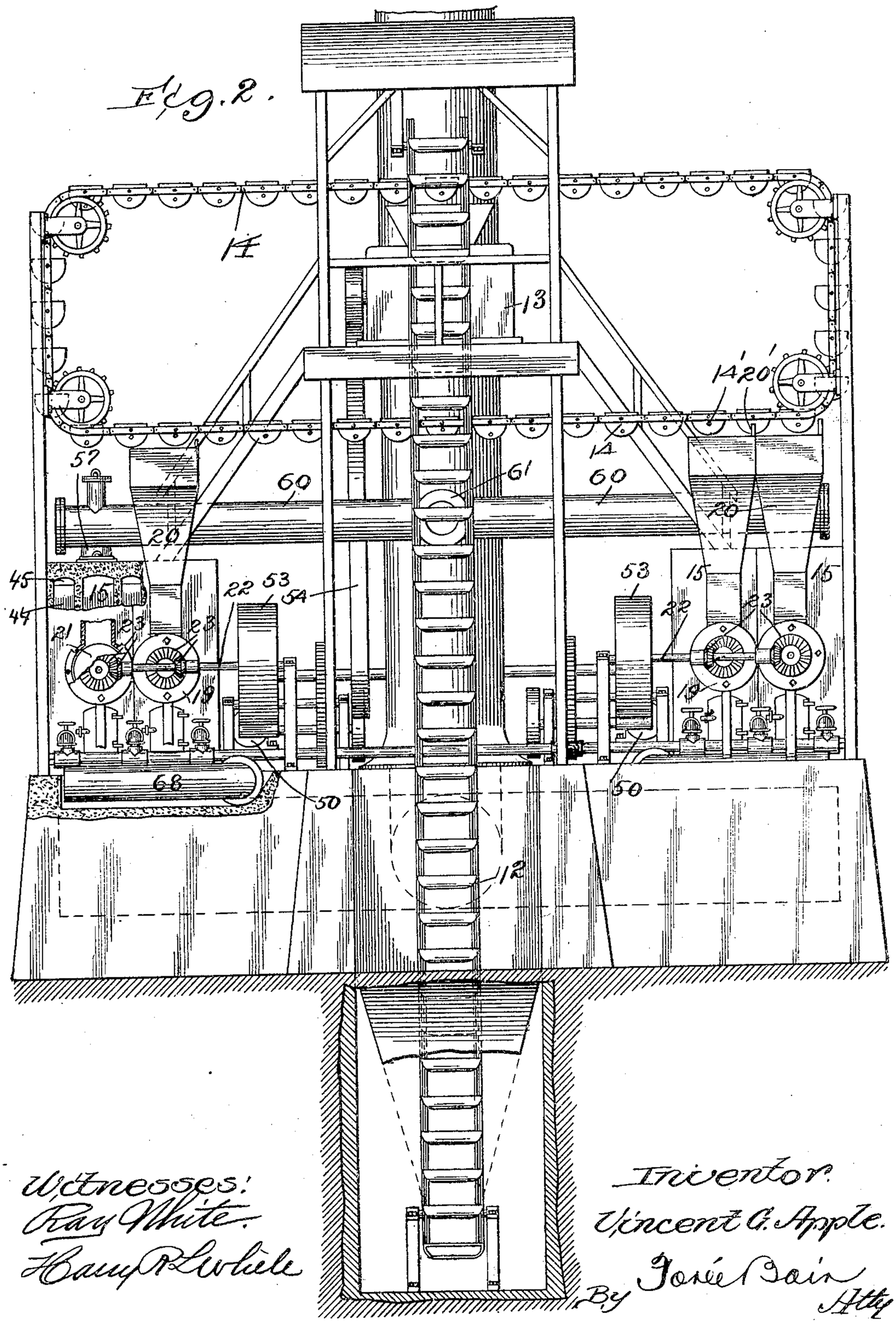
5 SHEETS—SHEET 2.

Fig. 2.



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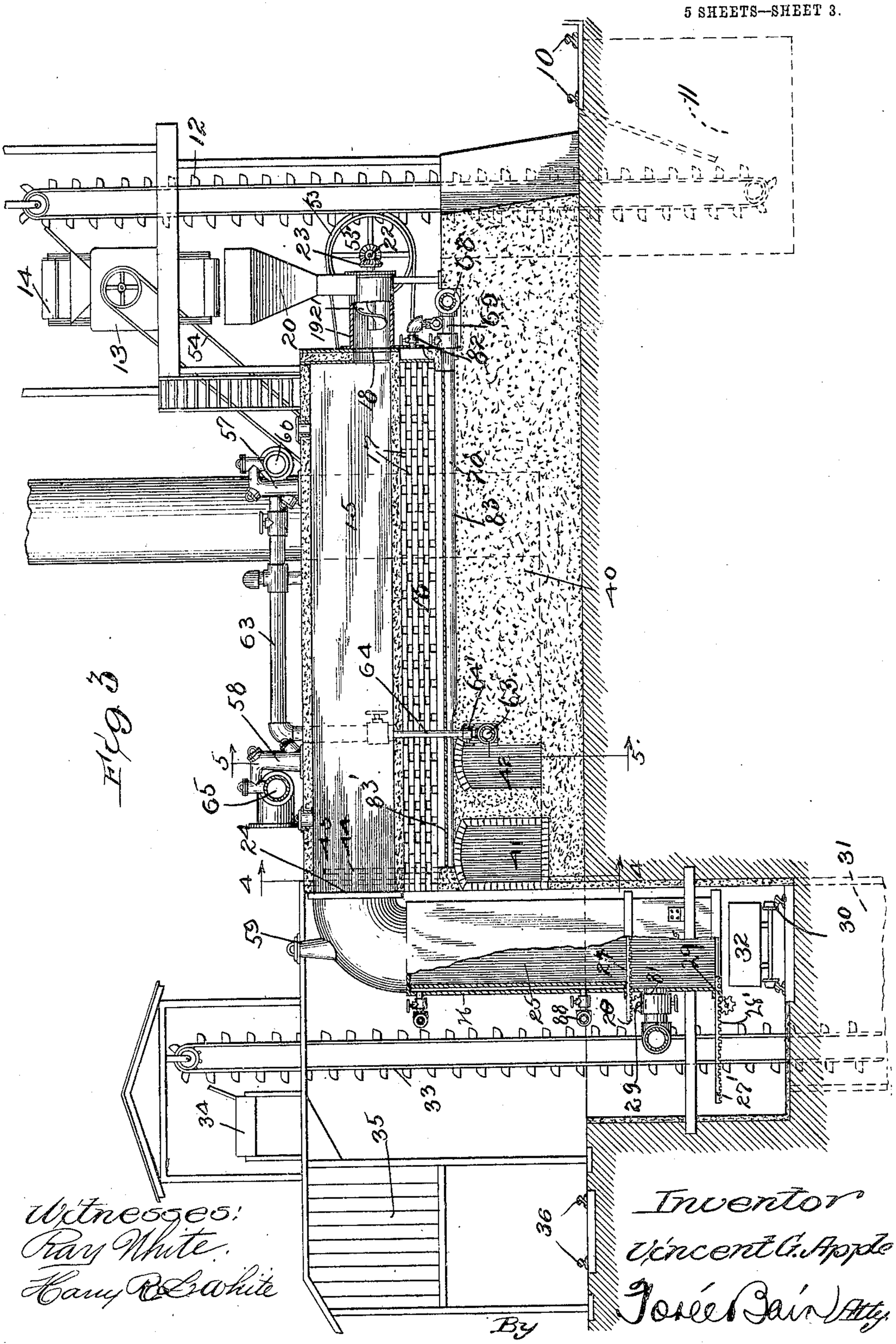
5 SHEETS—SHEET 3.



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5 SHEETS—SHEET 4.

Fig. 4.

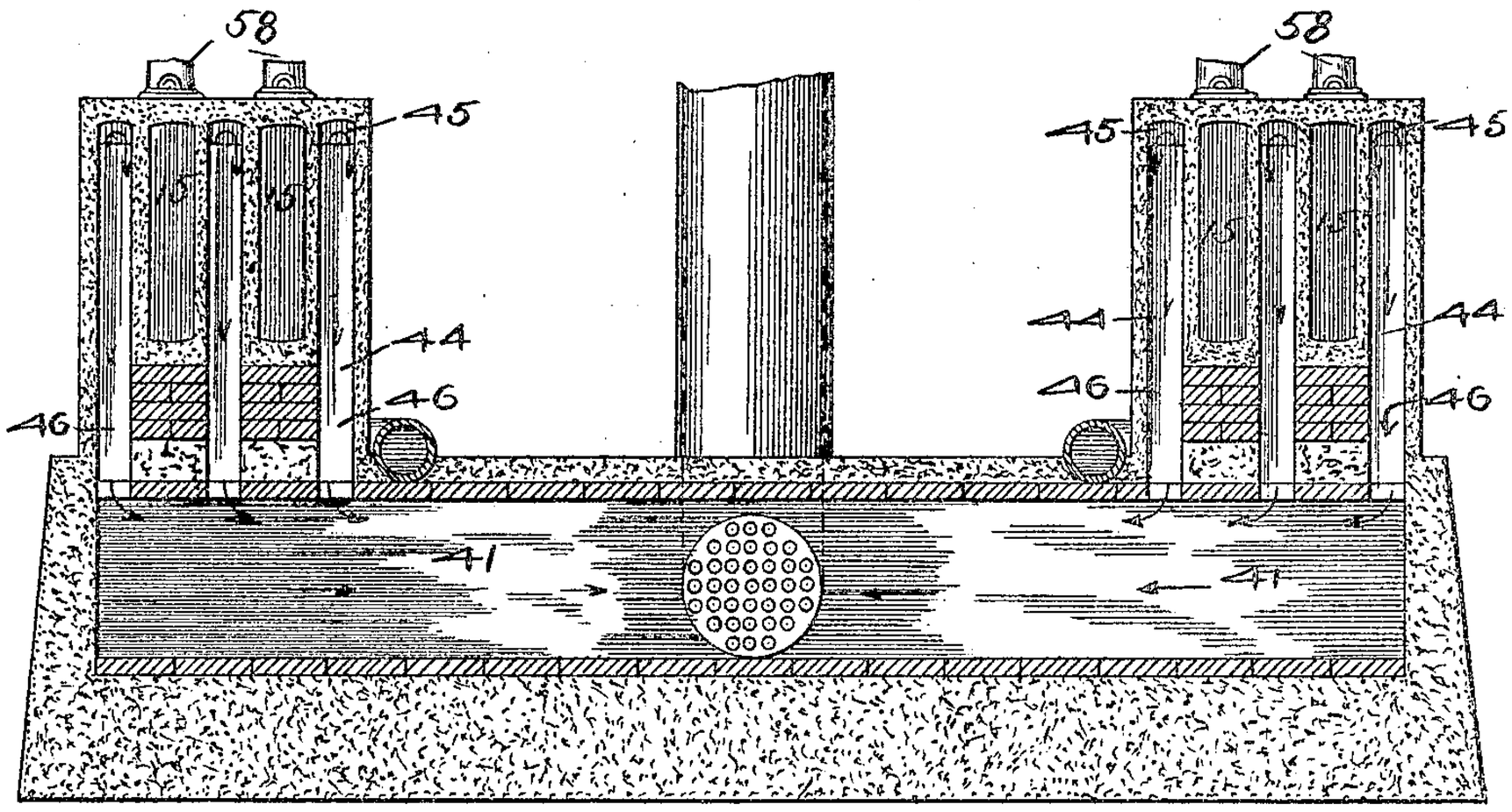
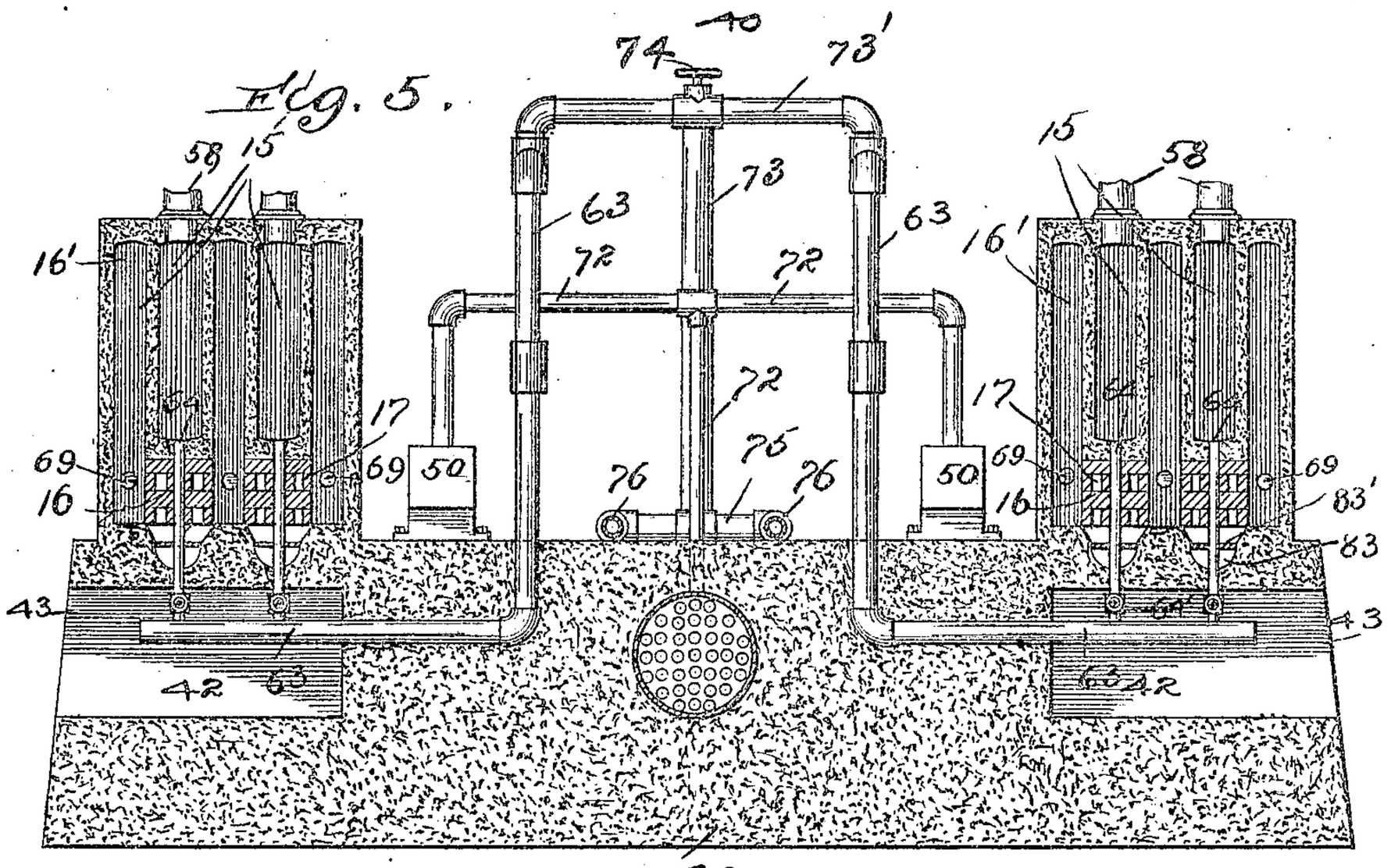


Fig. 5.



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5 SHEETS—SHEET 5.

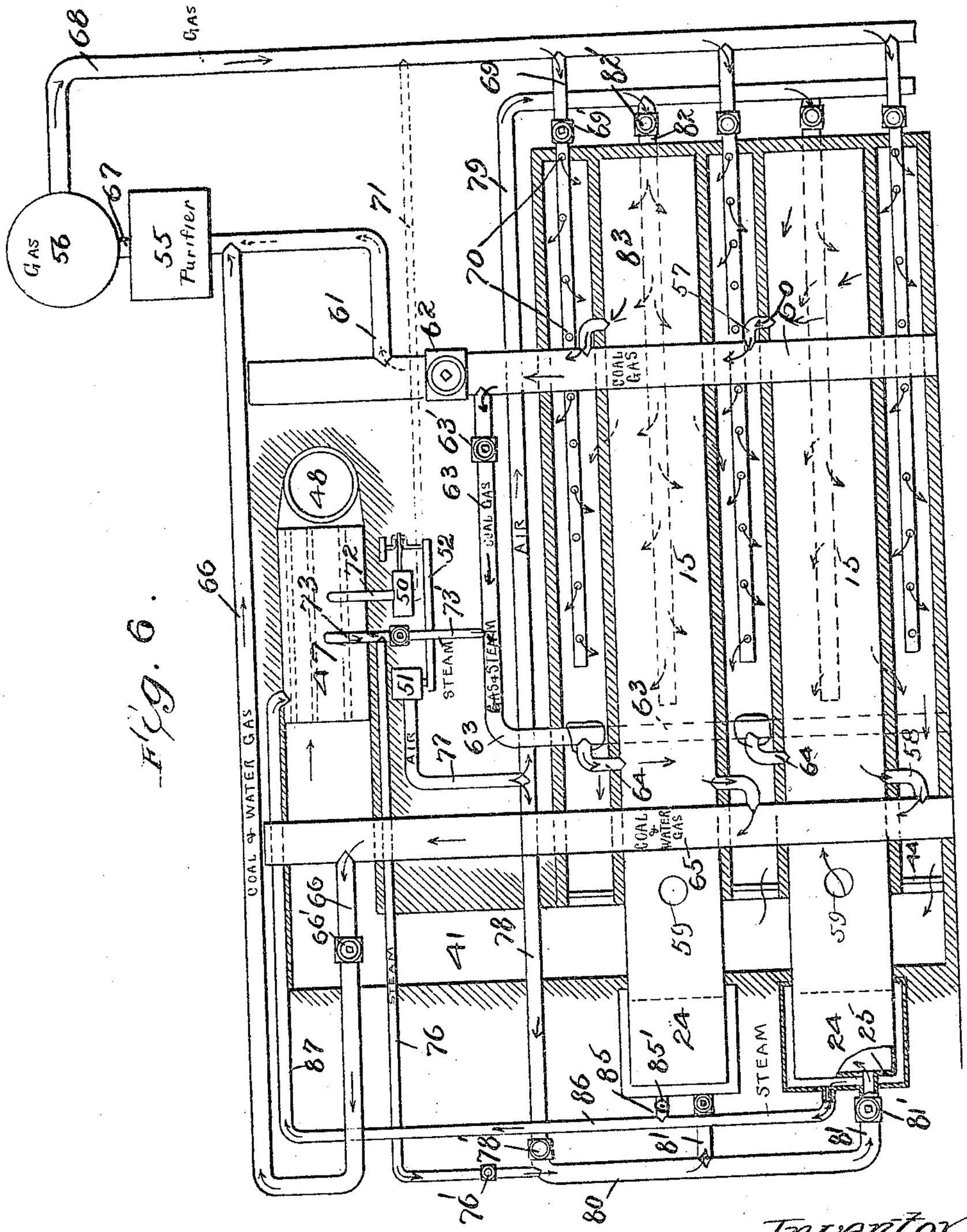

Fig. 6.

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UNITED STATES PATENT OFFICE.

VINCENT G. APPLE, OF DAYTON, OHIO.

COKE AND GAS PLANT.

No. 807,532. Specification of Letters Patent. Patented Dec. 19, 1905.

Application filed September 10, 1903. Serial No. 172,549.

To all whom it may concern.

Be it known that I, VINCENT G. APPLE, of Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Coke and Gas Plants; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

One of the objects of my invention is to provide a coke and gas plant wherein any retort may be operated to continuously produce coke and gas.

A further object of my invention is to provide a system of devices whereby many of the operations incident to the handling of the carbonaceous material employed in the gas and coke production may be automatically performed.

A still further object of my invention is to provide improved apparatus for the treatment of carbonaceous material in the production of gas and coke.

A still further object of my invention is to provide a system of arrangement for such apparatus whereby the waste of heat may be reduced to a minimum and high efficiency of gas and coke production may be attained; and a still further object of my invention is to provide an arrangement of batteries of distilling apparatus relative to those devices common to them all—for instance, their power and material supply devices—such that the number of elements of the distilling apparatus employed may be extended from unity to maximum capacity of the said common devices without necessitating material changes in said common devices.

With a view to attaining these and other objects, which will become apparent to those skilled in the art from the following description, my invention consists in the features of arrangement and construction hereinafter more fully described, and specified in the claims.

In the drawings, wherein like numerals of reference refer to like parts, Figure 1 is a plan view of a plant constructed and arranged to embody my invention. Fig. 2 is a front elevation thereof. Fig. 3 is a vertical section on line 3 3 of Fig. 1. Fig. 4 is a transverse section on line 4 4 of Fig. 3. Fig. 5 is a similar section on line 5 5 of Fig. 3. Fig. 6 is a distorted diagrammatic plan illustrating the piping connections employed in the embodiment of my invention.

Generally speaking, the drawings illustrate a plant having a set of power and material supply devices and storage-depots centrally arranged relative to two batteries of coal-distilling retorts and so associated with said distilling apparatus through the intermediary of transfer and conducting systems that carbonaceous material may be constantly supplied to said distilling apparatus from the central supply devices and the products of distillation constantly returned from the distilling apparatus to the central storage-depots.

In the drawings, 10 indicates an incoming railroad-track, whereon coal-cars may be run.

11 indicates a coal-pit suitably arranged relative to the track to receive coal dumped from the cars thereon and to serve as a coal-supply bin. 12 indicates a conveyer-flight of any suitable or preferred construction arranged to convey coal from said pit to the elevated coal-crusher 13.

14 indicates a coal-transportation system of any suitable design arranged to receive coal from the crusher 13 and transport the same to the feeding devices of the distillation-retorts, to be hereinafter described.

15 15 indicate generally the coke-retorts, of which there may be any suitable number. These retorts are divided into two batteries disposed in lateral alinement, but separated sufficiently to permit the interposition between said batteries of such machinery and devices as are common to all of the distilling apparatus of the plant. Associated with the retorts are arranged suitable heaters, preferably gas-furnaces 16, shown as provided one for each retort. I prefer that the furnace-retort arrangement be substantially as herein illustrated—that is to say, that the retorts 15 be arranged side by side and separated by passages 16′, which constitute heat-flues for the furnaces 16, each retort being mounted upon a checker-work 17 of refractory brickwork or the like. Each retort is provided at its front end with a feed-inlet 18, opening into a feed-spout 19, which communicates with a vertical hopper 20, arranged to receive coal from the conveyer system 14. The various hoppers are preferably provided with means for automatically tripping certain of the carrier devices of the conveyer system 14, so that at regular intervals said hoppers

receive proper quantities of coal to constantly maintain a supply therein. In the present instance such arrangement is suggestively illustrated by the graduated pins 20′, mounted on the hoppers, and the correspondingly-arranged studs 14′, carried by the receptacles of the conveyer system 14. Pressure devices are provided in connection with each retort for forcibly feeding carbonaceous material thereto and propelling the same through the retort from the feed inlet to the outlet provided at the opposite end of the retort-chamber. In the present embodiment, 21 indicates a screw arranged within the feed-spout 19, the shaft whereof projects from the front end of said spout and is arranged to be driven from a power-shaft 22, common to the entire battery, through the intermediary of suitable gearing 23. At its rear end each retort is provided with an outlet 24, communicating with a vertically-disposed coke-receiver 25, of which there is preferably one for each retort. Each coke-receiver is surrounded by a jacket 26, arranged to form with the wall of the receiver 25 a water-jacket chamber.

27 and 27′ indicate two sliding doors arranged at the bottom of receiver 25 and inclosing therebetween a space of equal capacity with the coke tram-car. The doors are provided with suitable means—such as the racks 28 and 28′ and their coacting gears 29 and 29′ for independently operating them.

30 indicates a tramway leading directly beneath the door 27′ of the coke-receiver and extending to a centrally-disposed coke-pit 31.

32 indicates a tram-car designed to run on the tramway 30 and to receive coke from the receivers 25 for conveyance to the central pit 31. 33 indicates a conveyer-flight communicating with said coke-pit and extending to an elevated coke-screen 34.

35 indicates an elevated coke-storage depot arranged to receive coke from the screen 34.

36 indicates an outgoing railway-track so located that its cars can pass beneath the storage-depot 35 to be loaded therefrom.

The entire batteries of retorts and furnaces, as well as the power devices and the like, to be more fully hereinafter described, are preferably mounted upon a solid base 40, of concrete or similar material, wherein are formed a transverse flue 41, extending completely across the plant beneath the retort-batteries and the central separating area, and two pipe-tunnels 42 42, each extending beneath one battery of retorts and their settings intermediate the ends thereof and each having a suitable outlet, as at 43, by which ingress can be had into the said tunnel. The flue 41 is arranged to communicate with each of the passages 16′, separating the retorts, to receive the heated air escaping from said flue-passages.

44 indicates a wall partially blocking the end of each passage 16′, but leaving an aperture 45, communicating with the passage 46, which extends to and opens into the flue 41.

Centrally of the plant is arranged a fire-tube, steam-boiler, and superheater 47, the tubes whereof at one end communicate with the flue 41 and at their other end communicate with a smoke-stack 48. Thus it will be apparent that the products of combustion escaping from all of the furnaces through the flue-passages 16′ are conducted into the flue 41 and thence pass through the boiler 47 into the stack 48. The boiler 47 constitutes a source of steam-supply for the operation of the plant. Associated with the boiler in its central arrangement relative to the batteries of retorts are suitable power devices adapted to drive the conveyer systems, crushers, and other mechanism requiring mechanical propulsion and an air-blower designed to supply air under pressure, as required in the most advantageous employment of the plant.

50 50 indicate engines, preferably two in number, each arranged to drive the power-operated mechanisms associated with its adjacent battery of retorts. The engines 50 may be either steam or gas engines and are preferably arranged to obtain motive power from the plant.

51 51 indicate air-blowers of any suitable construction associated with the engines 50 50 and respectively driven therefrom by suitable belting 52 or other power-transmission devices.

53 indicates a belt connecting power devices directly to the engine with a pulley 53′, mounted upon the shaft 22, which operates the coal-propelling devices within the various retorts.

54 indicates a belt connecting one of the engines with the coal-crusher 13.

Associated with the plant at any suitable point are arranged the gas-purifiers and storage appliances required in the customary treatment and handling of gas.

55 indicates diagrammatically a purifying-house, and 56 a gas-storage tank.

The piping connections of the plant are preferably arranged as follows: Each retort 15 is provided with an ascension-pipe 57, communicating therewith at a point toward the forward end thereof. 58 indicates a secondary ascension-pipe arranged generally near the rear end of the retort. 59 indicates a closable outlet arranged in vertical alinement with the coke-receiver 25. 60 indicates a hydraulic main with which all of the ascension-pipes 57 communicate. 61 indicates a main connecting the hydraulic main with the purifier-house 55. 62 62 indicate suitable valves for controlling the communication of the hydraulic main with the main 61. 63 63 indicate two gas-mains communicating with the hydraulic main 60 and provided with valves 63′ to control such communication. At their rear ends the said pipes 63 are led downward and then laterally into the tunnels 42 beneath

the furnaces on their respective sides and within said tunnels are provided with a series of vertical branch pipes 64, valved, as at 64′, which lead upward into the retorts 15 at points approximately below the secondary ascension-pipes 58. The secondary ascension-pipes 58 communicate with a common main 65, which has a piping connection 66, valved, as at 66′, with the purifier 55—as, for example, through a connection with the main 61, heretofore referred to, and as illustrated in Fig. 6. The usual connections are of course made between the purifier and the storage-tank, as indicated at 67. From the storage-tank a fuel-supply main 68 is led into proximity to the furnaces 16, and branch pipe 69, valved, as at 69′, is led therefrom into each furnace, such pipes being preferably arranged within the chambers 16′ intervening between adjacent furnaces. Within the furnaces the said pipes are perforated, as at 70, to form gas-burners. If the engine 50 heretofore adverted to be a gas-engine, a pipe 71 (indicated in Fig. 6 in dotted lines) may be led from the supply-main 68 to the cylinder of said engine to supply fuel thereto. If, however, the engine be a steam-engine, a pipe 72 (indicated in full lines in the drawings) is led from the superheater 47 to the cylinder of the engine to supply steam thereto. 73 indicates a steam-pipe, valved, as at 74, at one end communicating with the steam-dome of superheater 47 and at its other end communicating by branches 73′ with the gas-pipes 63. Other branches 75 establish communication between the steam-dome and pipes 76, which latter are angularly bent in opposite directions and extend into communication with pipe-section 80, to be described. From the air-blower 51 extends an air-pipe 77, at a suitable point divided into two branches 78 and 79, the former of which extends into communication with pipe-section 80, arranged to extend along the rear of the coke-receivers 25 in proximity thereto. Valves 78′ and 76′ control the communication of the pipes 78 and 76, respectively, with the pipe-section 80. From the pipe-section 80 branch pipes 81, controlled by valves 81′, lead into communication with the coke-receiver at a point below the level of door 27. On the other hand, the pipe 79 is led into proximity to the front ends of the retort of the furnaces 16 and is provided with a series of branches 82, each valved, as at 82′, each of which branches communicates with a corresponding conduit 83, formed in the concrete base 40 directly below the checker-work 17 of the furnace. A perforated plate 83′ covers the top of the conduit 83 and serves to properly distribute the air-supply thereto beneath the checker-work of the furnace. From the top of each water-jacket chamber 26 surrounding a coke-receiver a branch pipe 85, valved, as at 85′, is led into communication with the common steam-pipe 86, connected, as by a branch 87, with the superheating-boiler 47. 88 indicates a water-pipe connecting the water-jacket 26 with any suitable source of supply. (Not shown.)

The operation of the plant described will be as follows: Gas drawn from the gas-tank 56 through mains 68 is supplied to the burners 70 within the furnace, air to support combustion being supplied from the air-blowers 51 by air-pipe 79 and conduit 83. By this means the retorts are heated to a proper degree. Coal transported to the plant by the incoming railway 10 is dropped into the pit 11, transferred by a conveyer-flight 12 to the crusher 13, thence deposited in the receptacles of the conveyer system 14 and distributed to the hoppers of the various retorts. From the said hoppers the coal is fed through the spouts 18 into the interior of the retorts to be distilled therein. The constant operation of the screws 21 serves to feed constantly-renewed supplies of material to the retorts and to propel the coal within the retorts forward in a mass toward the rear or outlet ends thereof. When the green coal is introduced into the front end of the intensely-heated retort, destructive distillation at once sets in and coal-gas is evolved, such evolution of gas continuing until the distillation is complete and only coke remains as a residuum of the original coal. It is my intention to so construct and operate the retort and feeding devices, respectively, that the coal is moved through the heated retort at such a rate relative to the length of the retort that the active distillation is substantially completed by the time the carbonaceous material has reached the point of entrance of pipe 64, so that the inlet of said pipe 64 will be beyond the area of active distillation and will be confronted by a mass of incandescent coke, from which substantially all of the gas has been removed. The gas evolved during the passage of carbonaceous material through the front portion of the retort is carried off through the ascension-pipe 57 into the hydraulic main 60, whence the coal-gas, freed from a portion of its impurities, passes into the gas-pipe 63, associated with the corresponding retort-battery, and at a suitable point is mingled with live steam received from the superheater 47 through pipe 73 and its branch 73′. The combined steam and gas thence pass through pipes 63 and the branch pipes 64 into the bottoms of the various retorts, and the mixture is there discharged upon the mass of incandescent coke. Through this incandescent mass the gas and steam pass to the secondary ascension-pipe 52, in its passage through the coke being transformed by the action of the heat into a fixed combined water and coal gas especially adapted for fuel purposes. From the secondary ascension-pipe this fixed gas is led off by the mains 66 to the purifying-house and storage-tank for proper purification and storage.

The coke produced within the retort is constantly forced rearward by the pressure generated by the screw into the top of the coke-receiver 25, whence it falls upon the door 27, being held thereby in a portion of the receiver surrounded by the jacket. Water introduced into the jacket through the water-pipe 88 is quickly converted into steam by heat extracted from the incandescent coke at the same time the coke is cooled. The steam thus generated is led off through the pipes 85, 86, and 87 to the superheater, into the steam-dome whereof it passes. Portions of the coke thus cooled within the receiver 25 are allowed by the opening of the door 27 to fall upon the door 27′, which for the purpose is moved to closed position. The door 27 is then restored to position, and after the car 32 has been brought into position beneath the coke-receiver the door 27′ is opened, permitting a load of coke to fall into the tram-car. The coke is then conveyed to the pit 31, from which it is elevated by the conveyer-flight 33 to the screen 34, and having been properly screened it is deposited in the storage-bin 35 in available position for exportation over the outgoing railroad 36.

It is well known to those skilled in the art that coke cooled without the direct application thereto of water is of a better quality than water-drenched coke, so that the coke produced by my furnace will be of a high grade. Furthermore, it will be seen that the heat emanating from the incandescent coke is employed in the production of steam to be used in the further gas-making operations. It will also be noted that the superheating-boiler is arranged in the path of the products of combustion, which escape from the furnace into the transverse flue 41 and thence pass through the tubes of the superheater into the smoke-stack 48. The surplus heat from the furnaces is thus employed to superheat the steam received from the water-jacket before its introduction into the coal-gas in the pipe 63 in the manner heretofore described. It is obvious, however, that an ordinary boiler might be employed instead of a superheater. Thus all of the heat generated in the plant is utilized to a high degree in the furtherance of the gas-making process, thereby securing great efficiency and economy in the operation of the plant.

Should it occur that the quantity of coke produced be greater than the demand or if the coke production be considered unimportant, the supply of gas generated may be increased by employing the coke-receiver 25 as a water-gas retort. The construction herein illustrated is susceptible of ready change to accomplish this end. The door 27 being opened and the valves 76′ and 78′ properly adjusted, air may be blown into the coke-receivers through the pipes 81 and permitted to escape through the outlets 59 at the top of the receivers. Thus the incandescent coke within the receiver is blown into active incandescence, after which the "blow" is stopped and the outlet 59 closed. Now steam from the steam-pipe 76 is turned into the pipe-section 80 and introduced into the incandescent mass, passing therethrough and through a portion of the coke within the retort into the secondary ascension-pipe 58.

While I have herein described an arrangement whereby the coal-gas is taken directly from the hydraulic main for mixture with steam and converted into fuel-gas, it will be apparent that the arrangement of the plant might readily be so varied that coal-gas would be first purified and its tar and ammoniacal impurities removed by passing it through a suitable purifier before its introduction into the said gas-mains.

Numerous modifications and variations in the specific embodiment of my invention might be made to suit the exigencies of the use of the invention without departing from the spirit thereof.

Among the advantages incident to the use of my invention in addition to that of economy of heat expenditure heretofore referred to it may be mentioned that the plant is susceptible to indefinite extension in either direction up to the full capacity of the power-supply devices without any material change in arrangement or equipment, the only requirement being the addition of conveyer elements and the like in proportion to the additional extent of the retorts. Again, it will be seen that the arrangement is such that the process of manufacture is continuous, fresh quantities of fuel being constantly fed to the retort and quantities of fuel being constantly removed therefrom. By the use of the term "constant" as respects the introduction and removal of material into and from the retorts I desire to be understood as meaning such additions and removal of material as will maintain always a sufficient supply of material on the one hand and accomplish a sufficient removal of material on the other to keep the plant continuously active. It will also be noted that the insertion and removal of material from the retort is effected without opening the retort to the air and that as the inlet and outlet apertures communicate, respectively, with the feed-spout and coke-receiver, both of which during the operation of the plant always contain more or less material, such apertures are constantly maintained closed against the undue ingress of air. The walls of the retort are therefore never subjected to the harmful sudden cooling to which ordinary retorts are necessarily submitted in the drawing of their charges, and a saving both of apparatus and of heat is consequently effected. Further, it is apparent that the arrangement is such that the entire plant is self-contained, the entire power for running the

plant being obtained from the plant itself. Other and further advantages will be apparent to those skilled in the art.

Having described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A coke and gas plant comprising two batteries of retorts arranged side by side in lateral alinement, a source of power-supply arranged in the space between said batteries, a source of material-supply, and means comprising a single continuously-operable equipment of transfer devices extending laterally of the retort-batteries and said source of material-supply for constantly conveying material to the retort, and operating connections between said transfer devices and the source of power.

2. A coke and gas plant comprising two batteries of retorts and their heating means arranged side by side and suitably separated, an engine arranged between the retort-batteries, a source of material-supply centrally arranged relative to said retorts, and transfer devices for conveying material from said source of supply to the retorts, operatively connected with said engine for actuation thereby.

3. A coke and gas plant comprising two batteries of retorts and their heating means suitably separated, a steam-boiler, disposed between said batteries, and arranged to derive heat from the retort-heating means, a steam-engine operatively associated with said boiler, a source of material-supply centrally arranged relative to the batteries, transfer devices arranged to convey material from the said source of supply to the retorts, and operating connections between the transfer devices and the steam-engine.

4. In a coke plant, a series of retorts each having an inlet-opening in one end in a plane substantially transverse to the direction of movement of material within the retort, and an outlet-opening relatively remote from the inlet, receptacles associated with said retorts in communication with said inlet-openings, pressure devices operatively associated with said receptacles, disposed outside of the retorts and arranged to propel carbonaceous material from the receptacles through the retorts, a common source of supply of carbonaceous material for said receptacles, and automatic means for transferring such material from the source of supply to the receptacle to keep the said receptacles constantly supplied with material.

5. In a coke plant, a coking-retort having an inlet, a coke-outlet, a primary gas-outlet, and a gas-inlet and its complementary secondary gas-outlet relatively remote from the primary outlet, means associated with the retort for propelling carbonaceous material through the retort from the inlet to the coke-outlet, a coke-receiver associated with the coke-outlet to receive coke therefrom, a water-jacket surrounding the receiver, a connection for conducting steam from said jacket to the gas-inlet of the retort, and a connection for conducting gas from the primary gas-outlet to said gas-inlet.

6. In a gas plant, a retort having a primary gas-outlet, a secondary gas-outlet, and a gas-inlet disposed adjacent the secondary outlet, a connection between the primary gas-outlet and the gas-inlet, a source of steam-supply and a connection between said source of supply and said gas-inlet.

7. In a coke plant, a series of retorts, and their appropriate furnaces, each retort having a feed-inlet and an outlet, devices for propelling carbonaceous material through the retort from the inlet to the outlet, a coke-receiver associated with the outlet to receive material therefrom, a water-jacket surrounding said receiver, a steam-motor for driving the propelling devices, and piping connections between said steam-motor and the said water-jacket.

8. In a coke plant, a horizontal retort having an inlet at one end and an outlet at the other, means for constantly feeding carbonaceous material through the retort from the inlet to the outlet, a coke-receiver of relatively large capacity vertically disposed in communication with the retort-outlet.

9. In a gas plant, a retort, adapted to constantly receive carbonaceous material at one area and discharge it at another area, a primary ascension-pipe communicating with the retort adjacent the receiving area, a secondary ascension-pipe communicating with the retort at a point relatively remote from said receiving area, and a piping connection between the primary ascension-pipe and the retort communicating with the retort at a point relatively remote from the said receiving area.

10. In a coke and gas plant, a retort having an inlet at one end and an outlet at the other end, a heater associated with said retort, a primary ascension-pipe communicating with said retort relatively near its inlet end, a secondary ascension-pipe communicating with said retort relatively near its outlet end, and a piping connection between the primary ascension-pipe and the retort communicating with the retort at a point adjacent the secondary ascension-pipe.

11. In a coke and gas plant, a retort, having an inlet at one end and an outlet at the other, a coke-receiver communicating with the retort-outlet, a source of steam-supply, a source of supply of air under pressure, piping connections between both the source of steam-supply and the source of air-supply and the coke-receiver, and an ascension-pipe communicating with the retort relatively adjacent the outlet.

12. In a coke plant, a coking-retort, a means for propelling material through the retort, a

coke-receiver communicating with said retort, a water-jacket surrounding said coke-receiver, a steam-engine for driving the material-propelling means; and steam-piping connections from the water-jacket of the coke-receiver to the steam-engine.

13. In a plant of the character described, a built-up base, having a transverse flue formed therein, a battery of retorts and their heating-furnaces supported on said base, connections for conducting heated air from the retort-furnaces to the flue, an outlet from said flue, and a boiler arranged in the path of the heated air escaping from said flue through said outlet to receive heat therefrom.

14. In a plant of the character described, a built-up base, having a transverse flue formed therein, two batteries of retort-heaters mounted on said base, with the outlet ends of said heaters substantially over said flue, substantially vertical passages connecting said heaters with the flue, a central outlet from the flue and a boiler arranged in the path of escape from the flue to receive heat from the heated air escaping from said flue.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

VINCENT G. APPLE.

Witnesses:
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L. M. ARNOLD.