No. 768,795. PATENTED AUG. 30, 1904.

L. GATHMANN.

SYSTEM AND APPARATUS FOR DISTILLING.

APPLICATION FILED AUG. 5, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

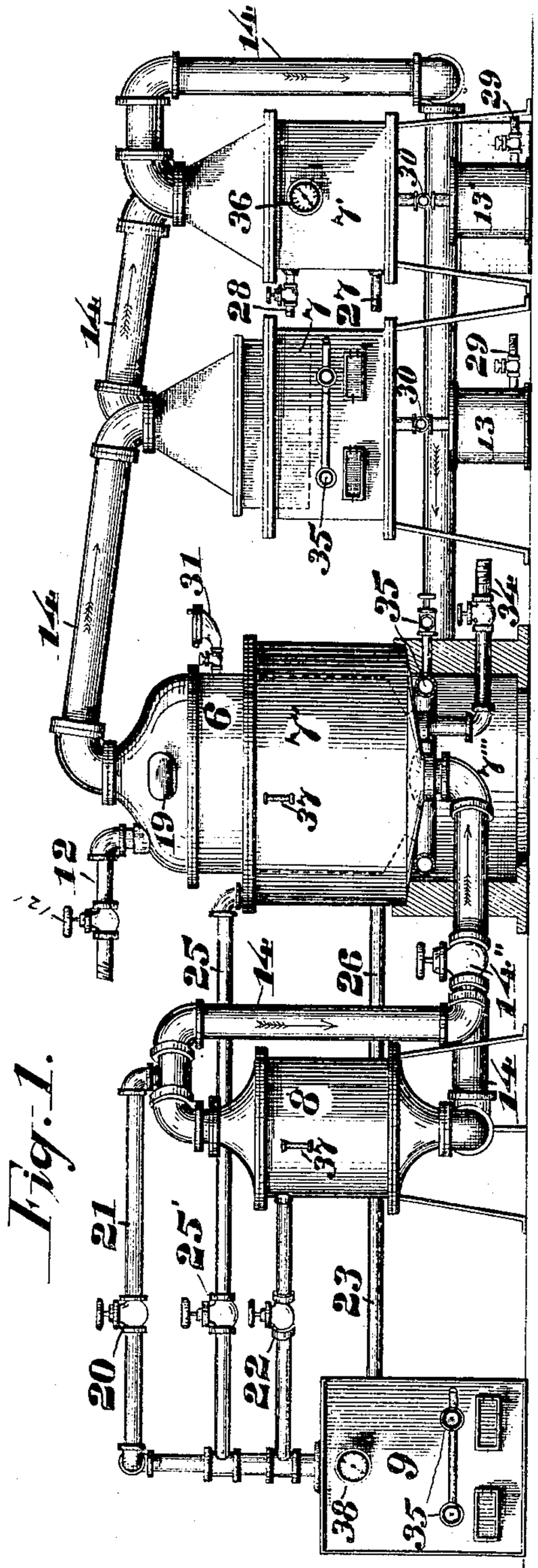

Fig. 1.

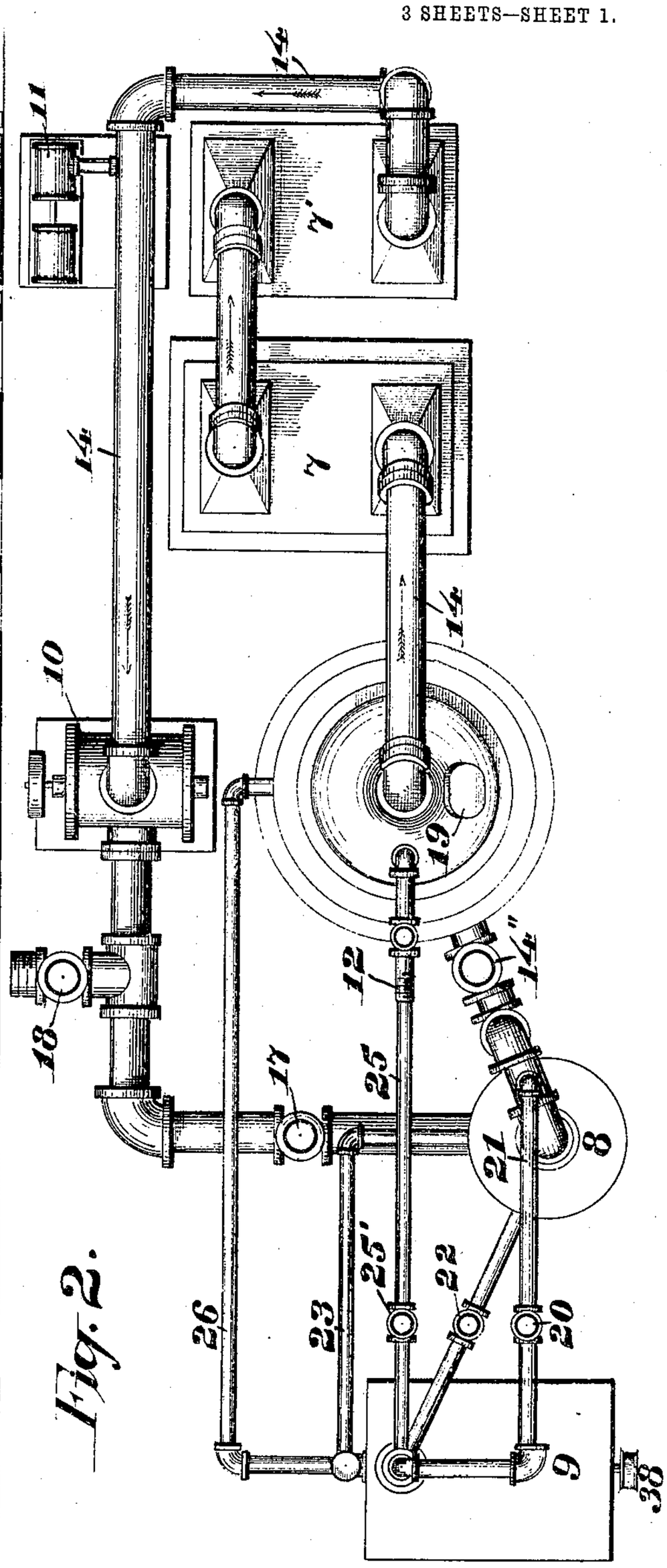

Fig. 2.

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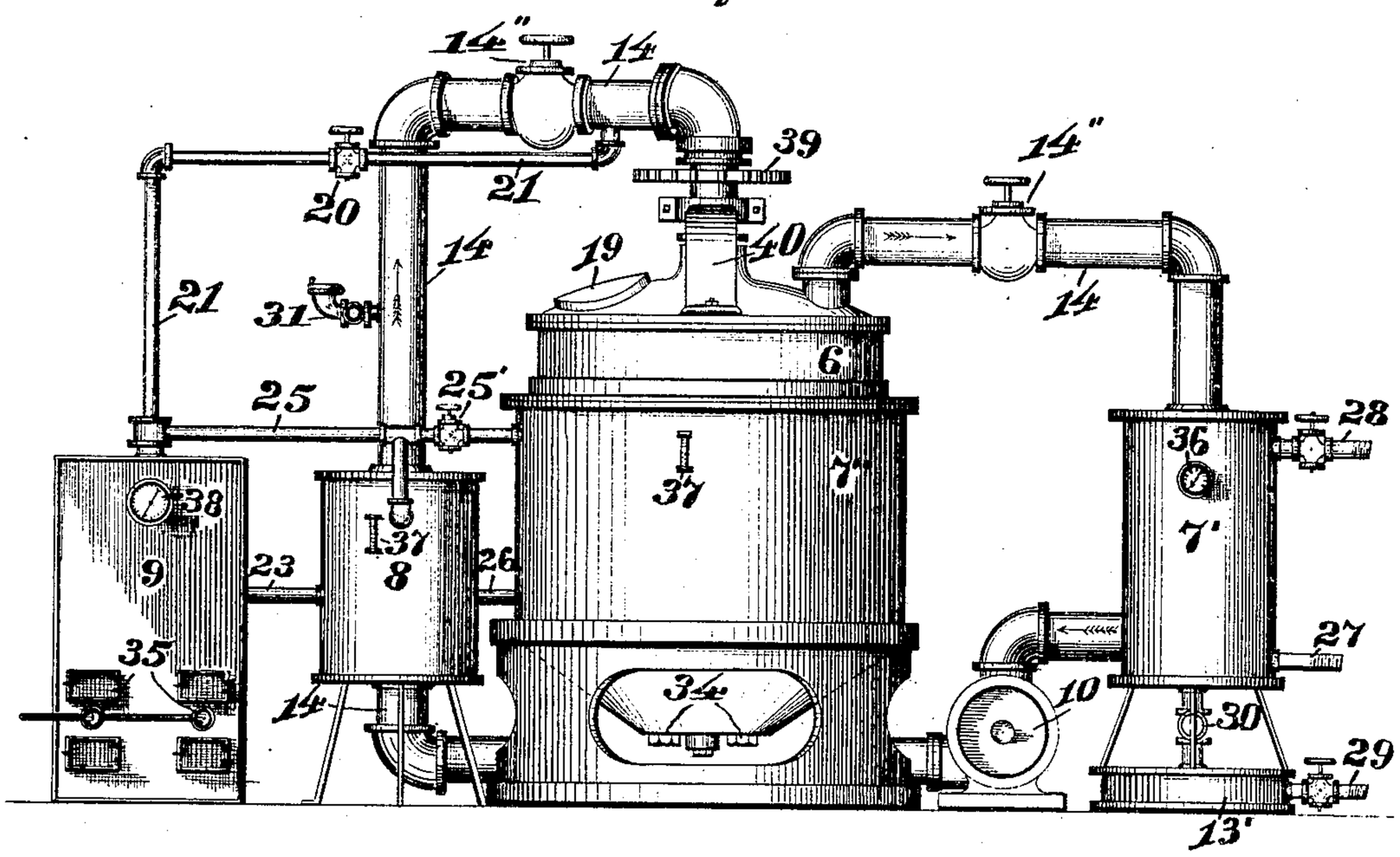
NO MODEL. 3 SHEETS—SHEET 2.

Fig. 3.



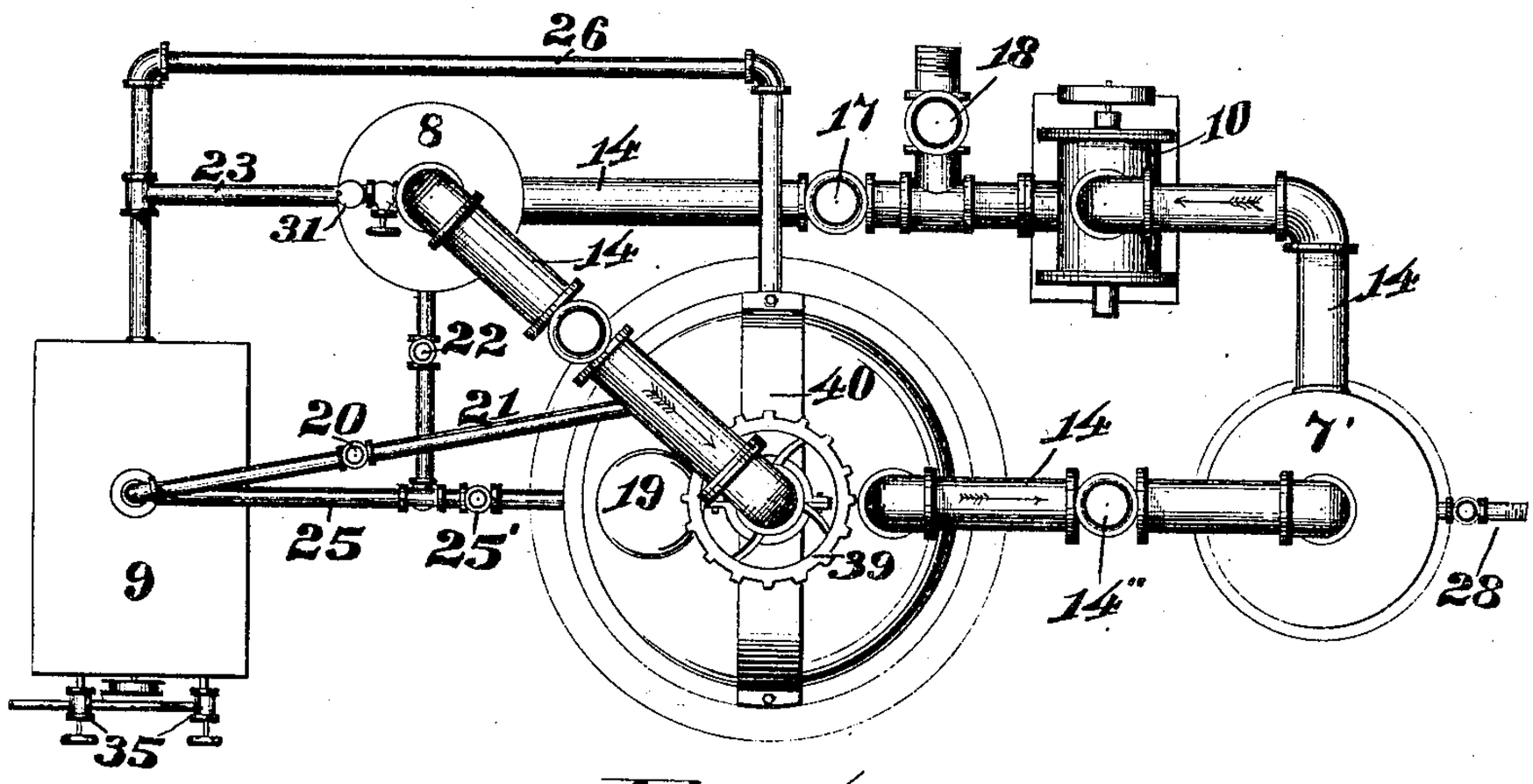


Fig. 4.

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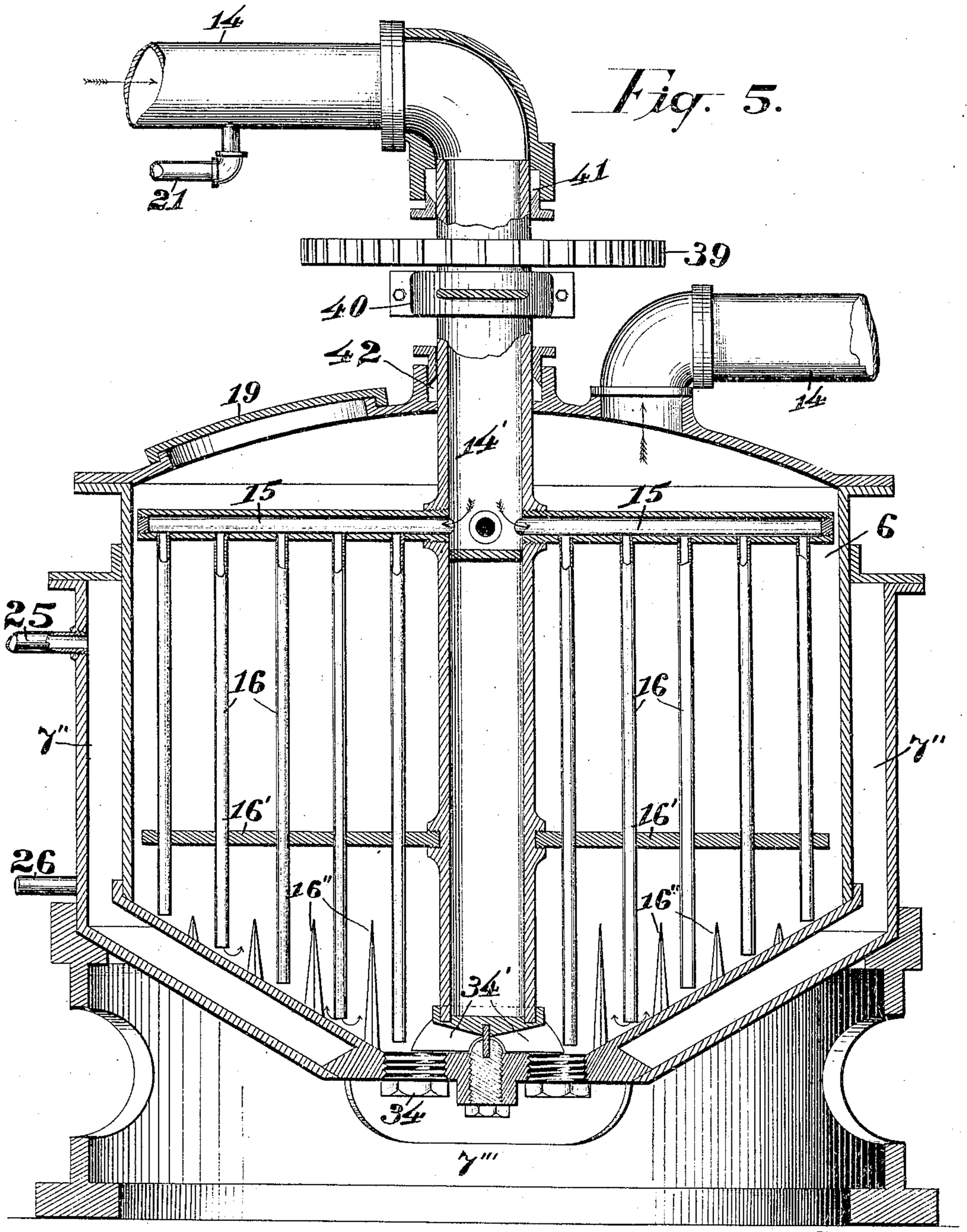
NO MODEL. 3 SHEETS—SHEET 3.

Fig. 5.



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No. 768,795. Patented August 30, 1904.

UNITED STATES PATENT OFFICE.

LOUIS GATHMANN, OF WASHINGTON, DISTRICT OF COLUMBIA.

SYSTEM AND APPARATUS FOR DISTILLING.

SPECIFICATION forming part of Letters Patent No. 768,795, dated August 30, 1904.

Application filed August 5, 1903. Serial No. 168,289. (No model.)

To all whom it may concern:

Be it known that I, LOUIS GATHMANN, a citizen of the United States, residing at Washington, District of Columbia, have invented a new and useful System and Apparatus for Distilling, Evaporating, &c., of which the following is a specification.

My invention relates to improvements in a distilling or evaporating system and apparatus for the same; and it consists in the following essential features—to wit, an evaporating system in a closed circuit comprising an evaporator or vessel adapted for containing liquid, means to force an air-current through the liquid to be evaporated, a condenser, means to maintain a minus atmospheric pressure within the circuit, and details of construction hereinafter pointed out and claimed.

I do not desire to claim herein the process of distilling and evaporating, as that forms the subject-matter of a separate application for patent filed April 22, 1904, Serial No. 204,369, and entitled "Processes of distilling or refining hydrocarbon oils or spirits, &c."

Two forms of the apparatus embodying my invention are shown in the accompanying drawings, wherein—

Figure 1 illustrates a perspective view of the distilling apparatus. Fig. 2 is a plan view of the same. Fig. 3 is a perspective view of another form of apparatus. Fig. 4 is a plan view of the same. Fig. 5 is a vertical section of the still or vacuum-pan.

Referring first to the form of the apparatus shown in Figs. 1 and 2, 6 is a still or vacuum-pan located adjacent to the rectifier 7, condenser 7′, heater 7″, heater 8, boiler 9, rotary pump 10, and vacuum-pump 11. The still is shown to be located over a furnace which is suitable for imparting the proper temperature to the contents of the aforesaid still. The still may receive its heating medium from the boiler 9, being heated in any ordinary or suitable manner. The rectifier 7, which may be of any suitable form, receives the heating or cooling medium in any ordinary or suitable manner and connects with the still in the usual way, but is located in a vacuum-circuit, as is shown in the drawings. The condenser 7′ is also located in the circuit, may be of any suitable form and connected to the rectifier in the usual way, as shown, and may receive its cooling medium in any ordinary or preferred manner. The heater 8 represents no special form or make, but may be of any construction, and is also connected to the vacuum-circuit by the flue or pipe 14, as shown. The rotary pump 10 may also be of the usual construction, being also connected and within the circuit, as shown. The boiler 9 is located adjacent to and furnishes heating medium to any desirable part of the apparatus and is shown furnishing a heating medium to the heater 7″, surrounding the still 6 and heater 8, and said boiler may be of any usual or preferred construction. 7‴ is a stand for the still 6. The vacuum-pump 11 may be of any usual construction and is connected to the vacuum flue or pipe 14, as shown. 12 is a valved pipe, by which the still may be charged. 13 is a reservoir for receiving the contents of the rectifier. 13′ is a reservoir for the condenser. 14 represents the circulating flues or pipes. 14″ represents valves for the same. 17 and 18 are manipulating-valves. 19 is a manhole. 20 is a steam-valve. 21 is a steam-pipe. 22 is a valve for regulating the heating medium for heater 8. 23 is the return-pipe of the same. 25′ is the regulating-valve, and 25 the supply-pipe, of the heating medium for the heater 7″. 26 is the return-pipe from the same to the boiler. 27 and 28 are induction and eduction ports, respectively, for the cooling medium for the condenser 7′. 29 is the eduction-port for the condensed vapors of the reservoirs 13 and 13′. 30 is a check-valve. 31 is a vent. 34 is the discharge-pipe from the still. 35 is the heating device for the boiler and furnace. 36 is a vacuum-gage. 37 is a thermometer. 38 is a pressure-gage.

Figs. 3 and 4 show another form of the apparatus for carrying out the method on which this application is based. In this apparatus the rectifier 7 (shown in Figs. 1 and 2) is omitted, for the reason that in many instances the rectifying of the evaporated products is not essential—for example, milk, syrup, &c. The vacuum-pump 11 is also omitted, because the rotary pump 10 may act in the capacity of a vacuum-pump in addition to

forcing a circulation of air through the apparatus. In some instances the heater 8 may also be omitted, as the still or vacuum-pan 6 may be sufficiently heated without the aid of heater 8. The direction of the circulation of the air is shown by arrows and that it enters the still or vacuum-pan above instead of below, as shown in Figs. 1 and 2. By referring to Fig. 5, which gives, on an enlarged scale, the interior of the evaporator, it will be seen that the circulating current in this case also passes upward through the still or vacuum-pan. This is, however, only a preferable form of an evaporator, as any vacuum-pan of ordinary or suitable form may be employed for carrying out my system by adding the proper implements and having them properly connected. 13′ is a reservoir below the condenser 7′ and receives the condensed constituents from the same. 14 is the circulating flue or pipe. 14′ is the circulating-flue in the vacuum-pan. (Shown in Fig. 5.) 14″ represents valves for flue or pipe 14. 15 represents distributing-pipes connected with pipe 14′. 16 represents blowpipes. 16′ represents arms or braces for bracing the blowpipes. 16″ represents breakers. These parts are only illustrated in Fig. 5. 17 and 18 are manipulating-valves for producing a vacuum in the circuit or the vacuum-pan. 19 is a manhole. 20 is a steam-valve. 21 is a steam-pipe. 22 is a valve for regulating the heating medium for heater 8. 23 is the return-pipe of the same. 25 is a supply-pipe for the heating medium to heater 7″. 25′ is the regulating-valve of the same. 26 is the return-pipe from the heater 7″ to the boiler 9. 27 and 28 are induction and eduction ports, respectively, for the cooling medium of the condenser 7′. 29 is the eduction-port of the reservoir 13′. 30 is a check-valve. 31 is a vent. 34 represents screw-plugs or valves for discharging the contents of the vacuum-pan. 34′ is a conveyer. 35 is a heating device for the boiler and furnace. 36 is a vacuum-gage. 37 is a thermometer. 38 is a pressure-gage. 39 is a sprocket-wheel. 40 is a bearing for pipe 14′. 41 and 42 are stuffing-boxes for the pipe 14′.

Referring again to Figs. 1 and 2 of the drawings, in operation the apparatus so far described to effect a separation of substances capable of such separation by distillation or evaporation is as follows: The still 6 may be filled with the solutions through pipe 12. Valve 12′ is then closed. The vacuum-pump 11 is designed to cause a vacuum in this distilling system or apparatus. However, the rotary pump 10 may also be set in motion to assist in producing a vacuum. This is accomplished by closing valve 17 and opening valve 18. This will force the air in the apparatus out in the atmosphere. When the desired vacuum is obtained, which may be indicated by a vacuum-gage, valve 18 is closed and valve 17 opened. The materials in the still are then heated to the required temperature necessary for the volatilization of the constituents to be separated therefrom. During this operation the rotary pump 10 forces a current through the heater 8 into the still 6 upward through the solutions and carrying with them the volatile constituents into the rectifier 7, where they (the volatile constituents) are treated in the usual manner—that is to say, the heavy constituents—for instance, water—are herein condensed by maintaining a heat above the boiling-point of alcohol, but below that of water. However, the current passes through and beyond the rectifier, carrying with it practically all the lighter constituents—such, for example, as alcohol—into the condenser 7′, where they are condensed in the usual manner. The air-current also passes through and beyond the condenser and will be practically freed from the volatile constituents. It is then returned into the rotary pump 10, completing one circuit. This operation is repeated until the distillation is completed as may be desired. Any desired vacuum may be maintained by pump 11 during the entire operation.

The product of reservoir 13, received from rectifier 7, may be returned into the still 6 in the usual manner, as in the distillation of spirits the contents may contain some volatile constituents worth saving.

The reservoirs 13 and 13′ are provided with check-valves 30 and eduction-ports 29. In discharging the contents of said reservoirs the check-valves may be closed by opening valves 29, which prevent fresh atmosphere from entering the circuit. The products of reservoir 13′, which may be the pure spirits, are disposed of in the usual manner.

Referring again to Figs. 3 and 4, the prime operation is practically the same, although the rectifier is omitted, because this apparatus is designed to be used, preferably, for substances where refining or rectifying the evaporated constituents is not essential—for example, in evaporation of the volatile constituents from milk, syrup, &c. The vacuum-pump is also omitted, because the rotary pump 10 is designed to produce the desired vacuum, and this is effected in the following manner: by closing valve 17 and opening valve 18 before the distillation commences and during the operation at intervals when it is found essential, as shown in Fig. 4. This will force the air out of the apparatus or circuit and into the atmosphere. However, it (the air) may be blown into a large condenser. When the desired vacuum is obtained, which may be indicated by a vacuum-gage, the valve 18 is closed and valve 17 opened, and the remaining air is circulated through the apparatus. During the operation the valve 30 may be opened; but valve 29 should be closed. When occasion arises, valve 30 should be closed and

valve 29 opened for withdrawing the condensed fluid from the reservoir 13′. By the proper manipulation of these two valves either by hand or automatically the atmosphere will be prevented from entering into the circuit, similarly as described in the operation of Figs. 1 and 2.

Referring to Fig. 5, the sprocket-wheel is designed to impart a slow rotation to circulation pipe or flue 14′ in the still 6. This movement is imparted to the air-distributing arm 15 and blowpipe 16, which form a rake. 16′ represents arms or braces for supporting the blowpipe 16. 16″ represents breakers. The rotation of the rake may not be essential at all times during the operation. In the evaporation of the volatile constituents of milk, syrup, &c., it may be essential only after the materials reach a pasty state. The object of this rotation is to break the paste into small particles. This gives large and fresh area for evaporating the volatile constituents rapidly, thereby saving time and handling of such products. The dried or partially-dried products may be further treated after leaving this apparatus. However, as this is not a part of this invention it is not further described. The direction of the current of air through this apparatus is also shown by arrows. It will be understood that an absolute vacuum is not obtainable, nor is it desirable; but it is desirable to have a low atmospheric pressure in the still, because the lower the pressure the lower is the boiling-point of the materials to be distilled. This is a well-known physical law, and it is extensively employed in vacuum-pans in the process of making sugar, &c. However, they apply only surface evaporation; but to facilitate the evaporation in any system I propose to produce a vacuum and force a current through the solution to be distilled and further produce a minimum pressure above the solution and a maximum pressure below. However, another circulating fluid may be employed in place of air. For instance, in the distillation of oils steam may be used.

It will be understood by the foregoing description that the distillation and evaporation is effected under the most favorable conditions—first, under a vacuum; second, under a circulation of rarefied air. It will also be seen that the air-current may be of practically the same air throughout the entire operation, which is of importance to many substances, because the air is practically sterilized.

In Figs. 1 and 2 the drawings show but one rectifier or receiver and one condenser. However, in some instances—for example, in the distillation of crude petroleum or when there are several constituents of different volatility to be evaporated—any number of rectifiers and condensers may be employed and the constituents condensed in the order of their volatility. "Rectifier" is used to signify a receiver or receptacle in which a fractional condensation is effected.

It is obvious that many modifications will suggest themselves—for instance, as to the proper temperature to be applied while the apparatus is in operation, particularly where there are a number of volatile constituents of different volatility to be evaporated in the still and be separated from each other. In this system the same rule may be followed as is usually practiced in distilling—that is, the lighter volatile constituents are first evaporated and the temperature is gradually raised step by step until all the volatile constituents are evaporated and separated as may be desired. However, in some instances the temperature may be raised at once to the highest boiling-point under which all the constituents will vaporize. The separating may then be effected by the proper rectifiers and condensers. Still in each instance the vacuum, volume, and force of the air or fluid current may be varied as may be found most advantageous at every stage of the operation and according to the materials to be treated.

It is obvious that the details of construction may be modified without departing from the spirit of the invention, and I do not wish, therefore, to be limited to the forms shown in the drawings.

I am aware that prior to my invention stills and evaporators have been made whereby a vacuum is obtained in conjunction with heaters, condensers, and vacuum-pump. Therefore I do not claim such a combination broadly; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. In an evaporator, the combination of a heating means adapted to heat liquid; means for circulating an air-current through said liquid; means for maintaining said circulating air below normal atmospheric pressure; means for returning said air through said circuit; and means for condensing the evaporated liquid prior to communication with the vacuum-pump, for the purpose set forth.

2. In a distilling apparatus, the combination of a heating means, adapted to heat liquid; a rectifier for causing fractional condensation; means for circulating an air-current through the heated liquid and through the rectifier; means for maintaining said circulating air below normal atmospheric pressure; means for returning said air through said circuit; and means for condensing the evaporated liquid prior to communication with the vacuum-pump, for the purpose set forth.

3. In a distilling apparatus, the combination of a heating means, adapted to heat liquid; a rectifier for causing fractional condensation; a condenser communicating therewith; means for circulating an air-current through the heated liquid, through the rectifier and through the condenser; means for maintain-

ing said circulating air below normal atmospheric pressure; and means for returning said air through said circuit, and means for condensing the evaporated liquid prior to communication with the vacuum-pump, for the purpose set forth.

4. An evaporating system working in closed circuit, comprising an evaporator; means to maintain the air in said circuit below normal atmospheric pressure; means to cause said air to circulate within said circuit and through the liquid in the evaporator; and means for condensing the evaporated liquid prior to communication with the vacuum-pump, for the purpose set forth.

5. An evaporating system working in closed circuit, comprising an evaporator; means to maintain the air in said circuit below normal atmospheric pressure; means to cause said air to circulate within said circuit and through the liquid in the evaporator; means for distributing said air through said liquid; and means for condensing the evaporated liquid prior to communication with the vacuum-pump, for the purpose set forth.

6. An evaporating system working in closed circuit, comprising an evaporator; means to maintain the air in said circuit below normal atmospheric pressure; means to cause said air to circulate within said circuit and through the liquid in the evaporator; a rotating rake for distributing said air; and means for condensing the evaporated liquid, for the purpose set forth.

7. In a distilling system, a still; means for heating said still; a rectifier communicating therewith; means for drawing off condensates therefrom; means for heating said rectifier; a condenser communicating therewith; means for cooling said condenser; means for drawing off condensates therefrom; means for drawing an air-current through the still, rectifier and condenser; a vacuum-pump adapted to maintain said circulating air below normal atmospheric pressure, for the purpose set forth.

8. In an evaporating apparatus, an evaporator; external air-forcing means; air-heating means; and tubular connections whereby said air-forcing means is adapted to circulate air through said air-heater and through said evaporator and fluid therein contained, in a closed circuit, said tubular means including a plurality of heating-tubes normally immersed in the contents of the evaporator and open at or near their lowest point, substantially as described.

9. In an evaporating apparatus, an evaporator, external air-forcing means, air-heating means, tubular connections whereby said air-forcing means is adapted to circulate air through said air-heating means and through said evaporator and liquid therein contained, in a closed circuit, said tubular connections including a tubular rake adapted to rotate in said liquid, substantially as described.

10. The combination of two liquid-receptacles; means for maintaining them at different temperatures; connections between the receptacle of lower temperature and the receptacle of higher temperature; means for withdrawing condensates from the first-named receptacle; a connection, other than that hereinbefore specified, for connecting the first-named receptacle with the second receptacle; means situated in said connections for diminishing the pressure of the gas within the system, and other means for circulating the gaseous fluid through the system, all substantially as described.

11. The combination of two liquid-receptacles; means for maintaining them at different temperatures; connections between the receptacle of lower temperature and the receptacle of higher temperature; means for withdrawing the condensates from the first-named receptacle; a connection, other than that hereinbefore specified, for connecting the first-named receptacle with the second receptacle; means situated in said connections for diminishing the pressure of the gas within the system, and other means for circulating the gaseous fluid through the system, and a tubular rake for distributing said gaseous fluid in the second receptacle, substantially as described.

12. The combination of two liquid-receptacles; means for retaining them at different temperatures; connections between the receptacle of lower temperature and the receptacle of higher temperature; means for withdrawing the condensates from the first-named receptacle; a connection, other than that hereinbefore specified, for connecting the first-named receptacle with the second receptacle; means situated in said last-named connection for diminishing the pressure of the gas within the system; other means for circulating the gaseous fluid through the system, and a heating device to restore the lost heat to the gas before it again circulates through the liquid in the still, substantially as described.

13. In a system of distilling and refining working in a closed circuit, comprising a still and one or more condensers; means for maintaining a circulating gaseous medium through said still and condensers; and other means for maintaining said circulating medium below atmospheric pressure, for the purpose set forth.

14. In an evaporating apparatus, an evaporator, means to cause air to circulate through said evaporator, through the liquid therein contained and out through external air-forcing means in a closed circuit, said circulating means including a plurality of tubes open at or near their lowest point, substantially as described.

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Witnesses:
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OTTO GATHMANN.