No. 785,238. PATENTED MAR. 21, 1905.

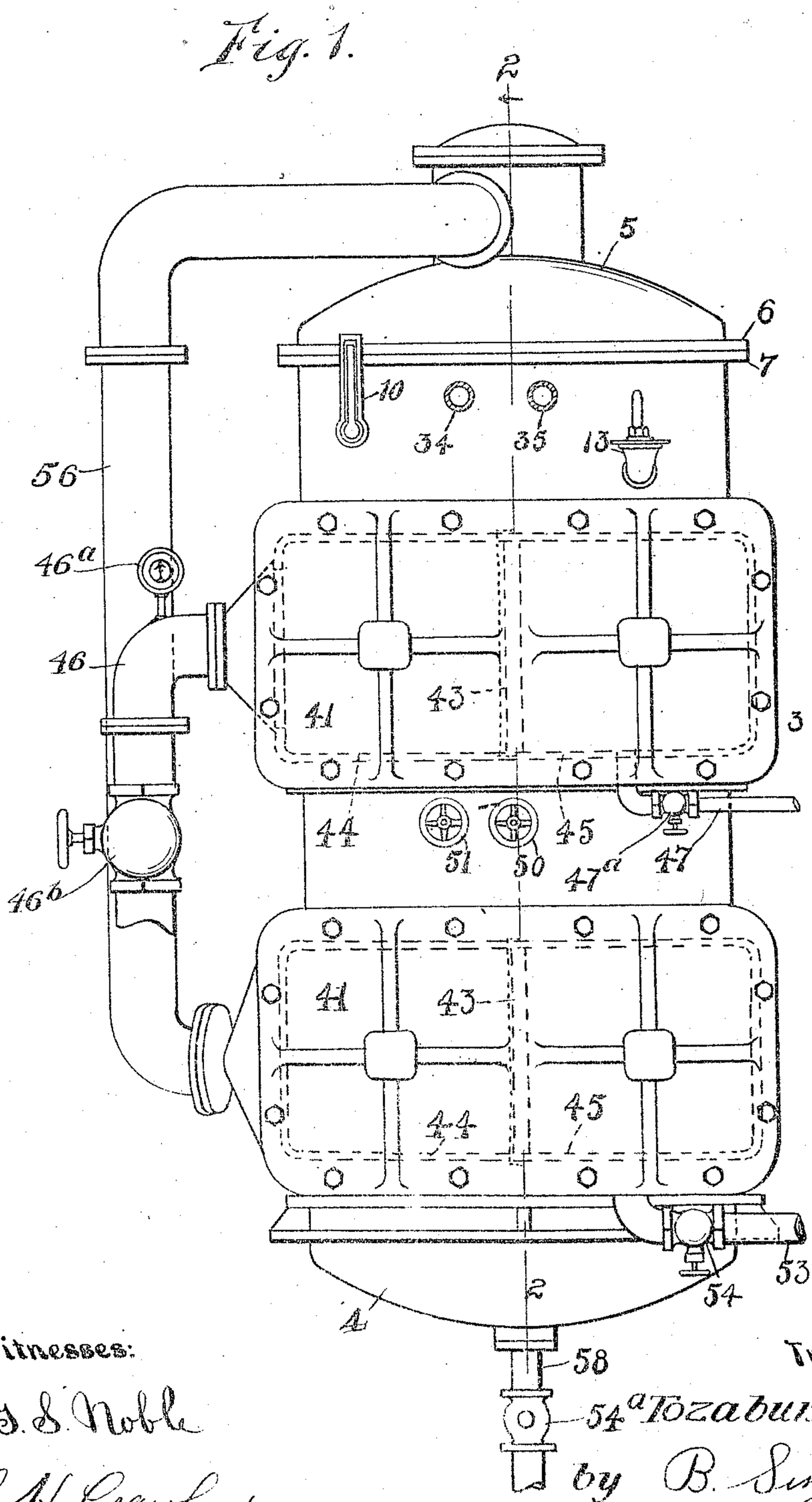
T. SUZUKI.

VACUUM EVAPORATING APPARATUS.

APPLICATION FILED OCT. 17, 1904.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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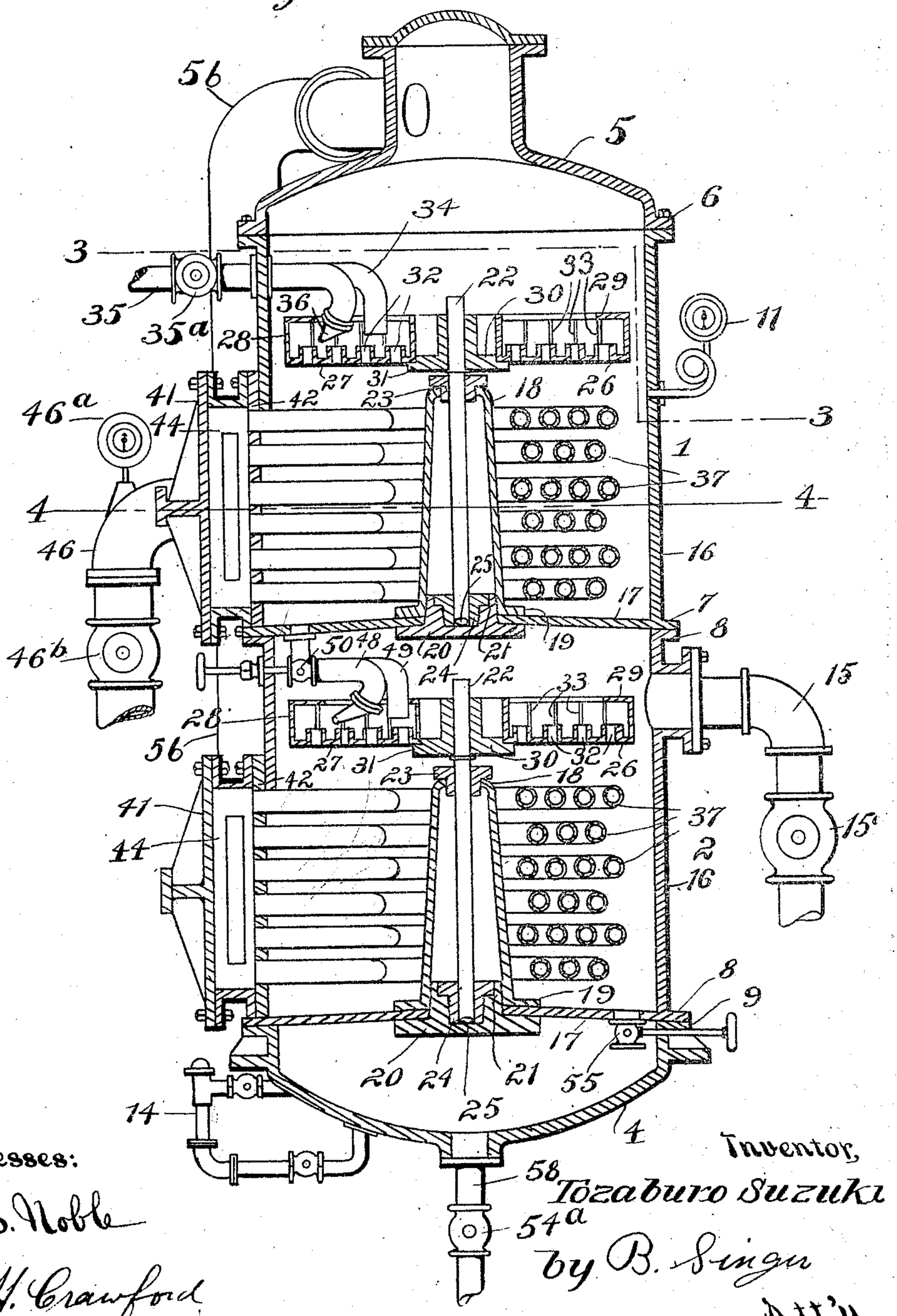
3 SHEETS—SHEET 2.

Fig. 2



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3 SHEETS—SHEET 3.

Fig. 3

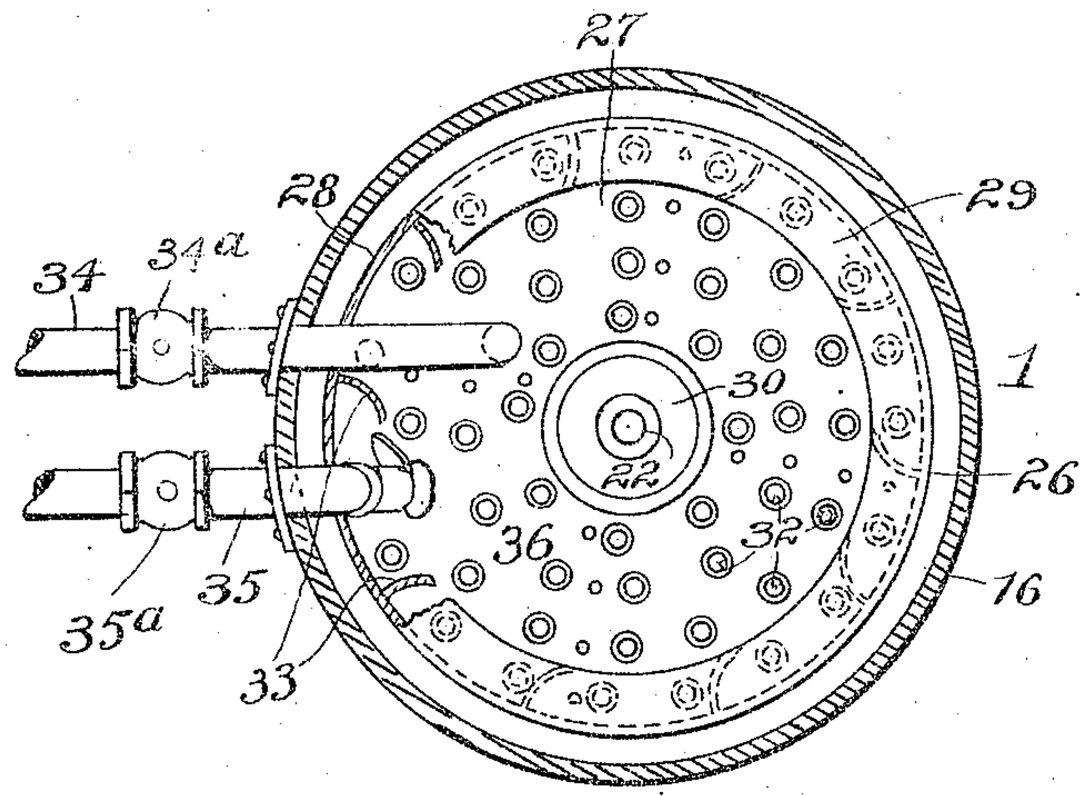
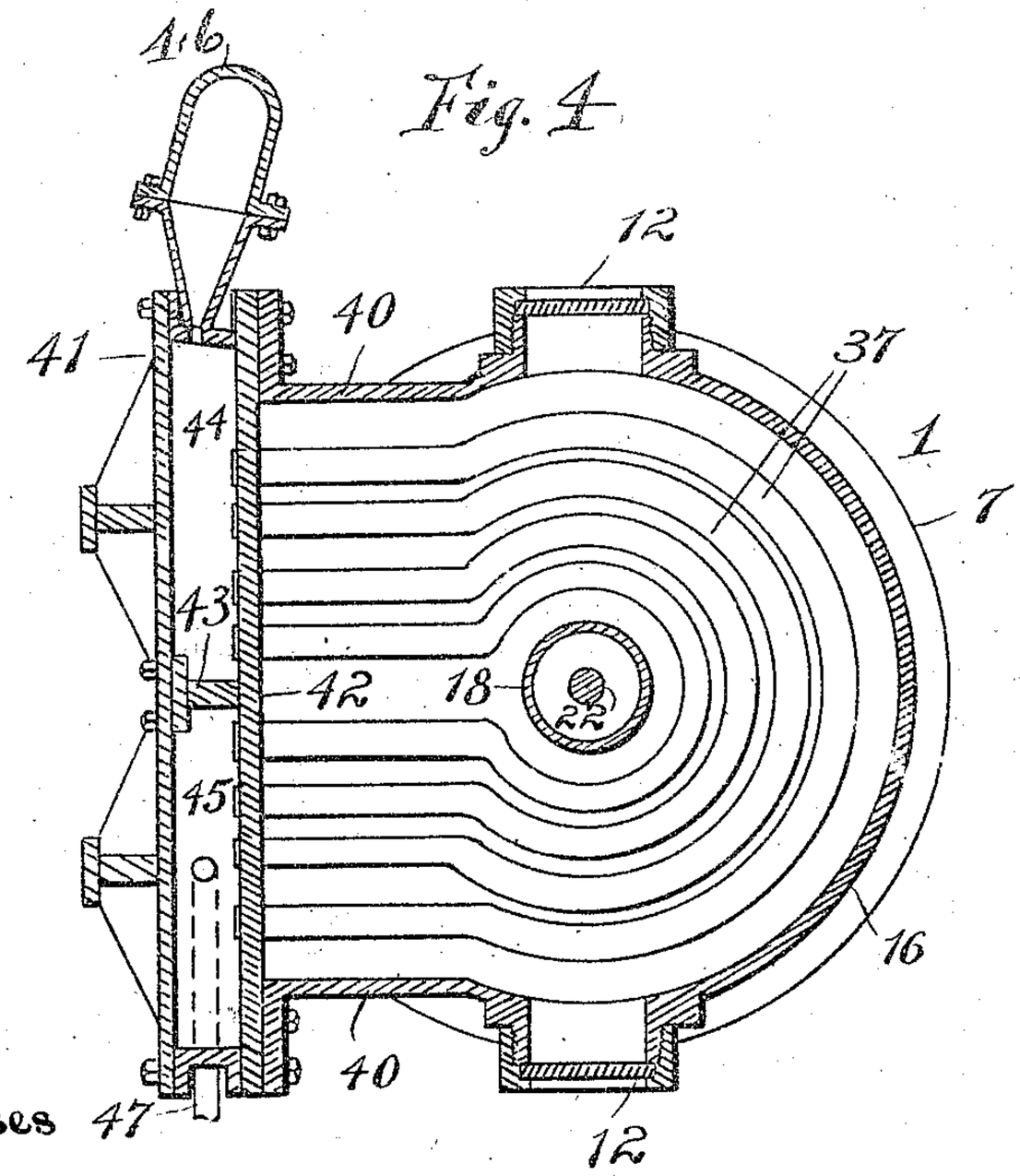


Fig. 4



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No. 785,238. Patented March 21, 190

UNITED STATES PATENT OFFICE.

TOZABURO SUZUKI, OF SUNAMURA, JAPAN.

ACUUM EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 785,238, dated March 21, 1905.

Application filed October 17, 1904. Serial No. 228,772.

To all whom it may concern:

Be it known that I, TOZABURO SUZUKI, a subject of the Emperor of Japan, residing at No. 401 Jibeishinden, Sunamura, in the county of Minami-Katsushika, in the Province of Tokio, Japan, have invented certain new and useful Improvements in Vacuum Evaporating Apparatus, of which the following is a specification.

My invention relates to piled vacuum evaporating appa_atus wherein a plurality of distinct evaporating chambers or pans connected in series coöperate with each other in the operation of evaporating liquid.

My invention relates more particularly to evaporating apparatus wherein liquid during the process of expansion is passed through a series of evaporating chambers or pans, one of the series, preferably the first, being supplied with a heat agency from an initial source, while the remaining chambers utilize discharged vapor of companion chambers as a heat agency to effect further expansion of the liquid in succeeding chambers.

My invention is an improvement upon apparatus covered by Letters Patent No. 764,393, issued to me July 5, 1904, wherein the evaporating-pans are shown as separate and distinct structures. I am enabled to effect substantial improvements in my improved device over the patented device by combining the distinct pans in a single composite structure. One of said improvements consists in providing a plurality of evaporating-coils and in the arrangement of said heating-coils in layers and desirably in staggered relation with each other, thereby materially increasing the evaporating efficiency of each chamber. A further improvement consists in utilizing the gravity flow of liquid from one chamber to the other to effect rotation of distributing-disks, thereby avoiding the employment of auxiliary mechanical appliances and power heretofore necessary.

My invention possesses other important advantages, which will be more fully described by reference to the accompanying drawings and will be more particularly pointed out in the appended claims.

In the drawings, Figure 1 is a view in elevation of a device embodying the main features of my invention. Fig. 2 is a vertical section on line 2 2 of Fig. 1. Fig. 3 is a horizontal section on line 3 3 of Fig. 2. Fig. 4 is a horizontal section on line 4 4 of Fig. 2.

Like characters of reference designate similar parts throughout the different figures of the drawings.

The device herein shown comprises a series of two distinct evaporating-chambers 1 and 2, embodied in a single composite structure 3. Each of the chambers 1 and 2 is a complete and distinct section of the structure 3, which latter may be expanded or contracted in size by the addition or subtraction of one or more sectional chambers. Thus an apparatus of the desired capacity may be supplied without the necessity of designing and building a special structure. The advantages of this feature are enhanced by constructing the lower or base portion 4 and the upper or hood portion 5 separate from the chambers 1 and 2. The points of juncture of the several sections are provided with annular attaching-flanges 6, 7, 8, and 9, whereby the evaporating-chambers may be joined in a hermetically-sealed structure. A thermometer 10 is desirably provided to determine the temperature of the chambers 1 and 2 and a gage 11 to determine the degree of vacuity attained in said chambers. Windows 12 are provided to enable the operator to inspect the interior of the chambers. An air-cock 13 for admitting air to the chambers 1 and 2 is provided, as shown, upon the chamber 1, the base 5 being equipped with a level-gage 14 to enable the operator to determine the amount of liquid which has settled in said base and, if necessary, to withdraw a portion of the same for purposes of examination. An air-exhaust pipe 15, leading from the chamber 2 to an air-pump (not shown) and having a valve 15ª, is provided, whereby a vacuum in the chambers 1 and 2 may be produced previous to starting the evaporating operation.

Each of the chambers 1 and 2 comprises an annular wall 16, open at one end and closed at the other end by an integral base-wall 17, which preferably constitute receiving-pans for the said chambers. Vertically-projecting bearings are separably united to the walls 17

and extend upwardly therefrom in planes coincident with the axes of said chambers. Said bearings, as herein shown, desirably comprise conical tubes 18, having annular flanges 19 upon their lower or larger ends and internal screw-threads adjacent thereto. A flanged nut 20, having a projecting stud 21 equipped with exterior threads, is provided and preferably coöperates with the threads of said tubes 18 to clamp the latter upon the walls 17. Said walls 17 are provided with centrally-disposed apertures to permit the passage therethrough of the studs 21 and their insertion into the base of the tubes 18, as will be clearly seen by reference to Fig. 2. Said studs 21 form seats or lower bearings for rotative shafts 22, which pass through and operate in upper bearings 23, separably united with the tubes 18. A lower bearing 24 is provided and, as shown, is removably secured in the studs 21, which are provided with antifriction mechanism 25. Said shaft 22 carries upon its upper end a rotative distributing-disk 26, comprising an open chamber formed by a lower wall 27, a vertical wall 28, and an overhanging wall 29. Said disk is desirably mounted on the shaft 22 by means of a seat 30, having an annular flange 31, upon which the said disk is directly seated. A series of apertures 32, having projecting flanges, are formed in the lower wall 27 of said disk 26, causing the liquid therein to attain some depth, so that a uniform overflow upon the heating-pipes below will be effected. Said disk is also provided with impact-blades 33, which, as herein shown, extend between the lower overhanging and vertical walls 27, 28, and 29. A supply of liquid to the disk 26 may be effected by means of a pipe 35, having a valve 35^a, which pipe enters said chamber 1 and carries upon its inner end a nozzle 36, the latter being positioned in a manner to direct liquid passing therethrough against the blades 33, thereby utilizing the force thus imparted to rotate the distributing-disk when it is desirable to effect such rotation. Liquid may also be supplied to said disk 26 by a pipe 34, which enters the chamber 1 and projects therein a sufficient distance to carry the liquid to the distributing-disk 26, as will be clearly seen by reference to Fig. 2. A valve 34^a is provided for said pipe. In starting the apparatus the valve 35^a in the pipe 35 may be opened sufficiently to start the disk 26, and when the latter attains the desired speed a further supply of liquid, if needed, may be secured by opening the valve 34^a in the pipe 34. When the liquid overflows the flanged apertures of the distributing-disk 26, it falls upon an area of heat-surface desirably of the following construction: A plurality of pipes 37, preferably arranged concentrically around said shaft 22, is provided, said pipes being grouped in layers spaced apart from each other, the pipes of one layer being in staggered relation with respect to the pipes of adjacent layers. Said pipes preferably occupy the space intervening the distributing-disks 26 and the bottom walls 17 of each chamber. The staggered relation of the different layers of pipes serves effectively to receive the liquid as it falls from the distributing-disks 26. The said liquid in failing to contact with pipes of the first layer is caught by the pipes of a succeeding or lower layer, which are out of vertical alinement with adjacent layers of pipes. The provision of a plurality of pipes avoids the necessity of providing numerous receiving-pans for the unevaporated liquid. This construction is also effective when it is desired that the liquid should accumulate in the chambers. A greater or less contact area between the liquid and pipes 37 may be effected by simply regulating the draining of chambers 1 and 2. I desirably mount the pipes 37 in a manner to permit their removal from the chamber by an operation both simple and effective. To this end a lateral hollow extension 40 is formed upon each of the chambers 1 and 2, having a passage of sufficient dimensions to permit the bodily insertion and withdrawal of the pipes 37 when access to the same or to the interior of the chamber is desired. Previous to withdrawing the pipes 37 it is necessary to remove the centrally-disposed bearings 18 from the chamber to which access is desired. In order that the pipes 37 may be more easily handled in the operation of removing the same from the chambers, I desirably provide a mounting to which both ends of each pipe of the different layers are rigidly attached. Said mounting preferably consists of a hollow chamber 41, divided into ingress and egress compartments, to the inner walls 42 of which the ends of the pipes 37 are attached. A dividing-wall 43 is preferably located in a manner to cause all of the ingress-pipe ends to communicate with the ingress-compartment 44 and all of the egress ends to communicate with the egress-compartment 45. Said mounting is desirably bolted to projecting flanges on the extension 40. A steam-supply pipe 46 communicates with the compartment 44, causing steam to flow through the pipes 37 and pass therefrom through compartment 45 to an outlet-pipe 47. Said pipe 46 is provided with a steam-gage 46^a and a valve 46^b. A valve 47^a is also provided for the outlet-pipe 47.

The construction of the second chamber 2 is desirably similar in all respects to that of chamber 1, hereinbefore described, and like characters of reference are applied. Pipes 48 and 49, which supply liquid to the distributing-disk 26 of chamber 2, are similar in all respects to supply-pipes 34 and 35 of chamber 1, except that instead of extending outwardly through the wall 16 of chamber 2 they communicate with chamber 1 and drain therefrom the liquid retained by the base-wall 17. Said pipes 48 and 49 are controlled by operating valves 50 51. The chamber 2 is provided, as

is chamber 1, with a removable mounting 41 for pipes 37, comprising a divided chamber having an ingress-compartment 44, communicating with the ingress ends of said pipes 37, and an egress compartment 45, communicating with the egress ends of said pipes. The ingress-compartment communicates, by means of a pipe 56, with the hood 5 to convey the vapor discharged from chamber 1 to the evaporating-pipes 37 of chamber 2. An outlet-pipe 53, having a valve 54, leads from the compartment 45 of chamber 2 to a suitable condenser and pump. (Not shown.)

While the operation of the apparatus may be obvious from the foregoing, a brief recapitulation may facilitate a clearer understanding thereof.

In starting the apparatus the confined air is withdrawn through the pipe 15, which leads to an air-pump. (Not shown.) Valves 50 and 51 of the pipes 48 and 49 are opened to establish communication between the chambers 1 and 2. Valve 46^b of the steam-supply pipe is closed; so, also, are valves 34^a and 35^a of the liquid-supply pipes 34 and 35 to chamber 1. Valve 54^a, leading from the base portion 4, is closed, while valve 55, controlling communication between said base portion 4 and the chamber 2, is opened. It will be seen that all parts of the apparatus from which air is to be withdrawn are now in communication with each other and the pipe 15. The gage 11 is also in general communication with the system, and the same is relied upon to indicate the degree of vacuity produced therein. Assuming that the desired vacuum has been produced, the valve 15^a is closed. Steam-passage through the evaporating-pipes 37 in chamber 1 is effected by opening the inlet-valve 46^b and outlet-valve 47^a. It will be understood that air may be exhausted from the steam-coil 37 through the medium of an air-pump (not shown) connected with the outlet-pipe 47. After the steam in the pipes 37 has produced the required temperature in the chamber 1, as indicated by the thermometer 10, valve 35^a is opened to convey liquid to the distributing-disk 26 by means of pipe 35 and the nozzle 36. As before stated, the impact of the liquid against the blades 33 effects rotation of the disk 26, serving to distribute uniformly the overflow through the apertures 32 upon the steam-coil or evaporating-pipes 37. The contact of the liquid with the pipes 37 and its subjection to the high temperature of the chamber 1 produces expansion in the form of vapor, which rises from the chamber 1 to the hood 5 and passes into the pipe 56, whereby it is conveyed to the ingress-compartment 44 of the chamber 2. The vapor as discharged from chamber 1 in passing through the coils 37 of chamber 2 is utilized therein as a heat agency to effect distillation of liquid from chamber 1 which has not been expanded by its passage therethrough. The liquid contents of chamber 1 is then conveyed to chamber 2 by means of pipes 48 and 49, controlled by valves 50 and 51, which pipes operate in a like manner to pipes 34 and 35. Circulation of the vapor through the heating-coils of chamber 2 is maintained by an air-pump and condenser (not shown) connected with the outlet-pipe 47. Thus any condensation of the vapor first admitted is prevented from forming a trap and impeding the passage of said vapor. The liquid remaining in the lower portion of chamber 2 may be drawn off by valve 55 into the base 4, where a pipe 58, having a valve 54^a, serves to further convey the remaining liquid to any suitable destination provided.

The operation of the device of my present invention does not differ materially from the device of my previous invention covered by Letters Patent hereinbefore identified, and the improvements secured by said patented apparatus are also present in the device described by the foregoing, together with additional improvements already fully set forth.

It will be obvious that changes may be made in the construction herein shown without departing from the spirit of my invention.

Therefore what I claim, and desire to secure by Letters Patent, is—

1. The combination, in a composite evaporating apparatus including a series of evaporating-chambers, perforated distributing-disks for said chambers, and means whereby liquid may be supplied to said disks to effect rotation thereof.

2. The combination, in a composite evaporating apparatus including a series of evaporating-chambers, perforated distributing-disks therefor having impact-blades, and liquid-supply nozzles adapted to direct liquid against said blades thereby effecting rotation of said disks.

3. The combination, in a composite evaporating apparatus including a series of evaporating-chambers, perforated distributing-disks having impact-surfaces, and a liquid-supply nozzle adapted to direct liquid against said surfaces thereby effecting rotation of said disks.

4. The combination, in a composite evaporating apparatus including a series of evaporating-chambers having rotary shafts, perforated distributing-disks separably mounted on said shafts, said disks having impact-blades, and a liquid-supply nozzle adapted to direct liquid against said blades thereby effecting rotation of said disks.

5. The combination, in a composite evaporating apparatus comprising a series of evaporating-chambers, operative distributing means therefor, and mechanism whereby liquid supplied to said distributing means serves to effect operation thereof.

6. The combination, in an evaporating apparatus, of evaporating-chambers, distribut-

ing-disks for said chambers, and means whereby liquid may be supplied to said disks to effect rotation thereof.

7. The combination, in an evaporating apparatus, of evaporating-chambers, distributing-disks therefor, having impact-blades, and a liquid-supply nozzle adapted to direct liquid against said blades thereby effecting rotation of said disks.

8. The combination, in an evaporating apparatus, of evaporating-chambers, distributing-disks having impact-surfaces, and a liquid-supply nozzle adapted to direct liquid against said surfaces thereby effecting rotation of said disks.

9. The combination, in an evaporating apparatus, of evaporating-chambers having rotary shafts, distributing-disks separably mounted on said shafts, said disks having impact-blades, and a liquid-supply nozzle adapted to direct liquid against said blades thereby effecting rotation of said disks.

10. The combination, in an evaporating apparatus of evaporating-chambers, operative distributing means therefor, and mechanism whereby said liquid supplied to said distributing means serves to effect operation thereof.

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

TOZABURO SUZUKI.

Witnesses:
R. S. MILLER,
U. JSHIWARA.