

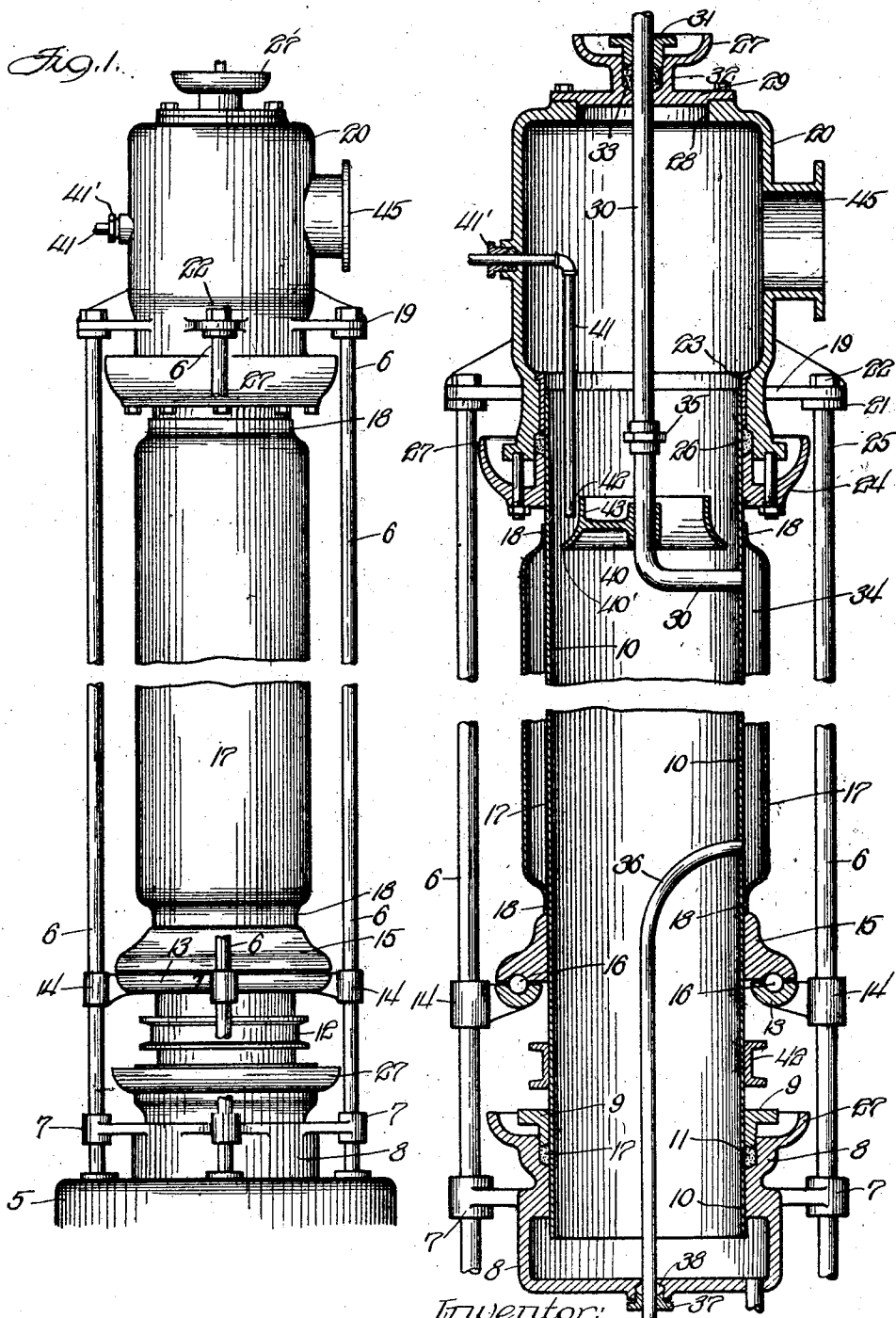
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M. J. KERMER

EVAPORATOR

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Inventor:

MARTIN J. KERMER

By *Josée Bain Hinkle atty.*

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# UNITED STATES PATENT OFFICE.

MARTIN J. KERMER, OF EVANSTON, ILLINOIS.

## EVAPORATOR.

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This invention relates to improvements in method of and machine for evaporating liquids.

One of the objects of the invention is to increase the efficiency of evaporators, condensers and the like.

Another object is to increase the capacity or working factor of such devices to the end that a machine of a given internal volume or surface has a larger evaporating and condensing capability than machines in which my invention is not present.

A further object is to provide a new method of procedure in which centrifugal action is utilized for bringing the liquid or matter acted upon into more intimate proximity with the more effective parts of the heating agent.

A still further object is to provide a machine which is self-cleaning.

A further object is to provide a device of this character in which the entire container is readily removable and replaceable and which, in form, is a pipe of standard size and shape.

Other objects, advantages and benefits will become readily apparent from a consideration of the following description when taken in conjunction with the accompanying drawing, wherein:—

Fig. 1 shows an elevation of the device centrally broken in two to indicate an indefinite length.

Fig. 2 is an enlarged axial section of one form of device embodying my invention.

In both views the same reference characters are employed to indicate corresponding parts.

The gist of the invention consists in rotating the substance to be dehydrated, when the device is used as an evaporator, in a container and about a substantially vertical axis, and cause it to cleave to the inner surface of the container by effect of centrifugal action and to gradually move down the wall thereof by effect of gravity so that all of the heated surface of the container will have been traversed by the moving material which is impacted on the wall thereof in a relatively thin mass or cover.

Spreading out and maintaining the material in a thin cylindrical film upon the inside surface of the inner chamber 10 subjects all of such material to the same uniform absolute pressure entirely eliminating

the resistance to ebullition due to the effect of hydrostatic head. In the operation of the device the ebullition from the thin cylindrical film of moisture is directed laterally toward the axis of the rotating cylinder and not vertically thru the thin film.

Another feature of the invention consists in rotating the heating agent in a jacket about said receptacle by effect of which the more ponderable constituents of said agent, such as moisture or more or less saturated steam, which has parted with latent heat, is thrown against the outer wall of the jacket, leaving the outer surface of the container for direct contact by the steam without the intervention of a film of insulating moisture which would be present if it had not been displaced by centrifugal action. As the steam gives up its latent heat to the contents of the container, it is condensed and the resulting moisture is thrown against the inner surface of the outer wall of said jacket, thereby automatically bringing and maintaining the more effective part of the heating agent always in more intimate proximity with the material being treated.

Another novel characteristic of the invention consists in utilizing the effect of centrifugal action for depositing the material to be dehydrated upon the inner wall of the container when it is first introduced into the container.

Another feature of advantage, due to the rotation of the two concentric containers, lies in the fact that the heat insulating film that would otherwise coat and cover the wall surface of the containers, and which is more or less of an insulating nature is wiped off, displaced or prevented by the relative rotatable movement of said material or materials and the surfaces of the walls of the containers, within which said materials are enclosed.

I have shown one embodiment of the invention which has given very satisfactory results, when used as an evaporator or condenser. There may be changes required, such as variation of the proportions and configuration of the parts to meet the necessities imposed by the character of material to be treated.

The physical structure consists of a suitable base 5 upon which the machine is mounted. Four rods 6 are erected upon the base. Secured to the rods 6 are arms 7

which support the bottom member 8 of the machine. To this member is connected the discharge conduit (not shown), through which the relatively dry material is to be conducted away from the machine.

A cylinder 10, to be rotated, is suspended in the member 8. A gland 9 and packing ring 11 provide a tight joint that permits the cylinder to be rotated.

A pulley 12 is secured to the lower end of the cylinder, by means of which the cylinder may be belt-driven. The cylinder may, however, be driven by a rope drive, friction drive, gearing or other suitable means.

A ring 13 is supported on the four posts 6 by arms 14 and constitutes the fixed ring of a ball bearing upon which the cylinder 10 is supported. Another cooperating ring 15, fixed to the cylinder 10, constitutes the other ball bearing member, and the balls 16, which may be rollers, if desired, afford the friction reducing bearing.

The cylinder 10 is open at both ends and may consist of a standard piece of smooth pipe. I have found a pipe fourteen inches in diameter and twelve or fourteen feet long to answer the purpose admirably.

A jacket, consisting of another pipe 17, spaced from the inner container pipe 10 and preferably concentric therewith is closed at both of its ends in a suitable manner. In the drawings it is shown to be contracted at its ends and welded to the inner pipe at 18. Between the pipes or cylinders 10 and 18 the heating agent is to be contained. The rods 6 support at their upper ends a head 20, by flanges 19, collars 21 and nuts 22. The head 20 carries a wearing ring 23 which may be made of babbitt, or the like, in which the cylinder 10 revolves.

A packing gland 24 is held by studs 25 to compact the packing ring 26, thereby to provide a tight joint and to permit the cylinder 10 to revolve. All of the glands have preferably an inverted skirt 27 to provide a receptacle to contain water which improves the seal and serves as an indicator to show when a gland needs tightening.

The head 20 has a central opening 28 closed by a plate 29 thru which a steam pipe 30 passes. A gland 31 is threaded in the hub 32 rising from the plate and contains a packing ring 33.

The steam pipe 30 is connected with the annular heat chamber 34, located between the cylinder 10 and the jacket 17. For convenience the steam pipe is separable into two sections by the union 35. A condensate pipe 36 is connected to the lower end of the annular chamber 34 and passes out thru the opening closed by the gland 37 and the packing ring 38.

It is now obvious that the cylinders 10 and 17 may be rotated without disturbance

to the steam connections and that the steam pipes will rotate with the cylinders.

Mounted on the steam pipe 30 is an outwardly flared ring or wheel 40, secured thereto by a central hub 39. An intake pipe 41 enters the head 20 and terminates at 42 immediately above the outturned portion 42 of the rim 43. The pipe 41 conveys the liquid or other material to be concentrated.

Before the material to be treated is introduced into the evaporator, the latter is rotated with steam in the steam chamber 34. The discharge from the pipe 41 is received on the outturned flange 40', by which it is thrown off by centrifugal action to the inner surface of the cylinder 10. The greater centrifugal action, due to the larger diameter of the cylinder, will cause it to cleave to the inner surface thereof and the effect of gravity causes it to gradually move toward the bottom of the cylinder into the lower head 10 from which it may be suitably trapped or otherwise discharged.

The lag of the material and the effect of gravity causes the material being treated to traverse the entire inner surface of the cylinder 10 and to be held forcibly in contact therewith.

The centrifugal effect causes the more ponderable portions of the steam, water or vapor, to be thrown outwardly into intimate contact with the inner surface of the jacket cylinder 17, leaving space between the more potential portions and the inner cylinder for more direct contact.

The cylinder 10 is not to be filled with material undergoing treatment at any time. A film, entirely covering the inner surface of the cylinder 10 will subject a large surface to the heating effect of the steam and to the liberation of moisture or vapor.

The speed of rotation of the rotatable elements of the machine, evaporator or condenser, may be varied and adjusted to determine the period of time which the material under treatment will remain in the evaporating chamber.

It will thus be seen that the evaporating or condensing effect may be continuous in operation and not intermittent, as heretofore, as the material is automatically introduced into the automatically discharged from the evaporating chamber.

It is further manifest that the material within the evaporator or condenser is forcibly maintained in form of a relatively thin, constantly changing vertical cylinder and that this cylinder is continuously being formed and disrupted at its relative extremities. It is also apparent that the material is at all times subjected directly to the greatest heat dispensing part of the steam without any intervening films of air or moisture which have insulated effects which reduce the efficiency of evaporators.

When the device is to be used as a condenser, the vapor or steam to be condensed or converted into liquid form is introduced into the outer chamber 34 and the cooling water is introduced into the inner chamber 10.

The chamber 34 may be entirely filled with the heat interchange material, such as steam or cold water, but the inner chamber 10 may have a relatively thin covering of the inner surface of the cylinder 10 which is maintained in contact therewith by centrifugal action.

Should the interior of the cylinder 10 become coated with the material which has been treated in the evaporator it may be easily cleaned by the automatic operation of the device.

To clean the device, sand, or a similar form of detergent, should be inserted thru the pipe 41, or by other means, upon the rotating curved surface 40' of the wheel 40. The centrifugal action will cause it to fly off and lodge in contact with the inner surface of the cylinder where it will remain by effect of centrifugal action and, gravitationally influenced, it will gradually work towards the bottom end of the cylinder. The lag of the sand will serve to scour the inner surface of the cylinder 10 and remove all deposits therefrom. Hot or cold water may be admitted with the sand or other solvents may be used as a cleansing agent in connection with or without the sand.

For the purpose of cleaning, the speed of the cylinder may be varied. The faster the cylinder is rotated the longer time it requires for the material in contact with the inner surface of the cylinder to move axially to the bottom discharge end thereof, and the slower the cylinder is rotated the shorter period of time will be required to accomplish this result. This is due to the fact that

the greater the centrifugal action the more tenaciously the material will adhere to the cylinder interior surface.

Where I have used the term "evaporator" in the claims for a clear definition of the structure it is obvious that the word is not a limitation but a word of definition and where I have referred to the outside concentric space as a steam chamber it is manifest that other heat interchange agencies such as cold water and the like may be used in the outer casing or jacket when the contents of the inner chamber or cylinder require the presence of such an agency.

Having described my invention what I claim as new and desire to secure by Letters Patent, is:—

1. An evaporator comprising a vertical cylinder open at both ends, to contain material to be dehydrated; a jacket surrounding the cylinder to contain steam; means to rotate the cylinder and jacket and centrifugally operating outwardly flared open annulus to deposit said material upon the inner surface of the cylinder.

2. An evaporator comprising a vertical cylinder open at both ends, to contain material to be dehydrated; a jacket surrounding the cylinder, to contain steam and rotatable therewith; means to rotate the cylinder and jacket; a relatively stationary head at each end of the cylinder; means on the upper head to connect it to an exhaust pump; a packing between the ends of the cylinder and the respective heads; a friction reducing bearing to support the cylinder between said heads; and an annulus flared outwardly to project the material being operated upon into contact with the inner surface of said cylinder.

In testimony whereof I hereunto set my hand.

MARTIN J. KERMER.