No. 711,719. Patented Oct. 21, 1902.

M. EKENBERG.

VACUUM PAN.

(Application filed Jan. 3, 1902.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 5

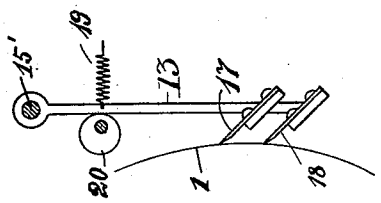


Fig. 6

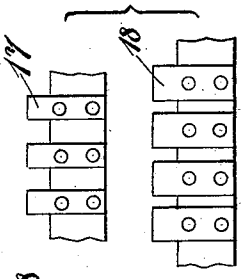


Fig. 2.

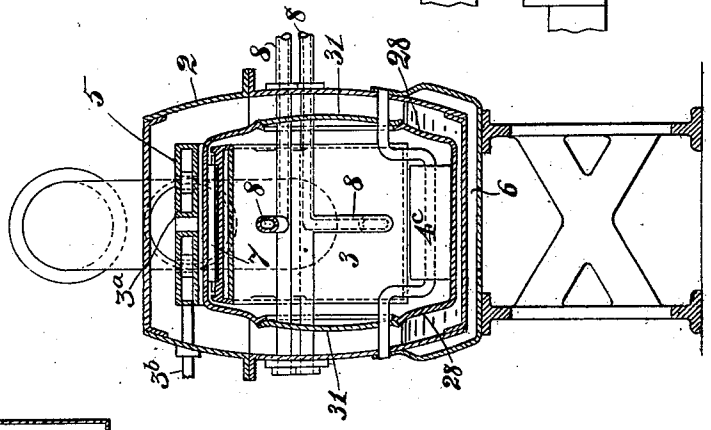


Fig. 7.

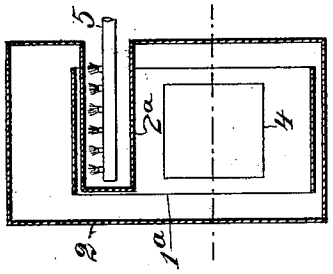
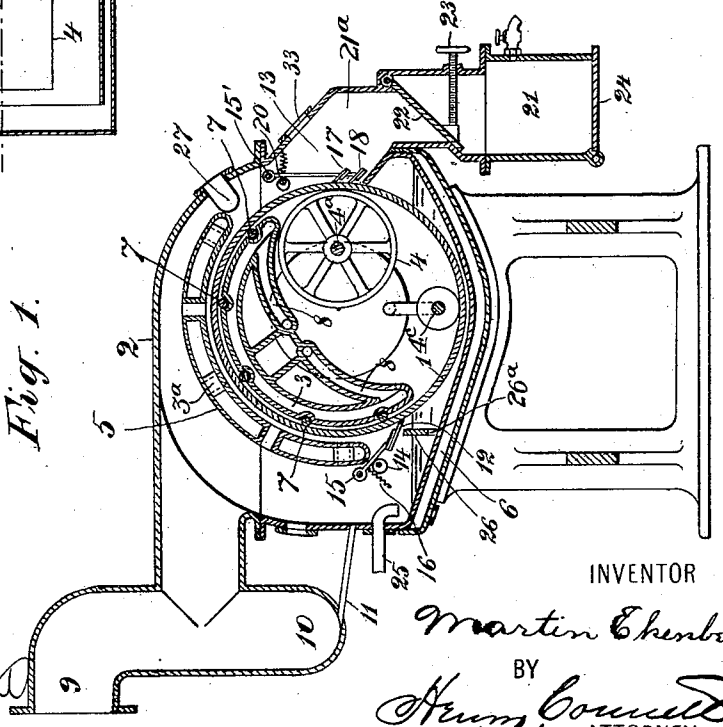


Fig. 1.



WITNESSES:

F. W. Ellmore

H. Alan Connett

INVENTOR

Martin Ekenberg

BY

Henry Connett

his ATTORNEY

No. 711,719. Patented Oct. 21, 1902.

M. EKENBERG.

VACUUM PAN.

(Application filed Jan. 3, 1902.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 4

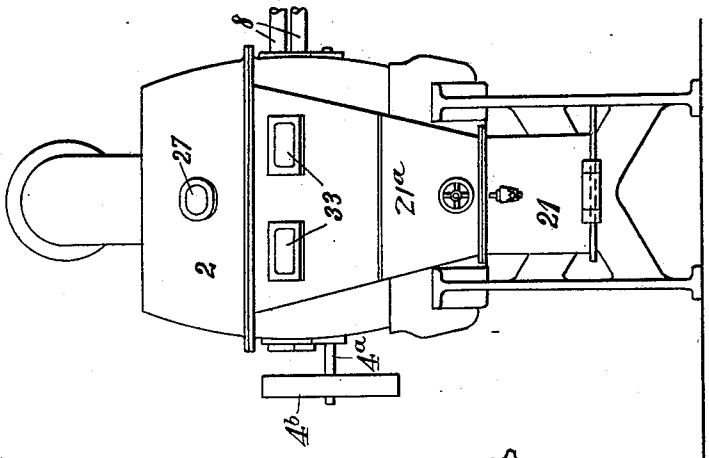


Fig. 3

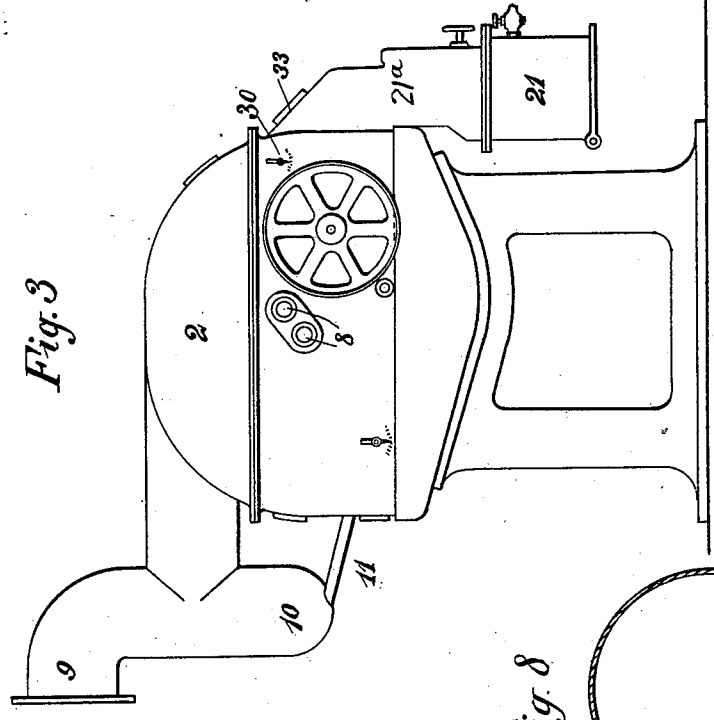
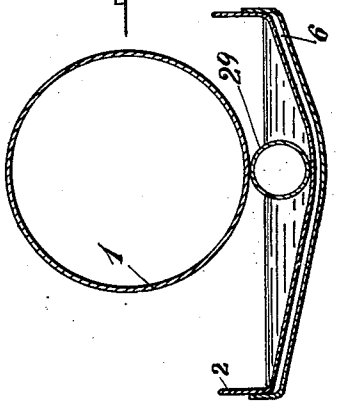


Fig. 8



Witnesses
F. W. Hinman
H. Alan Connell

Inventor
Martin Ekenberg
By his Attorney
Henry Connett

UNITED STATES PATENT OFFICE.

MARTIN EKENBERG, OF GOTHENBURG, SWEDEN.

VACUUM-PAN.

SPECIFICATION forming part of Letters Patent No. 711,719, dated October 21, 1902.

Application filed January 3, 1902. Serial No. 88,290. (No model.)

To all whom it may concern:

Be it known that I, MARTIN EKENBERG, a subject of the King of Sweden and Norway, and a resident of Gothenburg, in the Kingdom of Sweden, have invented certain new and useful Improvements in Vacuum-Pans, of which the following is a specification.

This invention relates to vacuum apparatus for reducing or condensing liquid substances by evaporation—such as milk, for example; and it belongs to that class of such apparatuses in which a moving part within a vacuum-pan carries up on its surface above the level of the mass of liquid substance a thin film of the latter, which is thus reduced by evaporation and scraped off. The moving surface may be the surface of a rotating drum.

In the present case the novel features of the invention reside partly in the construction and arrangement of the drum or moving body inside of the pan, partly in the means for scraping off and receiving the condensed or evaporated substance, partly in the means for heating the said drum or moving body, and partly in other details of the construction.

In the accompanying drawings, which illustrate an embodiment of the invention, Figure 1 is a vertical mid-section of the apparatus in its preferred form, the plane of the section being transversely of the axis of the inner rotatable drum; and Fig. 2 is also a vertical section of the same, but taken along the axis of the said inner drum. Fig. 3 is a side elevation of the apparatus, and Fig. 4 an end elevation of same as seen from the right in Fig. 3. Figs. 5 and 6 are detail views of the main scraping device. Fig. 7 is a sectional view illustrating somewhat diagrammatically a means of heating with gas-jets, and Fig. 8 is a fragmentary view showing a supplementary roller for applying the substance to be condensed to the surface of the moving body or drum.

The vacuum-pan 2 is herein shown as provided with an outlet 9, leading to a powerful exhausting apparatus of the usual kind, (not shown,) a pocket 10 to catch the drip, a pipe 11 to lead the drip back into the pan, a jacket 6 at the bottom to receive steam or other heating medium, and a feeding-inlet 25. Within the pan 2 is a rotatable drum 1, which is hollow, the heads or ends of the drum each having in it a large central aperture, which may be, however, closed by a cover 31, Fig. 2, that does not rotate with the drum. The annular part 28 of the drum head or end should or may be wide enough to prevent the liquid substance in the bottom of the pan 2 from overflowing into the drum at its ends, as the covers 31, if employed, will not be fixed to the drum.

The drum 1 is driven by a wheel or roller 4, the shaft 4^a of which extends out through the central apertures in the ends of the drum and rotates in packed bearings in the sides of the pan 2. On the outer end of the shaft 4^a is a driving-pulley 4^b, Figs. 3 and 4. As seen in Fig. 1, the wheel or roller 4 bears on the inner face of the hollow drum and drives it to the right as the parts are seen in Fig. 1. A bearing and guide roller 4^c bears on the inside of the drum at the bottom and tends to keep the drum down in place. The stationary shaft on which this roller turns is bent so as to pass out through the central apertures in the ends of the drum, and it is secured at its extremities in the side walls of the pan 2.

Inside of the drum 4 is a fixed hollow heater 3, supplied with steam through suitable pipes and passages 8. This heater is of a substantially semicircular form exteriorly, its curved outer face conforming substantially to the curvature of the inner face of the drum. Mounted rotatively in the outer face of the heater 3 are rollers 7, which bear upon the drum and form antifriction-guides. The pipes 8 and shaft 4^a will pass through the non-rotating covers 31, if such covers are employed, and the pipes pass out through packed apertures in the side walls of the pan 2. It will be noted that the several rollers 4, 4^a, and 7 form internal guide-bearings to keep the drum in its proper position as it rotates and that the lower side of the drum extends nearly to the bottom of the pan 2.

Preferably there will be a hollow concave heater 3^a exterior to the drum 1 (see Fig. 1) and adapted to receive steam through a pipe 3^b.

At the back of the drum 1 (seen at the left in Fig. 1) is a scraper 12, hinged at 15 and held up to an eccentric 14 by a spring 16. Normally this scraper is not quite in contact with the drum-surface; but the eccentric en-

ables it to be set up toward the drum. At the front (seen at the right in Fig. 1) is another scraper, which consists of two comb-like blades 17 and 18, Figs. 5 and 6, secured on an arm 13, hinged at 15' and furnished with an adjusting-eccentric 20 and compression-spring 19. The detail views show the construction plainly, Fig. 5 being a side view, and Fig. 6 a plan view, of the two scraping-blades. In Fig. 6 it will be noted that the teeth of the two scrapers are so set that those of the scraper 18 come opposite the spaces between those of the scraper 17. The arbors of the two eccentrics 14 and 20 extend out through the sides of the pan and are provided exterior to the pan with pointers 30, respectively, which traverse graduations on the pan. These devices aid in securing accurate adjustment to the scrapers.

21 is a receiver or chamber to receive the substance removed by the scrapers 17 and 18. This substance falls first into a trunk 21^a, which leads it down to the receiver 21. 22 is a hinged valve in the trunk above the receiver 21, and 23 is a screw for operating said valve to open or cut off communication between the receiver 21 and the pan 2. This valve is to be closed when the bottom 24 of the receiver 21 is opened for the removal of the condensed material or substance collected. The valve 22 and hinged bottom 24 form a kind of air-lock of the receiver 21.

A partition 26 in the bottom of the pan 2 and between the drum 1 and inlet 25 extends above the level of the liquid substance in the pan and acts as a baffle or check to prevent the fresh liquid as it enters from flowing over the surface of the thicker liquid in the pan and directly to the drum. This partition or baffle has, however, apertures 26^a at its bottom, through which the liquid may pass.

The operation is as follows: The drum 1 rotates, as stated, to the right, as seen in Fig. 1, and the milk or other liquid to be condensed is fed in at the inlet 25 in a continuous manner by preference. A vacuum or partial vacuum is maintained in the pan by known means. Only a small part of the rotating drum is immersed in the liquid. As the thickened and partially-condensed liquid is carried up on the drum the scraper 12 removes any surplus, leaving only a thin layer or film on the drum. This layer is condensed, and when it reaches the scraper-blades 17 and 18 these scrape it off and it falls down into the receiver 21. The valve 22 may be left open normally and be closed only when the chamber 21 is to be emptied. The operation may be observed through a glazed sight-aperture 33 in the trunk, and the interior may be illuminated by a lamp 27, set in the casing of the pan.

Fig. 7 shows how the drum or its equivalent may be heated interiorly by means of gas-jets or the like. In this construction the ends of the drum 1^a are left wholly open, and a reëntering portion 2^a of the pan 2 extends into the drum at one of its open ends. A gas-pipe 5 extends into the chamber thus formed and has burners for heating the wall of the chamber and through it the drum.

In Fig. 8 a modification is shown somewhat diagramatically wherein the drum 1 does not itself extend down into the liquid, but an immersed roller 29 carries the liquid to the lower surface of the drum.

I do not limit myself to the specific construction of the apparatus herein shown and described, as this may be varied in many respects without departing in any material degree from my invention. For example, I have shown several ways of heating the drum or moving part in the pan; but obviously other means of heating may be employed as well. Also I have shown said moving part in the form of a drum; but it may have other forms, and by the word "drum" as herein used I mean to imply any endless movable carrying device having a surface which will take up a film of the liquid substance, said device operating in combination with means for scraping or removing the film of condensed substance from said surface.

One of the important features of my machine or apparatus is the open drum, whereby the pressure inside is the same as that outside. The covers 31, if used, do not close the drum hermetically.

Having thus described my invention, I claim—

1. In an apparatus for the purpose specified, the combination with a vacuum-pan to contain the liquid to be condensed, a rotating drum in said pan open to the interior of the pan so as to equalize the pressure on its outer and inner faces, a convex-faced heater within the drum and having its convex face adjacent to the inner face of the drum, means for supplying a fluid heating medium to said heater, and means for scraping the film of condensed substance from said drum.

2. In an apparatus for the purpose specified, the combination with a vacuum-pan to contain the liquid to be condensed, a drum rotatively mounted in said pan and having a central opening in each end, a driving-wheel within and bearing on the drum, the shaft of said wheel extending out of the open ends of the drum and having bearings in the pan-casing, and means for heating the drum.

3. In an apparatus for the purpose specified, the combination with the vacuum-pan, the rotating drum within the pan, and means for scraping the condensed substance from the drum, of a steam-heater adjacent to the drum, and bearing-rollers between said drum and heater.

4. In an apparatus for the purpose specified, the combination with the vacuum-pan, of the open-ended rotating drum within the pan, means for holding the lower side of said drum immersed in the liquid, a rotating driving-wheel in the drum and bearing on the inner face of the drum, a scraper in the pan exterior to the drum and opposite to said driv-

ing-wheel, and means for heating said drum with a fluid medium.

5. In an apparatus for the purpose specified, the combination with the vacuum-pan, of the free, open-ended drum within the pan and rotatable in the liquid therein, the driving-wheel 4 within the drum, its shaft, the convex heater within the drum, means for supplying a fluid heating medium thereto, and two sets of scrapers for removing the condensed film from the surface of the drum.

6. In an apparatus for the purpose specified, the combination with the vacuum-pan and the rotating drum therein, of the scraper comprising the two comb-like blades 17 and 18, adapted to bear on the drum obliquely, one in advance of the other.

7. In an apparatus for the purpose specified, the combination with the vacuum-pan, of the open-ended drum 1 within the same, driving means within the drum for rotating it, a convex, hollow heater within the drum, said heater having rollers bearing on the inner surface of the drum, and two scraper devices, one of said scraper devices being in contact with the surface of the drum and the other out of contact therewith, the heater being situated between said scraper devices.

8. An apparatus for the purpose specified comprising a vacuum-pan, a drum therein having equal pressure on its inner and outer surfaces, means for moving said drum, interior and exterior heaters which fit up closely to said drum, said heaters being inside of the pan, and means for scraping the condensed substance from the outer surface of the drum.

9. In an apparatus for the purpose specified, the combination with a vacuum-pan, and a drum rotative within said pan, said drum having central openings in its respective ends of less diameter than the drum, of means for rotating said drum, said means being situated inside of the drum, a convex-surfaced heater within the drum, pipes for supplying a heating fluid to said heater through the open end of the drum, and scrapers for removing the condensed substance from the drum.

10. An apparatus for the purpose specified, having a vacuum-pan, a rotary, horizontal, open-ended drum within said casing, and a heater within said drum, the surface of said heater conforming in shape to the inner surface of said drum.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

MARTIN EKENBERG.

Witnesses:
ERNST SVANQVIST,
A. F. LUNDBORG.