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M. AUDIFFREN & H. A. SINGRÜN.

ROTARY REFRIGERATING MACHINE.

APPLICATION FILED JUNE 20, 1906.

Fig. 1

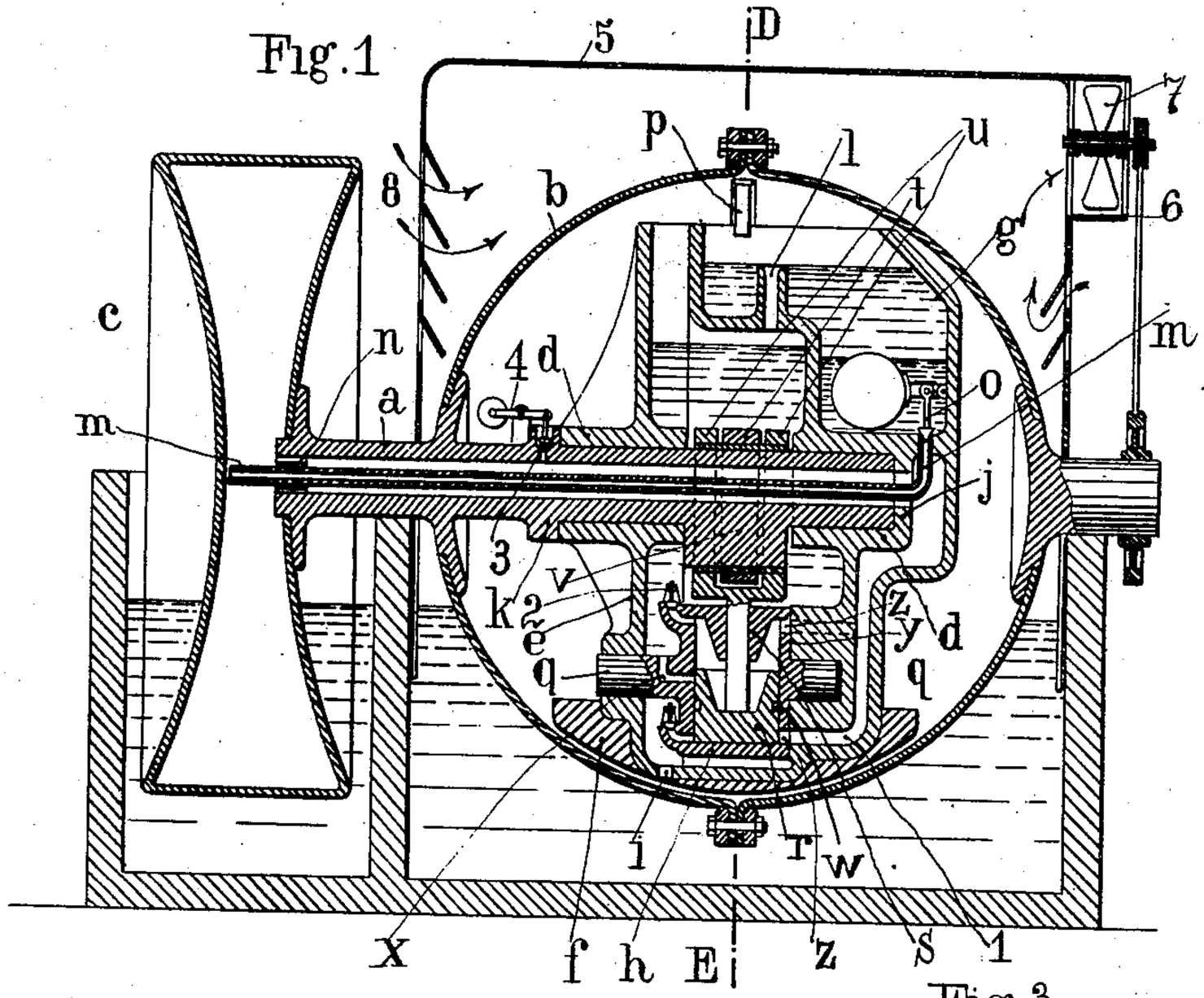



Fig. 2

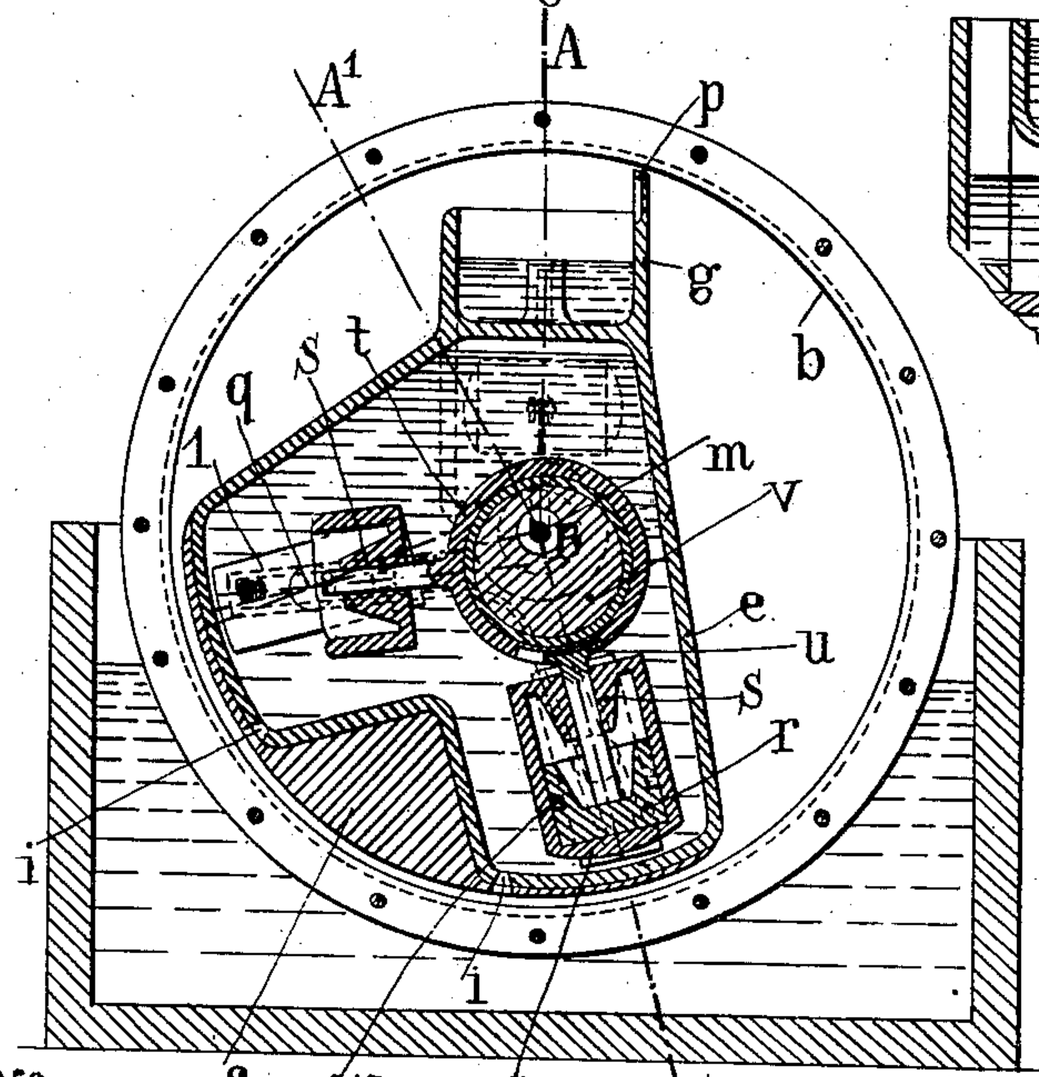
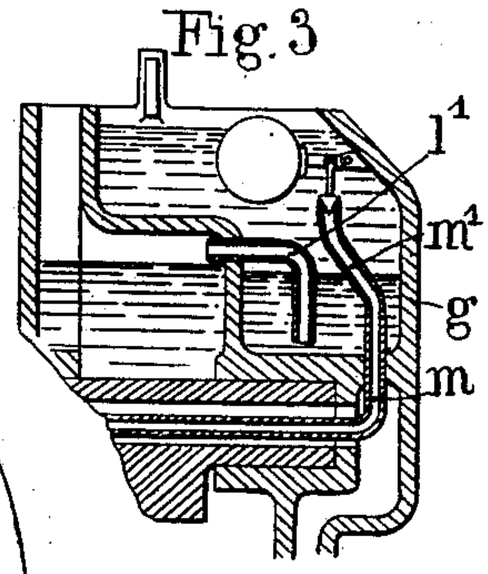



Fig. 3

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## ROTARY REFRIGERATING-MACHINE.

No. 898,400. Specification of Letters Patent. Patented Sept. 8, 1908.

Application filed June 20, 1906. Serial No. 322,545.

*To all whom it may concern:*

Be it known that we, MARCEL AUDIFFREN and HENRI ALBERT SINGRÜN, citizens of the French Republic, and residents the first of Golbey, near Epinal, Vosges, and the second of Epinal, Vosges, France, have invented new and useful Improvements in Rotary Refrigerating-Machines, of which the following is a specification.

The present invention relates to improvements in rotary refrigerating machines, that is to say machines for the production of cold, consisting of a rotary condenser, within which are arranged one or more compressors of liquefiable gases (such as sulfurous acid) and any convenient form of evaporator or refrigerator.

In rotary refrigerating machines hitherto constructed the oil which is introduced into the condenser to assure the lubrication of the working parts only performs this work imperfectly, and moreover diminishes the output of the compressors owing to the absence of suitable means for effecting its complete separation from the refrigerating liquid within the condenser and a proper circulation of each of these liquids. The improvements to be described below obviate these disadvantages.

Figure 1 of the accompanying drawing is a section, on the broken line A. B. C. in Fig. 2, of an apparatus furnished with these improvements, in the position which it occupies when rotating and working with a refrigerating liquid heavier than oil. Fig. 2 is a section of the same apparatus on the line D E of Fig. 1. Fig. 3 is a partial section on the line A B of Fig. 2, showing the arrangement which may be adopted when a refrigerating liquid lighter than oil is employed.

A hollow shaft *a* carries and actuates in the ordinary way the condenser *b* (within which is all the mechanism for compressing the liquefiable gases), and it also carries the evaporator or refrigerator *c*, and puts these two parts into communication for circulating the gases and liquids. From this shaft is suspended by means of two sleeves *d d* a casting *e* weighted by a weight *f*, which prevents it from turning, and surmounted by a separating reservoir *g*. It carries in addition the compressors *h* and also the mechanism for distributing the lubricating oil and for collecting the same and separating it and for circulating the liquids. The whole of this mechanism, which when the machine is in operation occupies the position shown in Fig. 2, on the machine coming to rest and when no longer working as a compressor, takes up a position by reason of its own weight at an angle equal to A′ B A to the position shown.

The casting *e* may be open at its base and even at its sides, or it may be closed at all points (as shown in the drawing by way of example). In the latter case it has at its base one or more drainage openings *i* for the oil, of suitable section as will be explained below.

At the inner end of the shaft *a* one of the sleeves *d* of the casting through which the shaft passes is furnished with an annular bearing *j*. A perfectly water tight joint at this bearing is automatically secured when the machine is in operation by reason of the partial vacuum in the refrigerator *c* and the compression in the condenser *b*, as a result of which the casting *e* is pressed against the end of the hollow shaft *a* through which communication between the two chambers takes place. In order to secure an almost indefinite life for the said joint and distribute the wear over a larger surface a second safety bearing may be formed by the end of the other sleeve *d* of the casting which abuts upon the collar *k* of the shaft *a*.

In the construction shown in the drawings in Figs. 1 and 2 which is specially designed for the case when the refrigerating liquid is heavier than the oil, or other lubricant employed, the separating reservoir *g* in the upper part of the casting which is intended to assure the separation of the liquids in the order of density has an outlet opening *l* by which the separated oil can escape onto the compressors *h* and all the working parts below. It has moreover a return pipe *m* which serves to return the refrigerating liquid to the evaporator *c*, as it is purified. The pipe *m* is rigidly connected with the casting *e* and consequently does not revolve with the shaft *a*. It passes into the evaporator *c* through a cross piece *n*, through the arms of which the necessary draft takes place.

Within the separating reservoir is arranged an obturating valve *o* with float or ball to control the opening of the pipe *m* so as only

to allow liquid which has been freed from oil to pass into the refrigerator. The ball is weighted so as to float only in the refrigerating liquid.

In the modification shown at Fig. 3, to meet the case where the oil is heavier than the refrigerating liquid, the pipe $l'$ for the escape of the oil reaches to the bottom of the separating reservoir, while the pipe $m$ is extended, the portion $m'$ reaching to the top of the reservoir.

A scraper or collector $p$ serves to automatically collect and bring into the separating reservoir the mixture of liquids which is held against the sides of the condenser $b$, by the centrifugal action of the machine. This device may be replaced by any suitable contrivance for raising liquids.

The compressors $h$ are oscillating and double acting and each is mounted in the casing $e$ by means of trunnions $q$, and is provided with a piston $r$ which is preferably hollowed on the side turned towards the axis of the apparatus, so as to exactly fit a projecting boss formed by the cover $s$ of the cylinder through which passes the piston rod, this arrangement being devised to reduce the diameter of the apparatus as much as possible.

The piston rods end in collars $t$ $u$ which embrace the eccentric portion $v$ of the shaft $a$, so that the rotation of the shaft reciprocates the pistons.

Instead of metallic packing the piston $r$ is furnished with a circular groove $w$ which is continually fed with oil by means of the passage $x$ in the side of the cylinder. This collar of oil forms an absolutely water-tight and at the same time lubricating packing.

Each oscillating compressor cylinder carries on the inlet side a valve plate $y$ furnished with two ports $z$ which the oscillation of the cylinder alternately puts into communication with the inlet passages $l$ in the casting $e$. All these passages open out opposite the end of the hollow shaft $a$. The cylinders $h$ are formed with valve plates $y$ which are automatically held tightly against the sides of the casting $e$ by the pressure in the condenser which, being greater than that in the refrigerator $c$ to which the cylinders are opened through the passage $l$, acts on one side of the cylinder (the left in Fig. 1) and the suction acts through the one or other of the passages $l$ leading to the ports on the other side of the cylinder, depending upon the position of the cylinder. In Fig. 1 this suction force is exerted through the passage leading to the upper port.

The outlet valves 2 of the compressors may be of any ordinary construction, the oil in which they work reducing the shock and insuring a perfect closure in all cases. If desired two, three or four multiple double acting compressors may be used, in which case they should be set apart at angles of 60°, 90° and 120°, respectively, for the purpose of overcoming the dead points and preventing the weight $f$ from balancing or revolving around the shaft $a$. The shaft $a$ is also provided with one or more equalizers, the object of which is to instantly equalize the pressures, on the machine being stopped, and consequently very rapidly equalize the temperatures in the condenser and refrigerator, by automatically putting them into communication as soon as the machine is stopped. This is of importance for allowing the machine to be started again immediately and for facilitating the detachment of the ice which has accumulated on the outer side of the refrigerator. This contrivance consists of a valve 3 actuated by a weighted lever 4 arranged opposite an opening in the shaft $a$. The automatic closing and opening of the valve is controlled by the counterweight which is acted on by the centrifugal force of the machine when running or is unaffected when the latter is at rest. Finally the condenser is covered by a hood 5 which reaches down into the cooling water. This hood is provided with a shaft 6 furnished with a ventilating fan 7, driven by the shaft of the machine or in any convenient manner; and with openings 8 for the circulation of the air. The air passing across the water in a finely divided state caused by the rapid rotation of the condenser effects a considerable cooling of the water and consequently reduces the amount of water required for condensation. Also the air drawn in by the fan 7 through the openings 8 at the opposite side of the casing 5 is cooled to a considerable extent by being drawn over the evaporator $c$. This, of course, aids considerably in cooling the water sprayed from the rapidly rotating condenser.

The operation of the apparatus is as follows: The compressors $h$ draw from the evaporator $c$, the vapors or gases of the refrigerating liquid, through the hollow shaft $a$, conduits $l$ and ports $z$, and force them out through the discharge valves 2 into the liquid in the casting $e$. These vapors or gases are thus compressed by the pumps into the condenser and are finally liquefied. The mixture of oil and refrigerating liquid which under the centrifugal action of the rotating apparatus is held against the inner side of the condenser, is being continuously collected by the collector $p$ which passes it into the separating reservoir $g$, where it separates in the order of density. The oil as it is separated continuously falls upon the compressor and on the working parts and passes between all the working surfaces which are in contact. When the casting $e$ is open, the oil covers all the parts with a circulating coating and when the casting is closed these parts are entirely immersed. In the latter case the

drainage openings are of a section which varies in proportion to the section of the collector and the rate of rotation of the apparatus so as to maintain the oil at about the level shown in the drawing.

The oil which falls into the condenser becomes cooled on coming into contact with the sides of the latter and is collected again together with the refrigerating liquid by the collector *p*, and returned to the upper portion of the separating reservoir, where it is again separated, falls again upon the compressors and so on.

The refrigerating liquid returns to the evaporator by the pipe *m* as it is freed from oil, the ball cock or float valve only allowing it to escape when perfectly separated from the oil, so that only oil circulates on the compressors and neighboring parts, and only refrigerating liquid is sent back into the evaporator. This circulation and separation is effected in a continuous cycle, thus assuring the cooling of the compressors and other parts, the absolute imperviousness of all joints, the diminution of shock to all working parts and perfect lubrication. It is further to be noted that immersion in the oil allows of dispensing with the inlet valves ordinarily used in compressors thereby doing away with the difficulties of regulating and also with the troublesome space which results with their use, and allows of replacing them by friction slides. The stuffing boxes of the piston rods may be done away with as well as the metallic packing for the pistons. Moreover the imperviousness of the joints, which is likewise due to the coating of oil, prevents the gases compressed in the condenser from passing into the refrigerator. In short, all these results which are due to a continual cycle of circulation and the separation of the liquids as described contribute to increasing the output and lasting properties of the apparatus.

What we claim and desire to secure by Letters Patent of the United States is:—

1. In a rotary refrigerating machine, a condenser, an evaporator, a hollow shaft common to both, a casting mounted loosely on the holow shaft within the condenser, a counterweight for the casting, a reservoir surmounting the casting, compressors, means for operating the compressors from the hollow shaft, an outlet to the compressors from the evaporator through the hollow shaft, means for collecting mixed lubricant and refrigerating liquid for the reservoir, a free outflow for the lubricant from the reservoir to the compressors and other working parts and an outlet valve for the refrigerating liquid automatically operated by a float floating on said liquid, and means for conveying the refrigerating liquid to the evaporator, substantially as described.

2. In a rotary refrigerating machine, a condenser and evaporator and hollow connecting shaft, in combination with a casting free on the shaft and a compresser in the casting, means for collecting the lubricant in the upper part of the casting from the revolving condenser, and the said casting having an outlet at the bottom proportionate to the rate of supply to maintain a constant level of lubricant above the compressors.

3. In a refrigerating machine, a rotary condenser and evaporator and hollow connecting shaft in combination with a casting mounted free on the shaft in said condenser, a separating reservoir surmounting the casting, a compressor, means for collecting the refrigerant and lubricant from the rotary condenser into said separating reservoir and means for conveying the former to the evaporator and the lubricant to the compressor.

4. The combination with a rotary condenser and a rotary evaporator communicating with each other, of a reservoir for the refrigerating liquid located within said condenser, means for conducting to said reservoir commingled refrigerating fluid and oil, an automatic float valve in the reservoir and a fixed pipe communicating therewith for leading away the refrigerating liquid to the evaporator as it is freed from oil, substantially as described.

5. The combination of a rotary condenser, a rotary evaporator, a hollow shaft common to both and a chambered casting freely mounted in the end of said shaft within the condenser, through which casting said shaft opens into the condenser from the evaporator and a compressor arranged in said passage through the casting, substantially as described.

6. The combination of the condenser, a casting situated therein oscillating compressor cylinders in the casting and ports in the cylinders and in the casting adapted to be alternately opened and closed by the oscillation substantially as set forth.

7. The combination of the casting containing lubricant, oscillating compressing cylinders therein, pistons in said cylinders, grooves around said pistons and an aperture through said cylinder for the admission of lubricant to the grooves, substantially as set forth.

8. A communicating rotary condenser and evaporator having a supplementary passage between the condenser and evaporator chambers, means for creating a difference in pressure in said chambers during the operation of the device, and an equalizing valve in said passage adapted to be closed by centrifugal force when said apparatus is in operation, substantially as described.

9. A refrigerating apparatus having communicating rotary condensing and evaporating chambers arranged adjacent each other, a water vessel into which said rotary con-

denser extends, a hood over said condenser having openings on the side toward the evaporator and a fan arranged to draw air past said evaporator and through the hood to cool the exposed surface of said condenser and the water thrown off by the same during its rotation.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

MARCEL AUDIFFREN.
HENRI ALBERT SINGRÜN.

Witnesses:
GUSTAVE DUMONT,
HANSON C. COXE.