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REFRIGERATION DRIVE
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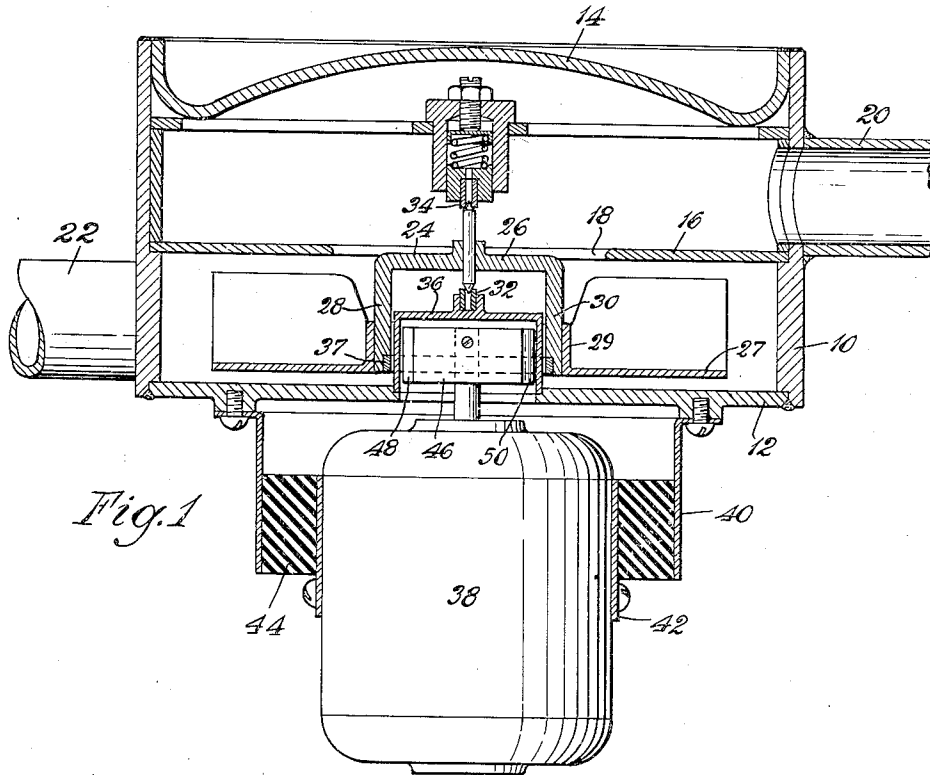


Fig. 1

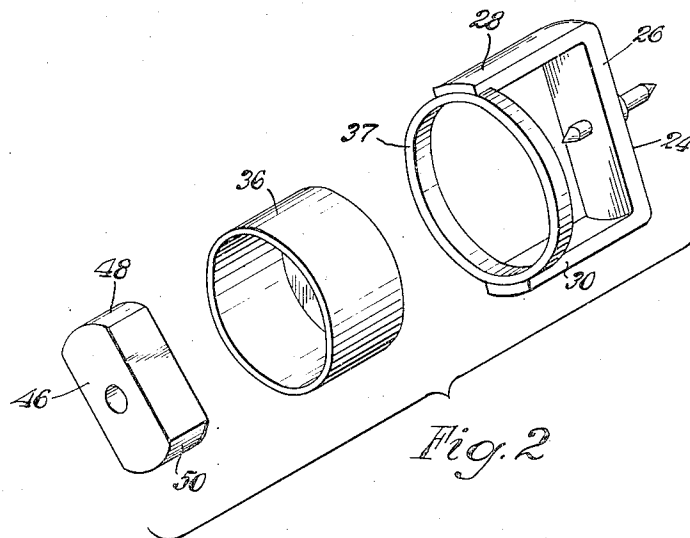


Fig. 2

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REFRIGERATION DRIVE

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3 Claims. (Cl. 172-284)

This invention relates to refrigeration and more particularly to a circulator unit for circulating the mediums in a three-fluid absorption refrigerating machine utilizing ammonia as the refrigerant, water as the absorbent, and an inert pressure equalizing medium such as nitrogen or hydrogen, and specifically to a magneto-motive device for driving the circulator.

Such machines are well known in the art and have a closed circuit between the evaporator and the absorber for the circulation of an inert gas therebetween.

The inert gas is for the purpose of equalizing the pressures throughout the entire machine, all the parts of which are in open communication, and for carrying refrigerant vapor from the evaporator to the absorber. In the evaporator the refrigerant liquid is vaporized by diffusion into the inert gas and in the absorber the refrigerant vapor is absorbed out of the inert gas by weakened absorption solution.

A closed circuit is also provided between the generator and absorber for the circulation of the absorption solution usually consisting of water solution of ammonia. In the generator, refrigerant vapor is driven from the solution by the application of heat and in the absorber the weak solution takes up refrigerant vapor from the inert gas.

Some means must therefore be provided for circulating the inert gas between the evaporator and the absorber and the solution between the generator and the absorber.

In prior art machines it has been usual practice to circulate the inert gas thermosiphonically or by differences in specific weights of different columns of the inert gas and to circulate the solution by a heat operated vapor liquid lift pump. Such machines operate satisfactorily under ordinary circumstances but in hot climates and at high room temperatures they are unsatisfactory because they operate inefficiently and have very low capacity. The problem can be solved if some means is provided for circulating the mediums which is not affected by changes in temperature. This is especially true in air cooled machines to which this invention relates.

It has been proposed to use mechanical pumps for the purpose of circulating the mediums in such refrigerating systems but the application of mechanical pumps to those systems is not a simple matter. The internal pressures of air cooled machines of this type vary from 250 to 400# per square inch under normal operating conditions and under certain abnormal conditions

they go to a much higher value. Before being put into service, the systems are hydraulically tested up to 800# per square inch.

Thus it is practically impossible to use mechanical pumps having moving parts extending through the walls of the system.

In order to solve this problem a way has to be found of hermetically sealing the moving parts of the mechanical circulator unit on the interior of the apparatus and the present invention has to do with the solution of that problem.

Since all the parts of a three fluid absorption refrigerating machine are in open communication with each other, the internal pressure is substantially the same throughout all parts except for liquid columns and the resistances of the circuits. As a result of this, a circulator unit which will develop the pressure difference of approximately four inches of water is sufficient for circulating all of the mediums in their circuits. Thus the power unit should be made very small and the problem of sealing the moving parts on the interior of the apparatus is not simple. Where a motor is used, the field coils and rotor should not be placed on the interior of the apparatus because they would be attacked by the corrosive atmosphere on the interior.

According to this invention, the entire motor unit is positioned exteriorly of the walls of the refrigerating apparatus. A fan for circulating the mediums is hermetically sealed within the walls of the inert gas circuit and motion is transmitted through the walls of the apparatus by a magnetic transmission.

Magnetic transmissions utilizing a permanent magnet driver and a magnetic follower have a high pull-out torque but the starting torque and the pull-in torque is comparatively weak. Thus after the refrigerating machine is in operation for some time the circulator is liable to become stalled due to corrosion and the collection of sludge and sediment about the bearings of the circulator.

According to this invention the starting and pull-in torque of a magnetic transmission utilizing a permanent magnet driver is increased so as to assure that the circulator will never become stalled and that the follower will quickly fall into step with the driver.

Specifically, according to this invention, a permanent magnet driver of "Alnico," an alloy of aluminum, nickel, iron and cobalt, is utilized to drive a magnetic follower on the interior of the hermetically sealed walls of an absorption refrigerating apparatus and being separated

from the driver by a thin cup-shaped annular wall of non-magnetic material, such as certain types of stainless steel extending into the chamber which houses the circulator unit. The driver magnet is mounted for rotation on the exterior of the system with its poles closely adjacent the inner periphery of the annular wall and the follower with a fan type circulator unit are mounted for rotation within the apparatus with the poles of the follower rotating closely adjacent the outer periphery of the annular wall. A metallic loop is attached to the poles of the follower and rotates therewith about the outer periphery of the annular wall. The loop is made of a material having high hysteresis characteristics, such as certain types of steel so as to act as a hysteresis rotor to augment the action of the magnetic follower. During starting and when the follower gets out of step with the driver the hysteresis effect produced in the loop creates a large additional force tending to pull the follower into step with the driver. The steel of the loop may be hardened to increase the hysteresis effect.

Other objects and advantages of this invention will become apparent when taken in connection with the accompanying drawing, in which:

Figure 1 is a sectional view of the circulator unit and magneto-motive power unit according to this invention; and

Figure 2 is an exploded view showing how the parts of the rotor are related to each other.

Referring to the drawing, the circulator unit, according to this invention, comprises a cylindrical casing 10 having a bottom plate 12 and a top plate 14 welded thereto. The casing 10 is divided into a suction chamber and a pressure chamber by a division plate 16 having an opening 18 therein leading to the eye of the fan. The casing 10 is welded to the inert gas circuit of an absorption refrigerating apparatus by means of conduits 20 and 22. A mixture of inert gas and refrigerant vapor enters by conduit 20 and exits by conduit 22.

The combined fan and magnetic follower indicated generally by the reference numeral 24 comprises a U-shaped member 26 of highly magnetic material constituting a magnetic follower with a fan secured thereto. The fan consists of an annulus 29, pressed tightly over the legs of the U-shaped member 26 and a shroud 27 which carries the fan blades as shown. The magnetic follower 26 has pole pieces 28 and 30 extending at right angles to the body of the follower 26 and is mounted for rotation on the interior of the casing 10 by bearing assemblies 32 and 34. The bearing surface of the bearing assemblies 32 and 34 are preferably made of material which does not require lubrication such as tungsten carbide, or the bearing assemblies 32 and 34 may be lubricated by absorption solution in any desired manner. The upper bearing assembly 34 is preferably spring-pressed, as shown, to take up for any slight wear on the bearing surfaces.

The bottom plate 12 is provided with a central opening, and welded to the periphery of this opening is an inverted cup-shaped member 36, the top of which supports the lower bearing assembly 32. The outer periphery of the side walls of the cup 36 are positioned closely adjacent the pole pieces 28 and 30 of the magnetic follower so as to provide only a slight air gap. The inverted cup-shaped member 36 is

made of non-magnetic material, preferably a non-magnetic stainless steel, so as to resist corrosion by the ammonia.

Secured to the inner faces of the pole faces 28 and 30, is a loop 37 which also rotates about the outer periphery of the inverted cup-shaped member 36 closely adjacent thereto. The loop 37 is made of a material having high hysteresis characteristics such as certain types of steel as distinguished from soft magnetic iron. The steel of the loop 37 may be hardened to increase its hysteresis characteristics.

Supported from the bottom plate 12 of the casing 10 is an electric motor 38. The motor 38 is supported by means of an annular metallic ring 40 secured to the plate 12 and an annular metallic ring 42 secured to the motor 38 separated by an annular rubber ring 44 bonded to the rings 40 and 42.

The rotating shaft of the motor 38 carries a permanent magnet 46 in the form of a bar magnet having two poles 48 and 50 and constitutes the driver magnet of the magneto-motive device. The motor 38 is mounted so that its shaft is in the exact center of the inverted cup-shaped member 36 and the poles 48 and 50 of the magnetic driver are of such size that only a small air gap is provided between the poles 48 and 50 and the interior periphery of the cup 36. The magnetic driver is preferably made of a nickel-aluminum-cobalt-iron alloy purchasable on the open market under the trade name of "Alnico."

The weight of the motor 38 and the driver 46 is carried by the rubber ring 44 by a shear stress on the rubber while any force tending to move them laterally is resisted by a compression stress on the rubber. Since rubber is approximately six times as soft when subjected to a shear stress than when subjected to a compression stress, the mounting provides a very soft resilient mounting for the motor 38 and the driver 46 while the support is comparatively rigid in lateral directions so as to prevent misalignment of the driver 46 with the interior periphery of the cup 36.

In operation, the motor 38 is energized and rotates the driver magnet 46. The poles of the driver magnet 46 will attract unlike poles of the magnetic follower 26, so that the follower 26 will be rotated with the driver 46. When the driver magnet 46 begins rotation, the poles of the magnetic follower 26 will tend to follow the poles of the driver 46 due to the attraction of unlike poles. At the same time magnetic lines of force will be set up in the hysteresis ring 37 and due to the fact that the material of the loop 37 has very high resistance to a change in magnetism, a large force will be created tending to bring quickly the follower 26 into step with the driver magnet 46. The slip between the driver 46 and the follower 26 will be greatest at starting; however, this is quickly reduced as the fan comes up to speed both by the action of the magnetism in the follower 26 and the resistance to a change in magnetism in the hysteresis loop 37 and the driver 46 and the follower 26 will quickly fall into step.

If for any reason a high resistance to rotation is placed on the fan 28, the magnetic effect in the follower 26 will greatly resist the tendency of the follower to pull out of step with the driver 46 but if this should occur the resistance to the change in magnetism in the hysteresis loop 37 will create forces tending to pull quickly the follower 26 back into step with the driver magnet 46.

The loop 37 should be made of such cross section and of such a material that it acts as a

hysteresis rotor without constituting a magnetic shunt to the poles of the follower 26.

Thus the effect of the hysteresis loop 37 of hardened steel is that of a hysteresis rotor which will augment the driving effect of the magnetism in the follower 26 to bring quickly the follower 26 into step with the driver magnet 46 and to bring the follower 26 back into step with the driver magnet 46, if for any reason they should fall out of step.

While I have shown but a single embodiment of my invention it is to be understood that this embodiment is to be taken as illustrative only and not in a limiting sense. I do not wish to be limited to the specific construction shown and described but to include all equivalent variations thereof except as limited by the scope of the claims.

I claim:

1. In combination, a hermetically sealed casing, a cup-shaped member of non-magnetic stainless steel extending into said casing and being welded thereto, a permanent magnet driver rotatably mounted within said cup-shaped member, a magnetic follower of highly magnetic material rotatably mounted within said casing and having its poles arranged about the outer periphery of said cup-shaped member and a loop having high hysteresis characteristics connecting the poles of said follower.

2. In combination, a hermetically sealed cas-

ing, an annulus of a non-magnetic material extending into said casing, having its interior open to the outside and being hermetically sealed to said casing, a permanent magnet driver rotatably mounted so as to rotate with its poles closely adjacent the inner periphery of said annulus, a magnetic follower of highly magnetic material rotatably mounted within said casing so as to rotate with its poles closely adjacent the outer periphery of said annulus and a loop having high hysteresis characteristics connecting the poles of said follower, said loop also rotating about the outer periphery of said annulus closely adjacent thereto.

3. In combination, a hermetically sealed casing, an annulus of non-magnetic material extending into said casing, having its interior open to the outside and being hermetically sealed to said casing, a permanent magnet driver rotatably mounted so as to rotate with its poles closely adjacent the inner periphery of said annulus, a magnetic follower of highly magnetic material rotatably mounted within said casing so as to rotate with its poles closely adjacent the outer periphery of said annulus and a loop having high hysteresis characteristics connecting the poles of said follower, said loop being connected to the inner faces of the poles of said follower closely adjacent the outer periphery of said annulus.

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