Feb. 13, 1940. H. F. SMITH 2,190,341

REFRIGERATING APPARATUS

Filed May 29, 1936 2 Sheets-Sheet 1

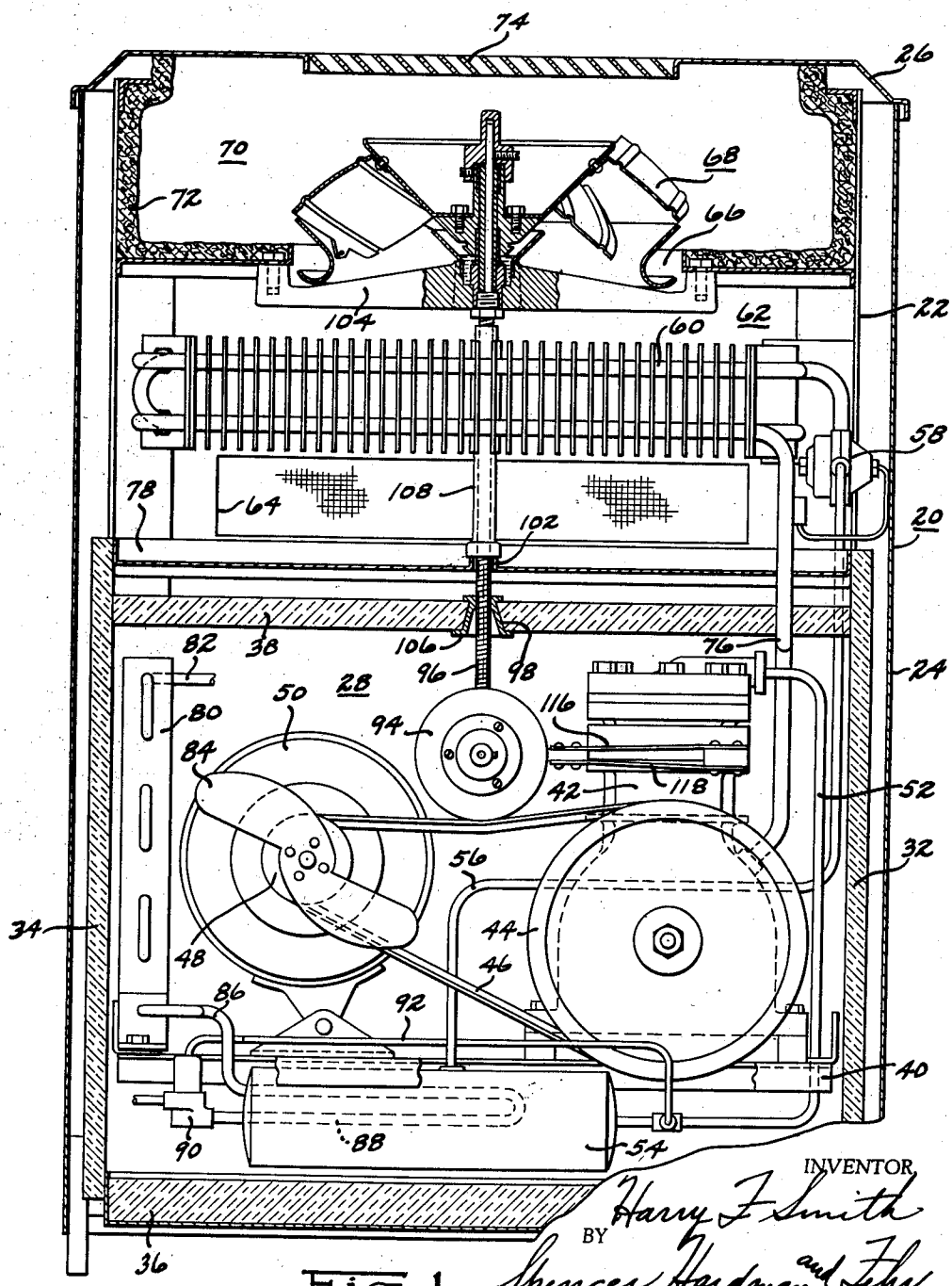

Fig. 1

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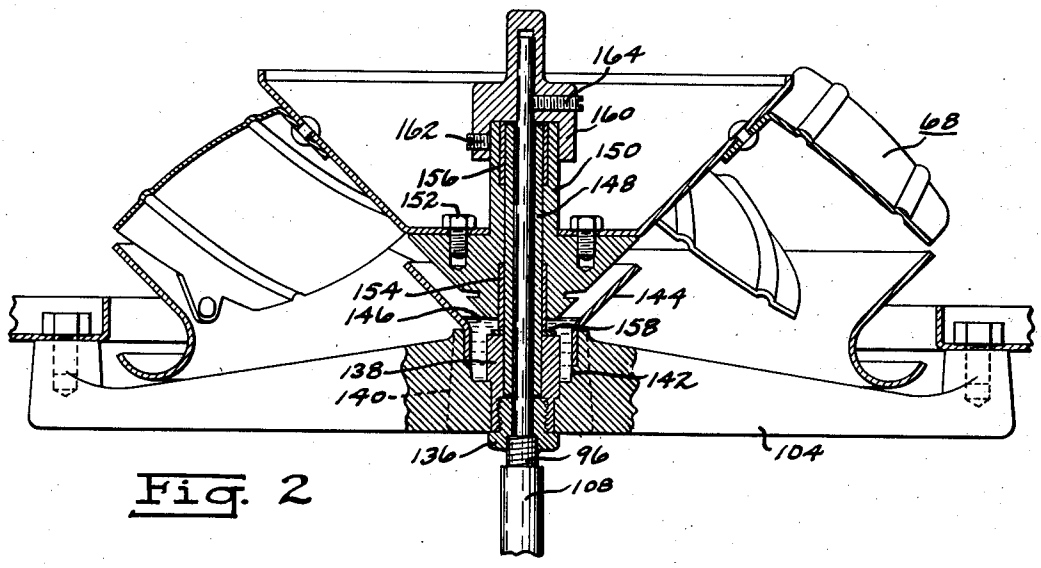

Fig. 2

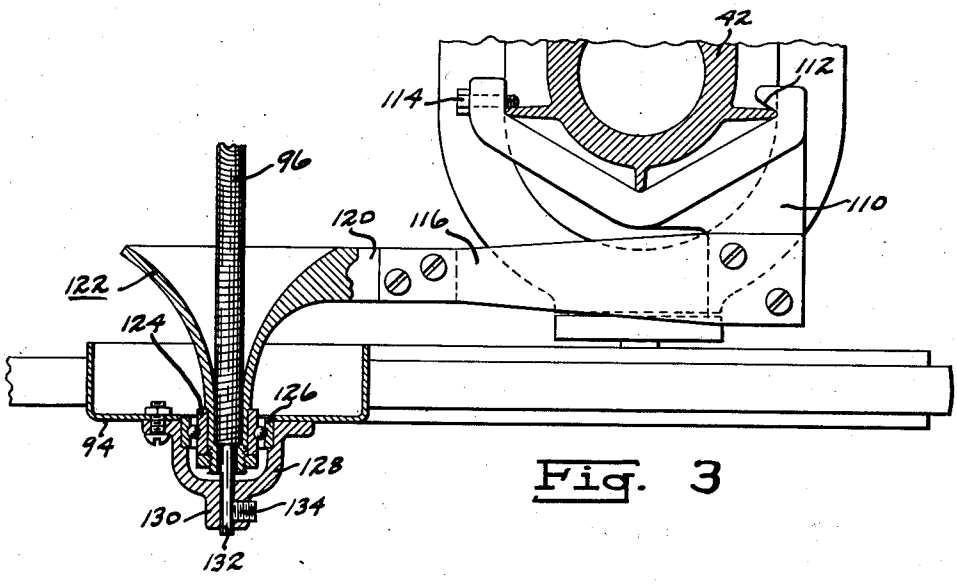

Fig. 3

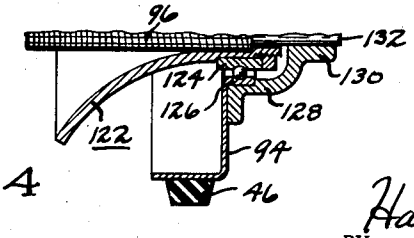

Fig. 4

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

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5 Claims. (Cl. 62—140)

This invention relates to refrigerating apparatus and more particularly to driving devices for driving the circulating means which circulates the medium to be cooled into heat exchange relation with the evaporating means.

In small present-day room coolers, there is ordinarily provided an enclosed machine compartment which contains a motor-compressor unit and often a water cooled condenser. However, the condenser is sometimes placed outside of the machine compartment, outside of the room to be cooled. Such room coolers also have another compartment containing an evaporating means and provided with a fan for taking the air from the room and circulating the air into heat exchange relation with the evaporating means and again returning the air to the room. Such fans, however, have ordinarily been driven by an independent electric motor.

It is an object of my invention to simplify the construction and reduce the cost of such room coolers by driving the circulating fan from the motor-compressor unit by an improved simplified form of driving means.

The machine compartment is ordinarily filled with warm air considerably above the temperature of the air in the room. Therefore, such compartments are ordinarily enclosed and insulated. However, in order to place the circulating fan outside the machine compartment and to drive it from the motor-compressor unit, it is necessary for the driving connection to pass through one of the walls of the machine compartment.

It is, therefore, an object of my invention to provide a driving means for the circulating fan which is provided with a seal to prevent the escape of warm air from the machine compartment into the room.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a vertical sectional view of a room cooler embodying my invention;

Fig. 2 is an enlarged sectional view of the circulating fan and upper portion of the driving connection shown in Fig. 1;

Fig. 3 is a horizontal sectional view through a portion of the driving connection in the machine compartment; and

Fig. 4 is a vertical sectional view through the pulley showing it in contact with the belt of the motor-compressor unit.

Briefly, I have shown a room cooler with an insulated enclosed machine compartment in its lower portion containing a liquefying apparatus including a reciprocating compressor driven through a V-belt driving connection by an electric motor. This machine compartment also includes a water cooled condenser and a cooler for the air of the machine compartment. Above the machine compartment is an evaporator compartment and above the evaporating means is a circulating fan located in the outlet of the evaporator compartment for drawing air through the evaporating means from the room and again discharging the air to the room.

In the machine compartment is a pulley which rides upon the top of the V-belt and which is connected by a flexible shaft which extends through a casing horizontally and upwardly to the circulating fan. This pulley is held in contact with the top of the belt by a pair of spaced spring metal strips. The casing of the flexible shaft is sealed by the rubber bushing at the point where it passes through the insulated top wall of the machine compartment. Within the evaporator compartment, the casing of the flexible shaft is covered by sponge rubber tubing to prevent the transfer of noise, as well as to prevent leakage from the drip pan.

Referring now to the drawings and more particularly to Fig. 1, there is shown a room cooler generally designated by the reference character 20 and provided with an angle iron framework 22 which is enclosed by outer metal panels 24 which form the outer vertical walls of the cabinet. These panels have a top member 26 resting upon their upper edges which forms the top of the cabinet. In the lower portion of the room coolers, there is provided a machine compartment 28 which is formed by slabs 32, 34, 36 and 38 on the sides, bottom and top of the compartment. These slabs are of some suitable insulating material having some structural strength and are fastened to the frame of the cabinet.

Within the machine compartment 28 is a metal framework 40 which forms the base of the compressor unit. This base is supported preferably through a resilient vibration absorbing supporting means from the framework of the cooler. This base 40 supports a reciprocating compressor 42 provided with a relatively large V-type flywheel pulley 44 which receives a V-belt 46 which in turn extends over a V-pulley 48 upon the electric driving motor 50. The electric motor 50 through its pulley 48, the belt 46, the compressor pulley 44, drives the compressor to compress

evaporated refrigerant and forward the compressed refrigerant through a conduit 52 to a water cooled condenser 54 where the refrigerant is condensed and collected.

The liquid refrigerant which is condensed within the condenser 54 is then forwarded through a supply conduit 56 to a thermostatic automatic expansion valve 58 which controls the supply of liquid refrigerant to the evaporating means 60. This evaporating means 60 is positioned transversely in a compartment 62 located immediately above the machine compartment 28 and provided with an inlet opening 64 beneath the evaporating means 60. The top of this compartment 62 is provided with an outlet opening 66 directly above the center of the evaporating means 60.

This outlet 66 receives a circulating fan 68 of a rather unusual type which is relatively highly efficient for this type of service. This circulating fan 68 draws air from the room into the compartment 62 through the opening 64 and then draws the air upwardly between the fins and conduits of the evaporating means 60 and thence through the opening 68 into a discharge chamber 70. This chamber 70 is lined with a sound absorbing and insulating material 72 which extends upwardly into sealing engagement with the top member 26. The top member 26 is provided with a grilled outlet opening 74 directly above the fan 68. The grille for this outlet opening 74 has blades positioned at a 45° angle so as to throw the air upwardly at an angle above the heads of the occupants of the room so as to avoid any direct draft upon any occupant. The air from the room so circulated is cooled by the evaporating means 60 which also condenses moisture from the circulating air and thereby reduces its moisture content. In this process, the liquid refrigerant in the evaporating means absorbs heat and evaporates under reduced pressure and this evaporated refrigerant is returned to the compressor through the return conduit 76.

Directly beneath the evaporating means 60 is a drip pan 78 supported by the framework of the cabinet for collecting moisture which condenses upon and drips from the evaporator 60. This drip pan 78 is provided with some suitable form of drain or other suitable form of water disposing means.

Within the machine compartment 28 is a finned heat absorbing member 80 provided with serpentine tubes which first receive the water for cooling purposes through the conduit 82. This heat absorbing member 80 absorbs heat from the air which is circulated within the machine compartment by a fan 84 provided upon the motor 50 adjacent the pulley 48. From the heat absorbing unit 80 the cooling water then passes through the conduit 86 to the water cooling coil 88 in the condenser 54. The outlet of this water cooling coil 88 is connected to a thermostatic control valve 90 which has a control element provided with a tubular connection 92 which connects to the compressor discharge conduit 52. This provides a control of the circulation of cooling water according to the so-called head or condenser pressure.

Heretofore, the circulating fan for circulating the air in heat exchange relationship with the evaporating means has been driven by a separate electric motor provided in a compartment such as the compartment or chamber 70. It has also been proposed to drive such a fan through an ordinary pulley and belt from the motor-compressor unit. However, such a belt drive does not appear to have proved practical, probably because of the necessity of preventing the escape of warm air from the machine compartment 28 into the room. While the use of a separate electric motor for the circulating fan provides satisfactory performance, it necessitates that an electric motor, in addition to the compressor driving motor 50, be provided. Such motors, principally because of their smaller size, are ordinarily less efficient than the compressor driving motor. They are also one of the more costly parts of such apparatus.

I have, therefore, provided an improved form of driving device which is capable of driving the circulating fan 68 from the motor-compressor unit, while at the same time, it does not provide an avenue for the escape of warm air from the machine compartment into the room. In this driving device, there is provided a pulley 94 which rests upon the top of the V-belt 46 and which is connected to a triple or quadruple wound flexible shaft which extends through a flexible metal casing 96, at first horizontally and then upwardly through an aperture 98 in the insulating slab 38 through a flanged aperture 102 in the drip pan 78 and thence between the center fins of the evaporator 60 up to a three arm spider bracket 104 located directly beneath the opening 66 between the compartments 62 and 70. This bracket 104 supports the fan 68 which is fastened to the upper end of the flexible shaft.

The aperture 98 in the insulating slab 38 is sealed by a tapered flanged rubber bushing 106 which provides a seal between the slab and the casing 96 of the flexible shaft. In order to prevent the transfer of noise from the flexible casing to the evaporating means 60 and to the circulating air, I provide an insulating casing for the casing 96 of the flexible shaft. This insulating casing 108 is in the form of sponge rubber tubing and receives the portion of the flexible casing 96 between the bracket 104 and the drip pan 78 and particularly has its lower end extending over the upper edge of the flanged aperture 102 to prevent any moisture from passing downwardly along the flexible casing 96 below the drip pan 78. This casing 108 insulates the casing 96 of the flexible shaft from the evaporating means 60 so that heat and noise from the flexible shaft will not be transmitted through metallic contact with the evaporating means 60 which would otherwise transmit the noise to the circulating air.

Referring now more particularly to Figs. 2, 3 and 4 for a detailed construction of my improved driving device, there is provided a bracket 110 having a notch 112 which receives one of the cooling fins of the compressor body while an opposite portion of the bracket is provided with a screw 114 which engages a cooling fin upon the opposite side of the compressor to firmly hold the bracket to the body of the compressor. This bracket 110, however, may be fastened to the compressor body by any of the usual forms of mounting such as by screws or bolts to some convenient part of the compressor. This bracket is provided with two spaced tapered spring metal leaf springs 116 and 118 which are fastened to the upper and lower faces of an arm of the bracket by screws. These two leaf springs extend in the same direction from the bracket 110 and are fastened by screws to the upper and lower faces of an arm 120. This arm 120 extends from a sort of a bell-shaped portion of a member 122 which receives the lower end of the flexible casing.

The reduced end of this member 122 is provided with a support for the inner portion 124 of a ball bearing. The outer portion 126 of the ball bearing is received within the hub 128 of the pulley 94. This hub 128 is provided with a boss which receives the lower end of the flexible shaft 132. This flexible shaft 132 is preferably made of spring wire wound in opposite directions and having three or four layers of wire. This form of flexible shafting is practically universally used for speedometer drive and serves this purpose admirably. It, however, has the disadvantage that it cannot transmit a great amount of torque and particularly should not be subjected to sudden torque loads. This flexible shaft is held to the hub 130 by a set screw 134. The springs 116 and 118 hold the pulley 94 in contact with the upper face of the belt. However, as will be seen best in Fig. 1, the pulley 94 has only a small portion of its periphery in contact with the belt at any one point and, therefore, only a relatively small torque will be transmitted to the pulley and the flexible shaft from the belt.

The driving motor 50 ordinarily operates at from 1700 to 1800 R. P. M. The pulley 94 on the other hand operates at only from 800 to 1200 R. P. M. This speed can readily be controlled by the size of the driving pulley 94. The flexible shaft 132 with its flexible metal casing 96 can readily accommodate the movement of the member 122 as necessary to keep the pulley 94 in contact with the upper portion of the belt. This pulley 94 will be subject to considerable movement because of the varying tension upon the upper portion of the belt under starting conditions and different forms of load conditions. The arm 120 and the spaced leaf springs 116 and 118 take care of the torque reaction involved in driving the pulley from the belt as well as hold the pulley in contact with the belt.

The upper end of the casing 96 of the flexible shaft is received within a threaded bushing 136 and fastened thereto either by a press fit or by a solder connection. This bushing 136 is threaded into another bushing 138 which fits tightly within the hub 140 of the spider supporting member 104. This hub 140 is provided with a recess 142 surrounding the upper portion of the bushing 138. This recess receives the lower portion of a sort of a funnel-shaped member 144. This funnel-shaped member 144 and the recess 142 are provided with oil designated by the reference character 146.

The bushing 138 receives the lower end of a hollow shaft or sleeve 148 which extends upwardly within the hub 150 of the circulating fan 68. This hub 150 is fastened to the sheet metal plate portion of the fan by cap screws 152. This hub 150 is also provided with lower and upper porous bearing bushings 154 and 156 which are preferably formed of a material known commercially as "Durex." A passage containing a wick connects the lower bearing 154 with the upper bearing 156 and lubricant from the recess 142 is drawn upwardly into the pores of the lower bearing and then by the wick into the pores of the upper bearing so as to provide lubrication for the bushings 154 so that the hub 150 may rotate with little friction upon the sleeve 148. This wick does not lie within the plane of the sections and therefore does not appear in the drawings. The lower portion of the bushing 154 rests upon a thrust collar or washer 158 located within the oil and resting upon the upper face of the bushing 138. The upper end of the hub is provided with a cap 160 fastened to it by a set screw 162 and fastened to the upper end of the flexible shaft which extends through the sleeve 148 by a second set screw 164.

This driving device is simple, convenient and free from many troubles of mis-alignment. It is not only advantageous in the specific application disclosed herein, but also in many others.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including a cabinet including a machine compartment and an evaporator compartment, a motor-compressor unit in the machine compartment, an evaporating means in the evaporator compartment, a condenser operably connected to the evaporator and compressor, a fan for circulating air in heat exchange relation with the evaporating means, means including a flexible shaft extending from the motor-compressor unit to said fan, and torque limiting means for limiting the amount of torque transmitted to the flexible shaft and said fan for driving said fan.

2. Refrigerating apparatus including a cabinet located in a room to be cooled, having a machine compartment enclosed to prevent leakage of air from the compartment to the room, an evaporating means outside of said machine compartment, a motor-compressor unit within the enclosed machine compartment, a condenser connected in operative refrigerant circuit relationship with said evaporating means and said motor-compressor unit, a fan means outside said machine compartment for circulating air from the room in heat exchange relationship with the evaporating means, a driving connection extending from said motor-compressor unit through an aperture in the enclosure of said machine compartment to said fan, said aperture containing the driving connection being sealed to prevent the escape of air from the machine compartment, said driving connection including a flexible conduit and a flexible shaft extending through said conduit from said motor-compressor unit to said fan, and means for limiting the amount of torque transmitted from the motor-compressor unit to said flexible shaft.

3. Refrigerating apparatus including a cabinet located in a room to be cooled, having a machine compartment enclosed to prevent leakage of air from the compartment to the room, an evaporating means outside of said machine compartment, a motor-compressor unit within the enclosed machine compartment, a condenser connected in operative refrigerant circuit relationship with said evaporating means and said motor-compressor unit, a fan means outside said machine compartment for circulating air from the room in heat exchange relationship with the evaporating means, and a driving connection extending from said motor-compressor unit through an aperture in the enclosure of said machine compartment to said fan, said aperture containing the driving connection being sealed to prevent the escape of air from the machine compartment, said driving connection including a pulley having its rim in contact with a movable portion of said motor-compressor unit, said pulley being provided with spring means for holding it in contact with the movable portion at a certain tension to limit the

amount of force transmitted to the pulley, said driving connection including a flexible shaft extending from said pulley to said fan.

4. Refrigerating apparatus including a cabinet located in a room to be cooled, said cabinet having a machine compartment, an evaporator compartment located above the machine compartment, the top wall of said evaporator compartment being provided with an aperture, a fan disposed substantially within said aperture and having a vertical axis of rotation, a motor and compressor located within the machine compartment, said motor and compressor being connected by a belt drive, a pulley with a horizontal axis having its periphery in engagement with the belt drive, spring means for keeping the pulley in contact with the belt drive, and a flexible shaft connecting said pulley and said fan.

5. Refrigerating apparatus including a cabinet located in a room to be cooled, said cabinet having a machine compartment, an evaporator compartment located above the machine compartment, the top wall of said evaporator compartment being provided with an aperture, a fan disposed substantially within said aperture and having a vertical axis of rotation, a motor and compressor located within the machine compartment, said motor and compressor being connected by a belt drive, a pulley with a horizontal axis having its periphery in engagement with the belt drive, spring means for keeping the pulley in contact with the belt drive, and a flexible shaft connecting said pulley and said fan, an evaporating means positioned horizontally within said compartment, a drip pan located beneath said evaporator, said drip pan being provided with an aperture having an upturned flange, said flexible shaft extending through the aperture in said drip pan and through said evaporator.

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