

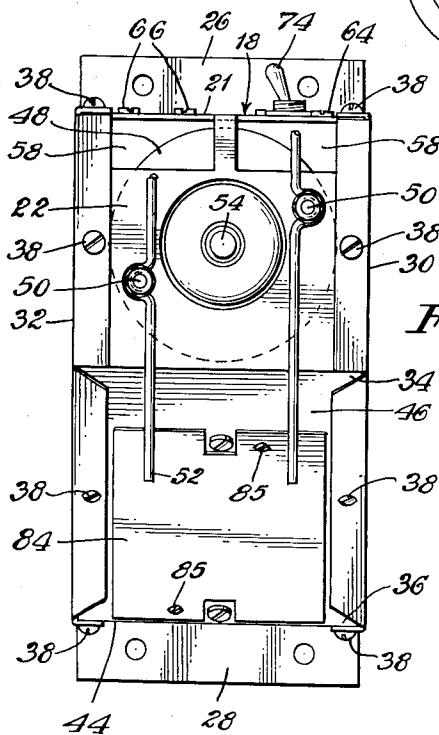
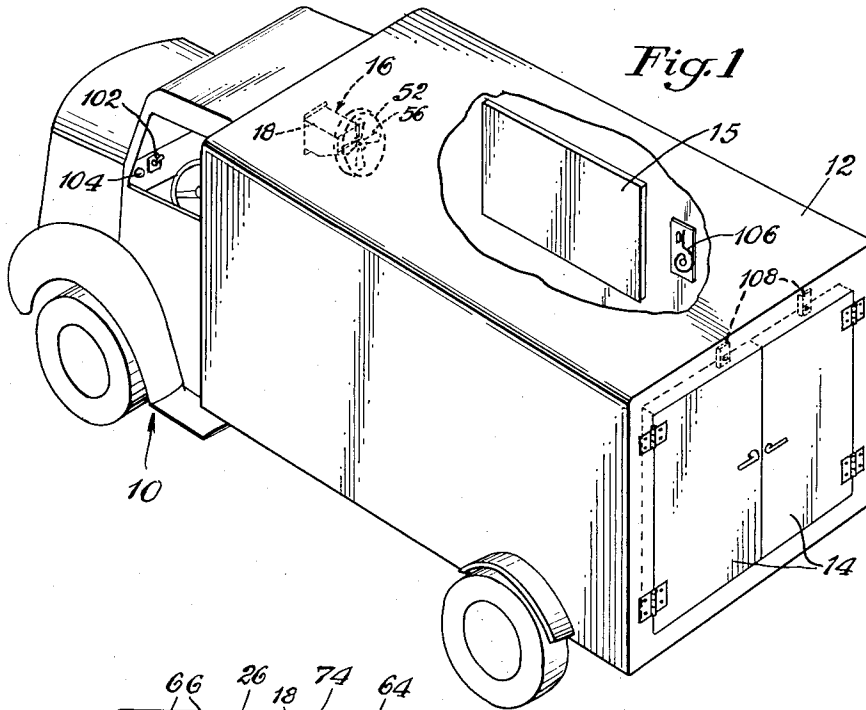
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A. P. BOEHMER ET AL
CONVERSION UNIT

2,972,057

Filed March 13, 1957

3 Sheets-Sheet 1



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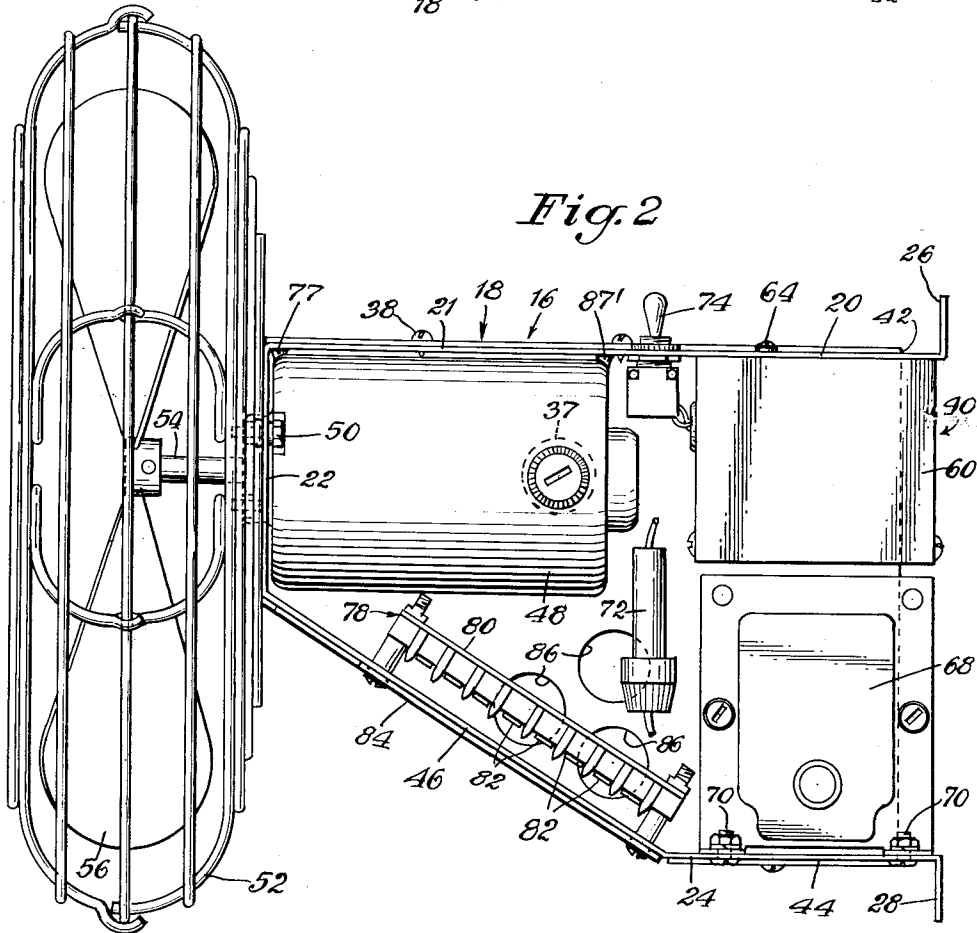
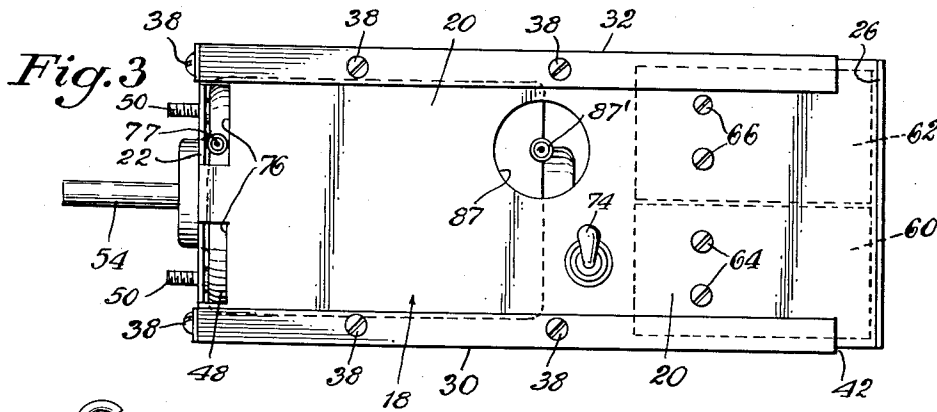
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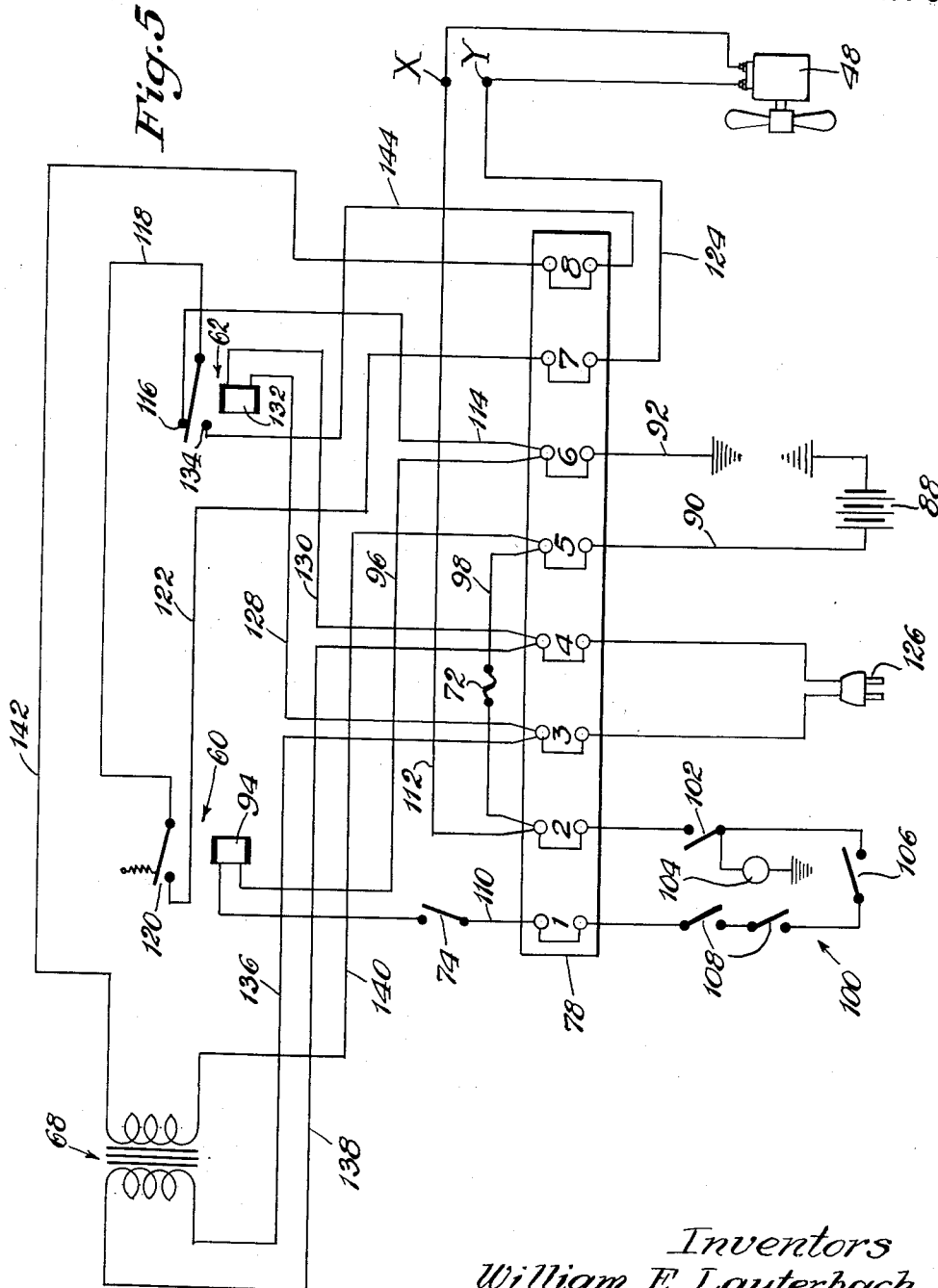


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CONVERSION UNIT

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13 Claims. (Cl. 307—10)

This invention is in the field of refrigerated trucks or motor vehicles or for that matter vehicles of all types but is specifically concerned with maintaining the proper velocity and c.f.m. flow of air within the refrigerated space of a vehicle while it is moving in transit from station to station or stop to stop and also while it is in the loading yard, for example, at night being refilled or during a temperature pulldown or both.

A primary object of our invention is a refrigerated vehicle fan and circuit for maintaining the proper circulation of air within the refrigerated space of the vehicle whether the vehicle is underway or parked in the yard or garage.

Another object is an electrical circuit for a refrigerated vehicle arranged to operate a single fan motor on either A.C. or D.C. current.

Another object is a circuit of the above type constructed to protect or reduce the wear and tear on the door switch or switches and the thermostat.

Another object is a packaged unit adapted to be installed in a refrigerator vehicle, such as a truck.

Another object is a circuit of the above type with a low voltage, low amperage control circuit.

Another object is a circuit of the above type arranged to switch over automatically from D.C. to A.C. when the A.C. line or connection is connected to an external A.C. source.

Other objects will appear from time to time in the ensuing specification and drawings in which:

Figure 1 is a diagrammatic perspective of a vehicle, a refrigerated truck, with our invention;

Figure 2 is a side view of the fan unit shown diagrammatically in Figure 1, with one side plate removed;

Figure 3 is a top view with the fan and fan guard omitted;

Figure 4 is a front view with the fan and part of the guard removed for clarity; and

Figure 5 is a circuit diagram.

In Figure 1 we have diagrammatically indicated a suitable vehicle at 10 which is shown generally as a truck of any suitable type having an enclosed chamber, cabinet or body at 12, suitably insulated, to be used for transporting frozen or cold storage products. The chamber or body 12 has one or more suitable doors at 14 which may be on the rear or the side, as desired, to provide access to the refrigerated space. The inner walls of the chamber may be lined or otherwise provided with refrigeration plates of the vacuum type or otherwise, such as indicated generally at 15, or the plates may be grouped appropriately in a separate housing such as the type shown generally in U.S. Patent 2,875,595, issued March 3, 1959, in the name of Herman W. Kleist.

In a suitable location we position what we shall hereinafter refer to, on occasion, as a fan package, designated generally at 16. This package may be attached to the wall of the refrigerated compartment in a manner to be explained hereinafter, and the primary function of the fan package is to circulate air uniformly and evenly

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throughout the enclosed chamber over the products and packages as well as over the cooling coils or plates. We intend for the fan to operate to perform its function while the vehicle is in the yard getting a temperature pulldown as well as while it is on the road making deliveries or between stations. The point is that we desire the fan to operate when the vehicle is both underway and stopped. When the vehicle is underway, the fan must be supplied with power from the D.C. battery on the truck, but when the vehicle is stopped, such as in the yard or garage, a suitable lead or line may be extended to a source of house current, thereby saving the battery, and this is A.C. current.

But this presents problems. To begin with, the battery of the truck supplies direct current while in all probability house power will be alternating current. In the past, it has been required that two motors be used for the fan, one being constructed to operate on direct current and the other on alternating current. Or two completely separate fan units complete with separate motors have been used. Also, it is desirable to stop the fan when the doors of the compartment are open to prevent cold air from being blown out of the compartment, and this has conventionally been done by one or more suitable door switches. But this has presented problems because the high amperage required by the fan motor, when operating on low voltage D.C. battery, will in many cases cause arcing across the contacts of the door switch resulting in damage. Also, this requires that a heavy gauge wire be used through the door switch and throughout the entire system or circuit to carry this high amperage.

Additionally, the fan should not be operating when the temperature load in the truck has been pulled down to the proper temperature and further refrigeration would either be unnecessary or would freeze the product. Therefore, it is conventional to install a suitable thermostat in the circuit to cut off the fan when the temperature approaches the danger point, but the high amperage required when the fan is on the D.C. battery current is also hard on the contacts of the thermostat and will in many cases damage them in the same way that it does the door switch contacts. Also, a heavy gauge wire must be used for the thermostat and this is undesirable.

Our invention is intended to take care of these and other difficulties.

In Figures 2, 3 and 4, the fan package has been shown as including a housing, indicated generally at 18, having a main body member 20 which may be a strip of sheet metal bent appropriately to extend across the top at 21, the front at 22, and bottom at 24, but open on the sides. The ends of the main body member are turned into flanges at 26 and 28 which are suitably apertured or otherwise formed to serve as mountings for the entire package. The sides of the housing are provided with left and right covers or plates 30 and 32 which are suitably notched at the corners, such as at 34 and 36 in Figure 4, providing a series of flaps or flanges which are appropriately bent perpendicular to the main portion of the covers so as to overlie the various sections or lengths of the main body member 20. Each cover may have a suitable opening 37 opposite the brushes on a fan motor, to be described hereinafter, for access and cooling. The covers may be removably connected to the main body member by suitable screws, such as at 33, or otherwise.

The rear of the unit may be generally open as at 40, and we prefer that the side or cover plates terminate short of the flanges 26 and 28 on the main body portion, as at 42, for a reason to be set forth later.

It will also be noticed that the bottom wall or lower portion of the main body portion is divided into two

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sections, a normal horizontal section 44 and an inclined area 46 leading to the front wall.

In the forward upper area of the thus formed housing, we position and secure a fan motor 48 which is the type that operates on both A.C. and D.C. current. Two or more suitable bolts 50 may extend through the front wall serving as a mounting or securing means for the fan motor as well as for a fan grill 52 of a suitable type. The shaft 54 of the fan motor projects through a suitable opening in the front wall and carries a conventional fan 56 with any desired number of blades. In the front wall generally aligned with the top of the fan motor, we provide two openings or air accesses 58 extending across the housing for the circulation of air to cool the fan motor. While these are shown as two separate slots spaced from each other slightly, it might be one continuous opening, or it might be more than two. The important point is that one or more openings are provided in the front wall at the top of the housing above the fan motor so that air may flow through.

At the rear in the top of the housing we position, side by side, a D.C. relay 60 and an A.C. relay 62, each held by suitable screws or the like 64 and 66 or otherwise. Below the relays we provide a transformer 68 which may be suitably secured by a number of bolts or the like 70 to the bottom wall. At a suitable intermediate location in the housing, we may locate a suitable fuse holder and fuse indicated generally at 72. In the top of the housing, we may provide a suitable main switch 74.

As shown in Figure 3, we provide additional slots 76 in the top wall of the housing adjacent the front end above the fan motor for both cooling and access to a lubrication tube 77 for the fan motor front bearing for lubrication. These slots may merge into the front wall slots 58, as shown.

The inclined wall portion 46 has a terminal block, designated generally at 78, attached to it by suitable screws or the like, and it may include a suitable terminal block plate 80 with any suitable number of terminals 82. In any event, below the terminal block the inclined wall is suitably apertured and closed by a cover plate 84 which may be removably held by suitable screws or the like 85.

A suitable number of holes 86 may be provided in at least one of the cover plates to allow leads or wires to enter. Also, we provide a hole 87 in the top of the housing for both ventilation and access to a lubrication tube 87' for the fan motor rear bearing for lubrication.

In Figure 5 we have shown a circuit for the above unit with like parts being indicated by the same reference numerals, for example, the terminal block is indicated at 78 with terminals running from 1 to 8, the D.C. relay generally at 60, the A.C. relay generally at 62, the transformer at 68, the fan motor generally at 48, and the fuse generally at 72.

When the truck is underway, it is desired to operate the fan motor on direct current, but when the truck is in the yard or in the garage, house current is available and it should be used to save the truck battery. Therefore, the fan motor 48 is a combination A.C.-D.C. motor, which in itself is conventional. For example, it might be a six volt D.C. and ten volt A.C. motor, or it might be a twelve volt D.C. and a twenty volt A.C. motor. The point is that we use a combination A.C.-D.C. motor. The truck battery is indicated generally at 88, and it should be understood that it may be either a six volt or a twelve volt D.C. battery, for example. In any event, opposite sides of the battery are connected to terminals 5 and 6 of the terminal block through suitable leads 90 and 92, the lead 92 being to ground for the battery. The D.C. relay 60 has a coil 94 which is energized by the battery. A suitable lead 96 connects terminal 6 to one side of the coil 94. The other terminal 5 is connected by a lead 98 to terminal 2 on the terminal block.

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It should be noted that lead 98 has the fuse 72. A control circuit extends between terminals 2 and 1 and is designated generally at 100. This circuit may include, first, a dash switch 102 and pilot light 104, a thermostat connection 106 and one or more door switches 108. From terminal 1, a suitable lead 110 is connected to the coil 94, and it should be noticed that this lead 110 has the main switch 74 shown in Figures 2, 3 and 4. The door switches 108 and thermostat 106 are diagrammatically indicated in Figure 1.

Current from the battery is supplied to the fan motor by the following. From terminal 2 a suitable lead 112 runs to one terminal X of the fan motor, and this connects terminal 5 to that terminal of the fan motor through lead 98 and the fuse 72. Terminal 6 (on the other side of the battery) is connected by a lead 114 to normally closed contacts 116 in the A.C. relay 62, it being understood that the upper contacts 116 are normally closed by a spring or the like. A lead 118 runs from the contacts 116 to contacts 120 in the D.C. relay. These contacts are only closed when the coil 94 is energized and are otherwise open. A suitable lead 122 runs from the contacts 120 to terminal 7 on the terminal block and then through a lead 124 to the other terminal Y on the fan motor.

Therefore, when the vehicle or truck is underway with the door switches 108 and the thermostat 106 closed, and the operator has both the dash switch 102 and the main switch 74 closed, coil 94 of the D.C. relay will be energized which closes contacts 120 and therefore supplies D.C. current to the fan motor.

But when the truck or vehicle is in the yard or garage, it is desirable to operate the fan on A.C. current which is house current and therefore we provide a suitable plug or connection 126 which is connected, as shown, to terminals 3 and 4 on the terminal board. The house current will be either 110 volts or 220 volts 60 cycle A.C. This must be stepped down through the transformer 68 before it can be supplied to the fan motor. Also, the circuit carrying the D.C. current to the fan motor must be disconnected. Therefore, by suitable leads 128 and 130 connected to terminals 3 and 4 and also to a coil 132 in the A.C. relay, we supply alternating current to the coil which, when energized, will close the bottom contacts 134 and open the top ones 116 thereby breaking the D.C. circuit to the fan motor. At the same time, alternating current is carried from the terminals 3 and 4 through suitable leads 136 and 138 to the transformer 68. From the secondary side of the transformer, a suitable lead 140 is connected to terminal 5 and alternating current will pass through lead 98, through the fuse 72, and through lead 112 to contact X on the fan motor. A second lead 142 from the secondary side of the transformer runs to terminal 8 on the board and then by a lead 144 through the contacts 134 in the A.C. relay, through lead 118 to contact 120 in the D.C. relay, through lead 122 to terminal 7 on the board, then through lead 124 to the other contact Y on the fan motor.

It will therefore be seen that while the vehicle is underway the fan motor will be supplied with direct current from the battery. If at any time the doors are opened by opening the door switches or the temperature in the compartment gets down to the danger point, the control circuit will automatically be broken which will deenergize the D.C. relay opening contacts 120 which breaks the D.C. power circuit to the fan motor.

When the truck is in the garage and the A.C. plug is connected to house current, the coil 132 automatically opens the D.C. power circuit to the fan motor by opening contacts 116 and closing the lower contacts 134. This supplies A.C. current to the fan motor, but at the same time the battery is supplying D.C. current through the control circuit which includes the door switches, thermostat, dash light, etc. Therefore, even while the truck is in the garage and the unit is being supplied with

house current, when the doors are opened, the D.C. relay will be deenergized and the fan motor will stop. Further, the thermostat contacts will be protected against arcing, and the thermostat will deenergize the D.C. relay, stopping the fan motor.

Primarily the control circuit is a low voltage arrangement that is not a hazard for the operator.

The use, operation and function of our invention are as follows:

We provide a simple but reliable packaged fan unit which may be mounted in a refrigerated vehicle, such as a truck or the like. The package may be installed in new construction or it may be supplied as a conversion unit.

The housing is constructed so that the fan motor is cooled properly. We provide openings at one corner in front of and above the motor so that cool air will be drawn through the housing. At the same time the side plates or covers 30 and 32 terminate short of the flange mountings, or whatever is used for mounting, so that vertical slots are provided on each side against the wall. In the arrangement shown, the relays in the top of the housing will effectively block the top part of the slots but the transformer in the lower part of the housing is formed so that air may flow in and around it and accordingly will enter through the slot. It should be noticed that by this arrangement air travels the maximum distance through the housing across the transformer where some cooling is effected but primarily across the fan motor to cool it. The movement or draft of air, of course, is set up by the fan itself which is blowing air out into the refrigerated chamber and accordingly it will suck air through the housing or package. Air also may enter through the top opening 87 to cool the motor.

We additionally provide easy access to the terminal board so that installation can be easily made in the field.

The electrical arrangement has the advantage that only D.C. current goes through the control circuit. Thus, the wire used for the control circuit may be of a relatively small gauge, for example, bell wire, because the amperage involved will be quite low. Additionally, the contacts of the thermostat and door switches are also in this circuit and, therefore, arcing is not a problem. It should also be noticed that regardless of whether the fan motor is being energized by the battery or by house current, the D.C. control circuit will function to either start or stop the fan because either A.C. or D.C. current must flow through the contacts in the D.C. relay which are either opened or closed depending upon whether the control D.C. circuit is energized or not.

The fan motor is a combination A.C.-D.C. unit and for D.C. it should be either six volt or twelve volt, for example, or in any event it probably should be matched to the truck's ignition system.

The A.C. connection prevents the battery from being run down when the truck is in the garage and the engine is not operating, for example, at night. The truck shown in Figure 1 may have a conventional refrigeration unit, not shown, which will be operated by the A.C. house current at night, this usually being 220 volts. Therefore, the fan motor will in all probability be run in parallel with the condensing unit. We might mention that the fan unit should be wired ahead of the compressor starter to prevent the fan from reverting to D.C. current when the compressor shuts off.

Our arrangement has the additional advantage that the operator does not have to shut off the D.C. current before he plugs in for house power. As soon as he connects the A.C. plug to a house power terminal, the D.C. current is automatically disconnected from the fan.

We have shown two switches for the door, but one might be used. We prefer that they be installed in the door frame on the hinge side to prevent rusting due to moisture, but this is optional, and they might be installed as shown diagrammatically in Figure 1.

One of the main advantages of the circuit is that small gauge wire may be used, such as, bell wire, in the control circuit. Additionally, the contacts in the thermostat and door switches are protected from arcing.

While we have shown and described the preferred form and suggested several variations of our invention, it should be understood that suitable additional modifications, substitutions, changes, alterations and variations may be made without departing from the invention's fundamental theme. We, therefore, wish that the invention be unrestricted except as by the appended claims.

We claim:

1. In a circuit for operating a fan unit for use in a refrigerated vehicle or the like, a D.C. source of current, a fan motor adapted to be driven by both A.C. and D.C. current, a first relay, a first circuit between the D.C. source of current and the first relay for energizing said first relay, a door switch in the first circuit adapted to be opened and closed by the door of the vehicle, a second circuit between the D.C. source of current and the fan motor for energizing said fan motor, including contacts in the first relay adapted to be closed when the first relay is energized but otherwise open, an A.C. plug adapted to be connected to a source of A.C. current, a second relay, a third circuit between the A.C. plug and the second relay for energizing said second relay, and a fourth circuit between the A.C. plug and the fan motor for energizing said fan motor, including contacts in the second relay, said first and second relays and their contacts and said fourth circuit being constructed so that the fan motor will be energized by the D.C. source of current only when the A.C. plug is not connected to the A.C. source of current but will be energized by the A.C. source of current only when the A.C. plug is connected to the A.C. source, the second relay including a double set of contacts, one set in the second circuit and the other set in the fourth circuit, said relay being spring biased so as to normally close only the said one set of contacts when the second relay is not energized and to close only the said other set of contacts when the second relay is energized thereby automatically opening the second circuit between the D.C. source of current and the fan motor when the A.C. plug is connected to the A.C. source of current.

2. In a circuit for operating a fan unit for use in a refrigerated vehicle or the like, a D.C. source of current, a fan motor adapted to be driven by both A.C. and D.C. current, a first relay, a first circuit between the D.C. source of current and the first relay for energizing said first relay, a door switch in the first circuit adapted to be opened and closed by the door of the vehicle, a second circuit between the D.C. source of current and the fan motor for energizing said fan motor, including contacts in the first relay adapted to be closed when the first relay is energized but otherwise open, an A.C. plug adapted to be connected to a source of A.C. current, a second relay, a third circuit between the A.C. plug and the second relay for energizing said second relay, and a fourth circuit between the A.C. plug and the fan motor for energizing said fan motor, including contacts in the second relay, said first and second relays and their contacts and said fourth circuit being constructed so that the fan motor will be energized by the D.C. source of current only when the A.C. plug is not connected to the A.C. source of current but will be energized by the A.C. source of current only when the A.C. plug is connected to the A.C. source, the second relay including contacts in the second and fourth circuits whereby the second circuit between the D.C. source of current and the fan motor will be automatically opened when the A.C. plug is connected to the A.C. source of current.

3. In a circuit for operating a fan unit for use in a refrigerated vehicle or the like, a D.C. source of current, a fan motor adapted to be driven by both A.C. and D.C. current, a first relay, a first circuit between the D.C.

source of current and the first relay for energizing said first relay, a door switch in the first circuit adapted to be opened and closed by the door of the vehicle, a second circuit between the D.C. source of current and the fan motor for energizing said fan motor, including contacts in the first relay adapted to be closed when the first relay is energized but otherwise open, an A.C. plug adapted to be connected to a source of A.C. current, a second relay, a third circuit between the A.C. plug and the second relay for energizing said second relay, and a fourth circuit between the A.C. plug and the fan motor for energizing said fan motor, including contacts in the second relay constructed so that the fan motor will be energized by the D.C. source of current only when the A.C. plug is not connected to the A.C. source of current but will be energized by the A.C. source of current only when the A.C. plug is connected to the A.C. source, the door switch controlling the first circuit and therefore controls the operation of the fan motor, whether it is being energized by either the A.C. or the D.C. source.

4. In a circuit for operating a motor for use in a refrigeration vehicle or the like, a battery for supplying direct current, a motor adapted to operate on either alternating or direct current, a relay, a first circuit between the battery and the relay for energizing it, a second circuit between the battery and the motor, an A.C. connection adapted to be connected to an alternating current source, a third circuit between the A.C. connection and the motor, contacts in the second and third circuits controlled by the relay so that the first circuit must energize the relay before the motor will be supplied with either direct or alternating current, and a switch in the first circuit so that the motor will not be supplied with either alternating or direct current when the switch is open.

5. The circuit of claim 4 further characterized by and including a second relay connected to the A.C. connection and having contacts in second and third circuits arranged so that when the motor is being supplied with alternating current, the second circuit will be deenergized and vice versa.

6. In a circuit for operating a fan unit for use in a refrigerated vehicle or the like, a D.C. source of current, a fan motor adapted to be driven by both A.C. and D.C. current, a first relay, a first circuit between the D.C. source of current and the first relay for energizing said first relay, a switch in the first circuit, a second circuit between the D.C. source of current and the fan motor for energizing said fan motor, including contacts in the first relay adapted to be closed when the first relay is energized but otherwise open, an A.C. plug adapted to be connected to a source of A.C. current, a second relay, a third circuit between the A.C. plug and the second relay for energizing said second relay, and a fourth circuit between the A.C. plug and the fan motor for energizing said fan motor, including contacts in the second relay, said first and second relays and their contacts and said

fourth circuit being constructed so that the fan motor will be energized by the D.C. source of current only when the A.C. plug is not connected to the A.C. source of current but will be energized by the A.C. source of current only when the A.C. plug is connected to the A.C. source.

7. The circuit of claim 6 further characterized in that the switch in the first circuit is controlled by a thermostat.

8. The circuit of claim 6 further characterized in that the switch in the first circuit is a door switch.

9. The structure of claim 4 further characterized in that the third circuit includes a step down transformer.

10. The structure of claim 4 further characterized by and including a second relay, the third circuit being connected between the second relay and the A.C. connection for energizing the second relay, and a fourth circuit between the A.C. connection and the motor for energizing the motor, the second relay including a double set of contacts, one set in the second circuit and the other set in the fourth circuit, the second relay being spring biased so as to normally close only the said one set of contacts when the second relay is not energized and to close only the other set of contacts when the second relay is energized thereby automatically opening the second circuit between the battery and the motor when the A.C. connection is connected to an A.C. source of current.

11. The structure of claim 6 further characterized in that the second relay includes contacts in the second and fourth circuits whereby the second circuit between the battery and the motor will be automatically open when the A.C. connection is connected to an A.C. source of current.

12. The structure of claim 6 further characterized in that the fourth circuit includes a step down transformer.

13. The structure of claim 6 further characterized in that the second relay includes a double set of contacts, one set in the second circuit and the other set in the fourth circuit, the second relay being spring biased so as to only close the one set of contacts when the said relay is not energized, and to close only the other set of contacts when the second relay is energized, thereby automatically opening the second circuit between the D.C. source of current and the fan motor when the A.C. plug is connected to an A.C. source of current.

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