Sept. 30, 1941. H. D. EUWER 2,257,164

AIR CONDITIONING UNIT

Filed April 16, 1937 4 Sheets-Sheet 1

Fig. 1.

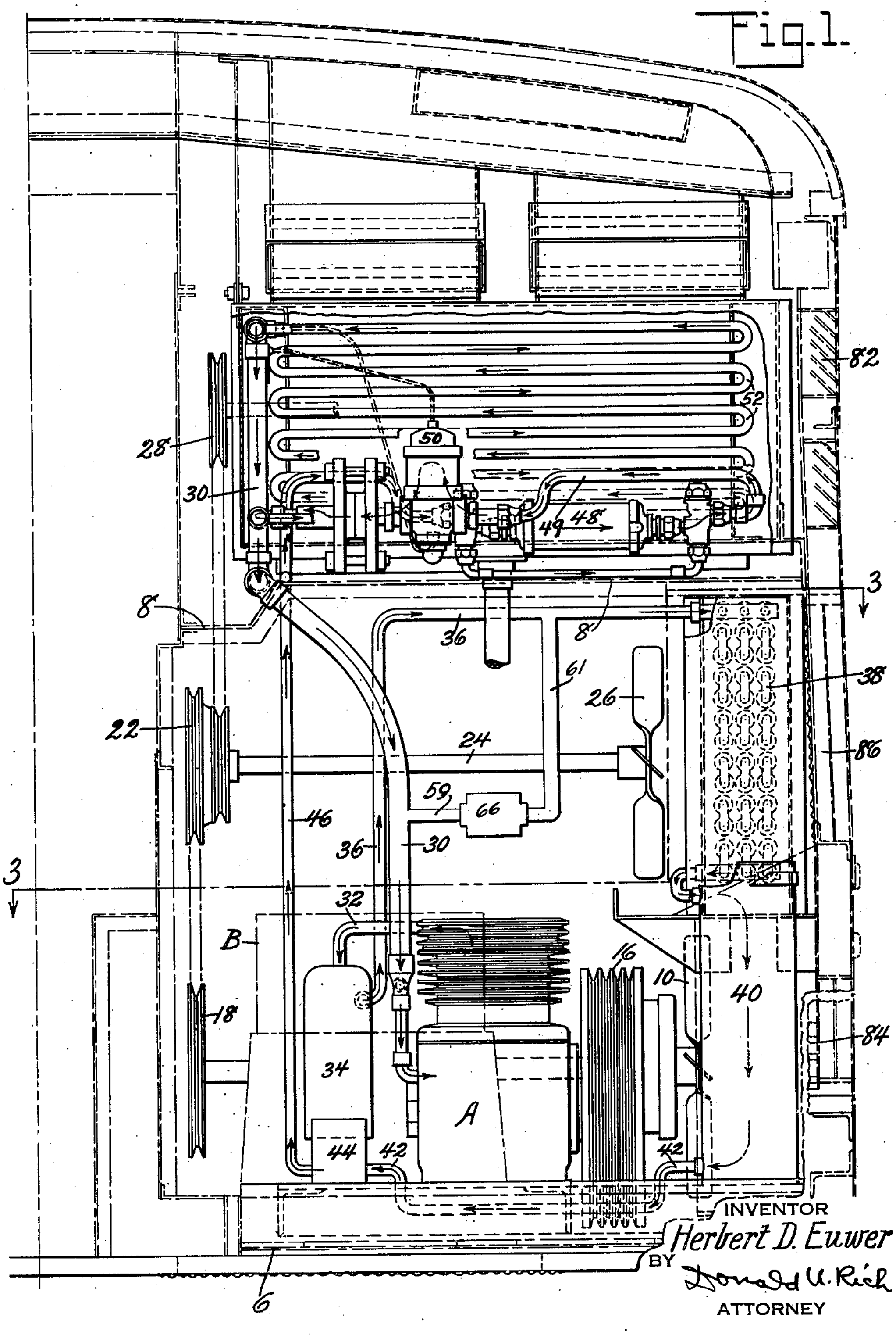

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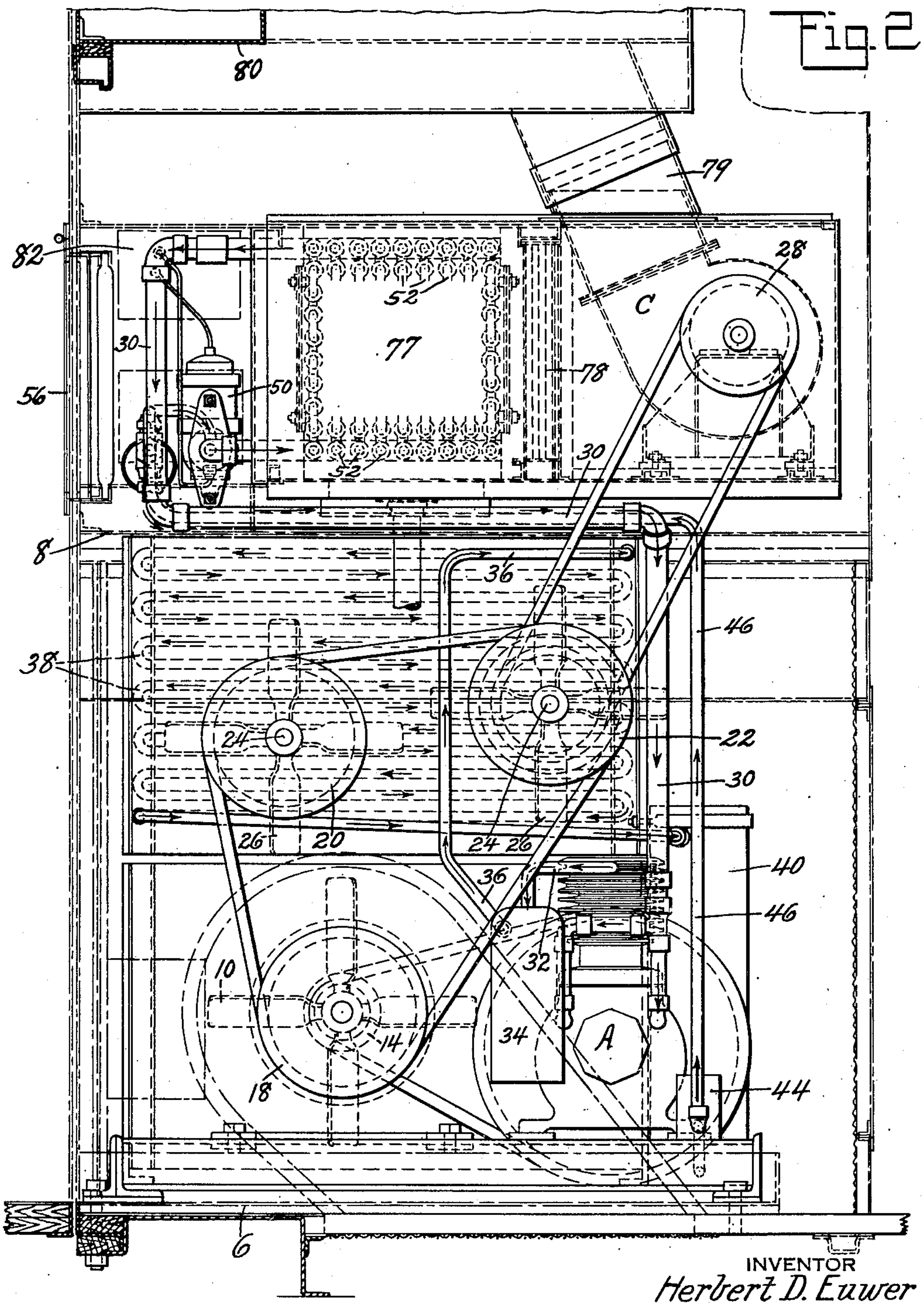
Fig. 2



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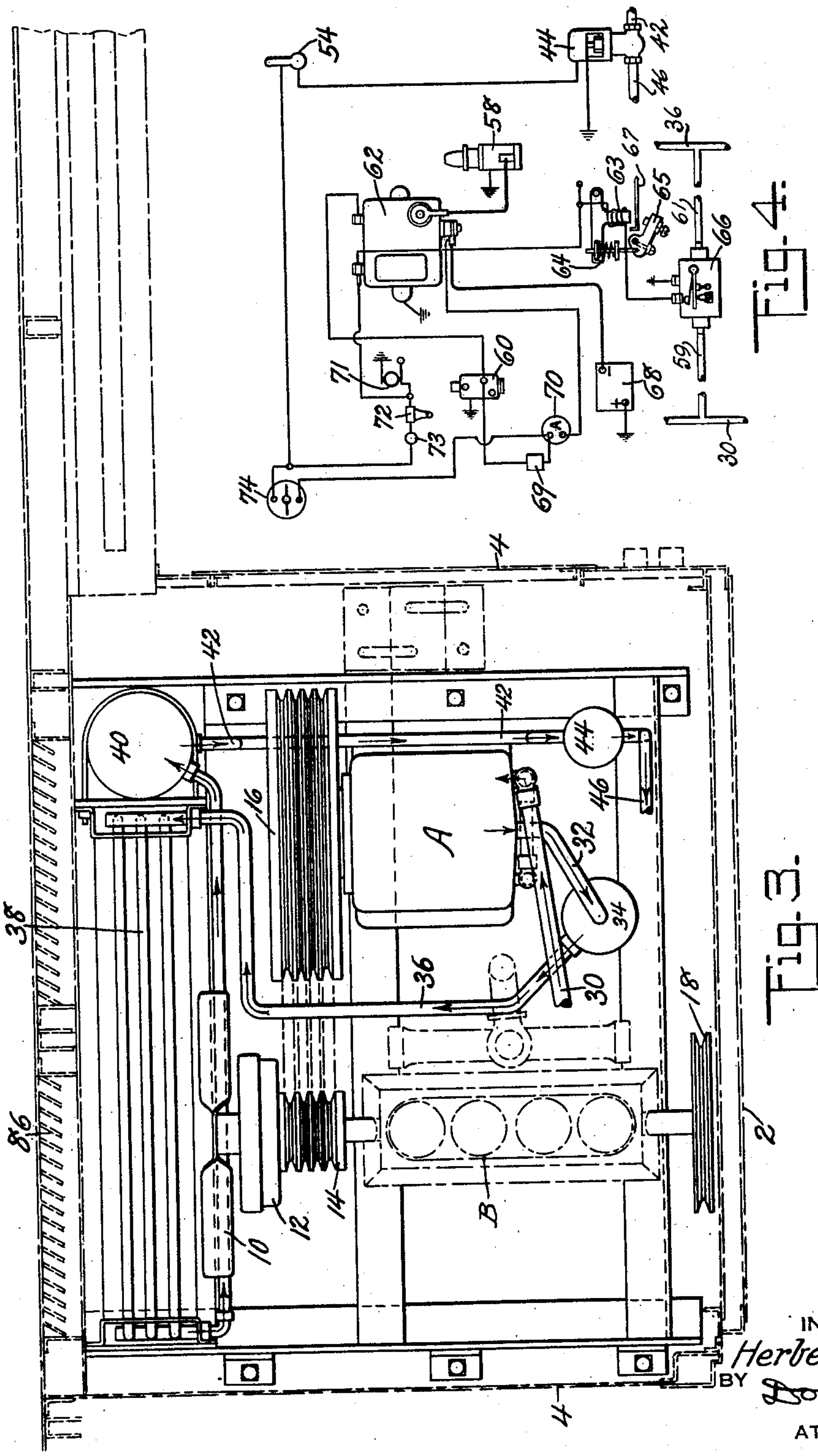

Fig. 4.

Fig. 3.

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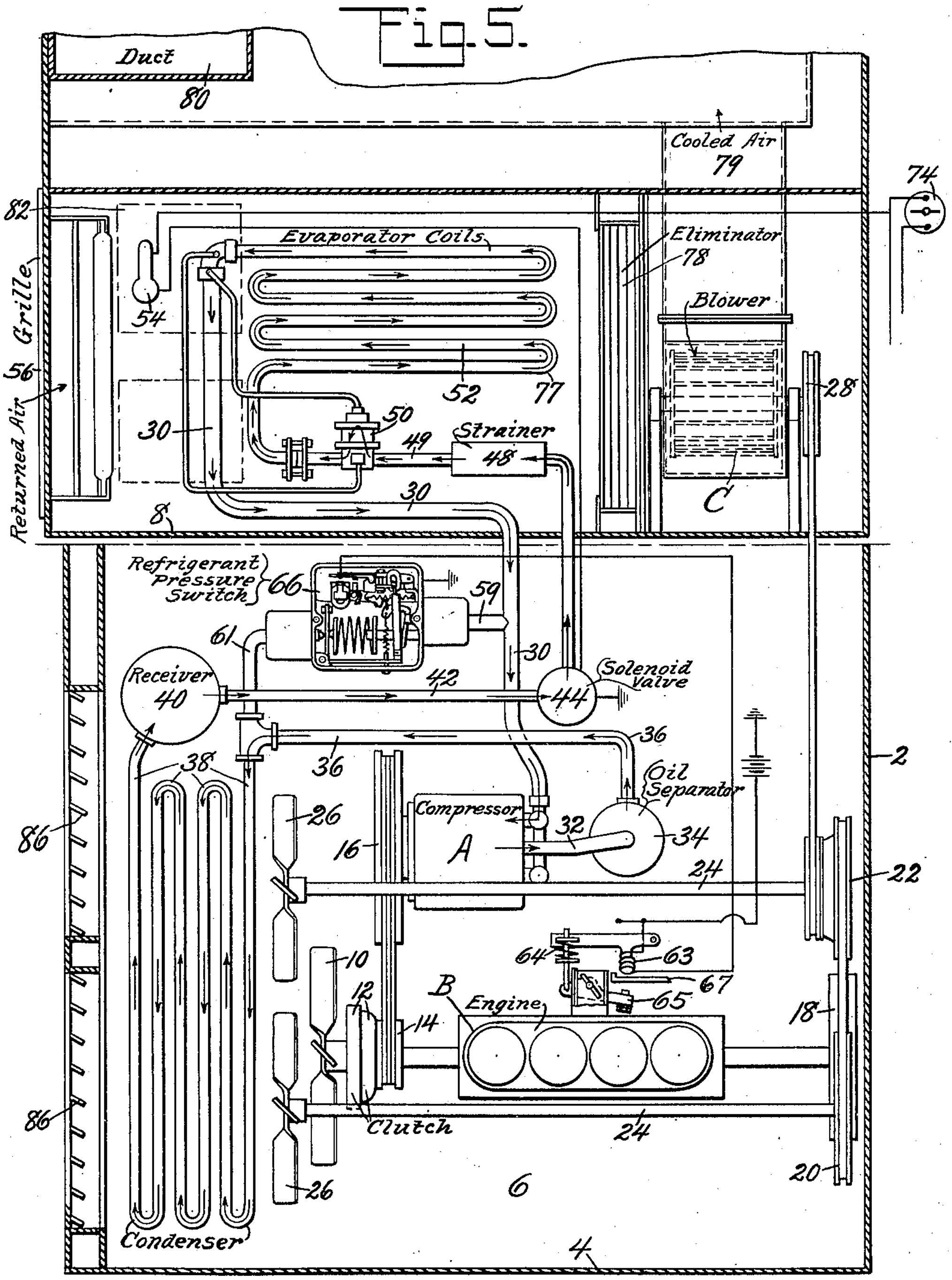
Fig. 5.



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UNITED STATES PATENT OFFICE

2,257,164

AIR CONDITIONING UNIT

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Application April 16, 1937, Serial No. 137,181

15 Claims. (Cl. 62—6)

This invention relates to air conditioning in general and in particular to self-contained air conditioning systems.

One of the objects of the invention is the provision of a compact self-contained air conditioning unit suitable for application particularly on mobile vehicles.

Another object of the invention is the provision of a compact self-contained air conditioning unit in which the prime mover directly operates all parts of the system.

A further object of the invention is the provision of a self-contained air conditioning system having a positive and simplified control.

These objects as well as others will be apparent to persons skilled in the art from a study of the following description and accompanying drawings, in which:

Figure 1 is an end view of the unit as applied to a railway car;

Fig. 2 is a side view of the unit shown in Figure 1;

Fig. 3 is a sectional view taken on line 3—3 of Figure 1;

Fig. 4 is a view showing diagrammatically the control system; and

Fig. 5 is a diagrammatic showing of the entire system and very similar to Figure 1 with the exception that confusing detail of the railway car has been omitted.

Referring now to the drawings in detail, it is seen that the unit consists mainly of two parts, that is, a lower part containing the power equipment and an upper part containing the cooling equipment. These parts are preferably contained in a housing having sides 2, ends 4 and a floor 6. The sides and ends are preferably formed with suitable openings, later to be referred to, and the housing is preferably divided into upper and lower compartments by a substantially horizontal partition 8.

The lower compartment has arranged therein the compresser A and the prime mover B which, in the present instance, is a gasoline engine although it may be an electric motor or expansion engine if desired. The engine is provided on one end of its crank shaft or rotor with a fan 10 and a centrifugally operated clutch 12, the outward element of which is connected to pulley 14 carrying a plurality of V-belts which drive the compressor pulley 16 whenever the clutch is engaged. The clutch is so arranged as to automatically disconnect the compressor from the engine at speeds below approximately 800 R. P. M., while at speeds above this and up to the maximum speed of the engine the compressor will be directly driven by the engine and at a speed directly proportional to the speed of the engine. The end of the crank shaft or rotor opposite from fan 10 is extended and carries thereon a pulley 18 by means of which pulleys 20 and 22 may be driven by a V or other type belt. The pulleys 20 and 22 are connected to shafts 24 carrying the condenser fans 26 adapted to force the cooling air out of the lower compartment. The pulley 22 is preferably a double pulley by means of which pulley 28 mounted on the shaft of the air circulating blowers C may be driven through a V or other suitable belt. It is thus seen that the fans operate at all times that the engine is running but that the compressor operates only under certain speed conditions.

The compressor is of conventional type being connected to the suction line 30 and discharging to the high pressure line 32 which is connected to oil separator 34 from which the hot compressed gases flow through pipe 36 to the air cooled condenser 38. The cooled liquid from the condenser flows into receiver 40 and from the bottom of the receiver through pipe 42 to the solenoid valve 44, thence through pipe 46 to strainer 48 (Fig. 1). From the strainer the fluid flows through pipe 49 to solenoid expansion valve 50 and from this valve through the evaporator coils 52 to the suction line 30 previously mentioned thus completing the circuit. The operation of the solenoid valve 44 is electrically controlled by the thermostat 54 (Fig. 4) which is preferably located in the recirculated air stream adjacent the grille 56. The expansion valve 50 is controlled by a thermostat attached to the suction line 30 beyond the evaporator (Figs. 1 and 2) and insures that gas of too low a temperature will not leave the evaporator coils, therefore, insuring a maximum efficiency.

The gasoline engine is equipped with an automotive type starter motor 58 (Fig. 4), a generator 60 and a starting control 62, which control may be of the type sold under the trade name of Startix Type D by the Eclipse Machine Company of Elmira, N. Y. The engine speed is controlled by means of a magnet 63 coupled through suitable balancing linkage 64 to lever 65 which is in turn directly connected to the butterfly valve of the carburetor. Separator 67 formed of a non-magnetic material is interposed between the lever 65 and the magnet core in order that residual magnetism cannot retain the lever in open throttle position upon deenergization of the magnet. The magnet 63 is controlled by means of a refrigerant pressure switch 66 having pipes 59 and 61 connecting it respectively to the suction and the high pressure side of the compressor. This pressure switch may be of the type known as Model LSP and manufactured by the Penn Electric Switch Company of Des Moines, Iowa. The engine generator supplies current to the small battery 68 through the customary generator cutout 69 and indicating ammeter 70 in the same manner as is done on present-day automobiles. The ignition for the engine is preferably supplied by a magneto 71, the operation of which may be controlled by a backfire safety switch 72 and emergency switch 73 as well as by the manually operated normal control switch 74.

The upper compartment is entirely separated from the lower compartment and contains the air conditioning and circulating equipment. This equipment consists in the main of a bank of evaporator coils 77, moisture eliminator 78 and the previously mentioned blowers C. In operation the blower will draw air for recirculation through grille 56 past the evaporator coils where it is cooled then through the eliminator to remove moisture droplets from the air. The air then flows to the blowers for discharge into connection 79 and the overhead duct 80 by which it is evenly distributed throughout the car. Fresh air may be supplied to the system as required by means of damper controlled inlets 82 (Fig. 1) located ahead of the evaporator coils so that the fresh air drawn in will be cooled and conditioned by the evaporator unit. As previously mentioned the thermostat 54 is located in the recirculated air grille and it is, therefore, subject to the temperature of the incoming air and will control the operation of the solenoid valve 44, thus controlling the operation of the evaporator unit. It will be seen that the blowers C in the upper compartment, as well as the cooling fans in the lower compartment, will operate at all times during which the engine is rotating regardless of its speed, due to the direct pulley and belt connection. The cooling air for the machinery and condenser will enter the lower compartment through suitable screened openings 84 formed in the side of the lower compartment and after flowing past the air cooled compressor and engine it will be forced by the fans 26 out through the condenser 38 and louvred openings 86 formed in the side of the housing. It is thus seen that the cooling air fans operate in series to assure a positive flow of air past the engine, compressor and condenser.

The operation of the system is as follows, assuming the engine as stopped and the car temperature at such a point that the thermostat 54 is closed: Upon turning the control switch 74 to the on position, current will be supplied to the starting control mechanism 62 which completes the circuit supplying current to the starting motor 58. The starting control 62 at the same time completes a circuit to the magneto 71 which will supply current to the engine during cranking to start the same. As soon as the engine has reached a speed in excess of 800 R. P. M. the centrifugally operated clutch 12 will function to connect the engine to the compressor. The engine is permitted to come up to top speed due to the fact that the thermostat 54 is closed causing solenoid valve 44 to be retained in the open position, thus lowering the pressure in the high pressure refrigerant line sufficient to cause pressure switch 66 to close. Closing of the switch 66 completes the circuit supplying current to magnet 63 which through the mechanical linkage and direct magnetic action will shift the carburetor butterfly to full open position. As soon as the car temperature has been lowered sufficiently for thermostat 54 to open, the solenoid valve 44 will close, thus causing the pressure in the refrigerant line to rise opening the pressure switch 66 and breaking the circuit to the magnet 63 permitting the throttle linkage to promptly return to the idling position due to the non-magnetic separator 67. The engine will then very rapidly drop from its high speed to its idling speed at which time the compressor is automatically uncoupled and the engine drives only the blowers and cooling air fans. It is, of course, obvious that pressure switch 66 will also open if for any reason the pressure from the high pressure refrigerant line exceeds a predetermined value and will close if for any reason the pressure in the suction line exceeds a predetermined value. The backfire safety 72 and emergency cutout switch 73 are provided merely as safety means to prevent any damage to the equipment during the starting or running thereof.

From the preceding description it will be seen that a compact self-contained mechanical air conditioning unit has been provided which may be readily applied to existing car structure or if desired to dwellings or office buildings and that the equipment will operate at maximum efficiency since direct drive is used in all cases and the prime mover or engine will drive the compressor only at such times as the compressor is needed. It is obvious that the engine being coupled to the compressor by means of a centrifugal clutch may attain a relatively high speed before being coupled to the compressor and this is particularly true if the engine is designed to pick up speed very rapidly, thus permitting an advantage to be gained due to the lag in the operation of the centrifugal clutch.

While the unit has been described more or less in detail, it is obvious that various modifications and rearrangements of parts may be made and all such modifications and rearrangements are contemplated as fall within the scope of the following claims.

What is claimed is:

1. In combination with an inclosure to be cooled, an air conditioning apparatus arranged therein, said apparatus comprising a housing forming a self-supporting structure independent of said inclosure and being divided into a plurality of compartments, an evaporator in a first compartment, a blower drawing air from the inclosure into said first compartment for cooling by the evaporator, an exit from said first compartment discharging the cooled air back into said inclosure, a refrigerating apparatus located in a second compartment, said apparatus including a substantially continuously operating air cooled internal combustion engine, a compressor intermittently connected to said engine, and a condenser connected to said compressor, and means driven directly by the engine for continuously forcing air through the second compartment and past the apparatus to cool the same.

2. In combination with an inclosure to be cooled, an air conditioning apparatus arranged therein, said apparatus comprising a housing forming a self-supporting structure independent of said inclosure and being divided into a plurality of compartments, an evaporator in a first compartment, a blower drawing air from the inclosure into said first compartment for cooling

by the evaporator, an exit from said first compartment discharging the cooled air back into said inclosure, a refrigerating apparatus located in a second compartment, said apparatus including a substantially continuously operating air cooled internal combustion engine, a compressor intermittently connected to said engine and a condenser connected to said compressor, and means driven directly by the engine for continuously forcing air through the second compartment and past the apparatus to cool the same, said engine also being directly connected to said blower in the first compartment to drive the same for continuously circulating air in the inclosure during operation of the engine.

3. In an air conditioning apparatus for cooling an inclosure, a housing divided into a plurality of compartments, an evaporator in a first compartment, a blower drawing air from the inclosure into said first compartment for cooling by the evaporator, an exit from said first compartment discharging the cooled air back into said inclosure, a refrigerating apparatus located in a second compartment, said apparatus including a substantially continuously operating air cooled internal combustion engine, a compressor, a centrifugal clutch intermittently connecting said engine to the compressor in accordance with engine speed, a condenser connected to said compressor, means directly driven by the engine for continuously forcing air through the second compartment and past the apparatus to cool the same, and means operable to increase the speed of the engine thereby causing the centrifugal clutch to connect the engine to the compressor, said means being controlled by a thermostat in accordance with the temperature of the air entering the first compartment.

4. In an air conditioning apparatus for cooling an inclosure, a housing divided into a plurality of compartments, an evaporator in a first compartment, a blower drawing air from the inclosure into said first compartment for cooling by the evaporator, an exit from said first compartment discharging the cooled air back into said inclosure, a refrigerating apparatus located in a second compartment, said apparatus including a substantially continuously operating air cooled internal combustion engine, a compressor, a centrifugal clutch intermittently connecting said engine and compressor in accordance with the engine speed, a condenser connected to said compressor, means driven directly by the engine for continuously forcing air through the second compartment and past the apparatus to cool the same, and means operable in accordance with the temperature of the air entering the first compartment to control the connection of the engine and compressor by varying the engine speed.

5. In an air conditioning apparatus for cooling an inclosure, a housing divided into a plurality of compartments, an evaporator in a first compartment, a blower drawing air from the inclosure into said first compartment for cooling by the evaporator, an exit from said first compartment discharging the cooled air back into said inclosure, a refrigerating apparatus located in a second compartment, said apparatus including a substantially continuously operating air cooled internal combustion engine, a compressor, a centrifugal clutch intermittently connecting said engine to the compressor directly in accordance with engine speed for supplying refrigerant to the evaporator, and means responsive to changes in the temperature of the air entering the first compartment to control the speed of the engine and thereby the operation of the centrifugal clutch to connect or disconnect the engine from the compressor.

6. In an air conditioning apparatus for cooling an inclosure over a period of time, evaporator means to absorb the heat from the air of the inclosure, condenser means to reject the heat absorbed by the evaporator, pumping means to force a refrigerant through a line joining the evaporator and condenser, a prime mover adapted to run continuously over the said period of time, fan means driven by said prime mover to move air past the evaporator and condenser during the said period of time, means including a centrifugal clutch responsive solely to changes in the speed of the prime mover and arranged to disconnect the prime mover from the pumping means or to so connect the pumping means to the prime mover during a portion of said period of time as to cause the prime mover to drive the pumping means at a speed directly proportional to the prime mover speed.

7. In an air conditioning apparatus for cooling an inclosure over a period of time, evaporator means to absorb the heat from the air of the inclosure, condenser means to reject the heat absorbed by the evaporator, pumping means to force a refrigerant through a line joining the evaporator and condenser, a prime mover adapted to run continuously over the said period of time, connecting means joining said prime mover to the pumping means for driving the same during a portion of said period of time, said connecting means being directly responsive to changes of prime mover speed to positively connect or disconnect the pumping means and prime mover, means responsive to the temperature of the air in the inclosure to control the flow of refrigerant to the evaporator, and means responsive to changes of pressure in the refrigerant line to modify the fuel supply to the prime mover thereby directly controlling the speed of the prime mover.

8. In an air conditioning apparatus for cooling an inclosure over a period of time, evaporator means to absorb the heat from the air of the inclosure, condenser means to reject the heat absorbed by the evaporator, pumping means to force a refrigerant through a line joining the evaporator and condenser, a prime mover adapted to run continuously over the said period of time, connecting means joining said prime mover to the pumping means for driving the same during a portion of said period of time, said connecting means being directly responsive to changes of prime mover speed to positively connect or disconnect the pumping means and prime mover, and means responsive to changes of pressure in the refrigerant line to modify the fuel supply to the prime mover thereby directly controlling the speed of the prime mover.

9. In an air conditioning apparatus for cooling an inclosure over a period of time, evaporator means to absorb the heat from the air of the inclosure, condenser means to reject the heat absorbed by the evaporator, pumping means to force a refrigerant through a line joining the evaporator and condenser, a prime mover adapted to run continuously over the said period of time, fan means driven by said prime mover to move air past the evaporator and condenser during the said period of time, connecting means joining said prime mover to the pumping means for driving the same during a portion of said

period of time, said connecting means being responsive to changes of prime mover speed to connect or disconnect the pumping means and prime mover, and means responsive to the temperature changes of the air in the inclosure to control the speed of the prime mover.

10. In an air conditioning apparatus for cooling an inclosure over a period of time, evaporator means to absorb the heat from the air of the inclosure, condenser means to reject the heat absorbed by the evaporator, pumping means to force a refrigerant through a line joining the evaporator and condenser, a prime mover adapted to run continuously over the said period of time, fan means driven by said prime mover to move air past the evaporator and condenser during the said period of time, connecting means joining said prime mover to the pumping means for driving the same during a portion of said period of time, said connecting means being responsive to changes of prime mover speed to connect or disconnect the pumping means and prime mover, and means responsive to changes of pressure in the refrigerant line to control the speed of the prime mover.

11. In an air conditioning apparatus for cooling an inclosure over a period of time, evaporator means to absorb the heat from the air of the inclosure, condenser means to reject the heat absorbed by the evaporator outside of the inclosure, pumping means to force a refrigerant through a line connecting the evaporator and condenser, a prime mover adapted to run continuously over the said period of time, connecting means joining said prime mover to the pumping means for driving the same during a portion of said period of time, said connecting means being directly responsive to changes of prime mover speed to connect or disconnect the pumping means and prime mover, and means cooperating to control the speed of the prime mover and comprising an element responsive to variations in temperature within the inclosure and an element responsive to changes of pressure in the refrigerant line.

12. In an air conditioning apparatus for cooling an inclosure over a period of time, evaporator means to absorb the heat from the air of the inclosure, condenser means to reject the heat absorbed by the evaporator outside of the inclosure, pumping means to force a refrigerant through a line connecting the evaporator and condenser, a prime mover adapted to run continuously over the said period of time, a centrifugal clutch connecting said prime mover to the pumping means for driving the same during a portion of said period of time and being directly responsive to changes of prime mover speed to positively connect or disconnect the pumping means and prime mover, and means cooperating to control the speed of the prime mover and comprising an element responsive to variations in temperature within the inclosure and an element responsive to changes of pressure in the refrigerant line.

13. In an air conditioning apparatus for cooling an inclosure, evaporator means for absorbing heat from within the inclosure, condenser means to reject the heat absorbed by the evaporator means, means connecting the evaporator means and condenser means, pumping means for forcing refrigerant between the evaporator means and condenser means, a continuously operating prime mover, connecting means joining the prime mover and pumping means to drive the latter, said connecting means being operative directly in response to changes of the prime mover speed to connect or disconnect the pumping means and prime mover, and means for controlling the speed of the prime mover comprising a first element operative in response to variations in temperature within the inclosure and a second element connected with said first element and operative in response to changes of pressure of the refrigerant.

14. In an air conditioning apparatus, a refrigerant circuit including a connected evaporator and condenser, means for forcing refrigerant through said circuit, a continuously operating prime mover, blower means operated continuously by said prime mover, and means operative in response to variations in pressure of refrigerant in said circuit for effecting intermittent operation of said refrigerant forcing means through positive connection and disconnection therewith of the continuously running prime mover.

15. In an air conditioning apparatus, a refrigerant circuit including a connected evaporator and condenser, means for forcing refrigerant through said circuit, a continuously operating prime mover, blower means operated continuously by said prime mover, temperature controlled means so arranged as to effect variations in pressure in said circuit, and means responsive to said variations in pressure to intermittently connect or disconnect said prime mover and said refrigerant forcing means.

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