

June 23, 1936.

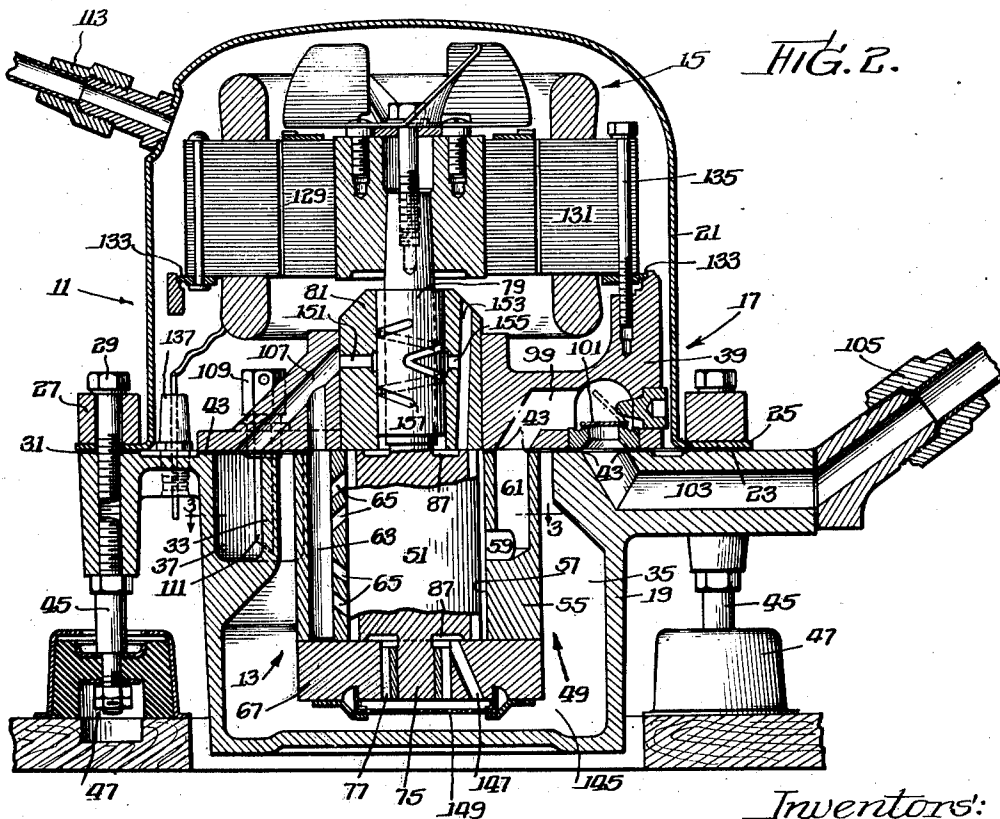
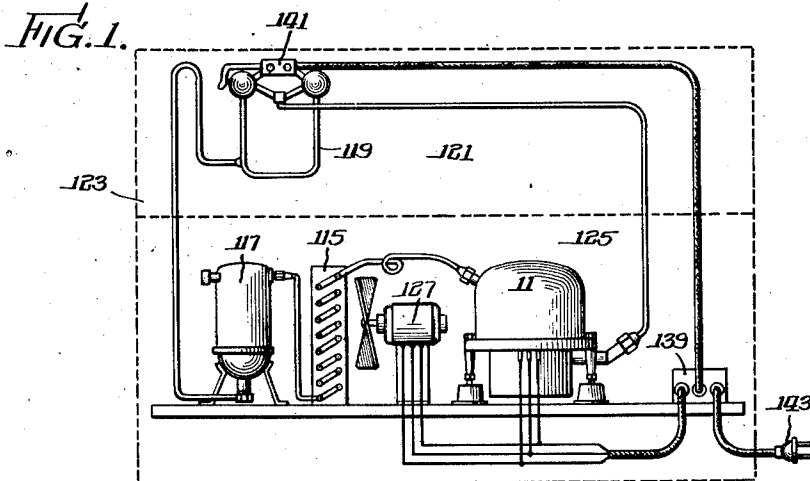
M. W. KENNEY ET AL

2,045,014

COMPRESSOR

Filed July 7, 1934

2 Sheets-Sheet 1



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FIG. 3.

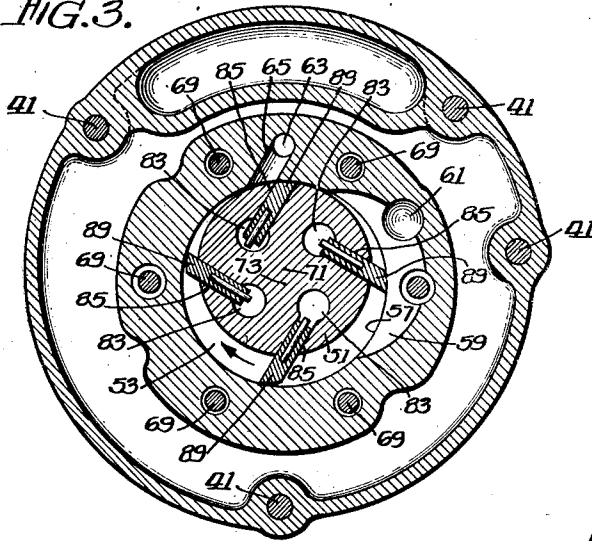


FIG. 5.

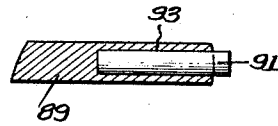


FIG. 4.

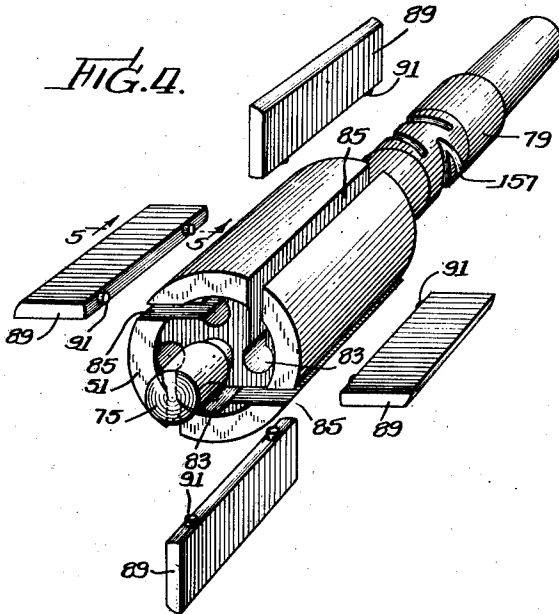
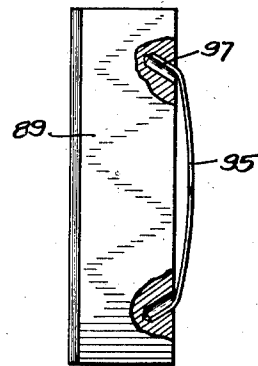


FIG. 6.



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UNITED STATES PATENT OFFICE

2,045,014

COMPRESSOR

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Application July 7, 1934, Serial No. 734,077

6 Claims. (Cl. 103—135)

Our invention relates in general to hydraulic machines, and has more particular reference to fluid forcing devices such as the compressor illustrated and described in our co-pending application for United States Letters Patent Serial No. 724,894, filed May 10, 1934.

The invention has for an important object the provision of a hydraulic machine comprising a fluid forcing device particularly well adapted for use in refrigerating systems of the so-called compression evaporation type in which a suitable refrigerating medium in gaseous condition is compressed, then liquefied by condensation, and finally evaporated for the absorption of heat, the gases evolved by the evaporation of the refrigerating medium being then returned to the compressor for a repetition of the refrigerating cycle, the invention relating more especially to a fluid forcing device or compressor comprising a piston or forcing element cooperatively disposed within a cylinder, the parts being arranged for relative movement in order to force fluid delivered in the cylinder through the space between the forcing element and the cylinder in response to the relative movement of the parts, wherein at least one of the parts carries one or more depressible blades adapted to extend in said forcing space and into contact with the other part, the invention particularly relating to the suppression of noise developed by the relative movement of the blades with respect to the parts on which the same are mounted.

Another important object is to provide, in general, a hydraulic device having relatively movable parts and one or more impeller blades movable on said parts, including means for suppressing noise developed by the relative movement of the blades on said parts.

Another important object is to provide a rotary hydraulic device having a rotary element provided with impeller blades carried in slotted portions of said element, and adapted for sliding movement in said slotted portions, said blades having buffer means for suppressing the noise developed by the impact of the blades with the bottom of the slots in which the same are mounted.

Another important object is to provide improved buffer means for hydraulic impeller blades which are slidingly mounted for operation in slots of an impeller member forming a part of a hydraulic device whereby to absorb the force of impact of said blades on said element.

A further object is to employ pegs of resilient shock absorbing and noise suppressing material

between the edge of a hydraulic impeller blade and the bottom of a slot formed in an impeller element and in which said blade is slidingly mounted; a further object being to mount the pegs in an edge of the blade.

A further object is to utilize a resilient metallic strip comprising spring means between the edge of the impeller blade and the bottom of the slot of an impeller element in which the blade is slidingly mounted; a further object being to arrange the strip in the form of a leaf spring having its opposed ends mounted on the edge of the blade.

Numerous other objects, advantages and inherent functions of the invention will become apparent as the same is more fully understood from the following description, which, taken in conjunction with the accompanying drawings, discloses preferred embodiments of the invention.

Referring to the drawings:

Figure 1 is a diagrammatic view of a compression-evaporation refrigerating system including a sealed motor compressor unit embodying our present invention;

Figure 2 is a sectional view taken substantially through the motor compressor unit illustrated in Figure 1;

Figure 3 is a view in horizontal section taken substantially on the line 3—3 in Figure 2;

Figure 4 is an exploded view of parts of the unit shown in Figure 2;

Figure 5 is an enlarged sectional view taken substantially on the line 5—5 in Figure 4, in order to illustrate the construction of impeller vanes forming a part of the fluid forcing device shown in Figure 2; and

Figure 6 is a view illustrating a modified impeller blade embodying our present invention.

To illustrate our invention, we have shown on the drawings a fluid forcing device, particularly well adapted for use as a compressor in a refrigerating system of the compression-evaporation type, although it will be obvious that the invention is not necessarily restricted to compressors or to devices for use in refrigerating systems. On the contrary, our invention includes features which may be incorporated to advantage in devices such as pumps and fluid motors operating by or through hydraulic action. The device of our present invention, however, is more particularly applicable in fluid forcing devices adapted for substantially noiseless operation, for which reason the invention is especially adapted for use in domestic refrigeration systems, in which noise-

less operation is an important consideration. To this end we have illustrated our present invention as embodied in a motor compressor unit 11, comprising a fluid forcing device 13, and driving means 15 for the forcing means. The driving means 15 preferably comprises an electric motor which, with the fluid forcing device 13, is housed in a substantially hermetic casing 17 formed in any suitable or preferred fashion. The casing is preferably formed in sections 19 and 21, the casing section 19 being preferably formed as a casing having an outstanding peripheral flange 23, and providing a receptacle for receiving the fluid forcing device 13. The other casing portion 21 is formed preferably of sheet metal, and is of dome-like shape affording an enclosure for the motor. The casing portion 21 has a peripheral flange 25 fastened as by means of a holding ring 27 and bolts 29 upon the flange portion 23 of the casing portion 19, an annular gasket 31 extending between the flanges 23 and 25, whereby the casing portions are sealingly secured in position to enclose the fluid forcing and driving elements 13 and 15. The casing portion 19 is formed with a partition 33 defining a chamber 35 adapted to receive the fluid forcing mechanism, and a second chamber 37 forming a muffler, both of said chambers opening upwardly in the casing portion. The portion 19 also carries a cover member 39 which extends across and closes the upper ends of the chambers 35 and 37. This cover is secured in place on the casing portion 19 in any suitable fashion as by bolts or other fastening devices 41. Suitable gasket means 43 extending between and being clampingly secured by and between the facing surfaces of the cover and the portion 19 on which it is mounted. The casing portion 19 is also provided with suitable depending legs 45 by which the casing and the mechanism therein may be mounted on a supporting base 47, the legs 45 being preferably provided with resilient or shock absorbing means 47 preferably of the character illustrated in our co-pending application Serial No. 714,447, filed March 7, 1934. Any suitable or preferred means, however, may be utilized for mounting the unit. The fluid forcing and driving means 13 and 15 may, of course, be mounted in the casing in any suitable or preferred fashion, but we prefer to mount them upon the cover 39, which, as will be apparent, forms a partition separating the casing into upper and lower chambers, in which the driving means and the fluid forcing mechanism are respectively mounted, the driving means being mounted on and supported by and above the cover 39, while the fluid forcing means is suspended upon and supported by and below the cover. This superposed arrangement is particularly well adapted to our purpose in that it facilitates assembly and lubrication of the operating parts of the unit.

The fluid forcing mechanism comprises a pair of cooperating elements 49 and 51 relatively shiftable in the performance of the hydraulic action of the device, the element 49 preferably comprising a cylinder, and the element 51 comprising a piston within the cylinder. The piston 51 is relatively smaller in external diameter than the internal diameter of the cylinder, and is mounted with its axis eccentric with respect to the axis of the cylinder, in order to form a crescent-shaped working space 53 between the piston and the cylinder. The driving means 15 is operatively connected with the fluid forcing mechanism in order to relatively shift the piston and cylinder. In the illustrated embodiment, the

piston is rotated on its axis by the driving means, while the cylinder is stationarily mounted, although other mechanical arrangements may be adopted in order to accomplish the hydraulic action.

The cylinder 49 is preferably formed as an open-ended cylindrical sleeve 55 having an internal cylinder bore 57 relieved as at 59 to form a port, which in the illustrated embodiment comprises an inlet port, a duct 61 being formed in the walls of the member 55 between the port 59 and an end of the member. The walls of the cylinder 55 are also formed with a channel 63 preferably extending parallel with the axis of the bore 57 and opening at the opposite ends of the cylinder, said channel having communication with the bore 57 through ducts 65, which are drilled through the wall intervening between the duct 63 and the bore 57 at angles as shown in Figure 2, this expedient permitting the ducts 65 to be formed by means of a drill applied through the opposite ends of the bore 57. The channel 63 and ducts 65, in the illustrated embodiment, form an exhaust manifold into which a work medium such as a refrigerant or other fluid, introduced into the cylinder through the inlet port 59, may be expelled by the fluid forcing action initiated by the relative movement of the piston within the cylinder. One end of the cylinder 55 is closed by means of a cover 67, which, with the element 55, is stationarily mounted upon the underside of the partition 39, the parts 55 and 67 being held in place by means of studs 69 which extend through suitable channels formed in the elements 55 and 67, and thread into sockets formed in the partition 39.

The fluid forcing element or piston 51 comprises a cylindrical rotor which is mounted within the work chamber, formed by the bore 57 between the faces of the cover members 39 and 67. This rotor or impeller is of less diameter than that of the bore 57 and the rotor is journaled for rotation about an axis 71 eccentric to the axis 73 of the bore 57, the cylindrical impeller 51 being positioned in the chamber so that it forms a contact with the cylindrical walls of the work chamber at a point between the inlet 59 and the outlet ducts 65 leaving the crescent shaped work place 53 between the impeller and the cylinder 55 on the side of the impeller opposite that at which it engages the cylinder. The rotor is formed at one end with an axial projection 75 by which it is journaled in the cover plate 67, said cover plate being formed with suitable bearing means 77 for receiving the axial projection 75. At its opposite end the rotor is provided with a projection forming an axle 79 which extends through and is journaled in a bearing 81 carried by the partition 39.

The rotor or impeller 51 is provided with a plurality of channels 83 extending parallel with and spaced from the axis of the rotor and slots 85 formed in the body of the rotor radially of said channels 83, said slots 85 extending in non-radial directions with respect to the axis of the impeller element and connecting the channels 83 with the surface of the impeller. The rotor is also undercut at its opposite ends to form annular channels 87 around the projections 75 and 79 and a fluid-forcing vane or blade 89 is arranged in each of the slots 85, said blades being slidable therein so that their outer edges may slidably engage the inner surface of the bore 57 at all times during the operation of the device.

The shaft 79 extends upwardly of the bearing 75

81 into the enclosure provided by the casing portion 21 and is there operatively connected with the driving means 15, which, when in operation, functions to relatively shift the impeller 51 with respect to the cylinder 55. In the illustrated embodiment the relative shifting comprises rotation of the impeller element 51 within the cylinder 55, the latter being held stationary. Where the invention is embodied as a fluid forcing device or compressor, the impeller will rotate in the direction indicated by the arrow in Figure 3 so that the blades 89 travelling with the rotating element 51 will force fluid delivered in the work chamber at the inlet 59 through the chamber and deliver the same under pressure into the discharge manifold 63. The blades, however, in travelling around the cylinder 55, will be depressed in the slots 85. When the impeller is rotating at normal operating speed, centrifugal action will urge the blades outwardly into position such that their edges are forced against and ride upon the inner surface of the bore 57. When the machine is initially started in operation as a compressor, the inertia of the blades against movement assisted by the sliding frictional engagement of the opposite end edges of the blades on the plates 39 and 67 will cause the blades to ride inwardly in their slots, the inner edges of the blades impacting with the internal abutments formed by the ducts 83. Thus at starting a clicking sound will be audible and moreover during long periods of operation without attention particularly where the machine is started and stopped frequently as when the same is used as a compressor in a domestic refrigeration system, appreciable wear may develop on parts at the points of impact. To eliminate the noise and wear, we provide resilient means between the inner edge of the blades and the abutment against which impact occurs. For this purpose we may utilize any suitable material. The resilient means may, as shown in Figures 3, 4 and 5, comprise pegs 91 of resilient material set in sockets 93 formed in the blades, the pegs having ends projecting from the edges of the blades in position to engage the wall of the ducts 83 when the blades are fully depressed in the slots. The pegs 91 may be of any suitable resilient material, although we prefer to employ wooden pegs and while any number of pegs, depending upon the length of the blade may be employed on a blade, we find that two pegs for each blade are ordinarily sufficient.

Alternately, as shown in Fig. 6, we may employ resilient means in the form of a spring, preferably a leaf spring 95 having its opposite ends off-set for insertion in a readily removable manner in the sockets 97 formed in spaced-apart position in the blade and opening on the inner edge thereof. The sockets 97 are preferably inclined as shown and when the ends of the leaf spring 95 are seated, the intermediate portions of the spring extend along the edge of the blade in resilient, outwardly bowed position, thus affording a yielding buffer for engagement with the abutment provided by the wall of the duct at the inner end of the slot at which the blade is or may be seated. We find that the provision of the resilient shock absorbing buffer means not only reduces wear, but also eliminates the undesirable clicking sound due to impact of the blades on the bottom of the slot when the machine is started in operation.

The blades 89 are, of course, freely depressible in the slots at all times, thereby permitting fluid

slippage past the blades at any time when abnormal pressures develop during normal operation as where incompressible liquids enter the cylinder. This construction is adapted to relieve locking of the device and consequent strain set up in the parts under such conditions. As heretofore stated, the blades, due to their inertia, recede in the slots when the machine is initially started. This, together with the fact that the blades are themselves depressible, permits operation of the impeller mechanism to relieve back pressure upon the rotor when the same is started in operation from rest. As the rotor commences to move, the inertia of the blades, together with the tangential arrangement of the same, causes the blades to slide inwardly in the slots, thus affording a space between the outer edges of the blades and the surface of the bore 57 through which the pump is unloaded at the instant of starting. As the speed of the impeller increases, a centrifugal action expels the blades outwardly in their slots into working contact with the cylinder slots so that the device becomes gradually loaded as it reaches normal operating speed. Should abnormal back pressures develop, the blades will remain depressed to permit the device to operate in partially loaded condition in order to avoid strain and damage to the parts.

The casing means is formed with an inlet channel communicating with the duct 61, and the casing is also provided with conduit means communicating with the exhaust manifold 63 and affording an outlet from the casing. In the illustrated embodiment, the partition is formed with a duct 99 communicating with the duct 61 and opening through a valve 101 into an inlet conduit 103 which is preferably formed on the casing member 19 and provided with connecting means 105 for attaching the inlet channel 103 with a source of fluid to be compressed. The partition 39 is also formed with duct means 107 communicating with the exhaust manifold 63 and opening into the muffler chamber 37. The partition also carries an outlet fitting 109 including a pipe 111 opening at its lower end in the muffler chamber and at its upper end in the space defined by the housing 21 above the partition. The fluid medium is drawn in through the inlet 103, thence through the valve 101 which functions to prevent return flow of fluid out through the inlet, through the ducts 99 and 61, thence between the elements 51 and 55. The fluid delivered from the elements 51 and 55 into the exhaust manifold 63 through the duct 65 enters the muffler chamber by way of the duct means 107 and escapes thence into the casing portion 21 above the partition and is finally ejected from the device through an outlet fitting 113 formed in the casing member 21.

We provide lubrication for the unit by forming a reservoir 145 for a suitable lubricating medium in the casing portion 19 and around the compressor therein. The plate 67 is formed with a duct 147 through which lubricant will be drawn in response to the operation of the parts 51 and 55 creating a reduced pressure within the cylinder 55. The lubricant entering the channel 147 passes through a screen 149 mounted on the plate 67 and enters the annular channel 87 at the lower end of the element 51. A certain amount of lubricant also will be drawn up through the bearing 77 as a result of the reduction in pressure. The lubricant accumulating in the annular channel 87 will flow upwardly through the ducts 83 behind the blades, a portion of the lubricant escaping outwardly through

the slots 85 on opposite sides of each blade into the work space in order to lubricate the moving parts of the elements 51 and 55 and of the blades 89. The lubricant thus delivered into the work chamber will be forced through the ducts 85 into the outlet manifold 83 and may be delivered to the upper bearing 81 through a duct 151 leading from the duct 107 into the interior of the bearing 81 to thus assist in lubricating the shaft 79. The lubricant which does not pass into the work space will be delivered through the ducts 83 into the upper annular space 87 and thence upwardly through a duct 153 formed in the bearing 81. A part of the lubricant passing through the duct 153 may enter the bearing 81 through an opening 155. The lubricant entering the bearing 81 through the openings 151 and 155 will be pumped in either direction through the bearing by means of pumping grooves 157 formed in the shaft 79, a part of the lubricant being discharged at the lower end of the bearing into the annular groove 87, and the rest being discharged at the upper end of the bearing, and this, together with the excess lubricant escaping from the upper end of the duct 153 will flow downwardly over the upper surface of the partition 39 and collect in a pool at the outer edge of the partition. The partition is provided with means for returning the so-collected lubricant to the reservoir 145.

While we have described the fluid forcing device or compressor of the type particularly well adapted for use in a domestic refrigeration system, our invention, of course, is not necessarily limited to compressors, but may have application generally in hydraulic devices. The particular compressor which we have described, however, is particularly well adapted for use in a refrigerating system of the so-called compression-expansion type wherein the compressor is connected in a refrigerant circulating system, the outlet 113 being connected by means of a suitable conduit with a condenser 115 which in turn is connected through a preferably float-controlled expansion valve 117 with a refrigerant evaporator or boiler 119 so that a compressed refrigerating medium in gaseous condition, delivered from the compressor, may be liquefied in the condenser by the removal of heat from the compressed refrigerant and delivered thus in liquid condition through the expansion valve and into the evaporator. The liquid refrigerant boils in the evaporator with consequent absorption of heat and the gases evolved during the boiling of the refrigerant in the evaporator are returned to the suction side of the compressor by means of a suitable conduit.

Where the refrigerating system is arranged in a cabinet for use as a domestic refrigerator, the evaporator 119 is preferably located in heat-exchange relationship with respect to the atmosphere within a cooling chamber 121, preferably forming a part of the cabinet 123. The cabinet is also preferably formed with a mechanism chamber 125 disposed adjacent the refrigerating chamber and in which the condenser, compressor, float-valve and a blower powered by a motor 127 for the purpose of cooling the condenser, may be arranged.

We prefer to use an electric motor for driving the compressor, which motor comprises a rotor 129 which is secured to and carried by the shaft 87 above the partition 39. This rotor fits within an annular stator 131 forming a part of the driving motor and which is mounted in seats 133 formed on the partition 39, the stator being

held in place by means of studs 135. Electrical power for operating the motor may be delivered through conductors, including a sealed inlet plug 137 in which the conductors extend through a wall of the casing means which encloses the unit. We prefer to operate the blower motor 127 and the compressor driving motor by connecting the same in parallel and to an electrical control system which is preferably enclosed in a casing 139 and mounted in the mechanism compartment 125, the control mechanism within the casing being connected by suitable conductors with thermostatic control devices 141 mounted in the refrigerating chamber 121, whereby the system may be placed in operation by starting the compressor whenever the temperature within the refrigerating chamber rises above the predetermined value. Electrical power for driving the motors 15 and 127 may be delivered through a cable fitted with a plug connector 143 for detachable connection with an available power source.

It is thought that the invention and numerous of its attendant advantages and inherent functions will be understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of the invention or sacrificing any of its attendant advantages, the forms herein described being preferred embodiments for the purpose of illustrating the invention, and we do not herein claim the refrigerating system or the general arrangement of the compressor and its driving motor since the same forms the subject matter of our co-pending application, Serial No. 724,894 filed May 10, 1934.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

1. A device of the character described comprising a cylindrical impeller element having a slot opening on a cylindrical surface of the element, a blade extending in said slot and adapted to be projected at one edge outwardly of the cylindrical surface of the slot by centrifugal action when the impeller element is rotated, and shock-absorbing means carried on the opposite edge of the blade in position to engage the bottom of the slot and to absorb the energy of impact between the blade and the bottom of the slot when the blade is projected into the slot, said shock-absorbing means being ineffective to urge the blade out of said slot.

2. A device of the character described comprising a cylindrical impeller element having a slot extending parallel with the axis of the element and opening on a cylindrical surface of the element, a blade extending in said slot and adapted to be projected at one edge outwardly of the cylindrical surface of the slot by centrifugal action when the impeller element is rotated, and shock-absorbing means carried on the opposite edge of the blade in position to engage the bottom of the slot and to absorb the energy of impact between the blade and the bottom of the slot when the blade is projected into the slot, said shock-absorbing means being ineffective to urge the blade outwardly of said slot.

3. A device of the character described comprising a cylindrical impeller element having a slot opening on a cylindrical surface of the element, a blade extending in said slot and adapted to be projected at one edge outwardly of the cylindrical surface of the slot by centrifugal action

when the impeller element is rotated, and shock-absorbing means comprising peg-like elements of yielding material carried on the opposite edge of the blade and projecting therefrom in position to engage the bottom of the slot and to absorb the energy of impact between the blade and the bottom of the slot when the blade is projected into the slot, said shock-absorbing means being ineffective to urge the blade out of said slot.

4. A device of the character described comprising a cylindrical impeller element having a slot opening on a cylindrical surface of the element, a blade extending in said slot and adapted to be projected at one edge outwardly of the cylindrical surface of the slot by centrifugal action when the impeller element is rotated, and shock-absorbing means comprising wooden pegs carried in sockets on the opposite edge of the blade, said pegs extending from said edge in position to engage the bottom of the slot and to absorb the energy of impact between the blade and the bottom of the slot when the blade is projected into the slot, said shock-absorbing means being ineffective to urge the blade out of said slot.

5. A device of the character described comprising a cylindrical impeller element having a slot opening on a cylindrical surface of the element, a blade extending in said slot and adapted to be projected at one edge outwardly of the cylindrical surface of the slot by centrifugal action when the impeller element is rotated, and shock-absorbing means comprising a strip of spring metal mounted at its opposite ends in spaced sockets

formed in the blade at its opposite edge, the medial portions of said strip extending outwardly of said edge in position to engage the bottom of the slot and to absorb the energy of impact between the blade and the bottom of the slot when the blade is projected into the slot, said shock-absorbing means being ineffective to urge the blade out of said slot.

6. A device of the character described comprising an impeller element having a slot therein extending substantially parallel to the axis of the element and opening on a cylindrical surface thereof, a plate-like blade in said slot having an edge adapted to be projected outwardly through said opening by centrifugal action when the element is rotated, said slot providing an abutment for limiting the movement of the blade inwardly in said slot, the plane of said slot and the blade therein being spaced from the axis of the element so that the blade is inclined on said element in the direction of rotation of the element whereby the inertia of the blade will cause the same to be projected inwardly of said slot when the element is initially rotated and resilient shock-absorbing means carried by the blade member in position to co-operatively engage said abutment when the blade is thus projected inwardly in the slot whereby to absorb the energy of impact between the blade and the abutment and suppress impact noises.

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