March 7, 1939. E. T. P. NEUBAUER ET AL 2,150,076

REFRIGERATION

Filed Sept. 25, 1936

Fig. 1

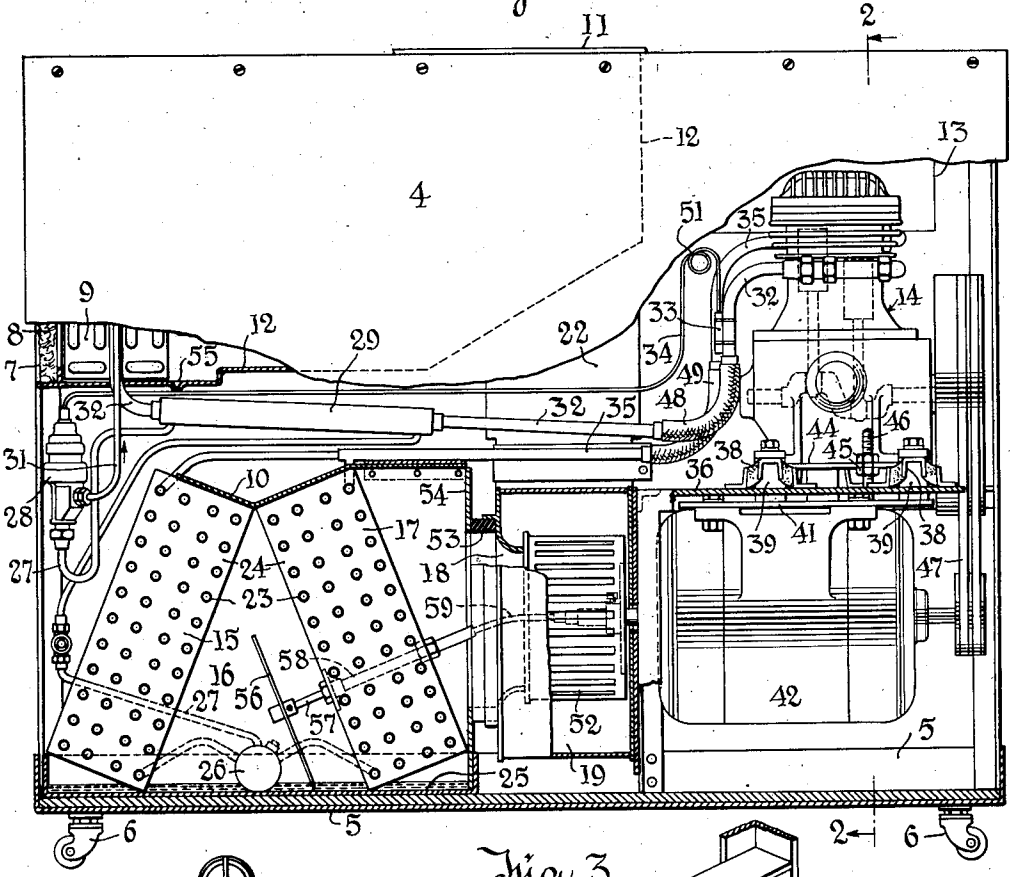


Fig. 2

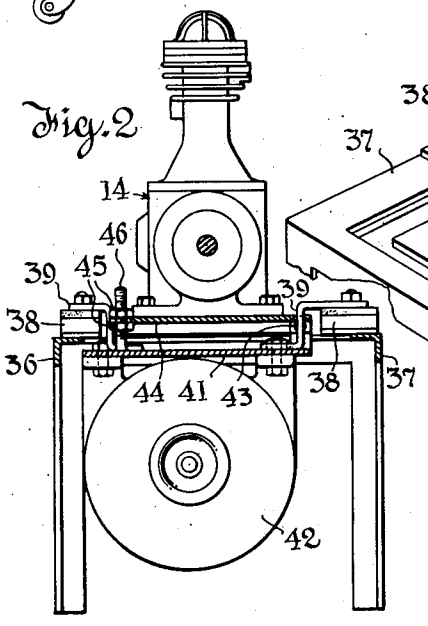
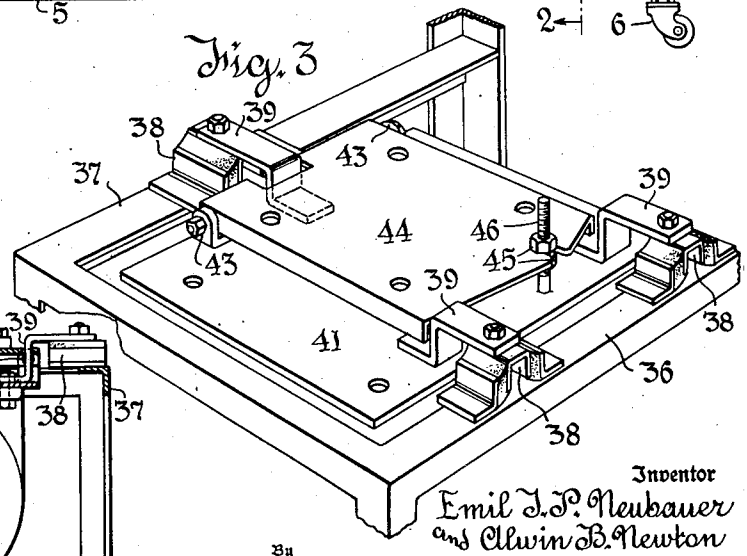


Fig. 3



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REFRIGERATION

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9 Claims. (Cl. 62—129)

This invention relates to refrigeration and particularly to mechanical aspects of the compressor drive and the drive for the condenser spray device.

In unit air conditioners it has heretofore been proposed to collect the moisture which deposits on the evaporator and evaporate it in the air stream which cools the condenser. It has also been proposed to spray this drip into the air after it has exchanged heat with a portion of the condenser and before it exchanges heat with another portion of the condenser. The effect is to dispose of drip without piping, and to improve somewhat the efficiency of the condenser, though the amount of water available is less than that desirable for best effect.

In prior devices pumps and spray nozzles have been used but these waste power, are rather complicated, and are troublesome to maintain.

In portable units, used in the room to be cooled, silent operation and freedom from vibration are controlling considerations. Hence yielding mounts for compressor and its motor are necessary.

The main purpose of the present invention is to afford a yielding mount for the compressor and its motor; provide for mounting the condenser fan on the motor shaft, and for driving a very simple type of sprayer from the motor shaft and still have the components above mentioned function satisfactorily with a relatively fixed fan housing and condenser, preferably a so-called "split" or two unit condenser.

A commercial embodiment of the invention is illustrated in the accompanying drawing, in which—

Fig. 1 is an elevation of a room cooler with part of the casing broken away and certain components sectioned to show the construction.

Fig. 2 is a fragmentary section on the line 2—2 of Fig. 1.

Fig. 3 is a perspective view of the mount for the motor and compressor.

The housing 4 encloses the device as usual and comprises an angle iron frame with removable enclosing plates. It is supported in a base plan 5 mounted on casters 6. The housing has an inlet 7 with filter 8 for room air to be cooled by the evaporator 9. Air is drawn through the evaporator by a motor driven fan (not shown) and is discharged back to the room through a grille at 11. The room air circuit is separated from the remainder of the space within housing 4 by a partition, part of which appears at 12.

At the back of housing 4 is an air inlet opening 13 which is connected to an outside source of cooling air by any suitable means such as the usual window board or adapter (not shown). Air entering at 13 flows over the compressor, generally indicated at 14, thence leftward beneath partition 12 and above baffle 10, thence downward and to the right around the tubes of condenser unit 15, through spray space 16, around the tubes of condenser unit 17, to the eye 18 of fan housing 19. The fan discharges through duct 22 to an outdoor connection, usually in the window board, just mentioned.

The condenser units comprise a number of tubes 23 with closely spaced plate fins 24 used to extend the heat transfer surface. The end plates are continuous across both units 15 and 17 and enclose spray space 16. These condenser units are mounted above a tray or sump 25 supported in base pan 5 and delivered liquefied refrigerant to receiver 26 from which the liquid line 27 leads to expansion valve 28 by way of the surface heat exchanger 29. Expansion valve 28 delivers refrigerant to evaporator 9 through connection 31.

Suction line 32 leads to compressor 14 through the other passage in the surface heat exchanger 29. A thermostatic bulb 33 on the suction line, connected by tube 34 with the expansion valve participates in the control of the expansion valve. The compressor discharges through line 35 to the condenser units 15 and 17 which in the example illustrated are connected in parallel as to refrigerant flow.

While the construction so far described embodies a number of novel and patentable features, they are the inventions of others, and are here described for purpose of explanation and to show the present invention in a preferred environment.

Rigidly supported within housing 4 is a frame structure including two rigidly supported sills 36 and 37 (see Figs. 2 and 3) which support three yielding mounts 38 of known type. On sill 36 are two yielding mounts 38 and on sill 37 is a single yielding mount 38, somewhat larger than the other two, and hence having about the aggregate load sustaining capacity of these two. Other types of yielding mount can be substituted, but the form shown is commercially available and satisfactory. Each mount comprises two rigidly mounted angle clips spaced from an intervening channel to which the clips are connected by rubber blocks vulcanized or otherwise connected with respective clips and with the channel. The clips and channel are relatively close together, so that the rubber blocks are of limited thickness and may be said to be stressed chiefly in shear, though

of course some bending moments and other stresses are actually developed.

Each channel component of the mounts 38 is connected by a corresponding offset arm 39 with a base plate 41 on the lower face of which the electric motor 42 is rigidly mounted. Above plate 41 and hinged thereto at 43 is an adjustable base 44 for the compressor 14. Adjustment is made by nuts 45 threaded on stud 46 fixed in plate 41, one nut being above and the other below base 44. The adjustment is to tension properly the multiple V-belt drive 47 through which the motor drives the compressor at reduced rotary speed. The axis of tilt of base 44 on hinges 43 is parallel with the axes of the motor and compressor shafts.

The compressor is of the familiar two cylinder type with cranks at 180° so that there are unbalanced forces producing a couple which tends to rock the compressor and motor about an axis normal to the plane of the drawing in Fig. 1. There are also unbalanced horizontal components transverse to the crank shaft and unbalanced vertical components caused by the reciprocating parts. Counterbalancing may be used to eliminate horizontal components and diminish vertical components, and weights may be used in the flywheel to diminish the couples. Such counterbalancing may minimize but cannot eliminate vibration of the compressor.

To minimize vibration further, the offset brackets 39 are dimensioned to bring the supports 38 into a common plane which passes substantially through the center of gravity of the assembly, the "assembly" being the motor, the compressor, the plates 41 and 44 and accessory parts, moving as a unit therewith. The two supports 38 on sill 36 are placed close enough together to lower the natural frequency of vibration of the assembly, below the frequency of the couple above mentioned. The vertical deflection of the supports is such as to reduce the natural frequency of the assembly in a vertical direction below the operating period of the unit.

Support in the plane of the center of gravity, proper spacing of supports, and use of unequal numbers of supports at the two sides of the compressor, all contribute to the attainment of the desired result, but the necessary effect is that the motor and compressor when running vibrate relatively to the housing and other components such as the condenser and evaporator which are relatively fixed. To accommodate this, flexible sections 48 and 49 are inserted in the suction line 32 and discharge line 35 respectively, and the slender tube 34 is looped to give flexibility as indicated at 51.

The motor 42 carries on the end of its shaft remote from belt drive 47 the bladed fan rotor 52. This turns in housing 19, but out of contact therewith, the housing being supported on columns which carry sills 35 and 36 and connected by a sponge rubber ring 53 with the ported partition 54. The port in this partition connects the condenser air passage with the entrance eye of the fan.

Atmospheric moisture condensing on the evaporator coils drips to a basin formed by an offset in partition 12 and passes thence through a row of drip ports 55 which direct it over condenser unit 15. Part of the water is evaporated and the remainder collects in sump 25. Water so collecting is forcibly sprayed into the air passing through space 16 by a spray wheel 56 which dips into the water in the sump.

Wheel 56 is fixed on shaft 57 which turns in a sleeve bearing 58 clamped through condenser unit 17. The sleeve passes through an opening formed by cutting away portions of the middle fin plates and is clamped at its ends to portions of certain tubes. It could be mounted in various other ways. Shaft 57 is driven from the shaft of motor 42 by a flexible shaft 59 which extends through the eye of the fan and is coupled to the hub of fan rotor 52.

Assuming that the motor 42 is running, the compressor 14, fan rotor 52 and spray wheel 56 are all in operation. Refrigerant compressed by the compressor flows to condenser 15, 17, where it is condensed, flows thence in the liquid phase through the exchanger 29 to expansion valve 28 which admits it at a controlled rate to the evaporator 9. In evaporator 9 the refrigerant boils at low temperature under the reduced pressure created by the suction of the compressor, and derives its latent heat of vaporization from the air circulated from the room over the evaporator and back to the room.

Since the evaporator is ordinarily below the dew point of the air, it not only cools the air but causes the air to deposit water which flows via ports 55 over condenser unit 15 to sump 25. The wheel 56 picks up the water and throws it in a fine mist across space 16, i. e., across the path of the condenser cooling air. Note that the cooling air enters at 13, cools the compressor, then cools unit 15 which is at least partly wetted by the drip. The air thus warmed meets the spray in chamber 16, which cools and further moistens the air, the air being thus rendered more effective to cool condenser unit 17. After passing unit 17 the air enters the fan and is discharged out of doors, carrying with it the heat rejected by the condenser and the moisture condensed from the room air. The moisture so discharged is in the vapor phase.

The arrangement described has demonstrated in commercial use, freedom from noise, substantial freedom from vibration of the housing and parts rigidly mounted therein, efficient operation and minimum maintenance requirements. These are important features in a portable unit intended to be operated within the room to be conditioned.

Modifications within the scope of the invention are possible and are contemplated.

What is claimed is:

1. The combination of a motor compressor unit, comprising a rotary motor and a reciprocating compressor arranged base to base, the motor being connected to drive the compressor; a support interposed between the bases of the motor and compressor and rigidly connected therewith; yielding mounts on which said support is carried, so arranged that the center of oscillation of the support with the motor and compressor is in the plane passing through said supports; a condenser; an evaporator; and means connecting said condenser and evaporator in circuit with said compressor, portions of said connections being flexible to accommodate motion of parts carried by said elastically supported base.

2. The combination of a rotary motor; a dynamically unbalanced compressor; a base supporting said motor and compressor; driving connections between said motor and compressor; elastic supports for said base, said supports lying in a plane passing through the axis of oscillation induced in the base and the parts supported thereby by operation of the compressor; a fan rotor supported by said base and driven by said motor; a fan housing coacting with said rotor but

out of mechanical contact with parts supported on said base; rotary spraying means supported independently of said base; a flexible drive shaft connecting said motor and spraying means, a condenser over which said fan circulates air; an evaporator; and means connecting said condenser and evaporator in circuit with said compressor, portions of said connections being flexible to accommodate motion of parts carried by said elastically supported base.

3. The combination of a condenser; an enclosure for said condenser including a sump and means for directing air flow in contact with the condenser; a fan housing communicating with the enclosure and yieldingly connected therewith; a unit comprising a driving motor, and a compressor and fan connected to be driven by said motor, the fan operating within said fan housing out of mechanical contact therewith; a yielding vibration damping mount for said unit; an evaporator; means connecting the compressor, condenser and evaporator in a refrigerating circuit; means for delivering drip from said evaporator to said sump; and a rotary sprayer driven by said motor and arranged to dip into water collecting in said sump to spray the same into the air which flows in contact with the condenser.

4. The combination defined in claim 3, in which the rotary sprayer is rigidly supported and the driving connection with the motor comprises a flexible shaft.

5. The combination in an air conditioner of an evaporator and a condenser forming part of a refrigerating circuit; a fan for circulating air through the condenser to cool the same; a sump for collecting beneath the path of condenser cooling air water drip from the evaporator; rotary spraying means associated with said sump for spraying said drip into the condenser air stream, at least a portion of the condenser being interposed between said spraying means and said fan; and a drive shaft for said spraying means extending through said interposed portion of the condenser and driven from said fan.

6. In an air conditioner, the combination of a refrigerating circuit comprising a compressor, an air cooled condenser, and an evaporator adapted to cool air below its dew point; a driving motor; a yielding base on which said motor and compressor are mounted as a unit; a fan rotor rigidly mounted on the motor shaft and serving to circulate air over said condenser; means for collecting water dripping from said evaporator adjacent the cooling path of said air; a rotary sprayer associated with said collecting means adapted to spray said water into the path of said cooling air; fixed bearings in which said sprayer is mounted to rotate; and a driving connection between said motor and said sprayer, said driving connection being of a flexible type so arranged as to permit universal motion of the motor and its yielding base relatively to the fixed bearings in which the sprayer rotates.

7. In an air conditioner, the combination of a refrigerative circuit, comprising a compressor, an air-cooled condenser and an evaporator adapted to cool air below its dew point; a driving motor; a yielding support upon which said compressor and motor are mounted; a fan rotor mounted on the motor shaft; a rigidly mounted fan housing enclosing said rotor and out of mechanical contact therewith, said rotor and housing functioning to circulate cooling air in heat exchanging contact with said condenser means for collecting adjacent the cooling path of said air water dripping from said evaporator; rotary spraying means coacting with said collecting means to spray said water into the path of said cooling air; and a drive connection between said rotary sprayer and said motor, said drive connection being of a flexible type arranged to accommodate motion of said yielding support relatively to said rotary spraying means.

8. The combination of a rotary motor; a dynamically unbalanced compressor connected to be driven thereby; a base supporting said motor and compressor; at least three elastic supports for said base, said supports lying in the common plane which passes substantially through the axis of oscillation induced in the base and the parts supported thereby by the operation of the compressor, the elastic characteristics and the spacing of the supports being so chosen that the natural period of oscillation of the base and parts supported thereby is lower than the operating period thereof; a condenser; an evaporator; and means connecting said condenser and evaporator in circuit with said compressor, portions of said connections being flexible to accommodate motion of parts carried by said elastically supported base.

9. The combination of a motor-compressor unit, comprising a rotary motor and a reciprocating compressor mounted on opposite sides of a common base, the motor being connected to drive the compressor; yielding supporting means for said base arranged substantially in a plane approximately parallel with the axis of the compressor shaft and passing substantially through the center of gravity of the unit, the elastic characteristics and the spacing of said supports being so chosen that the natural period of the unit is lower than its operating period; a condenser; an evaporator; and means connecting said condenser and evaporator in circuit with said compressor, portions of said connections being flexible to accommodate motion of parts carried by said elastically supported base.

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