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C. GIGLER

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LUBRICATION IN REFRIGERATOR COMPRESSOR

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Fig. 1.

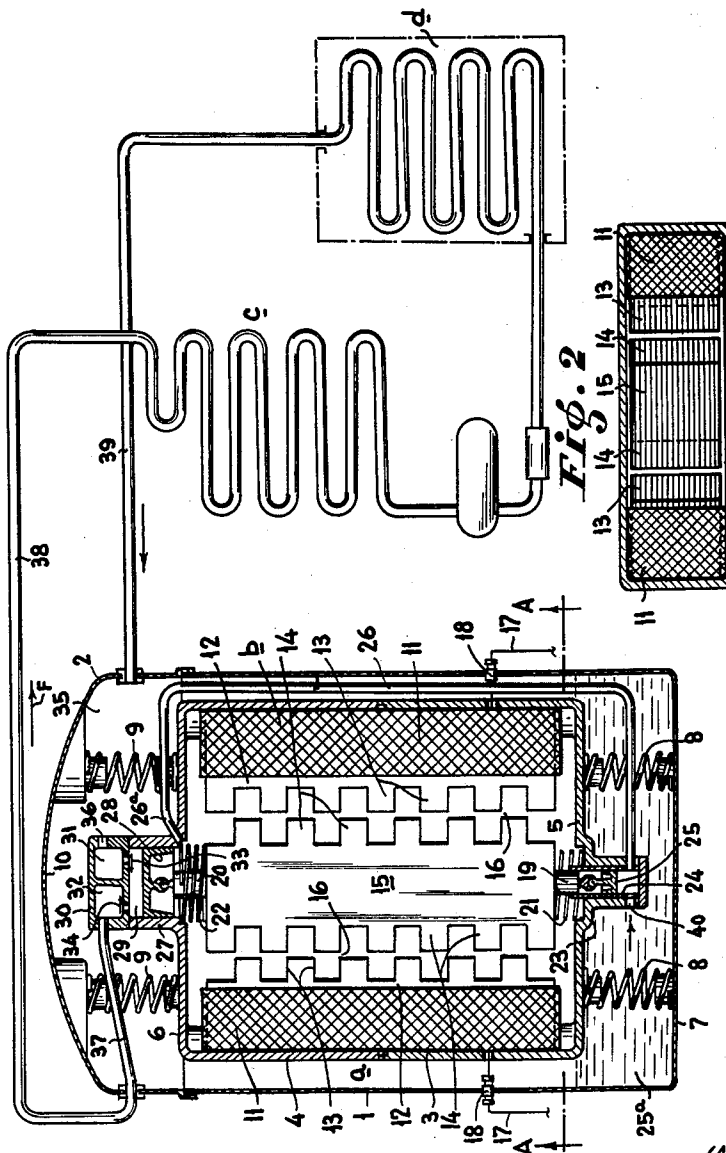


Fig. 2

INVENTOR
CARLOS GIGLER

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2,865,559

LUBRICATION IN REFRIGERATOR COMPRESSOR

Carlos Gigler, Buenos Aires, Argentina

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9 Claims. (Cl. 230—55)

My present invention relates to certain new and useful improvements in refrigerating plants, more particularly in household refrigerators, and its main object consists in providing a novel driving apparatus for use in these refrigerators with the end in view of considerably simplifying the construction and correspondingly reducing the costs of manufacture of said refrigerators.

The driving apparatus for refrigerating plants, in particular for household refrigerators, according to the invention, is essentially characterized by that the movable armature of an electromagnetically-operated reciprocating motor is arranged in free suspension between compensation springs and is directly operatively connected with the piston of the compressor of a refrigerator.

In accordance with the invention, in a refrigerator the piston of the compressor of the cooling agent is directly caused to reciprocate with the frequency of about 50 cycles per second by the reciprocating armature of an electromagnetically-operated reciprocating motor the field coil of which is energized by a normal alternating current of like frequency, with the advantageous result that all the well known inconveniences and drawbacks of the refrigerators employing an electric motor are entirely eliminated.

A characteristic feature of the driving apparatus for refrigerators according to this invention consists in that as afore-said the armature which is provided with pole teeth and is caused to reciprocate by the similarly toothed pole pieces of the electromagnet of a so-called electromagnetically-operated reciprocating motor is directly operatively connected with the compressor piston, thereby avoiding not only the necessity of power-transmitting means, but also the loss of energy with the advantageous result that the costs of both the manufacture of the refrigerator and its operation are reduced.

In this arrangement according to the invention the compressor piston accomplishes a double function; at the one hand, it causes the cooling agent to circulate and to be compressed and, at the other hand, by virtue of its being directly coupled with the armature of the electromagnet, it acts as a frequency transformer and permits to obtain in accordance with the number of windings of the field coil a predetermined increase of the number of periods over the normal frequency of the alternating current i. e. up to 60 cycles per second with the advantageous result that the driving apparatus of the present invention is reliably operative within the frequency range of from 50 to 60 cycles per second.

An important feature of the present invention consists in that the reciprocating armature of the electromagnetically-operated reciprocating motor is provided at both ends with axially projecting stud means and that one of these studs is operatively connected with the compressor piston, whereas the stud of the opposite end of the armature is operatively connected with the piston of an oil pump in charge of permanently lubricating the cylinder and piston of the compressor, with the advan-

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tageous result that a good and efficient operation of the compressor is ensured.

In combination with this feature and the one previously mentioned consisting in that the armature is arranged between compensation springs an additional advantageous feature of the invention resides in that the oscillating armature is properly guided at both ends and by virtue hereof the air gap between the pole teeth of the armature and of the pole pieces of the electromagnet may be kept relatively small thereby increasing the output of the electromagnetically-operated reciprocating motor. The said compensation springs arranged at both ends of the armature and so as to conveniently surround the afore-mentioned stud means are so elected that the vertically arranged armature becomes practically weightless. By virtue of this spring effect and of the parallel guiding of the armature ensured by the stud means, a relatively high mechanical efficiency of the driving apparatus according to the invention is obtained and interruptions of its operation are avoided, more particularly if in accordance with the invention at least one of said studs is guided by means of the respective cylinder with the piston of which it is operatively connected.

Another characteristic feature of the invention consists in that the electromagnetically-operated reciprocating motor is arranged within a hermetically sealed casing of diamagnetic material, in that this casing is provided in its bottom and top portions with axially projecting sleeve-like extensions for containing the afore-mentioned compressor and oil pump, respectively, and in that said diamagnetic casing is arranged within an outer or main casing between compensation springs whereby the natural vibration of said motor is absorbed.

An additional feature of the invention finally consists in that the compressor cylinder formed by the upper sleeve-like extension of the afore-mentioned diamagnetic casing has its free open end hermetically closed by a small cylindrical casing wherein by means of a partition wall an inlet chamber and an outlet chamber for the cooling agent are formed, these chambers being connected, at the one hand, by way of non-return valves operating in opposite directions with the interior of the compressor cylinder and, at the other hand, by way of suitable pipe connections with the condenser and the evaporator, respectively, of a refrigerating plant. The arrangement of the said inlet and outlet chambers simplifies and facilitates the installation of the non-return valves.

With these objects and advantageous features in view, the present invention comprises the arrangement, combination and construction of parts as will be hereinafter fully described with particular reference to the accompanying drawing, whereon a preferred embodiment of the invention has been schematically illustrated by way of example only and whereon

Figure 1 shows in a vertical sectional view the electromagnetic driving device and compressor of a refrigerator according to the invention and

Figure 2 shows the electromagnet of said driving mechanism as seen from the plane A—A of Figure 1.

The electromagnetic driving device as shown on the accompanying drawing comprises an outer main casing 1 with an air-tight cover 2. Within this casing 1 there is an inner casing *a* of diamagnetic material composed of two halves 3 and 4 and having bottom and top portions 5 and 6. This inner casing *a* is also hermetically sealed and is elastically suspended within the casing 1 by means of pressure springs 8 and 9 arranged between the bottom portions 5 of the inner casing *a* and 7 of the main casing 1 and between the top portion 6 of said inner casing

and the top portion 10 of the cover 2 of said main casing.

The diamagnetic inner casing *a* contains an electromagnetically-operated oscillating motor *b*. The stator of this motor comprises the field coil 11 and the pole piece 12 provided with pole teeth 13, which are arranged opposite the free spaces formed between adjacent pole teeth 14 of the armature body 15. The reference numeral 16 indicates the air gap formed between the pole teeth 13, 14. The field coil 11 is connected by way of terminals 18, conductors 17 and switch (not shown) to a source of alternating current of 220 volts and a frequency of 50 periods per second.

The armature body 15 is provided at both ends with axially projecting studs 19, 20 which are surrounded by pressure springs 21 and 22, respectively, abutting, at the one hand, upon the armature body and, at the other hand, upon a recessed annular edge of the top portion 6 of the casing *a*, respectively upon the bottom of an annular recess of the bottom portion 5 of said casing. The springs 21 and 22 are so elected that the armature is practically weightless and freely suspended between the pole pieces 12 of the electromagnet 11, 12. When alternating current of a frequency of 50 periods per second is supplied to the field coil 11, the armature 15 will be oscillated with the same frequency.

The stud 19 of the armature 15 projects into a cylinder 24 and is directly operatively connected with a pump piston 25 operating in said cylinder. This cylinder is fixedly mounted in a cylindrical recess 23 of the bottom portion 5 of the casing *a*, and the two cylinders 23 and 24 project into a charge of lubricating oil 25a provided in the lower portion of the main casing 1. An opening 40 permits the pump piston 25 to draw in the oil which by the operation of said piston is supplied by way of the pipe 26 and its mouth piece 26a to the compressor cylinder 27 formed by a sleeve-like extension of the top portion 6 of the casing *a*. Thus the pump 24, 25 takes charge of the proper lubrication of the compressor cylinder 27 and the piston 28 operating therein, this piston being directly operatively connected with the stud 20 of the armature 15. Thus the oscillating armature 15 operates both the pump piston 25 and the compressor piston 28. The direct connection of the armature studs 19, 20 with the pistons 25 and 28, respectively, the penetration of the stud 19 in the cylinder 24 and the arrangement of the springs 21, 22 ensure a correct parallel guiding of the armature 15 with regard to the pole piece 12.

The outer open end of the sleeve-like portion 27 forming the compressor cylinder is hermetically sealed by a casing 30. This casing is subdivided by a partition wall into two chambers 31 and 32. The inlet chamber 31 and the outlet chamber 32 are communicated with the interior of the compressor cylinder 27 by way of non-return valves 33 and 34, respectively, operating in opposite direction, so that the compressor piston 28 may draw in the cooling agent from the inlet chamber 31 and force the same after compression into the outlet chamber 32. This outlet chamber is connected by way of the pipes 37, 38 with the condenser *c*, whereas the opening 36 of the inlet chamber 31 communicates with the interior 35 of the main casing which in turn by way of the pipe 39 is connected with the evaporator *d*. Thus the circulation of the cooling agent produced by the compressor 27, 28 proceeds from the interior of the cylinder 27 by way of the valve 34, chamber 32, pipes 37, 38 in the direction of the arrow *F* to the condenser *c* and from the evaporator *d* by way of the pipe 39, the interior 35 of the casing 1, opening 36, inlet chamber 31 and valve 33 back into the compressor cylinder 27.

The operation of the refrigerating plant independently of its driving device is generally known so that it need not be described in detail.

What I claim as new and desire to secure by Letters Patent is:

1. In a refrigerator, a compressor and lubricating arrangement therefor comprising, in combination, an outer casing having opposite end walls; an inner casing having opposite end walls and being arranged within said outer casing in such a manner that one of said end walls of said outer casing and one of said end walls of said inner casing form a compressor chamber between themselves and that the other of said end walls of said outer casing and the other of said end walls of said inner casing form a lubricant chamber between themselves, the latter being adapted to receive a lubricant or the like; compressor pump means arranged within said compressor chamber and including a compressor cylinder and a compressor piston slidably arranged therewithin; lubricant pump means arranged within said lubricant chamber and including a lubricant cylinder and a lubricant piston slidably arranged therewithin, said lubricant pump means being so constructed and arranged and communicating with said compressor pump means in such a manner that a lubricant received within said lubricant chamber will, during reciprocation of said lubricant piston within said lubricant cylinder, be moved from said lubricant chamber into said compressor cylinder of said compressor pump means, thereby lubricating the latter; electromagnetic motor means arranged within said inner casing and including a stator and an armature mounted for reciprocation relative thereto, said stator and armature being so constructed and arranged that upon electrical energizing of said motor means said armature is electromagnetically reciprocated in both directions; and connecting means connecting said armature of said motor means with both of said pistons for simultaneously reciprocating the same relative to their respective cylinders during operation of said motor means, whereby said lubricant pump means and said compressor pump means are operated simultaneously, the latter being continuously lubricated during operation thereof.

2. In a refrigerator, a compressor and lubricating arrangement therefor comprising, in combination, an outer casing having top and bottom walls; an inner casing having top and bottom walls and being arranged within said outer casing in such a manner that said top walls form an upper compressor chamber between themselves and that said bottom walls form a lower lubricant chamber between themselves, the latter being adapted to receive a lubricant or the like; compressor pump means arranged within said compressor chamber and including a compressor cylinder and a compressor piston slidably arranged therewithin; lubricant pump means arranged within said lubricant chamber and including a lubricant cylinder and a lubricant piston slidably arranged therewithin, said lubricant pump means being so constructed and arranged as to move, during reciprocation of said lubricant piston within said lubricant cylinder, a lubricant received within said lubricant chamber; conduit means for placing said lubricant cylinder in communication with said compressor cylinder in such a manner that a lubricant moved by said lubricant pump means lubricates said compressor pump means; electromagnetic motor means arranged within said inner casing and including a stator and an armature mounted for reciprocation relative thereto, said stator and armature being so constructed and arranged that upon electrical energizing of said motor means said armature is electromagnetically reciprocated in both directions; and connecting means connecting said armature of said motor means with both of said pistons for simultaneously reciprocating the same within their respective cylinders during operation of said motor means, whereby said lubricant pump means and said compressor pump means are operated simultaneously, the latter being continuously lubricated during operation thereof.

3. In a refrigerator, a compressor and lubricating arrangement therefor comprising, in combination, an outer casing having top and bottom walls; an inner casing

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having top and bottom walls and being arranged within said outer casing in such a manner that said top walls form an upper compressor chamber between themselves and that said bottom walls form a lower lubricant chamber between themselves, the latter being adapted to receive a lubricant or the like; compressor pump means arranged within said compressor chamber and including a compressor cylinder and a compressor piston slidably arranged therewithin, said compressor cylinder being connected to said top wall of said inner casing; lubricant pump means arranged within said lubricant chamber and including a lubricant cylinder and a lubricant piston slidably arranged therewithin, said lubricant cylinder being connected to said bottom wall of said inner casing and said lubricant pump means being so constructed and arranged as to move, during reciprocation of said lubricant piston within said lubricant cylinder, a lubricant received within said lubricant chamber; conduit means for placing said lubricant cylinder in communication with said compressor cylinder in such a manner that a lubricant moved by said lubricant pump means lubricates said compressor pump means; electromagnetic motor means arranged within said inner casing and including a stator and an armature mounted for reciprocation relative thereto, said stator and armature being so constructed and arranged that upon electrical energizing of said motor means said armature is electromagnetically reciprocated in both directions; and connecting means connecting said armature of said motor means with both of said pistons for simultaneously reciprocating the same within their respective cylinders during operation of said motor means, whereby said lubricant pump means and said compressor pump means are operated simultaneously, the latter being continuously lubricated during operation thereof.

4. The combination defined in claim 3 wherein said compressor cylinder is integral with said top wall of said inner casing and wherein said lubricant cylinder is integral with said bottom wall of said inner casing.

5. The combination defined in claim 4 wherein said inner casing is spring-mounted within said outer casing.

6. In a refrigerator, a compressor and lubricating arrangement therefor comprising, in combination, a fluid-tight outer casing having top and bottom walls and forming a refrigerant chamber; a fluid-tight inner casing having top and bottom walls and being arranged within said outer casing in such a manner that said top walls form an upper chamber portion between themselves and that said bottom walls form a lower chamber portion between themselves, the latter being adapted to receive a lubricant or the like; compressor pump means arranged within said upper chamber portion and including a compressor cylinder

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der and a compressor piston slidably arranged therewithin, said compressor cylinder having inlet and outlet ports, one of said ports communicating with said refrigerant chamber and the other of said ports communicating with the exterior of said outer casing; lubricant pump means arranged with said lower chamber portion and including a lubricant cylinder and a lubricant piston slidably arranged therewithin, said lubricant piston slidably arranged therewithin, said lubricant pump means being so constructed and arranged as to move, during reciprocation of said lubricant piston within said lubricant cylinder, a lubricant received within said lower chamber portion; conduit means for placing said lubricant cylinder in communication with said compressor cylinder in such a manner that a lubricant moved by said lubricant pump means lubricates said compressor pump means; electromagnetic motor means arranged within said inner casing and including a stator and an armature mounted for reciprocation relative thereto, said stator and armature being so constructed and arranged that upon electrical energizing of said motor means said armature is electromagnetically reciprocated in both directions; and connecting means connecting said armature of said motor means both of said pistons for simultaneously reciprocating the same within their respective cylinders during operation of said motor means, whereby said lubricant pump means and said compressor pump means are operated simultaneously, thereby moving a refrigerant within said refrigerant chamber relative to the exterior of said outer casing while said compressor pump means is continuously lubricated during operation thereof.

7. The combination defined in claim 6 wherein said compressor cylinder is integral with said top wall of said inner casing and wherein said lubricant cylinder is integral with said bottom wall of said inner casing.

8. The combination defined in claim 7 wherein said inner casing is spring-mounted within said outer casing.

9. The combination defined in claim 6 wherein said armature is toothed and said stator is constituted by an electromagnet formed with similarly toothed pole pieces.

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