July 4, 1933. M. H. PENDERGAST 1,917,057

COMPRESSOR

Filed June 1, 1932

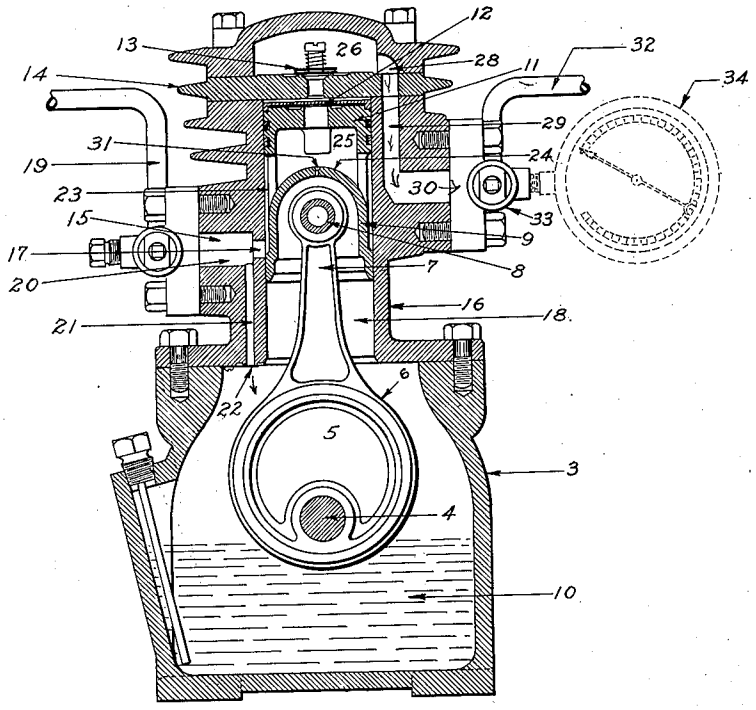



FIG. 1

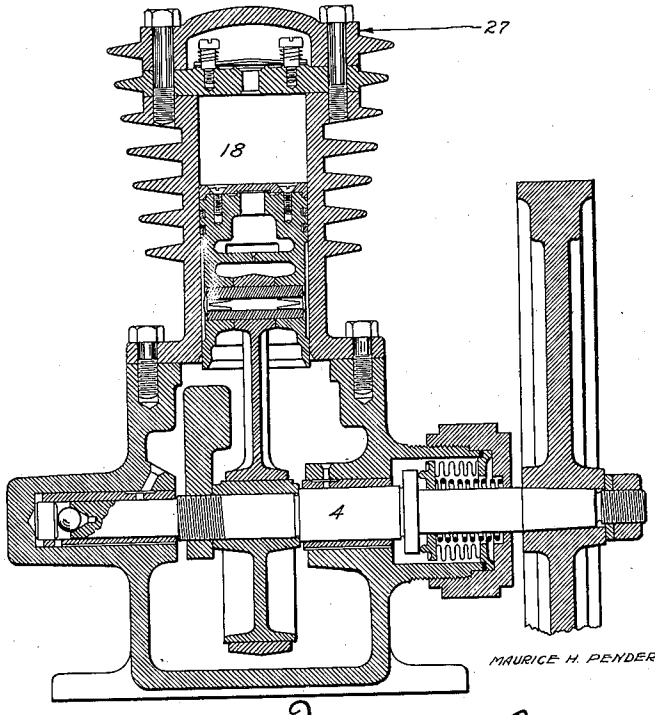



FIG. 2.

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# UNITED STATES PATENT OFFICE

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## COMPRESSOR

Application filed June 1, 1932. Serial No. 614,791.

My present invention relates to compressors of the type particularly designed and constructed for use with electrically-operated refrigerators of domestic sizes.

The main purpose of my present invention is to provide a new and improved compressor and particularly one which is noiseless and efficient in operation.

It is well recognized that one of the greatest drawbacks to the broad adoption of electric refrigerators for domestic purposes is that the compressors heretofore produced have not been noiseless in operation. Some compressors heretofore made have made considerable noise all of the time they are in operation and some compressors have been produced which are moderately quiet except at the time they begin operation or shortly before they cease operation. It is one of the main purposes of this invention to provide a compressor of such construction and having such co-operation of its parts that it will be noiseless at all stages of operation.

Another object of this invention is to produce a compressor wherein special means are provided for effectively separating the oil from the refrigerant to the end partly of aiding the compressor in being silent and also to make the action of the refrigerator unit using the compressor economical and effective.

Fig. 1 is a transverse vertical sectional view of a compressor embodying this invention, the piston being shown in upward or raised position.

Fig. 2 is a longitudinal vertical sectional view through said compressor with the piston shown in its lowermost position.

Referring to the drawing in a more particular description it will be seen that the compressor includes a lower casing 3 through the chamber of which extends the power-driven shaft 4 which has mounted thereon the eccentric wheel 5 engaging the eccentric strap 6, the outer end 7 of which projects upwardly. The outer and upper end of this strap is pivoted upon the cross pin 8 secured transversely in the piston 9. The parts of the eccentric and also the bearing between its upper end 7 and cross pin 8 are lubricated by the splash system through the movement of the eccentric and eccentric collar down into the oil in the oil chamber 10, said chamber being formed by the lower casing 3 and the normal level of the oil therein is indicated by the long dotted lines shown in Fig. 1. To the flat top of the lower casing 3 is securely fastened the bottom of the upper casing 16, the main central and vertical chamber of which forms the cylinder in which the piston 9 reciprocates vertically.

Preferably the piston 9 is considerably longer than its diameter to aid in the special construction of the piston hereinafter mentioned. Centrally disposed at the top of the piston is the piston check valve 12 and directly thereabove is the fixedly located or cylinder check valve 13 mounted upon the top of the end plate 14 covering and securely fastened to the top of the upper casing and forming the end of the cylinder of the compressor.

In the side of the upper casing 16 there is formed an outer chamber 15 somewhat larger and extending somewhat to a slightly lower level than the bottom of the inlet port 17 leading from said chamber 15 into the cylinder or compressor chamber 18 of the upper casing. To the outer end of the outer chamber 15 there is connected the suction pipe 19 leading from the compressor to the usual refrigerating coils (not shown). The space in the chamber 15 below the level of the bottom of the inlet port 17 forms a pocket 20 where a few drops of oil may accumulate and lie without being carried through the port 17 with the inwardly passing refrigerant. From this pocket and preferably from a point close to the inlet 17 there extends downwardly a by-pass 21 provided in the metal of the upper casing and leading to the bottom surface of the upper casing and consequently to the top of the oil chamber 10, the aperture in the top of the lower casing 3 being considerably larger than the diameter of the cylinder or compressor chamber 18 as indicated in Figs. 1 and 2. At the bottom of this by-pass 21 there is located a very thin leaf spring check valve 22 tensioned to have its free end yieldingly

rest against and close the lower end of the by-pass 21. During the upward stroke of the piston 9 the normal pressure of say about five and one-half pounds in the suction pipe and in the oil chamber 10 is reduced in the oil chamber 10 and in the lower part of the piston or compressor chamber 18 by the increase of the space below the rising piston. This lower pressure below this check valve 22 is enough to allow that check valve to open and thereby allow a few drops of oil that may have accumulated in the pocket 20 and in the by-pass 21 to come downward through the by-pass past the check valve 22 and into the oil chamber 10. As the piston travels downwardly from its upper position shown in Fig. 1 to its lower position shown in Fig. 2 the check valve 22 is closed by the increase of pressure in the lower part of the piston or compressor chamber 18 and in the oil chamber 10 and the oil can again remain or accumulate in the by-pass 21 and the pocket 20. The piston 9 is hollow in general construction and also is somewhat spool-shaped in that only its upper and lower parts closely engage the walls of the cylinder or compressor chamber 18. Furthermore, from the lower portion of the piston there extends upwardly a dome 24 within which are located the piston cross pin 8 and the adjacent upper portion of the piston rod 7. The reduced diameter of the central portion of the piston already mentioned as giving the piston a spool-like form results in leaving an annular space 23 between the lower part of the piston up past the dome 24 of the piston to the upper part or third approximately 11 of the piston about the sides of which upper part 11 are provided the usual annular grooves and piston rings for making a tight but easy joint between the moving piston and the walls of the cylinder.

The parts are so proportioned that the annular space 23 has its lower part come opposite the inlet port 17 when the piston is in upward position. During the downward movement of the piston the refrigerant passes upwardly from the inlet port 17 through the space 23 still registering therewith and into the upper central cavity 25 formed in the hollow upper portion 11 of the piston and above the curved outer surface of the dome 24. From this cavity the gaseous refrigerant passes upwardly through the now opened piston check valve 12 into the part of the compression chamber 18 that is above the top of the piston. Upon the upward stroke of the piston the piston check valve closes and the refrigerant is forced past the now opened cylinder check valve 13 in the usual way of such compressors into the chamber 26 of the cap 27 secured to the top of the end plate 14.

To avoid building up so great a pressure in the oil chamber 10 as to render the check valve 22 inoperative and also so as to allow the escape of the refrigerant and foamed oil from the oil chamber 10 there is provided in the top of the dome 24 of the piston a small opening 31. This opening is of a diameter of say about one-fiftieth of an inch as compared to the by-pass 21 having a diameter of about one-eighth of an inch. By placing this opening 31 as high up from the oil as possible very little liquid oil will escape out through said opening, but escaping material will be the refrigerant in the form of gas and some oil in the form of oil foam mixed therewith due to the splashing of the oil in the chamber 10. These materials passing upward through the hole 31 continue on with the pumped refrigerant at the next stroke of the piston.

During the last few minutes of an idle period of one of these compressors the refrigerant may become so saturated that it will not at once permit the gravity separation of the oil in the pocket 20 and this situation may allow the oil suspended in the saturated refrigerant to carry the oil through the compressor when the compressor is automatically started. After the compressor gets into action, however, this accumulation of oil will be properly separated at the next time it comes to the compressor because by that time the gas will not be so heavily saturated as to hold the oil in suspension therein.

It will be understood that a certain amount of oil should be present between the piston and the cylinder wall in order to provide lubrication and of this a certain amount will be pushed up and on with the refrigerant. Also it may be noted that a small amount of oil is necessary to keep the two check valves 12 and 13 properly lubricated. A part of this oil and in fact all that is forced past the upper check valve must ultimately pass through the refrigerating system and come back on the low side or suction side of the compressor. A small amount of such oil passed through the system is harmless but an excessive amount of such oil if allowed to pass through the system affects the efficiency of the refrigerant and tends to make a noise in the compressor. Heretofore one common cause of noise in these compressors has been that the oil has been allowed to accumulate about the upper or cylinder check valve and this accumulation has been accenuated and rendered possible through the fact that in most compressors heretofore the outlet from the cavity 26 of the cap 27 has been at the top or well up on the sides of the cap and thus has allowed a pocket of considerable size and particularly depth in which oil may accumulate before it would have a chance to be carried off with the oncoming refrigerant to the rest of the system. In this compressor I have over-come this disadvantage by having the outlet opening 28 from the cap 27 at the side of the cap and on a level with the top of the plate 14. From

this opening a vertical passage 29 provided partly in the plate 14 and in the upper casing 16 leads downwardly to the horizontal outlet 30 to which is connected the pipe 32 leading to the rest of the refrigerator system. It will now be seen that any accumulation of oil in drops upon the valve seat on the end plate 14 about the check valve 13 can at once flow horizontally sidewise towards the opening 28 and thence on through the system until it can be separated as it comes back to the pocket 20 on the suction side of the compressor. In this way any accumulation of oil about the upper check valve 13 is prevented and one of the most usual and troublesome causes of noise in the operation of the compressor is overcome.

The feature of providing the outlet from the side of the cap 27 and putting the outlet 30 part way down in the side of the upper casing 16 results in being able to make a compressor that is appreciably shorter than commonly done heretofore. In my compressor the cap 27 is the highest part of the compressor. As the pipe 32 connected to the high pressure side of the compressor usually has to have a valve and during any testing also a gage close to the compressor, these parts have heretofore made an appreciable additional height above the compressor beyond the height of the outlet pipe from the top of the compressor. In my construction the feature of having the outlet pipe 32 part way down upon the upper casing allows such gage and valve to be placed upon said pipe without increasing the effective height of the compressor. This reduction in total necessary height of the compressor enables the compressor unit to be placed in a smaller chamber than has heretofore been practicable and thus reduce the height of a refrigerator without affecting its efficiency and convenience.

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

1. In a compressor the combination of hollow casing members forming a vertical compression cylinder and, communicating therewith below, an oil chamber, and having an outlet port leading from the upper end of the cylinder and an inlet port to the cylinder, a passage leading to said inlet, a by-pass extending from said passage to the oil chamber, a check valve controlling said by-pass and tensioned to open towards said oil chamber on upward movement of the piston, a check valve on the outlet port, a rotatable shaft horizontally mounted in said chamber, an eccentric on said shaft, a piston mounted in the cylinder and connected to said eccentric and a check valve on the piston.

2. In a compressor the combination of hollow casing members forming a vertical compression cylinder and, communicating therewith below, an oil chamber, and having an outlet port leading from the upper end of the cylinder and an inlet port to the cylinder, a passage leading to said inlet and having a pocket extending below the bottom of the inlet port, a by-pass extending from said pocket to the oil chamber, a check valve controlling said by-pass and tensioned to open towards said oil chamber on upward movement of the piston, a check valve on the outlet port, a rotatable shaft horizontally mounted in said chamber, an eccentric on said shaft, a piston mounted in the cylinder and connected to said eccentric and a check valve on the piston.

3. In a compressor the combination of hollow casing members forming a vertical compression cylinder and, communicating therewith below, an oil chamber, and having an outlet port leading from the upper end of the cylinder and an inlet port in the side of the cylinder below the level of said outlet port, a passage leading to said inlet, a by-pass extending from said passage to the oil chamber, a check valve controlling said by-pass and tensioned to open towards said oil chamber on upward movement of the piston, a check valve on the outlet port, a rotatable shaft horizontally mounted in said chamber, an eccentric on said shaft, a piston mounted in the cylinder and connected to said eccentric and a check valve on the upper part of the piston, said piston being hollow and spool-like in form and having upper and lower annular flanges engaging the cylinder and therebetween being spaced from the cylinder leaving an annular passage always in register with the cylinder inlet port, said piston having a dome-shaped partition extending from the lower flange upwardly above the connection of the upper end of the piston rod to the piston but spaced from the piston check valve, said partition having a small aperture below the piston check valve.

4. In a compressor the combination of hollow casing members forming a vertical compression cylinder and, communicating therewith below, an oil chamber, and having an outlet port leading from the upper end of the cylinder and an inlet port to the cylinder, a passage leading to said inlet, a by-pass extending from said passage to the oil chamber, a driven shaft horizontally mounted in said oil chamber, a piston mounted in the cylinder, means operatively connecting said shaft to the piston, a check valve on the piston, a check valve on the outlet port and a check valve controlling said by-pass and tensioned to move towards said oil chamber on upward movement of the piston.

5. In a compressor the combination of hollow casing members forming a vertical compression cylinder and, communicating therewith below, an oil chamber, and having an outlet port leading from the upper end of the cylinder and an inlet port to the side of the cylinder below the level of said outlet port,

a passage leading to said inlet, a by-pass extending from said passage to the oil chamber, a driven shaft horizontally mounted in said oil chamber, a piston mounted in the cylinder, means operatively connecting said shaft to the piston, a check valve on the piston, a check valve on the outlet port and a check valve controlling said by-pass and tensioned to move towards said oil chamber on upward movement of the piston, said piston having a piston head at its top and spaced downwardly therefrom, a dome-shaped partition over the means connecting the piston to the shaft and extending at its edges to the lower end of the piston and having a small aperture in the upper part of said dome, said piston having a recess in its side extending between the piston-head and the lower part of said partition and always in register with the inlet port of the cylinder whereby the main supply of gas passes from the inlet port into the cylinder above the said piston partition on the suction stroke and oil and some gas pass from the passage outside the inlet port down into the oil chamber on the upward stroke of the piston.

6. In a compressor the combination of hollow casing members forming a vertical compression cylinder and, communicating therewith below, an oil chamber, and having an outlet port leading from the upper end of the cylinder and an inlet port to the cylinder below the level of said outlet port, a passage leading to said inlet, a by-pass extending from said passage to the oil chamber, a driven shaft horizontally mounted in said oil chamber, a piston mounted in the cylinder, means operatively connecting said shaft to the piston, a check valve on the piston, a check valve on the outlet port and a check valve controlling said by-pass and tensioned to move towards said oil chamber on upward movement of the piston, said piston having a piston head at its top and, spaced downwardly therefrom, a partition over the means connecting the piston to the shaft and having a small aperture therein, the chamber in the piston between said partition and said piston head being always in register with the inlet port of the cylinder whereby the main supply of gas passes from the inlet port into the cylinder above the said piston partition on the suction stroke and oil and some gas pass from the passage outside the inlet port down into the oil chamber on the upward stroke of the piston.

In witness whereof I have affixed my signature, this 16th day of May, 1932.

MAURICE H. PENDERGAST.