Oct. 22, 1935. R. R. CANDOR 2,017,946

REFRIGERATION

Filed April 28, 1932 2 Sheets-Sheet 1

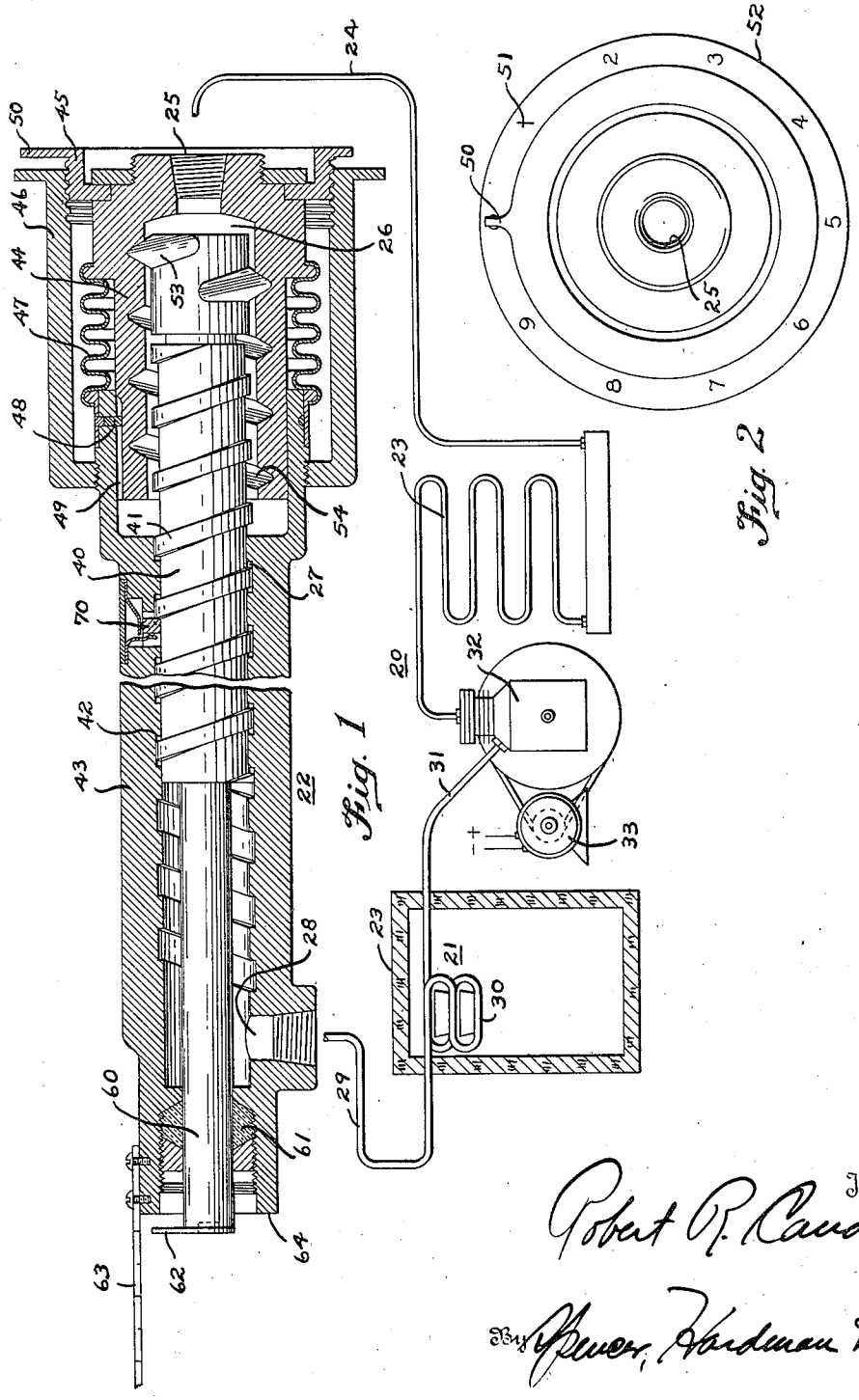


Fig. 1

Fig. 2

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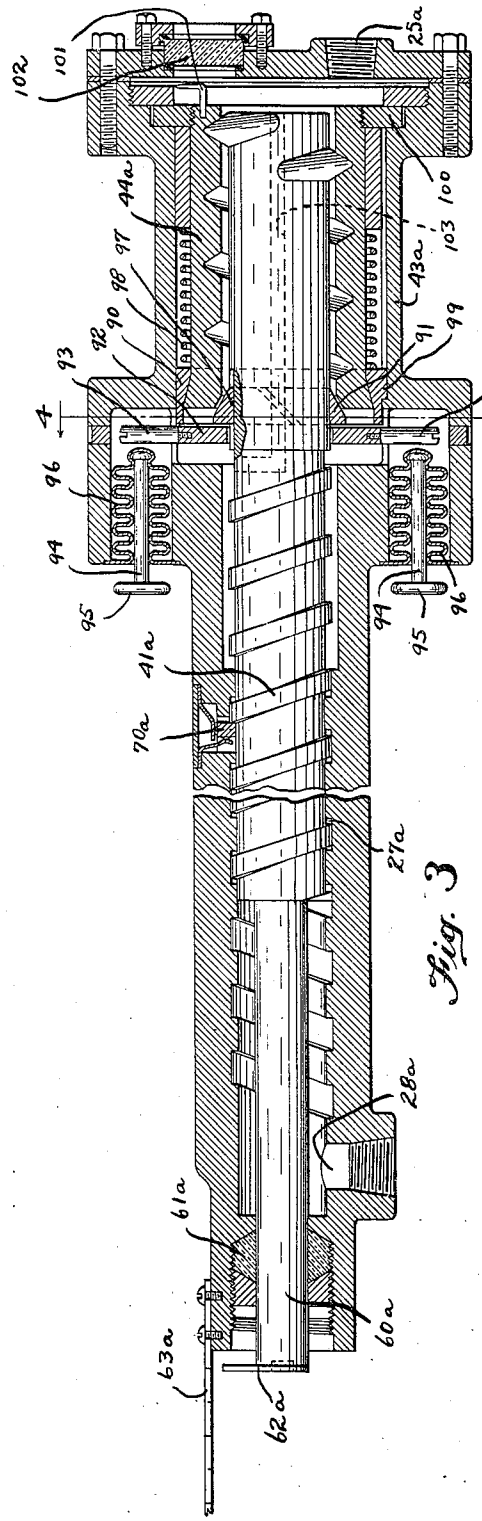


Fig. 3

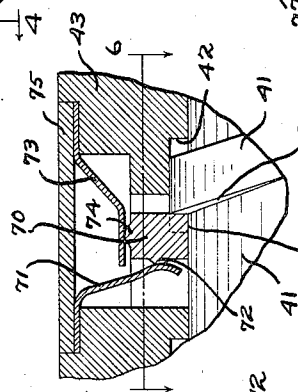


Fig. 5

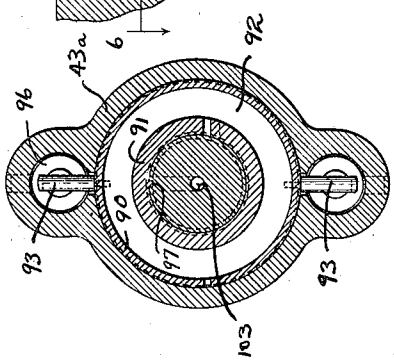


Fig. 4

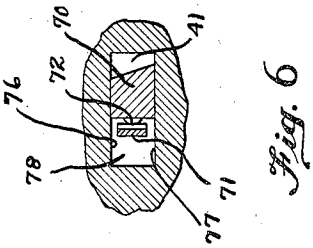


Fig. 6

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UNITED STATES PATENT OFFICE

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REFRIGERATION

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Application April 28, 1932, Serial No. 608,026

10 Claims. (Cl. 62—127)

This invention relates to refrigeration.

It is among the objects of this invention to provide a refrigerating apparatus and method in which a refrigerant expander of the elongated orifice type is used, and in which means are provided for varying the cross-sectional area and the length of the orifice independently of each other without removing the expander from the system in order to control refrigeration characteristics of the system.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 shows a refrigerating apparatus, partly diagrammatic and partly in cross-sectional area;

Fig. 2 is an end view of a portion of the apparatus shown in Fig. 1;

Fig. 3 shows a slightly modified form of a portion of the apparatus shown in Fig. 1;

Fig. 4 is a cross-sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is an enlarged cross-sectional detail of a portion of Figs. 1 or 3; and

Fig. 6 is a cross-section taken along the lines 6—6 of Fig. 5.

A refrigerating apparatus in accordance with this invention comprises, in general, a refrigerant liquefying unit generally designated as 20 and a refrigerant evaporating unit generally designated as 21. A refrigerant expander, generally designated as 22, is interposed between said units to expand the refrigerant passing from the liquefying unit to the evaporating unit. This type of expander may be used in a system in which the compressor is operated continuously at a constant speed and the condenser is subjected to temperature conditions substantially in accordance with the temperatures of the atmosphere surrounding the cabinet 23 in which the evaporating unit is placed. In this type of system the length and cross-section area of the refrigerant expander interposed between the condenser and evaporator are so calibrated that the heat infiltration into the cabinet and the capacity of the system are coordinated by the rate of flow through the expander so that the temperature within the cabinet is automatically maintained within a predetermined temperature range regardless of variations in the temperature of the atmosphere surrounding the cabinet notwithstanding the continuous operation of the compressor as more fully disclosed in the application of Andrew A. Kucher, S. N. 599,239, filed March 16, 1932, for "Refrigeration". The refrigerant expander 22 disclosed in this application may be used to calibrate such continuously operating refrigerating systems without removing the expander from the system and even without stopping the compressor for the calibration and when a proper length and cross-section for an expander have been found for any particular system which maintain the proper temperature within the cabinet 21, the expander shown in this application may be removed from the system and a cheaper expander of similar length and cross-section but without any adjustable features may be substituted for the one herein shown. An expander as shown in this application, however, may be used as a permanent fixture in the system without substitution and may be used as a temperature control to change the temperature conditions within the cabinet 21 either temporarily or permanently as desired. The expander herein disclosed may also be used with an intermittently operated refrigerating system in the same manner that an elongated orifice of the fixed area or length type is used, and thus provides the additional advantages of adjustment.

In the embodiment shown in Fig. 1, the refrigerant from the condenser 23 flows through the pipe 24 to the inlet 25 of the expander 22 thereafter it flows through the chamber 26 to the portion 27 forming the elongated orifice of the system. From thence the expanded refrigerant is discharged through the outlet portion 28 to the pipe 29 leading to the evaporator 30 within the cabinet 21 and continues through the pipe 31 to the compressor 32 which is driven either continuously at a constant speed by means of the constant speed motor 33, or intermittently by control of the usual thermostatically responsive switch, not shown.

The cross-sectional area of the expander may be varied by causing the threaded member 40 to be moved axially without any substantial rotation, thus decreasing or increasing the area of the orifice 27 between the edge of the thread 41 on the threaded member 40 and the edge of the thread 42 on the casing 43 of the expander. To this end a sleeve 44 is placed in threaded engagement with the member 40 and is provided with means for moving the sleeve axially of the device in order to vary the cross-section of the orifice 27. This may be accomplished by providing a rotatable sleeve 45 having a threaded engagement with the continuation 46 of the cas-

ing 43, the sleeve 44 also being connected by means of a bellows 47 with the casing 43. Rotation of the member 45, which is rotationally free but axially locked with the sleeve 44, moves the sleeve 44 axially of the expansion device. The sleeve 44 is locked against rotation movement by the key 48 but is free to move axially because of the slot 49 in which the key 48 is fitted. The member 45 may be provided with a pointer 50 which, cooperating with the scale 51 on the flange 52, may be used to indicate the cross-sectional area of the passage 27.

The length of the elongated orifice 27 may be adjusted independently of the cross-sectional adjustment by rotating the member 40 so as not to disturb the cross-sectional area of the passage 27. To this end a threaded engagement is provided between the sleeve 44 and the member 40 at the thread 53. The pitch of the thread 53 and the spiral slot 54 in the sleeve 44 is identical with the pitch of the threads 41 and 42, so that movement along the slot 54 by the thread 53 causes the thread 41 to travel along the thread 42 but does not vary the distance between the edges of the threads 41 and 42. Thus the area of the passage 27 is maintained substantially constant while its length is varied. To provide means for turning the threaded member 40, an extension 60 is provided passing through the packing gland 61 and terminating in a combined turning lever and pointer 62. The scale 63 together with the pointer 62 may be used to indicate the length of the elongated orifice formed between the threads 41 and 42 fractional turns being indicated on the face 64.

The cross-sectional area of the elongated orifice 27 may be varied by turning the member 45 without substantially varying the length of the elongated orifice 27, and that the length of the orifice 27 can be varied without substantially varying its cross-sectional area by turning the member 41 by means of the lever 62 while maintaining the member 45 stationary.

Means for preventing the passage of refrigerant along both sides of the thread 41 are provided. One or more followers 70 may be provided for this purpose along the length of the thread 42. Follower 70 may comprise a substantially rectangular block having springs to force the same both longitudinally and radially of the member 41. For example, a spring 71 is provided which cooperates with a bead 72 and forces the block 70 axially of the member 41 while a spring 73 cooperates with a bead 74 to force the block 70 of the member 41. The springs 71 and 73 may be held in place by means of a plate 75 welded or otherwise secured within the casing 43. The block 70 fits in sealing relation to the faces 76 and 77 of the slot 78 and against the faces 79 and 80 of the member 41.

In the modification shown in Figs. 3 and 4, the length of the elongated orifice 27*a* is varied substantially the same as in Fig. 1 by the rotation of the lever indicator 62*a* cooperating with the scale 63*a* in the same manner heretofore described. The cross-sectional area, however, is varied by causing the sleeve 44*a* to be rotated without any axial movement. To this end means are provided for locking the member 41*a* and the sleeve 44*a* so that both the sleeve 44*a* and the member 41*a* may be rotated together without axial movement of either, thus causing a change in the cross-sectional area of the orifice 27*a* without changing its length. This is accomplished by providing a stationary clutch 90 and a rotating clutch 91 for the sleeve 44*a*, said clutches being provided with suitable frictional surfaces, such as knurled or toothed surfaces. By disengaging the clutch 90 and engaging the clutch 91 between the member 41*a* and the sleeve 44*a*, the sleeve 44*a* is caused to rotate with the member 41*a*. Means for actuating clutches 90 and 91 comprises a loose disk 92 adapted to actuate the clutches 90 and 91, the disk 92 being provided with extensions 93 which are actuated by means of push rods 94 provided with manipulating surfaces 95 and sealing bellows 96. By actuating the push rods 94 to the right of Fig. 3 the clutches 90 and 91 are also moved to the right, the clutch 90 disengaging the sleeve 44*a* and the clutch 91 engaging the sleeve 44*a* and rotating with the member 41*a*, since the clutch 91 has a slot and key engagement with the member 41*a* as indicated at 97. This movement of the clutches permits the member 41*a* to be turned by the lever 62*a*, together with the sleeve 27*a*.

The length of the orifice 27*a* can be varied independently of the cross-section by releasing the push rods 94 and by turning the pointer lever 62*a*. The release of the push rods 94 causes the spring 98 to move the clutch 90 into engagement with the sleeve 44*a*. Since the clutch 90 is in slot and key engagement with the casing 43*a* as shown at 99, this action locks the sleeve 44*a* against rotational movement. The clutch 91 having moved to the left, the member 41*a* is free to be rotated relatively to the sleeve 44*a* and to change the length of the orifice 27*a* in the same manner as described with respect to Fig. 1. The sleeve 44*a* is prevented from moving axially but is permitted to rotate when declutched because of the flange 100 which permits a rotational movement and prevents an axial movement, the flange 100 being keyed to the sleeve 44*a*.

The sleeve 44*a* is provided with a pointer 101 which may be observed through the window 102 to indicate on a suitable scale, etched on the glass 102, the cross-sectional area of the orifice 27*a*. The refrigerant enters through the inlet 25*a* and passes out through the outlet 28*a*, first passing through the passage 103 and thence through the orifice 27*a*. Other features heretofore described with respect to Fig. 1 are also provided in Fig. 3. The follower 70*a* is actuated in the same manner as described with respect to Figs. 1, 5 and 6. Sealing gland 61*a* is provided for the extension 60*a* in the same manner.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An expander for a refrigerating system or the like comprising means forming an elongated orifice for the expansion of refrigerant, and means for varying the transverse cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice.

2. An expander for a refrigerating system or the like comprising means forming an elongated orifice for the expansion of refrigerant, and means for varying the cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice, the variation in

cross-sectional area being substantially independent of the variation in length.

3. The method of refrigeration of an article to be cooled which comprises circulating a refrigerant in a closed cycle through a compressing zone, a condensing zone, an expansion zone of definite length and cross-sectional area and an evaporating zone, and independently varying the length and cross-sectional area of said expansion zone to coordinate the circulation of refrigerant with the heat accumulation of said article to be cooled.

4. The method of refrigeration of an article to be cooled which comprises continuously circulating a refrigerant in a closed cycle through a compressing zone, a condensing zone, an expansion zone of definite length and cross-sectional area and an evaporating zone, and independently varying the length and cross-sectional area of said expansion zone to coordinate the circulation of refrigerant with the heat accumulation of said article to be cooled.

5. An expander for a refrigerating system or the like comprising means forming a helical elongated orifice for the expansion of refrigerant, and means for varying the transverse cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice.

6. An expander for a refrigerating system or the like comprising means forming a helical elongated orifice for the expansion of refrigerant, and means for varying the cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice, the variation in cross-sectional area being substantially independent of the variation in length.

7. An expander for a refrigerating system or the like comprising telescoping inner and outer members forming an elongated orifice between them, and means for varying the cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice, the variation in cross-sectional area being substantially independent of the variation in length.

8. An expander for a refrigerating system or the like comprising telescoping inner and outer members forming a helical elongated orifice between them, and means for varying the cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice, the variation in cross-sectional area being substantially independent of the variation in length.

9. An expander for a refrigerating system or the like comprising telescoping inner and outer cylindrical members at least one of said members having a groove forming an elongated orifice between them, and means for varying the cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice, the variation in cross-sectional area being substantially independent of the variation in length.

10. An expander for a refrigerating system or the like comprising telescoping inner and outer cylindrical members at least one of said members having a groove forming a helical elongated orifice between them, and means for varying the cross-sectional area and the length of said orifice to vary the flow of refrigerant through said orifice, the variation in cross-sectional area being substantially independent of the variation in length.

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