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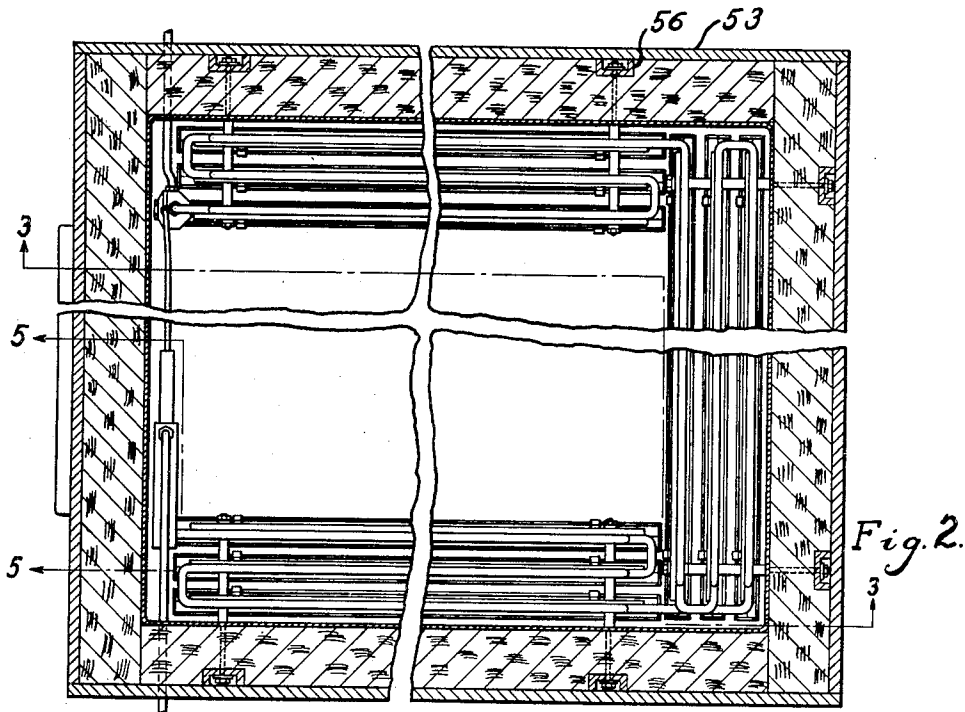
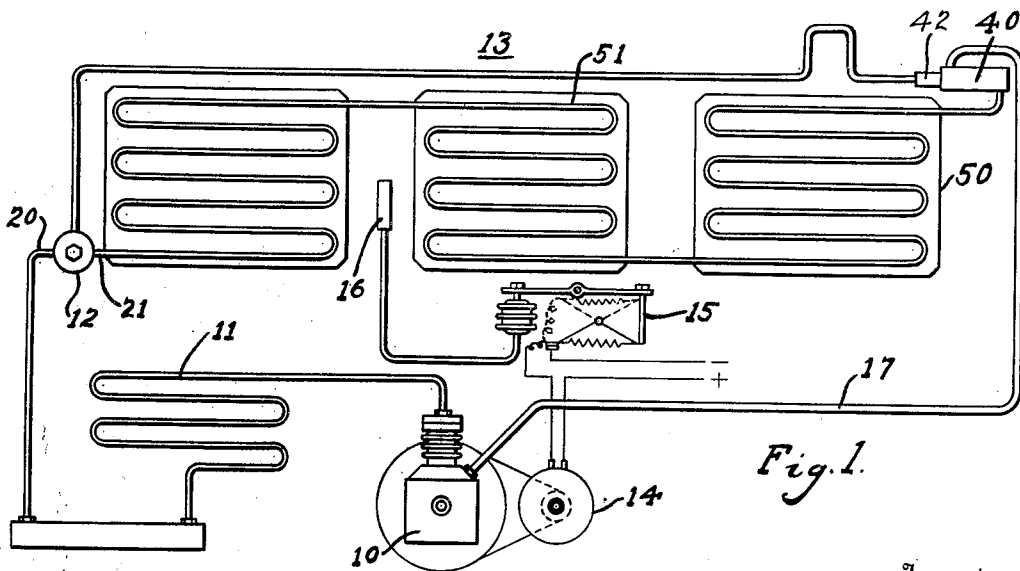
H. B. HULL

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REFRIGERATING APPARATUS

Filed Dec. 31, 1928

3 Sheets-Sheet 1



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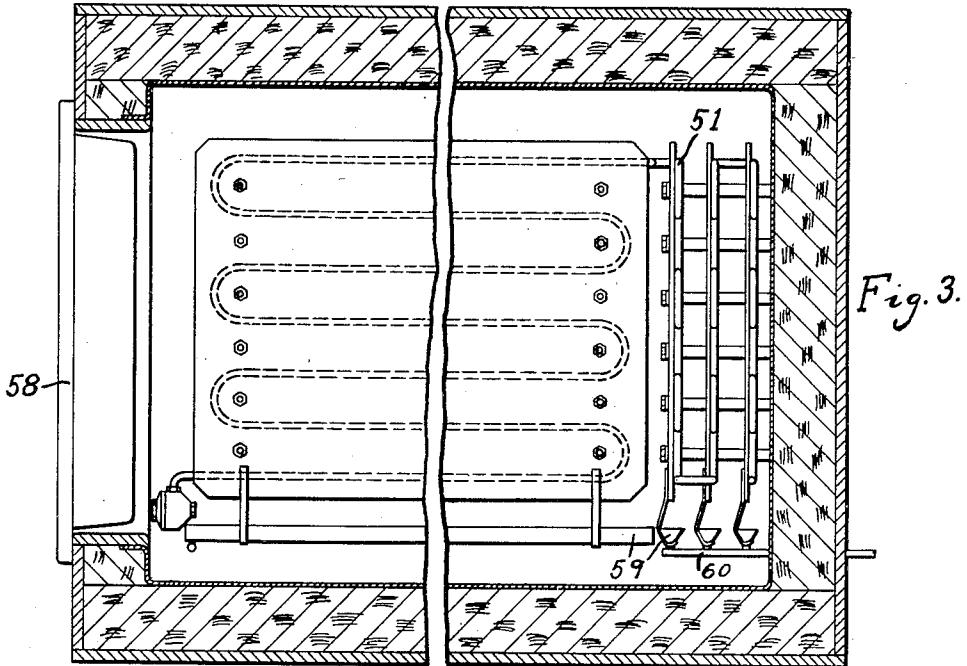
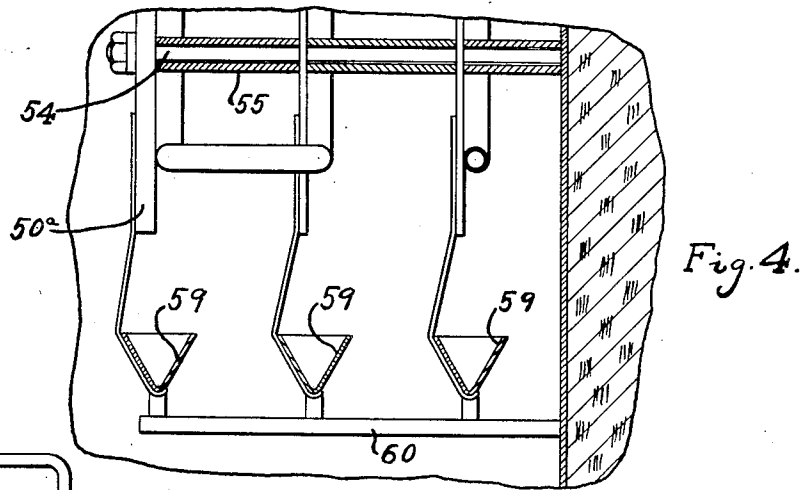
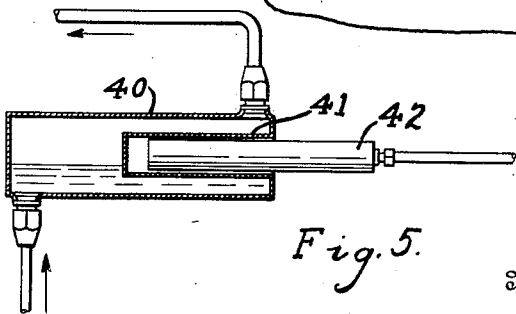
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REFRIGERATING APPARATUS

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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

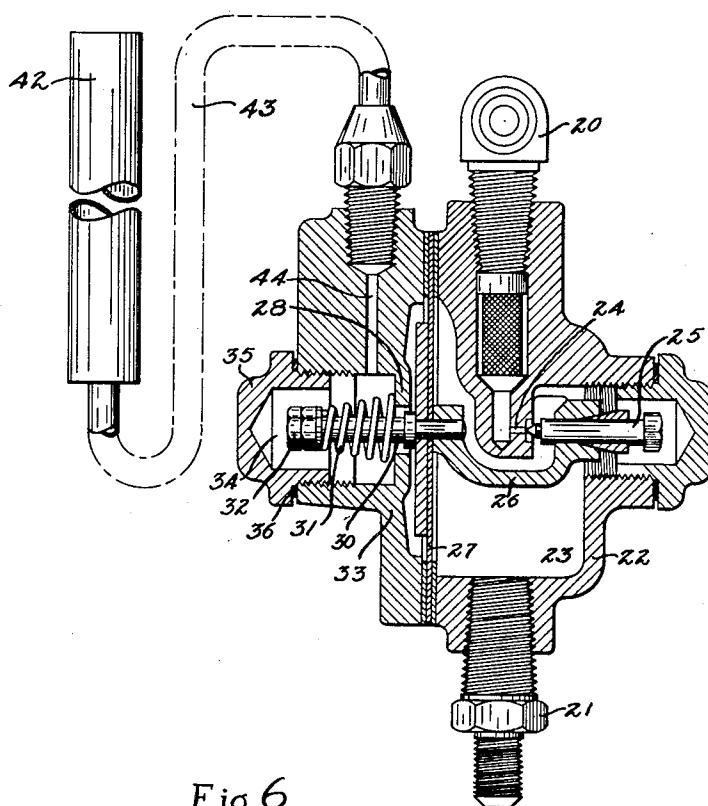


Fig 6

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REFRIGERATING APPARATUS

Application filed December 31, 1928. Serial No. 329,497.

This invention relates to refrigerating apparatus and particularly to the novel construction and arrangement of refrigerating elements in a refrigerating cabinet.

5 One of the objects of the invention is to provide an improved construction and arrangement of a refrigerating element which is economical to build and which conserves space.

10 Another object is to provide an improved refrigerating element especially adapted to withstand the impact of heavy articles being placed within a refrigerator.

15 Another object of the invention is to provide improved means for regulating a refrigerating element to produce efficient operation.

20 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 invention is clearly shown.

In the drawings:

25 Fig. 1 is a diagrammatic illustration of a refrigerating system embodying my invention.

Fig. 2 is a horizontal section of a refrigerating cabinet having an improved refrigerating element therein.

30 Fig. 3 is a section on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged section of a portion of the apparatus corresponding to Fig. 3.

35 Fig. 5 is a section on the line 5—5 of Fig. 2, and

Fig. 6 is a section of an expansion valve forming part of the apparatus.

Referring to Fig. 1 the refrigerating system includes the customary compressor 10 and condenser 11, a pressure-responsive expansion valve 12 and an evaporator 13. The compressor may be driven by a motor 14 under the control of a switch 15 actuated by a thermostat 16 responsive to the temperature of the evaporator, evaporated refrigerant being drawn into the compressor thru the vapor return conduit 17. In such systems the expansion valve controls the flow of liquid refrigerant into the evaporator in response to the pressure existing within the evaporator.

This is accomplished by means such as shown in Fig. 6 wherein 20 is a conduit supplying liquid refrigerant at high pressure from the condenser to the expansion valve and 21 is a conduit conducting the liquid refrigerant at low pressure from the evaporator, the conduit 21 being in effect part of the evaporator.

These conduits are attached to a casing 22 and communicate with chamber 23, in which the pressure existing in the evaporator is maintained. Liquid refrigerant enters this chamber through the orifice 24 under the control of a needle valve 25 which is carried on a yoke 26 attached to a flexible diaphragm 27 forming one wall of the chamber. Attached to the diaphragm and to the yoke is a post 30 which forms a rigid structure with the yoke and needle valve 25. This post is urged to the left as shown in Fig. 6 by a spring 31 compressed between a stationary abutment 28 and adjusting nuts 32 threaded on the post. Thus it will be seen that the spring urges the diaphragm and yoke to the left and tends to close the valve. The post 30, spring 31 and its adjusting mechanism are placed within a casing 33 forming a chamber 34 which is sealed from the atmosphere by a plug or cap 35 and gasket 36.

Assuming that the pressure within the chamber 34 is constant, it will be apparent that whenever the pressure within the chamber 23 is reduced sufficiently below that of chamber 34 the diaphragm 27 will move to open the valve 25 against the force of the spring 31, and that the amount of such opening depends upon the actual value of the pressure in the chamber 23. Thus having a constant pressure in the chamber 34, whenever the pressure in the evaporator is reduced to a value below that corresponding to the setting of the spring the valve will open to admit liquid refrigerant. This refrigerant will be evaporated and tend to increase the pressure within the evaporator above the value corresponding to the setting of the spring. When the pressure increases above this value the valve will be closed. Thus the valve will maintain a constant refrigerant pressure within the evaporator.

When the evaporator is warm the liquid

refrigerant will be vaporized immediately or at least shortly after being admitted to the evaporator, that is all of the evaporation will take place near the expansion valve. However as the evaporator becomes cold liquid will travel to greater and greater distances along the evaporator before all of it has passed into vapor. Since the only portion of the evaporator that is practically effective as a refrigerating element is that part which contains liquid refrigerant, it is evident that in order to increase the effectiveness of the evaporator it is desirable to distribute liquid throughout as much of the evaporator as possible. However if liquid is maintained up to the outlet of the evaporator, there is great danger that some liquid will be drawn into the compressor, which is a very undesirable result.

In order to keep liquid distributed throughout the entire evaporator at all temperatures, and at the same time to prevent the entrance of liquid into the compressor I use the following mechanism for regulating or controlling the expansion valve. A liquid collecting chamber or trap 40 is placed at the outlet of the evaporator and the vapor return conduit 17 is connected to the top of this trap as shown in Fig. 5 so that only vapor can be withdrawn from the evaporator. The trap includes a well 41 in which is slidably mounted a container 42 for an expansible fluid connected by a conduit 43 with a duct 44 (see Fig. 6) in the casing 33 which communicates with the chamber 34. The pressure within the chamber 34 therefore varies in response to the temperature of the container 42. When there is no liquid present in the trap 40 the container 42 will be relatively warm, and its fluid will exert a relatively high pressure in the chamber 33 on the diaphragm 27, tending to open the valve 25. When liquid is present in the chamber 40 and is being evaporated therein by the suction produced by the compressor, the container 42 will be very cold and its fluid will exert a relatively low pressure on the diaphragm 27 letting the valve close. When liquid enters the trap and begins to evaporate there will be a sudden decrease in the temperature of the container 42. The nature and amount of the expansible fluid may be so selected that the valve 25 will remain open until liquid enters the trap, after which it will be suddenly closed. The valve will not be opened until there is no liquid present in the trap. This will produce an alternate opening and closing of the expansion valve which keeps liquid in the evaporator up to the trap. Alternatively, the nature and amount of the expansible fluid can be so selected that instead of completely closing the valve 25, the latter will be partially closed upon the occurrence of liquid in the trap 40. Thereafter refrigerant will continue to circulate thru the evaporator 13

at a lower rate, but one which is sufficient to maintain liquid distributed thruout the evaporator. In either case the adjustment and regulation of the expansion valve will be facilitated by adjusting the thermal relation between the container 42 and the chamber 40 which may be conveniently accomplished by sliding the container into or out of the well 41.

The evaporator preferably takes the form of a plurality of plates 50 to each of which is secured a sinuous coil of refrigerant conduit 51. The plates are arranged in sets of two or more, for example three, the plates in each set being bolted together in spaced relation as shown in Figs. 2 to 4, and the set supported on the side wall of a refrigerating cabinet or cold storage chamber 53. Preferably the plates are secured together by bolts 54 and spaced apart by collars 55 as shown in Fig. 4, the bolts passing thru the wall of the cabinet as shown in Fig. 2 and being secured to channel irons 56 in the walls. The plates are thus spaced from each other and from the wall of the cabinet and form a number of air circulating flues extending substantially from the bottom to the top of the cabinet as shown in Fig. 3. All of the coils 51 in each set are connected in series and all of the sets are connected in series. Preferably a set of plates is placed on each of three walls of the room or cabinet, the fourth wall being left for a door 58. To each plate is secured an individual drain gutter 59, the gutters being spaced from each other and from the walls and floor of the cabinet as shown in Figs. 3 and 4 to permit the unrestricted circulation of air downwardly thru the flues formed between adjacent plates. The gutters are connected to suitable drains 60 to carry off water formed when the refrigerating element is defrosted.

Preferably each of the plates occupies an entire side wall of the cabinet, only sufficient room being left above and below the plate to provide sufficient air circulation. The sets of plates are relatively thin and thus take up a relatively small portion of the total volume of the cabinet leaving a relatively large amount of space for storage.

Refrigerating apparatus of this character is especially suited to the cooling of rooms or cabinets large enough to permit a person to walk into them, in which are frequently stored large or heavy boxes and barrels of meat or other articles to be cooled. The placing in and taking from the cooler of such articles involves a certain amount of unavoidable bumping of the refrigerating element and for this purpose I preferably form the outermost plate 50a of each set of heavy rigid material such as steel boiler plate to act as a bumper to protect the refrigerating element from impact. The other plates of these sets

are preferably made relatively thin for the sake of economy and may be formed of copper for the sake of thermal conductivity.

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. Refrigerating apparatus comprising in combination a cabinet and a refrigerating element in the cabinet including a plurality of vertical plates supported on a side wall of the cabinet and spaced from each other and from the wall to form one or more air circulating flues adjacent the wall, and conduit means for circulating refrigerant secured to the plates, the outermost plate being of heavy rigid construction to act as a bumper to protect the refrigerating element from the impact of heavy articles placed in the cabinet.

2. A refrigerating element for refrigerating apparatus including a bumper plate of heavy, rigid construction, and a refrigerant conduit secured to the protected side of the bumper plate for cooling the latter.

3. Refrigerating apparatus comprising in combination an evaporator of the dry expansion type, a pressure regulating valve for admitting liquid refrigerant to the evaporator, a chamber for collecting liquid refrigerant at the outlet of the evaporator and means for adjusting the valve in response to the presence of liquid in said chamber including a container for expansible fluid thermally associated with said chamber, the thermal relation between the chamber and container being adjustable.

4. Refrigerating apparatus comprising in combination an evaporator of the dry expansion type, a pressure regulating valve for admitting liquid refrigerant to the evaporator, a chamber for collecting liquid refrigerant at the outlet of the evaporator and means for adjusting the valve in response to the presence of liquid in said chamber including a well in said chamber and a container for expansible fluid slidably mounted in said well and connected to said valve.

5. Refrigerating apparatus comprising in combination a cabinet and a refrigerating element in the cabinet including a plurality of vertical plates supported on a side wall of the cabinet and spaced from each other and from the wall to form one or more air circulating flues adjacent the wall and conduit means for circulating refrigerant secured to the plates, an individual drain gutter associated with each plate, said gutters being spaced from each other to permit unrestricted circulation of air between the gutters.

6. Refrigerating apparatus comprising in combination a cabinet and a refrigerating element in the cabinet including a plurality of vertical plates supported on a side wall of

the cabinet and spaced from each other and from the wall to form one or more air circulating flues adjacent the wall and conduit means for circulating refrigerant secured to the plates, an individual drain gutter associated with each plate, said gutters being spaced from each other and from the floor of the cabinet to permit unrestricted circulation of air between the gutters.

In testimony whereof I hereto affix my signature.

HARRY B. HULL.

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