The dampers or inlet openings to admit air should be arranged to give uniform supply to all condensers. Exhaust fans can be located in an exterior wall or on the roof of the equipment room.

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CHAPTER 60

HOUSEHOLD REFRIGERATORS AND FOOD FREEZERS

Part I—Refrigerators: Special Storage Compartments, Automatic Defrosting, Cabinet Design, Compressor Units, Condensers, Capillary Tubes, Evaporators, Controls, Processing, Performance, Operating Cycle for Heat-Operated Absorption Refrigerator, Thermoelectric Refrigeration; Part II—Freezers: Cabinet, Refrigerating Systems, Condensing Units, Storage and Freezing Temperatures, Refrigeration Failure, Testing and Rating

IN GENERAL, the refrigerator user of today assumes satisfactory mechanical operation and places greater emphasis on improved appearance, utility, and convenience. As a result, the most significant design trends over the last few years have been in these categories. An interesting new development is the application of thermoelectricity to refrigeration which is discussed in Chapter 2, Thermoelectric Cooling.

PART I: REFRIGERATORS

While the demand for more refrigerated-food storage space has increased, the kitchen size in homes has decreased. As a consequence, there has been a marked increase in the ratio of the food storage volume of the refrigerator to the floor area it occupies. This has been accomplished by reducing the physical size of the motor compressor unit, and relocating it, so that all or a portion of the bottom of the food compartment can be lowered; and by using thinner but more effective insulation.

Special Storage Compartments

The greatly increased use of frozen foods has resulted in the need for providing refrigerators with much larger and colder frozen-food storage compartments. In a large number of refrigerators this increased frozen-food storage volume is provided by a freezing compartment which extends substantially the full width of the food compartment, in the upper part of the cabinet. So that the evaporator can be operated at the low temperatures required for proper frozen-food storage, but at the same time maintain temperatures above freezing in the normal food-storage compartment, an insulated baffle is placed beneath the evaporator. This baffle is designed to permit sufficient air movement around it to provide the necessary cooling for the main food-storage compartment.

Another approach to the problem of large and adequately cooled frozen-food storage compartments in refrigerators has been the introduction of a two-door design. In this modification there are two separate compartments, each having its own exterior door.

Another recent trend has been to locate the frozen food and ice freezing section of the refrigerator in the lower portion of the cabinet. Such an arrangement provides greater utility. The most frequently used above-freezing portion of the refrigerator is placed in the more accessible location. Some of these refrigerators are built with two separate compartments housed in a single outer shell, and others with a single inner compartment separated into two sections by a suitable insulated baffle. Either a single or two outer doors can be used. The volume of the frozen-food compartment may vary from approximately 20 to 100 percent of the normal food storage compartment volume. Those in the latter category are classified as combination refrigerator-freezers.

A single condensing unit is used to refrigerate both freezer and refrigerator compartments. The surface of the freezer compartment is usually in the form of a box made up of refrigerated plates. The fresh-food compartment may be cooled by: (1) a separate evaporator surface in series with the freezer evaporator but located within the fresh-food compartment (with cooling accomplished by natural circulation of air or by forced convection), (2) an evaporator cooled by a secondary system operating from the freezer evaporator, or (3) a combination of these systems.

In the first system, the compressor cycling is controlled by the temperature of the fresh-food compartment evaporator. A temperature control having a wide differential is used to enable the refrigerant to reach a low temperature for suitable cooling of the freezer during the compressor operating time. A high cut-on temperature of this control insures defrosting of the fresh-food compartment cooling surface during each compressor off-time, while frozen-food temperatures do not rise appreciably, due to normal mass and adequate insulation.

The second and third arrangements provide a fresh-food compartment that does not require manual defrosting.

A recent modification is the built-in refrigerator. In this design, the refrigerator, as a complete unit structure, is inserted in a cavity in a wall and the surface of the refrigerator substantially flush with the wall surface.

Recent styling trends have resulted in an external appearance similar to the conventional kitchen cabinet with sharp radius corners and essentially flat surfaces. To accomplish this appearance, door hinging has been altered to allow the door to open with very little projection beyond the cabinet width; forced convection condensers are used and inlet and outlet air movement is confined to the front toe space below the door. This permits installation of the cabinet close to the kitchen wall and cabinets. The condenser must be designed to avoid the trapping of dust and lint.

The trend toward specialized interior appointments has been marked. *Meat-storage compartments* maintained at temperatures slightly above freezing with relative humidities of 90 percent are common. Special *high humidity* compartments for storage of leafy vegetables are provided in practically all refrigerators. These are generally in the form of a sliding drawer or drawers located at the bottom of the food compartment. Shelves on the inner panel of the door *frequently are provided* for storage of small containers, bottles, eggs, etc. Compartments with heating means for maintaining butter at suitable spreading temperatures are common.

Other forms of sealed, high-humidity compartments are provided as special features. Such compartments may also be maintained at a temperature just above freezing to provide optimum conditions for extended storage of unwrapped or uncovered perishable foods. These conditions may be achieved by surrounding the sealed chamber with cold air at the same temperature as that desired inside. In conventional refrigera-

The general responsibility for this chapter is assigned to TC 8.1, Domestic Refrigerators and Food Freezers.