Nov. 17, 1953 E. L. HART 2,659,213

REFRIGERATING APPARATUS AND CABINET STRUCTURE

Filed March 15, 1951 3 Sheets-Sheet 1

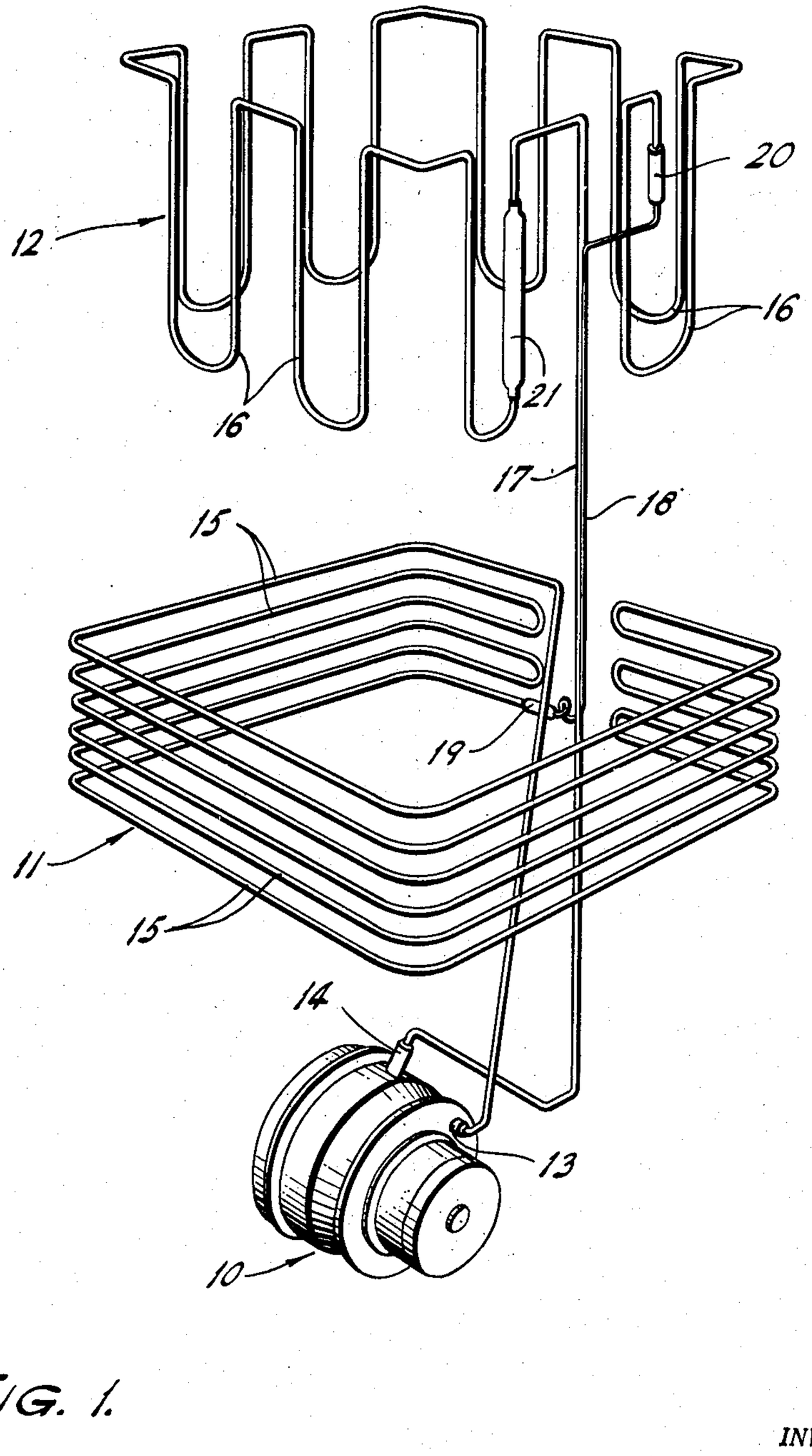

FIG. 1.

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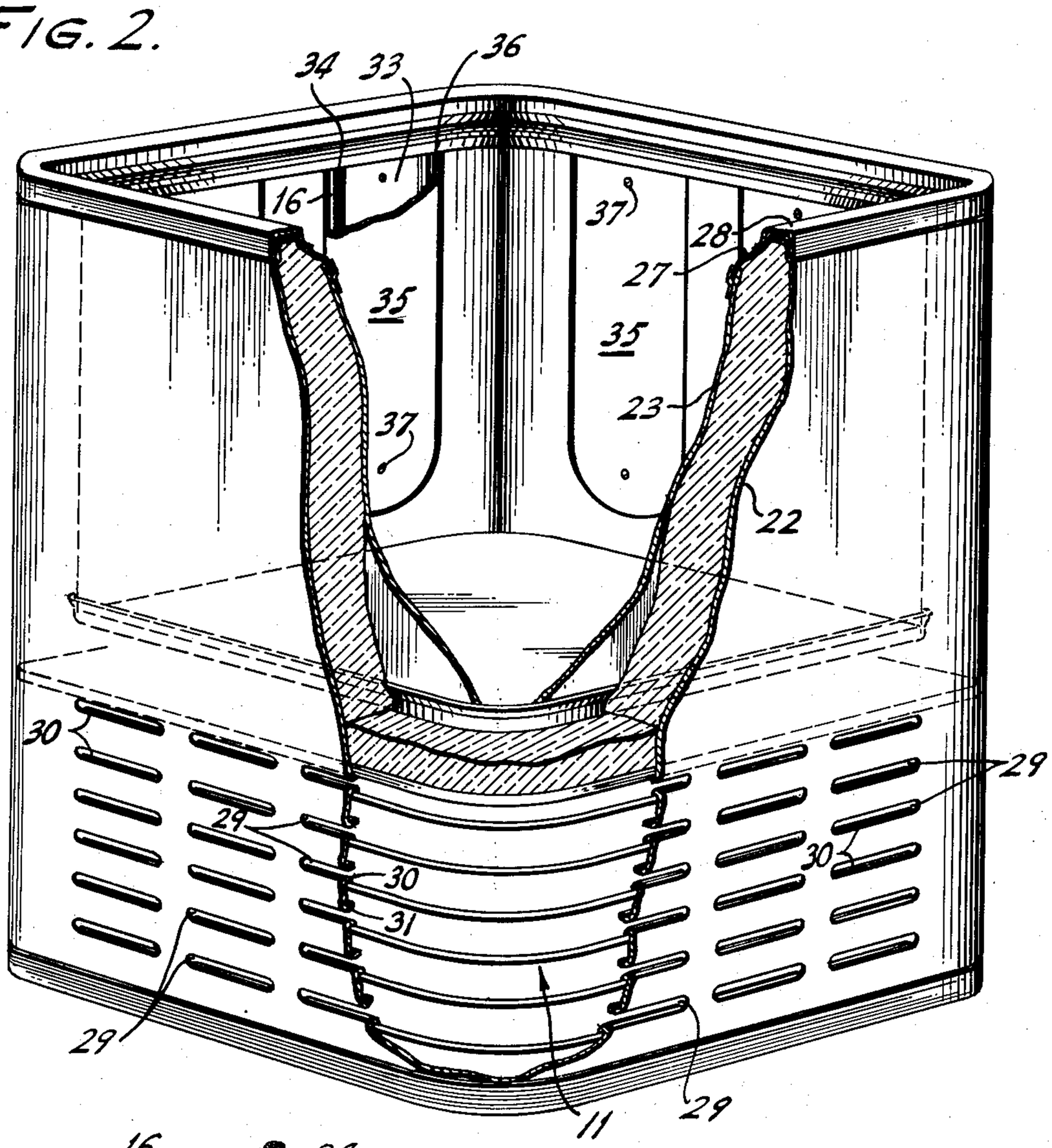
FIG. 2.



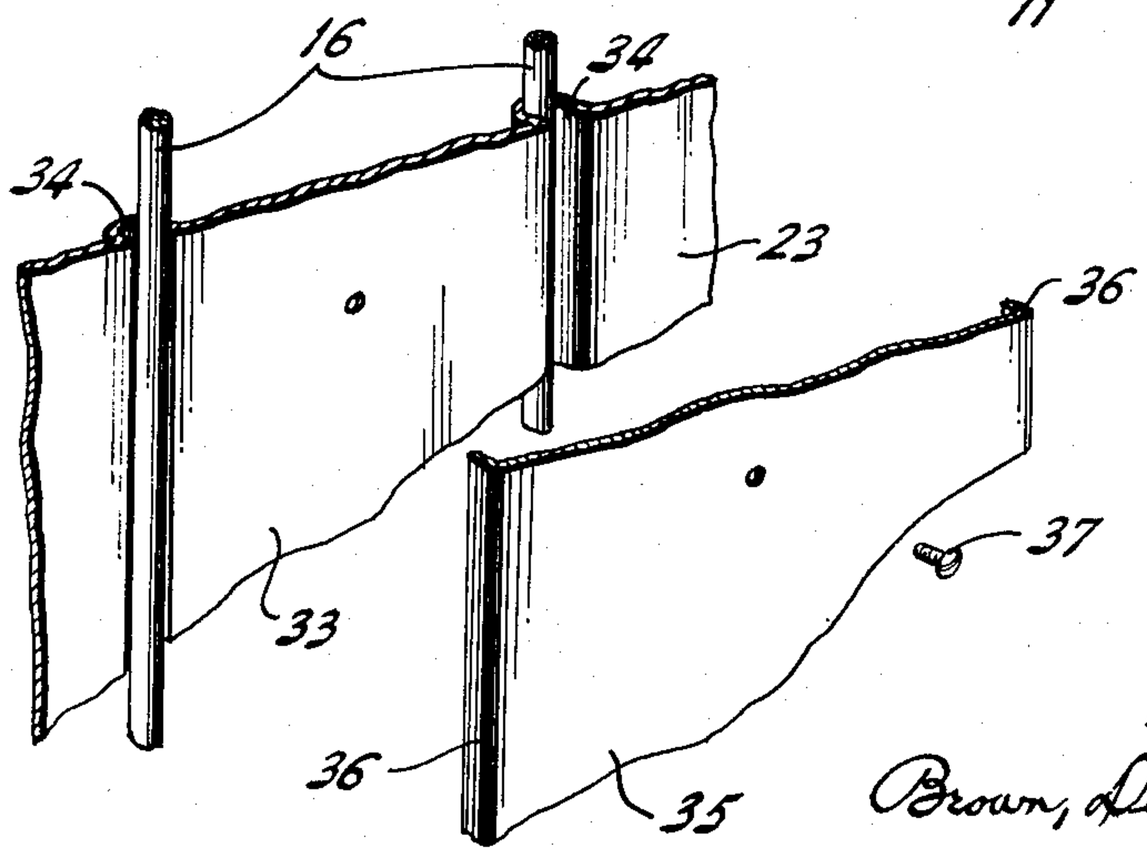


FIG. 3.

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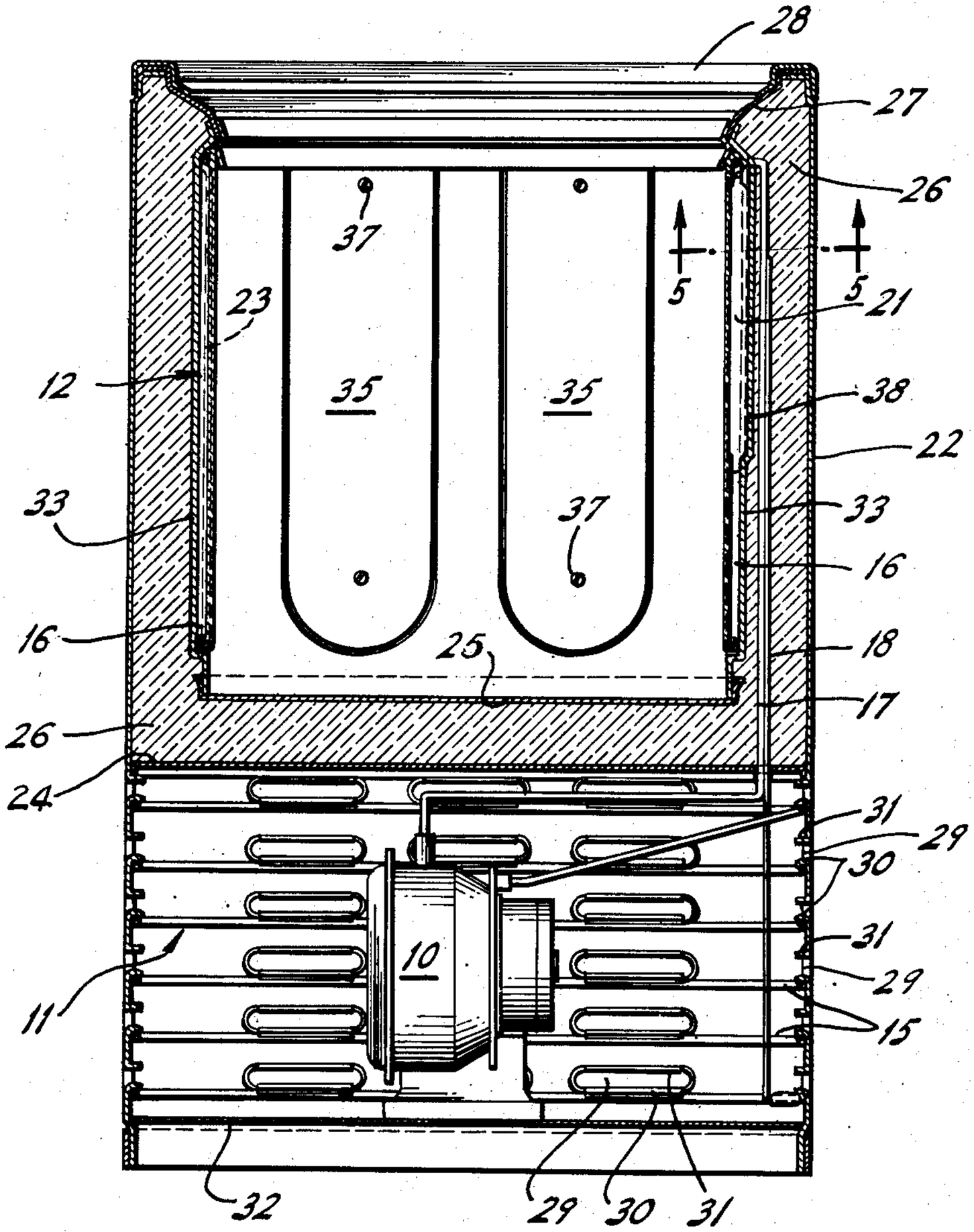
FIG. 4.



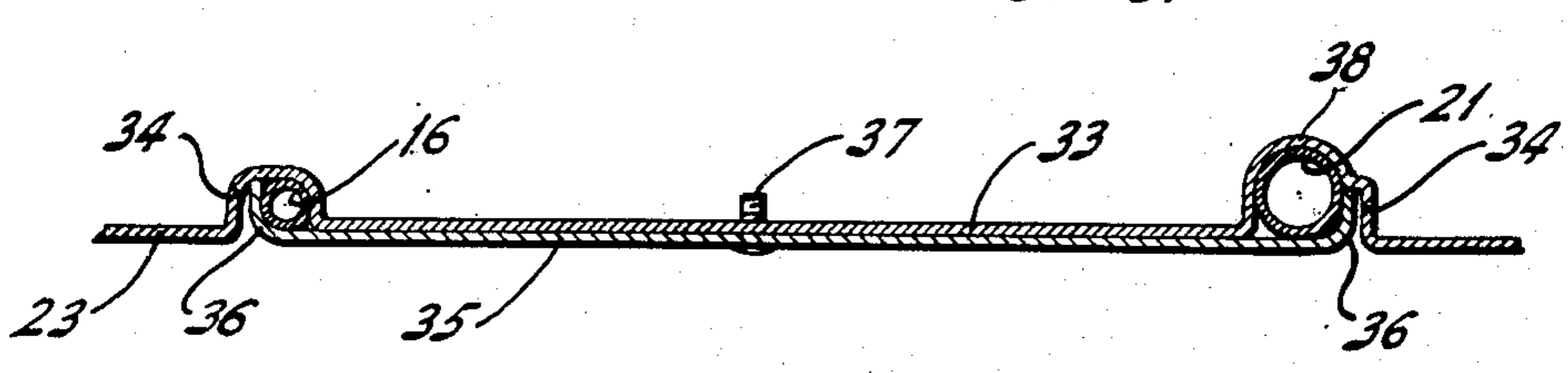


FIG. 5.

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS AND CABINET STRUCTURE

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5 Claims. (Cl. 62—117.4)

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The present invention relates to refrigerators. Particularly, the invention concerns an improved structure for a refrigerant circulating system, and for a refrigerator cabinet with which the system is associated.

In refrigerators, especially those of the smaller portable variety, the desirability of providing a compact lightweight refrigerating system and a practicable cabinet construction for association with such a system, gives rise to serious difficulties and problems, and it is the primary object of this invention to overcome these difficulties and to solve these problems.

Other and more specific objects of the invention have to do with simplicity of construction to facilitate association of the refrigerating system with the refrigerator cabinet, and with novel improvements in the cooperative relationship between parts of the system and parts of the cabinet structure to provide a light yet rugged assembly.

In accordance with the broadest aspect of the invention, both the condenser and evaporator of the refrigerating system are formed of tubing, and the cabinet structure includes walls constructed in a novel manner to support and to retain said condenser and evaporator. According to a narrower aspect of the invention, the cabinet walls with which the condenser is associated are provided by an outer shell which incorporates combined tube-clamping and louver-forming means whereby the condenser tubing is readily and effectively supported in intimate heat exchange relationship with said walls, and whereby ambient air is permitted to circulate freely about said tubing. Also in accordance with this narrower aspect of the invention, the cabinet walls with which the evaporator tubing is associated, are provided by an inner liner which incorporates tube-housing means whereby the evaporator tubing is easily placed and maintained in intimate heat exchange relationship with said walls. According to a preferred embodiment, the housing means for the evaporator tube includes reentrant portions defining generally U-shaped grooves into which correspondingly shaped portions of the evaporator tubing are nested. These reentrant portions are formed in the inner liner which defines the walls of the storage compartment, and covering sections which overlie said reentrant portions and nested tubing, are seated flush with other portions of the inner liner, so that the interior of said storage compartment is provided with a smooth even surface.

It is an important feature of the invention to

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arrange the tubing which forms the condenser and the evaporator, in such a manner that said condenser and evaporator tubing may be advantageously gathered into bunches. These bunches of tubing can then be handled and inserted into the cabinet with ease and, when inserted into the cabinet, can be readily spread out for convenient fitting in heat exchange relationship with the tube receiving and holding means incorporated in the cabinet walls.

Additional novel features of the invention, together with the foregoing and other objects and advantages, will be best understood from the following description of the embodiment shown in the accompanying drawings, in which:

Figure 1 is a perspective view of a refrigerating system constructed in accordance with the present invention;

Figure 2 is a perspective view of a refrigerator cabinet constructed in accordance with the invention, certain portions being broken away to illustrate the association of the refrigerating system with said cabinet;

Figure 3 is a perspective exploded fragmentary view, on an enlarged scale, of a portion of the refrigerator cabinet and associated tubing portion of the refrigerating system;

Figure 4 is a cross-sectional view taken vertically through the refrigerator cabinet and associated refrigerating system, as shown in Figure 2; and

Figure 5 is an enlarged sectional fragmentary view taken substantially on line 5—5 of Figure 4.

Referring more particularly to the drawings, the system as shown in Figure 1, essentially includes a motor-compressor 10, a condenser 11 and an evaporator 12.

In accordance with the present invention the condenser and evaporator are constructed of tubing which extends continuously from outlet 13 to inlet 14 of the motor-compressor. From the outlet of the motor-compressor the tubing runs back and forth in a series of horizontal loops 15 to form the condenser. These horizontal loops, at substantially equidistant points, are angularly bent so that the condenser is given a generally square box-like configuration. From the condenser, the tubing runs up and down in a series of vertical loops 16 to form the evaporator. Certain of these loops, at substantially equidistant points, are angularly bent so that the evaporator also is given a generally square box-like configuration. From the evaporator, a tubing portion 17 which leads directly to the inlet of the motor-compressor, serves as the suction line.

A tubing portion 18 between the condenser and the evaporator has a reduced cross-sectional dimension as compared to the cross-sectional dimension of the rest of the tubing, so that said portion of smaller diameter serves as an impedance or capillary tube, which, as is customary, is arranged in heat exchange relationship with a portion of said suction line. In practice, a tubular strainer 19 and a tubular dryer 20 are advantageously interposed at the connection of said impedance or capillary tube with the condenser and evaporator, respectively. Also, in practice, a tubular header 21 is conveniently interposed at the connection of the suction line with the evaporator.

In operation of the system, gaseous refrigerant is compressed in the motor-compressor and then discharged into the condenser where the compressed gaseous refrigerant gives up heat and is converted to liquid state. Liquified refrigerant flows from the condenser, through the strainer, then through the impedance or capillary tube and dryer, into the evaporator where the refrigerant expands. In the process of expanding, the refrigerant absorbs heat and some of the refrigerant is converted to gaseous state. Gaseous refrigerant is withdrawn from the evaporator and is discharged into the motor-compressor through the suction tube portion. The header between the outlet of the evaporator and the inlet of the suction tube portion, acts to prevent the passage of liquid refrigerant into the motor-compressor.

With particular reference to Figures 2, 3, 4 and 5, the refrigerator cabinet construction adapted for association with the above described refrigerating system includes an outer shell 22 and an inner liner 23, of suitable metallic sheet material. In the illustrated embodiment, the cabinet is of the top access variety and, accordingly, the sheet material of which the outer shell and inner liner are made, is formed to provide four right angularly disposed upright side walls which correspond to the general configuration of the condenser and evaporator of the refrigerating system. As best seen in Figure 4, a partition 24 extends horizontally across the space delineated by the outer shell to divide said space into upper and lower compartments. The upper compartment encloses the inner liner which is spaced from the outer shell. A suitable panel 25 which is spaced from dividing partition 24 associated with the outer shell, extends across the lower end of the inner liner and cooperates with the latter to define a storage compartment. The outer shell and inner liner are insulated from each other, in the usual manner, by means of insulation 26 which fills the space between said shell and liner and between their respective partition 24 and panel 25, and by means of breaker strip frame 27 which seals the gap between the upper marginal portions of the shell and liner. A trim member 28 is arranged about the edge of the open top of the cabinet to give a finished appearance to said edge and, as is customary, the open top of the cabinet is closed by means of a door (not shown) of suitable well-known construction.

The mentioned lower compartment defined by the dividing partition and the outer shell, houses the motor-compressor 10 and condenser 11 of the refrigerating system; and the mentioned storage compartment defined by the closing bottom panel and the inner liner, houses the evaporator 12 of said system. For that purpose, means are arranged on those portions of the outer shell which define the machinery compartment, to maintain the condenser tubing in heat exchange relationship with said portions; and means are arranged on the inner liner to receive the evaporator tubing and to maintain the same in heat exchange relationship with said inner liner.

In accordance with the invention, the means employed to maintain the condenser tubing in contact with the specified portions of the outer shell, advantageously take the form of combined tube-clamping and louver-forming means which are conveniently obtained by providing rows of spaced horizontal slots 29 on said portions, the shell material along one edge of each slot being curled in the shape of clamps 30 which encircle part of the tubing and draw the latter snugly against said portions, and the shell material along the other edge of each slot being bent in the shape of baffles 31 which promote circulation of air through the machinery compartment and around the condenser tubing. As more clearly shown in Figure 4, the motor-compressor is conveniently and readily mounted within the machinery compartment by means of a platform 32 which also serves to close the lower end of said compartment.

In accordance with the invention, the means employed to house the evaporator tubing and to maintain the same in contact with the inner liner comprise spaced vertical reentrant portions 33 providing generally U-shaped grooves or channels 34 into which the vertical loops 16 of the evaporator tubing sit. It will be noted that these reentrant portions are set slightly back from the remaining portions of the inner liner so as to accommodate cover plates 35 which lie flush with said remaining portions of the inner liner, thus providing the storage compartment with an even and smooth interior surface. Each cover plate is advantageously formed with a marginal flange 36 which overlaps the associated loop of the evaporator tubing and which assists in firmly holding the latter in intimate heat exchange contact with the inner liner. The cover plates are conveniently secured in position by means of suitable fastening elements 37. As best seen in Figures 4 and 5, one of the mentioned reentrant portions has an outwardly depressed recess 38 housing the tubular header 21 which, as hereinbefore stated, is included in the refrigerant circulating system.

From the foregoing, it will be appreciated that the present invention greatly simplifies the manufacture and assembly of compact lightweight refrigerators. Especially, the provision of a refrigerating system which (except for the motor-compressor) consists entirely of tubing, and the fact that the means necessary to mount the condenser and evaporator tubing are formed directly in the walls of the cabinet, most effectively contribute to the compactness and lightness of the assembled refrigerator. Furthermore, the fact that the refrigerating system consists mostly of tubing and that this tubing can be readily manipulated for arranging the condenser and evaporator on their corresponding refrigerator walls, is an important factor in the ease with which the system and cabinet can be put together. It will be understood that, because of the particular construction and configuration of the condenser and evaporator tubing, this tubing can be folded or collapsed and bunched into a comparatively small package for convenient handling. Also, it will be understood that, when mounting the system within the cabinet structure, the folded or collapsed condenser and evaporator tubing can

be readily introduced into the machinery compartment and storage compartment, respectively, and then unfolded or erected and placed in operative association with the walls of said compartments.

I claim:

1. A refrigerator comprising a refrigerant circulating system consisting of a motor-compressor and tubing extending continuously from the outlet to the inlet of said motor-compressor, a portion of said tubing being formed into a series of loops defining a condenser, another portion of said tubing being formed into a series of loops defining an evaporator, a cabinet including an outer shell and an inner liner, said outer shell having rows of spaced slots, the shell material along one edge of said slots forming clamps encircling parts of said condenser loops and drawing them into contact with the outer shell, the shell material along the other edge of said slots forming louvers promoting the circulation of air about said condenser loops, said inner liner having spaced reentrant portions defining generally U-shaped grooves into which said evaporator loops are nested, said reentrant portions setting back from the remaining portions of the inner liner, and cover plates overlying said reentrant portions and evaporator loops and lying flush with the said remaining portions of the inner liner.

2. A refrigerator as set forth in claim 1, in which each cover plate has a marginal flange extending into the associated groove and overlapping the associated evaporator loop.

3. A refrigerator comprising a refrigerant circulating system including an evaporator consisting of tubing forming a series of loops each in the shape of an elongated U, a cabinet provided with an inner liner defining a storage compartment and having an open portion providing said compartment with an access opening, and spaced reentrant portions provided in said liner and extending in a direction crosswise of said access opening, each of said reentrant portions defining a groove in the shape of an elongated U corresponding to and receiving one of said loops of said evaporator.

4. A refrigerator as set forth in claim 3, in which the mentioned reentrant portions are set back from the remaining portions of the inner liner, and cover plates overlie said reentrant portions and evaporator loops therein and lie flush with said remaining portions of the inner liner.

5. A refrigerator as set forth in claim 4, in which each cover plate has a marginal flange extending into the associated groove and overlapping the associated evaporator loop.

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