

May 14, 1940.

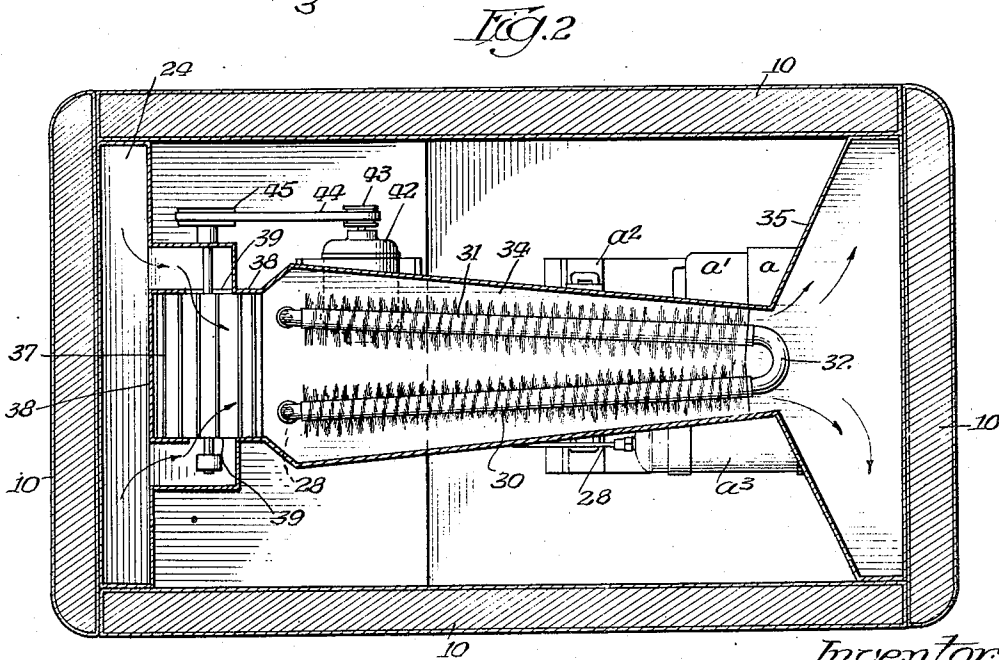
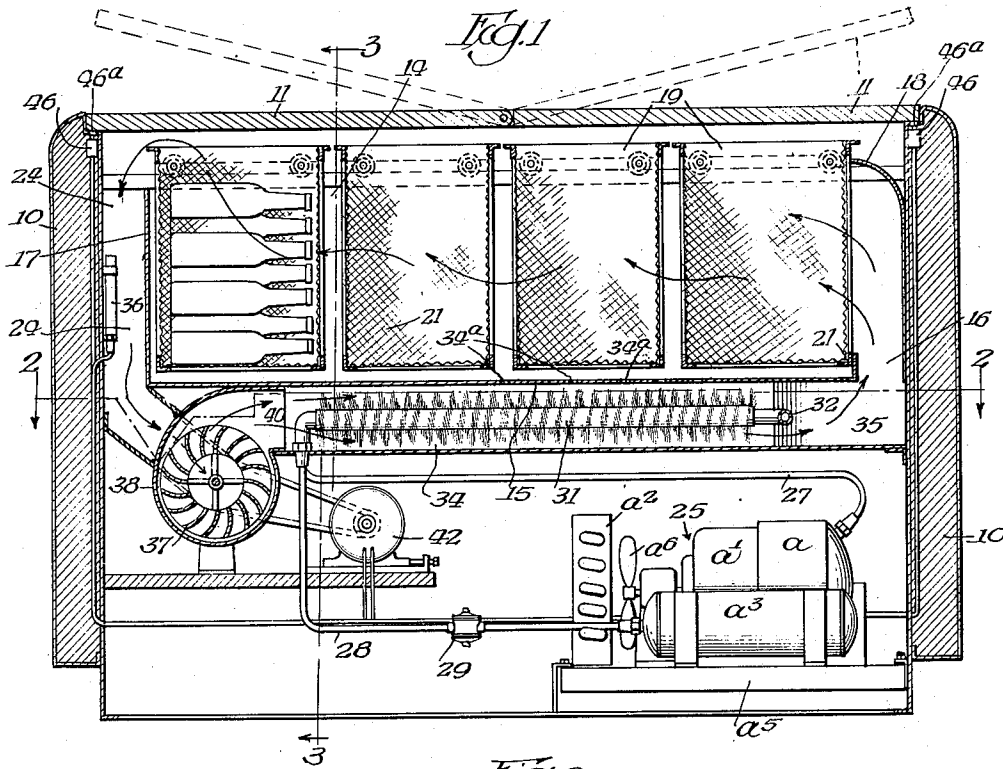
G. G. JOHNSON

2,200,502

REFRIGERATOR

Filed Dec. 24, 1938

2 Sheets-Sheet 1



Inventor:
Gordon G. Johnson
By Fred. C. Calkins
His Atty.

May 14, 1940.

G. G. JOHNSON

2,200,502

REFRIGERATOR

Filed Dec. 24, 1938

2 Sheets-Sheet 2

Fig. 3

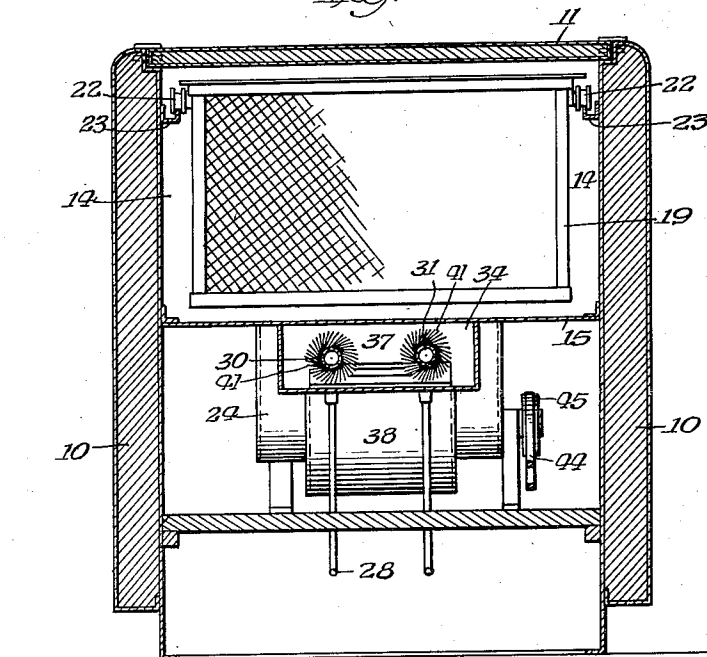


Fig. 6

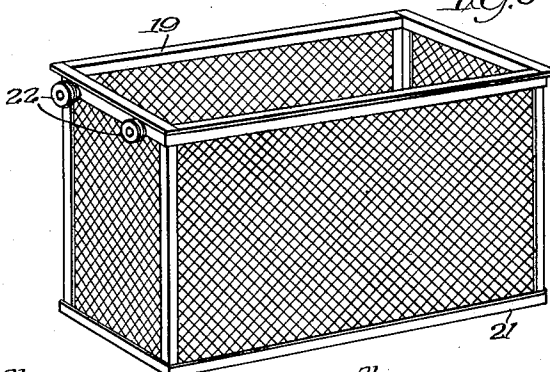


Fig. 4

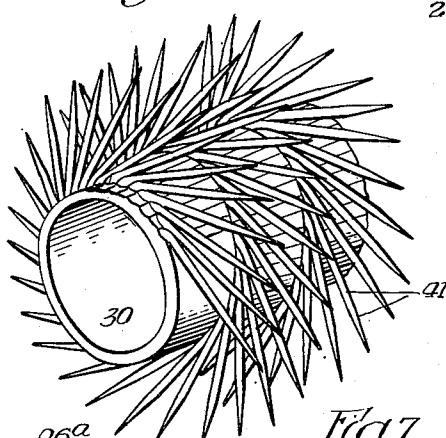


Fig. 5

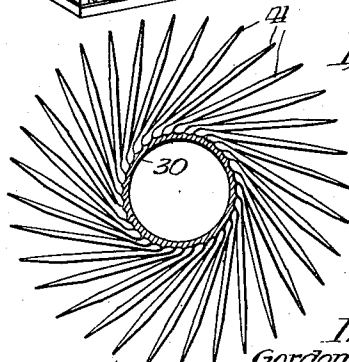
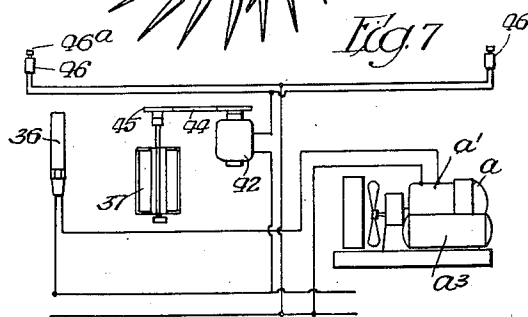


Fig. 7



Inventor
Gordon G. Johnson
By Fred Herlach
His Atty.

UNITED STATES PATENT OFFICE

2,200,502

REFRIGERATOR

Gordon G. Johnson, Connersville, Ind., assignor
to Auburn Automobile Company, Connersville,
Ind., a corporation of Indiana

Application December 24, 1938, Serial No. 247,602

3 Claims. (Cl. 62—102)

The invention relates to refrigerators and more particularly to the type in which the compartment of a cabinet containing the articles is cooled by air and the air is cooled by an evaporating unit connected to a compressor unit.

One object of the invention is to provide a refrigerator which comprises a blower for high speed circulation of air and an evaporating unit around which the air is forced which has sufficient heat-transfer efficiency to sufficiently cool the air to the desired temperature while the air is passing around it at high speed.

Another object of the invention is to provide a refrigerator of the air-cooled type with an air cooler comprising a blower and a simple and efficient evaporating unit which is composed of one or several comparatively short tubular members extending generally in the direction of travel of the air and heat transfer elements of high efficiency so that the unit can be economically produced without great length of tubing, such as is required in constructions in which the cooling effect is directly proportional to the area of the tubing presented to the air flowing over it and is somewhat dependent on the duration of the time of contact with the air.

Another object of the invention is to provide a refrigerator of the air-cooled type with an air-cooler which is simple in construction and efficient in operation.

A still further object of the invention is to provide the refrigerator which comprises an air-cooled compartment, an air-cooling unit and a blower for circulating air through the air-cooling unit and the cooling compartment and which operates continuously while the cabinet is closed, with automatic means for stopping the blower when a door of the cabinet is opened and for starting it when the door is closed.

Other objects of the invention will appear from the detail description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings: Fig. 1 is a longitudinal section of a refrigerator embodying the invention. Fig. 2 is a horizontal section on line 2—2 of Fig. 1. Fig. 3 is a vertical section taken on line 3—3 of Fig. 1. Fig. 4 is a perspective and Fig. 5 is a transverse section of a portion of tubing of the evaporator unit and the spines thereon for cooling the air. Fig. 6 is a perspective of one of the bottle-holders used in the cooling compartment. Fig. 7 is a diagram of the electrical con-

nections for the compressor unit for the refrigerant and the motor for driving the blower for circulating air through the duct containing the evaporator unit and the article-cooling compartment.

The invention is exemplified in a refrigerator cabinet comprising insulated side and end-walls 10 and provided with an open top, normally closed by a pair of pivoted lids or doors 11 which provide access to the contents of the cooling compartment 14 of the cabinet. Compartment 14 is adapted to contain the articles to be cooled, and is formed in the upper portion of the cabinet. Compartment 14 is defined by a horizontally extending transverse bottom-wall 15 and an end-wall 17 at the outlet end of the compartment. Bottom-wall 15 terminates so as to provide an inlet duct 16 for air at the inlet end of compartment 14. The wall 18 has a curved upper end to deflect the air laterally toward the articles in compartment 14. End-wall 17 terminates below the top of compartment 14 and is spaced from its adjacent end-wall to form an air outlet duct 24.

The cabinet is illustrated as equipped for cooling articles, such as bottles filled with liquid. Compartment 14 is adapted to receive and hold a series of bottle-holders 19. Each holder or basket 19 comprises a suitable rectangular metal frame and sides and ends of foraminous material, such as wire netting 21, to permit the circulation of cold air vertically and laterally through the holders and around the articles contained therein. Each end of holder 19 is provided with a pair of peripherally grooved rollers 22 which are adapted to travel on suitably flanged rails 23 which are fixed to the inner faces of the sides 10 of the cabinet. The rollers support the holders so their bottoms will be spaced above wall 15, and permit the holders to be shifted longitudinally in the compartment 14 to bring them into different positions. The holders are removable through the open top of the cabinet. The cooled air from inlet duct 16 is directed into one end of compartment 14 where it can flow through, under and over the holders, and around the articles contained therein. The tops of the holders are open and the bottoms of the holders are spaced from the bottom 15 of compartment 14 so that air from the inlet end 50 can flow longitudinally of the compartment.

A compressor unit is provided for the refrigerant and is removably mounted in the compartment 25 in the lower portion of the cabinet and may be of any suitable construction. This unit

comprises a compressor a , an electric motor a^1 , a condensor a^2 , a fan a^3 for cooling the condensor, and a refrigerant-receiver a^4 , all mounted on a suitable base a^5 . One end of the evaporating-unit hereinafter described, is connected by a pipe 27 to the low side of the compressor a and a pipe 28 connects the refrigerant-receiver a^4 to the other end of the evaporating-unit. A suitable expansion-valve 29 is included in the pipe 28.

The evaporating unit is contained in an air-duct 34 which underlies the bottom 15 of the cooling compartment and comprises a pair of straight tube-sections 30 and 31 and a semicircular connecting loop 32 to cause the refrigerant to pass consecutively through the members 30, 31. One end of the pipe-member 30 is coupled to high-pressure refrigerant-pipe 28 so that the refrigerant will flow to and through the evaporating-unit. Return pipe 27 for the spent refrigerant is coupled to the end by pipe-member 31. Pipe-members 30, 31 extend longitudinally of the air-duct 34 so that the air, in passing through said duct, will flow lengthwise of said pipe-sections. The tubular members of the evaporating unit constitute a single longitudinally extending loop or U-shaped member. The outlet end of duct 34 is connected by a trunk 35 to the lower end of the inlet duct 16 at one end of compartment 14. A thermostat 36 is electrically connected, as well understood in the art, to control the operation of the compressor-motor a^1 to maintain a predetermined temperature in the discharge duct 24 through which air flows from the cooling compartment so that the refrigerant circulating through the evaporating unit will maintain the desired temperature in the cooling-compartment.

In order to effect sufficient cooling from the evaporating unit constituted of the single loop of tubing, through which the refrigerant passes while the air is forced at high speed, through the duct 34 and longitudinally around said tubular members, each of said members is provided with a multiplicity of integral spines 41 which diverge outwardly and extend tangentially from the periphery of the tube. These spines are formed in a helical series and cut from the stock, usually copper, in the outer portion of the wall of the tubing from which the member is formed. The spines are formed with pointed outer ends or tips and are of sufficient length for efficient heat transfer. The air forced through the duct 34 impinges against the spines and flows between them and this results in cooling the air sufficiently so that upon leaving the conduit 34 it will be sufficiently cool to cool or refrigerate the articles in the cooling compartment 14 to the desired degree. The helically arranged and divergent spines interrupt the direct flow of air sufficiently for the efficient heat desired. A characteristic of this refrigerating unit is that the tubular members extend generally in the direction of the air flow or longitudinally of the duct and the air is diverted or deflected by the spines so that it will be adequately cooled in passing through the duct. This avoids the necessity of loops of pipe extending transversely across the duct in evaporating units in which the cooling effect is directly proportional to the area of the loops or coil of tubing presented to the air flowing over it. Furthermore, the heat transfer is sufficiently rapid to reduce the temperature of a rapidly flowing current of air under pressure forced through the conduit. As a result, the evaporating unit is sufficient for a rapidly traveling current of air by

a pressure or vane type of blower and the construction of the refrigerating unit is greatly simplified.

A vane or pressure type of blower is provided to force air through duct 34, around the evaporating unit in said duct, through the cooling compartment 14 and from the compartment 14 back to the blower. This blower comprises a rotor 37 of the vane type and an enclosing casing 38. The sides of casing 38 are provided with inlet openings 39 for the entry of air to the blower from the return duct 24. The casing is provided with a closed discharge trunk 40 which is connected to the inlet end of the walls of the duct 34 and forms a connection whereby all of the air from the casing of the blower will be forced through duct 34 and around the evaporator unit under pressure and to circulate through the cooling-chamber back to the blower-casing.

As the result of the use of the evaporating unit with a multiplicity of spines, the air speed through conduit 34 provided by the vane type of blower, may be sufficiently high to cool the air to the desired degree, notwithstanding the reduction of time which the air remains in the conduit surrounding the evaporating unit.

If desired, the side-walls of conduit 34 may converge from the trunk 40 to the delivery conduit 16 and the tubular members 30, 31 of the evaporating unit may also be convergent. This will produce an increase of velocity toward the outlet end of conduit 34 from a constant supply from the blower to increase the transfer efficiency of the spines. If desired, some of the air from conduit 34 may be delivered through openings 34^a in bottom-wall 15 to the lower compartment 14 for better circulation.

The rotor 37 of the blower is driven by an electric motor 42 by means of a pulley 43 on the motor-shaft, a belt 44 and a pulley 45 on the shaft of the rotor. The apparatus contemplates continuous cooling of the air and its rapid circulation through the cooling compartment by the continuous operation of the electric motor 42 and the blower. When, however, one of the lids 11 is open, it is desirable to interrupt the forced air circulation to prevent the escape of a blast of cold air from the compartment 14. For that purpose, a switch 46 is provided adjacent each end-wall 10 of the cabinet. Each switch is provided with a button 46^a which is normally pressed outwardly by a suitable spring and is adapted to be engaged to close the switch by one of the doors 11 when the latter is closed and to be pressed outwardly to open the switch when the door is raised or opened. Switches 46 are included in the power-circuit for the electric motor 42, as illustrated in Fig. 7. When either of the doors 11 is opened the power-circuit for motor 42 will be opened at one of the switches by the release of one of the switch-buttons to automatically discontinue the operation of motor 42 and the blower for forcing of air through the cooling-compartment. When the door is closed, it will engage the button of its associated switch 46 and close the motor-circuit to operate the blower.

In operation, the compressor unit will be operated intermittently, as well understood in the art, under control of the thermostat 36 to compress the refrigerant supplied to the evaporating unit for cooling the air flowing to the cooling compartment 14 from the blower. The continuously driven rotor 37 of the blower will draw air from the return conduit 24, force it at high-speed through the casing 38 and trunk 40 into

one end of the conduit 34. In transit through said conduit at a high rate of speed, the air will be adequately cooled by the evaporating-unit before it leaves conduit 34 for the cooling desired in the compartment 14. The air will impinge against and flow between the spines to effect a rapid cooling of the air. Since the blower is of the vane or pressure type, the spines will not retard the volume of air flowing through the conduit. As a result, the air will be cooled while it flows lengthwise of the tubular members 30, 31 of the refrigerating unit. The use of a high air-speed in the conduit and the spines for heat-transfer make it possible to use a rapid circulation of air in the cooling-compartment to effect a rapid cooling of the articles in the compartment. When either of the doors 11 is lifted for the removal or replacement of the contents of the cooling-compartment 14, the blower will be stopped by the opening of one of the switches 46. When the door is closed it will engage and close the switch and re-start the motor 46 for the operation of the blower.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. A refrigerator comprising a cabinet provided with a cooling compartment extending horizontally across the top thereof for retaining articles, such as bottles and the like, and provided with an access-opening in the top thereof, a top lid for providing access to the articles in the compartment, the compartment being provided with a bottom-wall, a conduit under said bottom-wall, extending longitudinally of the cabinet, connected to deliver air longitudinally along the underside of said wall and to discharge air upwardly at one end of the compartment and having a closed bottom and sides, an evaporating unit comprising tubing having longitudinally extending branches extending substantially the full length of the conduit and provided with outwardly projecting heat-transfer elements for cooling the air passing through the conduit, the bottom-wall being provided intermediate its ends with means for delivering cold air from the conduit directly into the bottom of the compartment, means for delivering a refrigerating medium to said unit and a blower connected to draw air from the opposite ends of the compartment and to circulate

air through the conduit around the evaporating unit and through the cooling compartment.

2. A refrigerator comprising a cabinet provided with a cooling compartment extending horizontally across the top thereof for retaining articles, such as bottles and the like, and provided with an access-opening in the top thereof, a top lid for providing access to the articles in the compartment, the compartment being provided with a bottom-wall, a conduit under said bottom-wall, extending longitudinally of the cabinet, connected to deliver air longitudinally along the underside of said wall and to discharge air upwardly at one end of the compartment and having a closed bottom and sides, an evaporating unit comprising tubing having longitudinally extending branches extending substantially the full length of the conduit and provided with outwardly projecting divergent spines between which the air flowing longitudinally will pass as it is forced through the conduit, means for delivering a refrigerating medium to said unit and a blower connected to draw air from the opposite end of the compartment and to circulate air through the conduit around the evaporating unit and through the cooling compartment.

3. A refrigerator comprising a cabinet provided with a cooling compartment extending horizontally across the top thereof for retaining articles, such as bottles and the like, and provided with an access-opening in the top thereof, a top lid for providing access to the articles in the compartment, the compartment being provided with a bottom-wall, a conduit under said bottom-wall, extending longitudinally of the cabinet, connected to deliver air longitudinally along the underside of said wall and to discharge air upwardly at one end of the compartment and having a closed bottom and sides, an evaporating unit comprising tubing having longitudinally extending branches extending substantially the full length of the conduit and provided with outwardly projecting divergent spines between which the air can pass as it is forced through the conduit, the bottom-wall being provided intermediate its ends with means for delivering cold air from the conduit directly into the bottom of the compartment, means for delivering a refrigerating medium to said unit and a blower connected to draw air from the opposite end of the compartment and to circulate air through the conduit around the evaporating unit and through the cooling compartment.

GORDON G. JOHNSON.