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(54) **DEVICE FOR DEICING AN AIR-COOLER FOR THE REFRIGERATED SHOWCASE OF SHOP EQUIPMENT**

(57) The invention relates to refrigeration engineering, in particular to systems for deicing refrigerated showcases provided with direct cooling units, preferably to low-temperature refrigeration shop facilities with anti-freezing heat carriers. The inventive device comprises a heat storage with an antifreezing heat carrier, a pump for circulating said antifreezing heat carrier and a recuperative heat exchanger which are connected to each other and elements for supplying heat to the heat exchange surface of a showcase evaporator, to the showcase bottom and to a drainage pipeline. The heat supply elements are embodied in the form of two sections, the first of which is arranged in the air-cooler evaporator and contacts the heat exchange surface thereof, whilst the second section is mounted in the showcase bottom near the drainage pipeline. The two sections being interconnected by means of the heat storage. Said device reduces a deicing time and energy consumption.

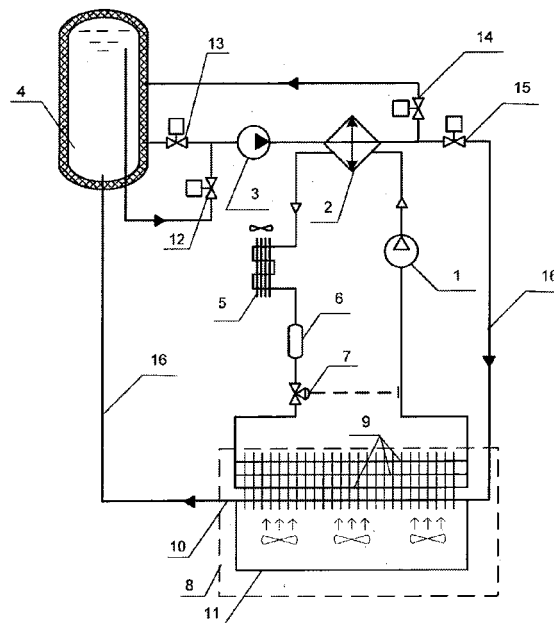


Fig. 1

Description

TECHNICAL FIELD

[0001] The invention relates to refrigeration engineering, in particular to systems for deicing refrigerated showcases provided with direct cooling units, preferably to low-temperature refrigeration shop facilities with anti-freezing heat agents.

[0002] The device is to be preferably used in large super- and hypermarkets where deicing of air-coolers is provided for several showcases simultaneously.

[0003] Deicing of frost deposit from the surfaces of low-temperature showcase coolers of the refrigeration shop facilities is achieved, basically, by electric heaters. Less known is a method of deicing with vaporous hot refrigerant which is guided directly from the compressor to the tubes of the evaporator covered with frost deposit.

1. Electric heating tubes are built in the rib holes, air-cooler pipes or are arranged nearby the air-cooler. The method is very simple in use, however it considerable electric power consumption is required, which is currently a serious fault. Besides, the deicing quality leaves much to be desired due to uneven warming-up of the evaporator (problems arise due to heat contact between the evaporator and the electric heater), which necessitates to make total deicing with the use of warm water once a month.

2. Hot vapours of the refrigerant give up heat to the cool evaporator and consequently condense. Liquid refrigerant can penetrate the compressor and cause its damage. However, even at small reflux of the refrigerant to the compressor crankcase that do not damage the compressor, the lubricant in the crankcase liquefies and its lubricating properties deteriorate. In doing so, the service life of the compressor reduces greatly. To preclude this situation, the liquid is heated with powerful electric heaters or heat storages. The drawback of such system is associated with a manufacturing complexity of the heat storage.

3. The brine systems make use of a separate closed circuit to heat the carrier with the same heat agent as in the main cooling circuit. Heat agent of the separate circuit is heated with the aid of a special heater (boiler) and a small centrifugal pump that pumps over the hot carrier through a system of batteries to be cooled by-passing the evaporator. Due to a good heat contact between the battery surface and the hot heat agent, the deicing time is minimized. However, in deicing systems of the low-temperature showcases where air-coolers belonging to the direct cooling systems are used, it is impossible to directly deice the air-cooler by pumping hot heat agent through the air-cooler sections. These sections are filled with the refrigerant and it is inadmissible to mix the refrigerant with the heat agent.

[0004] The proposed device for deicing an air-cooler can be applied not only in the low-temperature showcases of shop equipment but also in the medium-temperature showcases - both with an individual refrigeration unit and with a multi-compressor block belonging to the centralized refrigerating unit. The proposed air-cooler deicing device allows of a considerable reduction of the deicing time (to 6-10 min. instead of 20-30 min.) as well as of the electric power consumption as the system heat is used to heat the antifreezing heat agent and the pump consumes relatively small electric power.

[0005] Scientific, technical and patent information sources describe a number of methods and devices to deice heat-transfer surfaces of direct cooling and brine cooling equipment of low-temperature refrigeration shop equipment: with the aid of electric heaters, by hot vapour of a refrigerant and antifreezing heat agents, e.g. by solutions of salts, glycol and organosilicone heat agents, and organic fluorine (see Dossat Roy J. Principles of refrigeration. Transl. from English. - M., Light and food industry, 1984 - pp. 448 - 445; Zelikovskiy I.H., Kaplan L.G. Small refrigeration machines and installations: Handbook. - 3rd revised ed. Add. Ed. - M.: Agropromizdat. 1989. - pp. 301, 473 - 482; Gogolin A.A., Koloty Yu.N. Deicing of air-coolers. M. TSNITElmyasomolprom. 1972; Deicing of air-coolers. - In coll.: «Kholodilnaya promyshlennost I transport». M., TSNITElmyasomolprom, 1969, issue 8).

[0006] Analyzing the analogs described in the above sources, the following can be noted: in the majority of instances the low-temperature showcases of refrigeration shop equipment are deiced with hot vapour of a refrigerant or by electric heaters.

[0007] Deicing device of the tube-and-rib air-coolers cooled with hot vapour of the refrigerant pumped by the compressor to the air-cooler incorporates the pressure pipeline with a by-pass line, and a solenoid valve. Upon opening of the solenoid valve, hot vapour enters the air-cooler by-passing the condenser. Deicing is accomplished by hot vapour of the refrigerant which gives up its heat to the cold air-cooler, and condenses. This deicing device has a number of drawbacks. During deicing the hot vapour quantity delivered by the compressor is limited as the major portion of liquid condenses and remains in the evaporator, and a smaller portion of the refrigerant returns to the compressor for re-circulation. The more serious fault is associated with the fact that liquid refrigerant can penetrate the compressor thereby causing its damage. To preclude such situation, the liquid is heated with the aid of powerful electric heaters or heat storages. Such system has a drawback because manufacturing heat storages is complex.

[0008] In order to deice frost from cooling units of the brine systems (with intermediate heat agent) at a temperature about -40°C, low-freezing liquids are applied - solutions of salts, glycol and organosilicone heat agents, and organic fluorine liquids. The deicing systems on the intermediate heat agent side are made, primarily, of a

closed type that incorporates closed type air-coolers wherein the heat agent does not contact air. When a low-freezing heat agent is used for deicing, it is placed in a heat-insulated chamber equipped with electric heating tubes, and in case a round-the-year heat source is available at the enterprise (hot water, steam), coils wherein hot water or steam circulate are installed in the heat-insulated chamber instead of the electric heating tubes. The heat agent heated to 30...40°C is pumped to batteries to be deiced or direct in the air-cooler pipes (see Chervyakov S.S., Kulakovskiy A.I. Basics of refrigeration: Manual for SPTU - 2nd revised and added ed. - M.: Vysshchaya shkola., 1988. - pp. 54, 62, as well as Kantorovich V.I., Yavnel B.K. Construction, operation, installation and repair of refrigeration units. Manual: - M.: Izd. Torgovoy literatury, 1960., pp. 204 - 206).

[0009] In order to deice frost from cooling units of the brine systems, a separate closed circuit using the same heat agent as in the main cooling circuit is applied. The separate circuit heat agent is heated with the aid of a special heater (boiler) and a small centrifugal pump pumps hot heat agent through a system of batteries to be deiced by-passing the evaporator. Due to a good heat contact between the battery surface and the hot heat agent, the deicing time is minimized.

[0010] In deicing systems of the low-temperature showcases where air-coolers belonging to the direct cooling systems are used, it is impossible to directly deice the air-cooler by pumping hot heat agent through the air-cooler sections. These sections are filled with the refrigerant and it is inadmissible to mix the refrigerant with the heat agent. Therefore, low-temperature showcases are deiced with electric heating tubes.

[0011] Deicing of ribbed air-coolers of low-temperature showcases is achieved with the aid of electric heating tubes. Heated is not only the heat-exchange surface of the air-cooler but also the showcase bottom and the drainage pipeline. Tubular electric heaters are built in the rib holes, air-cooler pipes or are arranged nearby the air-cooler. Deicing cycle is commenced upon a closure of the solenoid valve in the liquid pipeline, consequently the air-cooler is emptied and then the compressor is shut down. Simultaneously electric heating elements of the air-cooler, bottom and drainage pipeline are switched on. Fans are switched off so that warm air cannot enter the cooled space. After the air-cooler, bottom and drainage pipeline deice completely, the electric heating tubes are switched off and the solenoid valve in the liquid pipeline is caused to open, the compressor, fans are switched on, and the entire units begins to function in the cooling mode.

[0012] The closest to the claimed invention is the device for deicing an air-cooler of the refrigerated showcase made of electric heating tubes. Tubular heating elements are installed inside special cuts of the evaporator and the same elements are installed in the bottom and near the drainage pipeline of the showcase (see Zelikovskiy I.H., Kaplan L.G. Small refrigeration machines and installa-

tions: Handbook. - 3rd revised ed. Add. Ed. - M.: Agropromizdat. 1989. - p. 301).

[0013] We chose the given device as a prior art device.

[0014] The prior art device and the claimed invention have such common features:

- elements of construction that supply heat to the heat-exchange surface of the air-cooler evaporator, showcase bottom and the drainage branch pipe (in the prior art device these are the electric heating tubes);
- the heat supply elements maintain heat contact with the heat-exchange surface of the air-cooler evaporator, the bottom and the drainage pipeline.

[0015] A disadvantage of deicing with electric heating tubes is due to their poor contact with the tubular surface of the air-cooler evaporator (mostly a point heat contact). As a result, deicing period lasts 20-30 minutes despite a high heating temperature developed by electric heating tubes (150-200°C). Consequently, the temperature within the cooled space rises considerably which, in its turn, leads to a comparatively long processing of frozen products with the warmed air. Besides, additional electric power is lost as it is consumed by electric heating tubes for heating at deicing as well as by the refrigeration unit for further cooling of the working space.

DISCLOSURE OF THE INVENTION

[0016] The task of the invention is to create an improved device for deicing the air-cooler for the refrigerated showcase of shop facility wherein deicing period can be shortened and the electric power consumption at deicing the air-cooler of the low-temperature refrigerated showcases and the refrigerated counters of shop equipment in super- and hypermarkets is reduced.

[0017] This task is accomplished in a device for deicing an air-cooler for the refrigerated showcase of shop equipment that includes the elements supplying heat to the heat-exchange surface of the air-cooler evaporator, the showcase bottom and the drainage pipeline, as well as additional heat storage operating on a low-freezing heat agent, the low-freezing heat agent recirculation pump and a recuperative heat exchanger that absorbs heat of the compressed refrigerant, while the heat supplying elements are designed as two additional sections, the first additional section being installed in the air-cooler evaporator so that it maintains heat contact with the latter's heat-exchange surface, and the second additional section being installed in the showcase bottom and near the drainage pipeline, both additional sections being connected to the heat storage.

[0018] Besides, the heat-exchange surface of the first additional section has a construction identical to the heat-exchange surface of the air-cooler evaporator.

[0019] The novelty features of the claimed invention are that the device is additionally provided with:

- a heat storage operating on a low-freezing heat agent;
- a low-freezing heat agent recirculation pump; and
- a recuperative heat exchanger that absorbs heat of the compressed refrigerant.

[0020] Also, the novelty of the claimed invention is due to the fact that the heat supply elements are designed as two additional sections, that they are located in a particular place and that the known and new units are interconnected in a particular way.

[0021] No knowledge is found in the sources of patent and scientific and technical information about deicing devices of air-coolers used in the shop facility low-temperature refrigeration showcases of super-and hypermarkets wherein:

1. The heat supplying elements intended for deicing the air-cooler evaporator are designed as two additional sections, the first one is installed in the evaporator, has a construction identical to the evaporator sections and maintains heat contact with its heat-exchange surface while the second one is installed in the showcase bottom and near the drainage pipeline;
2. Both sections are connected with a heat storage using a low-freezing heat agent by a deicing line;
3. A heat storage is connected to the circulation pump with the heat agent circulation lines so as to heat the heat agent in the recuperative heat exchanger by means of the refrigerant vapour compressed by the compressor and direct the hot heat agent to both additional sections.

[0022] All these distinctions characterize the claimed deicing device by a new set of features as compared to the technical solutions known in science and technology that impart the invention new properties and create a positive effect.

[0023] New properties are as follows: as one of the sections has a good heat contact with the heat-exchanging surface of the evaporator, the entire evaporator, being a single construction, warms up fast and evenly. Heat agent is heated with a hot vapor of the refrigerant, i.e. by a waste heat.

[0024] Positive effect comprises a reduction of deicing period (to 6-10 min.) and electric power consumption due to a comparatively small electric power consumed by the pump.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The claimed device for deicing an air-cooler for the refrigerated showcase of shop equipment is presented in the drawings wherein:

- Fig. 1 - schematic diagram of the device;
Fig. 2 - sectional view of the showcase.

ALTERNATIVE EMBODIMENT OF THE INVENTION

[0026] The device for deicing an air-cooler for the refrigerated showcase of shop equipment incorporates the elements interconnected with process pipelines, viz.:

- 1 - compressor,
- 2 - recuperative heat exchanger,
- 3 - antifreezing heat agent circulation pump,
- 4 - heat storage with antifreezing heat agent,
- 5 - condenser,
- 6 - receiver,
- 7 - thermal expansion valve,
- 8 - air-cooler with fans and an evaporator,
- 9 - air-cooler evaporator with finned coil heat-exchanging surface,
- 10 - first additional section for deicing the air-cooler evaporator,
- 11 - second additional section for deicing the bottom and the drainage pipeline of the showcase,
- 12, 13, 14, 15 - solenoid valves,
- 16 - deicing line,
- 17 - heat agent circulation lines intended for its heating,
- 18 - showcase bottom,
- 19 - drainage pipeline.

[0027] Conventionally, when automating the deicing process of refrigerated showcases of shop equipment, deicing is accomplished alternately, on expiration of equal periods, upon a signal given by electronic units in accordance to a preset program. The air-cooler of the refrigerated showcase of the low-temperature shop equipment is deiced according to the proposed system as follows.

[0028] In the cooling mode the electronic unit (not shown in the drawing) causes compressor 1 to turn on and opens solenoid valves 12 and 15 with the continuously operating antifreezing heat agent circulating pump 3. Compressed vapour of the refrigerant is pumped by compressor 1 to recuperative heat exchanger 2 where the refrigerant compressed by compressor 1 gives up heat to the antifreezing heat agent which the antifreezing heat agent circulating pump 3 delivers from the heat storage containing antifreezing heat agent 4 via the opened solenoid valve 13. Heated solution is returned from recuperative heat exchanger 2 to heat storage containing antifreezing heat agent 4 via the opened solenoid valve 14. Refrigerant is directed from recuperative heat exchanger 2 to condenser 5 and, then, to receiver 6. In the course of cooling a frost deposit is formed on the finned coil surface of evaporator 9 of air-cooler 8, and the bottom of showcase 18 and drainage pipeline 19 become encrusted with ice.

[0029] To commence deicing of air cooler 8, the electronic unit causes compressor 1 and air-cooler fans 8 to turn off, closes solenoid valves 13 and 14, and opens solenoid valves 12 and 15 thereby letting the heated heat

agent flow from heat storage 4 and enter the first additional section 10 and the second additional section 11 of air-cooler 8 via deicing line 16. Frost deposit thaws as a result of a heat exchange between evaporator 9 and additional section 10 due to a high heat conductivity of fins of the tubular surface of evaporator 9. Second additional section 11 heats the bottom of showcase 18 and drainage pipeline 19. Defrosted water drips from the air-cooler down to the bottom of showcase 18 where it joins the defrosted water flowing down drainage pipeline 19 and is discharged to sewerage. Deicing period is 6-10 min. Whenever the temperature of the heat exchange surface of evaporator 9 and of additional sections 10 and 11 rises to 4...5°C, the electronic unit switches off solenoid valves 12 and 15, compressor 9 and the fans, opens solenoid valves 13 and 14, and the showcase returns to the cooling mode. Hereafter the described sequence is reiterated.

INDUSTRIAL APPLICATIONS

[0030] The proposed device for deicing an air-cooler for the refrigerated showcases can also be applied in the direct cooling systems of the medium-temperature refrigerated shop facilities both with an individual refrigeration unit and with a multi-compressor unit.

[0031] The deicing device makes it possible to considerably reduce deicing time to 6-10 min. as compared to 20-30 min. when using electric heating tubes, and diminish electric power consumption due to utilization of the internal heat of the device for heating the antifreezing heat agent, and comparatively small electric power consumption by the pump.

Claims

1. A device for deicing an air-cooler for the refrigerated showcase of shop equipment that includes the elements supplying heat to the heat-exchange surface of the air-cooler evaporator, the showcase bottom and the drainage pipeline, **distinct in, that** it is additionally provided with an additional heat storage operating on a low-freezing heat agent, the low-freezing heat agent recirculation pump and a recuperative heat exchanger that absorbs heat of the compressed refrigerant, while the heat supplying elements are designed as two additional sections, the first additional section being installed in the air-cooler evaporator so that it maintains heat contact with the latter's heat-exchange surface, and the second additional section being installed in the showcase bottom and near the drainage pipeline, both additional sections being connected to the heat storage.
2. A device according to item 1, distinct in, that the heat-exchange surface of the first additional section has a construction identical to the heat-exchange surface of the air-cooler evaporator.

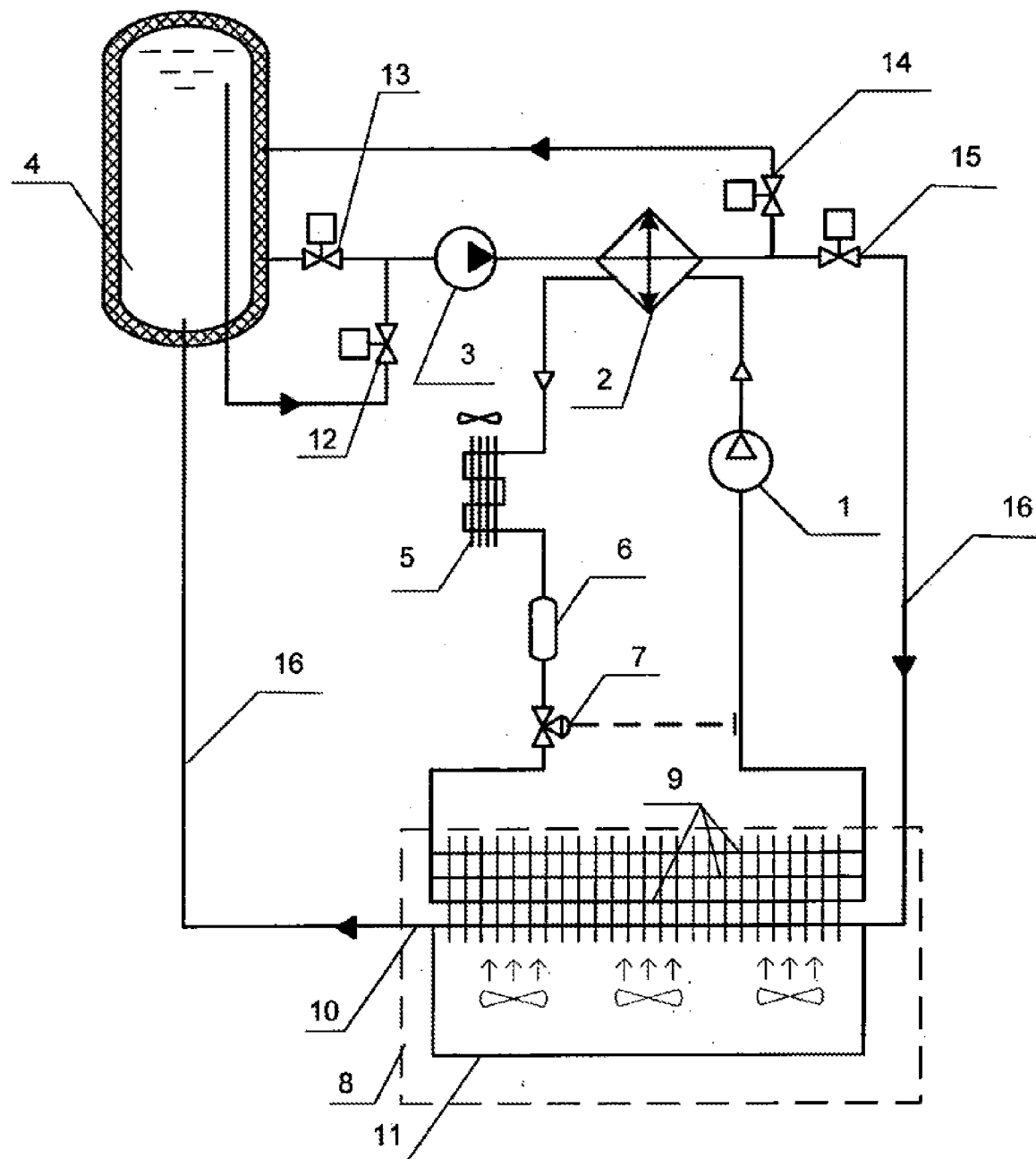


Fig. 1

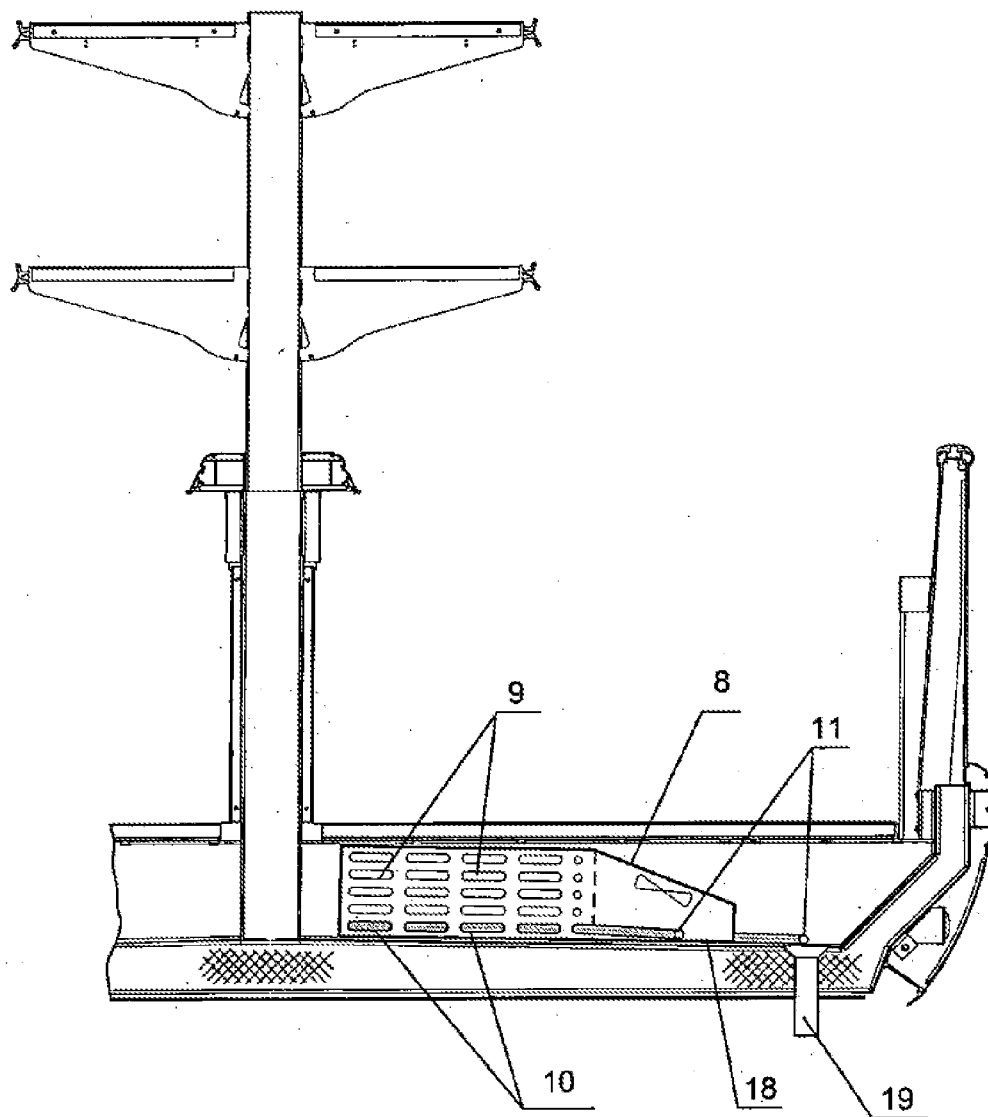


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/UA 2008/000007

A. CLASSIFICATION OF SUBJECT MATTER		<i>F25B 47/02 (2006.01)</i> <i>F25D 21/12 (2006.01)</i>
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
F25B 47/00-47/02, F25D 21/00-21/12		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
Esp@cenet, RUPAT, RUABRU, RUPAT-OLD, RUABU1		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	I.KH. ZELIKOVSKII et al. <i>Malye kholodilnye mashiny i ustanovki</i> , Moscow, Agropromizdat, 1989, page 299-301	1-2
A	US 4766734 A (ELECTRIC POWER RESEARCH INSTITUTE) 30.08.1988	1-2
A	SU 1402779 A1 (BRYANSKII TEKHNOLIGICHESKII INSTITUT) 15.06.1988	1-2
A	US 5987916 A (MARK EGBERT) 23.11.1999	1-2
A	JP 2005274057 A (SANDEN CORP) 06.10.2005, the abstract	1-2
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
17 June 2008 (17.06.2008)		03 July 2008 (03.07.2008)
Name and mailing address of the ISA/		Authorized officer
Facsimile No.		Telephone No.

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **Dossat Roy J.** Principles of refrigeration. Transl. from English. *Light and food industry*, 1984, 448-445 [0005]
- Small refrigeration machines and installations: Handbook. **Zelikovskiy I.H. ; Kaplan L.G.** Agropromizdat. 1989, vol. 301, 473-482 [0005]
- **Gogolin A.A. ; Kolotyi Yu.N.** Deicing of air-coolers. M. *TSNIITEllmyasomolprom.*, 1972 [0005]
- Deicing of air-coolers. - In coll.: «Kholodilnaya promyshlennost I transport». M. *TSNIITEllmyasomolprom*, 1969, vol. 8 [0005]
- **Chervyakov S.S. ; Kulakovskiy A.I.** Basics of refrigeration: Manual for SPTU. 1988, 54, 62 [0008]
- Construction, operation, installation and repair of refrigeration units. Manual: - M. **Kantorovich V.I. ; Yavnel B.K.** Izd. Torgovoy literatury. 1960, 204-206 [0008]
- **Zelikovskiy I.H. ; Kaplan L.G.** Small refrigeration machines and installations: Handbook. 1989, 301 [0012]