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(54) **Continuous air cooling method for medium-temperature refrigerating displays of shop equipment**

(57) A method of continuous air cooling of the medium-temperature gastronomic refrigerating displays of shop equipment with the air cooler consisting of two independent evaporators (7,9) have been proposed. The air cooling is being effected with both evaporators (7,9) simultaneously whereas defrosting of evaporators is being effected by turns so that the defrosting cycle of one of the evaporators (7,9) is effected with a time shift relative to another evaporator by ½ of the defrosting period. During the entire defrosting period of one of the evaporators (7,9) the refrigerant supply to the other (cooling) evaporator is being effected continuously irrespective of the preset temperature control program.

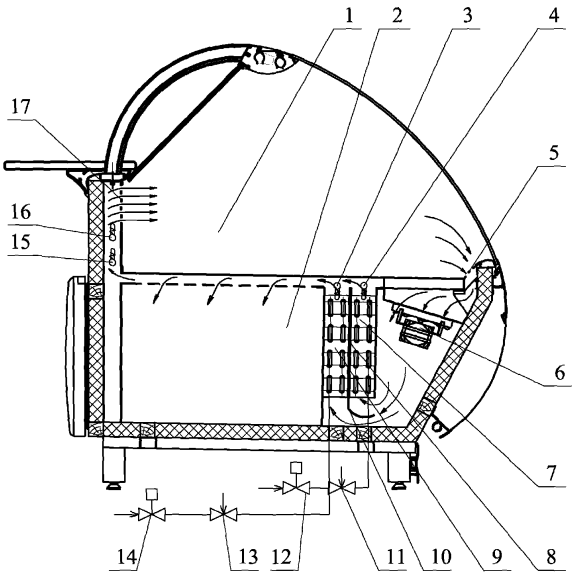

Fig. 1

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Description

[0001] This claimed invention relates to shop refrigeration equipment and specifically to medium-temperature gastronomic and multi-tier side open refrigerating displays intended for short-period storage, display and sale of unpacked preliminary cooled to storage temperature perishable foodstuffs such as salads, cookeries, sausages, cheeses, smoked and salted fish, meat, chickens, sea food, etc.

[0002] Preferred use is in shops, catering facilities and in big super- and hypermarkets.

[0003] A method of continuous air cooling is described in scientific, technical and patent information and is accomplished in European models of medium-temperature gastronomic displays:

- V-models with an operating temperature of +2/+4°C, +2/+6°C manufactured by KOXKA (Spain);
- KLARA models with an operating temperature of +1/+5°C manufactured by PASTORKALT A.S. (Slovakia);
- BERIL models with an operating temperature of +2/+4°C, KALKEDON model with an operating temperature of +4/+8°C manufactured by KAPLANLAR (Turkey);
- R-model, with an operating temperature of +1/+10°C manufactured by COLD (Poland);
- EXPOSER model with an operating temperature of +4/+6°C manufactured by FRAMEC (Italy), (see booklets of the above mentioned firms);
- VHS-2-3 type medium-temperature multi-tier side displays with a temperature in the cooled space within the range 0/+8°C (see Zelikovsky I.H., Kaplan L.G., Small refrigeration machinery and units: Reference Book, Moscow, Agropromizdat, 1989, pp. 299-308).

[0004] In a majority of listed analogues, a method of air cooling in medium-temperature refrigerating displays of shop equipment, both during the cooling cycle and the defrosting cycle, includes a continuous forced air cooling of the air cooler evaporator by means of fans using the air circulating within the cooled space of the display, and defrosting of frost-dew settling on the evaporator surface at regular intervals by cutting off a supply of the refrigerant to the evaporator in accordance with a signal given by its electronic unit to shut off its solenoid valve and remove the drip water.

[0005] After a temperature of the air cooler surface rises to + 3...+4°C, the electronic unit receives a signal from the temperature transducer and opens a solenoid valve thereby resuming the cooling process. Thereafter, the described sequence will reiterate.

[0006] A defective feature of this method is that temperature of the air coming into the cooled space increases to 12-15°C during the defrosting period in parallel with the increase of the air humidity. The air contacting colder foodstuffs causes moisture to settle on the foodstuffs surface, which leads to intensive development of microorganisms. Defrosting process is lengthy and results in a considerable temperature increase within the cooled space, which impacts negatively the quality of foodstuffs.

[0007] A method of continuous air cooling is discovered that provides for two independent evaporators structurally designed in one unit and is accomplished both in medium-temperature and in low-temperatures cooled displays:

- US 3103796, Cl. 62-234,17.09.1963;
- US 3499295, F25b 41/00, 10.03.1970;
- US 5031413, F25D 21/06, F25B 5/02, 16.07.1991;
- Fr 2688299, A47F 3/04, F25D 17/06, F25D 21/06

[0008] In these displays air is cooled in alternate with the use of one evaporator at a time while the other evaporator is in a defrosting cycle. It allows of stabilizing temperature and humidity in the cooled space of the display.

[0009] Conventionally, air cooling (including temperature control) and air cooler defrosting process in displays takes place in alternate, at intervals, with the aid of electronic units of various types in accordance with the preset program.

[0010] A method described in the US patent 5031413, F25D 21/06, F25B 5/02, 16.07.1991 «LOW-TEMPERATURE FOODS PRESERVING CASE AND ITS TEMPERATURE CONTROL METHOD» is the most congenial to the claimed continuous air cooling method, therefore it has been chosen as a prototype.

[0011] This method provides for a continuous simultaneous forced air cooling of two air cooler evaporators by means of two fans using the air circulating within the cooled space of the display and defrosting, in alternate and at regular intervals, of frost-dew settling on the evaporator surface by cutting-off a refrigerant supply to one of the evaporators in accordance with a signal given by its electronic unit to shut off its solenoid valve and remove the drip water.

[0012] The drawback of this method is linked to a necessity of having two sets of full-size evaporators, each one being able to develop full required cooling capacity that is necessary for a continuous operation of the display. So, the air cooler cost is practically doubled.

[0013] It is the main object of this invention to stabilize the temperature and humidity performance of short-term storage of pre-cooled foodstuffs in medium-temperature displays of shop refrigerating equipment while reducing the displays cost.

[0014] This task is achieved so that in the known method of continuous air cooling in medium-temperature refrigerating displays of shop equipment in the air cooler consisting of two independent evaporators structurally joined in one unit providing for continuous simultaneous forced air cooling of both air cooler evaporators by means of fans using the air circulating in the cooled space of the display and alternate, at regular intervals, defrosting of

the frost-dew settling on the evaporator surface by cutting-off the refrigerant supply to one of the evaporators in accordance with a signal given by its electronic unit to shut off its solenoid valve and remove the drip water, both evaporators cool circulating air simultaneously, then one of the evaporators is being transferred to the defrosting mode so that the defrosting cycle of this evaporator is effected with a time shift relative to the other evaporator by ½ of the defrosting period, while the other evaporator continues to cool the circulating air, then the defrosted evaporator is being transferred to the cooling mode by opening its solenoid valve, and two evaporators continue to cool simultaneously the circulating air until the other evaporator is being shifted to defrosting mode. Subsequently, the described sequence is repeated in accordance with the program input in the electronic unit.

[0015] This task is also achieved so that during the entire period of defrosting of one of the evaporators the refrigerant supply to the other (cooling) evaporator is being effected continuously by maintaining the compressor in a turned-on mode irrespective of the preset temperature control program. Thereby, deeper air cooling is achieved by the operating evaporator while the other evaporator is in the defrosting cycle, which compensates the air temperature rise due to defrosting of the other evaporator.

[0016] Fig. 1 presents a cross-section of the medium-temperature gastronomic refrigerating display in accordance with the claimed method.

[0017] Fig. 2 illustrates a diagram of the air cooling operating process.

[0018] Positions in Fig. 1 are:

1 - cooled space of the gastronomic display; 2 - additional cooled space for storing daily stock of foodstuffs; 3, 4 - temperature transducers of the evaporator surface; 5 - air intake; 6 -fan; 7, 9 -evaporators; 8 - partition; 10 - air flow distributor; 11, 13 - temperature control valves; 12, 14 - solenoid valves; 15, 16 - temperature transducers for air directed to the cooled space; 17 - perforated wall of the cooled space delivery duct of the display.

[0019] A method of continuous air cooling of the medium-temperature gastronomic refrigerating display with an air cooler is accomplished as follows. Upon turning on the refrigerating unit compressor (not shown in Fig. 1), electromagnetic valves 12 and 14 are open and let the refrigerant in evaporators 7 and 9; a fan 6 is switched on thereby blowing warmed air from the cooled space of the display 1 via air intake 5 and evaporators 7 and 9 so as to distribute it evenly between the evaporators by means of air distributor 10 (point 0 in Fig. 2) so that for some time both evaporators operate in the cooling mode. As time passes, after frost-dew is formed on the heat-exchanging surfaces of both evaporators, the electronic unit (not shown in the drawing) of one of the evaporators, e.g. 7, de-energizes solenoid valve 12 in ½ period between defrosting, thereby cutting off the refrigerant supply to evaporator 7 (point 0,5 in Fig. 2). Fan 6 continues to blow warmed air through both evaporators 7 and 9, evaporator 7 being defrosted as it acquires warmth of the circulating air thereby additionally cooling and humidifying such air. Melted water drips down to the display tray and to sewerage. Evaporator 9 continues to cool the circulating air. Upon a signal generated by temperature transducer 4, its electronic unit causes solenoid 12 to open and evaporator 7 shifts to a cooling mode (point C in Fig. 2) so that now both evaporators cool the circulating air again directing it through the perforated partition 17 to the cooled space 1. In ½ period between defrosting cycles the electronic unit initiates a signal to shut off solenoid valve 14 and evaporator 9 shifts to defrosting mode (point T in Fig. 2) while air is being cooled by evaporator 7. Afterwards, the sequence of events is repeated automatically. The compressor operates in accordance with a control program input in the electronic unit (mode A in Fig. 2), when both evaporators cool air, and is continuously turned on whenever any evaporator is in the defrosting mode.

[0020] The proposed method allows of stabilizing temperature and humidity of air within the cooled space and of using smaller evaporators as compared to the embodiments of the method chosen as the prototype as the required cooling capacity is achieved by two evaporators simultaneously, and not by a single evaporator. Therefore, the cost of the air cooler can be considerably reduced.

Claims

1. A method of continuous air cooling of the medium-temperature gastronomic refrigerating displays of shop equipment in the air cooler consisting of two independent evaporators structurally joined in one unit providing for continuous simultaneous forced air cooling of both air cooler evaporators by means of fans using the air circulating in the cooled space of the display and alternate, at regular intervals, defrosting of the frost-dew settling on the evaporator surface by cutting-off the refrigerant supply to one of the evaporators in accordance with a signal given by its electronic unit to shut off its solenoid valve and remove the drip water distinct in that at the beginning of the operating cycle of the display both evaporators cool the circulating air simultaneously, then one of the evaporators is being transferred to the defrosting mode so that the defrosting cycle of this evaporator is effected with a time shift relative to the other evaporator by ½ of the defrosting period, while the other evaporator continues to cool the circulating air, then the defrosted evaporator is being transferred to the cooling mode by opening its solenoid valve, and two evaporators continue to cool simultaneously the circulating air until the other evaporator is being shifted to defrosting mode, with subsequent reiteration of the described operation sequence.

2. A method of continuous air cooling of the medium-temperature gastronomic refrigerating displays of shop equipment in the air cooler consisting of two independent evaporators structurally joined in one unit providing for continuous simultaneous forced air cooling of both air cooler evaporators by means of fans using the air circulating in the cooled space of the display and alternate, at regular intervals, defrosting of the frost-dew settling on the evaporator surface by cutting-off the refrigerant supply to one of the evaporators in accordance with a signal given by its electronic unit to shut off its solenoid valve and remove the drip water; in so doing at the beginning of the display operating cycle both evaporators cool the circulating air simultaneously, then one of the evaporators is being transferred to the defrosting mode so that the defrosting cycle of this evaporator is effected with a time shift relative to the other evaporator by ½ of the defrosting period, while the other evaporator continues to cool the circulating air, then the defrosted evaporator is being transferred to the cooling mode by opening its solenoid valve, and two evaporators continue to cool simultaneously the circulating air until the other evaporator is being shifted to defrosting mode, with subsequent reiteration of the described operation sequence distinct in that during the entire defrosting period of one of the evaporators the refrigerant supply to the other (cooling) evaporator is being effected continuously by keeping the compressor turned on irrespective of the preset temperature control program.

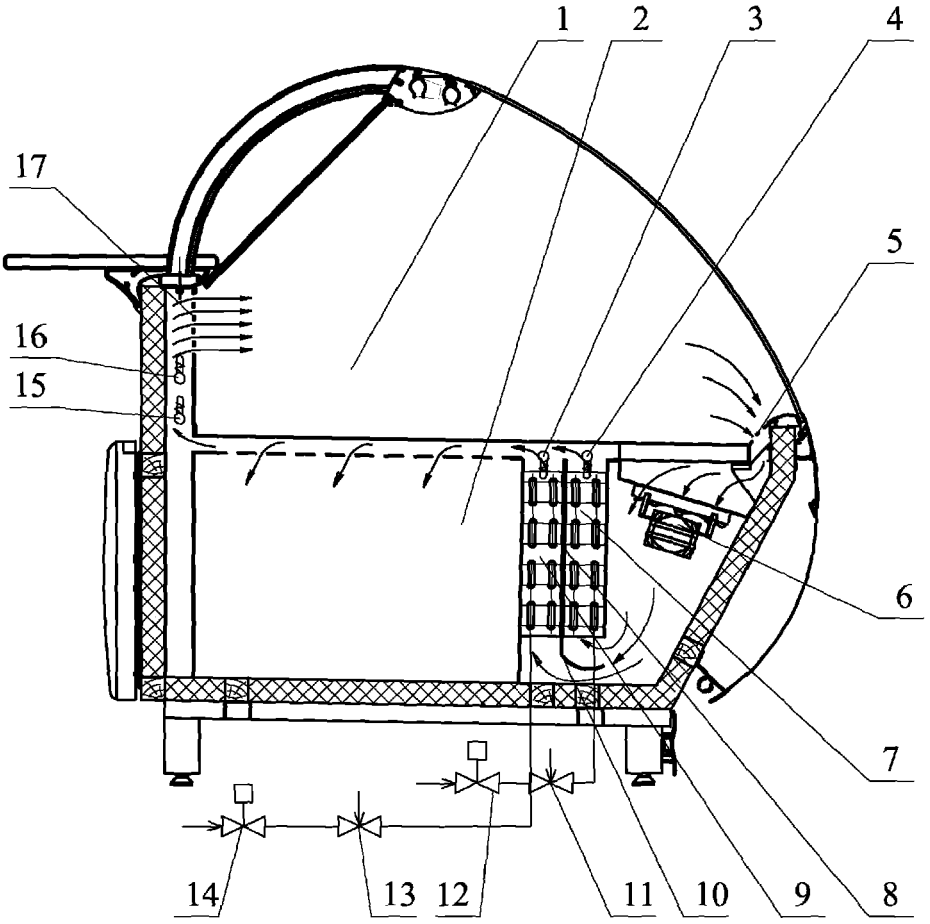

Fig. 1

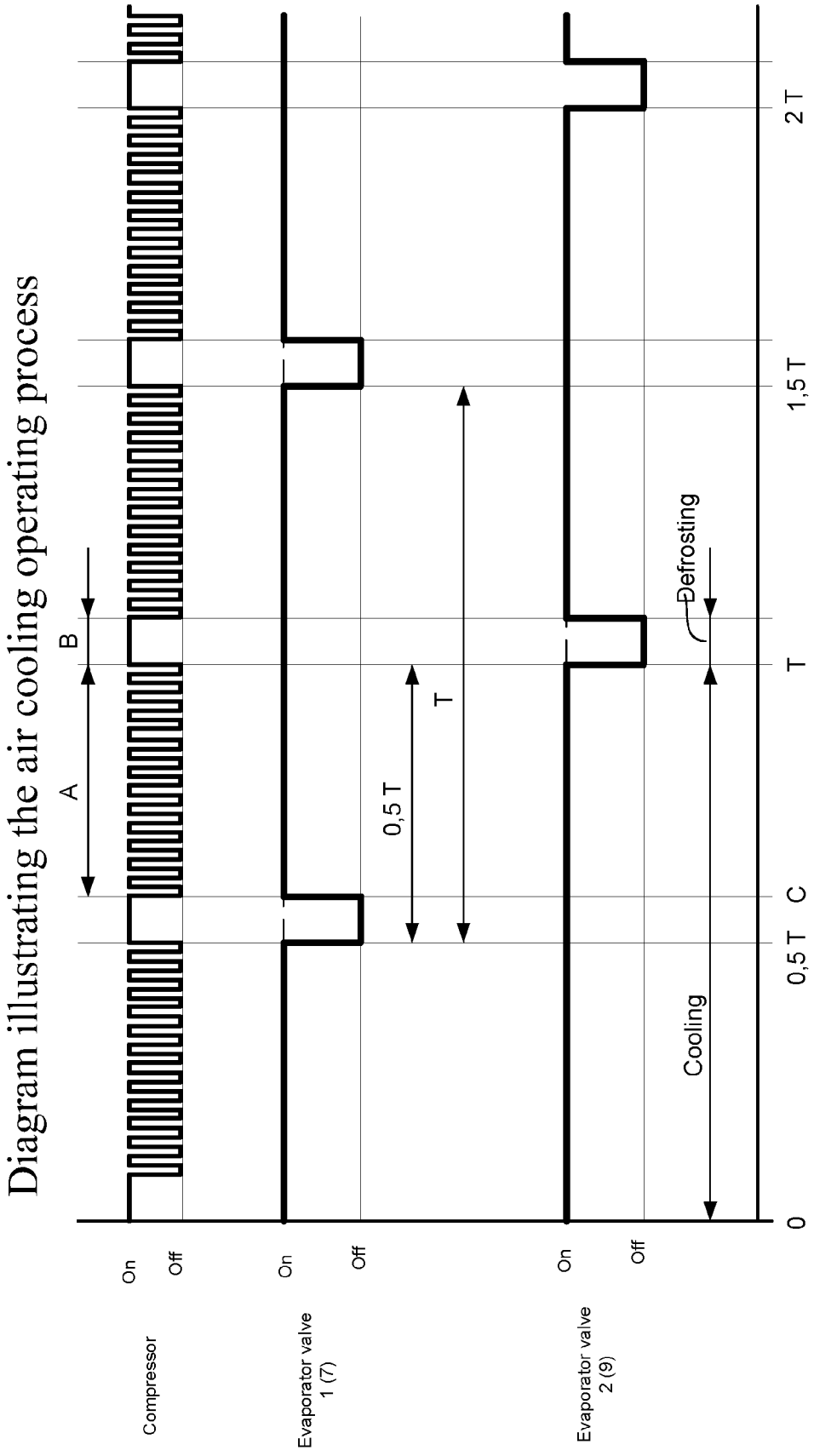

Fig. 2

A - compressor operating mode acc. to electronic unit program
B - continuous operating mode of the compressor irrespective of the electronic unit program

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 3499295 A **[0007]**
- US 5031413 A **[0007] [0010]**

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