U-3ARC
TRAINING WEBINAR #15

DEFROST OF COLD ROOMS

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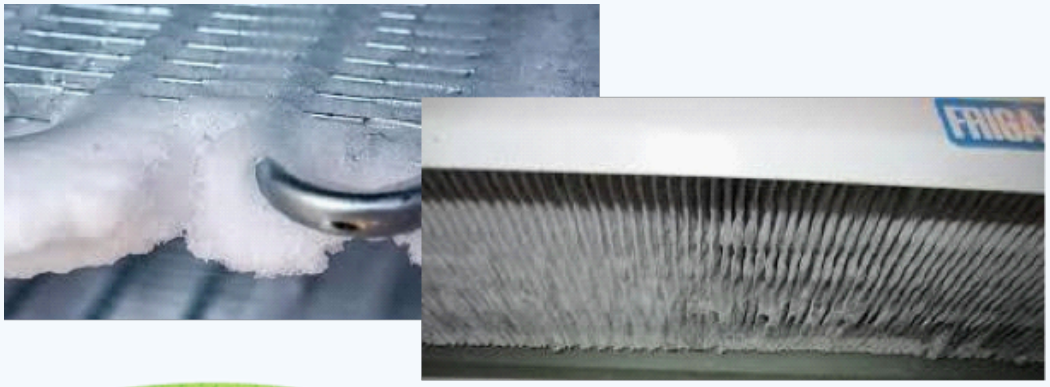
Intelligent defrosting of evaporators

Frost

In air cooler evaporators, when the coil temperature is below 0°C, frost is deposited on the tubes. Frost reduces the intensity of heat exchanges and the mixing of air.
Regularly defrost the coil (evaporator, duct, drip tray, etc.).



Frost

Heating modes

Different processes can be used, alone or simultaneously, depending on the heating mode

Heating from inside the tubes

- hot gases,
- hot liquid refrigerant.

Heating from the outside of the tubes,

- air,
- water,
- electric heating,
- non-freezing solution.

Frequency

It should be defrosted at the optimum frequency.

Low frequency
Heat transfer coefficient deteriorates System efficiency decreases.
High frequency
The thermal load of the room increases Reduction in the efficiency of the system, all the more noticeable when the room is at low temperature.
Optimal frequency
The conditions of use of the premises The nature of the load The external conditions.
Points to take into account:
Number of door openings (use of the room), Type of evaporator (spacing of the fins), Nature of the load, Temperature difference between the interior and the exterior...

Terms

A defrosting operation is broken down into three periods:

Warm-up period

during which the battery and the frost are warmed up to a temperature equal to 0°C.

Melting period

during which, in addition to the heat required to eliminate the frost, the heat required to dry the battery must be taken into account.

Cooling period

during which the defrosted coil is cooled down to the set room temperature.

Defrost control

The automatic control of evaporator defrost operations consists of three devices;

- the first causes defrosting,
- the second determines the defrost sequence,
- the third commands the end of defrosting.

Beginning

A defrost operation can be triggered either when:

1. Has formed a certain thickness of frost
2. Either at regular and predetermined time intervals.

- In the first case, the frost thickness can be assessed by a thickness detector.
- In the second case, the defrosting operations are triggered by means of a clock (several times a day). This stops cold production and triggers the defrost sequence.

Duration

- The duration of the defrost corresponds only to the first two periods.
- The quantity of heat brought into play by the melting of the frost is a fraction of the overall balance of a defrosting operation.

The efficiency of defrosting, can be expressed by the ratio of these two quantities of heat. It is all the higher when:

- the mass of frost to be evacuated is significant,
- the duration of defrosting is short,
- losses are small

Sequence

An automatic system of defrosting operations includes, depending on the heating mode adopted, all or some of the following operations:

- Evaporator drain; shutdown, if necessary, of the compressor; stopping the fans,
- Commissioning of the battery heater and drip tray,
- Cooling the battery to freeze water droplets.

Arrêt

La fin du dégivrage peut-être commandée:

- **Par un thermostat d'élément (fin de dégivrage) qui détermine l'élévation de la température de la batterie à une valeur supérieure à 0°C.**
- **Par un pressostat basse-pression qui déclenche quand la pression devient suffisamment élevée.**
- **Par l'horloge; dans ce cas la durée du dégivrage est prédéterminée. Ce dispositif présente l'inconvénient d'être aléatoire:**

  - ✓ **Si la durée est excessive, la dépense énergétique est inutilement accrue,**
  - ✓ **Si la durée est trop courte l'évaporateur est mal dégivré.**

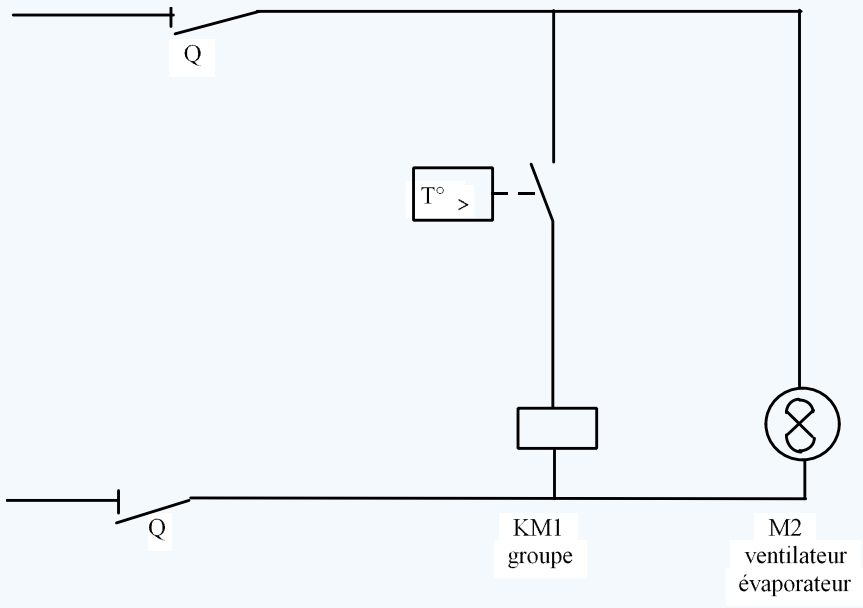
Different modes of defrosting positive cold rooms

When the evaporation temperature drops below zero degrees, frost forms on the evaporator.

Defrosting is ensured when the unit is stopped, by forced ventilation of the evaporator in an ambient environment at positive temperature.

At each cycle:

- The regulation (thermostatic or pressostatic) controls the unit.
- The evaporator fan operates in forced operation.



This permanent ventilation dries out the stored unpackaged products.

Different modes of defrosting positive cold rooms

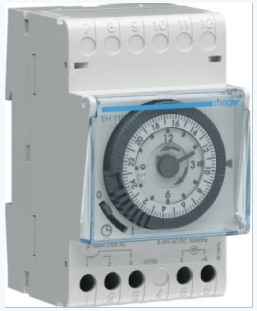
By pendulum

Make defrosting automatic and cyclical.

At fixed time:

A contact of the clock de-energizes the unit control another contact supplies forced operation to the evaporator ventilation.

These two separate contacts can be replaced by a three-contact changeover contact.



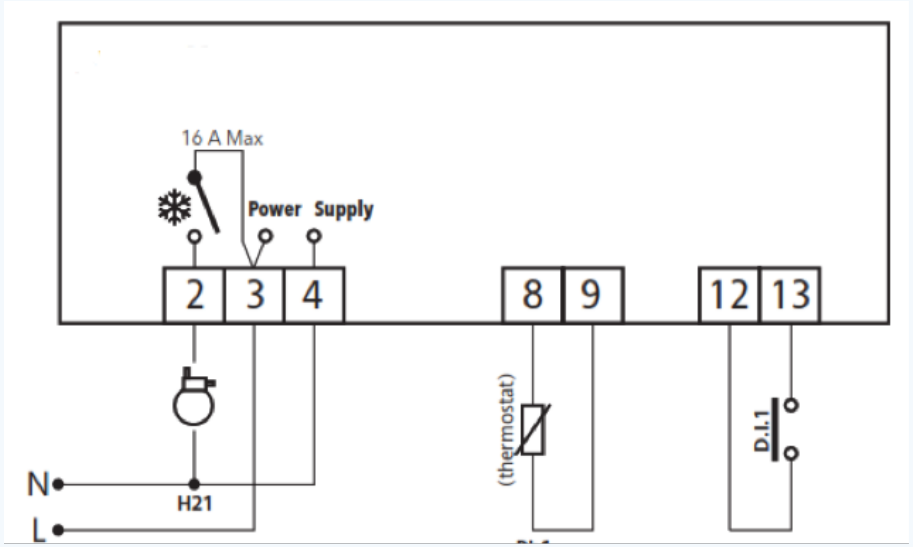
Different modes of defrosting positive cold rooms

By single sensor controller

Make defrosting automatic and cyclical.

At fixed time:

A regulator contact de-energizes the unit control, the evaporator ventilation in forced operation 24/24.



Defrosting of negative cold rooms

Different defrost modes:

Manual defrost:

Example: old generation container.

This defrost requires:

- ➢ **the stop of the group,**
- ➢ **the transfer of frozen products to another conservator,**
- ➢ **opening the door to warm the atmosphere well above 0°C.**

Automatic defrosts:

They will all be ordered:

- ❑ **By pendulum (time switch)**
- ❑ **By regulator with 02 probes**

Defrosting of negative cold rooms

Defrost pendulum:

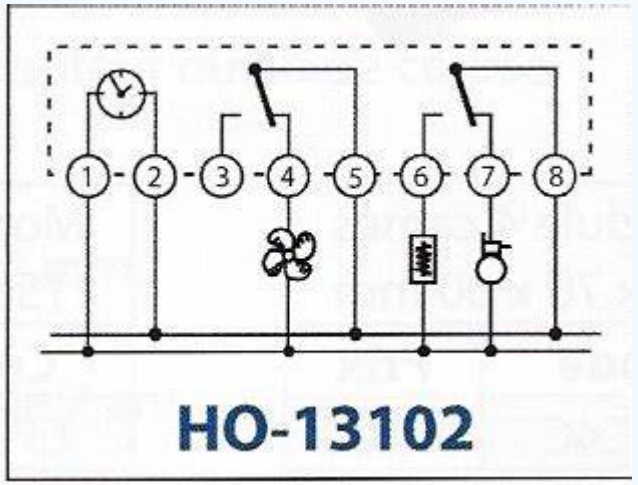
Powered by single-phase 220V then set to the time, it must be programmed for several daily defrosts during off-peak hours of use of the cold room (four in general).

Its role is to trigger at fixed times on the control circuit:

stopping freezing

defrost circuit power supply

At the end of the sequence (after complete defrosting of the evaporator) the clock controls refreezing.



Defrosting of negative cold rooms

Defrosting by electric heating resistors:

Pin-shaped resistors run right through the evaporator parallel to the tubes. The frost and ice come off and end up melting in the drainer, which is also heated by resistors. A pipe kept frost-free to the outside of the chamber by a heating cord evacuates the defrost water.

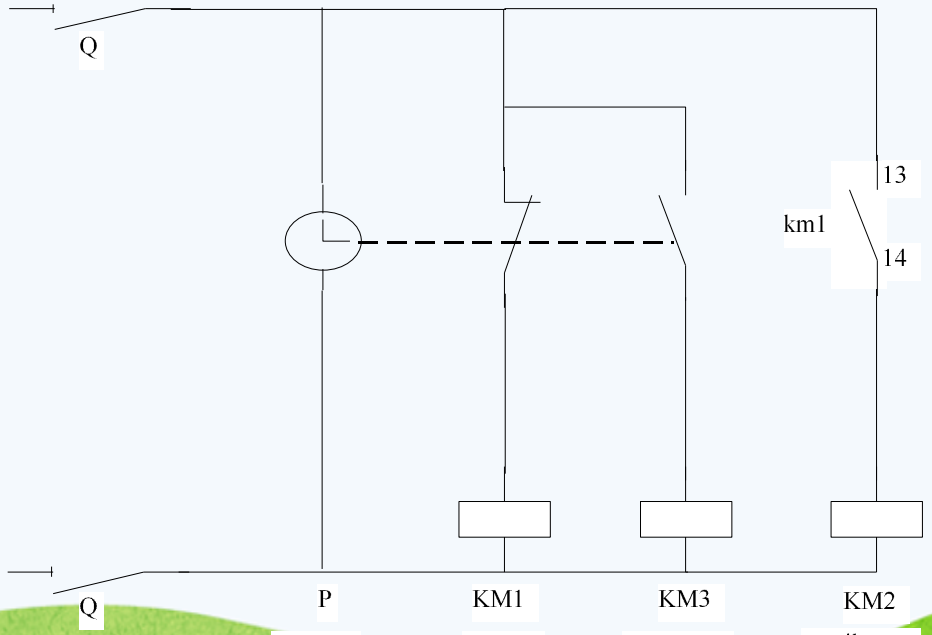
Defrosting of negative cold rooms

Several cases of regulation:

1st case: The clock has two simultaneous simple contacts or a changeover contact

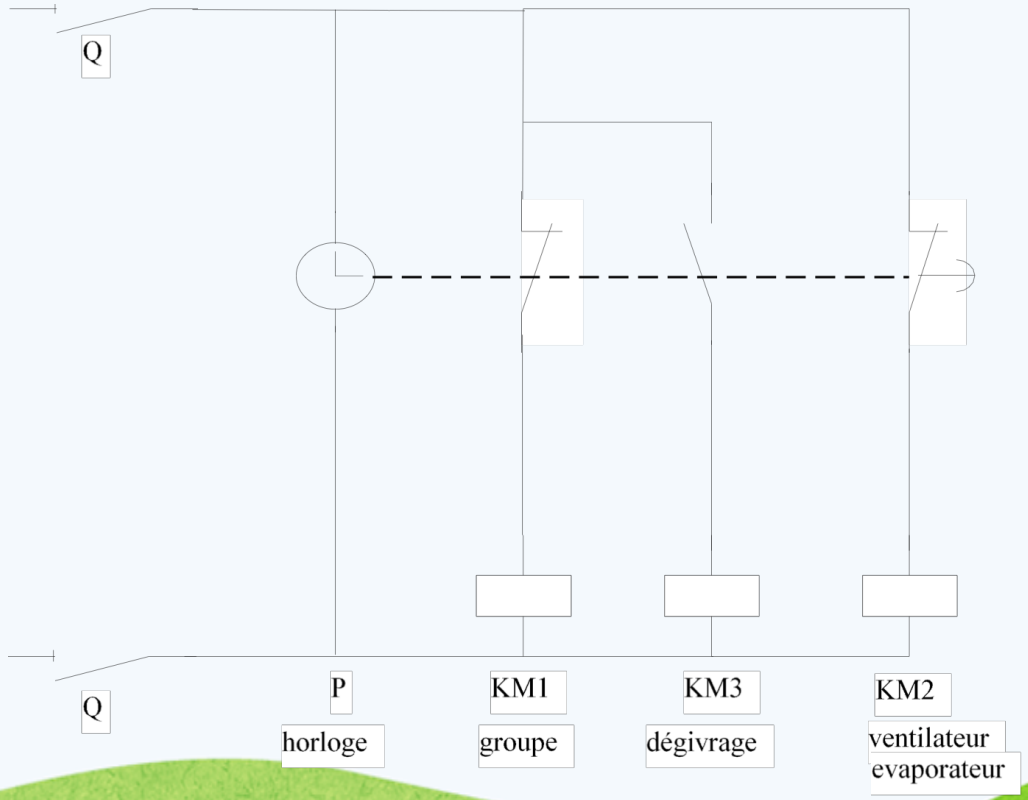
Disadvantages:

When refreezing, the ambient air is ventilated on the hot evaporator (+2°C < ϑ < +12°C).



Defrosting of negative cold rooms

2° case: The clock has an inverter and an additional delayed closing contact (mechanically delayed closing).

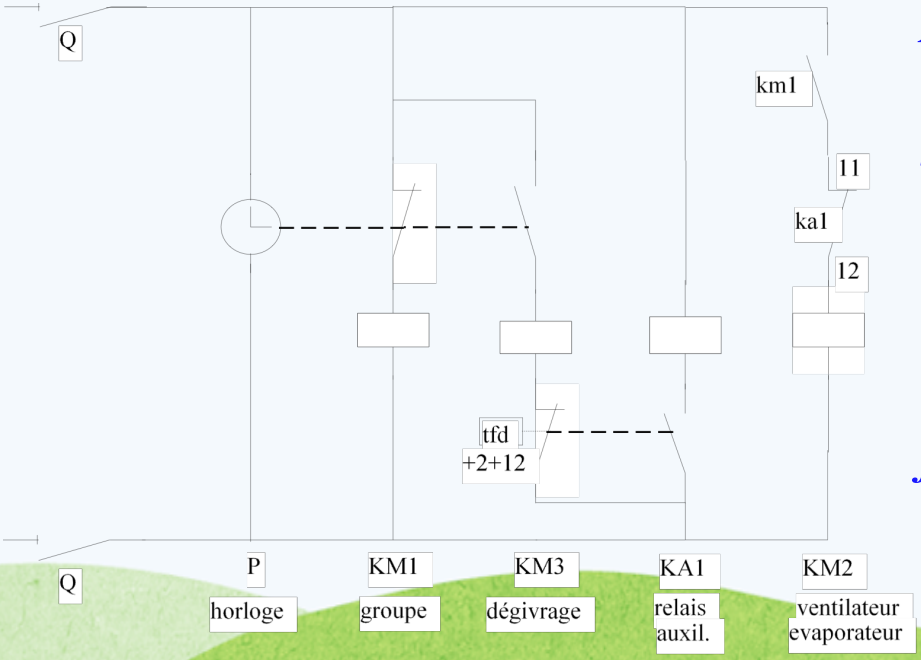


Defrosting of negative cold rooms

3° case: An end of defrost thermostat completes the regulation

Functioning:

This end-of-defrost control thermostat, whose bulb (or pellet) is placed between the fins at the outlet and at the top of the evaporator, is set to cut off at +12°C and re-supply the defrost circuit at +2°C .



Advantage:

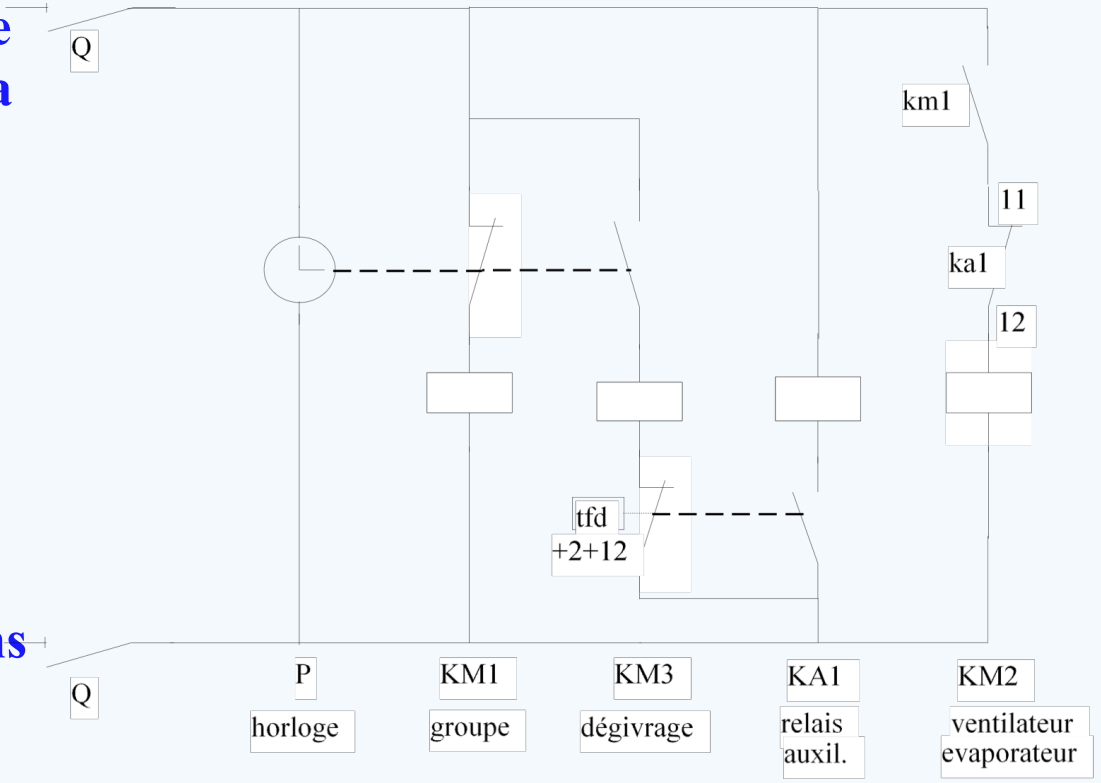
It allows despite a programmed defrost sequence higher than normal to stop the defrost as soon as it is finished. It thus limits the heating of the room and the vaporization of water which can lead to layers of snow on the ceiling and on the foodstuffs.

Defrosting of negative cold rooms

4° case: regulation identical to 3° case but the third stud of the end of defrost thermostat and a KA relay replace the delayed contact of the KA clock 11 - 12 opens at +12°C and closes at +2° vs.

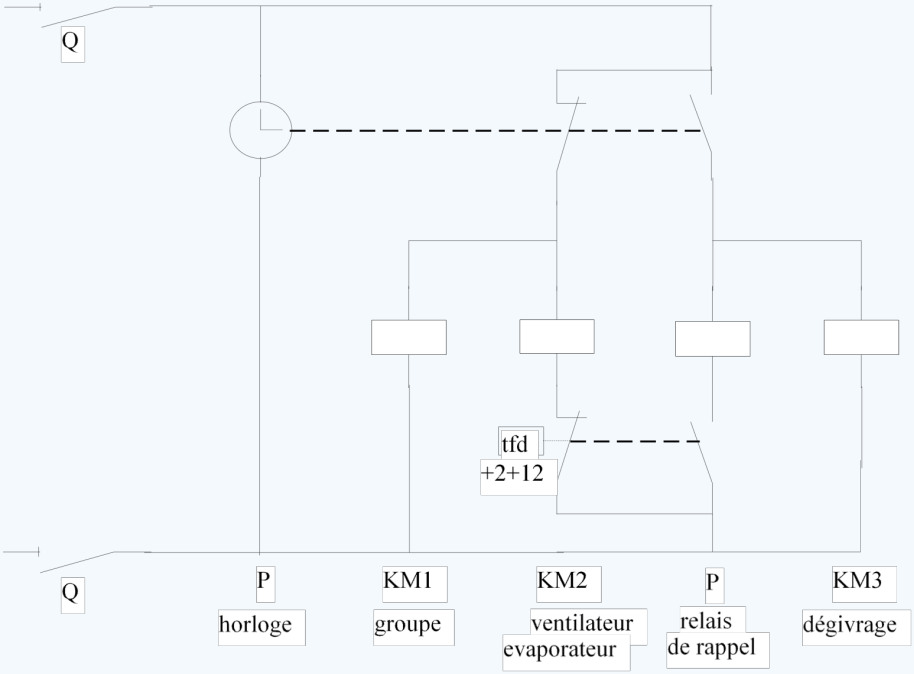
Advantage:

This unfixed evaporator fan delay adapts to each defrost. It limits the Δt avoiding bringing the BP to vacuum when the fans stop.



Defrosting of negative cold rooms

5th case: regulation identical to 4th case with the advantage of restarting freezing as soon as defrosting has actually ended, thanks to a reminder relay fitted to PARAGON 61-21 series clocks



Defrosting of negative cold rooms

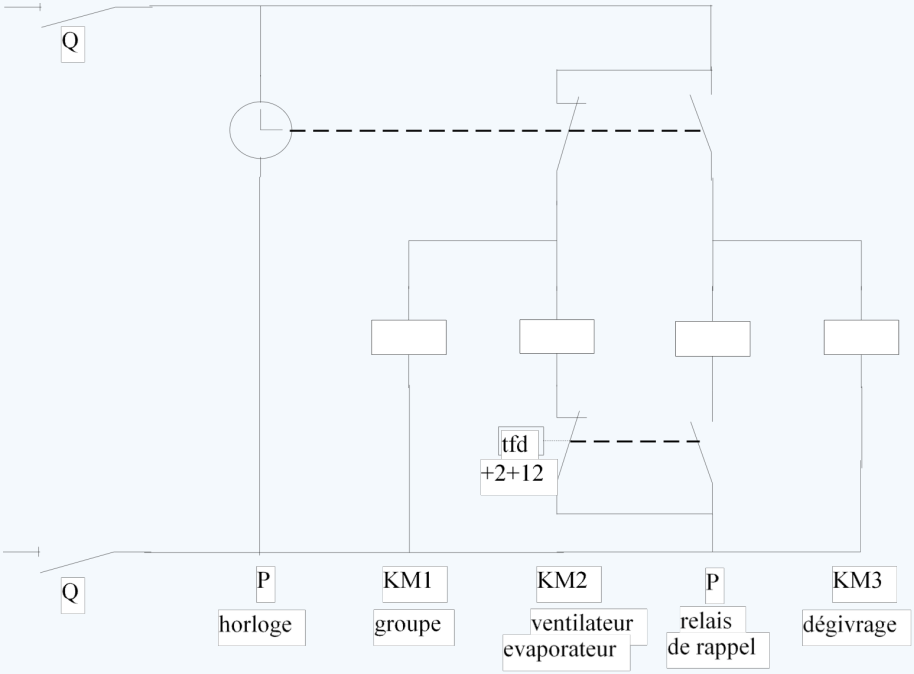
Functioning:

- Freezing: pendulum contact closed on KM1 and tfd contact closed on +2°C.

Defrost: pendulum contact closed on KA1 and tfd contact closed on +2°C.

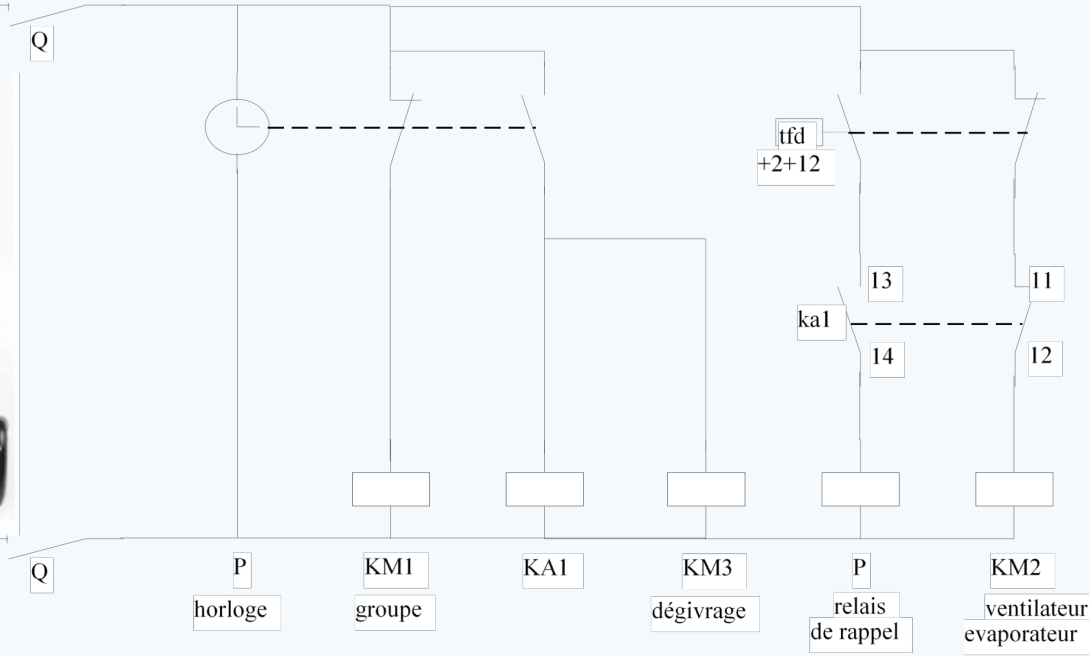
- End of effective defrost: pendulum contact closed on KA1, tfd contact closed on +12°C.

Energized, the reminder relay switches the P contact to KM1 (freezing) stopping defrosting and simultaneously powering freezing. The fan delay is ensured by the tfd at +2°C.



Defrosting of negative cold rooms

6° Case: regulation identical to 5° case with an additional AC relay fitted to PARAGON type E 61-21 FR clocks.

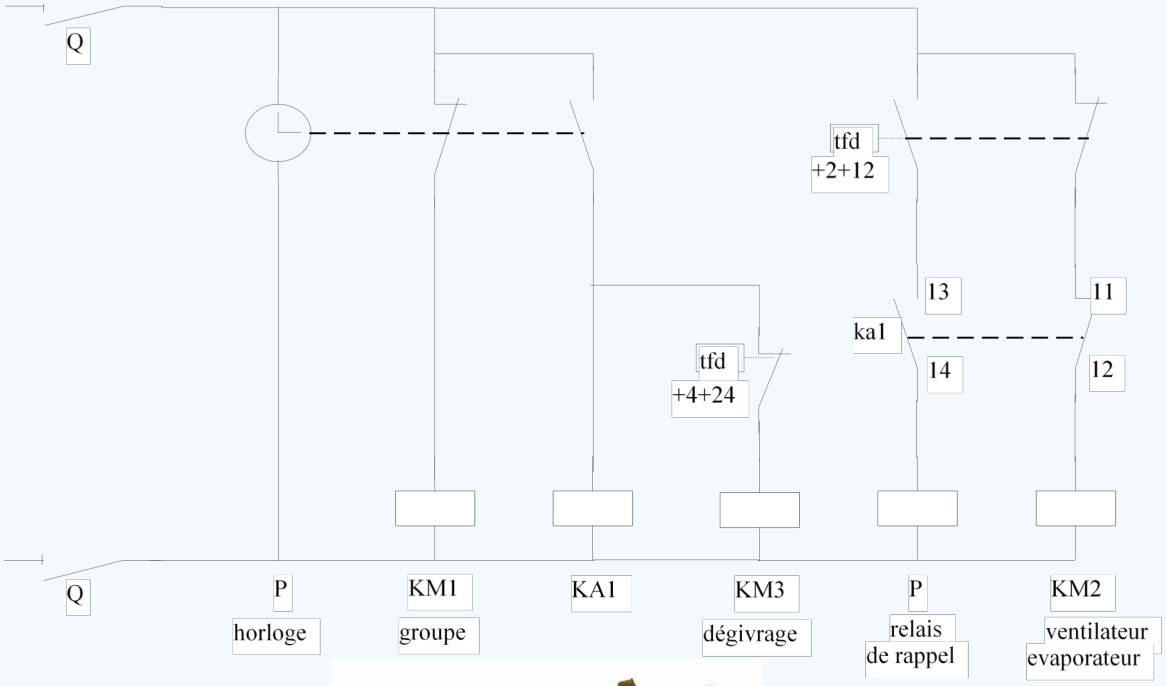


Defrosting of negative cold rooms

Defrost end safety devices: The end of defrosting is ensured by:

-The clock: case n° 1-2

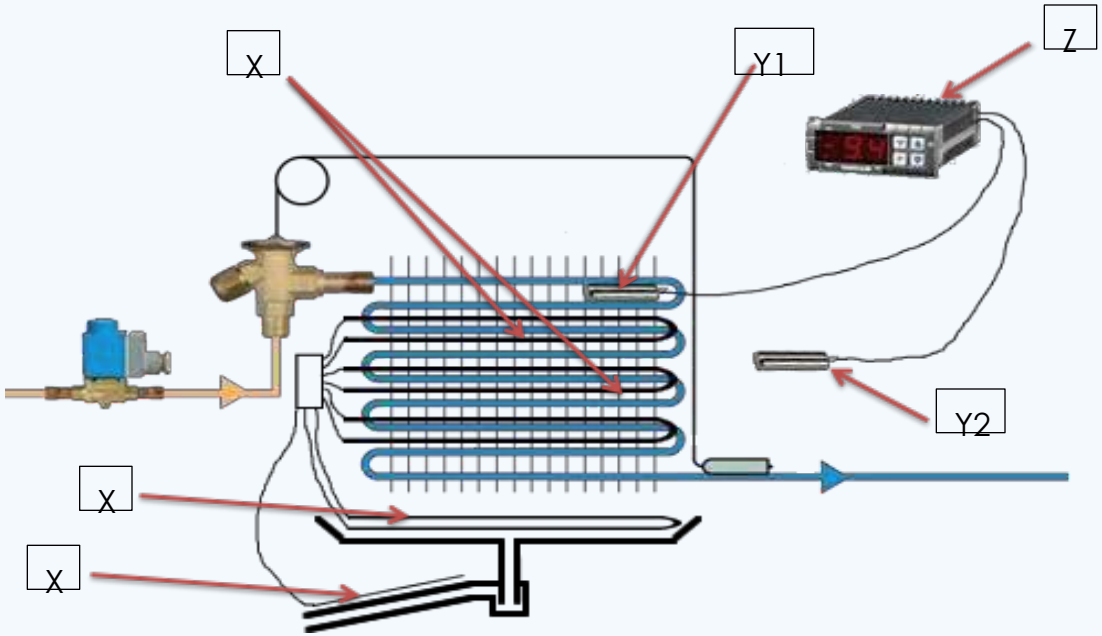
- The clock and an end of defrost control thermostat, case n° 3-4-5-6.
- In all cases, a safety thermostat whose bulb is close to the end of defrost thermostat can be used. Fitted in series with the defrost relay, its contact opens at +24°C and closes at +4°C.



Defrosting of negative cold rooms

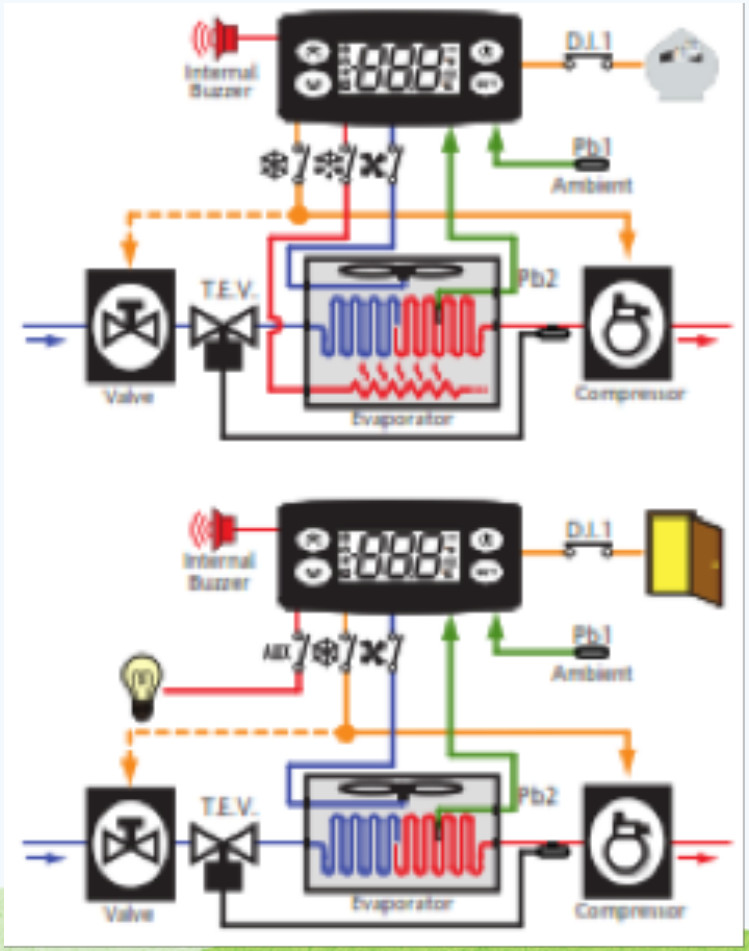
Configurable regulator

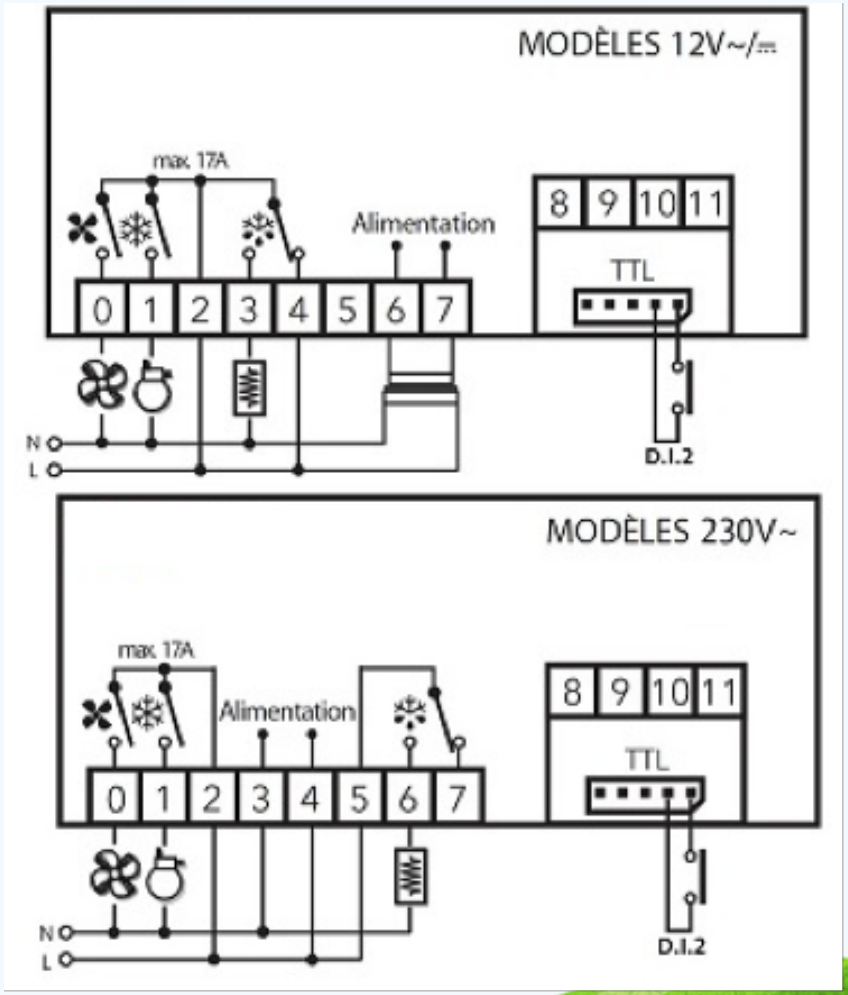
X: Resistors
Y1: Defrost probe
Y2: Room sensor
Z: Configurable controller



Defrosting of negative cold rooms

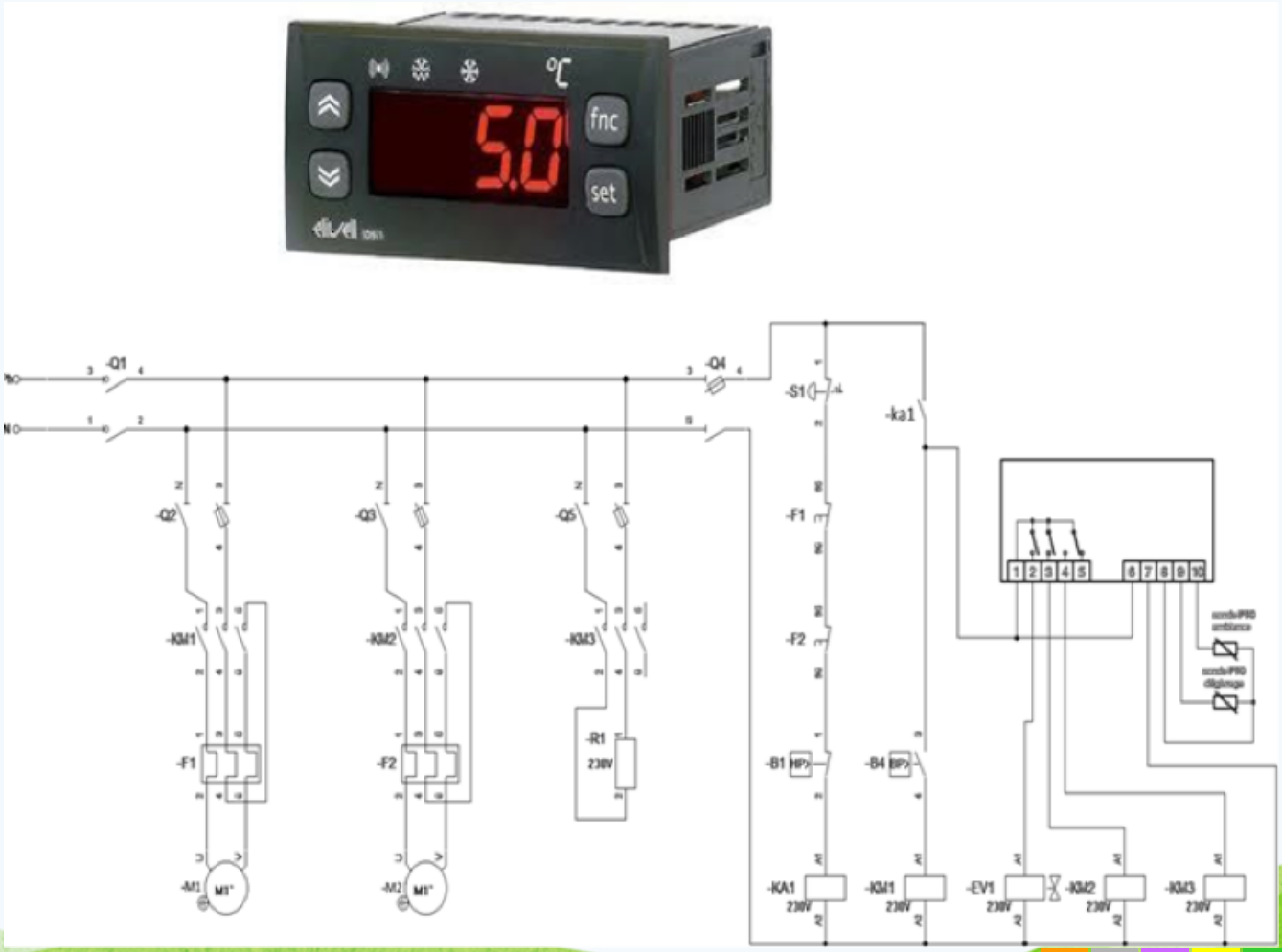
Configurable regulator





Defrosting of negative cold rooms

Régulateur paramétrables



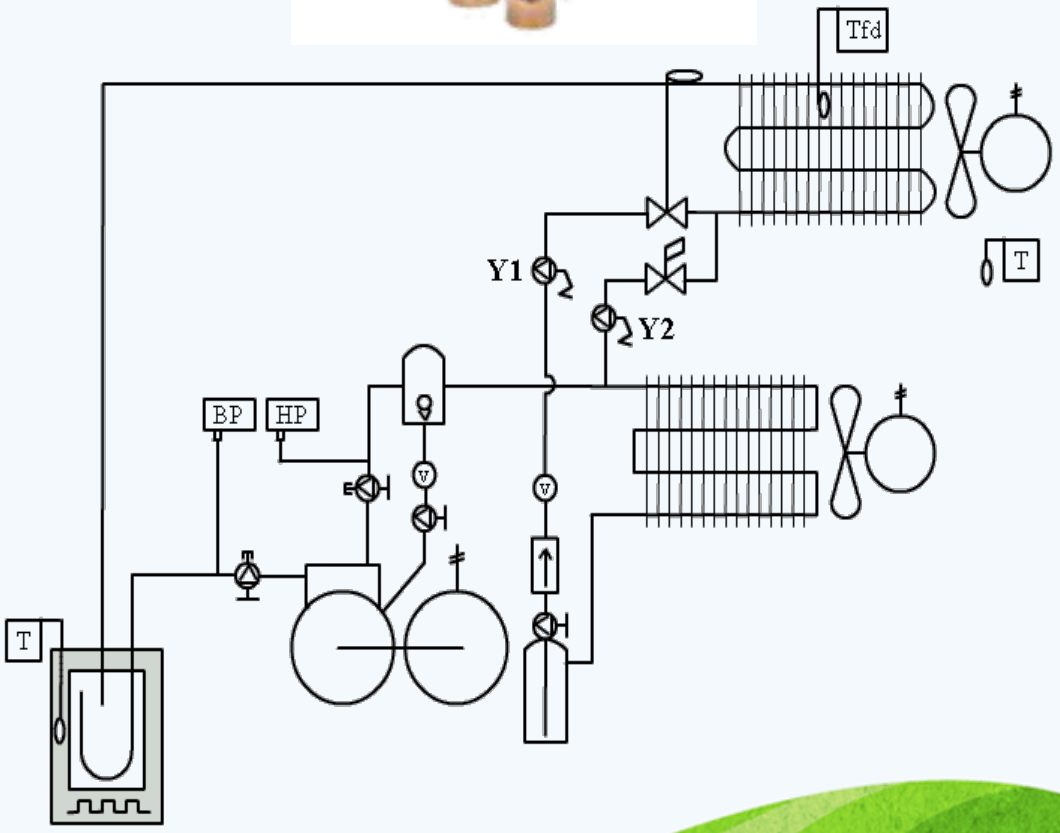
Hot gas defrosts

This defrost is based on the use of a 4-way valve

VEM Y2 is used for hot gas injection. Y1 is used for pump down

Important :

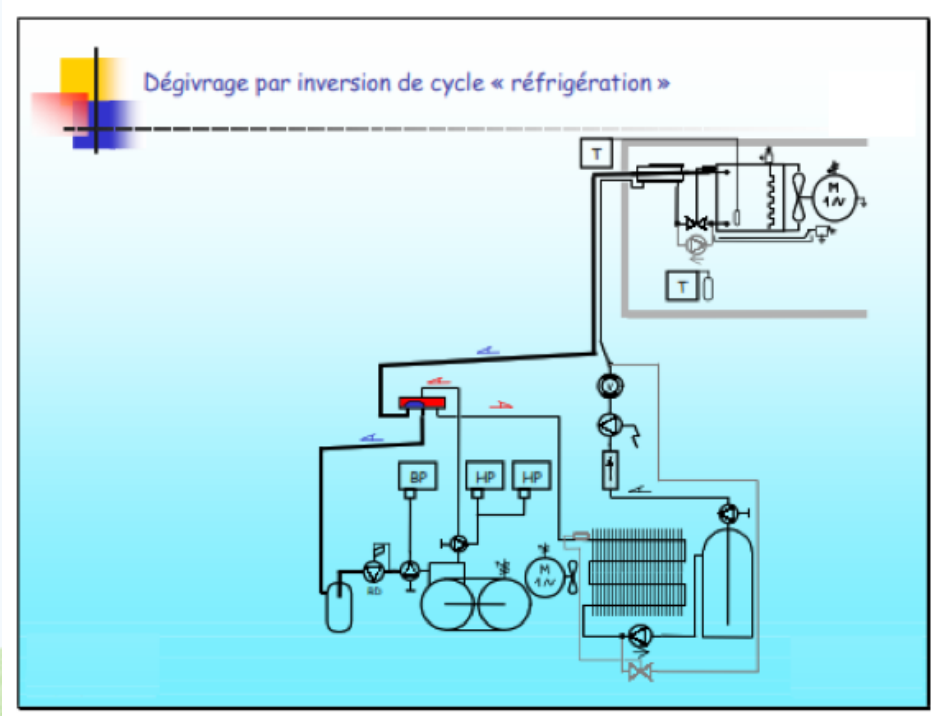
An automatic evacuation (pump down) is preferable before injecting hot gas. This will limit the defrosting time and therefore an excessive rise in temperature in the cold room.

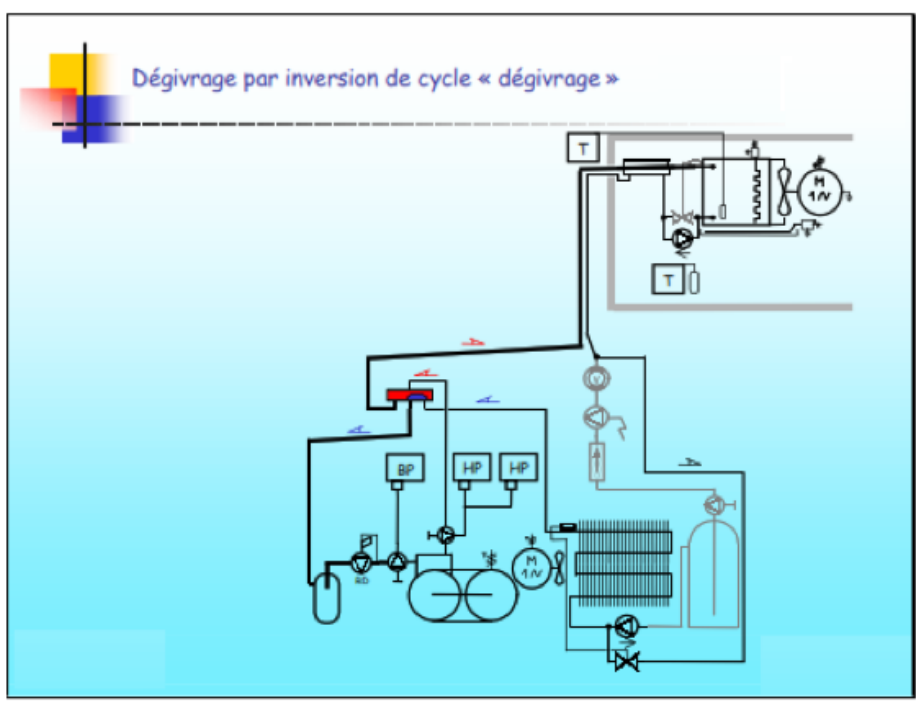


Cycle inversion defrosts

These systems shut down the chiller fans and reverse system operation, heat is almost entirely retained within the unit

Suitable for packaging units

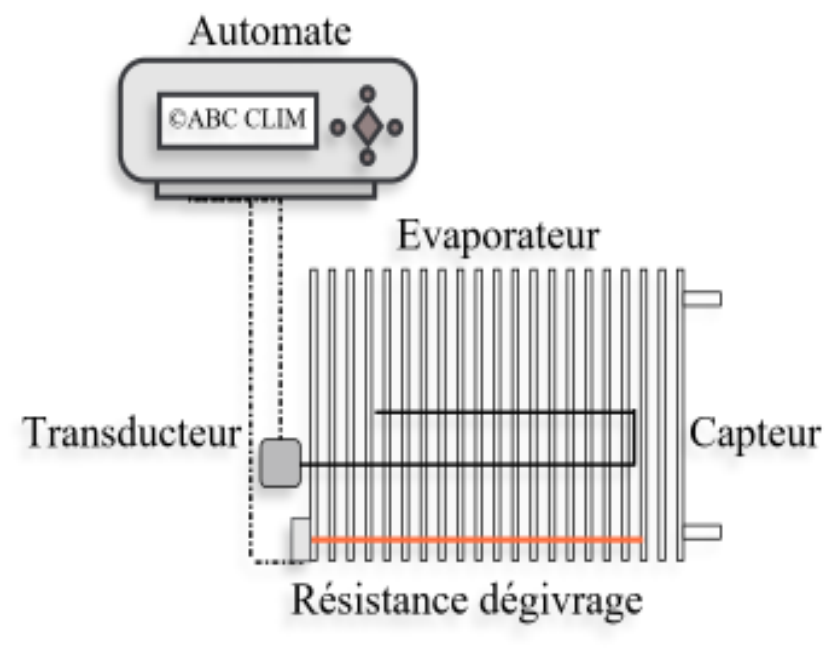




Intelligent defrosting of evaporators

On the other hand, intelligent defrosting allows optimized management of defrosting cycles, only allowing its operation if frost is actually detected on the evaporator.

The temperature of the refrigerated chamber will be more uniform and operating costs can be reduced by 5 to 10%.



Intelligent defrosting of evaporators

Integration on the PLC of a sensor releasing a 4 to 20 mA signal, ice detection device.

This type of sensor consists of a transducer and a dielectric probe, the latter does not conduct electricity but induces an external electric field which is disturbed by the actual presence of frost on the evaporator.

The transmitted signal (4mA = no frost, 20 mA = presence of frost) The controller allows to start a defrost if necessary and to stop it when the need arises.

Intelligent defrosting of evaporators

Analysis of the temperature curve of the enclosure as well as that of the evaporator.

The automaton continuously records this data, an algorithm interprets the different data to order a defrost or not, it also makes it possible to establish statistics of the defrost time in order to refine its duration.

For example, during defrosting, if the controller registers a short temperature rise in the evaporator, it means that it is no longer covered with frost and will stop the resistances, which will reduce the number of defrosts.

Intelligent defrosting of evaporators

Other more advanced regulators register the air flow through the evaporator and the mass flow at the level of the expansion valve here an electronic type expansion valve will be used which will act as a flow meter.

By comparing these measurements of air flow and flow at the level of the expansion valve, it is possible to determine the efficiency of the evaporator and to deduce the importance of the icing of the evaporator.

This very precise method drastically reduces untimely defrosting, it should also be noted that the additional cost of this type of regulation is quickly amortized.

شكرا

Merci

Thanks

Gracias

Obrigado