

## GESTRA Steam Systems

# GESTRA Information A 1.5

## How to avoid operating trouble

### in steam and condensate systems caused by freezing of equipment and plant

The recent cold winter brought us many unpleasant surprises, but, in many cases, also made us realize that those parts of a plant which are liable to freezing should be better protected.

These examples and hints taken from our practical experience may help you in winterizing your plant effectively.

We have to differentiate between “freezing” and “damage caused by frost”.

“Freezing”: All parts and equipment of a plant will freeze where on shut-down water (condensate) cannot drain off completely or where the temperature during operation drops rapidly because of very low condensate flowrates (= amount of heat). Although freezing causes operating trouble or even breakdown, the plant will operate again after having thawed.

“Damage caused by freezing”, however, means ruin of equipment caused by the increase in volume of water when freezing.

In condensate systems the danger of freezing is greatest for the steam trap. The most frequently used types of steam traps are:

1. Duo (bimetallic) steam traps (with thermostatic/thermodynamic control)
2. Membrane steam traps (with thermostatic control)
3. Thermodynamic steam traps with valve disc
4. Float traps, either with ball float or inverted bucket.

The first three types of traps mentioned do not need a water seal to operate. They can be installed in any position.

**With freeze-proof installation** – in vertical lines with downward flow – these traps are self-draining when the plant is shut down.

**Therefore they cannot freeze.** This applies, too, to traps with integral non-return valve.

**With non-freeze-proof installation**, for example, in horizontal lines or in a water pocket, pipelines and traps freeze of course, if the system is not drained. There is, however, little danger of the traps being ruined by frost as the trap body is made of rather thick-walled forged steel.

The regulators are surrounded by water and so robust that they are not ruined either.

What may happen is just an elongation of the cover bolts.

The trap types shown in **figs. 1–3, and 6** are drained to the level of the outlet port. The remaining condensate in the trap freezes, but the trap is not ruined. If the plant is restarted the first condensate can flow off freely and after a short while the ice will have thawed.

Float traps are directly controlled by the condensate level in the trap. Consequently they can only be installed in a given position. They are not self-draining and freeze if the plant is shut down. Depending on the type of material, the wall thickness of the trap body, the design features, and the direction of flow they may even be ruined by the frost. The ball floats freeze in the ice formed by the condensate and may be deformed.

There is an exception, the GESTRA float trap type UNA 23/26 with Duplex control in vertical design (**Fig. 6**). After cooling down the ball float is lifted by the Duplex control (thermic element) so that the outlet port is opened. The condensate can flow off exactly as it would from a thermostatic trap. As the ball float hangs above the remaining water level it cannot freeze.

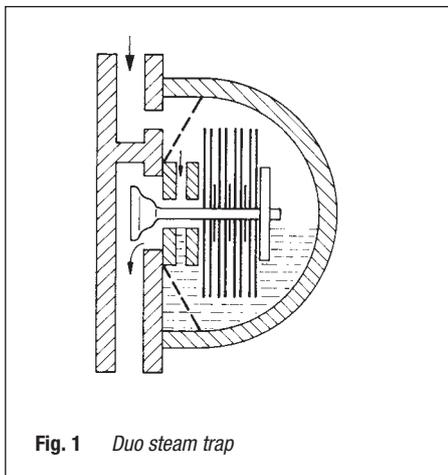


Fig. 1 Duo steam trap

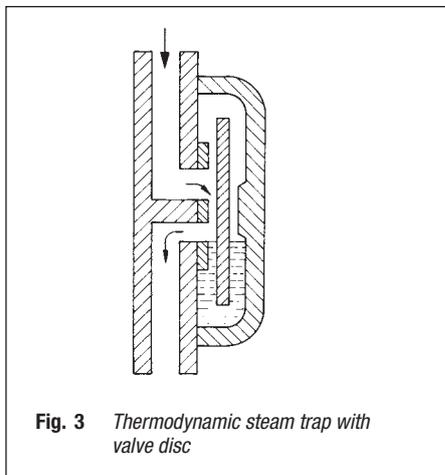


Fig. 3 Thermodynamic steam trap with valve disc

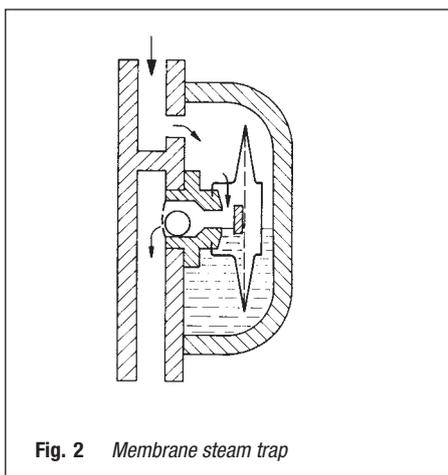


Fig. 2 Membrane steam trap

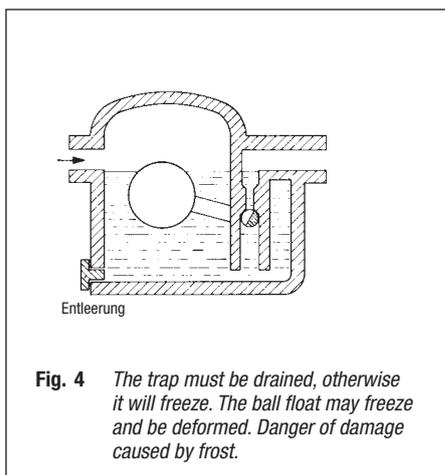


Fig. 4 The trap must be drained, otherwise it will freeze. The ball float may freeze and be deformed. Danger of damage caused by frost.

If the bodies of the traps shown in **figs. 9, 10, 11** are in welded construction of thin metal sheet there is a further danger in the case of frost.

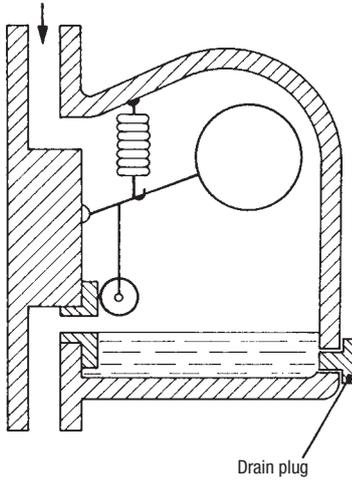
During periods of standstill the pipelines, too, cool down and shrink. Depending on the pipe layout and supports tensile stress results which may lead to a deformation of the trap body and to cracks in the welding seams.

The following examples show reasons for freezing during operation and on shutdown and possible ways of avoiding it.

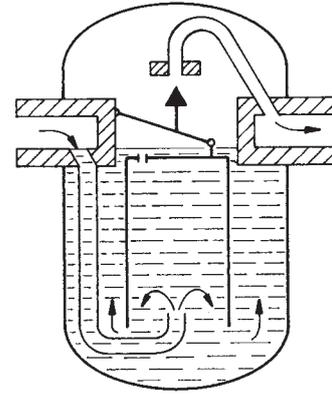
**Danger of freezing during operation regardless of trap type**

Condensate systems and heat exchangers may freeze for the following reasons:

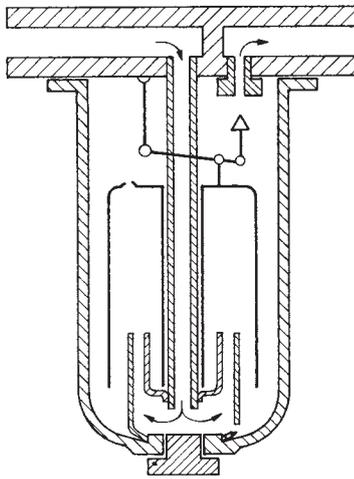
1. Faulty trap operation or completely dirt-logged strainer upstream or inside trap.
2. The differential pressure is not large enough to obtain sufficient condensate discharge.
3. Unfavourable flow conditions in the heating system of the heat exchanger (this applies in particular to air heaters using outside air).
4. Unsuitable pipe layout downstream of trap.



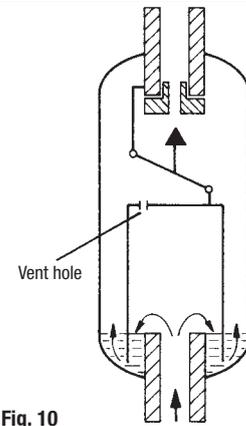
**Fig. 6**  
*Float trap type UNA 23/26v, self-draining.  
 The ball float cannot freeze and be deformed.  
 No danger of damage caused by frost.*



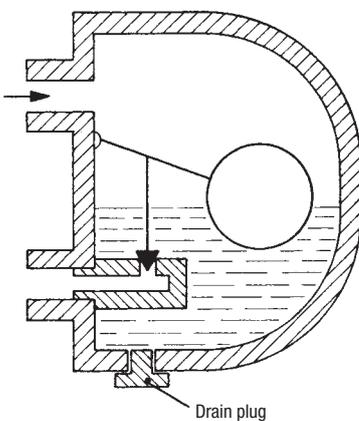
**Fig. 9**  
*The trap cannot be drained and will freeze.  
 Danger of damage caused by frost.*



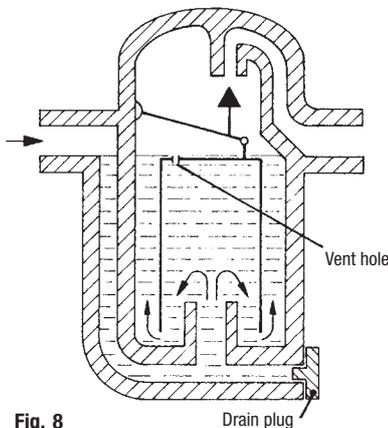
**Fig. 7**  
*The trap must be drained, otherwise it will freeze.  
 After removing drain plug, the trap can drain completely.*



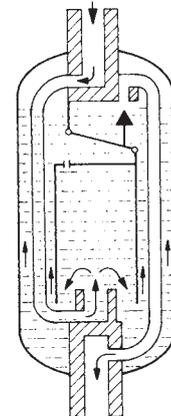
**Fig. 10**  
*The trap cannot be drained unless the line upstream of the trap has been drained.  
 A complete drainage is not possible.  
 The bucket will freeze.  
 When the plant is restarted the condensate flow through the small vent hole is not sufficient to thaw the ice in the trap.*



**Fig. 5**  
*The trap must be drained, otherwise it will freeze.  
 The ball float may freeze and be deformed.  
 Danger of damage caused by frost.*

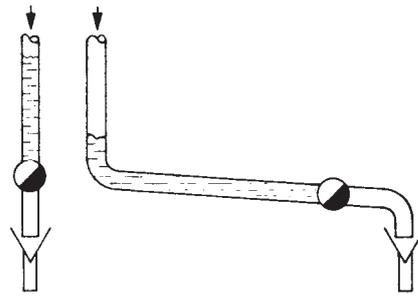


**Fig. 8**  
*The trap must be drained, otherwise it will freeze.  
 Danger of damage caused by frost.  
 Complete drainage is not possible, the inverted bucket freezes in the frozen condensate.  
 When the plant is restarted the condensate flow through the small vent hole is not sufficient to thaw the ice in the trap.*

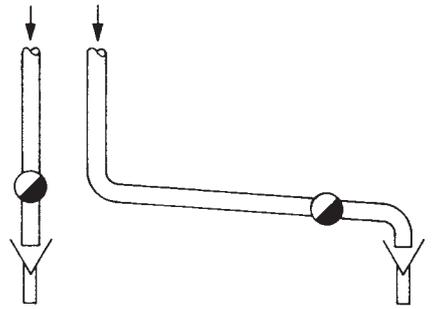


**Fig. 11**  
*The trap cannot be drained, on the contrary it remains almost completely filled with water.  
 It will freeze and be ruined by the frost (e.g. cracks in welding seams, deformation of trap body by strain on material beyond yield point).  
 Insulating the trap will only delay freezing and damage caused by frost.*

**Danger of freezing:**



**Remedy:**

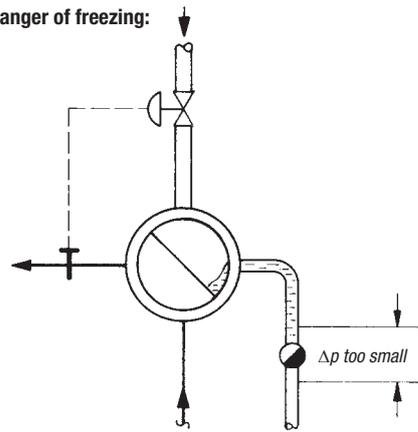


**Fig. 12**

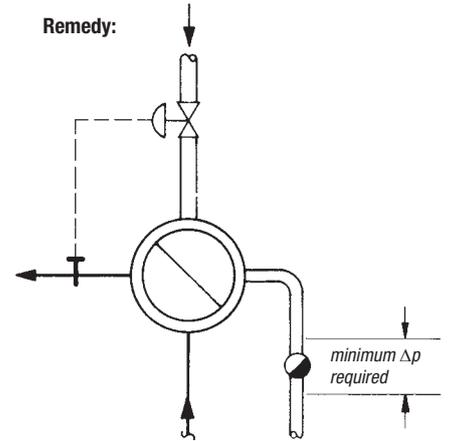
Steam trap and pipeline will freeze as the strainer in the trap is completely dirt-clogged or the trap closed because of a failure or maladjustment (possible with thermostatic traps).

Avoid complete dirt-clogging of strainer and disturbances in the trap.

**Danger of freezing:**



**Remedy:**

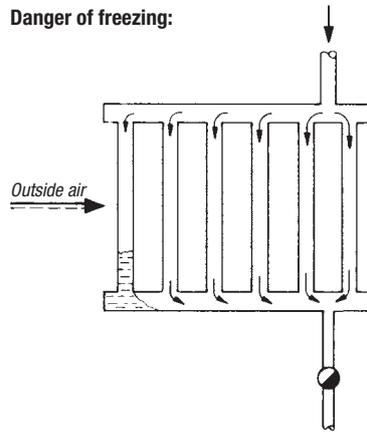


**Fig. 13**

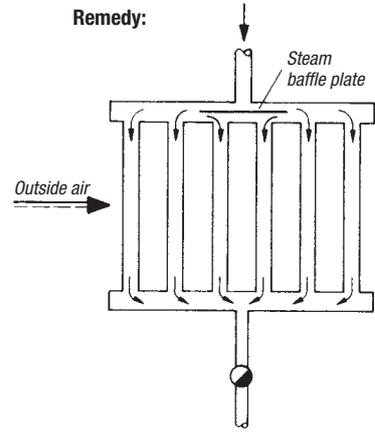
Steam trap and pipeline will freeze because the differential pressure available for the trap is not large enough to provide sufficient condensate discharge (e.g. at partial load).

Increase differential pressure or maintain minimum differential pressure.

**Danger of freezing:**



**Remedy:**

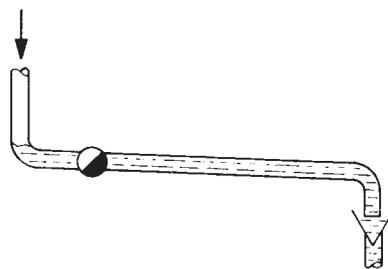


**Fig. 14**

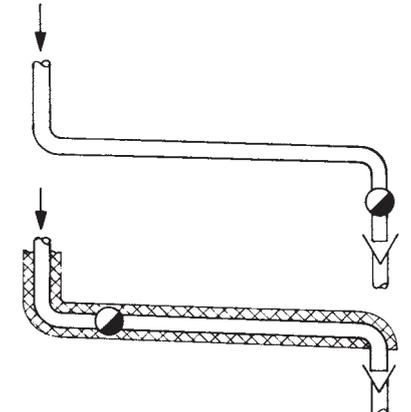
Heat exchanger (in particular air heaters with admission of air from outside) will freeze as a result of unfavourable flow conditions.

Provide better steam distribution and thereby improved flow conditions.

**Danger of freezing:**



**Remedy:**



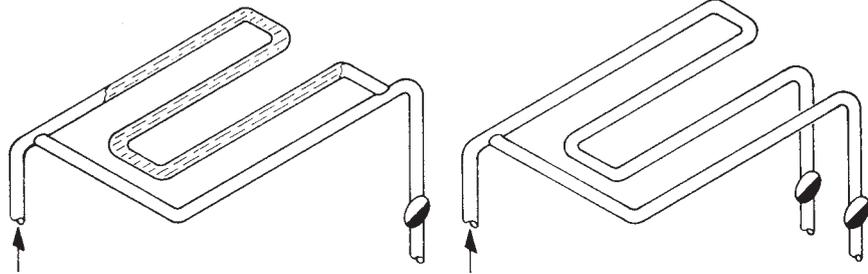
**Fig. 15**

Discharge line and possibly trap will freeze up as ice building up from the pipe outlet, the pipeline downstream of the trap being too long. This is often the case if the condensate flowrate is very low, as, for instance, in tracing systems.

Install trap at the end of pipeline or keep pipe downstream of trap as short as possible. If a long pipeline cannot be avoided, insulate line.

**Danger of freezing:**

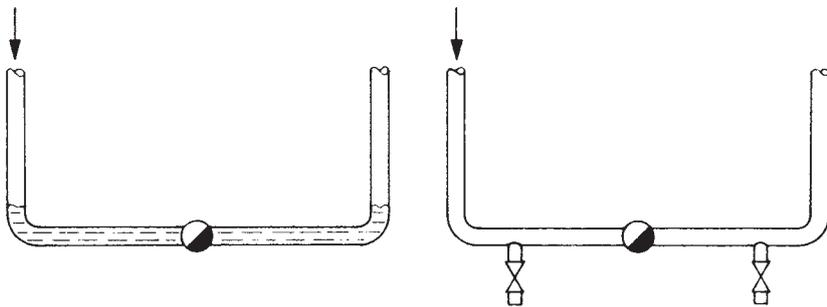
**Remedy:**



**Fig. 16**  
 If heating lines mounted in parallel are drained by a common steam trap, the line with the higher pressure drop may freeze.  
 Provide individual drainage for each line.

**Danger of freezing:**

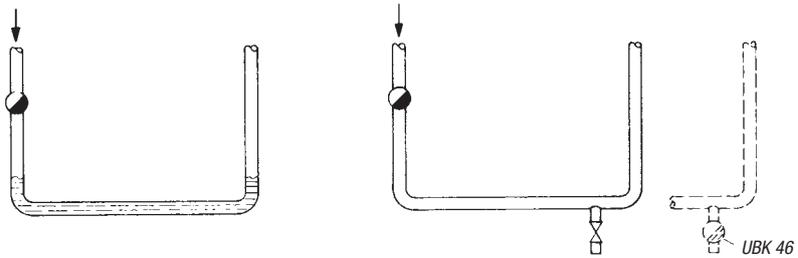
**Remedy:**



**Fig. 17**  
 Condensate line and trap will freeze because the remaining condensate cannot flow off.  
 Drain system manually on shutdown.

**Danger of freezing:**

**Remedy:**



**Fig. 18**  
 Pipeline will freeze.  
 Drain line manually or automatically with a GESTRA steam trap type UBK 46.  
 The trap opens as soon as the temperature drops below approx. 80 °C. The pipeline should preferably be installed so that the condensate is free to flow towards the trap.

**Danger of freezing on shut-down of a plant**

All traps will freeze and may be ruined by frost if they are wrongly installed, i.e. if they are not self-draining.

Pipelines will freeze if they are laid such that water pockets are formed or if the condensate has to be lifted.

Heat exchangers will freeze if the remaining condensate cannot flow off.

Additional valves are therefore required for draining the individual parts of a plant after shut-down. These may be in the form of stop valves which have to be opened by hand, but also of GESTRA drain valves type AK 45 or GESTRA steam traps type UBK 46 which open automatically.

GESTRA DISCO non-return valves may be used as automatic vacuum breakers.

The following examples of installation refer only to systems equipped with steam traps which, if correctly installed are self-draining. The other trap types would need manual drainage either by opening drain plugs, if provided, or by using special valves.

**Danger of freezing:**

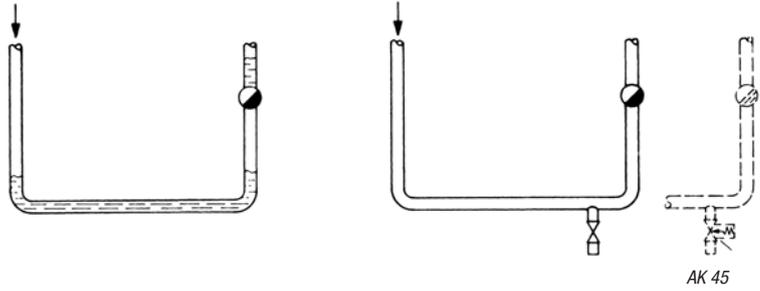
**Remedy:**

**Fig. 19**

Pipelines upstream and downstream of trap will freeze. The condensate above the trap freezes if the trap functions also as non-return valve so that the condensate cannot flow back.

Use trap without non-return valve effect.

Drain pipeline manually or automatically with a GESTRA drain valve type AK 45. The AK opens automatically as soon as the pressure in the system drops below 2 bar (29 psi) – the opening pressure can be adjusted. The pipeline should preferably be installed so that the condensate is free to flow towards the valve.



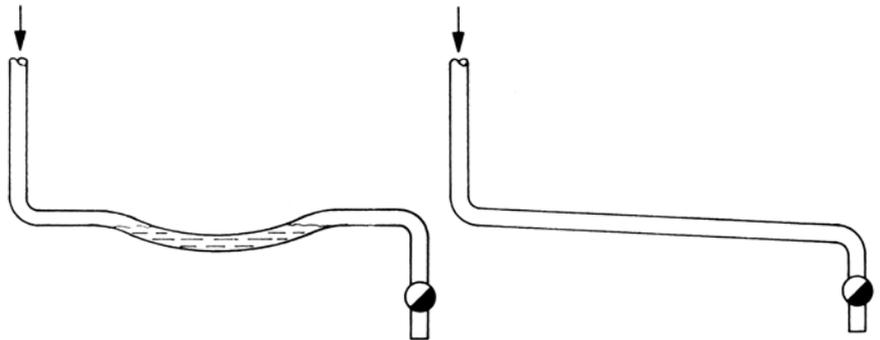
**Danger of freezing:**

**Remedy:**

**Fig. 20**

Pipeline is sagging (water pockets) and will freeze.

Remove water pocket. Lay pipeline so that condensate is free to flow towards the trap.



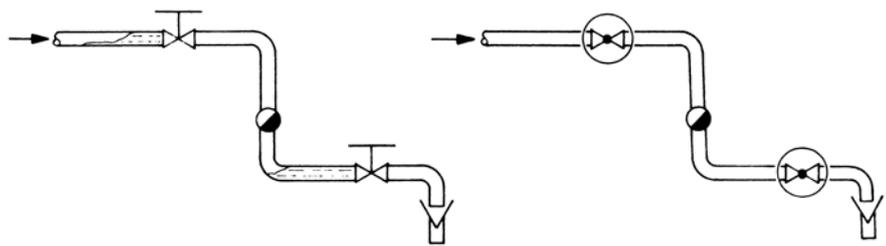
**Danger of freezing:**

**Remedy:**

**Fig. 21**

Pipeline upstream of valves will freeze because reversal of flow inside valve prevents the condensate from flowing off completely.

Use slide valves, install valve into vertical lines or install valve so that its spindle is horizontal. If possible lay pipeline so that the condensate is free to flow towards the valves.



**Danger of freezing:**

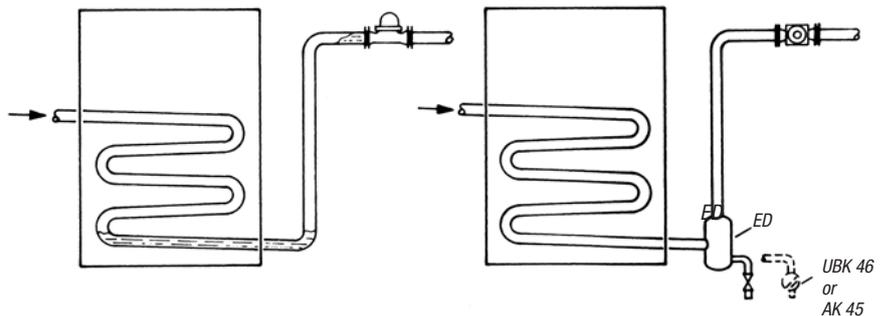
**Remedy:**

**Fig. 22**

The lowest heating coil will freeze. Line upstream of trap may freeze.

Mount a GESTRA condensate dampening pot type ED for the prevention of waterhammer between coil and trap and drain it either manually or automatically with a GESTRA stream trap type UBK 46 or a drain valve type AK 45. If the amount of condensate formed is low the ED is not necessary. In this case the line should be drained at its lowest point.

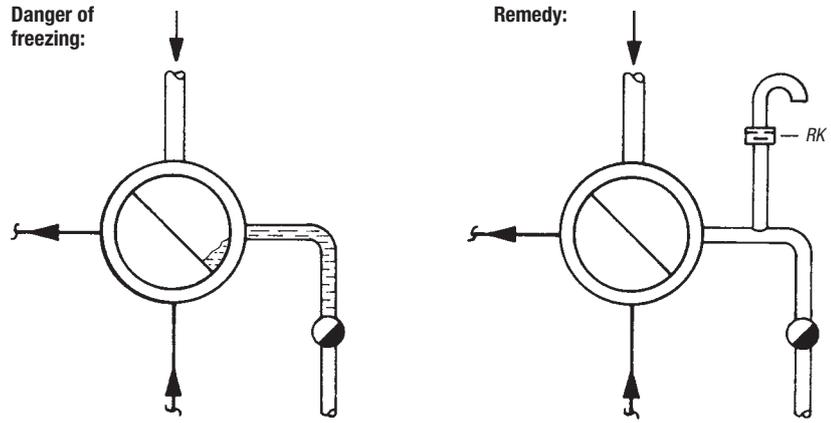
Install thermostatic and thermodynamic traps with their covers pointing sideways.



**Fig. 23**

*Pipeline and possibly part of the heat exchanger will freeze as condensation of the remaining steam produces a vacuum so that the condensate cannot flow off.*

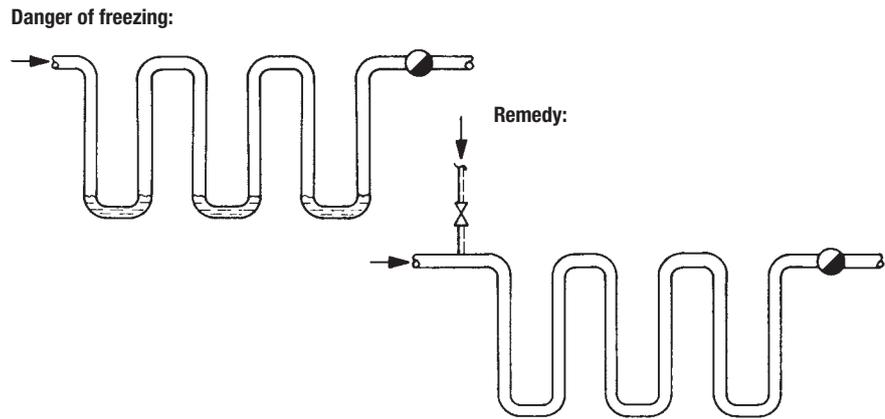
*Prevent the formation of vacuum by installing a GESTRA DISCO non-return valve as vacuum breaker.*



**Fig. 24**

*The heating coil will freeze at all low points. Very unfavourable pipe layout.*

*Empty pipelines by blowing compressed air through them. Only traps should be used with sufficient air-venting capacity.*





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