# Refrigerated sales cabinet

The present invention relates to a refrigerated sales cabinet.

In the prior art, refrigerated sales cabinets are known in which the compressor of a vapor compression cycle is arranged at or within the cabinet body. In such vapor compression cycle, a refrigerant circulates through the elements of the vapor compression cycle, in particular through the compressor, a condenser, an expansion device and an evaporator. The refrigerant can be flammable or non-flammable.

There may occur situations where refrigerant, especially a flammable refrigerant such as R290, exits the vapor compression cycle through one or more leaks which can cause fire or even an explosion. Some refrigerants, including flammable refrigerants have the tendency to sink down to the bottom of the refrigerated sales cabinet, when having exited the vapor compression cycle through a leak. This is dangerous, since if the amount of leaked refrigerant which collects at the bottom of the refrigerated sales cabinet exceeds a certain threshold, there is a high risk of fire or even an explosion, if such leaked refrigerant is somehow ignited.

There are regulations that limit the acceptable amount of leaked refrigerant, particularly at the bottom of the refrigerated sales cabinet. For example, the European regulation EN 60335-2-89 limits the acceptable amount of leaked refrigerant at the bottom of the refrigerated sales cabinet such that the concentration of the flammable gas is sufficiently below the lower flammability limit..

It is therefore an object of the present invention to provide a refrigerated sales cabinet which significantly reduces the risk of damage by leaked refrigerant and which meets the typical requirements of the existing regulations with respect to the acceptable amount of leaked refrigerant.

A refrigerated sales cabinet according to exemplary embodiments of the invention comprises: a cabinet body, the cabinet body having a rear wall; a compressor of a vapor compression cycle arranged within a compressor compartment; and a riser

conduit having an inlet port at the compressor compartment and an outlet port positioned outside, particularly behind the cabinet body and above the inlet port such that gas, including leaked refrigerant may flow from the compressor compartment through the riser conduit and exit the riser conduit through the outlet port to mix with ambient air.

The inventors of the present patent invention have understood that the risk of refrigerant leaking out of the vapor compression cycle is particularly high at or in the vicinity of the compressor, since the refrigerant within the compressor or leaving the compressor through the pressure line is at a high pressure level, and since the refrigerant conduit at the compressor typically comprises bent and welded portions and/or manifolds, which are susceptible for forming leaks therein. Typically the compressor is arranged at the bottom of the refrigerated sales cabinet, and therefore the bottom of the refrigerated sales cabinet is typically the area where leaks are formed.

By the exemplary embodiments of the invention the risk that leaked flammable refrigerant collects at the bottom of the refrigerated sales cabinet, particularly within the compressor compartment, and constitutes a considerable risk of fire and explosion, can be considerably reduced or even fully avoided.

Hot, particularly pressurized refrigerant that might exit the vapor compression cycle through a leak at the compressor or in the vicinity of the compressor, rises through the riser conduit and exits the same through its outlet port to mix with ambient air.

Thus, leaked refrigerant can be reliably evacuated from the compressor compartment, which can also be called machine room. It is reliably avoided that such leaked refrigerant will collect in the bottom portion of the refrigerated sales cabinet, particularly in the compressor compartment, where it would constitute a risk of fire or explosion.

Accordingly, the refrigerated sales cabinet according to exemplary embodiments of the invention ensures that the refrigerant concentration at the bottom of the refrigerated sales cabinet, particularly within the compressor compartment will stay below the acceptable threshold stipulated by the typical regulations, including the European regulation EN60335-2-89.

Furthermore, such riser is comparably easy and cheap to manufacture and to retrofit within existing refrigerated sales cabinet. No additional elements like fans are necessary.

The reason why some refrigerants, including typical flammable refrigerants such as R290 have the tendency to sink down to the bottom of the refrigerated sales cabinet, when having exited the vapor compression cycle through a leak, is that they are heavier than air, particularly have a higher density than air. Therefore they tend to collect in the lowermost portion of the refrigerated sales cabinet, particularly in the compressor compartment.

However, when exiting the vapor compression cycle through a leak at or in the vicinity of the compressor, such leaked refrigerant is at a higher pressure level than the air within the compressor compartment.

Therefore, the inventors of the present patent application have discovered that such higher pressure level causes the leaked refrigerant to flow through the riser conduit and to exit the same through its outlet port where it mixes with ambient air. This pressure differential is used to efficiently evacuate leaked refrigerant from the compressor compartment.

The gas which is contained within the compressor compartment typically is air which can be mixed with leaked gaseous refrigerant, which is undesirable. Therefore, the expression “gas, including leaked refrigerant” is used to specify the gas or gas - leaked refrigerant mixture within the compressor compartment.

When such discharged leaked refrigerant has mixed with ambient air, particularly at a position behind the rear wall of the cabinet body, such refrigerant and air mixture still is heavier than the ambient air and tends to sink down, however, the concentration of the refrigerant, particularly the flammable refrigerant, in such mixture is lower than the acceptable threshold stipulated in any of the existing regulations and is small enough such that there is no risk of fire or explosion.

The diameter or cross-sectional area of the riser conduit should be large enough such that it provides a comparably low flow resistance.

The refrigerant sales cabinet is of the front access type and can be equipped with or without doors at its front access portion.

A suitable number of shelves on which the goods to be presented can be placed and supported can be provided within the refrigerated sales space.

The cabinet body typically provides a refrigerated sales space for storing goods to be presented therein.

The compressor compartment is typically located at or in a rear part of a bottom portion of the cabinet body.

In a first embodiment, the riser conduit extends substantially in a vertical direction, which provides for a particularly efficient discharge of the gas, particularly the leaked refrigerant from the compressor compartment.

In another embodiment, the outlet port of the riser conduit is located behind the rear wall of the cabinet body at a height between a middle portion of the rear wall and the roof portion, particularly at a height of 1.50 to 2.00 meters above the floor on which the refrigerated sales cabinet stands.

If the outlet port is located at such height, the gas, including the leaked refrigerant exiting such outlet port will mix sufficiently with ambient air before sinking down to a bottom portion outside the refrigerated sales cabinet.

The riser conduit can be located at, within or behind the rear wall of the refrigerated sales cabinet.

According to another embodiment, at least a portion of the riser conduit is formed by the rear face of the rear wall of the cabinet body and a ledge, particularly a U-shaped ledge mounted on the rear face of the real wall of the refrigerated sales cabinet.

In another embodiment where the inlet port of the riser conduit is arranged at an upper portion of the compressor compartment, the gas, particularly the leaked refrigerant can be discharged efficiently into an upper direction.

The outlet port of the riser conduit can be arranged at or behind the rear wall of the refrigerated sales cabinet so as to discharge the gas, including the leaked refrigerant, to an environment behind the refrigerated sales cabinet, such that the gas, in particularly the leaked refrigerant exiting such outlet port will mix with ambient air behind the rear wall of the cabinet body.

According to another embodiment, the riser conduit is formed as a fanless riser conduit. For cost and manufacturing reasons, it is particularly advantageous that no additional components like fans, pumps or the like are needed for discharging the gas, particularly the leaked refrigerant through such riser conduit.

According to another embodiment, the compressor compartment is arranged at or in the rear wall of the cabinet body.

The compressor compartment can enclose at least one compressor and separate the interior of the compressor compartment in which the at least one compressor is arranged, from the refrigerated sales space and/or from the outside of the refrigerated sales cabinet.

The rear side of the compressor compartment can be formed by a removable rear cover closing an opening within the rear wall of the cabinet body.

Such compressor compartment provides for a compact design and a safe and reliable operation of the refrigerated sales cabinet while maximising the size of the available refrigerated sales space. It has been found out, that such compressor compartments often are not fully not gas-tight such that gas, particularly refrigerant, can flow out of the same through existing gaps and can accumulate on the floor on which the refrigerated sales cabinet stands, where it would form a risk of fire or explosion. This risk, however, is significantly reduced or even fully avoided by the provision of a riser conduit according to the exemplary embodiment of the invention.

If the rear cover of the compressor compartment is removable, this allows for efficient repair, maintenance and replacement operation of the compressor.

The refrigerated sales cabinet can be formed as semi-plug-in cabinet; wherein the vapor compression cycle comprises at least one compressor, at least one con-

denser, an expansion device and an evaporator and refrigerant conduits interconnecting these elements and circulating a refrigerant therethrough; and wherein the at least one condenser is formed as a heat exchanger transferring heat from the compressed hot refrigerant to a brine.

Such brine typically comprises brine conduits arranged at or on top of the roof portion of the refrigerated sales cabinet. Such semi-plug-in cabinet does not have condenser fans which could contribute to mixing the gas, particularly the leaked refrigerant discharged from the compressor compartment.

The refrigerated sales cabinet can also be formed as a plug-in cabinet; wherein the vapor compression cycle comprises at least one compressor, at least one condenser, an expansion device and an evaporator and refrigerant conduits interconnecting these elements and circulating a refrigerant therethrough; and wherein the at least one condenser is formed as a heat exchanger transferring heat from the compressed hot refrigerant to ambient air.

The at least one condenser can be equipped with one or more condenser fans. When arranging the outlet port of the riser conduit in the vicinity of such condenser fans, the gas, particularly the leaked refrigerant discharged from the compressor compartment can be mixed particularly efficiently with ambient air at or above the roof portion of the refrigerated sales cabinet.

According to another embodiment, the at least one condenser is arranged at or on top of a roof portion of the cabinet body. The vapor compression cycle can further comprise a pressure line extending between the at least one compressor and the at least one condenser. The pressure line can extend behind the rear wall of the cabinet body and can be covered, at least partially, by a ledge, particularly a U-shaped ledge, mounted on the rear face of the real wall of the refrigerated sales cabinet, seen from behind. Such ledge protects the pressure line, for example during transport of the refrigerated sales cabinet.

According to another embodiment, the interior space of the ledge, enclosed by the rear face of the rear wall of the cabinet body and the inner surfaces of the ledge and which is not occupied by the pressure line, forms the riser conduit. The cross section of such interior space can be in the range of 2 to 8 $cm^2$.

In this embodiment the interior space of the ledge which is provided for protecting the pressure line from behind can be used as riser conduit or at least as part of the riser conduit.

The cross-sectional area of the riser conduit can be in the range of 2 to 8 $cm^2$ providing for an efficient discharge of a gas, particularly the leaked refrigerant from within the compressor compartment.

Alternatively, the riser conduit can be formed separately from the pressure line, for example as a separate vertical riser conduit mounted to the rear face of the rear wall of the cabinet body.

A refrigerated sales cabinet according to another exemplary embodiment of the invention comprises a cabinet body having a rear wall; a refrigerant containing component located in the lower section of the refrigerated sales cabinet; and a riser conduit having an inlet port at the refrigerant containing component and an outlet port positioned outside, particularly behind the cabinet body and above the inlet port such that gas, including leaked refrigerant flows from the refrigerant containing component through the riser conduit and exits the riser conduit through the outlet port.

All the advantages and embodiments as explained above also apply to such refrigerated sales cabinet and will not be repeated here for reasons of brevity.

The refrigerant containing component can be any refrigerant containing component located in the lower section of the cabinet having a potential leak without significant air flow. By way of such riser conduit, the refrigerant is quickly dispersed.

In the following, a refrigerated sales cabinet according to exemplary embodiments of the invention is described in more detail with respect to the enclosed Figs.

Fig. 1 shows a schematic side view of a refrigerated sales cabinet according to an embodiment of the invention;

Fig. 2 shows a rear view onto the refrigerated sales cabinet of Fig. 1;

Fig. 3 shows a more detailed perspective side view of the refrigerated sales cabinet of Figs. 1 and 2; and

Fig. 4 shows a schematic horizontal cross-sectional view of the rear wall, the pressure line, the riser conduit and the U-shaped ledge of the refrigerated sales cabinet, taken along the line A-A-in Fig. 2.

The refrigerated sales cabinet 2 is of the front access type and can be provided with or without doors on the front. The refrigerated sales cabinet 2 can be a freezing cabinet providing freezing temperatures within the refrigerated sales space and comprising doors on the front (not shown). The refrigerated sales cabinet can also be a cabinet providing cooling temperatures of above 0°C within the refrigerated sales space, without doors on the front (as shown). In the appended Figs. 1 and 3, the side walls are omitted for purpose of illustration.

As shown in Fig. 1, the cabinet body of the refrigerated sales cabinet comprises substantially horizontal bottom and roof portions and a rear wall 12 connecting the rear ends of the bottom and roof portions. The bottom and roof portions, the rear wall 12 and the side walls (not shown) and, optionally, doors provided at the front (not shown) enclose a refrigerated sales space 6 in which refrigerated goods to be sold are supported and presented, e.g. on shelves 8.

The refrigerated sales space 6 formed in the interior of the cabinet body 4 is enclosed by a bottom plate, a particularly perforated rear wall and a ceiling plate. A cooling air cycle circulates through the intermediate spaces between the bottom plate of the refrigerated sales space 6 and the bottom portion of the cabinet body 4, between the rear wall of the refrigerated sales space 6 and the rear wall 12 of the cabinet body 4 and between the ceiling plate of the refrigerated sales space 6 and the roof portion of the cabinet body 4.

In these intermediate spaces, particularly between the rear wall of the refrigerated sales space 6 and the rear wall 12 of the cabinet body 4 at least one evaporator 30 can be arranged which is shown in Fig. 3.

The cooled air exits through a cold air supply baffle at the front end of the ceiling plate, flows downward forming a cooling air curtain and enters the return air baffle at the front end of the bottom plate of the refrigerated sales space 6.

The refrigerated sales cabinet 2 can be formed as plug-in cabinet or a semi-plug-in cabinet, which means that all the elements of the vapor compression cycle, namely at least a compressor 6, a condenser 20, an expansion device (not shown), an evaporator 30 (see Fig. 3) and refrigerant conduits circulating a refrigerant therethrough, are integrated within or arranged at the refrigerated sales cabinet 2.

At the bottom portion of the rear side of the refrigerated sales cabinet 2, there is arranged a compressor compartment 14 enclosing a/the compressor 16. In the present embodiment, the compressor compartment 14 is arranged within the rear wall 12 of the cabinet body 4. The compressor compartment 14 comprises a bottom plate, a front cover, a top cover and a removable rear cover (not shown in Fig. 1). The front cover of the compressor compartment 14 is arranged behind the lower portion of the rear wall of the refrigerated sales space 6 so as to provide a passage for the cooling air circuit therebetween.

The condenser 20 is located on top of the roof portion of the cabinet body 4. A pressure line 18 connects the discharge side of the compressor 16 to the inlet side of the condenser 20. This pressure line 16 exits the compressor compartment 14 through its top cover, it extends along the rear face of the rear wall 12 of the cabinet body 4, is mounted with appropriate clamps or ledges to the rear wall 12, makes a bend at its upper end and connects to the inlet port of the condenser 20.

If the refrigerated sales cabinet 2 is formed as a semi-plug-in cabinet, the condenser 20 transfers heat from the compressed hot refrigerant to a brine circuit (not shown). The brine circuit typically comprises brine conduits located on top of the roof portion of the refrigerated sales cabinet 2.

If the refrigerated sales cabinet 2 is formed as a plug-in cabinet, the condenser 20 is transferring heat from the compressed hot refrigerant to the ambient air, and typically also comprises condenser fans improving such heat transfer efficiency.

The refrigerated sales cabinet 2 further comprises a riser conduit 22 having an inlet port 24 and an outlet port 26. The inlet port 24 is located at an upper rear portion of the compressor compartment 14. The outlet port 26 is arranged at a height

of typically 1,50 to 2,00 m above the floor on which the refrigerated sales 2 stands.

The riser conduit 22 is formed in a fanless fashion and discharges gas, including leaked refrigerant exiting the vapor compression cycle at or in the vicinity of the compressor 16 in an upwards direction. Such leaked refrigerant is typically at a higher pressure level than the surrounding gas, particularly the air within the compressor compartment 14.

Such discharged gas, including leaked refrigerant exits the riser conduit 22 through its outlet port 26 and mixes with ambient air behind the refrigerated sales cabinet 2. Thus the risk of fire or explosion resulting from leaked flammable refrigerant is significantly reduced or even fully avoided.

Fig. 2 shows a rear view onto the rear wall 12 of the refrigerated sales cabinet 2.

The rear cover of the compressor compartment 14 can be formed as removable rear cover plate. Furthermore, it can be seen that the riser conduit 22 is formed as a U-shaped ledge 34 mounted to the rear face of the rear wall 12 of the cabinet body 4, for example by lateral attachment flanges that are screwed or otherwise connected with the rear wall 12. This is shown in greater detail in Fig. 4.

In the embodiment of Fig. 2, the outlet port 26 is at a position below the roof portion of the cabinet body 4, however, it can also be positioned higher or in the vicinity of the roof portion of the cabinet body 4.

In Fig. 2 only one compressor with compressor compartment 14, one riser conduit 22, one pressure line 18 and one condenser 20 are shown. However, it is to be understood that the refrigerated sales cabinet 2 can also be equipped with a plurality of such arrangements

Fig. 3 shows a perspective side view of a refrigerated sales cabinet 2 in which more details are visible.

The particularly perforated rear wall of the refrigerated sales space 6 is omitted for the purpose of illustration.

The evaporator 30 is arranged in front of the rear wall 12 of the cabinet body 4. Furthermore, it can be seen that the removable rear cover 32 of the compressor compartment 14 closes an opening within the rear wall 12 of the cabinet body 4. Furthermore, elements like a night blind, lighting means, structural elements and isolation means are depicted.

The riser conduit extends from an inlet port 24 at an upper rear portion of the compressor compartment 14 to an outlet port 26 positioned approximately at 2/3 of the total height of the cabinet body 4. By way of such riser conduit 22, as already explained above, gas, including leaked refrigerant, can be discharged to mix with ambient air such that the risk of fire or explosion can be significantly reduced or even fully avoided.

Fig. 4 shows a schematic horizontal cross-sectional view of the rear wall 12, the pressure line 18, the riser conduit 22 and the U-shaped ledge 34 of the refrigerated sales cabinet 2, taken along the line A-A-in Fig. 2.

The riser conduit 22 is formed as a U-shaped ledge 34 mounted to the rear face of the rear wall 12 of the cabinet body 4, for example by lateral attachment flanges 36 that are screwed or otherwise connected with the rear wall 12.

The rear face of the rear wall 12 of the cabinet body 4 and the inner surfaces of the U-shaped ledge 34, particularly of the rear wall and the side wall portions of the U-shaped ledge 34, enclose both the pressure line 18 and the riser conduit 22.

The pressure line 18 occupies part of the cross-sectional area of the interior space enclosed by the rear face of the rear wall 12 and the inner surfaces of the U-shaped ledge 34, and the interior space of such cross-sectional area which is not occupied by the pressure line 18 forms the riser conduit 22.

The cross-sectional area of such interior space is typically in the range of 2 to 8 $cm^2$.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without depart-

ing from the scope of the claims. In addition many modifications may be made to adopt a particular situation or material to the teachings of the invention without departing from the scope of the claims. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed, but that the invention includes all embodiments falling within the scope of the claims.

List of reference numerals

2 refrigerated sales cabinet
4 cabinet body
6 refrigerated sales space
8 shelves
10 front access portion
12 rear wall
14 compressor compartment
16 compressor
18 pressure line
20 condenser
22 riser conduit
24 inlet port
26 outlet port
30 evaporator
32 removable rear cover
34 U-shaped ledge
36 lateral attachment flanges

Claims

1. Refrigerated sales cabinet (2) comprising
a cabinet body (4) having a rear wall;
a compressor (16) of a vapor compression cycle arranged within a compressor compartment (14); and
a riser conduit (22) having an inlet port (24) at the compressor compartment (14) and an outlet port (26) positioned outside, particularly behind the cabinet body (4) and above the inlet port (24) such that gas, including leaked refrigerant flows from the compressor compartment (14) through the riser conduit (22) and exits the riser conduit (22) through the outlet port (26).

2. Refrigerated sales cabinet (2) of claim 1,
wherein the riser conduit (22) extends substantially in a vertical direction.

3. Refrigerated sales cabinet (2) of claim 1 or 2,
where in the outlet port (26) of the riser conduit (22) is located behind the rear wall (12) of the cabinet body (4) at a height between a middle portion of the rear wall (12) and the roof portion, particularly at a height of 1.50 to 2.00 meters above the floor on which the refrigerated sales cabinet (2) stands.

4. Refrigerated sales cabinet (2) according to any of the preceding claims,
wherein the riser conduit (22) is located at, within or behind the rear wall (12) of the refrigerated sales cabinet (2).

5. Refrigerated sales cabinet (2) according to any of the preceding claims,
wherein at least a portion of the riser conduit (22) is formed by the rear face of the rear wall (12) of the cabinet body (4) and a ledge (34), particularly a U-shaped ledge (34) mounted on the rear face of the rear wall (12) of the refrigerated sales cabinet (2).

6. Refrigerated sales cabinet (2) according to any of the preceding claims,
wherein the inlet port (24) of the riser conduit (22) is arranged at an upper portion of the compressor compartment (14); and/or

wherein the outlet port (26) of the riser conduit (22) is arranged at or behind the rear wall (12) of the refrigerated sales cabinet (2) so as to discharge the gas, including the leaked refrigerant, from the compressor compartment (14) to an environment behind the refrigerated sales cabinet (2).

7. Refrigerated sales cabinet (2) according to any of the preceding claims, wherein the riser conduit (22) is formed as a fanless riser conduit (22).

8. Refrigerated sales cabinet (2) according to any of the preceding claims, wherein the compressor compartment (14) is arranged at or in the rear wall (12) of the cabinet (2) body; and/or

wherein the compressor compartment (14) encloses at least one compressor (16) and separates the interior of the compressor compartment (14) from the refrigerated sales space (6) and/or from the outside of the refrigerated sales cabinet (2); and/or

wherein the rear side of the compressor compartment (14) is formed by a removable rear cover (32) closing an opening within the rear wall (12) of the cabinet body (4).

9. Refrigerated sales cabinet (2) according to any of the preceding claims, wherein the refrigerated sales cabinet (2) is formed as a semi plug-in cabinet (2);

wherein the vapor compression cycle comprises at least one compressor (16), at least one condenser (20), an expansion device and an evaporator (30) and refrigerant conduits interconnecting these elements and circulating a refrigerant therethrough; and

wherein the at least one condenser (20) is formed as a heat exchanger transferring heat from the compressed hot refrigerant to a brine.

10. Refrigerated sales cabinet (2) according to any of claims 1 to 8, wherein the refrigerated sales cabinet (2) is formed as a plug-in cabinet;

wherein the vapor compression cycle comprises at least one compressor (16), at least one condenser (20), an expansion device and an evaporator (30) and refrigerant conduits interconnecting these elements and circulating a refrigerant therethrough; and

wherein the at least one condenser (20) is formed as a heat exchanger transferring heat from the compressed hot refrigerant to ambient air.

11. Refrigerated sales cabinet (2) according to claim 9 or 10,

wherein the at least one condenser (20) is arranged at or on top of a roof portion of the cabinet body (4);

wherein the vapor compression cycle further comprises a pressure line (18) extending between the at least one compressor (16) and the at least one condenser (20); and

wherein the pressure line (18) extends behind the rear wall (12) of the cabinet body (4) and is covered, at least partially, by a ledge (34), particularly a U-shaped ledge (34), mounted on the rear face of the real wall (12) of the refrigerated sales cabinet (2), seen from behind.

12. Refrigerated sales cabinet (2) according to claim 11,

wherein the interior space of the ledge (34), enclosed by the rear face of the rear wall (12) of the cabinet body (4) and the inner surfaces of the ledge (34) and which is not occupied by the pressure line (18), forms at least part of the riser conduit (22); and/or

wherein the cross sectional area of such interior space is in the range of 2-8 $cm^2$; or wherein the riser conduit (22) is formed separately from the pressure line (18).

13. Refrigerated sales cabinet (2) comprising

a cabinet body (4) having a rear wall;

a refrigerant containing component located in the lower section of the refrigerated sales cabinet; and

a riser conduit having an inlet port (24) at the refrigerant containing component and an outlet port (26) positioned outside, particularly behind the cabinet body (4) and above the inlet port (24) such that gas, including leaked refrigerant flows from the refrigerant containing component through the riser conduit (22) and exits the riser conduit (22) through the outlet port (26).