Claims:

1. A pressure relief valve for use in connection with a high pressure fluid system, said pressure relief valve comprising a protective cap for limiting the exposure of personnel to a high pressure fluid venting from the pressure relief valve in response to an over pressure condition within the fluid system.

2. The pressure relief valve as set forth in clam 1 wherein said protective cap includes a skirt flange disposed to deflect the high pressure fluid venting from the pressure relief valve.

3. The pressure relief valve as set forth in claim 2 further comprising a valve body having at least one vent hole establishing fluid flow communication between a valve chamber and an environment external of said valve body, said protective cap mounted to said valve body with said skirt flange defining a surface juxtaposed opposite the at least one vent hole for deflecting the high pressure fluid venting through the at least vent hole along an exterior of said valve body.

4. The pressure relief valve as set forth in claim 1 installed on a transport refrigeration unit having a refrigeration vapor compression system charged with carbon dioxide as a refrigerant.

5. The pressure relief valve as set forth in claim 1 wherein said pressure relief valve comprises a spring-loaded pressure relief valve.

6. The pressure relief valve as set forth in claim 1 wherein said pressure relief valve comprises a rupture disc pressure relief valve.

7. A pressure relief valve for use in connection with a high pressure fluid system comprising:

a valve body extending along a longitudinal axis and defining a valve chamber, said valve body having a proximal end and a distal end longitudinally opposite said proximal end, said distal end having at least one vent hole opening through said distal end and providing a fluid flow passage for venting high pressure fluid from the valve chamber to an environment exterior of the valve body in a direction generally transverse to the longitudinal axis; and

a protective cap mounted to said distal end, said protective cap having a skirt flange disposed in spaced relationship to said distal end and defining a surface juxtaposed opposite

the at least one vent hole for deflecting high pressure fluid venting from the valve chamber through the at least one vent hole away from an outwardly directed path generally transverse to the longitudinal axis of the valve body.

8. The pressure relief valve as set forth in claim 7 wherein said surface defined by said skirt flange extends generally parallel to the longitudinal axis of the valve body.

9. The pressure relief valve as set forth in claim 7 wherein:

the at least one vent hole comprises a plurality of circumferentially spaced vent holes disposed about a circumference of said distal end of the valve body; and

said skirt flange comprises a circumferential extending flange circumscribing said distal end of the valve body.

10. The pressure relief valve as set forth in claim 7 wherein said surface defined by said skirt flange deflects high pressure fluid venting from the valve chamber through the at least one vent hole in a direction generally toward a proximal end of the valve body.

11. The pressure relief valve as set forth in claim 7 wherein said surface defined by said skirt flange deflects high pressure fluid venting from the valve chamber through the at least one vent hole in a direction generally along an exterior surface of the valve body.

12. The pressure relief valve as set forth in claim 7 wherein said protective cap comprises a cylindrical cap body secured to said distal end of the valve body, the cap body having a closed base end and an open end, said skirt flange extending circumferentially about the open end of the cap body.

13. The pressure relief valve as set forth in claim 12 wherein the cap body is threaded directly to said distal end of the valve body.

14. The pressure relief valve as set forth in claim 12 wherein the cap body is threaded to an intermediate member and the intermediate member is threaded directly to said distal end of the valve body.

15. The pressure relief valve as set forth in claim 12 further comprising a circumferential seal member disposed between an inner circumferential surface of the cap body and an outer circumferential surface of said distal end of the valve body.

16. The pressure relief valve as set forth in claim 15 wherein the circumferential seal member comprises a compressible O-ring seal.

17. A refrigerant vapor compression system comprising:

a refrigerant circuit charged with carbon dioxide as a refrigerant and having in serial refrigerant flow relationship a compression device for comprising a refrigerant, a refrigerant heat rejection heat exchanger, a first expansion device, an economizer, a second expansion device, and a refrigerant heat absorption heat exchanger disposed in heat exchange relationship with air to be refrigerated and supplied to a cargo box of a refrigerated transport container; and

at least one pressure relief valve disposed in said refrigerant circuit for relieving pressure therein when the pressure exceeds a predetermined pressure level, said at least one pressure relief valve having a protective cap for limiting the exposure of personnel to high pressure refrigerant vapor venting from said at least one pressure relief valve in response to an over pressure condition within the refrigerant circuit.

18. The refrigerant vapor compression system as set forth in claim 17 wherein said at least one pressure relief valve includes a pressure relief disposed between the compression device and the refrigerant heat rejection heat exchanger, said pressure relief valve configured to actuate when exposed to a predetermined pressure level in the refrigerant circuit selected in the range from about 2200 psia to about 2500 psia.

19. The refrigerant vapor compression system as set forth in claim 17 wherein said at least one pressure relief valve includes a pressure relief disposed between the refrigerant heat absorption heat exchanger and the compression device, said pressure relief valve configured to actuate when exposed to a predetermined pressure level in the refrigerant circuit selected in the range from about 1300 psia to about 1500 psia.

20. The refrigerant vapor compression system as set forth in claim 17 wherein said at least one pressure relief valve includes a pressure relief disposed between the first expansion device and the economizer.

CLAIMS

1. A pressure relief valve (20) for use in connection with a high pressure fluid system comprising:

   a valve body (24) extending along a longitudinal axis and defining a valve chamber (30), said valve body (24) having a proximal end (26) and a distal end (28) longitudinally opposite said proximal end (26), said distal end (28) having at least one vent hole (50) opening through said distal end (28) and providing a fluid flow passage for venting high pressure fluid from the valve chamber (30) to an environment exterior of the valve body (24) in a direction generally transverse to the longitudinal axis; and

   a protective cap (22) mounted to said distal end (28), said protective cap (22) having a skirt flange (54) disposed in spaced relationship to said distal end (28)and defining a surface juxtaposed opposite the at least one vent hole (50) for deflecting high pressure fluid venting from the valve chamber (24) through the at least one vent hole (50) away from an outwardly directed path generally transverse to the longitudinal axis of the valve body (24);

   wherein said protective cap (22) comprises a cylindrical cap body secured to said distal end (28) of the valve body (24), the cap body having a closed base end and an open end, said skirt flange (54) extending circumferentially about the open end of the cap body; and characterized in that the inner circumferential surface (66) of the protective cap (22) is juxtaposed radially outboard of and in spaced relationship with the outer circumferential surface (68) of the tip portion of the distal end (28) of the valve body (24) thereby forming a gap therebetween;

   a circumferential seal member (70) is disposed between the inner circumferential surface (66) of the cap body and the outer circumferential surface (68) of said distal end (28) of the valve body (24);

   the open distal end (28) of the valve body (24) is provided with internal threads; a set screw (60) being provided with external threads, the set screw (60) being threaded into the open distal end (28) of the valve body (24); and

   the closed base end of the cap body (52) has a threaded recess (62) formed in the inside face (64) of the protective cap (22) facing the open distal end (28) of the valve body (24); the threaded recess (62) of the protective cap (22) being threaded onto the external threads of the set screw (60), or

   said closed base end of the cap body (52) has a threaded head (74) formed on and extending axially outwardly from the inside face (64) of the protective cap (22) facing the open distal end (28) of the valve body (24), said threaded head (74) of the protective cap (22) being threaded into the interiorly threaded set screw (60).

2. The pressure relief valve (20) as set forth in claim 1 wherein said surface defined by said skirt flange (54) extends generally parallel to the longitudinal axis of the valve body (24).

3. The pressure relief valve (20) as set forth in claim 1 wherein the at least one vent hole (50) comprises a plurality of circumferentially spaced vent holes (50) disposed about a circumference of said distal end (28) of the valve body (24); and

   said skirt flange (54) comprises a circumferential extending flange circumscribing said distal end (28) of the valve body (24).

4. The pressure relief valve (20) as set forth in claim 1 wherein said surface defined by said skirt flange (54) deflects high pressure fluid venting from the valve chamber (30) through the at least one vent hole (50) in a direction generally toward a proximal end (26) of the valve body (24).

5. The pressure relief valve (20) as set forth in claim 1 wherein said surface defined by said skirt flange (54) deflects high pressure fluid venting from the valve chamber (30) through the at least one vent hole (50) in a direction generally along an exterior surface of the valve body (24).

6. The pressure relief valve (20) as set forth in claim 1 wherein the cap body is threaded directly to said distal end (28) of the valve body (24).

7. The pressure relief valve (20) as set forth in claim 1 wherein the cap body is threaded to an intermediate member and the intermediate member is threaded directly to said distal end (28) of the valve body (24).

8. The pressure relief valve (20) as set forth in claim 1 wherein the circumferential seal member (70) comprises a compressible O-ring seal.

9. A refrigerant vapor compression system (100) comprising:

   a refrigerant circuit charged with carbon dioxide as a refrigerant and having in serial refrigerant flow relationship a compression device (102) for compressing a refrigerant, a refrigerant heat rejection heat exchanger (104), a first expansion device (112), an economizer (106), a second expansion device (108), and a refrigerant heat absorption heat exchanger (110) disposed in heat exchange relationship with air to be refrigerated and supplied to a cargo box of a refrigerated transport container; and

   at least one pressure relief valve (20) according to any of the previous claims disposed in said refrigerant circuit for relieving pressure therein when the pressure exceeds a predetermined pressure level.

10. The refrigerant vapor compression system as set forth in claim 9 wherein said at least one pressure relief valve (20) includes a pressure relief disposed between the compression device (102) and the refrigerant heat rejection heat exchanger (104), said pressure relief valve (20) configured to actuate when exposed to a predetermined pressure level in the refrigerant circuit selected in the range from about 2200 psia (152 bar) to about 2500 psia (172 bar).

11. The refrigerant vapor compression system as set forth in claim 9 wherein said at least one pressure relief valve (20) includes a pressure relief disposed between the refrigerant heat absorption heat exchanger (110) and the com pression device (102), said pressure relief valve (20) configured to actuate when exposed to a predetermined pressure level in the refrigerant circuit selected in the range from about 1300 psia (90 bar) to about 1500 psia (103 bar).

12. The refrigerant vapor compression system as set forth in claim 9 wherein said at least one pressure relief valve (20) includes a pressure relief disposed between the first expansion device (112) and the economizer (106).