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PRESSURE RELIEF DEVICE



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BACKGROUND TO THE INVENTION

In the open flow system as found in hot water hand wash system, hot shower
5 system or similar such system, when in operation, water at ambient temperature is
admitted continuously into a canister with a heating device positioned within and
with said heating device heating up said continuous flow of water. Subsequently the
heated water exits continuously through an outlet connected to the canister when the
system is still in operation. In the unfortunate event whereby the outlet connected to
10 the canister is obstructed when the system is still in operation water contained within
said canister gets heated to a high temperature level and with the pressure built up
within said canister reaching an unsafe level. If the built up pressure within the
canister is not safely relieved further increase in the built up pressure can have
detrimental effects typically rupture of said canister and endangering any personnel
15 in the vicinity. To reduce the possibility of such an event happening pressure relief
device is commonly incorporated onto the canister to relief the pressure built up
within said canister.

Pressure relief devices for the above mentioned purpose come in various
designs. Some of them utilize complicated spring mechanism to vent the built up
20 pressure and pressure relief devices in this category are usually relatively expensive.
There are other pressure relief devices that automatically reset after they are
activated and hence do not reveal to the users that said devices had been activated
and less so the cause of their activation. There are still other pressure relief devices
that utilize mechanisms that can be used only once and upon activated said

mechanisms have to be replaced by new sets altogether. Typically in the later group are devices that depend on rupture of membranes or similar to relieve the built up pressure. Services of skill technicians may be needed to reset or to replace some of the above mentioned devices after said devices had been activated.

5 It is to overcome the above-mentioned problems with their associated costs and inconvenience that the pressure relief device of the present invention is forwarded. The pressure relief device of the present invention is simple in design and in construction, consists of minimum parts and can be reset easily by the user after it has been activated.

10 It is the objective of the present invention to forward a pressure relief device for the relief of built up pressure in an open flow system that is in operation with said device that is simple in design and in construction.

 It is a further objective of the present invention to forward a pressure relief device for the relief of built up pressure in an open flow system that is in operation
15 with said device that can be reset easily by the user after said device has been activated.

SUMMARY OF THE INVENTION

 The pressure relief device of the present invention is deployed in an open
20 flow system typically that of domestic water heater when it is in operation whereby water at ambient temperature is admitted continuously from an inlet into a canister with a heating device positioned within and with said heating device continuously heating up the water in said canister and with the heated water exiting continuously through an outlet connected to said canister. In the unfortunate event whereby the

outlet gets obstructed when the system is in operation water contained within the canister gets heated to a high temperature resulting in the pressure within said canister building up to an unsafe level. If the built up pressure within the canister is not safely relieved further build up of pressure can have detrimental effects typically rupturing of said canister and endangering any personnel in the vicinity and to reduce the possibility of such an unfortunate occurrence a pressure relief device is commonly incorporated onto or connected to the canister to relief the built up pressure that has reached an unsafe level.

The pressure relief device of the present invention comprises a body, a piston that resides partially within said body, an 'O' ring positioned onto a circumferential groove of said piston and a stopper.

The body further comprises an open-ended tube having three connected internal sections, the upper section, the intermediate connecting section and the lower section, with said sections having substantially circular cross-sections and with the cross-section of the upper section smaller as compared to that of the intermediate connecting section and the lower section. In another embodiment of the body there exists a plurality of ridges on the upper section and towards the connection between said upper section and the intermediate connecting section with said ridges lying at a substantially similar level and on a circumference of said upper section. In yet another embodiment there exists a single circumferential ridge on the upper section and towards the connection between said upper section and the intermediate connecting section. Externally the body has a flange at its lower end and a set of external screw threads located above said flange with said external screw threads for coupling the pressure relief device to the canister by having said

external screw threads engaged to matching internal screw threads of a boss that extends from said canister.

The piston comprises a head and a bar with said head having a hemisphere at its top end and on the side of said head is a level circumferential groove where an 'O' ring is positioned. The head of the piston with the 'O' ring in place when positioned at the upper section of the body fits tightly to the inner wall of said upper section but when positioned at the lower section of said body a clearance is present between the outer perimetrical surface of the 'O' ring and the inner wall of said lower section. Extending from the bottom end of the head is a bar having a narrower diameter as compared to that of said head. The overall length of the piston is greater than that of the body of the pressure release device and said piston is able to transverse longitudinally along a defined distance within said body. A restrain means is present to limit the travel of the piston within the body with part of said restrain means in the form of a plurality of ribs, of a defined length, attach onto the surface of the bar of said piston. A piston cap designed to fit firmly onto the bottom end of the bar of the piston.

The stopper acting in conjunction with the ribs on the bar of the piston form the restrain means to limit the downward movement of said piston within the body of the assembled pressure release device. Additionally the stopper also acts as a guide for the piston in its travel within the body. The stopper comprises a plate with an aperture and with said plate having an upper face and an opposing lower face and a bush, with open ends and of height greater than the thickness of said plate, located upright at the aperture of said plate and with said bush having a plurality of splines evenly distributed and upright on its external circumferential surface and with said

bush connected at its lower section to said plate through said splines. Through slots are present between the bush and the plate with said slots separated from one another by adjacent splines and with said slots there to allow pressurized water from the canister to flow out after the pressure relief device is activated.

5 At the lower section of the pressure relief device the stopper fits partially into the body with the upper end of the bush located within said body and the plate outside. The bush encircles the bar of the piston with said bush acting as a guide for said bar and hence said piston in its travel within the body of the pressure relief device. The piston cap fits firmly onto the lower end of the bar of the piston with
10 said piston cap to limit the upward movement of said piston when said piston is pushed back up the body to reset the pressure relief device after it has been activated.

 In the assembled pressure relief device the piston fits partially within the body and at the initial stage when the piston is at the upper section of said body the
15 outer perimetrical surface of the 'O' ring at the head of said piston contacts the inner wall of said upper section forming a seal with friction between said outer perimetrical surface of the 'O' ring and said inner wall of said upper section of said body holding the piston in this fixed position. In the embodiments of the body wherein there is either a plurality of ridges or a single circumferential ridge on the
20 upper section the position of head of the piston with the 'O' ring fitted is above that of said plurality of ridges or said single circumferential ridge.

 If excess pressure is present in the canister said excess pressure would be felt as a resultant downward force on the piston and when the resultant downward force on said piston exceeds the frictional force between the outer perimetrical surface of

the 'O' ring and the inner wall of the upper section of the body said piston would be forced progressively down said body. When the 'O' ring has slipped past the upper section of the body and into the lower section of said body pressurized water from within the canister flows through the clearance between the outer perimetrical surface of the 'O' ring and the inner wall of said lower section, down the body and eventually out of the pressure relief valve through the slots of the stopper to relieve the built up pressure in said canister. In the embodiments of the body wherein either a plurality of ridges or a single circumferential ridge is present at the upper section of the body the piston with the 'O' ring has to overcome said plurality of ridges or said circumferential ridge before it can descent to the lower section of said body to relief the built up pressure in the canister and in this manner said plurality of ridges or said circumferential ridge acts as a more accurate control on the pressure built up within the canister. After the pressure relief valve is activated the extend of downward travel of the piston within the body is limited and restrained when the lower ends of the ribs on the bar of said piston come into contact with and restrained by the upper rim of the bush of the stopper.

To reset the pressure relief device the piston is pushed up the body until the 'O' ring on said piston locates within the upper section of said body and is confirmed when the upper rim of the cap reaches the lower rim of the boss of the stopper.

These and other features, advantages and objectives of the present invention will be further understood and appreciated by those skilled in the art by the following specification, appended drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the components of the pressure relief device.

FIG. 1A shows external details of the body of the pressure relief device.

FIG. 1B shows details of the piston of the pressure relief device.

5 FIG. 1C shows details of the stopper of the pressure relief device.

FIG. 1D shows the bottom view of the stopper of the pressure relief device.

FIG. 1E shows details of the piston cap of the pressure relief device.

FIG. 2 shows a sectional view of the body of the pressure relief device.

10 FIG. 2A shows the sectional view of the pressure relief device at the initial setup.

FIG. 2B shows the sectional view of the pressure relief device at the intermediate stage with pressure building up within the canister.

15 FIG. 2C shows the sectional view of the pressure relief device at the final stage with said pressure relief device able to relieve pressure built up within the canister.

FIG. 2D shows the top view of another embodiment of the body of the pressure relief device with said body having a plurality of ridges on the upper section and towards the connection between said upper section and the intermediate connecting section.

20 FIG. 2E shows a sectional view of the embodiment of the body of the pressure relief device, as in FIG. 2D, with said body having a plurality of ridges on

the upper section and towards the connection between said upper section and the intermediate connecting section.

FIG. 2F shows the top view of yet another embodiment of the body of the pressure relief device with said body having a single circumferential ridge on the
5 upper section and towards the connection between said upper section and the intermediate connecting section.

FIG. 2G shows a sectional view of the embodiment of the body of the pressure relief device, as in FIG. 2E, with said body having a single circumferential ridge on the upper section and towards the connection between said upper section
10 and the intermediate connecting section.

FIG. 3 shows the pressure relief device location in relation to the canister of a heater system.

DETAIL DESCRIPTION OF THE INVENTION

15 The pressure relief device (10) of the present invention is deployed in an open flow system typically that of domestic water heater as indicated in FIG. 3. When such a system is in operation water at ambient temperature is admitted continuously from an inlet (12) into a canister (11) with a heating device positioned within and with said heating device continuously heating up the water in said
20 canister (11) and with the heated water exiting continuously through an outlet (13) connected to said canister (11). In the unfortunate event whereby the outlet (13) gets obstructed when the system is in operation water contained within the canister (11) gets heated to a high temperature resulting in the pressure within said canister (11) building up to an unsafe level. The pressure built up within the canister (11) is

further aggravated by the uninterrupted inflow of water from the inlet (12) while the outlet (13) is being obstructed. If the built up pressure within the canister (11) is not safely relieved further build up of pressure can have detrimental effects typically rupturing of said canister (11) and endangering any personnel in the vicinity. To
5 reduce the possibility of such an unfortunate occurrence a pressure relief device is commonly incorporated onto or connected to and in communication with said canister (11) typically through a receiving boss on said canister (11) to relief the built up pressure that has reached an unsafe level.

The pressure relief device (10) of the present invention to relieve the
10 pressure that has built up to an unsafe level within a canister (11) in an open flow system comprises a body (1), a piston (2) that resides within said body (1), an 'O' ring (4) positioned onto a circumferential groove (32) of said piston (2) and a stopper (3). The parts comprising the pressure relief device (10) of the present invention are shown in FIG. 1.

15 The body (1), as shown in FIG. 1A and FIG. 2, further comprises an open-ended tube (20) having three connected internal sections, the upper section (21), the intermediate connecting section (27) and the lower section (22), with said sections (21, 27, 22) having substantially circular cross-sections. Additionally the cross-section of the upper section (21) is smaller as compared to that of the intermediate
20 connecting section (27) and the lower section (22) as shown in the sectional view of the body (1) in FIG. 2. In another embodiment of the body (1A) there exists a plurality of ridges (27) on the upper section (21) and towards the connection between said upper section (21) and the intermediate connecting section (27) as shown in FIG. 2D and FIG. 2E. These ridges (27) lie at a substantially similar level

and on a circumference of the upper section (21). It is also possible in yet another embodiment of the body (1B) to have a single circumferential ridge (27a) occupying the full circumference and at a specific level of the upper section (21) as shown in FIG. 2F and FIG. 2G. Externally the body (1) has a flange (23) at its lower end and a set of external screw threads (25) located above said flange (23) as shown in FIG. 1A. The external screw threads (25) is for coupling the pressure relief device (10) to the canister (11) by having said external screw threads (25) engaged to matching internal screw threads of a boss (not shown) that extends from said canister (11). On the outer circumferential edge of the flange (23) is a plurality of flats (24) designed for locating the fingers of a human hand when the pressure release device (10) is coupled by screwing to tighten said pressure release device (10) onto the receiving boss of the canister (11).

The piston (2), as shown in FIG. 1B, comprises a head (30) and a bar (33) with said head (30) having a hemisphere (31) at its top end in the preferred embodiment. On the side of the head (30) of the piston (2) and below the hemisphere (31) is at least a level circumferential groove (32) with said circumferential groove (32) designed to accommodate an 'O' ring (4). The head (30) of the piston (2) with the 'O' ring (4) in place when located at the upper section (21) of the body (1) fits tightly to the wall of said upper section (21) and forming a seal in the process as shown in FIG. 2A. When head (30) of the piston (2) with the 'O' ring (4) in place is located at the lower section (22) a clearance (26) is present between the outer perimetrical surface of said 'O' ring (4) and the inner wall of said lower section (22) as shown in FIG. 2C. Extending from the bottom end of the head (30) is a bar (33) having a narrower diameter as compared to that of said head (30)

and preferably with the longitudinal axis of said bar (33) and the longitudinal axis of said head (30) substantially coincidental. The overall length of the piston (2) is greater than that of the body (1) of the pressure release device (10) as shown in FIG. 2A and said piston (2) is able to transverse longitudinally along a defined length within said body (1). A restraint means is present to limit the downward travel of the piston (2) within the body (1) of the assembled pressure release device (10). Part of the restraint means is incorporated onto the bar (33) taking the form of a plurality of ribs (34), of a defined length, attach onto the surface of said bar (33) with said ribs (34) extending downwards from the joint of the head (30) and said bar (33) of the piston (2) in the preferred embodiment. A piston cap (6), as shown in FIG. 1E, is designed to fit firmly onto the bottom end of the bar (33) of the piston (2) with the function of said piston cap (6) described later.

The stopper (3) acting in conjunction with the ribs (34) on the bar (33) of the piston (2) form the restraint means to limit the downward movement of said piston (2) within the body (1) of the assembled pressure release device (10). Additionally the stopper (3) also acts as a guide for the piston (2) in its travel within the body (1). The stopper (3), as shown in FIG. 1C and FIG. 1D, comprises a plate (40) with an aperture that is substantially central to said plate (40) and with said plate (40) having an upper face (43) and an opposing lower face (44) and a bush (41), with open ends having a upper rim (50) and a lower rim (51) and of height greater than the thickness of said plate (40) and locates upright at the aperture of said plate ring (40) and with said bush (41) having a plurality of splines (42) evenly distributed and positioned upright on its external circumferential surface. The bush (41) is connected at its lower section to the plate (40) through the splines (42). Through

slots (48) are present between the bush (41) and the plate (40) at the aperture with said slots (48) separated from one another circumferentially by adjacent splines (42) as shown in FIG. 1D. The slots (48) are there to allow pressurized water from the canister (11) to flow out after the pressure relief device (10) is activated.

5 At the lower section of the pressure relief device (10) the stopper (3) fits partially into the body (1) with the upper end of the bush (41) located within said body (1) and the plate (40) outside as shown in FIG. 2A. The bush (41) encircles the bar (33) of the piston (2) and with said bush (41) acting as a guide for said bar (33) and hence said piston (2) in its travel within the body (1) of the pressure relief
10 device (10). A piston cap (6), having a top rim (49), fits firmly onto the lower end of the bar (33) of the piston (2) concealing said lower end as shown in the sectional views of FIG. 2A, FIG. 2B and FIG. 2C. The piston cap (6), as shown in FIG. 1E, comprises a body (46) with a closed bottom end and an open top (45) with a top rim (49). The piston cap (6) is to limit the upward movement of the piston (2) when said
15 piston (2) is pushed back up the body (1) of the pressure relief device (10) in order to reset said pressure relief device (10) after it has been activated. The pressure relief device (10) is correctly reset when the top rim (49) of the piston cap (6) comes in contact with and restrained by the lower rim (51) of the bush (41) as illustrated in FIG. 2A.

20 In the assembled pressure relief device (10) the piston (2) fits partially within the body (1) of said pressure relief device (10) as shown in cross-section in FIG. 2A to FIG. 2C. At the initial stage when the head (30) of the piston (2) is at the upper section (21) of the body (1) the outer perimetrical surface of the 'O' ring (4) on said head (30) contacts the inner wall of said body (1) forming a seal in the process as

shown in FIG. 2A. Friction between the outer perimetrical surface of the 'O' ring (4) and the inner wall of the upper section (21) of the body (1) at the regions of contact holds the piston (2) in this fixed position. In the embodiment of the body (1A) wherein there is a plurality of ridges (27) on the upper section (21) the position of head (30), with the 'O' ring (4) on it, of the piston (2) is above that of said ridges (27). Likewise in the embodiment of the body (1B) wherein there is a single circumferential ridge (27a) on the upper section (21) the position of head (30), with the 'O' ring (4) on it, of the piston (2) is above that of said circumferential ridge (27a).

10 If excess pressure is present in the canister (11) said excess pressure would be felt as a resultant downward force on the piston (2). When the resultant downward force on the piston (2) exceeds the frictional force between the outer perimetrical surface of the 'O' ring (4) and the inner wall of the upper section (21) of the body (1) said piston (2) would be forced progressively down said body (1).
 15 When the 'O' ring (4) has slipped past the upper section (21) of the body (1) and into the lower section (22) of said body (1), as shown in FIG. 2C, a clearance (26) exists between the outer perimetrical surface of the 'O' ring (4) and the inner wall of the lower section (22) and pressurized water from within the canister (11) is able to flow through the clearance (26), down the body (1) and eventually out of the
 20 pressure relief valve (10) through the slots (48) of the stopper (3) and in the process relieving the built up pressure in said canister (11). In the embodiment of the body (1A), as shown in FIG. 2D and FIG. 2E, wherein a plurality of ridges (27) is present the piston (2) with the 'O' ring (4) has to overcome said ridges (27) before it can descent to the lower section (22) of said body (1A) to relief the built up pressure in

the canister (11). Likewise in the embodiment of the body (1B), as shown in FIG. 2F and FIG. 2G, wherein a single circumferential ridge (27a) is present the piston (2) with the 'O' ring (4) has to overcome said circumferential ridge (27a) before it can descent to the lower section (22) of said body (1B) to relief the built up pressure in the canister (11). The plurality of ridges (27) or the single circumferential ridge (27a) in the different embodiments of the body (1A and 1B) in this manner provides a more accurate control on the built up pressure within the canister (11). After the pressure relief valve (10) is activated the extend of downward travel of the piston (2) within the body (1) is limited and restrained when the lower ends of the ribs (34) on bar (33) of said piston (2) come into contact with and restrained by the upper rim (50) of the bush (41) of the stopper (3), as shown in FIG. 2C, and further downwards movement of said piston (2) is restricted.

To reset the pressure relief device (10) the piston (2) is pushed up the body (1) until the 'O' ring (4) on said piston (2) locates within the upper section (21) of said body (1). This is confirmed when the upper rim (49) of the cap (6) contacts with and is restrained by the lower rim (51) of the boss (41) of the stopper (3) as indicated in FIG. 2A.

The foregoing description is considered as illustration of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

CLAIMS

1. A pressure relief device (10) for relief of built up pressure in a canister (11) with a heating device positioned within and with said canister (11) being part of an open
5 flow system and with said pressure relief device (10) in communication with and connected to said canister (11) typically through a receiving boss on said canister (11) and with said pressure relief device (10) comprises :-

a body (1) comprises an open-ended tube (20) having three connected internal sections, the upper section (21), the intermediate connecting section (27) and the lower
10 section (22), and with said sections (21, 27, 22) having substantially circular cross-sections and with the cross-section of said upper section (21) smaller as compared to that of said intermediate connecting section (27) and said lower section (22);

a piston (2) of overall length greater then that of the body (1) with said piston (2) comprises a head (30) and a bar (33), having a narrower diameter as compared to that of
15 said head (30), connected to the bottom end of said head (30) and with said piston (2) locating partially within said body (1) with said piston (2) able to transverse longitudinally along a defined length within said body (1) and with said head (30) having at least a level circumferential groove (32) fitted with an 'O' ring (4) and when said 'O' ring (4) in place said head (30) when located at the upper section (21) of said body (1)
20 the outer perimetrical surface of said 'O' ring (4) fits tightly to the inner wall of said upper section (21) forming a seal but when said head (30) is located at the lower section

(22) of said body (1) a clearance (26) is present between said outer perimetrical surface of said 'O' ring (4) and the inner wall of said lower section (22);

a stopper (3) comprises a plate (40) with an aperture with said plate (40) having an upper face (43) and an opposing lower face (44) and a bush (41), with
 5 open ends having a upper rim (50) and a lower rim (51), of height greater than the thickness of said plate (40) located upright at the aperture of said plate (40) and with said bush (41) having a plurality of splines (42) positioned upright on its external circumferential surface and with said bush (41) connected at its lower section to said plate (40) through the splines (42) and with through slots (48) present between said bush (41)
 10 and said plate (40) with said slots (48) separated from one another circumferentially by adjacent splines (42) and with said slots (48) able to discharge pressurized water from the canister (11) through the body (1) and with said stopper (3) fitted to the lower section of said body (1) with the upper end of said bush (41) located within said body (1) and said plate (40) outside and with said bush (41) encircled the bar (33) of the piston (2) acting as
 15 a guide for said bar (33), and hence said piston (2), in its travel within said body (1);

a restrain means to limit the downward movement of the piston (2) within the body (1) after said pressure relief device (10) is activated;

a restrain means to limit the upwards movement of the piston (2) within the body (1) when said pressure relief device (10) is reset.

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2. A pressure relief device (10) as in claim 1 wherein the top end of the piston (2) is a hemisphere (31).

3. A pressure relief device (10) as in claim 1 wherein the longitudinal axis of the bar (33) and the longitudinal axis of the head (30) are substantially coincidental

4. A pressure relief device (10) as in claim 1 wherein the restrain means to limit
5 the downward travel of the piston (2) within the body (1) takes the form of a plurality of ribs (34), of a defined length, attach onto the surface of the bar (33) and extending downwards with said piston (2) downward travel within said body (1) restrained when the lower ends of the ribs (34) on said bar (33) come into contact with and restrained by the upper rim (50) of the bush (41) of the stopper (3).

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5. A pressure relief device (10) as in claim 1 wherein the restrain means to limit the upwards movement of the piston (2) within the body (1) when the pressure relief device (10) is reset takes the form of a piston cap (6) having a top rim (49) with and fitted firmly onto the lower end of the bar (33) of said piston (2) and with the upward
15 movement of said piston (2) limited when said top rim (49) of said piston cap (6) comes in contact with and restrained by the lower rim (51) of the bush (41).

6. A pressure relief device (10) as in claim 1 wherein in another embodiment of the body (1A) there exists a plurality of ridges (27) on the upper section (21) and towards
20 the connection between said upper section (21) and the intermediate connecting section (27) with said embodiment of ridges (27) lying at a substantially similar level and on a circumference of said upper section (21) and with said plurality of ridges (27) below the

head (30) of the piston (2) and the 'O' ring (4) when said piston (2) and said 'O' ring (4) are located at said upper section (21) and when said pressure relief device (10) is not activated.

5 7. A pressure relief device (10) as in claim 1 wherein in yet another embodiment of the body (1B) there exists a single circumferential ridge (27a) occupying the full circumference and at a specific level of the upper section (21) and with said single circumferential ridge (27a) below the head (30) of the piston (2) and the 'O' ring (4) when said piston (2) and said 'O' ring (4) are located at said upper section (21) and when
10 said pressure relief device (10) is not activated.

 8. A pressure relief device (10) as in claim 1 wherein externally the body (1) has a flange (23) at its lower end and a set of external screw threads (25) located above said flange (23) with said external screw threads (25) for coupling said pressure relief device
15 (10) to the canister (11) by having said external screw threads (25) engaged to matching internal screw threads of a boss that extends from said canister (11).

 9. A pressure relief device (10) as in claim 8 wherein on the outer circumferential edge of the flange (23) is a plurality of flats (24) designed for locating the fingers of a
20 human hand when said pressure release device (10) is coupled by screwing to tighten said pressure release device (10) onto the receiving boss of said canister (11).