CLAIMS

1. Roller shutter-type rollable occlusion device (1) for closing an opening (2) such as a door, a window or a bay window of a residential building such as a private or collective dwelling, or of an industrial building such as a shop, a factory, a garage/car park or a warehouse, said closing device comprising an external frame (20) mounted in the opening (2) and provided with at least two lateral guiding slides (22) with a U-shaped cross-section facing one another, in order to define a general closure plane (P), and a set of transverse slats (11) hinging relative to one another in pairs by the respective longitudinal edges (11a, 11b) thereof, the slats (11) sliding within the two lateral slides (22) between a first inactive raised position in which said slats (11) are rolled up around an upper transverse shaft (30) and a second active lowered position in which said slats (11) are unrolled and form an apron (10) for closing said opening (2),
characterised in that:
- the cross-section (D) of the lateral slides (22) is greater than the thickness (E) of the slats (11),
- in the second, active lowered position of the closure apron (10), the slats (11) adopt a vertical accordion configuration in the lateral slides (22) and form, relative to one another consecutively in pairs, front (α) and rear (β) angles not equal to 180°, and
- in a third lowered position, the slats (11) adopt a protective and reinforced fluid-tight configuration, referred to as the position under frontal load, when the closure apron (10) is subjected to a force (F) on a front face (10f), for example the pressure exerted by a height

of water, so that the slats (11) form, relative to one another consecutively, an angle (α; β) as close as possible to 180°, or even equal to 180°, so that the closure apron (10) is disposed in the general closure plane (P) or parallel thereto.

2. Device (1) according to claim 1, characterised in that, in the second active lowered position, the slats (11) are alternately inclined in a repeated and regular manner at identical front (α) and rear (β) angles respectively.

3. Device (1) according to claim 2, characterised in that, in the second active lowered position, the absolute values of the front (α) and rear (β) angles are identical.

4. Device (1) according to any one of the preceding claims, characterised in that the absolute value of each rear (α) and front (β) angle is comprised between about 90° and 179°, preferably between about 125° and 175°, and advantageously between 150° and 170°.

5. Device (1) according to any one of the preceding claims, characterised in that it comprises a first longitudinal means (40) for creating a passive seal between the slats supporting a low-pressure from a fluid.

6. Device (1) according to claim 5, characterised in that the first longitudinal low-pressure passive sealing means (40) includes at least, on a lower longitudinal edge (11b) of a given first slat (11), a prominent transverse rib (41) and, on an upper longitudinal edge (11a) of a slat (11) that is below said given first slat (11), a transverse

groove (42) enclosing a first flexible, transverse seal (43), said prominent, transverse rib (41) increasingly compressing said first flexible, transverse seal (43) in the transverse groove (42) so as to progressively compress the latter as the slats (11) move from the second position to the third lowered sealing position, so as to seal the device (1) against fluid.

7. Device (1) according to claim 5, characterised in that the first longitudinal low-pressure passive sealing means (40) includes at least, on the lower longitudinal edge (11b) of a given first slat (11), a transverse groove (45) enclosing a flexible, transverse seal (43) and, on an upper longitudinal edge (11a) of a slat (11) that is below said given first slat (11), a prominent, transverse rib (44), said prominent, transverse rib (44) increasingly compressing said first flexible, transverse seal (43) in the transverse groove (45) so as to progressively compress the latter as the slats (11) move from the second position to the third lowered sealing position, in order to seal the device (1) against fluid.

8. Device (1) according to any one of claims 5 to 7, characterised in that the first transverse seal (43) is a strip with a polygonal, circular or oval cross-section.

9. Device (1) according to any one of claims 5 to 8, characterised in that the first seal (43) is made of silicone or EPDM rubber.

~~10. Device (1) according to any one of claims 5 to 8, characterised in that the first seal (43) is made of EPDM rubber.~~

101. Device (1) according to any one of the preceding claims, characterised in that it further comprises a second longitudinal means (50) for creating a passive seal between the slats supporting a high-pressure from a fluid.

~~12. Device (1) according to claim 11, characterised in that the second longitudinal, passive, high-pressure sealing means (50) includes, on a rear face (11d) of a front part (10f) of a given first slat (11), a transverse recess (51) receiving a second flexible, transverse seal (52) cooperating with the front (53f) of a hinge hook (53) of a slat (11) below said given first slat (11), the front (53f) of said hinge hook (53) increasingly compressing the second flexible, transverse seal (52) in the transverse recess (51) so as to progressively compress the latter as pressure (F) is exerted on the front face (10f) of the closure apron (10) in order to seal the device (1) against said fluid.~~

~~13. Device (1) according to claim 11, characterised in that the second longitudinal, passive, high-pressure sealing means (50) includes, on a front face (53f) of a hinge hook (53) of a given first slat (11), a transverse recess (55) enclosing a second flexible, transverse seal (52) cooperating with a rear face (11d) of a front part (10f) of a second slat (11) above said given first slat (11), said rear face (11d) of the front part (10f) of the second slat (11) increasingly compressing the second~~

~~transverse seal (52) in the transverse recess (55) so as progressively to compress the latter as pressure (F) is exerted on the front face (10f) of the closure apron (10) in order to seal the device (1) against said fluid.~~

~~14. Device (1) according to any one of claims 12 to 13, characterised in that the second transverse seal (52) is a strip with a polygonal, preferably rectangular, or circular or oval, cross-section.~~

115. Device (1) according to any one of the preceding claims, characterised in that it further includes:
- a lower, transverse channel (23) connecting the two lateral slides (22) and intended to receive at least one bottom end slat (13) of the closure apron (10), and
- at least a third longitudinal, passive, low-pressure sealing means (60).

126. Device (1) according to claim 115, characterised in that the third longitudinal, passive, low-pressure sealing means (60) includes:
- a third flexible transverse seal (62) rigidly connected to a lower longitudinal edge (13b) of the bottom end slat (13), and
- a bottom wall (23b) of the lower channel (23) so that, in the third lowered sealing position, the third flexible transverse seal (62) is compressed against said bottom wall (23b) in order to seal the device (1) against said fluid.

137. Device (1) according to claim 125, characterised in that the third flexible transverse seal (62) is positioned

in a transverse groove (63) rigidly connected to a bottom wall (23b) of the lower channel (23) so that, in the third lowered sealing position, the third flexible, transverse seal (62) is compressed between a lower longitudinal edge (13b) of the bottom end slat (13) and said transverse groove (63) in order to seal the device against said fluid.

14~~8~~. Device (1) according to any one of claims 11~~5~~ to 13~~7~~, characterised in that the lower channel (13) includes a protective covering (70) comprising a hinged upper cover (71), a leaf spring (72) bearing against a bottom wall (23b) of said lower channel (13) and said closure cover (71), and a hook (76) provided on a rear wall (13d) of the channel (13) and capable of cooperating with a corresponding hook (75) provided along the lower edge (13b) of the bottom slat (13) to form an anti-unhooking/separation device so that, in the second position, the third flexible, transverse seal (62) bears against the closure cover (71) and, in the third lowered sealing position, the hooks (75, 76) are engaged to prevent any inadvertent raising of the closure apron (10).

15~~9~~. Device (1) according to claim 14~~8~~, characterised in that the anti-unhooking/separation device consists of a plurality of hooks (75) spaced apart and distributed transversally along the lower edge (13b) of the bottom end slat (13).

16~~20~~. Device (1) according to any one of the preceding claims, characterised in that each lateral slide (22) houses a fifth lateral sealing means (90).

17~~21~~. Device (1) according to claim 16~~20~~, characterised in that the fifth lateral sealing means (90) includes a flexible stopper seal (91) penetrating recesses (11e) in the respective lateral ends (11c) of each of the slats (11).

~~22. Device (1) according to claim 21, characterised in that the fifth lateral sealing means (90) further includes, for each lateral slide (22), a U-shaped vertical seal (92) that can move transversally between a distant position in which it is distant from each stopper seal (91) and a proximate position in which the latter is pressurised by means of a vertical clamping bar (93) and a pressing member (100) compressing said U-shaped vertical seal (92) against each stopper seal (91) as frontal pressure (F) is exerted on the front face (10f) of the closure apron (10) in order to seal the device (1) laterally against said fluid.~~

~~23. Device (1) according to claim 22, characterised in that the fifth lateral sealing means (90) further includes a lateral activation bar (101) that can move in translation along each lateral slide (22) and that acts on the pressing member (100) to move the vertical U-shaped seal (92) from the distant position into the proximate position.~~

~~24. Device (1) according to claim 23, characterised in that the pressing member (100) includes:~~
~~- a pressure shoe (107),~~
~~- a bistable lever (103) in the form of a square supporting the pressure shoe (107) and hinged about a shaft (106) attached to the corresponding lateral slide (22) so as to take a first stable, inactive, retreated position in which~~

~~the pressure shoe (107) is distant from the vertical clamping bar (93) and a second stable, active, advanced position in which the pressure shoe (107) clamps the vertical clamping bar (93) against the vertical U-shaped seal (92) in order to compress the latter against each stopper seal (91),~~

~~- extension springs (108) to hold each lever (103) in each of the stable positions.~~

~~25. Device (1) according to claim 23, characterised in that the pressing member (100) includes a series of pairs of vertically stacked springs (141, 142) controlled by the displacement of the lateral activation bar (101), said springs each having an unmoving end (143) and the other end connected to a common movable point (144) and acting on the vertical clamping bar (93) to cause it to move from a first stable, inactive, retreated position in which the vertical U-shaped seal (92) is distant from each stopper seal (91) into a second stable, active, advanced position in which the vertical U-shaped seal (92) bears against each stopper seal (91).~~

~~26. Device (1) according to claim 23, characterised in that the pressing member (100) includes a series of vertically-stacked double pantographs (151, 152) controlled by the displacement of the lateral activation bar (101), each pantograph (151) being hinged about an unmoving shaft (153) and about a moving shaft (155) linked to the activation bar (101) and each pantograph (152) being hinged about said moving shaft (155) and having a bearing end (154) acting on the vertical clamping bar (93) to cause it to move from a first stable, inactive, retreated~~

position in which the vertical U-shaped seal (92) is distant from each stopper seal (91) into a second stable, active, advanced position in which the vertical U-shaped seal (92) bears against each stopper seal (91).

27. Device (1) according to claim 23, characterised in that the pressing member includes a series of vertically-stacked single pantographs (161) controlled by the displacement of the lateral activation bar (101), each pantograph (161) being hinged about a moving shaft (164) linked to the activation bar (101) and has a bearing end (164) acting on the vertical clamping bar (93) to cause it to move from a first stable, inactive, retreated position in which the vertical U-shaped seal (92) is distant from each stopper seal (91) into a second stable, active, advanced position in which the vertical U-shaped seal (92) bears against each stopper seal (91).

28. Device (1) according to any one of claims 23 to 27, characterised in that it includes a cable (110; 110') rotated about at least one roller (110; 111a, 111b) and provided with a pin (112; 37) for the vertical displacement of said lateral activation bar (101).

29. Device (1) according to claim 28, characterised in that it further includes a lever finger (103a) linked to the lateral activation bar (101) and mounted so as to pivot about a shaft (106a) rigidly connected to a lateral slide (22), said finger (103a) being rotated by the movement of the pin (112; 37) rigidly connected to the cable (110; 110') so that, in a first movement of the cable (110; 110') causing the pin (112; 37) to descend, the latter pivots

~~the lever (103a) so as to clamp the vertical U-shaped seal (92) against each stopper seal (91), and, in a second, opposite movement of the cable (100; 110') causing the pin (112; 37) to rise, the latter pivots the lever (103a) in the opposite direction about its shaft (106a) so as to move the vertical U-shaped seal (92) away from each stopper seal (91).~~

~~30. Device (1) according to claim 29, characterised in that the cable (110) is tensioned between the drive shaft (30) of the closure apron (10) and a lower tension roller (111).~~

~~31. Device (1) according to claim 29, characterised in that the cable (110') is tensioned between an upper roller (111a) and a lower roller (111b), the cable (110') being rotated by an independent stepper motor (36).~~

~~32. Device (1) according to any one of claims 23 to 27, characterised in that the lateral activation bar is displaced by means of a bistable electromagnet (181) having two extreme positions.~~

~~33. Device (1) according to any one of claims 23 to 32, characterised in that the lower channel includes a locking and unlocking system comprising a latch (80) which is tilted into its locking position when the lateral activation bar (101) is lowered when the closure apron (10) is completely lowered and returns to its unlocking position when said lateral activation bar is raised before the apron is raised.~~

~~34. Device (1) according to claim 33, characterised in that the latch (80) includes a main body (81) hinged about an unmoving shaft (82) between two extreme open and closed positions, and two fingers (83, 84) capable of acting on a catch (85) rigidly connected to the activation bar (101) to hold the latter in the third lowered sealing position.~~

~~35. Device (1) according to claim 22, characterised in that the pressing member (100) includes cylinders bearing against the vertical clamping bar (93) to move the latter from a first stable, inactive, retreated position, in which the vertical U-shaped seal (92) is distant from each stopper seal (91), into a second stable, active, advanced position, in which the vertical U-shaped seal (92) bears against each stopper seal (91).~~

~~36. Device (1) according to claim 22, characterised in that the pressing member (100) includes a series of cams (131) hinged about a common shaft (132) and acting on the vertical clamping bar (93), said cams (131) passing from a first stable, inactive, retreated position in which the vertical U-shaped seal (92) is distant from each stopper seal (91) into a second stable, active, advanced position in which the vertical U-shaped seal (92) bears against each stopper seal (91).~~

18~~37~~. Device (1) according to claim 22, characterised in that the pressing member (100) includes a reversible expansion joint (171) which bears against each stopper seal (91) and fills the space between the latter and the bottom wall (22a) of the corresponding lateral slide (22).

~~38~~19. Device according to claim ~~37~~18, characterised in that the reversible expansion joint (171) is of the hydraulic or pneumatic type.

~~39~~20. Device according to claim ~~37~~18, characterised in that the reversible expansion joint (171) is of the chemical expansion type.

~~40. Device (1) according to claim 22, characterised in that the pressing member (100) includes:~~
~~- a pressure shoe (107),~~
~~- a bistable lever (103) in the form of a square supporting the pressure shoe (107) and hinged about a shaft (106) attached to the corresponding lateral slide (22) so as to take a first stable, inactive, retreated position in which the pressure shoe (107) is distant from the vertical clamping bar (93) and a second stable, active, advanced position in which the pressure shoe (107) clamps the vertical U-shaped seal (92) against each stopper seal (91),~~
~~- a vertically movable, lateral ribbon (191) including first long, transverse strands (192), each connected to the end of a first long arm (104) of the lever (103), and second short, transverse strands (193), each connected to the end of a first short arm (105) of the same lever (103), and~~
~~- extension springs (108) to hold each lever (103) in each of the stable positions.~~

~~41. Device (1) according to claim 22, characterised in that the pressing member (100) includes:~~
~~- a pressure shoe (107),~~

~~- a bistable lever (103) in the form of a square supporting the pressure shoe (107) and hinged about a shaft (106) attached to the corresponding lateral slide (22) so as to take a first stable, inactive, retreated position in which the pressure shoe (107) is distant from the vertical clamping bar (93) and a second stable, active, advanced position in which the pressure shoe (107) clamps the vertical clamping bar (93) against the vertical U-shaped seal (92) in order to compress the latter against each stopper seal (91),~~

~~- a vertically-movable, lateral ribbon (191) including transverse strands (192), each connected to the end of a first long arm (104) of the lever (103), said strip being tensioned against the return force of the springs (108) when the vertical clamping bar (93) is in its first retreated position, and~~

~~- extension springs (108) to hold each lever (103) when the clamping bar (93) is in its second advanced position.~~

~~42~~21. Device (1) according to claim ~~21~~17, characterised in that the fifth lateral sealing means (90) includes two longitudinal profiles (190) disposed inside the two lateral slides (22) on either side of the ends of the slats (11), each longitudinal profile (190) being provided, for the slats (11) disposed facing said longitudinal profile, with a first lateral seal (195) and a second lateral seal (196), said profile (190) being hinged about a vertical shaft between:

- a first inactive position in which the first lateral seal (195) does not exert any pressure on the stopper seal (91) of the given slat (11), and

- at least a second active position in which the first lateral seal (195) exerts lateral pressure on said stopper seal (91) and the second lateral seal (196) exerts pressure against a portion (126; 127; 128) of the lateral slide (22) as pressure (F) is exerted on the front face (10f) of the closure apron (10), when the latter is in the lowered position, in order laterally seal the device (1) against said fluid.

~~43~~22. Device (1) according to claim ~~42~~21, characterised in that:

- the longitudinal profile (190) includes a curved crescent shape defining a lever hinged about a pivot formed by an internal rib (122) of the corresponding lateral slide (22), a first free end (190a) of said profile being provided internally with the first lateral seal (195), whereas a second opposite end (190b) located on the other side of the pivot (122), is disposed facing the second lateral seal (196), and
- when the longitudinal profile (190) is in the second position, the first free end (190a) thereof compresses the first lateral seal (195) against the stopper seal (91) of a given slat (11) and the rear of the second free end (190b) thereof compresses the second lateral seal (196) against a portion (126; 127) of the corresponding slide (22).

~~44~~23. Device (1) according to claim ~~43~~22, characterised in that the slide (22) has a hollow recess (126) close to the pivot (122) for receiving the second lateral seal (196) in order to hold it in position.

~~45~~24. Device (1) according to claim ~~43~~ 22 or ~~44~~23, characterised in that the rear of the second free end (190b) of the longitudinal profile (190) is provided with a hollow inner recess (197) for receiving the second lateral seal (196) in order to hold it in position.

~~46~~25. Device (1) according to claim ~~42~~21, characterised in that:
- the longitudinal profile (190) includes a curved crescent shape defining a lever hinged about a pivot formed by an internal rib (122) of the corresponding lateral slide (22), a first free end (190a) of said profile (190) being provided internally with the first lateral seal (195), whereas a rear rib (198) fitted between the two free ends (190a, 190b) of the profile (190), is disposed facing the second lateral seal (196), and
- when the longitudinal profile (190) is in the second position, the first free end (190a) thereof compresses the first lateral seal (195) against the stopper seal (91) of a given slat (11) and the rear rib (198) thereof compresses the second lateral seal (196) against a rear edge (128) of the corresponding slide (22).

~~47~~26. Device (1) according to any one of claims ~~42~~ 21 to ~~46~~25, characterised in that the first free end (190a) of the longitudinal profile (190) is provided with a hollow inner recess (191') for receiving the first lateral seal (195) in order to hold it in position.

~~48~~27. Device (1) according to any one of claims ~~42~~ 21 to ~~47~~26, characterised in that the second free end (190b) of the longitudinal profile (190) includes a hook (194)

disposed facing a vertical rear slot (291) formed in the thickness of at least some of the lower slats (11), such that the pressure (F) exerted by the water on the front face (10f) of the closure apron (10), when in its lowered position, causes said given slats to retreat and the hook (194) to slide along an inclined plane (292) of said vertical slot (291), in turn causing the longitudinal profile (190) to progressively rotate about the pivot (122) and increasing the force exerted on the stopper seal (91) as said pressure (F) increases.

~~49~~28. Device (1) according to any one of claims ~~42~~ 21 to ~~48~~27, characterised in that the fifth lateral sealing means (90) further includes a system (200) for activating the longitudinal profiles (190), which system is disposed in the lower part of each lateral slide (22), said activation system (200) causing at least the bottom slat (13) to advance from the front face (10f) towards the rear face (10d) of the closure apron (10) as the slats (11) descend along the lateral slides (22), so as to tilt the longitudinal profiles (190) from the first position into the second position.

~~50~~29. Device (1) according to claim ~~49~~28, characterised in that each activation system (200) includes a ramp (201) having a vertical plane (203) that is inclined from the rear face (10f) to the front face of the closure apron (10) along which the bottom slat (13) slides as it descends.

~~51~~30. Device (1) according to claim ~~50~~29, characterised in that each activation system (200) further includes an upper roller (210) connected to one end of a given slat (11) and

adapted to bear against a lateral distribution plate (212), which is itself placed on a vertically-moving, longitudinal bar (214) resting on a lower, curved, lateral clamping sheet (216), such that the descent of the upper roller (210) exerts a vertical force directed downwards on the distribution plate (212), which causes the vertical bar (214) to descend, pressing on the lower, curved clamping sheet (216) which thus presses laterally on the longitudinal profile (190) to cause it to rotate vertically and create the lateral seal on the given lower slats (11).

~~52~~31. Device according to claim ~~51~~30, characterised in that each longitudinal profile (190) is provided with a compression member in the initial vertical position, including a compression spring connected between a top end of said longitudinal profile (190) and the corresponding upper support roller (210).

~~53. Device according to any one of claims 20 to 42, characterised in that it includes a sensor for detecting the rise of fluid along the closure apron (10) and an actuator which automatically triggers the activation of said fifth lateral sealing means (90) during said rise of fluid.~~

~~54~~32. Device according to any one of the preceding claims, characterised in that each lateral slide (22) is provided, on at least one of the walls (23d; 23f) thereof, with a vertical rib (24) penetrating a vertical groove (19) in each slat (11) so as to block the latter in the lateral slide (22) at least in the third lowered sealing position.

~~55. Device (1) according to any one of the preceding claims, characterised in that the slats (11) are aluminium profiles with a hollow cross-section provided longitudinally with reinforcing ribs spaced apart from one another.~~