

Grout nozzle for a grout extruder

Technical Field

The present disclosure relates to the field of grouting of tiles and grouting products thereof. In particular, to a nozzle for a grout extruder which can be used for grouting, and
5 more particularly, to a nozzle for a grout extruder of an autonomous grouting robot.

Background

After tiles are installed on a surface, grout is typically applied to fill the gaps between adjacent tiles or between edge tiles and a wall. Grout is fluid mixture which sets hard and is typically a cement-based fluid mixture comprised of water, cement and depending upon the
10 application, additives such as sand and polymers. Epoxy and polymer grouts are also used in certain applications. Grout is used to add mechanical strength to tiles (i.e. to support the edges and to keep them spaced apart), to protect the surface beneath the tiles and to improve the visual appearance of the tiles.

Applying grout is laborious process in which a tool such as a trowel or grout float is
15 used to push grout into gaps between tiles. The application is performed by pushing the grout along a grouting direction over a gap between tiles. Any excess grout is then progressively cleaned off the tiles using a sponge or cloth while taking care not to disrupt/remove the grout in the gap between the tiles. Given the manual and laborious nature of the task, various attempts have been made to develop improved tools and apparatus (including automated
20 robots).

However, this is a challenging task as grouting must be performed on a wide range of tiles of different sizes, shapes and colours laid in a wide range of geometrical configurations. In particular, the perimeter size and shape of the grout application zone varies significantly, and care must be taken with grouting around edges to avoid grout on walls or surrounding
25 areas. Further the grouting must be performed in a wide range of lighting and environmental conditions (e.g. indoor and outdoor locations).

Accordingly, many of the tools or apparatus developed to date are only useful for specific tasks such as cleaning with a sponge or operating in large open areas away from boundaries. As such they remain inefficient compared to an experienced human grouter/tiler
30 with a trowel and sponge that is more versatile and able to grout a range of different tiles

(including into corners and edges) in a range of locations and environments.

Grout nozzles for grout extruders are generally known. These grout nozzles are suitable for applying grout into gaps between floor tiles and into edge gaps between a floor tile and a wall or a wall tile. The grout nozzles generally have slots that need to be aligned to the gaps for proper application of grout. However, there remains a need to improve grouting reliability in automated grouting systems or apparatuses.

The present disclosure is directed, at least in part, to improving or overcoming one or more aspects of the prior art system.

Brief Summary of the Invention

The present disclosure describes a grout nozzle for a grout extruder of an autonomous grouting robotic apparatus as defined in claim 1. The grout nozzle improves grouting reliability by allowing more error in alignment between the spreading of grout and the gap between the tiles or the grout line. The grout nozzle simulates the use of a trowel or a grout float that allows for simultaneously spreading discharged grout over the grout line and pushing the discharged grout into the grout line. The hydrostatic pressure of the grout is also regulated during the application process. The grout nozzle is removable and may be interchanged based on the needs of the specific situation, such as, but not limited to, the width of the grout line and the depth of the grout line.

As defined in the appended dependent claims, the grout nozzle provides for multiple scrapers that operate sequentially to push grout further into the grout line. The plurality of scrapers simulates a human hand going across a grout line multiple times. The grout nozzle also redirects residual grout with a flow-guide so that the residual grout may be spread over the grout line again.

Brief Description of the Drawings

The foregoing and other features and advantages of the present disclosure will be more fully understood from the following description of various embodiments, when read together with the accompanying drawings, in which:

Fig. 1A is an isometric view of a first embodiment of a grout nozzle according to the present disclosure;

Fig. 1B is a top view of the nozzle of Fig. 1A;

Fig. 1C is a side view of the nozzle of Fig. 1A;

Fig. 1D is a rear view of the nozzle of Fig. 1A;

Fig. 1E is a front view of the nozzle of Fig. 1A;

Fig. 1F is a bottom view of the nozzle of Fig. 1A;

5 Fig. 2A is an isometric view of a second embodiment of a grout nozzle according to the present disclosure;

Fig. 2B is a top view of the nozzle of Fig. 2A;

Fig. 2C is a side view of the nozzle of Fig. 2A;

Fig. 2D is a rear view of the nozzle of Fig. 2A;

10 Fig. 2E is a front view of the nozzle of Fig. 2A;

Fig. 3A is an isometric view of a third embodiment of a nozzle according to the present disclosure;

Fig. 3B is a top view of the nozzle of Fig. 3A;

Fig. 3C is a side view of the nozzle of Fig. 3A;

15 Fig. 3D is a rear view of the nozzle of Fig. 3A;

Fig. 3E is a front view of the nozzle of Fig. 3A;

Fig. 4A is an isometric view of a fourth embodiment of a nozzle according to the present disclosure;

Fig. 4B is a top view of the nozzle of Fig. 4A;

20 Fig. 4C is a side view of the nozzle of Fig. 4A;

Fig. 4D is a rear view of the nozzle of Fig. 4A;

Fig. 4E is a front view of the nozzle of Fig. 4A;

Fig. 5 is an isometric view of an alternative to the first embodiment of a grout nozzle according to the present disclosure;

25 Fig. 6 is a top view of a grout nozzle according to the present disclosure with a plurality of scrapers and outlets; and

Fig. 7 is a side view of an autonomous grouting robotic apparatus.

Detailed Description

30 This disclosure generally relates to a grout nozzle that spreads grout discharged from a grout extruder over a grout line. A grout line is a gap to be filled with grout. An example of

a grout line is a gap between tiles. The grout line is located in an application zone that is identified for grouting. The application zone includes the grout line and the surfaces flanking the grout line. The grout nozzle may be engaged with an autonomous grouting robotic apparatus for application of grout in an application zone.

5 Figs. 1 to 6 (is taken to denote all the figures identified with sub-letters A-F) illustrate various embodiments of grout nozzles **10**. The following description discloses the general features that are common to the embodiments. Each of the embodiments of the grout nozzle **10** have a coupling member **12** and a grouting member **14**. The grouting member **14** is arranged opposite to the coupling member **12**. The coupling member **12** and the grouting member **14** are formed on the opposite sides of the grout nozzle **10**.

In an embodiment, the coupling member **12** and the grouting member **14** are respectively provided on opposite surfaces of a body of the grout nozzle **10**. The coupling member **12** and the grouting member **14** may be formed as a monolithic structure. In an alternative embodiment, the coupling member **12** and the grouting member **14** are
15 respectively provided on separate bodies of the grout nozzle **10**. Fig. 6 illustrates an autonomous grouting robotic apparatus **100** with a grout extruder **102**.

With reference to Figs. 1 to 6, in an embodiment, the grout nozzles **10** may be longitudinally extended and have a longitudinal axis **A**. The grout nozzles **10** may have first end **11** and a second end **13**. The first and the second ends **11**, **13** are the transverse ends of
20 the grout nozzle **10**. The longitudinal axis **A** extends through the first and the second ends **11**, **13**.

During operation, the grout nozzle **10** is required to be moved over a grout line along a grouting direction **X**. The grout nozzle **10** has a defined orientation with the first end **11** ahead of the second end **13** relative to the grouting direction **X**. Specifically, the first end **11**
25 leads the second end **13** when the grout nozzle **10** is aligned in the grouting direction **X**. The longitudinal axis **A** may be aligned to the grouting direction **X** during operation. The grouting direction **X** may be substantially parallel to the grout line.

In an embodiment, the grout nozzle **10** may have an elastomeric coating. Such a coating may be rubber or a rubber-like substance. The coating simulates a softer trowel used
30 for grouting and to leave an acceptable finish while not damaging the tiles. An example may

be a plastic grout nozzle **10** having a rubber coating.

With reference to Figs 1 to 6, the coupling member **12** is configured for coupling to a grout extruder. The coupling member **12** has a coupling means **16** for engaging the grout extruder and an opening **18** for receiving grout from the grout extruder. The coupling means **16** are configured to removably engage a discharge end of a grout extruder **102**.

In an embodiment, the coupling means **16** are configured for a sliding engagement with correspondingly configured structure in the grout extruder **102**. The sliding means **16** comprise an axially extending mating structure that slidably fits into a corresponding structure provided in the grout extruder **102**. The coupling means **16** may be open at the second end **13** to permit relative sliding engagement between the coupling means **16** and corresponding structure on the grout extruder **102**. The grout nozzle **10** is engaged to the grout extruder **102** by sliding relative to the grout extruder **102** against the grouting direction **X**. The coupling means **16** may be closed at the first end **11** to impede relative sliding engagement between the coupling means **16** and corresponding structure of the grout extruder **102**. The grout nozzle **10** is disengaged from the grout extruder **102** by sliding relative to the grout extruder **102** along the grouting direction **X**.

In alternative embodiments, the coupling means **16** may be configured with a removable mechanical engagement means such as a snap fit engagement or a clasp engagement.

With reference to Fig. 1F, the opening **18** enables grout extruded from the grout extruder **102** to be discharged through the grout nozzle **10**. The opening **18** is positioned on a surface that faces the grout extruder **102**. The opening **18** may be positioned centrally in the coupling member **12**. Opening **18** may be bordered by the coupling means **16**. The coupling means **16** may surround the opening **18**. In another embodiment, the opening **18** may be defined by the coupling means **16**. In an alternative embodiment, the opening **18** may be provided in the coupling means **16**. Fig. 1F is representative of a bottom view of the embodiments of Figs. 2 to 4. The embodiments of Figs. 2 to 4 have a structure with the opening **18** as in the first embodiment of Fig. 1. Fig. 5 has an opening **18** shown in Fig. 1F. Fig. 6 has a plurality of the openings **18**.

In an embodiment, the grout is discharged directly into the grout nozzle **10**. Grout

from the grout extruder **102** is generally discharged into the opening **18** at substantially the same pressure as the extrusion pressure. In an alternative embodiment, the grout discharge pressure may be different from the grout extrusion pressure.

With reference to Figs 1 to 6, the grouting member **14** is configured for applying grout into gaps in an application zone. Grouting member **14** faces the application zone and contacts the surface of the application zone during application of grout. The grouting member **14** is configured to perform the application of the grout discharged from the grout extruder **102** to the application zone. Grout discharged into the opening **18** flows through the body of the grout nozzle **10** to the grouting member **14**.

The grouting member **14** comprises a grout surface **20**, containment means **22**, at least one outlet **26** and at least one scraper **30**. The grout surface **20** is an external layer of the grouting member **14**. In an embodiment, grout surface **20** is formed on the opposite side to the surface having the opening **18**. The grout surface **20** may be a portion of the external surface of the grouting member **14**. In an embodiment, the grout surface **20** may comprise the entire external surface of the grouting member **14**. The grout surface **20** faces the application zone during operation of the grout nozzle **10**. In an embodiment, the grout surface **20** may be a plane surface. Grout surface **14** may be substantially parallel to a surface of the application zone. Grout flowing out from the grout nozzle **10** leaves through the grout surface **20**. The grout may flow along the grout surface **20** as the grout nozzle **10** moves along the grouting direction **X**.

The containment means **22** contain flow of the grout on the grout surface **20**. By restricting the flow of grout, the containment means **22** regulate the hydrostatic pressure of the grout. The containment means **22** extend from the grout surface **20**. Containment means **22** extend substantially vertically relative to the grout surface **20**. In an embodiment, containment means **22** may be perpendicular to the grout surface **20**. The containment means **22** may be rigidly provided on the grout surface **20**. The containment means **22** may be monolithic with the grout surface **20**.

Containment means **22** have a free edge **23** that contacts the surface of the application zone during operation. The free edge **23** is elevated relative to the grout surface **20**. Height of the containment means **22** determines the magnitude of elevation of the free edge **23** and the

quantity of grout that can be contained. The height of the containment means **22** is constant such that the free edge **23** has a uniform elevation across the containment means **22**. In an embodiment, the height of the containment means **22** may vary continuously from the first end **11** to the second end **13** or vice versa such that the elevation of the free edge **23** changes accordingly. Free edge **23** may be flat. Free edge **23** may be parallel to the grout surface **20** and/ or the surface of the application zone. In an alternative embodiment, free edge **23** may be inclined or curved.

The containment means **22** define a grout flow zone **24** on the grout surface **20**. The grout flow zone **24** is defined by the containment means **22**, the grout surface **20** and a plane formed on the free edge **23**. The grout flow zone **24** is bound by the containment means **22** relative to the horizontal axis of the grout flow zone **24**. The containment means **22** sets the lateral limits for the grout flow zone **24**. The grout flow zone **24** is bound by the grout surface **20** relative to the vertical axis of the grout flow zone **24**. The grout surface **20** sets an upper limit and the plane formed by the free edge **23** sets the lower limit. Grout flow over the grout surface **20** and through the grout zone **24** is contained by the containment means **22** and the grout surface **20** in conjunction with the surface of the application zone.

Application of grout in the application zone is controlled by the quantity, hydrostatic pressure and flow of grout in the grout flow zone **24**. The sides of the containment means **22** that define the grout flow zone **24** may be substantially perpendicular to the grout surface **20** to retain the flow of grout and the hydrostatic pressure of grout in the grout flow zone **24**.

Unused grout may flow away from the grout zone **24** through an area not restricted by any containment means **22**. A passage **25** may be formed at an area without containment means **22**. In an embodiment, a plurality of passages **25** may be formed in the containment means **22**. In an alternative embodiment, the containment means **22** may be formed without a passage **25**. In yet another embodiment, the containment means **22** may be formed with a passage **25** that is occluded by a scraper as hereinafter disclosed.

In an embodiment, the containment means **22** comprises a plurality of containment walls **22**. The containment walls **22** at least partially surround the grout surface **20**. An area on the grout surface **20** may remain without any containment walls **22**. The containment walls **22** extend horizontally over the grout surface **20**. The containment walls **22** extend

linearly across the grout surface **20**.

In an embodiment, the containment walls **22** comprise a pair of sidewalls **40**, **42** that extend on opposite sides of the grout surface **20**. The pair of sidewalls **40**, **42** may be parallel to each other and have the same axial length. The pair of sidewalls **40**, **42** may be parallel to the longitudinal axis **A**. The pair of sidewalls **40**, **42** extend linearly from the first end **11** towards the second end **13**. The containment walls **22** may comprise an end wall **44** that connects the pair of sidewalls **40**, **42** at an end of the grouting surface **20**. End wall **44** may be positioned adjacent to or at the first end **11**. End wall **44** may be flush with the first end **11**. The end wall **44** is perpendicular to the pair of sidewalls **40**, **42**. The end wall **44** extends transversely to the longitudinal axis **A**. The length of the end wall **44** is determined by the mutual distance between the sidewalls **40**, **42**. The pair of sidewalls **40**, **42** may not be mutually connected at the end opposite the end wall **44** thereby forming the passage **25**.

In another embodiment, the containment means **22** comprises a single containment wall **22**. The containment wall **22** at least partially surrounds the grout surface **20**. An area on the grout surface **20** may remain without any containment wall **22**. The containment wall **22** is formed by a single wall without angles. The containment wall **22** extends horizontally over the grout surface **20**. The containment wall **22** may be curved, arcuate shaped or circular arc shaped. The ends of the containment wall **22** do not contact so as to form the passage **25**.

In an alternative embodiment, the containment wall **22** or containment walls **22** may be configured to contain grout flow over the entire grout surface **20**. Containment walls **22** encircle the entire grout surface **20**. A passage **25** is not formed in this embodiment of the containment wall **22** or containment walls **22**.

The outlet **26** provides for the egress of the extruded grout. Grout extruded from the grout extruder **102** into the opening **18** passes therefrom and through the outlet **26** into the grout flow zone **24**. The outlet **26** is provided in the grout surface **20** and is positioned in the grout flow zone **24**. Outlet **26** is formed at the level of the grout surface **20**. The outlet **26** is connected to a through hole that connects to the opening **18**. The through hole may extend through the body of the grout nozzle **10**.

Outlet **26** may be shaped and dimensioned according to the grout application requirement of the grout nozzle **10**. In an embodiment, the outlet **26** is rectangular in plan

view. The outlet **26** is orientated such that longitudinal axis thereof is perpendicular to the longitudinal axis **A**. Grout egresses from the outlet **26** at substantially the same pressure as the extrusion pressure. In an alternative embodiment, the grout egress pressure may be different from the grout extrusion pressure.

The outlet **26** is located at an end of the grout surface **20**. Outlet **26** is positioned at the leading end of the grout surface **20** relative to the grouting direction **X**. Outlet **26** is positioned adjacent the first end **11**. Outlet **26** is positioned adjacent the containment means **22**. In an embodiment, outlet **26** is contiguous with the containment means **22**. Particularly, outlet **26** is adjacent the end wall **44**. The outlet **26** may be contiguous with the end wall **44**.

Outlet **26** is positioned centrally relative to the sides of the grout nozzle **10**. The outlet **26** is located along the longitudinal axis **A**. In an embodiment, longitudinal axis **A** passes through the centre of the outlet **26**.

The grouting member **14** may have a first outlet which is outlet **26** and a second outlet **28**. The second outlet **28** provides for further egress point of the extruded grout. Grout extruded from the grout extruder **102** into a second opening **19**, as shown in Fig. 1F, passes therefrom and through the second outlet **28** into the grout flow zone **24**. The second outlet **28** is provided in the grout surface **20** and is positioned in the grout flow zone **24**. The second outlet **28** is formed at the level of the grout surface **20**. The second outlet **28** is connected to a through hole that connects to the second opening **19**. The through hole may extend through the body of the grout nozzle **10**.

In another embodiment (not shown), both the first and second outlets **26**, **28** may be connected to the first opening **18**. Grout extruded from the grout extruder **102** into the first opening **18** passes therefrom and through the first and second outlets **26**, **28** into the grout flow zone **24**.

The second opening **19** is axially spaced away from the first opening **18**. Grout extruded from the grout extruder **102** is discharged from both the first and second openings **18**, **19**. Fig. 1F is representative of a bottom view of the embodiments of Figs. 2 to 4. The embodiments of Figs. 2 to 4 have a structure with the second opening **19** as in the first embodiment of Fig. 1. Fig 6 has a plurality of the second openings **19**.

Second outlet **28** may be shaped and dimensioned according to the grout application

requirement of the grout nozzle **10**. In an embodiment, the second outlet **28** is rectangular in plan view. The second outlet **28** is orientated such that longitudinal axis thereof is parallel to the longitudinal axis **A**. In an embodiment, the longitudinal axis of the second outlet **28** is coincident with the longitudinal axis **A**.

5 Grout egresses from the second outlet **28** at substantially the same pressure as the extrusion pressure. In an alternative embodiment, the grout egress pressure may be different from the grout extrusion pressure. Grout egressing from the second outlet **28** mixes with residual grout from the first outlet **26** that is not pushed into the grout line.

10 The second outlet **28** is located at an end of the grout surface **20**. Second outlet **28** is positioned at the trailing end of the grout surface **20** relative to the grouting direction **X**. The second outlet **28** is spaced away from the first end **11** and positioned towards the second end **13**. Second outlet **28** may be positioned adjacent the second end **13**. In an embodiment, second outlet **28** is positioned adjacent the passage **25** in the containment means **22**. In an alternative embodiment, the second outlet **28** may be positioned in the passage **25**. In yet
15 another embodiment, second outlet **28** is positioned adjacent the containment means **22**.

The second outlet **28** is positioned centrally relative to the sides of the grout nozzle **10**. The second outlet **28** is located along the longitudinal axis **A**. In an embodiment, longitudinal axis **A** passes through the centre of the second outlet **28**.

20 The first outlet **26** is axially spaced apart from the second outlet **28** in the grout flow zone **24**. First outlet **26** precedes the second outlet **28** along the grouting direction **X**. First outlet **26** is positioned between the first end **11** and the second outlet **28**. The length of the first outlet **26** is longer than the width of the second outlet **28** wherein the length of the first outlet **26** and the width of the second outlet **28** are both orientated perpendicular to the longitudinal axis **A**. The width of the first outlet **26** is shorter than the length of the second
25 outlet **28** wherein the width of the first outlet **26** and the length of the second outlet **28** are parallel or coincident to the longitudinal axis **A**.

In an embodiment, the grouting member **14** may have a plurality of first and/ or second outlets **26**, **28**. The plurality of first outlets **26** may be linearly arranged along the longitudinal axis **A** between the end wall **44** and the second outlet **28**. The plurality of first
30 outlets **26** may be arranged to be mutually equidistant along the longitudinal axis **A**. The first

outlets **26** are each connected to corresponding first openings **18**. The terminal first outlet **26** that is closest to the second end **13** is followed by the second outlet **28**. In a further embodiment, a plurality of second outlets **28** may be positioned linearly along the longitudinal axis **A** between the first outlet **26** and the second end **13**. The plurality of second outlets **28** may be positioned to be mutually equidistant along the longitudinal axis **A**. The second outlets **28** are each connected to corresponding second openings **19**.

Grout egressing from the following first outlet **26** or plurality of outlets **26** mixes with residual grout from the preceding first outlet **26** that is not pushed into the grout line prior to arriving to the following second outlet **28** or plurality of outlets **28**. Grout egressing from the following second outlet **28** or plurality of outlets **28** mixes with residual grout from the preceding first outlet **26** or plurality of first outlets **26** that is not pushed into the grout line.

The scraper **30** is configured to push the egressed grout into gaps in the application zone. During operation, grout exiting from the outlet **26** comes into contact with the scraper **30** and is pushed by the scraper **30** along the grout line and into the gaps that are required to be filled. The scraper **30** extends from the grout surface **20** and is positioned in the grout flow zone **24**. The scraper **30** extends substantially vertically relative to the grout surface **20**. In an embodiment, scraper **30** may extend perpendicularly relative to the grout surface **20**. The scraper **30** may be rigidly provided on the grout surface **20**. The scraper **30** may be monolithic with the grout surface **20**.

The scraper **30** has a free edge **31** that contacts the surface of the application zone during operation. The free edge **31** is elevated relative to the grout surface **20**. Height of the scraper **30** determines the magnitude of elevation of the free edge **31**. Free edge **31** may be flat. The free edge **31** may be parallel to the grout surface **20** and/ or the surface of the application zone. In an alternative embodiment, free edge **31** may be inclined or curved. Scraper **30** may extend to the same height as the containment means **22**. Free edge **31** of the scraper **30** may have the same elevation as the free edge **23** of the containment means **22**. In an embodiment, free edge **31** of the scraper **30** may be flush with free edge **23** of the containment means **22**.

The scraper **30** is located towards an end of the grout surface **20**. Scraper **30** is positioned towards the leading end of the grout surface **20** relative to the grouting direction

X. Scraper **30** is positioned towards the first end **11** and spaced away from the second end **13**. Scraper **30** is positioned adjacent the first outlet **26**.

The scraper **30** may be positioned centrally relative to the sides of the grout nozzle **10**. The scraper **30** may be located along the longitudinal axis **A**. In an embodiment, longitudinal axis **A** passes through the centre of the scraper **30**. Scraper **30** is positioned axially adjacent the first outlet **26**. The first outlet **26** and the scraper **30** are axially aligned. In an embodiment, first outlet **26** and the scraper **30** are mutually aligned on the longitudinal axis **A**. Scraper **30** may be centrally positioned relative to the first outlet **26**.

In an embodiment, the scraper **30** has a rectangular base in plan view. Scraper **30** is orientated such that the longitudinal axis of the rectangular base is perpendicular to the longitudinal axis **A**. In an embodiment, the length of the rectangular base of the scraper **30** is shorter than the length of the first outlet **26** wherein the respective lengths are perpendicular to the longitudinal axis **A**. In another embodiment, the length of the rectangular base of the scraper **30** is the same as the length of the first outlet **26**.

The scraper **30** may have a face **33** that faces the first outlet **26**. The face **33** may be inclined. The inclined face **33** extends from the base of the scraper **30** to the free edge **31**. The base is formed on the grout surface **20**. In an embodiment, the base may form part of the grout surface **20**. In another embodiment, the base may be raised from the grout surface **20**. The base may be raised perpendicular to the grout surface **20**.

The inclined face **33** may be inclined away from the first outlet **26**. The inclined face **33** has an angle of inclination relative to the base. The angle of inclination may be from 30 degrees to 60 degrees relative to the grout surface **20**. Particularly, the angle of inclination may be 45 degrees relative to the grout surface **20**. In an embodiment, the inclined face **33** is adjacent the first outlet **26** and the free edge **31** is axially spaced away from the first outlet **26** from a plan view. The base edge of the inclined face **33** may be conjunct with the first outlet **26**. In another embodiment, the inclined face **33** is spaced away from the first outlet **26** and the free edge **31** is positioned axially spaced away from the first outlet **26** from a plan view. The base edge of the inclined face **33** may be spaced away from the first outlet **26**.

In an embodiment, the inclined face **33** may be inclined towards the first outlet **26**. The inclined face **33** has an angle of inclination relative to a plane formed by the first outlet

26 or the grout surface **20**. The plane of the first outlet **26** is level to the grout surface **20** surrounding the first outlet **26**. The angle of inclination may be from 30 degrees to 60 degrees relative to the plane of the first outlet **26** or the grout surface **20**. Particularly, the angle of inclination may be 45 degrees relative to the plane of the first outlet **26** or the grout surface **20**. In an embodiment, the inclined face **33** is adjacent the first outlet **26** and the free edge **31** is positioned axially over the first outlet **26** from a plan view. The base edge of the inclined face **33** may be conjunct with the first outlet **26**. In another embodiment, the inclined face **33** is spaced away from the first outlet **26** and the free edge **31** is positioned adjacent or axially spaced away from the first outlet **26** from a plan view. The base edge of the inclined face **33** may be spaced away from the first outlet **26**.

In an embodiment, the scraper **30** may have a form of a right angled prism with a rectangular face formed on the grout surface **20** and the triangular sides positioned to be substantially parallel to the longitudinal axis **A** with the right angled corners being opposite to the first outlet **26**. The inclined face **33** being opposite to the right angled corners is faces to the first outlet **26**. The tip being truncated to form the free edge **31**.

In an embodiment, the face **33** may be perpendicular to the grout surface **20** or the plane of the first outlet **26**. The perpendicular face **33** extends from the base of the scraper **30** to the free edge **31**. The base is formed on the grout surface **20**. In an embodiment, the base may form part of the grout surface **20**. In another embodiment, the base may be raised from the grout surface.

In an embodiment, the perpendicular face **33** is adjacent the first outlet **26** and the free edge **31** is positioned axially adjacent to the first outlet **26** from a plan view. The base edge of the perpendicular face **33** may be conjunct with the first outlet **26**. In another embodiment, the perpendicular face **33** is spaced away from the first outlet **26** and the free edge **31** is positioned axially spaced away from the first outlet **26** from a plan view. The base edge of the perpendicular face **33** may be spaced away from the first outlet **26**.

In an embodiment, the scraper **30** may have a form of a right angled prism with a rectangular face formed on the grout surface **20**, the triangular sides positioned to be substantially parallel to the longitudinal axis **A**. The perpendicular face **33** faces the first outlet **26**. The tip being truncated to form the free edge **31**.

The first outlet **26** precedes the scraper **30** along the grouting direction **X**. First outlet **26** is positioned between the scraper **30** and the first end **11**. The first outlet **26** is positioned between the scraper **30** and the containment means **22**. First outlet **26** is positioned between the scraper **30** and the containment means **22** relative to the longitudinal axis **A**. Particularly,
 5 first outlet **26** is positioned between the scraper **30** and the end wall **44**. In an embodiment, the scraper **30** is contiguous with the first outlet **26**. An edge of the scraper **30** may border the first outlet **26**. The first outlet **26** may be interposed between the scraper **30** and the end wall **44**. In alternative embodiment, the scraper **30** may be spaced away from the first outlet **26**. The alignment of the first outlet **26** and the scraper **30** on the longitudinal axis **A** forms an
 10 axial first grouting arrangement. The pair of sidewalls **40**, **42** are positioned on opposite sides of the first grouting arrangement of the scraper **30** and the first outlet **26**.

The grouting member **14** may have a first scraper which is scraper **30** and a second scraper **32**. The second scraper **32** is configured to push the residual grout into gaps in the application zone. In an embodiment, the grout nozzle **10** may comprise the first arrangement
 15 of the first outlet **26** and the first scraper **30** with a second scraper **32** that is spaced away from the first scraper **30**.

During operation, grout exiting from the outlet **26** comes into contact with the first scraper **30** and is pushed along the grout line and into the gaps that are required to be filled. The grout that is not pushed into the gaps become residual grout which moves along the grout
 20 flow zone **24** to the second outlet **28** or the second scraper **32**.

In an embodiment, the residual grout or the combined residual grout and grout egressed from the second outlet **28** comes into contact with the second scraper **32** and is pushed along the same portion of the grout line and is pushed into the same portion of the gaps having grout therein. The second scraper **32** is configured to provide a finishing. In an
 25 embodiment, the second scraper **32** aids in pushing some residual grout into the grout line.

The second scraper **32** extends from the grout surface **20** and is positioned in the grout flow zone **24**. The second scraper **32** extends substantially vertically relative to the grout surface **20**. In an embodiment, second scraper **32** may extend perpendicularly relative to the grout surface **20**. The second scraper **32** may be rigidly provided on the grout surface **20**.
 30 The second scraper **32** may be monolithic with the grout surface **20**.

The second scraper **32** has a free edge **35** that contacts the surface of the application zone during operation. The free edge **35** is elevated relative to the grout surface **20**. Height of the second scraper **32** determines the magnitude of elevation of the free edge **35**. Free edge **35** may be flat. Free edge **35** may be parallel to the grout surface **20** and/ or the surface of the application zone. In an alternative embodiment, free edge **35** may be inclined or curved.

Second scraper **32** may extend to the same height as the first scraper **30**. Free edge **35** of the second scraper **32** may have the same elevation as the free edge **23** of the containment means **22**. Second scraper **32** may extend to the same height as the containment means **22**. In an embodiment, free edge **35** of the second scraper **32** may be flush with free edge **23** of the containment means **22**. Free edge **35** of the second scraper **32** may have the same elevation as the free edge **31** of the first scraper **30**. In an embodiment, free edge **35** of the second scraper **32** may be flush with free edge **31** of the first scraper **30**. Free edge **35** of the second scraper **32** may have the same width as the free edge **31** of the first scraper **30** wherein the respective widths are parallel to the longitudinal axis **A**.

The second scraper **32** is located at towards an end of the grout surface **20**. Second scraper **32** is positioned towards the trailing end of the grout surface **20** relative to the grouting direction **X**. Second scraper **32** is positioned towards the second end **13** and spaced away from the first end **11**. Second scraper **32** is positioned between the second outlet **28** and the second end **13**. Second scraper **32** may be positioned adjacent the second outlet **28**. Second scraper **32** may be positioned in the passage **25** of the containment means **22**. Second scraper **32** may be centrally positioned in the passage **25**. The second scraper **32** may be positioned between the ends of the containment walls **22** or the sidewalls **40, 42**. In an embodiment, second scraper occludes the passage **25**.

The second scraper **32** may be positioned centrally relative to the sides of the grout nozzle **10**. The second scraper **32** may be located along the longitudinal axis **A**. In an embodiment, longitudinal axis **A** passes through the centre of the second scraper **32**. Second scraper **32** is positioned axially adjacent the second outlet **28**. The second outlet **28** and the second scraper **32** are axially aligned. In an embodiment, second outlet **28** and the second scraper **32** are mutually aligned on the longitudinal axis **A**.

In an embodiment, the second scraper **32** has a rectangular base in plan view. Second

scraper **32** is orientated such that the longitudinal axis of the rectangular base is perpendicular to the longitudinal axis **A**. In an embodiment, the length of the base of the second scraper **32** is longer than the width of the second outlet **28** wherein the length of the base of the second scraper **32** and the width of the second outlet **28** are perpendicular to the longitudinal axis **A**.

- 5 In another embodiment, the length of the base of the scraper **30** is the same as the width of the second outlet **28**.

The second scraper **32** may have a face **37** that faces the second outlet **28**. The face **37** extends from the base of the second scraper **32** to the free edge **35**. The base is formed on the grout surface **20**. In an embodiment, the base may form part of the grout surface **20**. In
10 another embodiment, the base may be raised from the grout surface. The face opposite to the face **37** and facing away from the second outlet **28** may be perpendicular or inclined to the grout surface **20**.

In an embodiment, the face **37** may be perpendicular to the grout surface **20** or the plane of the second outlet **28**. The perpendicular face **37** may be adjacent the second outlet **28**
15 and the free edge **35** is positioned axially adjacent to the second outlet **28** from a plan view. The base edge of the perpendicular face **37** may be adjacent the second outlet **28**. In another embodiment, the perpendicular face **37** is spaced away from the second outlet **28** and the free edge **35** is positioned axially spaced away from the second outlet **28** from a plan view. The base edge of the perpendicular face **37** may be spaced away from the second outlet **28**. The
20 face opposite to the perpendicular face **37** and facing away from the second outlet **28** may be inclined to the grout surface **20**.

In an embodiment, the second scraper **32** may have a form of a right angled prism with a rectangular face formed on the grout surface **20**, the triangular sides positioned to be substantially parallel to the longitudinal axis **A**. The perpendicular face **37** faces the second
25 outlet **28**. The tip being truncated to form the free edge **35**.

In alternative embodiment, the face **37** may be inclined. The inclined face **37** extends from the base of the second scraper **32** to the free edge **35**. The base that is formed on the grout surface **20**. In an embodiment, the base may form part of the grout surface **20**. In
another embodiment, the base may be raised from the grout surface. The face opposite to the
30 face **37** and facing away from the second outlet **28** may be perpendicular to the grout surface

20.

In an embodiment, the inclined face **37** may be inclined away from the second outlet **27**. The inclined face **37** has an angle of inclination relative to grout surface **20**. The angle of inclination may be from 30 degrees to 60 degrees relative to the grout surface **20**.
 5 Particularly, the angle of inclination may be 45 degrees relative to the grout surface **20**. In an embodiment, the inclined face **37** is adjacent the second outlet **28** and the free edge **35** is axially spaced away from the second outlet **28** from a plan view. The base edge of the inclined face **37** may be conjunct with the second outlet **28**. In another embodiment, the inclined face **37** is spaced from the second outlet **28** and the free edge **35** is axially spaced
 10 from the second outlet **28** from a plan view. The base edge of the inclined face **37** may be spaced away from the second outlet **28**. The face opposite to the inclined face **37** and facing away from the second outlet **28** may be inclined or perpendicular to the grout surface **20**.

In an alternative embodiment, the inclined face **37** may be inclined towards the second outlet **28**. The inclined face **37** has an angle of inclination relative to a plane formed
 15 by the second outlet **28** or the grout surface **20**. The plane of the second outlet **28** is level to the grout surface **20** surrounding the second outlet **28**. The angle of inclination may be from 30 degrees to 60 degrees relative to the plane of the second outlet **28** or the grout surface **20**. Particularly, the angle of inclination may be 45 degrees relative to the plane of the second outlet **28** or the grout surface **20**. In an embodiment, the inclined face **37** is adjacent the
 20 second outlet **28** and the free edge **35** is positioned over the second outlet **28** from a plan view. The base edge of the inclined face **37** may be conjunct with the second outlet **28**. In another embodiment, the inclined face **37** is spaced away from the second outlet **28** and the free edge **35** is adjacent or axially spaced from the second outlet **28** from a plan view. The base edge of the inclined face **37** may be spaced away from the second outlet **28**. The face
 25 opposite to the inclined face **37** and facing away from the second outlet **28** may be inclined or perpendicular to the grout surface **20**.

In an embodiment, the second scraper **32** may have a form of a right angled prism with a rectangular face formed on the grout surface **20**, the triangular sides positioned to be substantially parallel to the longitudinal axis **A** and with the right angled corners being
 30 opposite to the second outlet **28**. The inclined face **37** faces the second outlet **28**. The tip

being truncated to form the free edge **31**.

The first scraper **30** is axially spaced apart from the second scraper **32** in the grout flow zone **24**. The second outlet **28** precedes the second scraper **32** along the grouting direction **X**. Second outlet **28** is positioned between the second scraper **32** and the first end **11** relative to the longitudinal axis **A**. Second scraper **32** is positioned between the second outlet **28** and the second end **13** along the longitudinal axis **A**. Second scraper **32** may be positioned between the second outlet **28** and the passage **25**. The second outlet **28** is positioned between the scraper **30** and the containment means **22** relative to the longitudinal axis **A**. Particularly, second outlet **28** is positioned between the second scraper **32** and the end wall **44**.

The alignment of the second outlet **28** and the second scraper **32** on the longitudinal axis **A** forms the second grouting arrangement. The pair of sidewalls **40, 42** are positioned on opposite sides of the second grouting arrangement of the second scraper **32** and the second outlet **28**.

In another embodiment, a second pair of sidewalls **46, 48** are positioned on opposite sides of the second grouting arrangement of the second scraper **32** and the second outlet **28**. The distance of the grouting surface **20** between the first pair of sidewalls **40, 42** is greater than the distance of the grouting surface **20** between the second pair of sidewalls **46, 48**. The second pair of sidewalls **46, 48** may be raised relative to the grout surface **20**. The second pair of sidewalls **46, 48** may have the same height as the first pair of sidewalls **40, 42**. In this embodiment, the second pair of sidewalls **46, 48** may be either perpendicular or inclined relative to the grout surface **20**. Alternatively, the second pair of sidewalls **46, 48** may be at the same level as the grout surface **20**.

The second grouting arrangement of the second outlet **28** and the second scraper **32** is aligned to the first grouting arrangement of the first outlet **26** and the first scraper **30** on the longitudinal axis **A**. Thus, the first and second outlets **26, 28** and the first and second scrapers **30, 32** are all mutually aligned on the longitudinal axis **A**. The first and second scrapers **30, 32** alternate with the first and second outlets **26, 28** where each outlet **26, 28** precedes the corresponding scraper **30, 32** in the grouting direction **X**. In another embodiment, the grout nozzle **10** may comprise the first grouting arrangement of the first outlet **26** and the first scraper **30** with an axial second grouting arrangement of the second outlet **28** and the second

scraper **32** that is spaced away from the first scraper **30**.

In an embodiment, the grouting member **14** may have a plurality of first and/ or second scrapers **30**, **32**. The plurality of first scrapers **30** may be arranged linearly along the longitudinal axis **A** between the first end **11** and the second outlet **28** or the second scraper **32**. The plurality of first scrapers **30** may be arranged to be mutually equidistant along the longitudinal axis **A**. The terminal first scraper **30** that is closest to the second end **13** is followed by either the second outlet **28** or the second scraper **32**, or both. The plurality of first scrapers **30** serve to pack the gap along the grout line with grout while the second scraper **32** serves to provide a finishing. The further application of grout by plurality of first scrapers **30** forces the first layer of grout deeper into the gap thereby substantially filling the gap. This further reduces the chances of having air pockets in the gaps along the grout line.

The plurality of second scrapers **32** may be arranged linearly along the longitudinal axis **A** between the first scraper **26** or the second outlet **28** and the second end **13**. The plurality of second scrapers **32** may be arranged to be mutually equidistant along the longitudinal axis **A**.

In an embodiment, each first outlet **26** precedes a corresponding first scraper **30** and each second outlet **28** precedes a second scraper **32** in the grouting zone **24** from the first end **11** to the second end **13**. In a plurality of first and second outlets **26**, **28** and a plurality of first and second scrapers **30**, **32**, the first outlets **26** alternate with the first scrapers **30** prior to the second outlets **28** alternating with the second scrapers **32**.

In an embodiment, a plurality of first scrapers **30** alternate with a plurality of first outlets **26** with a first outlet **26** positioned in the lead and a first scraper **30** positioned at the end. In an embodiment, a plurality of second scrapers **32** alternate with a plurality of second outlets **28** with a second outlet **28** positioned in the lead and a second scraper **32** positioned at the end.

In another embodiment, a plurality of first grouting arrangements of first outlets **26** and first scrapers **30** is positioned prior to the second grouting arrangements of a second outlet **28** and a second scraper **32**. The plurality of first grouting arrangements is mutually spaced apart. The plurality of first grouting arrangements is mutually spaced apart along the direction of the longitudinal axis **A**.

In a further embodiment, with reference to Fig. 6, a plurality of first grouting arrangements of the first outlets **26** and the first scrapers **30** is positioned prior to a plurality of the second grouting arrangements of the second outlets **28** and the second scrapers **32**. In the plurality of the first grouting arrangements the first scrapers **30** are contiguous with the first outlets **26**. The faces **33** of the first scrapers **30** adjacent to the second outlets **28** are inclined. In the plurality of the second grouting arrangements the second scrapers **32** are spaced apart from the second outlets **28**. The terminal second scraper **32** nearer the second end **13** has a perpendicular face **37** that faces the corresponding second outlet **28**. The second scraper **32** nearer the first end **13** has an inclined face **37** that faces the corresponding second outlet **28**.

Residual grout cascades from a preceding grouting arrangement to the next along the grouting direction. The sidewalls **40**, **42** are positioned on opposite sides of the plurality of the aforesaid grouting arrangements.

In an embodiment, the second scraper **32** is contiguous with the second outlet **28**. In an embodiment, first scraper **30** is contiguous with the corresponding first outlet **28** and second scraper **32** is spaced apart from the second outlet **28**. In an alternative embodiment, first and second scraper **30**, **32** are contiguous with the corresponding first and second outlets **26**, **28**.

With reference to Figs. 1 to 4, the grouting member **14** further comprises a flow guide **34** for redirecting the residual grout towards the second outlet **28** and/ or the second scraper **32**. Residual grout flows away from the first scraper **30** and is guided by the flow guide **34** to the second outlet **28** and/ or the second scraper **32** in the grout flow zone **24**. The flow guide **34** extending from the grout surface **20** and being positioned in the grout flow zone **24**. The flow guide **34** extends substantially vertically relative to the grout surface **20**. In an embodiment, the flow guide **34** may be perpendicular to the grout surface **20**.

The flow guide **34** projects horizontally on the grout surface **20** from the containment means **22** into the grouting zone **24**. The flow guide **34** may be positioned in the grouting zone **24** after the first scraper **30**. In a plurality of first outlets **28** and first scrapers **30**, a plurality of flow guides **34** is provided after each first scraper **30**. In a plurality of first grouting arrangements of the first outlets **26** and the first scrapers **30**, a flow guide **34** may be

positioned after each of said first grouting arrangements. A flow guide **34** may be provided after a plurality of first grouting arrangements. With reference to Fig. 6, a pair of flow guides **34** extend from opposite containment walls **22** towards respective second outlets **28**.

The flow guide **34** comprises a first flange **36** and a second flange **38**. The first flange **36** and the second flange **38** may be inclined relative to the longitudinal axis **A** on the horizontal axis. Each flange **36, 38** is inclined away from the first outlet **26** and towards the second outlet **28** or the second scraper **32**. The first flange **36** and the second flange **38** may each be inclined from the first end **11** towards the second end **13**. The first flange **36** and the second flange **38** may have the same length.

The first flange **36** and the second flange **38** respectively projects from the containment walls **22** on opposite sides of the grout surface **20**. The first flange **36** projects from a first containment wall **22** and the second flange **38** projects from a second containment wall **22** wherein the first containment wall **22** faces the second containment wall **22**. The first flange **36** projects from the sidewall **40** and the second flange **38** projects from the opposite sidewall **42**. First and second flanges **36, 38** are inclined relative to respective sidewalls **40, 42**. In another embodiment, the flow guide **34** is interposed between the first pair of sidewalls **40, 42** and the second pair of side walls **46, 48**.

In an embodiment, the first and second flanges **36, 38** project towards the second outlet **28** or second scraper **32**. The first and second flanges **36, 38** terminate at the second outlet **28** or second scraper **32**. Residual grout is redirected directly towards either the second outlet **28** or second scraper **32**. In another embodiment, the first and second flanges **36, 38** project towards to an area between the first scraper **30** and the second outlet **28** or second scraper **32**. The first and second flanges **36, 38** terminate at the area between the first scraper **30** and the second outlet **28** or second scraper **32**. Residual grout is redirected towards an area that precedes either the second outlet **28** or second scraper **32**.

In an embodiment, the first and second flanges **36, 38** are formed as upright walls that linearly project across the grout surface **20**. In another embodiment, the first and second flanges **36, 38** are formed as extensions of the containment walls **22**.

The first and second flanges **36, 38** have respective free edges **39** that contact the surface of the application zone during operation. The free edges **39** are elevated relative to the

grout surface **20**. Height of the first and second flanges **36, 38** determine the magnitude of elevation of the respective free edges **39** and the quantity of residual grout that can be redirected. First and second flanges **36, 38** extend to the same height. The height of the first and second flanges **36, 38** is constant such that the respective free edges **39** have a uniform elevation. Free edges **39** may be flat. Free edges **39** may be parallel to the grout surface **20** and/ or the surface of the application zone. In an alternative embodiment, free edges **39** may be inclined or curved.

First and second flanges **36, 38** extend to the same height as the containment means **22**. First and second flanges **36, 38** extend to the same height as the first and second scrapers **30, 32**. Free edges **39** of the first and second flanges **36, 38** are flush with the free edge **23** of the containment means **22**, the free edges **31** of the first scraper **30** and free edge **35** of the second scraper **32**.

In an embodiment, a pliable connecting member **50** is interposed between the coupling member **12** and the grouting member **14**. The pliable connecting member **50** enables the grouting member **14** to move relative to the coupling member **12**. The first outlet **26** is connected to the first opening **18** via a through hole that passes through the pliable member **50**. In an embodiment, the second outlet **28** is connected to the second opening **19** via a through hole that passes through the pliable member **50**. In an embodiment, the pliable connecting member **50** may be made from an elastomeric polymer. Such a polymer may be rubber or a rubber-like substance.

With reference to Figs. 1A to 1F and Fig. 5, the first embodiment and the alternative to the first embodiment comprises the general features herein described. In addition, the first embodiment and the alternative to the first embodiment has the following features. The grouting member **14** and the coupling member **12** are formed as a monolithic structure. The grouting member **14** has an exterior surface **15**, opposite to the coupling member **12**, that is flat. The first outlet **26** is interposed between the end wall **44** and the first scraper **30**. The inclined face **33** of the first scraper **30** is inclined away from the first outlet **26**.

Specifically with reference to Figs. 1A to 1F, the second outlet **28** is axially spaced from the first scraper **30**. The first and second flanges **36, 38** project towards and terminate at the second outlet **28**. The second scraper **32** is axially spaced away from the second outlet **28**.

The second scraper **32** has a perpendicular face **37**. The second scraper **32** is axially spaced away from the second end **13**.

The containment walls **22** rise from the exterior surface **15** to cordon the grout surface **20** from the rest of the exterior surface **15**. Sidewalls **40, 42** of the containment walls **22** are vertical internally along the grout flow zone **24**. On the exterior of the grout flow zone **24**, the sidewalls **40, 42** are inclined. The external inclined surfaces of the sidewalls **40, 42** extend from the boundary of the exterior surface **15** towards the free edge **23**. Adjacent the free edge **23** the inclined surfaces have respective upright portions connecting to the free edge **23**. The ends of the sidewalls **40, 42** that define the passage **25** may be slanted relative to the longitudinal axis **A**. The ends may be slanted from the first end **11** towards the second end **13**. The terminal points on the ends may be positioned past the second scraper **32**.

With reference to Figs. 2A to 2E, the second embodiment comprises the general features herein described. In addition, the second embodiment has the following features. The grouting member **14** and the coupling member **12** are formed as a monolithic structure. The grouting member **14** has an exterior surface **15**, opposite to the coupling member **12**, that is substantially sloped from the containment walls **22** towards the coupling member **12**. In particular, with respect Figs. 2D and 2E the exterior surface **15** is convex shaped on both sides.

The first outlet **26** is interposed between the end wall **44** and the first scraper **30**. The inclined face **33** of the first scraper **30** is inclined away from the first outlet **26**. The second outlet **28** is axially spaced from the first scraper **30**. The first and second flanges **36, 38** project towards and terminate at the second outlet **28**. The second scraper **32** is axially spaced away from the second outlet **28**. The second scraper **32** has a perpendicular face **37**. The second scraper **32** is adjacent the second end **13**. The second scraper **32** is flush with the second end **13**.

The containment walls **22** rise from the exterior surface **15** to cordon the grout surface **20** from the rest of the exterior surface **15**. With respect in particular to Fig. 2C, the magnitude of elevation of the containment walls **22** increases from the first end **11** to the second end **13**. The height of the second scraper **32** is in line with the height of the ends of the sidewalls **40, 42**.

Sidewalls **40, 42** of the containment walls **22** are vertical internally along the grout flow zone **24**. On the exterior of the grout flow zone **24**, the sidewalls **40, 42** are vertical. The ends of the sidewalls **40, 42** that define the passage **25** may be slanted relative to the longitudinal axis **A**. The ends may be slanted from the first end **11** towards the second end **13**. The terminal points on the ends may be in line with a portion of the second scraper **32**.

With reference to Figs. 3A to 3E, the third embodiment comprises the general features herein described. In addition, the third embodiment has the following features. The grouting member **14** and the coupling member **12** are formed as separate structures. A pliable member **50** is interposed between the grouting member **14** and the coupling member **12**.

The grouting member **14** has an exterior surface **15** that is substantially inclined from the containment walls **22** to the base of the grouting member **14**. In particular, with respect Figs. 3D and 3E the exterior surface **15** is inclined on both sides. The exterior surface **15** is formed on the grouting member **14**.

The first outlet **26** is interposed between the end wall **44** and the first scraper **30**. The inclined face **33** of the first scraper **30** is inclined away from the first outlet **26**. The second outlet **28** is axially spaced from the first scraper **30**. The first and second flanges **36, 38** project towards and terminate at the second outlet **28**. The second scraper **32** is axially spaced away from the second outlet **28**. The second scraper **32** has a perpendicular face **37**. The second scraper **32** is adjacent the second end **13**. The second scraper **32** is flush with the second end **13**.

The containment walls **22** rise from the exterior surface **15** to cordon the grout surface **20** from the rest of the exterior surface **15**. Sidewalls **40, 42** of the containment walls **22** are vertical internally along the grout flow zone **24**. On the exterior of the grout flow zone **24**, the sidewalls **40, 42** are vertical. The ends of the sidewalls **40, 42** that define the passage **25** may be slanted relative to the longitudinal axis **A**. The ends may be slanted from the first end **11** towards the second end **13**. The terminal points on the ends may be positioned before the second scraper **32**.

With reference to Figs. 4A to 4E, the fourth embodiment comprises the general features herein described. In addition, the fourth embodiment has the following features. The grouting member **14** and the coupling member **12** are formed as a monolithic structure. The

grouting member **14** has an exterior surface **15** opposite to the coupling member **12**. Grout surface **20** is formed as a depression into the exterior surface **15**. The first outlet **26** is spaced away from the first end wall **11** and is contiguous with the first scraper **30**. The inclined face **33** of the first scraper **30** is inclined away from the first outlet **26**. The second outlet **28** is axially spaced from the first scraper **30**.

With respect to Figs. 4C to 4E, the second scraper **32** has an elastic portion that is configured to move relative to the grouting surface **20**. The second scraper **32** has a base portion **52** and an inclined portion **54**. Inclined portion **54** is movable relative to the base portion **52**. Inclined portion **54** is movable relative to the grout surface **20**. In an embodiment, the inclined portion **54** is vertically movable. In an embodiment, inclined portion **54** is made from an elastomeric material. The inclined face **37** is formed on the inclined portion **54**. The inclined portion **54** has the free edge **35**. The second scraper **32** is contiguous with the second outlet **28**. The inclined face **37** of the second scraper **32** is inclined away from the second outlet **28**. The second scraper **32** is positioned at the second end **13** and occludes the passage **25**. The width of the second outlet **28** is narrower than the length of the base portion **52**.

With reference to Figs. 4A and 4B, the first and second flanges **36**, **38** project towards and terminate at an area between the second outlet **28** and the first scraper **30**. The first and second flanges **36**, **38** are formed as a part of the of the containment walls **22**. The containment walls **22** are formed in the grouting member **14** and extend vertically from the raised exterior surface **15** to the depressed grout surface **20**.

The containment walls **22** has a first pair of sidewalls **40**, **42** and a second pair of sidewalls **46**, **48**. The distance of grouting surface **20** between the first pair of sidewalls **40**, **42** is greater than the distance of the grouting surface **20** between the second pair of sidewalls **46**, **48**. The first sidewalls **40**, **42** and the second first sidewalls **46**, **48** of the containment walls **22** are vertical internally along the grout flow zone **24**.

Fig. 7 illustrates an autonomous grouting robotic apparatus **100** comprising a grout nozzle **10** herein described. The autonomous grouting robotic apparatus **100** comprises a grout extruder **102**. The grout extruder **102** comprises a grout extruder mounting assembly (not shown) which either supports a grout storage container **104** or is configured to receive and support a removable grout storage container **104**, and a motorised plunger (not shown).

The grout storage container **104** is configured to receive the grout nozzle **10**.

The skilled person would appreciate that foregoing embodiments may be modified or combined to obtain the grouting nozzle **10** of the present disclosure.

Industrial Applicability

5 This disclosure describes a grouting nozzle **10** for application of grout into gaps between tiles of shower or kitchen floors. The grouting nozzle **10** can be removably coupled to a grouting extruder **102** for application of grout. Particularly, the grouting nozzle **10** is used with a grouting extruder **102** provided in a grouting machine such as an autonomous grouting robotic apparatus **100**.

10 The width of the first and scrapers **30, 32** and consequently the grout nozzle **10** may be adjusted based on thickness of grout lines. The width may also factor in movement that may occur in the axis perpendicular to the grouting direction X to account for any errors.

 Accordingly, this disclosure includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any
15 combination of the above-described elements in all possible variations thereof is encompassed by the disclosure unless otherwise indicated herein.

 Where technical features mentioned in any claim are followed by reference signs, the reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, neither the reference signs nor their absence have any limiting effect
20 on the technical features as described above or on the scope of any claim elements.

 One skilled in the art will realise the disclosure may be embodied in other specific forms without departing from the disclosure or essential characteristics thereof. The foregoing embodiments are therefore to be considered in all respects illustrative rather than limiting of the disclosure described herein. Scope of the invention is thus indicated by the
25 appended claims, rather than the foregoing description, and all changes that come within the meaning and range of equivalence of the claims are therefore intended to be embraced therein.

Claims

1. A grout nozzle (10) for a grout extruder (102) of an autonomous grouting robotic apparatus (100), the grouting nozzle (10) comprising:

a coupling member (12) for coupling to the grout extruder (102), the coupling member (12) having coupling means (16) for engaging the grout extruder (102) and an opening (18) for receiving grout from the grout extruder (102); and

a grouting member (14) for applying grout into gaps in an application zone, the grouting member (14) being arranged opposite to the coupling member (12) for passage of grout from the grout extruder (102) to the application zone wherein the grouting member (14) comprises:

a grout surface (20);

containment means (22) for containing flow of the grout on the grout surface (20), the containment means (22) extending from the grout surface (20) and defining a grout flow zone (24);

at least one outlet (26) for egress of the extruded grout, the at least one outlet (26) being provided in the grout surface (20) and being positioned in the grout flow zone (24); and

at least one scraper (30) for pushing the egressed grout into gaps in the application zone, the at least one scraper (30) extending from the grout surface (20) and being positioned in the grout flow zone (24) wherein the at least one outlet (26) and the at least one scraper (30) are axially aligned in a first grouting arrangement and the at least one outlet (26) precedes the at least one scraper (30) along a grouting direction (X).

2. The grout nozzle (10) of claim 1 further comprising a second scraper (32) for pushing the grout into gaps in the application zone, the second scraper (32) extending from the grout surface (20) and being positioned in the grout flow zone (24) wherein the second scraper (32) is axially spaced apart from the first grouting arrangement in the grout flow zone (24).

3. The grout nozzle (10) of claim 2 further comprising a second outlet (28) for egress of the extruded grout, the second outlet (28) being provided in the grout surface (20) and being positioned in the grout flow zone (24) wherein the second outlet (28) and the second scraper (32) are axially aligned in a second grouting arrangement and the second outlet (28) precedes the second scraper (32) along a grouting direction (X) wherein a first grouting arrangement is axially spaced apart from the second grouting arrangement.
4. The grout nozzle (10) of claim 3 wherein the coupling member (12) has a second opening (19) for receiving grout from the grout extruder (102), the second opening (19) being axially spaced apart from the first opening (18) wherein the first opening (18) is connected to the first outlet (26) and the second opening (19) is connected to the second outlet (28).
5. The grout nozzle (10) of claim 2, 3 or 4 wherein the second scraper (32) has a perpendicular surface (37) facing the second outlet (28).
6. The grout nozzle (10) of claim 3, 4 or 5 wherein the second scraper (32) is spaced apart from the second outlet (28).
7. The grout nozzle (10) of claim 3, 4, 5 or 6 wherein the grouting member (14) further comprises a flow guide (34) for redirecting residual grout towards the second outlet (28) and/ or the second scraper (32), the flow guide (34) extending from the grout surface (20) and being positioned in the grout flow zone (24).
8. The grout nozzle (10) of claim 7 wherein the flow guide (34) comprises a first flange (36) and a second flange (38), each flange (36, 38) being inclined relative to a longitudinal axis (A) of the grout nozzle (10) away from the first outlet (26) and towards the second outlet (28) or the second scraper (32).
9. The grout nozzle (10) of claim 8 wherein the containment means (22) comprises

containment walls (22) wherein the first flange (36) projects from a first containment wall (22) and the second flange (38) projects from a second containment wall (22) wherein the first containment wall (22) faces the second containment wall (22).

- 5 10. The grout nozzle (10) of any one of preceding claims wherein the first scraper (30) is contiguous with the first outlet (26).
11. The grout nozzle (10) of claim any one of preceding claims wherein the first scraper (30) has an inclined face (33) facing the first outlet (26) wherein the direction of inclination is
10 away from the first outlet (26).
12. The grout nozzle (10) of any one of preceding claims wherein the containment means (22) comprise a pair of sidewalls (40, 42) positioned on opposite sides of the first grouting arrangement of the at least one scraper (30) and at least one outlet (26).
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13. The grout nozzle (10) of claim 12 wherein an end wall (44) connects the two sidewalls (40, 42) at an end of the grouting surface (20) adjacent the at least one first outlet (26).
14. The grout nozzle (10) of any one of preceding claims further comprising a plurality of
20 first grouting arrangements wherein the plurality of first scrapers (30) and first outlets (26) are axially aligned.
15. The grout nozzle (10) of claim 14 wherein the plurality of first grouting arrangements is mutually spaced apart along the grout surface (20).
25
16. The grout nozzle (10) of any one of preceding claims wherein a pliable connecting member (50) is interposed between the coupling member (12) and the grouting member (14).
- 30 17. The grout nozzle (10) of claim 2 wherein the second scraper (32) has an inclined portion (54) configured to move relative to the grouting surface (20).

18. The grout nozzle (10) of claim any one of preceding claims wherein the coupling means (16) is configured for a sliding engagement with correspondingly configured structure in the grout extruder (102).

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19. The grout nozzle (10) of any one of preceding claims wherein the coupling member (12) has an opening at a second end (13) of the grouting nozzle (10) for access to the coupling means (16) and is closed at a first end (11) of the grouting nozzle (10) for limiting sliding engagement of the coupling means (16).

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20. An autonomous grouting robotic apparatus (100) comprising a grout nozzle (10) of any one of the preceding claims.