

DEVICE, PERIPHERAL DEVICE, SYSTEM AND METHOD FOR MINING

FIELD OF THE INVENTION

5 **[0001]** The present disclosure relates to a device, a peripheral device, a system, and method for mining.

BACKGROUND ART

10 **[0002]** The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

15 **[0003]** An existing extraction equipment for mining has been proposed. Such existing extraction equipment is allowed to reach at a determined depth and discharge water outward to liquefy layer to create a slurry. However, such existing extraction equipment does not include a structure to efficiently direct the created slurry toward a surface of sea, thus failing to address an environmental issue.

[0004] There exists a need to alleviate at least one of the aforementioned problems.

SUMMARY

20 **[0005]** The present invention seeks to address and/or ameliorate the problem in the prior art by providing a device, a peripheral device, a system, and method for mining.

25 **[0006]** Throughout this document, unless otherwise indicated to the contrary, the terms 'comprising', 'consisting of', 'having' and the like, are to be construed as non-exhaustive, or in other words, as meaning 'including, but not limited to'.

[0007] Furthermore, throughout the document, unless the context requires otherwise, the word 'include' or variations such as 'includes' or 'including' will be

understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0008] Furthermore, throughout the document, unless the context requires otherwise, the word 'water' will be understood to imply water, or liquid containing both water and at least one material.

[0009] Furthermore, throughout the document, unless the context requires otherwise, the terms 'high pressure' and 'low pressure' are not limited to being indicative of a particular amount of pressure. The term 'high pressure' is, for example, used to indicate a relatively higher pressure than the term 'low pressure'.

[0010] According to one aspect of the disclosure, a device for mining comprises a first tubular member defining a first passageway therein along a first axis and a plurality of peripheral tubular members arranged coaxially around the first tubular member, the plurality of peripheral tubular members comprising a first set of peripheral tubular members and a second set of peripheral tubular members, wherein at least one of the first set of peripheral tubular members is arranged to allow a first fluid passing therethrough to flow toward a predetermined area outside of the device via a lateral side of the device, and wherein at least one of the second set of peripheral tubular members is arranged to allow a second fluid passing therethrough to flow toward the first passageway.

[0011] In some embodiments, the plurality of peripheral tubular members further comprise a third set of peripheral tubular members, and wherein at least one of the third set of peripheral tubular members is arranged to allow a third fluid passing therethrough toward a predetermined area outside of the device via a bottom side of the device.

[0012] In some embodiments, the pressure of the third fluid is higher than the pressure of the first fluid.

[0013] In some embodiments, the device further comprises a body defining therein a plurality of compartments, wherein a first compartment of the plurality of compartments is arranged in fluid communication with the at least one of the first set of peripheral tubular members, and wherein a second compartment of the plurality of

compartments is arranged in fluid communication with the at least one of the second set of peripheral tubular members, and wherein third compartment of the plurality of compartments is arranged in fluid communication with the at least one of the third set of peripheral tubular members.

5 **[0014]** In some embodiments, the device further comprises one or more first inlet pipes arranged to receive the first fluid and to supply the first fluid to the first compartment; one or more second inlet pipes arranged to receive the second fluid and to supply the second fluid to the second compartment; and one or more third inlet pipes arranged to receive the third fluid and to supply the third fluid to the third
10 compartment.

[0015] In some embodiments, the number of the first set of peripheral tubular members is three, the number of the second set of peripheral tubular members is two, and the number of the third set of peripheral tubular members is three.

[0016] In some embodiments, the angle of discharging the second fluid to the first
15 passageway is an acute angle in relation to a horizontal direction of the device.

[0017] In some embodiments, the device further comprises a pump arranged to supply the first fluid to the at least one of the first set of peripheral tubular members and to supply the third fluid to the at least one of the third set of peripheral tubular members, a compressor arranged to supply the second fluid to the at least one of
20 the second set of peripheral tubular members.

[0018] In some embodiments, the device further comprises a controller arranged to control the pump and the compressor, wherein the controller controls the pump to supply the third fluid to the at least one of the third set of the peripheral tubular members at a first determined time, and after the first determined time, the controller
25 controls the pump to discontinue supplying the third fluid to the at least one of the third set of the peripheral tubular members, controls the pump to supply the first fluid to the at least one of the first set of the peripheral tubular members, and controls the compressor to supply the second fluid to the at least one of the second set of the peripheral tubular members.

[0019] In some embodiments, a peripheral device for mining comprises a second tubular member defining a second passageway therein along a second axis and one or more peripheral members arranged around the second tubular member, wherein each of the one or more peripheral members is arranged to allow a fourth fluid passing therethrough to flow toward a device via a lateral side of the peripheral device, the device comprising a first tubular member defining a first passageway therein along with a first axis, and wherein the second tubular member is arranged to allow a fifth fluid passing therethrough to flow toward a predetermined area outside of the second tubular member via the second passageway and a bottom side of the second tubular member.

[0020] In some embodiments, the pressure of the fifth fluid is higher than the pressure of the fourth fluid.

[0021] In some embodiments, a system for mining comprises the device according to any one of claims 1 to 9 and a plurality of peripheral devices disposed around the device, wherein at least one of the plurality of peripheral devices comprises a second tubular member defining a second passageway therein along with a second axis and one or more peripheral members arranged around the second tubular member, and wherein each of the one or more peripheral members is arranged to allow a fourth fluid passing therethrough to flow toward the device via a lateral side of the peripheral device.

[0022] In some embodiments, the second tubular member is arranged to allow a fifth fluid passing therethrough to flow toward the predetermined area outside of the second tubular member via the bottom side of the second tubular member.

[0023] In some embodiments, the pressure of the fifth fluid is higher than the pressure of the fourth fluid.

[0024] In some embodiments, the plurality of peripheral devices are disposed equidistant around the device.

[0025] In some embodiments, the plurality of peripheral devices are disposed around the device spaced at a determined angle.

[0026] In some embodiments, the method comprises preparing a first tubular member defining a first passageway therein along with a first axis; preparing a plurality of peripheral tubular members arranged coaxially around the first tubular member; supplying a first fluid to at least one of a first set of peripheral tubular members of the plurality of peripheral tubular members to discharge the first fluid passing through the corresponding one of the first set of peripheral tubular members toward a predetermined area outside of the device via a lateral side of the device; and supplying a second fluid to at least one of a second set of peripheral tubular members of the plurality of peripheral tubular members to discharge the second fluid passing through the corresponding one of the second set of peripheral tubular members toward the first passageway.

[0027] In some embodiments, the method comprises before supplying the first fluid and the second fluid, supplying a third fluid to at least one of a third set of peripheral tubular members of the plurality of peripheral tubular members to discharge the third fluid passing through the corresponding one of the third set of peripheral tubular members toward a predetermined area outside of the device via a bottom side of the device.

[0028] In some embodiments, the pressure of the third fluid is higher than the first fluid.

[0029] In some embodiments, the first fluid and the third fluid are supplied from a pump, and wherein the second fluid is supplied from a compressor.

[0030] In some embodiments, a method of using a peripheral device for mining, the method comprising preparing a second tubular member defining a second passageway therein along with a second axis; preparing one or more peripheral members arranged around the second tubular member; supplying a fourth fluid to at least one of the one or more peripheral members to discharge the fourth fluid passing through the corresponding one of the one or more peripheral members toward a device via a lateral side of the peripheral device, the device comprising a first tubular member defining a first passageway therein along with a first axis, before supplying the fourth fluid, supplying a fifth fluid to the second passageway to discharge the fourth fluid passing through the corresponding one of the one or more peripheral

members toward a device via a lateral toward a predetermined area outside of the second tubular member via a bottom side of the second tubular member.

[0031] In some embodiments, a method of using a system for mining, the method comprising preparing a first tubular member defining a first passageway therein along with a first axis; preparing a plurality of peripheral tubular members arranged coaxially around the first tubular member; preparing a second tubular member defining a second passageway therein along with a second axis; preparing one or more peripheral members arranged around the second tubular member; supplying a first fluid to at least one of a first set of peripheral tubular members of the plurality of peripheral tubular members to discharge the first fluid passing through the corresponding one of the first set of peripheral tubular members toward a predetermined area outside of the device via a lateral side of the device; supplying a second fluid to at least one of a second set of peripheral tubular members of the plurality of peripheral tubular members to discharge the second fluid passing through the corresponding one of the second set of peripheral tubular members toward the first passageway; and supplying a fourth fluid to at least one of the one or more peripheral members to discharge the fourth fluid passing through the corresponding one of the one or more peripheral members toward a device via a lateral side of the peripheral device, the device comprising a first tubular member defining a first passageway therein along with a first axis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Various embodiments are described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a perspective view of a device 1000 according to some embodiments of the present disclosure.

Figure 2 (Figure 2a and 2b) illustrates a perspective view of a first end assembly 100 according to some embodiments of the present disclosure.

Figure 3 (Figure 3a and 3b) illustrates a perspective view of a first end assembly 100 according to some embodiments of the present disclosure.

Figure 4 (Figure 4a and 4b) illustrates another perspective view of a first end assembly 100 according to some embodiments of the present disclosure.

Figure 5 (Figure 5a and 5b) illustrates a first flange 110 according to some embodiments of the present disclosure.

- 5 Figure 6 (Figure 6a and 6b) illustrates a second flange 120 according to some embodiments of the present disclosure.

Figure 7 (Figure 7a and 7b) illustrates a first plate 134 according to some embodiments of the present disclosure.

- 10 Figure 8 (Figure 8a and 8b) illustrates a second plate 136 according to some embodiments of the present disclosure.

Figure 9 (Figure 9a and 9b) illustrates a third plate 138 according to some embodiments of the present disclosure.

Figure 10 (Figure 10a and 10b) illustrates a fourth plate 140 according to some embodiments of the present disclosure.

- 15 Figure 11 (Figure 11a and 11b) illustrates a perspective view of a second end assembly 900 according to some embodiments of the present disclosure.

Figure 12 (Figure 12a and 12b) illustrates a perspective view of a second end assembly 900 according to some embodiments of the present disclosure.

- 20 Figure 13 illustrates a perspective view of a second end assembly 900 according to some embodiments of the present disclosure.

Figure 14 (Figure 14a and 14b) illustrates a perspective view of a first plate 934 according to some embodiments of the present disclosure.

Figure 15 (Figure 15a and 15b) illustrates a perspective view of a second plate 936 according to some embodiments of the present disclosure.

- 25 Figure 16 (Figure 16a and 16b) illustrates a perspective view of a third plate 938 according to some embodiments of the present disclosure.

Figure 17 (Figure 17a and 17b) illustrates a perspective view of a first end member 950 according to some embodiments of the present disclosure.

Figure 18 illustrates a flange 920 according to some embodiments of the present disclosure.

- 5 Figure 19 illustrates a second end assembly 900 according to some embodiments of the present disclosure.

Figure 20(Figure 20a and 20b) illustrates a perspective view of a peripheral tubular member 224 according to some embodiments of the present disclosure.

- 10 Figure 21 illustrates a side view of a peripheral device 1100 according to some embodiments of the present disclosure.

Figure 22 illustrates a side view of a part of a peripheral device 1100 according to some embodiments of the present disclosure.

Figure 23 illustrates a side view of a part of a peripheral device 1100 according to some embodiments of the present disclosure.

- 15 Figure 24 (Figure 24a and 24b) illustrates a perspective view of a part of a peripheral device 1100 according to some embodiments of the present disclosure.

Figure 25 illustrates a bottom view of a peripheral device 1100 according to some embodiments of the present disclosure.

- 20 Figure 26 illustrates a perspective view of a vessel 2000, a device 1000, and a peripheral device 1100 according to some embodiments of the present disclosure.

Figure 27 illustrates an enlarged perspective view of a device 1000 and a peripheral device 1100 according to some embodiments of the present disclosure.

Figure 28 illustrates an enlarged perspective view of a device 1000 and a peripheral device 1100 according to some embodiments of the present disclosure.

- 25 Figure 29 illustrates a perspective view of a vessel 2000, a device 1000, and a peripheral device 1100 according to some embodiments of the present disclosure.

Figure 30 illustrates an enlarged perspective view of a device 1000 and a peripheral device 1100 according to some embodiments of the present disclosure.

Figure 31 illustrates an enlarged perspective view of a device 1000 and a peripheral device 1100 according to some embodiments of the present disclosure.

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DETAILED DESCRIPTION

[0033] The present invention may be suited for a device for mining for a resource within/at a pre-determined area. The pre-determined area includes ocean sea bed enclaves and other locations, etc. where mining of resources such as tin, copper, gold, oil etc. can take place.

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[0034] Unless defined otherwise, all other technical and scientific terms used herein have the same meaning as is commonly understood by a skilled person to which the subject matter herein belongs.

Device 1000

[0035] Figure 1 illustrates a perspective view of a device 1000, which can be in the form of an extraction equipment, according to the present disclosure. As shown in figure 1, the device 1000 comprises a first end assembly 100, a connecting part 300, a second end assembly 900. The first end assembly 100 may be detachably attached to the connecting part 300 by fasteners such as screws, rivets, interference fits, or other known connectors, and the connecting part 300 may be detachably attached to a second end assembly 900 by fasteners such as screws, rivets, interference fits, or other known connectors. The first end assembly 100, the peripheral tubular members 224, 226, 228, the connecting part 300 and the second end assembly 900 are coaxially disposed in an assembled state of the device 1000. An arrow shown in figure 1 indicates a flow of a fluid (e.g. water, air) in the device 1000 in normal operation.

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[0036] Figures 2 to 4 illustrate perspective views of a first end assembly 100 according to the present disclosure. As shown in figure 1, the first end assembly 100 may be positioned at a top side in normal operation. As shown in figures 2 to 4, the

first end assembly 100 comprises a first tubular member 101, a first flange 110, a second flange 120, a body 130, and peripheral tubular members 224, 226, 228. The first tubular member 101 is shaped and dimensioned as a hollow tube. With such configuration, the first tubular member 101 defines a first passageway therein along an axis. The first flange 110 is, for example, provided at an upper end of the first tubular member 101, and the second flange 120 is, for example, provided at a lower end of the first tubular member 101.

[0037] Figure 5 illustrates a first flange 110 according to some embodiments of the present disclosure. Figure 6 illustrates a second flange 120 according to some embodiments of the present disclosure. As shown in figure 6, the second flange 120 comprises a plurality of slots, the first openings 120H, second openings 120L, and the third openings 120A. Each of the plurality of slots is arranged to allow a corresponding pipe (e.g. the peripheral tubular member 224, the peripheral tubular member 226, or the peripheral tubular member 228) to pass therethrough. The second flange 120 further comprises a plurality of slots 120a each disposed between adjacent slots (e.g. the first openings 120H, second openings 120L, the third openings 120A). The plurality of slots 120a are configured to receive fasteners such as screws, rivets, interference fits, or other known connectors.

Body 130

[0038] As shown in figures 2 to 4, the body 130 is, for example shaped and dimensioned as a tube and placed between the first flange 110 and the second flange 120. The body 130 comprises four plates, a first plate 134, a second plate 136, a third plate 138, and a fourth plate 140. The four plates 134, 136, 138, 140 may be arranged as rings around the first tubular member 101, thereby creating in the body 130 three compartments, the same being a first compartment 144, a second compartment 146, a third compartment 148. It should be noted that the first plate 134, the second plate 136, the third plate 138, and the fourth plate 140 may be collectively referred to as 'plates 132'. It should be noted that the first compartment 144, the second compartment 146, the third compartment 148 may be collectively referred to as 'compartments 142'.

[0039] The first compartment 144 is a space to accommodate a third fluid (e.g. high pressure water) supplied from inlet pipes 154. The second compartment 146 is a space to accommodate a first fluid (e.g. low pressure water) supplied from inlet pipes 156. The third compartment 148 is a space to accommodate a second fluid (e.g. air) supplied from inlet pipes 158.

[0040] The first compartment 144 is formed between the first plate 134 and the second plate 136, and is arranged in fluid communication with the inlet pipes 154 and arranged in fluid communication with the peripheral tubular members 224. The second compartment 146 is formed between the second plate 136 and the third plate 138, and is arranged in fluid communication with the inlet pipes 156 and inner space of the peripheral tubular members 226. The third compartment 148 is formed between the third plate 138 and the fourth plate 140, and is arranged in fluid communication with the inlet pipes 158 and arranged in fluid communication with the peripheral tubular members 228. The first compartment 144, the second compartment 146, and the third compartment 148 are arranged along the first end assembly 100. It should be noted that the inlet pipes 154, the inlet pipes 156, and the inlet pipes 158 may be collectively referred to as 'inlet pipes 150'.

Plates 132

[0041] Figure 7 illustrates a first plate 134 according to the present disclosure. As shown in figures 2 to 4, the first plate 134 forms a bottom surface of the body 130. Each of a plurality of slots in figure 7, is arranged to allow a corresponding pipe (e.g. the peripheral tubular member 224, the peripheral tubular member 226, or the peripheral tubular member 228) to pass therethrough. The plurality of slots include, but not limited to, three openings 134H, three openings 134L, and two openings 134A. Each of the three openings 134H is for insertion of the corresponding peripheral tubular member 224. Each of the three openings 134L is for insertion of the corresponding peripheral tubular member 226. Each of the two openings 134A is for insertion of the corresponding peripheral tubular member 228.

[0042] Figure 8 illustrates a second plate 136 according to the present disclosure. As shown in figures 2 to 4, the second plate 136 is arranged to form a plurality of slots. Each of a plurality of slots in figure 8 is arranged to allow a corresponding pipe

(e.g. the peripheral tubular member 226, or the peripheral tubular member 228) to pass therethrough. The plurality of slots include, but are not limited to, three openings 136L and two openings 136A. Each of the three openings 136L is for insertion of the corresponding peripheral tubular member 226. Each of the two openings 136A is for
5 insertion of the corresponding peripheral tubular member 228.

[0043] Figure 9 illustrates a third plate 138 according to the present disclosure. As shown in figure 9, the third plate 138 forms two openings 138A. Each of the two openings 138A is arranged to allow a corresponding pipe (e.g. the peripheral tubular member 228) to pass therethrough. The plurality of slots include, but not limited to,
10 two openings 138A. Each of the two openings 138A is for insertion of the corresponding peripheral tubular member 228.

[0044] Figure 10 illustrates a fourth plate 140 according to the present disclosure. As shown in figure 10, the fourth plate 140 forms an upper surface of the body 130.

Inlet pipes 150

[0045] Referring back to figures 2 to 4, the inlet pipes 154 are, for example, arranged to pass therethrough a fluid (e.g. high pressure water) supplied from a first apparatus (not shown) toward the first compartment 144. The inlet pipes 156 are, for example, arranged to pass therethrough a fluid (e.g. low pressure water) supplied from a second apparatus (not shown) toward the second compartment 146. The inlet
15 pipes 158 are, for example, arranged to pass therethrough a fluid (e.g. air) from a third apparatus (not shown) toward the third compartment 148.

[0046] The number of the inlet pipes 154, the number of the inlet pipes 156, and the number of the inlet pipes 158 are, for example, two and may be other than two.

[0047] It should be noted that the each of the first apparatus and the second apparatus may be, for example, configured to be a pump and the third apparatus is, for example, configured to be a compressor. The first apparatus may be positioned above water to minimize wear and tear of the same. In some embodiments, the low pressure water supplied from the first apparatus and the second apparatus may be at a pressure of 15 bar and at a flow rate of between 20,000 litres and 50,000 litres
25 per minute. It is to be appreciated that the low pressure water supplied from the first
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apparatus and the second apparatus may be at any pressure and at any flow rate as to be determined based on different mining context and operations. In this regard, the term 'low pressure' fluid or water is relative. It is to be appreciated that the flow rate may be determined at the time of an operation or may be pre-determined.

5 **Peripheral tubular members 224, 226, 228**

[0048] Referring to figures 2 to 4, each of the peripheral tubular members 224, 226, 228 may be coaxially disposed around the first tubular member 101 and each peripheral tubular member 224, 226, 228 may be spaced apart from an adjacent peripheral tubular member 224, 226, 228. Each of the peripheral tubular members
10 224, 226, 228 is arranged to include a passageway therein. The passageway may be arranged parallel to the first passageway.

[0049] The passageway in the peripheral tubular members 224 is arranged in fluid communication with the first compartment 144, the connecting part 300, and the second end assembly 900 so that the high pressure water in the first compartment
15 144 is directed to the connecting part 300 and the second end assembly 900 via the peripheral tubular members 224.

[0050] The passageway in the peripheral tubular members 226 is arranged in fluid communication with the second compartment 146, the connecting part 300, and the second end assembly 900 so that the low pressure water in the second compartment
20 146 is directed to the connecting part 300 and the second end assembly 900 via the peripheral tubular members 224.

[0051] The passageway in the peripheral tubular members 228 is arranged in fluid communication with the third compartment 148, the connecting part 300, and the second end assembly 900 so that the air in the third compartment 148 is directed to
25 the connecting part 300 and the second end assembly 900 via the peripheral tubular members 224.

[0052] The number of the peripheral tubular members 224, the number of the peripheral tubular members 226, and the number of the peripheral tubular members 228 are, for example, respectively three, three, and two, and may be other than the
30 number stated above.

Connecting part 300

[0053] Referring back to figure 1, the connecting part 300 comprises a body 301, peripheral tubular members 311 and flanges 321, 322. The body 301 is, for example, shaped and dimensioned as a tube and disposed between the flange 321 and the flange 322 in an assembled state. The peripheral tubular members 311 may be integrally formed or moulded with the peripheral tubular members 224, the peripheral tubular members 226, and the peripheral tubular members 228. Each of the flanges 321, 322 is, for example, configured similarly as the second flange 120.

Second end assembly 900

[0054] Figure 11 illustrates a perspective view of a second end assembly 900 according to the present disclosure. As shown in figure 1, the second end assembly 900 may be positioned at a bottom side in normal operation. Figure 12 illustrates a perspective view of the second end assembly 900 according to the present disclosure. As shown in figures 11, 12, the second end assembly 900 comprises a first tubular member 901, a flange 920, a body 930, and a first end member 950. The first tubular member 901 is shaped and dimensioned as a hollow tube. The flange 920 is, for example, provided at an upper end of the first tubular member 901. It should be noted that the first tubular member 901 may be integrally formed or moulded with the first tubular member 101. It should be noted that the configuration of the flange 920 may be configured similarly as the second flange 120 shown in figure 6.

Body 930

[0055] As shown in figures 11, 12, the body 930 is, for example, shaped and dimensioned as a tube and placed between the flange 920 and the first end member 950. The body 930 comprises four plates each being a first plate 934, a second plate 936, a third plate 938, and a fourth plate 940, thereby creating in the body 930 three compartments each being a first compartment 944, a second compartment 946, a third compartment 948. It should be noted that the first plate 934, the second plate 936, the third plate 938, and the fourth plate 940 may be collectively referred to as 'plates 932'.

[0056] The first compartment 944 is formed between the first plate 934 and the second plate 936, and is arranged in fluid communication with the peripheral tubular member 224 to receive low pressure water. The second compartment 946 is formed between the second plate 136 and the third plate 138, and is arranged in fluid communication with the peripheral tubular member 226 to receive air. The third compartment 948 is formed between the third plate 938 and the fourth plate 140, and is arranged in fluid communication with the peripheral tubular members 228 to receive high pressure water.

[0057] As shown in figures 11, 12, the body 930 comprises a plurality of openings 930L. Each of the plurality of openings 930L is arranged to allow passage of low pressure water in the first compartment 944 therethrough.

[0058] As shown in figure 13, the first tubular member 101 comprises a plurality of openings 901A formed around the circumference (such as an inner circumference) of the first tubular member 101. Each of the plurality of openings 901A is configured to allow passage of air therethrough. The plurality of openings 901A are formed so that the air can flow therethrough. The direction of each of the openings 901A is, for example, 30 degree with respect to an axis (such as the horizontal axis as represented by a direction of an arrow in the figure 13) of the first tubular member 101 in order to cause the flow of the air toward downward in the first tubular member 101. The number of the plurality of openings 901A is, for example, six and may be other than six. In some embodiments, the plurality of openings 901A may be arranged in a 'spiral-like' configuration around the inner circumference of the first tubular member 101, with each row of openings 901A arranged in a manner such as to facilitate the generation of airflow along the longitudinal axis of the first tubular member 101.

[0059] In some embodiments (not shown), an opening may be formed at the bottom side of the body 930 to direct high pressure water in the third compartment 948 toward a bottom end of the device 1000 in operation.

Plate 932

[0060] Figure 14 illustrates a perspective view of a first plate 934 according to the present disclosure. As shown in figures 12, 13, the first plate 934 forms one of a

surface of the body 930. The configuration of the first plate 934 shown in figure 14 is, for example, same as the first plate 134 shown in figure 7.

[0061] Figure 15 illustrates a perspective view of a second plate 936 according to the present disclosure. As shown in figures 12, 13, the second plate 936 comprises a plurality of slots. Each of the plurality of slots in figure 15 is configured to allow a corresponding pipe (e.g. the peripheral tubular member 224 or the peripheral tubular member 226) to pass therethrough. The plurality of slots include, but not limited to, two openings 924A, three openings 924H.

[0062] Figure 16 illustrates a perspective view of a third plate 938 according to the present disclosure. As shown in figures 12, 13, the third plate 938 comprises a plurality of slots. Each of the plurality of slots in figure 16 is arranged to allow to pass a corresponding pipe (e.g. the peripheral tubular member 224) therethrough. The plurality of slots include, but not limited to, three openings 938H.

First end member 950

[0063] Figure 17 illustrates a perspective view of a first end member 950 according to the present disclosure. As shown in figures 11 and 12, the first end member 950 is, for example, disposed at a bottom of the second end assembly 900 in normal operation. As shown in figure 17, the first end member 950 is configured to be an annular structure. The first end member 950 forms a plurality of recesses 950a and is attached to bottom part of the body 930. The plurality of recesses 950a are, for example, spaced apart equally, thereby creating first parts 950b each being in the form of taper and located between adjacent recesses 950a. The angle A1 in figure 17 is, for example, acute angle and may be 60 degrees.

[0064] Figure 18 illustrates a flange 920 according to the present disclosure. As shown in figure 18, the flange 920 may comprise a plurality of slots. Each of the plurality of slots is arranged to allow a corresponding pipe (e.g. the peripheral tubular member 224, the peripheral tubular member 226, or the peripheral tubular member 228) to pass therethrough. The plurality of slots include, but not limited to, three openings 920H, three openings 920L, and two openings 920A. The flange 920 may further comprise a plurality of slots 921. Each of the plurality of slots 921 is configured

to receive fasteners such as screws, rivets, interference fits, or other known connectors.

[0065] Figure 19 illustrates a second end assembly 900 according to the present disclosure. As shown in figure 19, the peripheral tubular member 924 is disposed
5 between the flange 920 and the body 930. A fluid such as water and/or air in the body 930 can be prevented from going up by using one or more devices to prevent backflow.

[0066] Figure 20 illustrates a perspective view of a peripheral tubular member 924 according to the present disclosure. As shown in figure 20, one end of the peripheral
10 tubular member 924 is connected to a plate 990a and the other end of the peripheral tubular member 924 is connected to a plate 990b. The plates 990a, 990b respectively comprise a plurality of slots 991a, 991b.

[0067] Each of the plurality of slots 991a is configured to receive the corresponding fasteners 992a. By employing the fasteners 992a, the peripheral
15 tubular members 224 are secured to the flange 920. Each of the plurality of slots 991b is configured to receive the corresponding fasteners 992b. By employing the fasteners 992b, the peripheral tubular members 224 are secured to the body 930.

[0068] It should be noted that fixing method of the peripheral tubular member 224 described above can be applied to fixing method of the peripheral tubular member
20 226 and the peripheral tubular member 228.

Peripheral device 1100

[0069] Figure 21 illustrates a side view of a peripheral device 1100 according to the present disclosure. As shown in figure 21, the peripheral device 1100 (also referred to as a stinger) comprises a second tubular member 1130, an assembly
25 1150, and a plurality of peripheral members 1200. As shown in figure 21, the plurality of peripheral members 1200 are disposed around the second tubular member 1130. An arrow shown in figure 21 indicates a flow of water and air in the peripheral device 1100.

Second tubular member 1130

[0070] The second tubular member 1130 is shaped and dimensioned as a tube and part of the second tubular member 1130 is arranged to be, for example, curved-shaped in the assembled state of the peripheral device 1100. The second tubular member 1130 is arranged to include a second passageway therein. The second tubular member 1130 comprises at one end thereof an opening 1130a. The second tubular member 1130 is, for example, arranged to pass therethrough a fluid (e.g. high pressure water) supplied from a fourth device (not shown). The fourth device is, for example, configured to be a pump. The fourth apparatus is, for example, positioned above water, thus reducing the breakage and replacement of the fourth apparatus and parts.

Peripheral members 1200

[0071] Each of the plurality of peripheral members 1200 comprises at one end thereof a first opening 1200a and comprises at the other end thereof a second opening 1200b. The second tubular member 1130 is connected to the assembly 1150. Alternatively, the second tubular member 1130 may be integrally formed with the assembly 1150. Each of the peripheral members 1200 is, for example, arranged to pass therethrough a fluid (e.g. low pressure water) from a fifth apparatus (not shown). It should be noted that the each of the fifth apparatus is, for example, configured to be a pump. The fifth apparatus is, for example, positioned above water, thus reducing wear and tear of the fifth apparatus and parts. The low pressure water supplied from the fifth apparatus may be at a pressure of 15 bar and at a flow rate of between 20,000 litres and 50,000 litres per minute. It is to be appreciated that the low pressure water supplied from the fifth apparatus may be at any pressure and at any flow rate as to be determined based on different mining context and operations. In this regard, the term 'low pressure' fluid or water is relative. It is to be appreciated that the flow rate may be determined at the time of an operation or may be pre-determined.

Assembly 1150

[0072] Figure 22 illustrates a side view of a part of a peripheral device 1100 according to the present disclosure. As shown in figure 22, the assembly 1150

comprises wings 1165 and a jetting member 1170. The wings 1165 are disposed at lateral surface of the body 1160. The jetting member 1170 is a part of the second tubular member 1130. Each of the other end of the second openings 1200b is, for example, placed nearby the wings 1165. That is, the direction of discharging water from each peripheral members 1200 is, for example, 90 degrees to the axis direction of the jetting member 1170.

[0073] Figure 23 illustrates a side view of a part of a peripheral device 1100 according to the present disclosure. Figure 24 illustrates a perspective view of a part of a peripheral device 1100 according to the present disclosure. As shown in figures 23 to 24, the jetting member 1170 is arranged to be bulge-formed and arranged to comprise thereon an opening 1170a, a plurality of openings 1170b, and a plurality of openings 1170c.

[0074] The opening 1170a is disposed at an end of the peripheral device 1100 in the downstream of the and is disposed so that high pressure water in the jetting member 1170 is discharged to outward along an axis of the jetting member 1170.

[0075] Figure 25 illustrates a bottom view of a peripheral device 1100 according to the present disclosure. As shown in figure 25, the plurality of openings 1170b are, for example, disposed equidistant around the opening 1170a at 120 degrees intervals, and are disposed so that high pressure water in the jetting member 1170 is discharged at, for example, 45 degrees to the axis direction of the jetting member 1170. The plurality of openings 1170c are disposed, at 120 degrees intervals to discharge high pressure water in, for example, a vertical direction to the lateral surface.

[0076] The plurality of openings 1170c are, for example, disposed at 120 degrees intervals around the opening 1170a, and disposed on the lateral surface of the jetting member 1170 at 120 degrees interval. The plurality of openings 1170c are disposed so that high pressure water in the jetting member 1170 is discharged at, for example, normal direction to the axis direction of the jetting member 1170.

[0077] As shown in figures 26 and 29, a vessel 2000 for suspending and/or deploying the device 1000 and the peripheral device 1100 may be provided. In some embodiments, one or more similar peripheral devices 1100 (not shown) other than

the peripheral device 1100 may be provided around the device 1000. High pressure water and low pressure water may be discharged from the peripheral device 1100 as shown in figures 26 to 28.

Example of operation of the device 1000 and the peripheral device 1100

5 **[0078]** In the context of operation it is assumed that the device 1000 is disposed so that an axis direction of the device 1000 is orthogonal or near orthogonal within operational limits to a surface of sea. In order to direct the device 1000 toward a determined depth such as a sea floor, the high pressure water from the first apparatus flows into the inlet pipes 154, followed by the first compartment 144. The
10 high pressure water in the first compartment 144 flows into peripheral tubular member 224 via one open end of the peripheral tubular member 224 and subsequently flows out from the peripheral tubular member 224 via another open end of the peripheral tubular member 224. The high pressure water is then filled in the third compartment 948. The high pressure water in the third compartment 948 flows
15 out from the device 1000 via the opening formed at the bottom surface of the body 930. The device 1000 is allowed to go down due to the high pressure water, and subsequently receives, upon reaching at the determined depth, the low pressure water via inlet pipes 156 and air via inlet pipes 158. The device 1000 may be go up by a determined distance after reaching at the determined depth so that a gap is
20 defined between the device 1000 and the sea floor.

[0079] After the device 1000 reaches at the determined depth, a controller (not shown) controls the first apparatus to discontinue supplying high pressure water to the inlet pipes 154. The controller then controls the second apparatus to supply low pressure water to the inlet pipes 156 and also controls the third apparatus to supply
25 air to the inlet pipes 158.

[0080] The low pressure water which discharged from the inlet pipes 156 flows into the second compartment 146. The low pressure water in the second compartment 146 then flows into peripheral tubular member 226 via one open end of the peripheral tubular member 226 and subsequently flows out from the peripheral
30 tubular member 226 via another open end of the peripheral tubular member 226. The low pressure water is then filled in the first compartment 944. The low pressure water

in the first compartment 944 flows out from first compartment 944 via the plurality of openings 930L.

[0081] The air which discharged from the inlet pipes 158 flows into the third compartment 148. The air in the third compartment 148 then flows into peripheral tubular member 228 via one open end of the peripheral tubular member 228 and subsequently flows out from the peripheral tubular member 228 via another open end of the peripheral tubular member 228. Assume that the device 1000 is at the determined depth, the volume of air is lessened as the air goes down through the peripheral tubular member 228 according to Boyles law.

[0082] Upon completion of the operation to discharge low pressure water and air from the device 1000, the controller controls the second apparatus to discontinue supplying low pressure water to the inlet pipes 156 and controls the third apparatus to discontinue supplying air to the inlet pipes 158. It should be noted that the low pressure water in the body 930 and air in the body 930 are not allowed to go up to the surface.

[0083] It should be noted that in the case where the device 1000 reaches at the determined depth, the second end assembly 900 is located at a tin-containing layer, where the tin-containing layer is below a clay layer and above a granite layer. The upper surface of the granite layer is, for example, the sea floor. In that case, layers above the clay are not affected when the high pressure water and low pressure water from the device 1000 are discharged. The determined depth may be in the range between 100 meters and 250 meters.

[0084] The air which flowed out from the peripheral tubular member 228 is then filled in the second compartment 946. The air in the second compartment 946 flows out from the second compartment 946 via the plurality of openings 901A and goes up to return to natural state, thus facilitating creation of spinning tornado effect (e.g. creation of flow of air in an spiral like manner toward an opposite direction of the arrow in figure 1 when in normal operation).

[0085] It should be noted that a detection means (which may include at least one sensor such as an optical sensor or an ultrasonic sensor) may be used to detect whether the device 1000 reaches at the determined depth. Upon the detection, the

detection means transmits a signal to the controller. The controller then controls the first apparatus to discontinue supplying high pressure water to the inlet pipes 154, controls the second apparatus to supply low pressure water to the inlet pipes 156, and controls the third apparatus to supply air to the inlet pipes 158. The detection means is, for example, attached at an outer surface of the device 1000 or separately disposed from the device 1000.

[0086] Assuming that four peripheral devices 1100 are disposed around the device 1000, the four peripheral devices 1100 may be disposed equidistant around the device 1000 at 90 degrees intervals in a plan view.

[0087] The high pressure water flows into the second tubular member 1130 via the opening 1130a and discharged from, for example, the opening 1170a, the plurality of openings 1170b, and the plurality of openings 1170c. The direction of the high pressure water discharged from the peripheral device 1100 is, for example, shown in figures 26 to 28.

[0088] The peripheral devices 1100 are allowed to go down due to the high pressure water, and upon reaching at the determined depth, receive the low pressure water via the first opening 1200a of the peripheral members 1200.

[0089] After one of the peripheral devices 1100 reaches at the determined depth, the controller controls a fourth apparatus (not shown) to discontinue supplying high pressure water to the corresponding second tubular member 1130 and then controls a fifth apparatus (not shown) to supply low pressure water to the peripheral members 1200.

[0090] It is appreciable that high pressure water may be discharged from bottom side of the peripheral device 1100 towards the device 1000 while low pressure water may be discharged from lateral side of the peripheral device 1100 toward the device 1000 as shown in figures 29 to 31.

[0091] The low pressure water supplied from the fifth apparatus flows into the peripheral members 1200 via the first opening 1200a and flows out from the second opening 1200b. The low pressure water is discharged from a lateral side of the peripheral device 1100 toward outside of the peripheral device 1100.

[0092] It should be noted that the distance between the device 1000 and each of the peripheral devices 1100 may be determined based on, for example, amount of pressure discharged from the peripheral members 1200.

[0093] It should be noted that the number of the peripheral devices 1100 is not limited to four and may be more than two. Assuming that three peripheral devices 1100 are disposed around the device 1000, the three peripheral devices 1100 are, for example, disposed equidistant around the device 1000 at 120 degrees intervals in a plan view.

[0094] To ensure that the device 1000 discharge low pressure water and air and the peripheral devices 1100 discharge low pressure water at a substantially same timing, the controller may have a function to manage whether all of the devices (the device 1000 and the peripheral devices 1100) reach at the determined depth. To be precise, the controller controls the second apparatus, third apparatus, and fifth apparatus to respectively discharge low pressure water, air, and low pressure water at a same timing in the case where the controller receives five signals each indicating a corresponding device reaches at the determined depth.

[0095] It should be noted that the detection means (which may be at least one sensor such as an optical sensor or an ultrasonic sensor) may be used to detect whether the peripheral device 1100 reaches at the determined depth. Upon detection, the detection means transmits a signal to the controller. The controller then controls the fourth apparatus to discontinue supplying high pressure water to second tubular member 1130 and controls the fifth apparatus to supply low pressure water to second tubular member 1130. The detection means is, for example, attached at an outer surface of the peripheral device 1100 or separately disposed from the peripheral device 1100.

[0096] The low pressure water discharged from the peripheral member 1200 can liquefy at least one layer such as tin-containing layer to create slurry. The created slurry (liquid mixture) is subsequently directed toward the device 1000. Both the low pressure water discharged from the peripheral tubular member 226 and the air discharged from body 130 contributes to creating spinning tornado effect at the first

passageway and then direct the created slurry toward the surface of the sea via the first passageway.

[0097] Once the slurry reaches the surface of the sea, it is put through a processing/extraction plant where the tin is separated from silica sand. The tin is then deliverable to the customer and the silica sand can be used for following purposes: (1) Fill back to the void left from the extraction. (2) Mixed with cement to create artificial reefs which can be lowered to the sand floor and allow coral reefs to re-grow which will re-populate the animal life. (3) Manufacture glass ingots in a 2nd on-site plant for delivery and sale to customers.

[0098] It should be noted that the device 1000 and the peripheral device 1100 may be collectively referred to as 'system'.

Advantageous Effect

[0099] According to the present disclosure, the device 1000 is configured so that low pressure water in the peripheral tubular member 226 is discharged toward outside of the device 1000 via a lateral side of the device 1000 and air in the peripheral tubular member 228 is discharged toward the first passageway, thus facilitating creation of spinning tornado effect. With this, a slurry around the device 1000 is efficiently collected and goes up to surface of sea. Further, taking the slurry from the sea can contribute to improving environment in the sea that is then suitable for fish and wildlife to live within a determined periods (e.g. a few months) compared with existing extraction equipment leaving with the environment polluted and dead.

[00100] Existing extraction equipment for mining is only allowed to reach at a limited depth (e.g. 40 meters) due to the configuration of the existing extraction equipment. In the case where such existing extraction equipment discharges water outward at the depth, extra things (e.g. over-burden) may be removed (taken out), thus disturbing the sea and killing the wildlife. Further, it takes a lot of time (e.g. 24 hours) to reach at the depth according to the existing extraction equipment.

[00101] In contrast, according to the present disclosure, the device 1000 is further configured so that high pressure water in the peripheral tubular member 224 is

discharged toward outside of the device 1000 via a bottom surface of the device 1000. Due to the high pressure water, the device 1000 reaches at a deeper depth (e.g. 150 meters) with less time (e.g. 1 hour) as compared with the existing extraction equipment.

5 **[00102]** According to the present disclosure, the peripheral member 1200 is configured so that low pressure water in the peripheral member 1200 is discharged toward outside of the peripheral member 1200 via a lateral side of the peripheral member 1200, thus facilitating liquefying at least one layer such as tin-containing layer to create slurry and then locating the created slurry near the device 1000. With
10 this, the created slurry near the device 1000 is more affected by the spinning tornado effect.

[00103] According to the present disclosure, with the modular configuration of the device 1000, required cost can be reduced. In this regard, the peripheral tubular member 224, 226, 228 can be a determined size (e.g. 10 meters in length) and more
15 sections can be added to the peripheral tubular member 224, 226, 228 in the case where the device 1000 is positioned at a deeper depth.

[00104] According to the present disclosure, the configuration of the device 1000 positioned under water surface has no moving parts, thus reducing the breakage and failure under the water surface and requiring less replacement of damaged parts.

20 **Possible variants**

[00105] The peripheral devices 1100 may be arranged or positioned to discharge low pressure water and high pressure water in a desired direction. In some embodiments, the second opening 1200b may be adjusted to direct the respective openings in a manner to discharge low pressure water toward any direction.

25 **[00106]** It is appreciable that the area to be excavated or mined may be of any shape or size so as to reduce wastage or material. In view of removing the wastage or the material efficiently, it is preferable that the peripheral devices 1100 form square-shaped in a plan view. However, it is appreciable that the peripheral devices 1100 may be arranged in any configuration to achieve the desired objective to direct
30 slurry towards the device 1000.

[00107] It should be noted that the present disclosure is applicable to operation for extracting any material or minerals on land as well as sea and it is capable of operating at any depth that is economically viable.

[00108] It should be noted that the number of the plates 132 used to divide a space in the body 130 is not limited to four and may be determined based on the number of different fluid that the body 130 receives from outside of the body 130. It should be noted that the number of the plates 932 used to divide a space in the body 930 is not limited to four and may be determined based on the number of the plates 132. The number of the plates 932 may be same as the number of the plates 132.

[00109] It should be noted that the number of peripheral device 1100 is not limited to four and may be three or more than five. Each of the peripheral device 1100 is, for example, disposed at 120 degrees intervals around the device 1000 in the case where the number of the peripheral device 1100 is three.

[00110] It should be noted that at least one of the present disclosure (e.g. the controller) is configured with hardware by way of example, but the disclosure may also be provided by software in concert with hardware.

[00111] In addition, the functional blocks (not shown) used for the hardware are typically implemented as LSI devices, which are integrated circuits. The functional blocks may be formed as individual chips, or a part or all of the functional blocks may be integrated into a single chip.

[00112] It should be noted that the direction of discharging water from each of the plurality of the openings 901A, the plurality of openings 930L, the opening 1170a, the plurality of the openings 1170b, the plurality of the openings 1170c, and the second opening 1200b is not limited to particular angles indicated the above.

[00113] It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

[00114] As would be understood by a person skilled in the art, each embodiment, may be used in combination with other embodiment or several embodiments.

Reference numerals

5	100	: first end assembly
	101	: first tubular member
	110	: first flange
	120	: second flange
	120a	: slots
10	130	: body
	132	: plates
	134	: first plate
	136	: second plate
	138	: third plate
15	140	: fourth plate
	142	: compartments
	144	: first compartment
	146	: second compartment
	148	: third compartment
20	154, 156, 158	: inlet pipes
	224, 226, 228	: peripheral tubular member
	300	: connecting part
	301	: body
	311	: peripheral tubular members
25	321, 322	: flange
	900	: second end assembly
	901	: first tubular member
	901A	: openings
	920	: flange
30	921	: slots
	924	: peripheral tubular member
	930	: body
	932	: plates
	934	: first plate
35	936	: second plate
	938	: third plate
	940	: fourth plate
	944	: first compartment
	946	: second compartment
40	948	: third compartment
	950	: first end member
	950a	: recess
	950b	: first parts

990a, 990b : plate
 991a, 991b : slots
 992a, 992b : fasteners
 1000 : device
 5 1100 : peripheral device
 1130 : second tubular member
 1130a : opening
 1150 : assembly
 1160 : body
 10 1165 : wings
 1170 : jetting member
 1170a, 1170b, 1170c : opening
 1200 : peripheral members
 1200a : first opening
 15 1200b : second opening
 2000 : vessel
 A1 : angle

CLAIMS

1. A device for mining, comprising:

5 a first tubular member defining a first passageway therein along a first axis;
and a plurality of peripheral tubular members arranged coaxially around the first
tubular member, the plurality of peripheral tubular members comprising a first set
of peripheral tubular members and a second set of peripheral tubular members,
wherein at least one of the first set of peripheral tubular members is arranged to
allow low pressure water passing therethrough to flow toward a predetermined area
10 outside of the device in an outward direction via openings provided in a lateral side
of the device, and wherein at least one of the second set of peripheral tubular
members is arranged to allow air passing therethrough to flow via openings into the
first passageway.

15 2. The device according to claim 1, wherein the plurality of peripheral tubular
members further comprise a third set of peripheral tubular members, and wherein
at least one of the third set of peripheral tubular members is arranged to allow high
pressure water passing therethrough toward a predetermined area outside of the
device via a bottom side of the device.

20

3. The device according to claims 2, further comprising:

a body defining therein a plurality of compartments, wherein a first
compartment of the plurality of compartments is arranged in fluid communication
with the at least one of the first set of peripheral tubular members, and wherein a
25 second compartment of the plurality of compartments is arranged in fluid
communication with the at least one of the second set of peripheral tubular
members, and wherein third compartment of the plurality of compartments is
arranged in fluid communication with the at least one of the third set of peripheral
tubular members.

30

4. The device according to claims 3, further comprising:

one or more first inlet pipes arranged to receive the low pressure water and to supply the low pressure water to the first compartment;

one or more second inlet pipes arranged to receive the air and to supply the air to the second compartment; and

5 one or more third inlet pipes arranged to receive the high pressure water and to supply the third fluid to the third compartment.

10 5. The device according to any one of claims 2 to 4, wherein the number of the first set of peripheral tubular members is three, the number of the second set of peripheral tubular members is two, and the number of the third set of peripheral tubular members is three.

15 6. The device according to any one of the preceding claims, wherein the angle of discharging the air into the first passageway is an acute angle in relation to a horizontal direction of the device.

20 7. The device according to any one of claims 2 to 6, the device further comprising:
 a pump arranged to supply the low pressure water to the at least one of the first set of peripheral tubular members and to supply the high pressure water to the at least one of the third set of peripheral tubular members,
 a compressor arranged to supply the air to the at least one of the second set of peripheral tubular members.

25 8. The device according to claim 7, the device further comprising:
 a controller arranged to control the pump and the compressor, wherein the controller controls the pump to supply the high pressure water to the at least one of the third set of the peripheral tubular members at a first determined time, and after the first determined time, the controller controls the pump to discontinue supplying the high pressure water to the at least one of the third set of the peripheral tubular
30 members, controls the pump to supply the low pressure water to the at least one of the first set of the peripheral tubular members, and controls the compressor to supply the air to the at least one of the second set of the peripheral tubular members.

9. A system for mining, comprising:

the device according to any one of claims 1 to 8; and

a plurality of peripheral devices disposed around the device, wherein at least

5 one of the plurality of peripheral devices comprises a second tubular member defining a second passageway therein along with a second axis and one or more peripheral members arranged around the second tubular member, and wherein each of the one or more peripheral members is arranged to allow low pressure water passing therethrough to flow toward the device via a lateral side of the
10 peripheral device.

10. The system according to claim 9, wherein the second tubular member is arranged to allow high pressure water passing therethrough to flow toward the predetermined area outside of the second tubular member via the bottom side of
15 the second tubular member.

11. The system according to any one of claims 9 or 10, wherein the plurality of peripheral devices are disposed equidistant around the device.

20 12. The system according to any one of claims 9 to 11, wherein the plurality of peripheral devices are disposed around the device spaced at a determined angle.

13. A method of using a device for mining, the method comprising:

25 preparing a first tubular member defining a first passageway therein along with a first axis;

preparing a plurality of peripheral tubular members arranged coaxially around the first tubular member;

supplying low pressure water to at least one of a first set of peripheral tubular members of the plurality of peripheral tubular members to discharge the low
30 pressure water passing through the corresponding one of the first set of peripheral tubular members toward a predetermined area in an outward direction outside of the device via openings provided in a lateral side of the device; and

supplying air to at least one of a second set of peripheral tubular members of the plurality of peripheral tubular members to discharge the air passing through the corresponding one of the second set of peripheral tubular members via openings into the first passageway.

5

14. The method according to claim 13, the method comprising:

before supplying the low pressure water and the air, supplying high pressure water to at least one of a third set of peripheral tubular members of the plurality of peripheral tubular members to discharge the high pressure water passing through the corresponding one of the third set of peripheral tubular members toward a predetermined area outside of the device via a bottom side of the device.

10

15. The method according to claim 14, wherein the low pressure water and the high pressure water are supplied from a pump, and wherein the air is supplied from a compressor.

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16. A method of using a system for mining comprising a device and at least one peripheral device, the method comprising:

preparing a first tubular member of the device defining a first passageway therein along with a first axis;

20

preparing a plurality of peripheral tubular members of the device arranged coaxially around the first tubular member;

preparing a second tubular member of the peripheral device defining a second passageway therein along with a second axis;

25

preparing one or more peripheral members of the peripheral device arranged around the second tubular member;

supplying low pressure water to at least one of a first set of peripheral tubular members of the plurality of peripheral tubular members to discharge the low pressure water passing through the corresponding one of the first set of peripheral tubular members toward a predetermined area outside of the device in an outward direction via opening provided in a lateral side of the device;

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supplying air to at least one of a second set of peripheral tubular members of the plurality of peripheral tubular members to discharge the air passing through the corresponding one of the second set of peripheral tubular members via openings into the first passageway, and

5 supplying low pressure water to at least one of the one or more peripheral members to discharge the low pressure water passing through the corresponding one of the one or more peripheral members toward the device via a lateral side of the peripheral device.

10 17. The method according to claim 16, the method comprising:

 supplying high pressure water to the second passageway before supplying the low pressure water through the corresponding one of the one or more peripheral members toward the device.

15