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(71) Applicants:
• **CRH Structural Concrete Belgium**
2500 Lier (BE)

• **CRH Group Services Limited**
Dublin 2 (IE)

(72) Inventor: **MOSTMANS, Hans**
2500 Lier (BE)

(74) Representative: **Sweetinburgh, Mark Roger et al**
Sweetinburgh & Windsor
3 Amberley Court
Whitworth Road
Crawley, West Sussex RH11 7XL (GB)

(54) **METHOD OF MANUFACTURING A CONCRETE SLAB**

(57) The present invention relates to a method of manufacturing a concrete slab (17) comprising:
a) providing a pipe (11) and a first flexible form (1), wherein the pipe (11) comprises a first end (13), and wherein the first flexible form (1) comprises a first aperture (7);
b) positioning the pipe (11) and the first flexible form (1) in a casting bed (20), wherein the first end (13) of the

pipe (11) is positioned within the first aperture (7) of the first flexible form (1);
c) casting concrete into the casting bed (20) using a slip-forming apparatus or an extrusion apparatus and forming a plurality of hollow cores (22) in the concrete; and
d) curing the concrete.

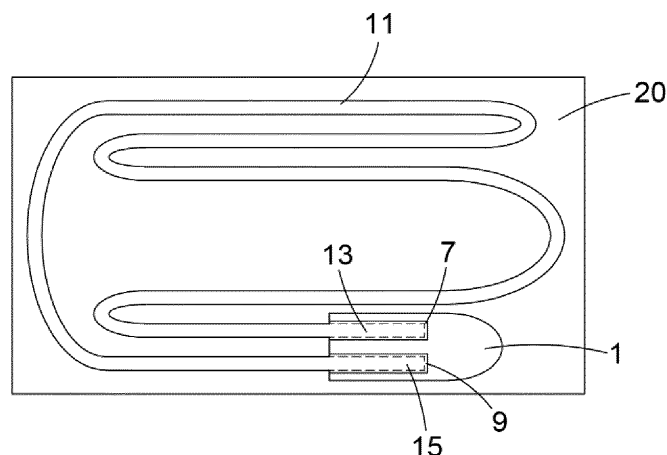


Fig. 8

Description

[0001] The present invention relates to a method of manufacturing a hollow core concrete slab, a flexible form, a hollow core concrete slab and a building containing a hollow core concrete slab.

BACKGROUND TO THE INVENTION

[0002] It is known to manufacture hollow core concrete slabs. Such slabs may have hollow cores, or a pipe embedded in them. The hollow cores are primarily present to reduce the weight of the concrete slab. A pipe is particularly used for heating and cooling, such as to allow fluid, particularly water, to be used to heat or cool the concrete slab and thus adjust the temperature of a building containing the slab. Hollow core concrete slabs are typically made using slipforming or extrusion methods. These allow hollow cores to be made in the slabs. These methods typically require a slipforming apparatus or an extrusion apparatus to move along a defined path to cast concrete and to make the hollow cores. It is important that these apparatuses are freely able to move along the desired path, without their movement being impeded by obstacles.

[0003] An embedded pipe inside a concrete slab need to be accessible, such as to enable it to be connected to a heating or cooling system. This can be achieved by drilling or cutting the concrete slab after it has been cured to access the pipe. This creates additional work to access the pipe. Further, undesirable dust and debris are produced by this method which creates waste which is undesirable. Further, there is a risk that the pipe is damaged when the concrete is removed. Further the area where the concrete is removed may be uneven and not aesthetically pleasing. Further, hardened concrete needs to be removed from the pipe ends before attaching a pipe to a building to ensure a tight coupling can be made.

[0004] It is known to cut and remove unhardened concrete from a slab to locate the end of an embedded pipe, such as by using a vacuum cleaner combined with water jetting to suck out the unhardened concrete. This creates additional work to remove the unhardened concrete and creates waste. Water jetting may plasticise the concrete which may reduce the durability and structural integrity of the concrete slab. Further, there is a risk that the pipe is damaged when the concrete is removed. Further the area where the concrete is removed may be uneven, not aesthetically pleasing and have reduced structural integrity. Further, it can be challenging to accurately locate the end of a pipe due to the forces applied to the pipe by the slipforming apparatus or the extrusion apparatus which may cause the pipe and pipe end to move during production of the concrete slab. Further, in practice, once the pipe end has been located, it is positioned in one of the uncured hollow cores which may damage the uncured hollow core and contaminate the pipe end with concrete. Further, hardened concrete then needs to be

removed from the pipe ends before attaching a pipe to a building to ensure a tight coupling can be made.

[0005] There is a need for a less labour intensive way to make a concrete slab with an accessible embedded pipe. There is a need for an environmentally friendly way to make a concrete slab with an accessible embedded pipe. There is a need for an accurate method to make an embedded pipe in concrete accessible. There is a need for a method of making an embedded pipe in concrete accessible without damaging the pipe. There is a need to create aesthetically pleasing access to an embedded pipe in a concrete slab. There is a need to access an embedded pipe in a concrete slab without reducing the structural integrity of the slab or plasticising the concrete during manufacture. There is a need to easily locate an embedded pipe in a concrete slab. There is a need to produce a concrete slab with an embedded pipe that does not have hardened concrete attached to the accessible ends. There is a need for an efficient method of manufacture of a hollow core slab with embedded pipes using a slipforming apparatus or an extrusion apparatus.

[0006] It is, therefore, an object of the present invention to seek to alleviate the above identified problems.

SUMMARY OF THE INVENTION

[0007] According to a first aspect of the present invention, there is provided a method of manufacturing a concrete slab comprising:

- a) providing a pipe and a first flexible form, wherein the pipe comprises a first end, and wherein the first flexible form comprises a first aperture;
- b) positioning the pipe and the first flexible form in a casting bed, wherein the first end of the pipe is positioned within the first aperture of the first flexible form;
- c) casting concrete into the casting bed using a slipforming apparatus or an extrusion apparatus and forming a plurality of hollow cores in the concrete; and
- d) curing the concrete.

[0008] In a second aspect of the invention, there is provided a flexible form comprising a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip.

[0009] In a third aspect of the invention, there is provided the use of a flexible form according to the second aspect of the invention in the manufacture of a concrete slab with an extrusion process or a slipforming process.

[0010] In a fourth aspect of the invention, there is provided a concrete slab manufactured according to the first aspect of the invention.

[0011] In a fifth aspect of the invention, there is provided

ed a building comprising a concrete slab according to the fourth aspect of the invention.

DETAILED DESCRIPTION

[0012] The present invention relates to a method of manufacturing a hollow core concrete slab comprising:

- a) providing a pipe and a first flexible form, wherein the pipe comprises a first end, and wherein the first flexible form comprises a first aperture;
- b) positioning the pipe and the first flexible form in a casting bed, wherein the first end of the pipe is positioned within the first aperture of the first flexible form;
- c) casting concrete into the casting bed using a slip-forming apparatus or an extrusion apparatus and forming a plurality of hollow cores in the concrete; and
- d) curing the concrete.

[0013] This method means that it is not necessary to remove concrete from around a pipe to make it accessible. The flexible form acts as a barrier to prevent concrete from covering the first end of the pipe. This protects the first end of the pipe from unsightly deposits of concrete which would need to be removed to allow a tight connection to another system, such as in a building. The method reduces the labour required to make the concrete slab as it is not necessary to remove excess concrete from around the pipe, either before or after hardening the concrete. Further, removal of excess concrete can be inaccurate as it is necessary to locate the position where the pipe is and further remove the required amount of concrete. This further runs the risk of damaging the pipe and affecting the structural integrity of the concrete slab. In the present invention, there is a physical item, the flexible form which can be located and removed at an appropriate point. This is much easier than judging how much concrete to be removed from around the pipe end and estimating where the pipe end is. This allows for an accurate method to make an embedded pipe in a concrete slab accessible. The method is environmentally friendly as the invention does not require the removal of excess concrete, either before or after hardening. Further, this reduces the manual labour required in the process as removing unhardened concrete is laborious. This reduces the use of concrete, the production time and the production of waste. The removal of the flexible form creates aesthetically pleasing access to an embedded pipe in a concrete slab. This is particularly desirable where the access to the pipe will remain visible to the end user, such as in environments where access to the pipe is desirable for functional or style reasons. It is a particular advantage of the invention that the flexible form can be used with existing slipforming and extrusion methods and that it allows the slipforming apparatus or the extrusion apparatus to move freely along the casting bed. An ad-

vantage of the flexible form is that it will not impede the relative movement of the slipforming apparatus or extrusion apparatus along the casting bed.

[0014] It is an advantage of the invention that the flexible form can be positioned over the first end of the pipe without restricting the motion of the slipforming or extrusion apparatus. The difficulty of positioning a fixed item, in the invention, a flexible form, in a slipforming or extrusion process is overcome by the present invention.

[0015] Slipforming apparatus and extrusion apparatus are known in the art. Both apparatuses preferably move along a casting bed to form a concrete slab on the casting bed. An extrusion apparatus typically casts concrete into the casting bed and then compacts the concrete using a screw. The hollow cores are typically formed substantially simultaneously with the compaction of the concrete using a screw. The top surface of the concrete layer is then smoothed using a vibration apparatus. A slipforming apparatus typically casts concrete into the casting bed. The top surface of the concrete layer is then smoothed using a trowel apparatus and/or a vibration apparatus.

[0016] Preferably, in step (c), the hollow cores are formed above the pipe and the first flexible form. This makes it easier to manufacture the concrete slab.

[0017] Preferably, the method further comprises:

- e) removing the first flexible form.

[0018] This allows access to the pipe. It is an advantage of the invention that the flexible form can be removed and used again in a method of manufacturing a further concrete slab. This is environmentally friendly as not only is less concrete used, but also the flexible form can be recycled and reused many times, such as about 50 to about 200 times.

[0019] Preferably, step (e) is carried out after step (d), that is after the concrete is cured. This allows the concrete to have a fixed shape when the flexible form is removed and prevents damage to the concrete slab and is most preferred.

[0020] Preferably, step (e) is carried out before step (d), that is before the concrete is cured. This facilitates the removal of the flexible form.

[0021] Preferably, step (e), is carried out during step (d), that is while the concrete is being cured. This has the benefit of reducing damage to the concrete slab, while facilitating removal of the flexible form.

[0022] Preferably, the concrete in step (c) is low slump concrete. Preferably, low slump concrete is in class S1, in accordance with EN12350-2. Preferably, class S1 has a slump test of about 10 to about 40 mm, in accordance with EN12350-2. An advantage of low slump concrete is that it holds its shape which ensures the formation of hollow cores.

[0023] Preferably, casting concrete comprises pouring concrete.

[0024] Preferably, step (c) comprises the following steps:

(c) (i) casting a concrete layer onto the casting bed and compacting the concrete layer; preferably wherein the concrete layer substantially covers the pipe and flexible mold;

(c) (ii) forming hollow cores in the concrete layer above the pipe and the flexible mold using a hollow core former;

(c) (iii) shaping the top surface of the concrete layer using a trowel apparatus and/or a vibration apparatus, preferably wherein the top surface is substantially flat.

[0025] Preferably, when an extrusion apparatus is used, step (c) (iii) comprises shaping the top surface of the concrete layer using a vibration apparatus and the hollow core former supports the hollow cores during this step.

[0026] Preferably, when a slipforming apparatus is used, step (c) (iii) comprises shaping the top surface of the concrete layer using a trowel apparatus and/or a vibration apparatus, preferably wherein the hollow core former supports the hollow core when the vibration apparatus is used.

[0027] Preferably, an additional layer of concrete may be applied prior to step (c) (iii). This aids the production of a smooth top surface of the concrete slab.

[0028] Preferably, step (c) comprises the following steps:

(c) (I) casting a bottom concrete layer onto the casting bed and compacting the bottom concrete layer; preferably wherein the bottom concrete layer substantially covers the pipe and flexible mold;

(c) (II) casting a top concrete layer on top of the bottom concrete layer and forming hollow cores in the top and/or bottom concrete layer using a hollow core former, wherein the hollow cores are above the pipe and the flexible mold;

(c) (III) shaping the top surface of the top concrete layer using a trowel apparatus, and/or vibration apparatus preferably wherein the top surface is substantially flat;

preferably, wherein the hollow core former supports the hollow cores when the vibration apparatus is used;

preferably, wherein a slipforming apparatus is used.

[0029] Preferably, an additional layer of concrete may be applied prior to step (c) (III). This aids the production of a smooth top surface of the concrete slab.

[0030] Preferably, the casting bed comprises the area in which the concrete is cast. Preferably, the pipe is substantially positioned above the bottom surface of the casting bed. This allows the pipe to be embedded in the concrete slab.

[0031] Preferably, the casting bed comprises a work floor or a track. Preferably the casting bed comprises

steel or concrete, preferably steel.

[0032] Preferably, the length of the concrete slab is defined by the length of the casting bed that receives concrete. This gives flexibility to cast the desired amount of concrete onto the desired amount of the casting bed. Preferably, the casting bed is about 60m to about 200 m long. Preferably, the concrete slab is cut to the desired length before or after step (d), preferably before step (d).

[0033] Preferably, the width of the concrete slab is defined by the width of the casting bed. Preferably, the casting bed is defined by the substantially horizontal casting bed and the edges of the casting bed, and/or the edges of the slipforming apparatus or the extrusion apparatus. This gives a uniform width to the concrete slab.

[0034] Preferably, the height of the concrete slab is defined by the slipforming apparatus or extrusion apparatus, preferably the height of the slab is between about 15 cm and about 100 cm, preferably between about 20 cm to about 60 cm, preferably between about 20 cm to about 50 cm.

[0035] Preferably, the method further comprises positioning a reinforcement element in the casting bed prior to step (c), preferably above the bottom of the casting bed, preferably substantially parallel to the casting bed.

Preferably, the reinforcement element comprises a longitudinal reinforcement element, preferably a plurality of longitudinal reinforcement elements. Preferably, the reinforcement element(s) are prestressed. Preferably each reinforcement element comprise a wire or a strand, preferably a steel wire or a steel strand. Preferably at least one, preferably at least two reinforcement elements act as guidelines for the slipforming apparatus or extrusion apparatus. Preferably the slipforming apparatus or extrusion apparatus comprise a spacer which runs along the reinforcement elements, preferably along the strands. The spacer helps to position the reinforcement elements, preferably the strands in the concrete element and reduce vibrations along the reinforcement element which helps improve tolerance on position of the strand and embedment of the strand in the concrete slab and thus the structural integrity of the resulting concrete slab by reducing the movement of the reinforcement element. Such reinforcement elements are known to provide resistance to tensile forces and reduce or prevent cracking. Preferably the reinforcement element(s) are embedded beneath the first pipe and/or above the first pipe, wherein the direction refers to the concrete panel in a substantially horizontal position.

[0036] Preferably, when the strands are positioned beneath the first pipe, a split spacer is used to position the strands in the casting bed and reduce vibrations along the strand. Preferably, the split spacer runs either side of the flexible form. This means the flexible form does not impede the movement of the spacer. An example of this is shown in figure 14. The split spacer may be designed as one piece, with a gap to go over the flexible mold.

[0037] Preferably, when the strands are positioned

above the first pipe, a suspended spacer, such as a series of hooks, is used to position the strands in the casting bed and reduce vibrations along the strand. An advantage of this arrangement is that the strands can be accessed from above, without the pipe or the flexible form impeding the suspended spacer. Further, since the strands are positioned above the pipe, it is possible for the pipe to be closer to the bottom of the concrete slab. This means that the thermal efficiency of a heating/cooling system can be adjusted as the pipe is closer to the bottom of the concrete slab.

[0038] Preferably, the pipe comprises a second end and the first flexible form comprises a second aperture, wherein in step (b), the second end of the pipe is positioned within the second aperture of the first flexible form. It is useful to be able to position the first end and second end of the pipe in the first flexible form to accurately position these within the concrete slab. This allows there to be a known and repeatable distance between the first end and second end of the pipe. Preferably, in use, the first end is an inlet and the second end is an outlet, preferably wherein fluid, preferably water, can enter the first end of the pipe and leave via the second end of the pipe. This is particularly useful when the pipe forms part of a heating or cooling system. Preferably, in use either hot water or cold water can enter the pipe via the first end and leave the pipe via the second end to control the temperature of the concrete slab, and thus the building the slab is in.

[0039] Preferably, the pipe comprises a second end and wherein step (a) further comprises providing a second flexible form, wherein the second flexible form comprises a first aperture, wherein in step (b), the second end of the pipe is positioned within the first aperture of the second flexible form. It is advantageous to be able to independently control the position of the first end and the second end of the pipe. This allows the first end and the second end to be positioned near each other, or further away, such as at opposite ends of the width and/or length of the concrete slab or any other position. This flexibility means that the concrete slab can be designed in accordance with the end users' requirements.

[0040] Preferably, the pipe is provided on a mesh, preferably a wire mesh, preferably a wire grid. This allows the pipe to be positioned at a desired height and the pipe to be arranged in a substantially horizontal position. Further, the mesh helps keep the pipe in position when the concrete is cast. The mesh is preferably positioned on one or more reinforcement elements. The mesh may preferably be positioned on a support, such as a plastic support to hold it in position. These are suitable ways to arrange the position of the pipe. Preferably, the first flexible form is positioned below the mesh and the first end of the pipe is below the mesh, positioned in the first aperture. In this way, there is easy access to the first end of the pipe, from the bottom of the slab.

[0041] Preferably, the method comprises positioning a plurality of reinforcement elements in the form of strands,

preferably steel strands, above the bottom of the casting bed and substantially parallel to the machine direction of the casting bed prior to step (c). Preferably, a plurality of wires, preferably steel are positioned above the strands. Preferably the pipe is provided on a mesh positioned on the wires. Preferably the strands and wires run along the length of the casting bed.

[0042] Preferably, the method further comprises positioning a plurality of reinforcement elements in the form of strands, preferably steel strands, above the pipe and substantially parallel to the machine direction of the casting bed prior to step (c). Preferably the pipe is provided on a mesh positioned below the strands. The mesh may preferably be supported on a plurality of wires, preferably steel wires or on a support.

[0043] Preferably a strand comprises multiple wires, preferably about 2 to about 8 wires, such as about 2 wires, about 3 wires or about 7 wires. Preferably, a strand has a thickness of about 4 mm to about 16 mm.

[0044] Preferably, the method further comprises positioning a plurality of reinforcement elements in the form of strands, preferably steel strands, above the bottom of the casting bed and substantially parallel to the machine direction of the casting bed prior to step (c). Preferably, the method further comprises positioning a plurality of reinforcement elements in the form of wires, preferably steel wires, above the strands. Preferably the pipe is provided on a mesh positioned on the wires. This allows a spacer to run along the strands while keeping the mesh and pipe away from the strands.

[0045] Preferably a wire has a thickness of about 3 mm to about 12 mm, preferably about 4 mm to about 7 mm.

[0046] Preferably the first end of the pipe comprises an end cap or a pressure cap. Preferably the second end of the pipe comprises an end cap or a pressure cap. Preferably the first end of the pipe comprises an end cap and the second end of the pipe comprises a pressure cap. This helps protect the pipe during manufacture of the concrete slab. A further advantage of a pressure cap is that it acts as a control device. In use, a pressure cap can indicate if there is a leak in the pipes.

[0047] It will be appreciated that the invention covers a hollow core concrete slab containing a pipe with a first end. It will be appreciated that relevant features of the first flexible form, first end of the pipe, and first aperture preferably apply to second and subsequent items of the same description.

[0048] Preferably, the first aperture of the first flexible form is a blind aperture. Preferably, the second aperture of the first flexible form is a blind aperture. Preferably, the first aperture of the second flexible form is a blind aperture. Preferably, a blind aperture means that the aperture does not break through the other side of the flexible form. Preferably in all cases the apertures are substantially blind apertures. Blind apertures help protect the first end of the pipe from the concrete. Further, the use of a blind aperture can help the manufacture of the concrete slab as the first end or the second end of the pipe can

be accurately positioned in the aperture, without having to judge how far to push the end into the aperture.

[0049] Preferably, the aperture is narrower at the entrance to the aperture than further into the aperture. Preferably, the entrance to the aperture is necked-in. Preferably, the aperture has a substantially circular cross-section and the diameter of the aperture at the entrance to the aperture is smaller than the diameter further into the aperture. Preferably, about 5 mm to about 5 cm of the length of the aperture is narrower at the entrance to the aperture, than further into the aperture, preferably about 1 cm to about 3 cm. This allows a tighter fit of the aperture around the pipe to help prevent concrete from entering the pipe while making it easy to position the first end of the pipe into the aperture.

[0050] Preferably, the aperture of the flexible form has a substantially circular cross-sectional area. Preferably, the aperture of the flexible form is substantially tube shaped. This is a suitable shape for accommodating a pipe. Furthermore, this allows the pipe to be easily connected after the flexible form has been removed as there is a length of pipe which is free from concrete.

[0051] Preferably, the first and/or second apertures are elongate. Preferably, the flexible form comprises a substantially planar bottom surface and the elongate first and/or second apertures are substantially parallel to the substantially planar bottom surface, preferably, wherein the first and/or second apertures are substantially tube shaped. It will be appreciated that the length of the first and/or second apertures is preferably substantially parallel to the substantially planar bottom surface.

[0052] Preferably, the aperture of the flexible form has a diameter in the range of about 10 mm to about 50 mm, preferably in the range of about 15 mm to about 15 mm to about 30 mm, preferably in the range of about 15 mm to about 25 mm. This is a suitable size for accommodating the end of a pipe.

[0053] Preferably, the aperture of the flexible form has a length in the range of about 5 cm to about 60 cm, preferably about 15 cm to about 50 cm. This allows a suitable length of the pipe to be accessible when the flexible form is removed.

[0054] Preferably, the first aperture of the first flexible form is shaped to fit around the first end of the pipe. Preferably, the second aperture of the first flexible form is shaped to fit around the second end of the pipe. Preferably, the first aperture of the second flexible form is shaped to fit around the second end of the pipe. This has the advantage of a closer fit between the end and the aperture to reduce the amount of concrete that may enter the aperture and/or the pipe end.

[0055] Preferably the flexible form has a length in the range of about 30 cm to about 80 cm, preferably about 40 cm to about 70 cm. In this regard, the length preferably means the distance that in use, would be substantially parallel to the pipe. This is a suitable size to allow access to the pipe, while minimizing the amount of pipe exposed.

[0056] Preferably, the flexible form has a maximum

height in the range of about 4 cm to about 10 cm, preferably about 5 cm to about 8 cm. In this regard, height is preferably the height in use when the concrete slab is in the horizontal position. These heights are particularly advantageous for fitting into a concrete slab.

[0057] Preferably, the flexible form has a maximum width of about 5 cm to about 30 cm, preferably about 10 cm to about 20 cm. In this regard, width is preferably the width in use when the concrete slab is in the horizontal position. Such widths are suitable for accommodating one or more than one pipe. It is preferable that the first, and second apertures are arranged substantially across the width of the flexible form. This maximises the access to the pipe in the formed concrete slab. Further, as the width of the concrete slab is preferably wider than the height, there is more space available for the first end and the second end of the pipe across the width, than across the height.

[0058] Preferably, the flexible form comprises a substantially planar bottom surface, preferably, wherein the bottom surface comprises an outer lip, preferably wherein the outer lip protrudes away from the substantially planar bottom surface, preferably wherein the outer lip protrudes in a direction substantially perpendicular to the substantially planar bottom surface, preferably by about 1 mm to about 5 mm, preferably about 2 mm to about 4 mm. Preferably, the outer lip protrudes in a direction substantially parallel to the substantially planar bottom surface, preferably about 5 mm to about 20 mm, preferably about 8 mm to about 15 mm. Preferably the outer lip is for abutment with the casting bed. It is advantageous for the flexible form to comprise a substantially planar bottom surface as this makes it easier to position on the casting bed. Further the outer lip helps hold the flexible form in place as the concrete is cast onto the casting bed as a partial vacuum may be formed between the casting bed and the flexible form which holds the flexible form in position. This also helps prevent concrete from going underneath the flexible form which helps to create a cleaner finish. Further the outer lip can be peeled back to help release the flexible form from the concrete slab.

[0059] Preferably, in use, the pipe is substantially parallel to the substantially planar bottom surface. This arrangement facilitates the removal of the flexible form.

[0060] Preferably, the flexible form comprises at least one curved end. Preferably, the flexible form comprises a curved end and an opposed substantially planar end, preferably wherein the first aperture and/or the second aperture are positioned in the substantially planar end, preferably first aperture and/or the second aperture continue towards the curved end. Preferably, the curved end is convex. This has the advantage of a clean line at the end where the pipe continues into the concrete slab, and an aesthetically pleasing shape by the end(s) of the pipe. Furthermore, when concrete is cast, this shape helps to ensure the flexible form stays in the correct position. Preferably, the concrete is cast over the curved end of the flexible form first as this helps ensure the flexible form

stays in the correct position. Further concrete can be compacted more easily over a curved surface.

[0061] Preferably, the first flexible form and/or the second flexible form comprise a first curved end and an opposed second curved end, wherein the first aperture and/or the second aperture are positioned in the first curved end. Preferably, the first curved end and the second curved end are convex. This shape helps to ensure the flexible form stays in the correct position. Further concrete can be compacted more easily over a curved surface.

[0062] Preferably, the flexible form comprises a shaped top surface, preferably a tapered top surface, preferably a curved top surface, preferably a convex top surface. Preferably, the convex top surface extends down to the bottom surface. This helps the concrete to be compacted more easily over the flexible form and form a substantially continuous layer over the flexible form.

[0063] Preferably, the flexible form comprises a substantially cuboidal shape. This is for ease of manufacture of the flexible form and for producing a clean shape within the concrete slab.

[0064] Preferably, the flexible form comprises a slot or handle, preferably wherein the slot or handle are positioned on the bottom surface of the flexible form. This has the advantage of making it easier to remove the flexible form from the concrete slab as the slot or handle can be used to remove the flexible form. Preferably, the slot or handle are positioned towards the first end of the pipe. This makes it easier to slide the flexible form over the pipe and out of the concrete slab.

[0065] Preferably, the flexible form comprise a fixing means for positioning the flexible form in the casting bed, preferably wherein the fixing means comprises a magnet, a vacuum or a mechanical means, such as a tie. A fixing means can help hold the flexible form in position as the concrete is cast. This provides additional support to hold the flexible form in position, together with the pipe end which is positioned within the aperture.

[0066] Preferably, in step (e), the flexible form is fixed to the casting bed by the fixing means and the concrete slab is removed from the casting bed. The flexible form preferably remains fixed to the casting bed. This allows the removal of the flexible form to be automated. Further, the flexible form may then be used in a method of manufacturing a further concrete slab. This reduces the labour required in the process. Further, it is preferable for health and safety for the removal of the flexible form to be automated.

[0067] Preferably, the fixing means is positioned at the opposite end of the flexible form to the first aperture and/or the second aperture. This allows the flexible form to bend in step (e) as it is separated from the concrete slab.

[0068] Preferably, the flexible form comprises a magnet. The magnet aids the removal of the flexible form from the concrete slab. This is because the attractive force of the magnet can be used in conjunction with a magnetic material to help remove the flexible form from

the concrete slab. This means the removal of the flexible form may be automated. Further, a magnet can help fix the flexible form in position when the casting bed comprises steel.

[0069] Preferably, the flexible form comprises a flexible polymer, preferably an elastomer, a natural rubber, a nitrile rubber, a silicone rubber, an acrylic rubber, neoprene, a butyl rubber, a fluorosilicone, a polysiloxane, a polyurethane or a styrene butadiene, or a combination of two or more thereof. Such materials have the advantage of being easy to remove from the concrete slab as they do not easily break and can be bent to remove the flexible form from the pipe end.

[0070] Preferably, the flexible form comprises a material that has a hardness shore A in the range of about 5 to about 50, preferably about 10 to about 40. The hardness shore A is preferably measured in accordance with ISO 868:2003.

[0071] Preferably, the flexible form comprises a material that has a tensile strength in the range of about 5 N/mm² to about 15 N/mm², preferably about 8 N/mm² to about 12 N/mm². The tensile strength is preferably measured in accordance with ISO37:2017.

[0072] Preferably, the flexible form comprises a material that has an elongation at break of in the range of about 400% and about 1400%, preferably about 800% to about 1200%. The elongation at break is preferably measured in accordance with ISO37:2017.

[0073] Preferably, the flexible form comprises a material that has a tear strength in the range of about 5 N/mm² to about 25 N/mm², preferably about 10 N/mm² to about 20 N/mm². The tear strength is preferably measured in accordance with ASTM D 624 B.

[0074] Preferably, flexible means that the item, such as the flexible form can be bent back on itself without breaking.

[0075] Preferably, the flexible form is positioned at the bottom of the casting bed. This means that the concrete can be cast over the top of the form which helps to keep it in position during manufacture. Further, it is easy to remove the flexible form from the concrete because it can be easily located at the bottom of the concrete slab. It will be appreciated that the concrete slab can be lifted and/or rotated, preferably after curing, in order to remove the flexible form.

[0076] Preferably, the pipe has a diameter in the range of about 10 mm to about 50 mm, preferably in the range of about 15 mm to about 15 mm to about 30 mm, preferably in the range of about 15 mm to about 25 mm. Such diameters are suitable for carrying fluids, such as water through a concrete slab.

[0077] Preferably, the wall of the pipe is about 1 mm to about 5 mm. This balances the need for strength of the pipe, with internal space, such as for a fluid, such as water, to flow.

[0078] Preferably, the pipe is made of plastic, metal or a combination of two or more thereof, preferably plastic. These are suitable materials to carry a fluid.

[0079] Preferably, the pipe has a substantially circular cross-section. This is for ease of manufacture and fluid flow.

[0080] Preferably, the pipe comprises one or more loops. This allows the pipe to go through a greater area of the concrete slab. This is particularly useful for heating or cooling systems, where it is desirable for the temperature to be adjusted across the width and length of the concrete slab.

[0081] Preferably, the pipe is flexible. This allows it to be arranged in the desired configuration, depending on the size of the concrete slab.

[0082] Preferably, the concrete slab is a concrete floor slab. Preferably, the concrete slab is both a concrete floor slab and a concrete ceiling slab. The invention has particular utility in these arrangements. It is advantageous for a concrete slab to act as part of the ceiling for one level of a building and part of a floor for the level above.

[0083] Preferably, the concrete slab comprises a recess around the open pipe end(s). The recess is shown when the flexible form is removed. The recess may remain in the concrete slab, or may be at least partially filled in after the open pipe end(s) have been accessed. Preferably, the recess is covered with a lid. This is for ease of access. Preferably, the recess is filled in with concrete. This has the advantage of strength. If the recess remains in the slab, the flexible form gives it a smooth shape which is aesthetically pleasing.

[0084] Preferably, the pipe is connected to a heating or cooling system, preferably a heating or cooling system in a building. This allows the concrete slab to be used as part of a heating or cooling system.

[0085] The present invention relates to a flexible form comprising a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip. Preferably, the outer lip protrudes away from the substantially planar bottom surface, preferably, the outer lip protrudes in a direction substantially perpendicular to the substantially planar bottom surface, preferably by about 1 mm to about 5 mm, preferably about 2 mm to about 4 mm. Preferably, the outer lip protrudes in a direction substantially parallel to the substantially planar bottom surface, preferably about 5 mm to about 20 mm, preferably about 8 mm to about 15 mm. The flexible form has particular utility in the present invention to protect a pipe end as a concrete slab is manufactured.

[0086] Preferably, the flexible form comprises a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip, wherein the first aperture and/or second aperture are a blind aperture. Blind apertures help protect the first end of the pipe from the concrete. Further, the use of a blind aperture can help the

manufacture of the concrete slab as the first end or the second end of the pipe can be accurately positioned in the aperture, without having to judge how far to push the end into the aperture.

5 **[0087]** Preferably, the flexible form comprises a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip, wherein the first and/or second apertures are arranged substantially across the width of the flexible form. It is advantageous for the flexible form to comprise a substantially planar bottom surface as this makes it easier to position on the casting bed. Further the outer lip helps hold the flexible form in place as the concrete is cast onto the casting bed as a partial vacuum may be formed between the casting bed and the flexible form which holds the flexible form in position. This also helps prevent concrete from going underneath the flexible form which helps to create a cleaner finish. Further the outer lip can be peeled back to help release the flexible form from the concrete slab.

10 **[0088]** Preferably, the flexible form comprises a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip, wherein the first and/or second apertures are substantially tube shaped, preferably wherein the length of the first and/or second aperture is in the range of about 5 cm to about 60 cm, preferably about 15 cm to about 50 cm. This is a suitable shape for accommodating a pipe. Furthermore, this allows the pipe to be easily connected after the flexible form has been removed as there is a length of pipe which is free from concrete.

15 **[0089]** Preferably, the flexible form comprises a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip, wherein in use, the pipe is substantially parallel to the substantially planar bottom surface.

20 **[0090]** Preferably, the flexible form comprises a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip, wherein the first and/or second apertures are elongate and their length is substantially parallel to the substantially planar bottom surface, preferably, wherein the first and/or second apertures are substantially tube shaped.

25 **[0091]** The flexible form preferably comprises any of the further features described herein.

[0092] The present invention related to the use of a flexible form as described herein in the manufacture of

a concrete slab with an extrusion process or a slipforming process.

[0093] The present invention relates to a concrete slab manufactured as described herein. Preferably, the concrete slab has a width in the range of about 0.5 m to about 2.5 m, preferably about 0.6 m to about 2.4 m. Preferably, the concrete slab has a length in the range of about 1.5 m to about 20 m, preferably about 4 m to about 16 m. Preferably, the concrete slab has a height in the range of about 15 cm and about 100 cm, preferably between about 20 cm to about 60 cm, preferably between about 20 cm to about 50 cm.

[0094] Such dimensions are suitable for construction. It will be appreciated that the distances are measures when the concrete slab is in a substantially horizontal position, such as a concrete floor slab, or a concrete ceiling slab.

[0095] The present invention relates to an array of concrete slabs manufactured as described herein. An array can be used to form a larger floor or ceiling area.

[0096] The present invention relates to a building comprising a concrete slab as described herein. Preferably, the pipe is connected to a heating or cooling system.

[0097] Example embodiments of the present invention will now be described with reference to the accompanying figures, in which:

- Figure 1 shows a bottom view of a flexible form.
- Figure 2a shows a top view of a flexible form.
- Figure 2b shows a top view of a flexible form.
- Figure 2c shows a top view of a flexible form.
- Figure 3 shows a side view of a flexible form.
- Figure 4 shows a cross-sectional view of a flexible form.
- Figure 5 shows a cross-sectional view of a flexible form.
- Figure 6 shows a cross-sectional view of a flexible form.
- Figure 7 shows a cross-sectional view of a flexible form.
- Figure 8 shows a top view of a casting bed.
- Figure 9 shows a bottom view of a concrete slab.
- Figure 10 shows a top view of a casting bed.
- Figure 11 shows a bottom view of a concrete slab.
- Figure 12a shows a cross-sectional view of a concrete slab.
- Figure 12b shows a cross-sectional view of a concrete slab.
- Figure 13 shows a top view of a casting bed.
- Figure 14 shows a cross-sectional view of a casting bed.
- Figure 15 shows a cross-sectional view of a casting bed.

[0098] Figure 1 shows a bottom view of a flexible form 1. The flexible form 1 has an outer lip 3 which extends beyond the substantially planar bottom surface 4 of the flexible form 1. The flexible form 1 is shown with a curved

end 2 and an opposed planar end 8. The sides 14 are shown as substantially parallel. The substantially planar bottom surface 4 has a slot or handle 5 positioned closer to the curved end 2 than the planar end 8.

5 **[0099]** Figure 2a shows a top view of a substantially cuboidal flexible form 1 with a convex top surface 6 and an outer lip 3. The outer lip 3 is visible as it extends beyond the substantially planar bottom surface (not shown).

10 **[0100]** Figure 2b shows a top view of a flexible form 1 with a convex top surface 6 and an outer lip 3. The outer lip 3 is visible as it extends beyond the substantially planar bottom surface (not shown). The flexible form 1 is shown with a first curved end 2a and an opposed second curved end 2b.

15 **[0101]** Figure 2c shows a top view of the flexible form 1 of Figure 1 with a convex top surface 6 and an outer lip 3. The outer lip 3 is visible as it extends beyond the substantially planar bottom surface (not shown). The flexible form 1 is shown with a curved end 2 and an opposed planar end 8.

20 **[0102]** Figure 3 shows a side view of a flexible form 1 with a convex top surface 6, a substantially planar bottom surface 4, with an outer lip 3. The outer lip 3 extends outwards and downwards from the substantially planar bottom surface. The flexible form 1 is shown with a curved end 2 and an opposed planar end 8.

25 **[0103]** Figure 4 shows a cross-sectional view of a flexible form 1. The flexible form 1 has a convex top surface 6 and a substantially planar bottom surface 4. A first aperture 7 is shown substantially centrally within the flexible form 1. It will be appreciated that an outer lip may also be present (not shown).

30 **[0104]** Figure 5 shows a cross-sectional view of a flexible form 1. The flexible form 1 has a convex top surface 6 and a substantially planar bottom surface 4. A first aperture 7 and a second aperture 9 are shown next to each other and disposed across the width of the flexible form 1. It will be appreciated that an outer lip may also be present (not shown).

35 **[0105]** Figure 6 shows a cross-sectional view of a flexible form 1 with a first end 13 of a pipe 11 positioned in a first aperture 7. The first aperture 7 is shown is necked in at the entrance to fit closely around the pipe 11. The first aperture 7 is elongate and substantially parallel to the substantially planar bottom surface. A magnet 10 is shown at the opposite end to the first aperture 7. In use, the magnet may help hold the flexible form 1 in position on a casting bed 20 (not shown) when concrete is cast. The magnet may also help remove the flexible form 1 from the concrete slab 17 (not shown) after the concrete slab 17 is made. For example, this allows the flexible form to bend in step (e) as it is separated from the concrete slab. It will be appreciated that an outer lip may also be present (not shown). Further, the magnet 10 may be a different fixing means as described herein.

40 **[0106]** Figure 7 shows a cross-sectional view of a flexible form 1 with a first end 13 of a pipe 11 positioned in a first aperture 7 and a second end 15 of the pipe 11

positioned in a second aperture 9. A slot/handle 5 is shown at the opposite end to the first aperture 7 and the second aperture 9. The flexible form 1, has an outer lip 3. In use, the slot/handle 5 can be used to help remove the flexible form 1 from the concrete slab 17 (not shown) after the concrete slab 17 is made.

[0107] Figure 8 shows a top view of a casting bed 20. A pipe 11 is shown in a looped form within the casting bed 20. A flexible form 1 is positioned at the bottom of the casting bed 20 before the concrete is cast. The flexible form 1 has a first aperture 7 and a second aperture 9. The pipe 11 has a first end 13 positioned in the first aperture 7. The pipe 11 has a second end 15 positioned in the first aperture 9. The method of manufacture comprises casting concrete into the casting bed using an extrusion apparatus or a slipforming apparatus, curing the concrete to form a concrete slab and then removing the flexible form 1. The end result is shown in figure 9.

[0108] Figure 9 shows a bottom view of a concrete slab 17. The concrete slab 17 has a recess 19 where the flexible form 1 (not shown) was removed. The first end 13 and the second end 15 of the pipe 11 are shown to be accessible as the flexible form 1 has been removed. The pipe 11 can then be connected for use, such as in a heating or cooling system. The recess 19 can be left empty, covered by a lid, or may be filled in with a material such as concrete once the pipe 11 has been accessed.

[0109] Figure 10 shows a top view of a casting bed 20. A pipe 11 is shown in a looped form within the casting bed 20. A first flexible form 1a is positioned at the bottom of the casting bed 20 before the concrete is cast. The flexible form 1a has a first aperture 7a. A second flexible form 1b is positioned at the bottom of the casting bed 20 before the concrete is cast. The second flexible form 1b has a first aperture 7b. The pipe 11 has a first end 13 positioned in the first aperture 7a of the first flexible form 1a. The pipe 11 has a second end 15 positioned in the first aperture 7b of the second flexible form 1b. The method of manufacture comprises casting concrete into the casting bed using an extrusion apparatus or a slipforming apparatus, curing the concrete to form a concrete slab and then removing the flexible forms 1a and 1b. The end result is shown in figure 11.

[0110] Figure 11 shows a bottom view of a concrete slab 17. The concrete slab 17 has a first recess 19a where the first flexible form 1a (not shown) was removed. The first end 13 of the pipe 11 is shown to be accessible as the first flexible form 1a has been removed. The concrete slab 17 has a second recess 19b where the second flexible form 1b (not shown) was removed. The second end 15 of the pipe 11 is shown to be accessible as the second flexible form 1b has been removed. The pipe 11 can then be connected for use, such as in a heating or cooling system. The recesses 19a and 19b can be left empty, covered by a lid, or may be filled in with a material such as concrete once the pipe 11 has been accessed.

[0111] Figure 12a shows a cross-sectional view of a concrete slab 17. A flexible form 1 is shown at the bottom

of the concrete slab 17. A mesh 28 is shown supported on a plurality of wires 26. A pipe 11 is shown supported by the mesh 28. The pipe 11 loops backwards and forwards across the width and length of the cross-section and is therefore shown multiple times in the figure. A cross-section of the pipe 11 is shown in the flexible form 1 inside the first aperture 7 and the second aperture 9. Multiple strands 24 are shown in cross-section and are arranged below the wires 26. It will be appreciated that in some embodiments, the wires 26 may be in the form of strands. The strands 24 run either side of the flexible form 1. This allows spacer (not shown) to run along the strands 24 to hold the strands 24 in position. Hollow cores 22 are shown in cross-section above the pipe 11.

[0112] Figure 12b shows a cross-sectional view of a concrete slab 17. A flexible form 1 is shown at the bottom of the concrete slab 17. A mesh 28 is shown supported on a plurality of wires 26. It will be appreciated that in other embodiments, the mesh 28 may be held in position in a different way, such as by a series of supports or hooks. A pipe 11 is shown supported by the mesh 28. The pipe 11 loops backwards and forwards across the width and length of the cross-section and is therefore shown multiple times in the figure. A cross-section of the pipe 11 is shown in the flexible form 1 inside the first aperture 7 and the second aperture 9. Multiple strands 24 are shown in cross-section and are arranged above the wires 26. Hollow cores 22 are shown in cross-section above the strands 24. This allows the pipe 11 to be positioned closer to the bottom of the slab 20 as they do not need to be positioned above the strands 24.

[0113] Figure 13 shows a top view of a casting bed 20. A flexible form 1 is shown. The first end 13 (not shown) of the pipe 11 positioned in a first aperture 7 (not shown) of the flexible form 1. The second end 15 (not shown) of the pipe 11 is positioned in a second aperture 9 (not shown) of the flexible form 1. The pipe 11 is shown supported by a mesh 28. As shown, the pipe 11 is above the mesh 28. The flexible form is shown to be below the mesh. It will be appreciated that the first end 13 of the pipe and the second end 15 of the pipe are not shown, but are located below the mesh 28 and inside the flexible form 1. The mesh is preferably supported on either the strands 24 (not shown) or the wires 26 (not shown) arranged beneath the mesh 28. The casting bed 20 is shown prior to the concrete being cast.

[0114] Figure 14 shows a cross-sectional view of a casting bed 20. A flexible form 1 is shown at the bottom of the casting bed 20 with a first aperture 7 and a second aperture 9. Multiple strands 24 are shown in cross-section and are arranged below the wires 26. The strands 24 run either side of the flexible form 1. Wires 26 are positioned above the flexible form 1. A spacer, split into two parts, 30a and 30b is able to run along the strands 24 to hold the strands 24 in position and pretension them. The spacer 30a and 30b fits under the wires 26 and around the flexible form 1 with 30a shown on the left hand side of the flexible form 1 and 30b shown on the right

hand side of the flexible form 1. The casting bed 20 is shown prior to a mesh 28 (not shown) being positioned on the wires 26 and a pipe 11 (not shown) being supported on the mesh 28 and positioned in the flexible form 1.

[0115] Figure 15 shows a cross-sectional view of a casting bed 20. A flexible form 1 is shown at the bottom of the casting bed 20 with a first aperture 7 and a second aperture 9. Wires 26 are positioned above the flexible form 1. Multiple strands 24 are shown in cross-section and are arranged above the wires 26. This allows the multiple strands 24 to be held in position and pretensioned by a suspended spacer, such as a series of hooks (not shown). An advantage of this arrangement is that the strands 24 can be accessed from above, without the pipe 11 or the flexible form 1 impeding the suspended spacer. The casting bed 20 is shown prior to a mesh 28 (not shown) being positioned on the wires 26 and a pipe 11 (not shown) being supported on the mesh 28 and positioned in the flexible form 1.

[0116] It will be appreciated that the flexible form, arrangement of the pipe, wires and strand may have a different form to those shown in the figures. It will be appreciated that an outer lip may also be present on the flexible form where this is not shown.

[0117] Within this specification embodiments have been described in a way which enables a clear and concise specification to be written, but it is intended and will be appreciated that embodiments may be variously combined or separated without parting from the invention. For example, it will be appreciated that all preferred features described herein are applicable to all aspects of the invention described herein and vice versa.

[0118] Within this specification, the term "about" means plus or minus 20%, more preferably plus or minus 10%, even more preferably plus or minus 5%, most preferably plus or minus 2%.

[0119] Within this specification, the term "substantially" means a deviation of plus or minus 20%, more preferably plus or minus 10%, even more preferably plus or minus 5%, most preferably plus or minus 2%.

[0120] Within this specification, reference to "substantially" includes reference to "completely" and/or "exactly". That is, where the word substantially is included, it will be appreciated that this also includes reference to the particular sentence without the word substantially.

[0121] Within this specification reference to "prevents" means that an action is substantially kept from happening.

[0122] It will be appreciated that reference to "one or more" includes reference to "a plurality".

[0123] It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its attendant advantages. It is therefore intended that such changes and modifications are covered by the appended claims.

Claims

1. A method of manufacturing a concrete slab comprising:

- a) providing a pipe and a first flexible form, wherein the pipe comprises a first end, and wherein the first flexible form comprises a first aperture;
- b) positioning the pipe and the first flexible form in a casting bed, wherein the first end of the pipe is positioned within the first aperture of the first flexible form;
- c) casting concrete into the casting bed using a slipforming apparatus or an extrusion apparatus and forming a plurality of hollow cores in the concrete; and
- d) curing the concrete.

2. A method according to claim 1, further comprising: e) removing the first flexible form.

3. A method according to any preceding claim, wherein step (c) comprises casting the concrete onto the casting bed; preferably wherein step (c) comprises the following steps:

- (c) (i) casting a concrete layer onto the casting bed and compacting the concrete layer; preferably wherein the concrete layer substantially covers the pipe and flexible form;
- (c) (ii) forming hollow cores in the concrete layer above the pipe and the flexible mold using a hollow core former;
- (c) (iii) shaping the top surface of the concrete layer using a trowel apparatus and/or a vibration apparatus, preferably wherein the top surface is substantially flat.

4. A method according to any preceding claim, wherein the pipe comprises a second end and wherein the first flexible form comprises a second aperture, wherein in step (b), the second end of the pipe is positioned within the second aperture of the first flexible form; or wherein the pipe comprises a second end and wherein step (a) further comprises providing a second flexible form, wherein the second flexible form comprises a first aperture, wherein in step (b), the second end of the pipe is positioned within the first aperture of the second flexible form.

5. A method according to any preceding claim, wherein the first aperture of the first flexible form, is a blind aperture; and/or

wherein the first aperture of the first flexible form is shaped to fit around the first end of the pipe;

- and/or
 wherein the first aperture is narrower at the entrance to the first aperture than further into the first aperture; and/or
 wherein the entrance to the first aperture is necked-in; and/or
 wherein the first and/or second apertures are elongate.
6. A method according to any preceding claim, wherein the first flexible form and/or the second flexible form comprises a flexible polymer, preferably an elastomer, a natural rubber, a nitrile rubber, a silicone rubber, an acrylic rubber, neoprene, a butyl rubber, a fluorosilicone, a polysiloxane, a polyurethane or a styrene butadiene, or a combination of two or more thereof.
7. A method according to any preceding claim, wherein the first flexible form and/or the second flexible form comprise a substantially planar bottom surface, preferably, wherein the bottom surface comprises an outer lip, preferably wherein the outer lip protrudes away from the substantially planar bottom surface, preferably wherein the outer lip protrudes in a direction substantially perpendicular to the substantially planar bottom surface, preferably by about 1 mm to about 5 mm, preferably about 2 mm to about 4 mm, preferably wherein the outer lip protrudes in a direction substantially parallel to the substantially planar bottom surface, preferably about 5 mm to about 20 mm, preferably about 8 mm to about 15 mm.
8. A method according to any preceding claim, wherein the first flexible form and/or the second flexible form comprise a curved end and an opposed substantially planar end, preferably wherein the first aperture and/or the second aperture are positioned in the substantially planar end; or
 wherein the first flexible form and/or the second flexible form comprise a first curved end and an opposed second curved end, wherein the first aperture and/or the second aperture are positioned in the first curved end; or
 wherein the first flexible form and/or the second flexible form are substantially cuboidal; and/or
 wherein the first flexible form and/or the second flexible form comprise a shaped top surface, preferably a tapered top surface, preferably a curved top surface, preferably a convex top surface; and/or
 wherein the first flexible form and/or the second flexible form comprise a slot or handle, preferably wherein the slot or handle are positioned on the bottom surface of the form; and/or
 wherein the first flexible form and/or the second flexible form comprises a magnet.
9. A method according to any preceding claim, further comprising positioning a plurality of reinforcement elements in the form of strands, preferably steel strands, above the bottom of the casting bed and substantially parallel to the machine direction of the casting bed prior to step (c), preferably wherein the pipe is provided on a mesh positioned on the strands; or
 further comprises positioning a plurality of reinforcement elements in the form of strands, preferably steel strands, above the bottom of the casting bed and substantially parallel to the machine direction of the casting bed prior to step (c) and positioning a plurality of reinforcement elements in the form of wires, preferably steel wires, above the strands, preferably wherein the pipe is provided on a mesh positioned on the wires.
10. A method according to any preceding claim, wherein the concrete slab is a concrete floor slab, preferably, the concrete slab is both a concrete floor slab and a concrete ceiling slab; and/or
 wherein the pipe is connected to a heating or cooling system, preferably a heating or cooling system in a building.
11. A flexible form comprising a first aperture and optionally a second aperture, wherein the first aperture and/or second aperture are each for receiving an end of a pipe, wherein the flexible form comprises a substantially planar bottom surface, wherein the bottom surface comprises an outer lip, preferably wherein the outer lip protrudes away from the substantially planar bottom surface, preferably wherein the outer lip protrudes in a direction substantially perpendicular to the substantially planar bottom surface, preferably by about 1 mm to about 5 mm, preferably about 2 mm to about 4 mm, preferably wherein the outer lip protrudes in a direction substantially parallel to the substantially planar bottom surface, preferably about 5 mm to about 20 mm, preferably about 8 mm to about 15 mm.
12. A flexible form according to claim 11, further comprising any of the features of the flexible form described in any of claims 4 to 8.
13. Use of a flexible form according to claim 11 or 12 in the manufacture of a concrete slab with an extrusion process or a slipforming process.
14. A concrete slab manufactured according to any of claims 1 to 10.
15. A building comprising a concrete slab according to claim 14, preferably wherein the pipe is connected to a heating or cooling system.

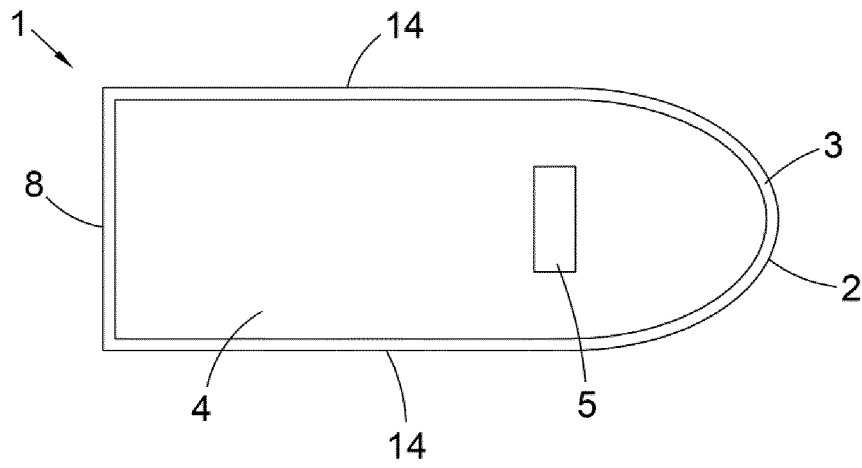


Fig. 1

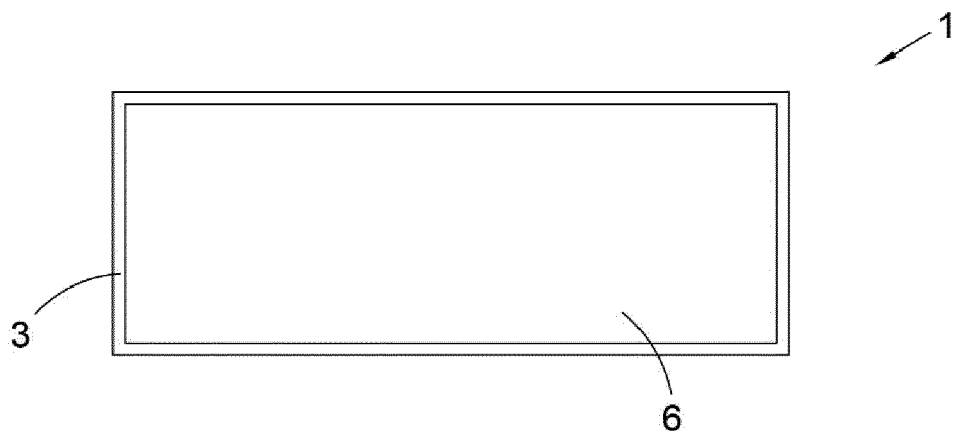


Fig. 2a

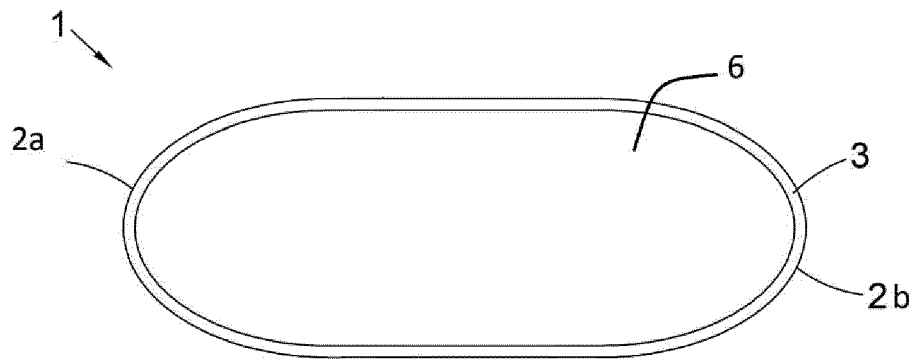


Fig.2b

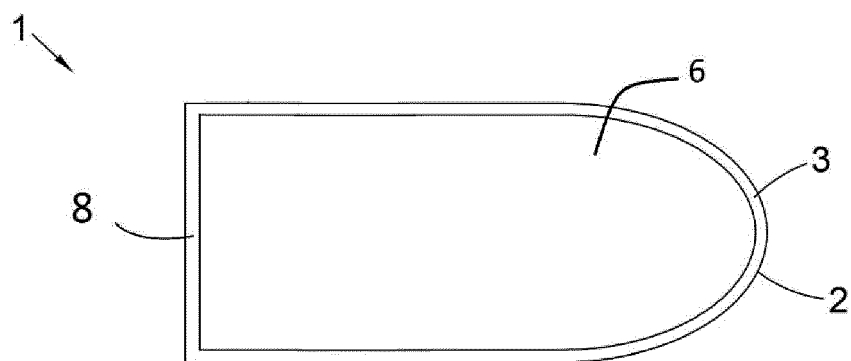


Fig.2c

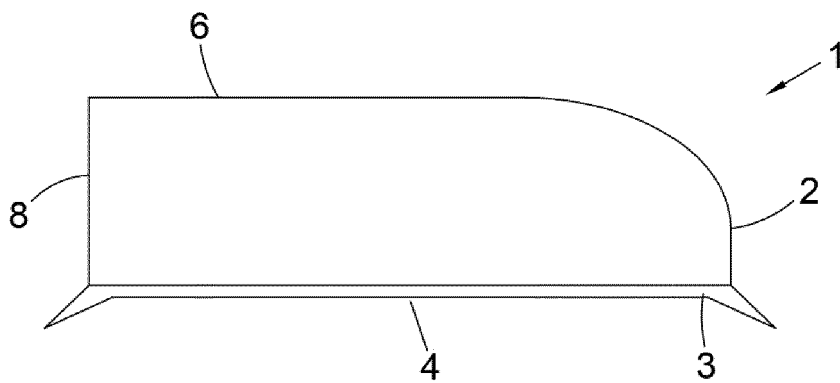


Fig. 3

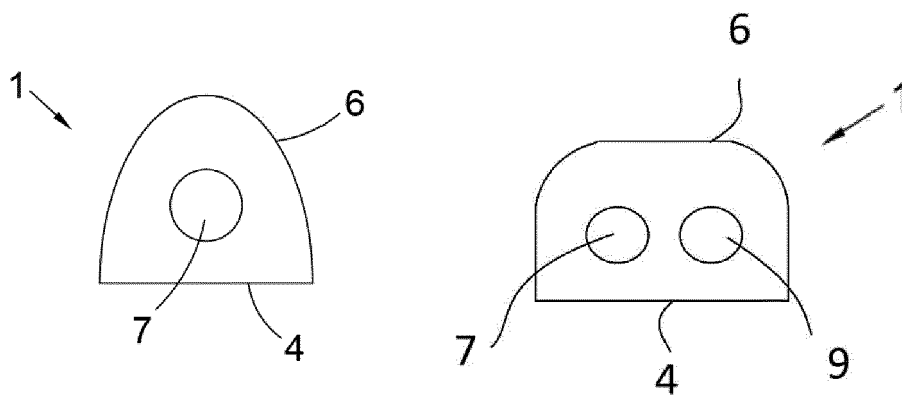


Fig. 4

Fig. 5

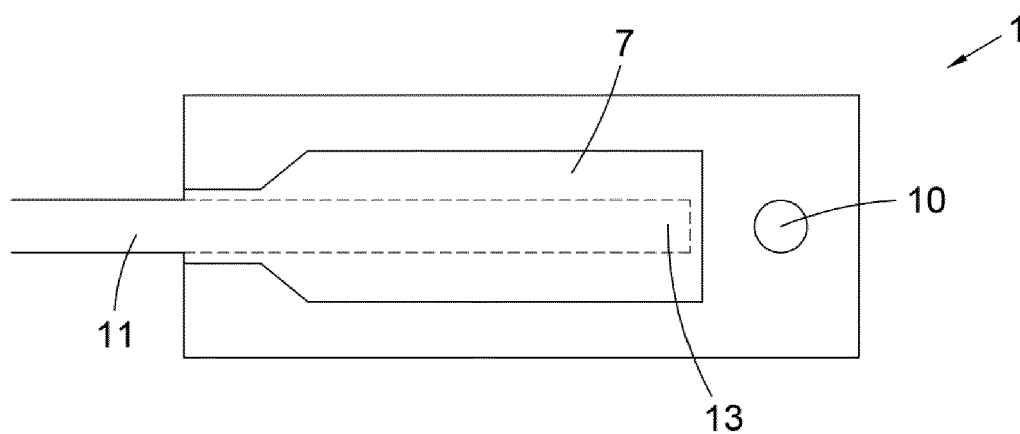


Fig. 6

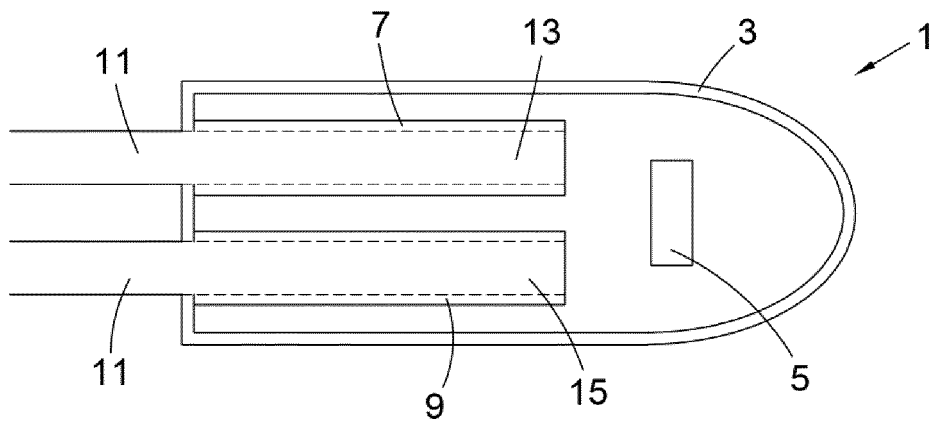


Fig. 7

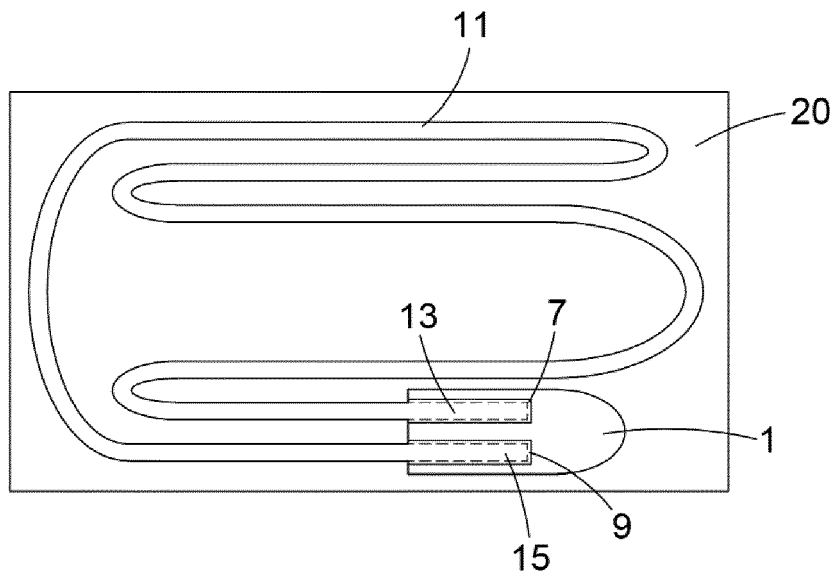


Fig. 8

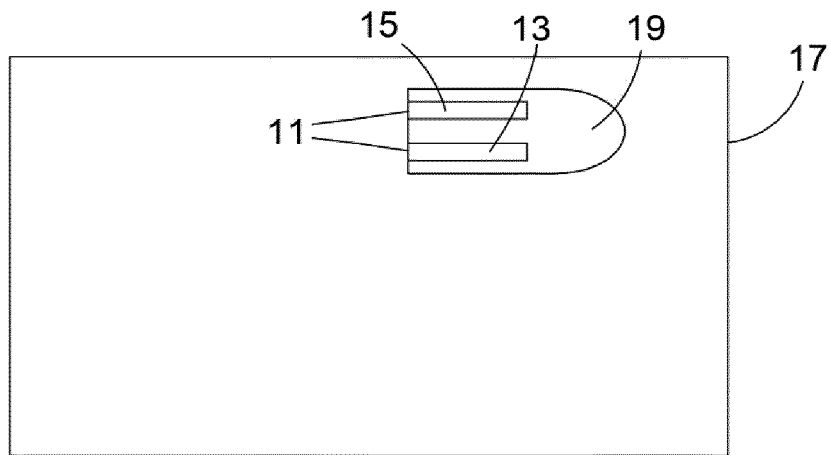


Fig. 9

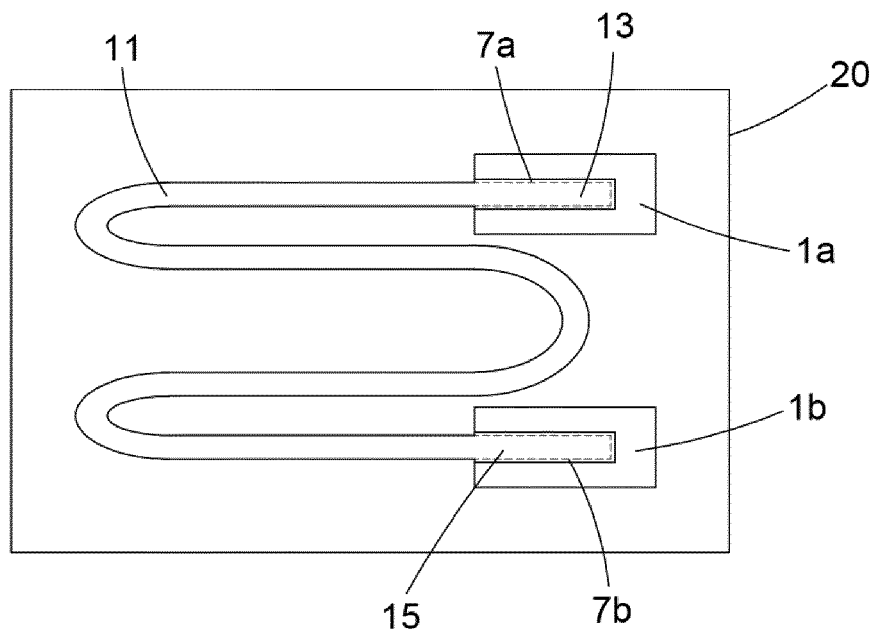


Fig. 10

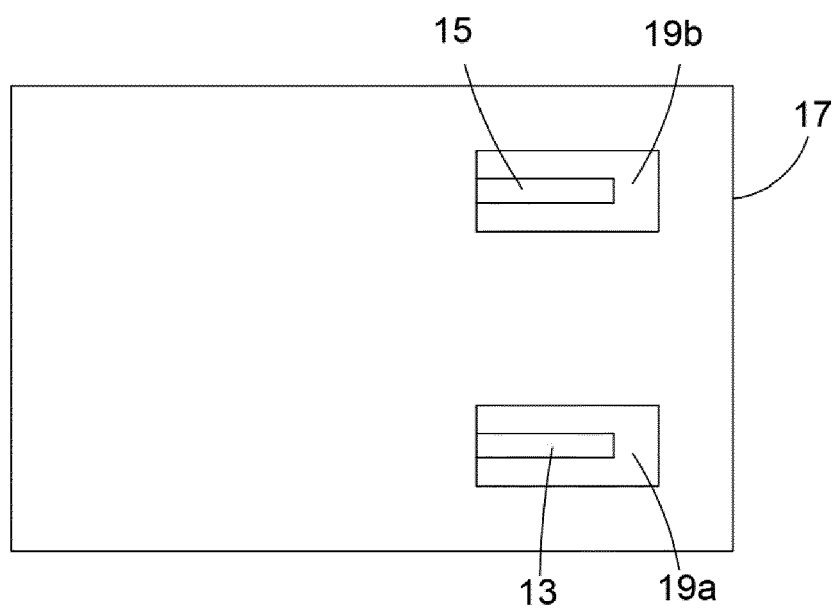


Fig. 11

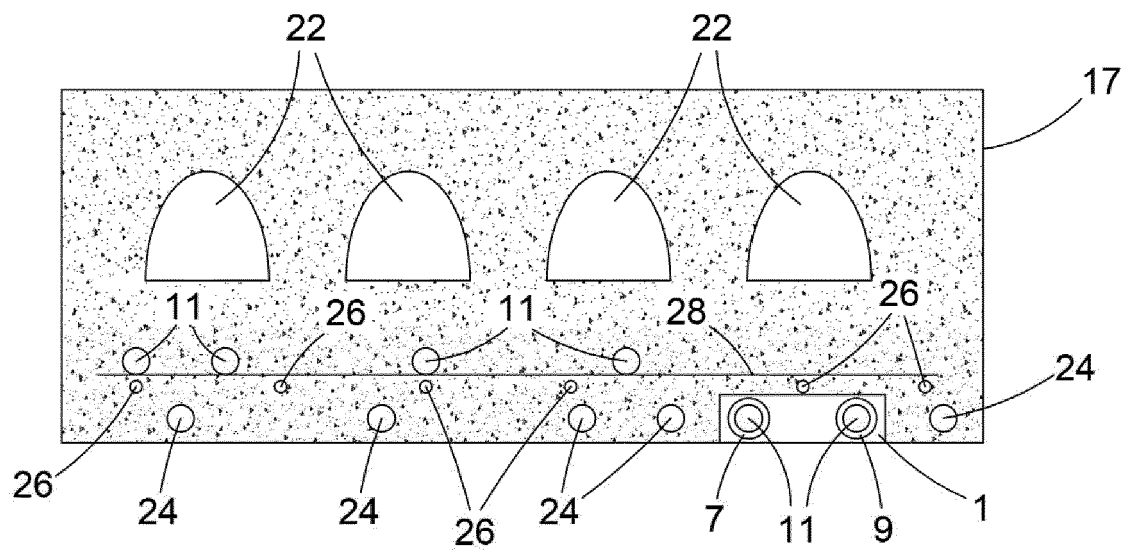


Fig. 12a

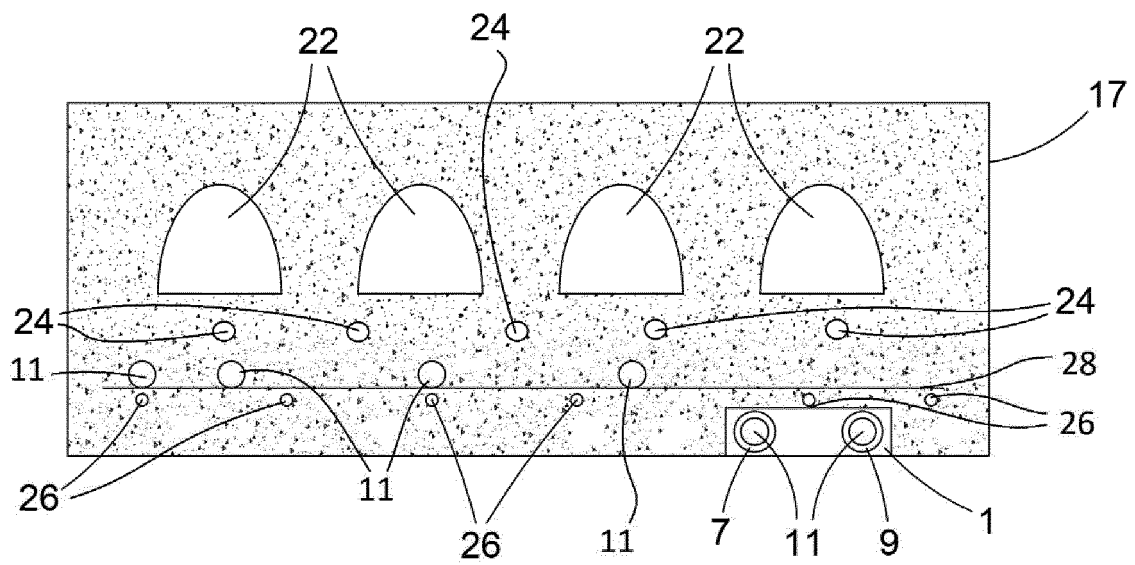


Fig. 12b

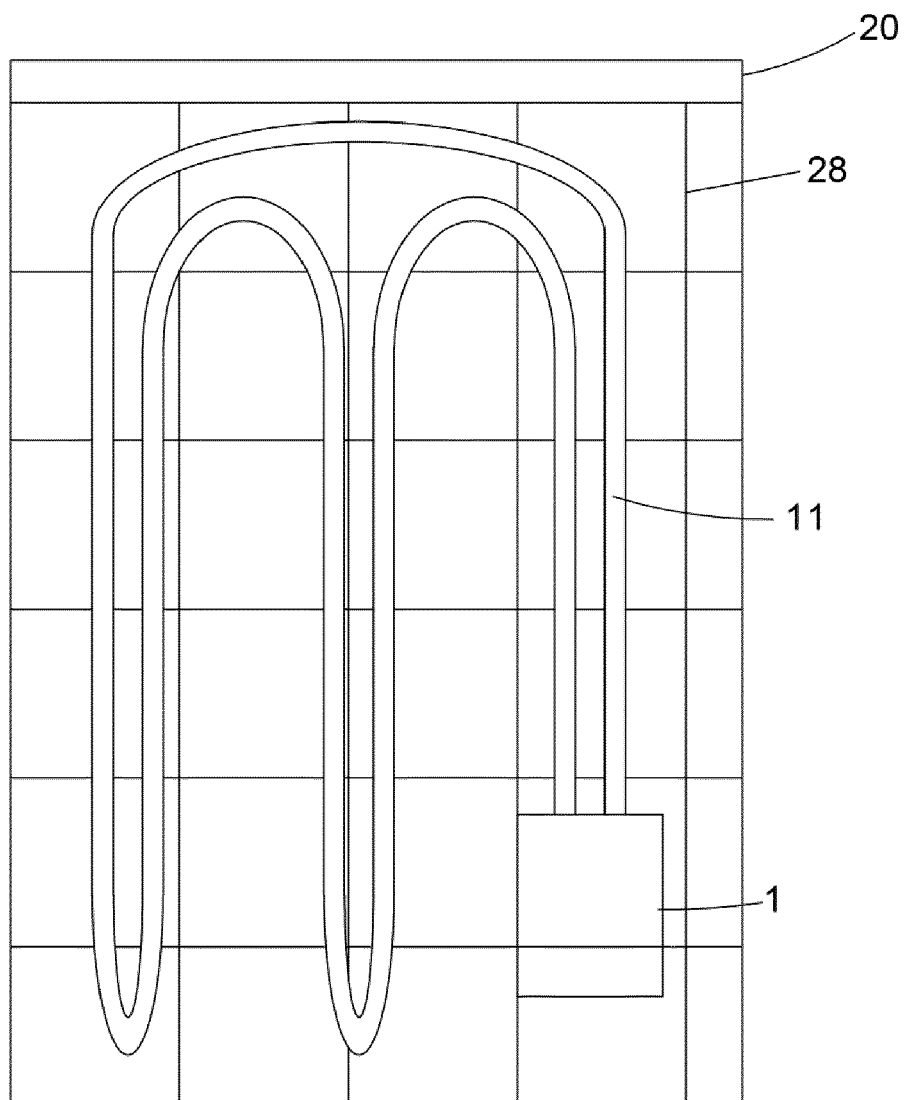


Fig. 13

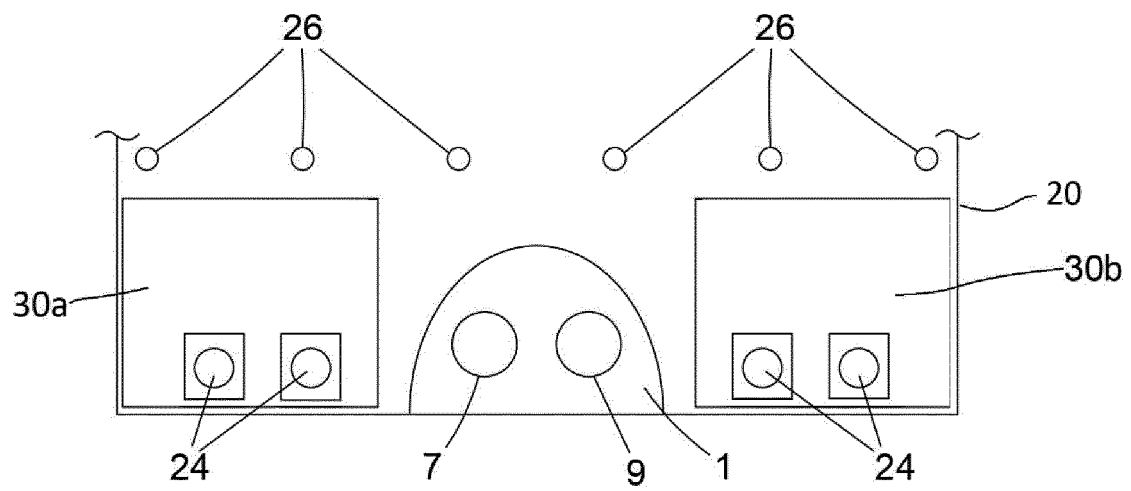


Fig. 14

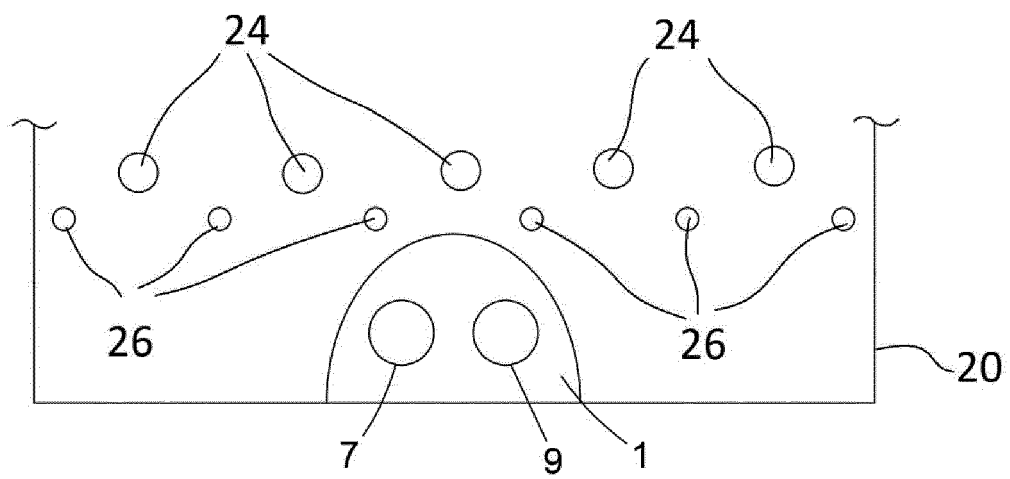


Fig. 15



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 818 606 A1 (VBI ONTWIKKELING BV [NL]) 31 December 2014 (2014-12-31)	14, 15	INV. B28B1/08
A	* figures 1-10 * * paragraphs [0023] - [0026], [0030], [0032] - [0038] *	1-10, 13	B28B3/22 B28B7/00 B28B7/06 B28B7/34
A	DE 10 2007 055134 A1 (KETONIA GMBH [DE]) 15 January 2009 (2009-01-15) * figures 1-14 * * paragraphs [0067] - [0070], [0092], [0093] *	1-10	B28B23/00 B28B23/04 E04B5/04 E04B5/48
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