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(54) CONSTRUCTION MODULE

(57) A precast reinforced concrete module (10, 20) is provided. It comprises a concrete wall (12); two longitudinal nerves (11) disposed each of them at an end of said concrete wall (12), said concrete wall (12) extending between said longitudinal nerves (11), said nerves (11) being configured for supporting vertical and horizontal efforts; engagement means (17; 171, 172, 173) for mechanical connection with another module (10, 20) forming a vertical wall; and supporting means (14, 15) mounted on said longitudinal nerves (11). The module also comprises at least one building service installation element (191, 192, 193, 194) preinstalled on said concrete wall (12) in at least one recess (31, 32) made along said concrete wall (12), said at least one building service installation element (191, 192, 193, 194) comprising at least one free ends for the connection with at least one building service installation element (191, 192, 193, 194) preinstalled on another module (10, 20). A construction wall formed by several modules (10, 20) is also provided. A rigid core assembly formed by several modules is also provided.

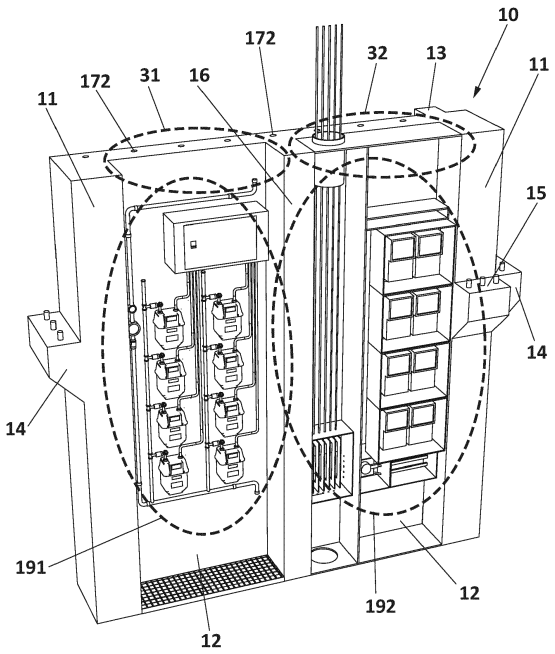

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of building construction. More precisely, it relates to precast modules and walls built from those precast modules.

STATE OF THE ART

[0002] The structure of a building must withstand any stresses from vertical actions, i.e., its own weight, dead load and live load, and horizontal actions, such as wind and earthquake, within minimum thresholds of safety and comfort for users. To this end, it has a superstructure on foundations composed of elements lying horizontally: beams, joists, slabs, etc., as well as vertically placed elements: columns, shear walls, rigid cores, etc. Normally this superstructure has been implemented by structural concrete by traditional means, building the work on-site and running handcrafted items. The disadvantage of this construction system is that it requires of large number of decentralized resources and significant costs in terms of time and budget execution. To resolve this problem precast concrete was developed, which solved the execution of vertical and horizontal elements of the superstructure.

[0003] Water, electricity, gas and telecommunications services in a building height require facilities, such as tubes, pipes and cables, which are internally disposed from the connection point, where the building is connected to external supply networks, to the point where each service is eventually required, within each home. These services also require consumption measurement systems of each home, security elements and maneuver, etc. Specific regulatory requirements must be fulfilled. All this set forms the internal distribution network. This internal distribution network is normally executed by hand, by placing and connecting the cables, pipes and tubes with their respective boxes, consumption measuring elements and security and maneuver systems. However, this internal distribution network has the same problems of implementation, with delocalized resources, longer terms and inability to work in parallel, which were already present in the case of structural precast. In other words, the term and construction budget is enlarged.

[0004] It is desirable to develop precast concrete walls that foresee the installation of facilities such as water, electricity, gas and telecommunications services. Some attempts of this idea have been developed.

[0005] United States patent US5127201 discloses a prefabricated concrete kitchen and bathroom core, which poses connections in a kitchen and bathroom through a core placed on a supporting wall. However, it does not disclose a structural precast such as a shear wall. Besides, it does not have embedded installations for facilities.

[0006] International patent application WO2011135123A1 discloses an open modular construction building comprising a central core of communications based on a typical rectangular arrangement. Between modules, some space is foreseen for locating the facilities associated to those services.

DESCRIPTION OF THE INVENTION

[0007] Therefore, there is a need for developing a construction precast module having preinstalled building service elements (water, electricity, gas and telecommunications services) within the module itself, in such a way that the internal distribution network of these services is disposed within the construction module, thus requiring a minimum number of on-site operations for its actual execution. The present invention solves this need by providing a precast module having pre-installed services. The invention also refers to a wall made of at least two of these modules and to a rigid core assembly comprising three modules.

[0008] In other words, the precast structure does not only provide its mandatory structural mission, but also contains one or more services, which remain embedded within the precast module and ready for connection and operation. The pre-installed services fulfil the same function as the internal distribution networks run by traditional means.

[0009] Therefore, in order to manage the passage of the facilities and the arrangement of the measuring elements, security and maneuver, and to generate an access to perform maintenance and inspection, it is necessary to create/open spaces within the precast module. This may risk the structural capacity of the module, due to the loss of area and inertia. Besides, the interconnectivity with other structural elements may also be reduced because connections of the structural part must transmit efforts in areas that have not been weakened by the passage of facilities. The present invention solves these challenges, which let the vertical passage of services to complete the distribution network through the cores of rigidity or building shear and load walls. These cores and walls have the dual mission of resisting the vertical and horizontal efforts in the building, which could be the dominant action for structural design in case of an earthquake, as a matter of fact.

[0010] The proposed solution overcomes the limitations of conventional disclosures, such as the prefabricated concrete kitchen and bathroom core disclosed in US5127201, which does not have embedded installations for facilities; or the modular building disclosed in WO2011135123A1, which neither has embedded installations for facilities.

[0011] The passage of water and gas distribution pipes, as well as of other services, are preferably installed in the most rigid and resistant parts of the building, ensuring safety in seismic events, wind, vibrations of use, etc. This has been done without compromising the structural integrity of the building to be built.

[0012] The proposed module can be industrially man-

ufactured by prefabricating concrete and pre-installing all services, in order for its quick installation in a building construction.

[0013] It is an object of the invention to provide a precast reinforced concrete module comprising: a concrete wall; at least two longitudinal nerves, wherein a first nerve of said at least two longitudinal nerves is disposed at an end of said concrete wall and a second nerve of said at least two longitudinal nerves is disposed at the opposite end of said concrete wall, said concrete wall extending between said first and second nerves, said at least two longitudinal nerves being configured for supporting vertical and horizontal efforts; engagement means for mechanical connection with another module forming a vertical wall; supporting means mounted on said longitudinal nerves. The module further comprises at least one building service installation element preinstalled on said concrete wall in at least one recess made along the height of said concrete wall, said at least one building service installation element comprising at least one free end for connecting said building service installation element with another building service installation element preinstalled on another module.

[0014] In a particular embodiment, the module further comprises a thin wall of compartmentalization disposed along the height of said concrete wall, parallel to said longitudinal nerves, configured to define at least two recesses for the passage of at least two building service installation element.

[0015] In a particular embodiment, at least one of said supporting means mounted on said longitudinal nerves is a longitudinal cantilever mounted on said longitudinal nerves for transmitting vertical and horizontal efforts.

[0016] In a particular embodiment, at least one of said supporting means mounted on said longitudinal nerves is a transversal cantilever mounted on said longitudinal nerves for transmitting vertical and horizontal efforts.

[0017] In a particular embodiment, the module further comprises at least one connection thin wall disposed as a prolongation of a longitudinal nerve, said connection thin wall being configured for connecting the module with a another one in such a way that they are perpendicular to each other. The module preferably comprises transversal engagement means disposed in said at least one connection thin wall. More preferably, the transversal engagement means comprise a passing cylinder and an elongated element that passes through the passing cylinder.

[0018] In a particular embodiment, the engagement means for mechanical connection with another module forming a vertical wall comprise a registration box, a passing cylinder and a threaded rod that passes through the passing cylinder.

[0019] In a particular embodiment, said at least one building service installation element is an element for the installation of a gas service, or an electricity service, or a water service or a telecommunications service.

[0020] In another aspect of the invention, it is provided a construction wall comprising at least two modules disposed longitudinally. The at least two modules may be disposed vertically with respect to each other or horizontally with respect to each other.

[0021] In another aspect of the invention, it is provided a rigid core assembly comprising three modules, wherein two of said modules are disposed parallel to each other, at the same height, separated by a distance, while a third module connects said two modules, said third module being disposed perpendicular to said two modules. In a particular embodiment, an assembly formed by a plurality of rigid core assemblies is provided, wherein said plurality of rigid core assemblies are disposed vertically in height.

[0022] The three modules may be: the three of them are modules like the already described; or two of said three modules are modules like the already described and the other module is an auxiliary module; or one of said three modules is a module like the already described and the other two modules are auxiliary modules.

[0023] In another aspect of the invention, it is provided the use of a module like the already described, in the construction of a building.

[0024] Additional advantages and features of the invention will become apparent from the detail description that follows and will be particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

Figure 1 illustrates a precast reinforced concrete wall according to a possible embodiment of the invention.

Figure 2 shows a front view of the precast module of figure 1.

Figure 3 shows a rear view of the precast module of figure 1.

Figure 4 shows the pre-installation in a precast module of a gas service according to an embodiment of the invention.

Figure 5 shows the pre-installation in a precast module of a water service and a telecommunications service according to an embodiment of the invention.

Figure 6 shows in detail a portion of the water service illustrated in figure 5.

Figure 7 shows the pre-installation in a precast module of an electricity service according to an embodiment of the invention.

Figure 8 shows in detail a portion of the telecommunications service illustrated in figure 5.

Figures 9 to 11 show different configurations of the assembly formed by more than one precast module as illustrated in figures 1 to 3. Figure 9 shows a shearing wall assembly formed by a plurality of precast modules disposed vertically. Figure 10 shows a rigid core assembly formed by three modules (two precast modules as illustrated in figures 1 to 3 and one auxiliary module) disposed perpendicularly defining a cavity. Figure 11 shows an assembly formed by a plurality of rigid core assemblies disposed vertically.

DESCRIPTION OF A WAY OF CARRYING OUT THE INVENTION

[0026] In this text, the term "comprises" and its derivations (such as "comprising", etc.) should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0027] In the context of the present invention, the term "approximately" and terms of its family (such as "approximate", etc.) should be understood as indicating values very near to those which accompany the aforementioned term. That is to say, a deviation within reasonable limits from an exact value should be accepted, because a skilled person in the art will understand that such a deviation from the values indicated is inevitable due to measurement inaccuracies, etc. The same applies to the terms "about" and "around" and "substantially".

[0028] The following description is not to be taken in a limiting sense but is given solely for the purpose of describing the broad principles of the invention. Next embodiments of the invention will be described by way of example, with reference to the above-mentioned drawings showing apparatuses and results according to the invention.

[0029] Figure 1 shows a precast reinforced concrete module 10 according to an embodiment of the invention. The concrete module 10 may be referred to as PWPS, which stands for **P**recast **W**alls with **P**reinstalled **S**ervices. It represents a block of precast reinforced concrete having dry joints or connections. Dry connections imply that there is no need for pouring fresh concrete and wait for its hardening before connecting it. On the contrary, connections are made by mechanical means, such as bolts, nuts, etc. that are mechanical connecting means making the module easily and quickly attachable and detachable. At least one recess (or hole or hollow) has been made along the entire height (that is, vertically, extending from the upper side to the lowest side of the module) of the main block forming the module 10. In particular, two recesses 31 32 have been made. This means that, without using more space, two requirements are fulfilled: the structural requirement itself and the location of recesses 31 32 for the passage of installations. When making the recesses, the structural requirement is guaranteed by leaving thick-enough nerves 11 at the ends of the module. In particular, figure 1 shows gas and electricity services 191, 192 preinstalled in recesses 31 32 formed on the precast module 10. In order to arrive at the shown development, several challenges have been overcome:

The first challenge is the generation of those recesses 31, 32 intended to act as shafts for risers. These shafts must have minimum dimensions that allow the passage of services and must meet certain requirements, such as being open and be suitable for survey. This compromises the structural mission, since the lever arm is reduced and the two recesses 31, 32 are divided by a minimum thickness of concrete (element 16 in figure 1), in order to avoid problems, such as fire spreading. All this must be solved without increasing the thickness of the wall, so that the architectural concept of the building in which it will be integrated is maintained. Therefore, the challenge is solved by means of wall thickness reduction minimizing the structural capacity loss, selecting the best place and taking advantage of the better execution control off-site, doing it on modules, what allows to reduce the safety coefficients keeping the proper structural reliability level.

[0030] The second challenge derives from the first one and is the maintenance of the structural mission of the wall. This implies not only maintaining the bearing properties of the wall with respect to vertical actions, such as the weight, dead load or live load (by weight of users, furniture, etc.) that are resting on the wall, or the ability of bracing against horizontal actions such as wind and seism; but also solving wall connections, taking into account the space constraints and the weakness induced by holes, which complicates the distribution of efforts by concentrating loads, in order to connect the wall in the structural system in which it is integrated (i.e. the walls located above and below, to the sides, at the same height but parallel and perpendicular, beams rushing the wall and rest on it, the floors, etc.). Also, since the module including its services must be able to be connected and disconnected without interrupting the construction process, a system having dry connection is preferably chosen, as simple as possible, in order to be competitive.

[0031] Another challenge is how to exploit the area generated by the recesses for the passage of the different services, how to distribute the required security and measurement elements, as well as the interconnection of recesses in order to form the line of vertical distribution and the connection with the horizontal distribution of each plant (floor). Each of the different services concerned:

electricity, gas, water and telecommunications, has its peculiarities that are resolved as described in particular embodiments discussed next. In figure 1, as a matter of example, the gas service 191 and the electricity service 192 have been preinstalled in the module 10.

[0032] As shown in figure 1, the structural system is based on a precast reinforced concrete module 10 preferably having dry joints or connections. Figures 2 and 3 show two views of the precast module. In figures 2 and 3, the preinstalled services are not shown. Figure 2 shows a front view of the module 20, while figure 3 shows a back view of the module 20.

[0033] The module 10, 20 comprises a concrete wall or background wall 12 which puts together the whole set formed by the module. This wall 12 acts as a bearing wall and bracing wall against shearing forces. In a particular embodiment, it has a minimum thickness of 20 cm.

[0034] The module 10, 20 also comprises at least two longitudinal nerves 11, preferably disposed at opposite ends of the concrete wall or background wall 12. In other words, the concrete wall 12 preferably extends between two outer longitudinal nerves 11. The term "longitudinal" refers here to the nerves 11 being vertical when the module 10, 20 is mounted. These at least two nerves 11 support vertical and horizontal efforts from the construction. In other words, these nerves 11 have structural mission in terms of bearing capacity and as heads of compression in bracing against horizontal actions. The contribution of the nerves 11, preferably placed at the ends or extremes of the wall 12, to the global inertia of the module, is very important. When a wall or another module is assembled to the module 10, 20, this assembly is done against a nerve 11. In a particular embodiment, the minimum section of a nerve 11 is: 50 cm of depth and 30 cm of thickness.

[0035] In a particular embodiment, these nerves 11 may also receive or hold connection thin walls 13, for connecting the structural system with a perpendicular wall or module, in the event there is such perpendicular wall or module to be connected. Connection thin walls 13 may also be used for connecting the structural system with a longitudinal wall or module. A connection thin wall 13 is disposed as a prolongation of a corresponding nerve 11, along its height and the height of the background wall 12, in order to be able to pull thanks to its reinforcement. A nerve 11 may have one connection thin wall 13 at most. In a particular embodiment, the minimum thickness of the connection thin wall 13 is of 15 cm and the minimum edgewise is of 15 cm, measured from the plane of the bottom concrete wall 12. The longitudinal nerves 11 receive or hold the connection thin walls 13 between other longitudinal and transversal walls or modules to be connected. In the embodiment shown in figures 1 and 2, the connection thin wall 13 is disposed at the side of the concrete wall 12 opposite to the side of the wall 12 having the recesses 31, 32. In alternative embodiments, not shown, the connection thin wall 13 may be disposed at the front side of the concrete wall 12, provided the nerve 11 has no transversal supporting means 15.

[0036] The module 10, 20 also comprises engagement means 17 for mechanical connection with another module disposed above or below. Preferably, there is a first plurality of engagement means 17 disposed at the upper side of the concrete wall 12 and a second plurality of engagement means 17 disposed at the lower side of the concrete wall 12. The upper engagement means 17 are used to connect the module 10, 20 with another similar module disposed above or on this module, while the lower engagement means 17 are used to connect the module 10, 20 with another similar module disposed below or under this one. Each plurality of engagement means 17 preferably form a row. The engagement means 17 comprised in a row are preferably symmetrically disposed in the row. In the embodiment disclosed in figures 1 to 3, each engagement means 17 is implemented by means of a registration box 171, a passing cylinder 172 and a threaded rod 173 that passes through the passing cylinder 172. As clearly shown in figure 3, a first end of the threated rod 173 remains within the registration box 171 and a second end of the threated rod 173, opposite to the first one, extends from the edge of the wall, in order to pass through a corresponding passing cylinder 172 of another engagement means 17 of another module 10, 20 to be connected to this module 10, 20. The registration box 171 preferably comprises a plate, such as a steel plate, disposed at the side of the box 171 closer to the edge of the module (either the upper edge or the lower edge, as the case may be). The plate is drilled in such a way that the passing cylinder 172 is made.

[0037] The module 10, 20 may also comprise longitudinal supporting means 14 mounted, made or disposed upon a longitudinal nerve 11. In particular, longitudinal supporting means 14 are cantilevers. They transmit vertical and horizontal efforts from the construction to the module 10, 20. As already mentioned, the longitudinal supporting means 14 project or extend from the outer nerves 11 in the same plane of the wall 12. In other words, the term "longitudinal" refers to the background wall 12. Longitudinal supporting means 14 are used to hold beams longitudinal to the wall 12, in a same plane. The mission of supporting means 14 is to support the beams on which the slabs gravitate and to transmit the vertical and horizontal efforts arising from those structures. In order to horizontally position and hold the beams on the longitudinal supporting means 14, elements such as bolts, buttresses or pins may be used, designed as convexity in order to fit in appropriate concave openings made for this purpose in the beams, preferably well surrounded by reinforced concrete in order to transmit the efforts.

[0038] The module 10, 20 may also comprise transversal supporting means 15 mounted, made or disposed upon the longitudinal nerves 11. In particular, the transversal supporting means 15 are cantilevers. They transmit vertical and horizontal efforts from the construction to the module 10, 20. The transversal supporting means

15 project or extend from the outer nerves 11 outside the plane of the wall 12. In other words, the term "transversal" refers to the background wall 12. Transversal supporting means 15 are used to hold beams transversal to the wall 12. Like the longitudinal supporting means 14, the mission of supporting means 15 is to support the beams on which the forged structures gravitate and to transmit the vertical and horizontal efforts arising from those structures. Besides, in order to horizontally position and hold the beams on the transversal supporting means 15, elements such as bolts, buttresses or pins may be used, designed as convexity in order to fit in appropriate concave openings made for this purpose in the beams, preferably well surrounded by reinforced concrete in order to transmit the efforts.

[0039] As already mentioned, the longitudinal nerves 11 hold the connection thin-walls 13 between longitudinal and transversal walls or modules, the longitudinal supporting means 14 and the transversal supporting means 15.

[0040] The height of a module 10, 20 is the same as the height between two slabs or storeys of the building to be built (normally between 2 and 4 m, preferably between 2.5 and 3.5 m).

[0041] The module 10, 20 also comprises at least one building service installation element preinstalled upon the concrete wall 12 of the module, in at least one recess 31, 32 practiced along the entire height of the main block forming the module 10, 20. Examples of building service installation elements are water, gas, electricity or telecommunications elements. Depending on the requirements of the building to be built, the module 10, 20 may include one or more of these preinstalled elements. In figure 1, a gas-service installation element 191 has been preinstalled in recess 31, while an electricity-service installation element 192 has been preinstalled in recess 32 of the precast module 10. In particular, a precast module 10 may have the four mentioned installation elements (water, gas, electricity or telecommunications) preinstalled in one or more recesses. In particular embodiments of the invention, not shown, the module may additionally have one or more recesses disposed at the other side of the concrete wall 12 for preinstalling service elements. Each building service installation element comprises at least one free end for connecting said building service installation element with another building service installation element preinstalled on another module 10, 20.

[0042] In a preferred embodiment, in which the module 10, 20 comprises or foresees more than one preinstalled building service installation elements 191 192, a thin wall of compartmentalization 16 is included. This thin wall 16 has the function of separating and compartmentalizing the holes or recesses 31 32 for the passage of the different services 191 192. For example, when there is one thin wall of compartmentalization 16, as illustrated in figure 1, one of the service elements 191 runs along the recess 31 delimited between the thin wall 16 and a first longitudinal nerve 11 disposed at one end of the module 10, and the other service element 192 runs along the recess 31 delimited between the thin wall 16 and a second longitudinal nerve 11 disposed at the other end of the module 10. Preferably, a single service is preinstalled within a recess. For example, if four services are preinstalled, the module may preferably have four recesses and there may preferably be three thin walls 16 separating neighbor recesses. Thus, there may be more than one thin wall of compartmentalization 16. The one or more thin walls of compartmentalization 16 are connected to the background wall 12, projecting from the background wall 12 as much as the longitudinal nerves 11. The thin walls 16 are embedded on the background wall 12. They are made from the same concrete part from which the background wall 12 is made. In particular embodiments of the invention, not shown, the module may additionally have one or more thin walls of compartmentalization disposed at the other side of the concrete wall 12 for preinstalling service elements.

[0043] In a preferred embodiment, in which the module 10, 20 may be intended to be connected to other modules horizontally, that is to say, by arranging and connecting another module along one of the outer longitudinal nerves 11, transversal engagement means 18 are used. They are placed in the connection thin wall 13, along its height, and provide mechanical connection with another module disposed next (at a same height as the module 10, 20). Preferably, there is a plurality of engagement means 18 disposed at the connection thin wall 13. This plurality of engagement means 18 preferably forms a column. The engagement means 18 comprised in the column may be symmetrically disposed in the column. In a particular embodiment, as shown in figure 3, each transversal engagement means 18 is implemented by means of a passing cylinder and an elongated element that passes through the passing cylinder. As clearly shown in figure 3, a first end of the elongated element projects from the end of the connection thin wall 13 further to the edge of the module 10, 20, and a portion of the elongated element including the end thereof opposite to the first end, extends from the end of the connection thin wall 13 closest to the edge of the module 10, 20. This portion of elongated element is intended to pass through a passing cylinder of another module to which this module 10, 20 is going to be connected. The elongated element may be implemented, for example, in the form of a bolt, pin or screwed rod, the two ends being fixed to the corresponding modules by means of, for example, nuts or washers.

[0044] Next, a particular embodiment is described, in which the pre-installation of a gas service according to a possible implementation is explained. Figure 1 shows, at the left of the thin wall of compartmentalization 16, the passage with pre-installation of a gas service, between the left-hand nerve 11 and the thin wall of compartmentalization 16. When a module is connected/ disposed above the one shown in figure 1 and another module is connected/ disposed below this one, a substantially

straight technical conduit or passage is formed along the height of the building to be built. This conduit or passage centralizes, in each building floor, the gas meters for each home. Also in each floor, there are connections between gas pipes in each home and the vertical main pipe disposed along the passage. This passage is exclusively reserved for gas installation. The passage comprises ventilation means at the lower and upper ends of the module. The technical conduit or passage comprises, at each floor, a door for accessing the conduit for inspection.

[0045] Figure 4 shows in detail the pre-installation of a gas service according to a possible implementation. It comprises a lower connection 41, which is the point of attachment or connection to an upper connection of a similar module disposed below this one, or to the external supply if this module is the first one (lowest one in the building to be built). It also comprises a main pipe 42. It may be made of copper, steel, stainless steel, plumb, or any other suitable material for keeping gas within it, including non-metallic materials for making flexible pipes. The main pipe 42 connects the lower connection 41 to the upper connection 43. Secondary pipes 44 start from the main pipe 42. They made be made to same materials as the main pipe 42. The secondary pipes 44 open branches in parallel, which start in the main pipe 42. Besides, meters 45 are connected between a secondary pipe 44 and the connection box 46. Meters 45 serve for reading consumption of each of the homes. Connection box 46 may be a proper box or simply a grip on the bottom wall. In any case, the output of each meter 45 is taken to this connection box 46. These outputs will in turn be taken to the homes. The upper connection 43 is the point of attachment or connection to a lower connection 41 of another module. Finally, there is also a stopcock 47. Its mission is to allow or prevent the movement of gas from the main pipe 42, thus allowing for appropriate safe handling and maintenance of the installation, avoiding leaks.

[0046] Next, a particular embodiment is described, in which the pre-installation of a water service according to a possible implementation is explained. This pre-installation may be disposed on the background wall 12 of a module, either between a nerve 11 and the thin wall of compartmentalization 16 or between two nerves 11 as shown in figure 2. A possible implementation of the pre-installation of a water service 193 is shown in figure 5 (left side). When a module is connected/ disposed above the one shown in figure 1 and another module is connected/ disposed below this one, a substantially straight main technical conduit or passage is formed along the height of the building to be built. This conduit or passage centralizes, in each building floor, the water meters for each home. Also in each floor, there are connections between water pipes in each home and the vertical main pipe disposed along the passage. Each main passage in a building (normally one per floor) is accessible from a door. It is exclusively reserved for water service installation. Figures 5 and 6 show in detail the pre-installation of a water service 193 in a shaft according to a possible implementation. It comprises a rising pipe 61. In the particular case in which the module is the lowest module (in a wall formed by several modules), the rising pipe 61 has at its base a check valve, a stopcock for maintenance, and a stopcock with tap or drain cap, located in areas easily accessible and conveniently identified. In the particular case in which the module is the upper module (in a wall formed by several modules), the rising pipe 61 has at least one purge device, either automatic or manual, with a separator or chamber that reduces water velocity, facilitating air outlet. The pre-installation of a water service 193 also comprises divisional meters 62. They have means for sending signals for remote meter reading. After each meter 62 there is a valve. The pre-installation of a water service 193 also comprises a stopcock 63, placed before each divisional meter 62, for regulating the supply of water, allowing its interruption and its operation. The pre-installation 193 also has a sink drain 64 connected either to the building evacuation general network, or to an independent evacuation network. The pre-installation 193 also has a descending pipe 65, straight and vertical. It may collect water from the sink drain 64 through a secondary pipe. Apart from this feature, it is similar to the rising pipe 61 and has specific elements when it belongs to an upper or lowest module. The pre-installation 193 also has independent meters 66 disposed in branches starting from the divisional meter 62. They measure the volume of water that passes towards each home. There is one meter 66 per home. Finally, the pre-installation 193 has home branches 67, that are outputs of the divisional meter 62 that provide water to each home.

[0047] Next, a particular embodiment is described, in which the pre-installation of an electricity service according to a possible implementation is explained. Figure 1 shows, at the right of the thin wall of compartmentalization 16, the passage with pre-installation of an electricity service 192, between the right-hand nerve 11 and the thin wall of compartmentalization 16. This passage may alternatively be disposed between two nerves 11. When a module is connected/ disposed above the one shown in figure 1 and another module is connected/ disposed below this one, a substantially straight technical conduit or passage is formed along the height of the building to be built. This conduit or passage centralizes, in each building floor, the electricity meters for each home. Also in each floor, there are connection points for connecting horizontal distribution branches between the main vertical cable and the homes. This passage is exclusively reserved for electricity installation. The technical conduit or passage comprises, at each floor, a door for accessing the conduit for inspection.

[0048] Figure 7 shows in detail the pre-installation of an electricity service 192 according to a possible implementation of the invention. It comprises a main switch 71 for connection and disconnection of electricity in the floor (but not the electricity in the main pipe or cable 76) in order to perform maintenance, inspection, etc. It is disposed immediately after the exit of the secondary register

78 and before the general busbar and safety fuses 72. The general busbar and safety fuses 72 are the point of interconnection of the four cables (three phases and neutral cable), from the secondary register 78, with the measuring unit 73. Safety fuses allow disconnection for safety reasons in case of short circuit. The measuring unit 73 is the box that houses individual meters for each home to which electricity is supplied. Two cables (one phase and a neutral cable) reach each meter and then leave the meter towards the protection busbar and output terminals 74. The protection busbar and output terminals 74 are the points of interconnection of each cable coming from an individual meter within the measuring unit, and the corresponding ground line 77, with supply branches to each of the homes which are connected to the output terminals. The pre-installation of an electricity service 192 also comprises a connecting pipe 75, which is a pipe for carrying cables within it. It allows passage of the cables from the main network along different modules vertically disposed one above another. It also comprises a main line 76, comprising a set of wires that forms the vertical line of the building. This main line 76 comprises three phases cables, a neutral cable and a ground line. The secondary register 78 is a connection box from which branches for a floor are taken out of the main line 76. There is also a ground line 77 outside the main line 76. Finally, there are register passages 79 which are hollows for the passage of the cables from the main line 76 coming from a lower module. They permit their insertion into the secondary register 78.

[0049] Next, a particular embodiment is described, in which the pre-installation of telecommunications services according to a possible implementation is explained. This pre-installation may be disposed on the background wall 12 of a module, either between a nerve 11 and the thin wall of compartmentalization 16 or between two nerves 11. A possible implementation of the pre-installation of telecommunications services 194 is shown in figure 8. When several modules are vertically connected/disposed one above another, a substantially straight main technical conduit or passage is formed along the height of the building to be built. In each floor, there are connection points for connecting horizontal distribution branches between the main vertical cable and the homes. This passage is exclusively reserved for telecommunications installation. The technical conduit or passage comprises, at each floor, a door for accessing the conduit for inspection.

[0050] The pre-installation of telecommunications services 194 comprises a secondary register 81 which keeps and store cables and their connections or splices. Several pipes, called service vertical pipes, leave the secondary register 81 upwards and downwards. Also, several horizontal branching pipes leave the secondary register 81 to the homes. For example, among the service vertical pipes, there are a Radio Broadcasting Television pipe 82, telephony pipes 84, optical fiber pipe 88 and spare pipes 90 (for possible future services). Each of these pipes carries the required, conventional cables, which are out of the scope of the present invention. And among horizontal branching pipes, there are a Radio Broadcasting Television pipe 83, a telephony pipe 85, pipe for broadband telecommunications services 87 and optical fiber pipe 89.

[0051] We now describe several possible configurations of the assembly of more than one module 10, 20 as explained and depicted in figures 1, 2 and 3. These modules can be assembled in several ways, depending on the structural mission they are intended to perform, depending on their contribution to horizontal stability forming a shearing wall (as illustrated in figure 9) or a rigid core (as illustrated in figures 10 and 11).

[0052] Figure 9 shows a shearing wall assembly 90 formed by a plurality of precast modules 10, 20 disposed vertically. In this configuration, the modules can be attached successively placing the last module upon the top of the previous one and executing the connection by a dry joint. Every module should be of the same height as the height between storeys of the building to be built. The connection between modules is then done by means of connecting means, such as a plurality of threaded rods, bolts or any other suitable connecting means, and each tightened with tightening means, such as a nut and washer set at each end. In a preferred embodiment, the washer is supported by a drilled steel plate inside the registration box 171 (as depicted for example in figure 3), in such a way that two consecutive modules become pre-stressed one against the other. The cantilevers 14, 15 are the support for beams and slabs resting upon it, in terms of vertical loads. The horizontal forces parallel to the resulting shearing wall are trasferred by these beams resting upon longitudinal cantilevers 14. Longitudinal cantilevers 14 are preferably placed at sufficient distance from the top and the bottom of the module 10, 20. The horizontal forces transmitted by the longitudinal cantilevers 14 are resisted by a falling strut that wears the force to a bottom tie, in which the force is shared with the module beneath by friction and by the plurality of threaded rods working by shear.

[0053] Figure 10 shows a rigid core assembly 100 formed by three precast modules 101, 102 and 103, disposed perpendicularly defining a cavity. The three modules forming the assembly may be: three modules 10, 20 like the ones described with reference to figures 1-3 (two of them being disposed in parallel, joined together by the third one, which is perpendicular to both of them); two modules 10, 20 disposed in parallel, joined together by an auxiliary module perpendicular to both of them (this is the configuration shown in figure 10); one module 10 and two auxiliary modules 103, wherein two of them are disposed in parallel and the third one, disposed perpendicularly to them, joins them together. Preferably, the auxiliary module is a conventional wall comprising dry connections. This cavity may house, for example, a lift or the stairs or any other element of the building to be built. Several assemblies 100 may be disposed one on

top of another one, until the desired cavity of the building is built in height (vertically, in order to cover several floors or storeys). This is done in a similar way as the one described in relation to figure 9. Two parallel shearing walls 101, 102 are elevated by disposing additional walls on top of them, as shown in figure 11. Each two parallel shearing walls 101 102 are separated by a distance D in order to generate the proper space for the lift, staircase, or whatever. However, for this execution there is a need for another auxiliary modular wall 103, used to connect these two 101, 102 in perpendicular at each storey, as shown in figure 11. This auxiliary wall 103 preferably has the thickness of the resulting space by the substraction of the connection thin-wall thickness from the nerve width and preferably has through-holes matching with the ones in the corresponding connection thin wall. The connection is then done by connecting means, such as steel threaded rods, with nuts and whashers, bolts or equivalent, keeping it as simple as possible. With this assembly, the horizontal forces parallel to the two modules are resisted as mentioned above for shearing walls, the horizontal forces perpendicular to them are resisted in the same way, but by the auxiliary modular wall, the bending moment is resisted by the torque pair induced by the compression of one module and the traction of the other, by porticoe effect. The shearing efforts in the connections between the modules and the auxiliary shearing walls are resisted by bolt shear. The connections between consecutive auxiliary walls in vertical are done and work by the same principles exposed for equivalent ones in modules.

[0054] In conclusion, the proposed construction precast module having pre-installed building service installation elements (water, electricity, gas and telecommunications services) enables that the internal distribution network of these services be disposed within the construction module itself, thus requiring a minimum number of on-site operations for its actual execution.

[0055] On the other hand, the invention is obviously not limited to the specific embodiment(s) described herein, but also encompasses any variations that may be considered by any person skilled in the art (for example, as regards the choice of materials, dimensions, components, configuration, etc.), within the general scope of the invention as defined in the claims.

Claims

1. A precast reinforced concrete module (10, 20) comprising:

   - a concrete wall (12),
   - at least two longitudinal nerves (11), wherein a first nerve of said at least two longitudinal nerves is disposed at an end of said concrete wall (12) and a second nerve of said at least two longitudinal nerves is disposed at the opposite end of said concrete wall (12), said concrete wall (12) extending between said first and second nerves, said at least two longitudinal nerves (11) being configured for supporting vertical and horizontal efforts;
   - engagement means (17; 171, 172, 173) for mechanical connection with another module (10, 20) forming a vertical wall;
   - supporting means (14, 15) mounted on said longitudinal nerves (11);

   the module (10, 20) being **characterized in that** it further comprises at least one building service installation element (191, 192, 193, 194) preinstalled on said concrete wall (12) in at least one recess (31, 32) made along said concrete wall (12), said at least one building service installation element (191, 192, 193, 194) comprising at least one free end for connecting said building service installation element with another building service installation element (191, 192, 193, 194) preinstalled on another module (10, 20).

2. The module (10, 20) of claim 1, further comprising a thin wall of compartmentalization (16) disposed along the height of said concrete wall (12), parallel to said longitudinal nerves (11), configured to define at least two recesses (31, 32) for the passage of at least two building service installation element (191, 192, 193, 194).

3. The module (10, 20) of any preceding claims, wherein at least one of said supporting means (14, 15) mounted on said longitudinal nerves (11) is a longitudinal cantilever (14) mounted on said longitudinal nerves (11) for transmitting vertical and horizontal efforts.

4. The module (10, 20) of any preceding claims, wherein at least one of said supporting means (14, 15) mounted on said longitudinal nerves (11) is a transversal cantilever (15) mounted on said longitudinal nerves (11) for transmitting vertical and horizontal efforts.

5. The module (10, 20) of any preceding claims, further comprising at least one connection thin wall (13) disposed as a prolongation of a longitudinal nerve (11), said at least one connection thin wall (13) being configured for connecting the module (10, 20) with a another one in such a way that they are perpendicular to each other.

6. The module (10, 20) of claim 5, further comprising transversal engagement means (18) disposed in said at least one connection thin wall (13).

7. The module (10, 20) of claim 6, wherein said transversal engagement means (18) comprise a passing

cylinder and an elongated element that passes through the passing cylinder.

8. The module (10, 20) of any preceding claims, wherein said engagement means (17; 171, 172, 173) for mechanical connection with another module (10, 20) forming a vertical wall comprise a registration box (171), a passing cylinder (172) and a threaded rod (173) that passes through the passing cylinder (172).

9. The module (10, 20) of any preceding claims, wherein said at least one building service installation element (191, 192, 193, 194) is an element for the installation of a gas service, or an electricity service, or a water service or a telecommunications service.

10. A construction wall comprising at least two modules (10, 20) disposed longitudinally according to any of the preceding claims, wherein said at least two modules (10, 20) are disposed vertically (90) with respect to each other.

11. A rigid core assembly (100) comprising three modules (101, 102, 103), wherein at least one of said three modules is a module according to any of the claims 1-9, wherein two of said modules (101, 102) are disposed parallel to each other, at the same height, separated by a distance (D), while a third module (103) connects said two modules (101, 102), said third module (103) being disposed perpendicular to said two modules (101, 102).

12. The assembly according to claim 11, wherein said three modules are modules according to any of the claims 1-9, or wherein two of said three modules are modules according to any of the claims 1-9 and the other module is an auxiliary module, or wherein one of said three modules is a module according to any of the claims 1-9 and the other two modules are auxiliary modules.

13. An assembly formed by a plurality of rigid core assemblies (100) according to any of the claims 11-12, wherein said plurality of rigid core assemblies (100) are disposed vertically in height.

14. Use of a module according to any of the claims 1-9 in the construction of a building.

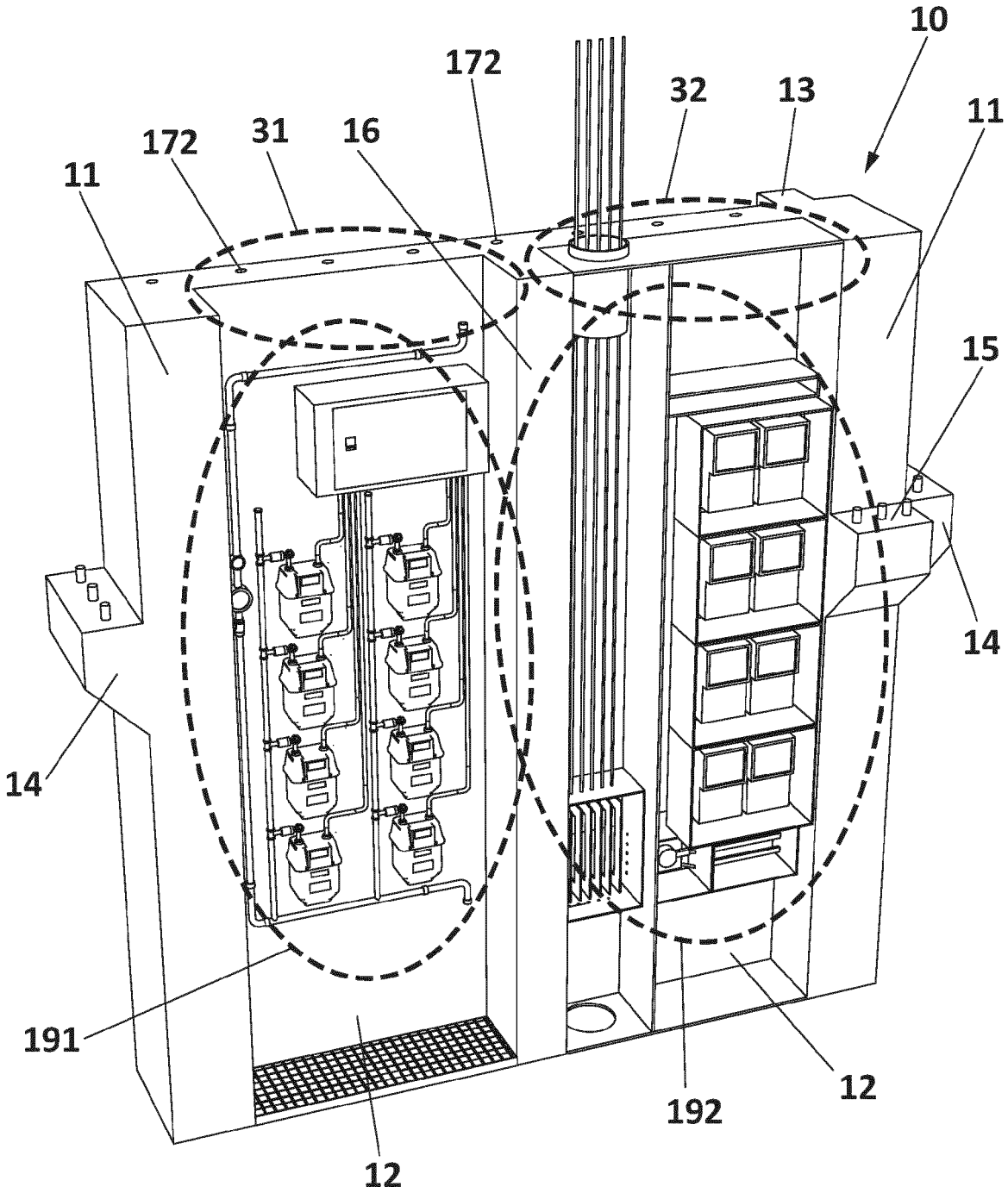

FIG. 1

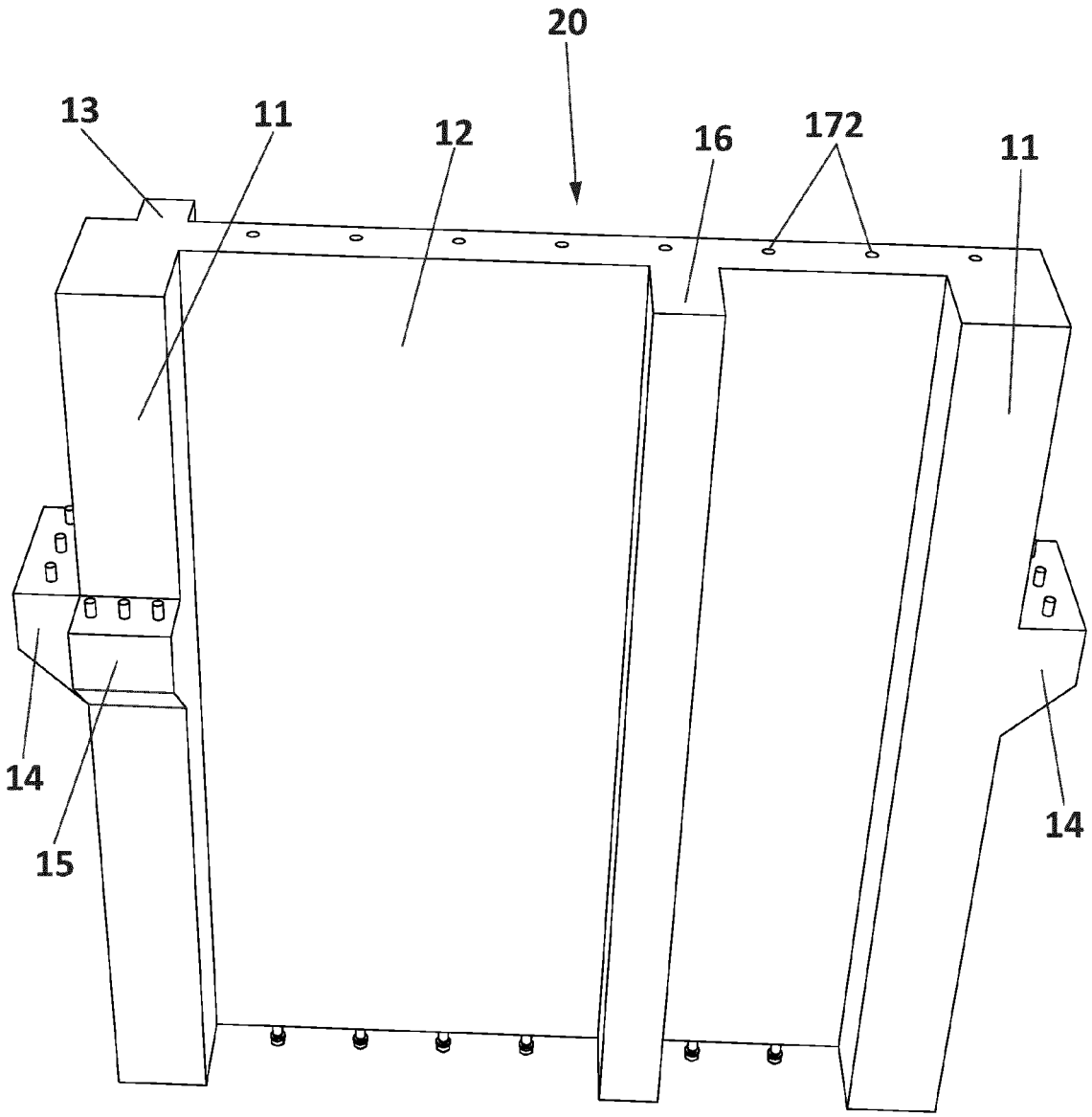

FIG. 2

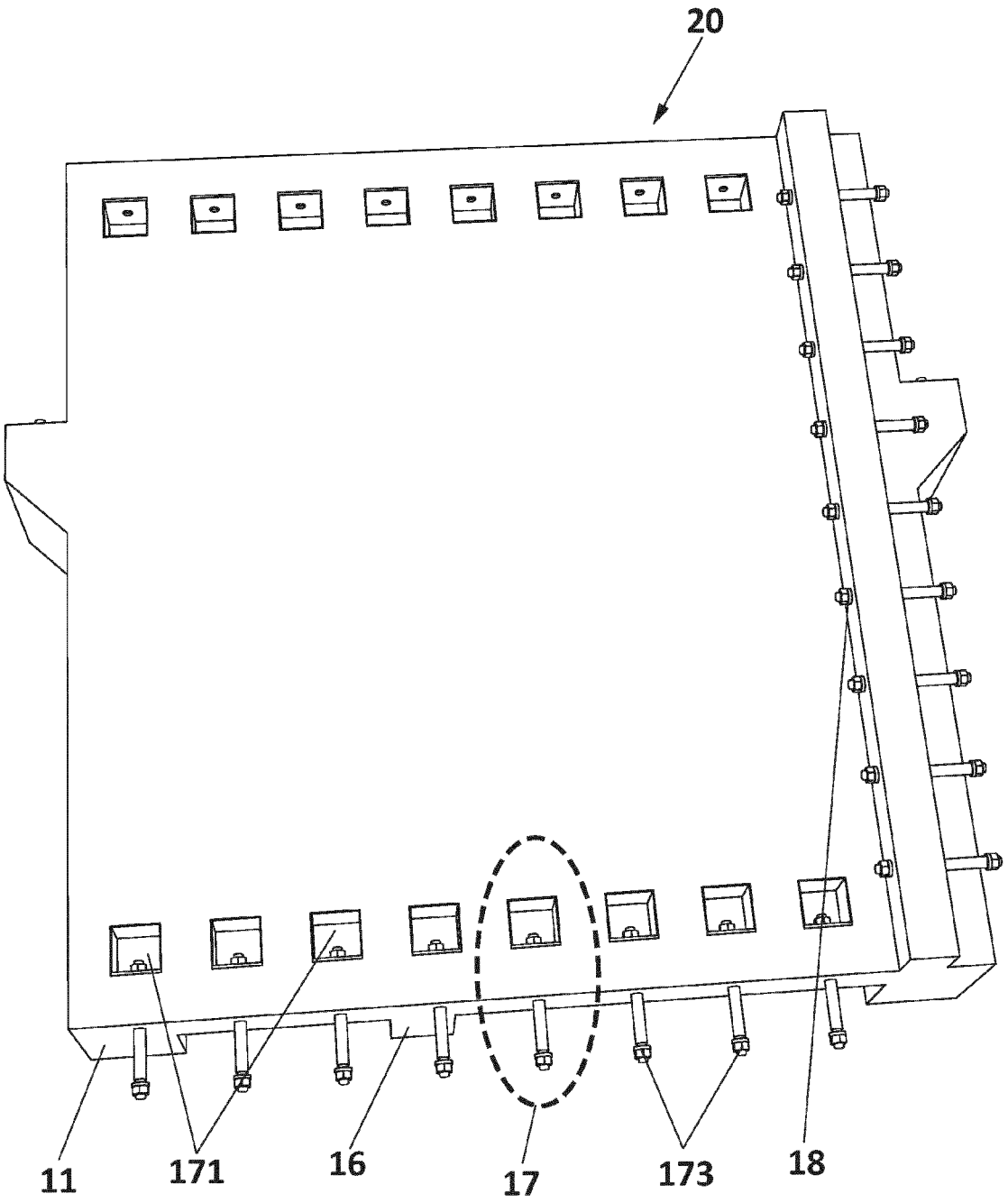

FIG. 3

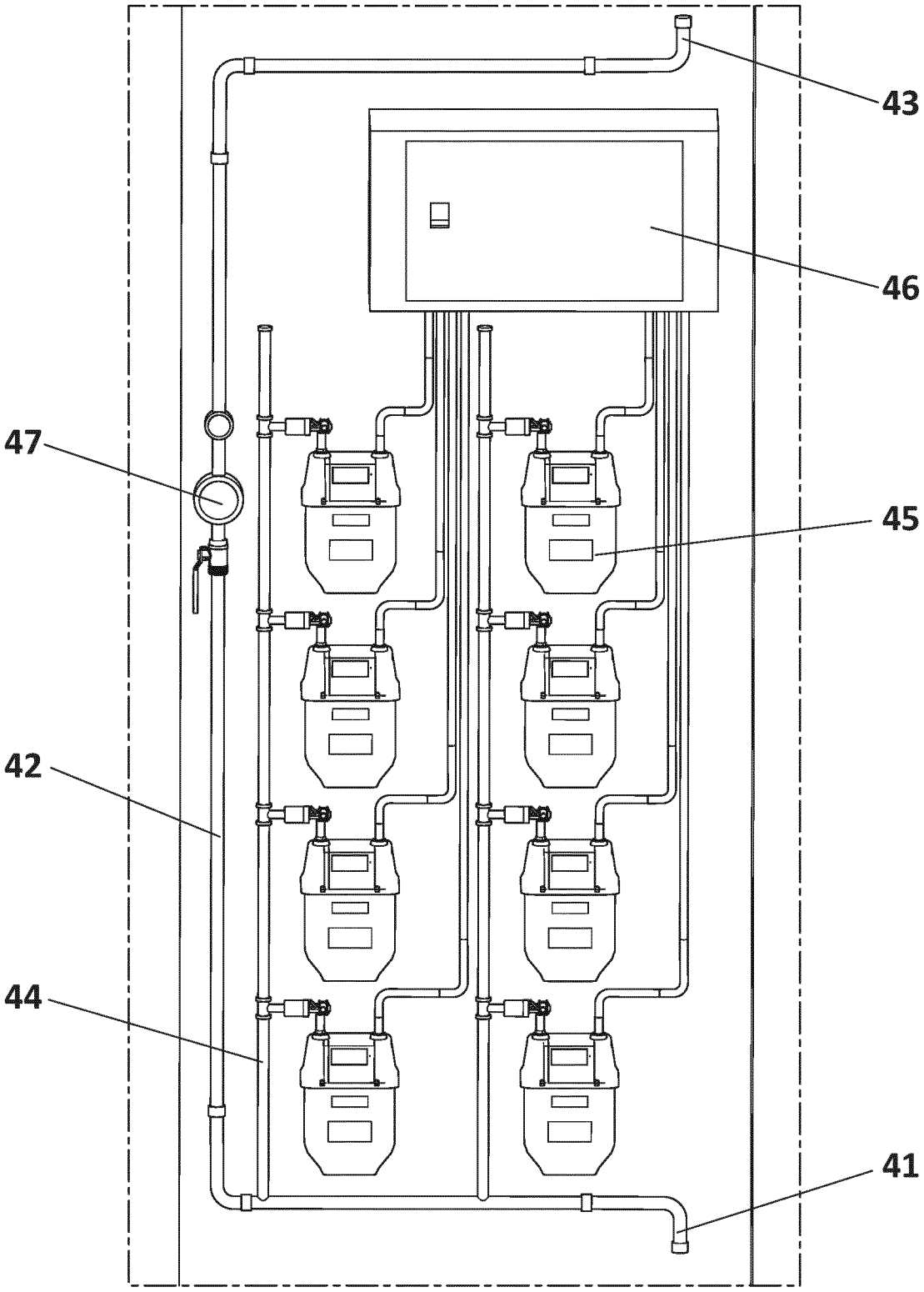

FIG. 4

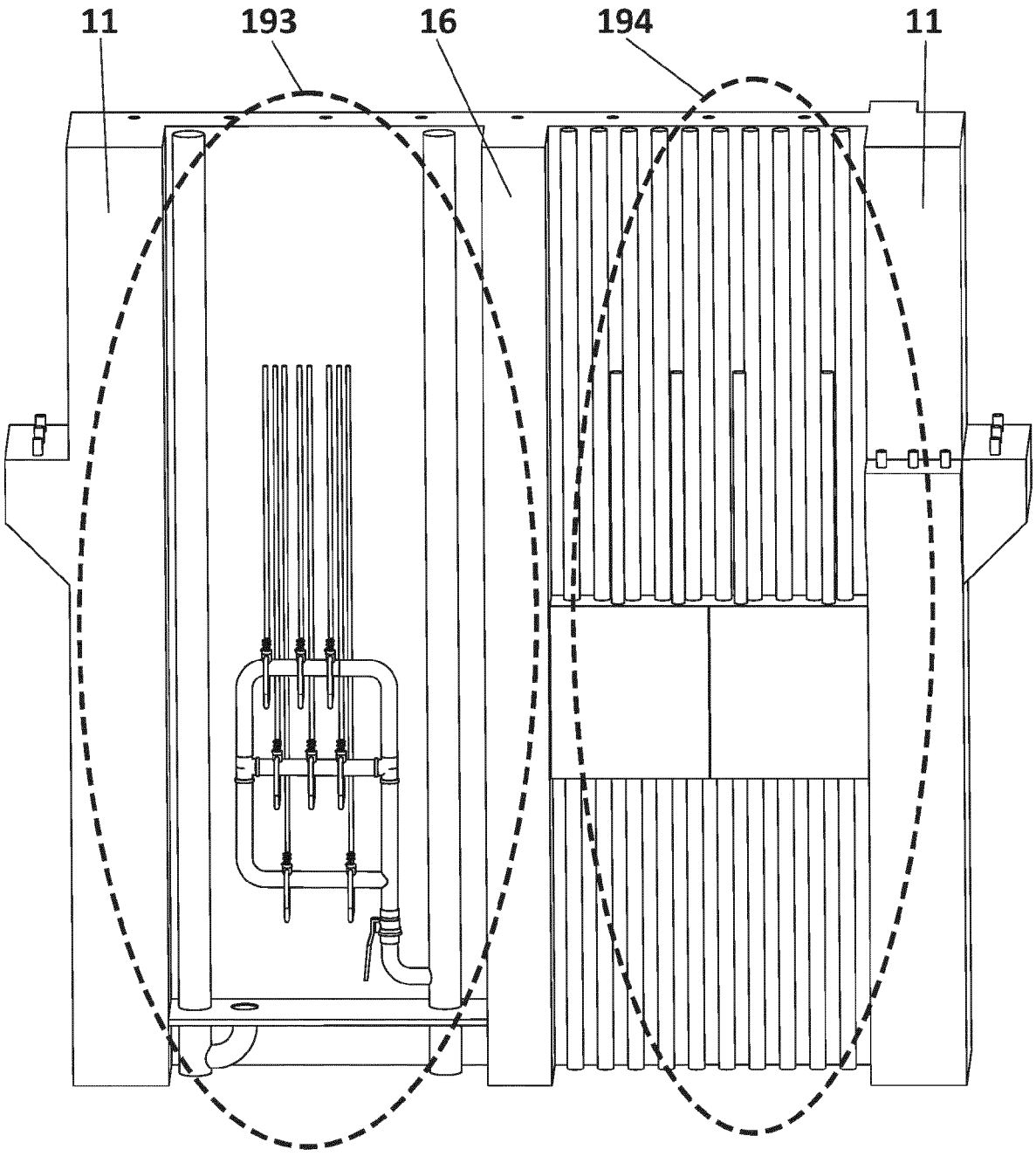

FIG. 5

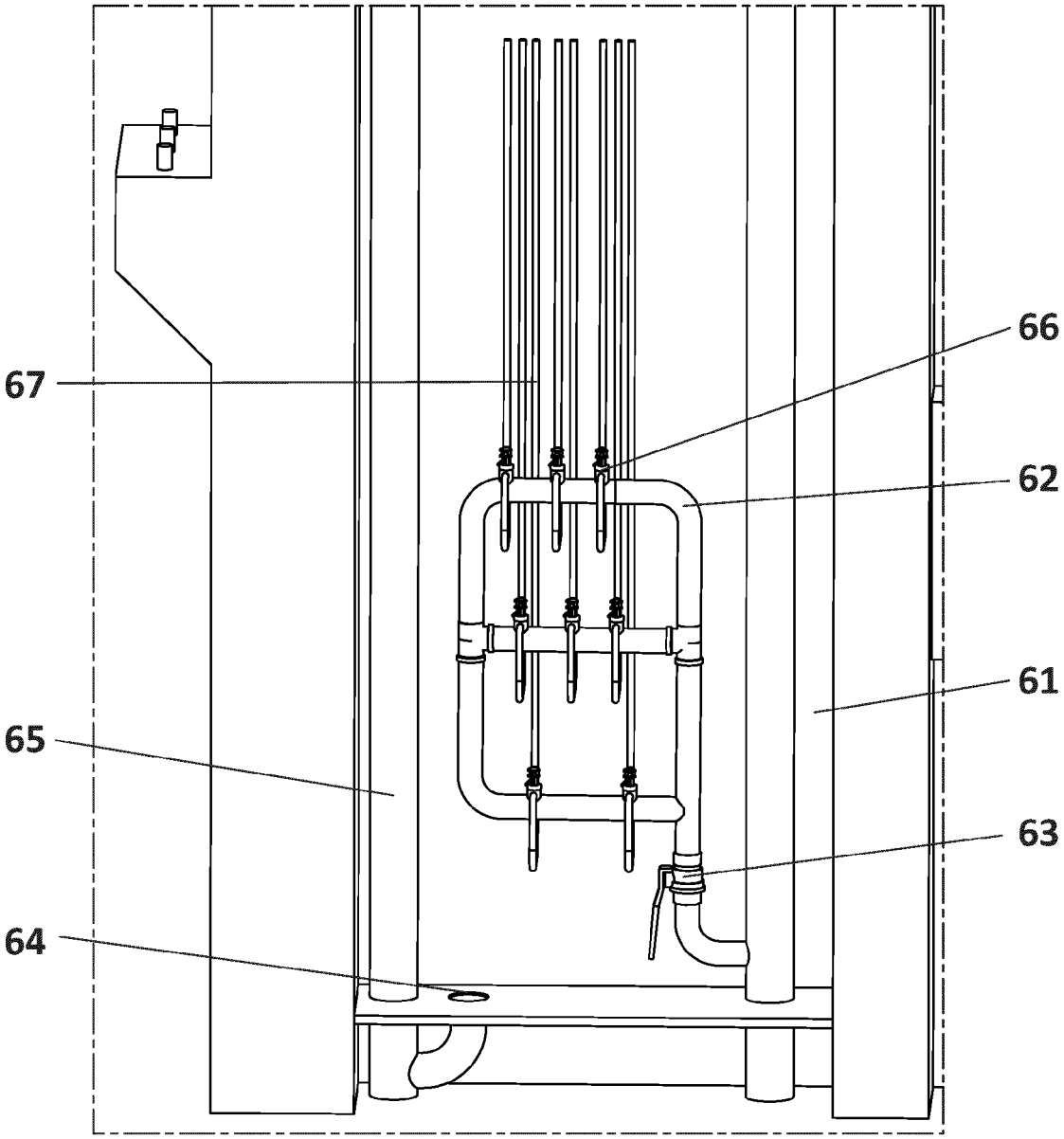

FIG. 6

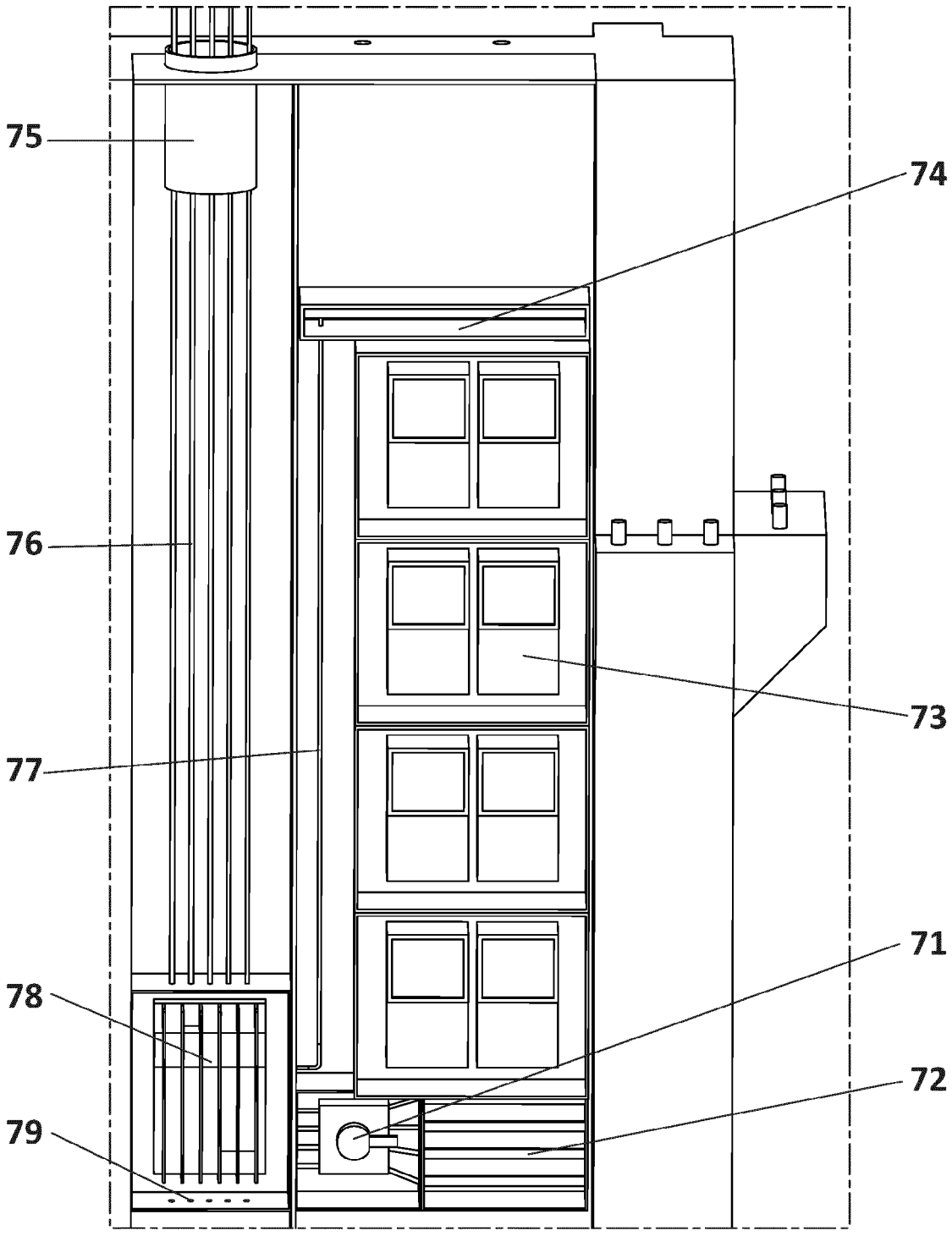

FIG. 7

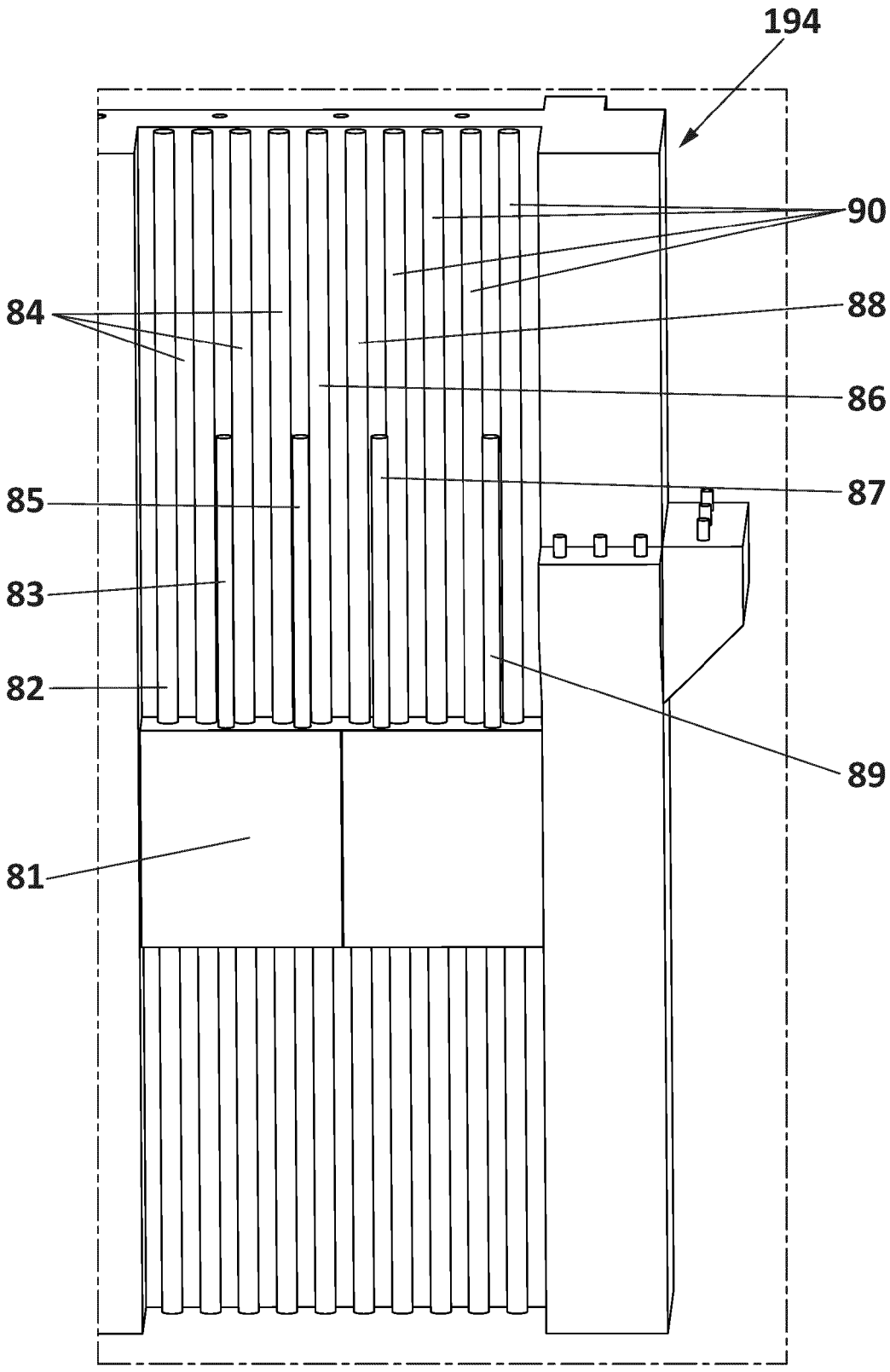

FIG. 8

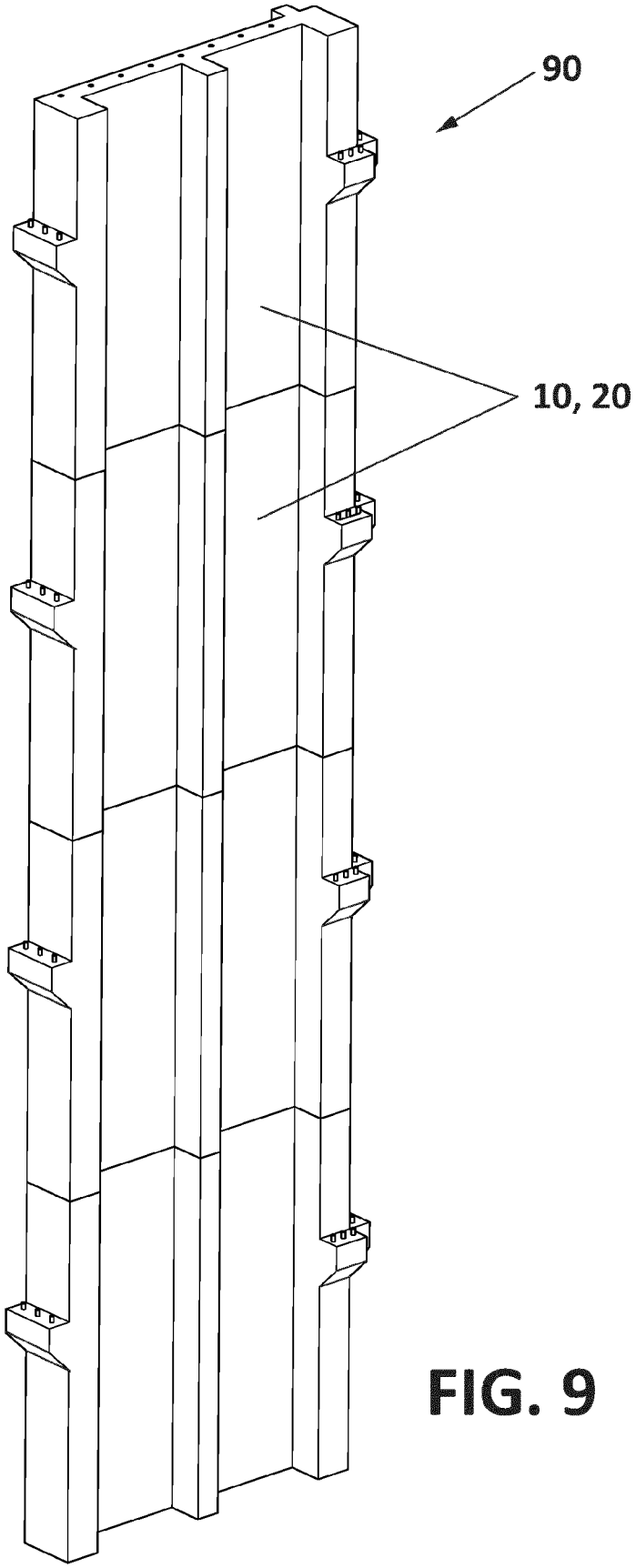

FIG. 9

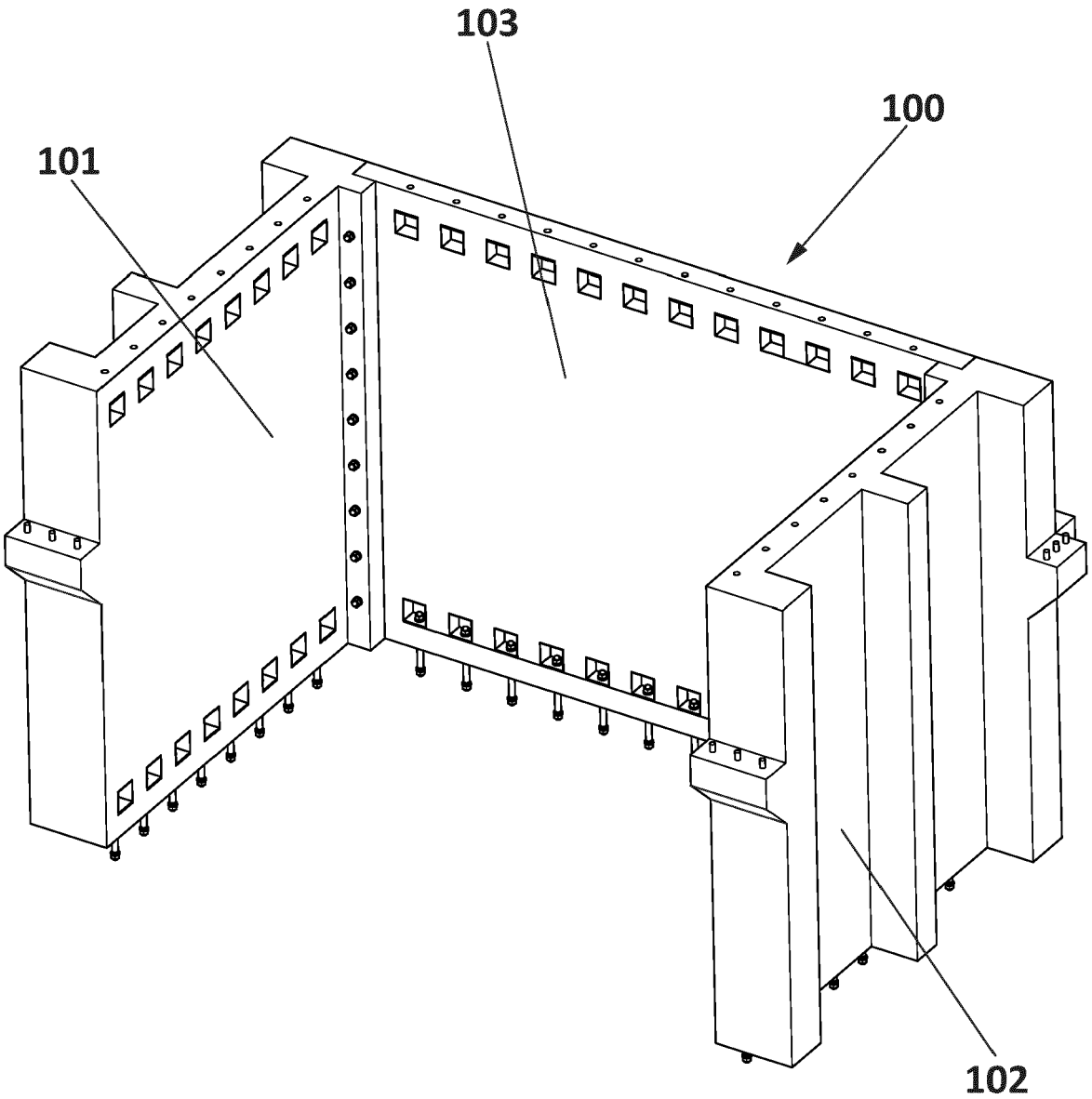

FIG. 10

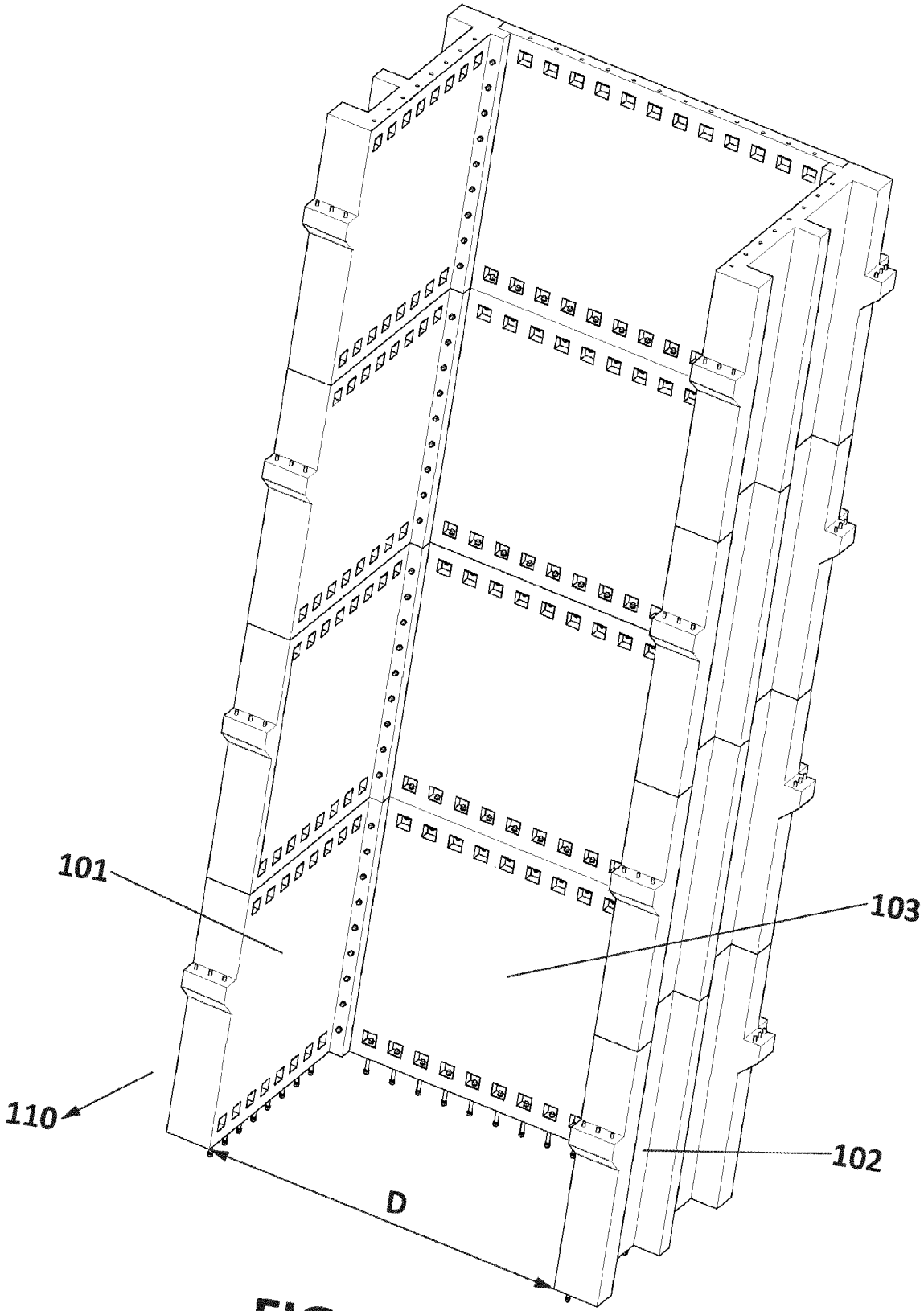

FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 16 38 2393

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 October 2016	López-García, G

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