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(54) **Modular unit**

(57) A modular unit comprises a floor slab (10) and walls (12a, 12b, 12c, 12d) having a first surface and a second surface. The first surfaces define a first room space, which has first fixed equipment and/or furniture for the use of the first room space. The second surface of at least one wall has second fixed equipment and/or furniture for the use of the second room space which is outside the modular unit and doesn't belong to the modular unit. The floor slab has fixing elements for attachment to the edges of the opening in the intermediate floor or the base floor of the building and the floor slab is dimensioned to bear the loads directed to the modular unit when supported by the fixing elements. A part of the floor slab can extend outside the area defined by the second surfaces of the walls, and this part of the floor slab can have second fixed equipment and/or furniture. The first room space can be a bathroom, in which case the fixed equipment and/or furniture of the room space comprise thus at least a part of the typical equipment of the bathroom.

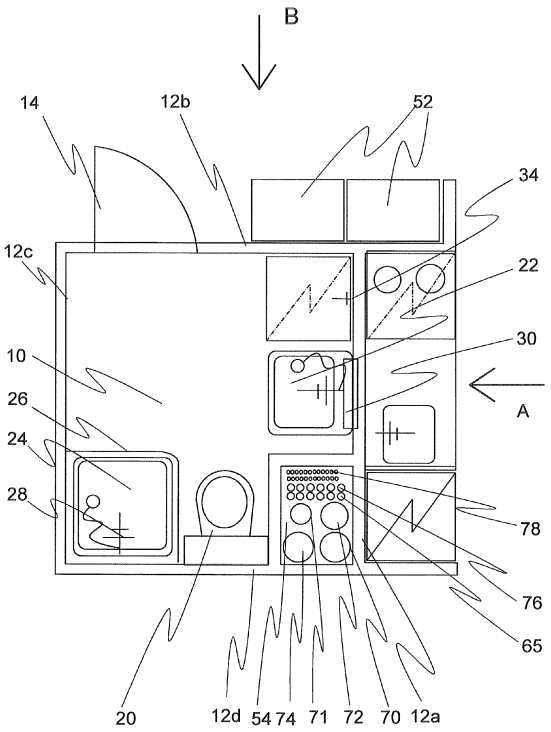


Fig. 1

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## Description

**[0001]** The invention relates to a modular unit, which comprises a floor slab and walls, which walls have a first surface and a second surface, the first surfaces of which walls define the first room space, which first room space has first fixed equipment and/or furniture for use of the first room space and the second surface of at least one wall has second fixed equipment and/or furniture for use of the second room space which is outside of the modular unit and does not belong to the modular unit.

**[0002]** The concentration of the population in cities and growth centres creates the demand to build new apartments of blocks of flats. The constant price increase of new apartments has led to the situation, in which many of those in need of apartments can't afford their own apartment. The rise of the construction costs also inevitably leads to the rise of the rent level, which also makes it harder to get a rental apartment for a reasonable price. There is thus a clear need for solutions reducing the construction costs of the blocks of flats.

**[0003]** One known way for reducing the construction costs is to increase the use of prefabricated structural elements, i.e. prefabricated units. The prefabricated structural elements can be manufactured in plant conditions faster and more efficiently than on the construction site, whereby the construction time shortens bringing savings to the construction costs. Typically, the use of prefabricated structural elements in the construction of blocks of flats is limited to the frameworks and outer walls of the building. Such previously known prefabricated structural elements are among others hollow-core slabs, step-ladder elements, partition wall elements and facade elements. The degree of prefabrication can be increased by using so-called modular units, i.e. entire ready room spaces, which are built in the element factory and installed in their places in the building at the construction site. In the blocks of flats modular units have been traditionally used mainly in sanitary cabins as so-called standard sanitary units.

**[0004]** Publication US 2010/0058675 describes a furnished modular unit, which comprises a floor slab and walls defining the room space. The modular unit is installed in its place in the frame of the building, so that the floor slab sets on the upper surface of the frame beams. Publications WO 2010/018267 and CN102068123 describe a furnished modular unit having a floor, walls and a ceiling. The modular units are designed to be installed on the load-bearing floor.

**[0005]** The object of the invention is to provide a modular unit, with which the prefabrication degree of buildings, especially apartments in block of flats, can be remarkably increased.

**[0006]** The objects of the invention are obtained with a modular unit, which is characterized by what is presented in the independent claim. Some advantageous embodiments of the invention are presented in the dependent claims.

**[0007]** The modular unit according to the invention comprises a floor slab and walls, which have a first surface and a second surface. The first surfaces of the walls define a first room space, which has first fixed equipment and/or furniture for the use of the first room space. The walls of the modular unit correspond in their structure and thermal and sound insulation properties to the partition walls of the buildings, i.e. the walls between different rooms of an apartment. The modular unit according to the invention is designed to be used inside the area defined by the outer walls of the residential building, whereby each wall of the modular unit is limited to the interior of the building. In the modular unit according to the invention the walls typically define only one room space inside them. The second surface of at least one wall has second fixed equipment and/or furniture for the use of a second room space which is outside the modular unit and does not belong to the modular unit. The floor slab has fixing elements for attachment to the edges of the opening in the intermediate floor or the base floor of the building and the floor slab is dimensioned to bear the loadings directed to the modular unit when supported from its edges. Thus, the modular unit does not need to be installed on the load-bearing slab, but it can be suspended from the edges of the floor slab to the load-bearing structures of the building.

**[0008]** The modular unit is designed to be installed to the building in a stage, when the base floor or intermediate floor forming the floor of the room space is already ready built at least in its load-bearing parts and the base floor has an opening in the intermediate floor, to which opening the modular unit is fitted. The modular unit is fitted to the opening, so that the upper surface of the floor element sets substantially to the same level as the final upper surface of the intermediate floor or the base floor surrounding the modular unit. The fixing elements in the floor slab are preferably arranged inside the area defined by the outer edges of the floor slab, in which case they do not increase the outer dimensions of the floor slab. Thus, it is not necessary to take the fixing brackets into account in the dimensions of the intermediate floor, but the opening can be dimensioned based on the dimensions of the floor slab.

**[0009]** In a preferred embodiment of the modular unit according to the invention a part of said floor slab extends along the length of at least one wall outside the area defined by the second surfaces of said walls and said part of the floor slab has second fixed equipment and/or furniture for use of the second room space. Preferably the modular units have been designed and equipped so that one modular unit according to the invention is needed for one apartment of the residential building.

**[0010]** In another preferable embodiment of the modular unit according to the invention a part of the floor slab extends outside the second surface of a first wall, the length of which part is substantially the same or bigger than the length of the first wall. The length of the wall refers here to the extension of the wall on the surface

level of the floor slab, i.e. the distance between the first vertical edge and the second vertical edge of the wall. Thus, a part of the floor slab forms outside the modular unit, in the place of one wall, an extension slab having a length of the entire wall. Furthermore, preferably a part of said floor slab extends outside the second surface of a second wall, the length of which part is substantially the same or bigger than the length of the second wall. Thus, a part of the floor slab forms an extension slab outside the modular unit in the place of two walls.

**[0011]** In a third preferred embodiment of the modular unit according to the invention said first room space is a bathroom. The first equipment and/or furniture installed in a fixed manner to the room space comprise thus at least a part of the typical bathroom equipment, such as WC-seat, hand basin with accessories, shower wall or curtain, shower faucet, bathroom cabinet, floor drain and washing machine connections. The second equipment and/or furniture on the second surface of at least one wall are preferably fixed kitchen equipment and/or furniture. Such typical equipment that belong to every kitchen are among others kitchen cupboards, range hood, kitchen sink with accessories as well as connections for installing dish washer, stove and refrigeration equipment. Preferably household appliances, such as stove, range hood, dish washer and refrigeration equipment that belong to the kitchen equipment, are in the modular unit ready installed in the working condition, i.e. connected to pipes, drains, ventilation channel system and electrical network. The second equipment and/or furniture can also be fixed hall equipment and/or furniture, such as closets.

**[0012]** Yet another preferred embodiment of the modular unit according to the invention has at least one radiation heater for heating the room space outside the modular unit. The heating device can be an electrically operated heating device, such as an electric heater or preferably a water circulating radiator. Because of the tightened heat insulation requirements of the outer walls of residential buildings the heating energy requirement of new residential buildings is nowadays quite small. Because of the low heating requirement only a small number of heating devices is needed in one apartment and their total demand of power is low. Furthermore, the heating devices can be located in the apartment quite freely. Thus, especially in small apartments the heating of the entire apartment can be arranged by couple of heating devices placed in the modular unit according to the invention.

**[0013]** Yet another preferred embodiment of the modular unit according to the invention further comprises a ceiling. The modular unit is thus a room space having all its walls closed. Naturally, at least one wall has an opening door for getting into the room space. Preferably, the modular unit further comprises a shaft parallel to the normal of the floor passing through the floor slab and ceiling for lead-through of the pipes and cables. The pipes and cables to be placed in the shaft are among others air pipes, pipes for cold and warm service water, pipes for heating water, drainpipes, possible sprinkling pipes and electric cables. The pipes and cables can be ready installed in the channel. In this case, the pipes and cables are dimensioned so that their first ends extend to the level defined by the under surface of the floor slab and their second ends extend at least to the level defined by the upper surface of the ceiling. The ends of the pipes and cables can have a ready-fitted joint part for forming the connection.

**[0014]** An advantage of the modular unit according to the invention is that it enables a remarkable increase of the prefabrication degree of the construction of block of flats, what shortens the construction time and brings savings to the construction costs. The support method of the modular unit enables the construction of the base floor or intermediate floor substantially ready before installing the modular units in their places, what makes the scheduling of the construction works easier.

**[0015]** Furthermore, the advantage of the invention is that it improves the construction quality, since the major part of the construction-technically demanding construction works is transferred from the construction site to be made in the plant conditions.

**[0016]** In the following, the invention will be described in detail. In the description, reference is made to the enclosed drawings, in which

Figure 1 shows by a way of an example a modular unit according to the invention as a ground plan,

Figures 2a and 2b show a modular unit of Figure 1 from the side, seen from two different directions, and

Figure 3 shows by way of an example the modular unit of Figure 1, 2a and 2b seen from above.

**[0017]** Figure 1 shows by way of an example a modular unit according to the invention as a ground plan. The modular unit has a floor slab 10 and four walls, a first wall 12a, a second wall 12b, a third wall 12c and a fourth wall 12d. The walls are constructed on the floor slab so that the lower edges of the walls set against the upper surface of the floor slab. The structures of the walls resemble the structures of the inner partition walls of the apartments, i.e. they are not suitable as outer walls of the building. The walls have a first surface and a second surface so that the first surfaces define one room space inside them. This room space has furniture and equipment fixed to the walls and floor slab for the use of the room space. The walls of the modular unit shown in Figure 1 define a bathroom inside them, which bathroom has a wall-mounted WC-seat 20, a hand basin 22 with water tap, a shower wall 26, a shower basin 24 with floor drain, a shower faucet 28, a bathroom cabinet 30. Furthermore, the first wall has electrical and water connections 34 for connecting the washing machine. In the corner of the first and fourth wall there is a shaft 54 parallel to the normal of the floor slab, which shaft is separated from the room space

by panels. Delivery and discharge pipes, such as supply air pipe 70, exhaust air pipe 72, discharge pipe of the range hood 71, drain pipe 74, pipes for cold and warm service water 76, heating water pipes 65 and electrical cables 78 necessary for the heating, plumbing, ventilation and electrical installation systems and house technical systems to be installed in the building are passing inside the shaft. All the furniture and equipment are ready installed in their places so that they are ready for use in their final places in the room space. Furnishing and equipping of the interior of the modular unit is as such known technique, which is not described here in more detail.

**[0018]** Along the length of the first wall 12a of the modular unit the edge of the floor slab 10 is in a distance from the second surface of the first wall, i.e. along the length of the first wall a part of the floor slab extends outside the area defined by the second surfaces of the walls. This part extending outside the outer surface of the first wall has furniture and equipment to be installed in a fixed manner, which furniture and equipment belong to the kitchen of a typical apartment. A part of the furniture is supported on the floor slab, and a part is mounted on the second surface of the first wall. Also on a part of the length of the second wall 12b of the modular unit the edge of the floor slab is in a distance from the outer surface of the second wall, i.e. a part of the floor slab extends also outside the area defined by the second wall. On this part of the floor slab extending outside the second wall has typical furniture to be installed in a fixed manner, such as closets 52, which typically belong to the hall of an apartment. Furthermore, the second wall 12b has a door 14 for getting into the room space. Along the length of the third and fourth wall 12c, 12d of the modular unit the edge of the floor slab sets substantially on the same level with the second surface of the wall.

**[0019]** In Figure 2a the modular unit of Figure 1 is shown by way of an example from one side, seen from the direction of arrow A, and in Figure 2b the modular unit is shown from an another side, seen from the direction of arrow B. Figure 2a shows the second surface of the first wall 12a of the modular unit and a part of the floor slab 10 exceeding the second edge surface of the first wall. Substantially all fixed furniture and equipment, which belong to the kitchen of a typical small apartment, are installed on the first wall of the modular unit. In the first edge of the first wall there is a dish washer 48 above which there is a combined refrigerator and freezer 50. Above the refrigerator-freezer there is an upper cupboard, inside of which a switchboard 51 of the apartment is located. In the second edge of the first wall, on the floor slab there is a stove 44. Lower cupboards with tillers 38 are located between the stove and the dish washer. A counter top 41, to which a sink 42 having a water tap 43 is embedded, is on the lower cupboards. Above the counter and stove there are upper kitchen cupboards 36, such as a dish drying cupboard, as well as a range hood 46. All furniture and equipment to be arranged on the second surface of the first wall are installed in their places so that they are substantially ready for use in their final places. The modular unit can also be equipped so that it does not have all electric kitchen furniture, such as a combined refrigerator and freezer, stove and/or dish washer, ready installed in their places. In this case, the furniture to be installed in a fixed manner, such as upper and lower cupboards 36, 38, to be arranged on the first wall, has been installed in their places so that the wall has correctly dimensioned spaces and finished installation connections ready, such as the necessary plug sockets and water and drain connections, for an easy retrofitting of the above-mentioned electric kitchen furniture.

**[0020]** Figure 2b shows the second surface of the second wall 12b of the modular unit and a part of the floor slab 10 exceeding the second edge surface of the second wall. All fixed furniture which substantially belongs to the hall of a typical small apartment is installed on the second wall 12b of the modular unit. This furniture comprises two closets 52. The closets are installed on the floor slab and attached to the wall second surface of the second wall 12b.

**[0021]** The modular unit has a ceiling 60, which forms the roof of the room space, i.e. bathroom, defined by the walls of the modular unit. The room height of bathrooms is typically smaller than the room height of the other room spaces. Thus, the modular units can be dimensioned for example so that the distance between the lower surface of the floor slab 10 and the upper surface of the ceiling 60 is 2500 mm. With this dimensioning, the height of the interior of the bathroom, i.e. the distance between the upper surface of the floor slab and the lower surface of the ceiling is 2300 mm. The modular unit according to the invention is designed to be used especially in blocks of flats. The modular unit is designed to be installed to the opening of the intermediate floor so that the upper surface of the floor slab of the modular unit and the upper surface of the intermediate floor substantially set to the same level. The edges of the floor slab 10 of the modular unit have fixing elements 11, with which the floor slab is attached to the edges of the opening of the intermediate floor. The edges of the opening of the intermediate floor can have receiving parts of the fixing elements, to which receiving parts the fixing elements of the floor element attach. In its simplest form the fixing elements of the floor slab can comprise steel adhesion plates, which plates are attached by welding to the steel fixing plates in the edges of the opening of the intermediate floor. The fixing elements are arranged to the floor slab so that they remain substantially entirely inside the area defined by the outer edges of the floor slab. This way the fixing elements do not increase the outer dimensions of the floor slab. The modular unit can thus be fitted in an opening of the intermediate floor, the dimensions of which opening are only slightly bigger than the dimensions of the outer edges of the floor slab. The floor slab is dimensioned to bear the loads directed to the modular unit when supported from its edges. The vertical loads of the modular unit installed in its place are thus transferred through the floor

slab to the intermediate floor and further to the frame of the building. The floor slab can for example be a reinforced concrete slab, to the edges of which steel fixing elements 11 have been cast. The floor height of blocks of flats is according to the current building regulations typically about 3000 mm, wherein the upper surface of the ceiling of the modular unit supported to the opening of the intermediate floor of an apartment remains depending on the height of the modular unit at a distance of about 260-460 mm from the roof of the apartment. Thus, an assembly space 62 remains above the ceiling 60 of the modular unit, in which assembly space the pipes and cables of the modular units to be superimposed can be connected.

**[0022]** The assembly space is surrounded in all its edges by a lining plate 64 (Figure 3). Along the length of the third and fourth wall the outer surface of the lining panel is in the same vertical level with the outer surface of these walls. In a part of the first and the second wall the lining panel is on the same vertical level with the edges of the floor slab, i.e. outside the level of the outer surface of the walls. A part of the lining plates or all lining plates can be removable, whereby they are installed in their places on the construction site after the connections and horizontal wirings of the pipes and cables to be arranged between the modular units to be superimposed are finished. The water circulation radiation heater 66 is integrated to the lining plates. The size and the number of the radiation heaters are dimensioned according to the calculated required heating power of the apartment.

**[0023]** In Figures 2a and 2b the radiation heater has a smaller size than the lining plate. The radiation heaters can also have a clearly bigger size; they can be horizontal water radiators having even the size of a lining plate. In this case, the upper edge of the lining plate or the wall extends in the vertical direction to the level of the upper edge of the roof of the house and from the roof upwards the wall surface continues as a radiation heater. The radiation heaters can be installed to their places in the modular unit already in the factory or only at the construction site. The radiation heaters can be located on one or several sides of the modular unit, and their size can vary. The radiation heaters do not necessarily need to be water circulating heaters, but it is also possible to use other kind of heaters.

**[0024]** Figure 3 shows by way of an example the modular unit of Figure 1, 2a and 2b seen from above. Horizontal supply air pipes 70 and air removal pipes 72, which connect from their first end to the corresponding vertical air pipes passing in the channel 54, are passing in the assembly space 62 above the ceiling of the modular unit 60. The second ends of the supply air pipes are led through the holes in the lining plates 64 outside the assembly space. The supply and exhaust air pipes 70, 72 passing in the assembly space and opening through the lining plate serve for ventilation of the space outside the room space defined by the walls 12a, 12b, 12c, 12d of the modular unit. The air pipes are arranged in the modular unit so that the ends of the air supply and removal pipes open to different sides of the modular unit as far as possible from each other. The horizontal pipings and wirings of the service water 76 and electric cables 78 passing in the channel as well as the heating water pipes 65 passing to the water circulating radiation heaters 66 are also led in the assembly space. The water pipes and electric cables are led inside the room space defined by the modular unit mainly through the ceiling 60, in which case it is not necessary to make leak sensitive lead-through connections to the walls of the modular unit.

**[0025]** In a preferred embodiment of the modular unit according to the invention the space above the ceiling 60, i.e. the assembly space defined by the lining plates 64 and/or radiation heaters and the equipment therein are formed as a separate technical element, which can be installed as one part on the ceiling of the modular unit. Thus, the modular unit consists of the actual room modular unit and of the technical unit to be installed thereon. With this solution, the height of the room modular unit can be decreased so that the room modular unit fits inside a conventional sea container. This enables the manufacturing of the modular units in countries with lower production costs.

**[0026]** Some advantageous embodiments of the modular unit according to the invention have been described above. The invention is not limited to the solutions described above, but the inventive idea can be applied in different ways within the scope of the claims.

## Claims

1. A modular unit comprising a floor slab (10) and walls (12a, 12b, 12c, 12d), which walls have a first surface and a second surface, the first surfaces of which walls define a first room space, which first room space has first fixed equipment and/or furniture for the use of the first room space, and the second surface of at least one wall (12a, 12b, 12c, 12d) has second fixed equipment and/or furniture for the use of the second room space which is outside the modular unit and does not belong to the modular unit, **characterized in that** said floor slab (10) has fixing elements (11) to be attached to the edges of the opening in the intermediate floor or base floor of the building and the floor slab is dimensioned to bear the loads directed to the modular unit when supported from its edges.

2. The modular unit according to claim 1, **characterized in that** the fixing elements (11) are arranged inside the area defined by the outer edges of the floor slab (10).

3. The modular unit according to claim 1 or 2, **characterized in that** a part of said floor slab (10) extends along the length of at least one wall (12a, 12b, 12c,

12d) outside the area defined by the second surfaces of said walls and said part of the floor slab has second fixed equipment and/or furniture for the use of the second room space.

4. The modular unit according to claim 3, **characterized in that** a part of said floor slab (10) extends outside the area defined by the second surface of a first wall (12a), the length of which part is substantially the same or bigger than the length of the first wall (12a).

5. The modular unit according to claim 3 or 4, **characterized in that** furthermore a part of said floor slab (10) extends outside the area defined by the second surface of a second wall (12b), the length of which part is substantially the same or bigger than the length of the second wall (12b).

6. The modular unit according to any of the claims 1-5, **characterized in that** said first room space is a bathroom, whereby the first fixed equipment and/or furniture of the first room space comprise at least a part of the following: WC-seat (20), hand basin (22) with accessories, shower basin (24), shower wall (26) or curtain, shower faucet (28), bathroom cabinet (30) and washing machine connections (34).

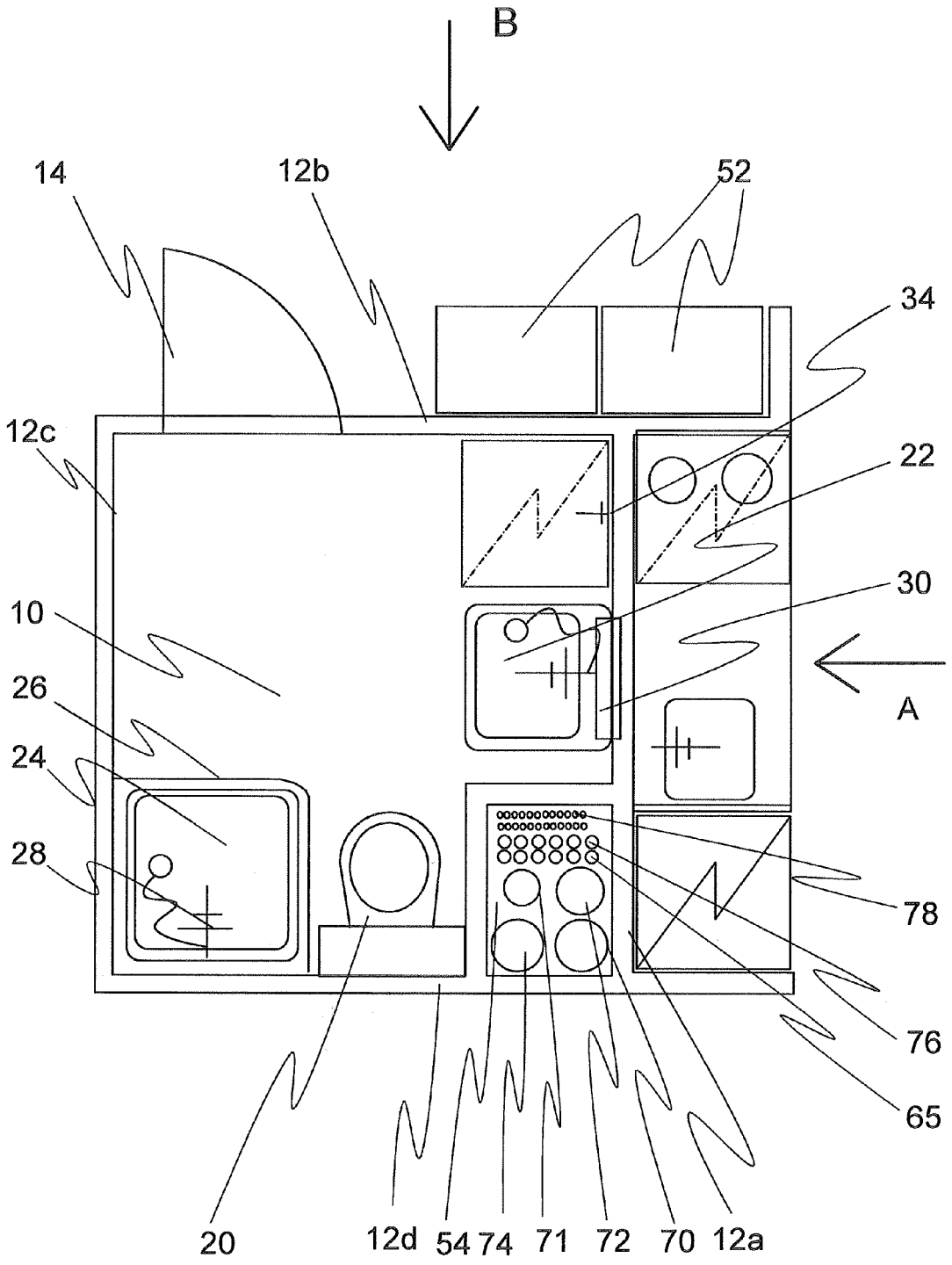
7. The modular unit according to any of the claims 1-6, **characterized in that** the second equipment and/or furniture on the second surface of said at least one wall (12a, 12b, 12c, 12d) and/or on the part of the floor slab (10) extending outside the second surface of said wall are fixed kitchen equipment and/or furniture, which comprise at least a part of the following: kitchen cupboards (36, 38), range hood (46), kitchen sink (42) with accessories and connections for installing dish washer (48), stove (44) and refrigeration equipment (50).

8. The modular unit according to any of the claims 1-7, **characterized in that** the second fixed equipment and/furniture on the second surface of said at least one wall (12a, 12b, 12c, 12d) and/or on the part of the floor slab (10) extending outside the second surface of said wall are hall equipment and/or furniture, such as closets (52).

9. The modular unit according to any of the claims 1-8, **characterized in that** the modular unit has at least one radiator (54) for heating the room space outside the modular unit.

10. The modular unit according to any of the claims 1-9, **characterized in that** it further comprises a ceiling (60).

11. The modular unit according to claim 10, **characterized in that** it comprises a shaft (54) parallel to a normal of the floor passing through the floor slab (10) and the ceiling (60) for the lead-through of the pipes (65, 70, 71, 72, 74, 76) and cables (78).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12b
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12c
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12d
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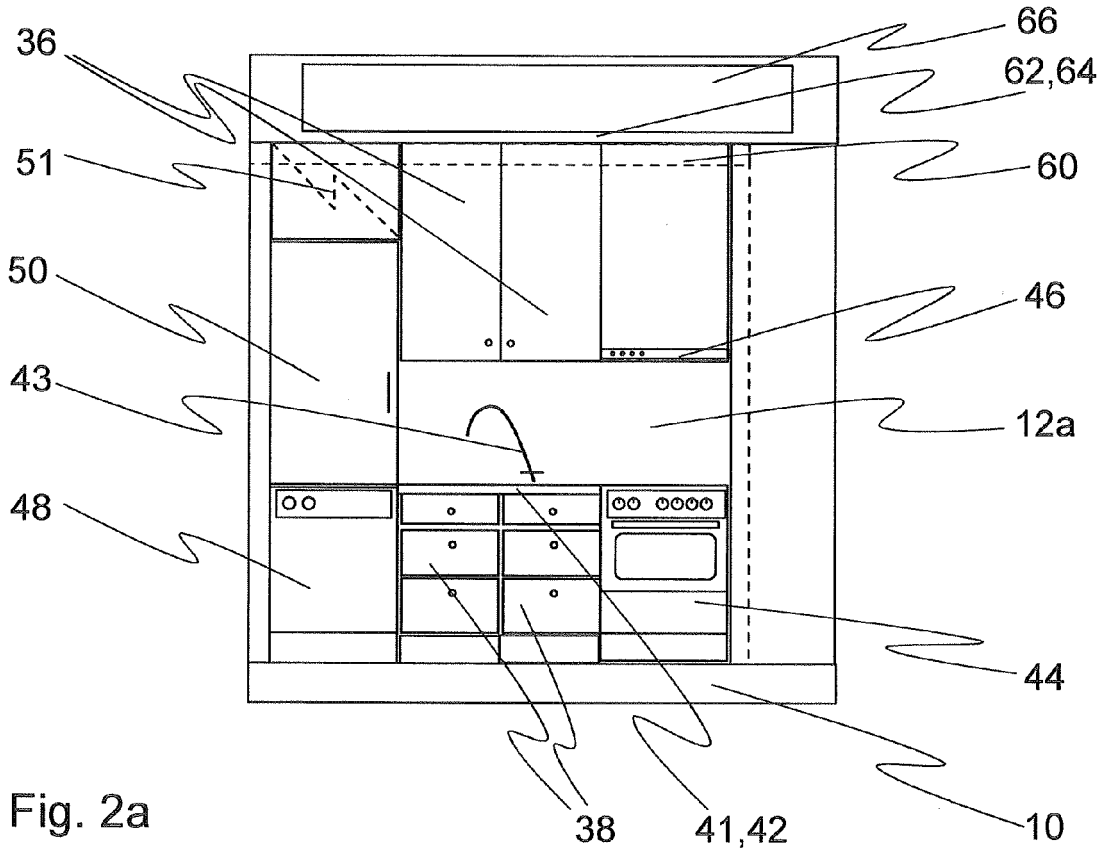
Fig. 1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12a
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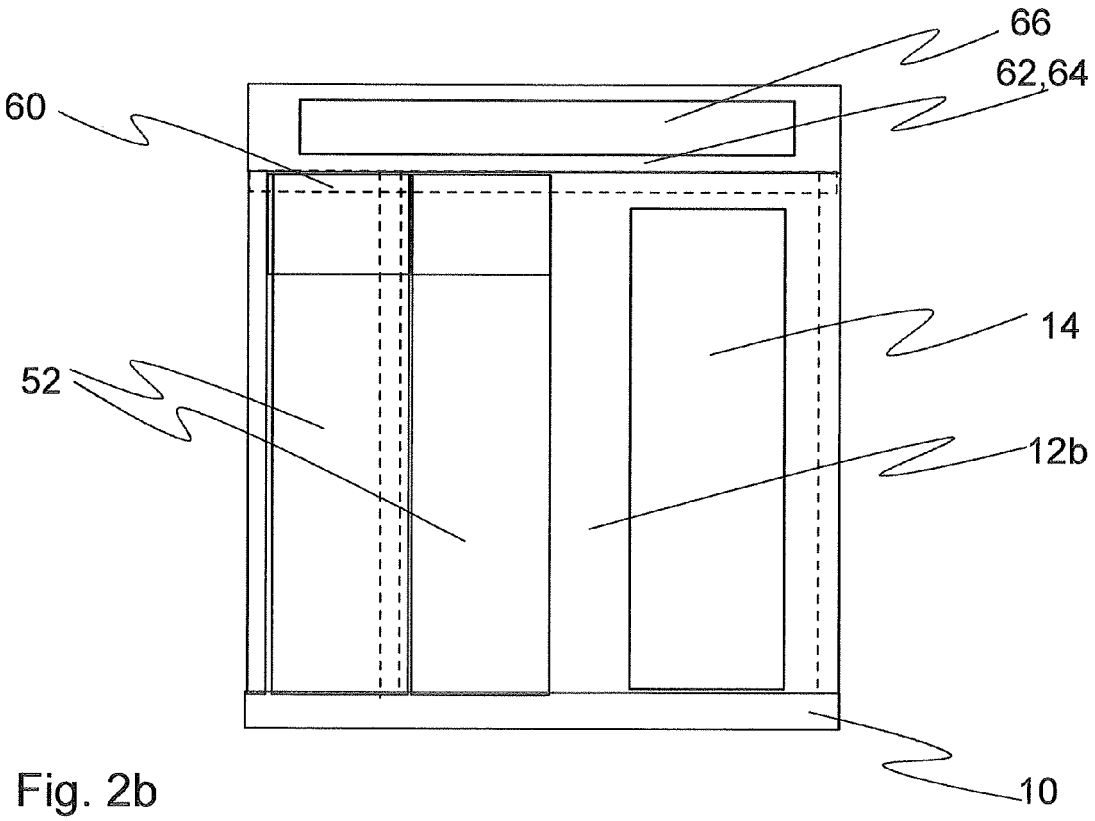
Fig. 2a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12b
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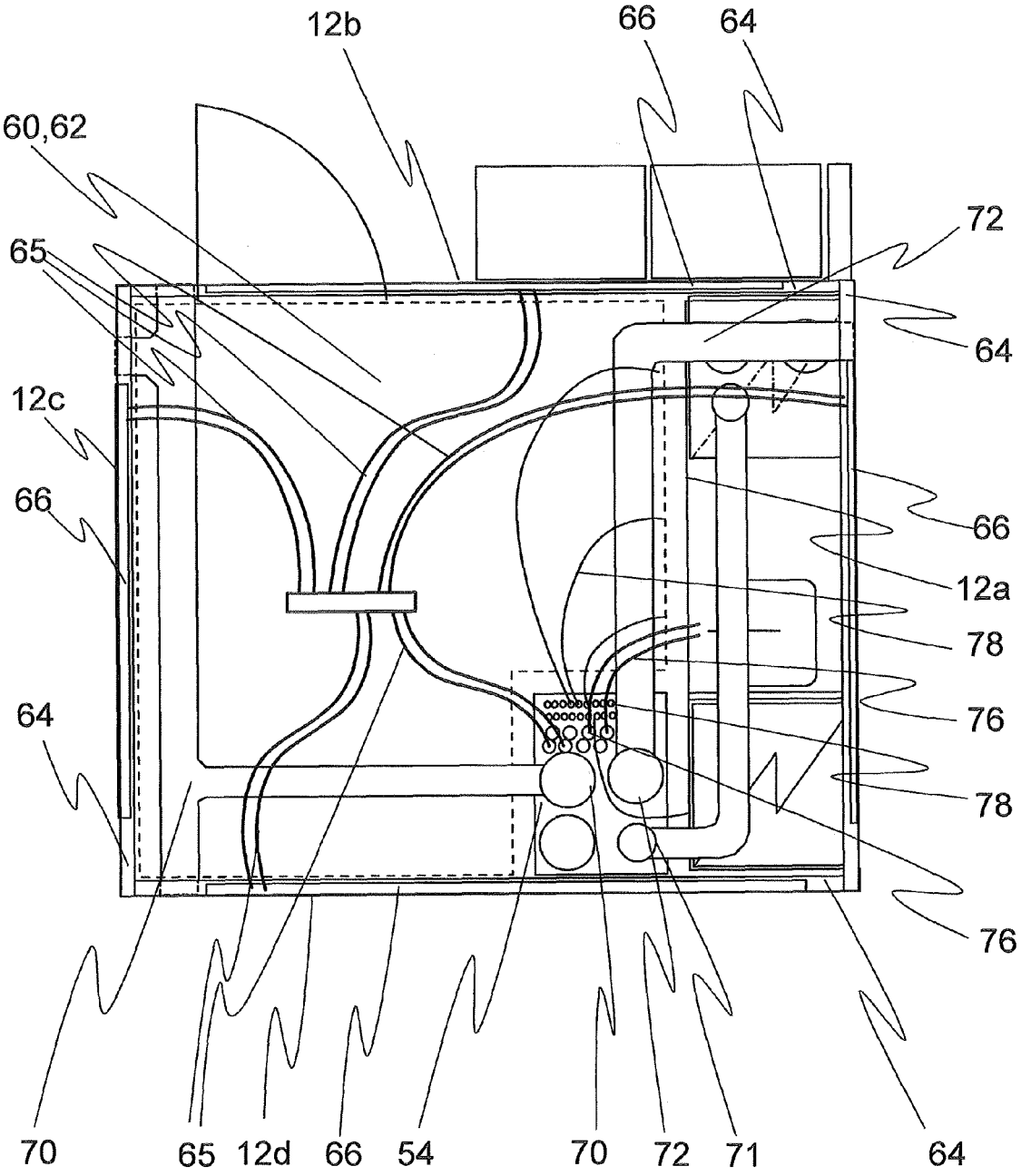
Fig. 2b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12c
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12a
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12d
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64

Fig. 3

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# EUROPEAN SEARCH REPORT

Application Number
EP 14 16 5126

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| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
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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 | 15 August 2014 | López-García, G |

CATEGORY OF CITED DOCUMENTS

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 16 5126

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15-08-2014

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## REFERENCES CITED IN THE DESCRIPTION

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