

## SPECIFICATION

### 1 FLOOR PANEL INCLUDING SUPPORT PORTIONS AND METHOD OF LAYING THE SAME

#### Field of the Art

5 The present invention relates to a floor panel including support portions and a method of laying the same. More particularly, the present invention is concerned with a modular floor constructed by removably connecting a plurality of such floor panels and laying unit panels on the floor panels. The modular  
10 floor may be arranged on the floor of a building in a double floor configuration in order to define spaces for accommodating electrical wirings, pipings, etc.

#### Background Art

15 Today, various kinds of office automation equipments are installed in offices and electrically connected by a number of diverse wirings laid on floors. A double floor panel is an implementation extensively used to deal with the increasing amount of wirings in offices.

20

Conventional double floor panels include one having channels for wirings, one having support legs formed integrally therewith, and one having removable support legs. Particularly, there is an increasing demand for a double floor panel light enough for any  
25 person to lay it on a floor, adapting itself even to the irregularity of

1 a floor, and shaking little. Also, a double floor panel with these  
features facilitates the renewal of the office environment.

A floor panel having channels for wiring is disclosed in, e.g.,  
5 Japanese patent laid-open publication No. 284854/1987. The floor  
panel taught in this document is implemented as a block made up  
of a molding of resin in the form of a sheet and a mass of concrete.  
Because this kind of floor panel is resistive to loads and heavy, it is  
free from displacement and can be laid on a floor while abutting  
10 against another block. In addition, the sheet is flexible and can  
follow the irregularity of a floor. However, the block is a heavy  
composite body and needs a number of covers for covering the  
channels, resulting in an increase in the number of parts.  
Consequently, the work for laying the blocks on a floor and the  
15 work for conveying them to and from a floor are time- and labor-  
consuming.

A floor panel having support legs formed integrally therewith  
is taught in, e.g., Japanese utility model laid-open publication No.  
20 164537/1985 or Japanese patent laid-open publication No.  
124366/1992 or 28834/1993.

This kind of floor panel has the support legs connected  
together at their connecting portions in a panel module  
25 configuration. Unit panels are laid on the support legs. However,  
the floor panel to be laid on a floor lacks a structure for connecting  
it to another floor panel, and therefore moves easily. Also, the unit

1 panels are implemented as steel sheets from the mechanical  
strength standpoint and therefore thick and heavy, again resulting  
in time- and labor-consuming execution. Moreover, the unit panels  
are often large size and cannot adapt themselves to the irregularity  
5 of a floor although the support legs may absorb the irregularity. As  
a result, the unit panels shake every time a person walks on the  
floor.

In light of the above, unit panels may be rigidly connected to  
10 posts by fasteners or similar affixing members, as proposed in the  
past. However, this kind of scheme increases the number of parts,  
lacks in reliability as to the affixing force, and obstructs efficient  
execution.

15 Typical of structure for connecting unit panels is taught in  
Japanese utility model laid-open publication No. 85845/1994 by  
way of example. In this structure, unit panels are connected  
together by an engaging structure entirely different from legs  
provided on the panels, and in addition the legs are spaced from  
20 each other by small gaps. This kind of scheme results in a  
complicated structure, makes it difficult for a person to connect and  
disconnect the unit panels, and prevents the unit panels from being  
efficiently laid on a floor. Further, because the legs are extremely  
closed to each other, the unit panels cannot accurately adapt  
25 themselves to the irregularity of a floor.

1 Japanese patent laid-open publication No. 322947/1994, for  
example, proposes a connecting structure using rings and support  
portions to be received in the rings. The problem with this  
approach is that the rings must be bodily lifted above the support  
5 portions and then coupled over the rings. This kind of procedure is  
troublesome.

As stated above, none of the conventional technologies can  
implement a double floor panel having the various desirable  
10 features mentioned earlier.

#### Disclosure of the Invention

It is therefore an object of the present invention to provide a  
floor panel including support portions and capable of adapting itself  
15 to the irregularity of a floor with a simple structure and thereby  
facilitating execution, and a method of laying the same.

It is another object of the present invention to provide a low  
cost, light weight floor panel including support portions and  
20 featuring sufficient resistance to loads and strength.

In accordance with the present invention, floor panel includes  
a group of support portions arranged in a substantially polygonal  
configuration, as seen in a plan view, a plurality of coupling  
25 portions arranged at at least one of two contiguous sides of the  
group of support portions, and each being substantially identical in  
configuration with the second support portions and having a

1     concave bottom, and a plurality of coupling portions arranged at at  
least one of other two contiguous sides of the group of support  
portions, and each having a convex portion complementary to the  
concave bottom of the coupling portion. The coupling portions of  
5     one floor panel are coupled over the coupling portions of another  
floor panel from the above.

Also, in accordance with the present invention, a floor panel  
includes a group of support portions arranged in a substantially  
10     polygonal configuration, as seen in a plan view, arms connecting the  
plurality of support portions, and extending substantially radially  
with a preselected width to thereby locate the plurality of support  
portions at the substantially same distance, first coupling portions  
provided on the arms extending outward from the first support  
15     portions arranged at at least one of two contiguous sides of the  
support portions, second support portions provided on the arms  
extending out from the support portions arranged at at least one of  
the other two contiguous sides of the support portions. The first  
coupling portions of one floor panel and the second coupling  
20     portions of another floor panel are engaged with each other. The  
support portions are uniformly spaced by the substantially same  
distance by the arms.

Further, in accordance with the present invention, a method of  
25     constructing a floor panel includes a first step of preparing a floor  
panel comprising a group of support portions arranged in a  
substantially polygonal configuration, as seen in a plan view, arms

1 connecting the support portions and extending substantially  
radially with a preselected width to thereby locate the support  
portions at the substantially same distance, first coupling portions  
provided on the arms extending outward from at least one of the  
5 support portions arranged at at least one of two contiguous sides of  
the support portions, second coupling portions provided on the  
arms extending out from the other of the support portions arranged  
at at least one of the other two contiguous sides of the support  
portions, the first coupling portions and the second coupling  
10 portions being engageable with each other, a second step of  
coupling the first coupling portions and second coupling portions to  
thereby lay a plurality of floor panels, and a third step of laying a  
plurality of unit panels on the support portions such that the unit  
panel have corners and substantially centers thereof sustained by  
15 tops of the support portions, whereby a modular floor for a double  
floor structure is constructed.

Furthermore, in accordance with the present invention, a floor  
panel includes a group of support portions made up of a plurality of  
20 support portions, arms connecting the support portions and locating  
then support portions at the substantially same distance, unit  
panels laid on the tops of the support portions, and engaging  
portions for allowing the top of any one of the support portions and  
one corner portion of any one of the unit panels to be engaged with  
25 each other.

1           Moreover, in accordance with the present invention, a floor  
panel unit includes a plurality of support portions arranged in a  
plurality of arrays, arms connecting the support portions to each  
other, the support portions each including a plurality of incisions  
5       formed in at least one of the top, outer periphery and inner  
periphery and substantially serving as reference positions, whereby  
the first support portion is capable of being cut apart in the vertical  
direction.

10           In addition, in accordance with the present invention, a  
method of laying a floor panel, includes a first step of preparing a  
floor panel unit comprising a plurality of arrays of support portions,  
arms connecting the support portions to each other, the support  
portions each including a plurality of incisions formed in at least  
15       one of the top, outer periphery and inner periphery and  
substantially serving as reference positions so as to be capable of  
being cut apart in the vertical direction, and coupling portions  
provided on the arms extending out from the support portions, a  
second step of cutting apart the floor panel unit according to a  
20       preselected rule along the plurality of incisions to thereby form a  
plurality of divided floor panel units, and a third step of connecting  
the divided floor panel units via the coupling portions such that the  
coupling portions do not appear at outside of the support portions,  
whereby a coupled floor panel unit different from the floor panel  
25       unit is reconstructed.

#### Brief Description of the Drawings

1           FIG. 1A is a plan view showing the basic configuration of a floor panel in accordance with the present invention and including support portions;

          FIG. 1B is a section along line 1B-1B shown in FIG. 1A;

5           FIG. 2A is a plan view showing a plurality of floor panels embodying the present invention and laid on a floor by a method particular to the present invention;

          FIG. 2B is a side elevation of the floor panels shown in FIG. 2A;

          FIGS. 3A-3D are enlarged fragmentary side elevations each  
10          showing a specific structure of a coupling portion included in the embodiment;

          FIG. 4 shows another specific configuration of the coupling portion;

          FIG. 5 shows how the floor panels included in the embodiment  
15          are connected to border members in the vicinity of walls;

          FIG. 6A is a plan view of a unit panel also included in the embodiment;

          FIG. 6B is a side elevation of the unit panel shown in FIG. 6A;

          FIG. 7 is an exploded perspective view showing a specific  
20          structure in which a first support portion and the unit panel are engaged with each other with the intermediary of a cushioning sheet;

          FIGS. 8A, 8B and 8C are sections along line VIII-VIII of FIG. 7 and each showing the structure of FIG. 7 held in a particular  
25          condition;

1           FIGS. 9A and 9B are sectional side elevations showing a support portion and the unit panel engaged with each other with the intermediary of another specific cushioning sheet;

FIG. 10 is a sectional side elevation showing a modification of any one of the embodiments;

FIG. 11A is an enlarged perspective view showing the basic configuration of the first support portion included in any one of the embodiments, and FIG. 11B is a bottom view of the first support portion shown in FIG. 11A;

10           FIGS. 12A and 12B each shows a modification of the first support portion of FIG. 11A both in a plan view and a side elevation;

FIGS. 13A-13D are plan views each showing a particular method of cutting apart the floor panel of any one of the embodiments; and

FIGS. 14A-14D are plan views respectively corresponding to FIGS. 13A-13D, and showing reconstructed floor panels.

#### Best Mode for Practicing the Invention

20           Embodiments of the floor panel including support portions in accordance with the present invention will be described in detail with reference to the accompanying drawings.

One of various embodiments of the present invention relates to a structure in which a plurality of floor panels are connected together by vertical plug-in type projections and recesses. Another embodiment consists mainly of a group of support portions, connecting portions, support portions for connection, and coupling

1 portions for connection. Still another embodiment pertains to a  
structure based on the engagement of support portions and panels.  
A further embodiment relates to a procedure for laying panels, a  
structure for cutting support portions, and a method for practicing  
5 the same.

Description of Basic and General Configurations of Floor Panel and  
Panel

Referring to FIGS. 1A and 1B, the basic configuration of the  
floor panel in accordance with the present invention is shown. As  
10 shown, the floor panel, generally 10, includes a group of support  
portions made up of a plurality of main legs 14 and a plurality of  
auxiliary legs 16. Tie bars 18 and 22 connect the main and  
auxiliary legs 14 and 16, as illustrated, and each has a preselected  
width. The tie bars 18 and 22 extend substantially radially from  
15 the main legs 14 and position the legs 14 and 16 at substantially a  
preselected distance from each other. First connecting portions 24  
are provided on the ends of the tie bars 22 extending out from the  
main legs 14 which adjoin at least one of two contiguous sides of  
the group of support portions. Likewise, second connecting portions  
20 26 are provided on the ends of the tie bars 22 extending out from  
the main legs 14 which adjoin at least one of the other two  
contiguous sides of the group of support portions. Let the tie bars  
22 be referred to as arms 22 in order to distinguish them from the  
other tie bars 18.

25

A plurality of unit panels 30 are laid on the floor panel 10 and  
supported by the tops of the main legs 14, auxiliary legs 16, and the

1 corners of the floor panel 10, constituting a modular floor over the  
floor of a building, as will be described in detail later. Specifically,  
the floor panel 10 is sized about 400 mm to about 600 mm square  
in conformity to the size of, e.g., a tile carpet customarily used as a  
5 floor finishing material. The tie bars 18 and arms 22 are  
continuously arranged in the form of letter X, as illustrated. The  
main legs 14 and auxiliary legs 16 are each located at the crossing  
point of letter X and spaced by a preselected distance from the  
adjacent legs. With this configuration, it is possible to stabilize the  
10 mechanical strength of the top of the floor panel 10.

The first connecting portions 24 are identical in configuration  
with the auxiliary legs 16, and each is implemented as a bottom-  
open hollow member. The second connecting portions 26 are lower  
15 in height than the first connecting portions 24 and engageable with  
the portions 24 of another floor panel 10 in the up-and-down  
direction by, e.g., insertion. For example, the second connecting  
portions 24 are implemented as stubs over which the hollow first  
connecting portions 24 can be coupled. A plurality of floor panels  
20 10 can be connected, positioned, and affixed surely and easily only  
if their first and second connecting portions 24 and 26 are engaged  
with each other. Such floor panels 10 constitute a continuous  
modular floor on which the connecting portions 24 and 26 are not  
conspicuous. Further, because the support portions 14, 16 and 24  
25 are equally spaced from each other by the tie bars 18 and arms 22,  
the floor panel 10 can sufficiently follow the irregularity of the  
floor of a building.

1           The floor panel 10 should preferably be implemented as a  
single molding, typically a molding of noncombustible or  
inflammable resin, in order to facilitate design and production. The  
tie bars 18, arms 22 and connecting portions 24 and 26 are formed  
5 integrally with the floor panel 10 by a minimum amount of resin.  
The unit panels 30 are implemented as thin steel sheets of identical  
shape so as to be shared by all the floor panels 10, and each is  
reinforced only by stamping and bending. The floor panel 10 and  
unit panels 30 are therefore light weight, low cost, and easy to  
10 convey and lay on the floor of a building.

          The main legs 14 and auxiliary legs 16 each has a particular  
diameter. Each main leg 14 supports one corner of a single unit  
panel 30 over one-fourth of the area of its top 14a, i.e., supports the  
15 corners of four adjacent unit panels 30 on its top 14a. The auxiliary  
legs 16 each supports substantially the center of a single unit panel  
30 over the entire area of its top. However, while each main leg 14  
constantly supports the corners of four unit panels 30 thereon, each  
auxiliary leg 16 sustains the associated unit panel 30 only when a  
20 load heavier than predetermined one acts on the unit panel 30.

          The main legs 14 and auxiliary legs 16 are implemented as  
posts having a polygonal, circular or similar cross-section. The top  
14a of each main leg 14 is formed with engaging portions 14b and  
25 14c for allowing the leg 14 to engage with the panels 30. The unit

1 panels 30 each is also formed with engaging portions 32, 38 and 43  
(see FIG. 6B) at its four corners 36 (see FIG. 6A).

5 Each unit panel 30 should preferably have an area about one-  
sixth to about one-third of the area of, e.g., a tile carpet or the floor  
panel (about 400 mm to about 600 mm square). Specifically, the  
unit panel 30 is about 100 mm to about 200 mm square (generally  
165 mm) so as to be laid on one of a plurality of divided areas of  
the floor panel 10. The unit panel or steel sheet 30 has a thickness  
10  $t$  ranging from 1.00 mm to 2.5 mm (generally 2.3 mm).

The unit panels 30 each having the above configuration  
should only be laid on the floor panel 10 such that they are  
sustained by the tops of the main and auxiliary legs 14 and 16 and  
15 the corners of the floor panel 10. This allows a uniform modular  
floor to be constructed which has a simple structure and stable  
support strength. With the above size, the unit panels 30 can follow  
irregularities on the floor of a building via the floor panels 10 laid  
on the floor.

20

The unit panels 30 have the same configuration and are  
sustained by the support portions having the same configuration.  
This, coupled with the fact that the unit panels 30 are provided  
with sufficient mechanical strength by stamping and bending,  
25 reduces the number of parts and cost of a modular floor.

#### Description of Preferred Embodiments

1 Preferred embodiments of the floor panel in accordance with  
the present invention will be described hereinafter. It should be  
noted that although the illustrative embodiments each is used to  
construct a modular floor for a double floor structure, such an  
5 application is only illustrative.

FIGS. 1A, 1B, 2A, 2B and 3A-3D show a preferred embodiment  
of the floor panel 10 in accordance with the present invention,  
particularly some different configurations of the legs and  
10 connecting portions for connecting the legs. As shown in FIGS. 1A  
and 2B, the floor panel 10 includes two different kinds of legs, i.e.,  
main legs 14 and auxiliary legs 16 having support surfaces smaller  
in area than the support surfaces of the main legs 14. The legs 14  
and 16 are connected together by the tie bars 18 each having a  
15 preselected width, as stated earlier. With this configuration, it is  
possible to reduce the weight of the floor panel 10.

In FIGS. 1A, 1B, 2A and 2B, the top (support surface  
hereinafter) 14a of each main leg 14 has a generally octagonal  
20 shape, as seen in a plan view. Alternatively, as shown in FIG. 4, the  
support surface 14 may be provided with a circular support surface  
14a. If desired, the number of the tie bars 18 included in the  
specific configurations may be increased in order to enhance rigid  
connection. In the specific configurations, the floor panel 10  
25 includes nine main legs 14 and four auxiliary legs 16. The unit  
panel 30 is sustained by and between the main legs 14 and  
auxiliary legs 16.

1 Specifically, as shown in FIGS. 2A and 2B, the support surface  
14a of each main leg 14 is formed with the previously mentioned  
engaging portions 14b for retaining the unit panels 30 and  
implemented as cruciform grooves. The main legs 14 and auxiliary  
5 legs 16 are connected together by the tie bars 18, constituting a  
group of legs. The arms 22, also included in the group of legs, each  
extends out from the respective outermost main leg 14 and has the  
same configuration as the tie bars 18.

10 More specifically, the arms 22 protrude from each outermost  
main leg 14 in the form of a letter V, as seen in a plan view. The  
first connecting portion (leg hereinafter) 24 or the second  
connecting portion (stub hereinafter) 26 is formed on the free end  
of each arm 22 or on the contiguous ends of nearby arms 22. Such  
15 a structure increases the mechanical strength of the arms 22 and  
allow them to withstand stresses to act thereon at the time of, e.g.,  
execution. The free ends of the arms 22 are positioned on four  
contiguous sides substantially forming a square which is indicated  
by a phantom line 100. In the illustrative embodiment, the legs 24  
20 are positioned on two contiguous sides of the above square while  
the stubs 26 are positioned on the other two contiguous sides of the  
square.

25 As shown in FIGS. 1B and 2B, the main legs 14 have the same  
height as each other while the auxiliary legs 16 have a height which  
is, e.g., slightly smaller than the height of the legs 14. More

1 specifically, each auxiliary leg 16 is positioned substantially at the  
center of the unit panel 30 supported by the adjoining main legs 14,  
as will be described in detail later. The height of the auxiliary leg  
16 is selected such that in the above condition the leg 16 bears, in  
5 the auxiliary manner, a load which may act on the center of the unit  
panel 30.

The legs 24 for connection are substantially identical in shape  
and height with the auxiliary legs 16. In addition, the legs 24 are  
10 spaced from the main legs 14 by substantially the same distance as  
they are spaced from the auxiliary legs 16. The stubs 26 for  
connection are far smaller in height than the main legs 14 and  
auxiliary legs 16. In the illustrative embodiment, the height of the  
stubs 26 is selected to be less than substantially one-third of the  
15 height of the legs 14 and 16. Each stub 26 has a rounded top.

FIG. 2A is a plan view showing a plurality of floor panels 10  
(10-1 and 10-2) joined together to constitute a modular floor and  
each having the configuration shown in FIG. 1A. In this sense, let  
20 the floor panels 10 be referred to as panel modules hereinafter. As  
shown, the two legs 24 of one panel module 10-2 are coupled over  
the two stubs 26 of the other panel module 10-1 from the above.  
In this manner, each panel module 10 has one kind of connecting  
portions at the two contiguous sides of the square and another kind  
25 of connecting portion at the other two contiguous sides of the  
square. Therefore, a number of panel modules 10 (10-1, 10-2, 10-  
3, ..., 10-n) can be sequentially connected together in a flat

1 configuration with ease without resorting to any complicated  
consideration of layout.

The unit panel 30 is formed of, e.g., metal and supported by  
5 four adjacent main legs 14, as illustrated. Bent portions 34 extend  
downward from the four corner portions of the panel 30 in order to  
increase the mechanical strength of the panel 30 against loads. The  
bent portions 34 are respectively received in the grooves 14b  
formed in the support surfaces 14a of the main legs 14.

10

When the two panel modules 10-1 and 10-2 are joined  
together, as shown in FIG. 2A, the main legs 14 and the legs 24  
located at the joint portion insure the positional relation between  
the main legs 14 and auxiliary legs 16 located at the other portions  
15 and insure the support of the unit panels 30. This prevents the  
structural members for connection from showing themselves above  
the modular floor and degrading its appearance. In addition, the  
legs 14 and 16 are arranged at the same intervals on the floor of a  
building underlying the modular floor, defining regular spaces for  
20 wiring.

A basic procedure for connecting the panel modules 10-1 and  
10-2 is as follows. As shown in FIG. 2B, one panel module 10-1 is  
laid on the floor of a building (base floor hereinafter). Then, the  
25 other panel module 10-2 is laid on the base floor with its legs 24  
coupled over the corresponding stubs 26 of the panel module 10-1.  
If desired, the main legs 14 and the auxiliary legs 16 and legs 24 of

1 each panel module 10 may be replaced with each other, in which  
case the modules 10 will be connected by use of the main legs 14  
and stubs 26.

5 Referring to FIG. 3A, a specific connection structure including  
the arms 22 and the legs 24 and stubs 26 for connection will be  
described. As shown, at least the tie bars 18 and arms 22 each has  
a thin flexible configuration implemented by, e.g., the molding of  
resin so as to be elastically deformable. Therefore, each arm 22 can  
10 be elastically bent upward with ease. To join the panel modules  
10-1 and 10-2, the module 10-2 is laid on the floor and then has its  
legs 24 coupled over the stubs 26 of the module 10-1 while being  
shifted toward the module 10-1, as shown in FIG. 2B. That is, the  
legs 24 should only be coupled over the stubs 26 at a height lower  
15 than the tops of the legs 24, i.e., at a height corresponding to the  
tops of the stubs 26. This makes it needless for the worker to lift  
the entire module 10-2 and then connect it to the module 10-1 laid  
on the base floor, as has been customary with modular panels.

20 The above embodiment includes the main legs 14 and  
auxiliary legs 16 smaller in support area than the main legs 14.  
FIG. 3B shows an alternative embodiment having main legs 32 (only  
one is shown), but lacking auxiliary legs. The main legs 32 have  
support surfaces flush with each other. Stubs (only one is shown)  
25 36 for connection has a height as small as one half of the height of  
the main legs 32. Legs (only one is shown) 34 for connection have  
the same height and contour as the main legs 32. A plurality of ribs

1     35 are formed on the inner periphery of each leg 34 for  
reinforcement, and each may have the configuration shown in FIG.  
3B. For connection, each leg 34 of one panel module is coupled over  
the associated stub 36 of the other panel module in the same  
5     manner as in the structure shown in FIG. 3A.

FIG. 3C shows a stub 40 having a modified configuration and  
usable in combination with the leg 24 shown in FIG. 3A. As shown,  
the stub 40 is split into two portions substantially at its center. The  
10     two portions of the stub 40 are slightly spaced from each other.  
The leg 24 has a hollow cylindrical configuration and is open at its  
bottom. When the leg 24 is coupled over the stub 40 from the  
above, the split portions of the stub 40 are pressed toward each  
other. In this condition, the split portions tend to elastically move  
15     away from each other, pressing the inner periphery of the leg 24  
outward. This maintains the leg 24 and stub 40 firmly joined  
together.

FIG. 3D shows a stub 42 having another modified  
20     configuration. As shown, the stub 42 is implemented as two pieces  
42a and 42b connected together at their bottoms. Of course, the  
two pieces 42a and 42b may be replaced with three or more pieces,  
if desired. The pieces 42a and 42b are elastically deformable  
toward each other when subjected to a force of preselected size.  
25     Each of the pieces 42a and 42b has a protuberance or larger  
diameter portion 43 protruding outward, as illustrated. In this  
case, the leg 24 is formed with two holes 25 corresponding in

1 position to the two pieces 42a and 42b of the stub 42 in its side  
wall. When the leg 24 is coupled over the stub 42 from the above,  
it causes the two pieces 42a and 42b to elastically bend toward  
each other. When the leg 24 is fully coupled over the stub 42, the  
5 protuberances 43 of the pieces 42a and 42b respectively fit in the  
holes 25. The leg 24 and stub 42 are therefore connected together  
more firmly than in the configurations of FIGS. 3A and 3B in which  
the hollow leg is simply coupled over the stub.

10 It should be noted that the stubs 40 and 42 shown in FIGS. 3C  
and 3D, respectively, are only illustrative. The crux is that the stub  
be formed by embossing, stamping or similar technology in such a  
manner as to be engageable with the associated leg in the up-and-  
down direction and locked in position when engaged.

15 Reference will be made to FIG. 5 for describing a specific  
double floor structure constructed on the base floor of a building by  
use of the panel modules 10 having any one of the configurations  
described above. Specifically, FIG. 5 shows the edge portions of an  
20 area where the modular floor using the panel modules 10 is to be  
constructed, i.e., the edge portions of the base floor adjoining the  
walls of the building. As shown, a plurality of panel modules 10  
joined together are laid on the floor of the building as far as a  
preselected position close to the walls. Border panels 50 are  
25 positioned by the walls, and each can have its width adjusted by  
being suitably cut off. A border cover 52 is laid on the portion of

1 each border panel 50 closest to the wall while a border sheet 54 is  
laid on the other portion of the border panel 50.

5 The panel modules 10 located at the edge portions of the  
above area are positioned such that their legs 24 for connection face  
the walls. Each border panel 50 is so adjusted in position as to  
extend to a preselected position spaced from the legs 24 by a  
preselected distance. The unit panels 30 are supported by the  
border panel 50 and main legs 14 at its opposite edge portions,  
10 spanning the space between them. In this condition, the unit panels  
30 are surely supported by the border panel 50, a part of each  
outermost main leg 14, and the legs 24 intervening between the  
border panel 50 and the outermost main legs 14. As a result, each  
outermost unit panel 30 is supported by the associated leg 24 at its  
15 center in the same manner as the other unit panels 30. Therefore,  
the unit panels 30 at the edges of the expected area are held as  
stably as the other unit panels 30.

As stated above, even in the regions where the border panel  
20 50 and panel modules 10 join each other, the unit panels 30 are  
sustained by the border panels 50 and main legs 14 at their four  
corners. In addition, the auxiliary legs 16 or the legs 24 for  
connection each is positioned at substantially the center of the  
individual unit panel 30 and capable of sustaining the panel 30.  
25 Specifically, the legs 16 and 24 each has a height slightly smaller  
than the height of the main legs 14. Assume that some load acts on  
the center of any one of the unit panels 30 due to the weight of an

1 equipment brought to the modular floor or the weight of a person  
walking on the modular floor. Then, the panel 30 is bent  
downward, but successfully sustained by the leg 16 or 24 at its  
center. With this configuration, it is possible to reduce the  
5 thickness and therefore the weight and cost of each unit panel or  
steel sheet 30 as far as possible, while preserving the load resisting  
function. For example, the thickness  $t$  of the unit panel 30 can be  
reduced below 2.3 mm, e.g., to 1.6 mm, realizing noticeable cost  
saving.

10

As shown in FIG. 5, it may occur that the stubs 26, instead of  
the legs 24, face the border panel 50 at the edge of the expected  
area. In such a case, the unit panels 30 will be sustained by the  
main legs 14 and border panel 50 at their opposite end portions,  
15 spanning the space close to the wall. However, because the stubs  
26 are far lower in height than the main legs 14, they cannot  
sustain substantially the centers of the panels 30, resulting in short  
mechanical strength. In light of this, a third support member 45  
may be fitted on each of such stubs 26 in order to provide it with  
20 the same height as the leg 24 or the main leg 14. This allows the  
borders to be dealt with in the same manner as the panel modules  
10 connected together by the insertion scheme.

In any one of the embodiments described above, the numbers  
25 and configurations of the support legs may be changed, as desired.  
The hollow legs may be replaced with solid legs, if desired. Further,  
all the legs may be implemented as hollow legs in order to reduce

1 the overall weight of the individual floor panel 10, in which case  
ribs for reinforcement will be formed on the inner periphery of  
each leg.

5 The foregoing embodiments each has various unprecedented  
advantages, as follows. The floor panels 10 can be connected  
together with ease by simple operation and stably held in a  
modular floor configuration. The floor panels 10 can be easily  
connected or disconnected without being bodily lifted away from  
10 the base floor. Moreover, connecting members do not protrude  
between the legs for supporting the unit panels 30, so that the  
connecting portions of the panels 30 are not conspicuous. In  
addition, when the floor panels 10 are used to construct a double  
floor structure, spaces for wiring can be effectively guaranteed  
15 even between the legs.

FIGS. 6A and 6B are respectively a plan view and a side  
elevation showing the unit panel 30 of FIGS. 1A-2B. As shown, the  
unit panel 30 is implemented as a flat steel sheet having a  
20 preselected thickness. As shown in FIG. 6A, the panel 30 is  
substantially square and formed with downward projections 32 at  
four corners 36 of its underside. As shown in FIG. 6B, each  
projection 32 has a substantially hemispherical convex surface 32.

25 As shown in FIGS. 6A and 6B, a side wall or bent portion 34  
extends downward from a preselected portion of each of four sides  
of the unit panel 30 in order to provide the panel 30 with sufficient

1 rigidity. Each side wall 34 has a height  $h$  and is spaced from the  
adjacent corners 36 of the unit panel 30 by a preselected distance  
in order to facilitate the attachment and detachment of the panel  
30. The side wall 34 has extensions 38 at its opposite ends. The  
5 extensions 38 each is inserted into one of the grooves 14b of the  
associated main leg 14, as will be described in detail later. Each  
extension 38 has a height so selected as to facilitate the insertion  
and removal of the extension 38 from the associated groove 14b.  
Preferably, the height of the extensions 38 should lie in a range  
10 slightly smaller than the height  $h$  of the side walls 34, but not  
greater than substantially one half of the height  $h$ .

More specifically, each side wall 34 is notched stepwise by a  
preselected amount in order to form the opposite extensions 38.  
15 The extensions 38 serve to adjust the engaging force of the unit  
panel 30 and thereby facilitate the attachment and detachment of  
the panel 30 from the grooves 14b of the main legs 14. However,  
this kind of structure is only illustrative. The height and/or the  
area of the extensions 38 may be varied in order to adjust the  
20 engaging force, as desired.

How the unit panel 30 is mounted to the associated main legs  
14 will be described specifically hereinafter. FIG. 7 is an exploded  
fragmentary perspective view demonstrating how a single panel 30  
25 is mounted to the floor panel 10. As shown, a sheet 40 intervenes  
between the unit panel 30 and the floor panel 10 and plays the role  
of a cushioning member. The sheet 40 may advantageously be

1 formed of an elastic material having a cushioning ability. For  
example, use may be made of a 0.5 mm to 2.5 mm thick sheet  
formed of flexible synthetic resin, foam material, rubber, unwoven  
cloth or similar material.

5

In the illustrative embodiment, the sheet 40 has a generally  
octagonal shape, as seen in a plan view, identical with the shape of  
the support surface 14a of the main leg 14. Slits 41 are formed in  
the sheet 40 at such positions that they overlie the grooves 14b  
10 when the sheet 40 is put on the support surface 14a. Four through  
holes 14c extend in the main leg 14, as illustrated. The sheet 40 is  
laid on the support surface 14a of the main leg 14 while covering  
the holes 14c, and then affixed to the surface 14a by a two-sided  
adhesive tape or similar two-sided adhering member, not shown.

15

The unit panel 30 is laid on four adjacent main legs 14 and  
over one auxiliary leg 16 with the intermediary of the sheet 40. At  
this instant, each corner 36 of the unit panel 30 occupies  
substantially one-fourth of the support surface 14a of the main leg  
20 14 underlying it. The corners of the adjacent unit panels 30 sharing  
the support surface 14a of a single main leg 14 are spaced from  
each other by a preselected gap so as not to contact each other.

Each protuberance 32 extending downward from the  
25 underside of the unit panel 30 is fitted in the associated hole 14c of  
the main leg 14 from the above with the intermediary of the sheet  
40. The panel 30 is therefore free from shaking ascribable to its

1 engaging condition on the floor panel 10. The extensions 38 of each  
panel 30 are respectively inserted into the grooves 14b via the slits  
41 of the sheet or cushioning 40, so that the panel 30 is surely  
locked to the floor panel 10.

5

The panel 30 is simply flat, i.e., lacks the side wall 34 at each  
corner 36 over a preselected length. The flat portion of the unit  
panel 30 rests on the support surface 14a of the main leg 14 with  
the intermediary of the sheet 40. The flat portion therefore limits  
10 the depth to which the extension 38 can be inserted into the groove  
14b. It follows that the unit panel 30 mounted to the support  
surface 14a in the above configuration can be easily dismounted  
from the same. For example, the unit panel 30 may be lifted and  
then removed from the panel module 10 by use of a suitable jig.

15

The engagement of the main leg 14 of the floor panel 10 and  
the unit panel 30 will be described more specifically with reference  
to FIGS. 8A, 8B and 8C which are sections along line VIII-VIII of  
FIG. 7. First, assume that the base floor of the building is free from  
20 irregularities. Then, as shown in FIG. 8A, the protuberance 32 of  
the panel 30 can be easily inserted into the through hole 14c of the  
main leg 14 via the sheet 40. This is because the inner periphery of  
the hole 14c has its upper portion contiguous with the support  
surface 14a implemented as a tapered portion 15.

25

Further, because the bottom of the hole 14c is open, the  
protuberance 32 inserted into the hole 14c is sustained only by the

1 tapered portion 15 without abutting against the bottom of the hole  
14c. In this condition, the protuberance 32 is surely retained by  
the wall of the hole 14c. Even if the unit panel 30 bends for a  
moment due to, e.g., a load acting thereon, the protuberance 32 can  
5 be sustained by the wall of the hole 14c without fail.

Moreover, the sheet or cushioning 40 holds the protuberance  
32 in such a manner as to wrap it. Therefore, elasticity available  
with the sheet 40 itself serves to absorb shocks which may act on  
10 the panel 30 in the up-and-down direction. In addition, the sheet  
40 is sandwiched between the surface 32a of the protuberance 32  
and the tapered portion 15, and is therefore protected from tearing  
or similar damage.

15 As shown in FIG. 8A, the extension 38 of the panel 30 is  
inserted into the groove 14b via the slit 41 of the sheet 40. At this  
instant, the portion of the sheet 40 around the slit 41 bends  
downward and maintains the edge 41a of the slit 41 in contact with  
the extension 38 at all times. In this condition, high frequency  
20 noise, among others, unpleasant to the human auditory sense and  
including the echoes of footsteps on the unit panels 30 can be  
reduced.

Assume that the floor panel 10 follows an irregularity existing  
25 on the base floor, causing the main leg 12 to be displaced. Then, the  
protuberance 32 of the unit panel 30 and the hole 14c of the main  
leg 14 are displaced from each other, as shown in FIG. 8B. In this

1 condition, the surface 32a of the protuberance 32 bites into the  
sheet 40 existing between the surface 32a and the tapered portion  
15. This successfully locks the protuberance 32 to the main leg 14,  
and at the same time cushions the unit panel 30 on the floor panel  
5 10. In addition, the sheet 40 intervenes between the unit panel 30  
and the support surface 14a of the main leg 14 and prevents them  
from directly contacting each other, as represented by a circled  
portion F in FIG. 8B. Therefore, the unit panel 30 can be cushioned  
more positively.

10

Further, assume that the unit panel 30 is slightly raised above  
the support surface 14a of the main leg 14 due to an irregularity  
existing on the base floor, as shown in FIG. 8C. Then, the portion of  
the sheet 40 yielding into the hole 14c contacts the protuberance 32  
15 of the unit panel 30 due to its elasticity, i.e., cushioning ability. As a  
result, the panel 30 is free from shaking ascribable to the  
irregularity of the base floor. This, coupled with the fact that the  
edge 41a of the slit 41 of the sheet 40 remains in contact with the  
extension 38 and side wall 34 contiguous with the extension 38,  
20 successfully reduces noise ascribable to footsteps.

It may occur that the irregularity of the base floor is so great,  
the protuberance 32 gets on the support surface 14a outside of the  
hole 14c. Even in such a case, the unit panel 30 can be surely fixed  
25 in place because the extension 38 remains in the groove 14b.  
Again, the sheet 40 intervening between the protuberance 32 and  
the support surface 14a cushions the unit panel 30.

1           As stated above, even when any one of the floor panels or  
panel modules 10 is displaced due to the irregularity of the base  
floor, the unit panels 30 laid on the panel module can be surely  
retained on the module 10. Also, the unit panels 30 remain stable  
5   on the panel module 10 without shaking, and the echoes of  
footsteps on the panels 30 are positively reduced.

          The configuration of the protuberance 32 of the unit panel 30  
shown and described is only illustrative. When the unit panel 30 is  
10   implemented by a steel sheet, the protuberance 32 may be replaced  
with a finger- or a tongue-like protuberance formed by, e.g.,  
punching, stamping or pressing. The crux is that the protuberance  
32 be capable of positioning and affixing the panel 30, capable of  
absorbing an irregularity via the sheet 40, and capable of mating  
15   with the hole 14c.

          FIG. 9A shows a structure lacking the protuberance 32 and  
through hole 14c for receiving a part of the protuberance 32. Even  
with this structure, it is possible to reduce, e.g., the echoes of  
20   footsteps on the unit panels 30 if the edges 41a of each slit 41 are  
held in contact with the extensions 38 of the panels 30 at all times,  
as shown in FIG. 9B. In addition, the support surface 14a of the  
main leg 14 and the adjacent panels 30 contact each other with the  
intermediary of the sheet 40. This prevents the adjacent panels 30  
25   spaced by a preselected gap from shaking.

1           Specifically, as shown in FIG. 9A, the unit panels 30 have their  
sides configured such that the opposite edges 41a of the slit 41 of  
the sheet 40 at least contact the above sides or even urge them  
toward each other. The sheet 40 covers the groove 14b formed in  
5   the top of the main leg 14 in order to reduce the echoes of  
footsteps. When such unit panels 30 are laid on the floor panel 10,  
the extensions 38 of the nearby panels 30 are received in the  
grooves 14b, as shown in FIG. 9B. In this condition, the edges 41a  
of the slit 41 at least contact the inner surfaces of the extensions 38  
10   of the unit panels 30 or even urge them toward each other. As a  
result, the echoes of footsteps, particularly high frequency  
components unpleasant to the human auditory sense, are reduced.

          The structure shown in FIGS. 9A and 9B has the following  
15   advantages. The sheet 40 contacts or holds the unit panel 30 only if  
the panel 30 has its extension 38 inserted into the groove 14b of  
the main leg 14, reducing the echoes of footsteps. The sheet 40  
should only be placed on the support surface 14a of the main leg 14  
with its slit 41 positioned above the groove 14b. Moreover, when a  
20   person walks on the unit panel 30 or when some load acts on the  
panel 30, the sheet 40 contacts at least one end of one edge of the  
panel 30 received in the groove 14b and thereby holds the panel  
30. Therefore, the unit panel 30 is surely prevented from  
producing noise even if the base floor has some irregularity.

25

          A modification of any one of the embodiment shown in FIGS.  
7, 8A, 8B, 8C, 9A and 9B will be described with reference to FIG. 10.

1 As shown, a floor panel 50 to be laid on the base floor of includes a  
support portion 54 formed with a preselected number of  
protuberances 51. Unit panels 60 to be mounted to the floor panel  
50 each has two through holes (only one is shown) 65 formed  
5 therein. This modification is similar to the configuration shown in  
FIG. 8A except that the hole 14c is inverted in position in the up-  
and-down direction. The modification is comparable with the  
configuration of FIG. 8A as to the function, operation, and  
advantages.

10

Specifically, the support portion 54 has a particular size  
depending on its position. The protuberances 51 are formed at  
preselected positions within the support portion 54. The  
protuberances are similar to the protuberances 32 shown in FIG. 3A  
15 except that they are turned upside down in the up-and-down  
direction.

The unit panels 60 each has a flat top wall 61 and four legs  
(only one is shown) 62 extending downward from the four corners  
20 of the top wall 61. The legs 62 each is made up of a wall 63 having  
a preselected height, and a bottom 64 extending from the lower end  
of the wall 63 in parallel with the top wall 61 toward the bottom  
64, not shown, of the opposite leg 62, not shown. The two through  
holes 65 are formed in the preselected positions of the bottom 64  
25 and capable of receiving the protuberances 51 of the support  
portion 54.

1           As shown in FIG. 10, a sheet or cushioning 80 is laid on the  
bottom 53 of the support portion 54 and has a substantially  
rectangular configuration so as to be positioned on the bottom 53.  
The sheet 80 should only be laid on the bottom 53 of the support  
5   portion 54, i.e., it does not have to be adhered to the bottom 53 as  
in the previous embodiments. In addition, the sheet 80 does not  
have to be formed with the slits 41 assigned to the extensions 38 of  
the unit panels 30.

10           In any of the above embodiment and modification, the panels  
30 or 60 can be positioned and affixed accurately by a simple  
procedure via the protuberances 32 of the panels 30 or 60 or the  
protuberances 51 of the support portions 54. This allows a modular  
floor and therefore a double floor structure to be constructed with  
15   ease.

          In any one of the structures shown and described, the through  
holes 14c may each be replaced with a bore having a bottom at its  
level where the sheet 40 pushed into the bore by the associated  
20   protuberance 32 will not contact the bottom.

          Each floor panel 10 or 50 should preferably be implemented  
as a single molding of noncombustible or noninflammable resin.  
Preferably, the panel module 10 or 50 is sized about 450 mm to  
25   about 600 mm square based on the tile carpet size. The unit panel  
30 and 60 should each preferably be implemented as an about 100  
mm to 200 mm square, about 1.0 mm to 2.5 mm thick steel sheet to

1 be laid on one of a plurality of divided areas of the floor panel 10.  
This kind of unit panel is capable of following and even absorbing  
the irregularity of the base floor and is light weight. The unit panel  
is therefore easy to transport and lay and implements a double  
5 floor structure sufficiently withstanding loads.

The cushioning sheet 40 or 80 may each be formed of a  
vibration reducing material or a sound absorbing material, if  
desired. The crux is that the sheet 40 or 80 be formed of an elastic  
10 material capable of protecting the unit panel 30 from shaking  
ascrivable to the irregularity of the base floor, and reducing, e.g.,  
the echoes of footsteps on the modular floor.

The configuration of each main leg or first support portion 14  
15 will be described more specifically with reference to FIGS. 11A and  
11B. As shown, the main leg 14 has incisions 14d in addition to the  
grooves 14b which play the role of guides in the event when the leg  
14 is cut apart, as will be described. The incisions 14d are  
contiguous with the grooves 14b and formed in either one of the  
20 lower part of the outer periphery of the leg 14 and the support  
surface or top 14a of the leg 14. A cutter or similar cutting tool  
may be applied to the incisions 14d and then pressed in the up-  
and-down direction in order to cut apart the leg 14. As shown in  
FIG. 11B, the leg 14 is made up of four hollow blocks 14-1, 14-2,  
25 14-3 and 14-4 positioned at the four corners of the leg 14. The  
hollow blocks 14-1 through 14-4 each has the top wall 14a, an  
outer side wall 15 and an inner side wall 13 each having a

1        preselected thickness  $t$ . Therefore, the hollow blocks 14-1 through  
14-4 each has a sufficient mechanical strength even when the leg  
14 is cut apart into two or four along the incisions 14d.

5            In the configuration shown in FIGS. 11A and 11B, the incisions  
14d are formed in both the lower portion of the outer periphery  
and the top 14a of the main leg 14. Alternatively, the incisions 14d  
may be formed only in the outer periphery or even in the inner  
periphery of the leg 14. If desired, such a different configurations  
10        of the leg 14 may be used either individually or in combination.

          FIGS. 12A and 12B each shows another specific configuration  
of the main leg 14 in a plan view (top) and a side elevation  
(bottom). As shown, four blocks 14-1 through 14-4 indicated by  
15        hatching each has the grooves 14b for receiving the side walls 34 or  
their extensions 38 of the unit panels 30, and the incisions 14d for  
allowing the leg 14 to be cut apart. In FIG. 12A, the incisions 14d  
are formed in the outside of the leg 14 with respect to the grooves  
14b while, in FIG. 12B, they are formed in the inside of the leg 14.

20

          In any one of the configurations shown in FIGS. 11A through  
12B, a cutter or similar cutting tool may be applied to at least one of  
the incisions 14d and then pressed in the up-and-down direction.  
This allows the leg 14 to be easily cut apart so as to form a space  
25        for receiving, e.g., a wiring device.

1           In FIGS. 11A and 11B, the leg 14 additionally has a through  
hole 19 having a circular cross-section at its center. When it is  
desired to cut away only one-fourth of the leg 14, in terms of the  
area of the top 14a, in order to form a space for receiving a wiring  
5 device, the through hole 19 prevents cuts from extending to the  
remaining three-fourths of the area of the top 14a.

          For example, an edged tool whose length is greater than the  
width of the leg 14 may be applied to any desired incisions 14d and  
10 the pressed or stamped in the up-and-down direction. With this  
kind of tool, it is possible to cut away one or more of the legs 14 at  
the same time, and therefore to facilitate the construction of the  
modular floor.

15           FIGS. 13A through 13D each shows a particular condition  
wherein the floor panel 10 including the legs 14 and 24, stubs 26,  
tie bars 18 and arms 22 is cut apart according to a preselected rule  
in order to reassemble a particular floor module. In FIG. 3, the floor  
panel 10 is cut apart along bold lines 101 and 103 so as to separate  
20 it into submodules a1-a4. In FIG. 13B, the floor panel 10 is cut  
apart along three bold lines 101 in order to separate it into  
submodules b1-b4. In FIG. 13C, the floor panel 10 is cut apart  
along a single bold line 101 and a single bold line 103 in order to  
separate it into submodules c1-c4. In FIG. 13D, the floor panel 10 is  
25 cut apart along two bold lines 101 and four bold lines 105 in order  
to separate it into submodules d1-d3. In this manner, the floor

1 panel 10 is cut apart according to a preselected rule. This step will  
be referred to as a first step.

5 In a second step, the submodules separated in the above first  
step have their legs 24 and stubs 26 coupled together in order to  
prevent them from appearing at the edges of the main legs 14. As  
a result, a floor module different in configuration from the floor  
module 10 is reconstructed. Specifically, the submodules a1-a4  
10 shown in FIG. 13A are rotated 180 degrees each and then have  
their legs 24 and stubs 26 coupled together in such a manner as to  
form a floor module shown in FIG. 14A.

The submodules b1-b4 shown in FIG. 13B and divided into  
three in the horizontal direction are reassembled in a horizontal  
15 array. First, the submodules b2 and b3 are connected horizontally  
via their legs 24 and stubs 26, and then the submodules b1 and b4  
are located to face each other and connected together in the same  
manner. The resulting b1 and b4 subassembly is connected to the  
above subassembly b3 horizontally. As a result, a panel module  
20 shown in FIG. 14B is produced.

The submodules c1-c4 shown in FIG. 13C are separated by  
cutting the floor panel 10 at its right side and bottom side. The  
submodules c1-c4 are again connected together at their positions  
25 symmetrical to their cut positions. First, the submodules c1 and c2  
are connected together at their left sides, and then the submodules  
c3 is connected to the submodule c1 at its one end. The remaining

1 submodule c4 is placed at the top left of FIG. 13C. Consequently, a  
panel module shown in FIG. 14C is produced which is basically  
identical with the panel module shown in FIG. 14A.

5 Further, the submodules d1-d3 shown in FIG. 13D are  
separated by cutting apart the upper and lower portions and four  
corner portions of the floor panel 10. The submodules d2 and d3  
are connected to both sides of the submodule d1 via the legs 24 and  
stubs 26. The four corner portions are not connected to any of the  
10 submodules d1-d3. As a result, an oblong panel module shown in  
FIG. 14D is produced.

A plurality of panel modules having any one of the above  
specific configurations is sequentially laid on the floor of a building  
15 so as to construct a modular floor for a double floor structure.

In a third step, a plurality of unit panels 30 are evenly laid on  
each of the above panel modules such that they are sustained by  
the main legs or first support portions 14 and auxiliary legs or  
20 second support portions 16.

As stated above, by cutting apart the main legs 14 along the  
incisions 14d according to any desired rule, e.g., one of the rules  
shown in FIGS. 13A-13D, it is possible to reconstruct a floor panel or  
25 panel module different in shape and/or area from the original floor  
panel 10. The reconstructed floor panel includes no legs 24 or no  
stubs 26 extending out therefrom, as shown in any one of FIGS.

1 14A-14D specifically. This kind of rearranged floor panel may be  
laid in a residual space on the base floor or in abutment against  
another kind of floor panel, e.g., the boarder panel 50, FIG. 5,  
facilitating the work for filling up residual spaces adjoining the  
5 walls. In addition, because the area of the rearranged floor panel is  
variable, the floor panel can be configured in matching relation to  
the residual area adjoining the walls.

Of course, the four different cutting patterns shown in FIGS.  
10 13A-13D are only illustrative. In accordance with the present  
invention, the main legs 14 may alternatively be cut apart and then  
rearranged complementarily to, e.g., a notch around a pillar.

#### Industrial Applicability

15 In summary, it will be seen that the present invention  
provides a floor panel including support portions and useful as, e.g.,  
a mat or a tile to be laid on the floor either inside or outside of a  
building. In addition, the floor panel of the present invention is  
capable of forming a modular floor lying over the floor of a building  
20 in a double floor structure, i.e., a so-called free access floor. The  
spaces available in the double floor structure may be used to  
arrange pipings, under-floor air conditioning arrangements, etc.  
Such spaces may even be used to store any desired goods.

25

## CLAIMS

1           1. A floor panel comprising:

          a group of support portions (14, 16) arranged in a substantially polygonal configuration, as seen in a plan view;

          a plurality of coupling portions (24) arranged at at least one of  
5       two contiguous sides of said group of support portions, and each being substantially identical in configuration with said second support portions (16) and having a concave bottom; and

          a plurality of coupling portions (26) arranged at at least one of  
          other two contiguous sides of said group of support portions, and  
10       each having a convex portion complementary to said concave bottom of the coupling portion (24), whereby said coupling portions of one floor panel are coupled over said coupling portions of another floor panel from the above.

1           2. A floor panel in accordance with claim 1, wherein said coupling portions (24) said coupling portions (26) are coupled together and laid on a floor of a building, constituting a modular floor (10) over the floor of the building.

1           3. A floor panel in accordance with claim 1, further comprising a plurality of unit panels (30) laid on tops of said (14, 16), each of said unit panels (30) having each corner thereof supported by substantially one-fourth of an area of the top of any one of said  
5       support portions, and having a substantially center thereof supported by the top of any one of said support portion.



1           4. A floor panel in accordance with claim 1, wherein said  
support portions (14, 16) comprise:

main legs (14) spaced from each other by a preselected  
distance; and

5           said portions (16) comprise auxiliary legs each being  
positioned between nearby main legs at a preselected distance and  
having a diameter different from a diameter of said main legs.

1           5. A floor panel in accordance with claim 3, wherein said  
support portions (14, 16) include a plurality of blocks (14-1, 14-2,  
14-3, 14-4) formed in the vicinity of the top thereof supporting  
corners (36) of said panels (30), and divided from each other by  
5           incisions (14d).

1           6. A floor panel comprising:

a group of support portions (14, 16) arranged in a  
substantially polygonal configuration, as seen in a plan view;

arms (22) connecting said plurality of support portions, and  
5           extending substantially radially with a preselected width to thereby  
locate said plurality of support portions at a substantially same  
distance;

first coupling portions (24) provided on the arms extending  
outward from the first support portions (14, 16) arranged at at  
10          least one of two contiguous sides of said support portions;

second support portions (26) provided on the arms extending  
out from the support portions (14, 16) arranged at at least one of  
the other two contiguous sides of said support portions;



wherein when said first coupling portions (24) of one floor  
15 panel and said second coupling portions (26) of another floor panel  
are engaged with each other, and wherein said support portions  
(14, 16) are uniformly spaced by a substantially same distance by  
said arms (22).

1 7. A floor panel in accordance with claim 6, further comprising  
unit panels (30) laid on tops of said support portions (14, 16), each  
of said unit panels (30) having each corner thereof supported by  
substantially one-fourth of an area of the top of any one of said  
5 support portions, and having a substantially center thereof  
supported by the top of any one of said support portions.

1 8. A floor panel in accordance with claim 6, wherein said  
support portions (14, 16) comprise:

main legs (14) spaced from each other by a preselected  
distance;

5 said portions (16) comprising auxiliary legs (16) each being  
positioned between nearby main legs (14) at a preselected distance  
and having a diameter different from a diameter of said main legs  
(14).

1 9. A floor panel in accordance with claim 6, wherein said  
support portions (14, 16) each includes a plurality of blocks (14-1,  
14-2, 14-3, 14-4) formed in the vicinity of the top thereof  
supporting corners (36) of said panels (30), and divided by incisions  
5 (14d) from each other.



1           10. A method of constructing a floor panel, comprising:  
a first step of preparing a floor panel (10) comprising a group  
of support portions (14, 16) arranged in a substantially polygonal  
configuration, as seen in a plan view, arms (22) connecting said  
5 support portions and extending substantially radially with a  
preselected width to thereby locate said support portions at a  
substantially same distance, first coupling portions (24) provided on  
the arms extending outward from at least one of said support  
portions arranged at at least one of two contiguous sides of said  
10 support portions, second coupling portions (26) provided on the  
arms extending out from the other of said support portions  
arranged at at least one of the other two contiguous sides of said  
support portions, said first coupling portions (24) and said second  
coupling portions (26) being engageable with each other;  
15 a second step of coupling said first coupling portions (24) and  
said second coupling portions (26) to thereby lay a plurality of floor  
panels (10); and  
a third step of laying a plurality of unit panels (30) on said  
support portions (14, 16) such that said unit panel have corners and  
20 substantially centers thereof sustained by tops of said support  
portions, whereby a modular floor for a double floor structure is  
constructed.

1           11. A method in accordance with claim 10, further comprising  
a fourth step of laying, after said third step, unit panels (30)



contiguously with said unit panels (30) in order to bridge border portions (50) adjoining walls or pillars.

1           12. A floor panel comprising:

          a group of support portions (14, 16) made up of a plurality of support portions;;

          arms (22) connecting said support portions and locating said  
5 : support portions at a substantially same distance;

          unit panels (30) laid on tops of said support portions (14, 16);  
and

          engaging portions (14b, 14c; 38, 34) for allowing the top (14a)  
of any one of said support portions and one corner portion (36) of  
10 any one of said unit panels to be engaged with each other.

1           13. A floor panel in accordance with claim 12, further  
comprising a cushioning (40) intervening between each of said  
support portions (14, 16) and each of said unit panels (30), and at  
least contacting the engaging portions of the unit panel (30).

1           14. A floor panel in accordance with claim 12 or 13, wherein  
said engaging portions (14a, 14b; 38, 34) comprise:

          protuberances (32, 51) formed on a support surface (36) of  
corner portions of said unit panel (30, 60) or a panel support  
5 surface of a support portion (54); and

          through holes (14c, 65) formed in the top (14a) of an  
individual first support portion or support surfaces (64) of corners



of an individual unit panel, said protuberances being received in said through holes.

1           15. A floor panel in accordance with any one of claims 12, 13  
and 14, wherein said engaging portions (14b, 14c; 38, 34) comprise:  
            grooves (14b) formed in the top of an individual support  
portion (14); and  
5           notched portions (38) extending from side edges of corners of  
an individual unit panel (30) and mating with said grooves (14b).

1           16. A floor panel in accordance with any one of claims 12, 13  
and 15, wherein when any one of said unit panels (30) is laid on the  
top (14a) of any one of said support portions, one of said engaging  
portions (38) of the one unit panel mates with an associated one of  
5           said grooves (14b) while the other of said engaging portions (38)  
mates with a groove (50b) formed in a top of a border portion (50),  
whereby said one unit panel (30) bridges a space between the one  
support portion and said border portion in a flush configuration.

1           17. A floor panel in accordance with claim 12, wherein said  
support portions (14, 16) each includes a plurality of blocks (14-1,  
14-2, 14-3, 14-4) formed in the vicinity of the top thereof  
supporting corners (36) of said panels (30), and divided by incisions  
5           (14d) from each other.

1           18. A floor panel in accordance with any one of claims 13, 15  
and 16, wherein said cushioning (40) at least partly contacts said



unit panel (30) when said unit panel is laid on the top of said first support portion.

1           19. A floor panel unit comprising:

          a plurality of support portions (14, 16) arranged in a plurality of arrays; and

          arms (22) connecting said support portions to each other;

5           said support portions (14) each including a plurality of incisions (14d) formed in at least one of a top (14a), an outer periphery (15) and an inner periphery (13) and substantially serving as reference positions, whereby the first support portion is capable of being cut apart in a vertical direction.

1           20. A floor panel unit in accordance with claim 19, wherein said support portions (14) each includes engaging portions (14d) formed on a top and each being engaged with an edge of a unit panel (30) when said unit panel is laid on said top;

5           said engaging portions (14b) substantially serving as reference positions for cutting apart the support portion.

1           21. A floor panel unit in accordance with claim 19 or 20, wherein said plurality of first support portions each includes a plurality of blocks formed in the vicinity of a top supporting corners of said panels, and divided by incisions from each other.

1           22. A method of laying a floor panel, comprising:



a first step of preparing a floor panel unit (10) comprising a plurality of arrays of support portions (14, 16), arms (22) connecting said support portions to each other, said support  
5 portions each including a plurality of incisions (14d) formed in at least one of a top (14a), an outer periphery (15) and an inner periphery (13) and substantially serving as reference positions so as to be capable of being cut apart in a vertical direction, and coupling portions (24, 26) provided on said arms extending out  
10 from said support portions (14, 16);

a second step of cutting apart said floor panel unit (10) according to a preselected rule along said plurality of incisions (14d) to thereby form a plurality of divided floor panel units (a1-a4, b1-b4, c1-c4, d1-d3); and

15 a third step of connecting said divided floor panel units (a1-a4, b1-b4, c1-c4, d1-d3) via said coupling portions (24, 26) such that said coupling portions (24, 26) do not appear at outside of said support portions, whereby a coupled floor panel unit (FIGS. 14A-14D) different from said floor panel unit (10) is reconstructed.



1

## ABSTRACT OF THE DISCLOSURE

A floor panel of the present invention and a method of laying it includes a group of support portions (14, 16) made up of main legs (14) and auxiliary legs (16) arranged in a polygonal configuration, as seen in a plan view, and spaced from each other by a preselected distance. Arms (22) having a preselected width extend substantially radially to connect the main legs and auxiliary legs. Legs (24) for connection are formed on those arms extending out from the support portions adjoining one of two contiguous sides of the polygon. Stubs (26) for connection are formed on those arms extending out from the support portions adjoining one of the other two contiguous sides of the polygon. Such floor panels (10) are connected together with their legs (24) and stubs (26) mating with each other. Unit panels (30) each is supported by one-fourth of the area of the top of the individual main leg (14) at its corner and by the individual auxiliary leg (16, 24) at its center. The floor panels connected together form a modular floor over the floor of a building, implementing a double floor structure.

FIG. 1 A

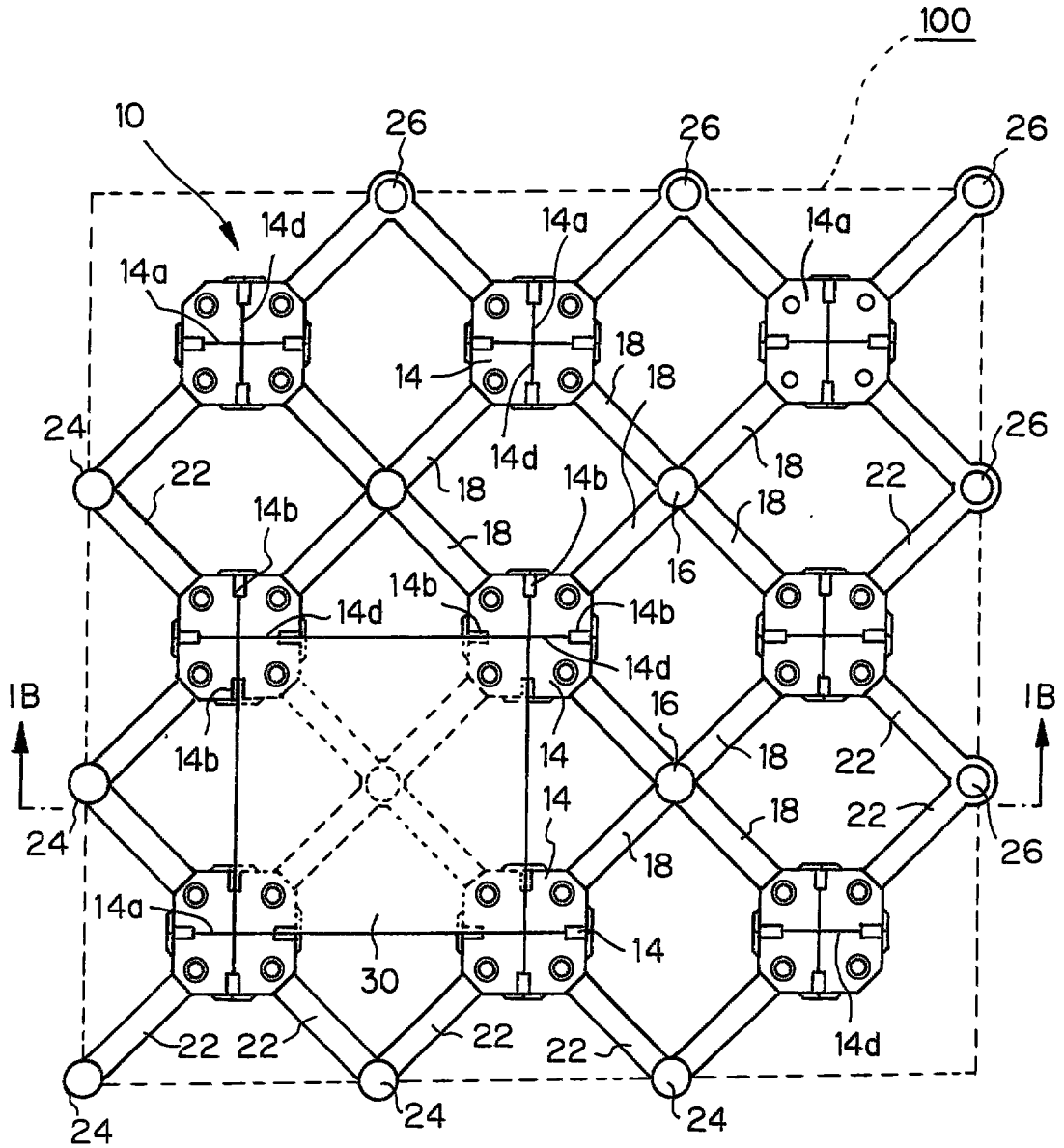
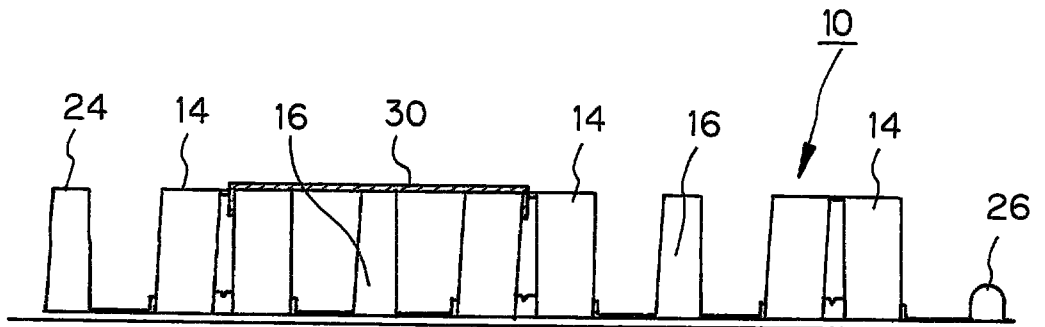


FIG. 1 B



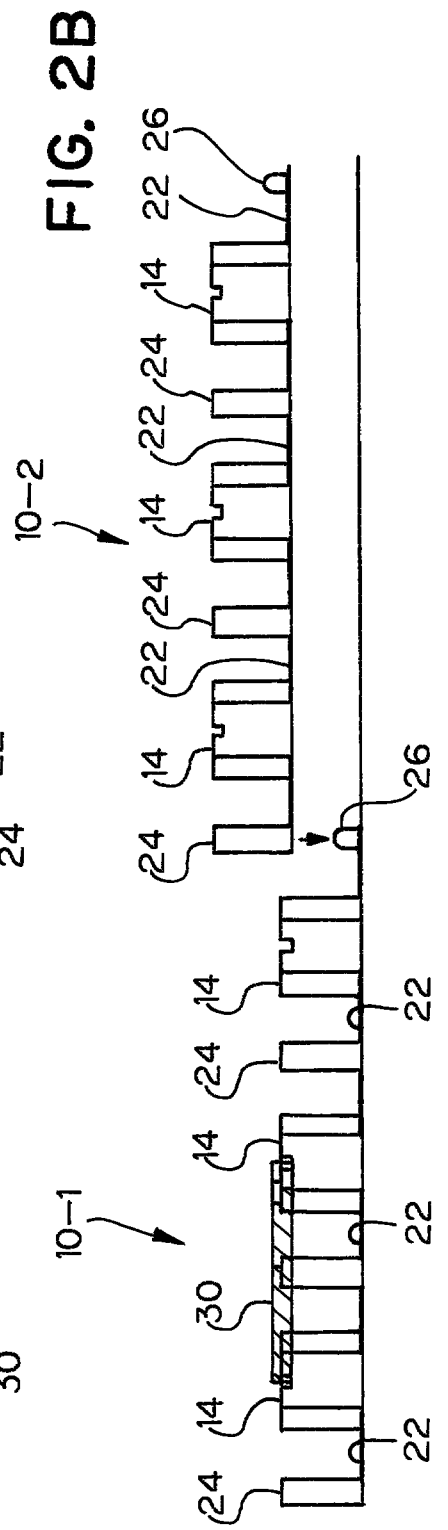
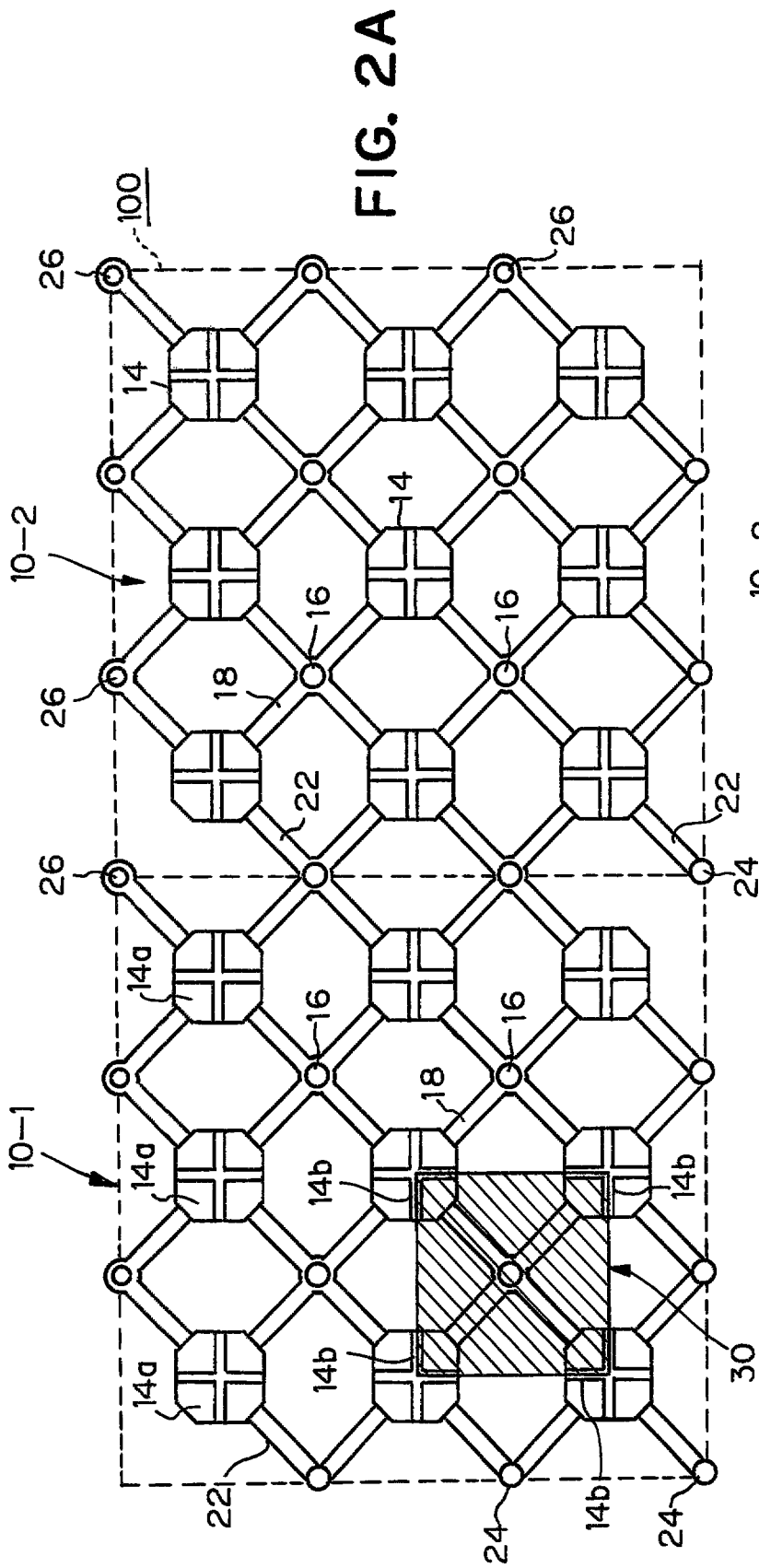


FIG. 3A

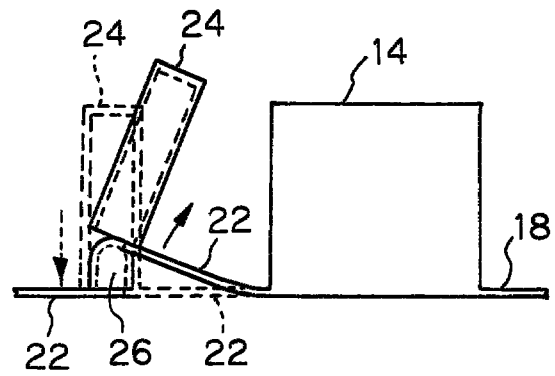


FIG. 3B

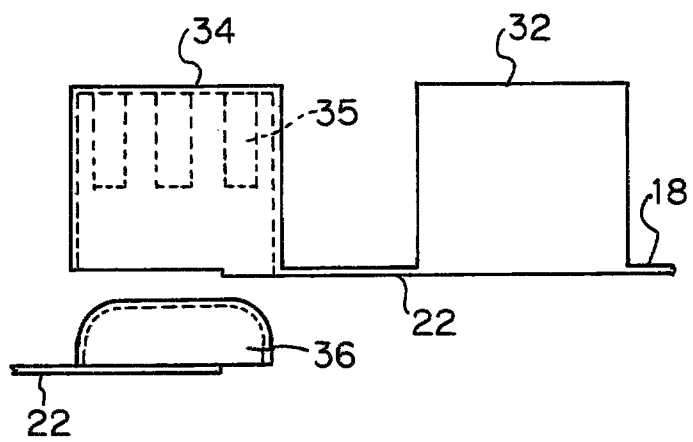


FIG. 3C

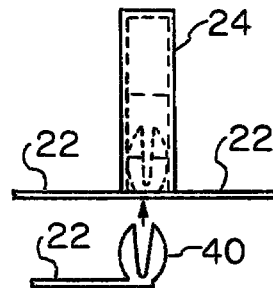
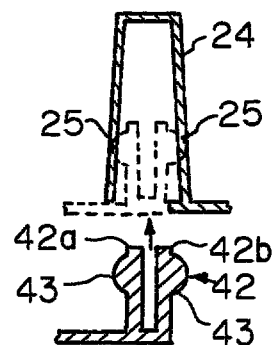


FIG. 3D



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FIG. 6A

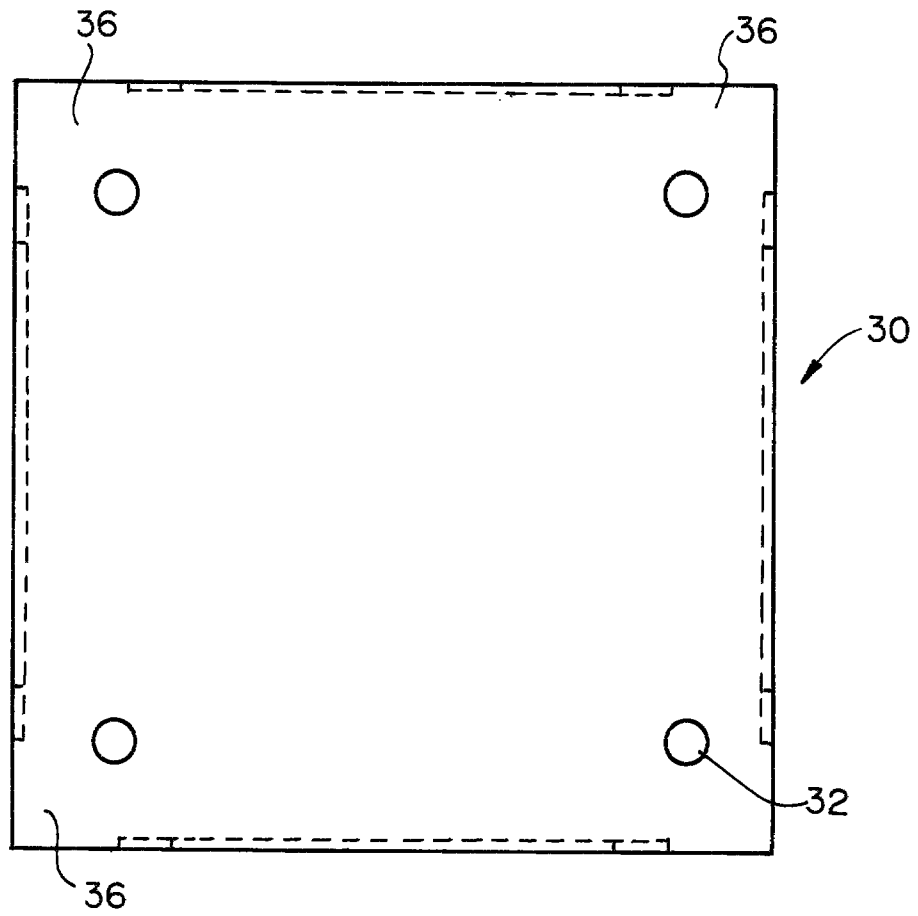


FIG. 6B

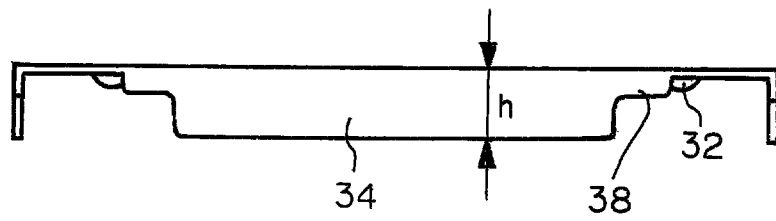


FIG. 7

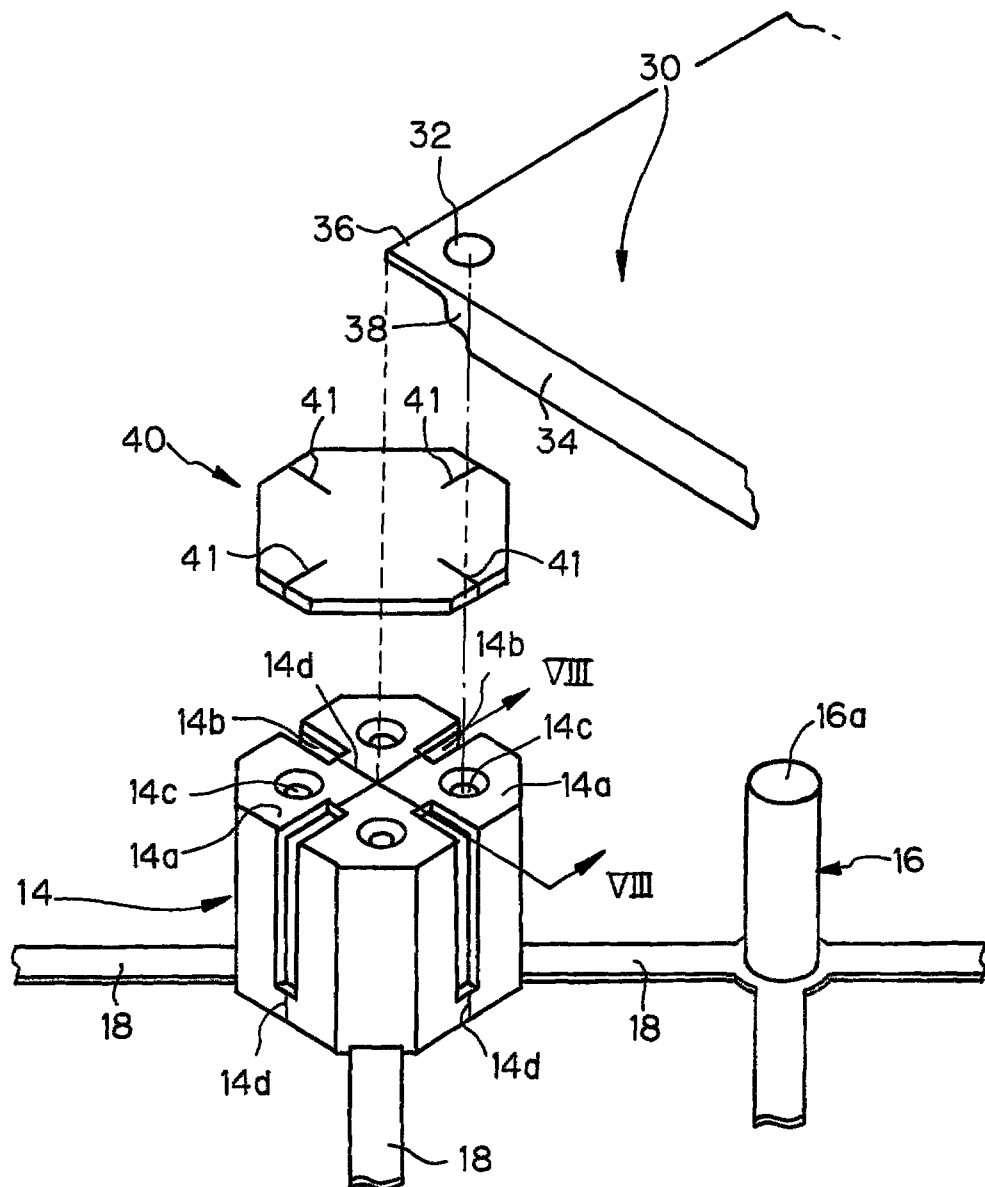


FIG. 8A

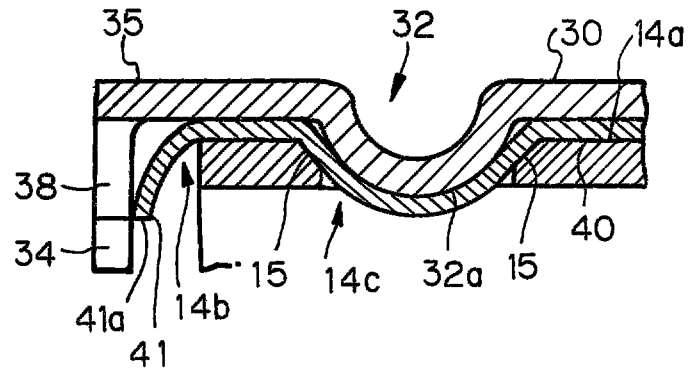


FIG. 8B

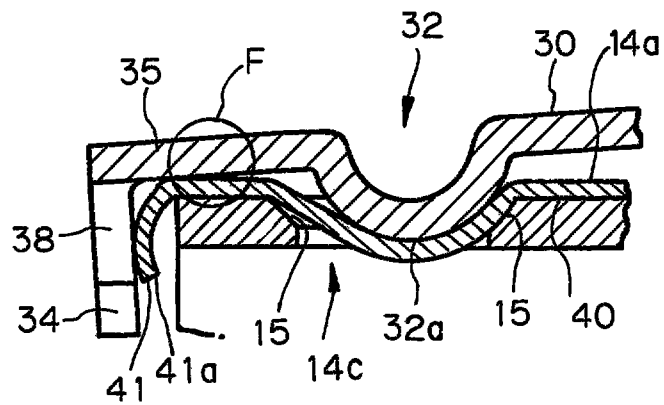


FIG. 8C

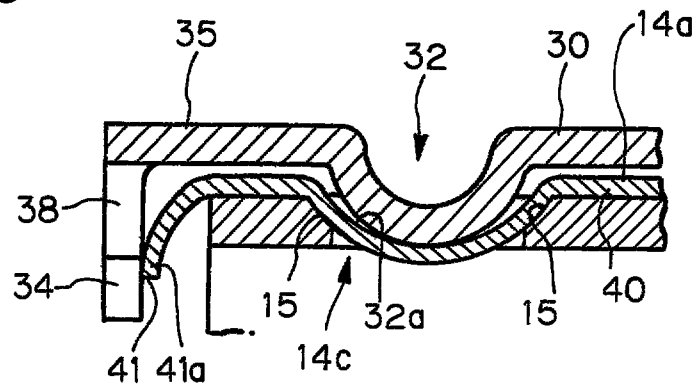


FIG. 9A

8/11

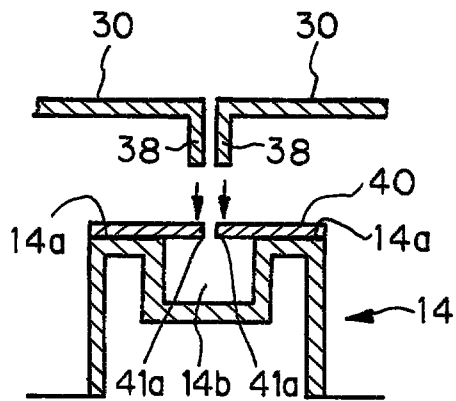


FIG. 9B

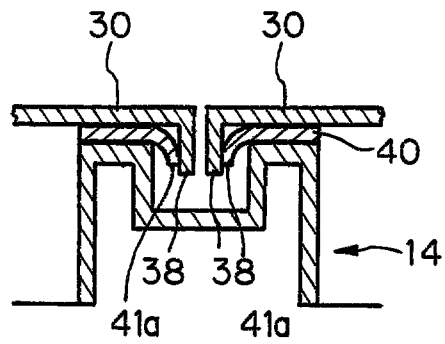


FIG. 10

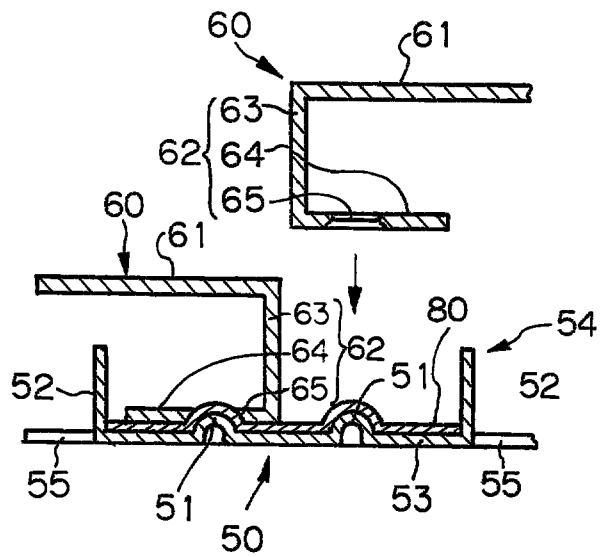


FIG. 11A

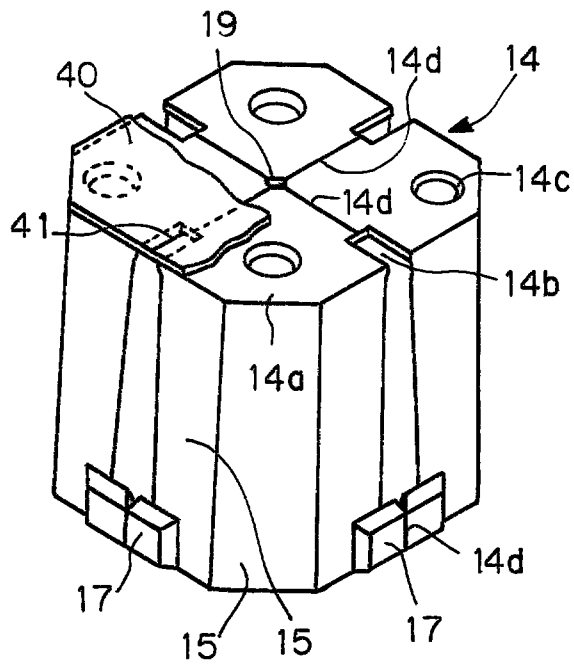


FIG. 11B

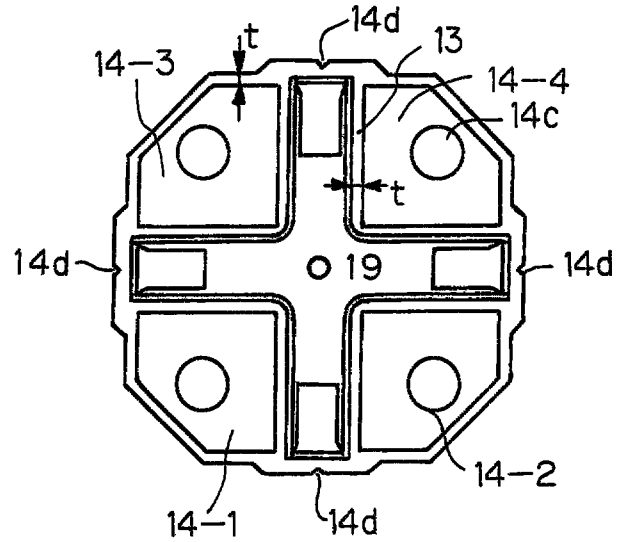


FIG. 12A

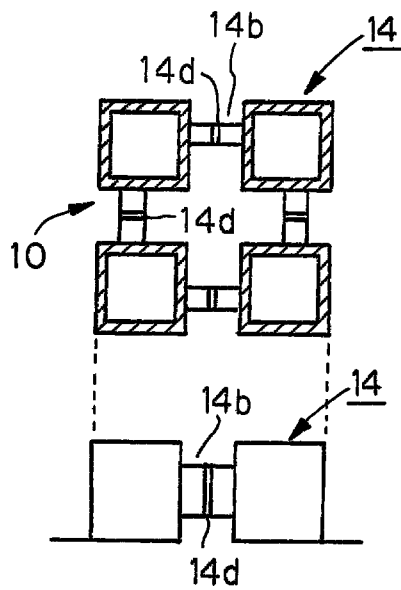


FIG. 12B

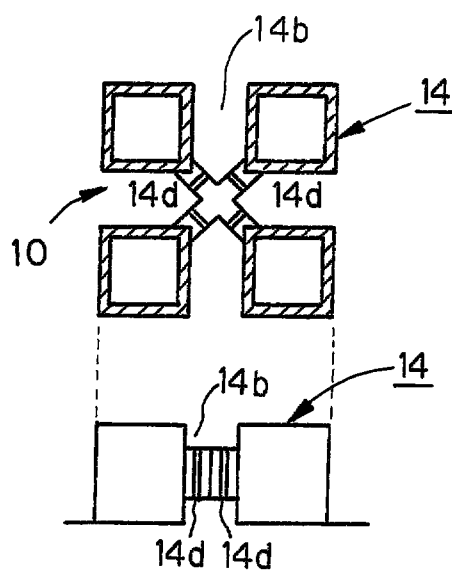


FIG. 13A

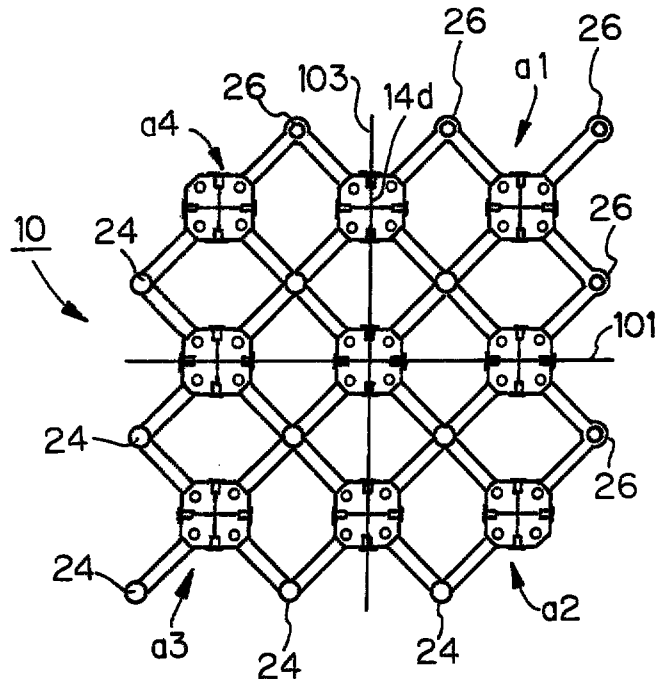


FIG. 13B

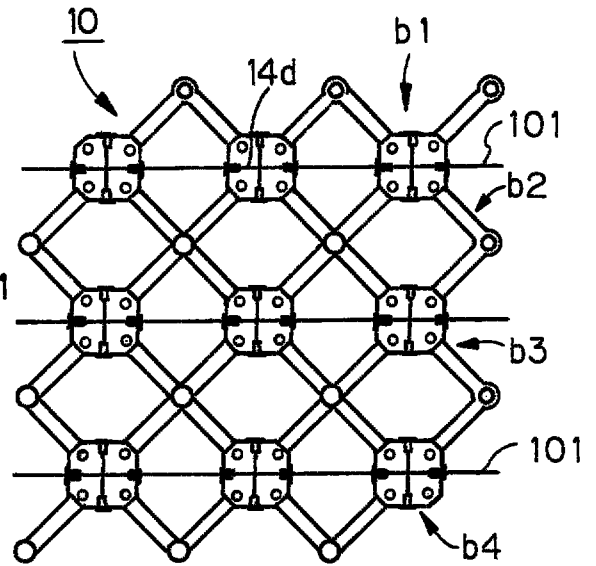


FIG. 13C

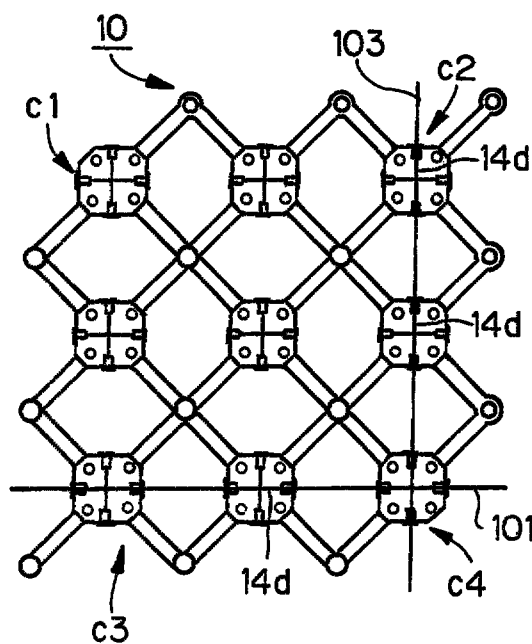


FIG. 13D

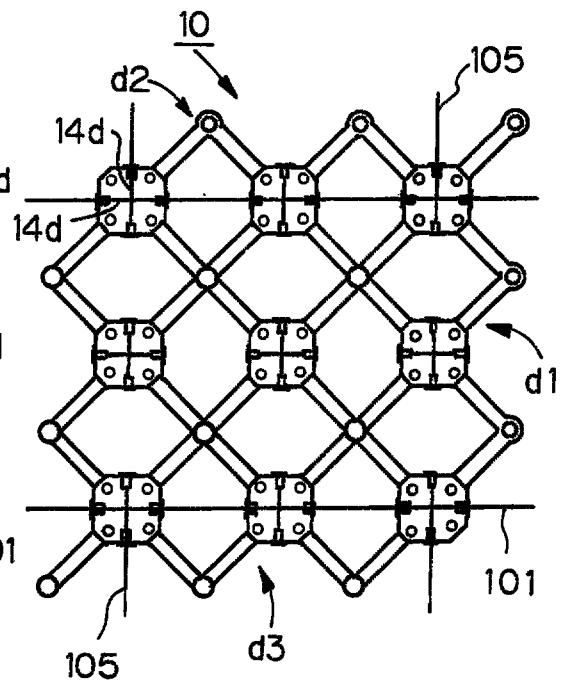


FIG. 14A

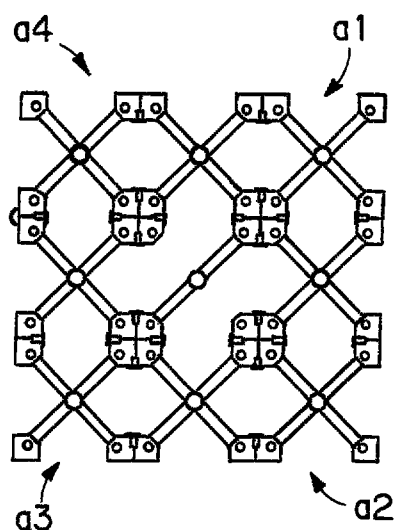


FIG. 14B

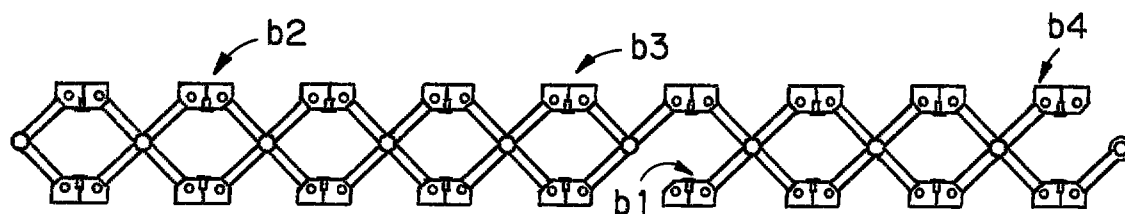


FIG. 14C

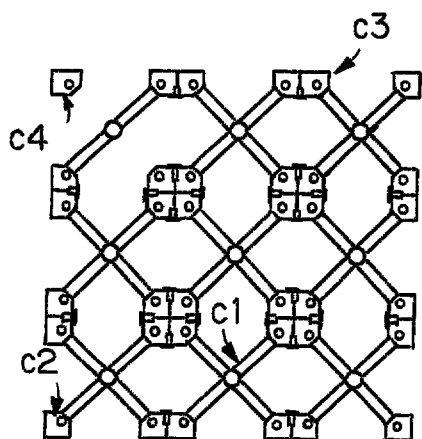
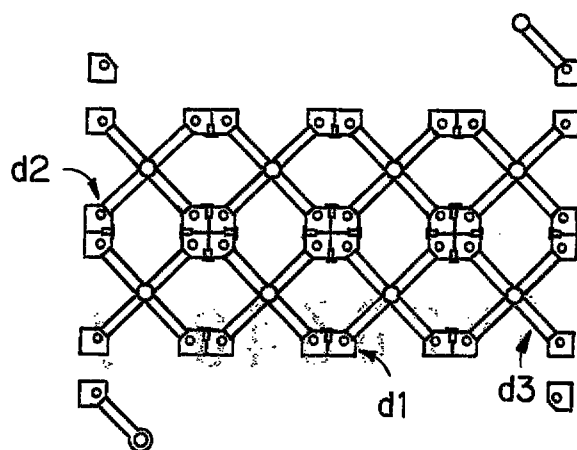


FIG. 14D



## CLAIMS

- 1           1. (Amended) A floor panel comprising:  
          a group of support portions (14, 16) arranged in a  
          substantially polygonal configuration, as seen in a plan view;  
          a plurality of coupling portions (24) arranged at at least one of  
5       two contiguous sides of said group of support portions, and each  
          being substantially identical in configuration with said second  
          support portions (16) and having a concave bottom; and  
          a plurality of coupling portions (26) arranged at at least one of  
          other two contiguous sides of said group of support portions, and  
10       each having a convex portion complementary to said concave  
          bottom of the coupling portion (24), whereby said coupling portions  
          of one floor panel are coupled over said coupling portions of  
          another floor panel from the above.
- 1           2. (Amended) A floor panel in accordance with claim 1,  
          wherein said coupling portions (24) said coupling portions (26) are  
          coupled together and laid on a floor of a building, constituting a  
          modular floor (10) over the floor of the building.
- 1           3. (Amended) A floor panel in accordance with claim 1,  
          further comprising a plurality of unit panels (30) laid on tops of  
          said (14, 16), each of said unit panels (30) having each corner  
          thereof supported by substantially one-fourth of an area of the top  
5       of any one of said support portions, and having a substantially  
          center thereof supported by the top of any one of said support  
          portion.



1           4. A floor panel in accordance with claim 1, wherein said  
support portions (14, 16) comprise:

main legs (14) spaced from each other by a preselected  
distance; and

5           said portions (16) comprise auxiliary legs each being  
positioned between nearby main legs at a preselected distance and  
having a diameter different from a diameter of said main legs.

1           5. A floor panel in accordance with claim 3, wherein said  
support portions (14, 16) include a plurality of blocks (14-1, 14-2,  
14-3, 14-4) formed in the vicinity of the top thereof supporting  
corners (36) of said panels (30), and divided from each other by  
5           incisions (14d).

1           6. (Amended) A floor panel comprising:

a group of support portions (14, 16) arranged in a  
substantially polygonal configuration, as seen in a plan view;

5           arms (22) connecting said plurality of support portions, and  
extending substantially radially with a preselected width to thereby  
locate said plurality of support portions at a substantially same  
distance;

first coupling portions (24) provided on the arms extending  
outward from the first support portions (14, 16) arranged at at  
10          least one of two contiguous sides of said support portions;



second support portions (26) provided on the arms extending out from the support portions (14, 16) arranged at at least one of the other two contiguous sides of said support portions;

15 wherein when said first coupling portions (24) of one floor panel and said second coupling portions (26) of another floor panel are engaged with each other, and wherein said support portions (14, 16) are uniformly spaced by a substantially same distance by said arms (22).

1 7. A floor panel in accordance with claim 6, further comprising unit panels (30) laid on tops of said support portions (14, 16), each of said unit panels (30) having each corner thereof supported by substantially one-fourth of an area of the top of any one of said  
5 support portions, and having a substantially center thereof supported by the top of any one of said support portions.

1 8. A floor panel in accordance with claim 6, wherein said support portions (14, 16) comprise:

main legs (14) spaced from each other by a preselected distance;

5 said portions (16) comprising auxiliary legs (16) each being positioned between nearby main legs (14) at a preselected distance and having a diameter different from a diameter of said main legs (14).

1 9. A floor panel in accordance with claim 6, wherein said support portions (14, 16) each includes a plurality of blocks (14-1,



14-2, 14-3, 14-4) formed in the vicinity of the top thereof  
supporting corners (36) of said panels (30), and divided by incisions  
5 (14d) from each other.

1 10. (Amended) A method of constructing a floor panel,  
comprising:

a first step of preparing a floor panel (10) comprising a group  
of support portions (14, 16) arranged in a substantially polygonal  
5 configuration, as seen in a plan view, arms (22) connecting said  
support portions and extending substantially radially with a  
preselected width to thereby locate said support portions at a  
substantially same distance, first coupling portions (24) provided on  
the arms extending outward from at least one of said support  
10 portions arranged at at least one of two contiguous sides of said  
support portions, second coupling portions (26) provided on the  
arms extending out from the other of said support portions  
arranged at at least one of the other two contiguous sides of said  
support portions, said first coupling portions (24) and said second  
15 coupling portions (26) being engageable with each other;

a second step of coupling said first coupling portions (24) and  
said second coupling portions (26) to thereby lay a plurality of floor  
panels (10); and

a third step of laying a plurality of unit panels (30) on said  
20 support portions (14, 16) such that said unit panel have corners and  
substantially centers thereof sustained by tops of said support  
portions, whereby a modular floor for a double floor structure is  
constructed.



1           11. A method in accordance with claim 10, further comprising  
a fourth step of laying, after said third step, unit panels (30)  
contiguously with said unit panels (30) in order to bridge border  
portions (50) adjoining walls or pillars.

1           12. (Amended) A floor panel comprising:  
a group of support portions (14, 16) made up of a plurality of  
support portions;;

arms (22) connecting said support portions and locating said  
5 support portions at a substantially same distance;

unit panels (30) laid on tops of said support portions (14, 16);  
and

engaging portions (14b, 14c; 38, 34) for allowing the top (14a)  
of any one of said support portions and one corner portion (36) of  
10 any one of said unit panels to be engaged with each other.

1           13. (Amended) A floor panel in accordance with claim 12,  
further comprising a cushioning (40) intervening between each of  
said support portions (14, 16) and each of said unit panels (30), and  
at least contacting the engaging portions of the unit panel (30).

1           14. (Amended) A floor panel in accordance with claim 12 or  
13, wherein said engaging portions (14a, 14b; 38, 34) comprise:

protuberances (32, 51) formed on a support surface (36) of  
corner portions of said unit panel (30, 60) or a panel support  
5 surface of a support portion (54); and



through holes (14c, 65) formed in the top (14a) of an individual first support portion or support surfaces (64) of corners of an individual unit panel, said protuberances being received in said through holes.

1           15. (Amended) A floor panel in accordance with any one of claims 12, 13 and 14, wherein said engaging portions (14b, 14c; 38, 34) comprise:

            grooves (14b) formed in the top of an individual support  
5     portion (14); and

            notched portions (38) extending from side edges of corners of an individual unit panel (30) and mating with said grooves (14b).

1           16. (Amended) A floor panel in accordance with any one of claims 12, 13 and 15, wherein when any one of said unit panels (30) is laid on the top (14a) of any one of said support portions, one of said engaging portions (38) of the one unit panel mates with an  
5     associated one of said grooves (14b) while the other of said engaging portions (38) mates with a groove (50b) formed in a top of a border portion (50), whereby said one unit panel (30) bridges a space between the one support portion and said border portion in a flush configuration.

1           17. (Amended) A floor panel in accordance with claim 12, wherein said support portions (14, 16) each includes a plurality of blocks (14-1, 14-2, 14-3, 14-4) formed in the vicinity of the top



thereof supporting corners (36) of said panels (30), and divided by  
5 incisions (14d) from each other.

1 18. (Amended) A floor panel in accordance with any one of  
claims 13, 15 and 16, wherein said cushioning (40) at least partly  
contacts said unit panel (30) when said unit panel is laid on the top  
of said first support portion.

1 19. A floor panel unit comprising:  
a plurality of support portions (14, 16) arranged in a plurality  
of arrays; and

arms (22) connecting said support portions to each other;  
5 said support portions (14) each including a plurality of  
incisions (14d) formed in at least one of a top (14a), an outer  
periphery (15) and an inner periphery (13) and substantially  
serving as reference positions, whereby the first support portion is  
capable of being cut apart in a vertical direction.

1 20. A floor panel unit in accordance with claim 19, wherein  
said support portions (14) each includes engaging portions (14d)  
formed on a top and each being engaged with an edge of a unit  
panel (30) when said unit panel is laid on said top;

5 said engaging portions (14b) substantially serving as  
reference positions for cutting apart the support portion.

1 21. A floor panel unit in accordance with claim 19 or 20,  
wherein said plurality of first support portions each includes a



plurality of blocks formed in the vicinity of a top supporting corners of said panels, and divided by incisions from each other.

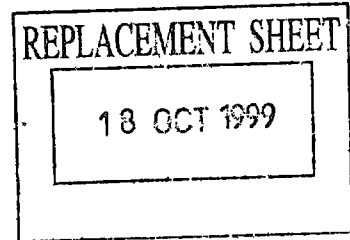
1           22. A method of laying a floor panel, comprising:

          a first step of preparing a floor panel unit (10) comprising a plurality of arrays of support portions (14, 16), arms (22) connecting said support portions to each other, said support  
5       portions each including a plurality of incisions (14d) formed in at least one of a top (14a), an outer periphery (15) and an inner periphery (13) and substantially serving as reference positions so as to be capable of being cut apart in a vertical direction, and coupling portions (24, 26) provided on said arms extending out  
10       from said support portions (14, 16);

          a second step of cutting apart said floor panel unit (10) according to a preselected rule along said plurality of incisions (14d) to thereby form a plurality of divided floor panel units (a1-a4, b1-b4, c1-c4, d1-d3); and

15       a third step of connecting said divided floor panel units (a1-a4, b1-b4, c1-c4, d1-d3) via said coupling portions (24, 26) such that said coupling portions (24, 26) do not appear at outside of said support portions, whereby a coupled floor panel unit (FIGS. 14A-14D) different from said floor panel unit (10) is reconstructed.





4. A floor panel in accordance with claim 1, wherein said support portions (14, 16) comprise:

main legs (14) spaced from each other by a preselected distance;  
and

said portions (16) comprise auxiliary legs each being positioned between nearby main legs at a preselected distance and having a diameter different from a diameter of said main legs.

5. A floor panel in accordance with claim 3, wherein said support portions (14, 16) include a plurality of blocks (14-1, 14-2, 14-3, 14-4) formed in the vicinity of the top thereof supporting corners (36) of said panels (30), and divided from each other by incisions (14d).

6. A floor panel comprising:

a group of support portions (14, 16) arranged in a substantially polygonal configurations, as seen in a plan view;

arms (22) connecting said plurality of support portions, and extending substantially radially with a preselected width to thereby locate said plurality of support portions at a substantially same distance;

first coupling portions (24) provided on the arms extending outward from the first support portions (14, 16) arranged at at least one of two contiguous sides of said support portions;

second coupling portions (26) provided on the arms extending out from the supporting portions (14, 16) arranged at at least one of the other two contiguous sides of said support portions;