United States Patent [19]

Tamboise

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[45] **Sept. 18, 1973**

[54] **METALLIC FRAMEWORK AND FLOOR RESULTING THEREFROM**

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[21] Appl. No.: **60,849**

[30] **Foreign Application Priority Data**

Aug. 12, 1969 France 6927771

[52] **U.S. Cl.** **52/406,** 52/618, 52/627, 52/656

[51] **Int. Cl.** **E04b 2/20**

[58] **Field of Search** ..... 52/404, 406, 488, 52/618, 627, 628, 656, 664, 666, DIG. 4, 582

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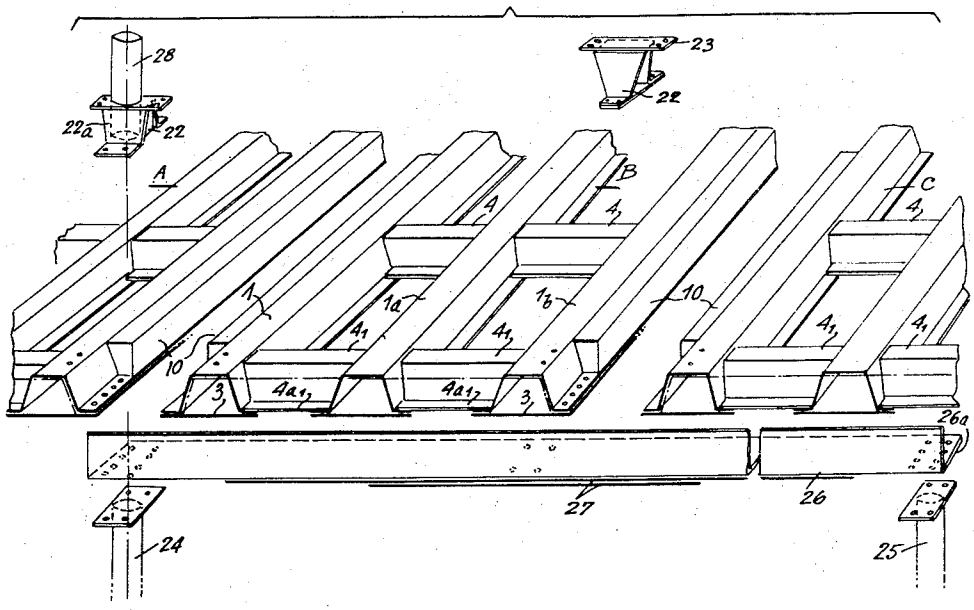
[57] **ABSTRACT**

The metallic frame-work and floor resulting therefrom is composed of lengthwise extending frame members closed on at least part of their length by an added metallic strip, cross-pieces being secured to lateral sides of said frame members and Z-shaped terminal flanges connected to outer sides thereof.

17 Claims, 11 Drawing Figures



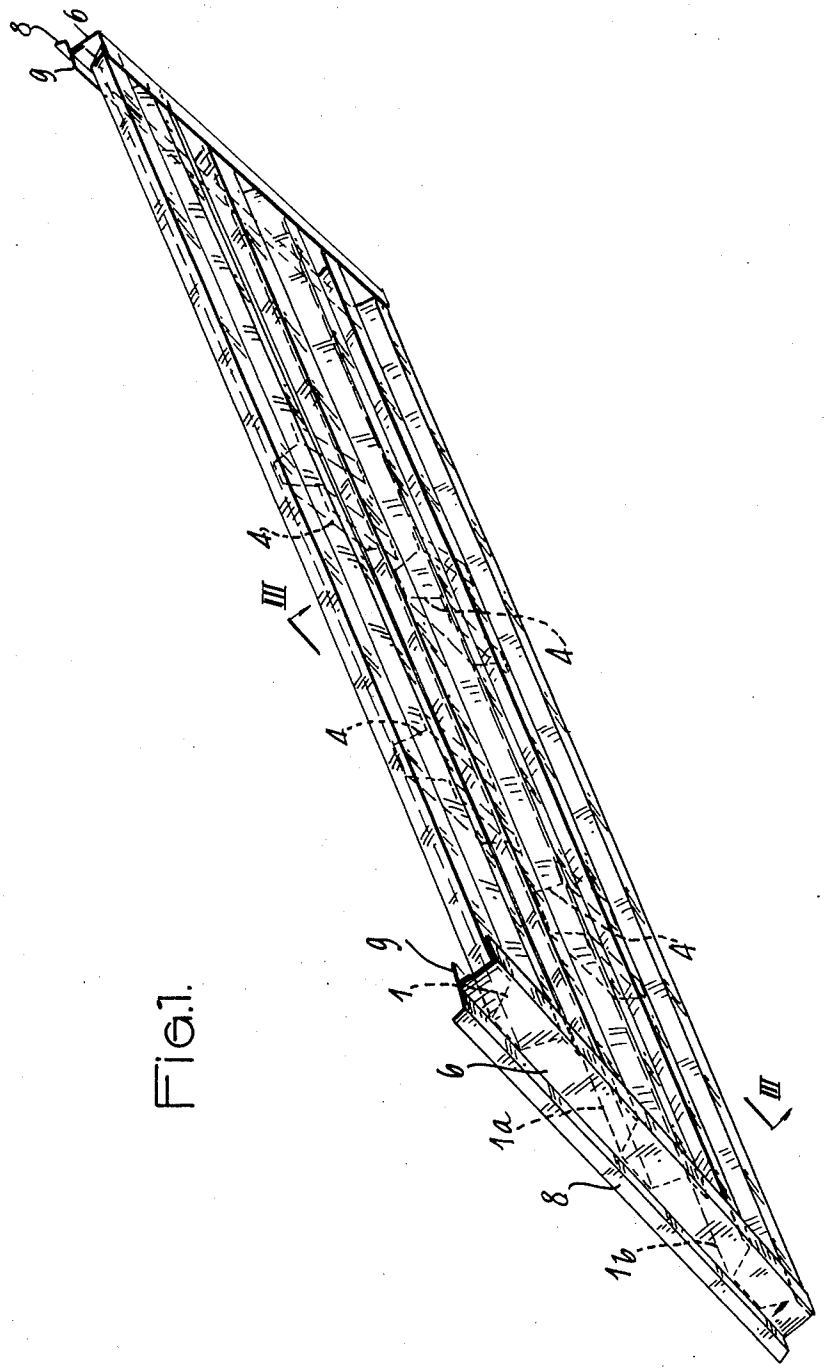


Fig.1.

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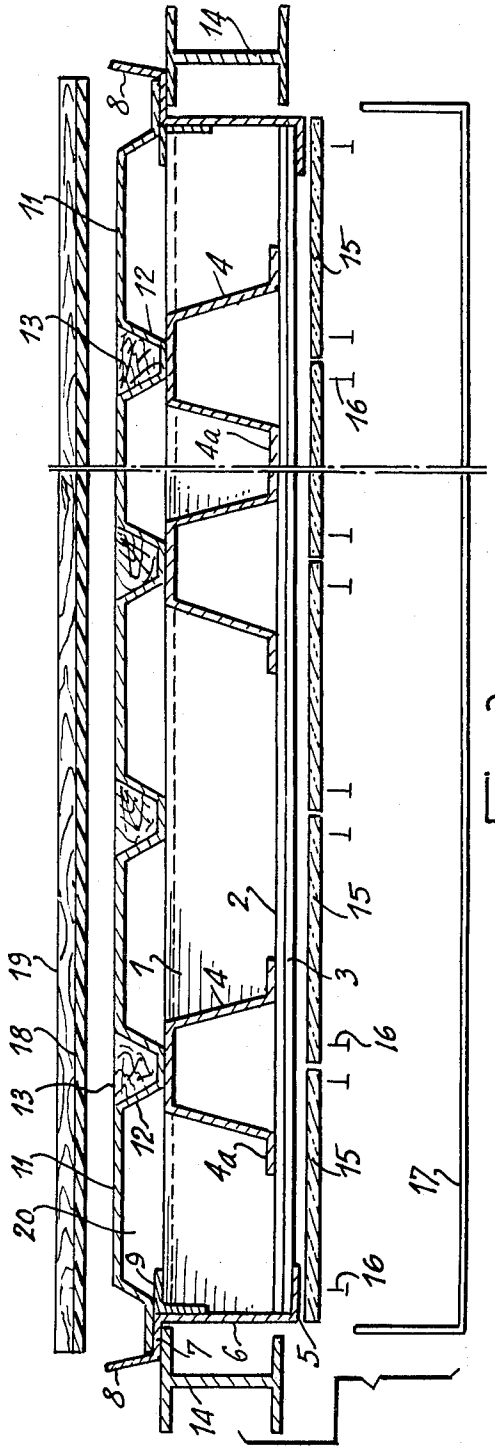

Fig.2.

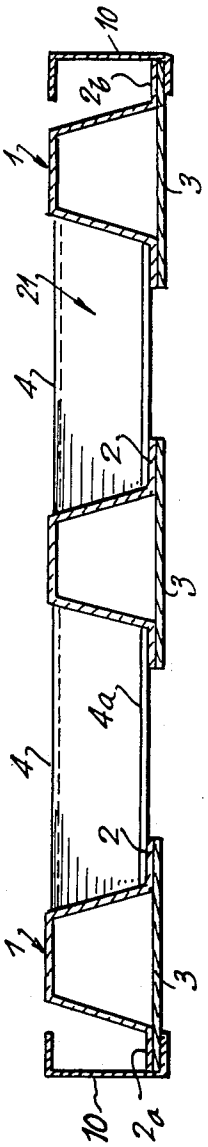

Fig.3.

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Fig. 4

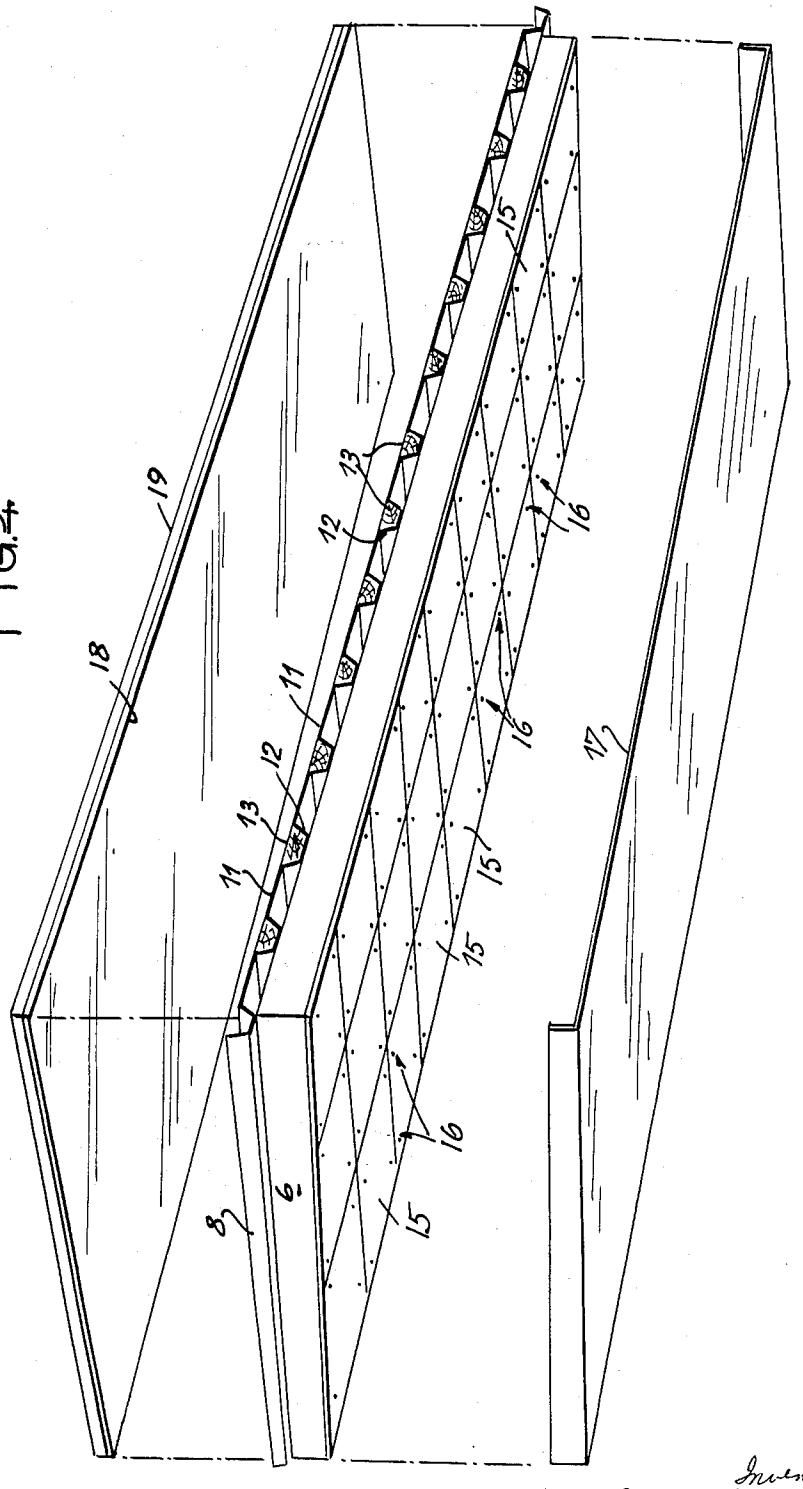

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Fig.5.

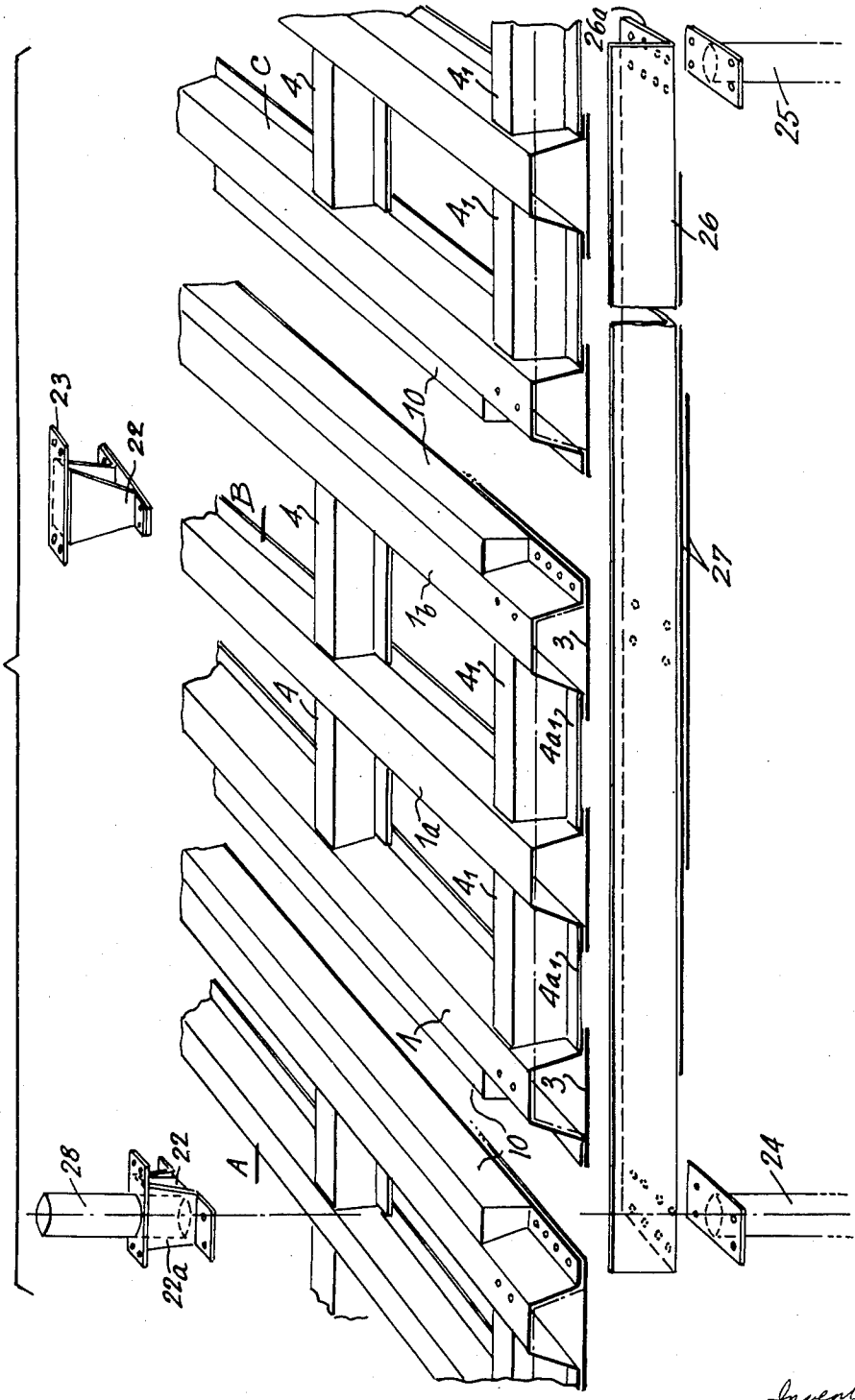

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Fig.6

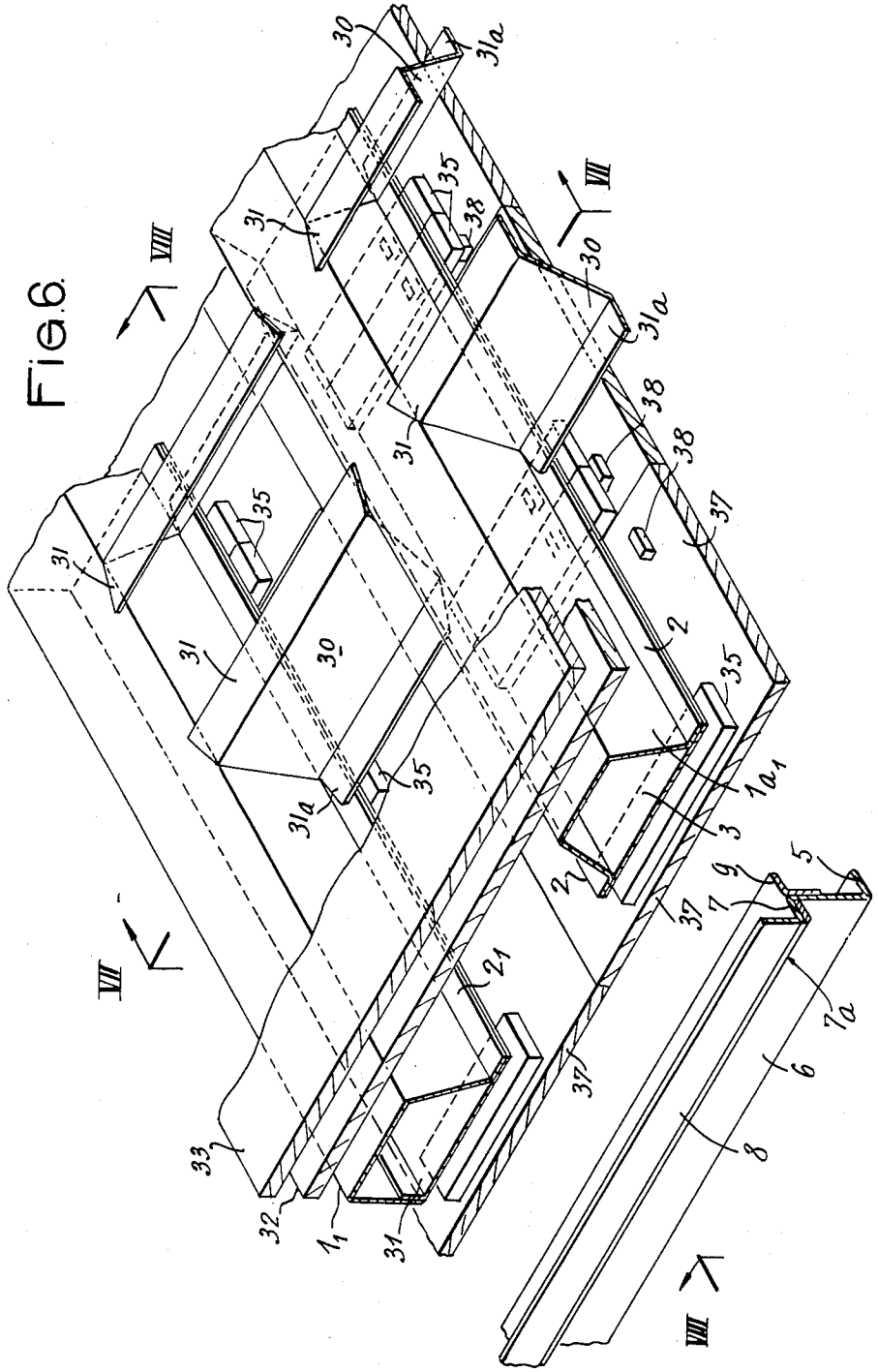

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Fig.7.

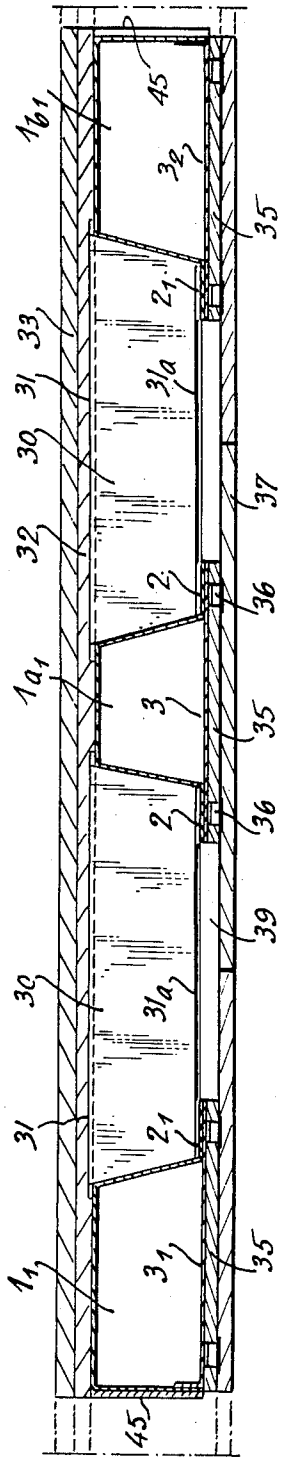

Fig.8.

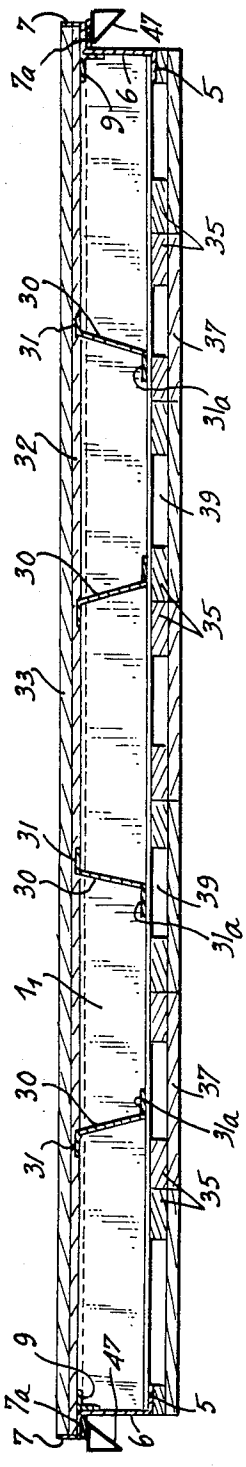

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Fig.9.

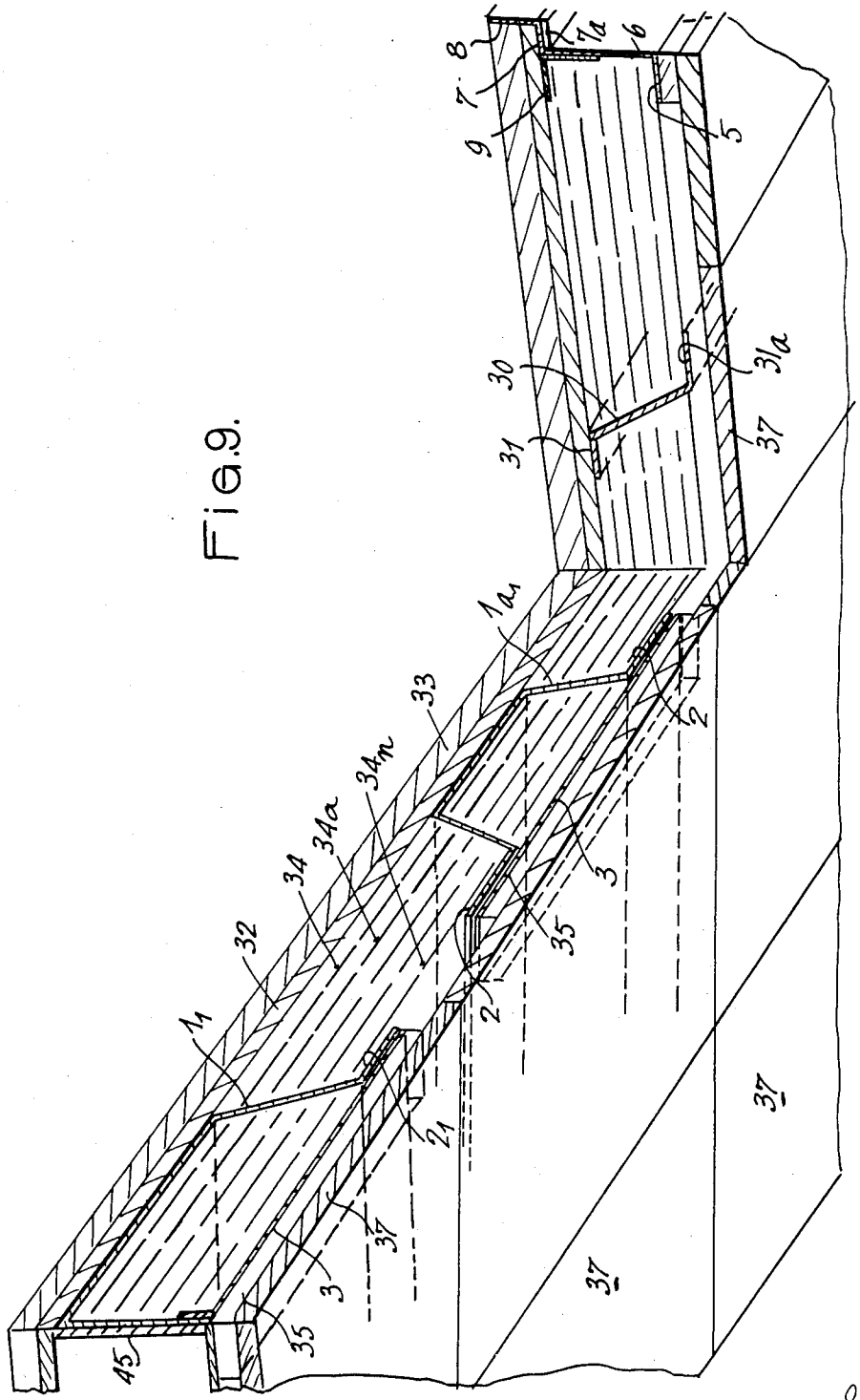

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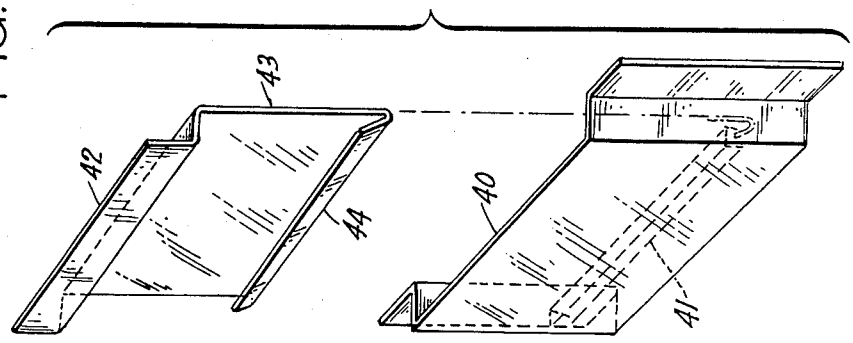
Fig.11.



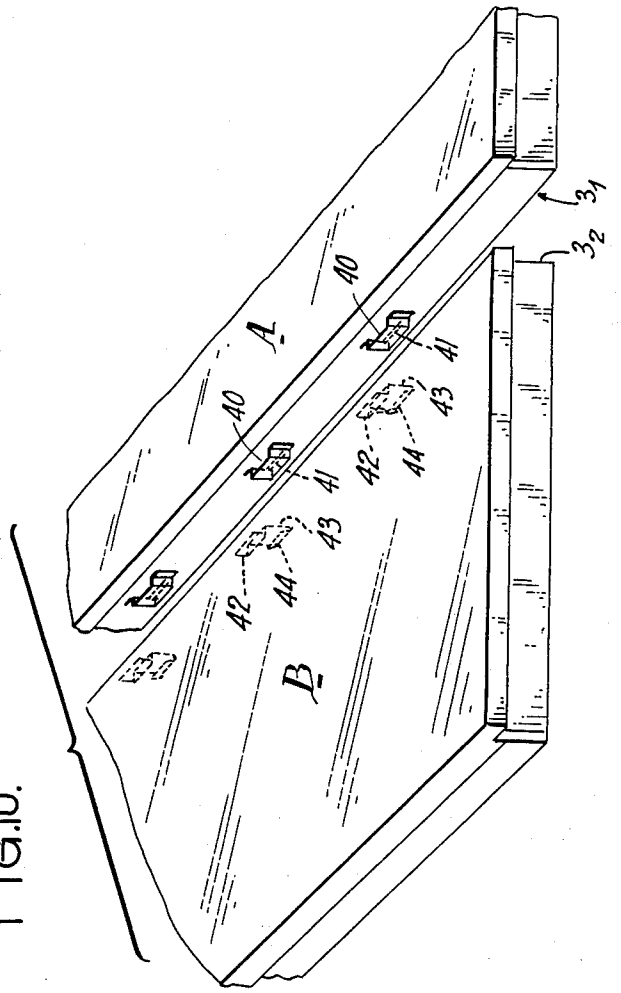


Fig.10.

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METALLIC FRAMEWORK AND FLOOR RESULTING THEREFROM

The present invention relates to a new frame-work for floors made of thin folded iron sheets and which, in case of need, makes possible the whole prefabrication at plant of a floor which eventually may include the ground coating and the ceiling coating and further inserted pipe for circulating fluids.

Besides, due to the particular structure according to the invention, the floor, although made of metal has high sound proofing properties.

Moreover, the floor is such that it may be mounted only by laying on framing elements of a building, without the necessity of making use of securing means or of a layer of concrete or like material.

A further advantage of the invention is that the floor may have a very long span between bearing points and thus makes possible the realization of very simple carrying structures and which participates to the resistance thereof.

According to the invention, the metallic frame work and floor resulting therefrom comprise lengthwise extending frame members constituted by steel sheets folded substantially in the shape of a trapezoid with the large base thereof directed downwardly and laterally extended by at least a wing, said frame members being closed on at least part of their length by an added metallic strip constituting said large base, cross-pieces having in cross-section the shape of a trapezoid extended by a wing protruding from the large base thereof and the ends of which are diagonally cut-off and secured to the lateral sides of said frame members and at least Z-shaped terminal flanges connected to outer sides of said frame members and provided at the top thereof with a bearing surface substantially aligned with the top of said floor.

Further characteristics of the invention will be apparent from the following detailed disclosure.

Some typical embodiments of the invention are shown, as not limited examples, in the accompanying drawings.

FIG. **1** is a partial prospective view illustrating the frame-work of the box-shaped floor of the invention.

FIG. **2** is a partial end section of the floor unit.

FIG. **3** is a cross section of the frame-work roughly made along line III—III of FIG. **1**.

FIG. **4** is a perspective view of the completed floor.

FIG. **5** is a perspective view showing a further application of the invention.

FIG. **6** is a partial perspective view showing the structure of the floor frame-work according to a modification.

FIG. **7** is a longitudinal sectional view of the floor shown along line VII—VII of FIG. **6**.

FIG. **8** is a transverse sectional view along line VIII—VIII of FIG. **6**.

FIG. **9** is an exploded perspective view showing the floor being completed.

FIG. **10** is a schematic partial perspective view illustrating a further development of the invention.

FIG. **11** is a perspective view showing a detail of FIG. **10**.

The floor frame-work is constituted of frame members **1**, **1***a*, **1***b* made of folded steel sheets, having in cross-section the shape of a trapezoid, the large base of which is extended by side wings **2** clearly shown on FIG. **3**.

The frame members **1** which have their concavity downwardly directed are closed on their whole length or on a part thereof by means of iron plates **3**, so that it is possible to regulate the moment of inertia of said frame members, of which the resistance to mechanical forces to which they are submitted may, thus be adjusted to have a very high value although the sheets used for the manufacturing of the frame members are very thin (for example about 1.5 mm).

The frame members are connected together from place to place by means of cross-pieces **4**, made exactly like the frame members by folded trapezoid shaped iron sheets. The ends of said cross-pieces are obliquely cut in order to bear on the sloped sides of the frame members **1**, while wings **4***a* thereof bear on the wings **2** of two consecutive frame members as clearly shown on FIG. **3**.

Connection between the cross-pieces **4** and the frame members is preferably made either by means of welding seams or, eventually, by electric welding between wings **2** and **4***a*.

At their ends, the frame members and eventually the iron sheets **3** secured to said frame members engage the base plate **5** of terminal flanges **6**, having towards the outside of the floor a protruding edge **7** extended by a raising edge **8** (FIG. **2**) whereby the terminal flange **6** has substantially a Z-shape extended by the raising edge **8**.

An angle iron **9** is connected to the flanges **6** in order to cover the top of the frame members which are thus boxed-up in the terminal flanges **6** to which they are secured by any suitable means.

In the same way, and preferably before laying the terminal flanges **6**, U-shaped folded sheets are placed on the side wings **2***a* and **2***b* of the side frame members of the floor; these U-shaped folded sheets are designated by the reference number **10** and are making up the side flanges of the floor. The height of these side flanges is equal to the height of the frame-members.

From the above description, it will be seen that when the frame-work of the floor is assembled, said frame-work have the shape of a frame delimited by the side flanges **10** and the terminal flanges **6**, and that cells are delimited in the thickness of the frame, by frame members **1** and cross-pieces **4**.

In order to provide a completed floor suitable to be prefabricated the above described frame-work is provided on its top with a wide-waved ribbed sheet **11** (FIGS. **2** and **4**). Lathes **13** made preferably of wood are disposed in the hollow ribs **12** of said ribbed sheet, these lathes extending across the direction of the frame members. In that manner, said ribbed sheet **11** shows a flat top surface since the lathes **13** are completely filling up the hollow ribs **12**.

The ends of said ribbed sheets are fixed to the terminal flanges **6** and the sides thereof to the flanges **10**. Moreover, the sheet may be connected by means of screws both to the members **1** and to the cross-pieces **4**. The lathes **13** are consequently used as filling material for the screwing of bolts, screws and the like.

It will be seen that, by such means, the covering sheet **11** is evenly distributing the loads on the whole area of the floor-frame, particularly since the ribs thereof extend transversally to the direction of said frame members.

The protruding edge 7 of the terminal flanges 6 is used as a bearing surface for making the whole of the floor to bear upon the top of supporting girders, such as girders 14 shown on FIG. 2. The width of the protruding edge is provided, for instance, to overlay only one half of the girder 14, so that two floors may be end-to-end joined.

The above described floor, when provided to be prefabricated in factory, includes advantageously the constitutive elements of a ceiling, said ceiling being made of slabs or wall-tiles 15, of square or rectangular shape, which are fixed under the frame members and under the cross-pieces, for example, by means of self tapering screws 16.

By properly choosing the nature of the material of the slabs, an additional fire-guard screw may be obtained.

In order to avoid the ceiling, of which sizes may be important, for example ranging about 6 meters in length per 1.80 meter in width, to be damaged during handlings, said ceiling is advantageously provided with a removable cover 17 made of steel sheet or synthetic resin sheet ; said cover fitting on the floor flanges and thus covering entirely the ceiling.

Likely it is possible to provide the floor during manufacturing with ceiling elements; said floor may also receive the ground coating and, in this case, as shown by FIGS. 2 and 4, it is provided to fix previously on the upper surface of the sheet 11, a sheet or plate 18 made of relatively flexible material — such as a felt or a rubbery product or the same — on which is laid the final ground coating, referred 19.

It is advantageous to provide respectively the side edges of the ground coating with groove and tongue joints, this making possible the interlocking at the time of laying two contiguous floors.

From the above description, it will be seen that the covering sheet 11 delimits with the floor frame-work channels and recesses 20 either for the passage of pipes, or used directly for the circulation of a gaseous fluid such as ventilating air.

The frame-floor such as above described may particularly be easily adapted to a building with a very deep sound proofing, and this in spite of its all metallic structure. Actually, the cells delimited between the frame members and the cross-pieces as well as the hollow bodies delimited by said frame members and cross-pieces are, preferably, filled-up with sound deadening material which is thus divided, this division improving the sound proofing qualities of the used materials.

The cells and hollow bodies are, preferably, filled-up with glass-wool compressed on a support, made for instance of bituminous kraft paper, thus making-up sound insulating panels which are stacked into said cells in such a manner that the supports are arranged in opposition with respect to the floor median plate 21 (FIG. 3). In this way, a reflective effect of the sound waves will be obtained simultaneously with a damping of said waves.

Outside faces of lateral flanges 10 will advantageously be coated with synthetic resin or with a glue and, if necessary, fitted with a plastic joint in order that two adjacent floor elements be jointly assembled, this avoiding any alternated bending effect, whereas said resin or joint is making up an expandion element.

FIG. 5 illustrates a further development of the invention according to which the frame-work comprises at the ends thereof cross-pieces 4_1 one of these having wing $4a_1$ flushing with the ends of the frame members.

It is moreover provided intermediate wedges 22, similar to cross-pieces 4, but these wedges comprise on their top surface a plate 23 in order to make possible their fixing, for instance by screwing together on the wings and on the top of lateral frame members of two adjacent frame-work elements, as for example elements A and C on FIG. 5.

By this means, a continuous girder is obtained at the ends of the successive frame-works of the floor and it is thus possible to join two successive uprights 24 and 25 only by means of a folded sheet 26 of which the wing 26*a* closes the girder formed by the floor-frame. Said wing which may be reinforced as shown at 27 fairly increases the bending moment of said girder.

By providing some of the wedges 22 with an upright — as shown by reference numeral 28 for the wedge 22*a*, it is possible to combine the mounting of the frame-work with the mounting of the floors and thus obtaining an homogeneous unit.

On FIGS. 6 – 11, the frame-work includes three frame members 1_1, $1a_1$ and $1b_1$ made of folded iron sheet. The median frame member $1a_1$ is similar to those described above and has in cross-section the shape of a trapezoid of which the large base is extended by lateral wings 2.

Lateral frame members 1_1 and $1b_1$ (FIG. 7) have the shape of a right angled trapezoid and are provided with only one lateral wing 2_1. Frame members 1 have their base closed on the whole or on part of the length thereof by means of iron sheets 3 for the median member 1*a*, and by means of iron sheets 3_1 and 3_2 for the lateral right angled trapezoid shaped members. Iron sheets 3_1 and 3_2 are folded at right angle in order to form a rising edge soldered within the volume delimited by said frame members 1_1 and $1b_1$.

Frame members are connected from place-to-place by cross-pieces but, as shown on FIGS. 6 – 8, the cross-members are made of iron sheets 30, cut in the shape of an isoceles trapezoid and folded in an obtuse angle, in order to be applied on the sloped sides of the frame members while, by means of their wings 31, they bear on the top of said frame members, and by means of their wings 31*a* they bear on the frame member wings.

Successive cross-pieces are arranged at intervals as well shown on FIG. 6 and on FIG. 8 and it is the reason why the cross-pieces, which are used as cross-braces between the frame members, extend respectively at nearly regular intervals without any narrow passage be found as it was the case in the above-described examples, in which cross-members were manufactured with two sheets 30 bound together. The connection between the frame members and the cross-pieces is made by welding, prefrably by electric welding or autogenous weld fillets.

From the above description, it is obvious that the main difference of the frame-work which has just been described with respect to the frame-work illustrated in the preceding figures is to manufacture the end frame members in the shape of a right angled trapezoid and the cross-pieces portion by only folded iron sheets.

Frame members are, at their ends, placed on the base plate 5 (FIG. 6) of the Z-shaped terminal flanges 6 having, towards the outside of the floor a protruding edge 7 extended by a raising edge 8.

A wedge of absorbing or damping material — as for example the material known under the same of neoprene — is fixed under the edge **7**, as shown in **7*a***, in order that said wedge insulates the floor from the metallic or concrete supports **47** (FIG. **8**) on which said floor bears by means of said edge **7**.

FIG. **8** shows that supports **47** provide a clearing with the flanges **6**, this avoiding sound transmissions and making possible the compensation of building tolerances frequently important in the building manufacturing. An angle iron **9** is fixed upon each flange **6** in the purpose of covering the frame members top surface, so that said frame members are wholly surrounded by the terminal flange **6** to which they are connected by any suitable means.

Owing to the right angled trapezoidal shape of lateral frame members 1_1 and $1b_1$, then said frame members are forming the lateral sides of the floor without the necessity of mounting of connecting any other part.

In order to establish a complete floor structure, able of being wholly prefabricated and having a high grade of sound proofing and heat insulation, the top surface of the above described frame-work is covered by plates **32**, preferably made of compressed rock-wool, said plates being besides themselves covered with a panel **33** made of agglomerated material making possible the further fixing of any kind of desired ground coating.

As shown on FIG. **9**, the volume extending from the bottom of the plate (or plates) **32** up to the iron sheets **3**, 3_1 and 3_2 closing the frame members is entirely filled with panels **34**, **34*a*** . . . **34*n*** arranged both between and inside the frame members, said panels being, for example made of rock-wool coated in a casing forming a spacer diaphragm between the various panels.

According to the invention, it has been found that the whole of said diaphragms extend respectively at the same level within the thickness of the floor, while successive panels such as **34** and **34*a*** may have the same thickness or a different thickness.

By this means, reflective screens are constituted spacing the absorbing coating forming the panel of rock-wool or similar material thereby preventing propagation of sounds in a very unexpected manner, owing to the slight mass of the floor with respect to a conventional floor composed of heavy elements, for instance made of concrete, and spaced by light elements made of felt or synthetic resin.

Sheets **3**, 3_1, 3_2 are used for fixing, under their bottom surface, strips **35** also preferably made of agglomerated rock-wool, said strips being, for example fixed by gluing by means of a glue made of synthetic resin. Strips **35** are provided within their thickness, are particularly shown on FIG. **7**, with magnetic parts **36** made for example of soft iron which are embedded within the thickness of the material of which said strips are made. By this means, it is possible, when the floor is mounted to easily secure on its bottom surface one ornamental ceiling made of panels **37**, having a square or rectangular shape, said panels being fitted with small magnets **38** arranged at some places in correspondence with the soft iron parts **36** of the strips **35**.

The strips **35** make that, between the ceiling and the insulating panels **34** . . . **34*n***, free spaces **39** are delimited (FIG. **7**) in which it is possible to lay out various pipes and eventually to set some fluids circulation.

The construction of the floor, such as above described is particularly suitable to the manufacture of rectangular floor panels with a thickness of 12 to 20 cm and having a length possibly reaching about 6 meters and a width 2.5 meters while using for the manufacture of such frame-works thin iron sheets of about 1.5 mm in thickness.

A further object of the invention is to make possible the automatic assembling of two adjacent floor-panels and, for this purpose, as shown on FIGS. **10** and **11**, the frame members lateral edges 3_1 are fitted with strap shaped gussets **40**, each of said gussets having a small bar **41** (FIG. **11**) fixed thereinto. As a complement, frame members 3_2 are provided with lugs **42** forming a tongue **43** bounded by a folded edge **44**.

In this manner, and taking into consideration FIG. **10**, when the floor A is laid on suitable bearing blocks, it is enough to let down the floor B, so that the tongues **43** get into the gussets **40**, the folded edge **44** being springly stressed as it passes along the bar **41** and then recovering its original position, whereby forming with said bar **41** a lock preventing any displacement of one of the floors one with respect to the other.

In order to avoid any possibility of vibrations transmission from one floor to the other, gussets **40** and **42** are at least for a part sunk into plates made of absorbing material made of agglomerated rock-wool; said plates being arranged on the lateral sides of frame members 3_1 and 3_2 as shown under reference number **45** on FIG. **2**.

It is important to notice that the vertical stresses applied to the floor incline to apply thereto a bending stress; but, owing to the position of the edges **7** of flanges **6**, said edges constituting the floor bearing points, this position is situated in the close vicinity of the floor top surface and thus the bending stresses caused said surface working like the surface of a girder center fiber and then, said stresses are, chiefly absorbed by the plates **3**, 3_1, 3_2, supporting a tensile stress, this constituting the best working conditions for metal.

I claim:

1. A frame-work having an upwardly directed load bearing surface and a downwardly directed surface comprising: a plurality of individual lengthwise extending frame members constituted by steel sheets folded substantially in the shape of a trapezoid having an open large base directed downwardly and provided with at least one laterally extending wing, said frame members each being closed along at least part of its length by an added metallic strip at said large base;

a plurality of cross-pieces secured in spaced relationship between lateral sides of said frame members and separating said frame members thus delimiting a hollow rigid cellular structure; and

a Z-shaped terminal flange connected to each end of said frame members, the top thereof being a bearing portion substantially aligned with the top of said frame members for supporting a floor.

2. Frame-work as set forth in claim **1**, wherein cross-pieces are further provided at the end of said frame members as well as wedges shaped like said cross-pieces and having small securing plates for connection with said frame members whereby a continuous hollow girder is formed by said cross-pieces and wedges at the ends of several adjacent floor frame-works lying on a folded iron sheet having a wing closing the bottom of said girder.

3. Frame-work as set forth in claim 2, wherein some of said wedges constitute bearings for uprights connecting two successive frame-work levels.

4. Frame work as set forth in claim 2, comprising further connecting means for lateral flanges of two adjacent frame-works.

5. Framework as set forth in claim 1, further including a ribbed iron sheet supported on the upper surface of said frame members, said iron sheet having ribs which extend transversely with respect to said frame members and said sheet being provided in those parts directing their concavity upwards with packing means for connection of a floor coating, and wherein the framework further includes ceiling panels mounted on the bottom surface of said frame members and cross-pieces whereby the whole of the framework with ceiling panels and floor coating may be completely prefabricated.

6. Framework as set forth in claim 5 further including a removable protecting member means for surrounding at least said terminal flange and for covering the whole of the ceiling panels before mounting of said floor.

7. Framework as set forth in claim 1 further including a plate made of agglomerated sound absorbing material covering the top of said frame members, and a panel for carrying a ground coating supported on said plate.

8. Frame-work as set forth in claim 1, including further plates fixed under said frame-members, said plates being provided with fixing means for fixing prefabricated plates constituting a ceiling.

9. Frame-work as set forth in claim 8, wherein said plates fixed under the frame-members are made of agglomerated sound absorbing material and contain pieces made of magnetic material, cooperating with parts also made of magnetic material, at least one of said parts being a permanent magnet, and being fixed to said panels constituting the ceiling.

10. Frame-work as set forth in claim 1, wherein one of the lateral frame-members is provided with gussets and the other with lugs engaged in gussets of an adjacent frame-member.

11. Framework as set forth in claim 10, further comprising a small bar enclosed by said gussets, and wherein lugs delimit a resilient folded edge engaging said small bar for interlocking adjacent frame-works.

12. Framework as set forth in claim 1, comprising two lateral frame members having in cross-section the shape of a right angled trapezoid having a large base directed downwardly.

13. Framework as set forth in claim 1, wherein space between the upper plane and the lower plane deferred by the top and bottom of the frame members and associated cross-pieces is at least partly filled with panels of absorbing material respectively arranged in parallel relationship in successive layers, said panels of absorbing material being spaced apart by spacer diaphragms, whereby a reflective effect of the sound waves is obtained together with a damping thereof.

14. Frame-work as set forth in claim 13, wherein each of the layers of the absorbing material arranged in the thickness of the frame is of equal thickness on the whole surface of the said framework, while successive layers are indifferently of same or different thickness.

15. Framework as set forth in claim 1, wherein the spaces defined between said frame members and cross-pieces are filled with an insulating material.

16. Frame-work as set forth in claim 15, wherein the insulating material is made of a mineral wool compressed on a support acting as a diaphragm and in that panels made of insulating material are stacked upon one another with said diaphragms respectively in opposed relationship from the median symmetrical plane of said floor frame-work.

17. Framework as set forth in claim 1, wherein the bearing surface of the terminal flange is underly provided with an absorbing insulating wedge thus preventing transmission of sounds from the floor supported on said framework to a structure supporting said frame-work.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,759,006 Dated September 18, 1973

Inventor(s) Maurice Paul Jean Joseph TAMBOISE

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page 1, Item [30], the Foreign Application Priority Data should be corrected to read as follows:

-- August 12, 1969 France.....6927771
(1st Addi.)January 30, 1970 France.....7003367 --

Signed and sealed this 29th day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334