Jan. 4, 1938.

S. SZEGÖ

2,104,443

FLOOR, ROOF, AND LIKE STRUCTURE

Filed June 17, 1935

4 Sheets-Sheet 1

Fig.1.

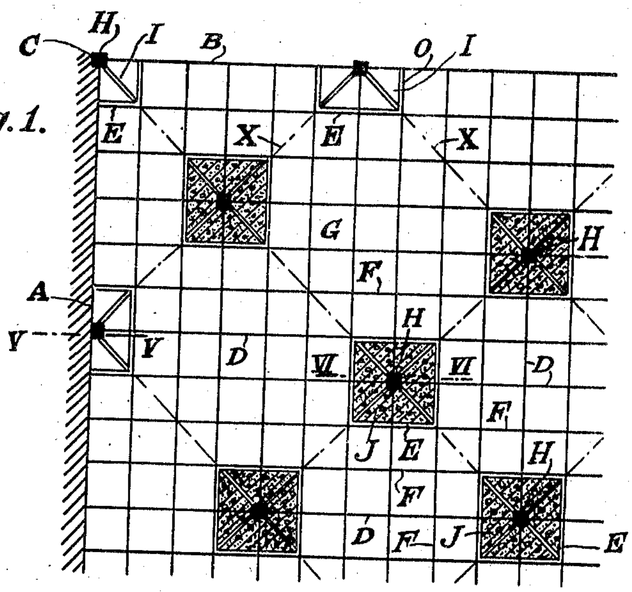
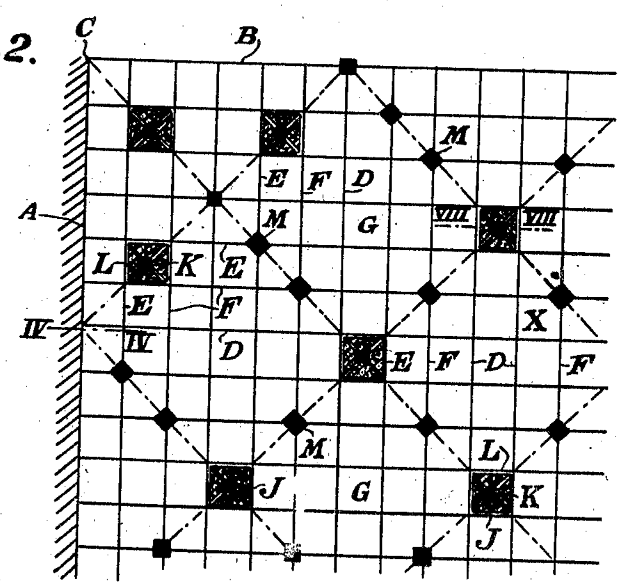


Fig.2.



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Stephan Szegö

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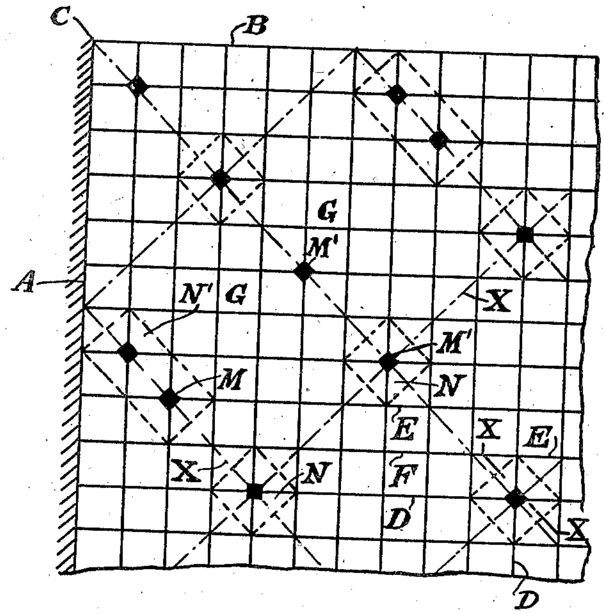


Fig. 3.

Fig. 4.

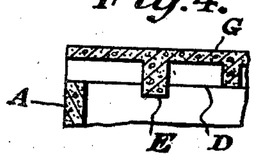


Fig. 6.

Fig. 8.

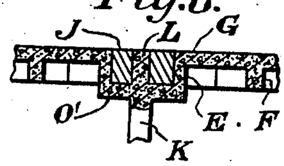


Fig. 5.

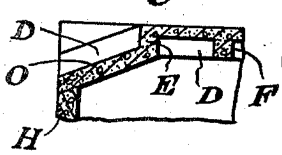


Fig. 7.

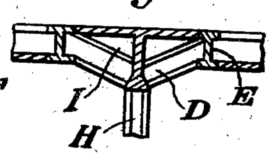


Fig. 9.

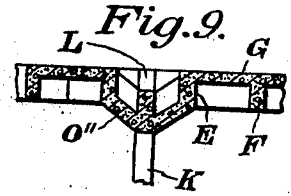


Fig. 10.

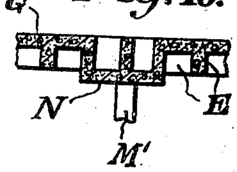
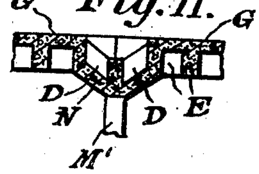


Fig. 11.



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FLOOR, ROOF, AND LIKE STRUCTURE

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Fig. 12.

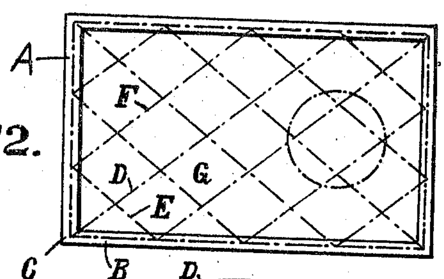

Fig. 13.

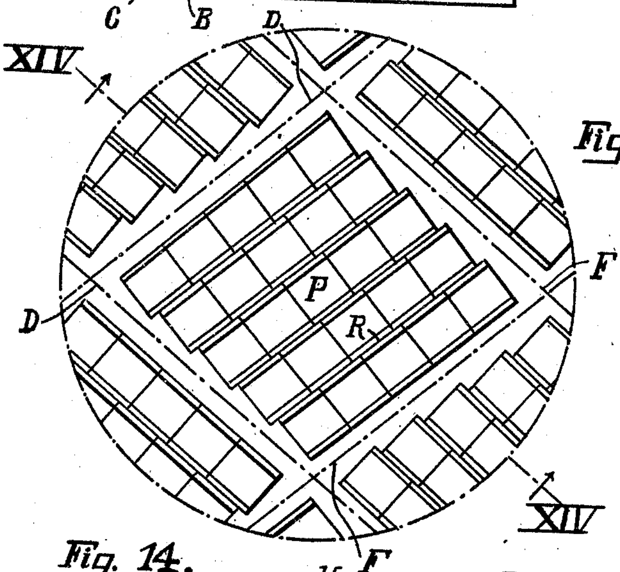

Fig. 14.

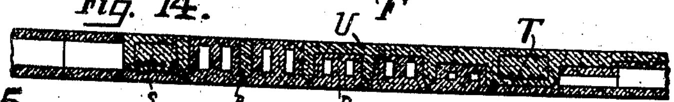

Fig 15.

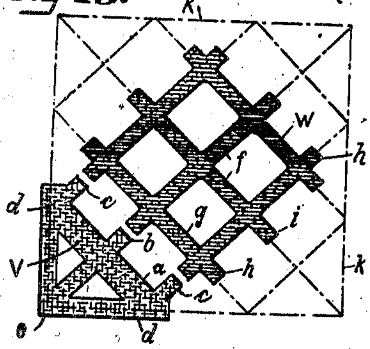

Fig. 16.

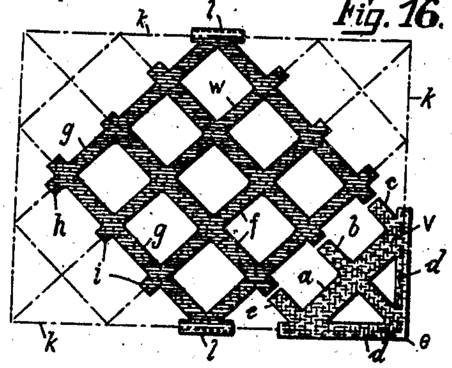

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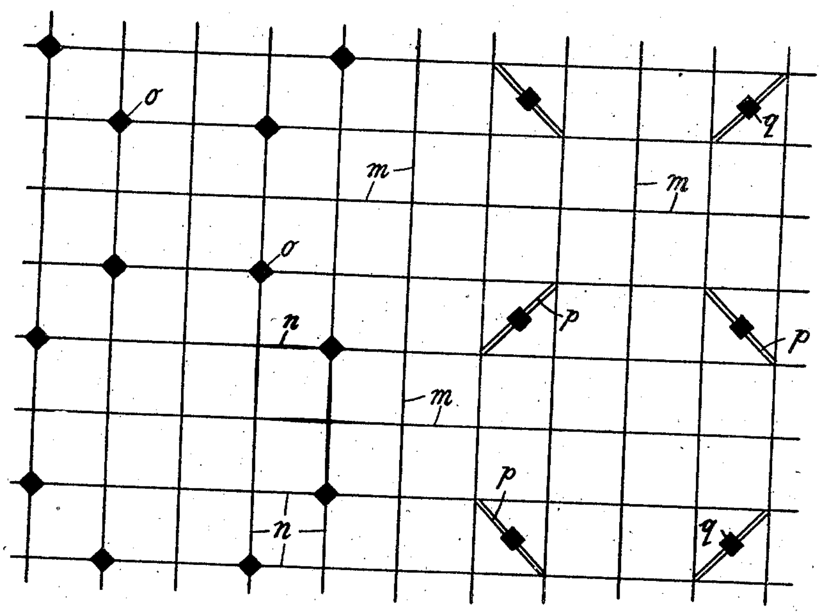
Fig. 17.



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Patented Jan. 4, 1938 **2,104,443**

UNITED STATES PATENT OFFICE

2,104,443

FLOOR, ROOF AND LIKE STRUCTURE

Stephan Szegö, Berlin-Johannistal, Germany

Application June 17, 1935, Serial No. 27,044
In Germany February 25, 1935

9 Claims. (Cl. 72—15)

This invention relates to floor, roof and like structures of the type in which a set of beams disposed in one direction intersects another such set disposed in a direction substantially at right angles thereto, and has for its object a novel method of constructing floors, roofs and other space enclosing structures loaded in a direction normal to the plane of the structure.

Generally speaking, any subdivision of a building by means of intermediate walls or the like is in directions conformable to the outlines; and for reasons of interior architecture and space saving it is advantageous, although not essential, for the beams to be arranged in the directions indicated, i. e., parallel to the sides.

The customary type of beam constructions for floors and roofs consists of secondary beams which are supported by main beams running transversely thereto, and which are of substantially equal length between the main beams, and also considerably smaller than the latter. The main beams in their turn, are carried by columns situated in the interior or on the boundary of the space covered, or both.

According to the present invention, on the other hand, the beams are arranged in two intersecting sets to form a visible structural grid. They are substantially of equal cross sectional areas, and supports for said beams are arranged along lines which are diagonal to the beams and form substantially rectangular bays each embracing a network of beams of different length. With this arrangement it is possible for the beams to remain parallel to the outlines of the building, and the required support for the beams is obtained by a variety of special methods of disposing and forming the columns (both in the interior and on the boundary) and the members adjoining thereto, as further described below.

These special methods enable floor or roof constructions to be carried out without any main beams over extensive spaces essentially quadrangular in plan and sub-divided into bays by columns, and they further have the effect that the usual maximum positive bending moments in a bay are not only resolved in two directions, but in addition thereto are resolved into positive and negative partial moments by reason of the shortest beams between the aforesaid lines of support serving as auxiliary supports for the longer beams. There is also a considerable partial relief of load by vault-like action; particularly when the said shortest beams are of Z section, i. e., when the slabs connected to these beams are level with the upper extreme fibre on one side and the lower extreme fibre on the other side. Thus these slabs, being subjected to compression or tension, co-operate, as integral parts of the system according to the invention, in taking up the imposed loads. The slabs may also be inclined to the levels of the beam axes. The result of the foregoing is that the several moments in a construction according to the invention are only about ⅛ as great as the moments in a customary kind of construction.

The system may be constructed in any desired structural material, such as reinforced concrete, steel, timber, etc. Hollow blocks or pre-cast members may, for instance, be used for filling in the panels between the beams of the system.

The invention is illustrated in the accompanying drawings in which—

Figs. 1–3 represent diagrammatic plan views of different floor structures constructed according to the invention,

Fig. 4 is a section on the line IV—IV of Fig. 2,

Fig. 5 is a section on the line V—V of Fig. 1,

Fig. 6 is a section on the line VI—VI of Fig. 1,

Fig. 7 is a similar section showing the employment of different material,

Fig. 8 is a section on the line VIII—VIII of Fig. 2,

Fig. 9 is a similar section showing a modified arrangement,

Fig. 10 is a section on the line X—X of Fig. 3,

Fig. 11 is a similar section showing a modified arrangement,

Fig. 12 is a plan view on an enlarged scale of one of the bays.

Fig. 13, is a still further enlarged view of the area shown in a circle in Fig. 12,

Fig. 14 is a section on the line XIV—XIV of Fig. 13,

Figs. 15 and 16 are plan views showing different constructional features of the floor, and

Fig. 17 is a diagram of a floor surface showing a further modification of the invention.

As shown diagrammatically in Figs. 1–3 the floor is formed with a grid of intersecting beams some of which are parallel and others at right angles to the enclosing walls A or other boundary B which meet at the corners C. Supporting columns are provided which according to the invention are arranged along lines X which are diagonal to the beams and form between them substantially rectangular bays each embracing a network of beams D, E, F of different length. The spacing of the columns may either be regular or irregular according to requirements, and the principal columns are connected by supporting members only to the beams by which they are immediately surrounded, i. e., the shortest beams of the adjacent bays. The supporting members of adjacent columns are in most cases separated by spans including a plurality of grid beam intersection points. In Fig. 1 the columns H are arranged under intersecting points of the grid beams, and the shortest beam portions E of the adjacent bays are supported on the columns in the first place by cantilevers I which are diagonal to the beams and meet the latter at their intersecting points. The soffits of the cantilevers may slope towards the columns, and the gaps between the levers are bridged by slabs O which adjoin the soffits of the levers as well as of the beam portions E and form a funnel-shaped structure. The traversing beam portions D confined within this structure may be made to follow the slope of the slabs as shown in Fig. 6. In the case of reinforced concrete constructions the spaces between the beam portions and the cantilevers may be filled in with suitable material J.

Fig. 7 shows the arrangement in the case of a steel construction.

With a column H placed near a wall A, as shown in Figs. 1 and 5, supporting elements are arranged in a similar manner at the free side of the column, the funnel shape being halved. At the corner C, the funnel shape is quartered.

Fig. 2 shows the principal supporting columns arranged between four adjacent beams with cantilevers L radiating from the column towards the intersecting points of the beams. The soffits of the cantilevers and of the adjacent beam portions E are adjoined by slabs which, in the arrangement shown in Fig. 8, combine with the beams and with top slabs G to form a stiffening structure of Z-shaped cross-section. Fig. 9 shows a modification of this arrangement wherein the soffits of the cantilevers and the slabs which adjoin them slope towards the column K.

Intermediate columns M without the cantilever structure may be placed where required directly under grid beam intersections situated on the line of support X. Where these lines meet near the wall A, the construction may take the shape shown in Fig. 4, and the shortest beam portions E of the adjacent bay is strengthened by increasing its cross-sectional area. A similar strengthening of the beam portions E surrounding the columns may be resorted to.

In the arrrangement shown in Fig. 3, the supporting columns M' are arranged under intersecting points of the beams, and the beam portions which radiate from the columns in the immediate neighbourhood thereof are adapted to replace the previously described cantilevers. The soffits of these beam portions, which may either remain parallel to the floor surface, as shown in Fig. 10, or sloped towards the column, as shown in Fig. 11, are adjoined by supporting slabs N which are of angular cross-section and which combine with the top slabs G of the floor to form a displacement resisting Z-section. Supporting columns arranged close together may be interconnected by elongated supporting slabs N' as shown in Fig. 3.

All the columns are preferably made of the same structural material as the beams of the system, and are connected with the beams bearing on them, and with the slabs situated between these, in such a way that they can take up the vertical loads and any horizontal forces and bending moments which may occur.

The beam node points (i. e., intersections) adjoining the above described columns may be supported by cantilevers crossing one another, and connected to the columns, beams and slabs in the above-described manner.

Fig. 12 shows a limited rectangular single bay, supported along lines "A" and "B" by columns, cantilevers, or main beams, with corners C and beams D, E and F and illustrates the use, according to the invention, of ordinary open-ended hollow blocks for filling in the panels G. Fig. 13 represents to a large scale, the floor panel G ringed round in Fig. 12; it shows that the hollow blocks P must be laid between the beams D and F in such a way that the intermediate ribs R extended between the beams, change their direction in alternate panels. Fig. 14 is a section through Fig. 13 along line XIV—XIV; it shows particularly that by using hollow tiles or blocks P of different depths, the beams may be not only of rectangular section S but also of T beam section T, and that the intermediate ribs R or U may also be of rectangular or T-section. The bearings S and T and the ribs R, U are cast in situ.

Fig. 15 shows the use of precast members for covering a square ground plan and supported along lines "*k*" by columns, cantilevers or main beams. On these supports are laid four similar corner members V consisting of two boundary beams *d* meeting at the corner *e*, one corner beam *a*, and parts of the diagonal beams *b* and the intermediate beams *c*. Further a centre member W is laid on the chamfered ends of the intermediate beams *c* and the diagonal beam *b*, which project into the interior of the bay. The centre member W comprises the interior parts *g* and *f* of the intermediate and diagonal beams respectively, made with end bearings *h* and *i* having sloped facings.

Fig. 16 shows the same fundamental solution for a rectangular field; the corner members V are exactly as before described whereas the centre member W contains one more intermediate beam.

Fig. 17 shows part of the ground plan of an extended floor surface and shows beams *m* without, and beams *n* with intermediate supports. The intermediate supports are arranged at regularly varying distances apart. Some supports *o* are arranged directly under the intersecting points of the beams, and other supports *q* are arranged under balance beams *p* whereon the grid beams rest, the balance beams being connected to diagonally opposite intersecting points of the grid beams.

I claim:

1. A floor or like structure comprising two sets of intersecting beams forming a visible structural grid, main columns for said grid beams arranged at the crossing points of lines which are diagonal to the beams and form between them substantially rectangular bays each embracing a network of beam portions of different lengths, and supporting members extending from each main column towards the beam portions which immediately surround it.

2. A structure as claimed in claim 1 wherein the supporting members comprise cantilever beams which extend across the columns to the intersecting points of adjacent grid beam portions.

3. A structure as claimed in claim 1 wherein the supporting members comprise slabs extending from the columns to the soffits of the adjacent grid beam portions.

4. A structure as claimed in claim 1 wherein

the supporting members comprise cantilever beams which extend across the columns to the intersecting points of adjacent grid beam portions, and slabs arranged to strengthen the cantilever beams on their soffits and forming together a funnel sloping upwards from the column to the adjacent grid beam portions.

5. A structure as claimed in claim 1 wherein the supporting members comprise slabs forming Z-shaped connections between the column and the adjacent grid beam portions.

6. A structure as claimed in claim 1 wherein the supporting members comprise cantilever beams which extend across the columns to the intersecting points of the adjacent grid beam portions, slabs arranged to strengthen the cantilever beams on their soffits and forming together a funnel sloping upwards from the column to the nearest grid beams, and top slabs forming together with said grid beams a Z-shaped connection with the funnel.

7. A structure as claimed in claim 1 wherein the columns are arranged centrally within squares formed by adjacent intersecting grid beam portions.

8. A structure as claimed in claim 1 wherein the columns are arranged under intersecting points of the grid beams.

9. A structure as claimed in claim 1 wherein the supporting members of adjacent columns are separated by spans each including a plurality of grid beam intersection points.

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