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Zetlin

[11] **3,903,667**

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[54] **STRUCTURAL FLOOR SYSTEM ACCOMODATING MULTI-DIRECTIONAL DUCTS**

[75] Inventor: **Lev Zetlin**, Roslyn, N.Y.

[73] Assignee: **Lev Zetlin Associates, Inc.**, New York, N.Y.

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Related U.S. Application Data

[63] Continuation of Ser. No. 371,050, June 18, 1973, abandoned.

[52] **U.S. Cl.** **52/227;** 52/221; 52/236; 52/252; 52/263; 52/283; 52/602

[51] **Int. Cl.²** **E04C 3/10;** E04C 3/22

[58] **Field of Search** 52/220, 227, 228, 231, 52/236, 252, 606, 583, 221, 283, 602, 301, 563, 562, 503, 341, 340, 294, 258, 263

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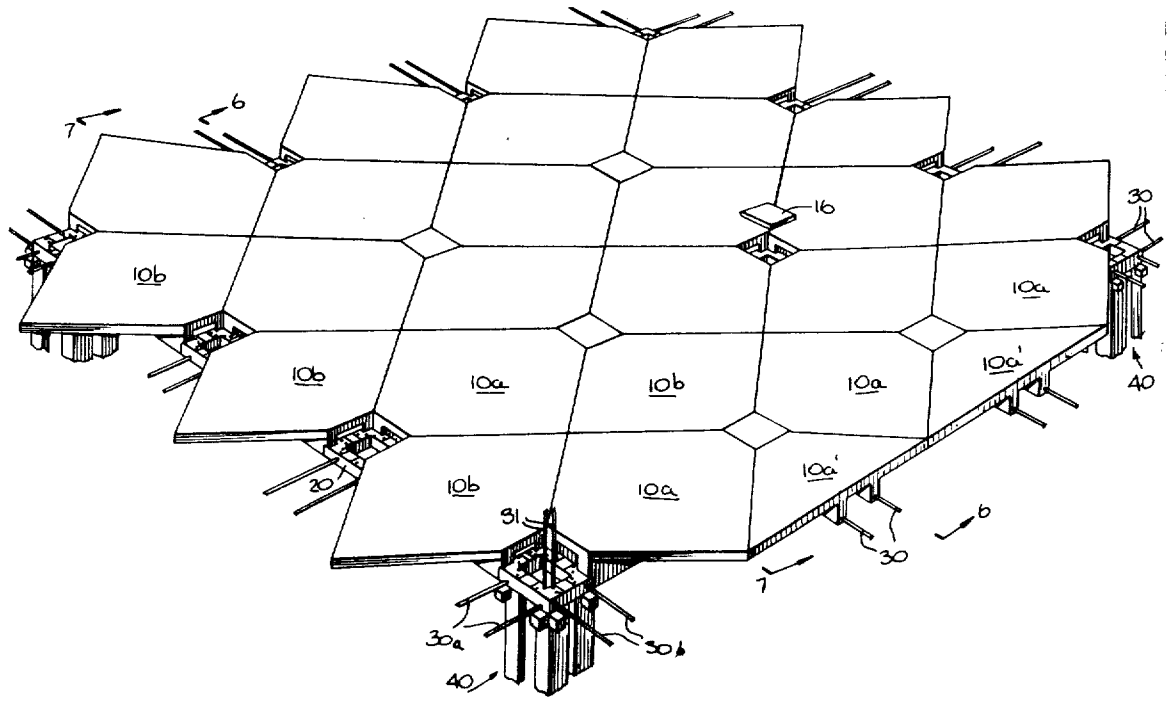
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Primary Examiner—Ernest R. Purser
Assistant Examiner—Leslie A. Braun
Attorney, Agent, or Firm—Henry Sternberg, Esq.

[57] **ABSTRACT**

A structural floor system of precast, prestressed, reinforced concrete beams arranged longitudinally and transversely in a square-grid pattern. Yoke members separate the ends of adjacent beams and longitudinal and transverse tension rods extend through the respective beams and through each of the yoke members for integrally tying the structure together. Each beam comprises a pair of spaced stems defining an axial channel. The yoke member adjacent the end of the beam spans the distance between the stems but leaves uncovered a sufficiently large portion of the open end of the channel to accommodate a duct extending through said open end. Thus, ducts may change direction and/or branch off at any of the yoke locations throughout the structure while remaining within the dimensional height confines of the floor beams.

20 Claims, 7 Drawing Figures



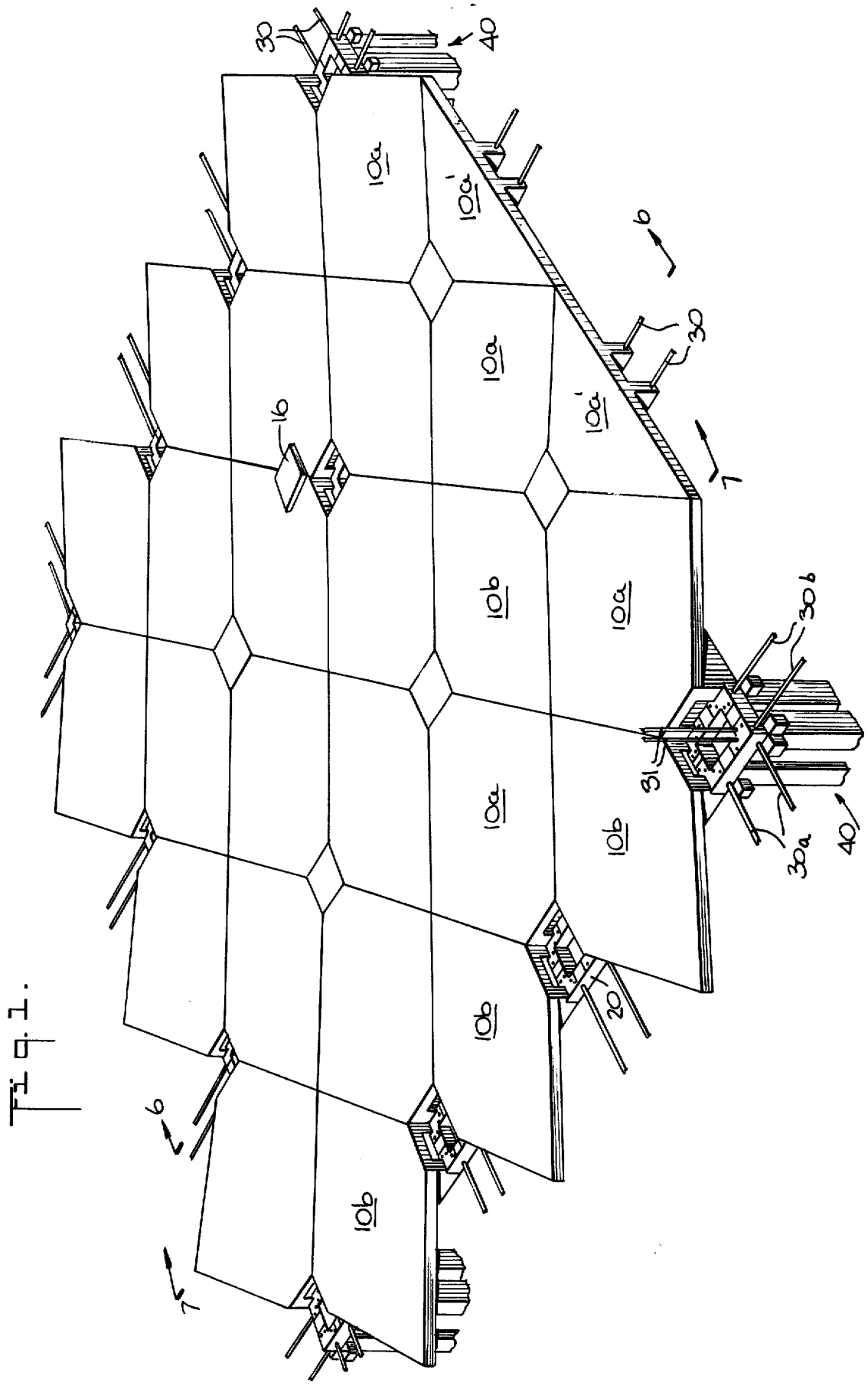


Fig. 1.

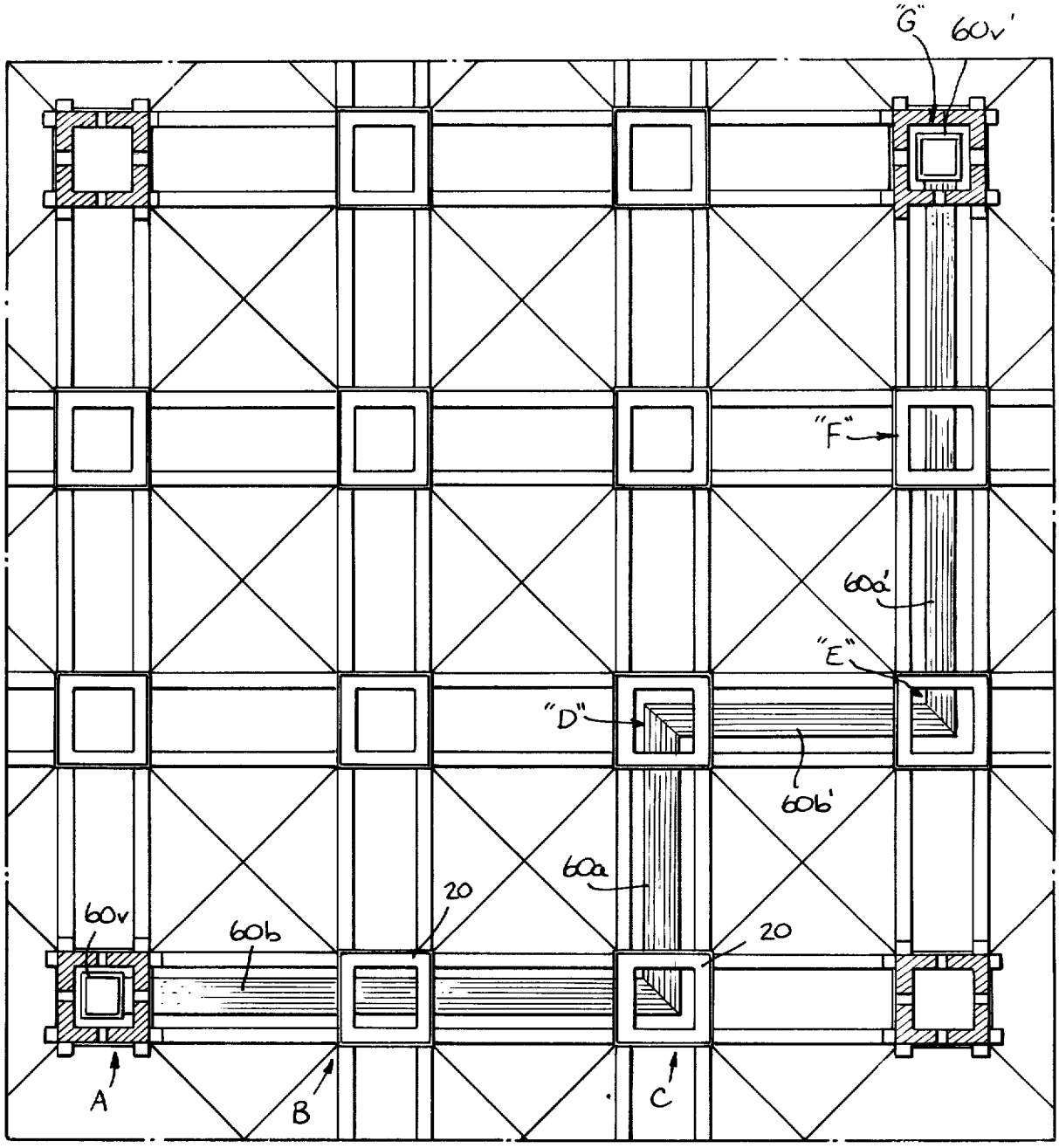


Fig. 2.

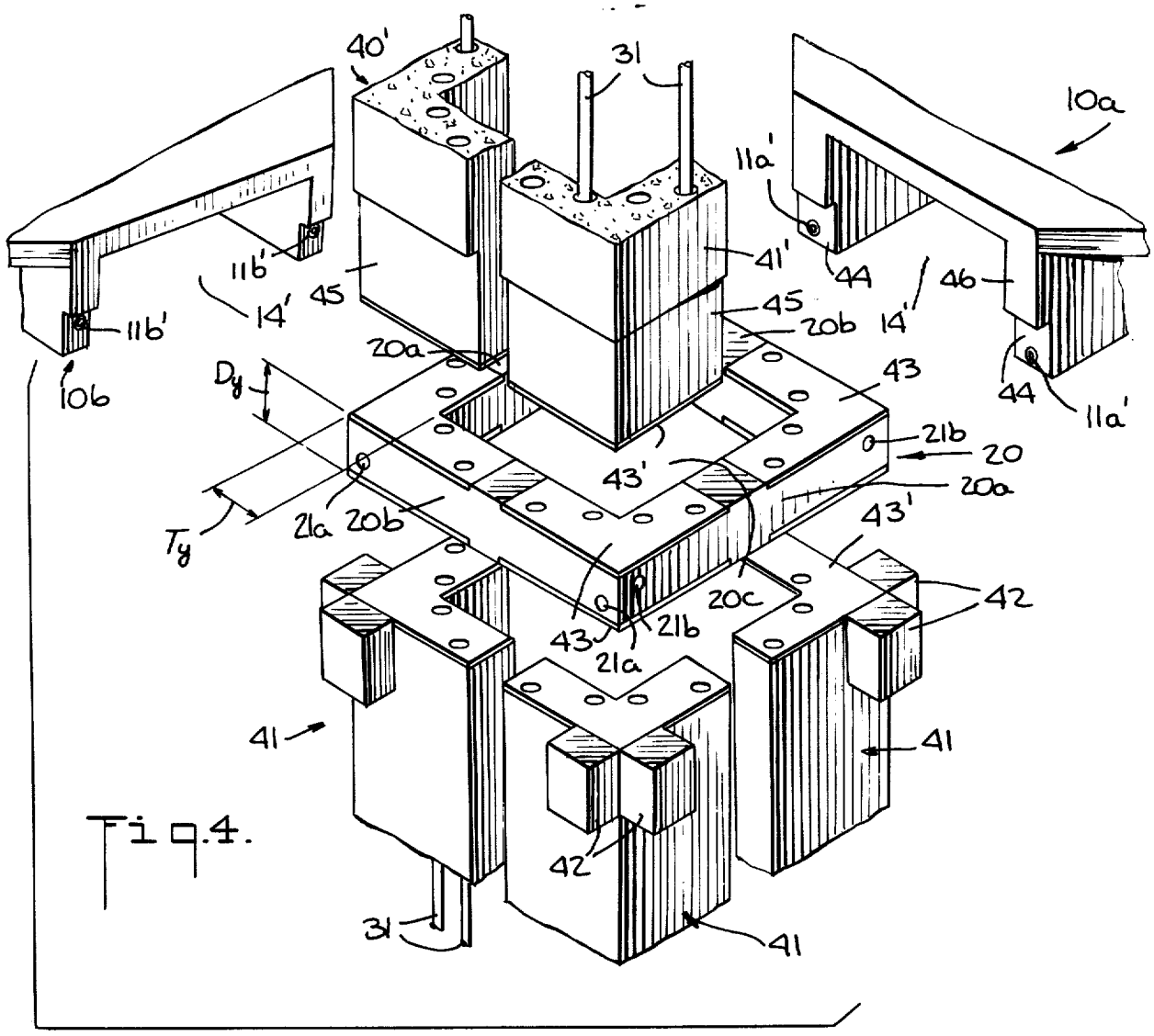

40'
31
10a
11a'
41'
44
46
45
20b
14'
11b'
14'
45
20a
106
D_y
43
21b
20
43'
20a
T_y
21a
20b
43'
20c
42
43'
21b
21a
41
41
42
31
41

Fig. 4.

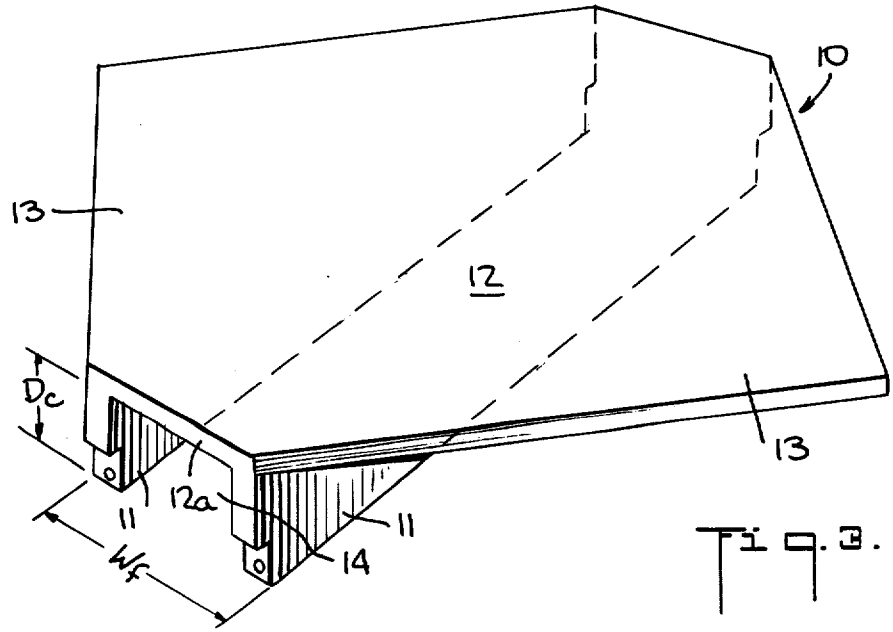

10
13
12
D_c
13
11
12a
11
14
W_f

Fig. 3.

Fig. 6.

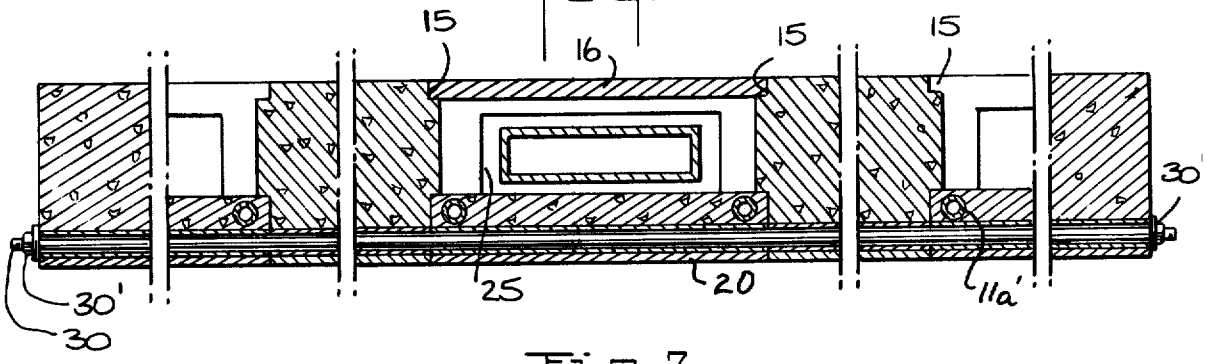
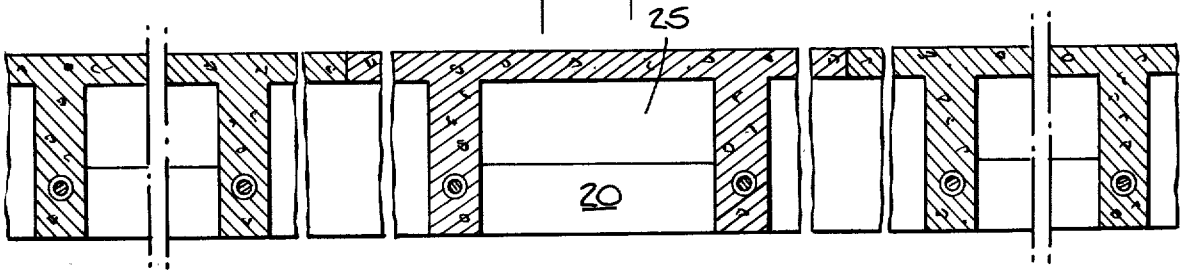


Fig. 7.



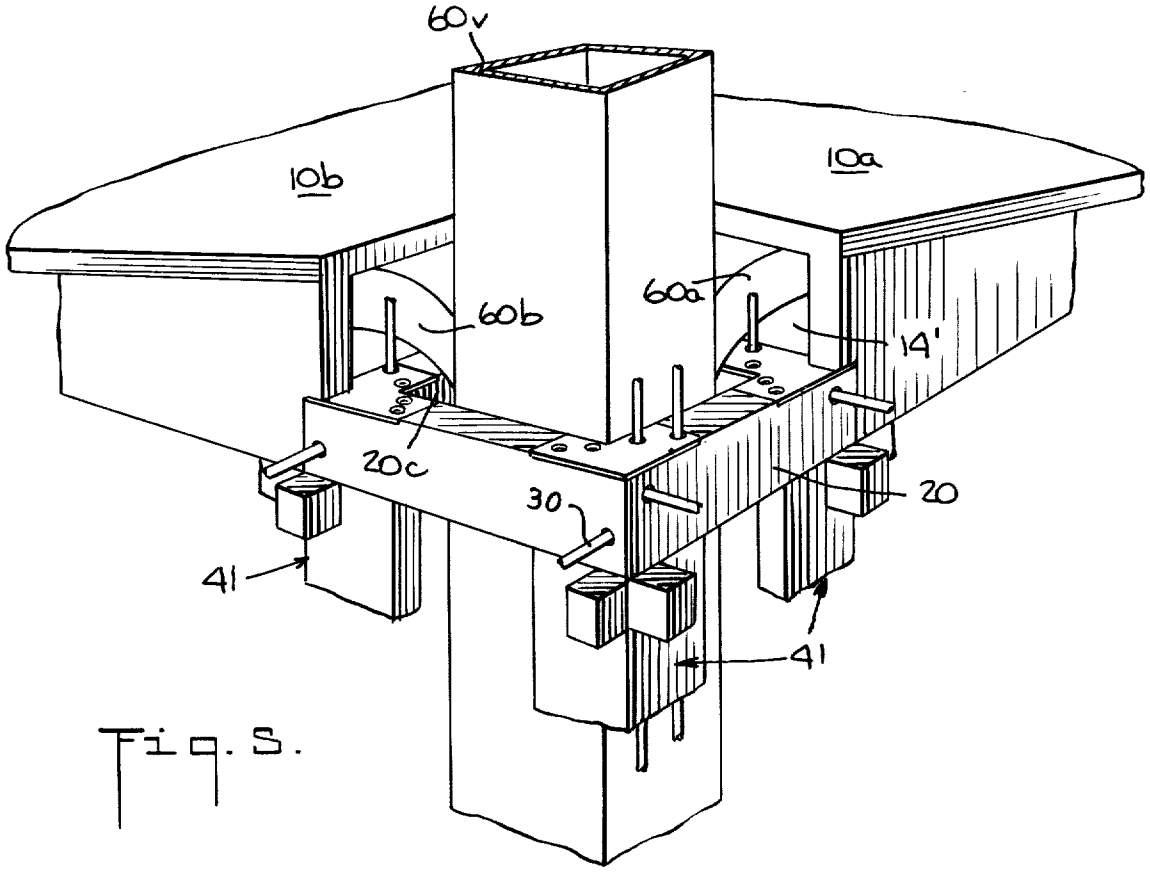


Fig. 8.

STRUCTURAL FLOOR SYSTEM ACCOMODATING MULTI-DIRECTIONAL DUCTS

This is a continuation of application Ser. No. 371,050, filed June 18, 1973, now abandoned.

BACKGROUND OF INVENTION

This invention pertains to structural floor support systems comprising precast reinforced concrete beams.

More specifically this invention pertains to a structural floor system of reinforced concrete beams arranged in such a manner that horizontal ducts for heating, cooling, etc. may, at any floor level, be positioned entirely within the dimensional confines of the structural floor beams themselves and yet extend in a multitude of longitudinal and transverse directions throughout the structure with numerous changes of direction and branch-offs readily possible.

It has been known, in the case of structures having a metal frame, to construct these of tubular metal members which are then bolted or welded together and to use the interior spaces of such tubular members as a duct. Examples of the latter are illustrated in U.S. Pat. Nos. 2,970,676 and 3,415,024. For structures comprised of parallely arranged beams of reinforced concrete extending from one side of the structure to the other, however, which are in wide use today, a simple and economical way had not yet been found to position ducts entirely within the vertical space required by the beams themselves, yet permit such ducts to change direction and/or branch-off at a multitude of locations throughout the structure as must invariably be the case with such ducts. In order to utilize the axial channels of the beams for housing the ducts, it has in the past been attempted to provide apertures in the stems of the beams for the duct in the channel to branch through such aperture in a transverse direction. An example of an apertured beam is shown in U.S. Pat. No. 3,363,375. Unfortunately such apertures in structural beams are likely to result in a weakened beam or one which is expensive to manufacture. Another system taught by the prior art is that illustrated in U.S. Pat. No. 2,477,256 where spaces between various independent groups of beams are utilized for duct work. Such a system, however, could not be used in a structure where all floor beams are to be integrally tied together and pretensioned both longitudinally and transversely.

As a result, the more common method in use today, of installing ducts, is to install the latter entirely below the concrete floor beams. Since all horizontal ducts are, in the latter construction, located entirely below the beams they can, of course, extend in any desired direction. The latter arrangement, on the other hand, while the most common, wastes a substantial amount of head room just for the duct system. A system which will eliminate this waste of precious vertical space, particularly in buildings having multiple stories, has long been sought.

While structural systems comprised of hollow reinforced concrete beams are per se known (as illustrated in U.S. Pat. No. 3,074,209), these had never been configurated in such a way as would permit multidirectional ducts to be housed entirely within the dimensional height confines of the beams themselves.

SUMMARY OF THE INVENTION

The present invention avoids the foregoing disadvantages by providing a structural system of reinforced

transversely and longitudinally pretensioned concrete π-shaped beams which are arranged and joined together in such a manner that not only do they form a rigid structure but the additional headroom space previously required for the duct system below beam level can now be used to better advantage. The arrangement is such that the ducts extend horizontally at each floor level entirely within the dimensional confines of the beams themselves. At numerous locations throughout the structure the ducts may change direction and/or branch off as desired.

According to the present invention there is provided, between each pair of aligned beams, a yoke member which cooperates with the adjacent beams to provide at numerous locations through the structure facilities for changing direction or branching-off of the duct. The yokes are preferably of reinforced concrete and each yoke has the shape of a rectangular frame. The sides of the yoke are dimensioned such that each spans the distance between the stems of an adjacent π-shaped beam and the depth of the yoke is such as to leave uncovered a portion of the open end of the channel of such beam sufficiently large to accomodate a duct extending there through and over the yoke which is in position between the beams. In such position the yoke holds adjacent, aligned, mutually post-tensioned beams in spaced relation. Thus, while the longitudinal and transverse beams and the intermediate yoke are integrally connected to and tensioned against one another there is nevertheless available an access space for a duct, through the interior of the yoke member, into the channels of the longitudinal beams as well as into the channels of the transverse beams at that location.

In its preferred form, the invention comprises modified π-shaped reinforced concrete structural beams. These beams have a pair of depending parallel stems connected by a central horizontal flange and include triangular flange extensions on opposite sides of the beam. Each such flange extension is preferably in the shape of a right triangle so that four such beams placed at right angles to one another (so as to form the sides of a square) completely cover, with their inwardly facing triangular flange extensions, the space therebetween.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a portion of a composite structural floor system according to a preferred embodiment of the present invention;

FIG. 2 is a diagrammatic bottom view of the floor structure of FIG. 1, showing the duct system;

FIG. 3 is a perspective view of a beam according to the preferred embodiment;

FIG. 4 is a partially perspective, exploded, view representative of any of the yoke locations of FIG. 2, enlarged and showing a yoke member, an associated longitudinal beam and an associated transverse beam, and showing also the support column means at representative vertical support location "A" or "G" of FIG. 2;

FIG. 5 is a perspective, partial view representative of any of the lettered yoke and beam connection locations "A" or "G" of FIG. 2, enlarged, and showing a vertical duct branching at said location in longitudinal and transverse directions;

FIG. 6 is a fragmented transverse sectional view in the direction of arrows 6—6 of the portion of the composite floor structure shown in FIG. 1;

FIG. 7 is a fragmented transverse sectional view taken in the direction of the arrows 7—7 in FIG. 1

DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in FIG. 1 a plurality of beams **10***a*, 10*b* and yokes **20** are supported on vertical columns **40** and integrally tied into a composite floor structure by longitudinally extending and transversely extending pairs of tension rods **30***a* and **30***b*, respectively.

FIG. 3 shows a typical beam as used in the structural system of the present invention. The beam **10** (representative of each of the beams **10***a* and **10***b*) comprises an integrally cast, reinforced concrete structure including two parallel spaced, elongated stem portions **11** and a flange **12** comprising a central flange portion **12***a* connecting the stem portions **11** and a pair of triangular flange extensions **13**. The central flange portion **12***a* and the flange extensions **13** are located in the same, generally horizontal, plane and form a continuous flat surface at the top of the beam. Each of the flange extensions **13** is preferably of right-triangular shape with the hypotenuse of the triangle being adjacent to and parallel with the corresponding stem **11** of the beam. The shape of the flange extension **13** is such that when four beams **10** are positioned at right angles to one another, as seen in FIGS. **1** and **2**, the inwardly facing flange extensions **13** of the beams will cooperate to form a continuous surface covering the enclosed space. The outwardly facing flange extensions **13** of each of the beams **10** are meanwhile in position to cooperate with additional beams for covering additional spaces. It will be readily understood that half-beams **10***a'*, as shown in FIG. **1**, can be positioned around the entire periphery of the illustrated structure so that the resulting structure would then be square and have linear longitudinal and transverse sides. The stems **11** of each beam form between themselves an axial channel open at both ends and open downwardly in the usual position of the beam, as shown in FIG. **3**.

Each stem **11** is provided in its lower portion with a longitudinal through-bore **11***a*, 11*b*. The bores **11***b* in the transverse beam **10***b* have their axes at a higher elevation (measured from the lower edge of the stem) than the corresponding bores **11***a* in the longitudinal beams **10***a*. Otherwise, beams **10***a* and **10***b* are identical. The through-bores **11***a*, 11*b* preferably have inserted therein sleeves **11***a'*, 11*b'* suitable for loosely receiving tension rods extending therethrough, as will be more fully explained below.

Preferably, a yoke member **20** (FIG. 4) is positioned at each corner of each of the squares forming the grid pattern of the structure. The longitudinally aligned beams **10***a* are tied to one another and to the intermediate yoke members **20** by tension means which are preferably in the form of longitudinal tension rods **30**. Similarly, the beams **10***b* in each row of aligned transverse beams are tied to one another and to the intermediate yoke members **20** by transverse tension rods **30**. Since the same yokes **20** which are tied to the longitudinal beams are also tied to the transverse beams, by having both longitudinal and transverse tension rods **30** extending through each yoke, the entire structure becomes a composite integral structure.

Yokes **20** preferably consist of reinforced concrete and are preferably in square-frame shape (FIG. 4). The pair of longitudinal arms **20***a* and the pair of transverse arms **20***b* of each yoke **20** define therebetween a central opening **20***c*.

Through each of the longitudinal arms **20***a* of the yokes **20** there extends a longitudinal sleeve **21***a* adapted for alignment with the sleeves **11***a'* of an adjacent beam **10***a* (FIG. 4).

Through each of the transverse arms **20***b* of the yokes **20** there extends a transverse sleeve **21***b* adapted for alignment with the sleeves **11***b'* of an adjacent beam **10***b*. The transverse sleeves **21***b* are positioned at a higher elevation in the yoke **20** than the longitudinal sleeves **21***a* (or vice versa) so that the longitudinal and transverse tension rods extending through the yoke will not interfere with one another. The length of the outer dimension of each of the arms **20***a* and **20***b* of yoke **20** is preferably substantially equal to the width dimension w_f (FIG. 3) of the stems **11** of a beam **10**. Furthermore, the depth D_y of the yoke member **20** (FIG. 4) is substantially smaller than the depth D_c of the channels **14** (FIG. 3) of the beams **10**, so that when a yoke is positioned adjacent the stems of a beam **10** a substantial portion of the open end **14'** of the channel **14** is left uncovered (FIG. 5). The thickness T_y of the arms **20***a* and **20***b* (FIG. 4) is preferably equal to the thickness of the corresponding stems **11** of the beam in alignment therewith.

By way of example, a square yoke **20** may be dimensioned as follows: each side may have an outer length of **54.0** inches, a depth D_y of **8.0** inches and a thickness T_y of **8.0** inches. The corresponding beams **10** (i.e. **10***a* and **10***b*) used in conjunction therewith may be **9.0** feet in length and have channels having a depth D_c of **24.0** inches and a width of **38.0** inches so as to have end openings each having an area of **912.0** square inches. Since the straddling yoke covers approximately **8** inches × **38** inches or **304.0** square inches of the latter area, there will remain uncovered and suitable for the passage therethrough of a duct a cross-sectional area equal to approximately **608.0** square inches.

FIG. **5** shows a yoke **20** in position adjacent longitudinal and transverse beams **10***a* and **10***b*, respectively, each of which is in contact with a respective side surface of the yoke member and each of which has its bores **11***a*, 11*b* in alignment with the corresponding sleeves **21***a* and **21***b* in the yoke, so that a pair of tension rods **30** may respectively pass, without interference, through the yoke and each said beam aligned therewith.

The bores **11***a* and **11***b* are located near the lower edges of the respective stems **11** so that the bottom surface of the yoke member **20** will be located in substantially the same, preferably horizontal, plane as the bottom surfaces of the stems **11**.

The column support arrangement is such that the entire floor structure according to the present invention is supported by vertical columns **40** at spaced locations as shown in FIG. **1**. Relatively widely spaced columns **40** may thus support this structure which is comprised of a relatively large number of longitudinal and transverse rows of aligned beams **10***a* and **10***b*, respectively. For example, the portion of the structure illustrated in FIG. **1** is supported by four vertical columns **40**. Each of the columns **40**, in turn, may consist of four separate columns **41** each having an L-shaped cross-section over the major portion of its length, and each preferably having a pair of projections **42** adjacent their uppermost portions, so as to provide the column at its top

with an X-shaped cross-section. Each column **41** is vertically aligned with a respective one of the four corners of the yoke member supported thereon. The X-shaped cross-sectioned top permits these columns to support not only the yoke but also the ends of the corresponding stems of the adjacent beams.

As seen in FIG. **6** the individual tension rods **30** extend from one end of the structure to the other and may be pre-tensioned during construction. They are anchored at their ends with conventional end anchorage means **30'** for prestressed rods.

According to the present invention, therefore, the main reinforcement means, namely the tension rods **30,** span longitudinally and transversely, respectively, across the full width of the building. The spaces above the yoke member **20** may be covered with rectangular slabs **16,** supported on shoulders **15,** for forming, together with the flanges **12,** a continuous floor surface (FIG. **1**). The slabs **16** may be precast or poured in place, as desired.

The space **25** formed between the top surface of a yoke **20** and the bottom surface of the corresponding slab **16** communicates, as may be seen in FIGS. **5** and **6,** with the central opening **20***c* in the yoke and, through the uncovered openings **14'**, with the interior of the longitudinal channels **14** in each of the beams **10***a* and **10***b* adjacent such yoke.

In modern buildings with large areas of floor space it is desirable to run under-floor ducts in longitudinal as well as in transverse directions and, in order to provide the greatest flexibility, it is desirable that the ducts change direction and/or branch off in various directions at numerous locations throughout the structure.

By arranging the floor beams as described herein and by providing the described cooperation between the beams and the yokes, there results a network of passages extending throughout the entire structure, as for example illustrated in FIG. **2,** which represents a view of the bottom of a floor structure according to the invention.

The network of passageways formed in accordance with the present invention may be used for ducts of all types including all necessary electrical conduits, air ducts for heating, ventilating and cooling purposes, plumbing and other services required in the building.

In FIG. **2** the ducts **60** are seen to extend in a multitude of directions throughout the structure. It will be understood that the duct can extend through any of the longitudinal or transverse beams in the respective channels thereof, can continue in its longitudinal or transverse direction, as the case may be, through any of the spaces **25** left uncovered by the yoke members **20,** or may at any of the yoke locations change direction or, as seen in FIG. **5,** branch off into other directions, e.g., transverse and longitudinal, and/or continue in the vertical direction to the next higher or lower floor. Thus, at any of the yoke locations the duct may either change directions from the longitudinal to the transverse or from either the longitudinal or transverse to the vertical, up or down, or may branch off into any desired number of branches at such location.

In FIG. **2** a vertical duct **60***v* at location "A" extends vertically through the yoke **20** at that location and branches off transversely as duct **60***b*.Duct **60***b* extends horizontally over and past the yoke **20** at location "B" to location "C". There the duct changes horizontal direction and becomes a longitudinal duct **60***a* which continues to locatin "D" where it changes direction once more to become a transverse duct **60***b'*. Then, at location "E" another change of direction to become longitudinal duct **60***a'* which then extends past location "F" to location "G" where the duct merges with another vertical duct **60***v'* which extends upwardly to the next higher floor level.

It will be seen in FIGS. **2** and **5** that the horizontal ducts are all positioned entirely within the spaces **14,** 14' and **25,** i.e., within the vertical dimensional confines of the beams **10***a* and **10***b*. Thus, the clear head room from the underside of the ducts will approximate the clear heights from the underside of the beams to the floor below.

In both the longitudinal and transverse directions, of course, the channels formed within the beams themselves provide the passageways for the ducts.

As for the vertical ducts **60***v* and **60***v'*, these are preferably arranged within the confines of the columns **40,** i.e., in the vertical passage formed between the four spaced apart vertical sub-columns **41** of which each column **40** is comprised.

These vertical passages communicate with the spaces **25** above each yoke member **20** through the opening **20**c in such yoke member.

FIG. **5** shows a vertical duct **60***v* coming from a lower floor level and branching off, above the yoke **20,** into a transverse duct **60***b* and a longitudinal duct **60***a*, while itself continuing on to the next higher floor level.

It will be seen (FIG. **2**) that the ducts may be left exposed at the underside of the floor structure. They are therefore readily accessible from below, for easy maintenance.

For constructing a multi-story structure in accordance with the present invention, additional vertical support columns **40'** are positioned over the floor structure shown in FIG. **1,** in alignment with the lower columns **40.** Each of these upper columns **40'** is composed of a group of four upper columns **41'**, each of which is in registry with a corresponding lower column **41.** The arrangement is such that the upper columns **41'** extend into the space formed between the end portions **46** of the beams which surround yoke **20** and bear with their own end portions directly on the upper surface of the yoke **20.** In this manner the entire load of the upper columns **41'** is transmitted directly into the intermediate yoke **20** and via the latter directly to the lower columns **41.**

Preferably the stems **11** of the beams **10***a*, 10*b* are provided, at their horizontal end portions **46,** with recesses **44** which together with the top surface of the associated lower column **41** form a cavity framing the intermediate yoke means **20.**

Similarly, the upper columns **41'** are formed at their lower ends with recesses **45** which, together with the top surface of the associated yoke **20,** form a cavity into which the unrecessed portions of the end portions **46** of the beams **10** extend. Sufficient vertical clearance is provided in each case by the respective recesses so that no load is transmitted from the upper columns **41'** to the beams **10***a* or **10***b*.

In order to facilitate the transmission of load from the upper columns directly to the lower columns, through the intermediate yokes, there are preferably provided flat, L-shaped steel bearing plates **43,** preferably positioned over and embedded in each corner of the upper and lower surfaces of the yokes **20.**

Corresponding L-shaped steel bearing plates **43'** are embedded in the top surface of the lower columns **41** and in the bottom surface of the upper columns **41'**, in registry with one another and with the adjacent plates **43** in the top and bottom surfaces of the yoke, for providing suitable load bearing surfaces between the yoke **20** and the upper and lower columns.

Vertical tension rods **31** extend loosely from the upper to the lower portion of the structure through columns **41** and **41'**, through suitably aligned vertical sleeves in the yokes **20,** and through suitably aligned holes in the plates **43** and **43'**. The vertical tension rods are anchored with conventional anchoring means for tension rods, in both the upper and lower portions of the structure.

Thus, the structure according to the preferred embodiment of the present invention is post-tensioned not only in the transverse and the longitudinal directions but also in the vertical direction through the use of the yokes **20.** Each yoke **20** not only provides a link between the longitudinal, transverse and vertical tensioning means, but further provides a communication between transverse, longitudinal and vertical passageways in the structure so as to accommodate a system of ducts extending in multiple directions throughout the structure, all within the dimensional confines of the structural elements themselves, i.e., without reducing the clear height from the underside of the structural floor beams to the floor below.

Whereas certain preferred embodiments have been shown and described, various other modifications will be apparent to those skilled in the art, in the light of this disclosure, and the invention should not, therefore, be deemed as limited, except insofar as shall appear from the spirit and scope of the appended claims.

What is claimed as new and desired to be protected by Letters Patent is:

1. In a floor structure, in combination:

a pair of longitudinal and a pair of transverse reinforced concrete beams, each having a horizontal flange portion and a pair of spaced parallel stem portions depending from said flange portion and defining between themselves an axial channel open at opposite ends;

a horizontally disposed rectangular yoke means having a first pairr of spaced parallel longitudinal side portions and a second pair of spaced parallel transverse side portions defining between themselves an opening;

each of said beams having a first end portion adjacent said yoke means and a second end portion spaced from said yoke means, said stem portions of said longitudinal beams being in substantial alignment with the respective ones of said longitudinal side portions of said yoke means, and said stem portions of said transverse beams being in substantial alignment with the respective ones of said transverse side portions of said yoke means;

a first pair of tension means extending in lengthwise direction through said respective stem portions of said longitudinal beams and said longitudinal side portions of said yoke means for integrally connecting together said pair of longitudinal beams with said yoke means and a second pair of tension means extending in lengthwise direction through said respective stem portions of said transverse beams and said aligned transverse side portions of said yoke means for integrally connecting together said pair of transverse beams with said yoke means whereby the entire structure is integrally connected together;

said yoke means spanning the distance between the stem portions of each of said beams and having a depth sufficiently smaller than the depth of the channels in said beams so as to leave uncovered a substantial portion of the open ends of said channels whereby said open ends are adapted to accommodate a duct extending therethrough.

2. The floor structure according to claim **1** wherein said yoke means is square and is comprised of reinforced concrete.

3. The floor structure according to claim **2** wherein said yoke means has a pair of sleeves extending lengthwise through the longitudinal side portions thereof and a second pair of sleeves extending lengthwise through the transverse side portions thereof, said sleeves being adapted to loosely receive the respective tension means extending therethrough.

4. The floor structure according to claim **3** wherein said tension means are tension rods.

5. The floor structure according to claim **4** wherein said longitudinal tension rods extend from one longitudinal end of the structure to the other and said transverse tension rods extend from one transverse end of the structure to the other.

6. The floor structure according to claim **1** wherein each of said stem portions of said beams is provided with a sleeve extending in lengthwise direction through the respective stem and adapted to loosely receive the respective tension means extending therethrough.

7. The floor structure according to claim **6** wherein the sleeves extending through said longitudinal beams are embedded therein at a different elevation than the sleeves extending through said transverse beams.

8. The floor structure according to claim **3** wherein said sleeves in said longitudinal side portions are at a different elevation than said sleeves in said transverse side portions.

9. The floor structure according to claim **5** further comprising anchoring means at the ends of said tension rods for anchoring the latter to the structure in tensioned condition.

10. The floor structure according to claim **1,** further comprising lower vertical column means supporting said yoke means and the end portions of said beams adjacent said yoke means.

11. The floor structure according to claim **10** for use in a multi-story structure, further comprising upper vertical column means supported on said yoke means, said yoke means and said upper and lower column means having aligned vertical through-bores and the structure further comprising vertical tension means extending through said through-bores and being anchored at the upper and lower portions of the structure for tying together multiple floors of the structure.

12. The floor structure according to claim **11** wherein said yoke means comprises parallel planar top and bottom surfaces and further comprising metal bearing plate means embedded in said top and bottom surfaces of said yoke means and cooperating metal bearing plate means in the respective cooperating top surface of said lower vertical column means and in the bottom surface of said upper column means.

13. The floor structure according to claim 1 wherein said yoke means comprises parallel planar top and bottom surfaces and the vertical distance between said top and bottom surfaces is less than half the vertical inside depth of the channel of the adjacent beams.

14. A multi-story structure comprising:

first and vertically spaced second horizontal floor systems each including a plurality of transverse and longitudinal beams of reinforced concrete arranged in a square grid pattern and each of said beams defining therein an elongated channel open at opposite ends, a plurality of square frame-shaped yoke means, each longitudinal beam being separated from the next longitudinal beam in the same longitudinal row by one of said yoke means and each transverse beam being separated from the next transverse beam in the same transverse row by one of said yoke means, said yoke means spanning the open end of the channel of the adjacent beams and being dimensioned so as to leave uncovered a portion of each such channel opening;

vertical column means including first vertical column means supporting at least one of said yoke means of said lower floor system, and second vertical column means supporting at least one of said yoke means of said upper floor system, said first and second vertical column means being in vertical alignment with each other and with each said one yoke means, said second vertical column means being supported on said one yoke means of said lower floor system and each said column means and said one yoke means including vertical through-openings in alignment with each other and communicating with the channels in adjacent ones of said beams;

tension means for tying the structure together including longitudinal tension means extending lengthwise through each longitudinal row of beams and yokes in each floor system, transverse tension means extending lengthwise through each transverse row of beams and yokes in each floor system, and vertical tension means extending lengthwise through said upper and lower column means and through each said one yoke means in alignment therewith.

15. The structure according to claim 14, further comprising duct means including longitudinal duct means extending lengthwise through the channel of at least one of said longitudinal beams in one of said floor system,

transverse duct means extending lengthwise through the channel of at least one of said transverse beams in said one floor system and communicatively connected with said longitudinal duct means in the region of one of said yoke means and vertical duct means extending lengthwise through at least one of said column means and at least one of the yoke means associated therewith and communicatively connected with at least one of said longitudinal and transverse duct means.

16. In a floor structure, in combination:

a reinforced concrete beam having a horizontal flange portion and a pair of parallel horizontally elongated stem portions depending from said flange portion and defining between themselves an axial channel open at opposite ends, said stem portions being spaced a given distance apart;

a horizontally disposed rectangular yoke means comprising a first pair of parallel leg portions spaced apart a distance substantially equal to said given distance and a second pair of spaced parallel leg portions transverse to said first pair of leg portions and connected thereto;

said beam having a first end portion abutting one of said second pair of leg portions and a second end portion spaced from said yoke means, each of said parallel pair of elongated stem portions of said beam being in substantial alignment in the direction of elongation thereof with a corresponding one of said first pair of leg portions of said yoke means;

a pair of tension means each extending in length wise direction through a respective one of said stem portions and through the leg portion of said yoke means aligned therewith for integrally connecting together said beam with said yoke means;

and

said yoke means spanning the distance between said stem portions and having a depth sufficiently smaller than the depth of the channel in said beam so as to leave uncovered a substantial portion of the open end of said channel whereby said open end is adapted to accommodate a duct extending therethrough.

17. The floor structure according to claim 16, further conprising a second beam of reinforced concrete having a flange portion and a pair of spaced parallel stem portions depending from said flange portion and defining between themselves an axial channel open at opposite ends, said stem portions of said second beam being aligned with a corresponding pair of leg portions of said yoke means, and

a second pair of tension means each extending in lengthwise direction through a respective one of said stem portions of said second beam and through the corresponding one of the last mentioned pair of leg portions of said yoke means aligned therewith, for integrally connecting together said second beam with said yoke means whereby the entire structure is integrally connected together.

18. The floor structure according to claim 17, wherein said stem portions of said one beam are aligned with said first pair of leg portions of said yoke means and said stem portions of said other beam are aligned with said second pair of side portions of said yoke means.

19. The floor structure according to claim 16, wherein said first pair of leg portions of said yoke means and said second pair of side portions of said yoke means define between themselves and opening extending substantially vertically through said yoke means.

20. The floor structure according to claim 17 further comprising a second pair of reinforced concrete beams, each having a horizontal flange portion and a pair of spaced parallel stem portions depending from said flange portion and defining between themselves an axial channel open at opposite ends;

said stem portions of said second pair of beams each being in alignment with a pair of leg portions of said yoke means.

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