United States Patent [19]

Cauceglia et al.

[11] **3,924,370**

[45] **Dec. 9, 1975**

[54] **RAISED FLOOR WITH CLAMPED PANEL SUPPORT**

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[21] Appl. No.: **491,343**

[52] **U.S. Cl.** **52/126;** 52/263; 52/220

[51] **Int. Cl.²** **E04F 13/08**

[58] **Field of Search** 52/126, 220, 263, 483, 52/478, 550, 122, 588, 629, 592, 593, 541, 585, 586, 390, 391

[56] **References Cited**

UNITED STATES PATENTS

3,150,748	9/1964	Liskey	52/126 X
3,316,680	5/1967	Chrastek	52/126
3,789,557	2/1974	Harvey	52/126

FOREIGN PATENTS OR APPLICATIONS

689,002	3/1953	United Kingdom	52/263

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[57] **ABSTRACT**

A raised floor structure supports electronic equipment units and provides space for electric cabling thereunder. A plurality of spaced parallel beams are supported above a subfloor by vertically adjustable pedestals. A first group of freely insertable and removable rectangular floor panels, each resting on a pair of adjacent beams, forms equipment unit access areas. A second group of rectangular floor panels, each having its underside rigidly attached to a pair of adjacent parallel beams, forms a base for equipment units. The rigidly attached floor panels provide horizontal structural support for the spaced parallel beams.

11 Claims, 6 Drawing Figures

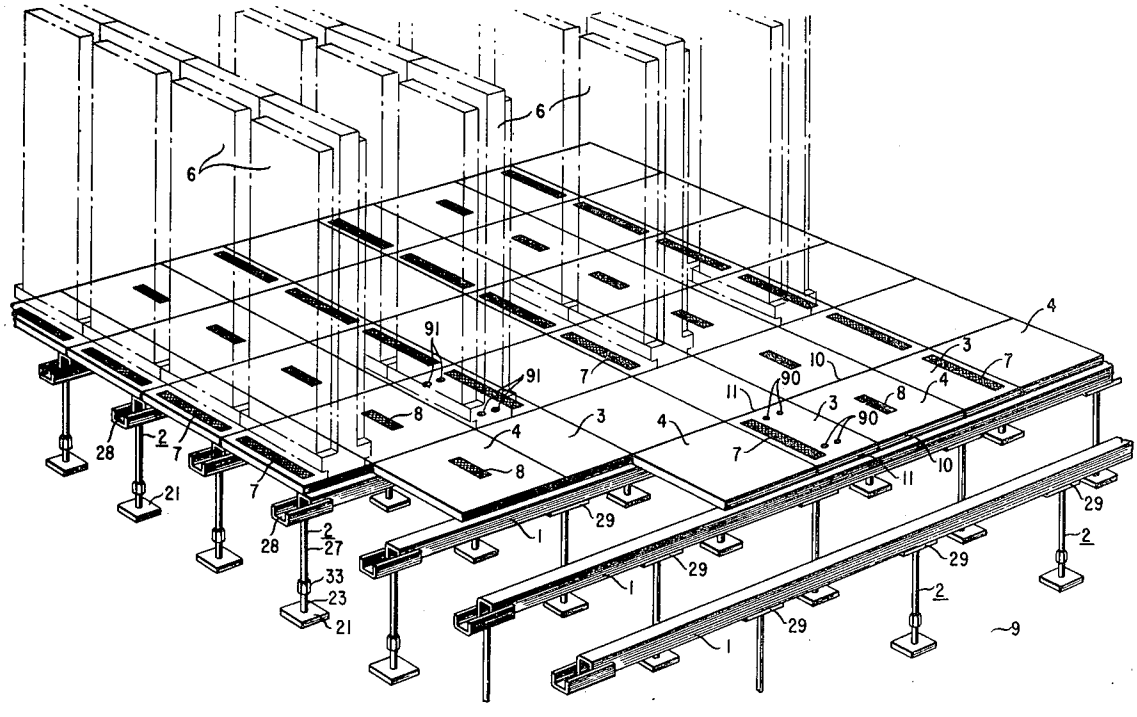


FIG. 1

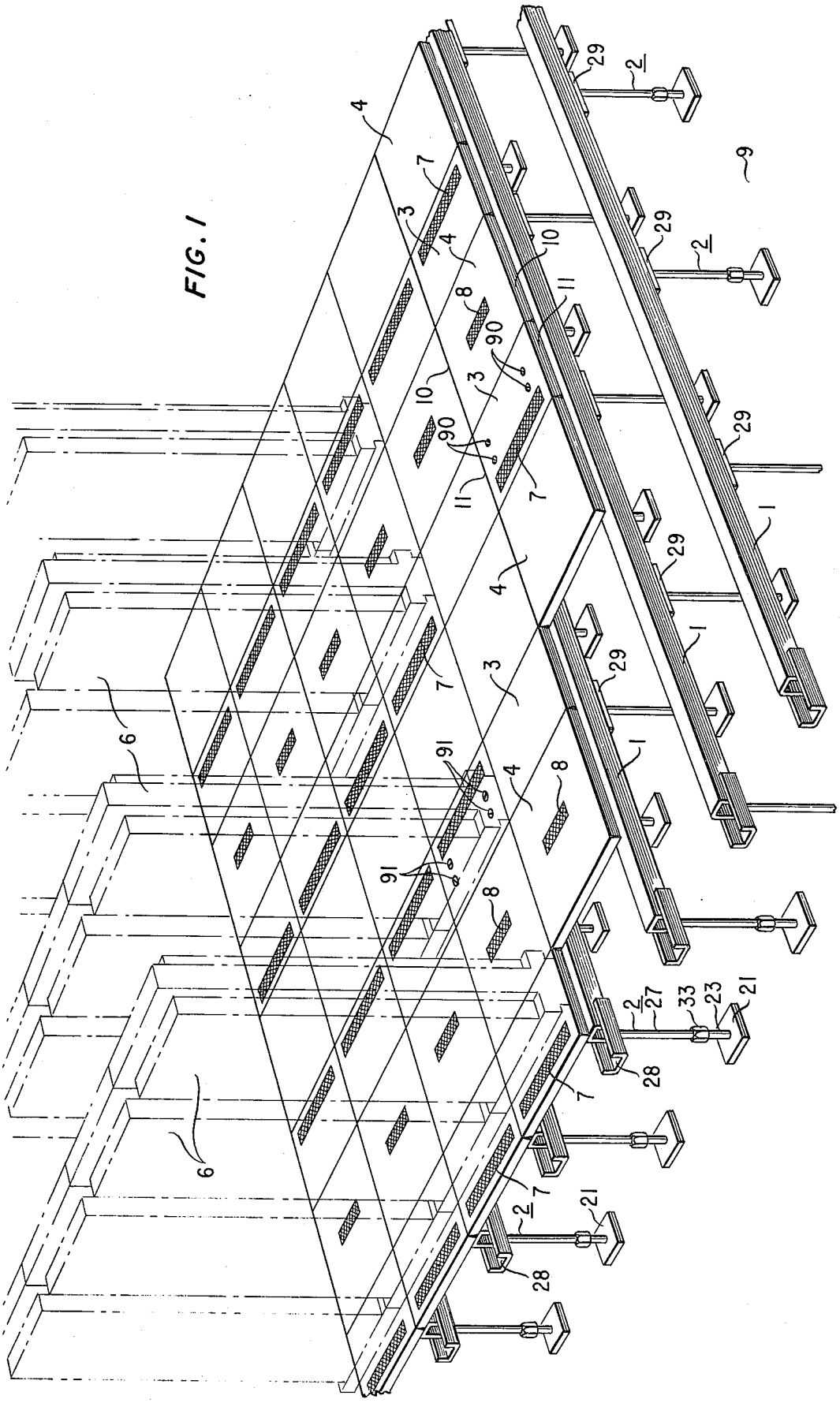


FIG. 2

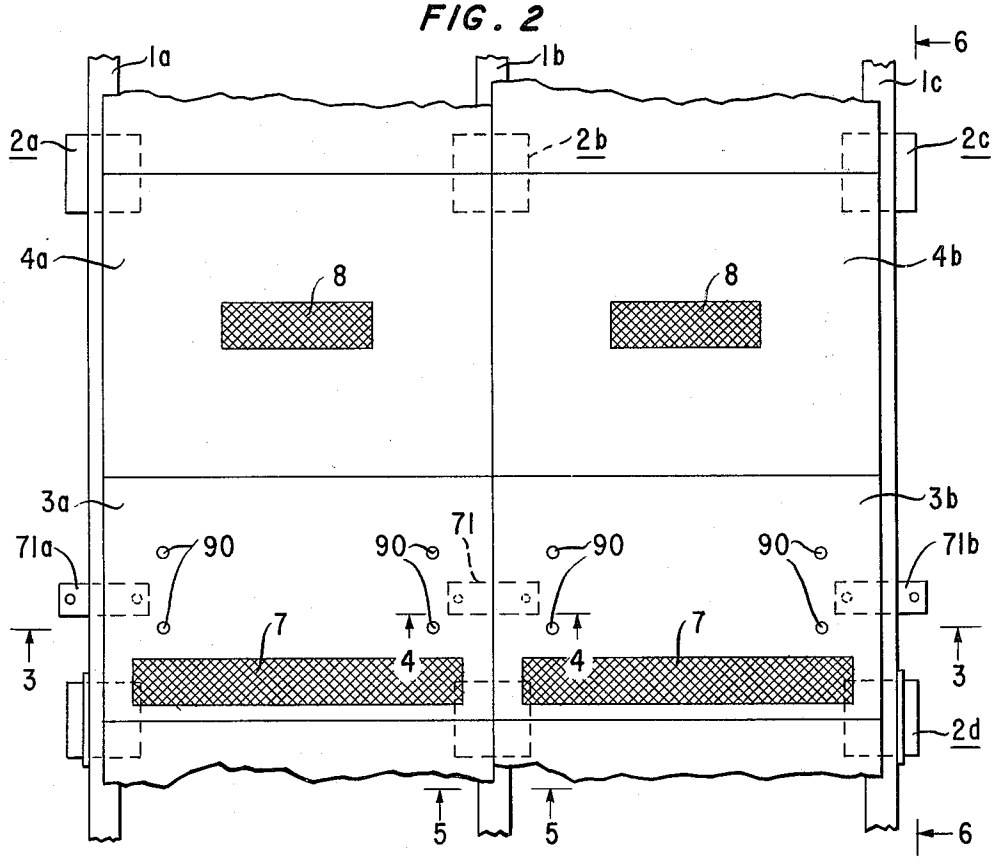


FIG. 3

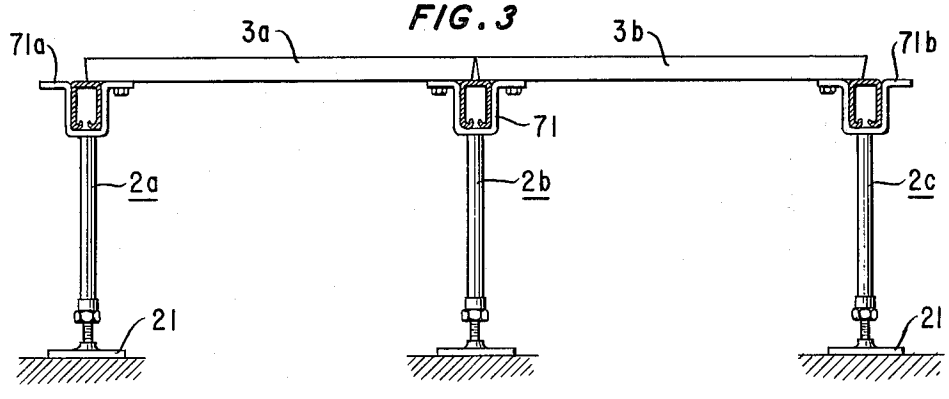


FIG. 6

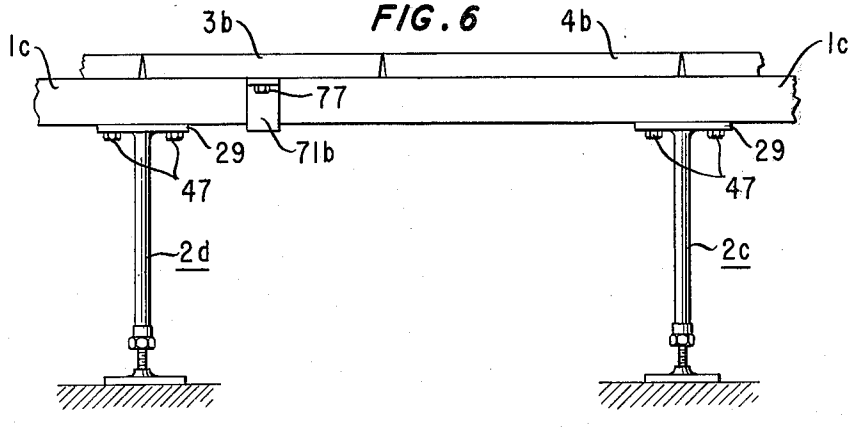


FIG. 5

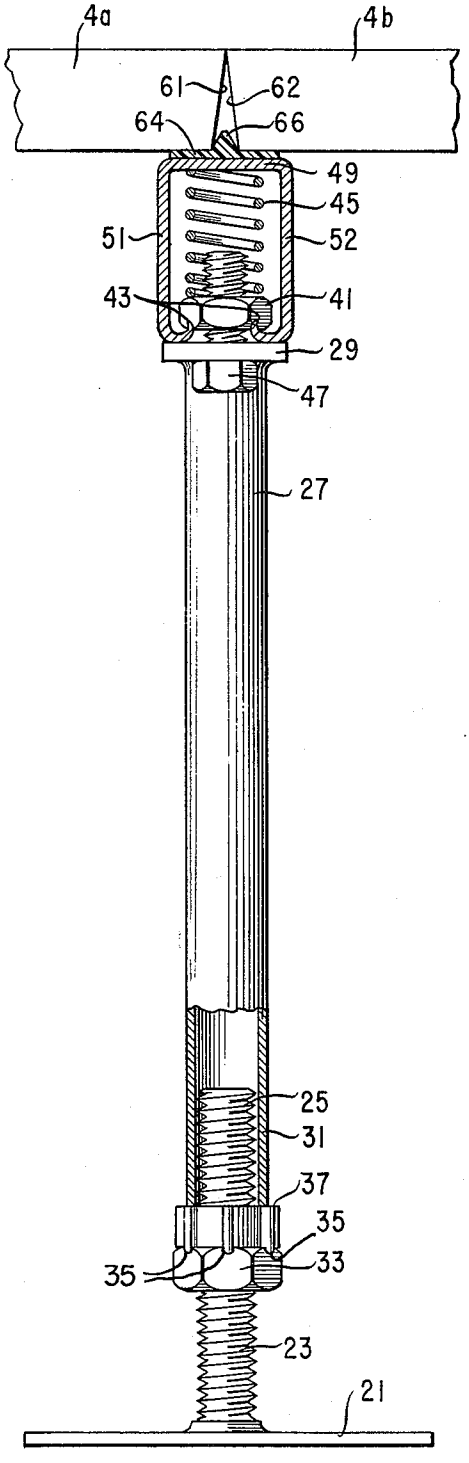
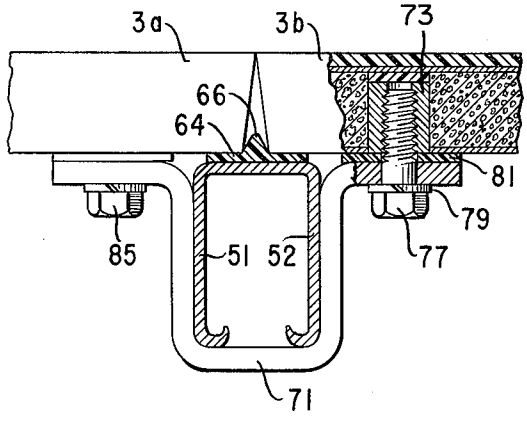

4a
4b
61
62
64
66
49
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51
52
43
41
29
47
27
25
31
37
35
35
33
23
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FIG. 4


3a
3b
73
66
64
81
79
85
51
52
77
71

RAISED FLOOR WITH CLAMPED PANEL SUPPORT

BACKGROUND OF THE INVENTION

Our invention relates to raised floor construction adapted to support equipment units requiring space thereunder for cabling and ancillary apparatus, and more particularly to raised floor structures having a plurality of panels supported on a pedestal arrangement over a subfloor.

In communication and computing facilities and elsewhere, the interconnection of electronic equipment units involves complex electrical cabling, piping and duct work between the equipment units. An elevated floor overlying the existing floor structure can be employed to provide space for cabling and other apparatus underneath the electronic equipment units in a manner that avoids interference with equipment units, interference with equipment operation and maintenance, accidental damage, and hazards to operating personnel. Such floor structures include removable sections for inspection and maintenance of the cabling and apparatus between the subfloor and the raised floor on which the equipment units are mounted.

In one type of priorly known raised floor construction, a plurality of rectangularly dimensioned, rigid, lightweight panels are placed over a rectangular grid of supporting beams. The beams, in turn, are attached to the subfloor by means of periodically spaced pedestals. Each panel is freely insertable and removable so that access to areas underneath the raised floor is available. The interconnection of the orthogonal beams, however, is complex and expensive owing to the requirement that the raised floor panels form a smooth, flat surface.

Another type of known floor panel construction utilizes a supporting structure of parallel beams running the length of the floor in one direction. Each beam is mounted on a plurality of pedestals, which pedestals rest on the subfloor. Each rectangularly dimensioned floor panel is spanned between a pair of adjacent beams and a continuous raised floor is formed by side-by-side panel placement. To prevent shifting of the parallel beams, the ends of the floor panels overlying the beams are rigidly attached to the beams by a bar structure running the beam length. In this manner, the raised floor is fully supported and the floor panels form an integral part of the support structure. The connection between the floor panels and the beams, however, increases the difficulty of removal of an individual panel for purposes of inspection or maintenance. Additionally, the structure of the floor panel ends, the beams, and the overlying bar are relatively complex in order that the junction of the floor panel ends and the overlying bar conform to the smooth surface of the raised floor. Further, the metallic bar structure provides an unwanted electrical path to ground through the raised floor structure.

It is an object of the invention to provide an improved raised floor supported on a parallel spaced beam structure and having freely insertable and removable individual floor panels for access to the space beneath the raised floor.

It is another object of the invention to provide an improved raised floor structure having a plurality of spaced parallel beams which are prevented from shifting by attachment of selected floor panels to the beams adjacent thereto.

It is yet another object of the invention to provide an improved raised floor structure having selected floor panels laterally supporting the spaced parallel beams and other panels freely insertable and removable to provide ready access to the space beneath the raised floor.

It is yet another object of the invention to provide an improved raised floor structure for supporting a plurality of equipment units wherein each laterally supporting floor panel underneath equipment has its underside rigidly clamped to the pair of adjacent beams on which it rests.

It is yet another object of the invention to provide an improved raised floor structure for supporting a plurality of equipment units wherein the laterally supporting floor panels are arranged in rows underlying the equipment units. Freely insertable and removable floor panels are arranged in rows adjacent to the laterally supporting floor panels whereby access to the space beneath the raised floor and the laterally supporting panel clamping arrangements is obtained.

It is yet another object of the invention to provide an improved raised floor structure adapted to protect electronic equipment mounted thereon from overturning.

SUMMARY OF THE INVENTION

The invention is directed to a raised floor structure for supporting equipment above an existing floor while allowing space beneath the equipment for cabling, pipes and other ancillary apparatus. A plurality of spaced, parallel beams are supported on subfloor mounted, vertically adjustable pedestals. Each of a first group of rectangularly dimensioned floor panels spans between adjacent parallel beams and rests thereon in nonequipment areas. Each of a second group of rectangularly dimensioned floor panels spans between adjacent parallel beams and rests thereon underneath equipment units. Each first group panel is freely insertable and removable from adjacent beams, but each second group panel has its underside portion thereof rigidly attached to the beams on which it rests whereby the second group panels provide transverse support for the parallel beam structure.

According to one aspect of the invention, the underside of each adjacent pair of said second group panels is attached to the common base underlying said panels by a removable clamp connected to the undersides of said pair of second group panels and to the common beam. Access to said clamp is obtained by removal of an adjacent first group panel.

According to another aspect of the invention, the second group panels are placed in rows running transverse to the direction of the parallel beams, said rows of second group panels underlying equipment units.

According to yet another aspect of the invention, selected first group panels and each second group panel includes an apertured venting section which permits air flow adjacent to said equipment units.

According to yet another aspect of the invention, each equipment unit is rigidly attached to the second group panel underlying said unit to prevent overturning of said unit.

In an embodiment illustrative of the invention, a plurality of rectangular cross-section beams are placed in a parallel spaced relationship to form supports for rect-

angularly dimensioned, rigid but lightweight raised floor panels. Each beam is mounted on a plurality of vertically adjustable pedestals, which pedestals rest on the subfloor. The raised floor is divided into sections that underlie and support electrical equipment units and into sections used by operating personnel for access to said equipment units. In the access sections, a plurality of first dimensioned rectangular floor panels are placed side by side to form a flat surface. Each first dimensioned floor panel spans between and rests on adjacent parallel beams and is juxtaposed with adjacent floor panels.

In the equipment unit floor sections, generally arranged in rows running transverse to the direction of the parallel beams, a group of second dimensioned floor panels are placed side by side to form a base underneath said equipment units. Each second dimensioned panel spans between adjacent beams and rests thereon so that a pair of juxtaposed second dimensioned panels rest on a common beam. The underside of each second dimensioned panel includes a threaded insert. A hat-shaped clamp is saddled around lower edge and sides of the rectangular common beam and is alinged with the threaded inserts of the juxtaposed second dimensioned panels. A cap screw fixedly connects the clamp to the juxtaposed second dimensioned panel. In this manner, the row of clamped second dimensioned panels forms a rigid transverse support to prevent shifting of the parallel spaced beams. Advantageously, only the second dimensioned beams which are trapped underneath equipment units are clamped in place. The first dimensioned panels in nonequipment sections are freely removable and insertable for access to cabling and ducts underneath the raised floor and for access to the clamps holding the trapped panels. The clamped panels may be moved and rearranged to adapt to modifications in equipment unit placement.

DESCRIPTION OF THE DRAWING

FIG. 1 depicts a perspective view of a raised floor illustrative of the invention, with parts broken away to illustrate construction;

FIG. 2 is a top view of a section of floor panels including a pair of floor panels which form the base for equipment units;

FIG. 3 is a front view of the adjacent panels of FIG. 2 taken along lines 3—3 of FIG. 2;

FIG. 4 is an enlarged view of the clamping arrangements for floor panels which form the base for equipment units taken along lines 4—4 of FIG. 2;

FIG. 5 is an enlarged view of the pedestal arrangements in FIG. 2 taken along lines 5—5 of FIG. 2; and

FIG. 6 is a side view taken along lines 6—6 of FIG. 2.

DETAILED DESCRIPTION

With reference to FIG. 1, equipment frames 6 are supported at a predetermined distance above subfloor 9 on the rectangular array of raised floor panels 3 and 4. The space underneath the array of raised floor panels and above subfloor 9 permits an electrical cable network to interconnect equipment units 6 and also permits ancillary apparatus servicing the equipment units to be placed between the raised floor and subfloor 9. Such ancillary units may include pipes and air-conditioning elements such as air plenum space for equipment cooling.

The raised floor structure includes a plurality of spaced parallel beams 1 running in one direction as shown in FIG. 1. Each beam comprises a rectangular cross-section channel and is supported on a plurality of equally spaced, vertically adjustable pedestals 2 which rest on the subfloor. The raised floor itself comprises first dimensioned rectangular panels 4 arranged to form a flat surface in equipment access areas and second dimensioned rectangular panels 3 underlying equipment units 6. Each first dimensioned panel 4 has opposite ends 10 resting on a pair of adjacent beams and the panel is freely insertable and removable from the floor. Each second dimensioned panel 3 has opposite ends 11 resting on a pair of adjacent beams and is rigidly attached to said adjacent beams to provide transverse support for the adjacent beams whereby shifting of the parallel beams is prevented. The dimensions of panels 3 are adapted to fit underneath equipment 6. It is to be understood, however, that panels 3 may be of different dimensions and may be the same sizes as panel 4.

FIG. 2 shows a top view of first dimensioned panels 3*a* and 3*b* in a particular equipment section of the raised floor along with adjacent freely insertable and removable panels 4*a* and 4*b*. Panel 3*a* spans between and rests on beams 1*a* and 1*b* and panel 3*b* spans between and rests on beams 1*b* and 1*c*. Panel 3*a* is rigidly attached to beams 1*a* and 1*b* by underside mounted clamp 71*a* and 71. Similarly panel 3*b* is rigidly attached to adjacent beams 1*b* and 1*c* by clamps 71 and 71*b*. Pedestals 2*a*, 2*b*, and 2*c* underlie beams 1*a*, 1*b*, and 1*c*, respectively.

FIG. 3 shows a front view of the raised floor structure of FIG. 2 wherein the hat-shaped clamps 71*a*, 71, and 71*b* are shown attached to floor panels 3*a* and 3*b*. Also shown in FIG. 3 are pedestals 2*a*, 2*b*, and 2*c*, which pedestals support beams 1*a*, 1*b*, and 1*c*, respectively. The individual pedestal structure and its connection arrangements to the underlying beam are shown in FIG. 5.

Referring to FIG. 5, pedestal 2 comprises base plate 21 which rests on subfloor 9. Lower column 23 extends upwardly from the center of base plate 21 and the upper portion of column 23 includes externally threaded section 25. Upper column 27 has a plate 29 fixedly attached to its upper end and said upper column includes a hollow lower end 31. Hollow end 31 is slid over threaded section 25 of lower column 23 and rests on jack nut 33 which is threadily engaged with lower column section 25. Adjustment of the height of jack nut 33 provides a vertical leveling adjustment for the overlying raised floor. The leveling adjustment accommodates variations in the surface of subfloor 9. Cylindrical ferrule 37 is press fitted on the outside of upper column 27 at its lower end 31 and rests on jack nut 33. Serrated grooves 35 in jack nut 33 receive corresponding projections of ferrule 37 and the weight of the raised floor structure bearing on upper column 27 urges member 37 into grooves 35 whereby the jack nut is constrained from rotation after the leveling adjustment has been completed.

Plate 29 on the top of upper column 27 includes a pair of holes symmetrically positioned on either side of column 27. Rectangular nuts 41 inserted into the slotted low side of beam 1*b* and held in place by the upwardly in-turned edges 43 of beam 1*b* are positioned over the holes in plate 29. The lower face of each rectangular nut includes serrated grooves into which in-turned edges 43 fit whereby nut 41 is prevented from rotating. Spring 45, resting against upper web 49 of

beam 1*b*, forcibly urges nut 41 downwardly against the in-turned edges 43. Cap screws 47 are pushed through the holes in plate 29 and are threaded through nuts 41 to rigidly connect the pedestal to beam 1*b*. A side view of the pedestal illustrating the positions of cap screws 47 and plate 29 is shown in FIG. 6.

Each beam 1 has a rectangular cross-section as shown in FIG. 5 and includes closed top or web 49 and flanges 51 and 52. The flanges extend vertically downward and have upwardly in-turned edges 43 whereby the lower face of the beam includes a slot formed by in-turned edges 43. Each beam may comprise sections of standard length whereby two or more end to end sections may be required in the raised floor structure of FIG. 1. Two beam sections may be joined over a pedestal by means of a U-shaped member 28 as illustrated in FIG. 1. The U-shaped member includes a pair of holes on either side of upper column 27 which screw into rectangular nuts. The rectangular nut is inserted into each beam section. The vertical sides of U-shaped member 28 are fitted tightly over flanges 51 and 52 to rigidly connect the two beam sections. The U-shaped junction member replaces plate 29 in the pedestal shown in FIG. 5.

FIG. 5 also shows the mounting arrangements for a pair of second dimensioned floor panels 4*a* and 4*b* on common beam 1*b*. A vinyl strip 64 having a wedge projection 66 overlying the beam web center is attached to web 49 and serves as a keying device for the proper positioning of panels 4*a* and 4*b*. Edge 61 of panel 4*a* and edge 62 of juxtaposed panel 4*b* each extend downwardly and inwardly so that the panels meet at their upper edge points and are displaced by wedge 66 at their lower edge points. Panel 4*a* rests over one half of web section 49, while panel 4*b* rests over the other half of web 49 whereby the loads on panels 4*a* and 4*b* are transmitted to beam 1*b* and therefrom to the subfloor via the pedestals supporting beam 1*b*. Panels 4*a* and 4*b*, as well as all other second dimensioned panels, are freely insertable and removable from the raised floor through the use of suction devices or other means well known in the art adapted to verticalaly lift and lower the floor panels.

FIG. 4 illustrates the mounting and clamping arrangements for a pair of first dimensioned panels 3*a* and 3*b* juxtaposed over common beam 1*b*. Panel 3*b* includes an internally threaded insert 73 which is epoxied into a hole of suitable dimensions drilled into panel 3*b* a preset distance from flange 52. Similarly, an insert is placed in panel 3*a*. Where the top plate of panel 3*b* is metallic, an insulating washer 75 is placed between the metallic plate and insert 73 to electrically insulate the plate from the raised floor structure. In this way the raised floor surface is electrically insulated from the beam and pedestal arrangement.

Hat-shaped clamp 71 of suitable width is saddled around beam 1*b* so that it tightly conforms to flanges 51 and 52. The holes in the horizontal extending members of clamp 71 are aligned with threaded insert 73 under washer 81, which washer has the same thickness as keying strip 64. A similar arrangement is provided for panel 3*a*. Cap screw 77 is threaded into insert 73 through washer 79 whereby clamp 71 is rigidly connected to panel 3*b*. Similarly, cap screw 85 is threaded into the insert of panel 3*a* to rigidly connect clamp 71 to panel 3*a*. Panels 3*a* and 3*b* are also clamped to beams 1*a* and 1*c* by clamps 71*a* and 71*b*, respectively, as shown in FIG. 2. In this way, the second dimensioned panels 3 form a transverse support to prevent beams 1 from shifting. Generally, second dimensioned panels 3 are arranged in rows transverse to the direction of beams 1; and the rigid connection of panels 3 to beams 1 provides a transverse structural support for the raised floor. The freely insertable and removable panels 4 adjacent to the rows of panels 3 provide access to the hat-shaped clamps and the cap screws connecting panels 3 to beams 1 and to the space beneath the raised floor.

In FIG. 1 each transverse row of clamped floor panels 3 form a base for equipment unit 6. Panel 3 includes a venting section 7 comprising a rectangular array of apertures which serve as cooling air passageways. Air flows downward past one side of equipment unit 6, through venting section 7 of panel 3, and into the space between the raised floor and the subfloor. This space functions as a return air duct for the cooling system arrangements not shown. Selected rows of freely insertable and removable panels 4 also include venting sections 8 located in the centers thereof. These venting sections provide air return passageways between adjacent rows of equipment unit 6 on the sides of the equipment units opposite to venting sections 7. The remaining rows of panels 4 provide personnel access ways to the equipment units. Panels 4 in these access rows do not include venting sections, since venting section 7 of adjacent panels 3 suffices for cooling.

Equipment units 6 in FIG. 1 have a relatively narrow and high silhouette whereby there is a possibility of accidental overturning. To avoid such possible overturning, the equipment units are fixedly attached to the underlying panels 3. Internally threaded inserts 90 are included in the upper sides of affixed panels 3 and the overlying equipment unit is bolted into place by bolts 91 which are threaded into inserts 90. Since panels 3 are rigidly attached to the space parallel beam structure, the bolting of equipment units to panels 3 provides adequate structural support for the equipment units.

The described raised floor advantageously provides a smooth, flat, continuous surface in both equipment and equipment access areas. The panels trapped underneath equipment units are rigidly affixed to the underlying spaced parallel beam structure whereby the beams are laterally supported to prevent shifting. The affixing of the beams to the underside of the trapped panels eliminates any possibility of electrical grounds on the floor surface. All other floor panels are freely insertable and removable so that access to the space underneath the raised floor is readily obtained.

What is claimed is:

1. A raised floor for supporting equipment above a subfloor and providing space underneath said equipment for cabling and ancillary apparatus comprising a plurality of beams in spaced parallel relation to each other running along one direction, a plurality of vertically adjustable pedestals for supporting each beam, a plurality of freely insertable and removable first rectangular floor panels each having planar edges and each spanning between a pair of adjacent beams and having opposite ends resting on portions of said adjacent beams, a plurality of second individually insertable and removable rectangular floor panels having planar edges underlying said equipment, each second panel spanning between a pair of adjacent beams and having opposite ends resting on portions of said adjacent beams and means for fixedly supporting said beams in said spaced parallel relation comprising means for rigidly

attaching each pair of adjacent second panels to the common beam on which said pair of adjacent second panels rest.

2. A raised floor according to claim **1** wherein said attaching means comprises means for rigidly clamping the underside of each second panel to each of the adjacent beams on which its rests.

3. A raised floor according to claim **2** wherein each beam comprises a rectangular cross-section channel having an upper web on which a pair of juxtaposed second panels rest and a pair of downwardly extending vertical flanges, and said clamping means comprises a clamp conformed around said flanges and including a horizontal extension underneath each of said juxtaposed second panels, each clamp horizontal extension being rigidly but removably connected to the underside of the overlying juxtaposed second panel.

4. A raised floor for supporting a plurality of equipment units above a subfloor comprising a plurality of uniform cross-section channels running in one direction in spaced parallel relation, a plurality of vertically adjustable pedestals resting on said subfloor for supporting each channel, a plurality of first rectangularly dimensioned individually insertable and removable floor panels having planar edges each spanning a pair of adjacent channels and having opposite ends resting on portions of said adjacent channels in equipment access sections, a plurality of second rectangularly dimensioned individually insertable and removable floor panels each having planar edges and each spanning a pair of adjacent channels and having opposite ends resting on a portion of each adjacent channel in sections underlying said equipment units, means for rigidly holding said channels in spaced parallel relation comprising means for rigidly but removably attaching the undersides of each pair of juxtaposed second panels to the channel on which said juxtaposed panels commonly rest.

5. A raised floor according to claim **4** further comprising means for rigidly attaching each equipment unit to the second panel underlying each equipment unit.

6. A raised floor according to claim **4** wherein said channel has a rectangular cross section comprising an upper web on which said floor panels rest and a pair of downwardly extending vertical flanges, and said attaching means comprises a hat-shaped clamp including a U-shaped section saddled around said channel flanges and a pair of horizontal extensions each underneath one of said juxtaposed second floor panels resting on said saddled channel, and means for rigidly but removably connecting the underside of each juxtaposed second panel to the underlying clamp horizontal extension.

7. A raised floor according to claim **6** wherein each horizontal extension includes an apertured section, each juxtaposed second panel includes a threaded insert overlying said apertured section of said clamp horizontal extension, and a cap screw threadily engaged with said panel threaded insert to rigidly connect said clamp to said overlying juxtaposed panel.

8. A raised floor for supporting a plurality of equipment units above a subfloor to provide space for cabling and ancillary apparatus beneath the equipment units comprising a plurality of spaced parallel beams, each beam running the length of said raised floor, a plurality of vertically adjustable pedestals attached to each beam and resting on said subfloor for supporting said beam, a group of first rectangularly dimensioned floor panels each having planar edges and sized to span between a pair of adjacent beams and having an opposite end resting on a portion of each adjacent beam, said first panels being individually insertable and removable and arranged side by side to form sections for accessing said equipment units, a group of second rectangularly dimensioned individually insertable and removable floor panels each having planar edges and each sized to span a pair of adjacent beams and having an opposite end resting on a portion of each adjacent beam, said second panels being placed side by side to form rows transverse to the direction of said beams, said equipment units being supported on said rows of second panels, and means for rigidly supporting said beams in said spaced parallel relation comprising means for clamping the undersides of each pair of adjacent second panels to the beam on which said adjacent panels commonly rest.

9. A raised floor according to claim **8** wherein each beam comprises an upper web section on which juxtaposed panels rest and a pair of vertical flanges extending downwardly from the edges of said web section, and said clamping means comprises a hat-shaped clamp including a U-shaped section saddling said flanges and a horizontal section extending underneath each juxtaposed second panel resting on said saddled beam, each juxtaposed second panel resting on said saddled beam including an internally threaded insert, each clamp horizontal section having an aperture aligned with said threaded insert and a cap screw for threadedly engaging said threaded insert to rigidly but removably affix said clamp to said juxtaposed second panel.

10. A raised floor according to claim **9** wherein said first panels and said second panels are arranged in alternating rows running transverse to the direction of said beams, each first panel being freely removable for accessing the underside of said adjacent second panels.

11. A raised floor for supporting rearrangeable equipment above a subfloor comprising a plurality of stringers each running the length of the raised floor in substantially uniform spaced parallel relation, a line of spaced vertically adjustable pedestals resting on said subfloor for supporting each stringer, a plurality of rectangularly dimensioned planar edged floor panels, each panel spanning adjacent stringers and having opposite ends resting on portions of said adjacent stringers, and means for rigidly fixing said stringers in said spaced parallel relation comprising means for rigidly but removably clamping the undersides of selected floor panels to the stringer on which said selected panels rest.

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