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(54) **Device for the transfer of loads from floors to columns**

Vorrichtung zur Übertragung von Lasten von Decken zu Säulen

Dispositif pour le transfert de charges d'un plancher à un pilier

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**EP-A- 0 557 731**                    **DE-A- 2 626 407**  
**FR-A- 438 950**                    **FR-A- 1 263 369**  
**US-A- 1 329 614**                    **US-A- 1 461 892**  
**US-A- 1 536 942**                    **US-A- 2 768 520**

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## Description

**[0001]** This invention relates to a device for the transfer of loads from floors to columns in the construction of a building

**[0002]** In the construction of buildings, there are two common means of construction. The first involves the use of reinforced concrete. In this means of construction, reinforced concrete floors are carried on reinforced concrete columns. While this method of construction produces perfectly satisfactory buildings, it will be understood that the horizontal dimensions of the columns in buildings of any height need to be quite large so as to carry the weight of the floors of the building. This can mean, particularly on the ground floor, a considerable loss of floor space.

**[0003]** The second method of building involves the use of a steel frame. Thus the concrete floors are supported by a steel frame and are carried on steel columns. In the optimum case a cylindrical form gives the smallest section proportion available for a given load. However, this method of providing an entire steel supporting structure has the disadvantage compared with the first method in that the overall floor construction depth is far greater.

**[0004]** The ideal solution would clearly be to enable the use of a combination of reinforced concrete flooring with steel columns but significant problems exist in transferring the necessary loads from the flooring to the columns due to the poor shear strength of the concrete flooring.

**[0005]** Several arrangements of structural members have been devised to enhance the shear strength of a concrete floor in the vicinity of a column and to transfer this shear to a column. Most of these devices consist of structural steel sections - channels or beams - embedded in the concrete floor. Another arrangement for enhancing the shear strength of the concrete floor consists of pre-assembled systems of reinforcement links which are dropped on to the shuttering for the floor and cast with other reinforcement.

**[0006]** In general these devices are meant for use with concrete columns. The structural steel sections in these devices act as short cantilevers. Being essentially flexural members; they tend to require heavy sections. Also they bear either directly on the column or they are located close to the column perimeter. In the former position they take up space which would otherwise be utilised for the vertical reinforcement in the concrete columns. This necessitates an increase in the column size. When placed around the column, the bearing surface for the cantilevers is not well defined and therefore they act at a reduced efficiency.

**[0007]** Such devices can be applied to rectangular profiled steel sections, but not to circular hollow steel sections.

**[0008]** US-A-1461892 and DE 2626407A show somewhat complicated arrangements for connecting

floors to columns using open ended frusto-conical elements.

**[0009]** Further, a device according to the preamble of claim 1 is detailed in US-A-1 329 614.

5 **[0010]** The present invention seeks to provide a simple arrangement which will enable the transfer of loads and moments from a reinforced concrete floor to a circular section steel column.

10 **[0011]** According to a first aspect of the invention, there is provided a device for connecting a concrete floor to a cylindrical steel column adapted to pass there-through comprising an hollow steel frusto-conical element and a further element located at the wider end of the frusto-conical element, the frusto-conical element being adapted for positive attachment at its narrower end to the cylindrical steel column with the further element, in use, dosing the wider end of the frusto-conical element except for a central circular passage through which the cylindrical steel column is adapted to pass, the device being suitable for embedding within and/or being placed beneath a concrete floor for carrying the said floor.

15 **[0012]** Preferably the device is so constructed that the dominant stresses in its parts are in-plane membrane stresses. The further element may be a stiffening plate closing said wide end of said frusto-conical element except for a central circular passage through which the cylindrical steel column is adapted to pass. Alternatively, the further element is a second frusto-conical element secured to the first said frusto-conical element by its widest end so as to form a mirror image thereof.

20 **[0013]** The hollow frusto-conical element may be attached to a sleeve which extends through the narrow end of the frusto-conical element, and through which a cylindrical steel column is intended to pass so as to be attachable thereto.

25 **[0014]** A stiffening collar may be provided around said sleeve beyond said frusto-conical element.

30 **[0015]** The frusto-conical element may be welded to a cylindrical steel column which passes therethrough. According to a second aspect of the invention, there is provided a building structure comprising a plurality of steel columns, a floor laid therebetween and a plurality of connecting devices as set out above connecting the floor to the cylindrical columns.

35 **[0016]** The connecting devices may be embedded in the concrete floor or may be located beneath the floor so as to support it.

40 **[0017]** With devices of the double frusto conical type, one frusto-conical element of each connecting device may be embedded in the floor while the mirror image frusto-conical element may be located beneath the floor.

45 **[0018]** The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:-

Figure 1 shows in perspective view and in exploded form, a first embodiment of a device in accordance

with the invention;

Figure 2 is a view similar to figure 1 but showing a second form of the invention;

Figure 3 shows diagrammatically one typical application of the device in accordance with the first embodiment of the invention:

Figure 4 is a view similar to figure 3 but showing a second application of the device in accordance with the first embodiment, and

Figure 5 is a view similar to figures 3 and 4 but showing an application using the second embodiment of the invention.

[0019] Referring firstly to figure 1, there is shown a first embodiment of a device in accordance with the invention. This is the basic form of device and comprises a hollow frusto-conical element 1 attached to a cylindrical sleeve 2 which passes through the apex of the element 1 so as to extend both inside and outside the element. On the inside of the element, the sleeve extends beyond the wider end of the element 1 so as to protrude therefrom as will be more clearly seen from figures 3 and 4. It is suitably attached to the element by welding. It has an internal diameter such as to achieve a close tolerance fit to a cylindrical column on which it is to be carried and which will be referred to hereafter. Above the junction between the apex of the element 1 and the sleeve 2, a stiffening collar 4 is incorporated. The base of the element 1 is substantially closed by a stiffening plate 5 which has a central hole the diameter of which corresponds with the outside diameter sleeve 2 and is welded to both the sleeve 2 and the perimeter of the element 1.

[0020] The device is specially constructed so that the dominant stresses in its parts are in-plane membrane stresses.

[0021] In this configuration, the device is welded to a carrying steel column at each end of the sleeve 2.

[0022] Figure 2 shows a second embodiment of the invention in which the stiffening plate, 5, is replaced by a second frusto-conical element 6 complete with a second sleeve. The sleeves 2 in this case are of reduced length so that they do not interfere with each other. The second element 6 is seam welded to the first element 1 at their outer perimeters. As can be seen, the second element 6 is identical to the first element 1.

[0023] Figures 3, 4 and 5 show some typical applications of the various embodiments of the invention above described.

[0024] In Figure 3, the device is welded to a cylindrical steel column 3 by welds at both ends of its tube 2. The device is located upside down as compared to figure 1 and concrete floor 7 is seated on the stiffener 5 so that the device project below the soffit of the slab and is in

compression.

[0025] The outer diameter of the device is chosen so as to eliminate the need for shear reinforcement in the concrete floor. The shear and bending moments from the floor 7 are transmitted to the circular steel column by the device.

[0026] In Figure 4, the situation is opposite to that shown in figure 3 with the device upright as compared to figure 1 and embedded within the concrete floor 7 and is in tension.

[0027] The arrangement shown in figure 5 utilises the second embodiment of the invention as shown in figure 2. Here the upper frusto-conical element 1 is embedded in the concrete floor 7 and is in tension while the lower frusto-conical element 6 is exposed below the soffit of the slab and is in compression.

[0028] It will be appreciated that various additions to or modifications of the embodiments described above may be made without departing from the scope of the invention as defined in the appended claims. For example, with certain constructions, the location of the stiffening flange 4 could be different to that shown and could, for example, be located where the frustum joins the tube.

#### Claims

1. A device for connecting a concrete floor (7) to a cylindrical steel column (3) adapted to pass there-through comprising an hollow steel frusto-conical element (1) adapted for positive attachment at its narrower end to the cylindrical steel column (3) **characterised by** a further element (5, 6) located at the wider end of the frusto-conical element, which, in use, closes the wider end of the frusto-conical element (1) except for a central circular passage through which the cylindrical steel column is adapted to pass, the device being suitable to be embedded within and/or being placed beneath a concrete floor (7) for carrying said floor.
2. A device as claimed in claim 1, wherein the device is so constructed that the dominant stresses in its parts are in-plane membrane stresses.
3. A device as claimed in claim 1 or 2 wherein the further element is a stiffening plate (5) closing said wide end of said frusto-conical element (1) except for a central circular passage through which the cylindrical steel column (3) is adapted to pass.
4. A device as claimed in claim 1 or 2, wherein the further element is a second frusto-conical element (6) secured to the first said frusto-conical element (1) by its widest end so as to form a mirror image thereof.

5. A device as claimed in any preceding claim, wherein the hollow frusto-conical element (1) is attached to a sleeve (2) which extends through the narrow end of the frusto-conical element (1), and through which a cylindrical steel column (3) is intended to pass so as to be attachable thereto.
6. A device as claimed in claim 5 and comprising a stiffening collar (4) around said sleeve (2) beyond said frusto-conical element (1).
7. A device as claimed in claim 1, wherein the frusto-conical element (1) is welded to a cylindrical steel column (3) which passes therethrough.
8. A building structure comprising a plurality of steel columns (3), a floor laid therebetween and a plurality of connecting devices as claimed in any preceding claim connecting the floor (7) to the cylindrical columns (3).
9. A building structure as claimed in claim 8, wherein the connecting devices are embedded in the concrete floor (7).
10. A building structure as claimed in claim 8, wherein the connecting devices are located beneath the floor (7) so as to support it.
11. A building structure as claimed in claim 8 with devices as claimed in claim 6, wherein one frusto-conical element (1) of each connecting device is embedded in the floor (7) while the mirror image frusto-conical element (6) is located beneath the floor.

#### Patentansprüche

1. Vorrichtung zum Verbinden einer Betondecke (7) mit einer zylindrischen Stahlsäule (3), die durch diese hindurch verläuft, mit einem hohlen, kegelstumpfförmigen Stahlbauteil (1) für eine formschlüssige Befestigung seines schmaleres Endes an der zylindrischen Stahlsäule (3), **gekennzeichnet durch** ein weiteres Bauteil (5, 6), das am breiten Ende des kegelstumpfförmigen Bauteils angeordnet ist, welches im Betrieb das breitere Ende des kegelstumpfförmigen Bauteils (1) schließt, mit Ausnahme eines mittleren kreisförmigen Durchgangs, **durch** welchen die zylindrische Stahlsäule hindurch verlaufen kann, wobei die Vorrichtung geeignet ist, innerhalb einer Betondecke (7) eingelassen oder unter dieser angeordnet zu sein, um die Decke zu tragen.
2. Vorrichtung nach Anspruch 1, wobei die Vorrichtung so aufgebaut ist, dass die vorherrschenden Belastungen in ihren Teilen Membranbelastungen

in der Ebene sind.

3. Vorrichtung nach Anspruch 1 oder 2, wobei das weitere Bauteil eine Versteifungsplatte (5) ist, welche das breite Ende des kegelstumpfförmigen Elements (1) schließt, mit Ausnahme eines mittleren kreisförmigen Durchgangs, durch welchen die zylindrische Stahlsäule (3) hindurch verlaufen kann.
4. Vorrichtung nach Anspruch 1 oder 2, wobei das weitere Bauteil ein zweites kegelstumpfförmiges Bauteil (6) ist, welches am ersten kegelstumpfförmigen Bauteil (1) mit seinem breitesten Ende befestigt ist, um ein Spiegelbild desselben zu bilden.
5. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das hohle kegelstumpfförmige Bauteil (1) an einer Manschette (2) befestigt ist, welche sich durch das schmale Ende des kegelstumpfförmigen Bauteils (1) erstreckt, und durch welche eine zylindrische Stahlsäule (3) hindurch verlaufen soll, um an dieser befestigbar zu sein.
6. Vorrichtung nach Anspruch 5 mit einem Versteifungshals (4) um die Manschette (2) über das kegelstumpfförmige Bauteil (1) hinaus.
7. Vorrichtung nach Anspruch 1, wobei das kegelstumpfförmige Bauteil (1) an einer zylindrischen Stahlsäule (3) angeschweißt ist, welche durch dieses hindurch verläuft.
8. Gebäudestruktur umfassend eine Vielzahl von Stahlsäulen (3), eine Decke bzw. einen Boden, der zwischen diesen liegt und eine Vielzahl von Verbindungsvorrichtungen nach einem der vorhergehenden Ansprüche, welche den Boden (7) mit den zylindrischen Säulen (3) verbinden.

9. Gebäudestruktur nach Anspruch 8, wobei die Verbindungsvorrichtungen in den Betonboden (7) eingelassen sind.
10. Gebäudestruktur nach Anspruch 8, wobei die Verbindungsvorrichtungen unter dem Boden (7) angeordnet sind, um diesen zu tragen.
11. Gebäudestruktur nach Anspruch 8 mit Vorrichtungen nach Anspruch 6, wobei ein kegelstumpfförmiges Bauteil (1) jeder Verbindungsvorrichtung in den Boden (7) eingelassen ist, während das spiegelbildliche kegelstumpfförmige Bauteil (6) unter dem Boden liegt.

#### Revendications

1. Dispositif pour relier un plancher en béton (7) à une

- colonne cylindrique en acier (3) adaptée pour traverser celui-ci, comprenant un élément du type tronc de cône en acier creux (1) adapté pour un raccordement positif à son extrémité la plus étroite à la colonne cylindrique en acier (3) **caractérisé par** un autre élément (5, 6) situé à l'extrémité la plus large de l'élément du type tronc de cône en acier, qui, à l'utilisation, ferme l'extrémité la plus large de l'élément du type tronc de cône en acier (1), à l'exception d'un passage circulaire central à travers lequel la colonne cylindrique en acier est adaptée pour le traverser, le dispositif étant approprié pour être intégré à l'intérieur de et/ou positionné en dessous d'un plancher en béton (7) pour supporter ledit plancher.
2. Dispositif selon la revendication 1, dans lequel le dispositif est construit de telle manière que les principales tensions sur ses pièces sont des tensions de membrane simples.
3. Dispositif selon la revendication 1 ou 2, dans lequel l'autre élément est une tôle de renforcement (5) fermant ladite extrémité large dudit élément du type tronc de cône (1) à l'exception d'un passage circulaire central à travers lequel la colonne cylindrique en acier (3) est adaptée pour le traverser.
4. Dispositif selon la revendication 1 ou 2, dans lequel l'autre élément est un second élément du type tronc de cône (6) protégé dudit premier élément du type tronc de cône (1) par son extrémité la plus large afin de former une image miroir de celui-ci.
5. Dispositif selon l'une quelconque des revendications précédentes, dans lequel l'élément du type tronc de cône creux (1) est fixé à une bague (2) qui s'étend à travers l'extrémité étroite de l'élément du type tronc de cône (1), et à travers laquelle une colonne cylindrique en acier (3) est censée passer afin d'être fixée à celle-ci.
6. Dispositif selon la revendication 5 et comprenant un collier de renforcement (4) autour de ladite bague (2) au-delà dudit élément du type tronc de cône (1).
7. Dispositif selon la revendication 1, dans lequel l'élément du type tronc de cône (1) est soudé à une colonne cylindrique en acier (3) qui le traverse.
8. Structure de construction de bâtiments comprenant une pluralité de colonnes en acier (3), un plancher situé entre celles-ci et une pluralité de dispositifs de raccordement selon l'une quelconque des revendications précédentes reliant le plancher (7) aux colonnes cylindriques (3).
9. Structure de construction de bâtiments selon la revendication 8, dans laquelle les dispositifs de raccordement sont intégrés dans le plancher en béton (7).
10. Structure de construction de bâtiments selon la revendication 8, dans laquelle les dispositifs de raccordement sont situés en dessous du plancher (7) afin de le supporter.
11. Structure de construction de bâtiments selon la revendication 8 avec des dispositifs selon la revendication 6, dans laquelle un élément du type tronc de cône (1) de chaque dispositif de raccordement est intégré dans le plancher (7) alors que l'image miroir de l'élément du type tronc de cône (6) est située en dessous du plancher.

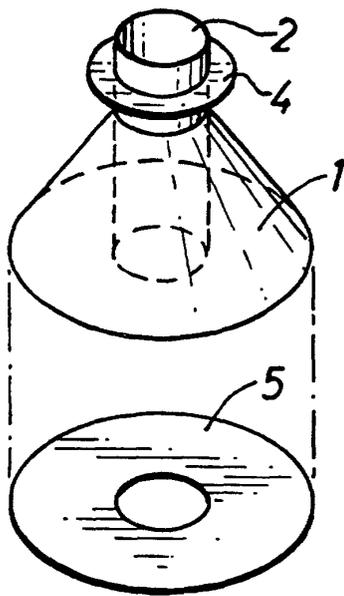


FIG. 1

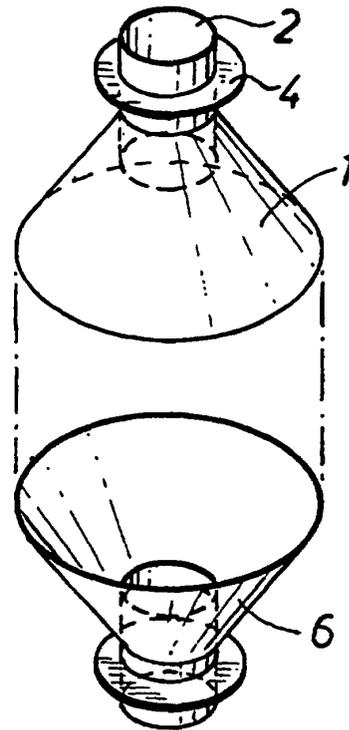


FIG. 2

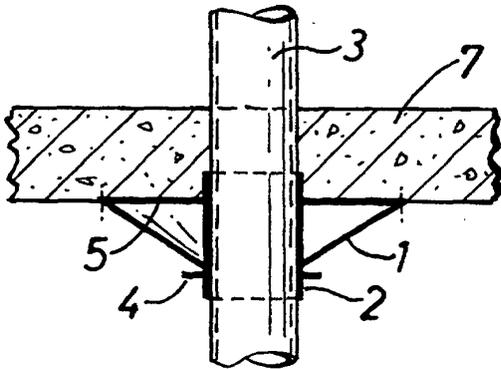


FIG. 3

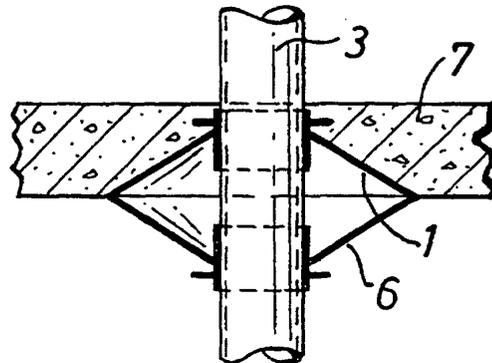


FIG. 5

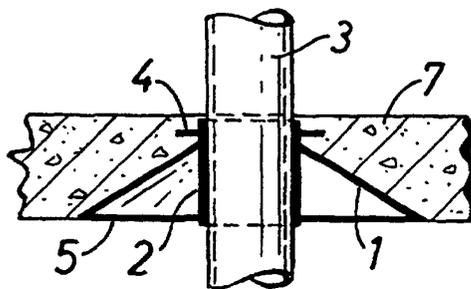


FIG. 4