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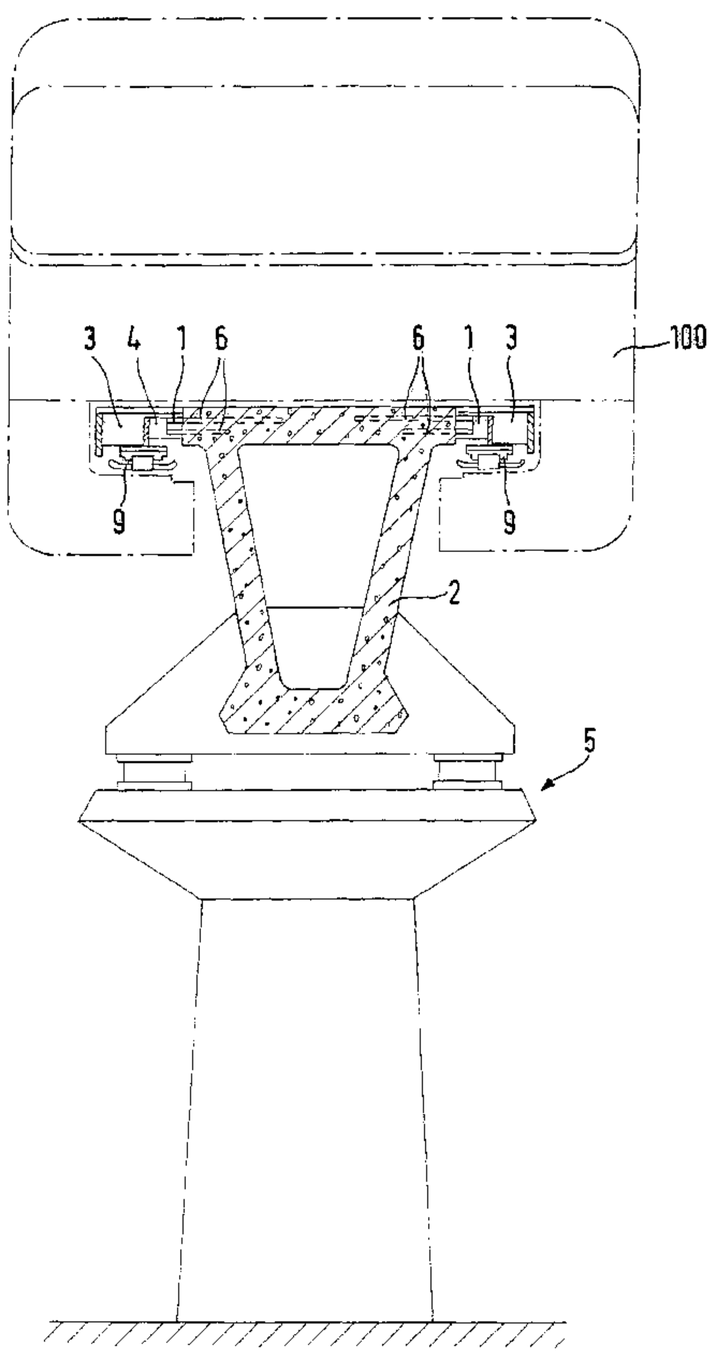


(57) Abrégé/Abstract:
The invention relates to a travel way support, particularly for a magnetically levitated train (100), for constructing a travel way through a number of supports (2) successively arranged in the direction of travel. Said travel way support comprises an upper support section (12), particularly an upper flange (12) and at least one bracing section (13, 14), in particular, a web (13, 14), which is arranged underneath the upper support section (12). Solar cells (7, 8) and/or solar collectors are arranged in the area of the upper support section (12) and/or of the at least one bracing section (13, 14).

## Abstract of the Invention

A guideway support, in particular for a magnetic levitation train 100, constituting a guideway by means of several supports (2) following each other in the sense of travel, is provided with an upper support segment (12), in particular an upper flange (12) and at least one support segment (13, 14), in particular a flange (13, 14) located below the upper support segment (12). In the area of the upper support segment (12) and/or of the (at least one) lower support segment (13, 14) solar cells (7, 8) and/or solar collectors are installed.

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(Fig. 1)

# Guideway Support

The present invention relates to a guideway support, in particular for a magnetic levitation train, to constitute a guideway through a plurality of supports following each other in the direction of travel, with at least one upper support section, in particular an upper flange and at least one support section located below the upper support section, in particular a web. The support has a hollow cross-section, whereby the hollow space is delimited on top by the upper support section, laterally by a web on either side and below by a lower, second support section.

EP 0 987 370 A1 discloses a guideway for a magnetic levitation train. The guideway consists of a support on which add-on parts are mounted. The support is a prefabricated concrete element attached on supports or pillars by means of consoles placed at the ends of the support. Such supports have the disadvantage they can be deformed under extreme climatic influences and that travel operations are thus limited.

US Patent 4,987,833 discloses a monorail support covered with solar cells. These solar cells produce current. Although the solar cells provide a certain amount of shade for the support, this can however not economically prevent bending of the support under the influence of temperature.

JP 07/054310 A discloses a support with heat insulation on the upper and undersides of the support. These additional means are however also cost intensive and can merely delay the bending of the support but cannot prevent it.

The guideway supports shown have large surfaces. It is the object of the present invention to further develop such a guideway support so that simple yet highly efficient utilization of free surfaces is realized on the guideway support.

If a support is designed so that the surfaces and masses of the support on the first and on the second flange that are exposed to the sun are similar to each other, the especially advantageous result of this is that a lower temperature gradient will exist within the support. This means that the support heats up very evenly in the area of the first flange and in the area of the second flange, and that greater expansion of the first flange or of the second flange than of the other flange is thus avoided. Bending of the support due to dissimilar heating can thus be avoided to a great extent. To promote even heating and expansion of the support, additional means are located on the support.

On the guideway of the type mentioned initially, solar cells and/or solar collectors are provided in the area of the upper support section and/or of the (at least one) bracing section.

The advantages of the invention consist in particular in the fact that such solar cells and/or solar collector used make it possible to utilize the free support surfaces in a rational manner. In particular the current produced by the solar cells can be used e.g. to power monitor systems of the guideway or the vehicles. Alternatively or in addition, technical measuring devices can be supplied with the current, e.g. temperature and humidity measuring instruments. In addition, the current can be used alternatively or in addition for a system that controls the temperature of the support material. If the support material is concrete, for example, this can be heated during winter operation by means of imbedded metal wires. Furthermore it is e.g. possible to illuminate advertising devices affixed to other free surfaces by means of the current of the solar cells or to operate luminescent writing. For that latter purpose, e.g. on rainy days, it is also possible to use electrical energy already available on the guideway.

The heat produced by the solar collectors can be used to heat warm water, also to produce current and to heat constructions, including parts of the guideway itself. It is also possible to cool constructions by means of heat pumps.

Within the framework of the invention, all suitable solar cell types can be used, e.g. thin-layer solar cells with high power/weight ratio. The utilization of flexible support materials for the solar cells, e.g. plastic, is also possible, since the solar cells can be rolled up in that case and large surfaces of the guideway support can thus be covered.

It is an additional advantage of the utilization of solar cells and/or solar collectors on a guideway support of the type according to the invention mentioned initially that in particular solar cells and/or solar collectors mounted on the upper side protect the support itself from direct sun irradiation and that thus uneven heating and consequential uneven deformation is avoided or reduced. Thus narrower tolerances can be observed for the support.

From the point of view of static and manufacturing technique it has been shown to be advantageous if the guideway support – in particular when used for a magnetic levitation train – has a hollow cross-section. For this two support sections or webs across from each other are preferably provided and are connected to each other via the upper support section or upper flange. The hollow space is advantageously closed up on the underside by a lower support section or lower flange. The support sections can have inclined sections directed towards the sun in this case, so that the solar cells or solar collectors attached to them supply current or heat in an efficient manner.

The travel way support is preferably supported on one or more pillars sunk in to the ground. This distribution makes good constructive processing of the support possible during manufacture as well as relatively easy installation on the site. Furthermore the space under the guideway support can be used. The solar cells and/or solar collectors installed high above ground are relatively safe from unauthorized access by third parties in that case.

The individual guideway supports are preferably placed one after the other in such manner that the distance between the support segments following each other is short or

negligible. In the extreme case this results in a continuous sequence of supports whereby the support segments constitute a kind of wall in the direction of the guideway on which solar cells and/or solar collectors can be attached. In this manner, a great number of solar cells and/or solar collector can be installed on the guideway.

The solar cells and/or solar collectors are preferably attached directly to the free outer surfaces of the support. The solar cells and/or solar collectors thus clad these surfaces, so that especially in strong winds barely any attack surface is provided that could result in the solar cells and/or solar collectors being torn out of their attachments on the support.

Due to the fact that a guideway support may have relatively large dimensions, it is advantageous for reasons of easier handling to install several smaller fields of solar cells and/or solar collectors next to each other in the direction of the guideway. This arrangement furthermore facilitates the replacement of damaged individual fields.

In order to promote even heating and expansion of the support, at least parts of the outside of the support are provided with a heat-absorbing or reflective surface. Thereby differences in sun irradiation of the different parts of the support can be equalized for example, so that again even expansion of the support takes place.

The heat-absorbing and or reflecting surface can be applied to the support in form of a coat of paint. Thereby t he different thermal characteristics of the support can easily be maintained.

If at least some parts of the outside of the support are provided with shading elements, this measure can also serve to maintain a low temperature gradient of the support. The characteristics in operation of the support can thus be adjusted to the most varied types of sun irradiation.

Under the invention, provisions are made to provide means for heat interchange in particular for heat exchange, between the first flange and the second flange on a support of the type described earlier. If the support is e.g. heated unevenly by sun irradiation, it would become deformed in an undesirable manner due to the temperature gradient thus produced. The precisely aligned components would no longer possess the required precision, so that the operation e.g. of a magnetic levitation train could no longer be reliably ensured. By providing heat interchange or heat exchange means it is now possible, e.g. in case of a more intensely heated first flange, to transfer the heat thus produced to the second flange so that the latter is also heated up and expands in similar manner as the first flange. The heat can be guided in a targeted manner into the areas of the support that are expected to receive less heat or have a greater mass and would thus require more time to be heated.

As a means for heat interchange, channels with heat-carrying liquid, in particular oil, have proven to be useful. Heat is conveyed through these channels from areas of the support that are heated more intensely to areas of the support receiving less heat.

Cooling and/or heating elements are advantageously used as active means for heat interchange. These cooling and/or heating elements that could be operated e.g. through solar cells, can also keep the temperature gradient low within the support when required and can thus extensively prevent the deformation of the support.

Advantageous further developments of the invention are characterized by the characteristics found in the sub-claims.

The invention is explained in further detail through the drawings.

Fig. 1 shows a known guideway with a magnetic levitation train.

Fig. 2 shows an alternative embodiment of a guideway support in cross-section, with solar cells,

Fig. 3 shows a view in perspective of the guideway according to Fig. 2;

Fig. 4 shows a cross-section through a support with heat interchange and

Fig. 5 shows a cross-section through an additional support.

As an example, the invention is described through a hybrid support system for railborne vehicles.

Fig. 1 shows a known guideway for a magnetic levitation train 100 according to the state of the art, shown in cross-section. Supports 2, preferably made of prestressed concrete, are installed on pillars 5 at the building site. Hereby several supports 2 are erected in a row in the direction of the guide way's course. The faces of the supports 2 are hereby adjoining each other directly. Laterally and at even distances, connection consoles 1, preferably made of steel, are installed on each support 2. To each connection console 1, tie rods 6 imbedded in the prestressed concrete of the support 2 are welded or screwed. Each console is provided with a head plate 4 to which the support 3 of the functional plane is attached, e.g. to receive stator packages 9.

Figs. 2 and 3 show an alternative embodiment according to the invention of a support 2, provided with an upper support segment 12 in form of an upper flange 12, two horizontal support segments 13, 14 in form of ridges 13, 14 at a distance from each other as well as with a lower support segment 15 in form of a lower flange 15. The flanges 12, 15 and ridges 13, 14 and the ridges 13, 14 delimit a hollow space 16 which has a nearly rectangular cross-section. The attachment of functional-surface supports 3 to connection brackets 1 is essentially the same as for the embodiment shown in Fig. 1.

According to the invention, solar cells 8 are installed on the outside of the ridges 13, 14 to produce current. The solar cells 8 shown in Figs. 2 and 3 have segments 8a 8b at an angle to each other that are adapted to the ridges 13, 14 which become wider towards the bottom. Several fields with solar cells 8 immediately following each other are installed in the direction of the guideway.

As can be seen in Fig. 1, the magnetic levitation train 100 reaches around the connection brackets 1 and the functional-surface supports 3 up to within proximity of the ridges 13, 14. The solar cells 8 are not brought up to the upper flange 12 but end with their upper edge below the magnetic levitation train 100. Since the diameter of the solar cells 8 is only minimal, it is of course also possible to install solar cells 8 also on the ridge segments directly across from the magnetic levitation train 100.

Solar cells 7 are also installed on the side of the upper flange 12 pointing up (left out in Fig. 3), and these abut each other and occupy nearly the entire width of the upper flange 12. Hereby the height of the solar cells 7 is selected so that no interference with the operation of the magnetic levitation train 100 occurs. Excessive heating up of the support 2 is effectively avoided here in particular by covering the upper flange 12 with the solar cells 7. Of course the solar cells 8 on the ridges 13, 14 also contribute to this. In this manner critical deformations of the concrete and thereby of the guideway can be prevented.

It is furthermore possible to install solar cells alternatively or in addition on the pillars 5, and in that case these come within the scope of the guideway supports and in particular within the scope of the support segment according to the claims of the present invention.

Outer surface segments on which no solar cells 7, 8 are attached can be used as advertising surfaces that can be illuminated by the current produced by the solar cells 7, 8. The current of the solar cells 7, 8 can be used in addition or alternatively for monitoring devices, measuring devices, etc.

The above description for the installation of solar cells on the guideway support can be applied without limitations to the analogous installation of solar collectors.

According t o Fig. 4 solar cells 20 are installed on the ridge 4'. In this embodiment it is assumed that the ridge 13 is exposed to more sun irradiation than ridge 14. Because of this it can be expected that the side of ridge 13 would heat up more and would result in a deformation of the support 2 if no heat interchange were to take place. This heat interchanged is accomplished by means of the solar cells 20 and a channel 21 connected thereto. The channel 21 conveys a heat-conveying liquid from the sun-irradiated side to the side of the support 2 in the shadow. As a result the ridge 14 and the lower flange 15 are also heated up. This in turn results in a similar heat expansion on both sides of the support 2 so that the deformation of the 2 remains within a tolerable range. A similar heat interchange can occur between the upper flange 12 and the lower flange 15 if a heat transfer takes place e.g. from the upper flange 12 to the lower flange 15 by means of a suitable layout of the channels 21. As an alternative to the shown solar cells 20 it is possible to achieve the insulation or heat absorption of the support by means of paints, heat insulating elements, cooling or heating elements as well as shading devices.

Fig. 5 shows another alternative embodiment of a support 2 according to the invention, in cross-section. Prestressing steel 19 is installed in the outer areas of the ridges 12 and 15 without adhesion to the concrete. The installation of the prestressing steel 19 in the outer areas of the ridges 12 and 15 makes an adjustment of the support 2 in y and z direction possible, especially if the prestressing steel 19 is designed so as to be accessible even after incorporation of the support 2. This adjustment in y and z direction is effected by suitably increasing the tension of the individual prestressing steel 19 elements, so that the support 2 is distorted in a predetermined manner. In this manner precise adaptation of the support 2 to the requirements of the guideway can be achieved e.g. in case of subterranean subsidence, thermal influences upon the support or other changes in alignment. The adjustment can be effected in a particularly delicate and precise manner

by using temperature-dependently controlled presses that increase the tension of the relevant prestressing steel 19 elements more or less to compensate for the deformation of the support 1 by one-sided heating. The presses can be connect ed to corresponding solar cells, for example.

Thanks to the design of the support according to the invention it is possible to produce positionally highly accurate single-span supports for the construction of a layout for the magnetic levitation train magnetic levitation train. Although single-span supports are clearly more prone to deflection than multi-span supports, the heat interchange and the change in the prestressing steel 19 make it possible to keep deflection within acceptable low tolerances.

## Claims

1. Guideway supports, in particular for a magnetic levitation train (100), to form a guideway by several supports (2) following each other in the direction of travel, with a first upper support segment (12), in particular an upper flange (12), and at least one supporting segment below the upper support segment (12), in particular a ridge (13,14), whereby the support (2) has a cross-section of hollow configuration, whereby the hollow space (16) is delimited on top by the upper support segment (12), laterally by a ridge (13, 14) on either side, and below by a second support segment (15), characterized in that the surfaces and masses of the support (2) irradiated by the sun are similar on the first support segment (12) and the second support segment (15), in that the heating of the support (2) in the area of the first support segment (12) and in the area of the second support segment (15) is even in order to achieve a low temperature gradient and an even temperature expansion, and in that means are provided on the support to assist in the even temperature expansion.

2. Guideway as in claim 1, characterized in that the means are solar cells (7, 8) and/or solar collectors installed in the area of the area of the upper support segment (12) and/or of the (at least one) support segment (13, 14)

3. Guideway as in claim 1 or 2, characterized by the erection on one or several pillars (5) imbedded in the soil.

4. Guideway as in one of the preceding claims, characterized in that the faces of the support segments (13, 14) across from each other of two supports (2) following each other in travel direction essentially connect to each other.

5. Guideway as in one of the preceding claims, characterized in that the solar cells (7, 8) and/or the solar collectors are installed on at least one of the surfaces

pointing to the outside of the (at least one) support segment (13, 14) and/or of the upper support segment (12).

6. Guideway as in one of the preceding claims, characterized in that several fields of solar cells (7, 8) and/or solar collectors are placed adjoining each other in the sense of the guideway.

7. Guideway as in one of the preceding claims, characterized in that means installed on the support are a heat absorbing and/or reflecting surface on the outside of the support (2).

8. Guideway as in the preceding claim, characterized in that the heat absorbing and/or reflecting surface is a coat of paint on at least part of the outside of the support (2).

9. Guiedway as in one of the preceding claims, characterized in that the means installed on the support are shading elements assigned to at least parts of the outside of the support (2).

10. Guideway as in one of the preceding claims, characterized in that the means provided on the support are means for heat interchange, in particular for heat exchange, installed between the first flange (12) and the second flange (15).

11. Guideway as in one of the preceding claims, characterized in that the means for heat interchange are channels (21) with heat-conveying liquid, in particular oil.

12. Guideway as in one of the preceding claims, characterized in that the means for heat interchange are cooling and/or heating elements.

13. Guideway as in one of the preceding claims, characterized in that a prestressing steel (19) without adhesion to the concrete is provided in the outer areas of the flanges (12, 15).

14. Guideway as in one of the preceding claims, characterized in that centered prestressing steel elements (19) are installed between the support segments (13, 14).

15. Guideway as in one of the preceding claims, characterized in that the centered prestressing elements are thermally insulated.

16. Guideway as in one of the preceding claims, characterized in that the means installed on the support are presses controlled in function of temperature by means of which the support (2) can be deformed in particular through unilateral heating of the relevant prestressing elements (19).

17. Guideway as in one of the preceding claims, characterized in that the presses are connected to corresponding solar cells and/or solar collectors.

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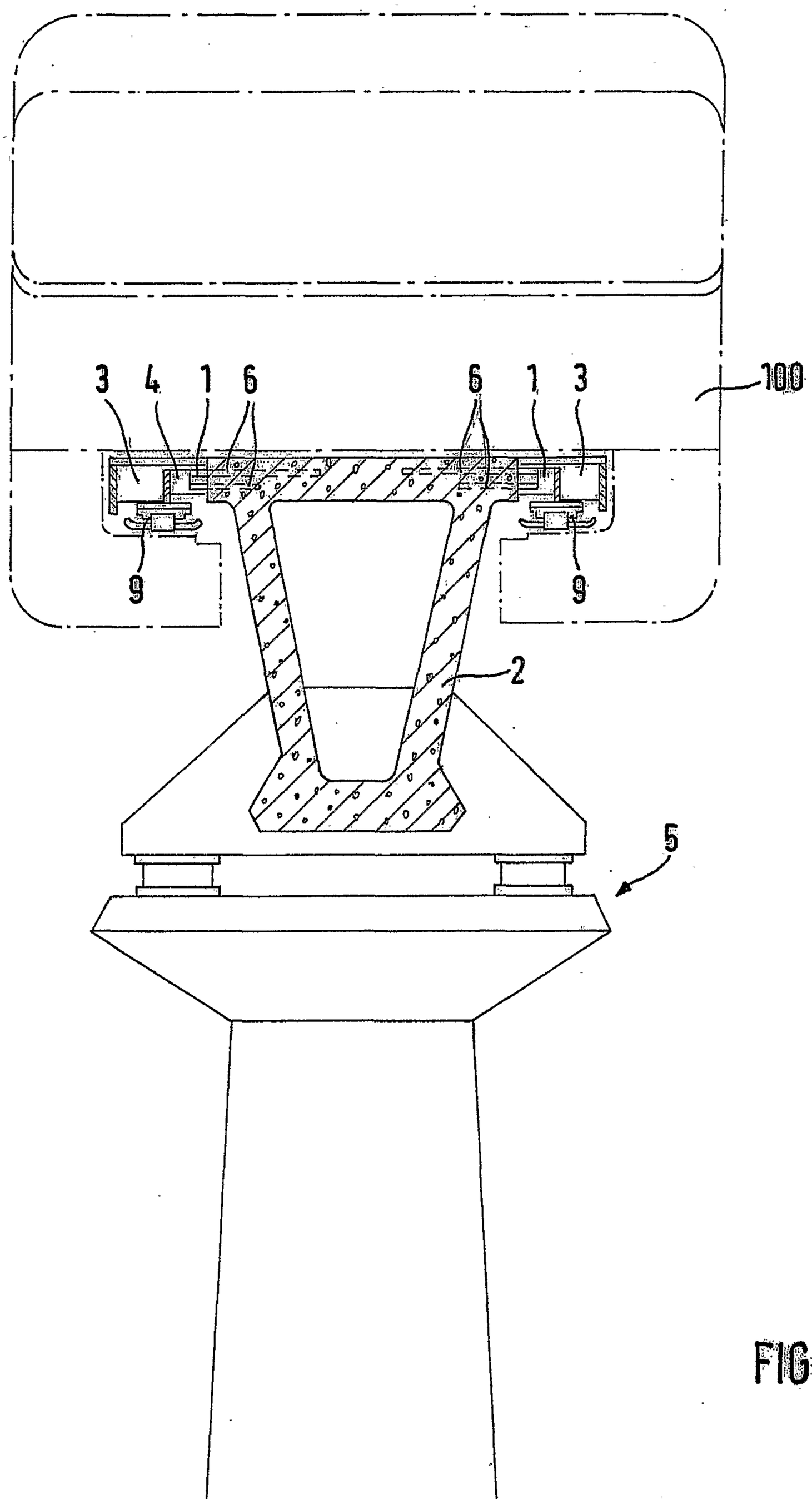



FIG.1

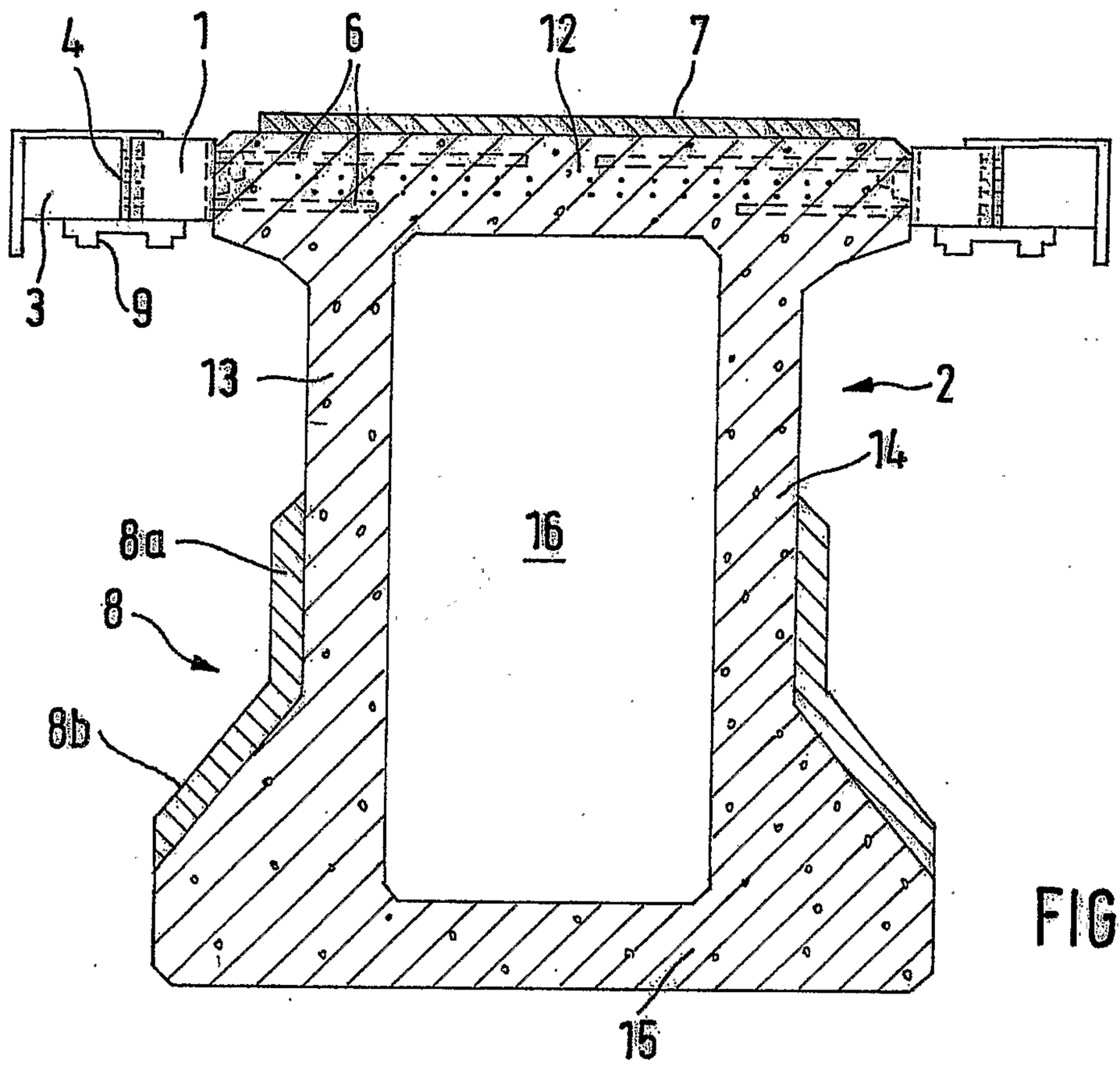



FIG. 2

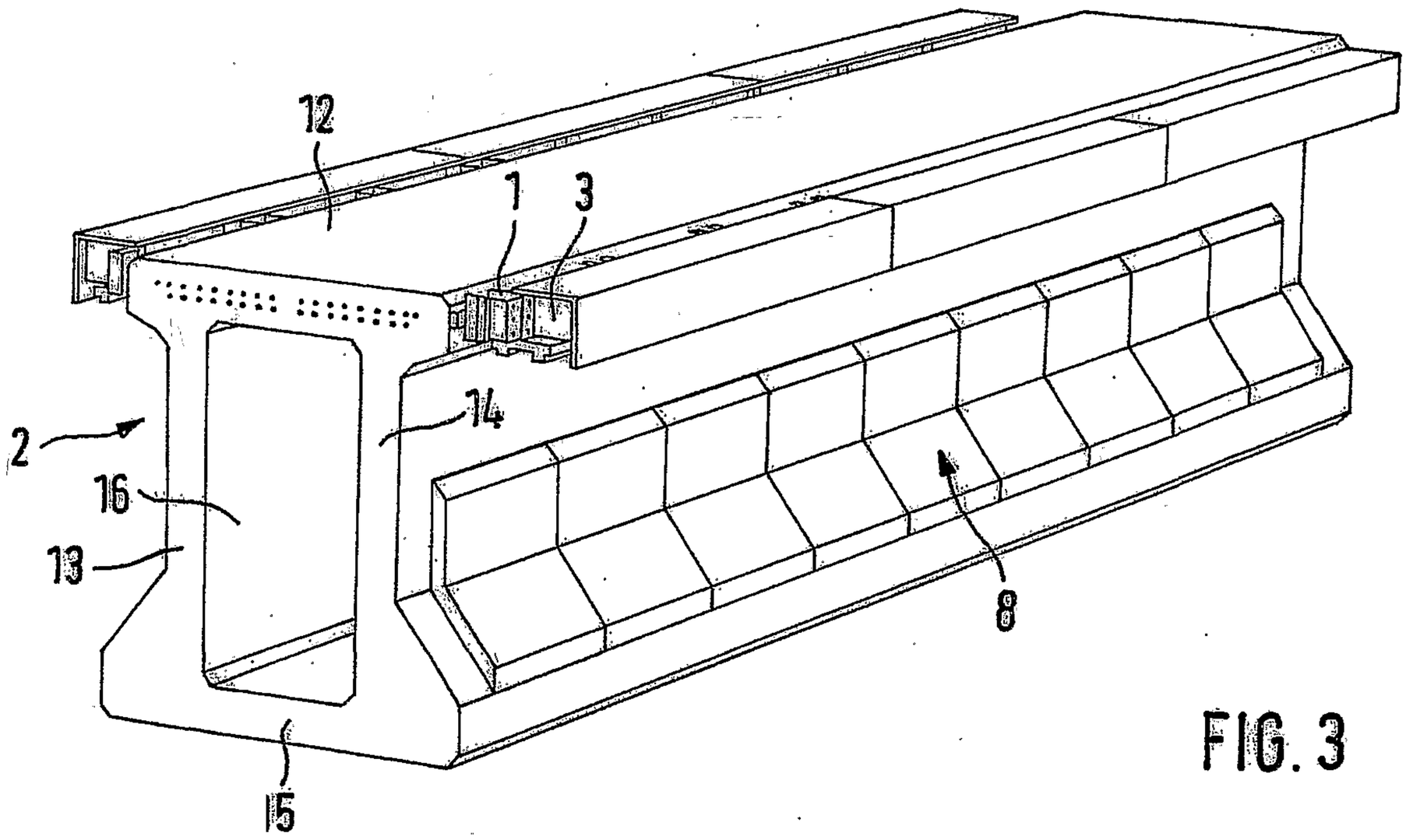



FIG. 3

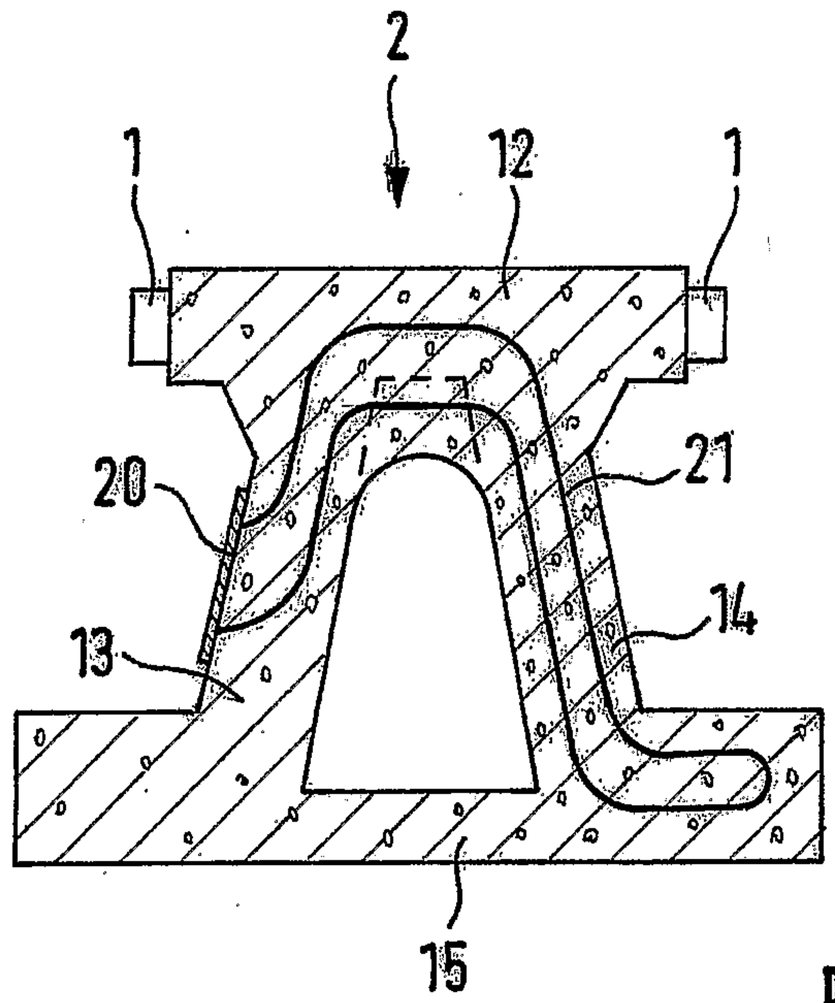



FIG. 4

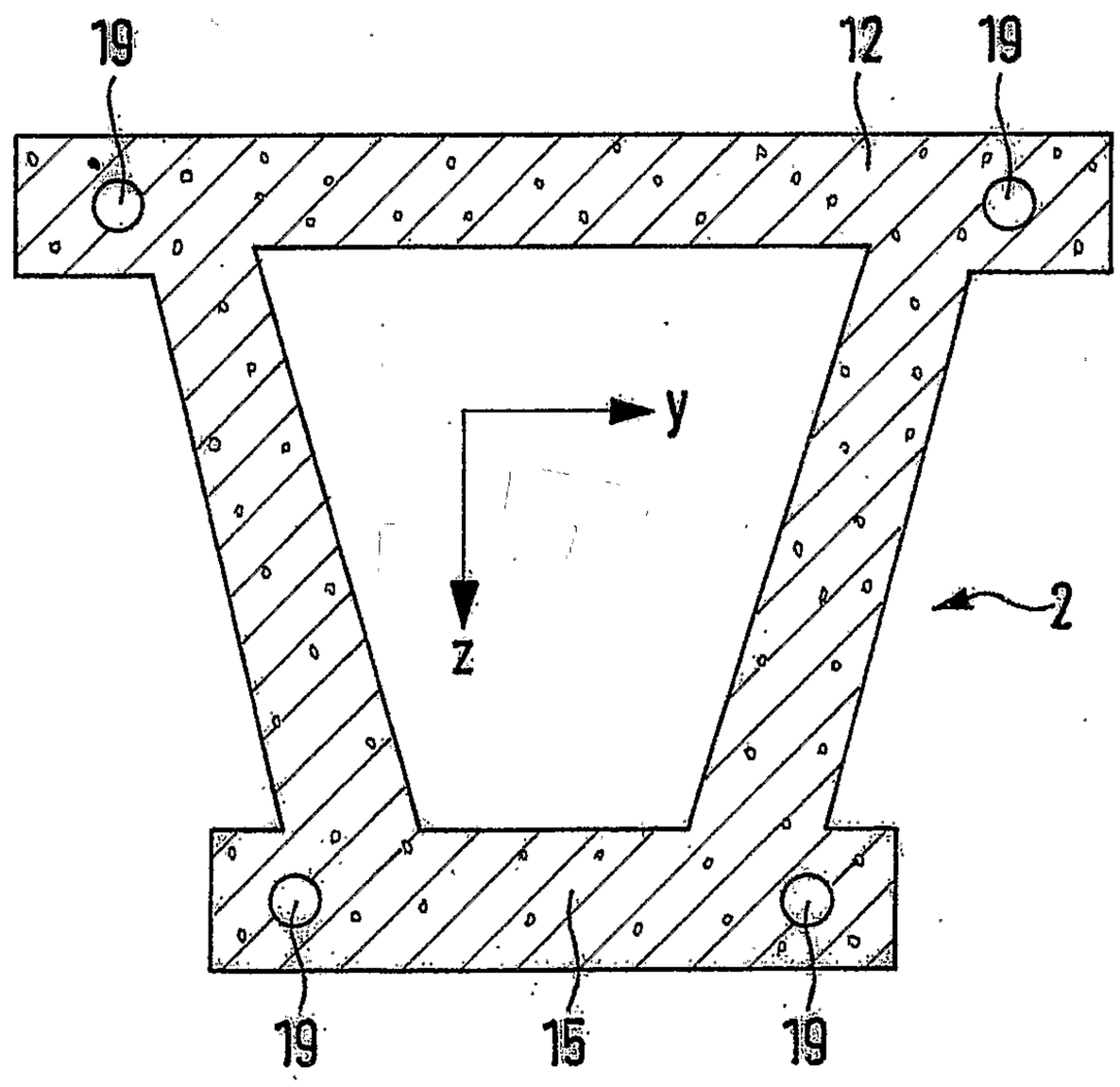
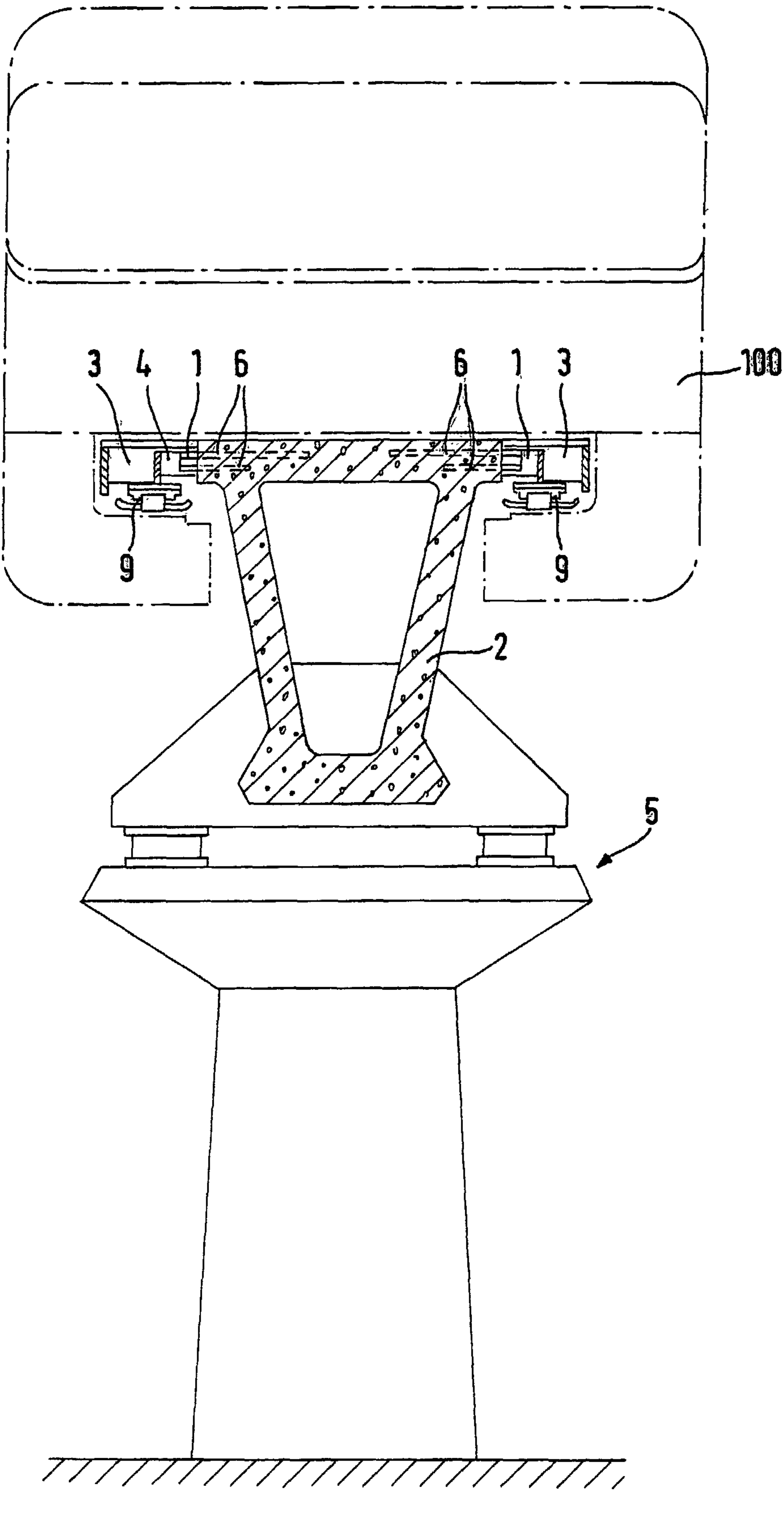



FIG. 5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