

(19)



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(11)

EP 0 881 332 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.12.1998 Bulletin 1998/49

(51) Int. Cl.⁶: **E01C 3/00, E02D 27/36**

(21) Application number: **98201804.6**

(22) Date of filing: **29.05.1998**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **30.05.1997 NL 1006180**

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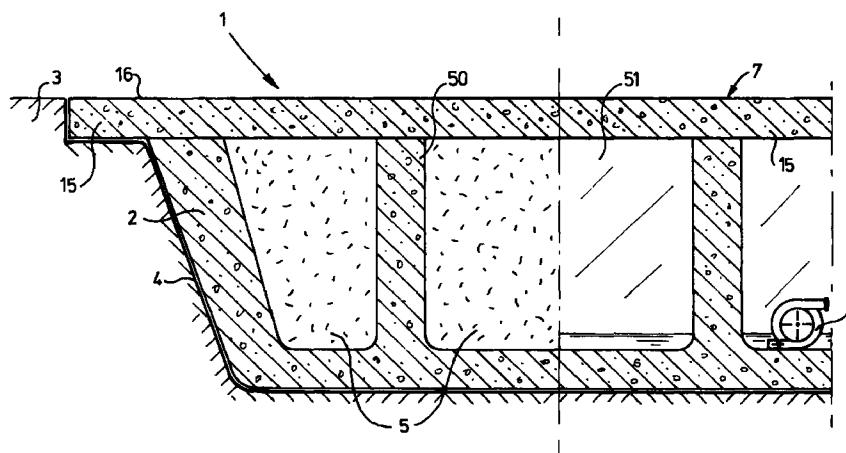
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(54) **Bearing element for supporting infrastructure such as roads, railways, runways and airports, and a method for the manufacture thereof**

(57) Bearing element (1) for supporting infrastructure such as roads, railways, runways and airports, which is intended for placing at least partially in the ground, the average weight of the bearing element (1) per linear metre being at most equal to the average

weight per linear metre of the soil which has been removed for the purpose of placing the bearing element (1), the bearing element (1) forming a tube in the longitudinal direction.

fig - 1



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Description

The present invention relates in the first instance to a bearing element for supporting infrastructure such as roads, railways, runways and airports, which is intended for placing at least partially in the ground, the average weight of the bearing element per linear metre being at most equal to the average weight per linear metre of the soil which has been removed for the purpose of placing the bearing element.

When infrastructure, such as roads and railways, is laid over relatively soft ground, such as that commonly found in the Netherlands, sand is generally used to support the infrastructure. A supporting element is laid in the ground with the aid of the sand. Railway tracks, for example, are generally placed on an embankment of sand, which sand is poured into a trench dug in the ground. So much sand is supplied here that the embankment projects partially above ground level. A ballast bed in which the track rails can be fixed with the aid of sleepers is subsequently placed on top of this so-called "earth track".

A major disadvantage of the use of a supporting element made of sand is that the weight of the constructed element, so in the case of railway tracks the weight of the earth track is much greater than the weight of the soil which was excavated for laying of the support. That means that the stress profile in the ground below the supporting element of sand changes because of the great weight of the latter. As a result of the stresses caused in the ground, the ground will be subject to subsidence, which means that the foundation becomes permanently deformed by the weight of the earth track.

A first major consequence of this is that in the case of a railway track the rails cannot be placed immediately on the embankment. Before the rails can be placed on an embankment, a substantial part of the permanent deformation of the foundation must already have occurred. During the construction of a railway track that means a considerable extension of the construction time.

Another consequence is that the rails have to be aligned repeatedly, because the high weight of the earth track causes the foundation of the railway track to be deformed permanently also during use.

A subsidence-free support for infrastructure, according to the type mentioned in the preamble is known, inter alia, from British Patent Application GB 2,300,009. The support according to this publication is constructed by placing plastic blocks, for example polyurethane or polystyrene, in an excavated trench. The trench is subsequently filled up with concrete. Although the support according to the British application can be placed in the ground so that it is subsidence-free, the rigidity and strength of the construction in its longitudinal direction are limited. If the known support is used, for example, in a foundation with weak spots locally, the support can subside locally. When the support has sub-

sided locally, it cannot be aligned again.

If the known support is to be used for supporting track rails, one of the important requirements, particularly from an acoustic point of view, is that the construction should have a high input impedance under the track rails. This cannot be achieved with the known construction.

It is the object of the present invention to provide a support of the type mentioned in the preamble which itself forms a rigid and strong element in the longitudinal direction.

That object is achieved in the present invention by the fact that the bearing element (1) forms a tube in the longitudinal direction.

The advantage of this is that the bearing element is supported along its entire length, which means that the bearing element can span relatively weak points (for example, old ditches) in the route itself. The road, railway track or, for example, runway cannot therefore subside very locally. The bearing element according to the present invention is consequently particularly suitable for laying high-speed lines (HSLs).

The bearing element according to the present invention preferably comprises one or more channels in its longitudinal direction. This has the advantage that the bearing element need not be in the form of a solid element, which means that "ordinary" construction means such as, for example, prestressed, fibre-reinforced and armoured concrete can be used for the construction of the bearing element.

The presence of the channels here has the advantage that the free space in the bearing element can be used, for example, for transporting shuttles, for containers or for other forms of transport. The channels can also be used for passing lines through them. The bearing element in that last instance acts as a pipe alley. In other words, by using the bearing element according to the present invention it is relatively simple to achieve dual ground use.

In an advantageous embodiment the bearing element comprises a lower half in the form of a shell, having at least a bottom and two side walls to be placed substantially horizontally, and a substantially flat upper half to be placed on the lower half.

One of the advantages of this is that a trench for laying a bearing element according to the present invention which is substantially the shape of a trapezium is relatively easy to dig in the ground. Furthermore, because of the shape, the lower half can be poured from concrete, in which case removable concrete shuttering can be used.

It is possible according to the invention for longitudinal walls extending in the longitudinal direction to be placed in the tube. It is advantageous here for transverse walls extending in the transverse direction to be placed between the side walls and/or the longitudinal walls.

These walls in the first place support the upper half

of the bearing element. Furthermore, the rigidity of the element is increased by the presence of the walls. An additional advantage is that the walls can be placed in such a way that at the places where the infrastructure is subjected to the greatest load (for example, just underneath the track rails) walls are fitted.

The bearing element according to the present invention preferably has in its longitudinal direction edges extending in the transverse direction.

The advantage of this is that jacks can be placed under these edges. Railway tracks, certainly the railway tracks used for high-speed trains, must have a high degree of accuracy as regards unevennesses in the vertical direction. If the bearing element has subsided locally owing to a disaster, the transverse edges fixed to the bearing element make it possible to place jacks underneath the bearing element, in order to raise the bearing element to the desired level.

The bearing element according to the present invention is further improved if means for pumping away leakage water are placed in the channels of the bearing element.

This has the advantage that any leakage water out of the ground, or leakage water which has reached the element through the top side, can be removed from the element by means of the pumps. In this way the weight of the bearing element is prevented from increasing at the moment when leakage water penetrates into the element.

It is also possible to fill the hollows in the bearing element with a plastic foam, for example a closed-cell foam.

That has the advantage that the foam forms a physical barrier against the penetration of leakage water into the bearing element.

As already stated above, the bearing element according to the present invention is particularly suitable for supporting track rails. In the prior art it is known to use a concrete slab as a support for the track rails, as an alternative to an earth track. In order to prevent subsidence of the foundation in the case of such a "slab track", the concrete slab can be supported on piles. However, the use of a slab track has two major disadvantages. First, it is relatively expensive to lay (certainly in the case of pile supports). Secondly, a slab track produces much more noise than a conventional ballast track.

The bearing element according to the present invention is therefore further improved by the fact that the top side of the bearing element is provided with means for fixing track rails, the channels and the longitudinal walls being placed in the bearing element in such a way that the bearing element has a high input impedance.

The advantage of this is that the track rails can be fitted relatively easily on the bearing element, the relatively simply constructed trenches serving as fixing means. The fact that underneath the rail supports is

precisely where the bearing element has no hollows, but actually a relatively heavy cross-section, has the advantage that the bearing element has a relatively great input impedance to vibrations. That means that at the moment when a train passes over the bearing element it will be difficult for the bearing element itself to be set in vibration by the train. The advantageous effect of this is that the use of the bearing element according to the present invention therefore produces a relatively low-noise railway track.

It is further possible according to the invention for the bearing element to be made of concrete. It is possible here for the bearing element to be made of fibre-reinforced, armoured or prestressed concrete, or any suitable combination thereof.

The present invention further provides the possibility of fitting road furniture on or in the bearing element. That means that the support of the overhead line, for example, is fitted on the bearing element, with the result that the overhead line can be coupled directly to the bearing element. That means that the distance between the bearing element and the overhead line is always constant, and it has the advantage that the bearing element cannot subside relative to the overhead line. In the case of roads, the lighting or the crash barriers, for example, can be fitted on the bearing element.

The present invention also relates to a method for manufacturing a bearing element for supporting track rails. Said method comprises the following steps: digging a long trench of suitable cross-section in the ground; laying a watertight membrane on the ground and along the walls of the trench, the bearing element provided with channels being made of concrete by means of sliding shuttering or another suitable shuttering, with the exception of the deck; and subsequently pouring the deck from concrete, with permanent shuttering or another suitable shuttering.

That has the advantage that the bearing element can be laid quickly and efficiently, and consequently relatively cheaply. Moreover, the construction of the bearing element in two phases makes it possible to carry out the first phase (lower half) relatively "roughly", while a relatively "accurately" manufactured upper part is placed on the lower half. That means a further possibility for saving costs during the construction of the bearing element.

It is also possible according to the present invention for the bearing element provided with channels to be made of concrete by means of sliding shuttering. Furthermore, it is possible for the bearing element to be made fully or partially of prefabricated concrete.

The method according to the present invention is advantageously expanded by the following steps:

placing at least two supports underneath the bearing element, at a distance from each other, and removing the soil present underneath the bearing element and between the supports.

The advantage of this is that an appreciable saving can be made on the construction of smaller structures underneath the railway track. If, for example, a cycle underpass or pedestrian subway is to be constructed underneath the railway track, two supports, for example walls, are placed underneath the bearing element according to the present invention. The soil between these walls is then excavated, and a passage is thereby produced underneath the bearing element. Such a method for the construction of small structures is out of the question in the case of a railway track according to the prior art.

Furthermore, the small structures according to the above method can be laid while the railway track remains in use. That produces considerable cost advantages.

The present invention will be described further with reference to the following drawings, in which:

- Figure 1 shows a cross-section of the bearing element according to the present invention;
- Figure 2 shows the bearing element according to Figure 1, provided with track rails on the top side;
- Figure 3 shows a cut-away side view of the bearing element according to Figure 2, with a cycle underpass underneath it;
- Figure 4 shows a possible embodiment of the upper part of the bearing element provided with a derailment guide;
- Figure 5 shows a possible embodiment of a track rail fastening.
- Figure 6 shows the bearing element according to the invention, used as a runway for aircraft.

Figure 1 shows the bearing element 1 for supporting infrastructure according to the invention. The bearing element 1 is preferably made of prestressed, armoured or fibre-reinforced concrete. The bearing element 1 can be manufactured in one piece, but it is advantageous if the bearing element consists of a lower half 2 and an upper half 7. In the present description the upper half 7 is also known as the "deck". Since the load exerted upon the ground per unit length by the bearing element may not exceed the load exerted by the soil at the position of the bearing element prior to the building of the infrastructure, the bearing element 1 is preferably in the form of a hollow tube. Viewed in the longitudinal direction, the average weight of the bearing element per linear metre may not exceed the average weight per linear metre of the soil removed.

The lower half 2 can be placed with the aid of sliding shuttering or in another way in a trench dug in the ground. The laying of this lower part 2 can be largely mechanized. For instance, it is possible to convey a laying train over an already laid track, in order to excavate, deposit the structure in the correct position and in the correct form, and provide the necessary longitudinal and transverse reinforcement. During the laying of this

lower half 2 a watertight sheeting 4, which prevents adverse effects of groundwater on the structure, is rolled out underneath the structure. If desired, the construction train (not shown) can act as a mobile concrete plant during the laying. The supply of the necessary materials (and the removal of the excavated soil) is by way of the laid structure (bearing element), so that working roads themselves are unnecessary. For the transportation of these materials, robot carriers commute between the starting point (i.e. supply point) and the construction train. These carriers travel along one track to the construction train and unload their conveyed building materials there, and subsequently return laden with soil by way of points along the other track to the supply point.

One or more longitudinal walls 50 can be placed in the lower half 2. In addition, one or more transverse walls 51 can be placed in the bearing element 1. These walls give the bearing element increased rigidity and strength.

After laying of the lower half 2, by means of sliding shuttering, the upper half 7 is laid. Said upper half 7 can be made by means of a permanent shuttering method. During the placing of the upper half 7 it is advantageous if a bearing element 1 which has a projecting edge 15 at both sides is produced. Said edge 15 can be used during use of the bearing element should the bearing element 1 as a whole begin to subside. Jacks can be placed under the edges 15 in the longitudinal direction of the bearing element 1, by means of which a subsided bearing element 1 can be moved upwards.

In order to prevent the bearing element 1 from filling up with water during use, the hollows of the bearing element 1 can, for example, be filled with foam 5. As an alternative, it is possible to place pumps 9 in the hollows, in order to be able to pump any leakage water out of the bearing element 1.

Figure 2 shows the case where the bearing element 1 is used for supporting track rails 6. The shape of the lower part 2 of the bearing element 1 is selected in such a way that when the rails 6 are fixed on the bearing element 1 a relatively large amount of mass is situated underneath the rails. The relatively large amount of material underneath the rails 6 means that the input impedance of the bearing element 1 is relatively great. That means that the bearing element 1 cannot easily be set in vibration by passing trains. The bearing element 1 in use consequently causes a relatively low sound emission.

The shape of the upper half depends, inter alia, on the way in which the rails are placed on the upper half 7. There are numerous possibilities for fixing the rails 6 on the bearing element 1. Figure 2 shows the case where the upper half 7 is provided with longitudinal trenches 8, for accommodating the rails 6. Another possibility for fixing the rails 6 on the bearing element can be seen in Figure 4. The longitudinal trenches 8 can be formed in one piece, simultaneously with the upper half 7. It is

important for the longitudinal trenches 8 to be placed with great dimensional accuracy on the upper half 7. That can be achieved by using a paver.

The rails 6 are fixed in the longitudinal trenches 8 in the bearing element 1 and secured there by means of an elastic material 10, which can be, for example, Flexapad, made by Edilon. The use of this cork rubber 10 ensures additional acoustic insulation of the railway construction.

The trenches are also provided with an acoustic cover 17. After the rails 6 have been placed in the bearing element 1, a thermally insulating and sound-absorbent layer 11 of, for example, gravel can be placed on the bearing element 1. Stress changes will occur in the bearing element 1 as a result of temperature changes (day/night and summer/winter). Owing to the sound-absorbent and thermally insulating top layer 11, the temperature change in the bearing element will be relatively low, thereby ensuring that stress changes in the bearing element 1 remain limited.

The abovementioned method for the laying of the bearing element 1 is only an example. The bearing element 1 could also be manufactured in one piece using sliding shuttering.

Moreover, in order to permit the use of changeover points, two bearing elements can be coupled to each other, or a plate resting on both bearing elements can be used, on which plate the changeover track can be laid.

Figure 3 shows a partially cut-away side view of the bearing element 1 according to Figure 2. It can be seen in the figure that the use of the bearing element 1 provides the possibility for easy fitting of small structures underneath the bearing element 1. For instance, it is possible to make, for example, a cycle underpass 20 underneath the bearing element 1. For the construction of the underpass it will suffice to construct two walls 21. After these two walls 21 have been positioned, the soil between said walls is removed and a road surface constructed, so that the cycle underpass 20 is produced.

It can also be seen in Figure 3 that the longitudinal trenches 8 in which the rails 6 are accommodated are interrupted at openings 12. These openings 12 can be made in the longitudinal trenches every 15 to 20 metres, in order to allow rainwater collecting between the longitudinal trenches to drain off. Since the rails 6 are supported almost over their entire length, the openings 12 can be made without jeopardizing the stability or alignment of the rails 6.

An additional advantage of the use of the bearing element 1 according to the present invention is that the supports 25 of the overhead line 23 can be coupled directly to the bearing element 1. That means that the distance between the bearing element 1 and the overhead line 23 is always constant, which has the advantage that the bearing element 1 cannot subside relative to the overhead line 23.

This in turn has the advantage that during passing

of the train the pantograph (not shown) cannot become detached from the overhead line 23. If the pantograph becomes detached from the overhead line 23, a spark is drawn between the two. The drawing of such a spark is accompanied by material loss from both the overhead line 23 and the pantograph.

Figure 4 shows an embodiment of the upper half 7 of the bearing element 1, which is provided with a derailment guide. If a train becomes derailed, it is very important that a railway track can still guide the derailed train to some extent as best it can. For instance, a derailed train must always be prevented from landing on another track.

The derailment guide according to Figure 4 is formed by the elevation 30 between two rails 6. The top side of this elevation 30 can be provided with an acoustically absorbent layer, for example a layer of sound-absorbent concrete 31. The height of the elevation 30 and the layer 31 is selected in such a way that the top surface 32 of the layer 31 projects a number of centimetres, for example 3 cm, above the top surface of the rails 6. This produces hollows 35 between the rails 6 and the elevation 30, in which hollows a train wheel which may have become derailed is caught, and which will guide that train wheel.

Placing a layer 31 of acoustic concrete on the elevation not only ensures that the railway track is quieter, but also that the concrete 31 has a function when derailments occur. Acoustically absorbent concrete is generally relatively soft. The relatively soft concrete layer 31 will therefore effectively be able to brake a derailed train wheel.

Figure 5 shows a possible embodiment of a fastening of a rail 6 to the upper half 7. A "runner" of elastic material 40 is fixed to the underside of the rail 6, for example by means of adhesive. The rail 6 is also wedged between two elastic, for example rubber, elements 44. These elements 44 are fixed to steel sections 43. The sections are fixed on the upper half 7 by means of fastening means 45.

With the rail support according to Figure 5 it is ensured that when a rail 6 is placed on the upper half 7 and aligned, any openings or hollows between the runner 40 and the surface of the upper half 7 can be filled up by means of an injectable layer 41. In this way the rail 6 is positioned in an efficient manner relative to the upper half 7. During injection of the layer 41 a temporary seal 42, for example consisting of foam strip, can be fitted next to the runner 40.

The embodiment according to Figure 5 further makes it possible to inject additional material 41 underneath a locally subsided rail 6 underneath the runner 40, also during use. In this way, the position of the rail relative to the upper half can be adjusted during use.

In order to prevent the underside of the runner 40 from adhering to the top side of the upper half 7 or to the injected layer 41, an intermediate layer 46 is preferably present on the underside of the runner material 40.

The lateral confinement of the rail 6 by means of the sections 43 can be carried out in such a way that most of the noise of the rail 6 is screened off.

A further advantage of the use of the bearing element according to the present invention, both in the embodiment according to Figure 2 and in the embodiment according to Figure 5, is that the height of the rails relative to the top surface 16 of the bearing element 1 can also be adjusted subsequently. That means that, for example in a bend, where the rails are always laid at a certain inclination relative to each other, said inclination can be adjusted. The angle of inclination at which the two rails are situated relative to each other in a bend is directly dependent on the speed at which the trains have to be able to travel along the railway track. When this speed changes, the angle of inclination must also change with it. That is possible when the bearing element 1 according to the present invention is used.

Figure 6 shows a view of the bearing element 1 according to the invention, which is used as a runway for aircraft. It can be seen from Figure 6 that the tubular construction makes it possible to use the open space in the bearing element 1, for example, for fitting lighting 60 in the road surface. The wiring 61 and the like can be conducted underneath the road surface. This makes it possible to carry out maintenance work on the runway without having to stop the use thereof.

Claims

1. Bearing element (1) for supporting infrastructure such as roads, railways, runways and airports, which is intended for placing at least partially in the ground, the average weight of the bearing element per linear metre being at most equal to the average weight per linear metre of the soil which has been removed for the purpose of placing the bearing element (1), characterized in that the bearing element (1) forms a tube in the longitudinal direction.
2. Bearing element (1) according to Claim 1, characterized in that the bearing element (1) comprises one or more channels in its longitudinal direction.
3. Bearing element according to Claim 1 or 2, characterized in that the bearing element (1) comprises a lower half (2) in the form of a shell, having at least a bottom and two side walls to be placed substantially horizontally, and a substantially flat upper half (7) to be placed on the lower half (2).
4. Bearing element according to one of the above claims, characterized in that longitudinal walls extending in the longitudinal direction are placed in the tube.
5. Bearing element according to one of the preceding claims, characterized in that transverse walls extending in the transverse direction are placed between the side walls and/or the longitudinal walls.
6. Bearing element according to one of the preceding claims, characterized in that the bearing element has in its longitudinal direction edges (15) extending in the transverse direction.
7. Bearing element according to one of the preceding claims, characterized in that means (9) for pumping away the leakage water are placed in the channels.
8. Bearing element according to one of the preceding claims, characterized in that the channels of the bearing element (1) are filled with foam (5).
9. Bearing element according to one of the preceding claims, characterized in that the top side of the bearing element is provided with means for fixing track rails, the channels and the longitudinal walls being placed in the bearing element in such a way that the bearing element has a high input impedance.
10. Bearing element according to one of the preceding claims, characterized in that the bearing element (1) is made of concrete.
11. Bearing element according to one of the preceding claims, characterized in that the bearing element (1) is made of fibre-reinforced concrete.
12. Bearing element according to one of the preceding claims, characterized in that the bearing element (1) is made of armoured concrete.
13. Bearing element (1) according to one of the preceding claims, characterized in that the bearing element (1) is made of prestressed concrete.
14. Bearing element (1) according to one of the preceding claims, characterized in that road furniture is fitted on or in the bearing element.
15. Bearing element (1) according to Claim 14, characterized in that the support (25) of the overhead line (23) is fitted on the bearing element (1).
16. Method for manufacturing a bearing element in situ according to one of the preceding claims, the method comprising the following steps:
 - digging a long trench of suitable cross-section in the ground, -laying a watertight membrane (4) on the ground and along the walls of the trench,
 - characterized in that
 - the bearing element (1) provided with channels

is made of concrete by means of sliding shuttering or another suitable shuttering, with the exception of the deck (7), and

- the deck (7) is subsequently poured from concrete, with permanent shuttering or another suitable shuttering. 5

17. Method according to Claim 16, the method comprising the following steps:

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- digging a long trench of suitable cross-section in the ground, -laying a watertight membrane (4) on the ground and along the walls of the trench, characterized in that 15
- the bearing element (1) provided with channels is made of concrete by means of sliding shuttering.

18. Method according to one of Claims 16 or 17, characterized in that the bearing element (1) is made fully or partially of prefabricated concrete. 20

19. Method according to one of Claims 16 to 18, in which a subway or an underpass (20) is constructed underneath the bearing element (1), comprising: 25

- placing at least two supports (21) underneath the bearing element (1) at a distance from each other, and 30
- removing the soil present underneath the bearing element (1) and between the supports (21).

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fig-1

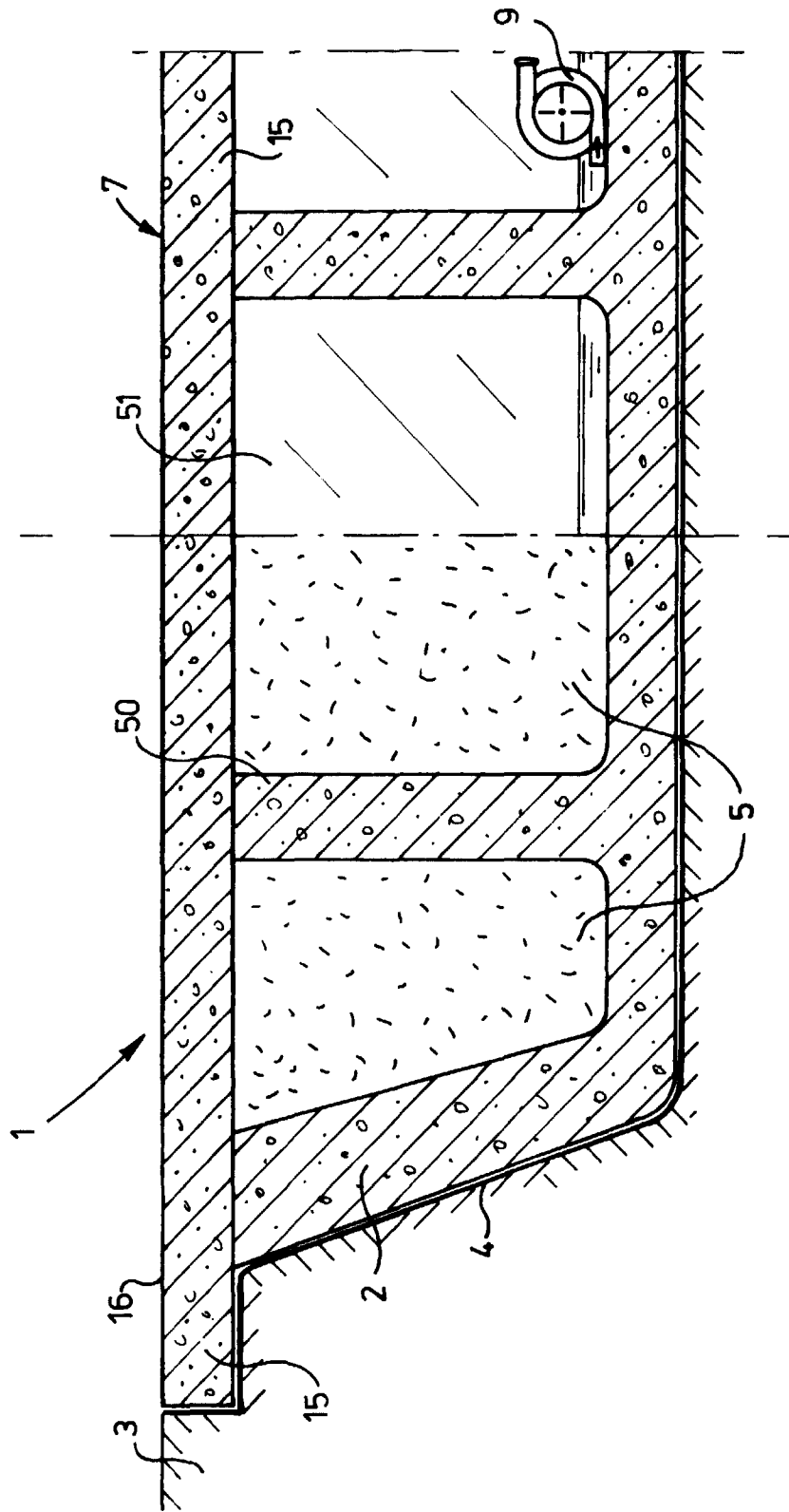


fig - 2

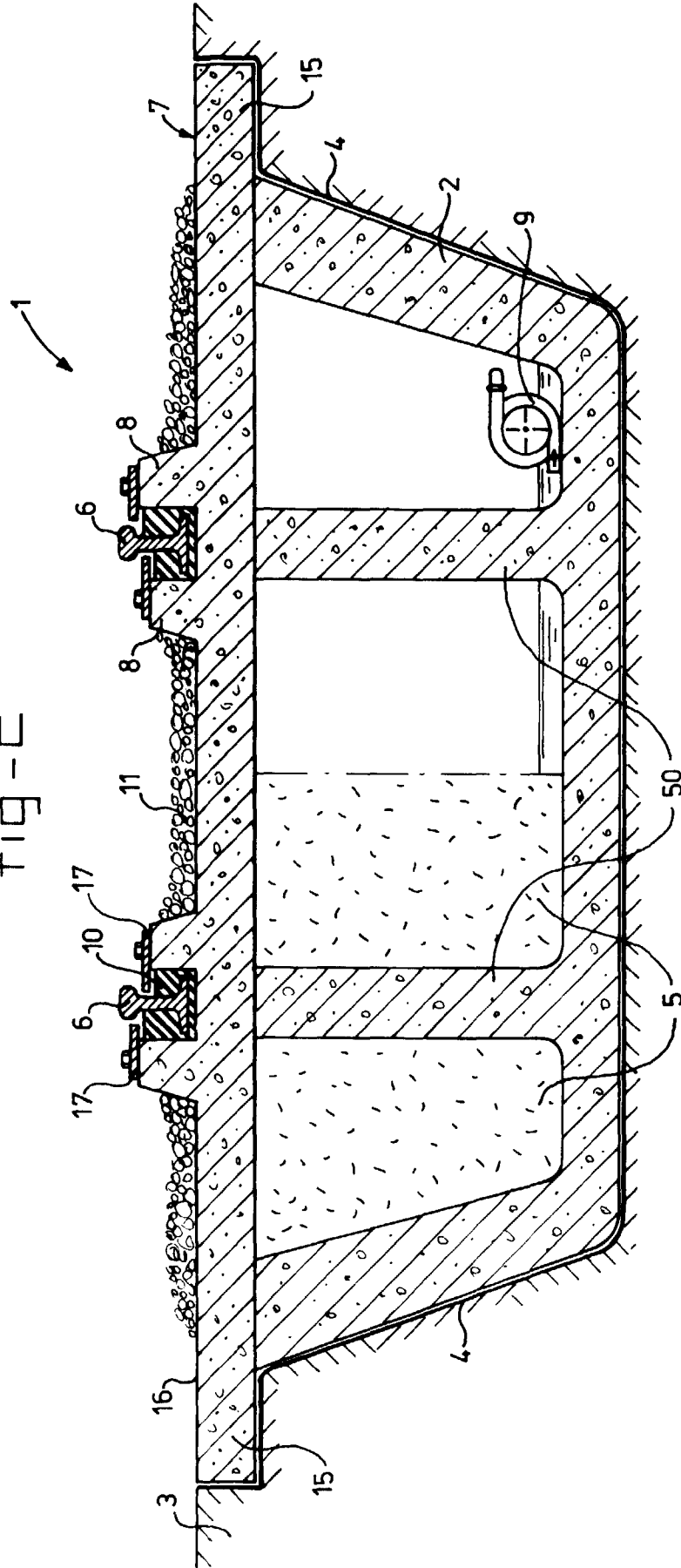
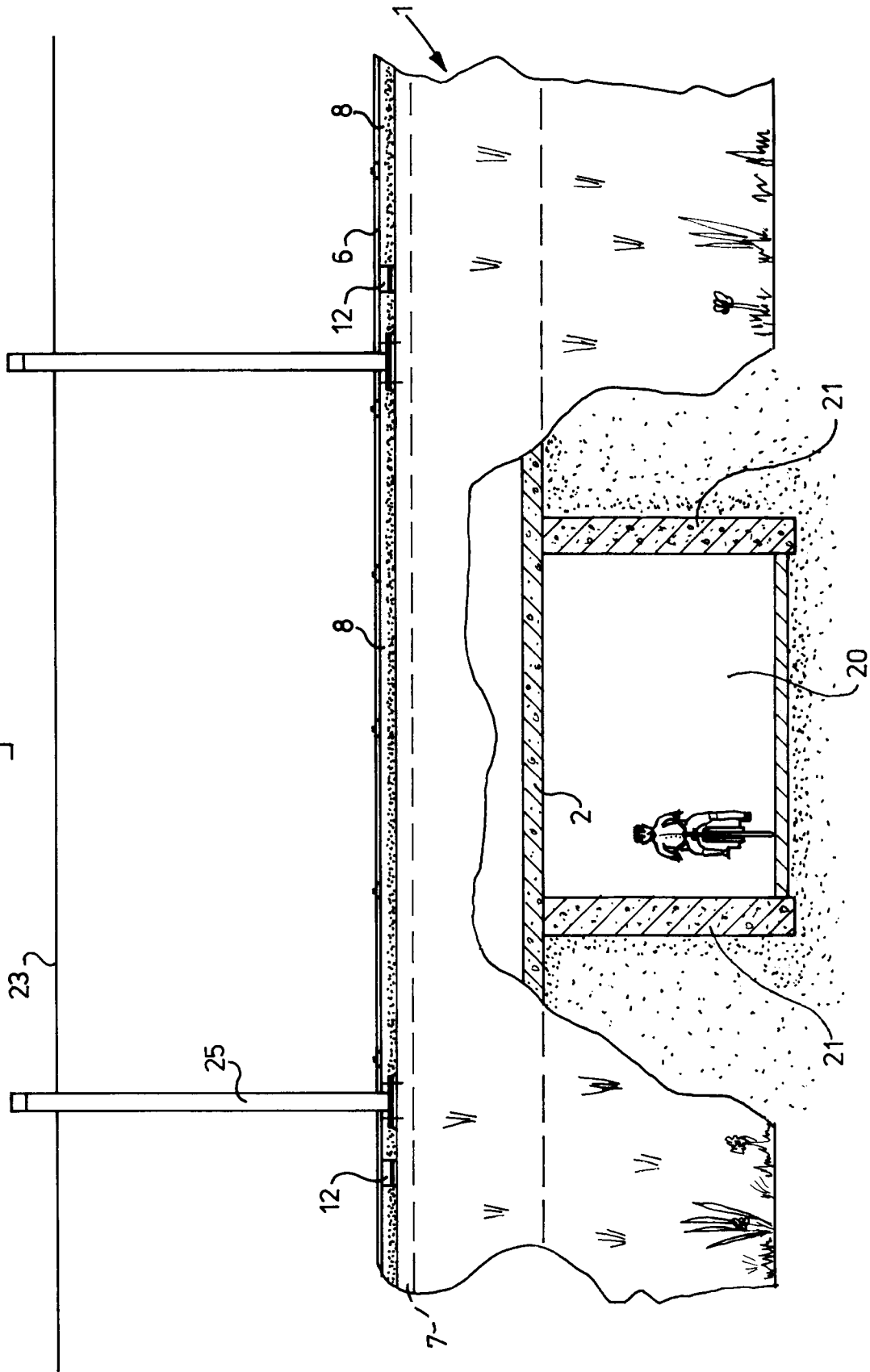
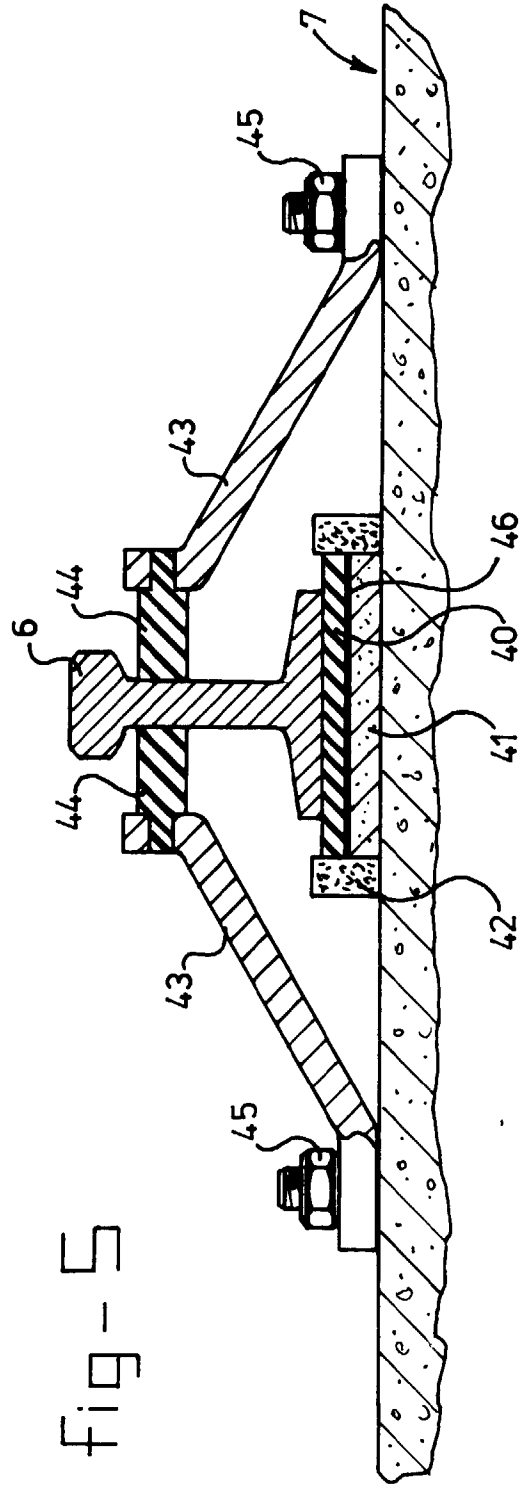
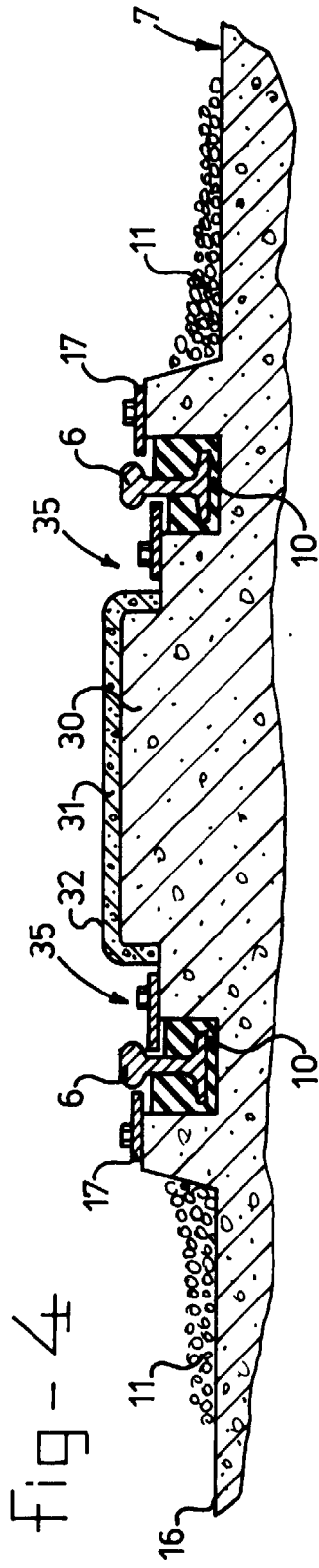
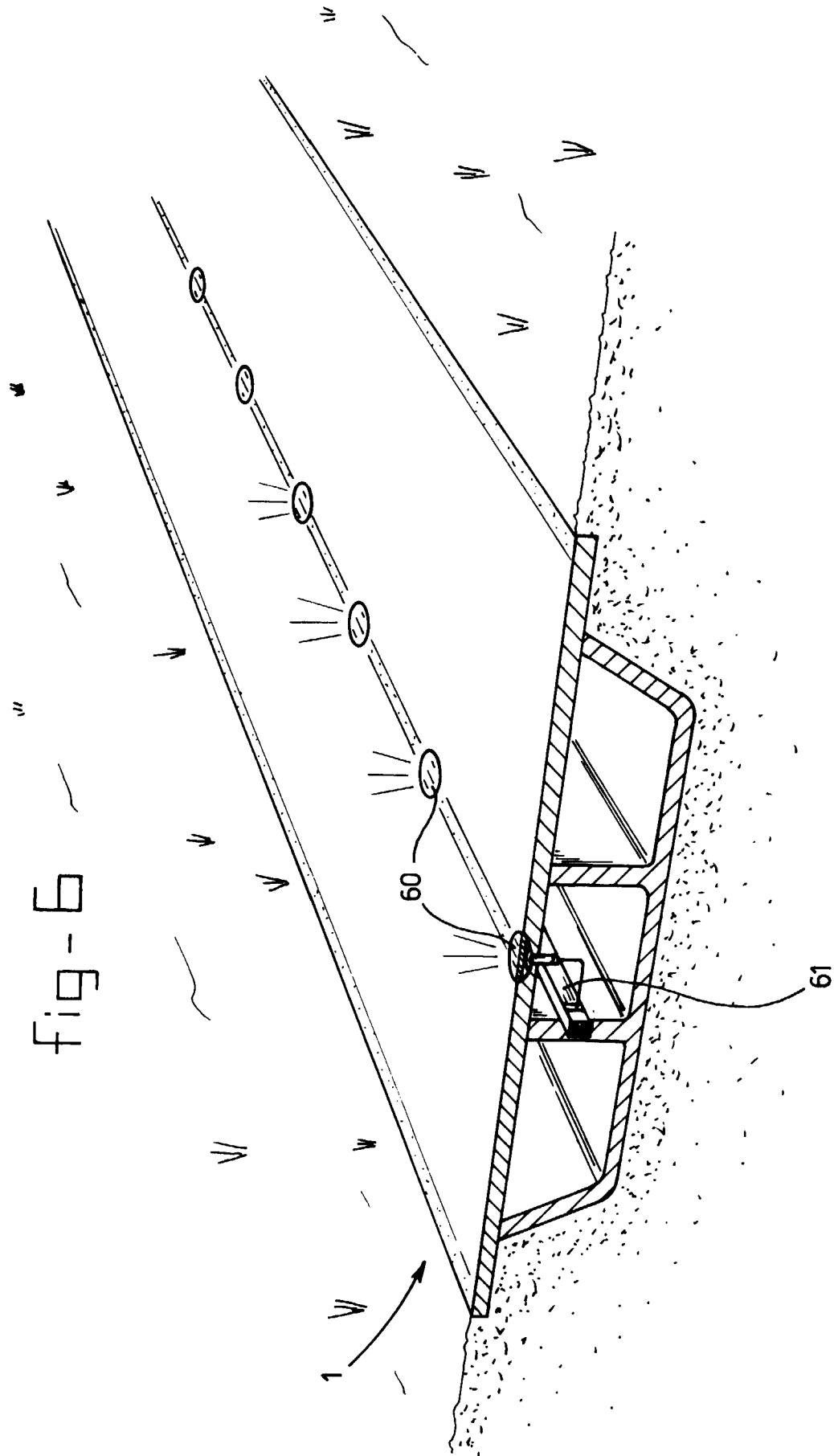


fig - 3









European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 98 20 1804

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR 799 825 A (ROBERT, RUDOLF, LODEWIJK DE MURALT) 20 June 1936	1-3, 9, 10	E01C3/00 E02D27/36
A	* the whole document *	4-8, 16-19	
A	--- NL 9 400 522 A (INBO ARCHITECTEN ADVISEURS B V) 1 November 1995	1	
A	* the whole document *		
A	--- US 1 565 682 A (STRAHAN) 15 December 1925	1	
A	* page 1, line 63 - page 4, line 52; figures 1-4 *		
A	--- DE 40 17 840 A (SCHROEDER KARL) 10 October 1991	1, 16	
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			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			E01C E02D E01B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16 September 1998	Examiner Tellefsen, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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