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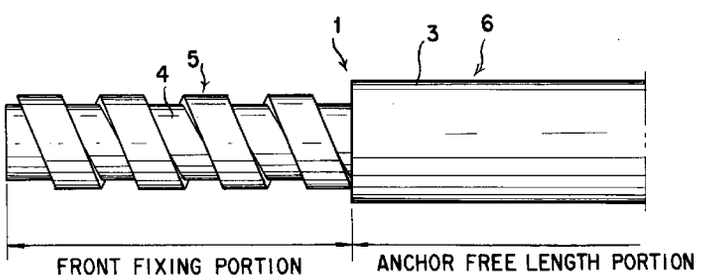
(54) ROD MATERIAL FOR EARTH ANCHOR AND METHOD OF USING THE SAME

(57) A reinforcing member for an earth anchoring method of the present invention has a construction comprising a rod composed of FRP and having irregularities formed thereon and a cover film covered around the rod, or construction comprising a rod composed of FRP and a string body spirally wound around a surface of the FRP rod so that a surface of the string body is almost flush with the surface of the rod. The reinforcing member is used in a manner such the cover film or string body is partially peeled off and the peeled portion is used as a fixing portion against a grout.

FIG. 2



EP 0 807 717 A1

Description

TECHNICAL FIELD

The present invention relates to a reinforcing member having a fixing portion against grout used in earth anchoring methods such as ground anchoring method, earth reinforcing method and NATM method, and more particularly, to a reinforcing member composed of FRP and a method of using the reinforcing member.

BACKGROUND ART

In recent years, as a reinforcing member for concrete, a reinforcing member composed of FRP (herein after referred to as "FRP reinforcement") which is excellent in corrosion resistance has started to be used in place of a steel member (hereinafter referred to as "PC steel member"). In the same way, this FRP reinforcement has been used as a reinforcing member for earth anchoring methods such as ground anchoring or the like.

Among the various reinforcing members used in earth anchoring methods described above, the reinforcing member to be used for the ground anchoring method comprises a front fixing portion to be fixed in ground by grout (for example, concrete), an anchor free length portion as an intermediate portion of the member and an anchor head portion to which a frame structure is fixed at the ground surface by an anchor nut or the like.

In this reinforcing member, as a matter of course, the front fixing portion is required to be firmly bonded to the grout and the anchor free length portion is required to have both corrosion resistance and non-adhesive property against the grout.

Therefore, in a case where the conventional reinforcing member composed of PC steel is used, the anchor free length portion of the reinforcing member is covered with a smooth sheath. Further, even in a case where the FRP reinforcement is used in place of the covered PC steel member, there is not posed a problem of corrosion resistance. However, in order to secure the sufficient non-adhesive property against the grout, as in the same manner as in the case of the PC steel member, the reinforcement is executed in such a manner that the smooth sheath is provided to the anchor free length portion under present circumstances.

Further, in a case where the smooth sheath is not used, an edge-separation for separating the anchor free length portion from the fixing portion is performed, for example, by winding a non-adhesive tape (vinyl tape) around the anchor free length portion.

In order to secure both the adhesive property against grout for the front fixing portion of the FRP reinforcement and non-adhesive property against the grout for the intermediate portion of the FRP reinforcer, each FRP reinforcement for the earth anchoring method is required to be provided with the smooth sheath at the intermediate portion as the anchor free length portion. Therefore, the construction of the FRP reinforcement will become complicated.

Furthermore, since the reinforcement has a construction in which the smooth sheath is attached, each of the FRP reinforcement for the earth anchoring method is required to be manufactured one by one at a factory, and a mass-production of the FRP reinforcement was difficult.

As the result, there were posed problems such that each of the FRP reinforcement for the earth anchoring method requires an increased cost and that since a length of the reinforcement was limited or fixed to a predetermined length, an anchoring length could not arbitrarily be selected or determined at a construction site.

Further, in a case where the separation is performed by winding vinyl tape around the anchor free length portion, each of the vinyl tapes is required to be carefully or minutely wound around the free length portion by a handwork, so that the winding operation would become remarkably troublesome or complicated at a construction site.

The present invention is achieved for solving the aforementioned problems and an object of the present invention is to provide a reinforcing member for an earth anchoring method and a method of using the reinforcing member which is not required to provide a smooth sheath or tape for imparting non-adhesive property against grout to the anchor free length portion and capable of easily imparting an adhesive property against the grout to only a front fixing portion of the member at the construction site.

DISCLOSURE OF THE INVENTION

In order to achieve the aforementioned object, the reinforcing member for an earth anchoring method according to the present invention is constructed such that a rod, which is composed of FRP and has a surface on which irregularities are formed, is covered with a cover film.

Further, the reinforcing member for an earth anchoring method according to the present invention is constructed such that a string body such as tape or the like is wound in a spiral shape around a surface of a rod composed of FRP so that a surface of the string body is almost flush with the surface of the rod.

Thus formed reinforcing member is used in a manner such that the cover film or the string body is partially removed and the removed portion is used as a fixing portion against the grout.

In the construction described above, when the cover film or the string body which is attached on the surface of the rod is peeled off, the irregularities formed on the rod surface of the peeled portion appear and the peeled portion having the irregularities will perform a function as a fixing portion against the grout, while another portion will perform a function as a non-fixing portion.

In particular, in a case where the cover film or string body is composed of a material which is dissolved or gelled through a reaction with an uncured grout, a non-fixing portion from which the cover film or string body is not peeled acts such that the cover film or the string body is dissolved or gelled through a reaction with the grout so as to form a void space having a thickness corresponding to that of the cover film or the string body, the void space being formed between the reinforcing member and the grout. Therefore, a non-adhesive property between the reinforcing member and the grout can be further improved.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more apparent and more easily be understood from the following detailed description when taken in conjunction with the accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative examples.

Further, the embodiments shown in the accompanying drawings are not for specifying or limiting the scope of this invention, but for merely making the explanation and understanding of this invention more easily.

In the accompanying drawings:

FIG. 1 is a perspective view showing a reinforcing member of a first embodiment according to the present invention;

FIG. 2 is an explanatory view showing a state where the reinforcing member according to the first embodiment is used;

FIGs. 3 and 4 are explanatory views respectively showing a sample for pull-out test;

FIG. 5 is a side view showing a reinforcing member of a second embodiment according to the present invention; and

FIG. 6 is an explanatory view showing a state where the reinforcing member of the second embodiment is used.

BEST MODE FOR CARRYING OUT THE INVENTION

The preferred embodiment of the reinforcing member for an earth anchoring method, a method of manufacturing the same and method of using the same according to the present invention will now be described hereunder with reference to the accompanying drawings.

In the drawings, a reference numeral 1 denotes a reinforcing member. The reinforcing member 1 has a construction comprising a rod 2 composed of FRP and a tubular cover film 3 formed of a resin for covering the rod 2. In addition, irregularities 4 are formed on a surface of the rod 2 in overall length.

When the reinforcing member 1 is used as a reinforcement for the earth anchoring methods such as ground anchoring or the like, the cover film 3 formed to the front portion requiring a sufficient adhesion strength is peeled off in a desired length by means of a cutter or the like.

As the results, as shown in FIG. 2, the portion from which the cover film 3 is peeled off performs as a front fixing portion 5, while the remaining portion performs as the anchor free length portion 6. Then, the reinforcing member 1 is cut in a desired length. Subsequently, an anchor head portion (not shown) is formed at another end portion, i.e., an end portion of the anchor free length portion side of the member.

These operations and works can be easily performed at the construction site by executing the earth anchoring method.

The thus formed reinforcing member 1 is inserted with its front fixing portion into an anchor box or hole formed in an anchoring ground. Thereafter, the grout is injected into the anchor box and then cured.

At this time, the grout is injected into whole of the anchor box and the reinforcing member 1 contacts to the grout at full length of the anchor length portion. However, the top fixing portion 5 from which the cover film 3 is removed is bonded to the grout, thereby to be firmly fixed to the ground side. On the other hand, at the anchor free length portion 6 having the cover film 3 thereon, since the cover film 3 is interposed between the reinforcing member 1 and the grout, the reinforcing member 1 and the grout are remained in a non-bonded state, so that the frictional resistance against the cured grout hardly occur. As described above, the cover film 3 attains a substitute function alternative to that of the smooth sheath used in the prior art.

In the FRP materials constituting the reinforcing member, as the example of the reinforcing fiber, inorganic fibers such as carbon fiber, glass fiber, or organic fibers such as aramid fiber or the like are preferably used. In addition, as the examples of the matrix resin, thermo-setting resins such as epoxy resin, unsaturated polyester resin, phenolic resin, vinyl ester or the like, and thermoplastic resins such as nylon, polyester or the like are preferably used.

The material constituting the cover film 3 is not limited as far as the materials can be easily peeled off from FRP. In

particular, it is preferable to use the material having an extremely small shearing strength or a large extension under a small stressed condition. As the example of the material, in addition to soft vinyl chloride, polyethylene, polypropylene, nylon or the like, rubber and elastomer are also generally used. However, the material is not limited to these ones.

Even if the shearing strength of the material is not small as described above, such material can satisfy the above conditions by lowering a thickness of the material. Further, a foam material having bubbles therein can be also used.

In addition, as a material for covering the aforementioned rod 2, the material having a small friction resistance is preferable. Such examples may include polyethylene, polypropylene, polyacetal, fluorine resin, silicon resin or the like. However, the materials are not limited to these ones.

As a material for constituting the cover film 3, it is preferable to use materials that contact and react with the uncured grout so as to be dissolved or to form a gelatine-like swelling-gel. In this case, during a time when the grout injected into the anchor box is cured, the cover film 3 is dissolved or swelling-gelled so as to form a void space between the rod 2 and the cured grout. Therefore, the friction resistance against the grout at the anchor free length portion 6 can be eliminated.

In this case, the materials for the cover film 3 may include crosslinked polyacrylamide, acrylic acid or the like. However, in consideration of that the concrete which is one example of the material for the grout has strong alkaline property, it is more preferable to use cellulose type or starch type materials such as crosslinked polyvinyl alcohol, agar each having no ion group therein. Further, as the material for the cover film 3, there can also be used a material in a form of non-woven fabric cloth bonded to the rod 2 through an adhesion agent which is soluble into water contained in the concrete.

The covering operation of the cover film 3 onto the rod 2 is performed in accordance with well-known methods such as coating a material in a molten state onto the rod or inserting the rod into a tubular member on the way of forming the rod 2 or after the completion of the rod forming.

FIGs. 1 and 2 respectively show an example of the reinforcing member which is formed in a manner such that the rod 2 is formed by winding a tape 11 around the surface of the rod so as to form irregularities 4 thereon, and a tubular cover film 3 is covered on the rod 2. Hereinafter, concrete examples will be shown.

Rod portion

Reinforcing Fiber:	carbon fiber, T700S, mfd. by Toray Co., Ltd.
Matrix Resin:	Epicoat No.6003 System, mfd. by Yuka Shell Co., Ltd.
Vf (Volume Fraction):	65%
Diameter:	10 mm
Shape of Groove:	groove width 4mm groove depth 0.5mm groove pitch 10mm

Covering portion

Material:	soft vinyl chloride EX512B, mfd. by Shinetsu Polymer Co., Ltd.
Thickness:	1mm

A part of the cover film 3 ranging 100mm from the top end of thus formed reinforcing member 1 was peeled off to thereby prepare two samples of A and B. Then, as shown in FIG. 3, a mortar body 15 having a diameter of 100 mm was bonded to only a portion of one sample of A from which the cover film 3 had been peeled off. While, as shown in FIG. 4, regarding the other sample of B, a mortar body 16 having a diameter of 100 mm was bonded to a portion in a total length of 300 mm including the portion of the cover film 3 having been peeled off and a portion adjacent to the peeled portion.

Then, with respect to each bonded sample, a pull-out test was conducted and repeated for three times. The test results are shown in Table 1 hereunder. Further, the mortar bodies 15 and 16 were composed of a mortar material of which trade name is Denka-Pletascon T-1 (mfd. by Denki-Kagaku Co., Ltd.), and a compressive strength of the respective mortar body 15 or 16 at the pull-out test was 482 kg/cm^2.

Table 1

Samples	1	2	3	Average Pull-out Load
A	3.18	3.05	3.47	3.23
B	3.82	3.54	3.88	3.74
Unit: ton				

As is clear from the results shown in Table 1, the pull-out loads in both the samples of A and B were almost the same to each other in an average value. This means that, in the case of sample B, the bonding to the mortar body was accomplished only at the portion of the cover film 3 having been peeled off. From this fact, it was confirmed that the edge-separation of the fixing portion from the non-fixing portion was securely accomplished in accordance with the presence or absence of the cover film 3.

In the above example, there is shown a reinforcing member comprising a rod 2 having the irregularities thereon and the cover film 3 covering the rod 2. In this regard, the cover film 3 is provided in order to lower the friction resistance against the grout. Therefore, if the surface of the rod 2 per se as a small friction resistance against the grout, the cover film 3 will not be required.

FIG. 5 shows an example of such structure, in which, in order to form a helical or spiral groove, the tape which had been wound around the rod 2 at the time of forming the rod 2 remains as it is even after the rod 2 has been cured. Then, the surface of the rod 2 is smoothly finished so that the surface of the rod 2 provides a small friction coefficient.

The thus formed reinforcing member 1 is cut in a desired length. Thereafter, as shown in FIG. 6, the tape 11 wound around the front fixing portion 5 is peeled off to thereby form a spiral groove 4a on the peeled portion.

In this case, the tape 11 wound around a portion except the front fixing portion 5 remains as it is, so that the friction resistance of the remaining portion against the grout can be reduced.

Hereunder, an explanation will be started with respect to the concrete example of the reinforcing member 1 which is used in a manner such that only the tape 11 having been wound around the front fixing portion 5 of the rod 2 is peeled off.

The specifications of the rod portion are the same as those of aforementioned example.

A part of the tape 11 ranging 100mm in the front fixing portion 5 of the thus formed rod 2 was peeled off so as to prepare two samples of a and b. Then, as in the same conditions as those applied to the case of the samples A and B from which the cover film 3 had been peeled off, the pull-out test was conducted and repeated for three times with respect to each of the peeled samples of a and b.The test results are shown in the following Table 2.

As is clear from the results shown in Table 2, and as the same as the aforementioned example, it was confirmed in both samples of a and b that the bonding to the mortar was accomplished only at the portion of the tape 11 having been peeled off. From this fact, it was also confirmed that the edge-separation of the fixing portion from the non-fixing portion was securely accomplished in accordance with the presence or absence of the tape 11.

Table 2

Samples	1	2	3	Average Pull-out Load
a	3.18	3.05	3.47	3.23
b	3.62	3.74	3.17	3.50
Unit: ton				

According to the present invention as described above, the reinforcing member 1 for the earth anchoring method has a construction comprising a rod 2 composed of FRP and having irregularities formed thereon and a cover film 3 covered around the rod 2. Due to this construction, when the cover film 3 is peeled off in a desired length, only such peeled portion can perform a function as a fixing portion for bonding to the grout, while the remaining portion covered with the cover film 3 performs a function as a non-fixing portion against the grout.

Accordingly, the construction of the reinforcing member for the earth anchoring method having both the fixing portion and non-fixing portion against the grout can be remarkably simplified without requiring a smooth sheath or a partially tape-winding. In addition, since the rod 2 is composed of FRP, the reinforcing member is free from a problem of corrosion.

Furthermore, when the reinforcing member 1 has a construction comprising a rod 2 composed of FRP and a string body such as tape 11 or the like for forming irregularities on a surface of the rod 2, the string body being spirally wound around the surface of the FRP rod 2 so that a surface of the string body is almost flush with the surface of the rod 2, then the string body is peeled off in a desired length, the peeled portion can perform a function as a fixing portion against the grout. Accordingly, the construction of the reinforcing member 1 requiring both the fixing portion and non-fixing portion can be simplified.

In addition, when the cover film 3 and the string body are composed of a material which is dissolved or gelled through the reaction with an uncured grout, it becomes unnecessary to peel off the cover film 3 and the string body, whereby the reinforcing member can be easily available.

Furthermore, the aforementioned reinforcing member 1 can be manufactured in accordance with the same proce-

dures as those of the ordinary reinforcing member composed of FRP.

In addition, in the reinforcing member 1 according to the present invention, when the cover film 3 or the string body is removed, the removed portion can perform as a fixing portion against the grout. Therefore, an adhesive property against the grout can be easily imparted to only the front fixing portion of the member even at the construction site, whereby the reinforcing member can be easily executed or applied.

Although the present invention has been described with reference to the exemplified embodiments, it will be apparent to those skilled in the art that various modifications, changes, omissions, additions and other variations can be made in the disclosed embodiments of the present invention without departing from the scope or spirit of the present invention. Accordingly, it should be understood that the present invention is not limited to the described embodiments, and shall include the scope specified by the elements defined in the appended claims and range of equivalency of the claims.

Claims

1. A reinforcing member for an earth anchoring method, characterized in that a rod, which is composed of FRP and has a surface on which irregularities are formed, is covered with a cover film.

2. A reinforcing member for an earth anchoring method according to claim 1, wherein said cover film is composed of a material having a small shearing strength.

3. A reinforcing member for an earth anchoring method according to claim 1, wherein said cover film is composed of a material having a small friction resistance.

4. A reinforcing member for an earth anchoring method according to claim 1, wherein said cover film is composed of a material which is dissolved or gelled through a reaction with an uncured grout.

5. A reinforcing member for an earth anchoring method, characterized in that a string body is wound in a spiral shape around a surface of a rod composed of FRP so that a surface of said string body is almost flush with the surface of said rod.

6. A reinforcing member for an earth anchoring method according to claim 5, wherein said surface of said rod around which said string body is wound is smoothly finished.

7. A reinforcing member for an earth anchoring method according to claim 5, wherein said string body is composed of a material which is dissolved or gelled through a reaction with an uncured grout.

8. A method of using a reinforcing member for an earth anchoring, characterized in that the reinforcing member comprising a rod composed of FRP and having a surface on which irregularities are formed is covered by a cover film and said cover film is partially removed so as to provide a fixing portion against a grout.

9. A method of using a reinforcing member for earth anchoring, characterized in that a string body is wound spirally around a surface of the reinforcing member comprising a rod composed of FRP so that a surface of said string body is almost flush with the surface of said rod and said string body is partially removed so as to provide a fixing portion against a grout.

FIG. 1

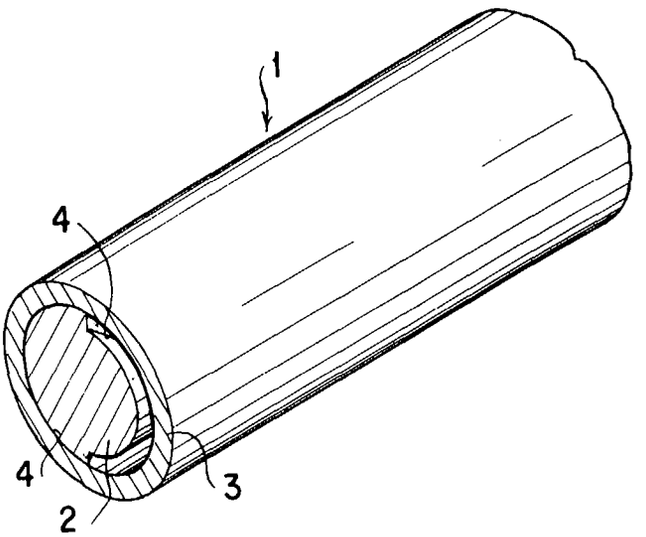
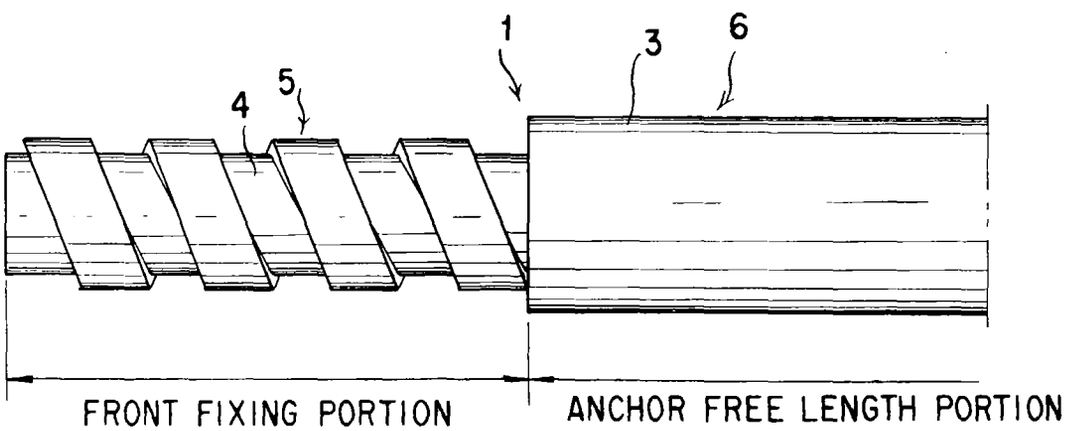

1
4
4
2
3

FIG. 2


1
3
6
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4
FRONT FIXING PORTION
ANCHOR FREE LENGTH PORTION

FIG. 3

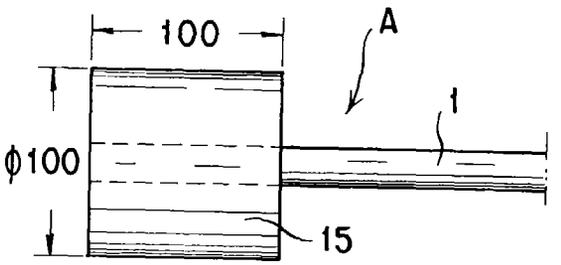


FIG. 4

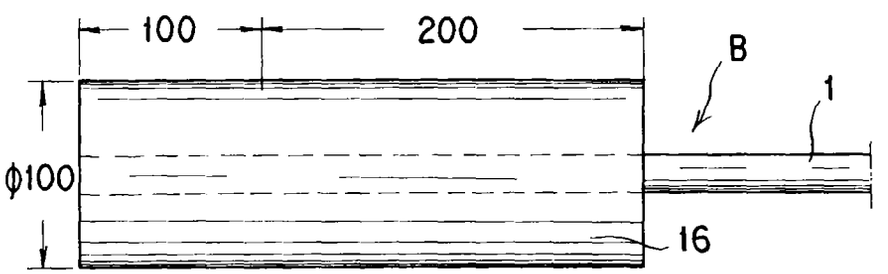


FIG. 5

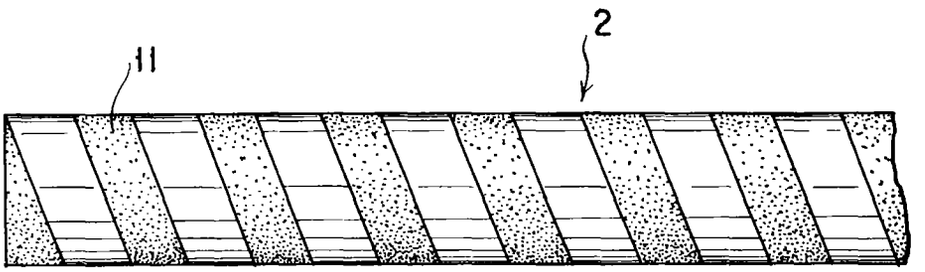
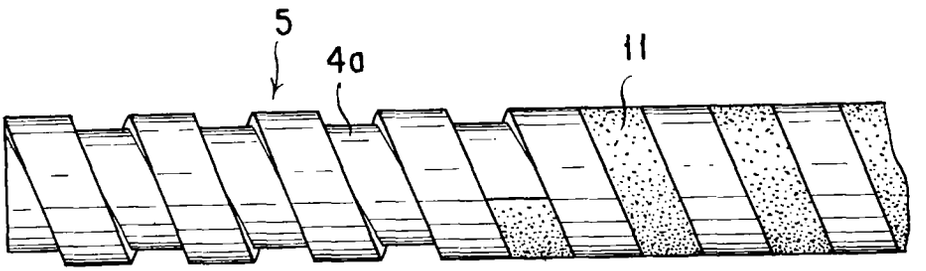


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/00192

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl^6 E02D5/80
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
Int. Cl^6 E02D5/80

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1962 - 1995
Kokai Jitsuyo Shinan Koho 1971 - 1995

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 64-29521, A (Shimizu Construction Co., Ltd.), January 31, 1989 (31. 01. 89), Line 11, upper right column, page 3 to line 13, upper left column, page 4, Figs. 1, 2 (Family: none)	1 - 3
Y	JP, 6-108463, A (The Zenitaka Corp.), April 19, 1994 (19. 04. 94), Line 6, right column, page 2 to line 6, left column, page 3, Fig. 1 (Family: none)	1-3, 8
Y	JP, 5-287737, A (The Zenitaka Corp.), November 2, 1993 (02. 11. 93), Line 31, left column to line 41, right column, page 3, Fig. 3 (Family: none)	1-3, 8
Y	JP, 4-353117, A (The Zenitaka Corp.), December 8, 1992 (08. 12. 92), Line 1, left column to line 18, right column, page 3, Fig. 1 (Family: none)	1 - 3

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
March 28, 1996 (28. 03. 96)	May 14, 1996 (14. 05. 96)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/00192

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 5-33336, A (The Zenitaka Corp.), February 9, 1993 (09. 02. 93), Line 47, left column, page 3 to line 36, left column, page 4, Fig. 1 (Family: none)	1 - 3

Form PCT/ISA/210 (continuation of second sheet) (July 1992)