(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 685 287 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
20.07.2016 Bulletin 2016/29

(51) Int Cl.:
E21B 47/01 *(2012.01)* ***G01V 11/00*** *(2006.01)*
G01V 1/16 *(2006.01)*

(21) Application number: **12187109.9**

(22) Date of filing: **03.10.2012**

(54) Fixture structure for reusing underground micro-seismic sensor

Befestigungsstruktur zur Wiederverwendung eines unterirdischen Mikroerdbebensensors

Structure de fixation pour la réutilisation d’un capteur micro-sismique souterrain

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **09.07.2012 KR 20120074315**

(43) Date of publication of application:
15.01.2014 Bulletin 2014/03

(73) Proprietor: **Korea Institute of Geoscience & Mineral Resources**
Yuseong-Gu
Daejeon City (KR)

(72) Inventors:
- **Cheon, Dae-Sung**
  Daejeon (KR)
- **Park, Eui-Sub**
  Gyeonggi-do (KR)
- **Huh, Dae-Gee**
  Daejeon (KR)

(74) Representative: **Colombo, Michel et al**
Brevinnov
310 avenue Berthelot
69008 Lyon (FR)

(56) References cited:
JP-A- 2001 242 259
US-A- 3 859 598
US-A- 5 080 190
US-A- 5 187 332

EP 2 685 287 B1

Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] The present invention relates to a fixture structure configured so as to separate and reuse a micro-seismic sensor insertedly installed in a borehole.

2. Description of the Related Art

[0002] In order to effectively study and prepare for a micro-seismic tremor, it is necessary to accurately sense micro-seismic event at the time of generation of the micro-seismic event and rapidly transmit the observed micro-seismic event data to a data analyzing center.

[0003] A micro-seismic sensor is mainly configured of a micro-seismic motion sensor and a recorder, wherein the micro-seismic motion sensor is classified into a speed meter for measuring a motion speed of a ground and an accelerometer for measuring force of motion.

[0004] The speed meter is classified into a short period sensor, a long period sensor, and a broad band sensor according to a used frequency band. The short period sensor, which is a sensor designed for the purpose of observing a local micro-seismic tremor, has a flat region at a frequency of 1Hz or more. Since the short period sensor has been designed for the purpose of a high frequency signal, it does not accurately sense a long distance micro-seismic tremor. On the other hand, the long period sensor shows a flat response in a low frequency band, such that it is appropriate for sensing a long distance seismic tremor, but has a difficulty in sensing a micro area seismic tremor generated in the vicinity. Since the broad band sensor, which uses a scheme of extending a band of a mechanical short period sensor up to a low frequency using a feedback circuit, may simultaneously record both of the micro area seismic tremor and the long distance seismic tremor, such that it may be appropriately used for studying a seismic tremor. The accelerometer, which is a sensor for sensing strong motion, provides important data in calculating an aseismic design parameter.

[0005] The micro-seismic sensor is classified into a ground surface micro-seismic sensor and an underground micro-seismic sensor according to an installation position thereof. Since the ground surface micro-seismic sensor is installed on a ground surface, it is directly affected by a surrounding environment, such that it may include a large amount of noise. On the other hand, the underground micro-seismic sensor is installed at a point at which it needs to be spatially installed even though an observation environment is not good, such that it may obtain good quality micro-seismic data. In the underground micro-seismic sensor, a scheme of first forming a borehole, temporarily fixing a micro-seismic sensor at a predetermined depth, and then permanently fixing the micro-seismic sensor by grouting is used. Therefore, once the micro-seismic sensor is installed, it may not be reused.

[0006] Prior art is known from : US3859598A, US5187332A, JP2001242259A and US5080190A.

SUMMARY OF THE INVENTION

[0007] The present invention has been made in an effort to provide a fixture structure capable of obtaining good quality micro-seismic data and increasing utilization of a sensor by allowing a micro-seismic sensor installed under the ground to be reused.

[0008] According to an exemplary embodiment of the present invention, there is provided a fixture structure according to claim 1.

[0009] The tube may be formed in a flexible air hose shape.

[0010] The separation unit may include a shear pin installed to be sheared by fluid pressure supplied through the tube.

[0011] The fixture structure may further include a diaphragm installed around the sensor body and having an inner peripheral surface closely adhered to an outer peripheral surface of the sensor body and an outer peripheral surface closely adhered to an inner peripheral surface of the borehole.

[0012] The diaphragm may be made of a rubber material and be formed in a disk shape.

[0013] The diaphragm may have an outer diameter larger than the borehole.

[0014] The fixture structure may further include a cable connected to the sensor body so as to lift the separated sensor body and formed to transmit an electrical signal of the sensor portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIGS. 1 to 3 show a fixture structure 100 for reusing an underground micro-seismic sensor according to an exemplary embodiment of the present invention, wherein FIG. 1 is a cross-sectional view showing a shape of the fixture structure 100 installed in a borehole DW; FIG. 2 is a cross-sectional view showing a state in which fluid pressure is applied to a tube 160 in order to separate the fixture structure 100 of FIG. 1; and FIG. 3 is a cross-sectional view showing a state in which a separation unit 130 is separated by the fluid pressure.

[0016] FIGS. 4 to 6 show a fixture structure 200 for reusing an underground micro-seismic sensor according to another exemplary embodiment of the present invention, wherein FIG. 4 is a cross-sectional view showing a shape of the fixture structure 200 installed in a borehole DW; FIG. 5 is a cross-sectional view showing a state in which fluid pressure is applied to a tube 260 in order to separate the fixture structure 200 of FIG. 4; and FIG. 6 is a cross-sectional view showing a state in which a separation unit 230 is separated by the fluid pressure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Hereinafter, a fixture structure for reusing an underground micro-seismic sensor according to the present invention will be described in detail with reference to the accompanying drawings.

[0018] FIGS. 1 to 3 show a fixture structure 100 for reusing an underground micro-seismic sensor according to an exemplary embodiment of the present invention, wherein FIG. 1 is a cross-sectional view showing a shape of the fixture structure 100 installed in a borehole DW; FIG. 2 is a cross-sectional view showing a state in which fluid pressure is applied to a tube 160 in order to separate the fixture structure 100 of FIG. 1; and FIG. 3 is a cross-sectional view showing a state in which a separation unit 130 is separated by the fluid pressure.

[0019] As shown in FIGS. 1 to 3, the fixture structure 100 according to the present invention is installed at a lower portion of the borehole DW formed from above ground to the underground.

[0020] The fixture structure 100 shown in FIGS. 1 to 3 includes a sensor body 110 having a sensing portion, a first fixture portion 120 and a second fixture portion 125 formed at a lower portion of the sensor body 110, and a separation unit 130 installed between the first fixture portion 120 and the second fixture portion 125. A cable 150 for transmitting a signal of the sensor portion or lifting the sensor body 110 of which separation is completed is connected to one side of the sensor body 110.

[0021] One side of the separation unit 130 is installed with a tube 160 extended toward an inlet of the borehole DW. The tube 160 is connected to a pump P for providing fluid pressure, that is, air pressure, water pressure, or oil pressure from the outside. The tube 160 is configured to supply a fluid from the outside to the sensor body 110 at the time of reuse of the sensor body 110 of which use is completed, thereby separating the sensor body 110.

[0022] The separation unit 130 is formed in a shape in which it may be sheared by the fluid pressure supplied through the tube 160. As a specific example thereof, the separation unit 130 may include a shear pin that may be sheared by the fluid pressure supplied through the tube 160. As the shear pin, a well-known shear pin may be used, and a description of a detailed structure or operation thereof will be omitted.

[0023] Therefore, in the case in which the micro-seismic sensor is to be reused, when a user supplies compressed air from the outside as shown in FIGS. 2 and 3 to supply pressure equal to or larger than reference set pressure, the separation unit 130 is separated from the second fixture portion 125.

[0024] FIGS. 4 to 6 show a fixture structure 200 for reusing an underground micro-seismic sensor according to another exemplary embodiment of the present invention, wherein FIG. 4 is a cross-sectional view showing a shape of the fixture structure 200 installed in a borehole DW; FIG. 5 is a cross-sectional view showing a state in which fluid pressure is applied to a tube 260 in order to separate the fixture structure 200 of FIG. 4; and FIG. 6 is a cross-sectional view showing a state in which a separation unit 230 is separated by the fluid pressure.

[0025] As shown in FIGS. 4 to 6, the fixture structure 200 for reusing an underground micro-seismic sensor according to another exemplary embodiment of the present invention includes a sensor body 210, a first fixture portion 220 and a second fixture portion 225 formed at a lower portion of the sensor body 110, a separation unit 230 installed between the first fixture portion 220 and the second fixture portion 225, and a diaphragm 240 installed around the sensor body 210 and having an inner peripheral surface closely adhered to an outer peripheral surface of the sensor body 210 and an outer peripheral surface closely adhered to an inner peripheral surface of a borehole DW. Also in another exemplary embodiment of the present invention, the separation unit 230 may include a shear pin that may be sheared by external force.

[0026] The diaphragm 240 may have an outer diameter larger than a diameter of the borehole DW. Therefore, when the sensor body 210 mounted with the diaphragm 240 is press-fitted into the borehole DW, the diaphragm 240 is concavely deformed so that a central portion thereof is lower than an edge thereof with respect to the inner peripheral surface of the borehole SW, as shown in FIG. 4.

[0027] In this state, as shown in FIG. 5, when fluid pressure is supplied to the tube 260 through a pump P, expansive force is generated at a lower portion of the diaphragm by the fluid pressure, such that the sensor body 210 is applied with force in a direction in which it is lifted upwardly.

[0028] When fluid pressure equal to or larger than a set pressure is applied, the shear pin of the separation unit 230 is sheared, such that the first fixture portion of the sensor body 210 is separated from the second fixture portion 220. Therefore, the body 210 may be withdrawn to an outer portion of the borehole DW by lifting a cable 250.

[0029] As set forth above, the fixture structure for reusing an underground micro-seismic sensor according to the exemplary embodiment of the present invention includes the separation unit configured to separate the first fixture portion and the second fixture portion from each other by the fluid pressure supplied from the outside, thereby making it possible to easily separate the micro-seismic sensor even in a deep borehole in which it is difficult to use a tool. With the separation method of the micro-seismic sensor as described above, since the micro-seismic sensor may be reused, a cost due to additional installation of the sensor may be reduced.

[0030] The fixture structure for reusing an underground micro-seismic sensor as described above is not limited to the configurations and the methods of the above-mentioned exemplary embodiments. All or some of the above-mentioned exemplary embodiments may also be selectively combined with each other so that various modifications may be made.

Claims

1. A fixture structure (100,200) for reusing an underground micro-seismic sensor, comprising:

   a sensor body (110,210) configured to be inserted in a borehole and having a sensing portion for sensing micro seismic event;
   a first fixture portion (120,220) formed at one surface of the sensor body;
   a second fixture portion (125,225) coupled to the first fixture portion and configured to be fixed to a grouting member injected into the borehole,
   characterized in that the fixture structure further comprises
   a separation unit (130,230) installed between the first fixture portion and the second fixture portion and configured to separate the first fixture portion and the second fixture portion from each other by external force; and
   a tube (160,260) connected to the separation unit and installed to be extended toward an inlet of the borehole.

2. The fixture structure of claim 1, wherein the tube (160,260) is a flexible air hose.

3. The fixture structure of claim 1, wherein the separation unit (130) includes a shear pin installed to be sheared by fluid pressure supplied through the tube.

4. The fixture structure of claim 1, further comprising a diaphragm (240) installed around the sensor body and having an inner peripheral surface closely adhered to an outer peripheral surface of the sensor body and an outer peripheral surface closely adhered to an inner peripheral surface of the borehole.

5. The fixture structure of claim 4, wherein the diaphragm (240) is made of a rubber material and is formed in a disk shape.

6. The fixture structure of claim 5, wherein the diaphragm (240) has an outer diameter larger than the borehole.

7. The fixture structure according to any one of the preceding claims, further comprising a cable (150,250) connected to the sensor body so as to lift the separated sensor body and formed to transmit an electrical signal of the sensor portion.

Patentansprüche

1. Befestigungsstruktur (100, 200) zur Wiederverwendung eines unterirdischen Mikroerdbebensensors, umfassend:

   einen Sensorkörper (110, 210), konfiguriert, um in ein Bohrloch eingesetzt zu werden und mit einem Erfassungsabschnitt zum Erfassen eines Mikroerdbebenereignisses;
   einen ersten Befestigungsabschnitt (120, 220), an einer Oberfläche des Sensorkörpers ausgebildet;
   einen zweiten Befestigungsabschnitt (125, 225), an den ersten Befestigungsabschnitt gekoppelt und konfiguriert, an einem in das Bohrloch eingespritzten Einspritzglied befestigt zu werden,
   dadurch gekennzeichnet, dass die Befestigungsstruktur weiterhin eine Trenneinheit (130, 230) umfasst, die zwischen dem ersten Befestigungsabschnitt und dem zweiten Befestigungsabschnitt installiert und konfiguriert ist zum Trennen des ersten Befestigungsabschnitts und des zweiten Befestigungsabschnitts voneinander durch externe Kraft;
   und ein Rohr (160, 260), mit der Trenneinheit verbunden und installiert zum Erweitertwerden zu einem Einlass des Bohrlochs.

2. Befestigungsstruktur nach Anspruch 1, wobei das Rohr (160, 260) ein flexibler Luftschlauch ist.

3. Befestigungsstruktur nach Anspruch 1, wobei die Trenneinheit (130) einen Scherstift enthält, der installiert ist, um durch durch das Rohr zugeführten Fluiddruck geschert zu werden.

4. Befestigungsstruktur nach Anspruch 1, weiterhin umfassend eine Membran (240), um den Sensorkörper herum installiert und mit einer Innenumfangsoberfläche, die eng an einer Außenumfangsoberfläche des Sensorkörpers haftet, und eine Außenumfangsoberfläche, die eng an einer Innenumfangsoberfläche des Bohrlochs haftet.

5. Befestigungsstruktur nach Anspruch 4, wobei die Membran (240) aus einem Kunststoffmaterial besteht und zu einer Scheibenform ausgebildet ist.

6. Befestigungsstruktur nach Anspruch 5, wobei die Membran (240) einen Außendurchmesser besitzt, der größer ist als das Bohrloch.

7. Befestigungsstruktur nach einem der vorhergehenden Ansprüche, weiterhin umfassend ein Kabel (150, 250), mit dem Sensorkörper verbunden, um den getrennten Sensorkörper anzuheben, und ausgebildet zum Übertragen eines elektrischen Signals des Sensorabschnitts.

Revendications

1. **1.** Structure de fixation (100,200) pour la réutilisation d'un capteur micro-sismique souterrain, comprenant :

   un corps de capteur (110,210) configuré pour être inséré dans un puits de forage et comportant une partie de détection pour détecter un événement micro-sismique ;
   une première partie de fixation (120,220) formée au niveau d'une surface du corps de capteur ;
   une seconde partie de fixation (125,225) couplée à la première partie de fixation et configurée pour être fixée à un élément de cimentation injecté dans le puis de forage,
   caractérisée en ce que la structure de fixation comprend en outre
   une unité de séparation (130,230) installée entre la première partie de fixation et la seconde partie de fixation et configurée pour séparer la première partie de fixation et la seconde partie de fixation l'une de l'autre par une force externe ; et
   un tube (160,260) connecté à l'unité de séparation et installé pour être étendu vers une entrée du puis de forage.

2. Structure de fixation selon la revendication 1, dans laquelle le tube (160,260) est un tuyau d'air souple.

3. Structure de fixation selon la revendication 1, dans laquelle l'unité de séparation (130) comporte une goupille de cisaillement montée pour être cisaillée par la pression de fluide exercée à travers le tube.

4. Structure de fixation selon la revendication 1, comprenant en outre un diaphragme (240) installé autour du corps de capteur et présentant une surface périphérique interne qui adhère étroitement à une surface périphérique externe du corps de capteur et une surface périphérique externe qui adhère étroitement à une surface périphérique interne du puits de forage.

5. Structure de fixation selon la revendication 4, dans laquelle le diaphragme (240) est réalisé en un matériau de caoutchouc dans la forme d'un disque.

6. Structure de fixation selon la revendication 5, dans laquelle le diaphragme (240) a un diamètre extérieur supérieur à celui du trou de forage.

7. Structure de fixation selon l'une quelconque des revendications précédentes, comprenant en outre un câble (150,250) connecté au corps de capteur de manière à lever le corps de capteur séparé et formé pour transmettre un signal électrique de la partie de capteur.

FIG. 1

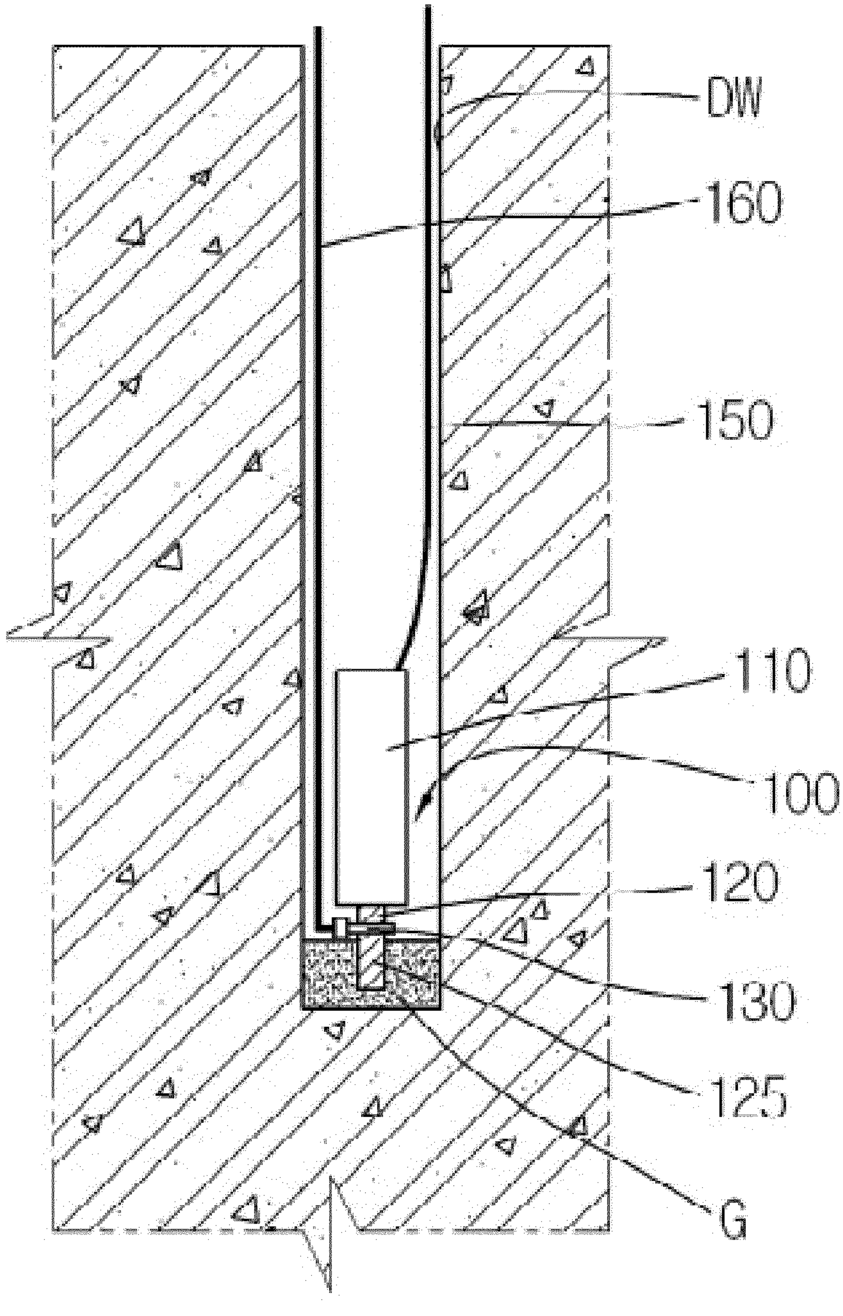


FIG. 2

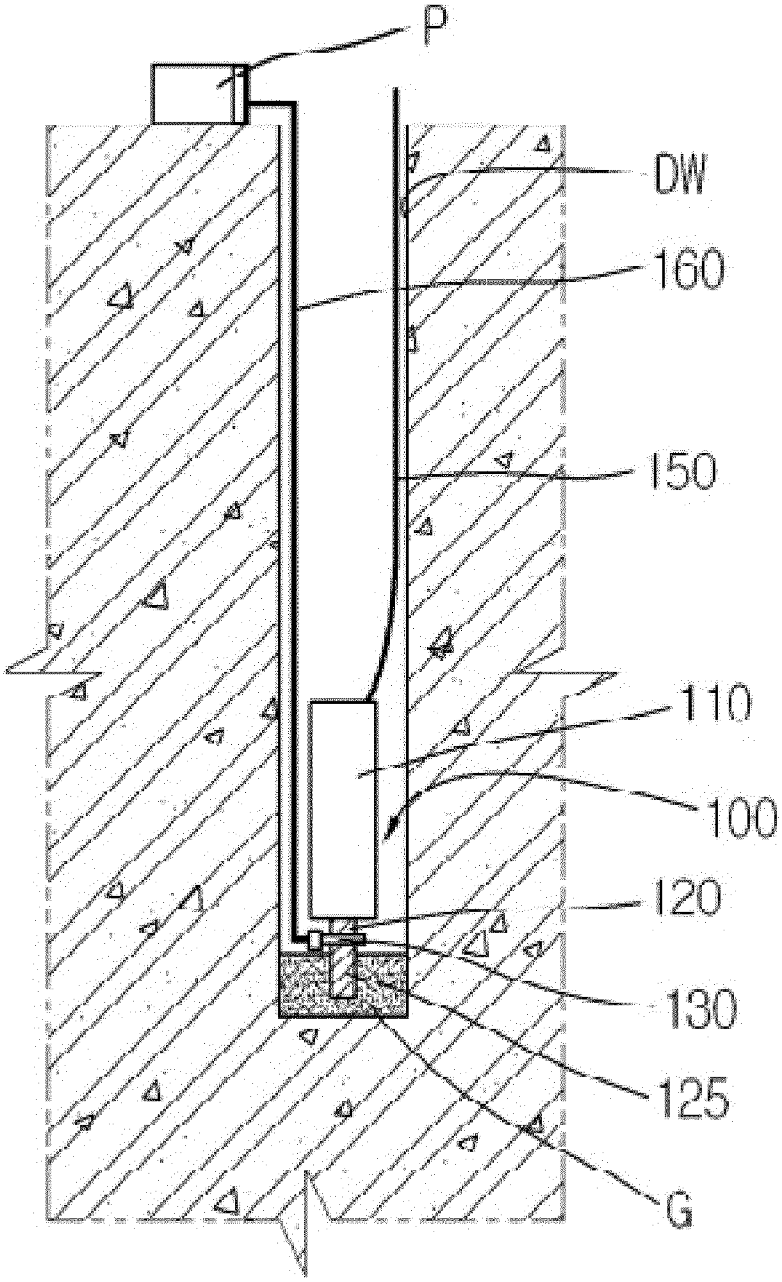


FIG. 3

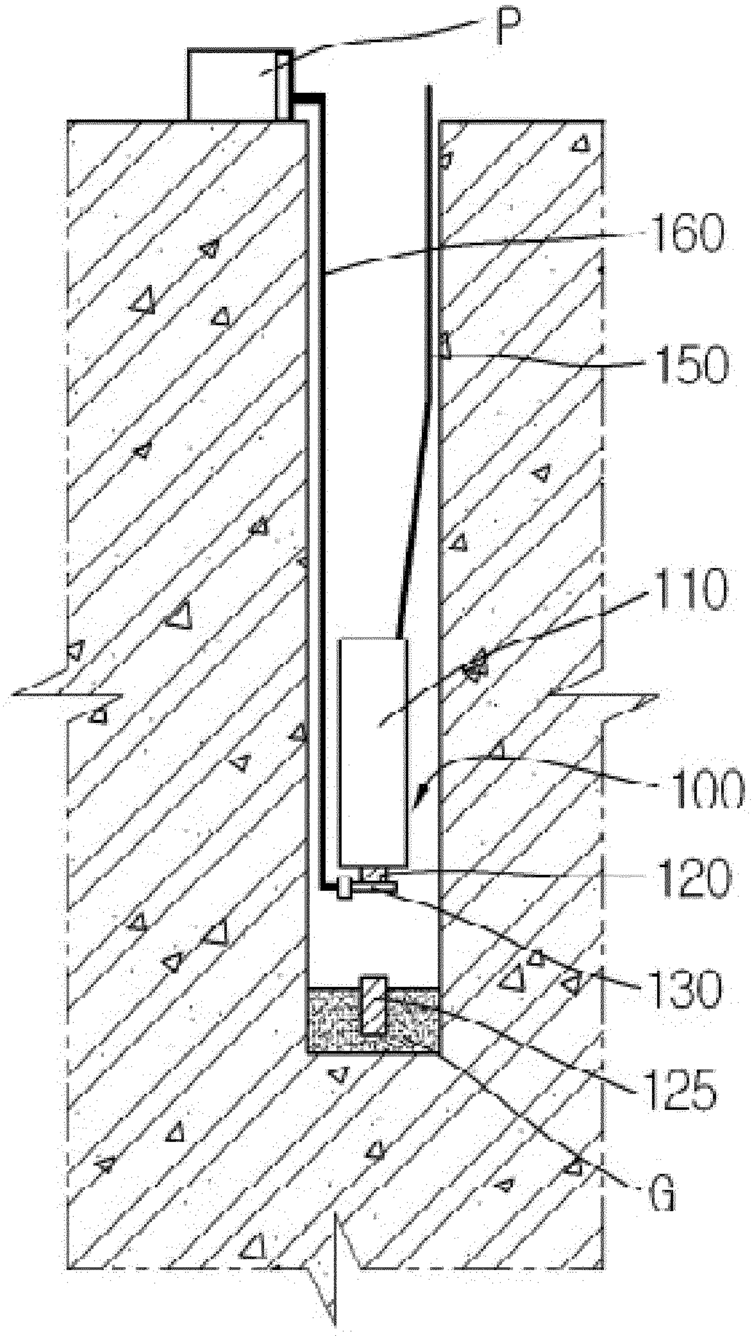


FIG. 4

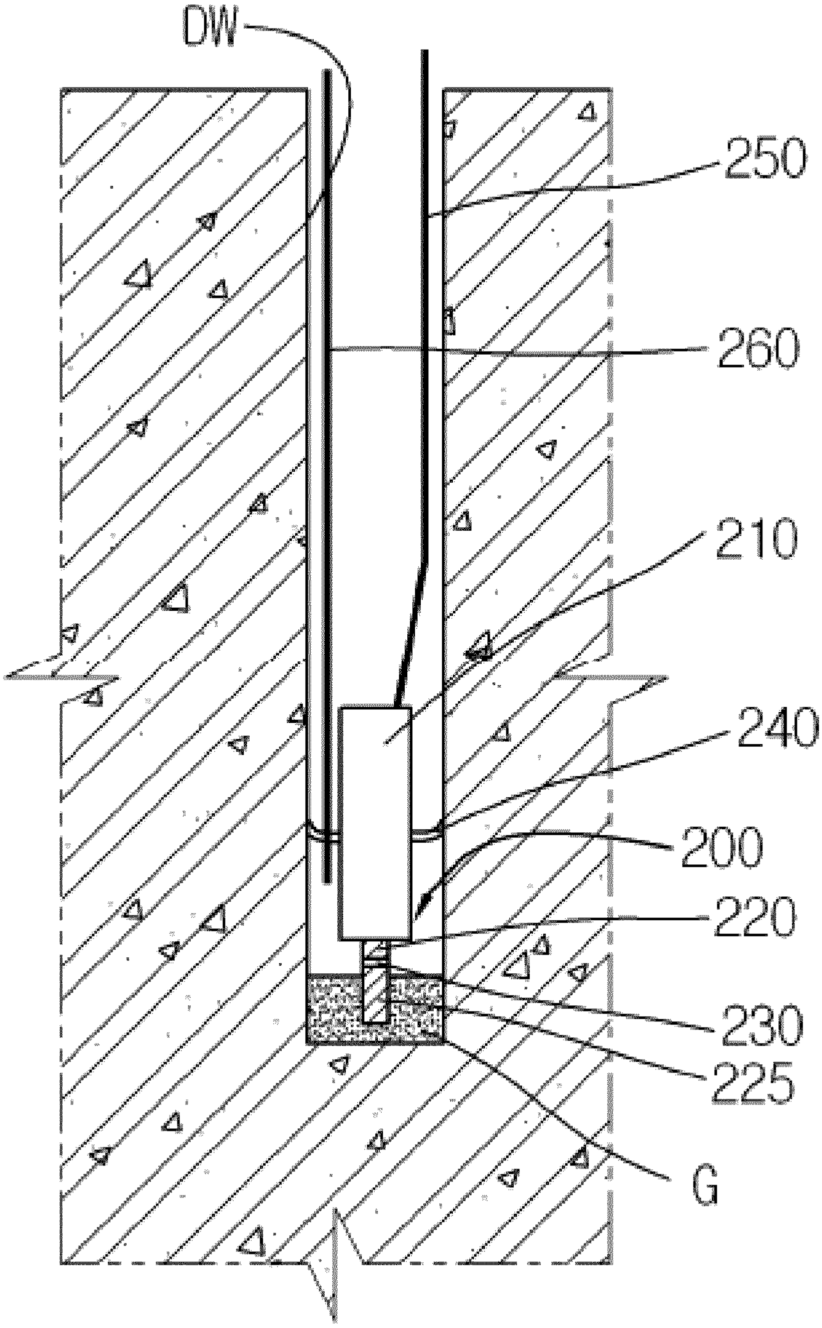


FIG. 5

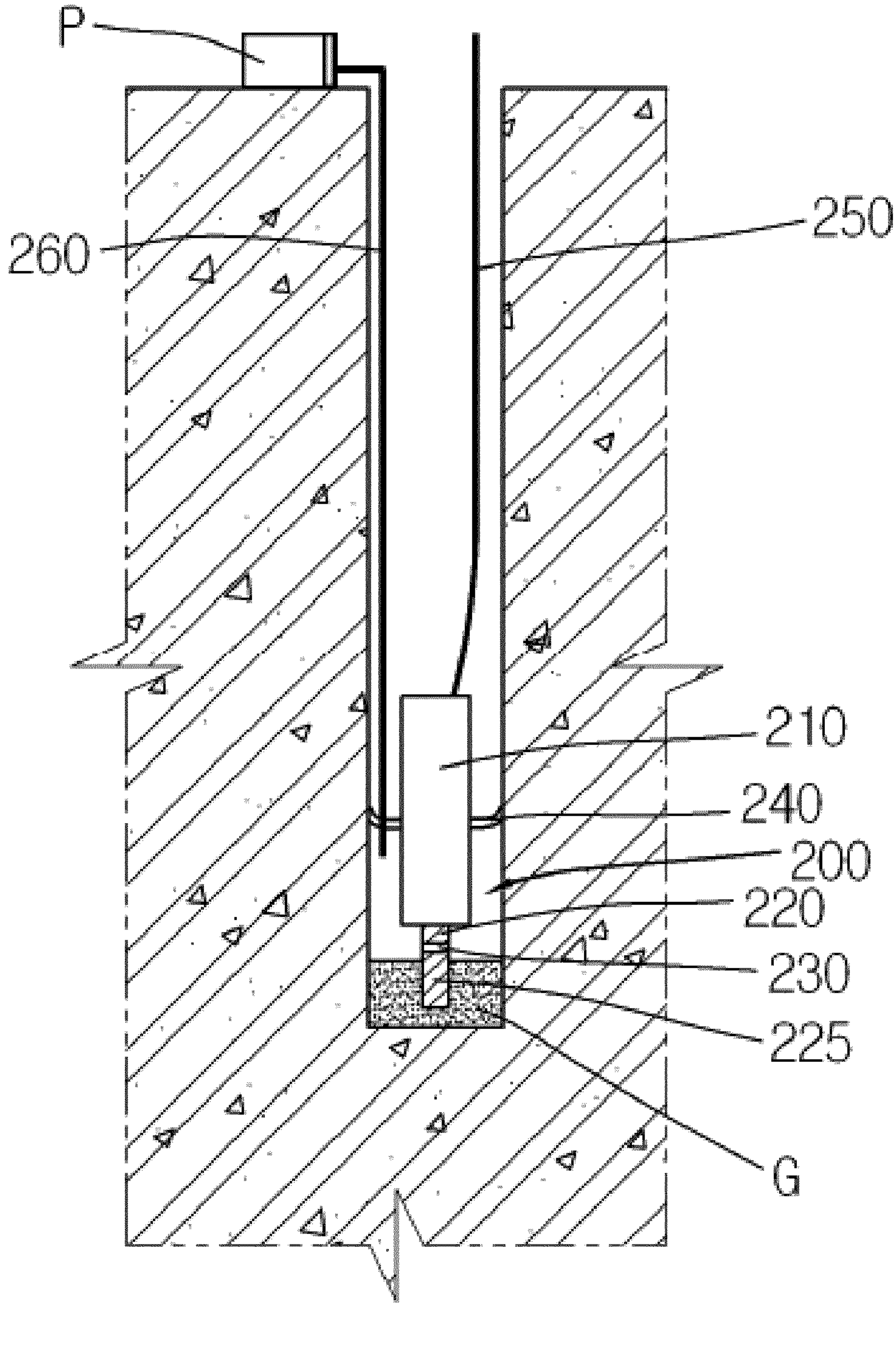
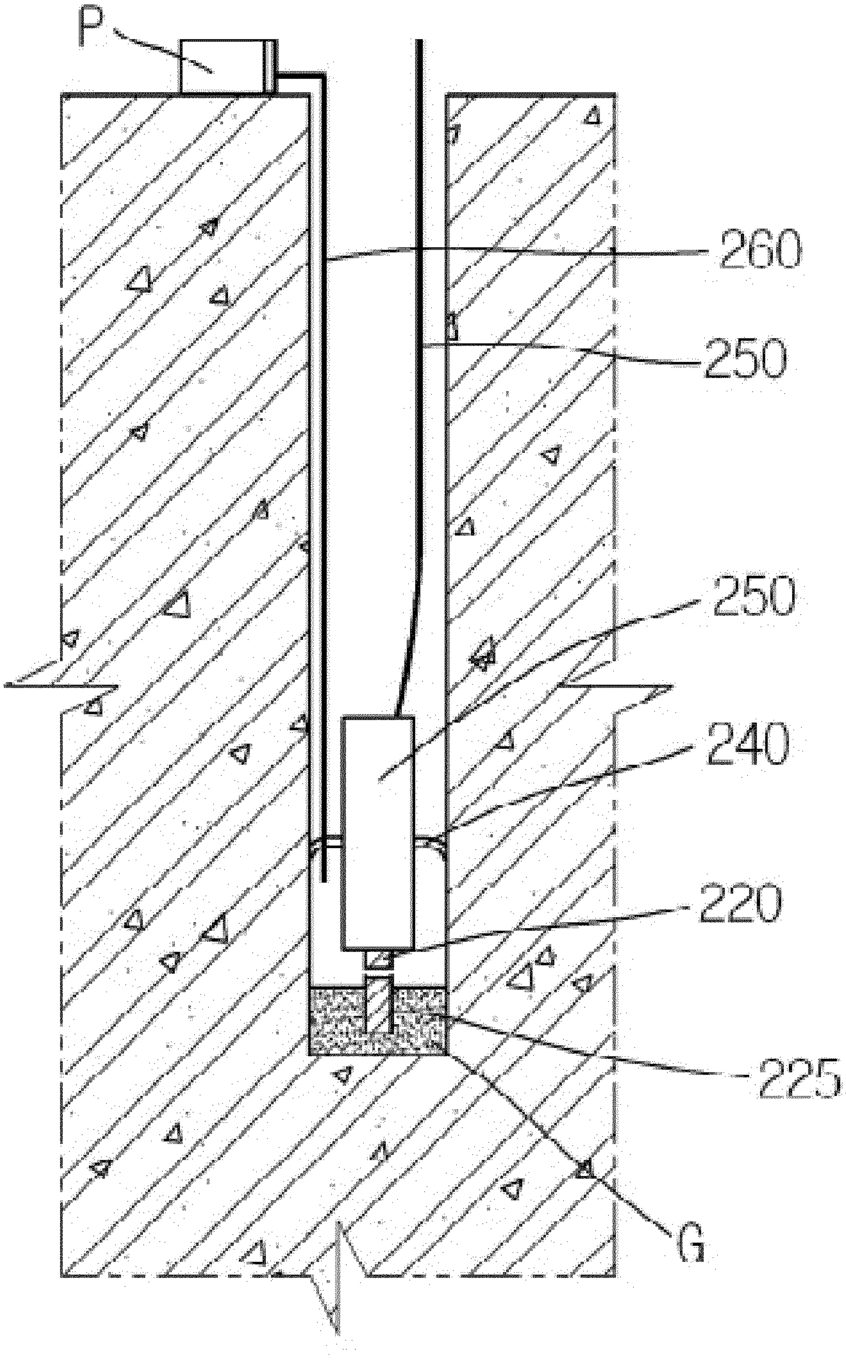


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 3859598 A **[0006]**
- US 5187332 A **[0006]**
- JP 2001242259 A **[0006]**
- US 5080190 A **[0006]**