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(54) METHOD FOR MAKING TUNNELS OR PERFORATIONS IN CIVIL ENGINEERING WORKS USING SACRIFICIAL TUNNELS

(57) Method for making tunnels or perforations in civil engineering works using sacrificial tunnels. This invention concerns the excavation of sacrificial tunnels to reduce or eliminate the need to use supporting elements in the construction of any tunnel. Accordingly a method is provided to make tunnels or perforations in civil engineering works to reduce or eliminate the use of supporting elements for earth or solid rock, characterized by the creation of a sacrificial tunnel, such that this sacrificial tunnel deforms by taking on the stresses and deformations caused by the weight of the earth and preventing transmission thereof to the main tunnel. The sacrificial tunnel, which may be used in conjunction with others, must in any case have a smaller diameter than the main tunnel and be located at a specific distance above the keystone of the main tunnel.

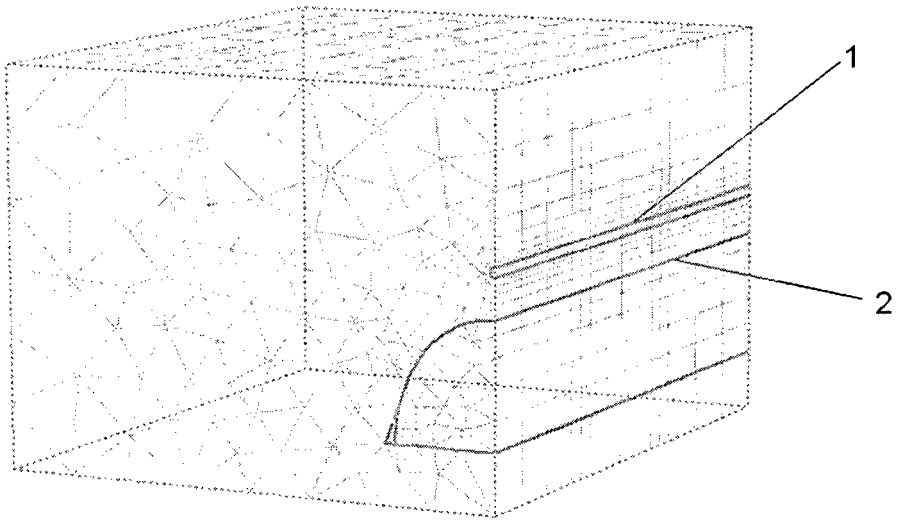

Figure 2

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Description

Field of the invention

[0001] The invention falls within the technical sector of the creation of tunnels and perforations for making linear construction projects, whether road, railroad, mining, communication, and goods transport tunnels, and all those related with perforations for the extraction of gases or combustible (solid or liquid) materials.

Background of the invention

[0002] The creation of the different types of tunnels and perforations in civil engineering works is carried out mainly in earth of solid rocks with low bearing capacity or high deformability, where a whole of systems annexed to the main excavation takes place and they serve as support of the earth or solid rock in which the excavation is made.

[0003] As an anchor and support mechanism solid bolts are used normal to the direction of advance of the main tunnel, they can be grouped in structures of bolt umbrella or fiberglass bolts located on the advancing front, achieving the supporting of the structure when reducing stresses and deformations (horizontal and vertical) that occur during the excavation works, caused by the weight of the earth or solid rock located above the excavation site, assuming these materials part of stress and deformation states of the work.

[0004] Regardless of the constructive procedure considered for the creation (German, Belgian, new Austrian method, tunnel boring machine in different formats), the bolts are very important elements in the above-defined sector, since their correct sizing allows a proper realization of the work, avoiding partial or complete collapses of both the advancing front and the part already excavated. Currently, this whole set of annexed systems needs for its creation both a complex equipment of work and high budget rates.

[0005] The aim would be to reduce stresses and deformations values in the main tunnel, moderating and eliminating in turn the need to use systems annexed to the same and thus decreasing both the time-frame for construction and the budget rates intended for that purpose, allowing an increase in safety during the realization of the works.

Explanation of the invention

[0006] The present invention focuses on the creation of one or several tunnels or perforations (called tunnel or sacrificial tunnels) with section circular and small diameter and located concentrically at some distance from the main tunnel or perforation, they can be coated or not, such that they assume stresses and deformations (horizontal and vertical) caused by the earth strata or solid rocks located above the main tunnel or perforation.

Brief description of the drawings

[0007] In the event that the sacrificial tunnel (1) is unique, as shown in figures 1 and 2, the sacrificial tunnel (1) is located above the vertical of the keystone of the main tunnel (2), at a distance of between 30% and 50% of the height of the latter, and with a diameter of between 10% and 20% of the height of the main tunnel, keeping the axis of the sacrificial tunnel parallel to the axis of the main tunnel.

Figure 1
Cross section of a tunnel in any section of earth, made with semicircular shape with elephant leg in the support area, being represented only and because of symmetry, the left side of the work. Above the keystone of the main tunnel (2), is located the sacrificial tunnel (1), in order to assume part of the stress and deformational state of the earth above it to the zero height of the same.

Figure 2
Cross-longitudinal section of the same tunnel shown in Figure 1, in which can be seen as the sacrificial tunnel (1) is parallel to the main tunnel (2), at a distance defined above the keystone of the latter.

Detailed description of the invention

[0008] The sacrificial tunnel (1), located in the vertical or in the vicinity of the keystone of the main tunnel or perforation, will be in circular section acting similarly to a sacrificial anode for the protection of corrosive processes, being responsible for taking the stresses and deformations due to the existence of the different earth strata or solid rocks located above the main tunnel or perforation, being deformed under these loads and thus avoiding that they are transmitted to the main section of the tunnel or perforation.

[0009] To do this, and depending on the mechanical and resistance characteristics of the earth or solid rock on which the works are carried out, the sacrificial tunnel (1) must be made prior to the main tunnel or perforation and by suitable mechanical methods during the excavation, being considered the best possible solution to its subsequent coating, in terms of the type of earth or solid rock object of the excavation works.

[0010] Numerical models carried out on different types of earth and rocky materials show that the diameter of the sacrificial tunnel (1) must have a value of between 10% and 20% of the height of the main tunnel (2) (or in the case of perforations, of the diameter of the same), being coated with hollow steel tube, gunite or hollow concrete, hollow glass fiber or geogrid with low transverse stiffness. In the event that the sacrificial tunnel (1) is unique, the results of numerical models carried out demarcate that it must be located at a distance from the keystone of the main tunnel (2) of between 30% and 50%

of the height of the main tunnel or perforation; in the case of considering the need that they are several, they will be distributed in a horizontal plane symmetrically with respect to a vertical plane containing the guideline of the main tunnel (2) and the keystone of the same.

Exemplary embodiment

[0011] The present invention is further illustrated by the following two examples, which are not intended to be limiting of its scope:

Example 1

[0012] The main tunnel of 6 m in height (with semicircular section and elephant leg in the lower sides) and coating of gunite, is located in an earth of low bearing capacity, the sacrificial tunnel is a concrete circular hollow tube with high transverse stiffness (EI = 2,25.104 KN.m^2/m), located on the vertical of the keystone of the main tunnel, 2.50 meters above the keystone and with a radius of 0.25 meters.

Example 2

[0013] In an area with high deformation capacity, the main tunnel is 6 meters in height (with semicircular section and elephant leg in the lower sides) and coating of gunite. The sacrificial tunnel would be in circular section of steel hollow tube with low transverse stiffness (EI = 1000 KN.m^2/m), located on the vertical of the keystone of the main tunnel, 2 meters above the keystone and with a radius of 0.35 meters.

Claims

1. Method for making tunnels or perforations in civil engineering works to reduce or eliminate the use of supporting systems for earth or solid rock, **characterized by** the creation of a sacrificial tunnel, with a diameter of between 10% and 20% of the height of the main tunnel, and at the vertical of the keystone of the main tunnel at a distance of between 30% and 50% of the height of the main tunnel.

2. Method according to the claim 1, where the sacrificial tunnel is coated with hollow steel, gunite or hollow concrete, hollow glass fiber or geogrid.

3. Method according to previous claims, where there are several sacrificial tunnels, located in a horizontal plane of symmetrically shape with respect to a vertical plane containing the guideline of the main tunnel and the keystone of the same.

4. Use of method according to the claim 3 to reduce the stress state and deformations affecting the main tunnel during its creation.

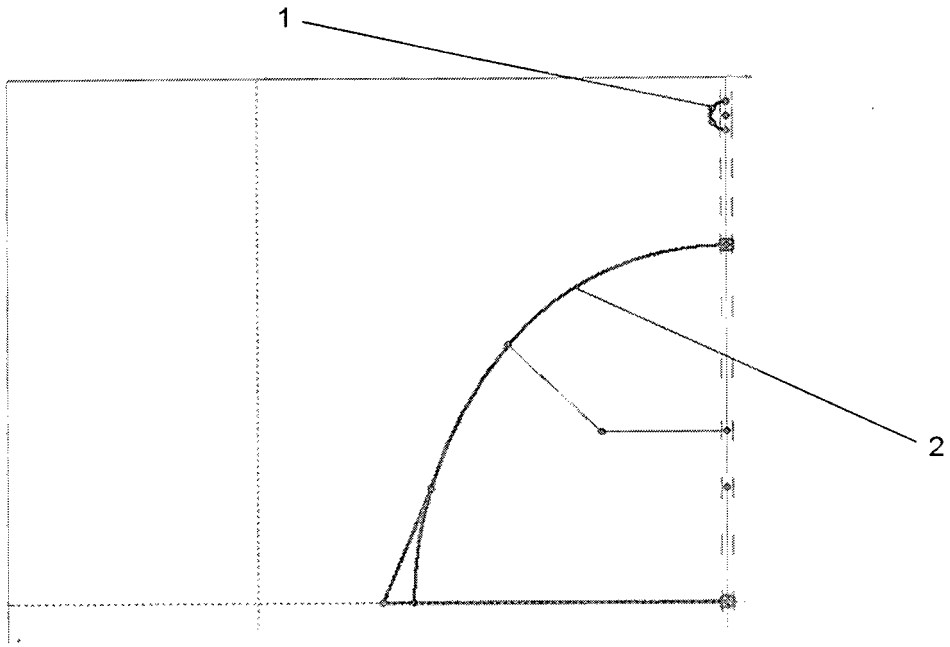

Figure 1

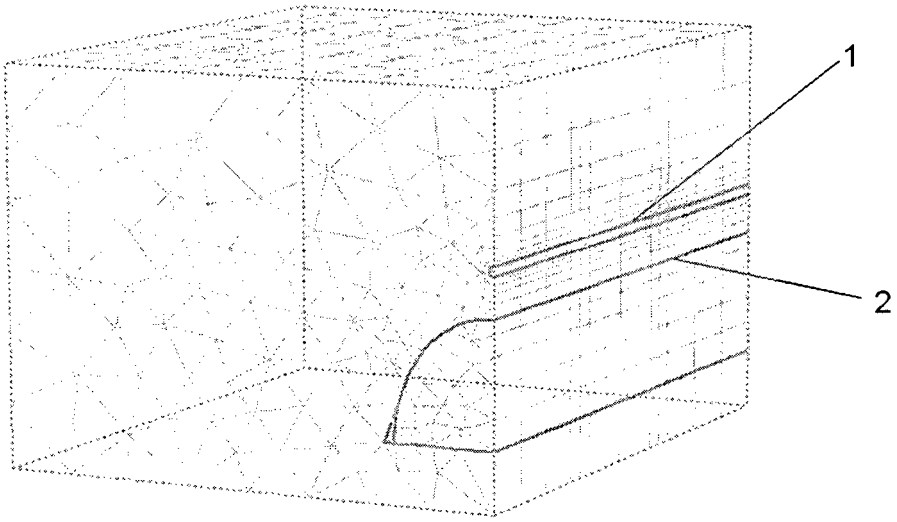

Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2010/000499

A. CLASSIFICATION OF SUBJECT MATTER

E21D13/02 (01.01.2006)
E21D9/04 (01.01.2006)
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)
E21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 6520718 B1 (NAGATOMO SHIGEKI ET AL.) 18/02/2003, column 2, lines 28-31; figures	1
A	JP 2005200992 A (OHBAYASHI CORP) 28/07/2005, figures & Abstract from DataBase EPODOC. Retrieved from EPOQUE; AN JP-2004010081-A	1
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance.
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07/03/2011	**(10/03/2011)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer F. Calderón Rodríguez Telephone No. 91 3495322

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2010/000499

C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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