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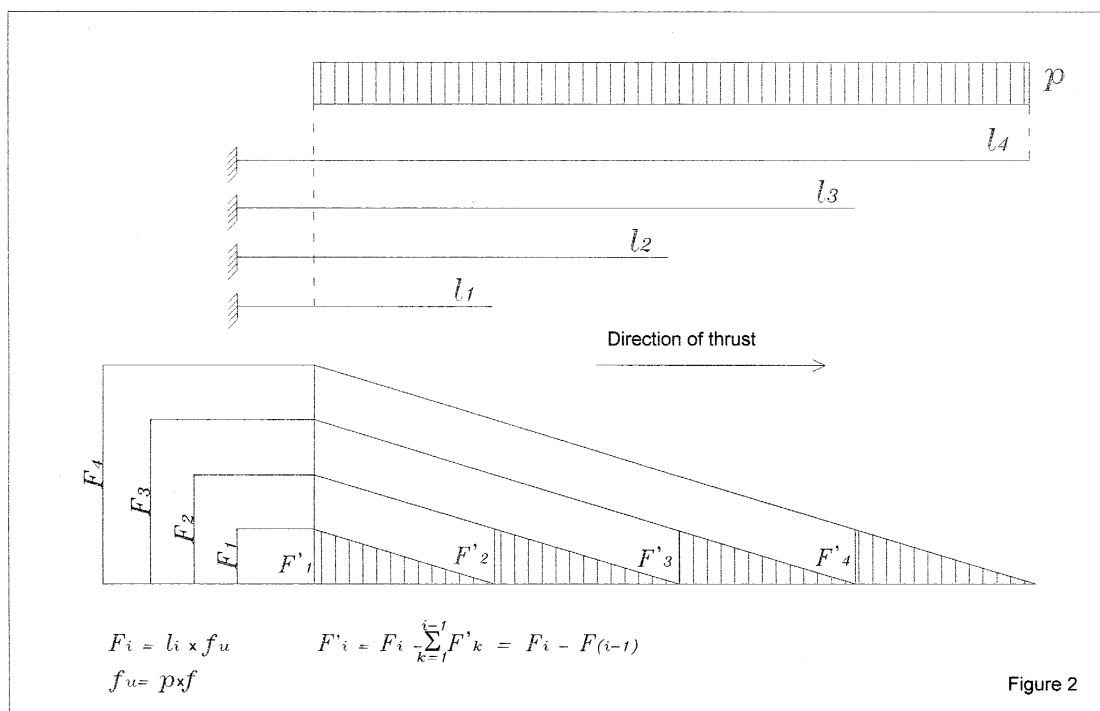
(54) **System for the execution of monolithic constructions deployed by penetration**

(57) New system which permits the easy realization of large monolithic construction works characterised by considerable length and/or by a considerable covering thickness, to be executed by an oleodynamic-thrust enabled penetration. This system employs devices capable of splitting up and reducing the forces which originate during penetration into several components and of releasing them onto the ground. Each device consists of:

mounted onto the monolith to be driven in and which are capable of containing a large number of sliding belts in order to satisfy any kind of technical need

□ Special multiple clamps capable of effectively constraining the fixed end of the sliding belts and of releasing to ground the overall generated forces acting on each belt.

□ Steel made sectional modules, which can be



Description

[0001] The invention described hereby concerns an innovative system which permits the easy execution, by means of an oleodynamic thrust-enabled penetration, of large-sized subways characterised possibly by a considerable length or by a thick ground covering. These are particular, yet recurrent, situations in which demanding problems arise especially as a consequence of

- the need of crossing either large railway stations, large roads or several parallel railway tracks or roads.
- the need of building subways with a considerably thick covering (i.e. when a big elevation gap exists between the level of crossed road and the extrados of the crossing monolith.)

[0002] The two requirements may also arise simultaneously.

[0003] The first need requires a very long monolith to be thrust into the ground (usually ranging from 30m to 100m). The second one implies that extremely high unit loads are exerted on the monolith during penetration.

[0004] Both problems imply extreme operating conditions, which not only cannot be overcome by traditional systems but even overcome the performances obtained by the oleo-dynamic thrust-enabled penetration system (Italian Patent n. 01303651) by the same author, named I.S.T.R.I.C.E., whose scheme is located in the upper area of Figure 1.

[0005] In fact the resultant of the friction forces acting on each sliding belt used by this system increases proportionally with the length of the monolith to be thrust and with the covering thickness, until the belt reaches its operative limits. This circumstance determines the maximum possible penetration length of a single-part monolith, obtained using the I.S.T.R.I.C.E., which for normal coverings ranges from 20m to 25m.

[0006] The invention described herewith provides a solution to the technical problems previously illustrated as it allows one to perform the excavation of long tunnels/subways, possibly located under a thick covering, in a single turn without dividing the execution and the monolithic module into parts since it brings the extreme operating conditions, typical of these cases, down to the normal operating levels typical of the so called normal operating situations. The system is based on a special device for the easy execution of large-sized constructions, subject of the invention presented hereby, conceived to split and reduce the forces acting on each sliding belt during the penetration so that each belt is subject to a smaller stress than the one that it would be subject to depending on the penetration length, on the covering thickness and other external loads.

[0007] If, for example the penetration length of the monolith is 100m, the aforementioned device is such

that the force acting on each single belt is not the high intensity force which would be exerted on the monolith when the device is not used, rather it is a smaller force corresponding to the one the monolith would be subject to if the penetration length were 10m or 20m only (or other measure depending on the number of additional belts set on the device).

[0008] Similarly, even if the covering were 10 m thick, the device would make each single belt to be subject to a stress equivalent to the one generated by a 1m or 2m thick (or other size, correspondingly to the tuning of the device) covering.

[0009] The bottom of Figure 1 gives a schematic representation of the system, where the segments denoted as l_i represent the belts. (In this example a series of 4 belts only, with length denoted as l_i , each one overlapping the subsequent one and all of them subject to a vertical load p ; note that, for the sake of simplicity, we consider each belt free to slide with respect to the other.)

[0010] It turns out immediately that if the belt, with length l_4 , were the only one acting during the penetration of the monolith (or in other words, if the other underlying belts were missing), then it would be subject to an overall force $F_4 = l_4 \times f_u$, with $f_u = p \times f$, where f is the friction coefficient arising in the contact between the monolith and the belt. However when the underlying belt l_3 is used, the overall force acting on belt l_4 reduces to $F_4 = F_4 - F_3$ with $F_3 = l_3 \times f_u$. Similarly belt l_3 will be subject to a force reduced from F_3 to $F_3 = F_3 - F_2$ when belt l_2 is applied and so forth. A greater number of belts can be deployed according to specific needs.

[0011] The graphic scheme represented in the Figure 2, shows clearly the way in which the system splits the force acting on the belts so that the force acting on the generic belt l_i is no longer $F_i = l_i \times f_u$, rather it is a reduced force $F_i = F_i - F_{i-1}$.

[0012] As far as its construction is concerned, the system is realised by using one or more devices mounted on the structure to be thrust. Each device is composed mainly by two elements, as represented in the bottom of Figure 1. The first element is a steel-made modular unit that can be mounted in the monolith to be thrust and contains the metallic belts (the number and length of which are to be selected accordingly to the specific case) that bear and split the friction forces and carry out all the functions already described. The second element is the junction connected to the fixed end of the belts, necessary to release to ground all the forces acting on each belt.

[0013] Figure 1 represents one possible realisation scheme of all the elements of the device. The design itself shows that the layout of the sliding belts is particularly fit also to effectively protect them from accidental breakdowns during the penetration of the monolith, thus guaranteeing an increased security level.

Claims

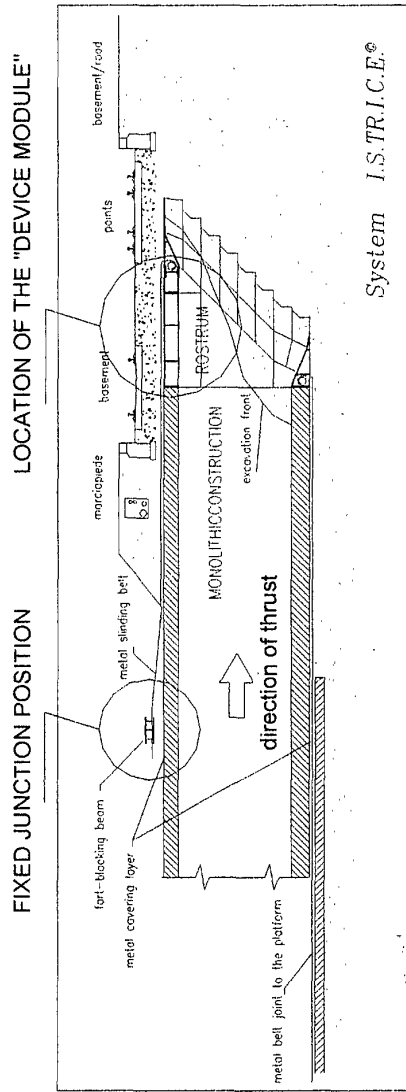
1. System for the realization of extensive construction works to be accomplished using on-site prefabricated modules deployed by plunging them into the ground. 5
2. System aimed to easily plunge very long monolithic modules without splitting them and without installing intermediate thrust stations 10
3. System aimed to easily plunge monolithic modules subject to heavy loads during the inward penetration, due to a thick ground covering located over the module's extrados. 15
4. System using devices aimed to split and reduce the forces which originate during the penetration and for releasing such forces to ground. 20
5. Device consisting of steel-made sectional modules suitable to be mounted on the monolith to be plunged and capable of containing many sliding belts, so to satisfy every possible necessity that may rise in any specific situation. 25
6. Device consisting of multiple elements capable of clamping efficiently the fixed end of the sliding belts and of releasing the set of the forces acting on each belt to ground. 30
7. Device particularly suited to obtain an efficient protection level of the sliding belts from external damages thus resulting in high safety level against accidental breakdowns. 35

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"DEVICE"

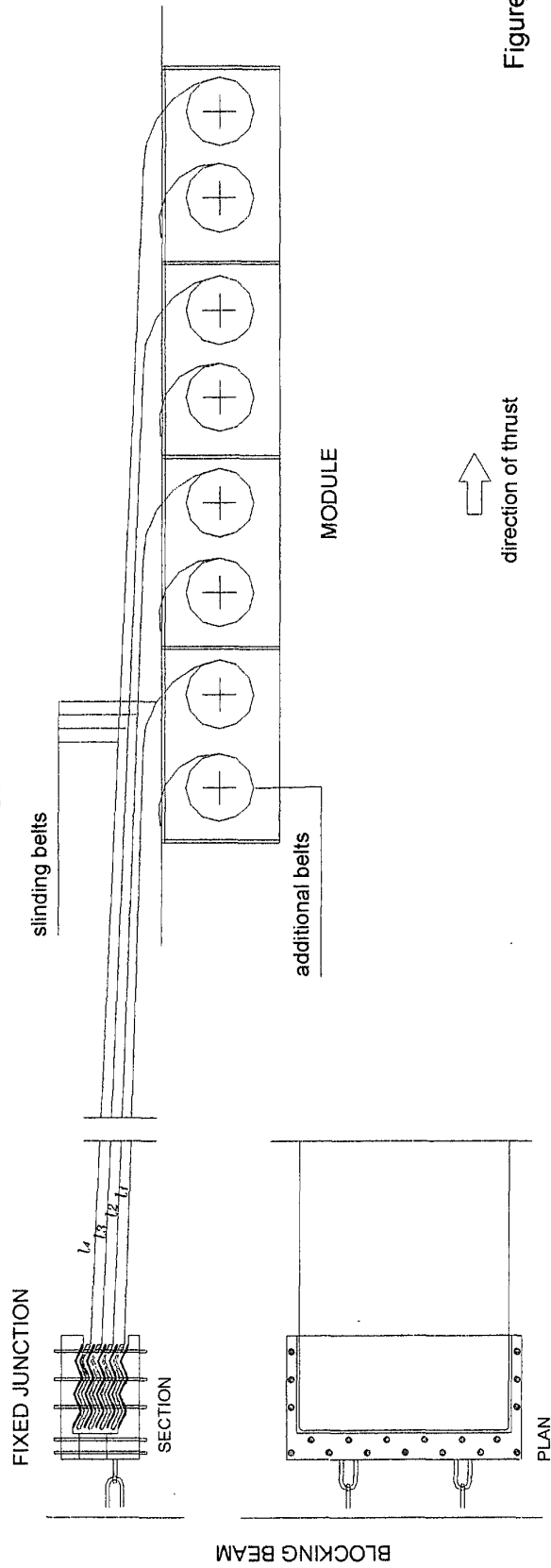
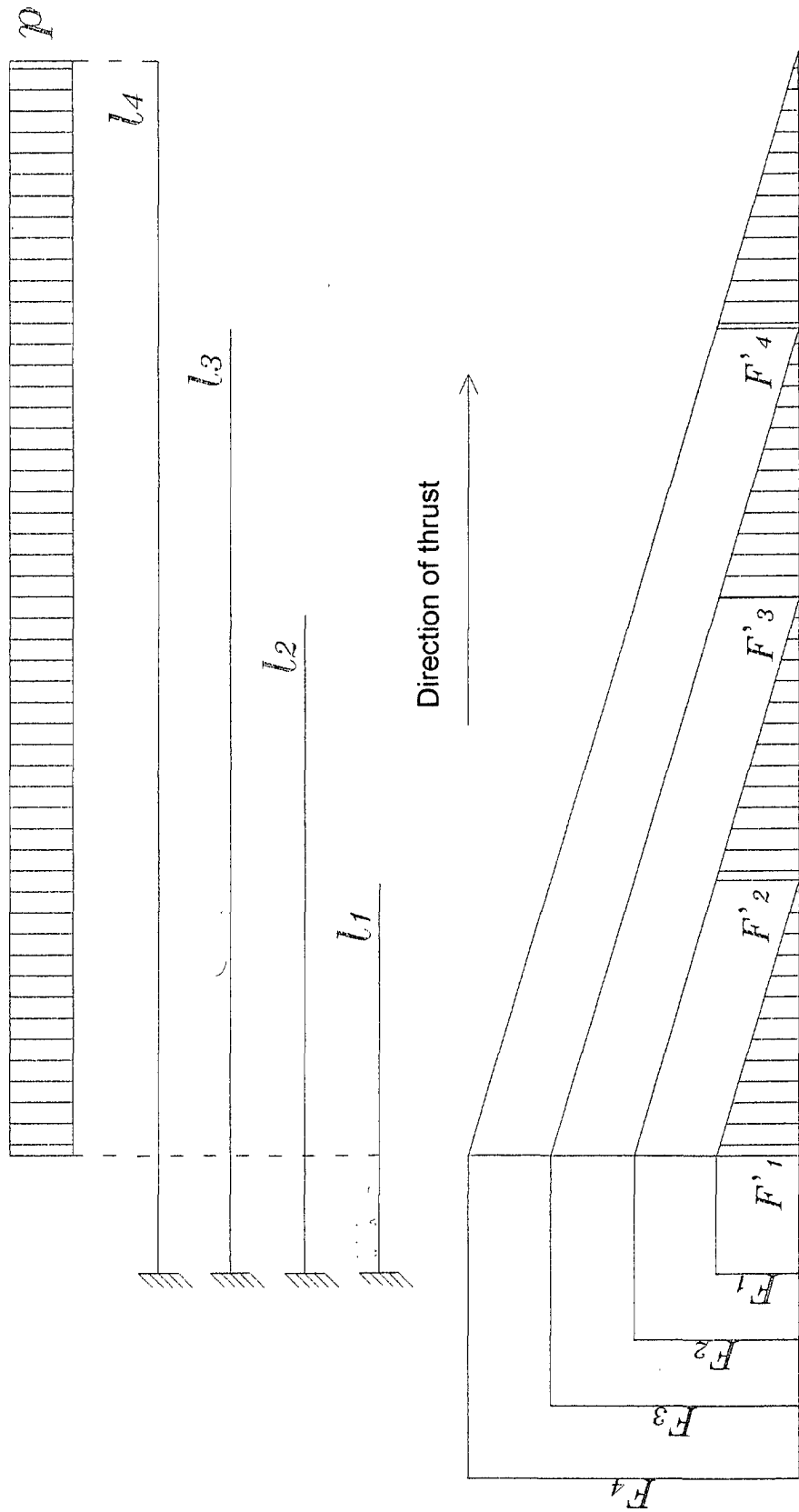


Figure 1



$$F_i = l_i \times f_u \quad F'_i = F_i - \sum_{k=i}^{i-1} F'_k = F_i - F_{(i-1)}$$

$$f_u = p \times f$$

Figure 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 83 0391

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.7)
X	BE 821 978 A (BATEN) 3 March 1975 (1975-03-03)	1-5, 7	E02D29/055 E21D9/00
A	* page 1, line 6 - page 3, line 5; figure 1 *	6	
X	--- CICORA F A: "INNOVATING SYSTEM FOR INFIXING UNDERPASS REINFORCED CONCRETE STRUCTURE BELOW RAILWAY LINES, OPERATING WITHOUT AUXILIARY TEMPORARY BRIDGES AND BEAMS" WORLD CONGRESS ON RAILWAY RESEARCH, XX, XX, 15 November 1997 (1997-11-15), page 1 XP000198991 * page 1 *	1-3	
X	--- GB 2 317 405 A (J MURPHY & SONS LIMITED) 25 March 1998 (1998-03-25) * page 4, line 19 - page 5, line 23; figures 1, 2 *	1, 3	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			E02D E21D E01F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 2 November 2001	Examiner Kergueno, 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			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 83 0391

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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02-11-2001

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