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(54) Title: SEMI-SUBMERGED BREAKWATER BARRIER RAISED FROM SEA BOTTOM

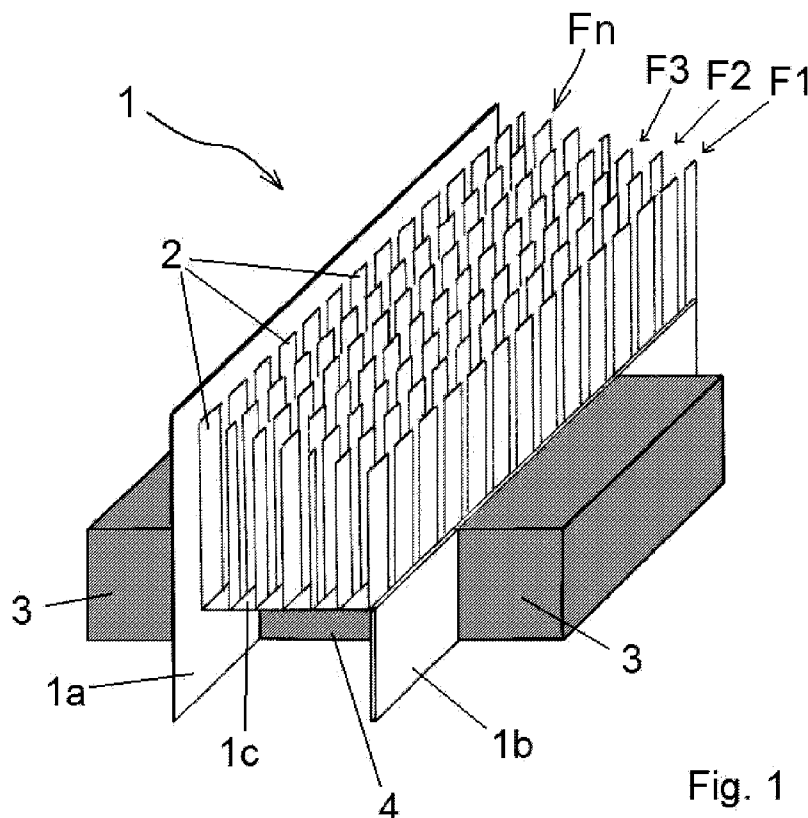


Fig. 1

(57) Abstract: The present invention relates to a semi-submerged breakwater barrier (1) designed to be suspended in the water with respect to the bottom of the water surface where it is installed, in such a way not to interfere with the normal flow of currents under it. The barrier comprises multiple parallel rows formed by staggered lamellar elements (2) which are protruding from a base plate and have an increasing height from the front to the back of the barrier. The barrier comprises support means (3-7) for holding the barrier in semi-submerged position.

Description**Semi-submerged breakwater barrier raised from sea bottom.**

The present application for industrial invention relates to a semi-submerged breakwater barrier raised from the sea bottom or from the bottom of other water surfaces to be protected.

5 The most commonly used breakwater structures are composed of fixed barriers obtained with piles of rocks or concrete prefabricated elements that are deposited on the bottom of the water surface in order to protect the coast against wave motion.

A second type of said breakwater structures consists in the use of surface floating barriers made of heavy or light materials, which are anchored to the
10 bottom by means of "dead weights" or ballasts of different kind.

However, it must be said that none of the current technologies can be defined as fully satisfactory, being impaired by numerous drawbacks.

With reference to the structures obtained with piles of rocks or prefabricated elements, it must be noted that, when they are simply used to protect coastal
15 or beach areas, they are subjected to silting up and (when used for sea areas) also to deviation of natural sea currents with consequent modification of the coastal profile.

When they are used to protect a port area, similar barriers generate a "closed" water surface, thus considerably limiting the change of water and
20 increasing the tendency of the water to be subjected to atrophy and contamination phenomena.

Another significant inconvenience is related with the tendency to silting up that is experienced in said closed water basins, thus forcing port maintenance operators to carry out expensive sweeping operations on a frequent basis.

25 In such a perspective it must be noted that the aforesaid floating breakwater barriers are to be preferred to said traditional fixed barriers. In fact, not being directly deposited on the sea bottom, they do not create a "closed" water basin, and therefore do not interfere significantly with natural water currents

and with the original morphology of coast and bottom.

However, the floating barriers that are currently available on the market provide an effective protective action only in the case of surface wave motion with reduced intensity, whereas they are basically ineffective in case of wave motion with medium or strong intensity (especially if compared to traditional fixed barriers). In the latter case, traditional floating barriers tend, at least within certain limits, to ride the waves rather than breaking them effectively.

5 US2002/0104469 discloses a box-shaped semi-submerged barrier that is provided with a lid composed of a base from which parallelepiped projections (with square section) having the same height protrude upwards

10 FR 2 720 086 discloses a box-shaped semi-submerged barrier with lamellar elements arranged at the same height according to a crossed grid.

EP 0 346 554 discloses a barrier that is provided with lamellar elements with increasing height arranged in parallel position. Said lamellar elements do not allow for good water circulation.

15 EP 1 650 335 discloses a semi-submerged barrier that is provided with internally empty barrier elements that protrude upwards from a base. The barrier elements are at the same height.

A careful examination of the prior art has resulted in a new type of breakwater barriers that is capable of overcoming the problems caused by traditional barriers.

20 It is a semi-submerged barrier that is designed to be raised with respect to the sea bottom, without interfering with the natural currents that are created in the depth of the sea.

25 This means that the lamentable problems related with the creation of a basically closed water surface are not generated in the place where such a barrier is installed.

Moreover, the barrier of the invention provides an effective protective action also in case of violent wave motion (according to modes that are fully compatible with traditional fixed barriers deposited on the sea bottom).

30 In particular, the latter characteristic is caused by the presence of a plurality of elements designed to intercept the wave motion, which are configured in

such a way to generate the most effective interference with the waves, thus consequently breaking them.

It can be otherwise said that the breakwater barrier of the invention is obtained by using elements that can be combined to create a structure that is
5 partially permeable to wave motion in order to effectively resist the orbital motion of water particles (that allows waves to form and propagate) and consequently dissipate most of the energy of the wave that breaks on it.

Referring to the installation of such a semi-submerged breakwater barrier, it must be said that, according to a first embodiment, it is supported by
10 submerged floating structures with "reduced thrust", being held by ballasts that are deposited directly on the bottom.

It is worthless saying that the connection between floating support structures and ballasts must be made with cables or chains, that is to say with means that do not interfere significantly with the flow of deep currents.

15 Alternatively, in case of lower bottoms, the breakwater barrier of the invention can be fixed on top of a solid bearing structure, composed of a plurality of piles directly driven on the bottom.

Also in this case, the decision to make such an anchoring structure according to the pile-work principle is explained by the need to minimise interference
20 with deep currents.

In view of the above, it must be noted that the barrier of the invention has been conceived as a semi-submerged barrier that - as such - is immune to the risk of being at the mercy of the waves, a condition that would considerably limit its efficacy.

25 For purposes of clarity, the description of the invention continues with reference to the enclosed drawings, which are intended for purposes of illustration only and not in a limiting sense, wherein:

- figure 1 is a diagrammatic axonometric view of a first embodiment of the semi-submerged breakwater barrier of the invention;
- 30 - figure 2 is a diagrammatic view of a first installation solution of the barrier of the invention;
- figure 3 is a diagrammatic view of a second installation solution of the barrier

of the invention supported with piles; and

- figures 4A to 4F are views of possible embodiments of the lamellar element used in the barrier of fig. 1.

Referring to fig. 1 the breakwater barrier (1) of the invention is composed of a bearing structure designed to support a plurality of lamellar elements (2) preferably made of plastic materials, which are effectively designed to interfere with the wave motion.

In particular, the bearing structure is formed of a back border (1a) and a front border (1b) with very reduced height, among which a horizontal wall (1c) is supported, from which said lamellar elements (2) protrude vertically.

In particular, said elements are arranged in multiple longitudinal parallel rows (F1, F2, F3, Fn), in such a way to occupy a volume that basically corresponds to a hypothetical parallelepiped with length higher than height and width.

The height of the front row (F1) of said lamellar elements (2) is lower than the row (F2) immediately behind it, which in turn has a height lower than the successive row (F3) and so on, in such a way that the various rows of lamellar elements (2) have an increasing height from the front to the back of the barrier of the invention (1).

In view of the above, the wave that breaks on a similar barrier (1) is subjected to increasing interference by the successive rows of said lamellar elements (2).

Moreover, it must be noted that the lamellar elements (2) that form, one next to the other, each of said rows (F1, F2, F3, Fn) are regularly spaced and the multiple rows (F1, F2, F3, Fn) of said elements (2) are staggered, meaning that the "full" spaces of each row at the front are arranged in correspondence with the "empty" spaces of the corresponding row at the back.

This is done to increase the capacity of the barrier of the invention (1) to break the waves, which are forced to travel along such a winding path between the "full" and "empty" spaces of the successive rows of lamellar elements (2).

Moreover, it must be noted that, although in Fig. 1 the lamellar elements (2) are shown in perfectly vertical position, the same elements (2) can be

arranged in a sub-vertical position with forward or backward inclination with respect to the bearing structure.

Likewise, the profile of said lamellar elements (2) can be changed as desired, according to Figs. 4A to 4F.

- 5 Fig. 4A shows a lamellar element (2) provided with "full" structure and rectangular section; whereas Fig. 4F shows a lamellar element with rectangular section and "empty" structure, stiffened by transversal partitions (2a).

- Figure 4B relates to a lamellar element with fretted section; fig. 4C relates to a
10 lamellar element with arched section; fig. 4D relates to a lamellar element with sinusoidal section; fig. 4E relates to a box-shaped lamellar element with a basically rectangular section that is open in one of the longitudinal sides and stiffened by suitable transversal partitions (2b).

- After explaining the configuration of said first embodiment of the barrier of the
15 invention (1), the following description continues with the illustration of the possible installation modes.

- According to a first solution, which is shown in figs. 1 and 2, the barrier (1) is associated with one or more floating bodies (3, 4), specifically two of said floating bodies (3) are externally mounted on said borders (1a, 1b), whereas
20 the third floating body (4) is mounted under said horizontal wall (1c) provided between them.

According to a preferred embodiment said floating bodies (3, 4) are provided with monolithic structure, consisting in a single floating body.

- In any case the floating bodies (3, 4), and the entire barrier (1) of the
25 invention with them, are anchored to a ballast (6) deposited on the bottom (F) by means of sturdy cables (5).

- As shown in fig. 2, by selecting a suitable length of said anchoring cables (5), it is possible to set the desired height of the floating bodies (3, 4) with respect to the free surface of the water (P) and, consequently, determine the length of
30 the top sections of said lamellar elements (2) that emerge from the water to efficiently resist wave motion.

According to the alternative solution shown in fig. 3, the barrier of the

invention (1), deprived of said floating bodies, is mounted on top of a suitable series of piles (7) directly driven on the bottom (F).

Also in this case, the position of the barrier (1) on top of said bearing piles (7) must be selected according to the desired height of the top sections of the
5 lamellar elements that emerge from the free surface of the water (P).

Claims

1) Breakwater barrier (1) comprising:

- a modular structure composed of a plurality of modular breakwater elements (2) arranged in such a way to form multiple longitudinal parallel rows (F1, F2, F3, Fn) in spaced staggered position, wherein the various adjacent lamellar elements (2) are regularly spaced with suitable configuration to occupy a volume that basically corresponds to a parallelepiped, and

5 - support means (3, 4, 5, 6, 7) designed to hold the barrier in semi-submerged position in the water, being raised from the bottom, in such a way that said breakwater elements (2) emerge partially with respect to the free surface of the water (P),

10 characterized in that

said modular breakwater elements (2) are lamellar elements that protrude from a bearing horizontal wall (1c), wherein said parallel rows (F1, F2, F3, Fn) of lamellar elements (2) have increasing height from the front to the back of the barrier (1).

2) Barrier as claimed in claim 1, characterized in that said support means (6, 5) comprise one or more floating bodies (3, 4) securely fixed to the barrier and anchored to a ballast (6) deposited on the bottom (F) by means of cables or chains (5).

20 3) Barrier as claimed in claim 1, characterized in that said support means (7) comprise a plurality of piles (7) directly driven on the bottom (F).

AMENDED CLAIMS

received by the International Bureau on 21 October 2010 (21.10.2010)

- 1) Breakwater barrier (1) comprising:
- a modular structure composed of a plurality of modular breakwater elements (2) arranged in such a way to form multiple longitudinal parallel rows (F1, F2, F3, Fn) in spaced staggered position, wherein the **modular breakwater elements comprise** various adjacent lamellar elements (2) are regularly spaced with suitable configuration to occupy a volume that basically corresponds to a parallelepiped, and
 - support means (3, 4, 5, 6, 7) designed to hold the barrier in semi-submerged position in the water, being raised from the bottom, in such a way that said breakwater elements (2) emerge partially with respect to the free surface of the water (P),
- characterized in that
- said modular breakwater elements (2) are lamellar elements that protrude from a bearing horizontal wall (1c), wherein said parallel rows (F1, F2, F3, Fn) of lamellar elements (2) have increasing height from the front to the back of the barrier (1), and
 - said support means (6, 5) comprise one or more floating bodies (3, 4) securely fixed to the barrier and anchored to a ballast (6) deposited on the bottom (F) of the water surface by means of cables or chains (5).**

Statement under Article 19(1) PCT

Amended claim 1 is based on claims 1 and 2 as filed.

Old claims 2 and 3 have been deleted.

1 / 3

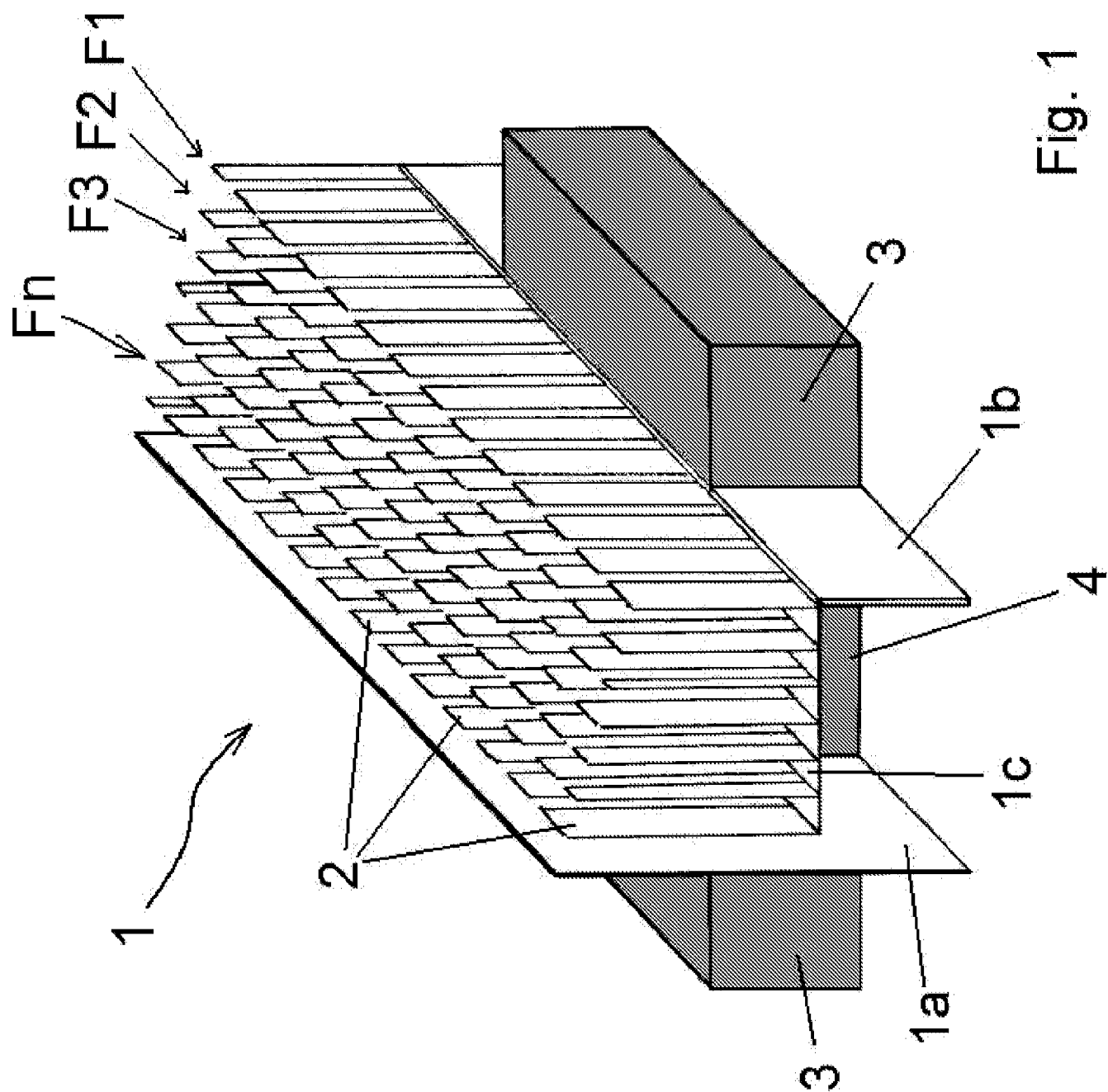


Fig. 1

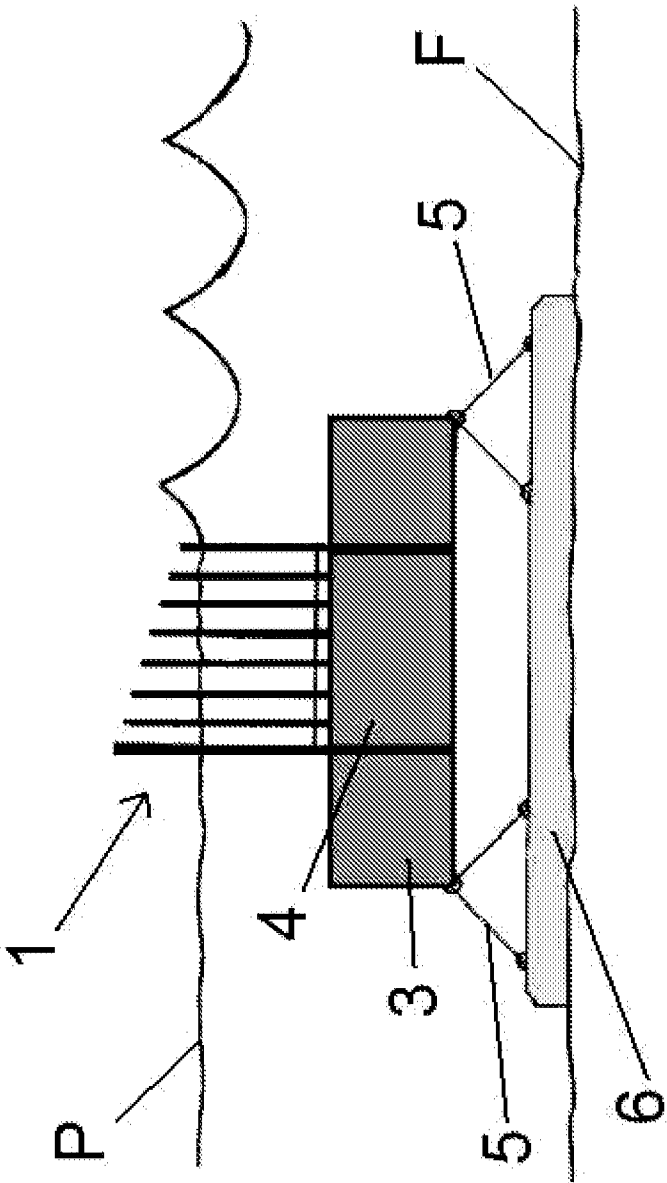


Fig. 2

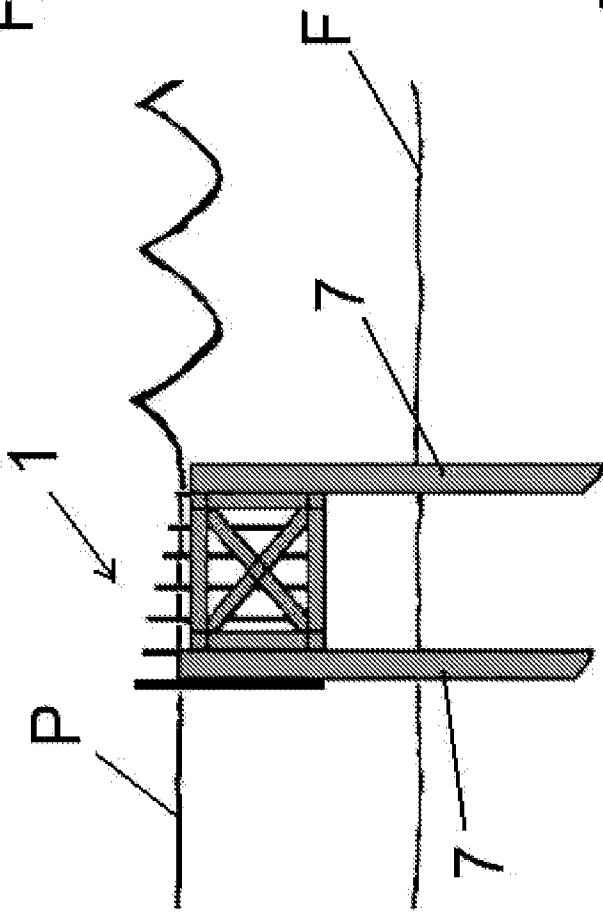


Fig. 3



Fig. 4A



Fig. 4B



Fig. 4C



Fig. 4D



Fig. 4E



Fig. 4F

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. E02B3/06

ADD.

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)

E02B

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR 2 720 086 A1 (DORIS ENGINEERING [FR]) 24 November 1995 (1995-11-24) cited in the application figures 1,3 * abstract	1,3
Y	EP 0 346 554 A1 (PRINCIPIA RECH DEV [FR]) 20 December 1989 (1989-12-20) cited in the application * abstract	1,3
A	US 3 785 159 A (HAMMOND D) 15 January 1974 (1974-01-15) figure 3	1-3



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

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

20 September 2010

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/058346

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2720086	A1	24-11-1995	NONE
EP 0346554	A1	20-12-1989	AT 67541 T 15-10-1991 DE 3865014 D1 24-10-1991 ES 2027789 T3 16-06-1992
US 3785159	A	15-01-1974	NONE