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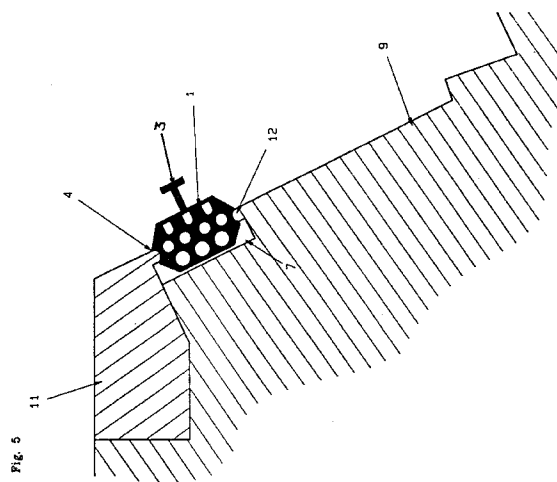
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(54) **Pre-cast concrete element and method of making same.**

(57) A pre-cast concrete element (2) has a sealing element (1) protruding from a face thereof, the sealing element having been incorporated in the concrete element at the time of casting. To facilitate this, a mould (9) includes means releasably to entrap the sealing element (1) to be cast in the concrete element so that the sealing element protrudes from a face of the concrete element. Manufacture of such concrete elements with sealing members is thereby facilitated.



EP 0 673 734 A1

This invention relates to a pre-cast concrete element and more particularly to an arcuate pre-cast concrete tunnel or shaft lining segment incorporating a sealing member to prevent ingress of moisture between abutting faces of the tunnel or shaft lining segments.

In locations where tunnel or shaft linings are erected in water-bearing ground and where it is necessary to seal the lining to prevent the ingress of moisture, such linings can be sealed by inserting resilient sealing strips between abutting faces of the tunnel or shaft lining. Water swellable rubbers have also been used.

As an example of known practice, EP-A0 375 427 discloses a tunnel lining segment with rubber sealing members, the sealing members having been seated and adhesively bonded in pre-cast grooves provided in the segments.

According to one aspect of the present invention, there is provided a pre-cast concrete element having a sealing element protruding from a face thereof, characterised in that the sealing element having been incorporated in the concrete element at the time of casting.

According to a second aspect of the present invention, there is provided a mould for making a pre-cast concrete element, the mould being characterised by means releasably to entrap a sealing element to be cast in the concrete element so as to protrude from a face thereof.

According to a third aspect of the present invention, there is provided a method of making a pre-cast concrete element having a sealing element protruding from a face thereof, including the steps of providing a mould for the element to be cast therein, pouring concrete into the mould and subsequently releasing the concrete element so formed, characterised in that the sealing element is releasably entrapped so as to protrude from an inner wall of the mould prior to the pouring of the concrete into the mould such that, when the concrete element is subsequently released, part of the sealing element protrudes from a face of the concrete element.

The concrete element can be in the form of an arcuate tunnel or shaft lining segment.

The sealing element can be a sealing strip and can be formed from a water swellable rubber, such as hydrophillic rubber, or a resilient elastomeric material such as rubber, neoprene or E.P.D.M.

Preferably, the sealing element is provided with a profile which causes the sealing element to be firmly anchored in the concrete element.

To enable the sealing element to be entrapped by the mould, the sealing element can be provided with opposed grooves into which respective parts of the mould can form a tight fit.

For a better understanding of the invention and to show how the same may be carried into effect, refer-

ence will now be made, by way of example, to the accompanying drawings in which:-

Figure 1 is a diagrammatic view of a concrete tunnel lining segment incorporating a cast-in sealing strip on its edge faces,

Figure 2 is a detailed view of the sealing strip cast into the segment,

Figure 3 is a diagrammatic exploded view of a segment mould incorporating the sealing strip,

Figure 4 is a detailed view of the sealing strip fixed in position in a side of the mould, and

Figure 5 is a detailed view of the sealing strip fixed in position in the head of the mould.

Referring to Figure 1 a member in the form of a sealing strip 1 is shown protruding from all four edges of a concrete member in the form of a pre-cast concrete tunnel lining segment 2, the sealing strip 1 having been incorporated in the concrete segment 2 at the time of casting.

Figure 2 shows the sealing strip 1 cast into the edge of the segment 2, the sealing strip 1 being retained in the segment by one or more continuous or interrupted anchors 3. If each anchor 3 has a continuous profile, then it will also form a continuous water bar between the segment 2 and the sealing strip 1. The water bar reduces the chance of moisture passing between the seal and the concrete due to imperfections in the concrete or the sealing strip 1.

It will be noted that the sealing strip 1 has outwardly facing grooves or notches 4 mid-way across its profile. These grooves 4 are provided in the sides of the sealing strip in order to fix it to the mould during casting.

Figure 3 shows a typical mould 9 having grooves 7 and 8 in the head of the mould to receive the sealing strip 1, which is in this case continuous (the sealing strip 1 in Figure 3 is only shown diagrammatically). The mould 9 also includes side shutters 10 and a detachable mould part 11 on the head of the mould to allow for segment demoulding after it has been formed.

Figure 4 shows in more detail the sealing strip 1 with its grooves 4 and anchor 3 inserted in the groove 8 in one of the side shutters 10. The grooves 4 on the sealing strip 1 are held captive by facing protruding parts formed by a constriction or lips 12 in the groove 8. It will be appreciated that the lips 12 can be located at any suitable position within the groove 7, 8 provided that there is a section of the sealing strip 1 which interlocks with the groove 7, 8. Because the sides such as 10 are detachable, the only consideration for demoulding is that the sealing strips 1 should be resilient.

Figure 5 shows the sealing strip 1 inserted in the grooves 7 in the head of the mould 9. The notches or grooves 4 on the sealing strip 1 are held captive by the lips 12 in the groove 7. Again, the lips 12 or other constriction in the grooves 7 can be at any position in the groove, the interaction between grooves 4 and

lips 12 holding the sealing strip captive whilst forming a seal to prevent flow of concrete during casting beyond the grooves 4 in the direction away from the anchor 3, viz. into the void at the base of the groove 7, 8.

In order to allow vertical demoulding of the segment, it is necessary to have the detachable sections 11 on the head of the mould 9 to allow the sealing strip(s) 1 to disengage from the mould.

It will be appreciated that the sealing strip 1 is cast in and is fully anchored to the segment 2 whilst being accurately held in position in the mould 9 prior to casting. Thus, the need to form grooves in the segments during casting is avoided, as well as the associated difficulties with providing a good quality and well-shaped groove free from imperfections. Also avoided is the need to fit and glue the sealing strip to the segment and the possibility of the sealing strip being dislodged is also reduced.

The protrusion and positioning of the sealing strip on the segment can be accurately controlled by the location of the grooves or notches 4 in the sealing strip and this increases pressure/gap performance of the seal.

Because of the continuous anchorage of the sealing strip in the segment, this provides a much improved seal between the concrete and the sealing strip to give a better seal when in use in a tunnel or shaft.

Claims

1. A pre-cast concrete element (2) having a sealing element (1) protruding from a face thereof, characterised by the sealing element (1) having been incorporated in the concrete element (2) at the time of casting.
2. A mould (9) for making a pre-cast concrete element (2), the mould being characterised by means (7, 8, 12) releasably to entrap a sealing element (1) to be cast in the concrete element (2) so as to protrude from a face thereof.
3. A method of making a pre-cast concrete element (2) having a sealing element (1) protruding from a face thereof, including the steps of providing a mould (9) for the element (2) to be cast therein, pouring concrete into the mould (9) and subsequently releasing the concrete element (2) so formed, characterised in that the sealing element (1) is releasably entrapped so as to protrude from an inner wall of the mould prior to the pouring of the concrete into the mould such that, when the concrete element (2) is subsequently released, part of the sealing element (1) protrudes from a face of the concrete element (2).

4. A pre-cast concrete element, or mould or method according to claim 1, 2 or 3, respectively, wherein the concrete element (2) is in the form of an arcuate tunnel or shaft lining segment.
5. A concrete element, mould or method according to claim 1, 2, 3 or 4, wherein the sealing element (1) is a sealing strip formed from a water swellable rubber.
6. A concrete element, mould or method according to claim 1, 2, 3 or 4, wherein the sealing element (1) is a sealing strip formed from a water swellable rubber or a resilient elastomeric material.
7. A concrete element, mould or method according to any one of the preceding claims, wherein the sealing element (1) is provided with a profile which causes the sealing element to be firmly anchored in the concrete element (2).
8. A mould according to claim 2 or method according to claim 3 or a method or mould according to claim 4, 5 or 6 as appendant to claim 2 or 3, wherein the sealing element (1) is provided with opposed grooves (4) into which respective parts of the mould (9) can form a tight fit to enable the sealing element to be entrapped by the mould.

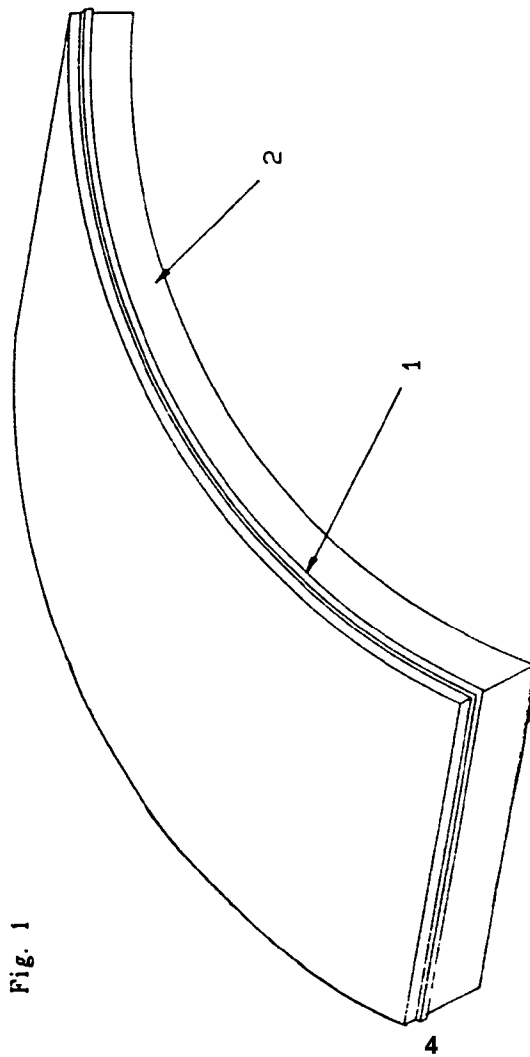


Fig. 2

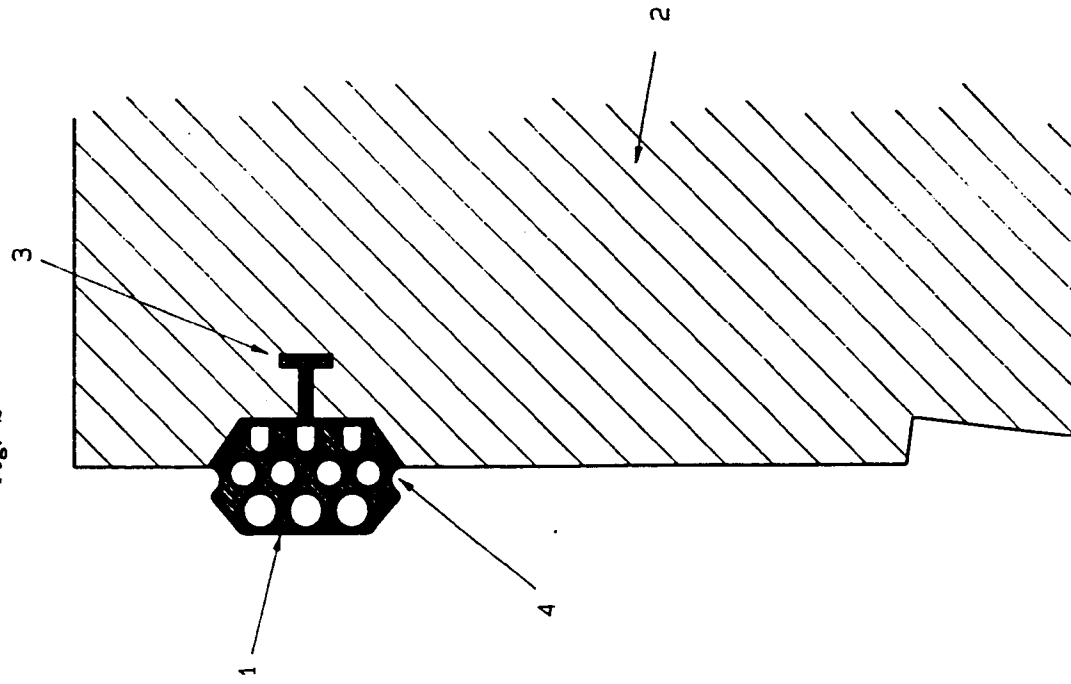


Fig. 3

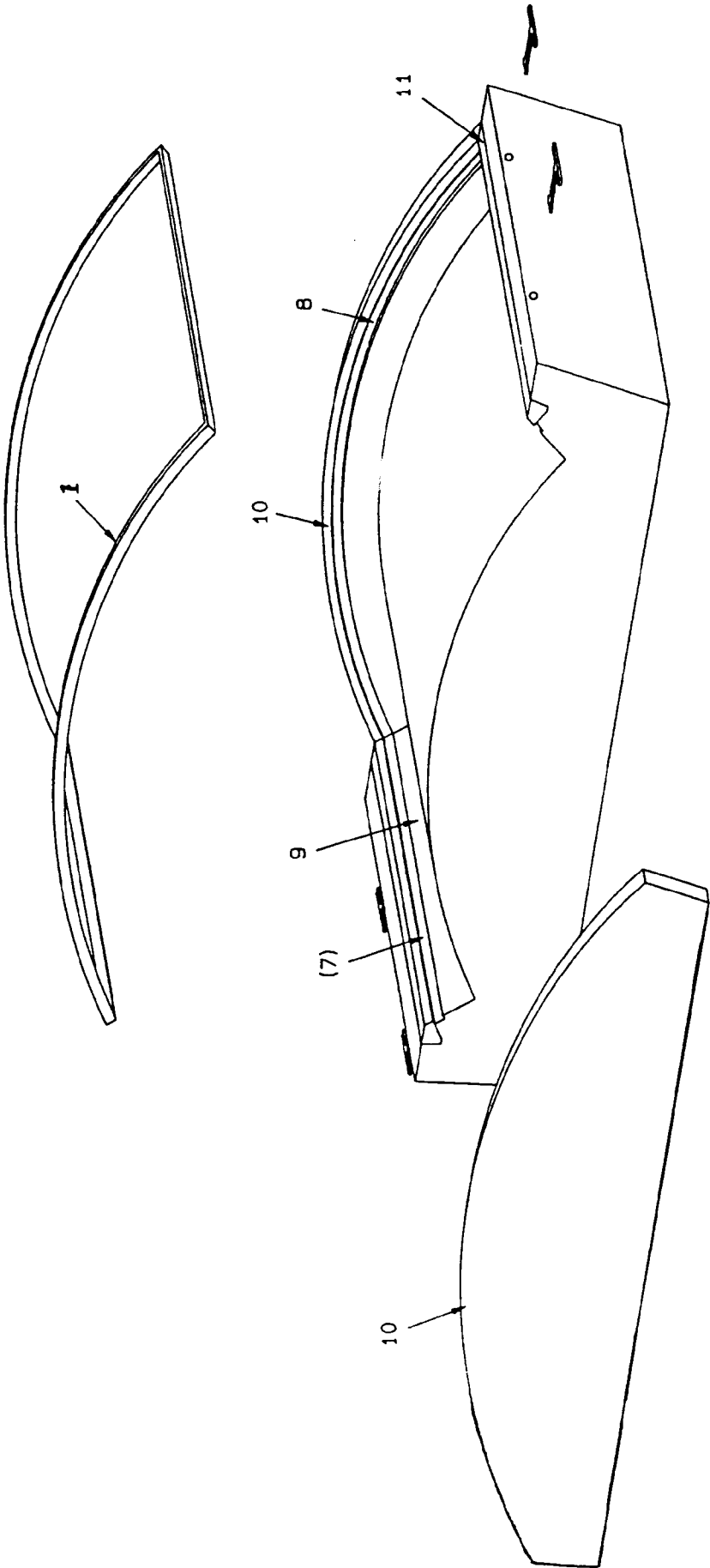


Fig. 4

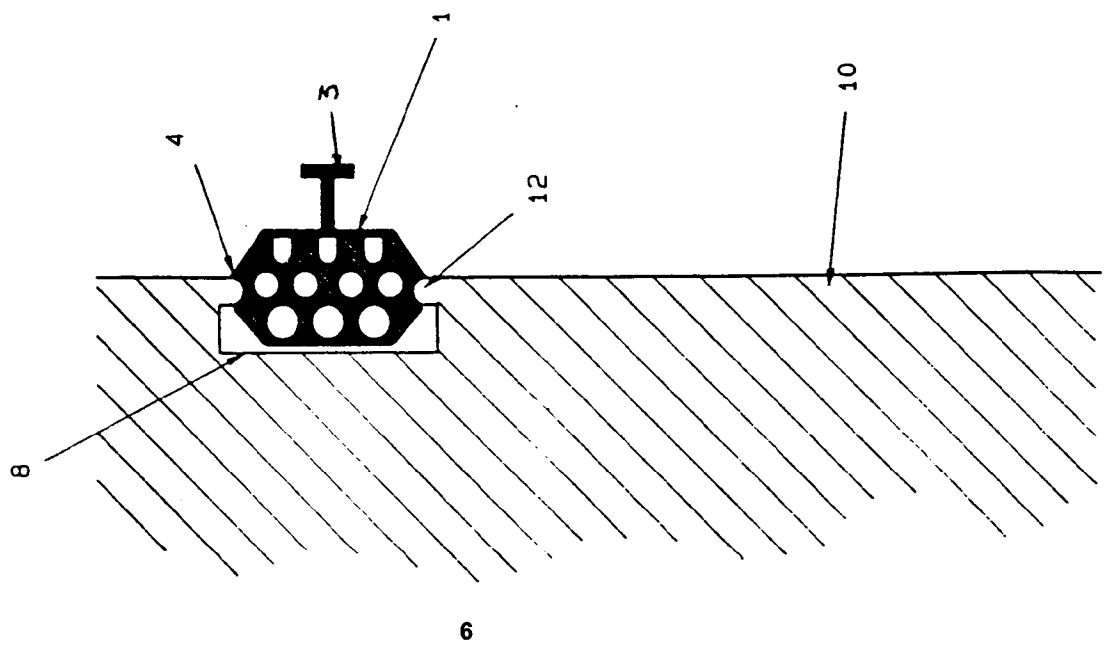
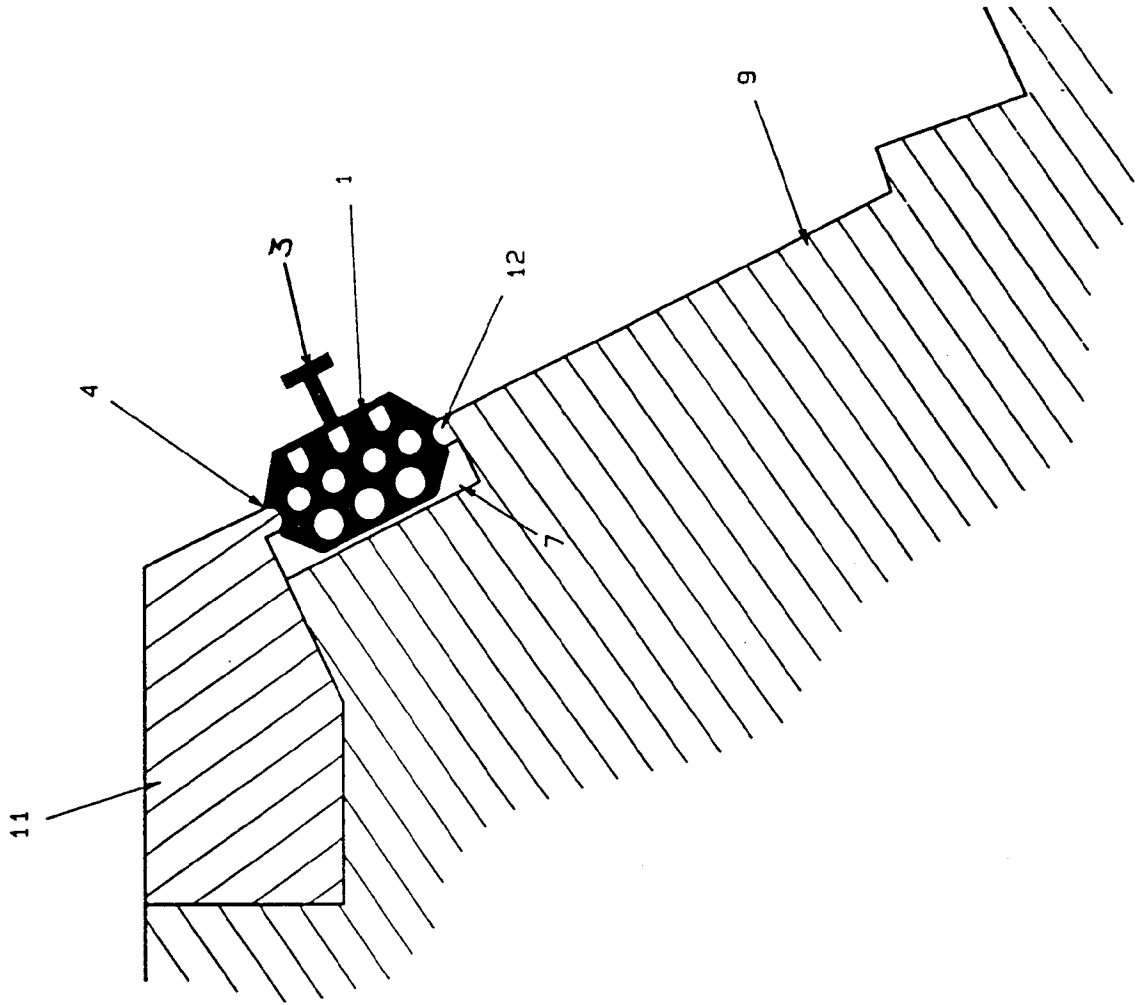


Fig. 5





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 1933

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.6)
X	FR-A-2 684 134 (LE JOINT FRANCAIS , SOCIETE EN NOM COLLECTIF) * the whole document * ---	1-8	B28B23/00 E21D11/38
X	DE-A-39 34 198 (PHOENIX AG) * the whole document * ---	1-3,5-7	
X	FR-A-2 678 680 (SOCIETE DITE : GTM BATIMENT ET TRAVAUX PUBLICS (S.A.)) * the whole document * ---	1-7	
X	DE-U-87 09 843 (H. MUCHER GMBH & CO KG) * the whole document * ---	1-3,5-8	
X	US-A-4 103 901 (J. DITCHER) * the whole document * -----	1-3,5-8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B28B E21D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 23 June 1995	Examiner Gourier, P
CATEGORY OF CITED DOCUMENTS		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	
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			

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