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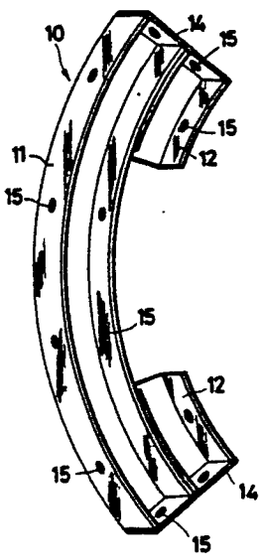
(54) Modular structural element for supporting excavations inside rock.

(57) A structural modular element (10) for supporting rock excavations has a curved shape with a U-like cross-section and flanges (11,12) directed toward the centre of curvature. A plurality of elements (10) are assemblable to each other, in order to provide a type of lining suitable to any particular geological situation, by means of slots (15) provided both on the flanges (11,12) and on the stiffing plates (14) of the elements (10).

Fig.1



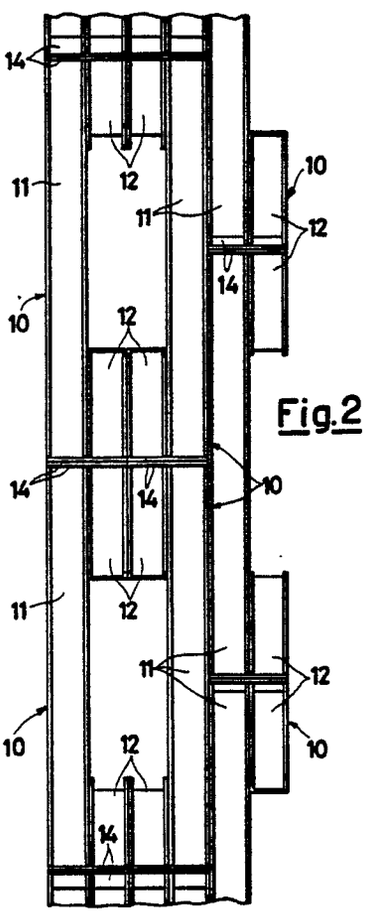


Fig.2

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"MODULAR STRUCTURAL ELEMENT FOR SUPPORTING EXCAVATIONS INSIDE ROCK"

The object of the present invention is a modular structural element for supporting excavations inside rock.

The problem of supporting the excavations inside rock is known, and is solved from time to time by using structural elements of very different types according to the requirements of excavation and economic suitability of the materials.

Such types of structural elements are not generally endowed with characteristics of homogeneity and modularity, with consequent increases in costs, above all in case of non-recoverable supports.

The purpose of the present invention is to obviate the above-said disadvantages, by providing a modular element which can be applied in any geological situations of the excavation, and which is easily assemblable and easily realizable.

Aiming at such a purpose, according to the present invention a modular structural element has been provided, which comprises a curved structural shape having an "U"-shaped cross-section, with the flanges of said structural shape being directed towards the centre of curvature, with, at the ends of said structural shape, in side-by-side position, curved portions of structural shape with "U"-shaped cross-section with flanges directed towards the centre of curvature being stably joined, furthermore on the end sections of said structural shape and of said portions of structural shape, stiffening plates being provided, and both of them being provided with through slots on their flanges, and on the stiffening plates. In order to better understand the characteristics and further advantages thereof, the present invention is now disclosed by referring to the figures of the hereto attached drawing tables, wherein:

Figure 1 shows a perspective view of a modular structural element according to the present invention,

Figure 2 shows a plan view of a plurality of elements of Figure 1 assembled with one another,

Figure 3 shows a partially sectional side view of a plurality of elements of Figure 1 assembled with one another,

Figures 4 and 5 show, for exemplifying purpose, a first diagram of assemblage of structural elements of Figure 1, respectively in perspective and in plan view,

Figures 6 and 7 show, for exemplifying purpose, a second diagram of assemblage of structural elements of Figure 1, respectively in perspective and in plan view,

Figures 8 and 9 show, for exemplifying purpose, a third diagram of assemblage of structural elements of Figure 1, respectively in perspective and in plan view,

Figures 10 and 11 show, for exemplifying purpose, a fourth diagram of assemblage of structural elements of Figure 1, respectively in perspective and in plan view,

Figures 12 and 13 show, for exemplifying purpose, a fifth diagram of assemblage of structural elements of Figure 1, respectively in perspective and in plan view,

Referring to the figures, by the reference numeral 10 a structural element according to the present invention is generally indicated, which is constituted by a curved "U"-shaped structural shape 11, extending along an arc of a circumference, with its flanges being directed towards the centre of curvature, with which curved portion of an "U"-shaped structural shape 12 are stably joined, e.g., by welding. The portions 12 are located in the nearby of the ends of the structural shape 11 in a side-by-side position to the same structural shape, and extend by a length equal to one fourth of the length of the same structural shape.

Furthermore, both the structural shape 11 and the portions 12 are provided, on their respective end sections, with stiffening plates 14, whilst slots 15 are provided both on the flanges and on the stiffening plates 14 of the structural shape 11 and on the portions 12, in order to make it possible to fasten a plurality of structural elements to one another.

Given the particular configuration of the modular structural element 10, one can easily understand how it can be coupled in the most different configurations according to the characteristics of the rock concerned by the excavation, i.e., according to the necessary lining type.

Given the particular shape of the individual structural element 10, it is possible to lay it inside the tunnel according to a variety of installation patterns.

The selection is subordinated to the characteristics of the rock concerned by the excavation which one wants to line.

In Figures from 4 to 13, five possible assemblage diagrams are shown.

The assemblage diagrams of Figures 6-7 and 10-11 make it possible to completely line the tunnel wall, in that the individual elements 10, by fitting into one another, completely cover the excavation; they are hence particularly suitable for supporting the rock in particularly difficult cases, in that a structure closed in this way is capable of

standing a load of approximately 27 kg/cm².

Due to the rather small dimensions of the individual element, in this case it is possible to proceed to assemble it, whenever necessary, immediately behind the head of a cutter machine.

The assemblage diagrams of Figures 4-5 and 8-9 make it possible to partially line the tunnel, in that the individual elements 10 are assembled with one another in such a way as to leave uncovered rock portions, that allows savings to be achieved both in material supply, and in the assemblage thereof.

If necessary, these spaces and the voids which are possibly produced between the metal panels and the rock can be easily eliminated by means of the application of Spritz-Beton.

The diagram of Figures 12-13 shows a further application from the very many which are possible in the assemblage of these elements, in as much as in this case a ring is assembled, which is composed by 18 elements, and which constitutes a distinct supporting structure, which is installed at regular distances, which are determined according to the characteristics of the rock; in this case too, a considerable saving is achieved in installation times and in material; savings which, however, to not endager the safety of the whole structure.

Substantially, with the same element, both partial and total linings can be carried out, as they are respectively necessary in case of cost savings (favourable geological situations) and in case of particularly difficult geological situations.

The present invention has been disclosed for illustrative and not limitative purposes, but it should be undestood that modifications and changes can be supplied by those skilled in the art, without going out of the scope of protection of the present invention.

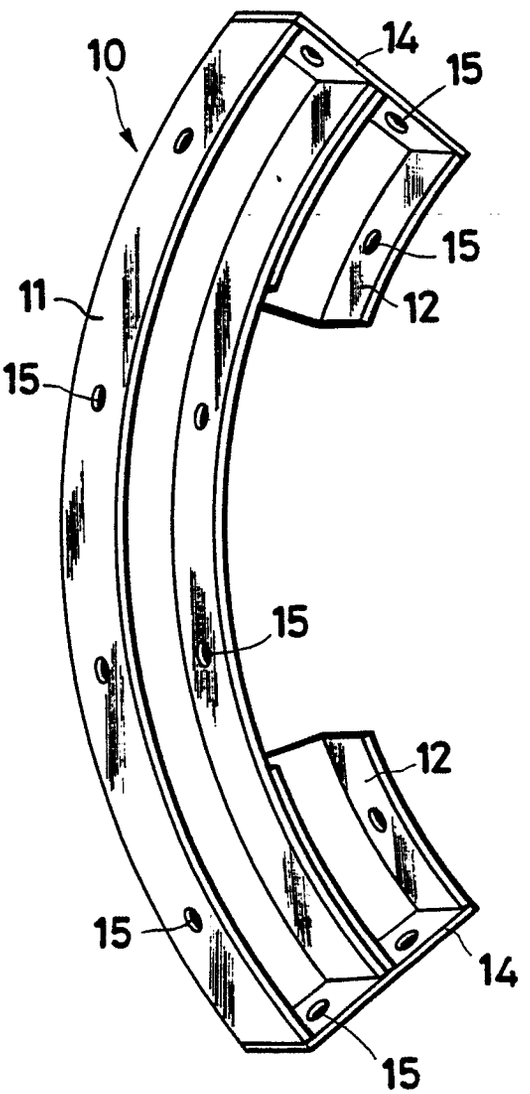
Claims

1. Modular structural element comprising a curved structural shape having an "U"-shaped cross-section, with the flanges of said structural shape being directed towards the centre of curvature, with, at the ends of said structural shape, in side-by-side position, curved portions of structural shape with "U"-shaped cross-section with flanges directed towards the centre of curvature being stably joined, furthermore on the end sections of said structural shape and of said portions of structural shape, stiffening plates being provided, and both of them being provided with through slots on their flanges, and on the stiffening plates.

2. Modular structural element according to claim 1, characterized in that the length of each one of said curved portions of structural shape in 1/4 of the length of the said curved structural shape.

3. Modular structural element according to any of the preceding claims, substantially as herein disclosed and illustrated.

Fig.1



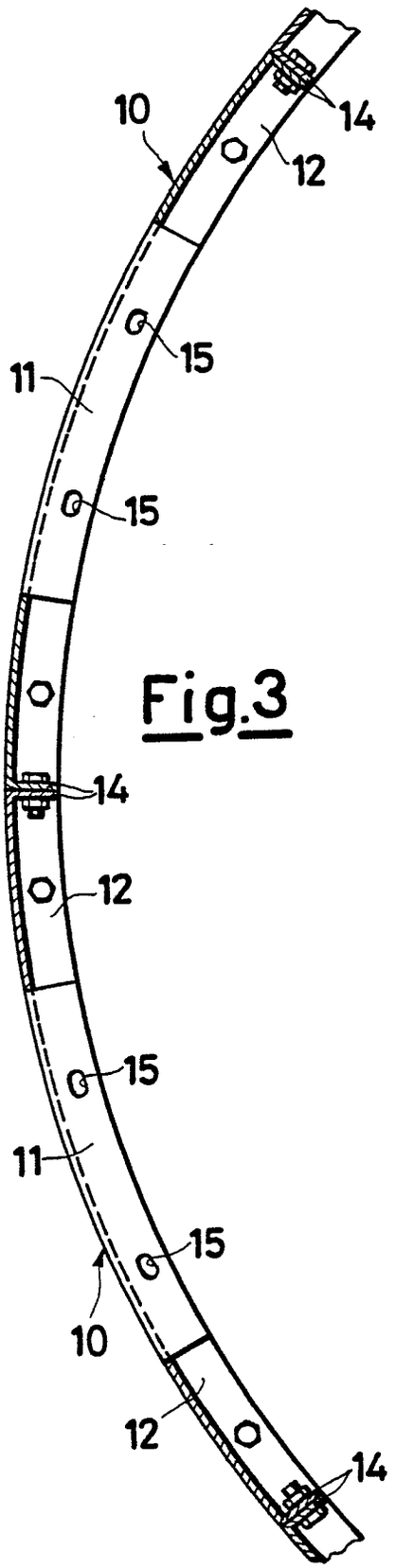

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Fig.3

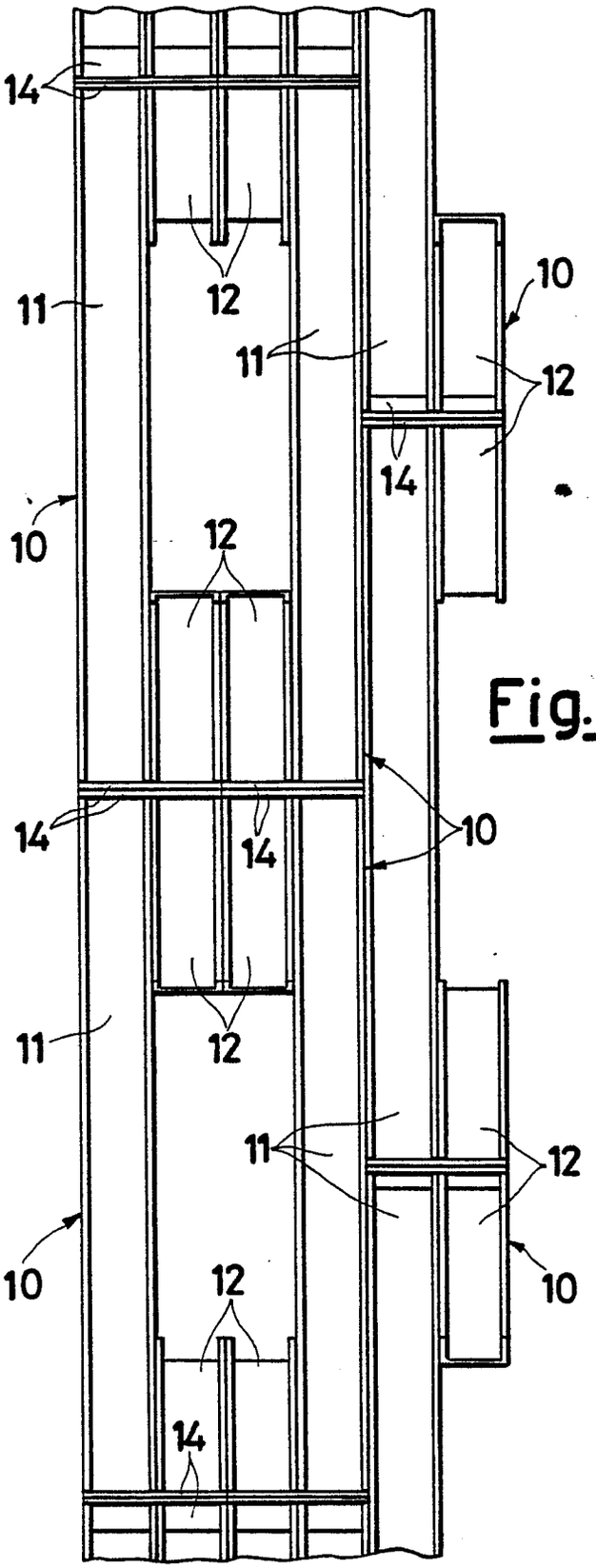
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Fig.2

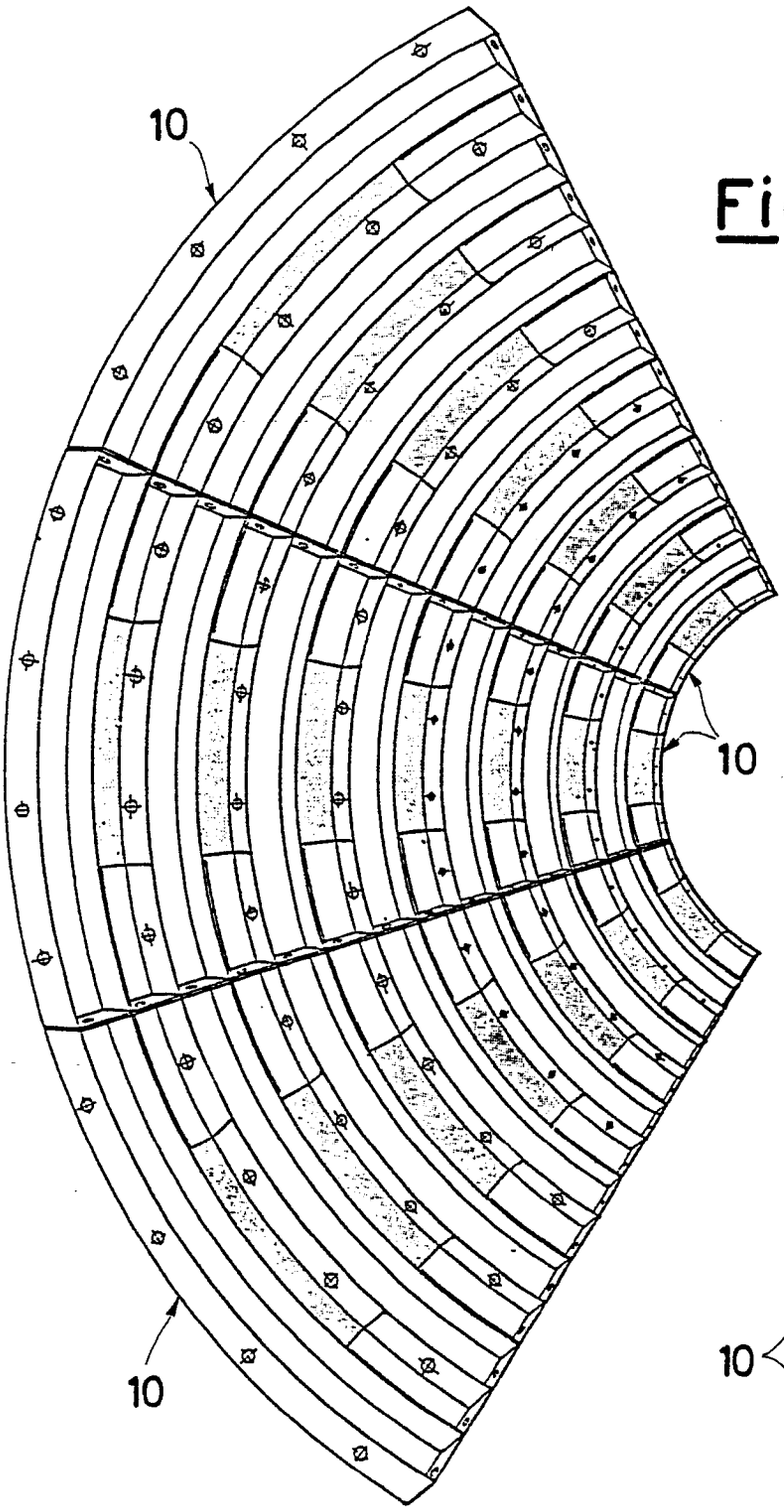
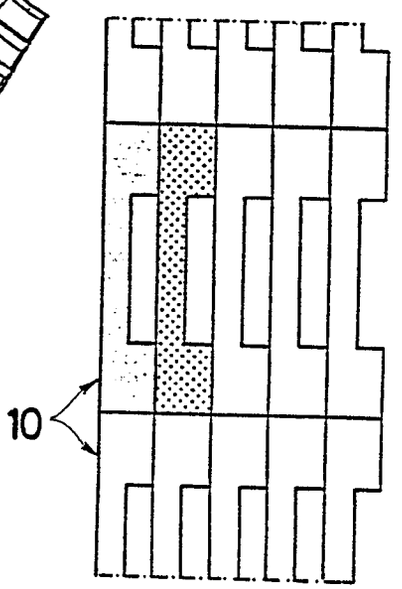


Fig.4

Fig.5



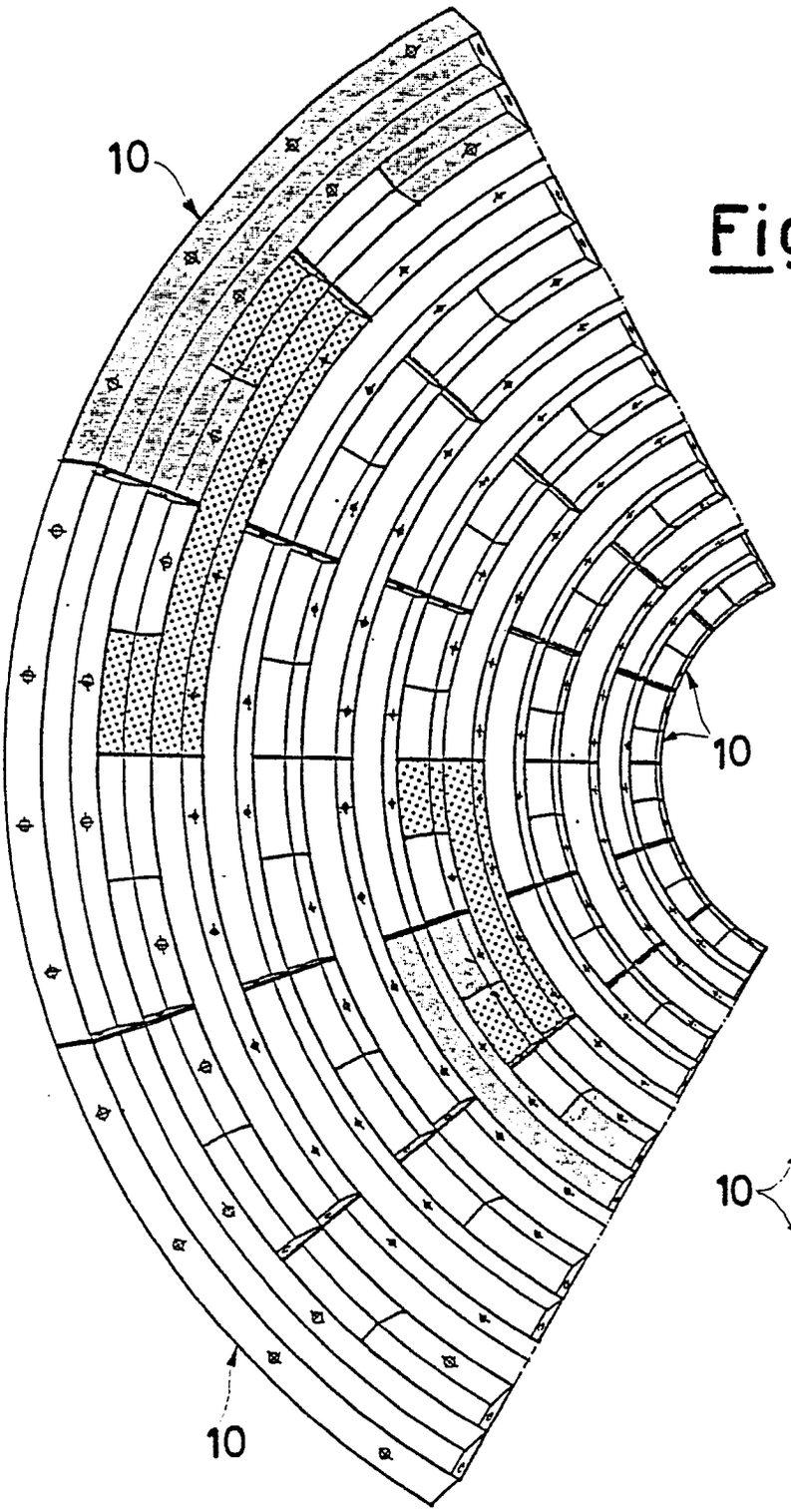
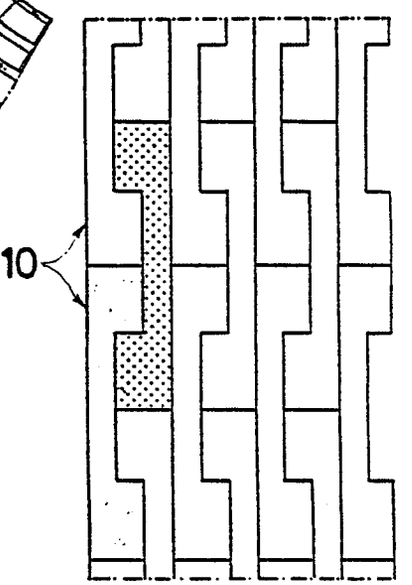


Fig.6

Fig.7



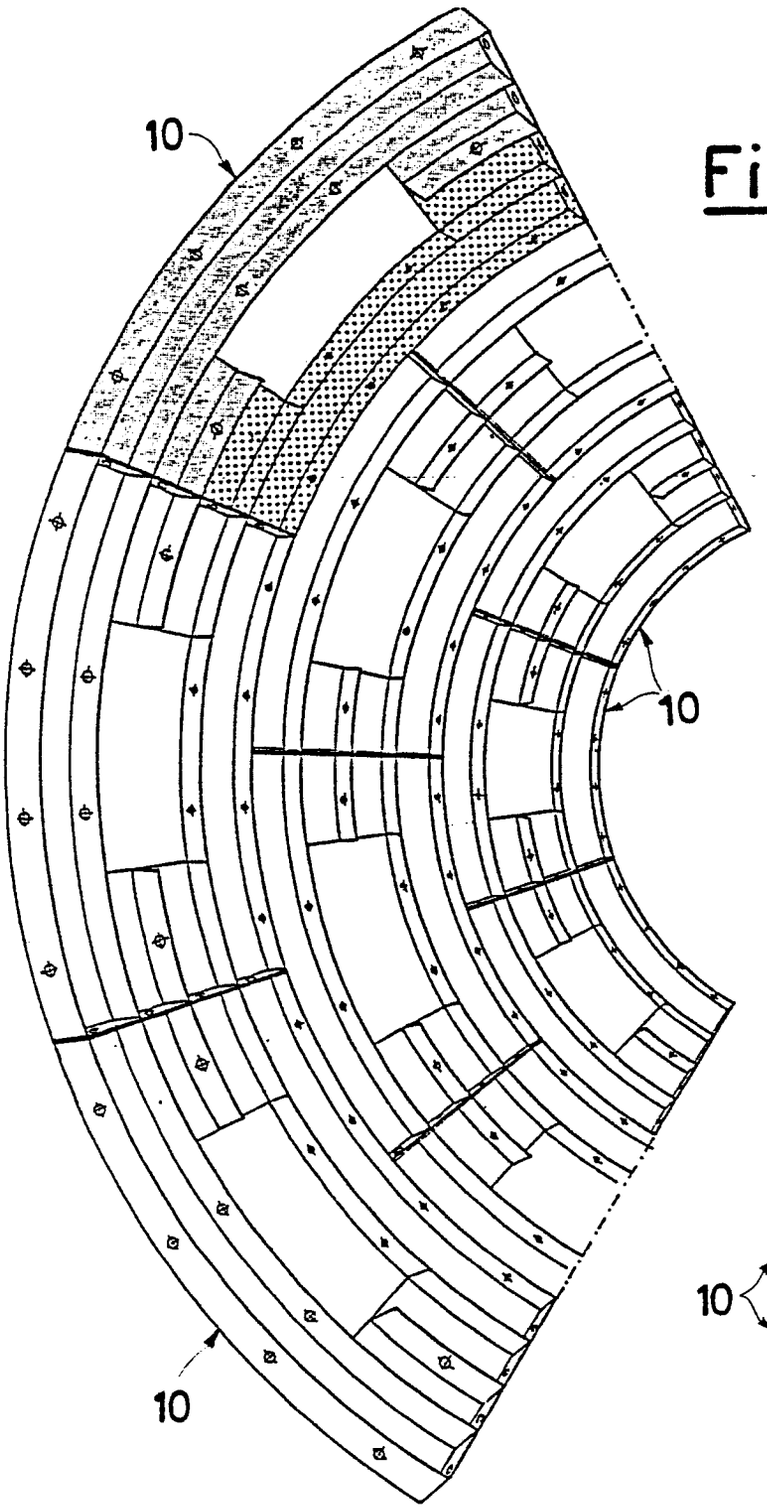
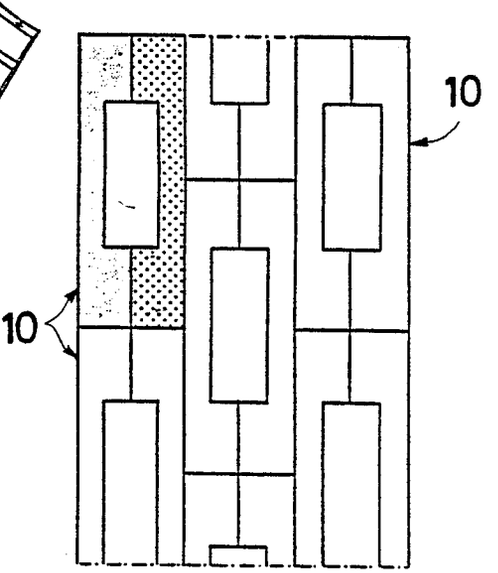


Fig.8

Fig.9



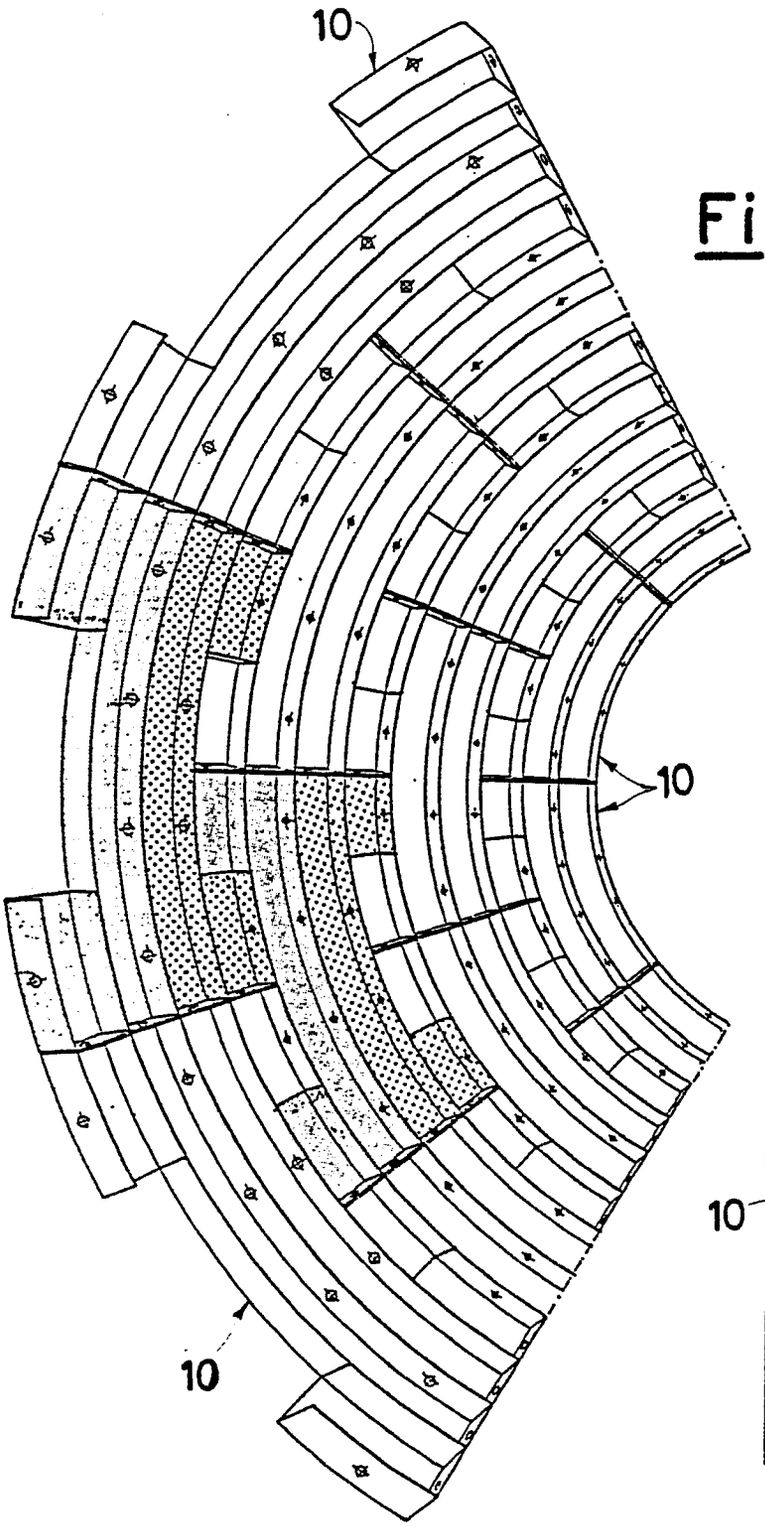
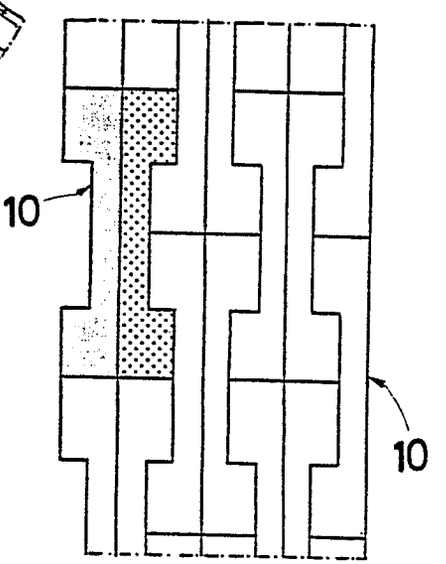


Fig.10

Fig.11



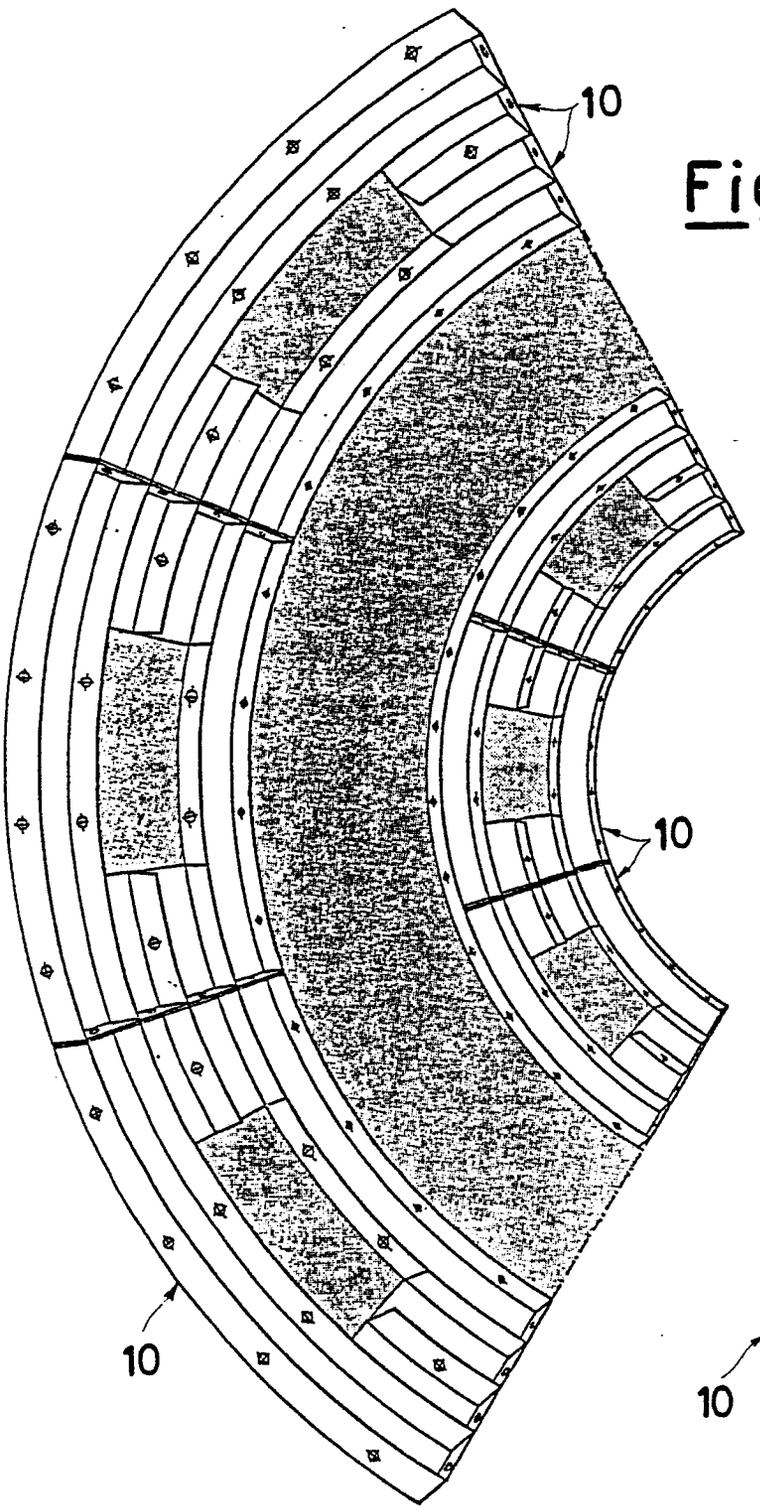
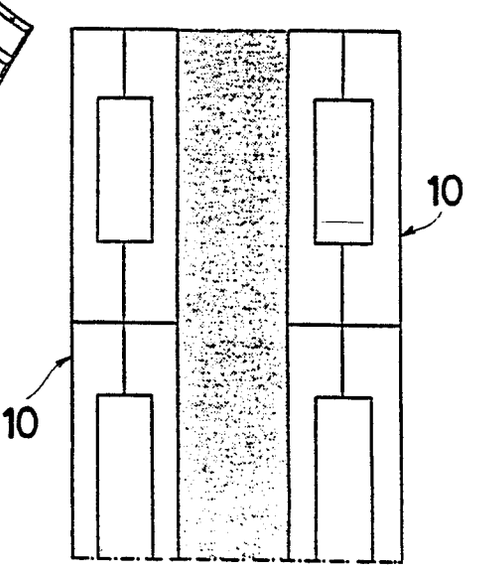


Fig.12

Fig.13



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EUROPEAN SEARCH REPORT

Application Number

EP 87 20 2425

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.4)
A	GB-A- 370 596 (BRAITHWAITE) * Figures * -----	1	E 21 D 11/15

TECHNICAL FIELDS SEARCHED (Int. Cl.4)
E 21 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10-03-1988	RAMPELMANN J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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