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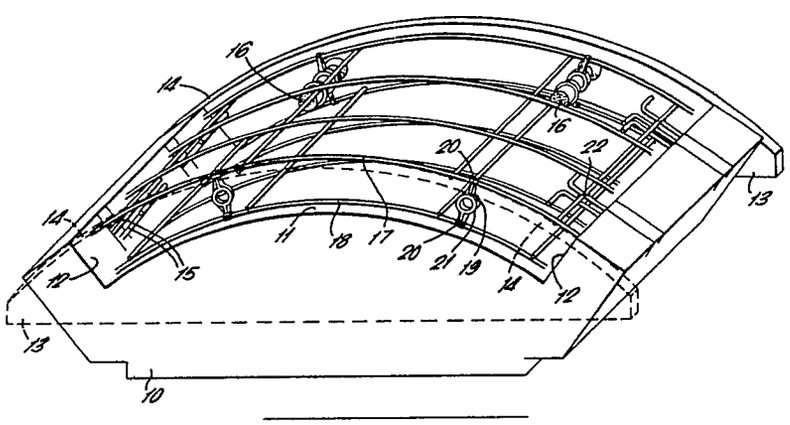
(54) Improvements in or relating to methods of manufacturing arcuate tunnel lining segments.

(57) The disclosure relates to a method of moulding an arcuate tunnel lining segment. A mould (10) has a mould cavity formed by a convexly curved surface (11) terminating in axially extending end faces (12) and bounded by side walls (13). Fastening devices in the form of preformed hoops (15) are mounted in the mould cavity at the ends (12) of the cavity and further fastening devices in the form of sockets (16) are mounted in the cavity on the side walls (13). Preformed arcuate reinforcement for the segment is then located in the mould cavity and connected to the fastening devices to support the reinforcement in the mould and concrete is cast in the mould over the reinforcement and fastening devices to form a reinforced cast concrete segment with casting fastening devices in the circumferential and axially extending edge faces.



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IMPROVEMENTS IN OR RELATING TO METHODS OF MANUFACTURING ARCUATE REINFORCED CONCRETE TUNNEL LINING SEGMENTS

This invention relates to arcuate concrete reinforced tunning lining segments.

The invention provides a method of moulding a arcuate tunnel lining segment providing a mould cavity including convexly curved surface to define the inner peripheral surface of the segment and peripheral walls extending along the circumferential and axially extending edges of the arcuate surface to define the circumferential and axially extending faces of the segment; mounting a plurality of tunnel lining fastening devices on said peripheral walls of the mould to project into the mould cavity at spaced locations around the cavity; preforming arcuate reinforcement for the segment and locating the arcuate reinforcement in the mould cavity reinforcement to extend through the segment to be cast in the mould; attaching the reinforcement to at least certain of said fastening devices to support the reinforcement in the mould at the required location and casting concrete in the mould over the reinforcement and fastening devices to form a reinforced cast concrete segment; and finally releasing the cast segment from the mould.

The reinforcement mesh may comprise inner and outer layers or meshes which are connected together by spacers and the spacers have location means which are engaged with the fastening devices provided in the mould to support the inner and outer layers of the mesh in the mould for the moulding operation.

More specifically the spacers may be connected between the inner and outer layers of the mesh along the circumferentially extending edges thereof at spaced positions to engage spaced fastening devices along the circumferential edges of the mould. Further the mesh may be connected directed to fastening devices at spaced locations along the axially faces of the mould.

The following is a description of a specific embodiment, reference being made to the accompanying drawing which is a diagrammatic illustration of a mould for casting a reinforced arcuate concrete tunnel lining segment.

The drawing shows a mould for casting a reinforced concrete arcuate tunnel lining segment comprises a base 10 form with an upwardly facing convex mould surface 11 shaped to form the inner arcuate surface of the segment to be cast. At the circumferential ends of the convex surface 11 there are upstanding end faces 12 which form the axially extending edges of the segment. Detachable side plates 13 are mountable on either side of the mould each having an upper convexly curved edge 14 to extend between the upper ends of the faces 12 and thereby define the outer arcuate surface of the tunnel lining segment.

The end faces 12 of the mould has spaced mounting locations where hoops 15 are temporarily supported for the mould operation with the hoops projecting from the mould cavity and the ends of the hoops extending into the mould cavity as indicated at 15. The hoops form part of a "stressed dowell" connection system described and illustrated in detail in our U.K. Patent No. 2004931 to which reference should be made for further details. Likewise the mould sides 13 are adapted to support sockets 16 projecting into the mould cavity from the mould sides at spaced locations around the sides to receive and hold dowell connectors for connecting adjacent segments together as described and illustrated in our Euro U.K. Patent No. 0114514 to which reference should be made for further details.

To reinforce the segment to be cast, a cage is formed comprising two arcuate layers of prefabricated steel reinforcing mesh 17, 18 to extend around the mould cavity. Layer 17, 18 are connected together by spacers 19 having end socket 20 to receive and engage the outer rims on the reinforcement mesh. The centers of the spaces comprises annular elements 21 which engage over the sockets 16 to locate the reinforcing mesh in the mould. Further location is provided by way of ties 22 between the transverse members of the mesh and legs 15 projecting from the ends of the mould cavity. The reinforcing mesh is thus located in the mould for the moulding operation and concrete is then poured into the mould to fill the mould. The concrete is vibrated for compaction and the outer surface is smoothed to the required finish for the outer surface of the segment. Once the concrete has set, the sides of the mould are released and the segment can then detached from the mould.

It will be appreciated that many modifications may be made to the above described embodiments without departing from the scope of the invention. For example, the arrangement is applicable to linings secured together in any other manner such as bolted linings where reinforcement is required and the lining has moulded in edge features to produce holes or the like the formers for which (whether temporary or permanent) may be used to support the reinforcement to the moulding or casting operation.

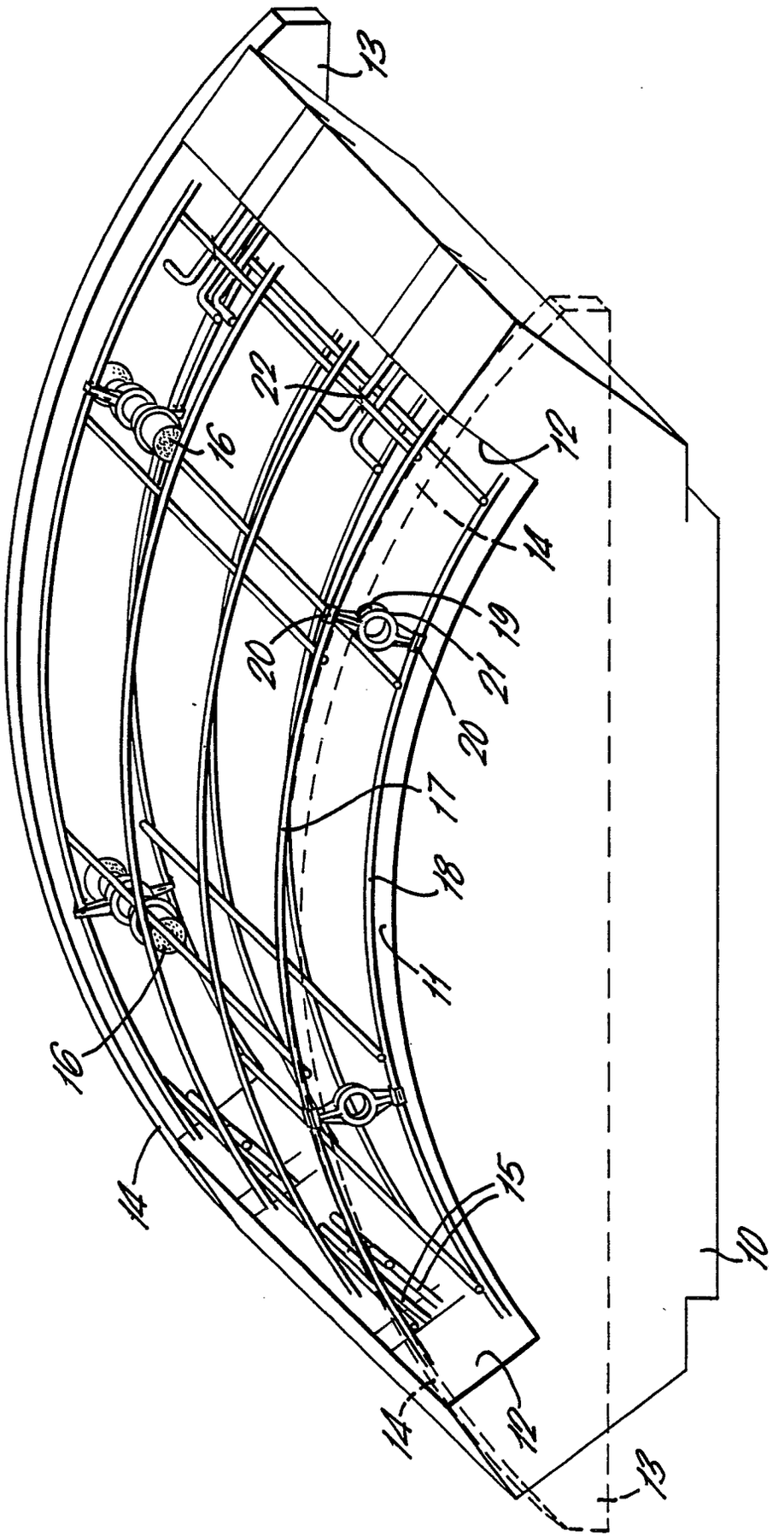
Claims

1. A method of moulding an arcuate tunnel lining segment providing a mould cavity including convexly curved surface to define the inner peripheral surface of the segment and peripheral walls extending along the circumferential and axially extending edges of the arcuate surface to define the circumferential and axially extending faces of the segment; mounting a plurality of tunnel lining fastening devices on said peripheral walls of the mould to project into the mould cavity at spaced locations around the cavity; preforming arcuate reinforcement for the segment and locating the arcuate reinforcement in the mould cavity to extend through the segment to be cast in the mould; attaching the reinforcement to at least certain of said fastening devices to support the reinforcement in the mould at the required location and casting concrete in the mould over the reinforcement and fastening devices to form a reinforced cast concrete segment; and finally releasing the cast segment from the mould.

2. A method as claimed in Claim 1, wherein the reinforcement comprises inner and outer layers or meshes which are connected together by spacers and the spacers have location means which are engaged with the fastening devices provided in the mould to support the inner and outer layers of mesh in the mould for the moulding operation.

3. A method as claimed in Claim 2, wherein the spacers are connected between the inner and outer layers of the mesh along the circumferentially extending edges thereof at spaced positions to engage spaced fastening devices along the circumferential edges of the mould.

4. A method as claimed in Claim 3, wherein the reinforcement is connected directed to fastening devices at spaced locations along the axially faces of the mould.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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 1860

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)
Y	GB-A-1 163 114 (A. BERTIE) * Page 2, lines 14-31,92-112; figures 4,5 *	1	E 21 D 11/08 B 28 B 23/00
Y	GB-A-1 502 207 (JUNICHI TSUZUKI) * Page 3, lines 79-87; claims 1,2; figure 1 *	1	
A	GB-A-2 131 469 (CHARCON TUNNELS LTD) * Page 1, lines 107-110; figures 6,7 *	2	
A	GB-A-2 124 679 (JUNICHI TSUZUKI) * Claim 5, figure 5 *	2-4	
A	GB-A-2 124 682 (JUNICHI TSUZUKI) * Figures 4-7 *	2-4	
A	FR-A-2 375 438 (CHARCON TUNNELS LTD) * Page 2, lines 3-4; figure 2 *	4	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 21 D
B 28 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05-06-1989	RAMPELMANN J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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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

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